Brigitte Shearer

From:	michelle kelley < :om>
Sent:	Wednesday, February 2, 2022 5:37 PM
To:	P&R Comm
Subject:	Comment on Hidden Canyon Park Proposal

Dear Belmont Park and Rec Commission,
Regarding Agenda item 6 B.
I want to let you know that I am in favor of the development of Hidden Canyon park. The plans look stunning, and I believe that by developing this space, our community will be able to enjoy this breathtaking area.
Thank you,
Michelle Kelley

Brigitte Shearer

From:	Mandy Gibbs
Sent:	Wednesday, February 2, 2022 6:20 PM
To:	P&R Comm
Subject:	Hidden Canyon open space

First I'd like to thank the Parks & Rec Commission for their dedication and measured approach to figure out how parks can best serve the Belmont community.

After reviewing the proposed plans for Hidden Canyon, it seems clear to me, that developing this property in accordance with the Master Plan will be a wonderful addition to the Belmont community. The plans appear to thoughtfully provide spaces that will serve many needs.

As someone who lives across the street from a neighborhood park, I love the community it provides and the opportunity to share the good fortune of living near an open space. And I'm sure the neighbors living around Hidden Canyon will find it equally rewarding to see others discover this special green space.

I look forward to hearing more about the plans tonight!
Thanks for all your work!

Mandy Gibbs
1642 Prospect St
Belmont

Brigitte Shearer

From: Brigitte Shearer
Sent: Monday, February 7, 2022 2:36 PM
To: P&R Comm
Subject: FW: Water Dog Open Space

See below

Brigitte Shearer
Parks & Recreation Director
Belmont Parks & Recreation

30 Twin Pines Ln, Belmont, CA 94002
P: (650) 595-7488 | E: bshearer@belmont.gov www.belmont.gov/parksandrec | Join our e-newsletter!

"Enhancing Quality of Life for the Community"
"As Always, Stay Positive, the Choice is Yours!"

-----Original Message-----
From: Pamela <
Sent: Monday, February 7, 2022 2:35 PM
To: info@belmontprosplan.com
Subject: Water Dog Open Space

I want the Park Commissioners and the Consultant reviewing the Open Space to know that the trails are unsafe to hikers and walkers due to bikers. In the last 5 days I've nearly been hit twice by bikers speeding around turns that stopped just 3-5 feet from me on the John Brooks trail. They skidded to a stop at the last second when they saw me. There was absolutely no warning to me as the bikers sped around blind curves. They had no bell or other device to warn me. I was fortunate in both these occurrences as I could have been crashed into by these bikers.
Many of the trails are only 30"-36" wide and cannot accommodate a bike rider and a hiker. I implore you to restrict bikers from riding on any trail that is less than four feet wide.
I must also state many of my friends will no longer walk or hike these trails due the danger posed by the bikers. Many of these Belmont residents have hiked these trails for years but they literally fear for their life on these trails due to the numerous bikers on the trails who sped on the trails making it extremely dangerous. At some point someone is going to be seriously injured. It falls on the biker who undoubtedly will be sued and also the City of Belmont for allowing this unsafe condition to exist.
Thank you.
Pamela Stahl

Sent from my iPad

Brigitte Shearer

From: Jonathan Carter
Sent: Thursday, February 10, 2022 9:04 PM
To: P&R Comm; Brigitte Shearer; Daniel Ourtiague
Subject: idea for Hidden Canyon park

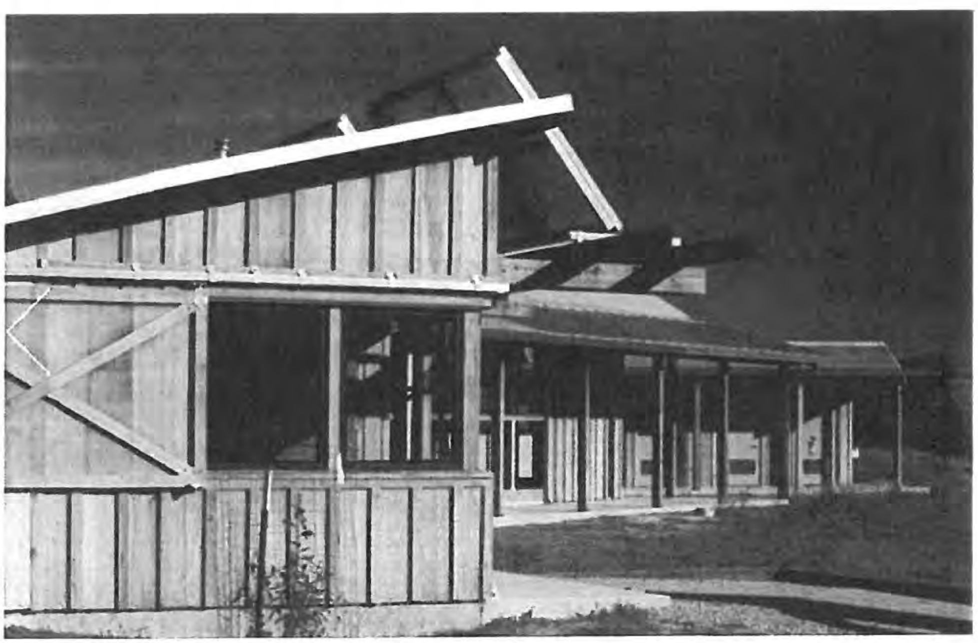
As we turn our attention to the plan for Hidden Canyon Park, one great idea has been to add a nature interpretive center along with public restrooms and drinking fountains. An excellent example is the interpretive center down at Arastradero Preserve in Palo Alto. Worth checking out if you haven't been there.

If we do build such a center, I was wondering if we could add a tool shed in the back to store our trail maintenance tools? I have them now stored on the side of my house, which is fine, but at some point Mrs. Carter might want to have her side yard back. And she's the boss!

Also, I think we could raise funds pretty easily to build something if we put our minds to it. A lot of folks would donate.

Warmly,

Jonathan Carter, MD
Lead, Waterdog Trailkeeper Volunteers



Brigitte Shearer

From: Wendy Miller ·
Sent: Thursday, February 24, 2022 9:31 AM
To: Brigitte Shearer
Subject: Ralston Ranch Park petition - neighbors within < 1-mile radius

Good morning Brigitte, it was nice talking to you this morning and I'm very happy to hear that further discussion of a dog park at Ralston Ranch Park has been terminated. We are all eager to see what the new plan looks like and if the other points in this petition have also been addressed.

Attached is a scan of our petition, with 97 signatures of residents within the 1-mile radius of Ralston Ranch Park - the area this park is intended to serve.

Thank you for listening and I know we all share a love of Belmont and are trying to find a good compromise.

Warmly - Wendy

--

RRR Petition.pdf

Wendy Miller
Head of HR
CompareNetworks, Inc.
395 Oyster Point Blvd, Suite 300
South San Francisco, CA 94080

February 12, 2022

Petition: Protect Our Open Space at Ralston Ranch Park

Dear Belmont Council and Parks and Recreation,

This petition represents the voices of homeowners in and around Ralston Ranch Park. We have attended city meetings and sent letters, but it appears there is still discussion about a dog park and other forms of development. By signing this document, we ask that you listen to the voices of those this park is meant to serve – Belmont residents within a 1-mile radius.

1. We would like to see the entire park left natural. Open space is what makes Belmont special and we are sad to see building permits granted for areas that had previously been restricted resulting in the continued loss of wildlife habitat. Ralston Ranch "woods" has more than 70 trees and is home to wood rats, bees, owls, hawks, rabbits, deer and occasional foxes, bobcats and mountain lions. We have already taken so much of their habitat; to see existing trees chopped down, land graded and sidewalks, fences and other structures added would be a shame.

2. If we can't leave the entire park natural, a minimal amount of space should be developed. Grading and removal of trees should be avoided. A play structure for small children and benches away from existing homes would be intended to serve families who live and walk in the neighborhood within a 1-mile radius.

3. We STRONGLY oppose a dog park and gathering places. Cipriani dog park is within a 1-mile radius for neighbors who don't want to walk their dogs on a leash, and during a recent feedback session, you heard a plea from one of the Ralston Ranch neighbors who's special needs children are triggered by dogs and will be severely impacted.

4. Let's focus on improving what currently exists. People already drive to Ralston Ranch Road (RRR) and park along the street to access the trailheads on both ends of RRR for hiking, dog walking and mountain biking. Let's instead put in a water fountain, trash and recycling cans at the RRR turn-around and service it *regularly* for the folks using the 16-miles of trails cut into Belmont's open space - which already encroaches wildlife habitat. And please, improve the sanitation and surveillance of Leo Ryan lookout. Trash overflows, broken liquor bottles on the sidewalk, and cars parked at all hours despite a sign that says no alcohol or use after sunset.

5. **And let's not create opportunity for increased crime.** The Leo Ryan lookout peers directly into the backyards and homes on either side of the lookout and just last night (Feb 11th) we had four men casing our neighborhood with flashlights and breaking into cars on our street. Inviting more people from outside the neighborhood with an excuse to "gather" alongside the fences of residences invites further crime. The Christian Avenue neighbors have had similar experiences,

and as Belmont Police have said, our location is an easy get-away because of the nearby on-ramps to highways 92, 280 and 101.

Unintended consequences must be carefully considered – these decisions cannot be reversed and will affect Ralston Ranch, Skymont, Canyon, Hallmark and other neighborhoods – and also the Belmont we leave to the next generation.

Sincerely,

Ralston Ranch and Surrounding Neighborhoods

Name	Address	Signature
Maurice Zwass	9 Ralston Ranch Rd	
Nichole Lee	11 Ralston Ranch Rd	
Kathy Chao	17 Ralston Ranch Rd	
JENNIFER ZWASS	9 RALSTON RANCH RD	
Sofia Zwass	9 Ralston Ranch Rd	
Phoenix Tong	35 Ralston Ranch Rd	
Faye Lee	35 Ralston Ranch Rd	
Nergis Malik	43 Ralston Ranch	
RAMI MALIK	43 Ralston Ranch	
PJ Camp Malik	43 Ralston Ranch	
Mohammed R Barlow	55 Ralston Ranch	
Milena Gruttner Leung	61 Ralston Ranch RD.	
Raphael Leung	61 Ralston Ranch Rd.	
Kip Leong	72 Ralston Ranch Rd	
Yvonne Ong	72 Ralston Ranch Rd.	
Carol Rossi	76 Ralston Ranch Rd	
alberto Rossi	76 Ralston Ranch Rd	
Tatsumi Tagawa	86 Ralston Ranch Rd	
MARK WEITZ	89 RALSTON RANCH RD	
Joyce Yee	89 Ralston Ranch Rd	
ROY M. SCHNABEL	97 Ralston Ranch Rd	
Maria Schnabel	97 Ralston Ranch Rd	
Wendy Miller	2 Ralston Ranch Rd	
Hailey Miller	2 Ralston Ranch Rd	
Homer Wong	2 RALSTON RANCH RD	
Elizabeth Cain	2482 Hallmark Dr	
Jun Xie	2850 Belmont Canyon Rd	
Ellen Sbaragia	2830 Belmont Canyon Rd	
MICHELLE CHEN	3822 WAUGHTON AVE	
Marc Blumer	3860 W. Naughton	

SUGANTHY MOHAN	7 RALSTON RANCH RD	[illegible]
MOHAN KRISHNAN	7 RALSTON RANCH RD	M. [illegible]
Wun-Yuan Mei	6 Ralston Ranch Rd	Wun-Yuan Mei
ILYA SHAPIRO	1 Ralston Ranch Rd	[illegible]
Lyubov Brodnitsky	1 Ralston Ranch Rd	[illegible]
MARIA DABYAN	3858 W Naughton Ave	[illegible]
Thomas Warner	2784 Belmont Canyon Road	[illegible]
Vera Fishchkin	2778 Belmont Canyon Rd	[illegible]
Linda Ehrlich	18 Ralston Ranch Rd	[illegible]
Jim Ungaud	18 Ralston Ranch Rd	[illegible]
Yihan Chan	93 Ralston Ranch Rd	[illegible]

Name	Address	Signature
Matthew Wood	2482 Hallmark Dr Belmont	[signature]
Richard Wood	2482 Hallmark Dr	[signature]

Teri Dunwoody	[signature]	16 Ralston Ranch Rd

Name	Address	Signature
Eugene Davydov	2744 Waltham Cross	Eugene Davydov
Aleksei Petrovski	1040 TAHOE DR	A. [illegible]
Natalie Mercamed	2636 Belmont Canyon Rd.	Natalie M[illegible]
Marina Sirota	2744 Waltham Cross	[illegible]
Hanna Petrovski	1040 tahoe DR	[illegible]
Maria Lapshina	1048 Tahoe Dr	[illegible]
Mikhail Lapshin	1048 Tahoe Dr	[illegible]

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February 12, 2022

Petition: Protect Our Open Space at Ralston Ranch Park

Dear Belmont Council and Parks and Recreation,

This petition represents the voices of homeowners in and around Ralston Ranch Park. We have attended city meetings and sent letters, but it appears there is still discussion about a dog park and other forms of development. By signing this document, we ask that you listen to the voices of those this park is meant to serve – Belmont residents within a 1-mile radius.

1. We would like to see the entire park left natural. Open space is what makes Belmont special and we are sad to see building permits granted for areas that had previously been restricted resulting in the continued loss of wildlife habitat. Ralston Ranch "woods" has more than 70 trees and is home to wood rats, bees, owls, hawks, rabbits, deer and occasional foxes, bobcats and mountain lions. We have already taken so much of their habitat; to see existing trees chopped down, land graded and sidewalks, fences and other structures added would be a shame.

2. If we can't leave the entire park natural, a minimal amount of space should be developed. Grading and removal of trees should be avoided. A play structure for small children and benches away from existing homes would be intended to serve families who live and walk in the neighborhood within a 1-mile radius.

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4. Let's focus on improving what currently exists. People already drive to Ralston Ranch Road (RRR) and park along the street to access the trailheads on both ends of RRR for hiking, dog walking and mountain biking. Let's instead put in a water fountain, trash and recycling cans at the RRR turn-around and service it *regularly* for the folks using the 16-miles of trails cut into Belmont's open space - which already encroaches wildlife habitat. And please, improve the sanitation and surveillance of Leo Ryan lookout. Trash overflows, broken liquor bottles on the sidewalk, and cars parked at all hours despite a sign that says no alcohol or use after sunset.

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and as Belmont Police have said, our location is an easy get-away because of the nearby on-ramps to highways 92, 280 and 101.

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Sincerely,

Ralston Ranch and Surrounding Neighborhoods

Name	Address	Signature
Sandy Paulazzo	3908 Christian Dr.	[signature]

February 12, 2022

Petition: Protect Our Open Space at Ralston Ranch Park

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Sincerely,

Ralston Ranch and Surrounding Neighborhoods

Name	Address	Signature
BEN BEI	3901 CHRISTIAN DR	[illegible]
Daniel Ateya	3900 Christian Dr.	[illegible]
[illegible]	3906 Christian Dr.	[illegible]
Patricia Chambers	3910 Christian Dr	P. Chambers
GARY KATO	3213 ADELAIDE WAY	[illegible]
ANTHONY J. CAPE	3920 CHRISTIAN Dr.	[illegible]
DAVID BADER	3924 CHRISTIAN DR.	[illegible]
CATHERINE RADER	3924 Christian Dr	[illegible]
Mary Lake	3324 Adelaide Way	Mary Lake
MICHAEL LAKE	3209 ADELAIDE WAY	Michael L
Carrie Dean-Hood	3806 Naughton Ave	Carrie Dean-Hood
Lisa Navarro	3915 Christian Dr.	[illegible]
Justin [illegible]	3923 Christian Dr	[illegible]
Robert O'Connor	3327 Adelaide Way	Robert O'Conn
ROWENA O'CONNOR	3327 Adelaide Way	Rowena O'Connor
David ONeill	3320 Adelaide WAY	D O'Neill
HUGO CHAU	3306 Adelaide Way	[illegible]
MICKIE SCHACH	3225 ADELAIDE WAY	M Schach
Rebecca Dorman	3302 Adelaide Wy	[illegible]
DEREK BULNEF	1916 BISHOP RD	[illegible]
Dario Yazdi	2033 Bishop Rd	[illegible]
Veronica Purcell	4221 Skymont Dr.	[illegible]
Ollie Simpson	2019 Bishop Rd	Ollie Simpson
Kim Beauchamp	2015 Bishop Rd.	Kim Beauchamp
Joseph Delucchi	1909 Bishop Rd	[illegible]
Lisa Karaeff-Delucchi	1909 Bishop Rd	[illegible]
Matt LeBlanc	3 Dianne Ct.	[illegible]
Melanie Yue	3210 Adelaide Way	[illegible]
Tom Schoenahl	3210 ADELAIDE WAY	[illegible]
SUSAN LASELL	4013 Marsten Ave	Susan Lasell

Roger K Fairchild	ROGER K. FAIRCHILD	2025 Bishop
Kathryn J Fairchild	Kathryn J. Fairchild	2025 Bishop

Name	Address	Signature
Jpence Leslie	4100 Shumont Dr	[illegible]
Mave Savich	4126 Marsten Ave	[illegible]
MAX SCHWINGES	4108 MARSTEN AVE	Max Schwinges
AILEEN TURNER	4110 MARSTEN Ave	[illegible]
WILLIE TURNER	4110 MARSTEN Ave	[illegible]
Jeanette Sacco-Belli	4011 Marsten Ave	Jeanette Sacco Belli
STEVE BELLI	4011 MARSTEN AVE	Steve Belli
Chris Parker	4007 Marsten Ave	[illegible]
Monique Salazar	3201 Lori Dr -	Monique Salazar
Mary Toalson	3242 Lori Ct.	Mary Toalson
JAMES TOALSON	3242 LORI CT	James Toalson
Jeff Gorrell	3212 Lori Ct	[illegible]
Ray Avanzino	3315 Adelaide	Ray Avanzino

4

2/12/22 2:27 PM – Official Petition to Protect Ralston Ranch Park

Brigitte Shearer

From: Bob Stahl
Sent: Saturday, February 26, 2022 10:51 AM
To: Kelley Lotosky; P&R Comm
Subject: Continued danger from bikers on Water Dog trails

I must again state the danger posed by bikers on the Water Dog trails. My wife and I have nearly been hit by bikers three times in the last three weeks by bikers on the John Brooks and Rambler trails. On many of these trails the width is less than 36 inches wide and there is no way for bikers to pass a walker or hiker safely without one party stopping to allow the other to pass.
Each of the last 3 weeks a speeding biker has come within inches of hitting us. Twice they rounded a blind turn in front of us. Neither they nor us saw each other until the last few seconds. The most recent time a biker came speeding up right behind us and veered off the trail to avoid hitting us- fortunately.
In any new plan for Water Dog Open Space, please plan to have separate trails for bikers and hiker/walkers.
Thank you.
Bob Stahl

Brigitte Shearer

From: Steff Moore ·
Sent: Sunday, February 27, 2022 11:21 AM
To: P&R Comm
Subject: Hallmark Park

To Whom it may concern:

We live at 2605 Wakefield Drive and have for the past 30 years. We love it here mainly because it is away from the crowds of the peninsula and the bay area. It is quiet and usually there isn't a lot of traffic. Our children grew up here and now our grandchildren enjoy almost the same serene environment. Although Belmont is hardly the same sleepy town it was back then, this neighborhood has maintained its quaintness. We tolerate the track practices and races that take place every year. We clean up the garbage the visitors leave, we give up our street parking and we are kind and friendly to the crowds. We do this because we understand the uniqueness of the area and honestly don't mind sharing it. The garbage accumulates and often overflows at the park and it takes the city quite some time to clean it up. The crows and other wildlife rummage around it and create quite a mess. We tolerate that as well. However, we are not prepared to do this on a daily basis.

If the city thinks for a moment that this will not affect our homes with the same issues we deal with when track season arrives, you are mistaken. If you want to update what is currently there, I am all for it. The current play structure is old and the wood is rotten and dangerous. The pathway is a trip hazard because of the tree roots coming through it. We already have a significant amount of people using the park daily for their workouts and tennis games. We don't need any more traffic. We paid to live here, we pay an association fee to keep the area in good condition. We don't need any interference from the city. If it's not broke, don't fix it.

Sinc

erely,

Mich

ael and Stephanie Moore

Brigitte Shearer

From: JoAnn Berridge <
Sent: Sunday, February 27, 2022 3:19 PM
To: P&R Comm
Subject: Hallmark Park

Dear Commissioners,

I write as a resident of Belmont Heights to object to certain of the plans to "improve" Hallmark park. Years ago, in the 1970s, the BHCIA fought for preservation of this open space as a casual, natural park with tennis courts. The tennis courts were a specific wish of the Belmont Heights residents. Have we asked for a bocce ball court in our neighborhood? Have we been surveyed about a bocce court, or any other structural additions for that matter? Yes, the tennis courts, current paved paths, and tot lot have been sadly neglected over the years. We would be grateful for those long overdue upgrades, as well as replacing non-native with native plants. Please seek neighborhood specific input before going any further with plans for structures and paved paths in our "neighborhood park."

Respectfully,
JoAnn Berridge

Brigitte Shearer

From: hfeng zen [illegible]
Sent: Sunday, February 27, 2022 4:00 PM
To: P&R Comm
Subject: Help Preserve Hallmark Park

To Whom IT May Concern:

Personally, I think the Hallmark Park should upgraded but not to the extent to attract more visitors, e.g., making the tot lot like a McDonald playland!

Adding the bocce court should be definitely ruled out! It will not only make our neighborhood very noisy but also congested with more cars creating

parking problems!

Our neighborhood has already attracted many bicyclists in the Water Dog area. We don't want our neighborhood to become a tourist attraction but for

the enjoyment of us neighbors!

Sincerely,

\Bessie Ip
10 Paddington Court

Brigitte Shearer

From: Deniz Bolbol
Sent: Monday, February 28, 2022 8:43 AM
To: info@belmontprosplan.com; P&R Comm
Subject: public comment: agenda item 6B

Thank you for all the work done on the PROS plan.

The Summary of Feedback is a step in the right direction but it is misleading due to the omission of pertinent data - specifically the number of supporters for various new amenities or sentiments.

Why is this important?

The Commission is given this summary without knowing whether one sentiment is more broadly supported by Belmont residents than another. For example, the Hidden Canyon neighborhood meeting had tremendous neighborhood attendance. The vast majority of residents (approx 10-15) opposed building a bathroom and gave reasons why. Only 2-5 residents supported the building of bathrooms. Yet, reading the Summary of Feedback the Commission would have no idea the tremendous opposition to the bathrooms. This is because the Summary of Feedback merely states there was neighborhood support and opposition for the toilets -- which makes it sound like it was an evenly contested issue. This is not reflective of the public comments given at the neighborhood meeting.

In an effort of transparency, on the Summary of Feedback, I urge staff to add the number of public comments received supporting each amenity or sentiment (the number can be put in parenthesis next to the sentiment). This will enable the Commission to have all the data when making decisions.

Thank you.
Deniz Bolbol

Brigitte Shearer

From: Kevin Sullivan ·
Sent: Monday, February 28, 2022 10:48 AM
To: P&R Comm
Subject: You are doing a GREAT job.

Hello,

Most of you know me pretty well. I wanted to take a few minutes to send you some information when I'm not on the clock and there is a bit less energy flying around.

I do want to say I think the entire commission is doing a great job in general and in working on the PROS plan in particular. I can well imagine how difficult it is at times with the venomous negativity coming from a few but it appears you have been able to weather that and stay focused on a plan that looks to me like it is really coming together in a way that is going to benefit many many people in the community.

This week's presentation is about community parks so that is what I'm going to talk about here.

I was fortunate to be a commissioner when Semeria and then Davey Glen park were designed and built. Both parks had many rounds of public input. Davey Glen was such a physical challenge due to being on a hillside that we almost didn't make it across the finish line. But we did and both of these parks are serving as the quiet but well loved community parks they are supposed to be. Both parks started out with a good deal of very local opposition to any plan to change what was there. Remember what was there in both cases was a dirt lot people had just gotten used to. In the case of Semeria park, a vocal minority wanted the muddy, dirt lot to remain so they could park their work trucks there. Lots of hand wringing about parking and no place to park for residents when the park filled up. None of those fears materialized. Davey Glen had people up in arms at commission meetings talking about all the drug use that would happen with teenagers because its gonna be dark at night in there. None of that happened, in fact there is much more light in there at night and not some hidden drug den.

So you will continue to hear these fears at meetings to discuss the details. SOME are legitimate fears about how their street will change. MOST are illegitimate stories being told because people don't want others to enjoy what they enjoy. In the case of people who live in the Pink homes at the top of Carlmont, everyone living there knows or should know the only reason those homes got built is because the developers and new buyers agreed to donate land and build a park at the end of the lane. What they don't seem to realize is that the park is going to create massive improvements for the people living in those homes. Lots of families in those homes have younger kids and thats exactly who tend to use these small parks the most.

So now the city (we) are looking at some new small parks and improvements to existing parks. I strongly feel people trying to propose "Keep everything natural" don't really want anything changed at all. In my mind, there is no point in putting in a park if it doesn't attract young residents to play. So incorporating lasting play elements is essential. Once construction of park elements is completed, parks quickly look like they have always been there and the improvements are obvious. I strongly encourage you to go by Semeria and or Davey Glenn a few times over the next weeks as the plan comes together. What I think you will see is the parks are almost never crowded and yet are also almost never empty. These parks attract people in the neighborhood to get out of the house for a few hours. They rarely drive their cars to the park but sometimes do. Many of the park users are kids in strollers with moms or nanny. They grow up using and knowing the park, then they become teenagers and have other interests. That leaves room for the next set of kids in strollers and play age. Its what happens in parks.

So please don't be afraid to be visionary in your plans. I love the idea of a Gateway to the open space and some of the examples could be copied as is, but why not create something of our own. Permanent and lasting conversation tables like we designed into Semeria and Davey glen provide for people to hang out and for people to have small parties or picnics. Once the initial construction is completed at Hidden Canyon, it will be more difficult to add or change once infrastructure has been installed. I encourage you to think big (well big for Belmont) and think of the people who will use the park. Plan for them not to appease the people who don't want a park anyway. If that is their only position and the city has decided a park is going in, its time to stop listening to the people who don't want the park. Listen to the people who will use it.

I know you all have the community in mind or you wouldn't be spending your time on this commission since it has often been testy lately. But your commission works together WAY better than the commissions I was on and we were able to pull it off. I know you can too. Keep up the good work and I look forward to supporting your continued actions to make Belmont a better place to live for our residents.

Hope that wasn't too long. I'll repeat some of it at the meeting. Have a great day.

Kevin Sullivan

Brigitte Shearer

From:	Gary & Yaffa
Sent:	Monday, February 28, 2022 10:55 AM
To:	P&R Comm
Subject:	Hallmark Park

We prefer keeping the Park largely as is.

"Do no harm"!

Better things to spend $$ on.

G & Y Weinstein
2532 Hallmark

Brigitte Shearer

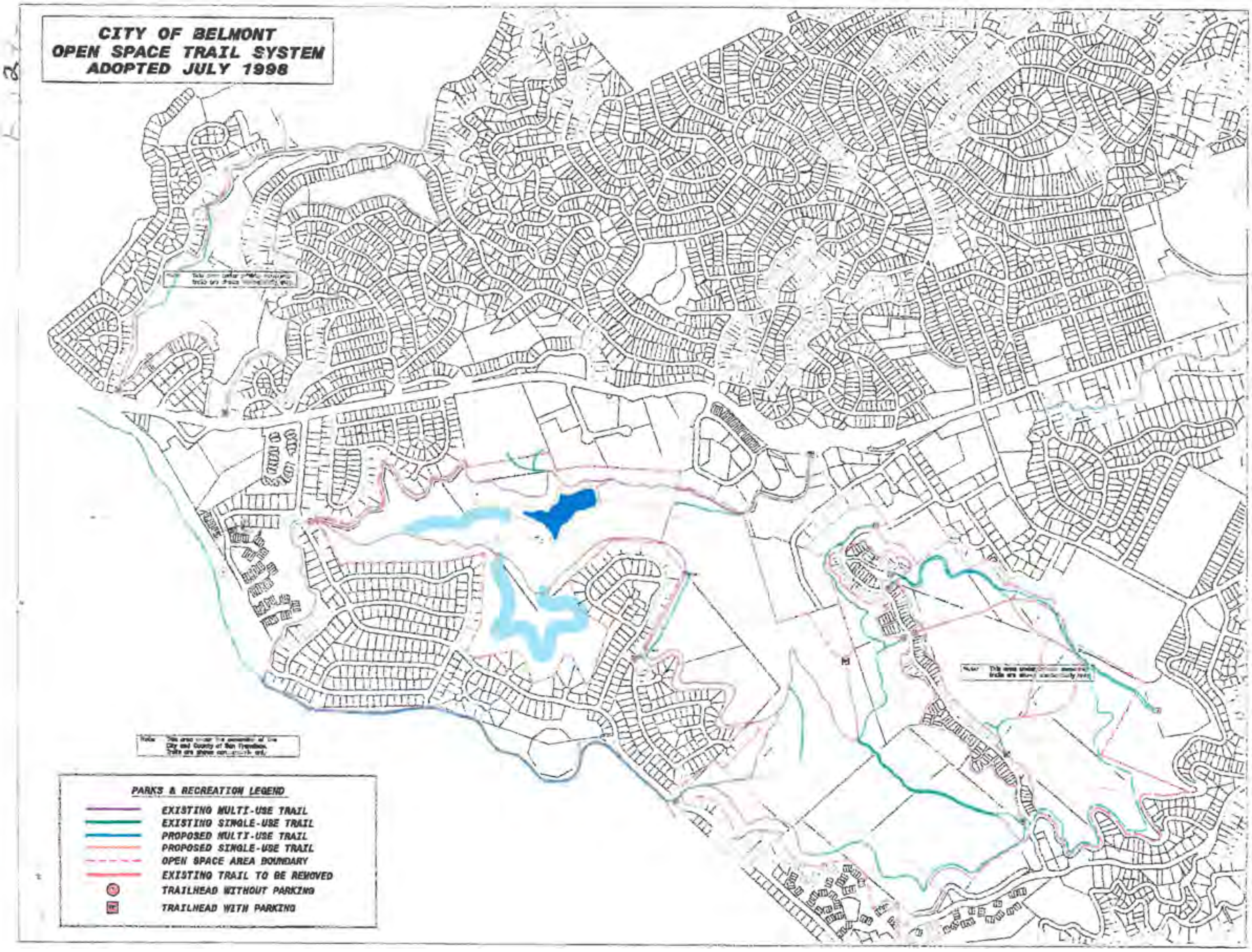
From: Paul Sheng
Sent: Monday, February 14, 2022 5:07 PM
To: Brigitte Shearer
Cc: P&R Comm; City Council; Belmontprosplan Info
Subject: Waterdog Open Space Stewards - correspondence for WRA Consulting
Attachments: EIS mountain bikes and Best Practices.pdf; MTBing in SW US 2006.pdf; Parks Canada Review of ecological effects of MTBing Feb2020.pdf; mbosc-mtb-impact-review-faq.pdf; Trailkeepers spreadsheet.pdf; Westlaw - List of 18 References for Scott Cashen MS.pdf; Belmont resolution re open space trail master plan.pdf; 1998 trail map (original).pdf; 1998 map (flow and ensatina highlighted).pdf; WRA letter.pdf

Brigitte,

Attached please find a letter and attachments that we would like forwarded to WRA Consulting.

Thanks,

Paul


CITY OF BELMONT
OPEN SPACE TRAIL SYSTEM
ADOPTED JULY 1998
PARKS & RECREATION LEGEND
EXISTING MULTI-USE TRAIL
EXISTING SINGLE-USE TRAIL
PROPOSED MULTI-USE TRAIL
PROPOSED SINGLE-USE TRAIL
OPEN SPACE AREA BOUNDARY
EXISTING TRAIL TO BE REMOVED
TRAILHEAD WITHOUT PARKING
TRAILHEAD WITH PARKING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Environmental Impacts of Mountain Biking: Science Review and Best Practices

By Jeff Marion and Jeremy Wimpey

Mountain biking is still a relatively new activity whose environmental impact and contribution to trail degradation is poorly understood. As with all recreational pursuits, it is clear that mountain biking contributes some degree of environmental degradation. In the absence of adequate research, land and trail managers have frequently been cautious, implementing restrictive regulations in some instances (Edger 1997). Surveys of managers have shown that they frequently perceive mountain biking to be a substantial contributor to trail degradation but lack scientific studies or monitoring data to substantiate such concerns (Chavez and others 1993; Schuett 1997). In recent years, however, a small number of studies have been conducted that help clarify the environmental impacts associated with mountain biking. This article describes the general impacts associated with recreational uses of natural surface trails, with a focus on those studies that have examined mountain biking impacts.

Trails are generally regarded as essential facilities in parks and forests. They provide access to remote areas, accommodate a diverse array of recreational activities, and protect resources by concentrating visitor trampling on narrow and resistant tread surfaces. Formal or designated trails are generally designed and constructed, which involves vegetation removal and soil excavation. These changes may be considered "unavoidable," in contrast to "avoidable" post-construction degradation from their subsequent use (e.g., trail widening, erosion, muddiness), or from the development and degradation of informal visitor-created trails.

Common environmental impacts associated with recreational use of trails include:

- Vegetation loss and compositional changes
- Soil compaction
- Erosion
- Muddiness
- Degraded water quality
- Disruption of wildlife

This article is organized into four broad categories: impacts to vegetation, soil, water, and wildlife.

Impacts to Vegetation: General Research

On formal trails, most vegetation is typically removed by construction, maintenance, and visitor use. This impact is necessary and "unavoidable" in order to provide a clear route for trail users. One goal of trail construction and maintenance is to provide a trail only wide enough to accommodate the intended use. Trails made wider than this through visitor use or erosion represent a form of "avoidable" impact. For example, a doubling of trail width represents a doubling of the area of intensive trampling disturbance. Wider trails also expose substantially greater amounts of soil to erosion by wind or water.

The creation and maintenance of trail corridors also removes shrubs and trees, allowing greater sunlight exposure that favors a different set of groundcover plants within trail corridors. Occasional trailside trampling within trail corridors also favors the replacement of fragile plants with those more resistant to trampling traffic. For example, shade-tolerant but fragile broadleaved herbs are frequently replaced by grasses and sedges that are trampling-resistant and require more sunlight to survive. Trail construction, use, and maintenance can also be harmful when trails divide sensitive or rare plant communities.

Trampling - the action of crushing or treading upon vegetation, either by foot, hoof, or tire - contributes to a wide range of vegetation impacts, including damage to plant leaves, stems, and roots, reduction in vegetation height, change in the composition of species, and loss of plants and vegetative cover (Leung & Marion, 1996; Thurston & Reader, 2001). Trampling associated with "avoidable" off-trail traffic can quickly break down vegetation cover and create a visible route that attracts additional use. Complete loss of vegetation cover occurs quickly in shady forested areas, less quickly in open areas with resistant grassy vegetation. Regardless, studies have consistently revealed that most impact occurs with initial or low use, with a diminishing increase in impact associated with increasing levels of traffic (Hammit & Cole, 1998; Leung & Marion, 1996). Furthermore, once trampling occurs, vegetative recovery is a very slow process.

Compositional changes in the vegetation along trail corridors can have both beneficial and adverse effects. Trampling-resistant plants provide a durable groundcover that reduces soil loss by wind and water runoff, and root systems that stabilize soils against displacement by heavy traffic. The ecological impacts of such compositional changes are not fully known, except when non-native vegetation is introduced to and spreads along trail corridors. Many of these species are disturbance-associated and are naturally limited to areas where the vegetation is routinely trampled or cut back. However, a few non-native species, once introduced to trail corridors, are able to out-compete native plants and spread away from the trail corridor in undisturbed habitats. Some of these species form dense cover that crowd out or displace native plants. These "invasive" species are particularly undesirable and land managers actively seek to prevent their introduction and spread. Unfortunately their removal is difficult and expensive.

Impacts to Vegetation: Mountain Biking-Specific Research

Only one study found specifically addresses the vegetation impacts associated with mountain biking. Thurston and Reader (2001) conducted an experimental trampling study involving mountain bikers and hikers in Boyne Valley Provincial Park of Ontario, Canada. The researchers measured plant density (number of stems/area), diversity (number of species present), and soil exposure (area of mineral soil exposed) before and after 500 one-way passes by bikers and hikers.

Data analysis and statistical testing revealed that the impacts of hiking and biking were not significantly different for the three indicators measured. They also concluded that impacts from both hikers and bikers were spatially confined to the centerline of the lane (trail).

Impacts to Vegetation: Management Implications

Trail managers can either avoid or minimize impacts to vegetation through careful trail design, construction, maintenance, and management of visitor use. Here are some recommendations to reduce vegetation impacts:

- Design trails that provide the experience that trail users seek to reduce their desire to venture off-trail.
- Locate trails away from rare plants and animals and from sensitive or critical habitats of other species. Involve resource professionals in designing and approving new trail alignments.
- Keep trails narrow to reduce the total area of intensive tread disturbance, slow trail users, and minimize vegetation and soil impacts.
- Limit vegetation disturbance outside the corridor when constructing trails. Hand construction is least disruptive; mechanized construction with small equipment is less disruptive than full-sized equipment; skilled operators do less damage than those with limited experience.
- Locate trails on side-hills where possible. Constructing a side-hill trail requires greater initial vegetation and soil disturbance but sloping topography above and below the trail bench will clearly define the tread and concentrate traffic on it. Trails in flatter terrain or along the fall line may involve less initial disturbance but allow excessive future tread widening and off-tread trampling, which favor non-native plants.
- Use construction techniques that save and redistribute topsoil and excavated plants.

There are also important considerations for maintaining and managing trails to avoid unnecessary ongoing impacts to vegetation:

- o While it is necessary to keep the trail corridor free of obstructing vegetation, such work should seek to avoid "day-lighting" the trail corridor when possible. Excessive opening of the overstory allows greater sunlight penetration that permits greater vegetation compositional change and colonization by non-native plants.
- o An active maintenance program that removes tree falls and maintains a stable and predictable tread also encourages visitors to remain on the intended narrow tread. A variety of maintenance actions can discourage trail widening, such as only cutting a narrow section out of trees that fall across the trail, limiting the width of vegetation trimming, and defining trail borders with logs, rocks, or other objects that won't impede drainage.
- o Use education to discourage off-trail travel, which 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.
- o Educate visitors to be aware of their ability to carry non-native plant seeds on their bikes or clothing, and encourage them to remove seeds by washing mud from bikes, tires, shoes, and clothing. Preventing the introduction of non-natives is key, as their subsequent removal is difficult and costly.
- o Educate visitors about low impact riding practices, such as those contained in the IMBA-approved Leave No Trace Skills & Ethics: Mountain Biking booklet (www.LNT.org).

For further reading see: Cessford 1995; Gruttz and Hollingshead 1995; Thurston and Reader 200l.

Impacts to Soils: General Research

The creation and use of trails also results in soil disturbance. Some loss of soil may be considered an acceptable and unavoidable form of impact on trails. As with vegetation loss, much soil disturbance occurs in the initial construction and use of the trail. During trail construction, surface organic materials (e.g., twigs, leaves, and needles) and organic soils are removed from treads; trails built on sidehill locations require even more extensive excavation. In addition, the underlying mineral soils are compacted during construction and initial use to form a durable tread substrate that supports trail traffic.

In contrast, post-construction soil displacement, erosion, and muddiness represent core forms of avoidable trail impact that require sustained management attention to avoid long-lasting resource degradation. This degradation can reduce the utility of trails as recreation facilities and diminish the quality of visitor experiences. For example, soil erosion exposes rocks and plant roots, creating a rutted and uneven tread surface. Erosion can also be self-perpetuating when treads erode below the surrounding soil level, hindering efforts to divert water from the trail and causing accelerated erosion and muddiness. Similarly, excessive muddiness renders trails less usable and aggravates tread widening and associated vegetation loss as visitors seek to circumvent mud holes and wet soils (Marion, 2006).

Research has shown that visitors notice obvious forms of trail impact, such as excessive muddiness and eroded ruts and tree roots, and that such impacts can degrade the quality of visitor experiences (Roggenbuck and others., 1993; Vaske and others., 1993). Such conditions also increase the difficulty of travel and may threaten visitor safety. Remedying these soil impacts can also require substantial rehabilitation costs. Clearly, one primary trail management objective should be the prevention of excessive soil impacts. Let's examine four common forms of soil impact in greater detail:

The Four Common Forms of Soil Degradation on Trails:

- Compaction
- Muddiness
- Displacement
- Erosion

Compaction: Soil compaction is caused by the weight of trail users and their equipment, which passes through feet, hooves, or tires to the tread surface.

Compacted soils are denser and less permeable to water, which increases water runoff. However, compacted soils also resist erosion and soil displacement and provide durable treads that support traffic. From this perspective, soil compaction is considered beneficial, and it is an unavoidable form of trail impact. Furthermore, a primary resource protection goal is to limit trailside impacts by concentrating traffic on a narrow tread. Success in achieving this objective will necessarily result in higher levels of soil compaction.

The process of compacting the soil can present a difficult challenge, especially on new trails. Unless soils are mechanically compacted during tread construction, initial use compacts the portions of the tread that receive the greatest traffic, generally the center. The associated lowering of the tread surface creates a cupped cross-section that intercepts and collects surface water. In flat terrain this water can pool or form muddy sections; in sloping terrain the water is channeled down the trail, gaining in volume, speed, and erosive potential.

Displacement: Trail users can also push soil laterally, causing displacement and development of ruts, berms, or cupped treads. Soil displacement is particularly evident when soils are damp or loose and when users are moving at higher rates of speed, turning, braking, or other movements that create more lateral force. Soil can also be caught in hooves, footwear, or tire treads, flicked to the side or carried some distance and dropped. Regardless of the mechanism, soil is generally displaced from the tread center to the sides, elevating inslopes or berms, and compounding drainage problems.

Muddiness: When trails are located in areas of poor drainage or across highly organic soils that hold moisture, tread muddiness can become a persistent problem. Muddiness is most commonly associated with locations where water flows across or becomes trapped within flat or low-lying areas. Soil compaction, displacement, and erosion can exacerbate or create problems with muddiness by causing cupped treads that collect water during rainfall or snowmelt. Thus, muddiness can occur even along trails where there is sufficient natural drainage. Subsequent traffic skirts these problem spots, compacting soils along the edges, widening mud holes and tread width, and sometimes creating braided trails that circumvent muddy sections.

Erosion: Soil erosion is an indirect and largely avoidable impact of trails and trail use. Soil can be eroded by wind, but generally, erosion is caused by flowing water. To avoid erosion, sustainable trails are generally constructed with a slightly crowned (flat terrain) or outsloped (sloping terrain) tread. However, subsequent use compacts and/or displaces soils over time to create a cupped or insloped tread surface that intercepts and carries water. The concentrated run-off picks up and carries soil particles downhill, eroding the tread surface.

Loose, uncompacted soil particles are most prone to soil erosion, so trail uses that loosen or detach soils contribute to higher erosion rates. Erosion potential is closely related to trail grade because water becomes substantially more erosive with increasing slope. The size of the watershed draining to a section of trail is also influential - larger volumes of water are substantially more erosive.

Water and the sediment it carries will continue down the trail until a natural or constructed feature diverts it off the tread. Such features include a natural or constructed reversal in grade, an outsloped tread, rocks or tree roots, or a constructed drainage dip or water bar. Once the water slows, it drops its sediment load, filling in tread drainage features and causing them to fail if not periodically maintained. Sediment can also be carried directly into watercourses, creating secondary impacts to aquatic systems. Properly designed drainage features are designed to divert water from the trail at a speed sufficient to carry the sediment load well below the tread, where vegetation and organic litter can filter out sediments. A well-designed trail should have little to no cumulative soil loss, for example, less than an average of one-quarter inch (6.3 mm) per year.

Impacts to Soils: Mountain Biking-Specific Research

Several studies have evaluated the soil impacts of mountain biking.

Wilson and Seney (1994) evaluated tread erosion from horses, hikers, mountain bikes, and motorcycles on two trails in the Gallatin National Forest, Montana. They applied one hundred passes of each use-type on four sets of 12 trail segments, followed by simulated rainfalls and collection of water runoff to assess sediment yield at the base of each segment. Control sites that received no passes were also assessed for comparison. Results indicated that horses made significantly more sediment available for erosion than the other uses, which did not significantly vary from the control sites. Traffic on pre-wetted soils generated significantly greater amounts of soil runoff than on dry soils for all uses.

Marion (2006) studied 78 miles (125 km) of trail (47 segments) in the Big South Fork National River and Recreation Area, Tennessee and Kentucky, measuring soil loss along transects across the trail to evaluate the influence of use-related, environmental, and management factors. Sidehill-aligned trails were significantly less eroded than trails in valley bottom positions, in part due to the influence of periodic floods. Trail grade and trail alignment angle were also significant predictors of tread erosion. Erosion rates on trails with 0-6 percent and 7-15 percent grades were similar, while erosion on trails with grades greater than 16 percent were significantly higher. And there was significantly greater erosion on fall line trails (alignment angles of 0-22 degrees) than those with alignments closer to the contour.

This study also provided an opportunity to examine the relative contribution of different use types, including horse, hiking, mountain biking, and ATV. Trails predominantly used for mountain biking had the least erosion of the use types investigated. Computed estimates of soil loss per mile of trail also revealed the mountain biking trails to have the lowest soil loss.

White and others (2006) also examined trails predominantly used for mountain biking in five ecological regions of the Southwest along 163 miles (262 km) of trail. Two trail condition indicators, tread width and maximum incision, were assessed at each sample point. Results show that erosion and tread width on these trails differed little in comparison to other shared-use trails that receive little or no mountain biking.

Goeft and Alder (2001) evaluated the resource impacts of mountain biking on a recreational trail and racing track in Australia over a 12-month period. A variety of trail condition indicators were assessed on new and older trail segments with uphill, downhill, and flat trail sections. Results found that trail slope, age, and time were significant erosion factors, and that downhill slopes and curves were the most susceptible to erosion. New trails experienced greater amounts of soil compaction but all trails exhibited both compaction and loosening of soils over time. The width of the recreational trail varied over time, with no consistent trend, while the width of the racing trail grew following events but exhibited net recovery over time. Impacts were confined to the trail tread, with minimal disturbance of trailside vegetation.

Bjorkman (1996) evaluated two new mountain biking trails in Wisconsin before and for several years after they were opened to use. Vegetation cover within the tread that survived trail construction work declined with increasing use to negligible levels while trailside vegetation remained constant or increased in areas damaged by construction work. Similarly, soil compaction within the tread rose steadily while compaction of trailside soils remained constant. Vegetation and soil impacts occurred predominantly during the first year of use with minor changes thereafter.

Wohrstein (1998) evaluated the impacts from a World Championship mountain biking race with 870 participants and 80,000 spectators. Erosion was found only on intensively used racing trails in steep terrain where alignments allowed higher water runoff. The mountain biking routes exhibited higher levels of compaction but to a shallower depth in comparison to the spectator areas, where compaction was lower but deeper.

Cessford (1995) provides a comprehensive, though dated, summary of trail impacts with a focus on mountain biking. Of particular interest is his summary of the two types of forces exerted by bike tires on soil surfaces: The downward compaction force from the weight of the rider and bike, and the rotational shearing force from the turning rear wheel. Mountain bikers generate the greatest torque, with potential tread abrasion due to slippage, during uphill travel. However, the torque possible from muscle power is far less than that from a motorcycle, so wheel slippage and abrasion occur only on wet or loose surfaces. Tread impact associated with downhill travel is generally minimal due to the lack of torque and lower ground pressures. Exceptions include when riders brake hard enough to cause skidding, which displaces soil downslope, or bank at higher speeds around turns, which displaces soil to the outside of the turn. Impacts in flatter terrain are also generally minimal, except when soils are wet or uncompacted and rutting occurs.

Impacts to Soils: Management Implications

Soil loss is among the most enduring forms of trail impact, and minimizing erosion and muddiness are the most important objectives for achieving a sustainable trail. Soil cannot easily be replaced on trails, and where soil disappears, it leaves ruts that make travel and water drainage more difficult, prompting further impacts, such as trail widening.

Existing studies indicate that mountain biking differs little from hiking in its contribution to soil impacts. Other factors, particularly trail grade, trail/slope alignment angle, soil type/wetness, and trail maintenance, are more influential determinants of tread erosion or wetness.

There are a number of tactics for avoiding the worst soil-related impacts to trails:

- Discourage or prohibit off-trail travel. 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.
- Design trails with sustainable grades and avoid fall-line alignments. (See p. 112 for more)
- When possible, build trails in dry, cohesive soils that easily compact and contain a larger percentage of coarse material or rocks. These soils better resist erosion by wind and water or displacement by feet, hooves and tires.
- Minimize tread muddiness by avoiding flat terrain, wet soils, and drainage-bottom locations.
- Use grade reversals to remove water from trail treads. Grade reversals are permanent and sustainable - when designed into a trail's alignment they remain 100 percent effective and rarely require maintenance.

Other strategies are more temporary in nature and will require periodic maintenance to keep them effective:

- While the use of a substantial outslope (e.g., 5 percent) helps remove water from treads, it is rarely a long-term solution. Tread cupping and berm development will generally occur within a few years after tread construction. If it is not possible to install additional grade reversals, reshape the tread to reestablish an outsloped tread surface periodically, and install wheel-friendly drainage dips or other drainage structures to help water flow off the trail.
- If it is not possible to install proper drainage on a trail, consider rerouting trail sections that are most problematic, or possibly hardening the tread.
- In flatter areas, elevate and crown treads to prevent muddiness, or add a gravel/soil mixture in low spots.

Finally, it is important to realize that visitor use of any type on trails when soils are wet contributes substantially greater soil impact than the same activities when soils are dry. Thus, discouraging or prohibiting the use of trails that are prone to muddiness during rainy seasons or snowmelt is another effective measure. Generally such use can be redirected to trails that have design or environmental attributes that allow them to better sustain wet season uses.

For additional information about minimizing soil impacts through trail design, construction, maintenance, and tread hardening, see Trail Solutions.

Impacts to Water Resources: General Research

Trails and their use can also affect water quality. Trail-related impacts to water resources can include the introduction of soils, nutrients, and pathogenic organisms (e.g., Giardia), and alter the patterns of surface water drainage. However, in practice, these impacts are avoidable, and properly designed and maintained trails should not degrade water quality. Unfortunately there is very little research to draw from on these topics, and none that is specific to mountain biking.

Poorly sited and/or maintained trails can be eroded by water, with tread sediments carried off by runoff. Generally, if water control features such as grade reversals and outsloped treads are used to divert runoff from trails, the water drops its sediment close to trails, where it is trapped and held by organic litter and vegetation. Soils eroded from trails rarely enter water bodies, unless trails cross streams or run close to stream or lake shorelines and lack adequate tread drainage features. Since many recreational activities, such as fishing, swimming, boating, and viewing scenery (e.g., waterfalls) draw visitors and trails to the vicinity of water resources, it is often necessary to route trails to water resources or visitors will simply create their own informal trails.

Trails that are close to water resources require special consideration in their design and management to prevent the introduction of suspended sediments into bodies of water. Eroded soil that enters water bodies increase water turbidity and cause sedimentation that can affect aquatic organisms (Fritz and others 1993). Trout and other fish lay their eggs in gravels on the bottom of streams and lakes, and sediments can smother those eggs, reducing reproductive success. Sedimentation can also hurt invertebrate organisms, which serve as food for fish and other creatures. In addition, some sediment may contain nutrients that can contribute to algal blooms that deplete the dissolved oxygen in water bodies when they die off.

Poorly designed trails can also alter hydrologic functions - for instance, trails can intercept and divert water from seeps or springs, which serve important ecological functions. In those situations, water can sometimes flow along the tread, leading to muddiness or erosion and, in the case of cupped and eroded treads, the water may flow some distance before it is diverted off the trail, changing the ecology of small wetland or riparian areas.

Trail users may also pollute water with pathogenic organisms, particularly those related to improperly disposed human waste. Potential pathogenic organisms found through surveys of backcountry water sources include Cryptosporidium spp., Giardia spp., and Campylobacter jejuni (LeChevallier and others, 1999; Suk and others, 1987; Taylor and others, 1983). This is rarely a significant concern where trail use is predominantly day-oriented, and waste issues can be avoided by installing toilet facilities or following Leave No Trace practices (i.e., digging cat-holes for waste away from water resources).

Impacts to Water Resources: Management Implications

The same trail design, construction, and maintenance measures that help minimize vegetation and soil impacts also apply to water. But there are also some additional efforts needed to protect water resources:

- Trails should avoid close proximity to water resources. For example, it is better to build a trail on a sidehill along a lower valley wall than to align it through flat terrain along a stream edge, where trail runoff will drain directly into the stream.
- It is best to minimize the number of stream crossings. Where crossings are necessary, scout the stream carefully to select the most resistant location for the crossing. Look for rocky banks and soils that provide durable surfaces.
- Design water crossings so the trail descends into and climbs out of the steam crossing, preventing stream water from flowing down the trail.
- Armor trails at stream crossings with rock, geotextiles, or gravel to prevent erosion.
- Include grade reversals, regularly maintained outsloped treads, and/or drainage features to divert water off the trail near stream crossings. This prevents large volumes of water and sediment from flowing down the trail into the stream, and allows trailside organic litter, vegetation, and soils to slow and filter water.
- On some heavily used trails, a bridge may be needed to provide a sustainable crossing.
- Where permanent or intermittent stream channels cross trails, use wheel-friendly open rock culverts or properly sized buried drainage culverts to allow water to cross properly, without flowing down the trail.

Impacts to Wildlife: General Research

Trails and trail uses can also affect wildlife. Trails may degrade or fragment wildlife habitat, and can also alter the activities of nearby animals, causing avoidance behavior in some and food-related attraction behavior in others (Hellmund, 1998; Knight & Cole, 1991). While most forms of trail impact are limited to a narrow trail corridor, disturbance of wildlife can extend considerably further into natural landscapes (Kasworm & Monley, 1990; Tyser & Worley, 1992). Even very localized disturbance can harm rare or endangered species.

Different animals respond differently to the presence of trail users. Most wildlife species readily adapt or become "habituated" to consistent and non-threatening recreational activities. For example, animals may notice but not move away from humans on a frequently used trail. This is fortunate, as it can allow high quality wildlife viewing experiences for visitors and cause little or no impact to wildlife.

Other forms of habituation, however, are less desirable. Visitors who feed wildlife, intentionally or from dropped food, can contribute to the development of food-related attraction behavior that can turn wild animals and birds into beggars. In places where visitors stop to eat snacks or lunches, wildlife quickly learn to associate people with food, losing their innate fear of humans and returning frequently to beg, search for food scraps, or even raid unprotected packs containing food. Feeding wild creatures also endangers their health and well-being. For instance, after food-attracted deer in Grand Canyon National Park became sickly and dangerously aggressive, researchers found up to six pounds of plastic and foil wrappers obstructing intestinal passages of some individuals.

The opposite conduct in wildlife - avoidance behavior - can be equally problematic. Avoidance behavior is generally an innate response that is magnified by visitor behaviors perceived as threatening, such as loud sounds, off-trail travel, travel in the direction of wildlife, and sudden movements. When animals flee from disturbance by trail users, they often expend precious energy, which is particularly dangerous for them in winter months when food is scarce. When animals move away from a disturbance, they leave preferred or prime habitat and move, either permanently or temporarily, to secondary habitat that may not meet their needs for food, water, or cover. Visitors and land managers, however, are often unaware of such impacts, because animals often flee before humans are aware of the presence of wildlife.

Impacts to Wildlife: Mountain Biking-Specific Research

The impacts of mountain biking on wildlife are similar to those of hikers and other non motorized trail users.

Taylor and Knight (2003) investigated the interactions of wildlife and trail users (hikers and mountain bikers) at Antelope Island State Park in Utah. A hidden observer using an optical rangefinder recorded bison, mule deer, and pronghorn antelope response to an assistant who hiked or biked a section of trail. The observer then measured wildlife reactions, including alert distance, flight response, flight distance, distance fled, and distance from trail. Observations revealed that 70 percent of animals located within 330 feet (100 m) of a trail were likely to flee when a trail user passed, and that wildlife exhibited statistically similar responses to mountain biking and hiking. Wildlife reacted more strongly to off-trail recreationists, suggesting that visitors should stay on trails to reduce wildlife disturbance. While Taylor and Knight found no biological justification for managing mountain biking any differently than hiking, they note that bikers cover more ground in a given time period than hikers and thus can potentially disturb more wildlife per unit time.

This study also surveyed 640 hikers, mountain bikers, and horseback riders on the island to assess their perceptions of the effects of recreation on wildlife. Most respondents felt they could approach animals far closer than the flight distance suggested by the research, and 50 percent felt that recreational uses did not have a negative effect on wildlife.

Another study evaluated the behavioral responses of desert bighorn sheep to disturbance by hikers, mountain bikers, and vehicles in low- and high-use areas of Canyonlands National Park (Papouchis and others., 2001). Following observations of 1,029 bighorn sheep/human interactions, the authors reported that sheep fled 61 percent of the time from hikers, 17 percent of the time from vehicles, and 6 percent of the time from mountain bikers. The stronger reaction to hikers, particularly in the high-use area, was attributed to more off-trail hiking and direct approaches to the sheep. The researchers recommended that park officials restrict recreational uses to trails, particularly during the lambing and rut seasons, in order to minimize disturbance.

An experimental study in Switzerland evaluated the disturbance associated with hiking, jogging, and mountain biking on high elevation chamois, which are goat-like mammals found in the European mountains (Gander & Ingold 1997). The authors assessed alert distance, flight distance, and distance fled, and found that approximately 20 percent of the animals fled from trailside pastures in response to visitor intrusions. The authors found no statistically significant differences, however, between the behavioral responses of animals to the three different types of user, and authors concluded that restrictions on mountain biking above timberline would not be justified from the perspective of chamois disturbance.

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 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).

Safety issues related to grizzly bear attacks on trail users in Banff National Park prompted Herrero and Herrero (2000) to study the Morraine Lake Highline Trail. Park staff noted that hikers were far more numerous than mountain bikers on the trail, but that the number of encounters between bikers and bears was disproportionately high. For example, three of the four human-grizzly bear encounters that occurred along the trail during 1997-98 involved mountain bikers. Previous research had shown that grizzly bears are more likely to attack when they first become aware of a human presence at distances of less than 50 meters. Herrero and Herrero concluded that mountain bikers travel faster, more quietly, and with closer attention to the tread than hikers, all attributes that limit reaction time for bears and bikers, and increases the likelihood of sub-fifty meter encounters. In addition, most of the bear-cyclist encounters took place on a fast section of trail that went through high-quality bear habitat with abundant berries. To reduce such incidents, they recommended education, seasonal closures of the trail to bikes and/or hikers, construction of an alternate trail, and regulations requiring a minimum group size for bikers.

Impacts to Wildlife: Management Implications

Many potential impacts to wildlife can be avoided by ensuring that trails avoid the most sensitive or critical wildlife habitats, including those of rare and non-rare species. There are a number of tactics for doing this:

- Route trails to avoid riparian or wetland areas, particularly in environments where they are uncommon. Consult with fish and wildlife specialists early in the trail planning phase.
- For existing trails, consider discouraging or restricting access during sensitive times/seasons (e.g., mating or birthing seasons) to protect wildlife from undue stress.

The education of trail users is also an important and potentially highly effective management option for protecting wildlife. Organizations should encourage Leave No Trace practices and teach appropriate behaviors in areas where wildlife are found:

- Store food safely and leave no crumbs behind - fed animals too often become dead animals.
- It's OK for wildlife to notice you but you are "too close" or "too loud" if an animal stops what its doing and/or moves away from you.
- It's best to view wildlife through binoculars, spotting scopes, and telephoto lenses.
- All wildlife can be dangerous - be aware of the possible presence of animals and keep your distance to ensure your safety and theirs.

Conclusion

While land managers have long been concerned about the environmental impacts of mountain biking, there are still very few good studies published in peer-reviewed journals. White and others (2006) and Hendricks (1997) note that the majority of mountain biking research has focused on social issues, such as conflicts between trail users. As a consequence, the ecological effects of mountain biking on trails and natural resources remain poorly understood.

Still, an emerging body of knowledge on the environmental impact of mountain biking can help guide current management decisions. All of the existing scientific studies indicate that while mountain biking, like all forms of recreational activity, can result in measurable impacts to vegetation, soil, water resources, and wildlife, the environmental effects of well-managed mountain biking are minimal.

Furthermore, while the impact mechanics and forces may be different from foot traffic, mountain biking impacts are little different from hiking, the most common and traditional form of trail-based recreational activity.

Key observations about the environmental impacts of mountain biking:

1. Environmental degradation can be substantially avoided or minimized when trail users are restricted to designated formal trails. Many studies have shown that the most damage to plants and soils occur with initial traffic and that the per capita increase in further impact diminishes rapidly with increasing subsequent traffic. Many environmental impacts can be avoided and the rest are substantially minimized when traffic is restricted to a well-designed and managed trail. The best trail alignments avoid the habitats of rare flora and fauna and greatly minimize soil erosion, muddiness, and tread widening by focusing traffic on side-hill trail alignments with limited grades and frequent grade reversals. Even wildlife impacts are greatly minimized when visitors stay on trails; wildlife have a well-documented capacity to habituate to non-threatening recreational uses that occur in consistent places.
2. Trail design and management are much larger factors in environmental degradation than the type or amount of use. Many studies have demonstrated that poorly designed or located trails are the biggest cause of trail impacts. As evidence, consider that use factors (type, amount, and behavior of trail visitors) are generally the same along the length of any given trail, yet there is often substantial variation in tread erosion, width, and muddiness. These impacts are primarily attributable to differences in grade and slope alignment angle, soil type and soil moisture, and type of tread construction, surfacing, and drainage. This suggests that a sustainable trail that is properly designed, constructed, and maintained can support lower-impact uses such as hiking and mountain biking with minimal maintenance or degradation.
3. The environmental degradation caused by mountain biking is generally equivalent or less than that caused by hiking, and both are substantially less impacting than horse or motorized activities. In the small number of studies that included direct comparisons of the environmental effects of different recreational activities, mountain biking was found to have an impact that is less than or comparable to hiking. For example, Marion and

> Olive (2006) reported less soil loss on mountain bike trails than on hiking trails, which in turn exhibited substantially less soil loss than did horse and ATV trails. Similarly, two wildlife studies reported no difference in wildlife disturbance between hikers and mountain bikers (Taylor & Knight 2003, Gander & Ingold 1997), while two other studies found that mountain bikers caused less disturbance (Papouchis and others. 2001, Spahr 1990). Wilson and Seney (1994) found that horses made significantly more sediment available for erosion than hikers or mountain bikers, which were statistically similar to the undisturbed control. One final point to consider, however, is that mountain bikers, like horse and vehicle users, travel further than hikers due to their higher speed of travel. This means that their use on a per-unit time basis can affect more miles of trail or wildlife than hikers. However, an evaluation of aggregate impact would need to consider the total number of trail users, and hikers are far more numerous than mountain bikers.

Mountain Bike Management Implications

So what does this mean for mountain biking? The existing body of research does not support the prohibition or restriction of mountain biking from a resource or environmental protection perspective. Existing impacts, which may be in evidence on many trails used by mountain bikers, are likely associated for the most part with poor trail designs or insufficient maintenance.

Managers should look first to correcting design-related deficiencies before considering restrictions on low-impact users. By enlisting the aid of all trail users through permanent volunteer trail maintenance efforts, they can improve trail conditions and allow for sustainable recreation.

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MOUNTAIN BIKING IMPACT REVIEW
FREQUENTLY ASKED QUESTIONS

MOUNTAIN BIKERS OF SANTA CRUZ

MOUNTAIN BIKING IMPACT REVIEW FAQ

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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:

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A Comparative Study of Impacts to Mountain Bike Trails in Five Common Ecological Regions of the Southwestern U.S.

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EXECUTIVE SUMMARY: A rapid increase in mountain biking participation over the past thirty years has led to concerns about ecological impacts to recreation environments, especially trails. It is widely accepted that recreational use of natural areas inevitably results in some degree of change to resource conditions, and managers must consider the social acceptability and ecological significance of such changes in their decision making. The ecological impacts of mountain biking, however, and relationships between impacts and trail features remain poorly understood.

This study uses Common Ecological Regions (CERs) as a mapped ecological framework to guide comparative analysis of differences in maximum trail incision and trail width at varying slope levels for mountain bike trails in five CERs in the southwest U.S. A point-measurement trail assessment procedure was utilized to measure maximum incision and width for 163.2 miles of mountain bike trails. Results show a significant effect of CER on trail width and maximum incision and a significant effect of trail slope on maximum trail incision. Maximum trail width and incision were greatest in the Arizona/New Mexico Mountains region, perhaps due to environmental features such as erodable soils and sparse trailside vegetation, higher use, and/or user behavior. Maximum incision increased consistently with slope for three of five CERs.

Relative to other trail impact research, the sites assessed in this study were in similar condition to other trails on the specific parameters measured. The findings from this study reinforce results from previous research that certain impacts to mountain bike trails, especially width, are comparable or less than hiking or multiple-use trails, and significantly less than impacts to equestrian or off-highway vehicle trails.

KEYWORDS: Recreation ecology, recreation impacts, ecological impacts, impact assessment, trail management

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Mountain biking is an increasingly popular outdoor recreation activity in North America. Although use estimates vary, according to the recent National Survey on Recreation and the Environment (2003), general bicycling was the second most popular land-based recreation activity in the United States. Of those who bicycled, an estimated 45.2 million people, or nearly 21% of the American public biked on backcountry roads, trails, or cross country on a mountain bike at least once in the twelve months prior to the survey. Mountain biking provides important individual benefits (e.g., physical exercise and opportunities to experience nature), social benefits (e.g., family bonding), environmental benefits (e.g., preservation of natural areas for trails), and economic benefits (e.g., local and regional economic stimulus). Over the past two decades, technological improvements in mountain bike materials, components, and designs have facilitated dramatic increases in participation, allowing more and more people to realize the benefits of this recreation activity.

The rapid expansion of mountain biking also has led to concerns over the potential for undesirable social and ecological impacts to recreation environments. Management issues include safety of trail users, conflict, crowding, and resource degradation. The increase in mountain biking popularity thus far has outpaced efforts to understand this activity's associated impacts, leading to confusion, user conflict, and, in some cases, strict regulations for mountain biking on public lands (Edger, 1997). In some cases, managers have implemented actions such as spatial and temporal zoning, dispersal strategies, and trail closures to address concerns. Such direct management actions that limit access can be controversial and raise issues of equity. Furthermore, the lack of scientific understanding of ecological impacts on mountain bike trails limits informed decision making. A nationwide study of U.S. state park directors conducted by Schuett (1997) demonstrated the potential for uninformed management actions. Schuett found that 67% of state park directors felt that resource degradation from mountain biking was a problem in their parks, but less than 13% of the park systems had actually conducted any studies to assess the resource impacts from mountain biking. Similarly, Chavez (1993) cited studies that suggested U.S. Forest Service and U.S. National Park Service managers were concerned about resource degradation from mountain biking, but managers "could not discern whether damage was specifically because of mountain bike use" (p. 1). As Hendricks, Ramthun and Chavez (2001) noted, "Resource impacts attributable to mountain bikes have remained debatable and understudied. At this time there is not a well-developed body of research on the environmental impacts of off-road cycling" (p. 40).

It is widely accepted that recreational use of natural areas inevitably results in some degree of change to resource conditions, and managers must consider the magnitude, social acceptability, and ecological significance of such changes in their decision-making processes. In the absence of sound scientific information, however, managers may apply a precautionary principle, and choose to restrict use or take regulatory action that is based on intuition, influence from advocacy groups, and questionable studies. Clearly, further research is needed to inform the development of best management practices to support sustainable mountain biking on established and properly constructed recreation trails.

Among the key factors affecting trail impacts deserving further study are: ecological attributes, such as vegetation and soil composition; use-related factors, such as amount and timing of use; and management factors such as trail design, alignment, and slope (Hammit & Cole, 1998; Leung & Marion, 1996). Although these significant influential factors and associated impacts have been identified, there have been relatively few quantitative studies of mountain bike trail impacts published to date that serve as building blocks for establishing relationships among the variables.

Furthermore, although there has been an increasing focus on the ecosystem concept in conservation and resource management in parks and recreation areas, the field of recreation ecology to date has not adopted a standardized mapped ecological region framework for organizing and comparing the studies that are conducted. Theoretically informed mapped ecological region frameworks are useful for classifying landscapes into hierarchical spatial units that represent characteristic patterns in the biophysical environment, human activities and impacts, and social and cultural meanings associated with landscapes (McMahon et al., 2004). Such frameworks are useful for describing and interpreting status and change in landscapes. McMahon et al. summarized the use of such frameworks by resource agencies in the U.S. and Canada which had mandated landscape assessments, biodiversity analysis, environmental monitoring and assessment, and selected indicators and standards for understanding environmental stressors and responses. According to McMahon et al., "The use of regions to stratify the underlying variability in natural conditions may increase the likelihood of detecting and understanding an environmental response generated by human activities" (p. 113). As recreation impacts are known to be related to both biophysical characteristics (e.g., soil, vegetation, and topography) as well as human activity (e.g., recreation type and amount, management intervention) it seems apparent that integrating impact studies with ecological regional frameworks might be fruitful. Also, using a standardized ecological region framework may facilitate the integration of recreation impact research into the widely accepted ecosystem research, assessment, and management framework.

To address these research needs, the goals of this study are twofold: one, to propose the use of Common Ecological Regions (CERs) (McMahon et al., 2001) as a mapped ecological region framework to guide comparative recreation impact research; and two, to evaluate the relationships between two influential factors and two common trail impacts. Specifically, this study assessed differences in maximum trail incision and trail width at varying slope levels for mountain bike trails in five common ecological regions in the southwest U.S.

Trail Impacts and the Emergence of Mountain Bike Research

The study of ecological impacts, often referred to as recreation ecology, has been, and continues to be a prominent field of inquiry for researchers, land managers, and academic professionals. Cole (1987) suggested that the field of recreation ecology began over 65 years ago with Meinecke's (1928) work on recreation impacts in the California Redwood State Parks. Recreation impacts research intensified during the 1960s and early 1970s as federal land management agencies sponsored studies to improve recreation management in natural areas. According to Leung and Marion (2000), the essence of today's ecological impact research and management lies in the desire to gain knowledge and to understand relationships among key causal and influential factors and significant effects. This knowledge is necessary to prevent, mitigate, and manage resource impacts. Campsites and trails receive the most attention from recreation impact researchers, with studies taking place in both remote backcountry and semi-remote front country settings.

The primary impact to recreation resources associated with trails occurs during initial trail design and construction (Birchard & Proudman, 2000; Sun & Walsh, 1998). Although this impact has the greatest magnitude and highest ecological significance, it is widely viewed as socially acceptable as the individual, social, and economic benefits of trail-based recreation typically outweigh the associated environmental costs (Cole, 1987). Most trail impact literature and recent research is organized around environmental and visitor-related factors (Hammit & Cole, 1998; Leung & Marion, 1996). Environmental impacts can be divided into four general categories: impacts to wildlife, water, vegetation, and soil. Visitor-related factors include amount of use, type of use, and user behavior. The foundation of recreation ecology research provides a platform for examining impacts associated with mountain biking.

The unprecedented explosion in mountain biking as a trail activity was sparked in the 1970s when cyclists began modifying bikes for off-road use (Schwartz, 1994). With balloon tires, a low, flat headset, and high clearance frame, mountain bikes brought drastic changes to places like Marin County, California. Fisher describes the early days: "In the mid-'70s we had a kind of cult riding everywhere on these clunkers" (Schwartz, 1994, p. 77). In 1981, Specialized Bicycle Components produced the first off-the-rack mountain bike, the Stumpjumper, and by 1999 mountain bike sales accounted to one-half of all units sold and one-third of all gross revenue for U.S. bicycle retailers (Bicycle Retailer & Industry News, 1999). In magazine articles from the 1980s, headlines portrayed mountain bikes as "Two-Wheel Terrors" (Foote, 1987) and "Vicious Cycles?" (Coello, 1989), and questioned whether mountain biking was "Sport or Spoil-Sport?" (Staub, 1984). Sensational captions depicted the "impacts" typical of mountain biking. Below a photo of bikers maneuvering a set of switchbacks, Foote included, "On the trail: cyclists pose a threat to nature" (p. 72). Next to a photo of two parallel bike tracks, Coello added the caption, "Along the

White Rim Trail, a jeep road in Canyonlands National Park, cyclists have gouged furrows on their way to the canyon rim" (p. 52). Cessford (1995a) questioned whether tread marks were an easy target, and one wonders if Coello would have made a similar statement about footprints leading to the canyon rim. Countering these claims, Grost (1989) noted that bikes "don't eat hay, grass ... or defecate" (p. 50) and "weigh about 872 pounds less than a horse" (p. 76).

In the 1980s and 1990s researchers began serious study of the social and environmental consequences of mountain biking. Hendricks (1997) recognized that "the 1990s have seen the mountain bike controversy mature from social and environmental issues debated with anecdotal evidence in board meetings, in popular magazines and through newspaper editorials to a land management issue supported by serious inquiry and examination" (p. 3). Researchers studied mountain biker demographics, preferences, and perceptions (Antonakos, 1993; Bowker & English, 2002; Cessford, 1995b; Goeft, 2000; Hollenhorst et al., 1995; Ruff & Mellors, 1993; Symmonds et al., 2000); manager preferences and management strategies (Baker, 1990; Chavez, 1996a, 1996b; Hendricks et al., 2001; Leberman & Mason, 2000; Mason & Leberman, 2000; Moore & Barhlow, 1997; Ruddell & Hendricks, 1997; Schuett, 1997); and social conflict (Banister et al., 1992; Carothers et al., 2001; Cessford, 2002; Ramthun, 1995; Watson et al., 1991).

The ecological impacts of mountain biking, however, remained poorly understood. In fact, several researchers indicated a need for further study in this area (Cessford, 1995a, 1995b; Chavez, 1996a; Chavez et al., 1993; Goeft, 2000; Goeft & Alder, 2001; Hendricks, 1997; Jacoby, 1990; Schuett, 1997; Thurston & Reader, 2001; Wilson & Seney, 1994). The absence of concrete information was evident in the earliest publications. In an early summary of mountain biking literature, Cessford (1995a) discussed ecological impacts and presented several astute observations, though the majority of his conclusions were derived from other forms of recreation, such as hiking and off-road motorcycling. His most notable inference was that mountain bikes will generate the most torque during uphill travel, but considerably less pressure on the trail in comparison to other users when moving downhill, although degradation is possible "in extremely wet conditions, on uncompacted surfaces, or due to poor braking practices" (p. 9). Cessford also admitted that the research available at that time could not reliably discern whether mountain biking was any more or less impacting than hiking, a sentiment shared by Ruff and Mellors (1993).

At the time of Cessford's (1995a) literature review, few physical impact studies included mountain biking. Wilson and Seney's (1994) quasi-experimental approach examined the effects of a mountain bike, hiker, horse, and motorcycle on runoff and sediment yield for trail sample plots in the Gallatin National Forest, Montana. The results of this analysis indicated that the four uses did not significantly alter runoff. With respect to sediment yield on pre-wetted plots, the horse and hiker dislodged more material than the motorcycle and mountain bike. On dry plots, the hiker, mountain bike, and motorcycle produced similar sediment yields, but again the horse produced highest yield. Sediment yield for each use was greater for pre-wetted plots than for dry plots. Wilson and Seney acknowledged that soil texture and slope are equally important factors as used in determining sediment yield. Another comparative quasi-experimental design was applied to mountain biking by Thurston and Reader (2001), who assessed the effects of hiking and mountain biking on vegetation loss, species loss, and soil exposure. Their most pertinent finding was that there was no significant difference between the impacts of hiking and mountain biking for the three variables.

Bjorkman's (1998) dissertation included two studies conducted in Wisconsin's forests. In the first project, Bjorkman determined that sediment yield and erosion associated with mountain biking were lower on a surface treated with a nylon/polypropylene liner and covered with a material made from recycled tires than on an untreated trail. For the second analysis, Bjorkman monitored a variety of impact variables over the first five seasons of, and 90,000 passes on, two newly opened mountain biking trails. The primary findings were: the greatest change in vegetation loss, compaction, cross sectional area and centerline depth on steep slopes, and mean trampled width occurred early in trail use; impacts were largely confined to the trail centerline; and erosion and trail width were greatest on slopes with ≥ 24 percent grade, though erosion was not significant on less steep slopes. In similar research, Goeft and Alder (2001) examined changes in soil compaction, erosion, trail width, and vegetation cover over one year on both recreation and racing trails in southwestern Australia. They noted that erosion was greatest on downhill slopes and at curves, and that erosion and compaction were strictly on-trail impacts. Off-trail vegetation impacts and changes in trail width proved insignificant, though both were most pronounced following a race. Widening was also more likely on wet soils and during the rainy season.

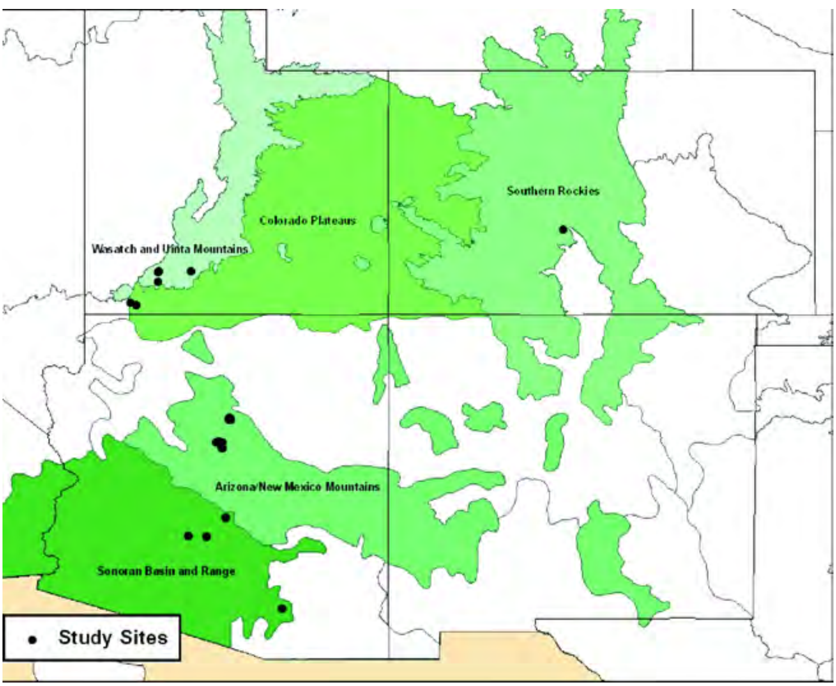
From these studies, several key points are evident. The magnitude of ecological impacts attributed to mountain biking appear to be comparable to those of hiking, and appear less than motorized trail use and equestrian use. In many cases, soil structure, slope, and environmental factors are as influential as type and amount of use in determining impacts such as soil loss. If managed properly, impacts such as compaction and vegetation loss can be confined to the trail, with minimal damage to trail peripheries. Mountain bikes have the greatest potential to damage trails in wet and muddy conditions and on steep uphill (spinning tires) and downhill slopes (skidding), which may prove problematic for managers, as many mountain bikers prefer challenging technical sections. In Bjorkman's (1998) words, "Usage has little influence in explaining impacts to the trail... The first several thousand passes create the most change whether later total use levels are 10,000 or 90,000" (p., 122). Though these limited findings acknowledge an incomplete understanding of the physical impacts of mountain biking, they do provide an early indication of conditions that may exist in the field.

Study Methods

Common Ecological Regions (CERs) Provide an Organizing Spatial Framework

This study was conducted in five common ecological regions in the southwest U.S.: Sonoran Basin and Range; Arizona/New Mexico Mountains; Colorado Plateau; Southern Rocky Mountains; and Wasatch and Uinta Mountains (see Figure 1). These ecological regions are a subset of a larger spatial framework developed through a cooperative partnership of nine U.S. federal earth science and resource management agencies. The CER spatial framework "is a mapped set of geographic regions that supports agency programs or studies" that was developed to guide cooperative ecosystem research efforts and facilitate "regionally generalized results from local investigations" (McMahon et al., 2001, p. 293-294). Thus, by using the ecological regions framework developed by the cooperating agencies, which include the Forest Service, Bureau of Land Man-

Figure 1
Map of Study Sites



agement, Fish and Wildlife Service, and National Park Service, researchers may obtain an "increased measure of confidence in moving from the results of their investigations to characterizing the region as a whole" (McMahon et al., p. 301).

The common ecological regions are based on similarities in biotic, abiotic, terrestrial, and aquatic features of the environment as well as social and cultural meanings attached to those environments (McMahon et al., 2004). These various factors were incorporated into the CERs from the amalgamation of three preliminary spatial frameworks developed by the Forest Service (USFS), Environmental Protection Agency (EPA), and National Resource Conservation Service (NRCS) (McMahon et al., 2001). Each of these three prevailing frameworks was created according to agency agendas and management directions. The latest Forest Service framework, for example, was spawned from an agency focus on ecosystem-based approach to managing national forests and grasslands. The NRCS major land resources framework was shaped from practical USDA requirements for soil classifications necessary for assessing agriculture potential and land use. The MLRA and other NRCS frameworks and soil maps work in a hierarchical manner when placed under the umbrella of the CER framework. Similar to the original USFS approach, the EPA framework is aligned with an overall ecosystem view. McMahon et al. (2001) provided a thorough review of how these three original and contributing frameworks have undergone subsequent quantitative and qualitative analysis to create the interagency coordinated CERs.

The five CERs in which data were collected for this study are characterized by vegetation, soils, physiographic, land use, land cover, and geology elements represented in the contributing frameworks mentioned above. The Sonoran Basin and Range region is characterized by extensive areas of palo verde-cactus shrub and giant saguaro cactus and has large tracts of federally managed lands. The basins are marked by grama-tobosa shrubsteppe while the ranges are covered with oak-juniper woodlands, and ponderosa pine on the higher elevations. The Arizona/New Mexico Mountains region is a relatively dry, warm environment, with chaparral at lower elevations, pinyon-juniper, and oak woodlands at lower to middle elevations, and higher elevations covered by Ponderosa pine forests and smaller areas of spruce, fir, Douglas fir, and aspen. In the Colorado Plateau region, differences in elevation distinguish this region from nearby Arizona/New Mexico Plateau where it reaches lower and Wyoming Basin to the north as it is generally more elevated. In large, low-lying areas, saltbrush-greasewood vegetation is dominant. The pinyon-juniper woodlands of the elevated plateaus of this region include sheer sidewalls of abrupt changes in local relief, ranging from 300-600 meters. The Wasatch and Uinta Mountains region, also the westernmost region in this study, encompasses a central area of high, precipitous mountains with intermittent valleys, plateaus, and open high mountains. Vegetation is manifest in a banded pattern where aspen, chaparral, and juniper-pinyon and oak are common at middle elevations. The region is also typified by less lodgepole pine and a greater emphasis on grazing livestock than in the neighboring Middle Rockies region to the north. Finally, the Southern Rockies region, which marks the eastern extent of the areas studied, includes high elevations and steep, rocky mountains. Large portions of this region are covered by coniferous forest, while the highest elevations take on alpine characteristics. Similar to the Wasatch and Uinta Mountains region, elevation banding dictates vegetation, soil, and land use in the Southern Rockies region. Lower elevations contain grasses and shrubs and are grazed heavily. Moderate elevations include grazing and are covered by Douglas fir, ponderosa pine, aspen, and juniper and oak woodlands. Higher elevations are abundant with coniferous forests that receive minimal grazing activity (US Environmental Protection Agency, 2005). Although there is variability in biotic and abiotic elements within ecological regions, this spatial framework provides a useful system for segmenting the region and providing context for interpretation and extrapolation of environmental research findings.

Trail Selection

The goal of the trail selection procedure was to identify mountain bike trails or trail segments within each ecological region that were generally typical of trail conditions in that region. A comprehensive list of potential trail segments was developed in cooperation with land management agencies and mountain bike and trail associations. The focus was to identify trail segments identified by the responsible management agency as system trails—in keeping with the purpose of the research to examine impacts to existing trails where mountain biking might be sustained as a legitimate activity. Some trail segments were initially user-created but had been adopted into the agency trail system if design parameters were within agency specifications. To isolate impacts associated with mountain bike trails to the greatest extent possible in a field research setting, trail segments were excluded from the sample frame if motorized use, equestrian use, or multiple-use was dominant. We initially planned to use a 3 x 3 x 5 full factorial design with three levels of use (low/medium/high) and three levels of slope (low/medium/high) across five ecological regions; however, once candidate trail segments were identified, the necessary diversity in use level in each region was lacking, given the use-type restrictions. Specifically, there were inadequate data points to fill cells for low use levels for four of the five CERs and medium use level for two of the five CERs. Ultimately, a total of 162.3 miles of trails were purposively selected in the five common ecological regions. Thus, several limitations of the completed sample should be noted, including the lack of diversity in use levels across the five study regions, the lack of verifiable use level information, and the small number of sample points collected in the Colorado Plateau region, which resulted from time and resource limitations for the field research data collection. Future researchers should consider collecting systematic trail use level information using trail counters or other methods.

The completed sample of trail segments in each region cannot be determined to be representative of that region and extrapolation of the study findings to the ecological region as a whole, is inappropriate at this time, and thus our findings should be cautiously interpreted at larger spatial scales. By adopting the common ecological regions as an eco-spatial framework for recreation impact research, however, we aim to encourage the long-term development of a comprehensive knowledge base of impact conditions across these regions. The CER framework is available for download as a GIS layer (US Environmental Protection Agency, 2005) and subsequent research utilizing this framework would facilitate comparative spatial analyses and ultimately confident generalizations about the relationships between specific causative and non-causative but related factors and specific impacts across different regions of the U.S., thus overcoming one of the limitations of recreation impact research—namely that research tends to be opportunistic, site-specific and driven by specific management concerns.

Trail Impact Assessment Procedures

A point-measurement trail assessment procedure was utilized in this study, focusing on measuring maximum incision and trail width. The point sampling method is most appropriate for assessing trail impacts, such as incision and width, which are continuous along the trail (Marion & Leung, 2001). For the point measurement method, a bicycle wheel measuring computer was used to identify systematic sampling points at intervals located every 805m (1/2 mile) along the trail after a random start point near the trailhead. Leung and Marion (1999) examined the influence of sampling interval on the accuracy of trail impact assessments for frequency of occurrence and lineal extent for four common impacts (tread incision, wet soil, exposed roots, multiple trailing) and found that intervals of less than 100m provided the most accurate estimate of lineal extent. Recognizing the inefficiency of such sampling intensity for most settings, however, the authors concluded that "sampling intervals between 100m-500m are therefore recommended to achieve an appropriate balance between estimate accuracy and efficiency of field work" (p. 178). Thus, a limitation of this study is a large sampling interval relative to other studies and the potential for loss in accuracy. The justification for this approach was to include as large a sample of trail miles as possible across a broad geographic region in this exploratory investigation.

At each sample point, trail boundaries were defined to include the area where the vast majority of trail use (>90%) occurred by identifying visually obvious disturbance indicated by changes in ground vegetation height, cover and composition. Temporary stakes were placed at the trail boundaries to establish a transect perpendicular to the trail tread. Trail width was defined as the distance between the trail boundary points and measured in inches to the nearest inch. A taut nylon cord was stretched between the base of the stakes and maximum trail incision (MIC) was measured as the maximum depth from the string to the trail surface in inches to the nearest quarter inch. At each measurement point, technicians used digital camera to capture site images and recorded locations using Global Positioning System (GPS) receiver. Data were collected between May 2003 and March 2005 during the primary use season for each ecological region, entered into an online Microsoft Access 2003 database and analyzed using SPSS (Version 12).

Results

Data for the study were collected from 162.3 miles of mountain bike trails across five common ecological regions, which resulted in 319 point measurements (see Table 1). Of the 162.3 miles of trails assessed, 91.7 miles were managed by the U.S. Forest Service, 27.5 miles by a county parks and recreation agency, 16.4 miles by a state government agency, 17.8 miles by the Bureau of Land Management, and 8.9 miles by a city government.

Table 1
Mileage of Mountain Bike Trails Assessed and Number of Sample Points Across Three Categories of Slope for Five Common Ecological Regions

	Mileage	Sample points			
		< 5%	5% to 10%	> 10%	Total
Colorado Plateaus	17.8	9	21	7	37
Wasatch and Uinta Mountains	26.8	16	19	19	54
Southern Rockies	29.3	15	25	12	52
Arizona / New Mexico Mountains	35.6	26	25	25	76
Sonoran Basin and Range	52.8	52	22	26	100
Total	162.3	118	112	89	319

Mountain biking was the dominant activity on all trail segments, with three trails engineered specifically for this use.

Trail slope is a key factor influencing potential for impacts to soil and vegetation on recreation trails (Goeft, 2000; Wilson & Seney, 1994) with trail slopes greater than 12% typically associated with higher potential for degradation. As shown in Table 2, 37% of the sample points had a slope of less than 5%, 35% had a slope of 5% to 10%, and 27% had a slope greater than 10%. The mean slope for all sample points in the study was 7.6% with a minimum of 0% and a maximum of 38%. Considering the trail segments in each of the CERs, the mean slopes were: Sonoran Basin and Range (7%); Arizona/New Mexico Mountains (8%); Colorado Plateau (7%); Southern Rocky Mountains (7%); Wasatch and Uinta Mountains (8%).

The mean maximum trail incision, or trail depth, across all sample points was 1.48 in. with a median of 1.0 in. and maximum 10.0 in. The

Table 2
Mean Trail Width and Maximum Incision at Three Slope Levels Across Five Common Ecological Regions

Common Ecological Region	Trail Grade	Trail Width (ft.)	MIC (in.)
Colorado Plateaus	< 5%	1.87	0.78
	5% to 10%	2.24	1.14
	> 10%	2.41	1.00
Wasatch and Uinta Mountains	< 5%	2.14	1.06
	5% to 10%	2.31	1.31
	> 10%	2.28	1.74
Southern Rockies	< 5%	1.94	1.73
	5% to 10%	2.10	2.00
	> 10%	4.02	1.67
Arizona / New Mexico Mountains	< 5%	3.45	1.62
	5% to 10%	4.12	1.88
	> 10%	2.61	2.20
Sonoran Basin and Range	< 5%	2.48	0.83
	5% to 10%	2.34	1.55
	> 10%	1.84	1.61

mean trail width across all sample points was 32 in., with a median of 26 in. and a maximum of 109 in. Table 3 displays the values for trail width and maximum trail incision by each trail slope category and across the five ecological regions. Multiple analysis of variance (MANOVA) was used to examine the relationships between the influential factors of CER and slope and the impacts of trail width and maximum trail incision. For MANOVA, the assumption is that dependent variables are multivariate normal; however analysis of variance is robust to departures from normality. The results, displayed in Table 4, showed a significant main effect of CER on both trail width and maximum trail incision. Average trail width for the sample points was significantly higher in the Arizona/New Mexico Mountains than all other regions; this was followed by Sonoran Basin and Range, Wasatch and Uinta Mountains, Southern Rocky Mountains, and Colorado Plateau. MIC was highest for the sample points in the Arizona/New Mexico

Table 3
Multiple Analysis of Variance (MANOVA) for Impact Parameters

Source	Dependent Variable	*df*	*MS*	*F*	*p*
Model	Width[a]	14	11.35	5.576	<.0005
	MIC[b]	14	4.38	4.007	<.0005
CER	Width	4	37.04	18.196	<.0005
	MIC	4	6.96	6.371	<.0005
Slope	Width	2	1.80	.885	.414
	MIC	2	4.67	4.272	.015
CER*Slope	Width	8	0.75	.371	.936
	MIC	8	0.79	.723	.671

Note. [a]R^2 = .20 (Adjusted R^2 = .17); [b]R^2 = .16 (Adjusted R^2 = .12).

Table 4
Multiple Analysis of Variance (MANOVA) for Impact Parameters

Source	Dependent Variable	df	MS	F	P
Model	Width[a]	14	11.350	5.576	.000
	MIC[b]	14	4.380	4.007	.000
CER	Width	4	37.037	18.196	.000
	MIC	4	6.964	6.371	.000
Slope	Width	2	1.802	.885	.414
	MIC	2	4.670	4.272	.015
CER*Slope	Width	8	.754	.371	.936
	MIC	8	.791	.723	.671

Note. [a]R^2 = .204 (Adjusted R Squared = .168); [b]R^2 = .156 (Adjusted R Squared = .117).

Mountains, followed by Southern Rocky Mountains, Wasatch and Uinta Mountains, Sonoran Basin and Range, and Colorado Plateau.

There was a significant main effect of trail slope on maximum trail incision—as slope increased, maximum incision increased. MIC for slopes of less than 5% was significantly lower than slopes of 5% to 10% and significantly lower than for slopes of greater than 10%. The latter two slope categories were not significantly different. There was not a significant main effect of trail slope on trail width, but, generally, as slope increased, trail width increased. Average trail width was 30 in. for slopes less than 5%, 32 in. for slopes 5% to 10%, and 34 in. for slopes greater than 10%. Figure 2 displays the findings for MIC across three categories of trail slope for each CER. For three of the five CERs—Arizona/New Mexico Mountains, Sonoran Basin and Range, and Wasatch and Uinta Mountains—incision was smallest on slopes less than 5%, higher on slopes 5% to 10%, and highest on slopes greater than 10%. In the two other regions, different patterns emerged. In the Colorado Plateaus, MIC increased from 0.78 in. at slopes less than 5% to 1.14 in. at slopes of 5% to 10%, but fell to 1.00 in. at slopes of greater than 10%. MIC for sample points in the Southern Rockies CER was 1.73 in. at less than 5% slope and increased to 2.00 in. at 5% to 10% slopes, but MIC lowest at slopes of greater than 10% (1.67 in.).

The effects of slope and CER on trail width are graphed in Figure 3. As noted earlier, slope did not have a significant effect on width for the sample points in the study, although in general higher slopes were associated with

Figure 2
Mean Maximum Trail Incision at Three Different Slope Levels Across Five Common Ecological Regions

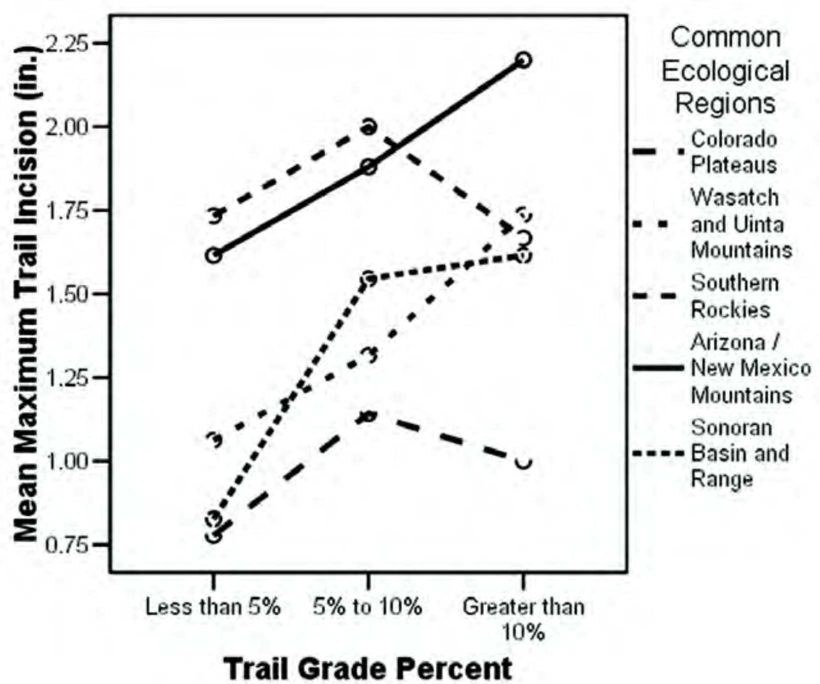
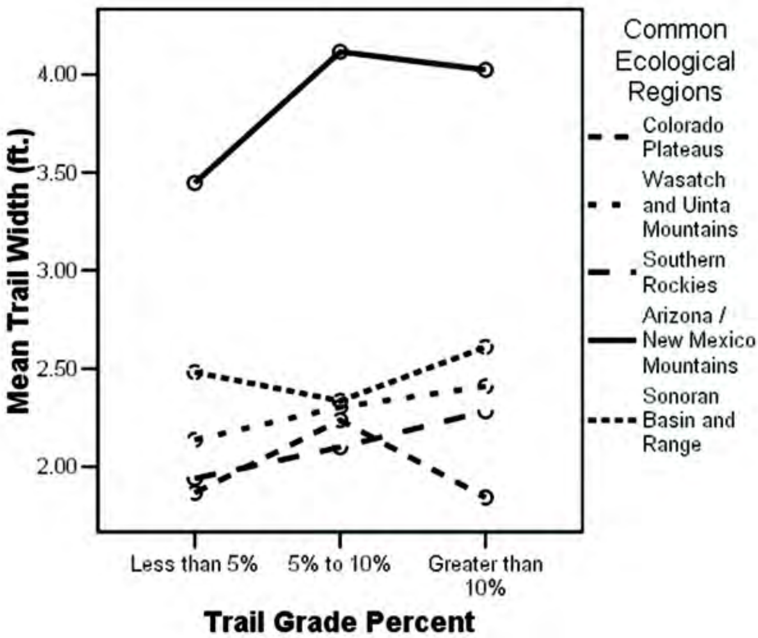


Figure 3
Mean Trail Width at Three Different Slope Levels Across Five Common Ecological Regions



higher trail width. For sample points in three of the five CERs—Arizona/New Mexico Mountains, Wasatch and Uinta Mountains, and Southern Rockies, the trend lines show higher slopes to be associated with increasing width, but the differences are small. Trail width for the sample points in the Arizona/New Mexico Mountains was significantly greater than all other regions at each slope level. In this region, width increased from 42 in. at less than 5% slope to 50 in. at 5% to 10% slopes and 48 in. at greater than 10% slope. For sample points in Colorado Plateaus, width increased from 22 in. at the lower slopes to 27 in. at the middle slopes, but then dropped to 22 in. at the steeper slopes. On the contrary, trail width for points in the Sonoran Basin and Range was lowest in the 5% to 10% slope category. The interaction between CER and slope was not significant.

Conclusions

Data for this study were collected from 319 sample points gathered from 162.3 miles of mountain bike trails in five common ecological regions of the southwest United States. Significant differences were identified between trails in different common ecological regions for both trail width and maximum incision. Trail width at sample points in the Arizona/New Mexico Mountains was significantly higher than sample points for all other regions. These finding may be explained by environmental features such as vegetation associations or soil, or by use-related variables or management factors at the specific trails included in this study. Without adequate controls, it is not possible to isolate the effects of each contributing factor, but several explanations are plausible. Environmentally, the dominant vegetation for most trail segments in the Arizona/New Mexico Mountains was sparse chapparal and pinyon-juniper and the soil was mostly sandy-loam to loam. Such relatively sparse vegetation and fine, homogenous soils may not prevent trail widening as effectively as, for instance, the imposing trailside cactus vegetation and rockier soils in the Sonoran Basin and Range or the more densely forested portions of the Southern Rockies and Wasatch and Uinta Mountains. Regarding use-related factors, the sampled trails in the Arizona/New Mexico Mountains region are located in the Coconino National Forest near Sedona and Flagstaff, Arizona and these trails were the most heavily used in the study. The trails are popular for day hiking and it is hypothesized that heavy use and user behavior contributed to increased width. For instance, although systematic observation of recreation behavior was not part of this study, field researchers' notes suggest that as mountain bikers passed others on the higher-use trails, users leave the main tread, disturbing soil and vegetation. This use-related explanation is consistent with Marion and Leung's (2001) study of trails in Great Smoky Mountains National Park, which found that trail width was the only impact condition significantly related to use level. Regarding maximum incision, values were significantly higher in the Arizona/New Mexico Mountains and Southern Rockies regions than all other regions.

Consistent with previous mountain bike trail research (Goeft & Alder, 2001; Wilson & Seney, 1994), increasing slope was associated with greater impact; in this case maximum incision. Specifically, MIC was greater at slopes of 5% to 10% than at slopes of less than 5% in all five CERs. This finding is significant, suggesting a direct relationship between slope and MIC, especially at small to moderate slopes. Future research might test this hypothesis through a multiple regression analyses to isolate the relative contribution of slope and ecological characteristics, as well as use level, and management agency. Although the interaction between CER and slope was not statistically significant, the pattern of results in the data show that MIC on sample points from two regions—Southern Rockies and Colorado Plateaus—was lower at slopes of greater than 10% than at slopes of 5% to 10%. This pattern may be explained by increased management attention to those trail segments at greater slopes, lower use on steep trail segments, or by more resistant soils. Further investigation is necessary to determine if environmental features, use-related variables, or management factors mediate the relationship between slope and incision at higher slopes. Trail slope was related to maximum incision but not trail width.

Relative to other trail impact research, the sites assessed in this study were in similar condition on the specific parameters measured. Average overall trail width for all sample points in our study was 32 in., with a median of 26 in., and average maximum incision was 1.48 in. with a range of 0 to 10 and median of 1.0 in. The width and depth of the trails in this study are similar to the multiple use trails Great Smoky Mountains National Park discussed by Marion and Leung (2001), where point sampling method found the range of width to be 9 in. to 57 in. with a median of 17 in., and a range of incision within current tread boundary of 0 in. to 6 in. and a median of 0 in. Average width in our study was similar to lower use mountain bike trails in Australia studied by Goeft and Alder (2001), which found width to range from 17 in. to 26 in., and mountain bike trails in Tennessee assessed by Marion and Olive (2004), which found average width to be 24 in. In the Marion and Olive study, average width for horse trails was 81 in. and average width on ATV trails was 104 in.; in that study, bike trails had significantly less erosion as measured by cross-sectional area, and less muddiness than horse and ATV trails as well. Similarly, Aust et al. (2005) found an average width of 82 in. for equestrian trails in Hoosier National Forest in Indiana. The findings from our study thus reinforce results from previous research that certain impacts to mountain bike trails, especially width, are comparable or less than hiking or multiple-use trails, and significantly less than impacts to equestrian or off-highway vehicle trails. Although our study focused on only two impacts, when combined with the findings of previous studies (Goeft & Alder, 2001; Wilson & Seney, 1994), a consensus seems to be emerging that recreation impacts to mountain bike trails are largely confined to the main tread and mountain biking is likely a sustainable activity on properly managed trails, at least in the environments studied thus far. To determine the sustainability of mountain biking, however, further research is warranted into other, potentially more ecologically significant impacts, such as wildlife disturbance or introduction and spread of invasive species, and across a broad range of ecological regions.

Our study does suggest that moderate to severe slopes are an area of management concern for increased incision; although we did not assess erosion (e.g., through cross sectional area), this is also a concern for moderate to severe slopes. This is potentially problematic as studies have shown that mountain bikers tend to prefer trails with steeper slopes, downhill features, and sharp curves (Cessford, 1995b; Goeft & Alder, 2001; Hollenhorst et al., 1995). For the trails in our study, the impacts were relatively modest, but systematic monitoring would be prudent. Managers may also want to clearly define and encourage a narrow trail tread in environments, such as the Arizona/New Mexico Mountains, that facilitate free travel along the trail periphery and on multiple-use trails where hikers and bikers frequently pass one another.

A final contribution of this study is the introduction of CERs as an organizing eco-spatial framework for recreation impact research. Additional studies that use this framework will facilitate comparisons of findings and ultimately allow for increased statistical power and meta-analyses to isolate the relative importance of various causal and influential factors on a wide range of impacts. Such studies, especially when using GIS analyses, have the potential to assist researchers and managers in moving from localized investigations to regionalized generalizations. Despite limitations, this study represents an exploratory first step in this progression.

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Belmont Waterdog Trail Keeper - Volunteer Hour Tracker

Date of Work	Project	Location	# of Volunteers	Hours/Volunteer	Total Hours
2/25/2018	Culvert and rolling grade reversal	Upper Rambler	2	4.0	8.0
3/24/2018	French drain addition	Lake Loop	2	6.0	12.0
3/31/2018	Trail corridor trimming	John Brooks	1	6.0	6.0
4/26/2018	Outslope tread, add grade reversal	John Brooks - CCC trail	2	4.0	8.0
5/9/2018	Trail corridor trimming	Finch	1	10.0	10.0
5/30/2018	Decking replacement	Ohlone	1	4.0	4.0
5/20/2018	Bridge replacement	Rambler-Canyon Creek	1	12.0	12.0
6/1/2018	Trail corridor trimming	Chap, Ohlone, Rambler, .	3	12.0	36.0
12/2/2018	Tread sloping, grade reversals	Flow	2	5.0	10.0
12/14/2018	Tread outsloping, drainaige	Lake Loow	1	4.0	4.0
1/19/2019	Lake Loop muddy section outslope and drainage	Lake Loop	8	4.0	32.0
1/29/2019	Slippery ramp	Berry	2	3.0	6.0
2/23/2019	Trail maintenance to remove ruts	Chapparal	4	5.0	20.0
3/11/2019	Tire Brush for sudden oak death	Hidden Valley	1	6.0	6.0
3/15/2019	Trail maintenance to remove ruts on switch backs	Finch	1	5.0	5.0
5/14/2019	Trail corridor trimming	Lake Loop	5	4.0	20.0
5/24/2019	Vegetation Cleanup	Lower Rambler	5	3.0	15.0
5/27/2019	New Ladder Ramp trail corridor trimming	Chapparel	1	8.0	8.0
5/29/2019	New Bridge	Finch	1	20.0	20.0
5/31/2019	Bridge fix (gap in planks)	Rambler	1	3.0	3.0
6/15/2019	Vegetation Cleanup	Upper Creek & Finch	3	10.0	30.0
6/7/2019	Felled Tree	Chapparal	1	4.0	4.0
6/18/2019	Add chicken wire to bridges	Ohlone	2	3.0	6.0
1/2/2020	Reroute trail away from creek erosion	Lower Creek	1	6.0	6.0
1/4/2020	Tread maintenance, trail corridor trimming	Rambler	16	5.0	80.0
1/11/2020	Bridge over mud pit	Lake Loop	1	8.0	8.0
1/12/2020	Felled tree removal	John Brooks	1	2.0	2.0
1/11/2020	Lake Loop bridge replacement	Lake Loop	2	8.0	16.0
1/20/2020	Rambler bridge replacement	Rambler	2	6.0	12.0

Belmont Waterdog Trail Keeper - Volunteer Hour Tracker

Date of Work	Project	Location	# of Volunteers	Hours/Volunteer	Total Hours
1/25/2020	Ohlone shortcut removal	Ohlone	2	3.0	6.0
1/18/2020	Barrel art project	Flow	2	6.0	12.0
2/20/2020	Tread inslope, rolling grade reversals	Flow	2	4.0	8.0
2/28/2020	Lake Loop - West Side Drainage fix	Lake Loop	24	5.0	120.0
3/12/2020	Upper Finch - trail corridor trimming	Finch	2	4.0	8.0
3/13/2020	Rambler switchbacks trail corridor trimming	Rambler	2	3.0	6.0
3/25/2020	Lake Loop Fallen Tree Removal	Lake Loop	3	1.0	3.0
4/22/2020	Rambler trimming	Rambler	2	4.0	8.0
4/25/2020	Chapparal trimming	Chapparal	5	4.0	20.0
4/26/2020	Chapparal trimming	Chapparal	2	3.0	6.0
4/20/2020	Canyon Creek trimming	Canyon Creek	2	5.0	10.0
4/28/2020	pruning, removal of pressure treated wood	Rambler, Canyon Creek	1	2.0	2.0
4/29/2020	trimming	Ohlone, Ramb switchbac	3	3.0	9.0
5/1/2020	trimming	LLoop, Ensatina, Berry	7	5.0	35.0
4/30/2020	trimming	Chapparal	1	6.0	6.0
5/4/2020	trimming	Ensatina	1	3.0	3.0
5/6/2020	Canyon Creek bridge decking replacement	Canyon Creek	2	4.0	8.0
5/11/2020	trimming	Rambler	1	3.0	3.0
6/13/2020	trimming	Rambler switchbacks	2	3.0	6.0
6/12/20	litter removal - pliking	Hallmark side of park	2	2.0	4.0
5/30/20	trimming	Finch	2	4.0	8.0
6/6/20	trimming	Upper Creek trail	1	2.0	2.0
5/23/20	trimming	Flow	1	3.0	3.0
6/15/20	litter removal - pliking	John Brooks and Chap	1	2.0	2.0
8/2/20	litter removal - pliking	Chap and JB	1	2.0	2.0
7/25/20	litter removal - pliking	Racoon Run, Hidden Car	1	2.0	2.0
12/31/20	litter removal - pliking	John Brooks, Chap	1	2.0	2.0
12/28/20	cheater line removal Ohlone, Rambler retread	Ohlone	2	5.0	10.0
12/26/20	add GetAGrip	Rambler, Finch bridges	2	2.0	4.0

Belmont Waterdog Trail Keeper - Volunteer Hour Tracker

Date of Work	Project	Location	# of Volunteers	Hours/Volunteer	Total Hours
12/19/20	Chap retread, rut removal, drainage	Chaparral	5	5.0	25.0
12/20/20	Chap switchback cheater removal, reveg	Chaparral	3	4.0	12.0
12/12/20	Chap new bridge over new pond	Chapparal	3	4.0	12.0
12/18/20	add GetAGrip	Lake Loop	2	1.0	2.0
11/28/20	close chute to Hidden Canyon	Elevator	4	1.0	4.0
11/28/20	shoulder rehabilitation / cheater removal	Canyon Creek	4	2.0	8.0
1/2/21	add nicks to drain puddles on Chap, Ohlone, Rambler,	Hidden Canyon	1	4.0	4.0
1/9/21	repair damaged log ramp on Chap	Chapparral	2	3.0	6.0
1/12/21	GetAGrip on Lake Loop bridges	Lake Loop	1	3.0	3.0
1/24/21	clear felled tree on Flow	Flow	2	2.5	5.0
1/24/21	drainage on Canyon Creek and Upper Creek	Canyon Creek	1	3.5	3.5
1/31/21	remove felled tree on Ensatina	Ensatina	1	2	2.0
5/9/21	brush in cutthroughs on JB	John Brooks	1	3	3.0
4/25/21	chainsaw felled oak on Berry	Berry	2	3	6.0
5/22/21	close and brush in Quick Escape, JB connector	Berry	4	3	12.0
10/30/21	dead tree removal	Chaparal	1	2	2.0
10/23/21	nick cleanout	Ohlone, Chapparal, Raml	1	3	3.0
11/9/21	root removal and resurface	Finch	1	3	3.0
11/10/21	removal of trail braid, rehab of barren area	Rambler	1	4	4.0
11/27/2021	culvert cleanout	John Brooks	2	4	8.0
11/30/2021	fallen trees on Ohlone	Ohlone	3	3	9.0
12/4/21	culvert cleanout	John Brooks	1	4	4.0
12/11/21	more culvert cleanout	John Brooks	1	4.5	4.5
1/3/2022	removal of berms on Chap	Chapparal	2	5	10.0
1/8/22	walk after rain, cleanout nicks, drain puddles	Chap, Ohlone, Rambler, .	1	4	4.0
1/8/22	culvert cleanout	Rambler	1	4	4.0
1/16/22	culvert cleanout	Rambler	1	4	4.0
1/18	fix ruts	Finch switchbacks	1	7	7.0
1/20/22	fix drainage, retread	Finch switchbacks	1	6	6.0

Belmont Waterdog Trail Keeper - Volunteer Hour Tracker

Date of Work	Project	Location	# of Volunteers	Hours/Volunteer	Total Hours
1/22/22	french drain, cobblestone treafd	Chapparal	9	4	36.0
1/22/22	felled tree	Ohlone	1	2	2.0
1/28/22	Rambler concrete cleanup	Rambler	1	4	4.0
1/29/22	Rambler concrete cleanup	Rambler	15	1	15.0
1/28/22	Rambler culvert cleanout	Rambler	1	2	2.0
1/30/22	Tree branch removal on Chap	Chapparal	1	1	1.0
2/6/22	Rambler culvert cleanout	Rambler	1	4.5	4.5
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Waterdog/Hidden Canyon Trail Work Summary

Year	Total Volunteers	Hours/Volunteer	Total Hours	Est. Cost Savings
2018	16	6.9	110.0	$3,300
2019	35	5.0	175.0	$5,250
2020	124	4.1	505.0	$15,150
2021	26	3.2	82.0	$2,460
Total	**201**	**4.3**	**872.0**	**$26,160**

Hourly Wage for City Maintenance Worker	**$30.00**

Waterdog Open Space Stewards
info@waterdogstewards.com

February 14, 2022

Via email bshearer@belmont.gov

Brigitte Shearer, Director
Belmont Parks & Recreation Department
30 Twin Pines Lane
Belmont, CA

Dear Ms. Shearer,

We are the Waterdog Open Space Stewards (WDOSS), a local community organization with wide local membership, (193 active members and over 3,000 on our mailing list) consisting of cyclists, hikers, runners, and dog walkers. We advocate for sustainable, equitable and inclusive policies for Belmont's open space. Our platform is that Belmont's successful 30+ history of inclusive multi-use access to open space (bike/hike/run/dog) has served our community well. We want to see these policies continue both for the community of today, and for generations to come.

We respectfully request that you forward this letter to WRA Environmental Consultants, Inc. for consideration under Task 2 of its scope of work for Belmont's comprehensive open space management plan, which includes reviewing ". . .the report prepared by Mr. Scott Cashen. . . and any other relevant studies prepared by other local environmental groups." In this letter we hope to provide our perspective on sustainability and open space management issues, and we will provide a critique of the study prepared by Mr. Scott Cashen.

While we advocate for equitable, inclusive, and sustainable trail access for *all user groups* (hikers, cyclists, runners, dog walkers), this letter will focus primarily on cyclists, because a handful of people are lobbying for severe restrictions to recreational access, and are blaming any and all problems in the open space on the cycling community. In our view this position is not supported by science, local user experiences, or land management best practices.

Peer-reviewed studies on the impact of cycling on trail systems show that cycling has no more impact than hiking, and that trail maintenance is the most important factor in preventing erosion.

We have attached for WRA's consideration some peer-reviewed studies on the impact of cycling on trails. The key takeaways from these studies are that the existing body of research does not support the prohibition or restriction of mountain biking from a resource or environmental protection perspective.

Existing studies indicate that cycling differs little from hiking in its contribution to soil impacts. Other factors, particularly trail grade, trail/slope alignment angle, soil type/wetness, and trail maintenance, are far more influential determinants of tread erosion or wetness. Land managers should look first to correcting design-related deficiencies before considering restrictions on low-impact users. By enlisting the aid of all trail users through volunteer trail maintenance efforts, they can improve trail conditions and allow for sustainable recreation.

- *Environmental Impacts of Mountain Biking: Science Review and Best Practices* by Jeff Marion and Jeremy Wimpey
- *A Comparative Study of Impacts to Mountain Bike Trails in Five Common Ecological Regions of the Southwestern U.S.* by Dave White, Troy Waskey, et al.
- *Mountain Biking: A Review of the Ecological Effects* by Miistakis Institute prepared for Parks Canada

While not a true peer-reviewed academic study, we have also attached a publication by the Mountain Bikers of Santa Cruz Science Committee, *Mountain Biking Impact Review Frequently Asked Questions* which is a helpful resource.

Volunteer trail maintenance by the local cycling community is vital to the continued sustainability of trails Belmont's open space.

As you know, the Belmont Parks and Recreation Department has a staff of 10 who are responsible for 63 acres of parks, 25 acres of school sports fields, 300+ acres of open space, and approximately 155,000 square feet of city facilities. Parks staff also oversee tree removal permits and the city's medians and gateways. The leanly-staffed department does not have sufficient resources for the considerable task of maintaining Waterdog's trails. For many years, volunteers from the cycling community have served as an extremely valuable asset that the Parks and Recreation Department has been able to leverage to keep the trails properly maintained in the open space.

The vast majority of volunteer trail maintenance is provided the Waterdog Trailkeepers, a Facebook group with over 400 members, most of whom are cyclists. This group has provided volunteer trail maintenance for many years, but a detailed recordkeeping system did not begin until 2018. Attached is a current spreadsheet of the Trailkeepers volunteer hours. An article on trail maintenance can be seen here.

From February 2019 to February 2021, there have been 40 separate trail maintenance days with over 800 volunteer hours and 183 volunteers committed to the maintenance and improvement of trails at Waterdog. One of the largest projects the group has undertaken was to fix the drainage issue on the Lake Loop trail in February 2020, which involved 24 volunteers with over 120 volunteer hours to complete.

More recent examples of trailwork in 2021-2022 can be viewed here. The photos show a French drain and cobblestone rock tread added to Chapparal trail in a perpetually wet ravine, tread improvements on John Brooks and Rambler trails, a felled tree cleared on Ohlone trail, small bridges added to Rambler trail to prevent rutting in muddy spots, de-berming and re-sloping the tread on Chapparal to reduce water acceleration and channeling, restoring a previously barren area at Rambler trail, where trail braids have been eliminated and and six native California Oaks have been planted, eliminating a trail shortcut on Rambler trail, clearing of concrete drainage ditches, and bags containing approximately 1/2 ton of concrete fragments hauled out from Rambler trail.

Designating the 300 acre Waterdog / Hidden Canyon open space as a nature preserve makes little sense given there is a 23,000 acre wildlife refuge one mile away.

The Waterdog open space is approximately 200-300 acres in size, and since the 1970s, it has been completely surrounded on all sides by the large, single-family homes of the Belmont Heights residential development.

About one mile away from the western edge of Waterdog open space, there is a 23,000 acre wildlife preserve: the San Francisco Public Utilities Commission (SFPUC) Peninsula Watershed. It is a state-designated fish and game refuge, and a protected area within the UNESCO Golden Gate Biosphere Reserve.

Waterdog is far too small and has far too many humans around to seriously be considered to be set aside as a nature preserve. Even if humans were completely banned from the borders of the open space, the animals in the open space would still be impacted by the dogs, cats, and humans who completely surround its perimeter. Unlike the fleeting and transitory presence of trail users, those homes and roadways completely encircling the open space have an associated impact that is present 24 hours a day, 7 days a week. More detail on this issue can be found in this article.

Continued multi-use access is clearly what the community wants.

As WRA will see when evaluating the PROS Plan documents, the PROS survey results showed that the public is overwhelmingly in favor of multi-use trails supporting hikers, bikers, trail runners, and dog walkers. For example, 2,153 respondents (77%) rated Waterdog's condition as excellent. The following respondents agreed the following would "greatly enhance" the open space experience: Trail Maintenance 2,448 (87%), adding trails 1,999 (71%), and improving trails 1,278 (46%) By contrast, only 945 (34%) respondents prioritized habitat protection, only 797 (28%) supported designating certain trails for certain uses, and a paltry 135 respondents (5%) checked off "Reduce number of trails." There was excellent turnout for the survey, and the results were clear. An article about the survey results is here.

Another data point to consider is that there was a candidate in the 2020 Belmont CIty Council election who was the only candidate to run on a platform of restricting recreational access to open space and having the Waterdog/Hidden Canyon open space designated as a nature preserve. That candidate was soundly defeated, getting only 7% of the vote.

Restricting bicycles to fire roads is unreasonable.

One of the radical changes to the status quo being demanded by anti-recreation lobbyists is banning bicycles from all trails except for fire roads. As we detail further in this article, segregating trails by user group and creating privileged classes of open space users contradicts the PROS guiding principles, which are to (1) Provide equitable access to resources and activities across the entire city; (2) Promote inclusion to people of all backgrounds, regardless of race, gender, sexual orientation, socioeconomic position, or physical/cognitive ability, and (3) Make all users feel welcome and safe.

If bicycles were limited to fire roads, the only bike-legal trails would be the Lake Road Trail (1.3 miles), and two short, non-contiguous sections of the John Brooks Trail that add up to less than one mile. Cyclists would be shut out of more than 75% of the trail system mileage, and there would be no way to do a loop ride in the trail system.

Lobbyists attempt to justify a segregationist approach by claiming that hikers cannot hike in peace or have quiet solitude with cyclists on the trail. In actuality, it is the recreational needs of cyclists that are currently underserved by our regional network of open space parks. Cyclists are limited to Waterdog and El Corte de Madera Creek Preserve (25 minutes away), whereas hikers have a plethora of local options, completely free of cyclists, to choose from: Crystal Springs Cross Country Course (17 feet from the Upper Lake Trail trailhead, 299 acres, 3 miles of trails), Big Canyon Park (10 minutes away[1], 16 acres, 1.7 miles of trails), Pulgas Ridge Preserve (11 minutes away, 366 acres, 6 miles of trails), Edgewood Preserve (12 minutes away, 467 acres, 10 miles of trails), Eaton Park (14 minutes away, 58 acres, 2 miles of trails), Mills Canyon Park (16 minutes away, 1,500 acres, 1.4 miles of trails), Phleger Estate (22 minutes away, 1,000 acres, 4.6 miles of trails), Huddart Park (24 minutes away, 973 acres, 28 miles of trails), and Foothills Park (25 minutes away, 1,400 acres, 15 miles of trails). These areas provide ample opportunities for hiking-only trail access.

Hikers, cyclists, runners, and dog walkers have successfully shared Waterdog open space trails for decades. Bringing all of these groups together outside fosters park users' sense of shared community. Segregating trails by user group is not a viable option from an equity and inclusiveness perspective, and as the scientific studies provided show, there is no justification for restricting classes of users from trails from a resource or environmental protection perspective.

The study by Scott Cashen is biased, flawed, and was commissioned by anti-recreation lobbyists.

In our opinion, the report of Scott Cashen has the veneer of a scientific study, but upon further examination it reveals flawed methodology, it perseverates on cycling and exposes clear bias, likely in an effort to serve the ends of the patron(s) of the study. It is our understanding that it was presented to the PROS Committee by Pat Cuviello, who is a lobbyist demanding that Waterdog open space be designated as a wildlife preserve, and the candidate who lost the City Council election in 2020 on this platform.

It appears to us that Mr. Cashen specializes in serving clients who seek to stop projects based on impacts to wildlife. His top Google search results show he was hired by the Sierra Club to challenge a habitat protection plan, hired by a group to to oppose a solar project, hired to oppose a dam project, and so on.

Mr. Cashen serves as a litigation expert witness, and it appears to us he is hired exclusively by parties seeking to stop projects based on impacts to wildlife.   When an expert is exclusively hired by one side of an issue, it raises questions in our mind as to whether that expert is in the business of providing unbiased scientific opinions, or serving as an advocate for a particular side.

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[1] Driving times measured from Hidden Canyon Park parking lot to parking lot of the other location by car, per Google Maps.

We question the scientific validity of the report, because it cites only to studies that support it's theme that mountain biking is the root of all environmental destruction. A truly scientific study would acknowledge and critically discuss the body of scientific literature showing that cycling differs little from hiking in its contribution to environmental impacts, and then provide evidence of how those studies are somehow wrong or inapplicable. The Cashen report does none of this. Rather, it “cherry-picks” studies that support the desired result. This fails the third and most important step of the basic scientific method, which is to (1) make an observation that describes a problem, (2) create a hypothesis, (3) *test the hypothesis*, and (4) draw conclusions and refine the hypothesis.

We also question the validity of the conclusions drawn in the report. In general, the report cites impressive-sounding literature on the threats to flora and fauna, but then provides tenuous and/or unsupported connections (or no connection at all) to how those phenomena actually occur in Belmont’s open space. For example, without providing any citation or support for this proposition, the report declares “Wildlife injuries or fatalities are more likely to occur due to collisions with bicycles because mountain bikers travel much faster than hikers. Reptiles, including the endangered San Francisco Garter Snake, are especially vulnerable to collisions with mountain bikes because reptiles often use open conditions created by trails for thermoregulation…” yet the report concedes that the San Francisco Garter Snake only has the “*potential* to occur in the study area.”

Mr. Cashen is a biologist, not a land use attorney, and his credentials do not describe any background, training, or experience in the law of charitable land conveyances. Yet the report offers opinions about the legality of the scope of the city’s utilization of the open space based the original land grant by John Brooks. In our opinion, there is no credible basis for these conclusions, and when an expert opines on issues outside his scope of expertise to argue for a result, that demonstrates bias.

Ensatina and Flow trails are sustainable and have served the public well for years.

There are 14 trails recognized in the city’s current published trail map. In addition, there are two public prescriptive / social trails that do not appear on the published trail map, but are well-established, well-maintained and have been enjoyed by the public for years.   Both of these trails were solidly constructed, follow the topographic contour lines of the terrain for the most part, and are not causing any measurable environmental degradation. These trails provide variety, route options with shade, and reduce the chances of trail user conflicts by spreading out trail traffic over more trails.

Some people try to characterize these trails as “illegal,” “unsanctioned,” or “rogue” trails. These characterizations are wrong. Both trails appear on the trail map approved by City Council in 1998 as and are identified in solid orange lines as “proposed single-use trail.” Although the reasons are not clear, these two trails did not make their way onto the published trail map back in the late 1990s. A copy of the resolution and trail map are attached. (Note: because the quality of the orange trail lines on the image is poor, two versions of the 1998 trail map are attached, one original image, and one with the two trails highlighted.)

The first trail is known as “Ensatina,” and connects the Lake Loop Trail with the John Brooks Trail. While this trail exists in a riparian area, it is well-compacted. Environmental impacts can be mitigated with continued maintenance, improvement, and construction of bridges over creek crossings.

The second one is known by various names including “Flow Trail” and “Labor of Love." This trail is a loop that connects with John Brooks Trail in two places, and runs behind Comstock Circle and Hallmark Drive. It is not feasible to remove this trail because it provides the only access to portions of the city storm drain infrastructure that runs throughout the open space. It runs alongside multiple drainage culverts and storm drain connections, which require periodic cleaning and maintenance.


Concrete storm drain culverts along “Flow” trail in need of maintenance.

Thank you for considering the information in this letter, and we would be glad to provide any further information or resources that may assist WRA in performing its scope of work in creating the open space management plan.

Sincerely,

Waterdog Open Space Stewards

Enclosures:

Environmental Impacts of Mountain Biking: Science Review and Best Practices

A Comparative Study of Impacts to Mountain Bike Trails in Five Common Ecological Regions of the Southwestern U.S.

Mountain Biking: A Review of the Ecological Effects

Mountain Biking Impact Review Frequently Asked Questions

Waterdog Trailkeepers volunteer hours log

Cashen references

1998 Belmont City Council resolution

1998 Waterdog trail map (original)

1998 Waterdog trail map (Ensatina and Flow trails highlighted)

Cc: Belmont Parks & Recreation Commission prcomm@belmont.gov

Belmont PROS Plan info@belmontprosplan.com

Belmont City Council CityCouncil@belmont.gov