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Mountain Biking as a Means to Encourage Public Health and Wellbeing

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Executive Summary

Mountain biking is a popular form of outdoor exercise. There are 8.3 million riders in the U.S., 2.8% of the population (The Outdoor Foundation, 2016). The National Survey on Recreation and the Environment (<https://www.srs.fs.usda.gov/trends/nsre-directory/>) places the number of participants much higher at 42.7 million riders, but their definition is less restrictive (Cordell, 2012). The National Survey includes anyone who has ridden a mountain or hybrid bicycle in the last twelve months, regardless of riding surface, while Outdoor Recreation Participation Top Line Report (The Outdoor Foundation, 2016) estimates are based on riding surface. Therefore, to avoid confirmation bias, the lower Outdoor Recreation Participation Top Line Report figures will be used for the remainder of this paper. Bicycling (including road and bicycle motor cross) is the second most frequently participated outdoor activity in America with an average of 63 annual outings, just behind running/jogging with 91 annual outings (The Outdoor Foundation, 2016).

Off-road cycling has its origins at the invention of the bicycle, but modern mountain biking is a child of 1970s California. Though a young sport, there are now many disciplines within the sport ranging from cross country, enduro (all-mountain), downhill, dirt jump, and freeride (see Table 1). There are competitions at the youth, high school, collegiate, olympic, and professional levels. There are specialized bikes for each purpose. Bikes may range from a few hundred dollars for an entry level bike to ten thousand dollars for the lightest bike with the most current technology (<https://www.specialized.com/us/en/bikes/mountain>).

Table 1

Mountain Biking Disciplines

Discipline	Bike	Style of riding
Cross country (CX)	27.5-29" tires, fully rigid, hardtail, or full suspension (100-130mm of travel).	Pedaling up and down hill on a variety of terrain. Competitions typically include a mass start. Courses are generally several miles long with different racer categories performing different numbers of laps.
Trail/All-mountain/Enduro	27.5-29" tires, full suspension (130-160mm of travel).	Pedaling up hill and down on a variety of terrain. In competition riders are not timed in between stages, but generally must pedal to the next stage. Multiple downhill stages are timed over the course of a day or multiday race.
Downhill (DH)	26-29" tires, full suspension (180-210mm of travel)	Typically performed at ski resorts in the summer. Ski lift or motor vehicle ascent, steep technical descent which often includes a mix of natural and built up terrain (berms, jumps, rock gardens, etc.). Competitions are timed on a racer's single run down a trail.
Dirt jump	20-26" tires, hardtail (100mm front suspension)	Man-made jumps with the goal of performing tricks off each jump.
Freeride	26-27.5" tires, full suspension (150-200mm of travel)	A combination of DH and dirt jump. Natural and built-up terrain with large jumps off of which riders may attempt to do tricks.

Although mountain biking is a popular form of outdoor exercise in America, legal access to suitable trails is limited and under constant threat to be further limited. This manuscript explains how mountain biking is related to public health and the issues underlying trail access in the United States. The author argues that public health organizations at local, state, and national levels should be advocates for mountain bike trail access.

Keywords: off-road cycling, mountain biking, trail access, physical activity

History of Mountain Biking

Off-road cycling has its origins at the invention of the bicycle; however, the modern multi-billion-dollar mountain biking industry is a child of 1970s California, as summarized by Savre, Saint-Martin, and Terret's (2010) article "A History of Mountain Biking". Invented in 1871, the bicycle was initially developed as a practical means of transportation rather than a pastime activity. The lack of paved roads at that time meant that bicyclists were obligatory off-road cyclists. During the first bicycle boom of the late nineteenth century, technologies such as pneumatic tires, chain drives, and gear ratios allowed cyclists to choose off-road paths for pleasure as well as necessity. During the 1950s cycling clubs such as the "Rough Stuff Fellowship" and "Velo Club Parisien" were modifying bikes to get away from roads (Savre et al., 2010, p. 1945). John Finely Scott, a University of California at Davis Sociology professor and cycling advocate, made the first known "mountain bike" in 1953 (Savre et al., 2010, p. 1945) (see Figure 1). The Woodsie had knobby tires and gears. Scott used it to explore the mountains of northern California.



Figure 1. John Finely Scott's "Woodsie" assembled in 1953 using a Schwinn World diamond frame, balloon tires, flat handlebars, and derailleur gears. Reproduced with permission from Marin Museum of Bicycling.

Thus, off-road cycling existed in many forms prior to the birth of modern mountain biking in the 1970s. A combination of mountainous terrain, favorable climate, and many trails near the Bay Area made it the birthplace of the mountain biking. As Gary Fisher, a pioneer of modern mountain biking stated:

San Francisco, is different say, from Los Angeles. Here, you have wilderness near a big city, plus, a large network of trails. In one day, you can cycle, surf, and find yourself in the middle of downtown San Francisco and go to a show: Marin is secret place to have fun! (Savre, Saint-Martin, & Terret, 2010, p. 8)

Groups of adventurous cyclists would modify the affordable and accessible Schwinn bicycles of the 1930s and 40s. They took their “clunkers” to race the fire roads and trails of Mount Tamalpais (Savre et al., 2010, p. 8).

These clunkers were used in cyclocross races and multi-surface races throughout the U.S., and soon there was a demand for mountain bikes. Some of those early tinkers, such as Gary Fisher, Joe Breeze, and Tom Ritchey, went on to start mountain bike companies that are still producing mountain bikes today. By the 1980’s all the major cycling brands had a mountain bike product line. In 1983 50,000 of the 9,000,000 bicycles sold were mountain bikes. Also in 1983, the National Off-Road Bicycle Association (NORBA) was formed. NORBA is now a subsidiary of USA Cycling (Cycling News, 2007). It sanctions over 1,000 mountain bike races annually in the U.S. Popularity and participation grew rapidly culminating in mountain biking being included in the 1996 Olympics in Atlanta (Savre et al., 2010). Today a quarter of all bicycles sold in the U.S. are mountain bikes (National Bicycle Dealers Association [NBDA], 2015).

Statement of Purpose

Although mountain biking is a popular form of outdoor exercise in America, legal access to suitable trails is limited and under constant threat to be further limited. This manuscript explains how mountain biking is related to public health and the issues underlying trail access in the United States. The author argues that public health organizations at local, state, and national levels should be advocates for mountain bike trail access.

Cycling and Health

Road based cycling is frequently studied as it relates to health. Particularly utilitarian cycling, e.g. cycling for transportation as opposed to recreation. Oja et al. (2011) completed a systematic review of scientific studies of the effects of cycling on health. The authors began with nearly 3,500 studies, but after excluding general activity studies, helmet and safety studies, studies without objective measures of morbidity and mortality, etc. they included 16 studies in their review. These included large scale cross-sectional studies, case-control studies, prospective cohort studies, and intervention studies. Only two of the studies reviewed failed to show a conclusive beneficial health effect of cycling. In Tanasescu et al.'s (2002) large prospective cohort study of specific physical activities in American men, cycling failed to show a statistically significant reduction in heart disease; however, Oja and colleagues point out that the study had a narrow classification of weekly activity volume: no cycling, up to 30 minutes/week, 30 minutes to one hour, and greater than one hour per week. The same study also failed to show risk reduction from swimming or jogging. Besson et al.'s (2008) United Kingdom based cohort study of cycling for transport failed to show significant reduction in all-cause, cancer, or cardiovascular mortality. Again, Oja and colleagues note that there was a narrow range of weekly activity; no cycling, up to 30 minutes/week, and over 30 minutes/week.

All of the intervention studies reviewed demonstrated strong evidence that cycling benefits cardiorespiratory fitness. There was also evidence that regular cycling can lower the risk of early death, heart disease, stroke, type-2 diabetes, metabolic syndrome, high blood pressure, hyperlipidemia, and colon and breast cancers. There was also evidence that it prevents weight gain, improves weight loss, and improves muscular fitness in adults. In older adults, regular cycling can prevent falls, reduce depression, and improve cognition (Oja et al., 2011). Most recently a British prospective cohort study with more than a quarter of a million participants reported a lower risk of cardiovascular disease, cancer, and all-cause mortality in commuter cyclist (Celis-Morales et al., 2017). Despite mounting evidence that bicycling is beneficial for health, there is a paucity of data on mountain biking specifically as it relates to health. There may be several reasons for this, as explored in the section below.

Little Research Relating Mountain Biking and Health

Road-based cycling (utilitarian and recreational) comprises the majority of cycling (The Outdoor Foundation, 2016). Utilitarian cycling is frequently studied as it relates to health, particularly in nations with a higher percentage of active commuters than the U.S. Since there are very few people fortunate enough to be able to commute via mountain bike, there is no such comparable data for mountain bikers. It is a younger sport, and sport of youth. Age stratification data are limited. In the 2016 Outdoor Participation Report, the percent of the population who reported taking part in the activity was 3.8% in 6 to 18 year olds, 3.3% in 18 to 24 year olds, and 2.8% in all Americans. This relatively healthy demographic makes it less likely to be a target of public health studies. From a laboratory study standpoint, there is also difficulty modeling the mountain biking environment. For example, when testing a road cyclist in the lab, adjustments must be made to account for rolling resistance, elevation gain, and wind resistance. To

representatively test a mountain biker, adjustments must be made to account for the aforementioned factors, the roughness of the trail, and the movement of the suspension.

Additionally, determining who is a *mountain biker* and who is not, is difficult. The categories and definitions within cycling are indistinct and there is a great diversity of bike types that are suitable for multiple surfaces. The term *road biker* brings to mind a Tour de France-esque character in lycra on a traditional road bike; however, in most studies paved road cycling encompasses riders of all ages, on all types of bikes, being ridden on pavement e.g. a 35-year-old female who rides a folding commuter bicycle from the train to her office is an on-road cyclist just as a 25-year-old Tour de France rider is.

Mountain biking now has so many subcategories that is difficult to evaluate them all under the term mountain biker. Refer back to Table 1 for a description of mountain bike types. A *down-hiller* is taking a ski lift up, and may only pedal a few strokes before letting gravity take over, while a *cross-country* rider will only stop pedaling for the absolute roughest portion of the ride. Additionally, the road and off-road cycling are not mutually exclusive. Bicycle enthusiasts own as many bikes and types of bikes as their significant others, garage size, or paycheck will allow. Finally, in which category would one place *gravel grinders* or *cyclocross* riders? Gravel roads are roads, but they aren't paved, and most of the bikes have a road based geometry. Cyclocross racing started as an off-season, off-road sport for road racers in the early 1900s, decades before modern mountain biking. Despite user outcry even Strava (<https://en.wikipedia.org/wiki/Strava>), "The Social Network for Athletes", cannot figure out appropriate identifiers (Surtees, 2012).

Mountain Biking and Health

Although there is a lack of empirical evidence, the author contends that mountain biking is as healthful an activity as road cycling, potentially more so. Physiologic characteristics of competitive mountain bikers have been studied and are consistent with the physiologic characteristics of competitive road cyclists (Impellizzeri & Marcora, 2007). It is generally accepted that mountain biking is more strenuous per mile or per hour than road cycling (Barber, 2016; TheGeneralist, 2011). As a physician and cyclist, the author supports these conclusions and would add a few more commonly held observations:

- Riding narrow trails, hereafter referred to as singletrack, on a mountain bike requires more upper body strength than riding a paved road or trail on a road bike. Riders must be able to lift the front wheel to get over obstacles, control the bike through rough terrain, and withstand the jolts of obstacles and landings. Downhill, enduro, and freeride, in particular require more upper body strength due to the large obstacles and high speeds of these types of riding.
- Mountain biking also requires more decision making during the ride. *Line choice* is the route a cyclist chooses over, around, or through obstacles on the trail. There is a constant mental effort during mountain biking to determine *line choice*.
- Mountain biking has a much higher rolling resistance than road biking. Mountain bike tires are wider and run at lower pressures than road bike tires. The tread on mountain bike tires varies greatly based on the intended riding surface. More aggressive tires have a much higher rolling resistance. Additionally, mud, grass, sand, rock or dirt all cause greater drag than concrete or asphalt.

- Due to the curvy nature of singletrack trails, mountain bikers must frequently accelerate and decelerate. The laws of physics dictate that start-up force is at least twice that of maintenance force (Lippert & Spektor, 2012).
- Mountain bikes are generally heavier than road bikes by several pounds.
- Suspension mountain bikes are less efficient to pedal than road bikes due to compression of the suspension during pedaling.

Which type of cycling is healthier or safer? Even if one accepts that mountain biking is more difficult than road biking, it is still debatable which is a healthier or safer form of exercise.

There are positives, negatives, and caveats for each version of two wheeled exercise.

- In road cycling it is easier to achieve a sustained effort over a longer period of time, due to a consistent riding surface and lack of obstacles. Trail characteristics in mountain biking may dictate the level of effort at any given time.
- In mountain biking, there is the aforementioned full body workout.
- The body position in mountain biking is more upright which is less strenuous on the lower back than traditional road geometry. Commuter bikes tend to have a geometry more similar to that of mountain bikes.
- Road cyclists are exposed to automobile pollution, while mountain bikers are exposed to attack by flora and fauna.
- Utilitarian cycling is easier to integrate into daily life and therefore may be done more frequently than mountain biking.

Injury rates. Injury rates may play a role in determining which type of cycling should be considered most healthful. Cyclist crash and injury rates are difficult to estimate. Hospital emergency department surveys only capture those crashes severe enough to require a physician's

evaluation. A mountain bike rider may crash several times in a single ride and not be injured severely enough to seek care. National Highway Traffic Administration data only includes those crashes severe enough to require a police report. A substantial portion of bicycle related crashes go unreported (Lopez, Sunjaya, Chan, Dobbins, & Dicker, 2012).

Popular consensus among cyclists is that crashes happen more frequently on mountain bikes, but the severity of injury may be worse in road crashes (personal communication Dr. Leland Webb, USAF surgeon, competitive road and off-road cyclist June 5, 2017). This may be due to generally higher speeds involved in road cycling; a harder landing surface (pavement versus natural terrain); and, significantly, cyclist vs. automobile collisions which likely end in severe injury or death for the cyclist. One published study has attempted to illustrate the complexities of such comparisons. Roberts et al. (2013) compared incidence, risk factors, and injury patterns of road and mountain bicycling. Road cyclist had a higher rate of severe injury and mortality than mountain bikers (1.8% v. 0.42%); however, the reported mortality rates were population rates. No attempt was made to relate them to participation rates for the respective activities. Canadian cycling participation rates are generally double U.S. rates, but no published statistics lists the proportion of on-road to off-road cyclist. Additionally, as the study took place in the Canadian Rockies it may only relate to mountainous U.S. states (Roberts et al., 2013).

Green exercise. Even if there is not a reduced mortality rate compared to road based cycling, mountain biking may have another health advantage. Green exercise, physical activity in a natural setting, became a research topic in the early 2000s. It is likely that there is a synergistic benefit to exercising and being exposed to nature, which results in a greater benefit than either activity standing alone (Pretty, Peacock, Sellens, & Griffin, 2005). Research suggests that green exercise may allow participants to increase physical activity levels with lower perceived levels of

exertion. Self-selected walking speeds are faster outdoors than indoors with a paradoxical lower reported effort level (Focht, 2009). The same is true when participants attempt to produce a prescribed exertion level. Participants walked faster and had higher exertion levels, verified by heart rate and blood lactate, when exercising outside (Ceci & Hassmen, 1991). Natural environment exposure is associated with physiologic functions which result in; stress reduction, restoration of mental fatigue, improved mood, self-esteem, and perceived health (Gladwell, Brown, Wood, Sandercock, & Barton, 2013). Compared with exercising indoors, exercising in a natural environment is associated with decreased feelings of tension, confusion, anger and depression; increased energy; and greater feelings of revitalization. Outdoor exercise participants also reported that they are more likely to repeat the activity (Thompson Coon et al., 2011).

Issues in Trail Access for Mountain Bikers

Nearly as soon as mountain biking began, access to trails became an issue. Mountain bikers were not welcomed by the incumbent users and land management agencies. In 1984 in response to pressure from established conservation groups such as the Wilderness Society and Sierra Club, the Wilderness Act of 1964 was amended to specifically ban mountain bikes from all federal land designated as Wilderness (Lindsey, 2016). In 1987 Newsweek published an article, "Two-Wheeled Terrors", in which it described the rise of mountain biking and the dangers it posed to hikers and equestrians (Foote, 1987). The article goes on to note that mountain bikes were already banned from most paths in state and local parks in California and Colorado. Many of the trails that were the birthplace of modern mountain biking were closed to bicycles within a decade of the sports emergence. To this day Marin County, the birthplace of mountain biking, only permits mountain bikers access to 15% of its singletrack. In contrast, equestrians are permitted on 88% and hikers are allowed access to 100% of the singletrack on

public lands in Marin County (Access 4 Bikes, 2017). In the face of widespread trail closures, five California mountain bike clubs banded together to form the International Mountain Bicycling Association (IMBA) in 1988 (Savre et al., 2010).

Political Organization

IMBA's stated mission is "To create, enhance and protect great places to ride mountain bikes" (International Mountain Bicycling Association [IMBA], n.d.a, Mission). They created and publicized "The Six Rules of the Trail" both as a code of responsible riding for mountain bikers and as a way for land managers to be comfortable allowing mountain bikers on public land (IMBA, n.d.b, IMBA's First 20 Years, Summer and Fall 1988). Additionally, IMBA produced advice documents such as "How to organize a mountain bike club" and "What to do if your local trails are being threatened by closure" (IMBA, n.d.b, IMBA's First 20 Years, Summer and Fall 1988). There are now over 200 local chapters and more than 40,000 members across the nation (IMBA, n.d.a.).

In recent years, hundreds of miles of established mountain bike trails in western states have been closed due to new designations as Wilderness areas. The Forest Service has gone so far as to prohibit bikes from regions that may someday become Wilderness (Lindsey, 2016). Mountain bikers value land conservation and environmentalism (Watson, Williams, & Daigle, 1991; Moore 1994) but paradoxically, due to the current interpretation of the Wilderness Act, may be politically positioned against pro-conservation legislation when advocating for trail access. IMBA and local organizations frequently oppose proposed designations of wilderness land instead arguing for less restrictive designations such as roadless areas, national recreation areas, or national monuments, as these designations do not specifically prohibit mountain bikers.

Though IMBA may oppose individual designations of wilderness, or work with the forest service to draw the lines so as not to lose too many miles of singletrack, the organization has not fought the outright ban of mountain bikes in wilderness. They explain:

IMBA will not support any broad efforts by any organization to amend the existing Wilderness Act in its entirety of the federal land management agencies' regulations on existing Wilderness areas as these are not strategically aligned with achieving our long-term mission (IMBA, n.d.c, Is IMBA trying to get bicycles in existing wilderness?).

After nearly 30 years of such accommodations, some mountain bikers have grown impatient with IMBA's acceptance of the wilderness ban. In response to new trail losses and that lack of progress, an alternative mountain biking advocacy organization was formed in 2015. The Sustainable Trails Coalition (STC) states that they have one objective, to reverse the ban on mountain bikes in federal wilderness. The STC is currently backing bills, H.R. 1349 and The Human-Powered Travel in Wilderness Act, in the House and Senate respectively (Sustainable Trails Coalition [STC], 2017).

Environmental Concerns

Trail conditions. Often when people or organizations attempt to justify a ban on mountain bikes environmental concern are cited. Negative impacts of recreational activities have been fairly well studied in the U.S. and Australia. As early as the 1920's human trampling of vegetation and soils in the natural environment was studied (Pickering, Hill, Newsome, & Leung, 2010). Studies of hiking impacts have dominated the field, but there has been a significant amount of research on the three primary recreational activities of concern: hiking, biking, and horseback riding. Pickering, Hill, Newsome, and Leung included 200+ studies of hiking, biking, and/or equestrian environmental damage in their 2010 review. These studies

covered trail specific impacts such as soil erosion, compaction, or changes in trail width, as well as wider environmental concerns such as changes to soil microbial communities, plant species, native vegetation, and fungal pathogens.

Equestrian activities cause substantially more environmental degradation than hikers or bikers. The weight of a horse and rider is an order of magnitude greater than that of hikers or cyclist. Additionally, that weight is concentrated on the comparatively small area of the horse's hooves (Pickering et al., 2010). There is also a biologic component. A 1,000-pound horse will produce 37 pounds of manure and 2.4 gallons of urine daily (Westendorf, 2015). Horses urinate and defecate directly onto the trail. This may be unpleasant for other users from an aesthetic and hygienic standpoint, but more importantly it changes the flora and fauna of the surrounding environment. Manure directly introduces foreign vegetation, microbial, and fungal lifeforms, while horse excreta increases the nutrient content of the soil. This indirectly changes vegetation type and growth rates (Pickering et al., 2010).

The impact of mountain biking and hiking on trail degradation has been directly considered in only a few studies. Of these none noted significantly more degradation caused by mountain bikes. Additionally, study of the impact of mountain biking on mountain bike specific trails compared to the impact of hiking on hiking specific trails revealed lower sedimentation rates on the trails used by cyclist. Mountain bike trails show higher compaction rates which acts to reduce the sedimentation rate (Pickering et al., 2010). Compaction rates are cited as a negative impact, but that is only valid if the trail is temporary, as highly compacted trails will regrow native flora more slowly. Of note the experimental studies were all in somewhat ideal conditions. They did not encompass user behaviors such as hikers going off trail or mountain bikers skidding through turns. Further research is needed in real world usage of trails.

Wildlife. “Take only memories, leave nothing but footprints,” credited to Chief Seattle of the Northwest American Suquamish tribe (Ratcliffe, 2011, p. 467), has become the defacto motto for outdoor organizations from the Boy Scouts (https://meritbadge.org/wiki/index.php/Leave_No_Trace) to the Sierra Club (<http://content.sierraclub.org/outings/wilderness-manners>). It acts as a simple guide to behavior in the wilderness. Unfortunately, all trails and all trail users affect wildlife. Trails alter and fragment wildlife habitat as well as altering the activities of nearby animals. Animals exposed to trail users may exhibit avoidance or habituation behaviors, either of which may be harmful to their wellbeing. (Hellmund, 1998). Critics, such as Wolke (2014), propose that mountain bikers have a greater impact on wildlife than other users, but research does not support that assertion.

An experimental study by Taylor and Knight (2003) found statistically similar response to hikers and bikers by bison, mule deer, and antelope. Papouchis, Singer, & Sloan (2001) observed bighorn sheep behavior in Canyonlands National Park. They noted that sheep flee hikers 61% of the time while only fleeing mountain bikers 6% of the time. The stronger reaction to hikers was attributed to hikers going off-trail or directly approaching sheep. Gander and Ingold (1997) noted similar flight behavior when chamois, a European mountain goat, were exposed to hikers, joggers, or mountain bikers respectively. Spahr (1990) evaluated the flushing behaviors of bald eagles when exposed to various recreationists. The eagles were more likely to take flight when people approached them slowly or stopped to observe them. They took flight most frequently when exposed to walkers, 46% of exposures. The eagles were less likely to take flight when they were passed quickly with a constant speed. They took flight 15%, 13%, and 6% of the time, when exposed to cyclist, joggers, and vehicles respectively.

Discussion and Recommendations

The American Hiking Society reports that there are 236,000 miles of trail in the U.S. (Hiking Trails in America, 2015); MTB Project, an online directory of mountain bike trails associated with IMBA, shows 47,544 miles of trail (MTB Project, 2017). The mountain bike community argues that there is not a legitimate environmental concern; therefore, it is inappropriate that mountain bikers are allowed on only 20% of the nation's singletrack. A popular explanation points to the concept of "turf" (n.d.), a term derived from urban culture referring to an area or neighborhood that a particular group views as its own and/or under its singular authority. The hiking and equestrian clans view the trails as their turf and are intolerant of a new group using their resources. Hikers have greater numbers than mountain bikers and equestrians have a greater historical presence; both were better organized and more politically powerful than mountain biking when it emerged (Lindsey, 2016) and still hold this dominant position. The formation of IMBA was necessary for mountain biking to have even a small voice, but 30 years after formally entering the political arbitration scene, mountain bikers are still confined to a small segment of America's trails.

I argue that bans on mountain bikes are a form of outdoor elitism no different than the snowboarder bans of the 1980s, unsubstantiated and biased. In 1985 only 7% of America's ski resorts allowed snowboarders. Today, only three resorts (0.007%) continue the ban (Poaching [snowboarding], 2017; National Ski Areas Association [NSAA], 2016). Those three resorts (Alta, Deer Valley, and Mad River Glen) pride themselves on their elitism and market their ban of snowboarders.¹

¹ Two of these resorts are on privately held land and therefore have no legal duty to allow expanded access. Alta ski resort is on public land and has been subject to legal actions by snowboarders in attempts to gain access.

Unfortunately, mountain bikers have made less progress toward equal trail access than snowboarders in the last few decades. Forty-six percent of U.S. ski resorts have mountain biking trails in the summer (Mill, 2007), representing a much greater rate of trail access than the estimated 20% of trails that mountain bikers may ride nationally. Ski resort trails are more likely to be open to cyclists than other trails. The difference in cyclist access may lie with the almighty dollar; one must pay for a lift ticket to ski, snowboard, or *downhill* mountain bike. Summer use of ski resort trails for mountain biking extends the financial season of the resort from use of the ski lifts and other resort amenities. One typically doesn't have to pay to go hiking or *cross-country* mountain biking. If one pays a fee to enter a state or national park to recreate, the primary goal of the land management organization is conservation and education, and the fees are applied to that primary goal. In addition, state park entrance fees are typically much less than ski lift ticket fees and other ski resort amenity fees. The mountain bike dollar will have little effect on access to trails on public lands.

The mountain bike trail bans divide the conservationists of the American public. The graying three million members of the Sierra Club can outspend the STC to fight any legislation that allows mountain bikers equal access. If they ceased to oppose mountain bikes in Wilderness, the Sierra Club could strategically widen their demographic representation by the eight million mountain bikers who generally support conservation efforts, but must sometimes oppose them to avoid losing their current access to trails. This isn't to say that there is not some perceived and real user conflict, such as potential conflicts between cyclist and equestrians using the same trail. Such user conflict may be a valid concern of land managers; however, trail design and user education could allow equal access to the trails through mitigation of overlapping trail use if stalwart users could abandon their biases and enter into collaborative planning. Public policy is

required to be neutral, and our government should not abet one group's intolerance of another (Lindsey, 2016). Human geographer Katrina Brown (2014) argues that segregating mountain bikers to trail centers and other domesticated nature in essence makes mountain bikers second class outdoor citizens. Further, she claims that this dichotomy poses a danger to the future of outdoor recreation and citizens ability share space and translate their knowledge from one "nature" to another (Brown, 2014, Abstract).

I have argued and presented evidence showing that mountain biking is as healthful an activity as road-based cycling, yet there are few population data to measure the health effects. Public health researchers should include mountain biking as an important area for future research. Wilhelm Stanis, Oftedal, and Schneider (2014) found that the county level density of non-motorized trails had a significant effect on 9th grade boys meeting weekly physical activity recommendations and lowering obesity rates, while parkland density did not. Research such as this could easily have added legal mountain biking trails as a variable to further our knowledge about which particular activities provide the most health benefits. Secondly, as mountain biking is a form of outdoor exercise which is popular amongst a younger demographic, it may be a tool for public health agencies fight against America's childhood obesity epidemic. Therefore, mountain biking should be included in public health agencies' physical activity promotions. Finally, as the American Public Health Association (2013) states that they are advocates for parks, gardens, and greenways, public health organizations should also be advocates for equal rights for mountain bikers with regards to trail access, from weighing in on local trail restrictions to supporting H.R. 1349 and The Human-Powered Travel in Wilderness Act.

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Appendix A: List of Competencies Met in CE

Wright State Program Public Health Competencies Checklist

Assess and utilize quantitative and qualitative data.
Apply analytical reasoning and methods in data analysis to describe the health of a community.
Describe how policies, systems, and environment affect the health of populations.
Make evidence-informed decisions in public health practice.
Evaluate and interpret evidence, including strengths, limitations, and practical implications.
Demonstrate ethical standards in research, data collection and management, data analysis, and communication.
Explain public health as part of a larger inter-related system of organizations that influence the health of populations at local, national, and global levels.

Concentration Specific Competencies Checklist

Public Health Management
Be capable of applying communication and group dynamic strategies to individual and group interaction
Be capable of applying decision-making processes
Have a knowledge of systems thinking principles
Have an awareness of strategies for working with stakeholders to determine common and key values to achieve organizational and community goals
A knowledge of ethical principles relative to data collection, usage, and reporting results