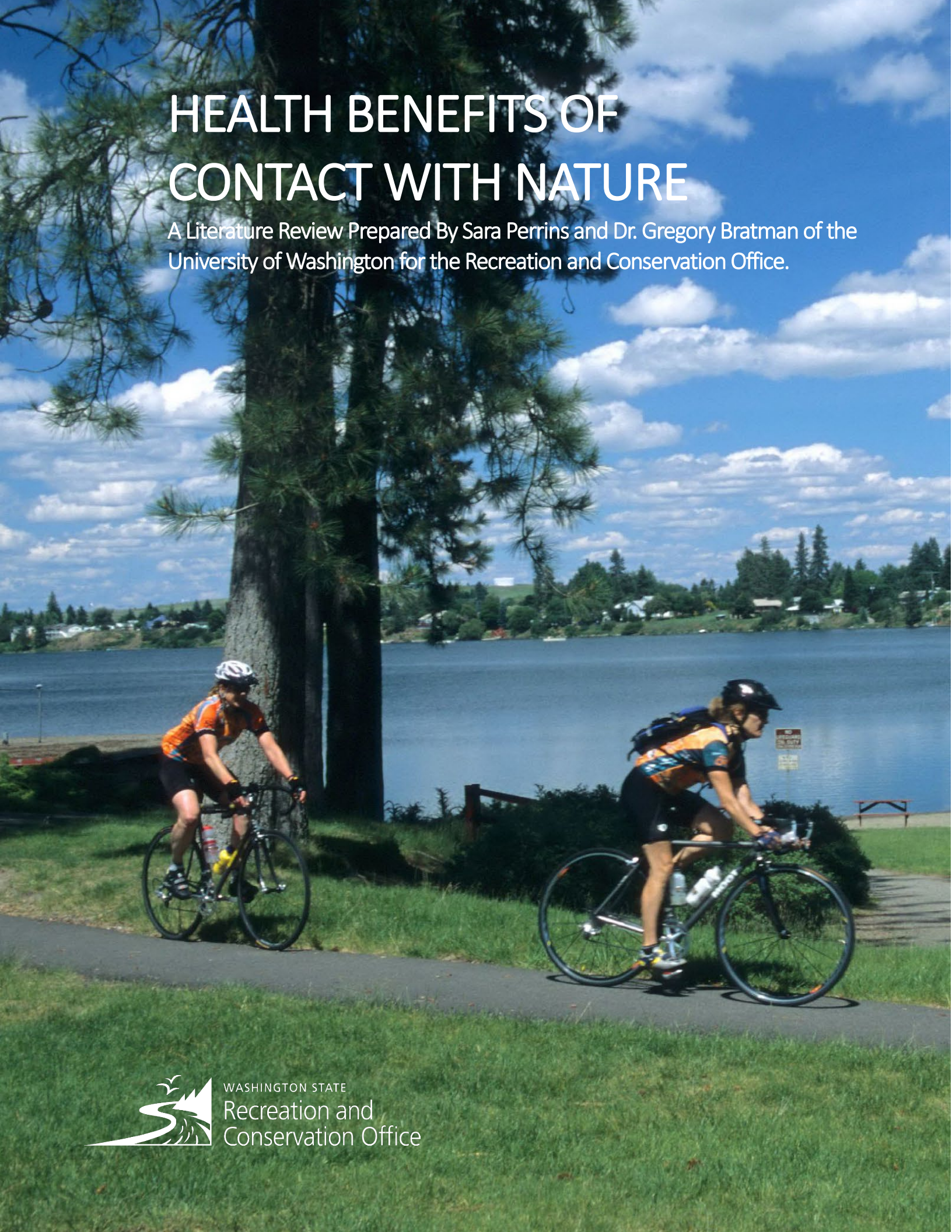

HEALTH BENEFITS OF CONTACT WITH NATURE

A Literature Review Prepared By Sara Perrins and Dr. Gregory Bratman of the University of Washington for the Recreation and Conservation Office.

WASHINGTON STATE
Recreation and Conservation Office

ACKNOWLEDGEMENTS

Sara Perrins and Dr. Gregory Bratman of the University of Washington, College of Forest Resources, prepared this report for the Recreation and Conservation Office. This study was directed by the Washington State Legislature in Section 304 (3) of the 2018 operating budget, as stated:

Section 304 (3) $125,000 of the general fund—state appropriation for fiscal year 2019 is provided solely for the board to conduct or contract for a study of the economic and health benefits of trail-based activities, including hiking, walking, and bicycling. The information gathered will assist in decision-making regarding the allocation of dedicated resources and investment in Washington's trail networks. Additionally, the information will aid in increasing and leveraging economic benefits in the development of public-private partnerships aimed at stewardship and growth connected to Washington's trail networks. The study may include, but is not limited to, analysis of the number of people in the state who hike, bike, and walk annually, economic contribution, environmental and social benefits, and mental and physical health outcomes. The study may also include regional case studies. As appropriate, the analysis must incorporate data from the state comprehensive outdoor recreation plan and federal initiatives to integrate outdoor recreation into GDP accounting. To allow for a collaborative process, the board must create an advisory committee of appropriate agencies and stakeholders, including hiking and bicycling groups. The board must report the results of the study to the appropriate fiscal and policy committees of the legislature by October 1, 2019.

This specific look at health effects and nature contact accompanies an economic study conducted by EcoNorthwest in 2019 titled *Economic, Environmental, and Social Benefits of Recreation Trails in Washington State*.

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STUDY DIRECTION AND PURPOSE

The Washington State Legislature directed the Recreation and Conservation in Section 304(3) of the 2018 state operating budget to conduct a study of the economic and health benefits of trail-based activities, including hiking, walking, and bicycling. This study presents a literature review of the health benefits – physical, mental, cognitive and social – from nature contact and presents findings from over 100 studies that identify evidence of close associations between health benefits and being outdoors. Because this is a new and emerging field of study, the studies cited in this report go beyond the specificity of health benefits resulting from recreational trails in Washington to include the health benefits from nature contact as observed in the United States and other countries. There is an accompanying report prepared by EcoNorthwest[1] detailing the economic, environmental and social benefits of recreational trails in Washington state.

WHY NOW, WHY WASHINGTON?

The evidence linking time spent in nature with improvements in mental and physical health has never been stronger, and more relevant. Consider that in Washington, more than 23 percent of adults reported having some form of depression,[2] 12 percent of adolescents had a major depressive episode in a single year, and nearly 63 percent of adults are obese or overweight,[3] and the urgency for change becomes apparent.

The solution might be as simple as stepping outside. A study among Washington adults found that those who spent more time outdoors reported less depression,[4] and another study of Washington residents found that more forests were associated with fewer days of mental health complaints.[5]

HIKING, BIKING AND WALKING AS DRIVERS OF HEALTH BENEFITS

Engaging in popular outdoor activities in Washington, including hiking, biking, and walking, could improve people's physical health. Research supports an abundance of benefits from biking including improved heart and lung fitness, fewer cardiovascular risk factors, fewer deaths, and less coronary heart disease, cancer risk, and obesity.[6] Walking and hiking require minimal special equipment and skills and offer numerous health benefits including improved cholesterol levels and protection against chronic diseases such as cardiovascular disease,

[1]EcoNorthwest, 2019. Economic, Environmental, and Social Benefits of Recreational Trails in Washington State. Prepared for the Recreation and Conservation Office.
[2]Centers for Disease Control and Prevention, 2015
[3]Centers for Disease Control and Prevention, 2017
[4]Cohen-Cline, Turkheimer, & Duncan, 2015
[5]Akpinar, Barbosa-Leiker, & Brooks, 2016
[6]Oja et al., 2011

diabetes, and obesity.[7] While biking and walking in particular may take place off trails (for example, cycling at the gym or walking around town), research suggests that additional benefits may occur when these activities are done in nature, adding support for the benefits of trail-based physical activity.[8]

BENEFITS TO HIGHLY IMPACTED POPULATIONS

The health benefits of nature contact may be particularly impactful for the 12.2 percent who have incomes below the poverty level.[9] Research has shown that these populations may be especially vulnerable to the cascade of poor health outcomes that stem from chronic psychological stress,[10] living near sources of pollution, and other environmental predictors of health. There is preliminary evidence that indicates that contact with nature may have greater and more beneficial impacts for underprivileged populations compared to their more affluent counterparts.[11] Nature contact thereby has the potential to offer much-needed health benefits to a large number of Washingtonians. Decision-makers should consider ways to support resources, such as trails, for populations in need.

CHILDREN AND NATURE CONTACT: BEYOND PHYSICAL ACTIVITY

Children also may particularly benefit from nature contact, as physical activity, play, social and emotional development, and improved cognitive functioning are all positively associated with time spent in nature.[12] Research has found that children who spent most of their time outdoors were less likely to be sedentary and more likely to achieve the recommended amount of daily physical activity levels.[13]

NATURE AND SENSE OF PLACE IN WASHINGTON

Nature also can foster deep, meaningful connection between people and place, coined as a "sense of place." For example, an avid kayaker may have a sense of place to the cliff-side waters of Deception Pass where he or she kayaks every weekend. Research has shown that trails also may create a sense of place. For example, a collaboration among poets and scholars from Central Washington University created a repository for Google Earth to pin poems to their maps.[14] One poem, pinned to Washington's Mount Baker, shares poet Derek Sheffield's photograph of himself on a steep, snowy trail alongside his poem of the resident marmot. As another example, social scientists

[7]Albright & Thompson, 2006; Ball, Bauman, Leslie, & Owen, 2001; Parkkari et al., 2000
[8]Pretty, Peacock, Sellens, & Griffin, 2005
[9]Office of Financial Management, 2018; US Census Bureau, 2017
[10]Sapolsky, 2004
[11]Mitchell, Richardson, Shortt, & Pearce, 2015; Mitchell & Popham, 2008
[12]Bodrova & Leong, 2005; Gray et al., 2015; Rivkin, 1995
[13]Schaefer et al., 2014
[14]Dempsey, 2011

from the U.S. Forest Service and Portland State University used in-person workshops and online participation to better understand the diverse connections people had with the forests around them, for the purpose of informing land management decisions.[15] Members of the public talked about places and how they matter to them, identifying favorite berry or mushroom gathering spots for example.

In Washington, two pilot studies found that more than 90 percent of the 6,000 Puget Sound area residents participating felt attached to the region and were proud to call it home.[16] In a different study, residents revealed deeply meaningful senses of place that often were passed through heritage and family traditions such as shellfish harvesting.[17]

Youths likewise are enriched by a sense of place. A Washington Trails Association program enlists high school volunteers to spend a week camping and working on trails. The participants speak about their involvement, highlighting some of the impactful connections they create through the experience.

The wide-reaching reverberations of sense of place in Washington, and the positive health outcomes of place connection (as well as the negative outcomes in its absence), are arguments for policy and land use decisions that advocate for the preservation of, and human connection to, nature.

ENVIRONMENTAL AND HUMAN HEALTH

Another statewide issue of critical importance for Washington is the well-being of its wildlife. The Washington Department of Fish and Wildlife lists dozens of species in danger of extinction.[18] As evidence builds for the interconnectedness of human health and the health of the greater ecosystem humans inhabit,[19] the present time is crucial for making decisions that will improve the environment. Policies that increase and expand the use of Washington's trails can boost the connections of people to nature and increase the health benefits, environmental stewardship, and greater well-being for humans and wildlife alike.

POLICY DIRECTIONS

Policies that focus on connecting underserved populations, such as certain ethnic and racial groups, the poor, and the elderly, to nature and trails are potentially of high impact. Underserved populations say they don't spend time in the outdoors because they don't feel safe and parks are too far away or too difficult to get to. There also is a lack of geographical diversity, with many programs Seattle-based. Policies should

[15]Koch & Cerveny, 2018
[16]Puget Sound Partnership, 2017
[17]Poe, Donatuto, & Satterfield, 2016
[18]Washington Department of Fish and Wildlife, 2019
[19]Centers for Disease Control and Prevention, 2019; Mace, Norris, & Fitter, 2012; Wheeler et al., 2015

seek to reduce barriers for underserved populations and increase the geographical base of outdoor programs. In addition, future research should fill knowledge gaps so scientists better understand how different types of green spaces affect health outcomes and how time spent outdoors affects different groups of people including rural residents.

KEY TAKEAWAYS

FOR PHYSICAL HEALTH

- Nature contact may be associated with a wide range of health outcomes including cardiovascular health, cancer, respiratory illness, diabetes, and death.
- Overall, the body of evidence suggests that walkable, natural areas may increase physical activity for adults and children.
- Nature settings are particularly conducive to play, and children can benefit from the health improvements associated with this play, including increased physical activity and social, cognitive, and emotional benefits.
- Outdoor exercise, such as on trails, has been demonstrated to improve mood, restore attention, and decrease anger, depression, and stress, compared to indoor exercise.
- Washingtonians enjoy hiking, biking, and walking, but many programs are Seattle-based, positioning policy-makers to support similar initiatives in different areas of the state.
- The gap between the healthiest and least healthy residents may decrease in areas with more access to green space.

FOR MENTAL HEALTH

- Studies in Washington State found that more green space was linked to decreased depression, mental health complaints, and stress.
- Those from underprivileged may experience greater mental health benefits from contact with nature. These populations often have the least amount of access to nature because of a variety of barriers.
- Among children, the evidence supports that contact with nature improves the overall mental well-being, resiliency, and quality of life, and reduces stress and aggressive behavior.

FOR COGNITIVE BENEFITS

- Nature contact has been shown to be associated with improved attention and intellectual activity.
- Research evidence supports improvements in Attention Deficit Hyperactivity Disorder symptoms, attention, and test performance in children who have more nature contact, including those who have more greenery around their schools.

EXECUTIVE SUMMARY | 1

- Nature contact has been shown to be connected to children's self-regulation and self-discipline, which are crucial predictors of academic achievement and health later in life.

FOR SOCIAL BENEFITS

- Social connections, networks, and bonds play a central role in health.
- Studies have shown that social cohesion is a causal mechanism in the physical and mental health benefits of nature contact– therefore trails that are conducive to positive social relationships and sense of support may be especially beneficial to health.
- Green space can increase social activity and social cohesion, as well as decrease crime rates.
- Sense of place creates intimate, emotional bonds between people and places, and Washington's nature creates rich, abundant senses of place for Washingtonians.
- Research in Washington involving more than 6,000 residents found that more than 90 percent of residents feel attached to the region, and are proud to call it home.

FOR BARRIERS TO NATURE CONTACT

- In Washington, underprivileged populations and the elderly face substantial barriers to nature access.
- The further people are from nature, the less likely they are to use it.
- If people perceive safety concerns, they are less likely to venture outside and will miss out on the restorative and social benefits of spending time in nature.
- Perceived barriers, such as the lack of park information in other languages or lack of culturally diverse park staff, may prevent people from spending time in nature.
- Reducing barriers, particularly for children, may cultivate long-lasting connections to nature and advocacy for the environment.

FOR RURAL POPULATION BARRIERS TO HEALTH

- In Washington, 30 of its 39 counties are rural.
- Rural citizens face high rates of illness and limited access to medical care.
- Stigma is a strong barrier to receiving mental health care.
- Nature contact and its physical and mental health benefits could be an important source of well-being.

INTRODUCTION | 2

Washington State's trails are important places for a wide variety of activities, from hiking and mountain biking to rollerblading and cross-country skiing. A growing body of scientific evidence suggests that places in nature, like those of the state's trails, confer a wide range of health benefits including physical, psychological, and cognitive improvements to their users. This evidence makes providing Washingtonians with access to trails an important public health issue.

2.1 | WHY NOW, WHY WASHINGTON

People's disconnection from nature is an anomaly in human history. Humans have spent 99 percent of their 2 million years of existence in intimate contact with nature, with survival advantages for those with a deep understanding of water, plants, animals, and landscapes.[20] Today, many studies are making Washingtonians aware of the cost of that disconnection, such as increased stress and mental health issues and reduced physical fitness.

Scientific evidence has begun to support a myriad of health benefits associated with contact with nature, whether it is hiking outdoors or just seeing greenery outside a classroom window. Using evidence-based decisions, such as increased resources and opportunities for contact with nature, may not only improve the well-being of many Washingtonians but may help state leaders navigate the complex web of urbanization, land-use trends, and health.

2.2 | URBANIZATION TRENDS

Urbanization is a global trend echoed by the State of Washington. Globally, in 2008, more people lived in urban areas than rural ones for the first time in human history,[21] and the percentage of urban dwellers is projected to increase to 68 percent by 2050.[22] In Washington State, the rural population decreased by 11.6 percent between 2000 and 2010, and is continuing to move to urban areas.[23] It is important to consider how the State can support the health of its residents as they move out of the countryside and into cities. The evidence presented in this report suggests contact with nature may be an important source of well-being for this population.

2.3 | HEALTH TRENDS

Washington also mirrors national and global trends in physical and mental health. Globally, depressive disorders and anxiety disorders are among the most prevalent. In 2015, depression affected 322 million people and anxiety disorders affected 264 million people,[24] and these numbers are growing.[25] In Washington, more than 2 percent of adults reported having

[20]Frumkin, 2001; Frumkin & Fox, 2011
[21]UNFPA, 2007
[22]United Nations, 2018
[23]Washington State Department of Health, 2017
[24]World Health Organization, 2008b
[25]Vos et al., 2016

some form of depression,[26] and 4.4 percent had a serious mental illness in a single year compared to the national average of 4.2 percent.[27] Among youths, 12.1 percent of Washington's adolescents had a major depressive episode in 2014 compared to the national prevalence of 11 percent.[28] Urban dwelling also is associated with increases in some types of mental illness. An analysis of 20 research studies from multiple countries found a 21 percent increased risk for anxiety disorders and 39 percent increased risk for mood disorders in people who lived in urban areas compared to rural areas.[29] This finding is especially relevant given that more Washingtonians are moving to cities.

Children also are affected deeply by mental illness. More than 6 million American children have been diagnosed with Attention Deficit Hyperactivity Disorder, with more than one-third of those also having an anxiety disorder diagnosis.[30]

Obesity is a national crisis: 30 percent of American adults and 27.7 percent of Washington adults are obese. In addition, nearly 1 in 5 Washington adults report not participating in any leisure-time physical activity. These sedentary lifestyles increase vulnerability to weight-related issues.[31] There is a clear need for healthier, more active lifestyles, and the research evidence linking contact with nature to improved physical and mental health outcomes is especially important at this time.

2.4 | WASHINGTONIANS UNDER CHRONIC STRESS

More than 12.2 percent have incomes below the poverty level.[32] Research has shown that these populations may be especially vulnerable to the cascade of poor health outcomes such as premature death, poorer cardiovascular health, and increased risk for depression.[33] Recent research also has shown that these underprivileged populations may experience bigger effects of the health benefits of contact with nature compared to their more affluent counterparts.[34] Contact with nature has the potential to offer much-needed health benefits to a large number of Washingtonians, and decision-makers should consider ways to support salutary resources, like trails, for such populations in need.

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[26]Centers for Disease Control and Prevention, 2015
[27]SAMHSA, 2015a
[28]SAMHSA, 2015b
[29]Peen, Schoevers, Beekman, & Dekker, 2010
[30]Danielson et al., 2016
[31]Centers for Disease Control and Prevention, 2017
[32]Office of Financial Management, 2018; US Census Bureau, 2017
[33]Lazarus, 2000: Lazarus & Folkman, 1984; Nielsen & Hansen, 2007; Sapolsky, 2004; Siegrist, 2008
[34]Mitchell, Richardson, Shortt, & Pearce, 2015

NATURE CONTACT AND HUMAN HEALTH BENEFITS | 3

3.1 | INTRODUCTION TO COMMON RESEARCH METHODS AND TERMINOLOGY

Nature: While there is no single, objective definition, researchers in the field of nature contact and human health often operationalize it as "the physical features of non-human origin including flora, fauna and abiotic elements like sunsets across spectra of degrees of human management and scale," which overlaps significantly with natural environment.[35]

Green Space: refers to land covered with vegetation (grass, trees, etc.).

Nature Contact: There are many forms of nature contact through various sensory pathways (e.g. seeing, hearing) and through a range of activities and levels of contact awareness.[36] This term is often used interchangeably with nature experience, although the latter tends to emphasize physical contact.

Measurement of Nature Exposure: Research studies often quantify natural spaces using satellite image data (e.g. Normalized Difference Vegetation Index, which measures light absorption versus reflection to characterize vegetation presence), and land cover maps, which categorize land plots by cover type (forest, cropland, etc.), or calculations of the relative amount of, or distance to, natural spaces. Other research studies may compare health outcomes in contrasting environmental conditions such as more urban versus more natural environments without necessarily characterizing or quantifying the environments at length.

Measurement of Outcomes: Subjective well-being can be assessed with survey instruments, many of which are validated measures used by researchers for many years and/or large population surveys such as nationally representative surveys by the U.S. Census Bureau. Self-reported health has been shown to have a strong association with objective indicators of health.[37] Objective measurements include body mass index, heart rate, respiration, blood pressure, and salivary cortisol, etc. Other sources of data may include publicly available health data.

Review Studies: Researchers compile the findings from multiple studies in order to summarize a general trend. Individual studies may investigate specific outcomes in specific populations, which may be difficult to generalize to understand Washingtonians' health. For example, one study may look at whether nature contact affects the prevalence of cardiovascular disease in older adults in Denmark. The findings would be difficult to apply to Washingtonians specifically. In contrast, review studies are

[35]Bratman, Hamilton, & Daily, 2012; Frumkin et al., 2017

[36]Frumkin et al., 2017

[37]Gallagher et al., 2016

beneficial because they aggregate results from a body of work as a whole and are more amenable in helping to form more generalized hypotheses.

3.2 | PHYSICAL HEALTH BENEFITS

KEY TAKEAWAYS

- Nature contact may be associated with a wide range of health outcomes including death, cardiovascular health, cancer, respiratory illness, and diabetes.
- Overall, the body of evidence suggests that walkable, natural areas may increase physical activity for adults and children.
- Children can improve their health by playing in nature, including improving their physical activity and social, cognitive, and emotional benefits.
- Compared to indoor or urban exercise, exercise outdoors, such as on trails, has been demonstrated to improve mood, restore attention, and decrease anger, depression, and stress.
- Washingtonians enjoy hiking, biking, and walking, but many local programs are Seattle-based, positioning policy-makers to support similar initiatives in different regions of the state.
- The gap between the healthiest and least healthy residents may decrease in areas with more access to green space.

Physical health is a core component of overall health and is affected by a multitude of factors including sleep, exercise, and diet. A seminal 1984 study found that contact with nature improved physical health. Hospital patients in recovery rooms with views of nature experienced less pain and shorter recovery times after surgery than patients with views of a brick wall.[38] Researchers since have investigated associations between nature contact and various physical health outcomes, and the number of studies contributing to this body of knowledge has surged in recent years. A review of scientific evidence through 2017 found particularly consistent and strong evidence for nature contact and decreased death, improved birth weight, and increased physical activity, as well as some improved cardiovascular health.[39] Another review also cites consistent associations between green space exposure and improved heart rates and less violence, as well as some mixed support for improved general health and less cancer, diabetes, and respiratory illness.[40] Among this breadth of physical health outcomes, physical

[38]Ulrich, 1984
[39]Fong, 2018
[40]Kondo, 2018

activity has been of especially high scientific interest due to its large role in overall physical health.

PHYSICAL ACTIVITY

Evidence accumulated since the 1950s has linked increased physical activity to risk reduction for a variety of chronic diseases (e.g. cardiovascular disease, obesity, diabetes, colon and breast cancer) and premature death.[41] Evidence is mounting to suggest that green space is associated with higher levels of physical activity and decreased likelihood of obesity.[42] Specifically, more green space has been tied to increased walking. A study of more than 333,000 people in the United Kingdom found that participants walked more with increasing amounts of natural areas within 600 meters of their homes.[43] Additionally, an international study of 12 countries showed significant positive association between park proximity and recreational walking.[44] However, some reviewers have noted mixed results among other studies. One researcher[45] reviewed United States-based studies on physical activity and access to parks. Of the 20 articles that met inclusion criteria, 5 found significant positive associations, 9 found no associations, and 6 had mixed results.

Reviewers posited that limitations in how the types and amounts of physical activity were assessed and the large variability in study designs, contribute to the inconclusiveness of the literature. More research is needed before a causal effect can be determined.[46] However, as a whole, the number of studies linking green space and physical activity exceeds the number with mixed or insignificant results, and the overall body of evidence suggests that walkable, natural areas can increase physical activity.

HIKING, BIKING, AND WALKING

Popular outdoor activities in Washington, including hiking, biking, and walking, have the potential to positively affect people's lives, not only physically but socially. Local organizations like Cascade Bicycle Club, the nation's largest statewide bicycle nonprofit, offers rides, events, and classes. One event rider shares the physical health benefits:

"All this fun activity has helped me lose over 30 pounds and gain lean muscle. At age 67, my doctor just told me I'm in excellent health and I feel as good as I can ever remember."

[41]Warburton, 2006
[42]Astell-Burt, Feng, & Kolt, 2014; Nielsen & Hansen, 2007; West, 2012
[43]Sarkar, 2017
[44]Sugiyama et al., 2014
[45]Bancroft, 2015
[46]Kondo, 2018; Bancroft, 2015; Ord and Mitchell, 2013

NATURE CONTACT AND HUMAN HEALTH BENEFITS | 3

Another adult participant contrasts cycling with riding a car:

"I used to drive a 4,800 pound German sedan, and I had tunnel vision. I couldn't see the people, or the community or cultures on my right or my left. When you're on a bike, you're in the midst of them, both literally and figuratively. You really relate to people and the environment much differently than if you're in a steel and glass cocoon."

Youth-oriented cycling programs, like the Major Taylor Project (MTP), introduces middle and high school students from low-income and diverse neighborhoods to cycling disciplines including trail mountain biking. One participant from Foster High School in Tukwila expresses:

"MTP has changed my life…now I ride my bike frequently. I love that MTP gives the opportunity to those who cannot afford a bike and gives them lots of memorable moments."

Another program, She Bikes Cascade, seeks to connect cycling to another underserved group: women. The program creates a space and community that encourages more women to "discover the joys and benefits of biking," and research supports an abundance of benefits from cycling. A review of 16 cycling-specific studies indicates benefits for cardiorespiratory fitness and cardiovascular risk factors, and some (but mixed) evidence for decreased death, coronary heart disease deaths, cancer risk, and obesity,[47] with these benefits outweighing risks related to increase inhaled air pollution or traffic accidents.[48]

Unlike cycling, walking requires minimal special equipment or skills and offers numerous health benefits including improved cholesterol levels and protection against chronic diseases such as cardiovascular disease, diabetes, and obesity.[49] Hiking shares the convenience of walking (i.e. minimal starting requirements) but with the added benefits associated with greater physical activity intensity. A study among trail users in Australia found hikers expended almost twice the number of calories as walkers because of their use of steeper, more difficult trails.[50]

As with cycling, hikers may seek community and a sense of belonging with other hikers who represent their backgrounds. The American Hiking Society's program, NextGen Trail Leaders, facilitates diversity by highlighting hikers who "champion diversity in the outdoors." For example, Seattle native Bam Mendiola, who is a mountaineer and queer person of color, has been featured in documentaries and news

[47]Oja et al., 2011
[48]de Hartog, Boogaard, Nijland, & Hoek, 2010
[49]Albright & Thompson, 2006; Ball, Bauman, Leslie, & Owen, 2001; Parkkari et al., 2000
[50]Wolf & Wohlfart, 2014

stories for efforts to make hiking more accessible for others.

The Washington trail system has the ability to facilitate these impactful forms of physical activity and sense of community for its residents. While cycling and walking in particular might take place off trails (for example, cycling at the gym or walking around town), research suggests that additional benefits may exist for activities conducted in nature, adding support for trail-based physical activity.

GREEN EXERCISE

Physical activity may be done in many places, including indoors, but compelling evidence suggests specific benefits for exercising outdoors—often referred to as green exercise. Researchers[51] had people during a walking exercise view scenes in four categories: pleasant rural, pleasant urban, unpleasant rural, and unpleasant urban, in addition to a control group that did not see any pictures. Of these groups, only those who viewed rural pleasant scenes experienced significant reductions in all three measures of blood pressure, indicating decreased stress and greater restoration. Both urban scene types increased blood pressure relative to the control group, suggesting the urban environment may negate the benefits of exercise.

In a study comparing walking outside versus in a laboratory, researchers found those walking outside were in better moods, enjoyed it more, and were more likely to say they would continue walking.[52] A systematic review[53] summarized other non-physical benefits for green exercise such as greater feelings of revitalization and positive engagement, and decreases in anger and depression, compared to indoor exercise. Together, the research specifically supports the importance of natural settings, such as trails, for positive health outcomes.

CHILDREN'S PHYSICAL ACTIVITY AND PLAY

Nature can boost physical activity of children by providing opportunities for active play. Like adults, children struggle with high rates of obesity; the Centers for Disease Control cites a tripling in youth obesity rates since the 1970s.[54] Because active children tend to be active adults,[55] it is important to connect children to environments that promote healthy amounts of activity. Nature-based preschools, such as Seattle's Fiddleheads Forest School, offer outdoor places and natural features, such as fallen logs and muddy hills, to provide a variety of physical activity and play behaviors.[56]

[51]Pretty, Peacock, Sellens, & Griffin, 2005
[52]Focht, 2009
[53]Thompson Coon, et al., 2011
[54]Fryar, Carroll, & Ogden, 2014
[55]Kjonniksen, Torsheim, & Wold, 2008
[56]"Fiddleheads Forest School," 2019

NATURE CONTACT AND HUMAN HEALTH BENEFITS | 3

Research has found that children who spent most of their time outdoors were less likely to be sedentary and more likely to achieve the recommended amount of daily physical activity levels.[57] Another study found that boys' levels of physical activity were more likely to be of higher intensity in green spaces.[58] A recent systematic review summarized the findings of nearly 30 studies from nine countries to reveal that the evidence overall suggests positive effects of outdoor time on children's physical activity, sedentary behavior, and cardiorespiratory fitness;[59] however, causality is undetermined and studies are needed.

Aside from providing environments conducive to more physical activity, nature settings also can boost children's well-being through play. Several decades of research link play to pivotal aspects of optimal child development including cognitive, social, physical, and emotional well-being. Play contributes to children's learning behaviors, problem-solving skills, social and emotional ties, cooperation, and creativity, among much else.[60] The importance of play is so well-established that the United Nations has deemed it a basic human right of every child.[61] Numerous studies have found that natural landscapes and elements are conducive to enriched play and learning[62] by allowing for more engaged and varied play.[63] Nature settings may be of particular importance for disadvantaged children, for whom access to safe, age-appropriate play spaces may be diminished.[64]

GREENER AREAS DECREASE HEALTH GAPS

A formative epidemiological study in 2008 found that poor people had worse health outcomes and less access to green space, but more importantly, that gaps in health decreased in areas with the most greenery.[65] While people of lower income were more likely to have all-cause mortality and circulatory disease, these inequalities were lesser in populations living in the greenest areas, suggesting income-based inequities may be reduced by more green space. While direct cause-and-effect relationships were not explored, the authors noted that the findings aligned with their hypotheses based on what was known about circulatory disease and death. For example, principal causes of circulatory disease are physical inactivity and response to stress, and

[57]Schaefer et al., 2014
[58]Wheeler, Cooper, Page, & Jago, 2010
[59]Gray et al., 2015
[60]Bodrova & Leong, 2005; Milteer, Ginsburg, Council on communications and media, & Committee on psychosocial aspects of child and family health, 2012; Zigler, Singer, & Bishop-Josef, 2004
[61]Office of the United Nations High Commissioner for Human Rights, 1989
[62]Rivkin, 1995
[63]Fjørtoft, 2001; Woolley & Lowe, 2013
[64]Milteer et al., 2012
[65]Mitchell & Popham, 2008

greener areas may be more conducive to physical activity and stress reduction. Epidemiological work also found reduced health gaps for mental health outcomes. Another large, more recent study using data on more than 20,000 residents from 34 European nations reported that socioeconomic differences in mental well-being was 40 percent narrower among people who had greater access to green areas than among those with less access.[66] Despite these findings, green space typically still is available more to higher income groups. Policies and decisions that affect the availability and accessibility of natural areas, especially for areas with large income-based health gaps, have the potential to mitigate chronic health inequities and improve public health.

3.3 | MENTAL HEALTH BENEFITS

KEY TAKEAWAYS

- One of the most studied and consistently supported ways that contact with nature improves health is by reducing stress.
- Studies in Washington State found that more green space was linked to decreased depression and mental health complaints.
- Those from underprivileged or vulnerable backgrounds may experience greater mental health benefits from contact with nature, and these populations are often those with the least amount of access to nature, due to a variety of barriers. These issues are a matter of environmental justice.
- Among children, the evidence supports that contact with nature improves overall mental well-being, resiliency, and quality of life, and reduces stress and aggressive behavior.

STRESS REDUCTION THEORY

Amidst the elevated stress in cities, people consistently and widely express affinity for nature—picnicking at the park, pulling off the road for scenic views, listening to nature soundtracks to fall asleep, etc. Study respondents also have listed nature experience (a walk in the forest) as their top recommendation for those feeling stressed.[67] What is it about nature that people find enjoyable and even restorative?

One prevailing theory, Stress Reduction Theory, posits that nature settings echo human's physiological and psychological evolutionary adaptions, and help to combat the elevated states of physiological arousal that accompany stress, through the activation of the parasympathetic nervous system.[68] Stress has been declared a worldwide public health problem, important for the prevention of disease and also for improved mental health and well-

[66]Mitchell, Richardson, Shortt, & Pearce, 2015
[67]Grahn & Stigsdotter, 2003
[68]Ulrich, 1984

being. Researchers have tested the Stress Reduction Theory by measuring physiological and other indicators of stress (e.g. heart rate, skin conductance, blood pressure) in different environments, such as natural versus urban conditions. An early study revealed faster blood pressure recovery in stressed individuals who watched videos of natural environments compared to those whose watched videos of urban, built settings.[69] Salivary cortisol (a hormone that is a correlate of stress) also has been used as an easy biomarker of stress. Individuals with more green space in their living environments, even among those living in socially disadvantaged districts, had lower cortisol levels than those with less green space.[70] In Sweden, a survey correlated fewer stress-related illnesses with greater use of open green spaces.[71] An epidemiological study of a Danish nationally-representative survey also supports the positive relationship between nature contact and decreased stress.[72]

Researchers also have demonstrated that nature can be a stress reducer. A recent study[73] investigated variables such as mental health status, social support, and physical activity and identified a cause-and-effect relationship between green space and improved general health. Importantly, they found a strong relationship between stress reduction brought about by contact with nature and greater affected general health, adding substantial support for Stress Reduction Theory.

Stress reduction from nature contact also has been shown to act as a protective buffer against negative life events. A representative sample of Dutch citizens found that people were less affected by stressful life events when they had high amounts of green space within 3 kilometers of their homes.[74] Evidence also suggests a buffering effect for children; vegetation near the homes of rural children lessened the impact of life stress, offering a protective factor and contributing to resilience.[75] These results together suggest important implications for those from disadvantaged backgrounds and children (especially those raised in urban environments) who may be more vulnerable to the impacts of stress.

MOOD, DEPRESSION, AND ANXIETY

Changes in emotional states are central to recovery from stress[76] and a body of evidence links positive emotional states to better well-being. Emotional states, or moods, encapsulate the experience of positive and negative

[69]Ulrich, 1991
[70]Roe et al., 2013; Ward Thompson et al., 2012
[71]Grahn & Stigsdotter, 2003
[72]Stigsdotter et al., 2010
[73]Dadvand et al., 2016
[74]A.E. van den Berg, Maas, Verheij, & Groenewegen, 2010
[75]Wells & Evans, 2003
[76]Berto, 2014

emotions such as happiness and anger. In general, nature is associated with more positive moods, albeit with variability in the way mood and nature are assessed.[77] There also is support for broader benefits such as decreases in rumination,[78] which is a known risk factor for depression.[79]

Depression and anxiety disorders affect a staggering number of Americans. Major depression affects about 7 percent of all U.S. adults and 9 percent of adolescents aged 12 to 17.[80] Anxiety disorders affect 1 in 3 adults at some point in their lives, with a similarly high prevalence among adolescents.[81] Robust studies including epidemiological, large cohort, and randomized controlled trials provide relatively strong evidence that nature contact is associated with decreased depression and anxiety.[82]

Studies in Washington have found evidence that having contact with nature can improve mental health. A study among Washington adults found that more access to greenspace was linked to decreased self-reported depression.[83] Another study of residents across 98 zip codes in Washington found that people in zip codes with more forestland had fewer mental health complaint days.[84]

Some studies found stronger effects for particular vulnerable populations, which may indicate that a large number of Washingtonians (such as those with lower income and less schooling) may benefit even more from nature contact. For example, Dutch data on 10,000 people found stronger, positive associations between green environments and well-being for those with less education.[85] Among pregnant women in the United Kingdom, those who lived in greener areas were about 20 percent less likely to experience depressive symptoms than those in less green areas, with a stronger effect for those from underprivileged backgrounds.[86] The state of the evidence suggests nature contact is a possible source of improved mental health and well-being, especially for those from underprivileged backgrounds.

YOUTH AND MENTAL HEALTH

Internationally and in the United States, organizations have published reports revealing that mental health disorders affect a greater proportion of young people than other age

[77]McMahan & Estes, 2015
[78]Bratman, Hamilton, Hahn, Daily, & Gross, 2015
[79]S Nolen-Hoeksema, 1991; Susan Nolen-Hoeksema, 2000; Susan Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008
[80]National Institute of Mental Health, n.d.-b
[81]National Institute of Mental Health, n.d.-a
[82]Gascon 2018; South, 2018; Banay et al., 2019
[83]Cohen-Cline, Turkheimer, & Duncan, 2015
[84]Akpinar, Barbosa-Leiker, & Brooks, 2016
[85]de Vries, Verheij, Groenewegen, & Spreeuwenberg, 2003
[86]McEachan et al., 2016

groups.[87] A landmark study using Dutch national survey data investigated the effects of green environments and found the strongest associations for improvements in psychiatric conditions in children.[88] Reviews of numerous studies[89] found that contact with nature improved Attention Deficit Hyperactivity Disorder symptoms, overall mental well-being, resilience, and health-related quality of life; reduced stress; as well as showed mixed results for improved depression and self-esteem outcomes. Other significant findings associated with increased nature contact include reduced aggressive behavior.[90] Researchers note, however, that several of the outcomes (e.g. stress) were explored by relatively few studies, and with large variability in the way predictors and outcomes were measured. Many of the studies also were observational or cross-sectional in design, limiting causal inference, although there were several studies over long periods of time.[91] The consistent evidence related to a second prevailing theory about the health benefits of nature: Attention Restoration Theory, which posits that contact with nature can improve cognitive functioning.

3.4 | COGNITIVE BENEFITS

KEY TAKEAWAYS

- Nature contact has been shown to be associated with restoration of attention and improved cognitive functioning.
- Research evidence supports improvements in Attention Deficit Hyperactive Disorder symptoms, attention, and test performance in children who have more nature contact, including those who have more greenery around their schools.
- Nature contact has been shown to be connected to children's self-regulation and self-discipline, which are crucial predictors of academic achievement and health later in life.

ATTENTION RESTORATION THEORY

Attention Restoration Theory stipulates that urban environments overly tax our finite resource of attentional control.[92] The barrage of stimuli (honking horns, blinking signs, the unpredictable movement of people, etc.) require us to sift through and block out irrelevant stimuli in order to attend to relevant stimuli, which increasingly fatigues our capacity for directed

[87]Department of Health and Aging, 2013; WHO, 2001
[88]Maas, van Dillen, Verheij, & Groenewegen, 2009
[89]McCormick, 2017; Tillmann, Tobin, Avison, & Gilliland, 2018; Vanaken & Danckaerts, 2018
[90]Younan et al., 2016
[91]Bezold et al., 2018; Dadvand et al., 2015; Feng & Astell-Burt, 2017
[92]Kaplan, 1993; Kaplan & Kaplan, 1989

attention. By contrast, natural environments are characterized by elements of soft fascination (the rustling of tree leaves, the trickle of a stream) that do not tax our attention capacity to the same degree, rather allowing our attentional resource to restore and replenish. Researchers have tested this theory with a range of methods, commonly using concentration and working memory tasks to measure attention performance. The theory suggests that people would perform better on such cognitive tasks after being restored through nature exposure, compared to those who experience no restoration or further taxing (through urban environments). In support of the hypothesis, mentally fatigued (via attention tasks) participants performed better after viewing nature images compared to those who viewed urban or geometric images.[93] Similar trends, including improved cognitive functioning and positive mood and decreases in negative mood, were found in participants who walked in natural environments versus urban environments,[94] suggesting attentional benefits can be received with varying exposures to nature (e.g. image viewing and walking).

CHILDREN AND COGNITIVE BENEFITS

Children's exposure to nature improved their attention and other cognitive functions. Several studies investigated the effects of nature exposure on children diagnosed with Attention Deficit Disorder and Attention Deficit Hyperactivity Disorder and found evidence of restoration. In a longitudinal study, children who moved to homes with more nature had significantly greater improvements in attention task scores than children who moved to homes without increases in nature.[95] Another study found symptoms of Attention Deficit Disorder and Attention Deficit Hyperactivity Disorder were attenuated in children who walked in parks[96] and after participation in activities (e.g. camping, fishing, playing soccer) in greener settings.[97] In a study of non-clinical populations, one researcher[98] saw improvements in attention and spatial working memory task performance in children who went on a nature walk, versus those who went on an urban walk.

Investigators also have explored connections between school settings–where children spend a significant portion of their time–and cognitive benefits. A longitudinal study of primary school children in Spain found improvements in cognitive development (measured by working

[93]Berto, 2005
[94]Bratman, Daily, Levy, & Gross, 2015; Hartig, Evans, Jamner, Davis, & Gärling, 2003
[95]Wells, 2000
[96]Faber Taylor & Kuo, 2009
[97]A. F. Taylor, Kuo, & Sullivan, 2001
[98]Schutte, 2017

memory tasks) in children with more surrounding greenness, particularly around their schools.[99] In the United States, researchers looked at more than 900 public elementary schools and their standardized test scores and found that higher levels of school greenness were associated with higher English and math scores, after adjusting for various inter-school differences such as income, race, English as a second language, and student-teacher ratio.[100] Among American high school students, those with mostly natural views in school had higher concentration scores compared to those with mostly built views.[101]

Children's self-discipline also has been found to relate to levels of greenery around the home.[102] Building upon the proposition that self-discipline (assessed through measures of concentration, impulse inhibition, and delay of gratification) and directed attention have the same underlying mechanisms,[103] one study explored the potential for environments to affect self-discipline in African American children from Chicago. These participants lived in high-rise buildings that were identical except for the varying degrees of nature views from their unit windows. Girls who lived in units with tree views performed better on all three measures of self-discipline than those who had views of a barren built environment. The authors provided plausible explanation for the insignificant associations for boys, citing findings that boys typically play farther from home than girls and therefore may net less contact with the nature directly beside their homes. The findings are highly relevant, even if only for females, because greater degrees of self-discipline may reduce negative outcomes such as skipping school and teen pregnancy, and support the development of positive social health, all of which are particularly impactful for children of lower socioeconomic backgrounds.

Nature contact may be especially important for children from underprivileged backgrounds because they are vulnerable to diminished social-emotional functioning and development of self-regulation skills. A prospective study of young children from low-income families linked family financial strain and negative impacts on delay of gratification.[104] Delay of gratification and executive functioning (i.e. cognitive abilities like attention and working memory) are crucial predictive factors for academic achievement, social determinants of health, and emotional health.[105] Ample research interest in executive function and delay of gratification has revealed their connections to optimal social functioning. Interventions that support healthy, social

[99]Dadvand et al., 2015
[100]Wu et al., 2014
[101]Matsuoka, 2010
[102]Taylor, Kuo, & Sullivan, 2002
[103]Taylor et al., 2002
[104]Duran, Cottone, Ruzek, Mashburn, & Grissmer, 2018
[105]Blair & Razza, 2007; McClelland, Acock, Piccinin, Rhea, & Stallings, 2013; Razza, Martin, & Brooks-Gunn, 2012

relationships and functioning, such as has been shown for nature contact, are therefore compelling.

3.5 | SOCIAL CAPITAL BENEFITS

KEY TAKEAWAYS

- Social connections, networks, and bonds play a central role for health.
- Studies have shown that social cohesion is a causal mechanism in the physical and mental health benefits of nature contact; therefore trails that are conducive to positive social relationships and sense of support may be especially beneficial to health.
- Green space can increase social activity and social cohesion, as well as decrease crime.
- Sense of place creates intimate, emotional bonds between people and places, and Washington's nature creates rich, abundant sense of place for Washingtonians.
- Research in Washington involving more than 6,000 residents found that more than 90 percent of residents feel attached to the region, and are proud to call it home.

Social capital refers to an individual's social connections, networks, and the collaborative bonds therein.[106] Healthy People 2020, a set of national health objectives set forth by the U.S. Department of Health and Human Services, explicitly emphasizes the importance of social determinants of health (e.g. safe housing, local food markets, access to education and job opportunities) as key factors in health promotion.[107] Strong social bonds and networks affect a broad range of health outcomes and are considered key correlates of health and well-being.[108] Research suggests nature exposure may facilitate components of social capital, particularly through the enhancement of social bonds. Neighborhood common spaces with more greenery increase beneficial social activity such as interpersonal interactions,[109] sense of safety, and individual-level adjustment,[110] as well as decrease negative social aspects such as crime.[111] Researchers have found that a lack of green space has been linked to damaging outcomes such as increased feelings of loneliness and perceived shortage of social support.[112]

Social cohesion, defined as the sense of community with trust, positive relationships, and

[106]Perkins & Long, 2002; Rocco & Suhrcke, 2012
[107]Koh, Piotrowski, Kumanyika, & Fielding, 2011; U.S. Department of Health and Human Services, n.d.
[108]Jennings, Larson, & Yun, 2016; Kawachi, Subramanian, & Kim, 2008
[109]Kaźmierczak, 2013; Sullivan, Kuo, & Depooter, 2004
[110]Kuo, Bacaicoa, & Sullivan, 1998
[111]Branas et al., 2011; Kuo & Sullivan, 2001
[112]Maas et al., 2009

feelings of acceptance and belonging,[113] appears to play an important causal role between nature contact and physical and mental health benefits.[114] Several theories may explain why social cohesion and social capital are facilitated through nature. For example, green spaces provide aesthetically pleasing surroundings that encourage individuals to visit, and subsequently socialize with their neighbors, thereby enhancing community ties. A similar theory posits nature contact may extend the person-to-person relationships to relationships between person and place, creating a sense of place. In other words, nature contact may provide physical places where people may connect or attach and may contribute to the meaningful emotional and spiritual ties to places that enrich quality of life and improve health.

SENSE OF PLACE

Sense of place is a concept that captures the meaningful connections between a person and a place,[115] including the physical,[116] aesthetic, emotional, spiritual, and psychological properties of a place.[117] Empirical studies showed that sense of place is connected to well-being[118] and quality of life.[119] In contrast, those who lack sense of place report more health issues and more stress.[120] Sense of place exists in rich variety, not defined by any single person, group, or interest.[121] It stems from long-existing dialogues about people-place relationships, and has come to be used in diverse ways, often inconsistently,[122] but psychology researchers tend to agree that sense of place is comprised of two complementary concepts: place attachment and place meaning.

Place attachment is the bond between people (as individuals or groups) and place, and the ability to exercise one's activities or preferences in that place.[123] For example, an avid kayaker may have an emotional bond to his or her home on the northern coast of Washington where weekends are spent paddling beneath the cliffs. Place attachment also has been shown to exist on trails, with respondents of a study expressing the extent to which they agreed to statements such as "I identify strongly with this trail," "Hiking here is more important than hiking in any other place," and "I will (do) bring my children to this place."[124] This research indicates that trails can inspire place attachment, and the trails

[113]de Vries, van Dillen, Groenewegen, & Spreeuwenberg, 2013; Forrest & Kearns, 2001
[114]de Vries et al., 2013; Sugiyama, Leslie, Giles-Corti, & Owen, 2008
[115]Tuan, 1977
[116]Stedman, 2003
[117]Frumkin, 2003; Taylor, 1996
[118]Moser, Ratiu, & Fleury-Bahi, 2002; Wright & Kloos, 2007
[119]Tartaglia, 2012
[120]Stokols & Shumaker, 1982
[121]Williams & Stewart, 1998
[122]Kudryavtsev, Stedman, & Krasny, 2012
[123]Altman & Low, 1992; Stokols & Shumaker, 1981; Williams & Vaske, 2003
[124]Kyle, Graefe, & Manning, 2005

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throughout Washington may likewise contribute to how people connect to those places. Through such meaningful connections, people value places.[125]

Place meaning is the symbolic meaning of a place through the eyes of the beholder. The same location may have different meanings from person to person or group to group.[126] That previously mentioned kayaker may cherish the solitary, restorative moments along the strait of Deception Pass, while the same place also signifies tradition and ceremonial gathering for members of the native Coast Salish peoples. Scholars have found varied approaches to capture the intangible, symbolic meaning of places. For example, a collaboration among poets and scholars from Central Washington University created a file repository for Google Earth to pin poems to their maps. One poem, pinned to Washington's Mount Baker, shares poet Derek Sheffield's photograph of himself on a steep, snowy trail alongside his poem of the resident marmot.[127] As another example, social scientists from the U.S. Forest Service and Portland State University used workshops and online participation to better understand the diverse connections people had with the forest around them to inform land management decisions. These workshops used human ecology mapping projects where members of the public could talk about places and how they matter to them, identifying places such as favorite berry or mushroom gathering spots.[128] Such community-based endeavors elucidate the deep and varied significances that places can hold.

SENSE OF PLACE IN WASHINGTON

In Washington, a state agency dedicated to the recovery and protection of Puget Sound assesses sense of place and markers of human health, such as quality of life.[129] Its two pilot studies involving more than 6,000 residents found that more than 90 percent of the participants felt attached to the region and were proud to call it home. In a different study looking at sense of place and well-being for Puget Sound residents, particularly people harvesting shellfish, semi-structured interviews revealed complex relationships among personal experiences, emotions, heritage, recreation, and identity.[130] The deeply meaningful senses of place, often passed through heritage and family traditions, are illustrated by such statements as these:

"The shoreline is a part of me, it's in my blood."

"It was a childhood you couldn't pay me a million dollars to do anywhere else. Some of the fondest memories are right there."

[125]Relph, 1976; Y. Tuan, 1980
[126]Masterson et al., 2017; Stedman, 2008
[127]Dempsey, 2011
[128]Koch & Cerveny, 2018
[129]Puget Sound Partnership, 2017
[130]Poe, Donatuto, & Satterfield, 2016

"It's a place that I go if I've had a tough day at work…it's such a beautiful, peaceful, serene area…"

One person's connection to place is evident when saying the following:

"I'll be down there and I go, 'Oh, the smelt are running!' you can definitely smell changes in [the place]. I don't know if it's just because I've been here so long, but I can go down there and smell the smelt coming."

The sense of place also is illustrated by heartfelt mourning for its loss, such as when the salmon population declined sharply in the 1980s:

"…it was the activity we enjoyed as people, we couldn't exercise because it wasn't there…not having the salmon there was almost like we had just lost a loved one."

Finally, at the thought of losing access to one's cherished place, one interviewee lamented:

"…it would be like the end of the world to me…it would be probably the deepest grief I could never get over."

The wide-reaching reverberations of sense of place in Washington, and the positive health outcomes of place connection (as well as the negative outcomes in its absence), are arguments for policy and land-use decisions that advocate for the preservation of, and human connection to, nature.

SENSE OF PLACE FOR WASHINGTON'S YOUTH

Youths are likewise enriched by connections to local nature. A Washington Trails Association program enlists high school volunteers to spend a week camping and working on trails. The participants speak about their involvement, highlighting some of the impactful attachments and meanings they create through the experience.[131] One participant speaks of social connection and education:

"I'm up there not to focus on technology, I'm up there to get away from it all, focus on meeting other people and learning new things."

Another expresses increased awareness of the nature around her:

"It's really nice to see what's in the state. You live here but seeing what's around is really important because it's really beautiful out here."

Two participants appreciate the effort required to connect people to nature trails:

"…in Washington we have some of the best recreation areas…if we weren't out here working on these trails they wouldn't be here…the trails would deteriorate and it would be a total waste."

[131]"Washington Trails Association: Youth volunteer vacations," 2019

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"A minute of walking is like three weeks of work, so that's a good realization for me, and I appreciate stuff more."

Programs and policies that connect youth to local nature may facilitate benefits such as increased physical activity and social capital. Enhanced sense of pride and place also, in turn, may affect pro-environmental behaviors. Such behaviors may lead to actions that increase greenspace and nature contact (such as sharing the special places with loved ones), perpetuate the cycle of nature contact, increase health benefits, and promote pro-environmental behaviors.

Studies show that sense of place informs environmental attitudes and behaviors. A study with Canadian national park visitors found that place attachment predicted pro-environmental intentions.[132] A different study investigating structural paths found that sense of place related positively to subjective well-being, which then related to pro-environmental behaviors.[133] Some studies revealed differences in place attachment for migrants, indicating potential cultural barriers in developing a sense of place.[134] Given Washington's rich cultural and racial diversity, and in light of the important health benefits of sense of place and social capital, it is important to consider how people or groups overcome barriers to connecting to the natural places around them.

3.6 | BARRIERS

KEY TAKEAWAYS

- In Washington, underprivileged populations and the elderly face substantial barriers to nature access.
- In Washington, social media platforms such as Facebook and Meetup host community groups like Outdoor Afro and Latino Outdoors to counter discrimination-based barriers to getting outdoors.
- It is important for nature to be close to where people live, especially for children and the elderly, because physical distance decreases green space use.
- When people perceive safety concerns, the restorative and social capital enhancing properties of green space are diminished.
- Perceived discrimination may take many forms, such as a lack of park information in other languages or culturally diverse park staff.
- Reducing barriers, particularly for children and families, may cultivate long-lasting

[132]Halpenny, 2010
[133]Junot, Paquet, & Fenouillet, 2018
[134]Peters, Elands, & Buijs, 2010

connections to nature and advocacy for the environment.

Despite what we know about nature contact and health benefits, some people are not getting outdoors. An outdoor recreation report prepared for Washington Governor Jay Inslee emphasized the need to help underprivileged populations and the elderly get outside.[135] Common barriers and the populations they tend to affect most, are discussed here.

NATURE PROXIMITY AFFECTS ACCESS

Children spend increasing amounts of time indoors and using technology.[136] Such lifestyles are associated with decreased physical activity and increased obesity risk.[137] In addition, parenting practices for children's roaming range (i.e. the spaces children are allowed to explore without adult accompaniment) have reduced children's independence and limited their exploration of the outdoors. Reduced roaming range is attributed to increases in safety concerns[138] and a study has shown that children with small home ranges had low independence scores, citing parental restrictions on where they could go limiting exploration.[139] A lack of proximity to natural areas is therefore a significant barrier for children who spend free, unstructured time close to home.

The importance of close-range nature also applies to adults. A study on physical activity and green space use found that respondents who lived closest to parks were more likely to be physically active and less likely to be overweight. In addition, the frequency of green space use declined as distance to green space increased.[140] Researchers also found positive association between the number of nearby parks and moderate-to-vigorous physical activity in subjects across 14 cities in 10 countries, and that a subject's perception of how close a park was affected how often they exercised there.[141]

SAFE NATURE

Children and adults, particularly elderly adults, are concerned with safety. The lack of safety not only acts as barrier to access, but also affects the restorative properties of green spaces.[142] A 2018 study among seniors in Seattle and Baltimore investigated the extent to which perception of safety (including high traffic volume and crime) may affect the relationship between green space and social capital.[143] While more natural sights were associated with

[135]Washington State RCO, 2014
[136]Larson, Green, & Cordell, 2011
[137]Goran & Treuth, 2001; Mitchell et al., 2009
[138]Karsten, 2005; Timperio, Crawford, Telford & Salmon, 2004
[139]Hand et al, 2018
[140]Coombes et al, 2010
[141]Cerin et al, 2018
[142]Herzog and Kutzli, 2002; van den Berg and Ter Hijne, 2005
[143]Hong et al., 2018

greater social capital, this association only existed when safety was rated highly, suggesting that safety may moderate the health effects of green space.

DISCRIMINATION AND EXCLUSION

Discrimination and perceptions of belongingness in different types of nature reflect barriers that are more culturally informed. In Washington, social media platforms such as Facebook and Meetup host community groups like Outdoor Afro and Latino Outdoors to counter these discrimination-based barriers to getting outdoors. Outdoor Afro's homepage shares, "For black people, feeling welcome and safe in the outdoors isn't a given...Outdoor Afro is changing that." Latino Outdoors is an organization that emphasizes Latino culture of nature contact with the vision statement "…where all Latino communities enjoy nature as a safe, inclusive, and welcoming place…a space for the community to…showcase how conservation roots have been ingrained in Latino culture for generations."

A Seattle ambassador for Latino Outdoors, Lylianna Allala shares her memory of her family's connection to nature:

"My Gramma Mema taught me to always have Sábila (Aloe Vera) and Manzanilla (Chamomile) in my house. Sábila to sooth burns, bug bites, and skin irritations. Manzanilla to aid with sleep, assuage the symptoms of cough or fever, or to ward off nightmares. My family has always had ties and connections to the land y cuando estoy afuera, me siento como que estoy con my familia, mis antepasados [translation: and when I am outside, I feel like I am with my family, my ancestors]. I feel that I am reconnected with myself."

Despite people's individual and culturally informed connections to nature, research has shown that discrimination impedes nature contact for people from culturally diverse backgrounds.

In a mix of surveys and focus groups of Latino residents in Los Angeles, respondents cited a cultural rift with American Caucasians that affected their use of the city's urban national park. They feared being ostracized by other park users due to their perceived lack of standing in the wider community, and the need to have some sort of permission to use the parks. One interviewee figured that the locals would "get mad" if they saw Latinos using the park.[144] As predominantly Spanish language speakers, respondents also felt that the lack of basic park information (e.g. hours, directions, possible activities) in Spanish and the lack of bilingual park staff were expressions of exclusion.[145]

[144]Byrne, 2012, p. 604

[145]Byrne, 2012

Exclusion along cultural barriers may perpetuate a lack of cultural affinity to natural areas.

An analysis of qualitative and quantitative projects revealed that in England and Scotland, people of color and those from underserved groups were less likely to visit forests and woodlands[146] because it wasn't their social or cultural norm. Discussions with respondents from underserved communities linked a general lack of confidence about visitation and little awareness of nearby woodland areas as reasons why their cultures didn't have an affinity for woodland recreation. This gap was further widened by relevant information being unavailable in their own languages or through their preferred media channels. The cultural accessibility of nature areas paints notions of whom parks are meant for. For example, if every sign about the park is only in English, or if special events at parks are advertised only in media outlets predominantly serving white, English-speaking populations, then the message may be that these parks are only for white, English-speaking groups.

Data from a government-commissioned survey of more than 60,000 adults in England explored reasons for infrequent nature contact.[147] Those who were not white, of higher socioeconomic status, married, and with children, were more likely to be infrequent visitors. Among the cited reasons were the following:

- "This isn't something for me/people like me."
- "I don't feel welcome/feel out of place."
- "Concerns about where allowed to go/restrictions."

Such beliefs in striated belongingness in nature is problematic. They impede people from receiving important health benefits and also derail an important feedback loop wherein people who spend time in nature feel connected to nature, and in turn exhibit pro-environmental behaviors that contribute to a brighter future for the nature around them. A nationally representative survey found a disconnect between people's cultural stereotypes of "environmentalists"—namely that white, educated people cared about environmental issues—and the high level of environmental concern expressed by non-white, low-income Americans.[148] Policy-makers can work to address the above barriers to create welcoming, empowering nature spaces for people to voice environmental concerns and express their pro-environmental behaviors.

[146]Morris, 2011
[147]Boyd, 2018
[148]Pearson, 2018

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NATURE CONNECTEDNESS AND PRO-ENVIRONMENTALISM

"We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect."

Aldo Leopold (ecologist), 1949

Pro-environmental attitudes, which may lead to actions and policies that champion nature, rely on people's deep connection to natural places.[149] Scholars captured this sense of connection to nature as the extent to which a person included nature in his or her representation of self.[150] Through the view of nature connectedness, hurting nature would therefore be akin to hurting oneself—a disturbing dissonance less likely than in those who view themselves as separate from nature.

Empirical evidence in the past 20 years supports the interplay of connectedness to nature and pro-environmental beliefs and behaviors. Researchers created a scale to measure individuals' affective connectedness to nature and found that this connectedness was a predictor of ecological behaviors.[151] Place attachment to natural areas was a significant predictor of civic engagement beliefs[152] and intentions, such as willingness to pick up litter, volunteer for parks, and pay higher entrance fees.[153] Connection to nature affects children's ecological behaviors as well. A survey of fourth-grade students in Florida found that their connection to nature influenced their interest and participation in environmentally-friendly behaviors.[154] Youths involved in environmental groups often cited meaningful childhood experiences in nature as a motivator.[155] In addition, those with high emotional affinity for nature (which predicted a willingness to protect the environment) cited family experiences in nature as a key reason for their pro-environmental attitudes. This suggests that families' nature experiences may create long-lasting relationships with nature for their children and produce a generation of environmental advocates that uphold both natural environments and the ecosystem services they provide.

3.7 | RURAL POPULATIONS

KEY TAKEAWAYS

- In Washington, 30 of its 39 counties are rural.

[149]Cheng & Monroe, 2012; Collado, Staats, & Corraliza, 2013; Frantz, Mayer, Norton, & Rock, 2005
[150]Schultz, 2002
[151]Mayer & Frantz, 2004
[152]Buta, Holland, & Kaplanidou, 2014
[153]Walker, 2003
[154]Cheng & Monroe, 2012
[155]Chawla, 2007

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- Rural citizens face high rates of illness and limited access to medical care.
- Stigma is a strong barrier to receiving mental health care.
- Nature contact and its physical and mental health benefits are positioned to be an important source of well-being.

Scientific evidence supports nature as a health-promoting amenity with gaps between those in need of this amenity and those who receive it. In particular, patterns of health and greenspace inequities across socioeconomic levels have been discussed. While many studies cited in this report focused on urban dwellers' contact with nature, the health benefits of nature are equally important for rural populations.

In Washington, 30 of its 39 counties are rural.[156] Rural populations historically and consistently have been vulnerable to hardships such as high rates of poverty and illness.[157] Rural residents face a doubled challenge as illness is met with limited access to care, particularly for mental health. Rural populations have higher rates of chronic disease and infant deaths, but less use of preventative health screening.[158] They have high levels of depression, substance abuse, child abuse, and suicides.[159] Of the areas with a shortage of mental health professionals, 62 percent are in rural areas.[160] It is not surprising, therefore, that rural residents say that the large distance to heath service is a major barrier to receiving care.[161]

Rural residents also may face social barriers to receiving care. Stigmas can be strong in rural areas and social acceptability for seeking mental health care in particular is low. In addition, the close social networks in rural communities may reduce anonymity; one's psychiatrist also may be a fellow school parent or church congregation member.[162] These social impediments devastate health outcomes directly. Evidence suggests that an individual's belief in available social support is a strong, central predictor of positive health outcomes,[163] which aligns with findings linking social capital and overall well-being. In this landscape of diminished health care options and accessibility, nature connection and its many health benefits are particularly positioned as a much-needed source of well-being.

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[156]Washington State Department of Health, 2017
[157]Smalley & Rainer, 2012; Weber, Duncan, & Whitener, 2002
[158]Coburn & Bolda, 1999
[159]Eberhardt and Pamuk, 2004; Smalley et al, 2010
[160]U.S. Department of Health and Human Services, 2017
[161]Robinson et al., 2012
[162]Larsen et al, 2012
[163]Hinds & Moyer, 1997

THE NEXUS OF ENVIRONMENTAL AND HUMAN HEALTH | 4

This is a critical time for environmental stewardship and conscientious land-use decisions that affect both human and wildlife health in Washington. The state's iconic forest-clad mountains and system of rivers and lakes create habitats that support an array of wildlife from the trout of the Cascades to the orcas along the Pacific Coast. However, Washington Department of Fish and Wildlife lists dozens of species in danger[164] of extinction. Humpback whales, grizzly bears, lynxes, northern spotted owls, skippers, and salmon are just a few of those in need of protection and recovery. The state's wildlife is also endangered by diseases like chronic wasting disease and avian influenza, and by changing habitats due to land use and climate pressures. As evidence builds for the interconnectedness of human health and that of the greater ecosystem, the present time is crucial for decisions that affect human and wildlife health in Washington. Policies that increase and expand the use of Washington's trails can start the cycle of sense of place, nature connectedness, health benefits, environmental stewardship, and greater well-being for humans and wildlife alike.

4.1 | ECOSYSTEM HEALTH AND HUMAN HEALTH: A SYMBIOSIS

The traditional definition of ecosystem services was interpreted largely to include only the material goods that natural environments provide people, such as clean water and food.[165] A more comprehensive valuation of ecosystem services now incorporates health services, such as physical and psychological benefits.[166] Some have argued that the traditional definition of ecosystem services is biased too heavily towards the use of nature for human benefit, which contradicts the harmony urged by so many. However, scholarship in the intersections of biodiversity and human health has contributed to an understanding of a more symbiotic system where the health of human or nature reciprocates to the health of the other.

HUMAN HEALTH MODELS INCORPORATE ECOSYSTEM HEALTH

Models of human health increasingly are including the health of the wider ecosystem. As humans proliferated and encroached on wildlife habitats, people were concerned about the transmission of disease. What began in the 1800s as a limited recognition of shared disease processes has expanded into biodiversity, which reveals that the flourishing of life (both human and wildlife) is at the crux of human health. Endorsement by government agencies has normalized this connection. The Centers for Disease Control proffers "One Health"–an approach to public health that recognizes that the health of people is connected to the health of

[164]Washington Department of Fish and Wildlife, 2019

[165]MA, 2005
[166]Bratman et al., 2012

animals and the health of the environment.[167] The section below discusses a key metric of human health: biodiversity.

BIODIVERSITY AND HUMAN HEALTH

Biodiversity is described as the variety of life within ecosystems.[168] It plays a large role in ecosystem health[169] and ecosystem services, such as human health. Loss of biodiversity can be catastrophic for human health because unstable ecosystems stymie the flow of materials through ecosystems and ultimately diminish the services, such as clean water, that are provided. Compromised ecosystems also may promote outbreaks of infectious disease and reduced protection from natural disasters.[170]

Although evidence for a direct link between biodiversity and human health is limited, studies suggest that contact with biodiverse environments improve human well-being. Researchers[171] investigated the psychological health outcomes in relation to biodiversity exposure; greater biodiversity (most notably the richness of plant and bird species) enhanced psychological health benefits. In addition, respondents' perceptions of biodiversity aligned with objectively measured levels of biodiversity, suggesting people are indeed sensitive to ambient species richness. A cross-sectional assessment of data from the 2011 Census across Great Britain found increased good health prevalence in areas with rich bird species diversity (an indicator of local biodiversity), even after adjusting for socioeconomic deprivation and rurality.[172] For aquatic biodiversity, an experimental study observed lower heart rates and higher self-reported mood in participants who saw greater fish diversity in aquariums.[173] The findings suggest that fish diversity can positively impact both physiological measurements and perceived assessments of health. While the collection of evidence on the direct links between biodiversity and human health is limited, healthy ecosystems and greater biodiversity should be objectives in models for human health.

[167]Centers for Disease Control and Prevention, 2019
[168]United Nations, 1992
[169]Mace, Norris, & Fitter, 2012
[170]Díaz, Fargione, Chapin, & Tilman, 2006; World Health Organization, 2015
[171]Fuller et al., 2007
[172]Wheeler et al., 2015
[173]Cracknell, White, Pahl, Nichols, & Depledge, 2016

FUTURE DIRECTION | 5

5.1 | NEXT STEPS IN RESEARCH

Although scientists have accumulated evidence pointing to a broad range of health benefits, many agree that the variability in methods is a limitation that should be addressed with future research. By converging on exposure and outcomes assessment methods, results can be further compared to create clearer pictures of any underlying relationships. Furthermore, many scholars are calling for the illumination of ways that contact with nature improves human health. Because nature exposure can create multiple avenues of benefits (e.g. improved air quality, encouragement of physical activity, more social bonding, etc.), identifying the pathways will allow decision-makers to tailor policies to target mechanisms. Identifying the underlying causes will require robust study designs, such as longitudinal methods and randomized controlled trials, to build upon the associations found through other methods. While these study designs are often expensive and difficult, such work can greatly extend the understanding of how nature exposure comes to confer benefits.

Much of the research on the availability of green space uses well-established assessments of spatial data, such as satellite imagery, to quantify vegetation land cover. While this provides much-needed information, more studies looking at vegetation specificity, such as the quality or species of trees present, would further the understanding of any nature and health relationships. For example, researchers could better understand if trees that work best for air quality also work best for reducing stress.

Additionally, the effects of nature contact may vary for different groups of people or different space uses. Researchers can expand these areas of knowledge by investigating further how people actually use green spaces, particularly different cultures.

The literature on the health benefits of nature contact is dominated by studies on urban nature and populations. Given the state of health and health care in rural places, more research is needed to investigate if and how rural populations may benefit from nature exposure.

5.2 | POLICY PRIORITIES

Policies should seek to connect children to nature and trail walking, hiking, and cycling activities. Children rely on the adults in their lives as well as programs and policies to experience nature and the resulting health benefits. Washington State launched its No Child Left Inside program in 2008 and awards about $1.5 million in grants every 2 years. There are far more proposed projects than funding available. Washington can further its impact on children's health by enacting policies and comprehensive strategies to connect children to nature through multiple avenues including outdoor education and recreation.

Policies that focus on connecting underserved populations to natural areas are potentially of high impact. The barriers outlined above mentioned several that hinged heavily on individuals' perceptions: safety, park proximity, cultural discrimination, and diversity representation. Policies that enlist a variety of

campaigns to affect perception may be critical for connecting communities to any health benefits. Objective availability of safe, accessible green space also is tied to well-being, so decisions that support the provision of ample, high-quality trails with affordances for popular activities can be powerful drivers of healthy lifestyles. Programs like Trailhead Direct, a pilot project sponsored by King County Department of Natural Resources and Parks, uses city buses to shuttle passengers to popular trailheads, reducing access barriers and potentially increasing sense of personal and traffic safety. Organizations like Outdoor Afro are largely Seattle-based and feature Seattle-area trips. Policies should support the reduction of nature contact barriers across diversity groups and geographical location.

5.3 | HEALTH INEQUITY

Health inequity is pervasive across America, following income, educational, and geographical patterns across populations.[174] People from low income or low educational attainment backgrounds are consistently at greater risk for poor health, largely due to differences in the physical, social, and economic living conditions, as well as differences in behavior tendencies that co-occur in these conditions.[175] For example, American low-income neighborhoods often lack access to fresh foods and supermarkets[176] increasing consumption of unhealthy food (e.g. fast food) and contributing to a higher prevalence of obesity.[177] Another difference in condition includes the inequitable distribution of green space in favor of wealthier, whiter neighborhoods.[178] With less nature contact, people from underprivileged backgrounds are often excluded from receiving the multitude of health benefits received through contact with nature. Policy-makers are positioned to address this issue of environmental and health injustice by investigating how to provide access to nature via trails and other means, to serve populations in need.

Policies for stewardship and protection of the state's wildlife can pay dividends through the provision of health ecosystem services. A well-known quotation from environmentalist Baba Dioum says the following:

"In the end we will conserve only what we love; we will love only what we understand; and we will understand only what we are taught."

To create a heritage and tradition that protects nature, Washingtonians must be taught environmental literacy and lifelong stewardship of natural resources and wildlife.

Policy and land-use decisions in Washington would benefit from the use of impact assessment resources and tools such as the

[174]World Health Organization & UN-Habitat, 2010
[175]World Health Organization, 2008a
[176]USDA, 2009
[177]Cannuscio & Glanz, 2011; Lovasi, Hutson, Guerra, & Neckerman, 2009
[178]Dai, 2011; Gobster, 2002

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Health Impact Assessment, which, in conjunction with local government agencies, systematically examines the potential effects of policies and projects on the health of a population[179] and helps guide stages of project development from stakeholder outreach to design. Health Impact Assessments have been used commonly in Europe but relatively recently, and sparingly in the United States.[180] The assessment toolkits specific to park and trail projects such as Parks and Trails Health Impact Assessment[181] and Studying Trail Enhancement Plans[182] exist to help weigh project decisions to consider such impacts as mental health, safety, inclusive access, and physical activity.

[179]European Centre for Health Policy, 1999
[180]Davis, Cruz, & Kozoll, 2014
[181]Centers for Disease Control and Prevention, 2019
[182]Davis et al., 2014

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