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Improving Human Health by Increasing Access to Natural Areas: Opportunities and Risks

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YALE PROGRAM ON STRATEGIES FOR THE FUTURE OF CONSERVATION

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Report of the 2013 Berkley Workshop

Held at the Pocantico Center of the Rockefeller Brothers Fund, Tarrytown, NY
July 2013

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Introduction

Bradford S. Gentry
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The United States spends more per capita on health care than any other country – and the amount keeps increasing. Access to natural areas offers considerable benefits to human health, as well as possible risks. Capturing these benefits while mitigating any risks is critical to both controlling health care costs, as well as to stewarding (and acquiring) conserved land over time. As a result, more efforts are underway to use conservation to deliver better health results and to manage any risks that might accompany those efforts.

The purposes of the 2013 Berkley Workshop were to:

- Review what is known about the connections between land conservation and public health;
- Describe some of the examples where land conservation efforts are being used to help deliver improved health outcomes; and
- Explore new ways to generate even more such efforts across the U.S.

Since considerable attention is already being given to topics such as exercise and obesity or access to healthy, local food, this workshop focused primarily on the following topics:

- The opportunities to improve the mental and physical health of adults (including veterans or others facing high stress situations) by expanding their access to natural areas
- The impact on children's cognitive development of access to greenspace, as well as its implications for educational programs
- The benefits and risks to human health that may be posed by more natural, recently restored or more fragmented landscapes, particularly in the face of climate change
- The possibility of offering improved access to health care as an incentive for more sustainable management of working lands

Participants were drawn from a range of backgrounds across the U.S., including conservation leaders, researchers, health professionals and others (see list below). Background materials

were developed by Yale graduate researchers in collaboration with participants. The workshop offered opportunities for both facilitated exchanges of experiences and ideas, as well as free time for informal discussions exploring possible new ways forward. The results of the workshop are published by the Yale School of Forestry & Environmental Studies as part of the on-going Berkley Workshop series at http://environment.yale.edu/publication-series/land_use_and_environmental_planning/. The workshop was made possible by the generous support of donors to the Berkley Program on Strategies for the Future of Conservation. As is the case with all materials resulting from meetings held at The Pocantico Center, the views expressed in this report are not necessarily those of the Rockefeller Brothers Fund, its trustees, or its staff.

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Workshop Summary

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Themes from the Discussion

Both the health and conservation communities are in periods of transformational change. The need to improve human health, while reducing costs and increasing access, is leading health care organizations "upstream" toward more preventive and community-based measures. At the same time, the need to expand the value of conserved land to a wider range of people is pushing conservation organizations toward incorporating their lands into broader efforts to build healthy communities.

The purpose of the 2013 Berkley Workshop was to explore some of these growing interconnections and to identify ways that the participants and others might help take them even further. The following areas were identified as among the most promising for work in the future:

- Focus on creating a healthy future, not just better health care;
- Reframe land trust missions to make improving health a core goal;
- Extend the research being done on the connections between access to nature and improved health;
- Disseminate both the research results and the practical lessons learned in this area to key actors through credible channels;
- Expand regional efforts around both research and action on these opportunities; and
- Connect networks of networks across the wide range of actors from the conservation, health, and related communities.

"Rising health care costs constitute a national crisis. The Affordable Care Act, by focusing national attention on prevention, offers a timely opportunity to bend the cost curve down. How can we prevent illness, and reduce health care costs, through 'upstream' interventions? How do we document the benefits of nature contact in this regard?"

– Howard Frumkin, University of Washington

The purpose of this summary is to highlight some of the major themes that ran through the discussions. More detailed write-ups of the specific topics covered are contained in the Sections that follow below – each of which contains a chapter of the background paper that was distributed prior to the workshop, as well as some of the additional examples and sources of information provided by the participants during the meeting.

Where and how do we start to explore these connections?

As the participants discussed the connections between human health and access to nature, they appeared to be building on a number of foundational assumptions:

- Humans have always had a love/hate relationship with nature – both dependent on, but fearful of it.
- Widespread destruction of natural habitats in the pursuit of economic growth and in the name of progress has resulted in many major, negative health consequences, for people and the environment.
- Epidemics of infectious diseases – solved in the past through public infrastructure to manage drinking water, garbage pickup and sanitary sewers – have been replaced by new epidemics of chronic diseases – obesity, diabetes, heart disease, and cancer.
- Infrastructure that promotes outdoor activity and accessible nature may well be part of the answer.
- Humans should invest in protecting, restoring and managing natural areas for many different reasons – including improving human health, while reducing costs and increasing access.

Who are the major players in both health and in conservation?

Capturing the opportunities to improve public health through improved access to nature, as well as managing the risks, requires recognition of the wide range of interests and groups involved in both the health and conservation arenas. Doing so will inform both an understanding of their needs/incentives, as well as strategies for influencing them.

On the health side, this includes a wide range of parties, such as:

- Individual patients: for many of whom drugs and technology represent progress; while appeals to nature are seen as primitive steps backwards.
- Health professionals: who will want to be sure that access to nature is effective and safe before changing their standard treatment practices.
- Hospitals: which are engaging more widely in the communities in which they work as part of their efforts to improve quality, increase access and reduce overall costs.
- Insurers: as they try to reduce health-care costs through their standards for reimbursements and support for community-based prevention programs.
- Employers: as they explore ways to improve the health of their employees and manage the costs of doing so.
- Policy makers: as they conduct cost benefit analyses and develop policy interventions around the best suite of incentives and behaviors for improving public health at the lowest cost.

- Health foundations: as they consider how grant-making and investment might best be coordinated for the greatest impact.
- Public health authorities and advocacy/research groups: as they work to overcome systemic health disparities (often in communities with little access to nature) and expanding health crises.
- Community planners/developers: as they seek to promote development in ways that both restore/protect critical natural resources and make those natural resources accessible to those living or working in those communities.

For each of these actors in the health sector, a number of different questions are important to understand better, including:

- What incentives affect how they do their work?
- To what information do they respond?
    - That based on: science? morals? business cases? broader public welfare?
    - Delivered through what channels and by whom?

Gathering this information across the variety of actors in the health sector will enhance efforts to identify overlapping areas of interests and pathways of influence as the opportunities and risks of improving human health through access to nature are explored further.

What are the social determinants of health?

According to the World Health Organization, the "social determinants of health are the circumstances in which people are born, grow up, live, work and age, and the systems put in place to deal with illness. These circumstances are in turn shaped by a wider set of forces: economics, social policies, and politics."

For more information see: http://www.who.int/social_determinants/thecommission/finalreport/key_concepts/en/index.html

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Presenting a similar segmentation of organizations involved in land conservation seems useful, as they do not all face the same institutional imperatives. For example:

- Public park agencies are subject to public funding processes – thereby requiring continual efforts to prove their value in the often short-term political domain.
- Water utilities protect large swaths of land as a means of reducing their capital and operating costs – subject to regulatory and pricing oversight.
- Private land trusts were set up to respond to threats of development by acting quickly to acquire interests in land of high conservation value – in order to protect that land in perpetuity, they now need to demonstrate continuing value to the communities in which the land is located.

- Public regulatory agencies oversee land development in many parts of the US – and vary in the extent to which those regulatory controls incentivize development, restoration or protection of natural areas.
- Environmental advocacy groups often focus on stopping particular development projects or supporting the adoption of land use regulations that slow development – rather than on supporting investments in "healthy" communities.
- Conservation funders, like those in the health community, are constantly seeking to lever their grant-making and investments in ways that deliver the greatest conservation values.
- Owners of working lands (such as forests or farms/ranches) are seeking new income streams from the stewardship of their holdings over time.
- Conservation developers are looking to combine attractive natural surroundings with attractive, healthy residences.
- Policymakers at the local, state and national level are facing a host of choices as they seek to increase the overall benefits to society from public lands and conservation funding.

How might this variety of conservation organizations best work with the variety of actors in the health community to help improve human health by improving access to and time in natural areas? The participants' answers to this question offered both top-down and bottom-up approaches.

On the one hand, there was support for developing a shared, overarching vision for what was hoped to be achieved. Such a vision could then be used to help coordinate and measure success across a wide range of efforts. The last section of this summary describes some of the participants' thinking on what such an overarching vision might include.

At the same time, there are a lot of exciting, bottom-up initiatives already underway – which need to be supported. Such efforts also offer opportunities for harvesting lessons learned and using them to help spur an even greater number of such efforts across even more communities.

"In the UK, we had plenty of good science but no policy support. Our strategy was *grassroots with ambition*. Start at the community level and expand upward."

– William Bird, Intelligent Health

Some of the efforts to bring health and conservation actors together at the regional level (such as in the Pacific Northwest, Maine or Connecticut) may offer examples of ways to combine these top-down and bottom-up approaches. More attention should be paid in the future to documenting and sharing this work across regions.

What are the potential health benefits of increasing access to nature?

There are many different connections to be made between health and land conservation, including many that were not directly covered in this workshop, such as:

- Preserving access to clean water – the number one reason people vote in favor of local ballot measures to fund land conservation programs.
- Reducing obesity and related diseases through outdoor exercise – a huge driver of investments in trails and park areas (see Section 6 below).
- Increasing access to local, healthy food through the expansion of urban agriculture (farms and gardens) and/or regional processing and distribution networks connecting local farms to urban communities.
- Mitigating urban flooding by increasing natural areas for receiving and retaining stormwater.
- Reducing air pollution and respiratory diseases by increasing urban tree/vegetation cover or improving on-farm practices.
- Reducing climate stresses to communities through natural vegetation effects – mitigating heat islands and offsetting rising temperatures in hot weather, while providing shelter from wind in cold.
- Strengthening communities by creating a sense of place and fostering social connections among residents.
- Capturing the co-benefits that accompany the creation of parks, trails or other "green infrastructure" in pursuit of any one of these benefits – while then providing the other benefits as well.

For the connections that we did cover – essentially improving the mental health of adults and the cognitive development of children – we heard about the:

- Growing body of research demonstrating the benefits to mental health/development from time spent in nature.
- Growing numbers of organizations working to deliver these benefits in their communities.
- Need to dig into the details of who is deciding what types of mental health or educational programs are worth pursuing and what evidence/stories are convincing to them – so that access to nature can be presented as an effective and attractive option.

Mental health resilience and access to nature

As described in Section 2 below, while great work is being done in the UK to bring increased time in nature into the national health effort, Dr. William Bird (of Intelligent Health, http://www.intelligenthealth.co.uk/) summarized the difficulties they continue to face with the following story:

> "At a recent medical conference, I described the health benefits from time in nature, but gave it the name 'Fitirex' so that people would think it was a medication. At first, they were all excited about this new drug…but the excitement ebbed away when I revealed that it was time spent walking in nature…"

So, as the evidence of these benefits mount, the need to overcome such reactions becomes even more clear. One way to do so might be to tell stories about why the benefits of nature exist – and to do so in ways that people can relate to across the scales of our native habitat, our bodies, our brains and our cells. Such responses also highlight the need to frame the opportunities in different ways for different audiences. As one participant noted:

> "If we just take the angle from the public health lens, we may have limited penetration with hospitals and doctors. If we just take a business or clinical lens, then we might lose the sectors that want the broader vision. We need to be able to do both."

While our technologies and societies have changed dramatically in the past few centuries, our bodies are still those of a hunter-gatherer. As such, we need healthy, natural places in which to live.

"Every zookeeper knows that great habitat is essential for animals, and the metric of success is obvious: thriving animal populations. But we rarely think about healthy human habitats in that same way. We are seeing substantial increases in a range of ailments: obesity; asthma; neurobehavioral disorders; autoimmune diseases; reproductive disorders; car crashes; depression. Can healthy human habitats, including nature contact, be part of the solution?"

– Howard Frumkin, University of Washington

Dr. Bird noted that evidence shows people need the following in order to thrive:

- To live in a place that is healthy or supports healthy choices,
- With groups of people that we trust,
- For and with whom we serve a purpose.

Our individual health diminishes if we lose any of these three factors – including a healthy habitat. While some efforts have been made to define the key factors in creating such a healthy habitat for humans, more work should be done to catalogue and disseminate those findings.

At the level of our brains, we need to recharge our mental energy by offsetting the time we spend devoting "direct attention" to our work by spending time on activities with a high degree of "indirect attention." The fascination that comes from relaxing in nature has been shown to be a good source of indirect attention and, hence, a site of replenishment for "direct attention" (Kaplan, 1995, Berto, 2005 – cited in Section 2 below).

At the cellular level, chronic stress, obesity and inactivity all cause damage to our mitochondria by increasing the production of free radicals that eventually result in cellular damage and increased inflammation, which is a trigger to many Western diseases of concern – such as diabetes, cardiovascular disease and Alzheimer's. Being active in a natural environment (so called "Green Exercise") reduces stress and increases activity in a manner that can reduce this damage (Moylana et al., 2013 – cited in Section 2 below).

Not only is this an attractive, accessible way to tell the story of the health benefits of time spent in nature – from healthy habitats, to the health of our bodies, our brains and our cells – there is much anecdotal evidence and a growing number of smaller studies to support these conclusions.

Unfortunately, there has been relatively little uptake of this information by the "traditional" medical or health communities in the U.S. This raises a number of questions:

- How might we aggregate the information being collected across these decentralized research and application efforts? Would it be worthwhile to develop a standard protocol/"science in a box" like package for use by members of coordinated networks of actors?
- How should the findings of this research best be presented so as to enhance its uptake within and use by medical audiences? What are the key data types, methods of collection and channels of communication that need to be used?
- What new approaches to research on the health benefits of time in nature – such as those using clinical trials and randomized sampling to focus on systems, doses and responses – should we be using to increase the credibility of the findings within the medical community?
- Should we be applying the same standard of proof to time in nature as a treatment method that we require for pharmaceuticals and other therapeutic methods – given the apparently small down-side risks and large co-benefits?

The discussion then moved from research on nature and mental health to how one might attract more people into nature – particularly from communities that are not known for spending large amounts of time in the woods.

We were fortunate to have Rue Mapp, the founder of Outdoor Afro (http://www.outdoorafro.com/ – see description in Section 2 below), with us to talk about her efforts to (re)connect more African-Americans to the land. While Ms. Mapp enjoyed a childhood spent in the outdoors at her family's ranch, such has not been the case for a large proportion of African-Americans. Many families were disconnected from their traditional lands when their parents or grandparents moved to the cities. The memories of violence committed against African-Americans in rural areas are also strong and widespread. Finally, even if an African-American family chooses to go to a national park today, they are not likely to see many people who look like them among the other visitors.

In response, Outdoor Afro focuses on connecting its members to "nearby nature." Instead of getting on a bus to travel somewhere else to nature, urban hikes to farmers' markets are organized among the members. Such easy, accessible, repeatable and enjoyable experiences build connections among the members and with the land, thereby creating opportunities to branch out even further.

Ambassador Landscapes - A New Mission For Preserved Lands

"Given the long-term nature of conservation, many land trusts are now re-thinking how some of their nature preserves could become more people-focused," Judy Anderson, Community Conservation Consultant and a participant in the workshop, noted. Such lands may become "Ambassador Landscapes," a phrase Anderson coined to describe a preserved area that is "very different from a traditional, or typical, nature preserve" in its mission. These landscapes, "from as small as a ¼ acre to hundreds of acres," are designed "to bring the joy of the out-of-doors and natural or agricultural landscapes to life in a way that is meaningful" to users.

"Ambassador Landscapes' have important work to do," Anderson says, "to instill a comfort for, and connection with, the landscape over generations."

Such experiences do raise questions about who do the parks "belong to"? What roles did neighbors have in creating or designing the park? Does it offer activities that are attractive and accessible to local residents? If not, is the park more likely to go "feral" and become a site feared – rather than used – by surrounding populations?

If the success of these ventures comes from building relationships with nature and each other, is there any way to help many more such relationships spring up in a decentralized process? Might "relationships in a box" be offered to help interested groups develop their own activities? This might draw from the work of groups like Outdoor Afro or the Children and Nature Network and its "family nature club" model (http://www.childrenandnature.org/directory/clubs/). Other communities with deep ties to land – Native American? New immigrants from agricultural or mountainous areas? – might also be valuable partners in these efforts.

Land trusts seem particularly well suited for helping to make these connections, given their roots in local communities. They will, however, need to shift their focus from solely acquiring interests in land to also building culturally-attractive pathways into nature for members of the surrounding communities. This may well be an effective theme around which to build their stewardship programs over time. Additionally, they might be in the position to sponsor local groups to support the renovation of local parks, improving facilities or offering richer programing and enhanced security in the process.

"Jim Fixx's book, The Art of Running, helped to create the running culture we now see in much of the U.S. We need similar books to help make spending time in nature a popular lifestyle choice across communities and cultures."

– Robert Ogilvie, ChangeLab Solutions

Children's cognitive development and access to nature

A similar storyline exists on the connections between children's cognitive development and access to nature:

- A growing body of research demonstrates the benefits; and
- Many schools are incorporating time in nature into programs for their students.

On the research side, it was noted that there are over 200 abstracts of studies showing these connections on the website of the Children and Nature Network (http://www.childrenandnature.org/ – see also Section 3 below). According to Dr. Ming Kuo from the Landscape and Human Health Laboratory at the University of Illinois (http://lhhl.illinois.edu/index.htm) this research includes findings such as the following:

- Children's' academic performance improved with more access to greenspace in the Chicago public schools, with the most powerful beneficial effects on children at risk;
- In the Netherlands, proximity to parks was connected to improvements in test scores – raising the possibility of understanding dose/response effects; and
- For children with ADHD, walks in green areas have been found to have similar effects as a dose of Ritalin – and parents are reporting that they notice the difference.

"Can we now say that a 20 minute walk in nature has the same effects on ADHD as a dose of Ritalin? If so, I can get people's attention with that."

- Rand Wentworth, Land Trust Alliance

The gap between the findings of these studies and their use by the medical system, however, poses the question of how might better use of this compelling body of evidence be made? Some of the areas to explore that came out of the discussions included the following:

- How might the researchers doing this work be helped to publish more of their findings more quickly? Might foundations and other donors find ways to help relieve them of other duties so that publications can be finished earlier? Might blogs be used to get initial findings out to interested networks before final academic articles are published?
- How might the various data sets being gathered and used in this work – across schools, cities, regions, countries – best be linked to allow for aggregated analysis and reporting?
- Should this research be shifting to designs that more closely mirror traditional approaches for research on medical treatments – such as clinical trials?
- How best respond to offers from health care groups like Kaiser Permanente to explore indicators of health outcomes – such as proximity to parks – in their enormous data sets?

The potential for analyzing "big data" sets in this arena seems huge – such as combining data on health and academic achievement with spatial proximity to parks and other features. In addition, finding ways to redesign or reframe the results of the research to appeal to the different audiences who might act on it is a critical on-going need.

On the delivery side, many schools are working to incorporate nature more directly into their educational programs. For example, we heard about the work being done by Common Ground in New Haven, CT (http://commongroundct.org/) – see also the description in Section 3 below). The organization offers a nature center, urban farm and small high school at the gateway to an urban park to students, their families, as well as students and teachers from across New Haven.

They have developed a pedagogy that relies heavily on "experiential learning" to convey key academic concepts while developing a connection to the natural world. At the core of their approach is an effort to incorporate nature into their teaching by asking students to:

- Get outside,
- Identify a problem (with some guidance from the teachers),
- And solve it –
- Using techniques learned from the teachers, textbooks and each other.

The hooks they use for attracting students, parents and others to their site include:

- Enhancing the academic performance of their students;
- Offering employment opportunities connected to food production and/or the natural environment for teenagers during the school year and the summer;
- Offering scholarships to help increase the affordability of their programs; and
- Making it "fun" to be outdoors by carefully incorporating unstructured outdoor play into their programs.

"Getting kids outside for the *first time* is hard – getting them out the 2nd time is easier. So we need to get them out once and make it fun."

– William Bird, Intelligent Health

Common Ground has found that food, farming and animal husbandry make effective gateways for kids and their families to use the site. Cooking and eating food immediately after harvesting it from the farm is particularly attractive. Food is also a powerful vehicle for raising issues of social justice in urban environments, as students recognize that the food raised by Common Ground is just one small part of a complex system and set of challenges surrounding access to a healthy diet.

"Public gardens should change their signs from saying 'don't pick the grapes,' to 'pick, eat, save and plant the seeds'."

– Marcie Tyre Berkley, Maine Huts & Trails

Parents and school officials generally have one of two reactions to the role that time outdoors has in their educational programs. Some are completely on board and think it is great. Many others see it as bad, as it takes time out of the classroom where "real learning" occurs. In many of these people's views, time spent with technology is progress, while time spent in nature is a step backwards.

The faculty and staff at Common Ground are trying to reframe this discussion around the question of – "what is the best way for your child to develop the brain that you would want her or him to have?" Access to the studies like those cited above is a huge help in this effort, as is the student body's continued high performance on traditional academic measures of success. The continuing efforts to digitize even more learning appear to raise both concerns and opportunities. If they mean that children will spend more time at desks indoors, that compounds the problem still further. If they offer new ways for children to enjoy their time in nature, say through games, they could be a major boost to efforts to get children outside.

Fortunately, land trusts and other conservation organizations have been and are doing even more with such programs in and near cities, such as the:

- Weekly "mud clubs" offered to four year olds by local land trusts.
- Efforts of the U.S. Fish and Wildlife Service to develop urban refuges for use by surrounding communities.
- Offer by the Warm Springs Tribe in Oregon to provide connections to the land to immigrant populations in the cities.
- Development of "unplug summer camps" for adults – and the opportunity to see the traditional summer camps for kids in a newly attractive light.
- Incorporation of technology into time in nature, such as through "geocaching" (http://www.geocaching.com/) and other activities.

All of these mean that there are many partnership opportunities available for groups who would like to promote the development of healthy brains in children by connecting them more regularly to natural areas.

Understanding and managing the risks from nature

At the same time, many people fear nature – whether they "should" or not. Workshop discussions included two perspectives on this question – one from the urban ecology research community and one from the management activities of the National Park Service.

"As Woody Allen said, 'I am at two with nature.' Just as with medications, people vary in their responses to nature. How much do we need to know about the benefits – and risks – of nature before we can more fully incorporate it into health practices?"

– Howard Frumkin, University of Washington

On the research side, we heard from Dr. Shannon LaDeau at the Cary Institute of Ecosystem Studies (http://www.caryinstitute.org/, see also the discussion in Section 4 below) about her work on the links between the ecology of disease and the greenspace restoration efforts in Baltimore. These links build from both the:

- Long-Term Ecological Research effort that has been underway in Baltimore for many years (http://www.beslter.org/frame4-page_3h_06.html), as well as the
- Decision by the City that a greener Baltimore is a more attractive Baltimore for the types of employers and employees they are seeking to have relocate there as part of their economic redevelopment efforts (http://www.baltimoresustainability.org/).

Dr. LaDeau noted that there is a growing body of scientific evidence that shows that, while there certainly are health risks associated with nature, they are usually outweighed by the health benefits (including those described above). It does appear that the risks of arthropod-borne diseases – Lyme Disease, Dengue Fever, West Nile, others – are on the rise as a result of spreading invasive species, climate change and the abandonment of urban areas (such as in parts of Baltimore) in the U.S. Since these vector-borne diseases are spread by insects and ticks interacting with both animals and humans, the risks are often the worst where there is the greatest mixing of people and animals – i.e., in the suburbs.

Dr. LaDeau reported, however, that many of the neighborhoods in which they are working in Baltimore are not supportive of efforts to restore natural areas. For example, many community members oppose planting more trees because they are seen as bringing more mosquitos, trash and criminals. Similarly, installing retention ponds or other green infrastructure to retain stormwater is also associated with more mosquitoes and trash dumping as well.

Both logic and emotion are involved in these concerns. For example, even if the "actual" risks from planting trees or installing green infrastructure are low (for reasons related to insect behavior, project design, management or other factors), the "perceived" risks can be quite high – particularly if they are unfamiliar and involuntarily imposed. This means that while comparative risk analyses need to be done, residents' concerns need to be addressed with information they can relate to, provided by people they trust.

"If you don't have a pet, you are likely to be frightened of dogs. If you are not spending time in nature, you are likely to be afraid of it."

– William Bird, Intelligent Health

On the management side, we learned that the National Park Service (NPS) is one of the few organizations in the U.S. currently working to incorporate both health and conservation values into its central mission. Through the *Healthy Parks, Healthy People US* initiative (http://www.nps.gov/public_health/hp/hphp.htm) the NPS is "working to reintegrate human, environmental and ecological health into the mission of public parks and public lands."

Dr. David Wong, chief of the Epidemiology Branch at the NPS, then discussed their approach to managing these sometimes conflicting goals.

The first step is to prevent health issues from arising by reducing visitor exposure to health risks. Monitoring and surveillance is a huge part of this effort, both by the NPS itself, as well as in partnership with state and local health officials.

Such monitoring goes beyond human health to include environmental factors – such as numbers of snakes or numbers of snakes biting domestic animals – as indicators of possible elevated risks to humans. Integrated dashboards are being developed across different datasets established by these collaborating institutions to help managers identify areas of possible threat. Developers of these dashboards envision that when a vet reports a dog being treated for a snake-bite in one county, nearby park managers and doctors will have access to that alert. Efforts are also underway to establish baselines for both patterns of park use, as well as the likely effects of a changing climate (such as mosquitos in the Everglades), so that changes can be tracked and used to predict new risks over time.

Based on the information collected, a wide range of management actions can be taken – from closures, to warnings, educational materials and programs. One new area of experimentation is to have interpretative rangers include more information on the history of health issues in and around the park as part of their tours – such as in the national historical park in the industrial city of Lowell, MA (http://www.nps.gov/lowe/index.htm).

In addition, targeted, efficient interventions – such as in building design or limited pesticide applications – can be used to help reduce identified risks. More broadly, efforts are underway to improve the healthy food options available as part of the effort to promote the public's health while visiting the national parks.

Even with such preventative efforts, outbreaks of diseases will still occur. In those situations, the NPS has rapid response mechanisms in place, again working with state and local health officials.

It was not clear to the participants whether many land trusts faced similar issues in their efforts to bring more people onto their lands or, if they did, how they were responding. Fortunately, the NPS is happy to share the lessons from their work with land trusts as they develop their own educational programs or risk management plans.

Linking incentives to conserve land to access to improved health care

In addition to considering the health benefits and risks of connecting people to nature, one of the new ways that protecting nature is being used to help fund access to better health care was also discussed.

As described in more detail in Section 5 below, the participants heard about the Pinchot Institute's effort to offer forest landowners expanded health care coverage by monetizing the carbon stored in their trees. This effort grew out of surveys of landowners and their children in the Pacific Northwest. Among the most striking results were the likely impacts of health care costs on the owners' ability to pass the forest to their children. In many cases, there was a real fear that the forest would have to be sold for development to pay the expected costs of caring for aging parents.

In response to this projected risk, the Pinchot Institute is offering an "ATreeM card" (http://www.pinchot.org/news/451) to help cover health care costs to forest landowners. The money available through the card comes from helping the landowner tap the markets for forest carbon – in which emitters of greenhouse gasses pay owners of forestland to manage their forests to store more carbon than they would otherwise. The proceeds from such sales are then transferred to the ATreeM card account and can be used to offset specified categories of health expenses.

Some of these emitters are in the health care industry. Market research suggests that they find the link between the amounts paid to store carbon and the use of those proceeds for health services attractive. The Pinchot Institute points to a variety of other potential benefits as well, including possibly keeping the landowners healthier for longer by keeping them engaged with their forests and by avoiding the carbon emissions that would occur should the forest be sold and cut down for development.

The success of this model depends on outside sources of funding (in this case, carbon credit buyers) "purchasing" the conservation value of the land in return for access to expanded health coverage. Under this model, markets for "ecosystem services" other than carbon storage – wetlands, endangered species, water quality, etc. – might also be tapped. More traditional sources of conservation funding – donations from individuals or foundations, public grants/loans – might also be used to engage landowners who are not yet ready to sell or permanently transfer rights. New funding from the health system around preventive programs might also be accessed to help promote healthier landowners, cleaner water and air, as well as the other health benefits of natural areas.

These efforts are one example of the work being done to explore new ways to connect land conservation and human health. Instead of just focusing on acquiring interests in land, might land trusts and other conservation organizations help create incentives for the more sustainable management of working forests and farms by investing in improved access to health care? More such efforts should be encouraged as these possible connections are explored more widely.

What are the critical next steps for making access to nature a key part of efforts to improve health?

After these wide-ranging discussions on just some of the connections between health and access to nature, participants broke into four small groups to develop their lists of critical

next steps. While each of the groups developed its own answers, the following broad themes emerged from across their discussions:

- Focus on creating a healthy future, not just better health care: the conservation community should join the health sector in looking upstream to community-based, preventive measures as part of efforts to build a healthier future.
- Reframe land trust missions to make promoting health a core goal: as part of both acquisition and stewardship activities, thereby enhancing their continuing relevance to the communities in which they work.
- Extend the research being done on the connections between access to nature and improved health: in both quantity and form, so that it can be even more readily used by health and conservation organizations.
- Disseminate both the research results and the practical lessons learned to key actors through credible channels: translate the results of both research and action into the language of the intended audiences and deliver it through messengers they trust.
- Expand regional efforts around both research and action: involve as wide an array of partners as best fits the local context.
- Connect networks of networks across the wide range of actors from both the conservation and health sectors: use existing networks to increase the sharing of information and the development of new projects across the huge number of actors in the health and conservation fields.

In considering these areas for possible further work, no effort was made to negotiate an agreed set of tasks for the group as a whole. Rather, the participants were asked to describe at least one action they were planning to take based on the workshop discussions. This list may be seen as a working menu of possible actions by participants and others interested in deepening these connections.

Using the broad themes described above as an organizing structure, this menu of possible actions suggested by the participants included the following (in no particular order):

- Focus on a healthy future:
    - Ensure that access to natural areas is reflected in the work by health institutions on building healthy communities.
    - Join with local hospitals to include time in/access to nature as part of their Community Health Needs Assessment under the Affordable Care Act.
    - Offer an attractive "nature rich future" as an alternative to the "dystopic"/"post-apocalyptic" stories that appeal to so many young adults today.

"Convinced that children, since they are an inalienable part of nature, not only have the right to a healthy environment, but also to a connection with nature and to the gifts of nature for their physical and psychological health and ability to learn and create…" the World Conservation Congress "[e]ndorses the child's right to nature and a healthy environment."

- Declaration of The World Conservation Congress, at its session in Jeju, Republic of Korea, 6–15 September 2012

- Reframe land trust missions:
    - Encourage land trusts to also work where people are, not just where they are not.
    - Encourage land trusts to be robust members of their communities, actively helping to improve access to food, education, health and jobs.
    - Highlight the accessibility to and use of land trust land by members of their neighboring communities.
    - Support efforts to inventory and make available lists of publicly accessible natural areas across the country.
    - Add more medical/health professionals to land trust boards.
    - Provide to health organizations the data being collected on proximity to parks by groups such as the Trust for Public Land.
    - Use their influence in Congress to seek additional NIH funding for this line of research.
    - Explore a new type of easement – possibly called a Public Health Easement – that ensures access to green space, local food and other public health benefits.
    - Encourage "gamefying nature," such as through walking events/challenges, geocaching competitions and similar activities.

"Long term goal: change infrastructure to get people walking more. Short term goal: grab kids' attention and get them outside."

- Small Working Group

- Extend the research:
    - Replicate the analyses done in Chicago on children's academic performance/attention span using the data available in New Haven and elsewhere.
    - Respond to Kaiser Permanente's request for proposals to run analyses on its health data to search for indicators of improved health related to proximity to/time in nature.
    - Determine who does and does not have a walking route under 0.5 of a mile between home and a public park entrance.

- Revisit the basic ecological research being done in Baltimore and elsewhere with an eye on making it more relevant to the greening efforts underway in the City, as well as to broader work on the health implications of access to natural areas.
- Collect more data on the impacts of "greener" school programs and others designed to increase children's time in nature.
- Develop new forms of research to meet even more directly the needs of the medical community.
- Specifically look at the role of access to nature in improving the social determinants of health.

· Disseminate the lessons learned:

- Petition the Environmental Health Roundtable of the Institute of Medicine (http://www.iom.edu/) to do a roundtable on/review of the science linking access to nature and improved health.
- Make the work being done/lessons being learned on managing vector-borne diseases in the National and other parks available to land trusts and other conservation organizations.
- Post more articles and blogs, while encouraging others to do so as well, on the Children and Nature Network's (http://blog.childrenandnature.org/) and other sites.
- Assemble the available data and use it to inform testimony to state legislatures about the importance of supporting the links between improved health and access to natural areas.
- Run innovation labs among graduate students at Yale (environment, management, health, others) and elsewhere to generate new ideas for strengthening these connections still further.
- Have leaders in the public health and land trust arenas jointly prepare an editorial for the Journal of the American Medical Association on the importance of these connections.
- Capture opportunities for reflecting the lessons learned in the UK in new medical school curricula being developed in the U.S.
- Bring these concepts into the strategic planning process already underway at foundations focused on improving public health.
- Run for local school boards to help bring these ideas into the local schools.
- Work together to write/edit books on the subject, such as the one underway in response to a request from Oxford University Press.
- Consider having the Land Trust Alliance and the Children and Nature Network jointly hire a health educator to work with land trusts to help them reframe their missions to include public health, as well as to help them communicate with donors and the public around this reframing.

- Focus on developing "natural leaders" – young people trained to form small neighborhood groups of their peers and to lead those groups in outdoor activities.
- Encourage retired folks seeking to remain engaged in "Encore Careers" to serve as mentors for youth and families engaging outdoors.

The "Gray is Green" program of the Natural Resources Defense Council (grayisgreen.org) is an example of an environmental education, advocacy, and action organization for older adults.

- Create more compelling graphical representations and infographics on these connections, such as the "23½ hours" infographic (http://www.youtube.com/watch?v=aUaInS6HIGo).
- Find a land trust/group to work with a local MacDonald's or other restaurants to "green the play space," by including more plants, shade and less plastic.
- Encourage and support the building of community gardens at neighborhood health clinics.
- istribute models for land trusts to use when working to get children out into nature and invest in regional pilot projects – both implementation and evaluation/sharing of lessons learned.
- Encourage the American Academy of Pediatrics to examine the evidence, issue guidelines, publish research and advocate to the Institute of Medicine.
- Be alert to the roles/impacts of power and privilege on access to health care and healthy habitats.
- Advocate for municipal, county and state zoning codes/requirements to include "walk-to" natural spaces and gardens in every school and neighborhood.
- Include access to natural areas in pre-school/headstart program requirements, as well as in elementary and high school curricula.

What might long-term goals look like for these efforts?

1. Parents, teachers, school administrators and government leaders are aware of the connection between nature and health.
2. Doctors, hospitals and public health administrators understand the connection between nature and health.
3. Ensure that every child growing up in America will be within a 10 minute walk of an entrance to a safe and accessible park, trail or public garden.

- Small Working Group

- Expand regional efforts:
    - Gather groups in Maine, the Pacific Northwest, Connecticut and elsewhere to pursue locally effective connections among conservation, health, school, food and related groups' efforts to build healthy, vibrant communities.
    - Focus on a key opportunity for making progress – such as on children's obesity – which holds strong appeal among parents.
    - Do a local pilot project on gaming as a way to increase children's time on trails and in the woods.
    - Explore the expansion of the ATreeM card approach to farm and ranch lands using food production guarantees or other mechanisms as a means for offering better health care to farmers.
    - Connect urban and rural audiences around health and land in Oregon and elsewhere.
    - Catalogue actions underway in Maine so that they can be taken to the Maine Health and Social Services Funders Network to explore collaboration opportunities.
    - Reflect the lessons learned about healthy design in efforts to redesign and rebuild state and municipal parks.
    - Do more wellness walks on conserved land with doctors, nurses, health clinic staff, students and their families.
    - Run a "forest bathing" pilot project in a part of Oregon near a medical school and a Veteran's Affairs hospital.
    - Reflect health co-benefits in efforts to expand the use of "green infrastructure" for water, air quality, temperature reduction and other purposes.
- Connect networks of networks:
    - Inventory and explore ways to connect the work of the many organizations that share overlapping goals in this arena, including the:
        - Children and Nature Network - http://www.childrenandnature.org/
        - One Health Initiative - http://www.onehealthinitiative.com/
        - Convergence Partnerships - http://www.convergencepartnership.org
        - North American Association for Environmental Educators - http://www.naaee.net/
        - Child Left Inside Coalition - http://www.earthday.org/partner/no-child-left-inside-coalition
        - American Academy of Pediatrics - http://www.aap.org/
        - American Planning Association - https://www.planning.org/
        - Centers for Disease Control and Prevention - http://www.cdc.gov/

- Prevention Institute - http://www.preventioninstitute.org/
- Funders Network for Smart Growth - http://www.fundersnetwork.org/
- Smart Growth America - http://www.smartgrowthamerica.org/
- Local food organizations
- Farm Based Education Association - http://www.farmbasededucation.org/
- Community Garden Association - http://www.communitygarden.org/
- Local business organizations, such as Chambers of Commerce, Rotaries, outdoor businesses and others
- Youth service organizations such as the Scouts, YMCA, Boys and Girls Clubs
- National Park Recreation Association - http://www.nrpa.org/
- AARP – particularly its research on walking - http://assets.aarp.org/www.aarp.org_/articles/health/2009_walking_guide_09%5B1%5D.pdf
- Rails to Trails Conservancies - http://www.railstotrails.org/
- Association of Schools of Public Health - http://www.aspph.org/
- Health Insurers, particularly their Wellness Programs
- Urban Land Institute - http://www.uli.org/
- Community foundations
- Community hospitals
- Community economic development organizations
- Transportation Demand Management Programs
- Safe Routes to School Programs - http://www.saferoutesinfo.org/

- Review and promote the Global Impact Investor Network's metrics on the human health outcomes of investments (http://giirs.org/).
- Explore connections with friends from the health or conservation sectors – such as a former head of the American Medical Association who is now a board member of a foundation working on these issues.
- Pursue coordinated strategies across health, education and conservation funders.
- Connect these efforts to build healthy human habitats to grassroots organizations working to improve neighborhoods in their cities.
- Form a coalition of land trusts and health professionals/organizations to influence public policy at the federal, state and local levels.

How to mobilize action across organizations – using the process recommended by Hanley-brown, Kania, & Kramer in the Stanford Social Innovation Review (2012) *Channeling Change*:

1. Start by listening to those in need.
2. Develop a common agenda.
3. Agree on shared measurements.
4. Implement mutually reinforcing activities.
5. Engage in continuous communications.
6. Fund backbone support organizations.

– *Small Working Group*

For more information see: http://www.ssireview.org/blog/entry/channeling_change_making_collective_impact_work

Section 1: Why is This an Important Question Now?

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The United States' healthcare and conservation communities are undergoing massive transformations as new business models are developed in response to financial, political, and other pressures. Given the historical connections between access to natural areas and impacts on human health – both good and bad – now is an appropriate time to review the opportunities for each community to work together to navigate through these turbulent times.

The purpose of this background paper is to give the Workshop participants a common base for conversations and, hopefully, some ideas for new directions. It is intended to provide an "on ramp" for the discussions by reviewing the current state of play in several key areas and identifying both questions and sources of information for further exploration.

1.1 Introduction

Throughout human history, people have both extolled the healthful benefits and feared the harmful dangers of the natural world. Early settlers to the Northeastern United States believed that disease-spreading spirits dwelled in the deep woods, leading the pioneers to shun their region's thick forests. In turn, the ancestors of these colonialists viewed those same woods from a softer perspective, one perhaps enlightened by the onslaught of the industrial revolution and its attending clamor. By the mid-1800's "[a] growing urban population began to embrace the romanticism of nature and sought out beautiful places among the rivers and mountains to relax, recreate, and improve their physical and mental health" (Valkenbergh and Olney). Today, the protection, management, and utilization of natural spaces are increasingly being viewed as an area of public health interest. At the same time, improving public health is a growing opportunity for the land conservation community.

In many regards, the conservation community has already begun to demonstrate the importance of land conservation to the public's health. Efforts to protect forestlands as a source

for clean, inexpensive drinking water have been a popular and well-understood reason for land conservation. This purpose has helped to support the preservation of large tracts of undeveloped land around major urban areas. Cities like Portland, Boston, New York, and Seattle all receive their drinking water from forested landscapes. More recently, many land trusts have begun to take an active role in helping to address the United States' growing obesity and diabetes epidemics through preservation of agricultural lands (for the provision of healthy food) and the protection of undeveloped spaces (to promote physical fitness through active and passive recreation).

While these efforts are critically important, a growing body of research also reveals that human health and open spaces are connected in even broader ways. As the chapters in this background report will document, urban green spaces and more rural natural areas offer a variety of health benefits and risks to different types of communities. Patients recovering from surgery or traumatic events heal faster when exposed to nature (Section 2). Adults focus better after simply looking at pictures of green space (Section 2). And children develop more creativity and better self-control through unstructured play in green spaces (Section 3). Conserved or restored lands and waters can also both reduce and, unfortunately, sometimes facilitate the spread of infectious diseases (Section 4). Improved access to health care is also being explored as an incentive for more sustainable management of working lands (Section 5). Finally, brief descriptions of some of the other connections between land conservation and human health (exercise/obesity; climate change/heat island effects) are provided at the end of the report.

Each day practitioners, scientists, and conservationists are uncovering new connections between land conservation and public health. While the relationships between these two systems are complex and, at times, obscure, they offer professionals within both the conservation community and the health care profession considerable opportunities for constructive collaboration and action.

What follows now is a rough review of some of the major themes governing consideration of human health and land conservation, including reasons why both issues may benefit from simultaneous attention. Threats from a changing climate, the continuing fragmentation of open lands, spreading invasive species, and growing healthcare access inequalities are a few of the major issues that require attention and which would benefit from partnerships between the healthcare and land conservation sectors.

1.2 Environmental Trends and their Potential Impacts on Public Health

The earth's natural systems are being transformed at an unprecedented rate and in manner never before experienced by humans. These changes are happening in such a way and at such a scale that the International Union of Geological Sciences is considering designating our time as a new geologic epoch, the Anthropocene, to reflect the impact that people are having on the planet (Stromberg, 2013). The continued fragmentation of landscapes, the emergence and spread of vector-borne and zoonotic diseases, the effects of non-native organisms, and the impacts of climate change are all influencing the public's health. They are contributing to

a variety of novel human ailments that directly stem from how the environment is managed on the local, regional and even global scales. All these issues require concerted attention.

Climate Change

Climate change may eventually influence all areas where the land conservation community interacts with the healthcare sector. Changes in climate are likely to lead to:

- Increases in infectious diseases;
- Increased heat stress mortality;
- Increased respiratory illness from air pollution;
- Nutrition impacts from changing food availability;
- Increased natural disasters; and ultimately
- Forced migrations of large populations.

Warming and precipitation trends associated with climate change over the last 30 years have already claimed over 150,000 lives a year according to the World Health Organization – and this trend is only expected to worsen (Patz et al., 2005).

Habitat Fragmentation & Infectious Disease

Habitat fragmentation, the loss of undeveloped open space to land-use changes, continues to alter the planet's ecological landscape. Around the world, changes are occurring to forests, farmlands, wetlands and waterways because of human demand for food, fiber, water, and shelter (Foley et al., 2005). Nearly 6,000 acres of open space are lost to "developed uses" every day in the United States (USDA, 2013).

These alterations are not only harmful to biodiversity, the integrity of natural systems, and the character of communities, but also to human health. Not only does development itself increase levels of air and water pollution, there are new findings that land fragmentation by itself may also increase the emergence and outbreak of infectious diseases, largely through the linking of natural and non-natural areas (allowing diseases to "jump" from animals to humans) (Patz et al., 2004) and the creation of habitats conducive to disease vectors like mosquitoes and ticks (Norris, 2004). Land conservation or restoration initiatives have the potential to help reduce fragmentation and some of its associated health risks, as will be discussed more in a later chapter of this paper.

Invasive Species & Altered Landscapes

Non-native organisms are significantly impacting the planet's ecosystems and can, as a consequence, harm human health. Invasive insects in the United States – just one example of many – are currently destroying or altering large forest regions. The spread of the Asian longhorned beetle (*Anoplophora glabripennis*) has led to widespread loss of maple trees in New England, the hemlock woolly adelgid (*Adelges tsugae)* has reduced the complexity of forests in the mid-Atlantic, and a small green beetle known as the emerald ash borer (*Agrilus planipennis*) has killed over 100 million ash trees across the Midwest and Northeast (Donovan et al. 2013).

Such devastation has obvious impacts to local economies, peace of mind, and cultural values that relate to human health. But there may also be direct physical impacts from such invasions as well. A recent study suggests that the loss of ash trees from the ash borer has resulted in a marked increase in human mortality related to cardiovascular and lower-respiratory-tract illness in regions where the insect has proliferated (Donovan et al. 2013). Examination of 18 years of data by Donovan et al. (2013) revealed that Americans "living in areas infested by the emerald ash borer suffered from an additional 15,000 deaths from cardiovascular disease and 6,000 more deaths from lower respiratory disease when compared to uninfected areas" (World Health, 2013, January 25).

More investigation is required to illuminate the mechanisms of these interactions and the other realms in which an explosion of invasive species may lead to degradations in human health. But these early results attest to the role that intact ecosystems can play in supporting or harming health.

1.3 Healthcare Trends Potentially Relevant to Land Conservation

Healthcare is a huge and complex issue, with many important trends and moving targets requiring policy action or concerted attention. Two big trends that may hold tie-ins for the land conservation community are the continuing efforts to:

Stem the rising costs of health care in the United States; and

Address rising inequalities in access to healthcare.

Both conservation organizations and the lands they steward may find room to contribute on both of these fronts.

Cost Control & Chronic Disease

The United States' ever-increasing health care costs are a point of great concern. In 2010, U.S. health care expenditures reached nearly $2.6 trillion - more than ten times the $256 billion that was spent in 1980. This dramatic increase has largely been attributed to three developments:

- The price of technology and prescription drugs has increased;
- Chronic disease rates are on the rise; and
- Administrative costs are and remain high (Kaiser, 2013).

The issue of rising healthcare costs has major implications for individuals and private insurers, as well as for the U.S. government's fiscal health. Along with defense spending, social insurance programs, which include Medicare and Medicaid, are the government's greatest expenses (CBO, 2011).

Estimates by the Center for Disease Control and Prevention (CDC) attribute approximately 75% of all health care expenditures to the treatment of chronic conditions (Kaiser, 2013). Land

conservation may not be able to bring down the costs of prescription drugs or healthcare administration, but it may have something to contribute to future reductions in chronic diseases. Many, though not all, chronic diseases, like obesity and diabetes, are firmly related to lifestyle trends and, as these chapters will discuss, may be improved by access to open spaces.

Access to Care

Today, 6.5% of Americans fail to obtain medical care because of cost and only 86.8% of people have a usual place to visit for care (CDC, 2013). Much of the inequity surrounding these statistics is directly related to the demographic factors of socioeconomic status and geographic location. There is an unequal distribution of providers and places to receive care in both inner city and rural communities. Entitlement programs that primarily assess qualification based on financial status, such as Medicaid, offer some improved access for the nation's poor; however, many people still lack access to care.

While the politics of insurance mandates are controversial, a large portion of the population remains uncovered by any type of health insurance. At the time of the 2011 National Health Interview Survey, 48.2 million people or 18.2% of the population did not have health insurance coverage (CDC, 2012). What is most interesting about this survey is that 7.0% of children under the age of 18 did not have any insurance coverage, while about 53% of the same age had private insurance and 41% had some form of a public plan (CDC 2012).

Though land trusts are unlikely to become direct providers of healthcare, there may well be ways to enlist their support in the quest to expand healthcare across the country. This seems particularly true in the rural regions where need is great and land trusts often act as stewards of the communities in which they work, in addition to being stewards of the land.

New Health Initiatives and Possible Connections with Land Trusts

In an effort to contain health care costs, several novel initiatives have emerged since the Patient Protection and Affordable Care Act was signed into law in 2010. While still in development, these initiatives, to be run through accountable and coordinated care organizations (ACOs and CCOs) offer the potential to improve patient care while making the health care system more efficient and less costly. Additionally, an increased use of Health Impact Assessments (HIA) may offer another way to improve community health while containing expense.

ACOs and CCOs are composed of doctors, hospitals, and other health care providers who voluntarily join together to coordinate care for their patients and the chronically ill. They strive to provide better health outcomes through better management, taking more time to assess real health needs and reducing, for example, unnecessary duplication of medical procedures (CMS, 2013). CCOs, in particular, focus on disease prevention, in addition to helping patients with chronic conditions receive efficient care, by spreading financial responsibilities and risks across patients, health care providers, and community members (OHPB, 2013). The State of Oregon is a big champion of CCOs as part of its ambitious plan to contain Medicaid costs, and to date there are 15 CCOs operating across the state.

Oregon Governor John Kitzhaber spoke to the effects of CCOs on improving health outcomes while reducing costs in an interview for the *New York Times* (April 12, 2013). Kitzhaber uses

an example of an elderly woman who develops congestive heart failure during a heat wave. He points out that under the current system, Medicaid will pay for the ambulance ride and $50,000 of hospital coverage; however, it will not pay for a $200 window air-conditioner that would outright prevent the problem. This type of comprehensive perspective looks beyond traditional medicine to incorporate more of the factors that contribute to costly ailments and conditions.

Land trusts may, by joining these CCO and ACO partnerships, find a way to help contribute to efforts by healthcare funders, municipalities, and patients. Such initiatives could help to expand the effectiveness of cost reduction programs and broaden the concept of what makes a community healthy. The protection and stewardship of open space lands has the potential to better control health care costs by creating communities where the natural environment can help improve overall wellness.

Health Impact Assessments (HIAs) may offer another opportunity to incorporate land conservation efforts into public health initiatives. Widely used in Europe, HIAs are a process that assesses the health impacts of a particular policy, project, or program where health is not the primary objective (Lock, 2000). At times, HIAs are conducted as supplements to environmental impact statements. In this context, the role that open space plays in supporting public health may become a barrier to projects that include poorly planned development. Conversely, land conservation efforts that are associated with mitigating development projects, like habitat banks, can be used to bolster public health benefits as well.

Within the United States, the City of Francisco and the State of Alaska are known for their use of HIAs. The City of San Francisco's widespread use of HIAs provides some unique insights into the effectiveness and benefits of using this type of assessment tool. A review of more than 10 years of HIAs found that the health impact assessment process helped to improve the political conditions for changing public health policy (Bhatia and Corburn, 2011). Researchers reported that:

"Health impact assessments have helped increase public awareness of the determinants of health, routine monitoring of these determinants, cooperation among institutions, health-protective laws and regulations, and organizational networks for health advocacy and accountability" (Bhatia and Corburn, 2011).

The breadth of benefits that HIAs provide offers an opportunity for increased collaboration across various disciplines to achieve improved health care outcomes.

HIA Case Study: Point Thomson, Alaska

In June 2011, a health impact assessment was completed as a supplement to an environmental impact statement for a large oil development project on Alaska's North Slope. As part of ExxonMobil's desire to drill in the Thompson Sand oil reservoir just outside of the Arctic National Wildlife Refuge, an assessment was conducted in order to assess how the project would potentially impact the local environment and the subsistence resources of surrounding communities. The assessment was conducted by the State of Alaska's Department of Health and Social Services with assistance from the Alaska Native Epidemiology Center. Among other factors, social determinants of health, potential exposure to hazardous materials, impacts to water and sanitation, and effects to subsistence food supply and nutrition were all studied.

This project exemplifies the potential that HIAs have as a planning and conservation tool. By comprehensively examining the impacts of proposed development projects, a holistic perspective on subsistence and traditional land use patterns was evaluated (AK DHSS). Such a consideration for the environment's connection to human health allowed for the development to occur in the least impactful way.

For more information see: http://www.epi.alaska.gov/hia/PointThomsonCompletedHIA.pdf

1.4 Opportunities for Collaboration & Action

The rich connections between open space conservation and public health which are explored throughout these background papers offer an opportunity to align many stakeholder groups around a series of common goals. Both land trusts and healthcare professionals have much to gain from novel collaborations. As a result, there is a need to develop new networks and mechanisms to allow for such interdisciplinary work.

Land Trusts

The potential to improve community wellness through the protection and sound management of open space presents the land trust community with many promising opportunities. Traditionally, land trusts have had to spend considerable time and resources recruiting individuals and organizations to assist in their efforts to protect land solely for the "sake of Nature."

In the case of land conservation for the benefit of public health, however, the paradigm begins to shift away from "what individuals can do for conservation" towards "what can conservation do for individuals" and, of course, their communities (Anderson, 2012). This change in thinking has the potential to re-contextualize the role of open space in our society such that all people have more of a personal stake in the conservation and protection of open space lands. With a clear understanding of management goals and the health values that open space provides, land trusts have the potential to significantly grow their constituencies and influence within communities.

Conservation organizations' capacities to achieve their land protection and program goals have also not been fully appreciated by many in the public health field. Many land trusts are more sophisticated, business savvy, and organized than they are perhaps often given credit for. Land trusts have repeatedly proven their ability to raise, leverage, and manage large amounts of money to advance objectives for the public good. The "2010 National Land Trust Census Report" completed by the Land Trust Alliance provides some insights into the significance of land trusts efforts. Since 2000, land trusts have conserved 23 million acres of land and, as of 2010, local, state, and national land trusts were managing $1.6 billion in the form of endowments and designated funds (Chang, 2011). While the scale of these efforts do not compare to the enormity of the United States' health care system, few other civic organizations contribute as much to the public's well-being.

Public Health Professionals & Organizations

C.E.A. Winslow, a formative figure in the field of public health, famously defined the field as:

> "The science and art of preventing disease, prolonging life and promoting health through the organized efforts and informed choices of society, organizations, public and private, communities and individuals" (Winslow, 1920).

Such a definition speaks to the foundational concept of prevention through comprehensive and collaborative efforts. By aligning public health goals with conservation initiatives, land trusts have a unique opportunity to help fill a gap within the public health field. All too often a comprehensive understanding of health issues emerges from academic institutions, but leads to limited action within society. Partnerships between land trusts and public health professionals could produce more accelerated and productive action – the former having strong boots-on-the-ground connections to communities and the latter having the knowledge and tools to assess or improve health.

Co-Benefits

Land conservation for the benefit of human health offers a truly wide breadth of benefits. While the connections between human health and land conservation can be very broad (e.g. the need for biodiversity to study and answer unique biomedical questions), there are numerous ways that land conservation can directly help address an individual's or community's health needs. Some of the most tangible connections surrounding the relationship between open space and human health include:

- Drinking water purification.
- Air pollutant removal.
- Areas to grow healthy food.
- Places for exercise and recreation.
- Temperature extreme mollification.
- Storm surge protection.
- Mental health improvement.

- Support for childhood cognitive development.
- Community and social network creation.

Costs & Funding

The prevention of health problems is considerably cheaper than treating acute ailments or managing chronic conditions. As such, land conservation has the potential to help reduce health care costs through the numerous services and benefits that natural systems provide – particularly in preventing acute conditions, such as those resulting from chronic stress and inactivity. In addition to the many reductions in health care costs that open space can provide, undeveloped areas also generate economic savings by providing services like treating storm water and cooling buildings.

The health benefits of access to natural areas and the need to manage any health problems arising from the outdoors has the potential to leverage novel sources of funding. The demand for healthy, local food is a prime example of how changing public desires have led to increased sources of state, federal, and private funding for small farming operations. By using an ever-growing body of research and a clearly articulated message, land trusts and public health professionals can work together to secure new sources of funding from government agencies and foundations.

Walk for Wellness: Wildlands Conservancy, Pennsylvania

The Walk for Wellness program is a prime example of a land conservation organization working to promote public health benefits from access to its properties. On their website the Wildlands Conservancy writes: "The Walk for Wellness program was created to encourage and facilitate walking for its beneficial, restorative effects. Walking has been shown to be the easiest and healthiest physical activity in which most people can engage. It benefits our mind and our body - wellness for the heart and soul!" To date, the organization has created a series of maps for 55 of the best hiking trails in the Lehigh Valley.

For more information see: http://wildlandspa.org

1.5 Conclusion

Author E.B. White once wrote: "I would feel more optimistic about a bright future for man if he spent less time proving that he can outwit Nature and more time tasting her sweetness and respecting her seniority" (Lloyd Albert, 2004).

The need for collaboration between land trusts and health care professionals speaks to this point. There is no escaping the fact that people are biological organisms with an innate connection to the natural world. Environmental change, humans' drift from nature, and

challenges with the health care system make this a critical moment in which to expand the purpose of land conservation and the role of natural areas in the pursuit of improved public health. With sound science guiding the way and an emphasis on helping the communities who need it most, great public benefits can be achieved.

1.6 Possible Questions for Discussion

- How can land trust and health care professionals translate research findings linking nature to better health into concrete programs or interventions?
- In what ways can the benefits of open space be better quantified in order to demonstrate conservation's importance to public health?
- What potential issues arise from land trust's involvement in public health? How might these conflicts be mitigated or avoided?
- What policy avenues should be pursued to bridge the gap between land conservation and human health?
- How might land trusts best work with health care funders/providers to achieve their mutual goals?

Some of the Organizations Doing Interesting Work on this Topic

Human Impact Partners - This nonprofit organization provides technical assistance to public agencies and other organizations working on health-based analysis in low-income communities. See: http://www.humanimpact.org/

Harvard Center for Health and the Global Environment – Housed at the Harvard School of Public Health, the Center studies and promotes research on the connection between biodiversity, climate, energy, food and health. The Center also offers educational material for policymakers and students from the kindergarten to graduate school level. See: http://chge.med.harvard.edu/

Nelson Institute, Center for Sustainability and the Global Environment (SAGE) – Located at the University of Wisconsin-Madison, the researchers at this academic hub explore the "connections between natural resources, technology, policy, human health, security, and changes in the global environment." See: http://www.sage.wisc.edu/

Program on Health, Equity, and Sustainability – Staffed by an interdisciplinary team, this program is part of the City of San Francisco's Department of Public Health. The program works to promote healthy environments and social justice within the city.

See: *http://www.sfphes.org/elements/parks-and-green-space*

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1.7 Examples, sources of information and other key points from the discussion

Some of the examples, sources of information and key points from the discussion included the following:

- There are deep historical connections in America between human health and access to nature, including:
    - Galen Clark, the man who discovered the Giant Sequoias of Yosemite Valley and led to their eventual protection, originally moved to the California mountains, like many at the time, to convalesce after contracting tuberculosis.
    - Henry David Thoreau, it was noted at the workshop, had been encouraged to go to Walden Pond, the eventual setting of his most famous transcendentalist work, as a response to deep mental restlessness that we would now classify as depression.
    - Frederick Law Olmstead, America's most treasured landscape architect, designed parks to be spaces of healing for the urban poor and the mentally ill. He believed in "sanitation" through design, and often took commissions to redesign the grounds of mental institutions and hospitals.
- New connections are being made as well:
    - The Los Angeles Neighborhood Land Trust is partnering with a hospital and high school to create a therapeutic garden and health clinic in one of LA's least healthy neighborhoods.
    - The Freshwater Land Trust in Birmingham, AL is working with local health care providers to fund bike and walking trails as part of efforts to reduce community obesity.
    - In Fresno, CA state health funds are being used to create neighborhood gardens to serve the mental health needs of immigrant communities with refugee status. See: http://www.nytimes.com/2013/05/26/us/in-california-gardening-for-mental-health.html?pagewanted=all
    - In Troy, NY local youth work on local farms to make local food available through convenience stores and "veggie mobiles". See http://www.theveggiemobile.blogspot.com/
    - The New Jersey Conservation Foundation has a goal of linking parks, farmland, trails, and historic lands across the Garden State to create an interconnected system of preserved land - these "hubs" can be used to get people outdoors and serve lager fitness, tourism, recreation, and conservation goals.

- The Regional Equity Atlas of the Pacific Northwest's Coalition for a Livable Future (http://clfuture.org/equity-atlas) is taking a geographical look at regional health disparities, linking health outcomes to quality of housing, transportation, airways and access to natural areas.
- Oregon Public Health Institute's Healthy Eating Active Living (HEAL) Campaign is helping civic leaders implement policies for healthier communities that include bike lanes, community gardens, and city employee health incentives. See: http://www.orphi.org/strategic-projects/strategic-overview/
- Portland's Upstream Public Health non-profit works to improve health by addressing, among other things, public transit, land use planning, and climate change goals. See: http://www.upstreampublichealth.org/issues-overview

Section 2: Resilience in Adult Mental Health Through Access to Natural Areas

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"In a civilization which requires most lives to be passed amid inordinate dissonance, pressure and intrusion, the chance of retiring now and then to the quietude and privacy of sylvan haunts becomes for some people a psychic necessity. It is only the possibility of convalescing in the wilderness which saves them from being destroyed by the terrible neural tension of modern existence."

– Bob Marshall, co-founder of The Wilderness Society

Three to four million people hike some portion of the Appalachian Trail each year. Nearly 8,000 people have completed the entire Trail – no small feat for one of America's longest hikes, one which can take up to seven months to complete (Appalachian Trail Conservancy, 2013). In a world where news events are reported in real time and billable hours can be tracked in 15 minute increments, how can we explain this surprising activity?

Researchers are increasingly discovering what weekend hikers and lunchtime park-walkers intrinsically understand: spending time in nature is restorative and calming, of benefit to both our physical and mental well-being. A study examining the motives of hikers on the AT found the top reasons for hiking were for "self-fulfillment, self-reliance, fun and enjoyment of life" (Goldenberg, Hill, & Freidt, 2008). The benefits of nature, which start with physical exercise and mental restoration and cascade out to financial and societal betterment, are useful for all participants but may hold extra value for particular populations like post-combat veterans, urban youth, ex-offenders, and Alzheimer's Disease and dementia patients.

2.1 How Does Access to Natural Space Impact Adult Mental Health?

Literature from disciplines as diverse as ecology and psychology brim with evidence of the positive effects of green space on adult health. In particular, researchers have documented notable mental health changes in adults who have spent time in natural space, such as:

- Improved mood, attention, and self-discipline (Berto, 2005).
- Reduced stress, anxiety, and aggression (Thompson et al., 2012).
- Improved recovery times from illness and management of symptoms for patients with dementia or Alzheimer's Disease (Thompson, et al., 2012) (Mooney and Nicell, 1992).

The range of these observed positive impacts can be organized into two categories of mental health benefits for adults: mental restoration and stress reduction.

Mental Restoration: Improving Cognitive Function and Overall Wellbeing

Rachel and Stephen Kaplan, pioneer researchers in the psychology of nature, have argued that the beneficial mental effects of nature can be explained through a process called "Attention Restoration Theory" (ART). According to ART, there are two forms of mental attention, direct and indirect, that each require different degrees of cognitive effort. We use direct attention, an effortful, concerted brain process, when we summon the mental focus required to complete productive tasks, like driving in traffic or holding a conversation.

The constant use of direct attention can lead to "mental fatigue" and feelings of stress (Kaplan, 1995). Indirect attention, meanwhile, represents the passive capture of our attention by "inherently fascinating" subjects, such as those often found in nature, like flowing streams or lapping waves (Berto, 2005). Exposure to fascinating subjects turns down your direct attention system, those neural networks used and perhaps exhausted by direct activity, and turns up the indirect attention system. A break in the use of direct attention allows the direct system to recharge and restore, in time renewing one's ability to concentrate on more complex and demanding tasks. In this way, the Kaplan's and their collaborators believe, nature restores human attention and mental health.

"Open a book and enjoy the grass."

Colleges and universities have often sought to decrease final exam stress through free food, snack and coffee breaks, and even trained comfort dogs. In 2011, students in Cornell University's Design and Environmental Analysis course tried a new method. Inspired by Attention Restoration Theory, the students designed and installed exhibits of real grass inside their school's library, bringing a bit of the outdoors indoor and aiding students' mental restoration as they prepared for finals.

For more information see: http://blog.seattlepi.com/bookpatrol/2012/12/16/stay-on-the-grass-nature-goes-inside-the-library/

Image Source: http://blog.seattlepi.com/bookpatrol/2012/12/16/stay-on-the-grass-nature-goes-inside-the-library/

Researchers at the University of Michigan recently put ART to the test in two experiments comparing the mental impacts of urban and natural environments. In one study, research subjects were given sequences of numbers to repeat backwards, a direct attention activity designed to produce brain fatigue (Berman, Jonides and Kaplan, 2008). Then the subjects went on a 2.8 mile walk – half the group through a park near campus, the other half through downtown Ann Arbor. After their walk, the study subjects were asked to again complete the number sequence recall.

The researchers found that cognitive performance on the number sequence recall test significantly improved when subjects walked in nature, but not when they walked through city landscapes.

In another experiment, participants were again asked to perform a series of number sequence recalls, requiring their direct attention. Then, instead of taking a walk outside, they were shown a series of pictures of either natural or city settings.

After ten minutes of viewing pictures, subjects repeated the number sequence recall test and, once again, those subjects exposed to nature out-performed those who had not – even if "nature" was just a static image. The authors concluded that those who would "consider the availability of nature as merely an amenity fail[] to recognize the vital importance of nature in [supporting] effective cognitive functioning" (Berman, Jonides and Kaplan, 2008, p.1211).

Stress Reduction from Nature

In addition to renewing mental attention systems, natural spaces may reduce stress and anxiety more directly. Self-reported surveys of adult stress levels, find, not surprisingly, that time spent in urban parks significantly reduces self-perceived stress (Grahn and Stigsdotter, 2003). If you measure circulating cortisol – the body's primary fight or flight stress hormone – you find the same phenomenon (Thompson, Roe, Aspinall, Mitchell, Clow, & Miller, 2012).

Though seemingly trivial when compared to major health issues like cancer and infectious disease, stress represents a huge strain on adult systems – one that can exacerbate other conditions or become a major concern in its own right. Prolonged high levels of stress cause high blood pressure, cardiovascular strain and a decrease in white blood cells, compromising one's immune system (Web MD 2011). Stress may also encourage unhealthy behaviors like smoking, overeating or undereating and sleep deprivation (Jenkens, Rew, and Sternglanz, 2005).

Some physiological outcomes of chronic stress

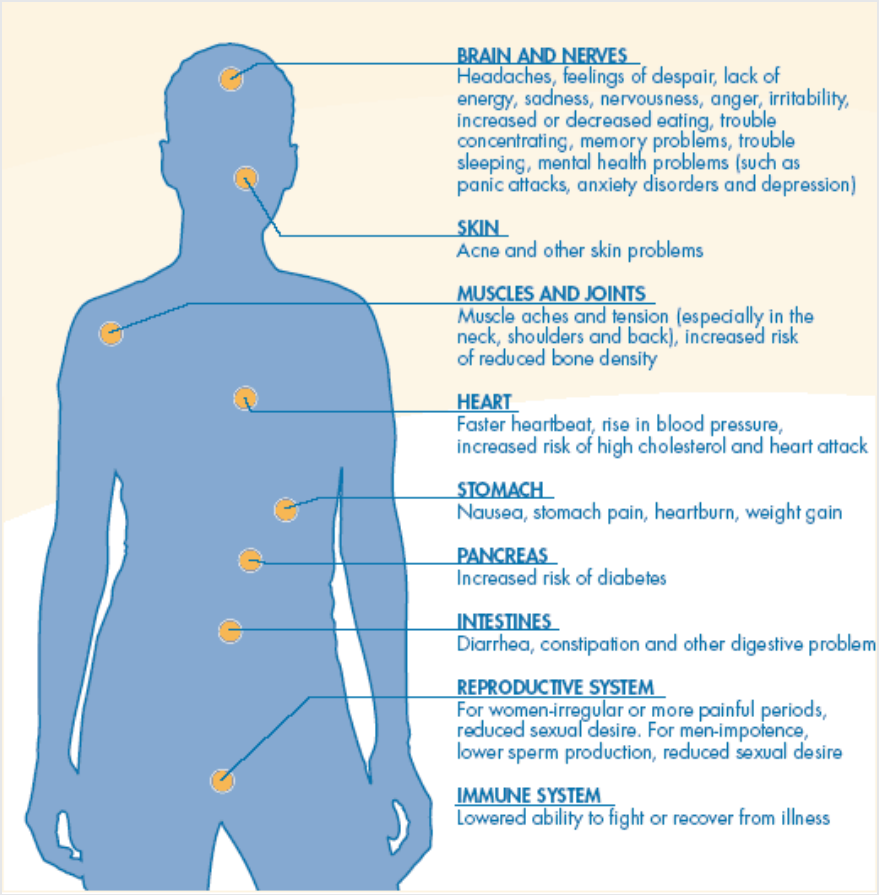

Photo credit: http://www.booki.cc/stress-anger-depression-anxiety-a-coping-skills-zine/what-is-stress/

The stress reduction benefits of time spent outdoors may cascade out to other benefits to society, particularly in reducing macro-scale health care costs and addressing systemic healthcare inequalities.

Annually, work-related stress in the United States costs the economy $300 billion in absenteeism, extended illness and recovery times, and compromised productivity (Smith, 2012). If urban spaces and natural retreats play a role in reducing stress across populations, the savings can be considered immense.

Additionally, costs for mental health and cardiovascular treatments in the United States are high – around $57.5 billion for mental health treatment a year (measured in 2006) and $273 billion for cardiovascular disease, about four and 17 percent of total annual healthcare

spending respectively (Insel, 2011). While there are myriad causes of mental health and cardiovascular disease, stress often plays a significant part in both (Heidenreich, 2011). As a result, actions that reduce stress should reduce costs in these important sectors.

Calculating Stress-Related Expenses

Stress Directions, a consulting company specializing in stress-knowledge tools, provides a Stress Cost Calculator that will generate annual organizational "stress costs" based on the number of employees. Derived from statistical studies at PricewaterhouseCoopers, the Bureau of Labor Statistics, and a generous consultant assumption that "50% of disability is related to stress," the calculator provides an insightful, though likely biased, picture of the monetary impacts of stress in the workforce.

Check your stress expenses at: http://www.stressdirections.com/res/costcalc.cgi

Natural spaces can also create macro-scale health benefits by addressing systemic health inequalities. Health inequalities are preventable health problems suffered disproportionately by certain population groups that frequently occupy minority positions by socio-economic, gender and ethnicity status.

A study from the University of Glasgow hypothesized that exposure to nature could reduce the prevalence of health inequalities. The researchers examined mortality records and calculated access to green space by reported living addresses, and compared access to green space to prevalence of specific diseases.

Those with the highest access to green space had significantly lower incidence of circulatory disease, but no difference in lung cancer or intentional self-harm. The study concludes that the more access to green areas, the greater reduction in socioeconomic health inequalities (Mitchell and Popham, 2008).

2.2 Out of the Doctor's Office and Into the Woods

Support for nature-based "medicine" has been building in recent years. Many doctors have become increasingly frustrated with limited clinical responses to mental and physical maladies that could be solved with physical activity and exposure to the outdoors. They are increasingly turning to "prescriptions" for time spent outside and in nature.

A prominent advocate for natural prescriptions is Dr. Daphne Miller, a San Francisco-based physician whose Washington Post article, "Take a Hike and Call Me in the Morning" helped begin a trend toward physicians advocating natural prescriptions (Miller, 2009). Today, bolstered by both land use and health organizations, programs around the country are promoting "Park Prescriptions."

Replacing Lipitor with Leaves

Many programs in the US now promote nature-based prescriptions. These programs typically have a mix of partnerships between land trusts and health care organizations. Some examples include:

- Park Prescriptions: Organized by the Institute at the Golden Gate, this is an umbrella organization, working to form partnerships between healthcare organizations and managers of public lands.
- Prescription Trails: A partnership in New Mexico between 30 healthcare organizations and several land and park services, designed to give patients more information on how to fill their healthy "prescriptions."
- Children and Nature Initiative: This organization in Brooklyn, NY provides physicians with local nature information in order to effectively prescribe outdoor activity to children.
- The Medical Mile: In Little Rock, a partnership between the National Park Service and Heart Clinic Arkansas used health related funds to build a one mile trail in downtown Little Rock that promotes recreation and educates the public on the health benefits.

For more information see: http://www.parksconservancy.org/assets/conservation/environmental-sustainability/pdfs/park-prescriptions-2010.pdf

Evidence-Based Design

Before there were nature-based prescriptions, there was evidence-based design, a body of research that has increasingly been used in "Healthcare Architecture" to speed up patient recovery times and decrease staff and patient stress. Dr. Roger Ulrich, of the Center for Health Systems & Design, has published widely on the positive effect of nature on patient recovery times in hospitals.

In one landmark study, Ulrich found that patients with a view of trees out their hospital window recovered faster and took fewer pain medications than those with a view of a brick wall (Ulrich, 1984). These positive benefits were attributed to reduced mental stress effected by the mechanisms discussed earlier in this chapter.

Intensity x Time = A "Dose" of Wilderness

If natural settings are good for the mind, the body and for healthcare prescriptions, how does one determine how much wilderness is enough? In other words, what constitutes an adequate "dose" of green space?

Professors Cole and Hall (2010) sought to answer this question by surveying hikers recreating in wilderness areas in Washington and Oregon. They found that hikers experienced

notable mental rejuvenation and lowered stress regardless of the intensity or duration of their hike (Cole and Hall, 2010).

Access to green space, it seems, may be beneficial in any dose. In fact, the more you "need" nature, the more you may benefit from exposure to it. Researchers in Finland found that the more anxiety a person has, the greater the relief they gained from time in nature. Interestingly, those with the most worry tend to spend the least amount of time in nature (Korpela et al., 2010).

Pavement to Parks in San Francisco

Building on the idea that green space, regardless of size, can be beneficial, San Francisco started a "Pavement to Parks" program in 2010. Through the program city officials have worked to create mini "parklets" out of unused road space. These parklets range in size from transformed plazas to a mini green space composed merely of a few chairs, a plant, and a protective barricade. The city is welcoming applications for new parklets that meet a small list of requirements such as the potential to improve pedestrian safety and surrounding uses that can attract people to the space.

For more information see: http://sfpavementtoparks.sfplanning.org/

Shinrin-yoku – the Practice of "Forest Bathing"

In Japan, spending time in nature has become a common preventive medicine method known as "shinrin-yoku," or forest bathing. Japan's Ministry of Agriculture, Forestry, and Fisheries has organized 48 official "Forest Therapy" trails, which provide walks and rest stops for natural relaxation and, interestingly, employ scientists to monitor health benefits.

After enjoying the trails, parkgoers have their blood pressure measured by researchers as part of a long-term study on the positive effects of forest bathing. Along with findings of lowered levels of cortisol and stress, researchers are also finding an increase in white blood cells – an implication that could make people more resistant to cancer and infections (Werts, 2013). Recognizing the benefits and cost savings for healthcare, the Japanese government has put $4 million into research studying forest-bathing since 2004 (Williams, 2012).

Forest Bathing Benefits: By the Numbers

Yoshifumi Miyazaki, a Japanese physiological anthropologist and vice director of Chiba University's Center for Environment, Health, and Field Sciences, has amassed a sample size of more than 600 subjects who have had medical exams following a forest bath. Compared to urban walks, Miyazaki has observed the following after a forest walk:

- A 12.4 percent decrease in the stress hormone cortisol.
- A 7 percent decrease in sympathetic nerve activity (the main regulator of flight or fight stress response in the body).
- A 1.4 percent decrease in blood pressure.
- A 5.8 percent decrease in heart rate.

Source: Williams, 2012.

2.3 Conclusion

This background paper has focused on the foundations of the connection between adult mental health and natural space. Through exposure to nature, we are able to restore our minds and attention and lower stress. These mental effects cascade out to real physiological benefits: lowered blood pressure, improved sleep, faster recovery from trauma, and decreased incidence of heart disease, to name a few. In addition, there are many mental health benefits that accrue at the macro-scale to benefit society through, for example, increased worker productivity and reduced crime. Even more broadly, mental health has positive outcomes for sense of wellbeing and community in populations across urban and rural landscapes.

This paper has covered the basics and mentioned some notable examples – but it should only be the start of the conversation on what mental benefits can be derived from nature and the potential partnerships across land use and healthcare forums that could result from considering these benefits.

2.4 Possible Questions for Discussion

- A major challenge in furthering the mental health implications of outdoor recreation – and bringing the land conservation community into the equation – is answering the question of how we can improve our assessments of the mental health impacts of time spent outdoors. Can we find new ways to measure these slippery concepts? Can we understand nature's impacts on the healthy as well as the infirm?

- How can land trusts engage with populations that are in need of nature's benefits, but may, by nature of their need, lack access? Patients recovering from surgery, addictions, or mental health disorders may benefit the most from time spent outdoors, but find it particularly difficult to acquire. What challenges and opportunities does serving this community offer to the land conservation world?
- What risks might land trusts face as a result of such engagement?
- How can land trusts or health organizations address the findings on "Affective Forecasting Errors" – a research finding that the therapeutic value of nature is commonly underestimated by those not normally exposed to it?
- Can land trusts play a more active role in supporting the research linking mental health benefits to natural spaces?

Some of the Organizations Doing Interesting Work on this Topic

Evidence-based research into positive mental effects of nature

- **Rachel Kaplan, PhD** – Researcher at University of Michigan's School of Natural Resources and the Environment; co-collaborator on the "Attention Restoration Theory." See: http://www.snre.umich.edu/profile/rkaplan
- **The Nature Therapy Project** – Out of Chiba University in Japan and headed by Dr. Yoshifumi Miyazaki, the Project researches the physiological effects of nature. See: http://www.fc.chiba-u.jp/research/miyazaki/index_e.htm
- **Nature and Human Security Program** – Based from Cornell University and headed by Dr. Keith Tidball, the program studies the interplay between humans, nature, and resiliency. See: http://dnr.cornell.edu/people/academic-staff.cfm?netId=kgt2
- **Landscape and Human Health Laboratory** – At the University of Illinois at Urbana-Champaign and directed by Dr. Ming Kuo, the lab's mission is to study the connection between greenery and human health. See: http://lhhl.illinois.edu/
- **Kalevi Korpela, PhD** – Docent of Environmental Psychology at the University of Tampere, Finland, Korpela has published widely on self-regulation and well-being in favorite, unpleasant, and restorative environments. See: http://www.favoriteplace.info/Korpela_Kalevi.htm

Land and Health Organizations United in a Common Cause

- **Outdoor Health Forum** – Run by Dr. William Bird, the Forum works as a gathering place for all environmental organizations in the UK who are committed to pursuing the connection between nature and health. See: http://cwhbird.typepad.com/
- **Therapeutic Landscapes Network** – A consortium of designers, health providers, scholars, and gardeners focused on evidence-based design in health-care settings. See: http://www.healinglandscapes.org/

- **Healthy Parks, Healthy People Central** – Online community serving as a resource for global initiatives worldwide seeking to reinforce the connection between healthy environments and people. See: http://www.hphpcentral.com/
- **United States Healthy Parks, Healthy People Initiative** – Run by the US National Park Service, the Initiative works to promote human health along with environmental and ecological health in public lands. See: http://www.nps.gov/public_health/hp/hphp.htm
- **Children and Nature Initiative** – This organization in Brooklyn, NY provides physicians with local nature information in order to effectively prescribe outdoor activity to children. See: http://www.neefusa.org/health/children_nature.htm

Outdoor Recreation Programs with a Mental Health Mission

- **R4 Alliance** – New in November 2012, the R4 Alliance unites eight rehabilitation organizations around the country that focus on outdoor recreation. The Alliance's explicit goal is to further the case for therapeutic outdoor programs by promoting, improving, and advocating evidence-based recreational program best-practices. The R4 Alliance is focused on military veteran mental health, but has broad implications. See: http://r4alliance.org/
- **Wounded Warrior Project Odyssey** – A special program at the Wounded Warrior Project, Project Odyssey provides outdoor, rehabilitative programs for veterans suffering from mental health stress. Their motto is, "Using Nature and Recreation to Heal the Spirit." See: http://www.woundedwarriorproject.org/programs/combat-stress-recovery-program/project-odyssey.aspx
- **Project Healing Waters** – Using fly fishing as a centerpiece, Project Healing Waters takes disabled veterans on fishing trips, building community and augmenting the mental health rebuilding process. See: http://www.projecthealingwaters.org/
- **Casting for Recovery** – Casting for Recovery provides weekend fly fishing retreats in all 50 states, free of charge, for women suffering from breast cancer. See: http://castingforrecovery.org/wordpress/about-2/

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2.5 Examples, sources of information and other key points from the discussion

Some of the examples, sources of information and key points from the discussion included the following:

- New research on mental health benefits from time spent in nature is very compelling, as are the efforts being made to connect exposure to nature to more biochemical and physiological benefits. Roger Ulrich, Professor of Architecture at the Center for Healthcare Building Research at Chalmers University of Technology in Sweden, was mentioned as a leader in these efforts. His studies examining how "how nature, gardens, and art can lessen pain, stress, and healthcare costs" deserve wider dissemination and replication. See: http://www.healthdesign.org/chd/about/board-directors/roger-s-ulrich-phd-edac
- Though African American communities are viewed as increasingly disconnected from nature, there are historical precedents and current initiatives connecting African American communities to the outdoors (and the benefits nature brings):
    - Rooted in the Earth: Reclaiming the African American Environmental Heritage – the latest book from environmental historian Dianne D. Glave "overturns the stereotype that a meaningful attachment to nature and the outdoors is contrary to the black experience," according to a review of her book. Glaves's work traces "the history of African Americans' relationship with the environment, emphasizing the unique preservation-conservation aspect of black environmentalism" and unearthing stories

of "black naturalists of the past." See: http://www.amazon.com/Rooted-Earth-Reclaiming-American-Environmental/dp/1556527667

- Publications like Minority Landowner tell new stories about diverse communities of American farmers and landowners fostering new and old connections to land. See: www.minoritylandowner.com/page8.php
- The Black/Land Project "gathers and analyzes stories about the relationship between black people, land and place" to "identify and amplify" "critical dialogues" on this issue. See: www.blacklandproject.org

Harriet Tubman – The "Environmental Moses"

Harriet Tubman has been called the "environmental Moses of her people." She traveled from her home in Philadelphia to the plantations of the South and back no less than thirteen times to help escaping slaves navigate north, often at night, through difficult wilderness and inclement seasons.

According to a review of Dianne Glave's book, Rooted in the Earth, Tubman "learned the skills of surviving in the woods and other landscapes" from her father, a timber worker, and was, from her own experience "familiar and comfortable with marshes" and the landscapes of the South. Tubman's deep connection to and knowledge of nature is chronicled among other stories of African Americans in nature in Rooted in the Earth.

See: http://dianneglave.wordpress.com/2011/09/10/harriet-tubman-working-nature/

- Government and city leaders are increasingly recognizing the role healthy environments and access to nature can play in fostering better public mental and physical health:
  - The United Kingdom's government has initiated many reviews and new programs concerned with natural spaces and human health:
    - Natural England, the government body charged with protecting England's natural environment, is fostering the idea of a "Natural Health Service" to complement the nation's more traditional "public health service." See: http://publications.naturalengland.org.uk/publication/31045
    - The United Kingdom's government's National Ecosystem Assessment of 2012 devoted an entire chapter to health and the environment. You can find the UK Faculty of Public Health and Natural England's joint summary and action report on these connections at http://www.fph.org.uk/uploads/r_great_outdoors.pdf

    - In 2011, the UK Government published an influential White Paper "Natural Choices: securing the value of nature" which includes details on how public health can use the natural environment to benefit the health of the nation. See: http://www.official-documents.gov.uk/document/cm80/8082/8082.pdf

- The German Government recently hosted a workshop on the spirituality of green space and the role of conservation in mental health. See: http://www.bfn.de/fileadmin/MDB/documents/service/Skript322.pdf
- In 2010 the New York City Mayor's office joined with the City's acting Commissioners to set new guidelines for "active design" to promote "physical activity and health" in the City. Improving access to parks and open spaces is a cornerstone principle of these guidelines. See: http://www.8-80cities.org/Articles/Active%20Design%20Guidelines%20NYC.pdf

The United Kingdom's Natural Health Service

The United Kingdom's department of natural resources, Natural England, recently partnered with the government's Faculty of Public Health to develop and promote the concept of a "Natural Health Service" to complement the country's existing institutional Health Service. In a compelling "action report" the two agencies describe how access to nature functions as a shadow health service that does "play a vital role in the health of the nation." This health service, they note, "may be as effective as prescription drugs" in treating some disorders and has the added benefits of "decreased health inequalities, reduced crime, and increased workplace productivity" in addition to direct health benefits.

In addition to describing the very real health benefits of the UK's natural spaces, the report identifies policy priorities and collaborative actions that can increase access to nature and improve public health (as well as challenges to be overcome).

For more information see: www.fph.org.uk/uploads/r_great_outdoors.pdf

Section 3: Fostering Child Cognitive Development Through Access to Green Space

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"Young hearts, young leaves, flowers, animals, the winds and the streams and the sparkling lake, all wildly, gladly rejoicing together!"
—John Muir, The Story of my Boyhood and Youth.

Children are drawn to nature. Plop any five year old down in the middle of a forest or field, sit back and watch. Within minutes she will begin to look around, touch blades of grass, or pick through leaves and acorns. Leave her a while longer and the relationship might become more involved, the child picking flowers or throwing rocks into a stream. Come back in a few hours and you might find her up a tree, facing down a skunk, or hidden away inside a fort of her own making.

Within those few hours of risk, self-discovery and imagination a connection will have been born – something intangible but valuable – between the subject and the object, child and nature.

Researchers today are just beginning to study the components of this connection. What they are finding, perhaps not surprisingly, is that contact with the natural world has a powerful, measurable effect on a child's social, emotional, physical, and cognitive development and health. A few of the most important effects are (Moore, 1997):

- Improved attention resources and corresponding cognitive function.
- More resilience in response to stress.
- Greater imagination and creativity.
- Skills development, including motor, communication and decision-making skills.

How many children today actually have an experience comparable to the one described above? Where, amid the piano practices, TV, computer games, and homework, does a child find the time? And where, in an increasingly urbanized environment crisscrossed by highways and strip malls, can she find the space?

In England in the mid 1970s Robin Moore began to ask these questions by studying patterns of access to the outdoors among eight to twelve year olds. What he found was a rapidly diminishing contact between children and their natural environments. This gap, termed the "nature-deficit disorder" by journalist Richard Louv, has since been studied by those increasingly concerned about the implications of this deficit, not only for the relationship of humans to their environment but also for human health itself.

John Muir's ideal childhood, lived afoot and afield in communion with nature, is rapidly becoming a thing of the past. Stephen Kellert (2012), a social ecologist based at the Yale School of Forestry and Environmental Studies, reports the following startling numbers:

- In an average week, the typical child spends less than 40 minutes outdoors.
- In 2010, a typical child spent about 52 hours a week engaging in electronic media, including television, computers, and video games.
- Over 90 percent of their time, children are indoors.
- In the last decade, the area in which children play (their "home range") has decreased by 90 percent.

In the children of the last few decades, we are seeing the symptoms of an epidemic of disconnectedness from their natural environment (Louv, 2005). While it is hard to track the exact effect of these changes on children and the adults they become, an expanding body of research suggests that the absence of green space in their lives could negatively affect their physical and psychological health over time.

In recent years, pediatricians and educators have seen a dramatic increase in diagnosed developmental disabilities among children, including learning disabilities and attention deficit disorders (ADD and ADHD) (CDC, 2011). At the same time, mental illness continues to be a major concern for this population (National Alliance on Mental Illness, 2013). Could some of these trends be correlated with nature-deficit disorder?

Humans evolved in close contact with the natural environment, shaping and being shaped by it. Because of this, time in nature may actually be necessary for the development and maintenance of cognitive function in the brain. Drawing from the fields of evolutionary biology, cognitive neuroscience, psychology, sociology, child development and design, researchers are gradually teasing apart the complex ways in which we are influenced by our surroundings. As this section will describe, these scholars are largely concluding that we must take active steps to reconnect adults and children to the natural environment.

The Children and Nature Network

The Children and Nature Network (C&NN) was founded in response to concern over "nature-deficit disorder." It is at the center of a growing movement striving to reconnect children and nature, serving as both a clearinghouse of information and resources, as well as a nexus for collaboration among researchers, educators, institutions and individuals devoted to creating "a world in which all children play, learn, and grow with nature in their everyday lives." C&NN's literature reviews and publications provide an excellent summary of the research conducted in this field and its website is full of useful links.

For more information see: www.childrenandnature.org

3.1 How Does Nature Matter in Child Development?

Nature has been cited in many studies for its potential role in shaping or maintaining child physical and psychological health. In addition to the cognitive and emotional development benefits mentioned above, other benefits from time spent in nature include improved self-confidence, discipline, independence, as well as more developed "sense of place" and "connectedness" to social groups. Natural landscapes, it seems, grant children a unique setting in which to explore their world, connect to others and fully develop their minds. Importantly, researchers are also finding that the earlier we get out, the better (Bird, 2010).

What Makes Children Different?

Children are particularly affected by their environment because, compared to adults, they are more vulnerable and less likely to have control over their surroundings. In addition, their neural plasticity is far greater than that of adults, meaning that their brains are still developing and open to different outcomes in terms of developing functional cognitive networks (Wells and Evans, 2003). The environment children grow-up in molds them in ways that follow them into adult life. Indeed, the "life stress" that children are subject to at an early age may permanently change the way their neural connections are formed and function, putting them at a disadvantage later in life (Louv, 2013; Kristof, 2012).

Wells and Evans (2003) have investigated the possibility that natural environments may serve as a "buffer" for such stress, mitigating the negative effects of adverse events and conditions and increasing children's natural resilience to change and trauma. By examining the level of psychological distress and reported "global self-worth" of children in different environments, Wells and Evans found that exposure to natural environments (defined by a high amount of plants and natural surfaces) seemed to reduce or attenuate the negative emotional effect of stressful life events in children.

The positive effects of exposure to nature were most pronounced in children who had experienced acute stressors like the changing of a home or school, undergoing family strife like divorce or being bullied. Wells and Evans suggest a variety of mechanisms for these findings: children who are exposed to more nature may have greater external resiliency in the form of tighter social networks, which can provide support in times of need, or greater internal resiliency such as improved mental perspective, clarity, or the ability to constructively problem-solve.

Why are Children More Disconnected from Nature?

Children of today are highly stimulated and busier than ever. They have far less time to simply go outside and discover the world for themselves and, increasingly, far less ability to get outside if they wanted to. Interestingly, the No Child Left Behind Act of 2001 has been blamed partly for this trend, as the policies of this law often led to reductions in the amount of time that children spent in recess – a time when they can play outdoors freely – in favor of more structured class time (Strife and Downey, 2009). At the same time, natural environments are threatened by development, pollution, and other human impacts, and as urban populations continue to grow, fewer children grow up with easy access to green space. By 2030, it is believed that 70% of the world's population will live in urban areas (Kuo 2010).

According to experts, other factors contributing to loss of time children spend outdoors are many and varied. They include (Charles and Louv, 2009; Moore, 1997):

- Availability and sophistication of electronic media.
- Changing family relations.
- Commercialization and over-structuring of play.
- Lack of access to green space.
- Reduction in recess or play time.
- Increased distance in suburban areas from school to home and increased vehicle commute times.
- Parental fear of the risks and dangers posed by the outdoors, including the "Bogeyman Syndrome" (in which parents fear that children will be abducted, kidnapped, of physically harmed if they play outside).

What Does this Mean for Children of this Generation?

A number of studies have explored the cognitive development of children who are unable to play outside due to factors including:

- An unsafe play environment;
- A lack of availability of open space;
- Poverty; or
- Parents who do not have the time or resources to supervise their children outside.

Five year old children in Zurich who were unable to play outside showed "poorer social, behavior, and motor skills and had fewer playmates than children with easy access to the outdoors," according to a study conducted in 1995. Similarly, a Swedish study that compared children in all day outdoor day care facilities with children in a more traditional setting in an urban area found that the children who spent time outdoors had better motor coordination and greater capacity to pay attention (Wells and Evans, 2003). Other studies have looked at the social effects of natural environments on families, one finding a decrease in domestic violence in Chicago public housing units that are greener (Kuo, 2010). This work supports the idea that accessible green, outdoor spaces improve cognitive function, well-being, social interaction and social connectedness in children and their families, particularly in impoverished urban communities where need for such spaces may be more acute. We do not need longitudinal studies to tell us that closer-knit, more peaceful communities and families make for less-traumatized, happier children, who are capable of better facing obstacles later in life (Kuo 2010).

The Role of Play

"Man is most nearly himself when he achieves the seriousness of a child at play." – Herodotus

Research has shown that children who play in green spaces feel better about each other and about their environment than those who do not. "Play" and the space in which children play are critical for developing motor and social skills. The type of play is particularly important, with unstructured play, defined as imaginative, creative, self-discovery without guidelines and often without the guidance of adults, being especially beneficial.

According to Frances Kuo, a researcher at the University of Illinois, much of current play is highly game-mediated, with clear goals, rules, and markers of success. Spontaneous, unregulated play may be much less end-driven and success can be much more broadly defined (Kuo, personal correspondence, 2010, April 26). Rather than scoring points in a structured game like basketball or football, children might collaboratively build a fort or find and observe insects in a stream. Some research has even shown that bullying may be reduced in green spaces where natural barriers prevent overcrowding (Bird, 2010).

Biophilia

Harvard biologist Edward O. Wilson developed the theory of "biophilia" to describe the natural affinity of humans to natural patterns, landscapes, and non-human species. It suggests that we are genetically programmed to form emotional connections to the places and species alongside which we evolved and that we are drawn to natural spaces in which we can thrive mentally and physically.

Stephen Kellert, a social ecologist at Yale University, has further expanded on this, concluding that biophilia actually encompasses a wide array of values that describe how we "attach meaning to and derive benefit from the natural world" (Kellert, 2012, xii). Nature in this view reflects a fundamental human need that is crucial to our fulfillment as individuals. Kellert has authored a number of books and articles on biophilia, ecological design, and the importance of natural environments for adults and children.

For children, Kellert writes, "direct experience" of nature is necessary for physical, emotional, intellectual and moral development. Psychologist Robert Pyle calls the current phenomenon of children staying indoors the "extinction of experience" and he warns that it could have dire consequences. Without direct experiences that tie them into the natural world, children may never fully develop the relationships and understanding that help them take on a role in a greater environment, nor will they value it in the same way (Kellert, 2012). Biophilia is the evolutionary and mechanistic underpinning of how our environments affect us.

3.2 Early Childhood Development

Educational and health research in recent years has highlighted the importance of early childhood years (prenatal to eight years of age) on the lasting health of an individual. According to the World Health Organization (WHO), these years are the most important for development throughout life. This is when the most intensive brain development happens and it is also a time when children are the "most sensitive to the influences of the external environment" (WHO, 2009).

Adequate stimulation is crucial to learning and growth, while adverse influences of stress or unsupportive home environments can inhibit a child's emotional, cognitive, and social development, preventing him or her from reaching full potential later in life (WHO, 2009). Nature is a uniquely diverse, stimulating, and changeable environment that supports children's growth in the early years. The current policy focus in the U.S. today on early childhood education provides an excellent opportunity to integrate more contact with nature into children's lives.

Udeskole and *Waldkindergarten*: (Outdoor Schools and Forest Kindergartens)

In parts of Europe, especially in Germany and Scandinavia, there has long been a movement to create outdoor schools, in which class and all other activities actually take place outside. In the Forest Kindergartens, a concept that has recently spread to the U.S., young children spend several hours outside every day, regardless of the weather, frequently taking advantage of nearby wildland parks and open spaces.

The *Udeskoles* are based around the concept of regular compulsory educational activities outside the classroom for children aged seven to 16. Curricula focus on cross-disciplinary, experiential learning experiences, such as the combination of math and home economics developed by one Norwegian math teacher who had his students build and use a home made scale to weigh ingredients as they made wild blackberry jam. Reported benefits from these schools include higher levels of physical activity throughout the school day and improved attention abilities.

For more information see:

http://blog.childrenandnature.org/2013/02/12/udeskole-in-scandinavia-teaching-learning-in-natural-places/

http://www.nytimes.com/2009/11/30/nyregion/30forest.html

School Achievement

An unpublished study from Frances Kuo's lab has taken ten years of data from nearly 500 Chicago schools to study impacts of school "greenness" (determined through examination of aerial photos) on standardized test scores in half a million students.

Researchers found a predictive correlation between school greenness and academic performance, both between schools in a given year, and in the same schools over time. Not only did schools that had more greenery around them show higher test scores, even when demographic factors like wealth, ethnicity, race, and gender were controlled for, but when individual schools became more green (through landscaping or plantings), children's learning (as shown in test scores) showed a marked increase at the time of the change (Kuo, personal correspondence, 2010, April 26).

Several older studies support these findings. For example, a study from 2000 showed that children who moved to housing with more nearby nature gained higher levels of cognitive function (cited by Wells and Evans, 2003). Research from 2002 looked at the effect of nature on girls living in Chicago public housing. When their views out the window were more "natural," containing more greenery, girls could better concentrate, delay impulses, and delay gratification. All of these are indicators of success in life that might help with academic achievement while also helping the children avoid such pitfalls as petty crime, teen pregnancy, and drugs (Taylor, Kuo, and Sullivan, 2002).

Improving the greenness of public housing complexes in urban areas could help youth improve self-discipline and concentration, leading to positive life outcomes (Bird, 2010).

Adolescent Experiences: The Outward Bound Model

Adolescence is a critical time in development, when many children are particularly vulnerable to depression, emotional instability, and feelings of isolation as they develop a sense of identity. Several studies have found a puzzling reduction in interest for natural places during the time of adolescence. This is when children may move from wanting to play outside to hanging out indoors in places like malls. This has been explained as a "reduced affinity to nature with preference for time spent with their own peers" (Bird, 2010). However, it has also been shown that exposure to nature during the teenage years can provide an incredibly positive influence on adolescence during this rocky time.

A large-scale survey of more than 800 participants in outdoor programs such as the National Outdoor Leadership School, Outward Bound and the Student Conservation Association, summarized some of these benefits. All three programs are challenging wilderness-based experiences targeted mainly towards adolescents and young adults. Participants consistently reported major effects on their personal and character development from these trips. Three-quarters of respondents considered it to be one of the most important experiences in their lives. Among the psychological, sociological, and physical benefits found in this study and others like it were improvements in:

- Self-confidence;
- Self-worth;
- Autonomy;
- Self-reliance;
- Strength;
- Coordination;
- Problem-solving;
- Working with others;
- Decision-making;
- Ability to cope with stress; and
- Communication ability.

Many young participants also reportedly felt a stronger sense of self-identity alongside a greater appreciation for and connection to nature (Kellert 2012).

However, wilderness trips of this sort are not universally accessible to all adolescents. Other approaches, a couple of which are described below, might prove equally effective in providing young adults with formative connections to the natural world.

The Nature Conservancy's LEAF program is another approach that is immersive, but less challenge or wilderness-focused than programs like Outward Bound.

The Nature Conservancy: LEAF Program

LEAF, or Leaders in Environmental Action for the Future, provides paid summer internships on Nature Conservancy preserves for students in environmental high schools across the US. From 1995 to 2011, it served over 500 students, mainly diverse youth from urban areas.

Reported impacts from the program include an increased awareness of possible environmental career paths, conservation literacy, self-confidence, professional work skills, independence and love for the outdoors. A high percentage of LEAF alums go on to successfully complete their higher education and to stay engaged in environmental issues. LEAF also provides environmental educators with resources and networks to share experiences and knowledge with each other.

For more information see: http://www.nature.org/about-us/careers/leaf/index.htm.

A growing network of environmental high schools like the Common Ground School (highlighted later) are another example of longer-term programs that engage adolescents at an age when much of their identity and relationship with the outdoors might be formed. These schools use environmentally-themed curricula integrated with outdoor trips to provide experiential, hands-on learning as well as leadership and community development for students.

A list of LEAF partner high schools can be found at http://www.nature.org/about-us/careers/leaf/partner-schools/index.htm, while the Green Schools National Network provides a directory of other environmental schools (K-12 and otherwise) at http://www.nature.org/about-us/careers/leaf/partner-schools/index.htm.

The Decline of Environmental Knowledge

A study from the University of Cambridge in 2002 tested children's knowledge of common wildlife species (like badgers and beetles) versus characters from Pokemon, a popular children's game and television series. Children successfully identified 78% of the Pokemon "animals" on printed cards, but only 53% of local wildlife (Bird, 2010).

This example is representative of the obstacles we are up against. Both children and adults today are less familiar with common species than they were in the past and less comfortable in outdoor settings. In extreme cases this can lead to "ecophobia," or fear of the natural world. This discomfort and fear in turn can lead to a tendency to devalue natural places and species, as we understand them less. Coupled with a human habitat that is increasingly less

biodiverse, it may soon become impossible for the children of the next generations to know what they are missing or feel that nature is important (Charles and Louv, 2009).

Implications for Adult Life

These findings have profound implications for the future of environmental stewardship. A study of the environmental attitudes, behaviors, and beliefs of 10,000 adolescents between 1976 and 2005 found that adolescents' environmental concern has decreased since the 1990s. This corresponds with an unwillingness to take personal action to protect the environment, or engage in conservation measures, like reducing energy use (Wray-Lake, Flanagan, and Osgood 2009 as cited in Charles and Louv, 2009.)

Work by several researchers shows that the best predictor of environmental behavior as an adult is sustained time spent in wild, natural areas as a child. Free play and exploration, sometimes mediated by an adult family member who modeled respect for and interest in nature, are also key experiences cited by environmentalists as reasons for their commitment (Sobel, 2012). Today's children, however, are often too distracted and too alienated from nature to have these experiences – so who will be the environmental stewards of the future?

Groups like Outdoor Nation (http://outdoornation.org/) attempt to bridge the gap by creating a movement of college-age youth interested in outdoor recreation. Outdoor Nation, as well as other groups, like the Outdoor Resources Review Group, suggest that outdoor experiences as well as training for the future job market are key in providing for our future stewardship needs as a nation.

3.3 Nature as Treatment

As discussed in Section 3 above, time in nature may provide rest for our direct attention networks and prove restorative for both adults and children. Such a natural benefit may have profound implications for youths with attention disorders, such as ADD and ADHD.

ADHD, according to the American Academy of Pediatrics is "the most common neurobehavioral disease of childhood" (Kuo and Faber Taylor 2004, p. 1580). A recent New York Times article reports that 11% of American school-age children have been diagnosed with ADHD.

Researchers and clinicians have struggled to find satisfactory long-term treatment for patients with ADHD. Chemical treatment of these disorders is problematic and many physicians express concern at over-prescription and overuse of costly and potentially harmful ADHD medications in children (Schwarz and Cohen, 2013).

However, research by Frances Kuo and Andrea Faber Taylor at the University of Illinois indicates that exposure to green outdoor environments may reduce ADHD symptoms in children. In one study, young children with ADHD were taken on 20-minute walks in three settings – a residential neighborhood, an urban downtown, and a city park. Afterwards, the children were given tests of concentration by a researcher who did not know which walk they had taken. Children's concentration after the park walk was consistently better

than in the two other settings (Faber Taylor and Kuo, 2009). Notably, their performance improvement was comparable to or better than that seen in peak performance boosts from taking Metadate CD and Concera, two widely prescribed ADHD drugs (Kuo, 2010).

Another study of 450 children with moderate to severe symptoms of ADHD across a broad range of demographics showed that this effect is not just limited to parks. When these children engaged in common weekend or afterschool activities in green settings, as well as in less green settings, such as the indoors or outdoor areas without vegetation, their parents were asked to rate the severity of their symptoms after the activity.

Parents consistently reported a "green advantage." The children who had spent time in a green setting showed improved attention and reduced symptoms of ADHD. While considerably more research is needed in this area, these findings suggest a hopeful solution for many children struggling with ADHD. The authors propose a possible regime of "green time" every day to expose children to the outdoors in order to treat or at least ameliorate some of their disorder's symptoms (Kuo and Faber Taylor, 2004).

Relief from ADD symptoms afforded by play indoors versus outdoors.

Image Source: http://www.cbf.org/ncli/problem/nature-deficit

While the American Academy of Pediatrics has not officially integrated these findings into its policy statements, many of its 57,000 members have shown their support for children spending time outdoors. C&NN provides a special portal for pediatricians to access and learn about this research and, additionally, offers physicians suggestions for what they can do to be involved. For more information see: http://www.childrenandnature.org/pediatricians/.

3.4 Equity

As the importance of nature for child cognitive development has been more widely recognized, equity and environmental injustice have emerged as key issues in children's access to the outdoors. Strife and Downey (2009) point to childhood development and access to nature as an important "New Direction for Environmental Inequality Research." Past child environmental health research has tended to focus more on disproportionate exposure to toxics in low income neighborhoods than on lack of exposure to green space. The work that has been done suggests that not only are low income and minority youth less likely to have good access to green spaces than white and higher-income youth, but that they are also less likely to have positive experiences in nature (Strife and Downey 2009).

Low income neighborhoods in Los Angeles, many of which are primarily communities of color, are less likely to have adequate park access than richer neighborhoods. These and other barriers render Latinos and African Americans less likely than Anglo Americans to use nature centers, local parks, and outdoor recreation areas. Differences in cultural preferences, language barriers, program expenses, racial discrimination, lack of transportation and unfamiliarity with natural areas are all contributing factors to this gap (Strife and Downey 2009). These differences may be deepened by a lack of cultural diversity in environmental education staff at nature centers and recreation areas, as well as perceptions from minority communities that these places are "for White people with money" (Strife and Downey 2009, p. 111).

While increasing park space and improving park facilities in low-income neighborhoods are one way to tackle this problem, such responses may give rise to other problems. Since urban greenspace has been shown to increase property values, enhancement of greenspace in neighborhoods may actually have the unintentional effect of forcing out low-income residents (Frumkin, 2005).

Across the country, conservation organizations are realizing that in order to survive they need to expand the demographics of their movement, and partner with organizations who have interests in common. Consequently, they are broadening their approach to take into account the needs of underserved communities (Forbes, 2011).

Major barriers still exist, however. Some experts suggest that conservationists may need to change their paradigms for land preservation and meet communities of color on their own terms if they are to overcome these obstacles (Rue Mapp, personal correspondence, 2013 April 4th). The connection between conserving green space and improving human health is one possible area of common ground.

In addition, if existing inequalities in access and use of natural areas are to be rectified, children and adults from low income and minority communities must be able to also access the health benefits that accrue to people who spend time recreating outside. This may require considerable outreach, and active removal of existing barriers to opportunities for connecting with nature.

Rue Mapp of the group Outdoor Afro notes that often, merely reaching out to children in diverse communities is insufficient to actually engage a whole population and provide them options for outdoor recreation. The following two organizations focus on the family as a whole, creating a longer-term solution that has benefits not just for children but for entire communities:

- *Youth Enrichment Strategies (YES)*, a non-profit based in Richmond, California is dedicated to "deepening relationships through experiences in nature" by bringing youth and families on multi-day camping trips around the San Francisco Bay Area and in nearby redwood forests. These camps provide parents with a welcome –"mini-vacation" where they can reconnect with their family members, their community, and sometimes even communicate across cultural divides with their neighbors. YES provides Spanish translation services, as well as home-cooked meals, programming for children and adults, and a staff member for each family who accompanies them throughout the weekend and helps address any needs they might have. For more information see: http://www.yesfamilies.org/viewpage.php?page_id=9
- *The Oakland Feather River Camp* takes a similar approach, running a number of camps throughout the summer for families from Oakland. These camps are run by the organization Camps in Common, which commits itself to building community and promoting respect for both human diversity and natural habitat. For more information see: http://www.featherrivercamp.com/programs-family.html

Other organizations, including land trusts like the Massachusetts-based Trustees of Reservations are also focused on creating improved programming that will allow whole families to have engaging experiences on conserved land.

3.5 Solution Spaces

Solutions to the current nature-deficit epidemic must be creative, multi-leveled, and multi-faceted. When she advocates for the creation of healthier human habitats, Frances Ming Kuo boils the best responses down to three main principles (Kuo 2010, p. 35):

1. "Provide as much nature, in as many forms, as possible."
2. "Bring nature to people."
3. "Bring people to nature."

Principles such as these are being reflected across disciplines in design, education, access, land protection, policy, and partnership efforts to capture these benefits for children's development.

Design

Evidence shows that green environments must be experienced deeply and for long periods of time to yield maximal benefits. But, as Section 3 described above, even briefly viewing green pictures or landscapes can produce some of the same positive mental effects of, for

example, a long hike (Kuo, 2010). While it is critical that the time that children spend outside in natural spaces be prioritized, even interior environments can be made more green through the strategic placement of windows, plants or depictions of nature where they can be perceived and experienced.

Biophilic design principles that emphasize naturalized green space and place-specific elements could help support child development and mental health on multiple scales (Kellert, 2012). These same ideas, of creating better "habitat" for children, should be applied in the planning of cities, residential communities, homes, and places where children naturally spend time, like playgrounds. Children of a certain age need to explore as they learn, and to seek out mysterious and hidden places.

White-Hutchinson

White-Hutchinson is a company that designs and builds green child care centers. They specialize in naturalized playground design for young children that encourages creative play and interaction with nature. Their natural playgrounds use participatory design to meet children's needs while employing green elements like moving water, multi-leveled vegetation, animal habitat, materials that can be moved around and manipulated, along with child-proportioned nooks and crannies. Some examples of their work may be seen at: http://www.whitehutchinson.com/children/playgroundexp.shtml

"Green" schools may enhance student performance in a variety of ways. School settings could be designed to better facilitate learning, mental health, and attention capacity in children by striving to be more green. Schools themselves could administer small "doses" of natural treatment for students with attention disorders, merely by creating more natural space inside and outside of the classroom. Schoolyards could have more natural plantings, vegetable gardens, trees, and flowers that would attract wildlife, while classrooms could contain plants, aquariums and windows with green views.

Environmentally-based lessons and curricula in a variety of subjects (from math to English) have been shown to increase student interest in subjects and lead to higher test scores, while also putting the natural elements of green schools in a learning context (Faber Taylor and Kuo, 2008). Careful design of school schedules to allow time for play and design of curricula that include experiential classes would provide an important complement to the physical layout of a campus.

The Common Ground School: A Charter School with a Purpose

The Common Ground School in New Haven, Connecticut is a charter high school, environmental center, and urban farm all in one. The school is located on 20 acres of city park land on the edge of one of Connecticut's largest parks – West Rock State Park. Its simple, wood-framed buildings are surrounded by trees, vegetation and its urban farms – where students learn to raise livestock and vegetables. The environmentally-themed curriculum changes from semester to semester, focusing in on one theme, like "climate change" or "water" to engage students in the big issues they will be facing in their lifetimes and to enable them to see relevant connections with their own lives. The success of Common Ground's students corresponds to findings that show students using environmentally-themed curriculums usually perform better on standardized tests than their peers in more traditional programs.

For more information see: commongroundct.org

As environmental curricula become more mainstream, organizations like the State Environmental Education Roundtable (www.seer.org) are helping develop guidelines for integrated environmental learning.

Educational Programming and Engagement

It is hard to compete with the newest video game for a child's attention. In a world where each week seems to bring a new device for technological play, it's no wonder that children are less interested in spending time outdoors.

But as more and more people recognize the importance of connecting kids to the natural world, school clubs, educational centers and other organizations have launched hundreds of programs and initiatives designed to get kids outdoors. These opportunities abound – it is merely a matter of tracking down the nearest ones to find a program serving your community.

The following section lists some innovative approaches to environmental education, along with some of the organizations that are using them.

The Sierra Club: "Building Bridges to the Outdoors"

The Sierra Club has been among the leaders in involving children in outdoor activities. Through the "Building Bridges to the Outdoors" program of their "Mission Outdoors" branch, they focus on giving children throughout the US access to outdoors experiences. In conjunction with the Outdoor Alliance for Kids (OAK), they are working as part of the First Lady's "Let's Move" campaign to create challenges and activities for children to participate in activities outside. Their "Inner City Outdoors" Program focuses on getting urban youth into the outdoors.

For more information see:

http://www.sierraclub.org/missionoutdoors/

http://www.letsmove.gov/lets-move-outside

Unplugged Week

The Campaign for Commercial Free Childhood has launched an annual "Screen-Free Week" that encourages children and families to take the pledge and turn off their computers, TVs, and other devices for a week of reconnecting with nature, family and play.

For more information see: http://www.commercialfreechildhood.org/screenfreeweek

In a very different approach, an experiment was conducted on children participating in Youth Day in Los Angeles, CA. Some groups of children were given technology-based outdoor activities (like taking photographs) and others were given non-technology-based outdoor activities (like a natural scavenger hunt or taking natural rubbings). The technology-based activities were rated higher by participants, suggesting that perhaps there can be a role for technology in helping children reengage with the outdoors (Chavez 2009 as cited in Charles and Senauer, 2010).

Increasing numbers of nature education programs are now successfully taking advantage of children's fascination with electronic gadgets to stimulate interest in outdoor learning. Nature photography, cell phones with bird calls and the use of GPS devices are becoming ever more popular in environmental education (Outdoor Resources Review Group, 2009).

Letterboxing, Geocaching, and Questing

The Connecticut Department of Energy and Environment is actively engaging the public through "letterboxing" and geocaching programs that place record books, stamps and other prizes to be found and collected throughout Connecticut's state forests.

"Quests" are activities developed by land trusts that are a combination of treasure hunt and education game that lets participants unravel a story about the place they are in while wandering through the fields and forests to get to a specified location, where they will often find a stamp and a log book. It is an engaging activity for families and creates a child-driven initiative to explore the depths of conserved land.

For more information see:

http://wlt-dev.accessionmedia.com/quests

http://www.ct.gov/deep/cwp/view.asp?a=2697&q=322826

Another approach involves using students' innate sense of equity and fairness to engage them and create an emotional connection to the environment. Many of the students at Common Ground are themselves from low income communities and when they participate in real world projects that bridge the gap between social and environmental justice, they develop an understanding and an investment that transcends simple academic interest.

For example, students in one class brought vegetables they had grown to sell at a retirement home that had no other local source of fresh produce. There they talked to the residents and eventually helped build a garden bed for them (Spear, personal correspondence, 2013, May 6th). As a result, not only did the students spend time outside, producing food through their own labor, but they also became invested in the environment and the good of their community.

Regardless of how children are engaged, it is clear that partnerships with educational institutions will be one of the cornerstones of any effort to build healthier humans from childhood up.

Access

It is not enough that there be parks for children to play in – in order for health benefits to be realized, children must actually spend time outside playing in places like parks. In many neighborhoods these opportunities simply do not exist.

Trust for Public Land: Parks for People Initiative

The Trust for Public Land's Parks for People Initiative helps plan, fund, and build parks where they are most needed. Partially in response to a study conducted by the Centers For Disease Control that showed that more than 80% of US census blocks are located more than half a mile from the nearest park, TPL works toward the goal of providing every child with access to a park or playground within a ten-minute walk of home.

For more information see:

http://www.tpl.org/what-we-do/initiatives/parks-for-people/

http://www.cdc.gov/physicalactivity/downloads/PA_State_Indicator_Report_2010.pdf

It should be noted, too, that mere proximity is not enough. When neighborhood parks are perceived as unsafe, they will not be used by children. Proper maintenance of and ensured safety at parks are extremely important parts of the equation (Kuo, 2010).

Land Protection

Without green space and natural land to play and learn on, children will not have the same opportunities that earlier generations had to benefit from nature. As per their mission, many conservation organizations are taking on the challenge to ensure that these places continue to exist.

The Conservation Fund: A Children and Nature Focus

The Conservation Fund works to conserve land for future generations. Among their focus areas are their Children and Nature projects, which help protect land for kids to get outdoors. They have also partnered with Richard Louv of the Children and Nature Network to hold the National Forum on Children and Nature. In 2008, the Forum endorsed 30 demonstration projects across the country that creatively reconnected children with nature.

For more information see:

http://www.conservationfund.org/our-conservation-strategy/focus-areas/children-nature/

http://www.funoutdoors.com/files/04-National%20Forum%20on%20Children%20and%20Nature%20Endorses%2030%20Projects.pdf

Policy

At the state, national, and international levels, a growing recognition of the connection between natural landscapes, environmental education and child health has spurred the creation of a movement to embed these principles in policy initiatives.

No Child Left Inside Initiative

The No Child Left Inside Bill of 2009:

- Emphasized the importance of environmental education in the United States;
- Set forth a process to create state environmental literacy plans; and
- Sought to establish a grant system to support environmental education.

Opponents of the bill claimed that it had a political agenda that should not receive federal funding. It was not passed in 2009 but was reintroduced to Congress in 2011 with the support of 60 cosponsors. Although it has not been enacted, in many states, chapters focused on achieving the goals of the initiative have popped up and have helped facilitate the formation of environmental education initiatives that make use of local parks and green spaces. At the first-ever White House Summit on Environmental Education, held April 16, 2013, then EPA administrator Lisa Jackson announced the formation of a Federal Interagency Task Force on Environmental Education. She also committed $5 million in EPA funds for environmental education to be deployed through the National Environmental Education Foundation (NEEF).

A Right to Nature?

In September 2012, the World Congress of the International Union for the Conservation of Nature (IUCN) passed a resolution on the "child's right to connect with nature and to a healthy environment," calling for the inclusion of this right in the United Nations Convention on the Rights of the Child. This was a follow up to a report co-written by the Children & Nature Network and the IUCN Commission on Education and Communication that showed that children worldwide are spending more time indoors and less time in free play outdoors.

For more information see:

http://www.childrenandnature.org/news/detail/addressing_childrens_nature-deficit_disorder_bold_actions_by_conservation_l/

Many federal and state agencies, from the US Forest Service to the Connecticut Department of Energy and Environment, are starting their own initiatives to engage youth outdoors. For example, the National Environmental Education Foundation (NEEF) – a group comprised of environmental educators, scientists and healthcare professionals – was established in 1990 as a complementary organization to the Environmental Protection Agency.

Partnerships

Creative partnerships are key to connecting kids to the green space that they need. Whether it is building the momentum to have lobbying power as part of a broader coalition, or finding the land to run youth outdoor empowerment programs, organizations and individuals across the spectrum are getting together to magnify their positive impacts.

The Trustees of Reservations and Boys and Girls Clubs of Western Massachusetts

The Trustees of Reservations, one of the oldest land trusts in the U.S., has been partnering with the local Boys and Girls Club, an organization that provides training, mentorship and opportunities for youth in need, to provide access to natural areas where Boys and Girls Clubs can run programs. They have worked together on community gardening projects and even on the purchase of Mt. Tom, a former ski area, which is the site of a future youth summer camp for the Boys and Girls Clubs.

For more information see:

http://www.thetrustees.org/email/find-your-place/partnering-community.html

http://www.thetrustees.org/places-to-visit/pioneer-valley/little-tom-mountain.html

The Outdoors Alliance for Kids (OAK)

The Outdoors Alliance for Kids is a strategic partnership of businesses and nonprofits united with the common goal of expanding the number and quality of opportunities for children, youth and families to connect with the outdoors. It includes organizations like The Sierra Club, YMCA, The American Heart Association, and The Children and Nature Network, as well as companies such as REI and The North Face. The coalition lobbies for policy objectives that support its mission.

For more information see:

http://outdoorsallianceforkids.wordpress.com/

3.6 Possible Questions for Discussion

- How can we better connect children with the outdoors in the face of continuing innovation and competition from technological entertainment?
- What are effective educational models that incorporate natural settings and elements into children's daily environments?
- What indicators can we use to continue studying the effects of nature on children, and how do we disentangle these findings from intuition or nostalgia?
- What role does equity play in considering access to greenspace? How can these principles and research findings be incorporated into low-income housing or school systems? Who could or should fund such work?
- What are the cultural barriers to children playing outdoors? Do they differ across the country? What are the ways to overcome or work with these barriers?
- How can land trusts and community organizations work in tandem to better achieve the goals of equity and access to the outdoors?
- How do you make land conservation relevant to today's youth and to their families? How do you get them to care and form emotional connections to land?
- How do you balance out active land use by children and families with the need to preserve delicate landscapes and species?

Some of the Organizations Doing Interesting Work on this Topic

Information and Advocacy

- The Children and Nature Network: http://www.childrenandnature.org/
- Therapeutic Landscapes Network: http://www.healinglandscapes.org/related/play.html
- The Child and Nature Alliance of Canada: childnature.ca
- Every Child Outdoors: http://www.everychildoutdoors.org/landing
- Outdoors Foundation Special Report on Youth participation in the outdoors: http://www.outdoorfoundation.org/research.youth.html
- White Hutchinson summary of recent research:http://www.whitehutchinson.com/children/articles/benefits.shtml
- Outdoor Nation: http://outdoornation.org/

Getting kids outside

- Wilderness Society Youth Recreation: http://wilderness.org/youth-recreation
- National Wildlife Federation: Engaging 10 million kids outside! http://www.nwf.org/What-We-Do/Kids-and-Nature.aspx

Policy

- Outdoors Alliance for Kids (OAK): http://outdoorsallianceforkids.wordpress.com/
- State Environmental Education Roundtable: www.seer.org
- Let's Move Outside Campaign: http://www.letsmove.gov/lets-move-outside
- National Environmental Education Foundation (NEEF): http://www.neefusa.org/

Schools

- Green Schools National Network: http://www.greenschoolsnationalnetwork.org/
- Environmental Charter Schools (CA): http://ecsonline.org/our-approach/
- Common Ground School: http://commongroundct.org/
- Cedarsong Nature School: http://cedarsongnatureschool.org/
- Eastwood Forest School (UK): http://www.urbanforestschool.co.uk/

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3.7: Examples, sources of information and other key points from the discussion

Some of the examples, sources of information and key points from the discussion included the following:

Participants noted many exciting new initiatives that seek to improve child health through more contact with nature and the outdoors. Less well-known, but more long-standing, examples were also offered, alongside new research supporting the benefits of time spent outdoors:

- One avenue of "low-hanging fruit" in the effort to get kids active and outdoors is transport to school. In the last few decades bus and car travel has largely replaced walking and biking to school. Many initiatives seek to turn this trend by making active transport to school a better alternative for kids in many American communities. The National Center for Safe Routes to Schools has targeted fostering active transport as one of their primary goals, in addition to other concerns around safety. They combine community organizing

and activity planning with online mapping tools and trainings for parents and educators. See: www.saferoutesinfo.org

The Walking School Bus

A "walking school bus" is an innovative student transport concept that has been popular in Australia since the early 90's, when it was first "invented", and across Europe and New Zealand more recently.

In a walking school bus (according to Wikipedia) schoolchildren are "chaperoned by two adults (a 'Driver' leads and a 'conductor' follows)" and they "walk to school, in much the same way a school bus would drive them to school. Like a traditional bus, walking buses have a fixed route with designated 'bus stops' and 'pick up times' in which they pick up children." As you might expect, these walking programs are having a lot of success, validated across independent surveys and studies, in helping kids achieve at least the minimum levels of healthy daily activity.

A number of organizations in the US are working at the community-level to identify safe walking routes and spread the gospel of the walking school bus.

For more information see:

http://www.walkingschoolbus.org/ http://guide.saferoutesinfo.org/walking_school_bus/

The national advocacy group, the National Environmental Education Foundation (NEEF) has published a concise "fact sheet" on the connection between nature and children's health. It provides details on common health risks to children, trends in rising diseases like asthma and obesity, and the role that time spent outdoors can play in modulating more common disorders, like ADD and ADHD. For more information see: www.neefusa.org/assets/files/NIFactSheet.pdf

The Urban Wildlife Refuge Initiative of the U.S. Fish & Wildlife Service (USFWS) is an exciting new avenue for forming partnerships between child health and education programs and nature conservation and advocacy groups. "How do we teach a new generation to love the land," the USFWS writes in an announcement for the program, "when pavement is what they usually see?" This new initiative is based on an understanding that "Americans will have much of their direct contact with nature while in an urban setting, thereby shaping the nation's conservation values, ethics and priorities," requiring the USFWS "to reach beyond our boundaries." This initiative will seek to bring wild nature deeper into cities through new parks, expanded partnerships, and changed management strategies and values. Ten "demographically and geographically varied cities" will be chosen to host the program, which began

in 2010 and will soon leave the planning and recommendation phase. For more information see: americaswildlife.org/wp-content/uploads/2011/03/Urban-Initiative-Fact-Sheet.pdf

Increasingly concerned with lifestyle impacts on public health in the US, The Robert Wood Johnson Foundation recently began a "Culture of Health" initiative designed to foster more vibrant and healthy US communities through changed values. They envision an America, "Where good health flourishes across geographic, demographic, and social sectors. Where being healthy and staying healthy is an esteemed social value. And everyone has access to affordable, quality health care." Through their blog on this topic the Foundation shares "our thoughts and ideas on how best to realize this vision" and fosters active engagement "in the conversation." See: www.rwjf.org/en/blogs/culture-of-health.html

Section 4: How Might Possible Benefits or Risks To Health From Conserved Lands Best Be Managed?

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4.1 Background

Historically, public health improvements arrived hand-in-hand with land development and economic progress as vector-borne diseases carried by insects were reduced when wetlands were drained for agriculture, rivers straightened for navigation and urban sewers sealed underground. Moreover, aggressive spraying of pesticides in the United States following WWII subdued the mosquito carriers of dengue and malaria while progress in medicine and public health eliminated human infections.

Today however, habitat fragmentation and hydrological disruption have fundamentally altered ecological dynamics, even as climate change and globalization are rapidly shifting species ranges. Since pathogens may originate directly in animals ('zoonosis') and may be transmitted by biting insects ('vector-borne'), disease dynamics are heavily dependent on the ecological contexts surrounding insects and humans.

Central to this issue is the question: What are the risks to human health that may be posed by either more natural or more fragmented landscapes, particularly in the face of climate change?

Since landscape management and personal protection measures can greatly modulate personal risk factors, the conservation and health communities ought to be asking:

- How might natural areas either reduce or increase risks to human health?
- What are the resulting implications for management?

Answers to these questions may inform management of currently preserved areas, new park designs, and outreach strategies – and ultimately lead to new partnerships and collaboration among the land trust community, conservation funding agencies, public health officials and research scientists.

As we believe that other connections between land conservation and human health relating to such issues as water contamination, chemical pollution, or personal safety are well covered elsewhere, this section outlines a number of examples relating specifically to tick- and mosquito-borne diseases, which comprise the majority of infection risks posed to humans near conserved or fragmented lands. Given the scope and complexity of these issues, this section only presents a brief introduction to these topics.

4.2 How Might More Natural Areas Reduce Risks to Human Health?

The Millennium Ecosystem Assessment (MEA) highlights the protective services that intact and species-rich ecosystems can provide for human well-being (UNEP, 2005). The MEA synthesizes scientific findings that intact ecosystems may be less sensitive to invasion, buffer disease agents and resist the outbreak of infections. In their subchapter on "The Ecosystem Regulation of Infectious Disease," Patz et al. (2005) describe how altered habitats, niche invasion and biodiversity losses drive changes in disease risk. These effects are visible both at the landscape scale in studies that describe the overall distribution and occurrence of disease, as well as in theories that seek to mechanistically explain changing dynamics.

On a global scale, the MEA offers a number of examples where land cover conversion creates new disease risks. For instance, deforestation has been linked to increased malarial risk in Africa and South America (Patz et al., 2005). As forests are cleared for agriculture, rates of water infiltration decrease and surface water may pool in ways favorable to the reproduction of the *Anopheles* mosquitoes that carry malaria.

In addition to changes in hydrology, deforestation promotes interaction between pathogens, vectors and hosts because it:

- Decreases wildlife habitat;
- Fragments the landscape into patches; and
- Increases the "edge-effect," such that the borders between different habitat types increase in length and frequency (Patz et al., 2004).

In the United States, landscape characteristics such as forest fragmentation are also correlated with disease risk. A study by Brown et al. (2008) is widely cited as evidence that forest fragmentation in the context of urbanization increases human risk of contracting West Nile Virus (West Nile).

In the Northeast, the relative percentage of forested land to urban can predict incidence rates of West Nile. Specifically, counties in the lowest quartile of percent forested area relative to urban were shown to have a fourfold higher incidence of human West Nile infections than their more forested counterparts (Brown et al., 2008). Although this makes intuitive sense because urban areas concentrate human population, the dynamics of species within forested systems deserve closer investigation.

West Nile Virus

A relatively recent concern in North America, West Nile Virus was first described in 1937 in Uganda before it made the leap to New York City from Europe in 1999. Although four out of five people infected may show no symptoms, West Nile may cause fever and can ultimately cause severe neurological damage in elderly individuals or those with weak immune systems. New York State reported 13 cases of West Nile in 2012, leading to two deaths. As an arthropod transmitted virus (arbovirus), West Nile spreads when mosquitoes of the genus Culex seek a blood meal from an infectious host, such as a passerine bird (songbird) or a horse, and in turn transmit the virus from animal to human. For West Nile to persist in a landscape, conditions must be right such that mosquitoes encounter a host that has amplified levels of the virus. The ability of a host to support high viral load is often described as 'competence.'

For more information see: http://www.cdc.gov/ncidod/dvbid/westnile/index.htm

The infection dynamics of species within forested systems respond to both forest fragmentation and land cover. While all passerine birds, including species as different as robins and crows, are susceptible to infection, these species prefer different habitat and exhibit greatly different competence to amplify West Nile. The American Crow (*Corvus brachyrhynchos*) easily succumbs to the virus and die-offs have been used to investigate the spatial and temporal dynamics of disease spread. Crow population declines from disease were most pronounced in urban settings that had less than 35% forest cover and exhibited warmer winter temperatures (LaDeau et al., 2011).

Although the mechanisms are still unclear, landscapes with less forest cover appear to be consistently linked to higher disease incidence. Not all forest cover classes seem to behave the same, however. For instance, orchards were positively and preferentially associated with West Nile infection in robins, sparrows and horses. These effects also increased during times of drought (Crowder et al., 2013). Such results pose a number of interesting questions concerning the relation of habitat quality to species composition.

At the scale of individual forest fragments, patch size has indirect implications for disease risk – for example, smaller forests can be expected to have more ticks infected with Lyme disease. Based on the finding that woodlands smaller than two hectares support exponentially greater white-footed mouse (*Peromyscus leucopus*) populations relative to larger fragments, Allan et al. (2003) investigated the relationship between patch size, tick prevalence and rates of nymphal infection with the Lyme disease spirochete. Nymph infection density was found to exponentially decrease as patch size increased (Allan, Keesing, and Ostfeld, 2003).

An interesting question faced by European environmental restoration of pine plantations to more natural mixed forests is whether those changes are likely to increase Lyme disease risk. Tack et al. (2012) found that though restoration into semi-natural woodlands increased presence of deer beds and the regrowth of the understory increased tick habitat, prevalence of Lyme disease infection in nymphs was not found to be significantly different (Tack et al. 2012).

Lyme Disease

The U.S. Center for Disease Control confirms that Lyme disease affected between twenty and thirty thousand people in the United States each year between 2002 and 2011, with 96% of cases reported from 13 states in the mid-Atlantic, Northeast and Great Lake states (CDC, 2013). Lyme disease is caused by infection with the spirochetal bacterium Borrelia burgdorferi via the ixotid, or black-legged tick Ixodes scapularis (also by Ixodes pacificus in Western states). Typical symptoms include a bulls-eye rash, fevers, headache and fatigue. If left untreated, borreliosis can progressively cause joint pain and eventual neurological impairment. Other common co-infections include Babesia microti, Anaplasma phagocytophilum and encephalitis (Rickettsia sp).

For more information see: http://www.cdc.gov/lyme/

One hypothesis concerning disease relations to landscape, termed the 'dilution effect,' has been demonstrated in a number of settings ranging from vector-borne to purely zoonotic systems (Ostfeld and Keesing, 2012). In principle, biodiversity loss could either increase or decrease disease transmission depending on changes to the hosts, vectors or parasites that alter relative abundance, behavior and condition (Keesing et al., 2010).

However, increasing biodiversity modulates a number of factors that appear to 'dilute' pathogens and reduce their transmissibility. Such factors include:

- Relative abundance: the probability that an insect vector will encounter a host that is both a preferred blood source and a good reservoir is effectively decreased when an ecological community supports high species richness.
- Behavior: the probability of 'horizontal' (within species) transmission likewise reduces as encounters between individuals become relatively less frequent.
- Condition: genetically diverse populations are better equipped to fight disease on a population level due to variations in immunological competence.

The complex ecology of Lyme presents many opportunities to test the dilution effect. Ticks may feed on mammal, bird and reptile hosts in their development from larvae to nymph and adult life stages (LoGiudice et al., 2003; Schmidt and Ostfeld, 2001). Empirical re-

search shows that the ubiquitous white-footed mouse is comparatively poor at grooming off ticks and subsequently a good reservoir for propagation of the Lyme pathogen (Keesing and Ostfeld, 2012). By looking at the diversity of mammal species (including the deer that adult ticks hitchhike across the landscape on), measures of diversity and species richness can be correlated with overall disease burden.

The dilution effect has also been seen in diseases that can be transmitted directly. An experimental example in Panama demonstrated that removing non-reservoir species caused an increase in Hantavirus infection prevalence among host rodent species (Suzan, 2009). In other words, removal of rodents unable to contract Hantavirus increased rates of contact between susceptible individuals, leading to a spike in infection among reservoir species.

Hantavirus

Although viruses in the Hantavirus family are endemic to the Americas, they were relatively obscure in the U.S. until the 1993 'Sin Nombre' outbreak. The United States reported 587 cases between 1993 and 2012 that exhibited an astronomical 30 percent fatality rate, making it a rare but especially fatal disease. Hantavirus pulmonary syndrome results from inhalation of dust particles originating in rodent urine and feces that contain the virus. Infection may progress swiftly and treatment options are limited to supporting the immune system fighting the infection. Zoonotic hosts of the Hantavirus include deer mice (living in woodlands across the US), cotton rat (shrubs and tall grasses in the Southeast), rice rat (marshy areas in the Southeast) and white-footed mouse (east of the Rockies). Outside the US, cases have been shown to cluster after unusual rains, bamboo flowering, human disturbance, or land use change.

For more information see: http://www.cdc.gov/hantavirus/index.html

4.3 How Might More Natural Lands Increase Risks to Human Health?

Whether they are wetlands, meadows or forests, lands preserved from development will continue to provide critical habitat for a multitude of species – and anticipating future risks will be key to successful management. While the dilution effect has been demonstrated to reduce disease risk as reservoir species diversity increases, mathematical modeling shows that more diverse vector communities can also increase risk (Roche et al., 2013).

Over the past fifty years, more than half of all emerging infectious diseases (EIDs) originated with a zoonotic host. Of these EIDs, the majority, 71.8 percent, came from wildlife (Jones et al., 2008). Dr. Peter Daszak, president of the EcoHealth alliance, told *The New York Times*, "[a]ny emerging disease in the last 30 or 40 years has come about as a result of encroachment into wild lands and changes in demography" (Robbins, 2012 July 14).

The EcoHealth Alliance

The mission of the EcoHealth Alliance is to preserve biodiversity, conserve ecosystems and protect human health. Internationally active, the organization partners with local veterinarians and ecologists to promote nature preservation and actively track the threat of emerging infectious disease. Examples of work include "Project Deep Forest," which tests the health protection effect of biodiversity in Malaysia, and the "PREDICT" program that seeks to identify geographic hotspots of potentially emerging diseases.

For more information see: http://www.ecohealthalliance.org/

OneHealth

A concept championed by the veterinary, ecology and conservation communities is the idea that human, animal and ecosystem health are inextricably linked. 'OneHealth' seeks to bridge disciplinary and departmental boundaries by uniting doctors, veterinarians, the CDC, USDA and National Environmental Health Association with the mission of reducing vector borne and zoonotic disease. For examples of OneHealth in action, see the Disease Detection and Response Team of the National Parks Service.

For more information see:

http://www.onehealthinitiative.com

http://www.nps.gov/public_health/di/di.htm

One recent example of disease risk that may be exacerbated by human intrusion into natural areas is the Hantavirus, which is now receiving increased attention in the American West. Hantavirus presents an interesting case because ecological research has previously confirmed both a dilution effect and a forest-edge effect that mediate disease transmission. For instance, when they investigated a series of sites in Panama's national parks and forest, Suzán et al. (2008) found that forest edges and disturbed habitat had higher prevalence of Hantavirus reservoir host species.

After news of a Hantavirus outbreak in Yosemite National Park hit media outlets in the summer of 2012, the National Parks Service was faced with the difficult task of tracking and communicating risk factors to the 230,000 odd visitors the park hosted since early June (Jaret, 2012). In a posting updated September, 2012, the CDC confirmed ten cases of Hantavirus that resulted in three fatalities (CDC, 2012). A retrospective look at the chronology of events suggests that most of the cases originated at the 'Signature Tent Cabins' in

Curry Village, with one case identified at 'High Sierra Camps,' as a result of close proximity of campers to mice living in the insulated platform tent walls. It takes contact with mouse droppings that are no more than three days old to transmit the virus, as dry conditions, ultraviolet light, and time deactivate the virus. In this case, it was the comfortable habitat provided in the campers' living quarters that led to such a high rate of infection.

Exposure and Liability

In what case is a landowner or employer liable for illness contracted as a result of exposure to vector-borne diseases? In the 1993 case Grano et al. v. Long Island Railroad, rail employees were able to win damages after contracting Lyme disease while laying signal cable next to the tracks. In this case, liability was established as a consequence of Long Island Railroad's neglect in controlling trackside vegetation, which was held to interfere with normal employee duties. Although strict liability may not be clearly applicable to private lands, it is instructive that the railroads are required to respond to tick-borne disease by providing their employees information, insect repellent and a vegetation management plan. As with many legal issues, case law is apt to change and a lawyer should be sought for true legal advice.

For more information see:

http://www.maurerlaw.net/Articles/Lyme-Disease-and-the-Risks-for-Railroad-Workers-By-Ira-M-Maurer-Esq.shtml

Though the earlier discussion of the potential health risks of natural areas focused on landscape-scale risk, the personal, individual risk faced by those encountering nature can best be determined as a function of time spent outdoors in areas where exposure is possible. Human epidemiological data suggests that actual cases of Lyme disease are correlated with exposure to natural settings. While both tick density and infection prevalence are higher in ticks occupying small patches in a fragmented landscape, human cases of Lyme disease were found to be correlated instead with large and isolated habitat patches (Brownstein et al., 2005). Why might this be true? Such a finding seems counterintuitive to the basic epidemiological model, where human infection events ought to correlate with the absolute number of infected ticks.

The human use patterns of natural areas may bear closer scrutiny in this case, as one answer may be that recreational users simply spend more time in large isolated habitats, eschewing fragmented landscapes. It is also possible that urbanites, fleeing to forested areas for recreation, acquire the disease while recreating, but do not discover it until they are back in their home cities. In support of this hypothesis, Pepin et al. (2012) found a negative correlation between Lyme disease risk predicted by nymph infection and cases actually reported in Massachusetts.

It is important to overlay patterns of human activity that mediate disease transmission risk on the overall quality of landscape. Brownstein et al. (2005) argue that suburbanization decreases overall human risk because the number of properties adjacent to suitable habitats is inversely correlated with development. Suburban real estate may, in this theory, be crowding out the microhabitats that harbor deer, mice and ticks.

Once again, how humans use their landscapes matters. If your average suburbanite spends most of their time indoors, this will affect the number of infection cases reported, as ecology is uncoupled from daily exposure. On the other hand, suburbanites may find themselves facing greater exposures around their property as woodpiles, stone walls and leaf piles make excellent habitat for mice and ticks, and many mosquitoes thrive in lushly irrigated suburban yards.

The decline of top predators may also influence disease outbreaks. Population losses for predators such as owls, bobcats, coyotes and foxes due to habitat destruction and forest fragmentation have had far reaching consequences on the population of prey species like white-footed mice that today may act as disease reservoirs. Even mid-size predators require a scale of habitat not often preserved in contiguous remnants and they have suffered major population declines. As a result, natural rodent control is lacking precisely in those places where people and animals meet (Levi et al., 2012).

4.4 How are the Benefits and Risks of Natural Lands Likely to Shift Under Climate Change?

As climate change drives insects adapted to warmer climates further north and into preserved natural areas adjacent to human settlement, the risk of insect borne disease may increase. Scientists have thoroughly described the thermal tolerance of mosquitoes, but insects are cold blooded and some may exhibit a nonlinear response to temperature change. Tick range, for example, could shift North by 200km by 2020 and 1000km by 2080 (Patz et al., 2008).

According to the Intergovernmental Panel on Climate Change AR4 report, climate change is expected to increase rainfall in wet areas, such as the Northeastern US, and worsen drought in dry areas, like the Southwest (IPCC, 2007). Flooding from excess rainfall and storm surges have recently captured attention after the great damages caused by hurricanes Irene (2011) and Sandy (2012). As we extend the built environment, runoff patterns will change, altering the prevalence of breeding grounds for mosquitoes and possibly displacing subterranean rodents. By way of example, rat sightings have increased following hurricane Sandy, raising health concern in a New York City experiencing changing climates (Peeples, 2013a; Peeples, 2013b).

Changes in water availability can also change the way that animals interact with one another. Similar to West Nile Virus, St. Louis Encephalitis is spread by bird-biting *Culex* mosquitoes. Early spring drought drives *Culex* mosquitoes into dense, moist hammocks of vegetation cohabited by wild nesting birds, meaning land surface wetness changes will change animal-insect interaction rates (Shaman, 2013). Hydrological models that can predictively describe mosquito occurrence provide a key tool for identifying areas of potential disease outbreaks. Shaman et al. (2006) developed an ensemble seasonal prediction method that couples data on hydrologic conditions and human encephalitis outbreaks in order to predict infection risk two to four months in advance.

Emerging diseases linked to climate changes are not limited to novel pathogens but, indeed, also include old foes such as dengue fever (Florida Department of Health, 2012). Since establishment of a disease requires both the presence of the specific mosquito species able to transmit the pathogen and the arrival of an infected host, the probability of epidemic outbreak only increases if mosquitoes can overwinter in northern cities.

Across the nation, cities such as Philadelphia are seeking to meet their Clean Water Act requirements by increasing the number of green acres in an attempt to soak up and attenuate rainfall before it floods storm drain systems (Philadelphia Water Department and USEPA Region III, 2012).

While critics of the 'green infrastructure' approach may say that promoting runoff-capturing tree pits, bioswales and even stormwater wetlands might increase mosquito habitat if they fail to drain according to their design specifications, research suggests that reducing combined sewer overflow (CSO) events could in turn decrease ephemeral habitat for West Nile-carrying mosquitoes.

In a study conducted in Atlanta, Georgia, authors Vazquez-Prokopec et al. (2010) found a strong spatial clustering of West Nile cases in humans, blue jays and crows around streams affected by CSO events. The mosquito *Culex quinquefasciatus* breeds in polluted water and was found to have significantly higher rates of West Nile infection in streams affected by CSOs. By restoring the infiltrative capacity of natural areas in an urban setting, green spaces have the potential to reduce this particular source of West Nile risk.

Beyond Infectious Disease: Could There Be Other Threats to Health?

Urban communities face many health challenges posed by air quality problems. Soaring asthma rates, especially among inner-city youth, has led many to fear vegetation, like ragweed, as they are regularly implicated in seasonal allergies. Although urban trees have been shown to increase air quality and reduce asthma rates, someone with severe seasonal allergies may view every green leaf with suspicion. They would not be heartened to learn that pollen production is often higher in urban environments than in natural areas, likely as a strange result of increased CO_2, nitrous oxides and other air pollutants in urban areas (Ziello et al., 2012). Artificially raised CO_2 levels have been shown to hasten and increase pollen production in pine (LaDeau and Clark, 2006) and warmer temperatures are expected to both speed ragweed growth and dramatically increase pollen output (Ziska et al., 2009). Tracking public perceptions through research programs like the Baltimore Ecosystem Study of The Long Term Ecological Research Network will be critical for engaging communities in the future.

For more information, see: http://www.beslter.org/.

4.5 Implications for Managing Potential Health Risks from Natural Areas

If natural areas could increase human health risks, as in some instances they may – what might land managers do to help mitigate or avoid health problems from conserved lands? The many pathogens currently present (and likely to arrive) on natural lands present a complex challenge for management.

As will be discussed, for any long-term management strategy to be effective, it should be implemented with the cooperation of professionals such as officials from the local Mosquito Control District, medical entomologists and others with epidemiological expertise.

Monitoring and Mapping

Many state mosquito management programs and county mosquito control districts throughout the US have implemented sophisticated monitoring programs in order to target integrated pest management efforts more efficiently. For instance, Connecticut has established an extensive system of light traps baited with carbon dioxide that are used to collect mosquitoes weekly, June through October, in order to test them for the presence of arboviruses. Additionally, state-controlled wetlands are sampled for larvae in an effort to identify where larval insecticide application would be most effective and where landscape-scale management would be appropriate (CT DEEP, 2013).

Data Tools on the West Coast

Risk maps and real-time data feeds from state agencies provide a valuable tool for monitoring the threat of disease. "Fight the Bite" is the public face of campaign that coordinates data between the California Department of Public Health, the UC Davis Center for Vectorborne Diseases, the California Department of Food and Agriculture and the Mosquito and Vector Control Association of California. By providing a county-level count of West Nile Virus activity (defined as positive tests from humans, horses, dead birds, mosquito pools, sentinel chickens, and squirrels), "Fight the Bite" provides an informational platform and hotline for coordinating vector-borne disease information in the west.

For more information see: http://westnile.ca.gov

Public Education

Public perceptions of disease risk matter. Among a variety of things they can influence personal vigilance and willingness to spend time outdoors. Preventative behavior may play a large role in regulating final disease transmission risk, as insect repellent and long sleeves followed by a thorough self-inspection can dramatically decrease infection risk from mosquitos and ticks respectively.

From a managing agency perspective, three key prevention strategies have been identified by Piesman and Eisen (2008) to combat tick-borne diseases:

- Encourage avoidance of habitats at the peak season of insect activity;
- Spread objective information about risk (maps, risk factors); and
- Educate about personal protection measures (clothing, repellents).

Innovative outreach can greatly improve the impact of ecological and epidemiological risk mapping. A team at the Yale School of Public Health led by Dr. Durland Fish has developed an interactive iPhone app to help users identify whether they are in endemic lyme disease territory, screen for and remove ticks, and, should they need, identify local physicians with relevant expertise (Yale School of Public Health, 2013). Their source map on human infection risk is based on a 2012 publication that is the most accurate eco-epidemiological assessment to date (Diuk-Wasser et al., 2012).

In the Northeastern U.S., peri-domestic exposure is cited as the leading cause of infection, whereas recreational activity is responsible for most exposure in the West. While personal protection is the most effective way of ensuring personal safety, people may be reluctant

to use chemical repellents (e.g., DEET & permethrin) due to perceptions of possible toxicity. Although a number of natural alternatives derived from eucalyptus, catnip, geranium, lavender and cedar oils have been tested as alternative insect repellents, researchers have only described them as 'somewhat effective' and 'show[ing] potential' to date (Piesman and Eisen, 2008).

Pesticide Application

The classic example of a landscape historically feared as unhealthy comes from our perception of wetlands. Conditions that promote mosquito breeding, such as pooling or ponded water, puddles, drainage ditches and abandoned swimming pools increase the likelihood of disease transmission. The requirement for water in the mosquito life cycle has great implications for wetland restoration, but also for patterns of development that intrude upon intact wetland habitat. For instance, both proposed 'green infrastructure' solutions to the storm surge faced by NYC and the new wetland mitigation banking developments in New York State could face intense scrutiny for their effects upon public health (Feuer, 2012; Mascia and Brett, 2013).

In an urban population center such as New York City, the prerogative to protect public health and prevent a human epidemic often outweighs other public goods arguments. Manhattan was sprayed with the pesticide 'Anvil' as recently as the summer of 2012, in an effort to control mosquitoes that could carry West Nile Virus (CBS New York, 2012). Notwithstanding this, the application of pesticides is generally unpopular among many citizen groups, not the least of which are organizations charged with protecting the vitality of local ecosystems.

For example, the Massachusetts Audubon Society (Mass Audubon) has presented a comprehensive position on mosquitoes and mosquito-borne disease (as of May 2012) that is generally against widespread pesticide application. They make efforts to educate property owners on how to exclude themselves from nuisance control spraying but acknowledge that, in a declared public health emergency, even its own property holdings may be sprayed (Massachusetts Audubon Society, 2013).

In contrast to mosquitoes, ticks are rather more difficult to control through the use of pesticides because the nymphal stage is entirely terrestrial and hidden among forest vegetation. This did not dissuade Soviet pest-control experts from broadly applying DDT between 1965 and 1971, successfully reducing tick-borne encephalitis in the Soviet Union by 2/3rds (Piesman and Eisen, 2008). However, after the phase-out of DDT it took only two decades for encephalitis to rebound.

Fire Island: A Case of Applied Tick Management

Home to both a National Seashore and a year-round population that numbers in the low hundreds, Fire Island is a barrier strand off the southern coast of Long Island that provides a clear example of compromise between nature preservation and public health intervention. Complaining of extremely high risk of Lyme disease, communities embedded in the park have advocated for landscape-level vector suppression through pesticide application. This clashes with the mission of the National Park Service to preserve "unimpaired the natural and cultural resources and values of the national park system" – and especially with designation of Fire Island as a 'Wilderness Area.'

Rather than broadcasting pesticides, a highly targeted strategy was deployed. As a result of multi-year research and collaboration with state agencies and Cornell University, the island is now home to a number of '4-poster' devices that apply the pesticide permethrin to deer lured-in by grain dispensers. This targets ticks on their favorite carrier and limits application of pesticides overall. Proactively controlling ticks has been shown to decrease overall vector occurrence in the surrounding area.

Another popular method of tick control involves placing pesticide-soaked cotton balls in tubes around the base of a resident's home. Foraging mice use the cotton fluff to build their nests and in so doing eliminate many of the nymph-stage ticks that both bite mice and propagate great disease risk to humans. This method has been investigated since the late 1980s, showing significant reductions in ticks in suburban settings (Mather et al. 1988).

A key prerequisite to any effective management plan is proper categorization of disease risk by a qualified medical entomologist. For a thorough risk analysis that considers climate suitability, host occurrence and actual reported human cases, see the comprehensive science synthesis paper written by Dr. Howard Ginsberg from the USGS Patuxent Wildlife Research Center at the University of Rhode Island.

For more information see:

http://wildlifecontrol.info/tickstudy/pages/default.aspx

http://www.nps.gov/fiis/parkmgmt/deer-veg-management-plan.htm

http://www.nps.gov/aboutus/mission.htm

Landscape Management

The 'Working Group on Land Use Change and Disease Emergence' authored a research meeting report titled "Unhealthy Landscapes: Policy Recommendations on Land Use Change and Infectious Disease Emergence" (Patz et al., 2004). This policy analysis recommended a number of actions that may improve land management and public health, including:

- Bringing land use into public health policy discussions; and
- Promoting more research on deforestation and infectious disease, including:
    - Collecting more baseline data.
    - Improving disease and land relationship models.
    - Designing health-relevant decision support tools for land managers.

Smart design of parks, restoration of wetlands, and even routine landscaping create and opportunity to reduce the chance that disease vectors contact people or eliminate these vectors outright. Dr. Ginsberg comments that the ecologically and visually compelling 'Sunken Forest' on Fire Island had been an ideal habitat for ticks to lie in-wait for hiking visitors until the Parks Service built an elevated boardwalk, which both protected sensitive vegetation and reduced encounters with health risk (Ginsberg, personal correspondence, 2013 April 4).

Vegetation management is reported to be an effective means of reducing tick populations. Piesman and Eisen (2008) note that the controlled burns traditionally practiced by Native Americans across the East Coast consequently controlled both understory vegetation and tick populations. A number of leaf litter removal, brush management, cedar mulch and controlled mowing techniques may be more appropriate for heavily used properties, but can present a challenge for conserved lands. Increased sunlight, frequent mowing, wood chip, mulch or gravel perimeters all present a barrier to tick migration.

One corollary to this is that white-footed mouse density decreases as a function of distance into open space like old fields and it has been demonstrated that the density of nymphs and nymphal infection prevalence negatively correlates with distance from the forest edge (Horobik, 2001). In fact, in one study cited in a report from the Connecticut Agricultural Extension "Managing Ticks on Your Property," 82 percent of deer ticks were found within nine feet of the forest edge (Stafford, 2005). On a broader scale, categorization of landscape features on residential properties in Westchester County, New York, showed that the abundance of nymphs decreased with the proportion, frequency and area of lawn (Frank, Fish, and Moy, 1998).

Invasive plants can also tip the ecological balance in favor of unwelcome animal communities. Controlling invasive ornamentals may prove effective at removing niches that shelter disease vectors. For instance, Japanese Barberry is a landscape ornamental that has become a notorious invasive because deer eschew the shrub in favor of less spiky vegetation. As a result, thickets of barberry abound in deer-heavy environments, providing a particular safe haven for the white-footed mouse.

Control of the invasive barberry may well then have a positive effect on reducing suburban risk of Lyme disease. Land trusts would do well to pay even closer attention to the question of invasives removal, as one Connecticut homeowner asked in an online forum: "If someone has a conservation easement on part of their property that forbids removal of trees & shrubs, can they remove invasives like Japanese Barberry from the easement?" (Henderson, 2012 April 18; Musante, 2012 August 22).

Wildlife management and proper fencing can greatly reduce tick hitchhiking and overall population size. The explosion of white-tailed deer in suburban America is a familiar example of an animal thriving on both natural and peri-urban lands. Deer exclusion fencing reduced tick larvae, nymphs and adults between 74 and 100 percent in an area 300 feet from an electric fence (Stafford, 2005).

While certain backyard practices to "enrich habitat" may raise concerns about changing animal behavior and increasing disease exposures, Townsend, Ostfeld and Geher (2003) found no correlation between bird feeders and prevalence of Lyme disease, to allay one fear at least.

4.6 Possible Questions for Discussion

- Should land managers try to interpret and apply the results of statistical epidemiological models to improve public health? Are there significant barriers to this work or opportunities for collaboration?
- Does land conservation increase the amount of time people spend outdoors during peak insect activity?
- Would access restrictions and visitor registration policies improve epidemiological tracking?
- Are we doing enough to track the spread of invasive species? Does the answer to that question vary by region of the country?
- To what degree are insect control measures the responsibility of land managers and where should heavy pesticides be considered? Can we identify areas where pesticide use should be strongly avoided? Strictly limited?
- What liabilities do organizations acquire when they inform their members of specific health risks?

Some of the Organizations Doing Interesting Work on this Topic

- U.S. Center for Disease Control and Prevention (www.cdc.gov)
- One Health Initiative (http://www.onehealthinitiative.com)
- EcoHealth Alliance (http://www.ecohealthalliance.org/)
- Cary Institute of Ecosystem Studies (http://www.caryinstitute.org)
- Yale University School of Public Health (http://publichealth.yale.edu/index.aspx)

- Baltimore Ecosystem Study LTER (http://www.beslter.org/)
- California Department of Public Health (http://westnile.ca.gov/)
- National Parks Service Fire Island National Seashore (http://www.nps.gov/fiis/)

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4.7 Examples, sources of information and other key points from the discussion

Some of the examples, sources of information and key points from the discussion included the following:

- Participants noted that land trusts and other conservation organizations are already coordinating with local, state, and federal public health organizations/agencies to assure the safe use of natural areas for health promotion and better stewardship.
    - In its report From Fitness Zones to the Medical Mile, the Trust for Public Lands presents a number of new programs and places where efforts are being made to "maximize a park's ability to promote physical activity and improve mental health." This is discussed more in Appendix 2. For more information see: www.tpl.org/research/parks/economic-health-benefits.html

- Participants noted that public perceptions of health risks from exposure to nature or time spent outdoors do not often line-up with realities. People will generally over-estimate the risk from rare events, like exposure to exotic pathogens, while underestimating real and preventable risks, like dehydration. There is plenty of work to be done – and partnerships to be forged – in the effort to change public perception of risk, both to lower real risks and to get more people outdoors.
    - The One Health Commission is a great example of an organization doing such work. This non-profit organization was formed to further the mission of the One Health Initiative by establishing new communication programs and demonstration projects that can "transform the way human, animal, and ecosystem health-related disciplines and institutions work together." Couched at Iowa State University, the Commission has key collaborations with diverse organizations including the American Medical Association (AMA), American Public Health Association (APHA), American Veterinary Medical Association (AVMA), among others. For more information see: https://www.onehealthcommission.org/en/resources/one_health_commission/

Unique Partnerships to Reduce Risk – Cornell Department of Communications and the National Park Service

In the effort to improve public perceptions of health risks from nature, the Cornell Department of Communications has partnered with the National Park Service (NPS) to fine-tune the messaging around the One Health Initiative (described earlier in section 4).

In a description of the collaboration the Cornell Center for Wildlife Conservation says: "Poorly crafted risk messages could decrease public support for species conservation, lessen tolerance for wildlife, or – in extreme cases – initiate backlash against certain species." "Well-crafted risk messages," meanwhile, "may be able to connect the concept of One Health and zoonotic disease risk to garner support for biodiversity and species conservation."

Cornell professors with expertise in communications, ecology, entomology, and natural resource management are working with scientists and project leads at the NPS to craft new, accessible educational media for public consumption.

For more information see: ccwc.cornell.edu/index.cfm/group.show/Riskcommunicationwiththeo.70.htm

- In the urban environment better stewardship of existing open spaces can lead directly to public health gains. One workshop participant noted the success that a regional initiative in California's San Joaquin Valley is having as they seek to improve community safety and children's health simply by keeping school playgrounds open after school. Without requiring new infrastructure or transportation alternatives, such initiatives can expand access to open space almost overnight.

- For a great source of information on the latest science of the benefits of nature in urban areas see the Green Cities: Good Health web portal, which forms a collection of good, recent peer-reviewed literature. See: http://depts.washington.edu/hhwb/Thm_ActiveLiving.html

San Joaquin's Joint Use of School Grounds

In the neighborhoods of California's San Joaquin Valley childhood obesity is a growing concern and open space, where children can safely pursue active recreation, is limited.

In response to these related issues, school officials and neighborhood residents have partnered with a public health organization, the Central California Regional Obesity Prevention Program (CCROPP), to easily expand open space in a surprising way: helping schools keep their park grounds and recreation areas open before and after school.

These school green spaces are already built and spaced across the community - but many barriers keep them closed after school hours, including liability and vandalism concerns. "When it comes to using school space … the liability issue can be a show- stopper," one of the project leads noted in a review of the program.

Through creative collaborations and strong community engagement this initiative has already had some success, helping keep a number of school grounds open longer and later. For more information see:

www.partnershipph.org/gallery/story/san-joaquins-joint-use-school-grounds-pixley

- Participants also noted that there are many new resources from public health institutions detailing health risks from disease vectors in natural landscapes and, increasingly, management strategies for how to limit these risks.

Emerging Diseases from Natural Landscapes: More Resources

A number of new resources are available on the nature of risk from infectious diseases emerging from natural lands. Howard S. Ginsberg, workshop participant and a scientist at USGS Patuxent Wildlife Research Center, provided some information on where to turn for details on how to identify or manage health risks from some of the most common vector-borne diseases acquired in America's natural landscapes:

Tick-borne

An excellent general resource for tick-borne diseases is the CDC website which has a page specifically devoted to tick-borne diseases (www.cdc.gov/ticks/). To determine which tick-borne diseases might be a problem in your area, consult the distributional maps on page 4 in the CDC publication Tickborne Diseases of the United States (www.cdc.gov/lyme/resources/TickborneDiseases.pdf).

Another useful online resource for information about ticks and about risk and management of tickborne diseases is the tick encounter website (www.tickencounter.org).

A valuable resource for information about ticks and the pathogens they carry, and practical information about tick management and tick-bite prevention (especially in the northeast), is the Tick Management Handbook by Kirby Stafford, published by the Connecticut Agricultural Experiment Station (www.ct.gov/caes/lib/caes/documents/publications/bulletins/b1010.pdf).

Mosquito borne

The major mosquito-borne pathogens in North America are arboviruses (arthropod-borne-viruses), with the most common being West Nile Virus (WNV), which causes one to several thousand cases per year. Other mosquito-borne viruses include Eastern Equine Encephalitis Virus, Western Equine Encephalitis Virus, St. Louis Encephalitis Virus, and Lacrosse Encephalitis Virus.

These viruses typically present most risk to humans in late summer and early fall, and have distinctive geographical distributions. Maps of their distributions are available at the disease maps website (diseasemaps.usgs.gov).

The CDC website has an excellent page about WNV (www.cdc.gov/westnile/index.html). Information on prevention is available in the publication West Nile Virus in the Unites States: Guidelines for Surveillance, Prevention, and Control (www.cdc.gov/westnile/resources/pdfs/wnvGuidelines.pdf).

Information about mosquito-borne diseases in general is available at websites of the CDC (www.cdc.gov/ncidod/dvbid/arbor/arbdet.htm) and the Association of State and Territorial Health Officials (ASTHO) (www.astho.org/Programs/Environmental-Health/Natural-Environment/) under the heading 'Vector-Borne and Zoonotic Diseases'.

In cases where you are specifically concerned about vector-borne diseases at a given locale, I suggest contacting local or state health departments and mosquito control districts for specific information and guidance."

– Howard S. Ginsberg, Ph.D., USGS Patuxent Wildlife Research Center

Section 5: Could Increasing Access to Health Care be an Effective Incentive for Sustainable Management of Working Lands?

Christopher R. Rooks
Yale School of Forestry & Environmental Studies

"Distribution of medical services to rural people is more expensive, and their means of payment are less, than in urban areas. Rural people thus have an interest in the solution of the national problem of the distribution of medical care; few groups have more to gain."

– Calvin W. Stillman, Journal of Farm Economics, 1949

The rising cost of health care in the U.S. and dwindling access to health services in rural communities are creating new challenges and opportunities for landowners and the conservation community. This chapter explores demographic trends and financial concerns among owners of working lands, the risks these trends and concerns pose to achieving sustainable land management and conservation goals, and recent efforts to create financial incentives linking these goals with rural health care access and coverage.

5.1 Health Care Challenges In Rural America

Achieving access to high-quality healthcare in rural areas is becoming increasingly difficult (Seshamani, 2009). Health care services are more expensive in rural areas and, not surprisingly, so are insurance rates. Rural patients will pay more for equal or, often, lesser coverage than their urban counterparts (RUPRI, 2009). And, increasingly, mergers and closures of health care institutions in rural areas are leading to reduced numbers of clinics (McNamara, 2009).

These trends of low healthcare access and affordability may soon become critical issues for the land conservation community. Nearly half the private forestland in the U.S. is owned by people aged 65 years or older, a population prone to health issues requiring long-term care (Butler, 2008). Many of these families are "land rich and cash poor," with forest hold-

ings representing their largest and most valuable assets upon which to draw in times of need. As a result, when faced with medical costs in emergency situations or unplanned long-term health care needs, rural landowners may be forced to harvest timber unsustainably or sell significant tracts of their forest for development. There is also a greater likelihood that landowners would need to move to an urban area for specialized long-term care, which risks further severing family ties to land and increasing parcel sales or development (Mater, 2012). Similar concerns face private family owners of farms, ranches, and other lands with significant conservation values.

Research conducted by the Pinchot Institute for Conservation suggests that healthcare-related risks to working forests and sustainable land management may be growing. A multi-year survey of landowners, including a series of interviews with over 1,000 families across five states, indicated that unaffordable medical expenses and the desire to insulate children from the financial burden of long-term care are emerging as important financial factors in landowner decision-making about their forests (Pinchot, 2012). In the context of generational shifts in land ownership, these concerns often ranked equal to or higher than "taxes" or "job loss" among families that would prefer to keep their land working and owned within the family.

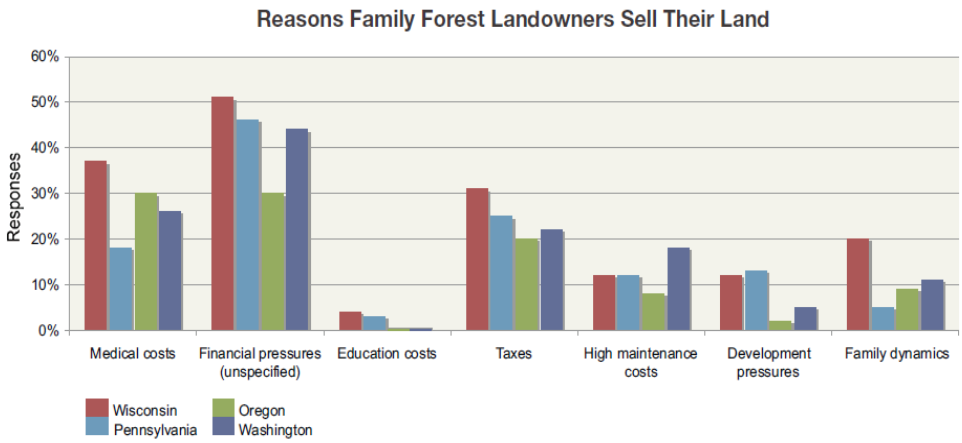

Image Source: Pinchot Institute for Conservation

In many rural communities, small medical service providers are not only the engines of health care delivery but they are also important employers and drivers of economic activity. This is especially true in aging and shrinking communities that have been historically dependent on extractive resources (Brown, 2011).

On the other side of the coin, health care providers in rural areas face their own challenges. They are generally small, with modest assets or financial resources, and often must provide care without the benefit of the larger health networks available to institutions in urban

centers. Rural health facilities also serve a higher portion of low-reimbursement patients, those without insurance or with low-paying Medicare and Medicaid coverage. Rural facilities also struggle to recruit and maintain a highly technical workforce, pay for increasingly expensive liability insurance premiums, replace and upgrade aging facilities, and procure and adopt new technologies and information systems. When a rural health care facility succumbs to these or other pressures and closes, it is unlikely that it will ever reopen (McNamara, 2009).

Recognizing the importance of maintaining cost-effective rural health care delivery systems, there is significant interest among states and medical industry associations in researching and piloting policy interventions that lower costs, improve health and preserve community healthcare services. In light of the multitude of challenges facing rural landowners in accessing care, and to rural healthcare systems in providing it, now is a particularly good time to ask whether and how land conservation organizations might assist in this effort.

5.2 How Might Conservation Organizations Help Rural Landowners and Healthcare Providers Address These Issues?

The economic conditions of landowners and communities facing the health care challenges described above are intertwined with the fate of many working forests, farms, ranches, and other privately owned lands that hold important environmental and cultural values for a variety of conservation interests.

While these connections between land conservation and human health are indirect, the confluence of such interests — combined with new conservation and health care financing mechanisms — has nonetheless presented new opportunities for innovative interventions to link and address them together.

Several domestic organizations are currently exploring and developing initiatives to create incentives for conservation and sustainable land management that specifically address the healthcare-related financial liabilities faced by landowners and the threats posed to rural livelihoods generally. Meanwhile, other programs in the U.S. and abroad may offer valuable lessons to inform the further development of such efforts.

Forest Carbon & Healthcare

Building on the results of its study on the demographics and healthcare concerns of aging forest landowners and their children, the Pinchot Institute recently partnered with PacificSource Health Plans to launch a project to provide healthcare payments to landowners derived specifically from the sale of carbon credits from their forests.

The Forest Health-Human Health Initiative

The Pinchot Institute's "Forest Health-Human Health Initiative" (FHHHI) is a national program introduced in 2010 that aims to help private owners of woodlands meet rising healthcare costs and resist development pressures by allowing them to pay for health-related expenses using the value of the environmental public benefits provided by their sustainably managed lands. Through a novel chain of value-adding linkages, FHHHI aims to connect the carbon in sustainably managed private forests, the health care industry's imperative to offset its carbon footprint and increase rural access to health care, and rural landowners' need to access affordable health care.

FHHHI is engaging with rural forest owners to develop carbon credits through the American Carbon Registry (ACR), which recently established new protocols specifically for family forest landowners. Under the twenty-year ACR contract, these carbon credits are generated from certified sustainable forest management practices, such as longer harvest rotations, rather than from longer-term preservation protocols with restrictions that have prevented many forest owners from the entering existing carbon markets, according to the Pinchot Institute.

Proceeds from the sale of these credits are provided to landowners in the form of regular cash deposits to an ATreeM™ card, a flexible new debit card from PacificSource Administrators that can be used anywhere for healthcare expenses such as prescription purchases, wellness care, dental care, co-pays, and insurance deductibles. Unlike other health savings accounts, flexible savings accounts, and health reimbursement arrangements, the ATreeM™ card does not require participation in any personal or employer-provided health insurance plan and is, therefore, expected to be particularly useful for the rural landowners that FHHHI is targeting. A portion of the proceeds will also be allocated to support rural healthcare clinics and networks.

FHHHI is also engaging with companies throughout the health care industry to purchase the carbon credits generated from sustainably managed private forests. They are especially targeting health care companies that not only have an interest in maintaining rural access to health care, but are also participating in the Carbon Disclosure Project[1], a voluntary initiative that commits companies to disclose their carbon emissions. It is estimated that the health care sector produces eight percent of the U.S.'s annual greenhouse gas emissions, providing significant incentive for these companies to offset that impact through sustainable forestry projects that benefit their patients and customers (Chung, 2009).

[1] Carbon disclosure Project Global 500 Climate Change Report 2012 (https://www.cdproject.net/enUS/Pages/global500.aspx)

FHHHI is currently being piloted in and around the rural northwest Oregon town of Vernonia (population 2,380), a once-bustling timber community in the Oregon Coast Range with large amounts of privately owned and very productive forestland, an economy transitioning away from timber production, few high-wage jobs, an aging population, and low rates of healthcare coverage (City of Vernonia, 2012). Efforts are underway to secure Oregon tax-exempt status for the ATreeM™ card, which would further increase its value for participants. Based on the outcome of this FHHHI pilot project in Vernonia, the Pinchot Institute hopes to expand the program to other communities and regions across the nation.

For more information see: http://www.pinchot.org/gp/FHHHI

Aligning Policies and Incentives Around Conservation and Healthcare

Building further on the research on the demographics and healthcare concerns of aging forest landowners and their children, the Pinchot Institute has joined forced with the Willamette Partnership to explore other opportunities to use payments for ecosystem services to connect the conservation of non-forest working lands in Oregon—such as farms and ranches that provide critical habitat for endangered species—with funding for landowners' healthcare and financing to address the healthcare access and delivery challenges faced by rural communities.

Though the federal government spends large sums of public money to incentivize conservation practices through programs such as the USDA's Conservation Stewardship Program, the results of these expenditures are rarely accounted for in such a way that their actual ecological benefits may be quantified. Recent advances in the development and application of sophisticated systems for measuring ecosystem services and tracking their credits' transactions[2], however, have enabled new levels of rigorous accounting for ecosystem services markets and incentive programs for conservation and biodiversity.

At the same time, in an effort to reduce the cost of health care—particularly Medicare and Medicaid, which represent a growing proportion of rural health funding—the federal government has granted healthcare waivers for states to experiment with new cost-saving healthcare delivery approaches (e.g., Coordinated Care Organizations to move portions of the health delivery system away from the fee-for-service model).

Meanwhile, many private owners of ranches and farms, including those in ecologically sensitive areas of states with healthcare waivers, have demonstrated that their choice of livelihoods and land management practices are often aligned with family, tradition, and lifestyle concerns, rather than being motivated by profit alone.

[2] The Willamette Partnership's Ecosustem Credit Accounting System (a package of protocols, tools, and resources that allow buyers and sellers to trade in multiple types of ecosystem credits) is a notable example. For more information see: http://willamettepartnership.org/ecosystem-credit-accounting.

These three factors – new ecosystem services accounting systems that allow for standardized and rigorous measurement of federally-funded conservation project benefits, federal waivers for states to experiment with new health care delivery systems, and the non-monetary motivations of many private landowners in ecologically sensitive rural areas that also face healthcare funding challenges – present opportunities for conservation organizations to play a role in helping to develop integrated solutions that bridge healthcare and conservation programs while saving taxpayers money.

Additional interdisciplinary research is needed on the relevant demographic, socio-economic and ecological factors at play in resolving these issues or developing new response tools, as well as on the funding flexibility and leverage points within different federal agencies to develop effective synergies between applicable healthcare and conservation programs. The Pinchot Institute and the Willamette Partnership are together developing a feasibility study, in collaboration with state healthcare policy specialists, to engage with government agencies and assess the options, pathways and implementation possibilities to expand healthcare coverage to priority conservation landowners in Oregon. This study will focus on opportunities afforded by the Oregon Health Plan and Oregon's unique federal healthcare waiver, such as the possibility of offering Medicare Advantage (a PPO/HMO type plan) for landowners producing measureable ecosystem services and of adjusting reimbursement rates for hospitals treating conservation landowners. It will also analyze the feasibility of establishing a new venture to deliver healthcare to rural landowners that protect and restore ecosystem services on their land.

Related Domestic and International Initiatives

A timber industry trade organization in Maine has developed a professional training and certification program that includes sustainable forestry practices in addition to its primary focus on improving worker safety. Certain types of loggers certified under this program are eligible for significantly reduced worker's compensation rates.

The Certified Logging Professional Program

The Maine Tree Foundation's Certified Logging Professional (CLP) program was founded in 1991 to establish a standard for safety and professionalism in the Maine timber industry, which was at the time experiencing a high rate of logging-related Worker's Compensation costs. A programmatic four-day training workshop covers first-aid and CPR, forest management and silviculture, safe and efficient timber harvesting, and related business skills.

Three of the 32 hours of training required for certification are devoted to "Conserving Fish and Wildlife" and "Water Quality and Logging," with a focus on compliance with applicable laws and regulations. The CLP's seven-part Code of Ethics includes "the professional logger protects our natural environment and enhances our natural resources."

Of the five certification categories offered by CLP, "Mechanical loggers" (i.e., harvesting equipment operators) currently enjoy state Worker's Compensation rates that are 69% lower than their non-certified counterparts. Loggers certified under other categories (including skidder/chainsaw operators, employers, supervisors, foresters, truckers and apprentices) do not receive reduced Worker's Compensation rates.

For more information see: http://www.clploggers.com/

An NGO in Indonesia is using access to health care as an incentive for villagers living around an ecologically significant national park to stop illegal logging, plant trees, and protect and restore watersheds.

Alam Sehat Lestari / Health in Harmony in Indonesia

Alam Sehat Lestari (ASRI) is an Indonesian NGO that works with local communities to integrate high-quality, affordable health care with strategies to protect the threatened rain forests of Gunung Palung National Park and improve the health and livelihoods of about 60,000 people living along its border. In partnership with the US-based organization Health In Harmony, ASRI combines health care, conservation, environmental education, and training in alternative livelihoods and medicine in Sukadana, West Kalimantan, Indonesia.

Communities in this impoverished region have long suffered from poverty and poor health, which has resulted in illegal logging of the area's tropical rainforests to pay for basic needs, including health care. As a result, habitat for rare and endangered species has been destroyed, fields have flooded and destroyed crops, and standing water has increased the incidence of diseases like malaria and dengue fever.

To address these social and environmental problems, ASRI implements several programs including a health clinic that provides free birth control for village women, free childhood immunizations, general medical care, a pharmacy and dental care, as well as a mobile clinic offering similar services in small villages around the national park. For the paid services, villagers can barter items used in conservation projects (e.g., seedlings for reforestation, manure for organic farming) and provide labor for reforestation projects. Communities that cease illegal logging within the park also receive extra discounts for ASRI's health care services.

ASRI also operates a reforestation program that engages local villages in restoration of the tropical rainforest, trains farmers in organic gardening to reduce slash-and-burn agriculture, and conducts conservation outreach and education to villagers with a focus on children.

All of ASRI's activities reinforce the connection between human and environmental health. Health In Harmony plans to replicate this model of "attaching care of the person to care of the earth" in other communities elsewhere around the world.

For more information, see:

http://alamsehatlestari.org/

http://www.healthinharmony.org/

In Tanzania, The Nature Conservancy and its partners have launched a project integrating family planning, primary healthcare and conservation in an area where extreme poverty and a growing population threaten a critical ecosystem and habitat for endangered species.

The Nature Conservancy's "Tuungane" Project in Tanzania

Tanganyika, the world's longest lake, holds 17 percent of the world's fresh water and is home to over 300 species of fish. Directly to its east, the Greater Mahale Ecosystem is nearly five million acres of mostly forested landscape home to about 93 percent of Tanzania's 2,800 endangered chimpanzees, many of which live outside the boundaries of Mahale Mountains National Park.

Sharing this landscape are indigenous communities of small-scale farmers and fishers that rely on the area's natural resources, their lives and livelihoods inextricably tied to the landscape. Lacking access to health services, education and modern contraception, the population of the remote villages in the area is growing rapidly along with settlements and farms. As a result, forests are being cleared for agriculture and sediment is damaging coastal zones and fisheries.

In partnership with several other international organizations and Tanzanian government agencies, The Nature Conservancy's Tuungane (Kiswahli for "Let's Unite") project is a community-focused effort to address these threats and improve the area's resilience by integrating support for women's reproductive health with conservation goals. The project's goals also include strengthening forest management, enhancing co-operative local management of fisheries, improving access to health care information and services, and diversifying and improving livelihoods through improved food security and access to markets.

By unifying these efforts around the theme of women's empowerment, The Nature Conservancy is leveraging women's connection to the growth, health and prosperity of families and communities while promoting a balance between the needs of people and nature's provision of fresh water, clean air, and fertile soil. "Day after day, we see that meeting women's needs for reproductive health services is not only a basic right, it is also a powerful development strategy with a host of environmental benefits," The Nature Conservancy says.

For more information, see:

http://www.nature.org/ourinitiatives/regions/africa/wherewework/tuunganeproject.xml

5.3 Some Possible Questions for Discussion

- Can program models such as the Forest Health-Human Health Initiative be applied to other ecosystem service benefits, such as protecting/improving water quality, habitats and biodiversity? Can existing markets or incentives for these services be used to expand health care access?
- Might healthcare funding represent a potential non-cash government incentive for landowners implementing quantifiable conservation benefits? Could states with federal health care waivers offer such landowners Medicare Advantage (a PPO/HMO type plan) or subsidize their long-term care? Would this require large policy or mission changes on the part of the government agencies or their partners? If so, what coalitions or associations could be brought together to advocate for such changes?
- Related to this question, can we envision a route for rural hospitals, in exchange for providing health care to conservation landowners, to gain increased access to grants, low-cost loans, new-market tax credits, etc. to finance medical facility upgrades? Could such hospitals receive increased Medicaid and Medicare reimbursement rates?
- Can ecosystem services accounting provide sufficient quantitative rigor for the measured benefits of conservation outputs and funding to be equated on a dollar-for-dollar basis with those of the healthcare system? Can standards be developed and accepted to allow such fungible exchanges across federal agencies subject to strict financial audits and oversight regimes?

Some of the Organizations Doing Interesting Work on this Topic

- Pinchot Institute for Conservation's Forest Health-Human Health Initiative has conducted valuable research on the demographics and healthcare funding concerns of families that own private forests. (http://www.pinchot.org/gp/FHHHI)

- Willamette Partnership's Counting on the Environment program is advancing the development of functioning ecosystem services markets through powerful innovations such as their Ecosystem Credit Accounting System in order to accelerate the pace, scope and effectiveness of conservation. (http://willamettepartnership.org/)

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Section 6: Appendices

Appendix 1: Cooling the Urban Heat Island

David R. Krause
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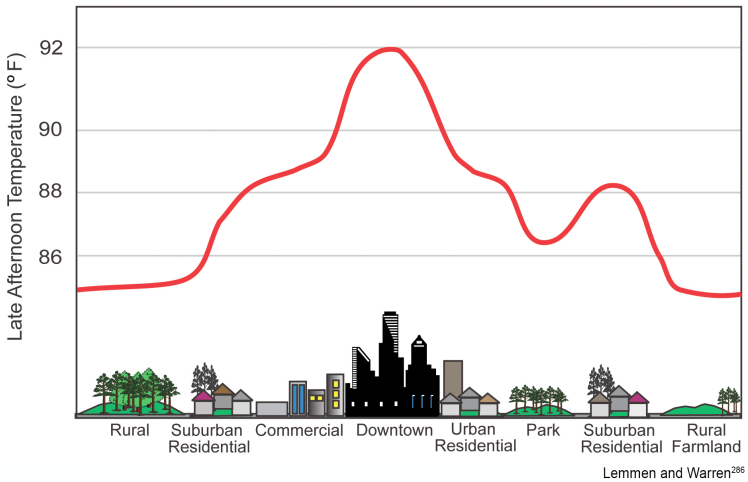
Background

Climate change is expected to increase the frequency and severity of extreme weather events. In large urban areas, heat waves are weather events of particular concern because of their impact on vulnerable populations (the very young, elderly, or infirm, outdoor athletes, etc.) and resulting increases in acute hospitalizations and mortality events.

Notable heat waves have contributed to a high number of fatalities over the last several years. During the summer of 1995, a short but intense heat wave was responsible for the death of over 1,000 people in the Midwestern United States, with more than 500 of these mortalities occurring in the City of Chicago (Changnon et al. 1996, Palecki et al., 2001). In 2003, an estimated 14,800 deaths were attributed to a heat wave that occurred in France (Kovats and Ebi, 2006).

A phenomenon known as the "urban heat island effect," is largely to blame for the exacerbated harm of heat waves in urban and suburban environments. The heat island effect describes the results of developed landscapes, with large buildings and concrete structures, absorbing and retaining more heat from the sun than natural, undeveloped lands. Heat islands are observed in areas primarily comprised of buildings, asphalt, bare soil, or short grasses. During summer months areas with these surfaces may be up to 10ºF warmer than nearby woodlands (Kim, 1992). The following figure represents this temperature disparity clearly.



Large amounts of concrete and asphalt in cities absorb and hold heat. Tall buildings prevent heat from dissipating and reduce air flow. At the same time, there is generally little vegetation to provide shade and evaporative cooling. As a result, parts of cities can be up to 10ºF warmer than the surrounding rural areas, compounding the temperature increases that people experience as a result of human-induced warming.

Image Source: U.S. Global Change Research Program (www.globalchange.gov)

The Benefits of Natural Areas in Urban Settings

The presence of vegetation and undeveloped open spaces can help to alleviate the burden of the heat island effect in developed suburban or urban environments. Leaves and branches from trees and shrubs provide shade and help to reduce the amount of solar radiation that comes in contact with the built environment. When trees are in leaf during the summer, only 10 to 30 percent of the sun's energy reaches the area below the canopy (Bell et al., 2008). Additionally, evapotranspiration of water from leaf respiration significantly cools the air around vegetation. Suburban areas with mature trees can be 2 to 3ºF cooler than suburban environments without trees, while air temperature within tree groves can be 5ºF cooler than in open fields (Bell et al., 2008).

In addition to reducing the heat island effect, planting trees, increasing vegetation and protecting open spaces within developed areas can have the notable impact of reducing air pollution, an effect with significant human health implications. Vegetation may remove pollutants from the environment through the uptake of gaseous pollutants and through dry deposition (Bell et al., 2008). Additionally, vegetation can reduce energy consumption from devices like air conditioners, and decrease power plant peak emissions (EPA, 2002). A recent study calculated that in one year urban trees in the United States removed 784,000 tons of air pollution from the environment, a service with a value of $3.8 billion (Bell et al., 2008).

Chicago Trees Initiative

Since its devastating heat wave in 1995, the City of Chicago has been a leader in climate change adaptation. Partnering with a very large group of community organizations, state and federal agencies, and developers, The Chicago Trees Initiative hopes to achieve a citywide average tree canopy cover of 20% by 2020 to create a "greener and healthier city." This program's emphasis on health speaks to the close relationship between both the environment and residents' wellness.

For more information see: http://www.chicagotrees.net/

There is then a distinct opportunity for land trusts and public health practitioners to form partnerships in the urban arena to work together to reduce heat and air pollution impacts on public health. Substantial health, economic, cultural and aesthetic benefits make a strong case for this type of initiative.

Possible Questions for Discussion

- Can lessons and achievements from small-scale urban tree planting initiatives be applied to the conservation of larger tracts or corridors of open space within cities?
- How might conservation organizations and public health professionals work together to increase vegetation within urban environments? Do their mandates overlap sufficiently to target the neediest communities?
- Can public health networks be tapped to assist in the stewardship of existing natural spaces in urban neighborhoods, which necessarily experience greater daily stress than their rural counterparts?
- How can the extensive co-benefits of urban vegetation be better communicated to policymakers and the public?

Some of the Organizations Doing Interesting Work on this Topic

- Alliance for Community Trees (ACT) is a national organization with member groups, ACT focus on the environmental and community benefits of urban tree planting. See: http://actrees.org/
- TreeVitalize is a large public-private partnership within Pennsylvania, this organization seeks to build urban forestry capacity by promoting the numerous benefits of trees and vegetation within cities. See: http://www.treevitalize.net/
- Urban Resources Initiative is a nonprofit-university partnership, U.R.I. works to improve and develop urban forests, teach green skills and develop community in New Haven, Connecticut. See: http://environment.yale.edu/uri/

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Appendix 2: Obesity, Exercise, and the Outdoors

Karen A. Tuddenham
Yale School of Forestry and Environmental Studies

"The link between lack of physical activity and obesity has now been documented and provides a compelling case, during the ongoing debate on health care reform, for promoting greater outdoor activity as a cost-effective, preventive approach to better health."

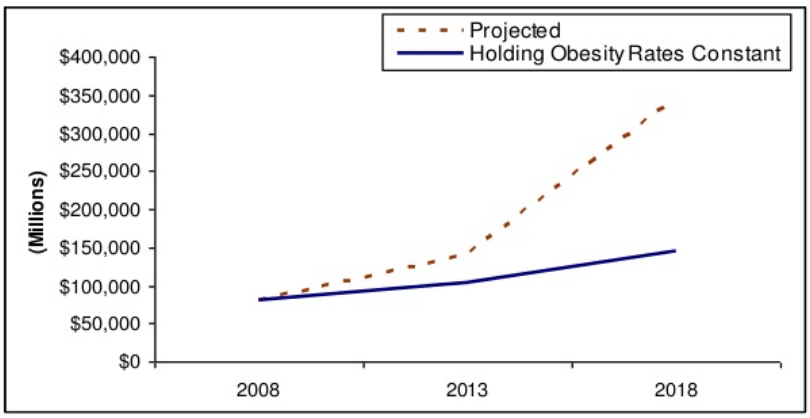
- Outdoor Review Board 2009

A Growing Epidemic

More than 35 percent of American adults are obese (CDC, 2012). In addition to direct impacts on quality of life, obesity predisposes individuals to heart disease, stroke, liver disease, sleep apnea, hypertension, osteoarthritis, multiple types of cancer and Type II diabetes. Currently, one in nine Americans have diabetes, but the number of people with "prediabetes" (higher than normal blood sugar) is far greater. At current rates, forty years from now nearly one third of the American population could have diabetes (CDC 2012). This suite of debilitating illnesses holds tremendous costs both for those who are ill and for society at large. Avoidable deaths, high health care costs and years of lost productivity follow these trends. In 2000, obesity-related diseases were the second leading cause of preventable death in the U.S. (Baxter 2011).

The US spends nearly $147 billion every year on the direct and indirect costs of obesity (Kuo, 2010). In 2006, medical spending for obese people was $1,429 greater than for people of normal weight (CDC, 2012). Healthcare costs related to obesity are projected to rise precipitously over the next decade, even if obesity rates remain constant (Baxter, 2011). In this environment, it is critical to focus on preventive care that will improve long-term health outcomes while simultaneously reducing costs.

Total Obesity-Related Direct Health Care Spending, U.S. (2008-2018)



Source: Thorpe, 2009

It is well-known that physical activity reduces the risk of a plethora of health problems, obesity and many of the diseases mentioned above, including colon cancer, osteoporosis, Type II diabetes, depression, cardiovascular disease and hypertension. However, a whopping 40% of adults in the U.S. report that they participate in no leisure physical activity whatsoever (McCurdy et. al., 2010).

Snapshot: Troubling Health Trends

- 35.7% of US adults are obese
- One in nine US adults have diabetes
- One in three children in the US are overweight
- 17% of US children are obese
- $147 billion is spent every year in the US on the costs of obesity.

Source: http://www.cdc.gov/obesity/data/adult.html

These dire numbers are unfortunately characteristic of a human population that now spends most of its time inside, sitting at desks and staring at screens, rather than outside, doing physical labor. Our work environments are stressful, highly-structured, and sometimes sterile. At the same time, the domestication and development of formerly wild, open spaces in cities means that even in our leisure time, it is harder and less pleasant to be outside. We are becoming creatures of the urban environment. The cities most Americans now live in were designed with the automobile in mind, not the pedestrian. Neighborhoods with reasonable walking distances between services and accessible green spaces seem to be less common than ever.

Only seven percent of the trips that Americans make in urban areas are conducted on foot or bike. Compare that to 46 percent in The Netherlands (Baxter 2011). The probability of obesity is directly correlated with the number of minutes spent in a car every day, and America is a nation of drivers (Frank, Andresen, and Schmid, 2004). Changes in diet, including increased consumption of fats, sugars, and highly processed food have exacerbated these health risks.

Meanwhile, it is not just adults who are suffering: a 1997 study showed that having obese parents more than doubled the risk that children would become obese adults. Parental habits become family routine and, if that routine is largely inactive, it is likely that children will suffer the consequences (McCurdy et.al., 2010). Rising numbers of children and young adults with health issues like asthma, Type II diabetes, obesity, ADHD and Vitamin D deficiency are attributable in large part to the sedentary, indoors lifestyles that so many of today's youth lead (McCurdy et. al., 2010). One in three children in the United States

today is overweight, and 17 percent are considered clinically obese. The current generation of children in the U.S. is the first whose lives may be shorter than those of their parents.

The Potential Role of Access to Natural Areas

Outdoor physical activity is a powerful, low cost health treatment and preventative healthcare tool, one that can be enjoyable and sustainable in the long term. Helping Americans get out and enjoy nature has long been, and should continue to be, a goal of many land trusts (some of which have been detailed in these reports).

Some new studies have found outdoor exercise to be particularly useful for supporting the health of children and adults. One study in Indiana found that on average, children living in greener neighborhoods weighed less (controlling for age, sex, neighborhood income, neighborhood density, and family income status) and were less likely to show weight gain over a two-year period than children living in less green neighborhoods (Bell, Wilson, and Liu, 2008 in Kuo, 2010).

A recent study from Australia found obesity indicators in young children decrease in relation to time spent outdoors, while vigorous physical activity increased (Cleland et.al., 2009). Other research has found that participants in outdoor exercise may enjoy it more, and thus be more likely to exercise frequently, than participants in indoor exercise. Exercisers also walk faster, train harder and find exercise less "demanding" when they recreate outdoors (Gladwell et. al., 2013).

An additional component to this is worth mentioning here: in general, minority populations and communities of color have some of the highest rates of diabetes and obesity in the country. Often, minority or otherwise disadvantaged communities in inner cities are the ones with the least access to green park space or wild land. Increasing outdoor recreation and improving access to green space for lower income neighborhoods could be an opportunity to even the gap and help ameliorate some of the other health problems these communities may be faced with (McCurdy et.al., 2010).

Solutions and Innovations

A number of institutions are pioneering new tools and approaches to managing obesity and public health through increasing activity and environmental engagement in select communities. Some examples of these efforts are detailed below.

Monitoring Public Health through the Environment

Natural Health England is a group that promotes public health and engagement with the outdoors. Information from its publication Monitor of Engagement with the Natural Environment (MENE) is being used by local health councils to assess and understand the health of residents, especially as it relates to how they use their outdoor space. http://www.naturalengland.org.uk/ourwork/research/meneandhealthfeature.aspx

Prevention through Design

The City of New York has published a set of what it calls "active design guidelines," to create healthier, more sustainable neighborhoods and citizens. These guidelines formalize ev-

idence-based strategies in architecture and urban design that can promote physical activity and healthier eating. They are a manual of best practices for architects and city planners to layout better streets, buildings, and public spaces. For example, the placement and design of walking paths, bike trails and green space is likely to affect how many people actually use them. Sustainable design strategies, such as LEED certification are also considered in how they might interact with active design (NYC.gov, 2013)

Health Insurance Companies for Healthy Environments

Kaiser Permanente, the largest private health insurance company in California, has started to take an active role in communities where it works to decrease obesity and promote healthy environments.

In Northern California, Kaiser partners with other organizations to investigate recreational and health needs in communities, increase and enhance outdoors spaces for recreation, and advocate for land use planning that will provide better access to green space. They have helped build bike paths and community gardens, and promote a number of other initiatives, including access to local food, safe walking routes to school, greater use of parks, trails, and other active public spaces, and joint use agreements (joint funding and use of open space like parks between park and local school).

From 2005 to 2011, Kaiser Permanente gave more than $6 million in grants related to open space, including efforts focused on underserved communities, active living, and other creative partnerships. For more information see: http://info.kaiserpermanente.org/communitybenefit/html/index.html

The Trails Challenge

Last year, 10,000 participants took part in the Trails Challenge, a self-guided hiking program that gives participants incentives to get out and hike in East Bay Park, promoting fitness and enjoyable outdoor recreation. A partnership between Kaiser Permanente of Northern California and the Regional Parks Foundation has offered free registration to residents of two counties. Registrants are given information about trails and parks, and challenged to log hikes on at least 5 trails, or 26.2 miles, before sending in their log for a pin. For more information see: http://www.regionalparksfoundation.org/page.aspx?pid=582

Joint Use for Recreation

Kaiser Permanente has also been promoting the use of Joint Use Agreements. These legal agreements can open up school facilities, including outdoor play space, to communities during after school hours to promote increased physical activity. Other versions of these agreements, which help defuse liability and property damage issues, allow outside groups to use school recreation facilities, while agreements between school districts and municipal government can open recreational facilities up to use by each other or by other parties.

Parks for Health

The Trust for Public Land (TPL) has worked across the U.S. to improve park systems and facilities. It has also spearheaded multiple health-focused initiatives such as building outdoor "Fitness Zones" with exercise equipment accessible to the public and improved programming to draw in participants to parks. With a focus on mixed-use, beauty, usability, connectedness and access, their parks have changed the landscape in neighborhoods that formerly had little open space. TPL also pursues innovative partnerships with city health departments and hospitals to improve the health of local communities.

Further Opportunities

CDC's Division of Nutrition, Physical Activity, and Obesity, currently funds state initiatives that address obesity and chronic disease by improving the environments in which Americans live, work, and play. Among the recommendations that CDC makes are taking active transport to school or work (such as biking or walking), improving school-based physical education, enhancing urban design to promote physical activity and developing better local food systems and access to farm-grown produce. The most explicit mention of nature it makes is in strategy 16 in its recommendations for communities – "Communities should improve access to outdoor recreation facilities" (CDC, 2012).

Any of these efforts to encourage active lifestyles represent potential opportunities for land trust community engagement. From the public health end, organizations like the CDC could take an active role in partnering with land trusts to expand outreach about the benefits of outdoor exercise and encourage the development of a national culture that facilitates people's outdoor recreation.

Possible Questions for Discussion

- How can we design open space that balances the use for recreation and exercise with conservation/habitat uses?
- How much infrastructure is needed for exercise on conserved land?
- Can health care institutions or insurers help contribute to the costs of maintaining access and infrastructure improvements on conserved land used by their clients?

Some of the Organizations Doing Interesting Work on these Topics

- Change Lab Solutions is a law and policy think tank focused on innovative solutions to tackle problems like childhood obesity. See: http://changelabsolutions.org/publications/model-JUAs-national
- The Obesity Society is a major clearinghouse website for research, education, and action on obesity. See: http://www.obesity.org/
- Let's Move Outside is a national government campaign to provide information and resources for kids and families to get active and have better to access outdoor recreation opportunities. See: http://www.letsmove.gov/lets-move-outside

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David R. Krause is a Master of Environmental Management and Master of Public Health candidate at Yale University. David's academic and professional interests center around how natural systems contribute to human health, and how conservation can improve health outcomes and access to health care. Prior to beginning his graduate studies, David worked at the Connecticut Agricultural Experiment Station's Center for Vector Biology and Zoonotic Disease and for the Subsistence Branch of the United States Fish and Wildlife Service on remote Yukon River tributaries. Most recently, David has worked for the Wild Salmon Center on policy to protect drinking water sources and wild salmon habitat in Western Oregon, and on a public health and community development initiative in southwest Alaska. He received his B.S. (Cum Laude) from Cornell University in 2008. David enjoys growing heirloom vegetables and is an avid angler.

Karen A. Tuddenham is a Master of Environmental Management candidate at the Yale School of Forestry and Environmental Studies. She has a particular interest in the effects of outdoor education on cognitive and social development in children. During her career as an outdoor educator, she worked with a variety of populations, including adults and children with mental and physical disabilities, inner city youth, and veterans. She continues to work for the Berkeley Scholars group with the goal of understanding the connections between existing health care and conservation networks in and around New Haven. She hopes to identify new space for innovative collaborations between these different communities based on the growing body of research that draws direct connections between human health and natural environments.

Sarah Barbo is a Master of Environmental Management and Master of Business Administration candidate at Yale University. She graduated with a degree in biology from the University of Dayton and then served five years in the U.S. Army as a Medical Services Officer, working in logistics and operations with a specialization in environmental health for a combat brigade. Her current work focuses on water resource management and the private sector. She hopes to develop innovative strategies to navigate the competing and overlapping demands of the business sector, human health, and natural resource management.

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REPORT AUTHORS Bradford S. Gentry, David Krause, Karen A. Tuddenham, Sarah Barbo, Benjamin D. Rothfuss, and Christopher Rooks.

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