Nature as a mental health intervention: State of the science and programmatic possibilities for the conservation community

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Abstract

Evidence suggests that exposure to nature and natural stimuli benefits individual and community-level mental health, leading to new efforts to incorporate mental health benefits into land conservation design, policy, and programming. This article summarizes the existing evidence about nature exposure and mental health and presents findings from a six-month knowledge-generation exercise conducted through the Yale School of the Environment to identify best practices and potential programmatic activities for the parks and land management sector to support youth mental health through nature-based, outdoor programming. Key recommendations include details on: (1) starting conversations about mental health and nature within the community, (2) recognizing organizational limitations and pursuing partnerships, (3) engaging communities in program development, (4) providing welcoming spaces to build participant comfort, and (5) creating programming that is flexible and adaptable, and becomes more challenging over time. Potential nature-based pilot activities include: (1) low-input ideas for short-term programming, one-off events, or reconfiguration of messaging materials, staff training, and the composition of the organization's board of directors; (2) medium-input ideas for partnering with outside organizations to connect existing user groups to preserved lands and expand activity offerings; and (3) high-input ideas for generating new programs, typically with organizational partners. The land conservation and parks stewardship sector has a unique opportunity to provide mental health benefits to the communities in which it operates, potentially raising the profile of conserved lands as important and beneficial for society.

Introduction

Expanding evidence suggests that individuals experience mental health benefits from contact with natural spaces (e.g., parks, gardens, wilderness) and natural stimuli (e.g., microbiota, plants, animals, weather) (Bratman, Hamilton et al. 2012; Kuo 2015; Bratman, Anderson et al. 2019). Efforts are now underway to translate these environmental-psychological findings into landscape design (Belčáková 2018), ecosystem-service modeling (Bratman, Hamilton et al. 2019), forest management (Stigsdotter 2017), public policy (Public Health England and National Parks England 2017; Public Health England 2020), educational programing (Gustafsson et al. 2012; Mutz and Müller 2016), and clinical care (Reuben 2019; South et al. 2020). This work provides an opportunity

for the conservation and land management community, including individuals and institutions who oversee parks and preserves, to engage new audiences in conservation if land managers can embrace mental health benefits as an additional form of "nature's contributions to people" (Díaz, Demissew et al. 2015; Díaz, Pascual et al. 2018).

This article summarizes the existing evidence about nature exposure and mental health (Section 1, Review of the literature) and then presents findings from a six-month knowledge-generation exercise conducted through the Yale School of the Environment to identify best practices and potential programmatic activities for supporting youth mental health through nature-based, outdoor programming (Section 2, Knowledge-generation exercise findings).

1. Review of the literature: Evidence on the mental health benefits of nature exposure

A number of reviews have comprehensively evaluated the existing evidence about mental health benefits of exposure to nature and natural stimuli (see Bratman, Hamilton et al. 2012; Gascon et al. 2015; Bratman, Anderson et al. 2019). This section briefly summarizes some of the most informative evidence, organized by target population (individuals from the general population, individuals with mental health concerns, local "neighborhood" communities) with an emphasis on mechanisms of effect and dosage.

While the precise mechanisms of effect are still being characterized, evidence to date has generated a number of hypotheses about potential pathways of natural stimuli influence on mental health (Markevych et al. 2015). Briefly, the three best-described pathways are: (1) the reduction of physiological stressors, like noise, heat, and air pollution, which have been associated with worse mental health (i.e., a physical-stressor-based pathway); (2) the provision of unique spaces for social interaction, self-reflection, and physical activity, which have been associated with better mental health (i.e., a behavior-based pathway); and (3) the reduction of sympathetic nervous system activity (i.e., the fight-or-flight stress response) and/or restoration of cognitive resources through evolutionarily designed pathways, both of which have been associated with reduced emotional distress and improved stress coping (i.e., a cognitive/nervous-system-based pathway).

Nature exposure as a preventative intervention for the general population

Observational and experimental studies indicate that nature exposure can provide moderate psychological benefits for general-population audiences. The following lists detail findings about psychological outcomes from cross-sectional and longitudinal observational studies of individuals exposed to nature passively (e.g., through the neighborhood environment) or through active outdoor programming not undertaken as a healthcare intervention.

General evidence

- Across numerous studies, adults who live in greener neighborhoods tend to report better mental health (Gascon et al. 2015). Although this association may be biased by residual socioeconomic confounding (Reuben, Arseneault et al. 2019), as greener neighborhoods tend to be wealthier, complex study designs have strengthened the inference that neighborhood greenery may have a causal effect on mental health. For example, when followed over time, individuals who move to greener neighborhoods tend to report fewer symptoms of mental distress (e.g., low mood, low ability to concentrate, etc.) following the move, with improvements sustained over multiple years, suggesting a given individual may experience a higher "baseline" mental health in greener neighborhoods (Alcock et al. 2014).
- Children living in greener neighborhoods demonstrate fewer problematic behaviors and show fewer symptoms of anxiety, depression, and somatization (feelings of physical distress), irrespective of socioeconomic circumstances (Madzia et al. 2019). Relatedly, children also appear to cope with stressful life events better (e.g., they demonstrate less psychological distress) when there is more nature around the home (Wells and Evans 2016).
- Systematic review of studies of youth outdoor programming have identified consistent patterns of improvement in child self-esteem, feelings of mastery, interpersonal comfort, ability to manage emotions when upset, and overall stress following evaluation of most, though not all, outdoor / adventure programs (Tillmann et al. 2018).
- Childhood exposure to natural stimuli has also been robustly linked to adult outcomes years later. Among approximately 1 million study participants, children raised in the greenest neighborhoods in Denmark were reported to be 55% less likely to develop a mental illness in adulthood than their peers raised in similar but less green neighborhoods, regardless of family socioeconomic circumstances and history of mental illness or of neighborhood socioeconomic circumstances and levels of urbanicity (Engemann et al. 2019).

Mechanistic evidence

A number of studies have provided evidence specifically

tied to evaluating the three proposed pathways for nature exposure effects on mental health: physical-stressor-based, behavior-based, and cognitive/nervous system-based.

- Evidence supports a *physiological "stress reduction" pathway* for green space effects (i.e., lowered physiological stress arousal—either due to lowered physical stressors such as noise and heat or due to lowered sympathetic nervous system activity). In counterbalanced within-subjects field experiments in Japan and the US (where the same participant experiences both the "treatment" and control conditions), study participants demonstrated lower cortisol stress hormone levels, pulse rate, blood pressure, and sympathetic nerve activity following forest walks compared to city walks (Hartig et al. 2003; Park et al. 2010). In the US, these participants also demonstrated improved attention and affect.
- Evidence supports a *behavioral pathway* for green space effects, with green spaces utilized as uniquely good places for engaging in behaviors that improve mental health, including physical activity and social interaction. In numerous studies, residents of greener neighborhoods have been found to be more physically active, in childhood (Grigsby-Toussaint et al. 2011; Reuben, Rutherford et al. 2020), adulthood (Coombes et al. 2010; Sugiyama et al. 2013), and older age (Astell-Burt et al. 2014; Dalton et al. 2016), with more social contacts and greater neighborhood social cohesion (Kweon et al. 1998; Maas et al. 2009; Peters et al. 2010; Fan et al. 2011; de Vries et al. 2013).
- Evidence supports a *cognitive pathway* for green space effects (e.g., enhanced cognitive flexibility or control over thoughts). Study participants asked to complete a 90-minute nature walk have reported significantly reduced levels of rumination, or anxious worry, accompanied by reduced activity on magnetic resonance imaging scans in brain areas linked to psychological distress (Bratman, Hamilton et al. 2015). In similar study designs testing direct attention and working memory, young adults perform better on cognitive tasks after nature walks than after city walks (Berman, Jonides, and Kaplan 2008). Finally, in brain-activity studies, viewing natural stimuli virtually (i.e., on digital displays) has been found to evoke neural activity similar to that associated with meditation, which improves cognitive control and flexibility (Chung et al. 2018).

Evidence about dosage

- Individuals who spent at least 60 minutes in natural environments each week were significantly more likely to feel that they were in good health and to report being satisfied with their lives as compared to those with no nature contact (White et al. 2019). These findings from a population-representative survey of approximately 20,000 United Kingdom (UK) citizens held after adjustment for individual-level measures of age, sex, socioeconomic status, health problems and disabilities, and physical activity, as well as for measures of individuals' neighborhood quality, greenery, and economic status (White et al. 2019). Researchers found that feelings of good health and well-being peaked among those experiencing over 120 minutes of weekly nature exposure.
- Outdoor exercise in natural settings (e.g., forests, woodlands, urban parks, farmland/countryside) has been robustly associated with improvements in mood and self-esteem "irrespective of duration, intensity, location, gender, age, and health status" (Barton and Pretty 2010: 3947). This was the conclusion of a meta-analysis of 10 studies in the UK, which reported that mood benefits accrue quickly (within five minutes) and marginally improve at longer durations of outdoor exercise (up to an entire day) (Barton and Pretty 2010). The presence of water in the setting was found to increase effects. A systematic review of studies comparing outdoor to indoor exercise have reported mixed results owing to too few high-quality studies, but generally support the conclusion that mood and enjoyment are greater following outdoor exercise, though physical effects (e.g., exercise exertion and intensity) may be the same (Thompson Coon et al. 2011; Lahart et al. 2019).
- Questions about dosage of nature exposure can also include differences in the intensity of the nature experience. Recent meta-analysis of experimental studies comparing mood benefits in actual versus simulated natural environments found that both conditions appear to reduce negative affect among study participants but that only actual natural environments increase positive affect (Browning et al. 2020). This finding is further supported by at least one qualitative study of park users who report better mental health and more meaningful experiences at more "intense" nature doses (i.e., in larger, wilder spaces) (Lev et al. 2020).

Nature exposure as a therapeutic intervention

There are few examples to date of empirically tested nature-based clinical interventions for individuals with existing mental health concerns (i.e., nature-based therapies). The following lists detail findings about psychological outcomes following exposure to natural stimuli among clinical or at-risk populations. In comparison to the large, general population studies discussed earlier, these studies typically have small

sample sizes but utilize experimental designs with control groups to better approach causal inference.

Children with attention deficits

- In a small, counterbalanced, within-subjects 2009 study of 17 children with attention-deficit/hyperactivity disorder (ADHD), guided 20-minute nature walks resulted in significant improvements in attention compared to city walks. The effect sizes reported were comparable to pharmacological intervention (Faber Taylor and Kuo 2009). While compelling, these findings should be interpreted with caution, as, to best of our knowledge, no study has yet replicated these results. However, a nationwide survey of US parents identified that activities conducted in outdoor natural settings appear to reduce ADHD symptom more than other common activities regardless of child age, gender, family income, or geographic region (Faber Taylor and Kuo 2011).

Adults with depression

- In a counterbalanced within-subjects design with a small overall sample (N=20), depressed individuals primed to ruminate on a negative past event who walked for 50 minutes in a natural setting demonstrated improved mood and memory capacity compared to when they walked for an equal time in urban settings (Berman, Kross et al. 2012). They did not ruminate less.
- A four-week gardening-based therapy intervention for adult patients with anxiety and depression found significant overall reductions in stress compared to patients in a control art-therapy intervention, and significant reductions in anxiety symptoms in men, though not in women (Vujcic et al. 2017).

Other clinical groups

- Low-income parents of patients served by an urban pediatric clinic with a majority non-white patient population who were taken on nature outings or counseled on the health benefits of nature demonstrated significant reductions in stress over multi-month follow-up (Razani et al. 2018).
- Among active-duty US Navy service members with psychiatric (e.g., post-traumatic stress disorder [PTSD], depression, etc.) or physical (e.g., traumatic brain injury, etc.) diagnoses, participation in a six-week surf therapy program resulted in significant reduction of symptoms of depression, anxiety, and negative affect within surf sessions and modest reductions overall (i.e., across sessions and after program completion) (Walter, Otis, Ray et al. 2019).
- Among nursing home residents across the US, those surrounded by more green space and tree cover are less likely to experience depression (Browning, Lee, and Wolf 2019).

Overall findings from systematic review

- A 2011 systematic review of studies of "nature-assisted" therapies (e.g., those conducted in natural settings, from horticultural therapy to wilderness adventure programs) for any health conditions (not just mental) found consistent evidence of moderate efficacy for improvements in domains such as physical activity, cardiovascular health, mental health, and overall mortality (Annerstedt and Währborg 2011).
- A 2019 systematic review of 133 studies measuring health outcomes following "immersive nature-experiences" (i.e., non-competitive activities in natural environments outside home or work) versus control conditions found consistent positive effects across studies in the domains of psychological well-being, psychosocial function, cognitive performance, and social skills and relationships (Mygind et al. 2019).
- A 2018 systematic review of studies of "nature exposure" influence on pediatric mental health identified positive associations in half of all identified studies (Tillmann et al. 2018).
- All three reviews noted significant shortcomings in the literature, which represent research gaps that must be filled before nature-based therapies can receival financial support as healthcare interventions (e.g., coverage by health insurance). Primary shortcomings include low sample sizes, lack of double-blinding, lack of adequate comparison conditions, and lack of participant randomization into treatment vs. control groups. Although evidence suggests that nature-exposure provides clinical benefits, it is not yet clear to what extent these benefits may support or interact with existing front line mental health treatments, including pharmacology and psychotherapy, which typically produce better results when combined (Anton et al. 2006; Hofmann et al. 2009; Vitiello 2009).

Nature exposure as a neighborhood community-level intervention

While targeted intervention can bring patient populations into natural settings, a body of evidence also suggests that greener residential environments afford neighborhood residents mental health benefits and, further, that proactive changes to the environment can elicit improvements in mental health.

The following bullets detail findings about psychological outcomes at the neighborhood community level (as opposed to the individual level).

- Across the European Union, neighborhoods with better access to green spaces and recreational areas demonstrate lower levels of socioeconomic inequality in mental well-being, meaning that the gap in mental well-being between people who are financially strained and those who are financially well-off is lower when parks are present (Mitchell et al. 2015).
- A study comparing cities across the Netherlands reported that antidepressant prescription rates tend to decrease as the proportion of green space within the city increases (Helbich 2018).
- In a cluster-randomized control study in Philadelphia, neighborhoods that received a pocket-park intervention (converting vacant lots into parks) saw community-level rates of poor mental health, feeling "depressed," and feeling "worthless" decrease by 63%, 42% and 51%, respectively, after park installation compared to no intervention. Cleaning vacant lots but not installing usable green space generated no discernable mental health benefits (South et al. 2018).
- Across three towns in southern England, rates of depression, anxiety, and stress were significantly lower when tree canopy cover was >20% (Cox et al. 2017). This indicates that there may be greenery thresholds above which the population prevalence of mental health issues is significantly reduced.

2. Knowledge-generation exercise findings: Potential to transform evidence into practice via outdoor programming for youth mental health

If nature exposure has a causal impact on psychological health, as existing evidence now suggests, the land conservation and parks stewardship sector have a unique opportunity to provide mental health benefits to the communities in which they operate. This can happen passively, by increasing the accessibility of natural lands for recreation, or actively, by concerted organizational efforts to communicate and develop programming that can foster connection and engagement with natural spaces to promote mental health.

Globally, estimates suggest that one in five people meet criteria for a mental disorder at any point in time (Steel et al. 2014), with a prospective longitudinal study suggesting that *most people* (>85%) will develop a diagnosable mental illness at some point in their lives (Schaefer et al. 2017). Pervasive stigmatization of and discrimination against those with mental disorders, and public inattention to mental health needs, means that the availability and quality of services is far lower than is needed in most countries and especially in low-income countries (Vigo et al. 2016). If the land conservation and management sector can play a larger role in supporting community mental health, millions worldwide could benefit, with a greater proportion of the population viewing conserved lands as important or beneficial for society.

In an effort to aid the translation of empirical evidence about the mental health benefits of nature exposure into practice, a knowledge-generation exercise surveying health-focused youth programming with natural or outdoor components currently employed in the US was conducted to identify best practices and pilot programming ideas that may be useful to the conservation sector. Youth were selected as the target programming audience because mental health problems tend to first emerge in childhood and adolescence (Kim-Cohen et al. 2003; Caspi et al. 2020), and because earlier emergence of symptoms tends to result in more severe cases with higher comorbidity and worse educational and occupational outcomes (Hartman 2019; Caspi et al. 2020). The conservation sector was chosen as the target program developer because this sector has the greatest capacity to provide *new* mental health benefits and has generally low awareness of mental health programming options or needs.

The knowledge-generation exercise followed two stages from January to June 2020. First, a targeted non-systematic literature review was conducted to identify existing best practices and case studies in the areas of overlap between the mental health, nature exposure, outdoor recreation, and youth health programming fields.

Second, targeted semi-structured interviews about challenges, best practices, programming ideas, and lessons learned were conducted with US experts and program managers engaged in: (a) youth-focused mental health programs with outdoor components; (b) youth-focused physical health programs with outdoor components; and (c) adult-focused mental health programs with outdoor components. Interviewees were identified through the initial literature review, pre-existing author knowledge, and snowball-style sampling whereby interviewees were asked to nominate other experts involved in similar work (Sedgwick 2013), which is an efficient research method for sampling of rare or difficult-to-identify study participants. Initial interview recruitment utilized participants and case studies detailed in the report of the Yale University-organized 2013 Berkley Workshop on "Improving Human Health by Increasing Access to Natural Areas" (Gentry et al. 2014). Interviews were conducted on a rolling basis over a six-month period. In total, 22 experts agreed to be interviewed and an additional 5 responded to email-based correspondence. They included mental health clinicians and practitioners, parks and health program managers, private land-trust employees, and researchers

in health and psychology. Following interviews, qualitative material was synthesized to identify consistent themes, recommendations, and best practices, which are summarized later in this article.

Table 1 lists consulted programs by type. In total, they covered 13 US states representing all geographic regions, including the South, Northeast, Mid-Atlantic, Midwest, Intermountain West, and West Coast, and included both urban and rural programming. See Himschoot, Lloyd, and Reuben 2020 for a more detailed description of the knowledge-generation project, including methods and consulted programs.

The following presents a short summary of the findings, including key recommendations on developing and deploying programming, gleaned from experts; and pilot programming ideas organized from (a) low-input activities to raise awareness of the mental health benefits of nature exposure, to (b) medium-input activities that involve partnering with outside organizations, to (c) high-input activities that involve developing health-focused programs new to your organization or community.

Key recommendations for developing and deploying nature-based or outdoor programming for youth mental health

Be willing to start the conversation about mental health and nature within your community. While professional members of the conservation sector reported awareness of the new empirical findings about the psychological benefits of nature exposure, few had engaged their surrounding local communities, practitioners, or land-user groups and stakeholders in discussion of these benefits or considered programming targeted at mental health. A recommendation emerged to "begin the conversation about mental health," to join the global effort to reduce mental health stigma, begin building relationships with the mental healthcare sector to identify potential programmatic partners, and raise awareness of the potential psychological "ecosystem service" provided by preserved lands.

Recognize your organization's limitations and pursue partnerships. Leaders from successful youth-focused programs with natural components noted that partnerships with organizations in other sectors, particularly youth health and education, were key to developing lasting programs that avoided redundancy at the community level and leveraged parks and preserves effectively. A recommendation emerged for the conservation sector to focus on offering welcoming and accessible natural spaces for program activities and finding partners that could bring new users to those spaces or expand existing programming. The report "Improving child & adolescent mental health through outdoor programming" (Himschoot, Lloyd, and Reuben 2020) includes a list of potential partners in the US context, both nationally and locally.

Engage your community in program development. Experts noted the importance of starting program development with community engagement for several reasons, with "community" considered broadly to include all individuals with a stake in managed land or the capacity to benefit or be harmed by programming. The reasons why are threefold. First, to find potential organizational partners (e.g., local groups that can engage new users or deliver new programs). Second, to avoid redundancy with existing community programs and to have a firm understanding of where to add value by addressing priority community needs or user groups. Third, to foster community ownership and long-term support for the program. Engagement can best begin by meeting community members where they already are (e.g., by attending annual community events, town halls, and planning meetings) or by inviting business, spiritual, health, and community leaders to tour preserved lands and share their perspectives on how nature-based experiences could best serve the community. Particularly good local engagement opportunities are afforded by *Community Health Assessments*, a health-needs assessment and delivery planning exercise required of hospital systems every three years by the 2010 US Federal Patient Protection and Affordable Care Act.

Provide an accessible and welcoming space for program participants that builds comfort over time. Experts noted that, regardless of their design, nature-based activities can be intimidating for the uninitiated, particularly for key demographics of interest when considering mental health benefits, including youth at risk for psychiatric illness or with current symptoms. Program managers reported numerous avenues to increase user diversity, comfort, participation, and repeated engagement, including:

- Staffing for diversity and aiming for staff demographics to match the demographics of the area in which you work or of particular communities that you hope to engage, whenever possible.
- Welcoming back former participants to serve as volunteers, mentors, leaders, or future staff. Camp-based programs, programs with military families, and programs connected to local schools found this approach to be particularly productive.
- Striving for consistency in meeting times and locations, particularly for programs aimed at families

TABLE 1. US organizations consulted to generate knowledge about best practices for youth programming for mental health with natural / outdoor components.

Domain of programming	*Organization* (*Headquarters*)	*Example programs /programming offered*
Youth-focused mental health programs with outdoor components	*Thorne Nature Experience* (Boulder, CO)	The Youth Nature Camp, along with other programs, provides hands-on, place-based youth learning using unstructured time and participant interest as a guide for outdoor educational experiences.
	Fear Facers (Gainesville, FL)	A 1- to 2-week summer camp for adolescents ages 8–15 with anxiety or obsessive-compulsive disorders provides participants with one-on-one and group outdoor therapy sessions to treat mental health concerns.
	Elevate Youth Outdoors (Boston, MA)	Programming engages school-aged adolescents in nature-based programs that increase in difficulty with age and promotive positive self-image, self-esteem, and mastery.
	Free Forest School (Minneapolis, MN)	A national organization facilitating independent, weekly group meetings for families to provide children with unstructured play-time outdoors to promote curiosity, self-confidence, and stress-coping.
	New Vision Wilderness Therapy (Medford, WI)	Pre-teen, teen, and young adult programs provide outdoor recreational and therapeutic exercises for individuals with mental and behavioral concerns, focusing on extended wilderness-based experiences.
Youth-focused physical health programs with outdoor components	*Wilderness Youth Project* (Santa Barbara, CA)	The Bridge to Nature program, along with other offerings, develops after-school programming and summer camps to engage youth ages 3–17 in the great outdoors, with incremental nature exposure and gradual increase in challenge.
	California Department of Parks and Recreation (Sacramento, CA)	The Outdoor Youth Connection and other programs provide an avenue for new users to gain exposure and confidence backpacking on state park lands.

TABLE 1 (cont'd). US organizations consulted to generate knowledge about best practices for youth programming for mental health with natural / outdoor components.

Domain of programming	*Organization* (*Headquarters*)	*Example programs /programming offered*
Youth-focused physical health programs with outdoor components (cont'd)	*Gather New Haven* (New Haven, CT)	The Schooner Camp offers educational programming related to ecosystem health and sailing for youth ages 6–14 in an effort to deepen participants' connection to nature in urban settings.
	BOKS (*Build Our Kids Success*) (Boston, MA)	An initiative of Reebok, BOKS programs offer free courses "designed to get kids active and establish a lifelong commitment to health and fitness" that can be deployed indoors or outdoors, by teachers or park managers.
	Wilderness Inquiry (Minneapolis, MN)	The Canoemobile program, a "floating classroom," brings students out on local waterways in 24-foot Voyageur canoes with support from federal, state, and local partners to offer youth outdoor experiences across the country.
Community or adult-focused mental health programs with outdoor components	*Fresh Water Land Trust* (Birmingham, AL)	FWLT's Red Rock Trail system was designed to connect parks, bike trails, and sidewalks across 750 miles of trail. Upon completion it will provide every resident in Jefferson County, Alabama, with access to a green space less than one mile from their home for outdoor recreation to benefit mental and physical health.
	*Institute at the Golden Gate** (San Francisco, CA)	IGG provides resources related to inclusive park programming and nature prescription programs to support the growing nature–health movement.
	Naval Medical Center San Diego (San Diego, CA)	NMC's Hike and Surf Therapy programs were designed as supplemental treatment opportunities for active duty military personnel with physical and mental health conditions.
	*Yale-New Haven Hospital** (New Haven, CT)	Yale Hospital provides nature-based prescriptions to the community; clinicians were consulted for their experiences with youth mental health and prescribing nature.

TABLE 1 (cont'd). US organizations consulted to generate knowledge about best practices for youth programming for mental health with natural / outdoor components.

Domain of programming	*Organization* (*Headquarters*)	*Example programs /programming offered*
Community or adult-focused mental health programs with outdoor components (cont'd)	*Trust For Public Lands* (New Haven, CT, chapter)	TPL's mission is to create parks and protect land for people to "ensure healthy, livable communities for generations to come." They provide resources related to community outreach and green space awareness..
	Satchel and Lahoma (Flintstone, MD)	S&L provides training for educators, youth leaders, and families on the basics of outdoor recreation and safety to support financially limited Black and minority families accessing nature for wellness.
	*Prickly Pear Land Trust** (Helena, MT)	PPLT has organizational expertise in community engagement during land and trail development.
	*Triangle Land Conservancy** (Durham, NC)	TLC provides mental health focused programing on preserved lands through yoga, meditation, and educational nature walks.
	Willamette Partnership (Portland, OR)	WP uses market-based conservation to preserve public health and working lands in the West. Among other initiatives, WP supports community partnerships at the intersection of conservation and healthcare.
	Blue Star Families (Alexandria, VA)	The Blue Star Parks program has 11 chapters that work to connect veteran families to local, state, and national parks to develop a community-specific connection to place that encourages social connections and repeat engagement with natural spaces.

* These programs were consulted for expert knowledge rather than for insights into specific programs. Two additional organizations were consulted but wished to remain anonymous.

or young children where parents with inflexible work schedules may wish to block-off or swap work dates well in advance.

- Building transportation support into the program design, including organizing activities around public transit locations and schedules or providing group or individual transportation from central locations, including hospitals and clinics.

Create programming that is flexible and adaptable, and becomes more challenging over time. Decades of health psychology literature, in particular around

childhood obesity intervention, have identified the importance of habit-building for long-term improvements in pediatric and adult health (Beeken et al. 2017; Salvy et al. 2018; Cleo et al. 2019). Programs that can build skills, or enable participants to pursue outdoor activities on their own, should be prioritized. Notable programs encouraged habit-building by having small cohorts return each week for multi-week activities that gradually increased in difficulty while encouraging more participant leadership and decisionmaking over time. The same was true of programs that considered past participants for future leadership roles and employment. Other programs planned for so-called "warm hand-offs," connecting participants to clinicians, neighborhood community volunteer groups, and gear-rental and guide services after program completion. Tracking participant retention and psychological benefits through short paper and pencil or phone-app-based "pre and post" surveys was identified as an important activity for helping programs monitor success, target gaps in programming and audience groups, and adapt to changing community needs over time. Such tracking could also be used to evaluate short- and long-term community benefits, potentially supporting grant applications and building the evidence around nature-based programming.

A menu of potential activities for engaging in nature-based programming

Following is a menu of potential nature-based activities for youth mental health that can be piloted by organizations and individuals involved in land conservation and management, ranging from low to high input in terms of institutional time, effort, partnership building, and resources that may be required to accomplish the task. These are a subset of ideas generated from a synthesis of expert interviews, categorized here by the authors based on loose, subjective estimates of input intensity and ease of implementation. More potential activities are listed in Himschoot, Lloyd, and Reuben 2020.

Low input. Low-input ideas involve short-term programming, one-off events, or reconfiguration of messaging materials, staff training, and the composition of an organization's board of directors. While not necessarily easy to accomplish, these activities are considered to be those that could either be undertaken across a short period, without a large budget, or without requiring long-term partnership building.

- **Targeted communication:** Promoting the mental health benefits of nature exposure in organizational communication materials and at events.
- **Supporting staff:** Facilitating and incentivizing staff to engage in mental health awareness, diversity, and anti-racism training.
- **Healthcare practitioner outreach:** Inviting local mental health experts to present to your organization (and vice versa) to foster cross-disciplinary knowledge about local health needs and resources.
- **Diversifying leadership:** Adding a member from the health sector to your organization's board of directors.
- **Broadening current programming:** Creating space in existing programs for mental health discussions, including mindful moments, quiet reflection, or group sharing about stress and coping during staff retreats, public nature outings, trail building events, etc.
- **Joining mental health "movements":** Engaging with existing stigma-fighting events, including hosting "mental health" hikes or activities on World Mental Health Day (October 10) and becoming a local StigmaFree campaign member in the National Alliance on Mental Illness's on-going StigmaFree campaign.
- **Listening:** Attending local community events with the intention to learn about community needs that nature spaces or outdoor programming could potentially fill.

Medium input. Medium-input ideas involve activities that might require more medium-term planning, offer multiple events, or require partnering with outside organizations to connect existing user groups to preserved lands and expand activity offerings.

- **Hosting forest bathing or nature meditation sessions.** Mindfulness, meditation, and forest bathing practitioners in the community can be invited to host sessions on preserved lands, through one-off or recurring events that require little new program design or advertising.
- **Engaging local arts organizations to bring their activities or audiences outdoors.** Nature-based activities do not need to be active to produce mental health benefits, nor do they necessarily have to "focus on" nature. Small events incorporating local art, dance, literature, or theater groups could help engage new audiences who may be intimidated by outdoor recreation or have mobility issues.
- **Connecting with pediatric clinics and youth mental health skills groups.** Group-based skills-learning groups are now a common component of clinical intervention for children and adults with a variety of mental health concerns, from PTSD to ADHD (Ezhumalai et al. 2018). These typically

operate side by side with one-on-one therapy to facilitate faster skill acquisition, provide a communal support group, or allow for "booster shots" of skills needing additional practice. Consider reaching out to local pediatric mental health clinics to offer outdoor spaces for group meetings or activities for end-of-session rewards.

- **Becoming a nature-prescription partner.** The non-profit Institute at the Golden Gate estimates that there are over 100 nature prescription programs now operating in the US to encourage patients to spend time outdoors for their health, typically through tracked prescriptions for activities, locations, or guided outings (Institute at the Golden Gate 2021). Some programs, like Park Rx America, are national, with prescribers operating in 37 states. Others, like Washington state's Parkscriptions program, are regionally based, with detailed databases of prescribable parks and activities accessed through phone or web apps to enable clinicians to make tailored recommendations. Find a local program via the Park Rx directory (https://www.parkrx.org/content/directory-programs) to have your preserved spaces or nature-based events added to clinicians' prescribable outdoor opportunities.

High input. High-input ideas involve introducing health-focused programs new to your organization or community, typically with organizational partners and with support or oversight from healthcare providers.

- **Partnering with a hospital or clinic to host a week-long or two-week summer camp for children with mental health concerns,** particularly anxiety or depression. Following the Fear Facers Summer Camp model designed by the University of Florida, week-long summer camps can take children with diagnosed psychological disorders to outdoor communal settings to make conquering mental illness more social, enjoyable, and connected to nature. The model has yet to be replicated widely, but, in an interview, the organizers reported low costs to participants, generally high treatment-response rates, and a long waiting list. Operated by University of Florida clinicians (PhD-level psychologists), with undergraduate counselors and local parks and recreation facilities, the Fear Facers program targets children ages 8–15 with anxiety and obsessive-compulsive disorders and pairs group activities, both indoor and outdoor, with one-on-one outdoor therapy sessions. Programs following this model would need to be undertaken in conjunction with licensed healthcare professionals.
- **Pilot a recreation-based multi-week nature therapy initiative.** Following the model of the Naval Medical Center's hike and surf therapy program for veterans with diagnosed mental illness (Walter, Otis, Glassmann et al. 2019; Walter, Otis, and Ray et al. 2019) consider piloting an outdoor recreation / nature-based therapy program with weekly sessions over several weeks. Early empirical evaluation of the Center's programs suggest good adherence and treatment response, with program leaders noting that many participants report improved symptoms, greater connection to the outdoors, and a high likelihood to repeat outdoor activities on their own. Many participants choose to return after program completion to serve as volunteers for the next cohort. Activities can include hiking, backpacking, surfing, kayaking, or climbing, and should gradually become more challenging, with participants taking on more responsibility across trips. Pilot programs should ideally involve partnering with a local hospital system to identify the best candidate patients, provide medical support if needed, and track adherence and treatment response.
- **Develop a local nature–health network.** Most successful initiatives identified in our knowledge-generation exercise grew out of multi-year engagements between organizations in the parks, conservation, and healthcare sectors. Bringing together and maintaining a local network of health and nature groups is a useful first step that can raise awareness of existing programs and resources in the short term and facilitate the development of new cross-sector initiatives, campaigns, and programs in the long term.

Conclusions

Diverse empirical evidence, from observational studies with large samples, experimental studies with patient populations, and community-level interventions, now supports the growing understanding that individuals experience distinct mental health benefits from contact with natural spaces and stimuli. This evidence, together with new efforts to translate scientific findings into health interventions at the individual and neighborhood–community levels, have created an opportunity for the parks and land management sector to engage new audiences in connecting with nature for the "contribution to people" of improved mental health.

This study's six-month knowledge generation exercise identified a number of best practices, as well as activities and initiatives, that can be undertaken across short-, medium-, and long-term time horizons with or without organizational partnerships. A theme that cut across recommendations was the need to collaborate with the

target community at all levels of activity: at the planning stage to ensure buy-in and the development of programs that meet actual community needs; at the implementation phase to ensure active participation, comfort, equity, and accessibility; and at the monitoring and evaluation stage to determine whether initiatives are working and whether there are ways that they can be improved, expanded, or concluded. These calls are supported by a small but growing literature on the critical nature of community engagement in altering local perceptions of the benefits of conserved lands (e.g., Harvey et al. 2018) as well as the use of and ultimate benefit from parks and conserved areas (Cohen et al. 2013; Zhang et al. 2020).

All natural lands open to some form of recreation can provide therapeutic mental health benefits to nearby communities. The task now facing land managers is to refine and scale up communication on the nature of these benefits, engage new audiences, and provide new opportunities and activities for communities most in need, particularly through partnerships with local community groups and members of the healthcare sector. The end result could be happier, healthier communities more connected to nature and more interested in preserving the environment for the next generation.

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