Children's Nature Deficit: What We Know – and Don't Know

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by Cheryl Charles, Ph.D., and Richard Louv

A growing body of evidence suggests that significant changes in childhood have occurred over the past several decades relating to children's experiences in nature. While there are always exceptions, there are strong indicators of an absence of direct experience with the natural world in many children's everyday lives.

In addition to direct measurements, there are a variety of ways to consider children's nature deficit and its extent. Numerous studies offer both quantitative and qualitative indicators of changes in childhood, among them: perception of growing demands on children's time, resulting in less free and unstructured outdoor playtime in nature than experienced by previous generations; reduced mobility and less range for exploration, including reduction in walking or riding a bike to school; growing fear of strangers, traffic and nature itself; and a dramatic rise in obesity and severe overweight, as well as vitamin D deficiency and other health issues that may in part be related to low levels of outdoor activity and a sedentary lifestyle. A lack of knowledge of species may also be an indicator of lack of access or lack of engagement in nature in an increasingly urbanized world.

Contributing historical trends are formidable and will likely continue: The U.S. has lost much of its small farming and ranching culture, even in rural areas. In some regions, this trend may be moderated by the growth of organic gardening near or in urban areas. But human beings are becoming an increasingly urban species: according to the United Nations Population Division, almost 50% of all people in the world live in urban areas and this is projected to increase to 65% by 2030. Unless urban planning and development changes significantly—emphasizing "nearby nature" within urban neighborhoods—growing urbanization will further reduce direct experience with the natural world and the sources of our food. The phenomenon of children's disconnect from nature is reported to be occurring in countries throughout the world. As one example, The Daily Monitor, published in Addis Ababa, Ethiopia, issued a plea in March 2007 for parents to get their children out of the house and into the outdoors, noting that "many Ethiopians will have reached adulthood far removed from outdoor experiences." At first glance, a nature deficit

in Africa may seem counterintuitive, but in an increasingly urbanized world, the reported disconnect makes sense. *The Daily Monitor, published in Addis Ababa, Berthe Waregay, "Ethiopia: 'No Child Left Inside,'" Daily Monitor, March 28, 2007.*

The following reports and research studies are a sample of the body of available evidence that strongly suggests a decline in participation in nature-based outdoor activities by many children and youth. Some are based on time studies and on children's knowledge of the natural world. The research methodology varies considerably, and questions are not uniform: for example, questions often mix experiences specific in nature, and independent play, with organized sports and other activities, including outdoor experiences that may or may not enhance the relationship between a child and the natural world.

Much of the relevant research seems to be centered in the US, UK, Canada, Australia, Germany, the Scandinavian countries, and to some extent Japan. Many of the studies may be limited due to their reliance on proxy and self-report. Another limitation is that most current research is relatively short-term rather than longitudinal and most is based on correlations rather than clear cause and effect relationships. C&NN is working with researchers to understand and communicate differences in interpretation of the data as well as to identify the gaps in current knowledge.

While studies are accumulating, more research needs to be done, including establishing baselines and defining what constitutes meaningful experiences in nature. Direct measures are needed of children's actual time in nature and the quality of their experiences in the natural world. Despite the number of studies and other findings described below, the relationship between children and nature has been understudied. Much of the research to date has been limited, although the body of research overall is generally consistent and provides insights into both the indicators of the nature deficit in children's lives, and the benefits to children's healthy development by direct experiences with nature in their everyday lives.

The Children & Nature Network is dedicated to helping to synthesize the growing body of evidence, and to helping identify the gaps in public understanding of both the disconnect from nature and the benefits to children from reconnecting with nature. The Network is committed to fostering additional, rigorous research on these topics. C&NN, along with Yale University and the University of Minnesota, convened the first National Children and Nature Research Summit in November, 2008. The Summit was co-chaired by C&NN Board Members, Dr. Stephen R. Kellert of Yale, and Dr. Martha Farrell Erickson, recently retired from the University of Minnesota.

There are some possible reasons for cautious optimism. In 2009, for example, some parks are reporting an increase in attendance. An increase in park visits has recently been credited by the press to an economic recession. But the increase may also indicate the growing effectiveness of the children and nature movement over the past four years. In addition, one recent study indicates a reported increase in children's outdoor activities, some of them in nature, from 2007 to 2009 (Cordell et al, 2009). This is one study amidst a large number of others indicating, in contrast, multiple indicators of reduced time in exploratory, unstructured, free play in nature-based settings by children. If these improvements are dependent on the recession, they may be short-lived as the economy improves. It is too early to determine if, in fact, these are early indicators of a fundamental societal shift to reconnect children

with the natural world in their daily lives—or to say why—but we hope this recent finding is an indicator of an emerging trend. Contributing factors may include short term changes in family finances; long term changes in attitudes and behaviors; and the growing influence of local, state, provincial and national campaigns and initiatives to reconnect children and their families with nature.

The studies described in this document are primarily concerned with indicators of the nature deficit to convey that the preponderance of current evidence suggests a long-term trend which has become most evident during the past 30 years. Health studies are included as they may suggest evidence of a sedentary lifestyle, which would work against children directly experiencing the natural world. For additional abstracts regarding health, cognition and other indicators of the benefits to children from direct experiences with nature, see C&NN Research and Studies, Volumes One through Four at www.childrenandnature.org/research. Some of the studies and reports described below have not yet been abstracted by C&NN and are pulled from public sources; others are derived from C&NN's four annotated and abstracted volumes of Research and Studies, now numbering more than 120 such studies with links to the actual research reports for an in-depth review; others have been altered for style, or have been combined with additional source material, which is credited.

C&NN is currently planning an independent baseline study to gather additional information on attitudes about the importance of nature experiences for children's health and well-being, and the extent to which those attitudes translate into behavior, and is encouraging others to do the same. This document is simply one resource developed by the Children & Nature Network to help establish a deeper understanding by all concerned for children's health and well-being about what we know, and don't know, about the role of nature in children's lives.

Because research into the relationship between children and nature has been neglected for so long, we cannot expect answers to many of our questions for many years, not only about the quantity of nature experiences but also their quality and meaningfulness. Among the gaps in knowledge we hope will be filled in coming years is the need for deeper knowledge about how parents, educators, health professionals, urban designers, and others can optimize the benefits of nature experiences in everyday life in both informal and formal settings. As Dr. Howard Frumkin, Director of the National Center for Environmental Health /Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention says, yes we need more research, "but we know enough to act."

How children spend their time: *Examining how children spend their time can tell us a great deal about their lives, what parents and society value, and what changes may be occurring over different generations. Despite the importance of this topic, few time-use studies have been conducted, especially those using longitudinal techniques (i.e., looking at changes over time). The existing studies do indicate that from the 1980s to 2000s children's lives have become increasingly structured and media oriented. This raises the question of how many hours are left in a typical 24-hour period for independent play of any kind, including unstructured play in nature.*

1. ***Direct experience in nature is critical and diminishing.*** Nature is important to children's development in every major way—intellectually, emotionally, socially, spiritually, and physically. In one of his newest books, *Building for Life: Designing and Understanding the Human-Nature Connection* (Island Press, 2005), Dr. Stephen R. Kellert of Yale University, and C&NN Board Member, devotes a chapter to the subject of "Nature and Childhood Development." Combining his original research with well-documented references to the research of others, this chapter is a powerful synthesis of what we know, and what we do not know, about the importance of nature to children's healthy development. Kellert states, "Play in nature, particularly during the critical period of middle childhood, appears to be an especially important time for developing the capacities for creativity, problem-solving, and emotional and intellectual development." He continues to state, "Unfortunately, during at least the past 25 years, the chances for children to directly experience nature during playtime has drastically declined. For many reasons, most children today have fewer opportunities to spontaneously engage and immerse themselves in the nearby outdoors." Kellert urges designers, developers, educators, political leaders and citizens throughout society to make changes in our modern built environments to provide children with positive contact with nature—where children live, play, and learn. *Kellert, Stephen R. "Nature and Childhood Development." In Building for Life: Designing and Understanding the Human-Nature Connection. Washington, D.C.: Island Press, 2005.* (Abstract by Charles, 2007)

2. ***Children spend less time playing outdoors than their mothers did when they were young—even in rural areas.*** Dr. Rhonda Clements, a professor of education at Manhattanville College in New York State, surveyed over 800 mothers in the United States to explore the extent to which children in the early 2000s play outdoors as compared to a generation ago when the mothers interviewed were children: 71 percent of today's mothers said they recalled playing outdoors every day as children, but only 26 percent of them said their kids play outdoors daily. In analyzing the survey results, Dr. Clements found that children in the early 2000s, as compared to a generation ago: 1) spend less time playing

outdoors; 2) participate in different activities outdoors (e.g., fewer street games and more organized youth sports); and 3) participate in more indoor than outdoor play activities. In her survey, Dr. Clements also asked mothers about obstacles to outdoor play and their thoughts regarding the benefits of outdoor play. She found that while almost all mothers recognized some of the diverse benefits of outdoor play, obstacles, such as television, computers, and concerns about crime, safety, and injury, prevented their children from participating in more outdoor play. "Surprisingly, the responses did not vary a great deal between mothers living in rural and urban areas," Clements reported. She continued, "However, this finding coincides with research conducted in England and Wales." The results of those studies negated the assumption that children living in rural areas would have access to greater public space for play and recreation. They found that farmlands, with their restricted use and lack of local supervision for children's activities, did not offer the rural child more opportunities for outdoor experiences." *Clements, R. "An Investigation of the State of Outdoor Play." Contemporary Issues in Early Childhood, Vol. 5(1):68-80, 2004. This study is available online: http://www.wwwords.co.uk/pdf/freetoview.asp?j=ciec&vol=5&issue=1&year=2004&article=7_Clements_CIEC_5_1_web (Abstract adapted from Senauer, 2007)*

3. ***Children's participation in outdoor activities declined in 2007.*** The Outdoor Foundation in cooperation with partner organizations commissioned a survey in 2008 to examine American's participation in outdoor activities in 2007. As part of this survey, researchers conducted over 40,000 online interviews with individuals and households from around the nation. If a person took part in one or more of 35 identified outdoor activities (e.g., running, biking, fishing, and hiking) at least once during 2007, he or she was considered to have participated in outdoor recreation. Researchers weighted gathered data to ensure that it reflected the U.S. population as a whole. In their report, the Outdoor Foundation discusses many findings. Some of the key findings with regard to youth include: 1) youth participated in outdoor recreation more than any other age group and participated with greater frequency, however, there is much room for improvement as 42% of youth participated in outdoor activities less than 30 times a year; 2) when compared to participation in 2006, in 2007 there was over an 11% drop in outdoor activity participation among 6- to 17-year-old children (from 66% to 55%); 3) participation among 6- to 12-year-old girls and boys changed from 2006 to 2007 with boys dropping from 79% to 72% in their participation, while girls dropped from 77% to 61% in participation, leading to a larger gap between boys and girls in their outdoor recreation participation; 4) for 6- to 17-year-old children, the primary motivation reported for starting participation in outdoor activities was parents, friends, family, and relatives; 5) participation in outdoor activities declined with age; and 6) "fun" was the most common motivation youth provided for participating in outdoor activities, while "lack of interest" was the primary reason for not participating in outdoor activities. While this

survey provides important information on American's participation in outdoor activities and is based on a large, representative sample, the survey method used did change from 2007 to 2008 and thus could influence comparisons between 2006 and 2007 data. *The Outdoor Foundation. (2008). Outdoor recreation participation report 2008. The Outdoor Foundation. This report is available online at: http://www.outdoorfoundation.org/research.participation.2008.html (Abstract by Senauer Loge, 2009)*

4. ***One set of studies suggests a recent US increase in the time that children spend outdoors, biking, jogging, walking, skate boarding, etc.*** In 2007, Cordell and colleagues started the National Kids Survey to improve our understanding of how much time children spend outdoors and the activities that they engage in while outside. To date, the survey has been implemented two times—fall-summer 2007/08 and summer-spring 2008/09. In analyzing data from these surveys, Cordell and colleagues present a number of findings in a series of three reports. A few of the researchers' key findings include: 1) over the two survey periods, about 61% of children were reported to spend two or more hours outdoors on a typical weekday and about 77% were reported to spend two or more hours outdoors on a typical weekend day; 2) more younger children (6- to 15-years-old) were reported to spend 2 or more hours outdoors as compared to older children (16- to 19-years-old) and more Hispanic children were reported to spend 4 or more hours per day outdoors on weekends as compared to white or black children; 3) the most popular outdoor activity reported was "just playing or hanging out outdoors" at 83% followed by "biking, jogging, walking, skate boarding, etc." at 79%; 4) almost 40% of respondents reported that children spent more time outside now as compared to the same time last year; and 5) in examining changes between survey periods, there was a slight, but statistically significant decline in the percentage of children that spent no time outdoors on weekend days. While this study may be limited due to its reliance on self or proxy report, it provides an important contribution to the literature as it is collecting and examining data on a large number of children over multiple years. Additional data are needed to make robust conclusions about changes in children's time spent outside and to understand factors causing any observed trends. *(Author Affiliation: Cordell and Betz are with the USDA Forest Service. Green is with the University of Georgia.) Cordell, K. H., Betz, C. J., & Green, G. T. (2009). National kids survey. Internet Research Information Series. These reports are available online at: http://warnell.forestry.uga.edu/nrrt/nsre/IrisReports.html) (Abstract by Senauer Loge, 2009)*

5. ***Children's discretionary time at home is diminishing.*** In the United States, from 1997 to 2003, there was a reported possible decline of 50 percent in the proportion of children 9 to 12 who spent time in such outside activities as hiking, walking, fishing, beach play, and gardening, according to a study by Sandra Hofferth at the University of Maryland.

Also, Hofferth reports that children's discretionary time (i.e., time not spent in school, child care, etc.) declined 7.4 hours a week from 1981 to 1997 and an additional two hours from 1997 to 2003, a total of nine hours less a week of time (a 16% drop). The way children spend their discretionary time has changed—less time is spent in unstructured activities (e.g., free play) and more time is spent in structured activities (e.g., sports and youth programs). Other changes of interest include a doubling of computer use and substantial increase in time spent studying and reading, as well as an increase in participation and time spent in church activities and youth groups. In a commentary on Playborhood.com, Hofferth elaborated: "Children were not very physically active in 2003. The proportion of 6-8 year-olds who spent time outdoors was small, only 12% in 2003, about the same as in 1997. The proportion of 9-12 year-olds spending time out of doors actually declined. Only 8% of 9-12 year-olds spent time out of doors walking, hiking, etc. in 2003, half of the 16% in 1997. The time spent was also very small. Of those who spent any time out of doors, in 2003 the average weekly time spent by 6-12 year-olds who spent any time in outdoor activities was 4 hours and 10 minutes. In addition, the proportion of children 6 to 8 and 9 to 12 who spent time playing sports, either informally or with a team, declined from 76% to 60% between 1997 and 2003." She added, "Playing on the computer has increased both in terms of the proportion who play (games) on the computer and the amount of time they spend. The proportion of children 6-8 playing with the computer rose from 11 % to 24% and the proportion 9-12 rose from 20 to 28%. Non-computer play time actually declined for all children. As a result, computer play took a larger chunk out of children's total play time in 2003 than in 1997. If computer use had not increased, total play time would have declined…The time spent watching television and playing video games rose for 9 to12 year olds, though not for 6 to 8 year olds. In 2003, children 6 to 8 spent 12 and one-half hours watching television and children 9 to12 spent almost 15 hours a week watching television. Forty percent of the 9 to 12 year olds played video games and those who did so spent 6 hours a week playing video games." Please note that the activity categories used in this study are inclusive of many subsets of activities. It is also important to note that these studies focus on activities at home; they do not describe activities that take place at school or other non-home settings. (Hofferth and Sandberg, 2001; Hofferth and Curtin, 2006). *Hofferth, S.L. & J.F. Sandberg. "Changes in American Children's Time, 1981-1997." In S.L. Hofferth & T.J. Owens (Eds.), Children at the Millennium: Where Have We Come From, Where Are We Going? (pp. 1-7). New York: JAI, 2001. This study may be available in a library or bookstore near you. Hofferth, S.L. & S.C. Curtin. Changes in Children's Time, 1997-2002/3: An Update, 2006. In addition, Hofferth's Playborhood essay can be found at* *http://playborhood.com/site/article/american_6_12_year_old_childrens_outdoor_and_indoor_leisure_time_1997_to_20/*

6. ***Children spend increased time with media and multiple forms of media.*** In two studies, one released in 2006 and the other in 2005, Dr. Donald Roberts and colleagues and Victoria Rideout and colleagues investigate media in the lives of children 6 months to 6 years of age, as well as in the lives of 8 to 18 year olds. These studies were conducted in association with the Kaiser Family Foundation. The studies were conducted with telephone surveys, questionnaires, and media-use diaries, as well as a series of small focus groups with parents in four cities, and involved over 3000 parents and teen-agers. Both studies took place during the school year and measured recreational (non-school) use of media, including TV and videos, music, video games, computers, movies, and print. A few of the key findings highlighted in these reports include: Children between the ages of 6 months and 6 years spend an average of 1.5 hours with electronic media on a daily basis, whereas children between the ages of 8 and 18 years spend an average of nearly 6.5 hours a day with electronic media. Eight to 18 year old children are packing more media into the same amount of time—when young people use media, about a quarter of the time they are using more than one medium at a time (e.g., reading and watching TV). Children's homes are filled with media—nearly one third of children from 6 months to 6 years of age live in households where the TV is on all or most of the time. Television and music remain the dominant media to which children are exposed—8 to 18 year olds spend an average of 3 hours a day watching TV and about 1.75 hours a day listening to music. *Roberts, D. F., Foehr, U., & Rideout, V. Generation M: Media in the Lives of 8 to 18 Year Olds. Kaiser Family Foundation, 2005. Rideout, V. and E. Hamel. The Media Family: Electronic Media in the Lives of Infants, Toddlers, Preschoolers, and Their Parents. Kaiser Family Foundation, 2006. (Abstract by Senauer, 2007)*

7. ***International study suggests low rates of children's nature experiences across many countries.*** "Is free-play declining?", an article published in the American Journal of Play in 2009, reported a survey of 2400 mothers in 16 countries: The percentage who said that their child often explored nature varied country by country, and were lowest in China, Indonesia, and Morocco: China 5%; Brazil 18%; Indonesia 7%; U.K. 25%; Morocco 7%; U.S. 33%; South Africa 18%; France 45%; India 18%. Of these mothers, 54% wished they could be more comfortable when their child got dirty while playing. When mothers were asked about free-time activities that their children did often: 72% said watching TV; 58% said playing outside. Also, 54% said that their children appeared happiest when they were playing outside in parks or playgrounds. And 73% said that their children would choose to play outside rather than inside if they could. *Singer, Dorothy, Singer, Jerome, D'Agostino, Heidi & DeLong, Raeka. 2009. Children's pastimes and play in 16 nations: Is free-play declining? American Journal of Play, Winter, 284-312.*

8. ***UK survey indicates changing relationships with nature.*** In March, 2009, the Report of Natural England on Children and Nature was published, focusing on "changing relationships with nature across generations." England Marketing undertook an online survey using a panel of respondents representative of the population of the UK. In total 1150 adults took part and 502 children. The children interviewed were of primary school age, aged 7-11.The data on adults was split into two age groups; under 50 years old and 51 plus years old. This broad split was to explore the extent to which differences might exist between the generation who could be parents and the generation who are more likely to be grandparents of children aged 7-11. Among the report's findings: "Children spend less time playing in natural places, such as woodlands, countryside and heaths than they did in previous generations. Less than 10% play in such places compared to 40% of adults when they were young. The most popular place for children to play is in their home, while for adults it was outdoors in local streets. 62 % of children said they played at home indoors more than any other place. 42 % of adults said they played outdoors in local streets more than in any other place. Three quarters of adults claimed to have had a patch of nature near their homes and over half went there at least once or twice a week. 64% of children reckon they have a patch of nature near their homes but less than a quarter go there once or twice a week. The favorite places to play have changed over time. In the past these were in the streets, near home (29%), indoors (16%) and in some natural places (15%) whereas nowadays children like playing indoors best (41%) and, to a lesser extent, in the garden (17%). The majority of children (over 70%) say they are supervised wherever they play, except only 52% are supervised in the garden and 31% in the streets near their homes. This rises to over 80% in natural places. The grandparents' generation had slightly more freedom than the younger adults and most feel that children have less freedom today (87%). The parents' generation were a little more likely to have played at organized venues but still feel that they had more freedom than children today. Parents would like their children to be able to play in natural spaces unsupervised (85%) but fears of strangers and road safety prevent them from giving much freedom to their children. Children would like more freedom to play outside (81%). Nearly half of the children say they are not allowed to play outside unsupervised and nearly a quarter are worried to be out alone. Traditional outdoor activities are as popular now as they were in the past with all achieving a mean score of more than 3 out of 5. Building a camp or den and exploring rock pools on the beach were and still are the most popular activities. There is little difference in attitudes across the country and little difference in attitudes based on whether adults and children live in urban or rural communities." *Report to Natural England on Childhood and Nature: a Survey on Changing Relationships with Nature Across Generations:* *http://www.naturalengland.org.uk/Images/Childhood%20and%20Nature%20Survey_tcm6-10515.pdf*

9. ***Children in The Netherlands report low contact with nature.*** Often associated with greener-than-average thinking, nonetheless, the Netherlands is a highly urbanized country where the young "have little contact with nature," according to a survey of students from seven Dutch secondary schools by Wageningen scientist Jana Verboom-Vasiljev. "There is little sign that a love of nature is inculcated at home. Indeed, about three-quarters of the pupils thought there was only 'a bit of interest' for nature at home, and eleven per cent said there was none." More than half never go to nature reserves and parks, zoos or botanical gardens. Most students were unable to name a single endangered plant species and knew only a few endangered animals. "The list of wild animals or plants they would miss if they became extinct was dominated by cuddly mammals or animals featured on television… It was a surprise to find even pets and domesticated animals on the list," according to Verboom-Vasiljev, reporting the research findings. Although the research was conducted in the Netherlands, "the picture we obtained may also apply to at least the more urbanized regions of Europe where the cultural, economic and social climates are broadly similar." Indeed, in Amsterdam, a study compared children's play in the Netherlands in the 1950s and 1960s to child's play in the first years of the 21st century: Children today play outside less often and for briefer periods; they have a more restricted home range and have fewer, less diverse playmates. *J. Verboom, R. van Kralingen, and U. Meier, Teenagers and Biodiversity-Worlds Apart?: An essay on young people's views on nature and the role it will play in, their future (Wageningen, Netherlands: Alterra, 2004).*

Visits to parks, national forests and other public lands are a possible indicator of the frequency of children's exposure to the natural world. *Notably, visits to US National Parks fell in recent decades, though there are signs of rebound, as reported in recent news articles, possibly due to the recession or greater public awareness about the benefits of nature to children. Some evidence suggests visits to national forests also fell.*

10. ***Between 1988 and 2003, per capita visits to U.S. national parks declined.*** University of Illinois researchers Oliver Pergams and Patricia Zardic note that in 2003 the average person spent 327 more hours per year with entertainment media than in 1987. They found that a number of entertainment media variables, as well as inflation adjusted oil prices, explained almost all of the decline in national park visits. While this study only looked at association between factors, and not causation, it is an important first step in beginning to understand why US national park attendance declined and what this might mean for children's exposure to

nature — and for future political support of our wilderness parks. (Note: some parks have reported a recent increase in attendance, credited by some observers to the recession or increased awareness, over the past four years, of the value of nature experiences for children.)
This study is available online at Dr. Oliver Pergam's website: http://www.pergams.com/

11. ***Researchers link decline in park visits to overall decline in nature-based recreation.*** As a follow-up to their recent work demonstrating about a 25% decline in per capita visits to U.S. National Parks between 1987 and 2003, Oliver R.W. Pergams and Patricia A. Zaradic test whether this decline in U.S. National Park visits is an isolated incident or a good indicator with regard to how much people are visiting natural areas more generally. The authors examined 16 large national and international nature-related visitor and activity data sets, including visitation to Japanese national parks, recreational visits to all U.S. state parks, and total number of U.S. hunting and fishing licenses. In analyzing these data sets, Pergams and Zaradic found that nature-based recreation peaked between 1981 and 1991, and has been declining at a rate of between 1 and 1.3% per year since this peak, for a total decline of 18-25% to date. The similarities among these multiple and different measures suggest a general decline in visits to natural areas in the U.S. and potentially in other countries, such as Japan. It is important to note that the impact of this decline varies for each variable. For example, many more people visit National Parks per year than finish the Appalachian Trail. The authors found that the most popular nature-based recreation activity in the US is camping, followed by fishing and hunting, all of which show a declining trend. Pergams and Zaradic found only one countertrend to nature use decline: a slight increase in hiking and backpacking. While the cause(s) for this over-arching decline requires further investigation, this study demonstrates a fundamental shift away from visits to natural areas, with potentially important implications for health, well-being, and conservation.
Pergams, O. R. W., & Zaradic, P. A. (2008). "Evidence for a fundamental and pervasive shift away from nature-based recreation." Proceedings of the National Academy of Sciences of the United States of America, 105(7), 2295-2300. Pergams, O. R. W., & Zaradic, P. A. "Is Love of Nature in the US Becoming Love of Electronic Media? 16-year Downtrend in National Park Visits Explained by Watching Movies, Playing Video Games, Internet Use, and Oil Prices." Journal of Environmental Management, 80(4), 387-393, 2006. This study is available online at Dr. Oliver Pergam's website: http://www.pergams.com/ (Abstract by Senauer, 2008)

12. ***Drop in visitations to national forests.*** In 2008, new federal figures showed far fewer people are visiting the national forests since 2004 – a national 13 percent drop. Researchers suggested possible causes including youths spending more time with electronics, gas prices, rising visitor fees, "and a busy, urban society with little time for outdoor pursuits," the Oregonian reported. "They say the decline is troubling for rural economies that increasingly look to tourism and recreation to replace

revenue lost when logging dried up. It also may leave fewer people who champion the value of public lands….. The figures are estimates based on surveys and counts around each national forest. Total forest visits dropped from 204.8 million in 2004 to 178.6 million in 2007, a 13 percent decline. Visits to Oregon and Washington national forests fell 27 percent……The Forest Service developed the new counting system to replace an earlier method that wildly overestimated numbers of recreational visitors." *National forests see fewer visitors, by Sherry Rainey, The Oregonian November 17, 2008, 8:50PM; National Forest Service report: http://www.fs.fed.us/fstoday/2008/081128/02National News/rec_use.html*

Evidence of decreased mobility, reduced availability of natural areas, and restrictions placed on children's activities in natural areas, suggests fewer opportunities to engage in the natural world.

13. ***Preschoolers more sedentary than thought, even when outdoors,*** according to a study by William H. Brown, Ph.D., of the University of South Carolina, and colleagues, published in the January/February issue of Child Development. MedPage Today reports: "Preschoolers are not necessarily the nonstop dynamos of their reputation, even when they're playing outside…preschoolers in a cross-sectional study spent 89% of their days at daycare centers doing sedentary activity. Note that even outdoors, kids spent 56% of their time in sedentary activity. As quoted by MedPage, the researchers said, "The 'conventional wisdom' of many early childhood educators is that young children are very active in preschools. [But] research has shown that, most often, young children's physical activity in preschools is primarily sedentary in nature." According to MedPage, "The number of preschoolers going to daycare programs has increased dramatically, hand-in-hand with the recent overweight trend among children, the researchers said." "[T]he researchers conducted the cross-sectional Children's Activity and Movement in Preschools Study (CHAMPS) of 476 children ages three to five enrolled in 24 preschools in a metropolitan area of South Carolina…A total of 264,809 indoor observations were made, accounting for 87% of all observations, and 29,694 outdoor observations were made, accounting for 10%... 'Even during outdoor play, our observations indicated that most often children's activities were sedentary,' the researchers said. 'Teachers very rarely used intentional methods such as encouragement to be physically active and teacher-arranged activities to increase physical activity.'" The study was funded by the Eunice Kennedy Shriver National Institute of Child Health and Human Development (NICHD). *Kristina Fiore, Staff Writer,*

MedPage Today Published: February 06, 2009 Reviewed by Dori F. Zaleznik, MD; Associate Clinical Professor of Medicine, Harvard Medical School, Boston. Source reference: Brown WH, et al "Physical activity in preschools" Child Dev 2009.

14. ***One US researcher suggests that a generation of children is not only being raised indoors, but is being confined to even smaller spaces.*** Jane Clark, a University of Maryland professor of kinesiology (the study of human movement) at the University of Maryland calls them "containerized kids"—they spend more and more time in car-safety seats, high chairs and even baby seats for watching TV. When small children do go outside, they're often placed in larger containers—strollers—and pushed by walking or jogging parents. Most kid-containerizing is done for safety concerns, but the long-term health of these children is compromised. In the medical journal The Lancet, researchers from the University of Glasgow in Scotland reported a study of toddler activity where the researchers clipped small electronic "accelerometers" to the waistbands of 78 three-year-olds for a week; they found that the toddlers were physically active for only 20 minutes a day. Similar patterns were found among Ireland's rural children. The childhood break from nature appears to be part of a larger dislocation—that is, physical restriction of childhood in a rapidly urbanizing world, with nature experience a major casualty.
Source: http://www.usatoday.com/news/health/2004-11-05-active_x.htm

15. ***Children's access to public play space has declined.*** Dr. Pamela Wridt spent over three years in a working-class New York City community conducting an historical analysis from the 1930s until the early 2000s of residents' spatial and environmental experiences between the ages of 11 and 13. In her study, she used a variety of research methods. In this particular paper, Dr. Wridt reports on her findings from extensive environmental autobiographies with residents by looking in-depth at three individuals whose experiences are representative of a particular time period. In her analysis, Dr. Wridt found that youth in this community in the 1940s spent a significant amount of time playing in the streets, which was an important space for adventure, meeting other children, and independence. By the 1950s, however, with the increased prevalence of automobiles and child death due to automobile accidents, numerous parks and playgrounds were built to protect children. As a result, children's play began to move off the streets into parks and playgrounds that, in many cases, offered structured, city-sponsored activities. By the 1970s and 1980s, with New York City's fiscal crises, many of the parks and playgrounds fell into disrepair and became unsafe. As a result, children's play began to move from the parks and playgrounds to indoor environments. Dr. Wridt found that in the 2000s, children in this community have largely retreated indoors. Their activities take place in private or institutionalized settings and are often dominated by in this community still play in the streets, parks, and playgrounds, their play generally occurs in indoor spaces and consists of activities that are

increasingly managed by adults and often take place in institutional settings. *Wridt, Pamela J. "An Historical Analysis of Young People's Use of Public Space, Parks and Playgrounds in New York City." Children, Youth and Environments 14(1), 86-106, 2004 (Abstract by Senauer, 2007)*

16. ***Children's use of space has changed from being primarily outdoors to indoors and supervised.*** Dr. Lia Karsten took a detailed look at three different streets in Amsterdam to investigate children's use of space in 2003 as compared with children's use of space during the 1950s and early 1960s. She made numerous observations of the three streets and conducted over 90 extensive interviews with children and parents and with adults who lived on these streets in the 1950s and early 1960s. To validate information from her interviews, Dr. Karsten also conducted archival and statistical analyses of historical data. Dr. Karsten found a great deal of similarity in children's daily lives in the 1950s and early 1960s. Specifically, she found that in this generation "playing meant playing outside." This was often a matter of both necessity, primarily due to small living spaces, and pleasure. She also found that children had considerable freedom to move around on their own, had a relatively large territory to roam, played with children from diverse backgrounds, and used urban public space for many of their activities. In contrast, Dr. Karsten found that children in 2003 did not play outside as much or for as long a period of time, had a more restricted range in which they could move freely, had fewer playmates from less diverse backgrounds, were more home-centered, and experienced many more parent-induced constraints. Importantly, Dr. Karsten documents how these changes from the 1950s and 1960s to 2003 have occurred within a spatial, social, and cultural context. She discusses contributing factors to many of these changes, such as the introduction of the car, which changed safety in the streets, and the trend toward bigger homes and fewer children, which made indoor space more readily available. She also documents how these changes are not universal and that neighborhoods differ in their support of children's activities. To capture this diversity, Dr. Karsten describes three primary types of children in the current generation —"outdoor" children, "indoor" children, and those she calls the "backseat generation" (i.e., children who are escorted many places and whose activities are largely driven by adults). Each type has benefits and drawbacks with regard to children's daily activities. *Karsten, L. "It All Used to be Better? Different Generations on Continuity and Change in Urban Children's Daily Use of Space." Children's Geographies, Vol.3 (3), pp275-290, 2005.(Abstract by Senauer, 2007)*

17. ***In two decades children's independent mobility has dramatically declined.*** This article summarizes some of the results of a study conducted by Dr. Mayer Hillman and colleagues in 1990 of almost 4,500 children and parents to explore junior (7 to 11 years of age) and senior (11 to 15 years of age) schoolchildren's travel patterns and levels of independence in England and Germany. This particular article focuses on

the results of the survey in England of junior schoolchildren and their parents, as compared to a 1971 survey that was implemented in the same schools. Some of the key findings highlighted in this article include: In 1971, 80% of 7 to 8 year olds could go to school on their own, whereas just 9% could do so in 1990. In 1990, only half as many 7 to 11 year olds as in 1971 could go to places other than school by themselves. In 1971, 66% of children who owned bicycles could use them on roads, whereas just 25% of children could do so in 1990. There were large increases in the proportion of children being driven to school by car (from about 9% in 1971 to about 32% in 1990) and the proportion of children being accompanied by adults (from about 30% of 7 year olds in 1971 to 92% in 1990). Hillman, M., & Adams, J. G. U. "Children's Freedom and Safety." Children's Environments, 9(2), 12-33, 1992. This study is available online. *Hillman, M., Adams, J., and Whitelegg, J. One False Move: A Study of Children's Independent Mobility. London: Policy Studies Institute, 1990. This report may be available in a library near you or can be purchased online. http://www.centralbooks.co.uk/html/ (Abstract by Senauer, 2007)*

18. ***Today's young children appear to have a more restricted range in which they can play freely, have fewer playmates, and in many cases their friends are less diverse.*** (Karsten, 2005). The percentage of children who live within a mile of school and who walk or bike to school has declined nearly 25 percent in the past 30 years. Today, barely 21 percent of children live within one mile of their school (Centers for Disease Control and Prevention, 2006). In another survey, 71 percent of adults report that they walked or rode a bike to school when they were children, but only 22 percent of children do so today (Beldon, Russonello and Stewart Research and Communications, 2003). Children predominantly play at home, with their activities monitored and controlled by adults, compared to children a generation ago. According to Stephen Kellert, professor of social ecology at Yale, experience in a surrounding home territory, especially in nearby nature, is linked to shaping children's cognitive maturation, including the developed abilities of analysis, synthesis and evaluation (Kellert, 2005). *From "The Powerful Link between Conserving Land and Preserving Human Health:" http://atfiles.org/files/pdf/FrumkinLouv.pdf*

19. ***Parental constraints have always been present, but in this generation they seem to exert much greater control on children's play.*** In this study, Dr. Christine Tandy surveyed 421 children (ages 5 to 12) and 165 parents from suburban primary schools in Newcastle, New South Wales, Australia to investigate changes in children's independent mobility over time by comparing play patterns of schoolchildren in the late 1990s with play patterns of their parents. Dr. Tandy found that children in the late 1990s spent their time predominantly playing at home and in activities that were monitored or controlled by adults as compared to children a generation ago. Despite the dominance of home-based play, children's

drawings, however, indicated a strong preference for outdoor activities. Dr. Tandy also found that while children in both generations had parental constraints placed on their activities out of concern for their safety, children a generation ago still had a high degree of mobility and freedom (33.1% of children a generation ago had only a few restrictions with regard to their play space as compared to just 3.1% of children in the late 1990s). Parents themselves recognized this difference and a number indicated that society had changed from one in which it was safe for children to freely play, to one where it is not safe and thus there was a greater need for supervision to ensure children's safety. *Tandy, C. "Children's Diminishing Play Space: A Study of Intergenerational Change in Children's Use of Their Neighborhoods." Australian Geographical Studies, 37(2), 154-164, 1999. This study may be available in a library near you or can be purchased through the publisher (Institute of Australian Geographers) at: http://www.iag.org.au/index.html#IAGPubs (Abstract by Senauer, 2007)*

20. ***Private and public land is increasingly restrictive regarding children's free play.*** Most housing tracts, condos and planned communities constructed in the past two to three decades are controlled by strict covenants that discourage or ban the kind of outdoor play many of us enjoyed as children. Today, 47 million Americans live in homes ruled by condominium, cooperative and homeowners associations, according to the Community Associations Institute. The number of community associations burgeoned from 10,000 in 1970 to 231,000 by 2005. These associations impose rules on adults and children ranging from mildly intrusive to draconian: from barring basketball hoops to the building of forts and treehouses. Public government also restricts children's access to nature. Other stringent restrictions on children's outdoor play spring from our efforts to protect nature from human population pressures. Poor land-use decisions, which reduce accessible nature in cities, do far more damage to the environment than do children. Two examples: Each year, 53,000 acres of land are developed in the Chesapeake Bay watershed; that's about one acre every 10 minutes. At that rate, development will consume more land in the Chesapeake watershed in the next 25 years than in the previous three and a half centuries, according to the Chesapeake Bay Alliance. Similarly, the Charlotte, North Carolina, region lost 20 percent of its forest cover over the past two decades; between 1982 and 2002, the state lost farmland and forests at the rate of 383 acres a day. The U.S. Department of Agriculture projects forests declining from 767,000 acres in 1982 to 377,000 in 2022. Amazingly, developed land in North Carolina increased at a rate twice that of the state's population growth. *From "Last Child in the Woods", Natural Resources Inventory Report, U.S. Department of agriculture, 2002. http://www.nrcs.usda.gov/technical/NRI/, Community Associations Institute: http://www.caionline.org/Pages/Default.aspx*

21. ***Is recess disappearing? If so, this may be especially true for African American and lower-income students.*** Setting aside the issue of greening schoolyards, some reports suggest that recess time has decreased in recent years. In a review of available statistics, Olga Jarrett, Ph.D., Georgia State University, Atlanta and Sandi Waite-Stupiansky, Edinboro University of Pennsylvania, suggest that "officially having recess and actually having recess are two different issues," and that "recess time is often cut because of academic pressures or as punishment for bad behavior." They point to a recent study in Pediatrics (Barros, Silver, & Stein, 2009). Using a national data set of 11,000 children, the study "found that 30% of third graders had fewer than 15 minutes of recess a day." "A nationwide study of how children spend their time at school found that 21% of the children did not have any recess on a randomly selected day (Roth, Brooks-Gunn, Linver, & Hofferth, 2003)." As Jarrett and Waite-Stupiansky write, the authors of that study reported that "39% of the African American students versus 15% of white students did not have recess; 44% of those living below the poverty line versus 17% of those living above the poverty line were deprived of recess; and 25% of the children below the mean on the standardized test versus 15% of those above the mean did not have recess. The National Center for Educational Statistics survey also found disparities, with rural schools and affluent schools more likely to have recess. A 2003 Georgia study found the same patterns but with 25% of kindergartners and nearly 50% of fifth graders having no recess." *What's on our minds. . . Play, Policy, and Practice (PPP) Interest Forum, Olga Jarrett, Ph.D., Georgia State University, Atlanta, Sandi Waite-Stupiansky, Edinboro University of Pennsylvania. The paper is available on line through naeyc.org, though NAEYC membership is required for downloading.*

22. ***Many children experience limits on their adventurous play, including in natural areas.*** Playday, an annual celebration of children's right to play, commissioned a series of four studies in the United Kingdom (UK) on risk and play to better understand the benefits and challenges of enabling children to manage their own risks while playing. ICM Research interviewed over 1,000 children (aged 7-16) and over 1,000 adults (aged 18+) across the UK by telephone about various aspects of risk and play. A few of the findings from the children's survey include that 51% of children (aged 7-12) reported that they are not allowed to climb a tree without an adult present and 42% reported that they are not allowed to play in local parks without an adult. In addition, they found that 77% of children would like more opportunities to take risks while playing and that this type of play makes 90% of children feel happy. While it can be difficult to directly compare adult memories of childhood to children's current day experiences, the survey also found that 1) 70% of adults experienced most of their adventurous play in natural environments when they were children whereas only 29% of children today experience most of their adventurous play in natural environments and 2) while both adults (when

they were young) and children today found bike riding/skateboarding and exploring new/unfamiliar places to be among the most adventurous activities, adults also found playing with nature to be among the most adventurous while children today identified electronic/computer games. Adult respondents identified an increasing concern with health and safety regulations and a perception of it being more dangerous for children to play as being key reasons why there has been a decline in opportunities for children to challenge themselves while playing. Additional information from a Playday 2008 opinion poll: a third of children (34%) aged 7-12 are not allowed to ride a bike to a friend's house without an adult present; yet three quarters of children (73%) aged 7-12 are allowed to surf the internet without an adult present. *Playday Survey Reports. British Market Research Bureau for the Children's Play Council, 2005, 2006. These survey results are available online. http://www.playday.org.uk/playday_campaigns/2008_give_us_a_go/2008_research.aspx*

23. ***Children's independent mobility influences their outdoor activity.*** A 2009 Australian study examined the amount of time children play outside after school and the relationship between outdoor play and children's independent mobility. As part of this study, nearly 1400 ten- to twelve-year-old children from schools in Sydney, Australia completed a five-day diary about their time spent playing outdoors and engaged in screen time (watching television/video or playing computer games). In addition, children answered a question about their independent mobility and parents provided family and demographic information. In analyzing the survey data, Wen and colleagues found that 37% of children reported spending less than 30 minutes a day playing outdoors after school, 43% reported spending more than 2 hours a day engaged in screen time, and 48% reported being allowed to mostly walk on their own where they live. With regard to these measures, researchers found some gender differences. For example, significantly more boys than girls spent 2 or more hours a day playing outdoors and engaged in screen time. In addition, boys were significantly more likely to have greater independent mobility as compared to girls. In examining the relationship between outdoor play and children's independent mobility, Wen and colleagues found a significant association between the two factors after adjusting for a number of other factors. Specifically, researchers found that children who reported being allowed to walk on their own sometimes or mostly were 1.74 and 2.56 times more likely to spend more than 30 minutes a day outdoors after school as compared to children who were never allowed to walk on their own near home. The researchers also found that children of parents who reported their neighborhood as being safe, reported being employed, and reported having an English-speaking home were more likely to have children that reported spending more time outdoors. While this study is cross-sectional in nature and relies on self-reported data, it provides important information from a relatively large sample concerning the role of independent mobility in children's time

spent outdoors. *(Author Affiliation: Wen, Kite, and Rissel are with the Sydney West Area Health Service in Australia. Merom is with the University of Sydney in Australia.) Wen, L. M., Kite, J., Merom, D., & Rissel, C. (2009). Time spent playing outdoors after school and its relationship with independent mobility: a cross-sectional survey of children aged 10-12 years in Sydney, Australia. International Journal of Behavioral Nutrition and Physical Activity, 6, 8. This study may be available in a library near you or can be purchased online through the publisher at: http://www.ijbnpa.org/ (Abstract adapted from Senauer Loge, 2009)*

24. ***Very few children walk to school and distance is the primary barrier.*** Beck and Greenspan documented children's usual mode of travel to school and reasons why children do not walk to school. Researchers used data from a nationally representative telephone survey where over 2,000 parents answered questions about the school travel behavior of their 5- to 15-year-old child. In analyzing the data, Beck and Greenspan found that about 46% of children traveled to school via car, 40% via school bus, and 14% via walking. Children's usual travel mode varied by age group, income and region of the country. For example, 5- to 11-year-old children were more likely to travel to school via car than 12- to 14-year-old children and children in the Northeast and West were more likely to walk to school than children in the South. In addition, researchers found that about 70% of parents identified distance as the primary barrier to their child walking to school, while about 9% identified traffic danger. While the study may be limited due to its emphasis on self-report, it provides important information concerning barriers to children walking to school, which could help inform policies and targeted interventions. *(Author Affiliation: The authors are with the National Center for Injury Prevention and Control in Georgia.) Beck, L. F., & Greenspan, A. I. (2008). Why don't more children walk to school? Journal of Safety Research, 39(5), 449-452. This study may be available in a library near you or can be purchased online through the publisher at: http://www.elsevier.com/wps/find/journaldescription.cws_home/679/description#description (Abstract by Senauer Loge, 2009)*

25. ***Walking and bicycling to school dropped nearly 25% over 30 years.*** The Centers for Disease Control and Prevention (CDC) has compiled statistical information that documents changes in children's active transportation to and from school over the past thirty years. The data indicate that the percent of children who live within a mile of school and who walk or bike to school as their primary means of transportation has declined almost 25% over the past thirty years (from 87% to 63%) and that children who walk or bike from any distance has declined 26% (from 42% to 16%). The CDC also provides statistical information regarding four common barriers to children's active transportation and how they have changed over time: distance to school, adverse weather conditions, traffic dangers, and crimes against children. The data indicate that distance to school and traffic volume have increased over the past thirty years (for example, 34% of children in 1969 lived within 1 mile of their school, whereas just 21% of children live within 1 mile of their school today),

whereas adverse weather conditions, crimes against children, and traffic-related accidents have not increased. Crimes against children (12 to 19 years of age) and traffic accident rates (from 1995 to 2002) have actually decreased. *Kids Walk-to-school: Then and Now—Barriers and Solutions. Centers for Disease Control and Prevention, 2006. http://www.cdc.gov/nccdphp/dnpa/kidswalk/then_and_now.htm (Abstract by Senauer, 2007)*

26. ***Sociodemographic and physical environment factors influence children's active travel between home and school.*** Larsen and colleagues investigated relationships between children's mode of travel to and from school and various social and physical environment factors among 11- to 13-year-old students from a diversity of schools in London, Ontario, Canada. As part of this study, over 600 students, living within 1 mile of their school, completed a survey about their travel behavior and neighborhood. In addition, researchers used a Geographic Information System to identify participants' home and school neighborhoods and used various databases to calculate specific sociodemographic and physical environment characteristics (e.g., presence of street trees, intersection density, and dwelling density). In analyzing the study data, Larsen and colleagues found that 62% of students actively traveled from home to school, while 72% of students actively traveled from school to home. Researchers found that students were more likely to actively travel to or from school if they lived closer to school, were male, their neighborhood had a higher land use mix, and there were more street trees. For example, boys were about 1.5 times more likely to actively travel to/from school than girls. Additional research is needed to understand why some of these factors influence children's travel behavior. While this study may be limited due to its reliance on self-report and use of neighborhood-level information, it improves our understanding of the social and physical factors influencing children's travel to and from school and highlights the importance of school location. *Author Affiliation: Larsten and Irwin are with the University of Western Ontario in Canada. Gilliand is with the Children's Health Research Institute and University of Western Ontario in Canada. Hess is with the University of Toronto in Canada. He is with the University of Texas. Larsen, K., Gilliland, J., Hess, P., Tucker, P., Irwin, J., & He, M. Z. (2009). The influence of the physical environment and sociodemographic characteristics on children's mode of travel to and from school. American Journal of Public Health, 99(3), 520-526. This study may be available in a library near you or can be purchased online through the publisher at: http://www.ajph.org/ (Abstract by Senauer Loge, 2009)*

In some cases, the public's health may be an indirect indicator of both cause and effect of nature deficit. *Nature may encourage and support children's physical activity and help them maintain a healthy weight. These studies highlight the current status of children's physical activity and weight, their exposure to sunlight, and other health issues.*

27. ***While the causes of obesity are complex, the growth of child obesity may provide indirect evidence of lack of active play outdoors.*** Obesity in children has increased from about 4 percent in the 1960s to close to 20 percent in 2004. Approximately 60 percent of obese children ages five to ten have at least one cardiovascular disease risk factor, while the *Journal of the American Medical Association* reported an upward trend in high blood pressure in children ages eight to eighteen (Centers for Disease Control and Prevention, 2006; and Muntner, He, Cutler, Wildman, Whelton, JAMA, 2004). Little research has been conducted on the specific association between nature play and obesity in children, but we do know that children are more physically active when they are outside — a boon at a time of sedentary lifestyles and epidemic overweight *(Klesges et al., 1990; Baranowski et al., 1993; Sallis et al., 1993).*

28. ***There is an increase in the number of overweight children in the United States.*** Over the past 40 to 50 years, the Centers for Disease Control and Prevention has conducted large national surveys to measure and better understand nutrition and health in the United States. By looking at some of these measurements over time, we can track changes with regards to various health measures, such as the prevalence of children and adolescents who are overweight. Dr. Richard Troiano and colleagues investigated overweight prevalence and trends for children and adolescents from the 1960s to the early 1990s, and Dr. Cynthia Ogden and colleagues investigated prevalence and trends from the late 1990s to 2004. Together, these two studies show that the prevalence of overweight children and adolescents has increased dramatically. The prevalence of children (ages 6 to 11) who are overweight has increased from about 4% in the 1960s to almost 19% in 2003/4. Similarly, the prevalence of adolescents (ages 12 to 19) who are overweight has increased from about 4.5% in the 1960s to about 17.5% in 2003/4. This increase in overweight children and adolescents appears to have started in the 1980s. It is important to note, and the authors discuss, that there are variations within these trends. For example, the prevalence of children and adolescents who are overweight at any given time period is not the same for males and females or for different racial and ethnic groups. *Troiano, R. P., Flegal, K. M., Kuczmarski, R. J., Campbell, S. M., & Johnson, C. L. "Overweight Prevalence and Trends for Children and Adolescents: The National-Health and Nutrition Examination*

Surveys, 1963 to 1991." Archives of Pediatrics & Adolescent Medicine, 149(10), 1085-1091, 1995. This study may be available in a library near you or can be purchased through the publisher (American Medical Association). Ogden, C. L., Carroll, M. D., Curtin, L. R., McDowell, M. A., Tabak, C. J., & Flegal, K. M. "Prevalence of Overweight and Obesity in the United States, 1999-2004." Jama-Journal of the American Medical Association, 295(13), 1549-1555, 2006. This study may be available in a library near you or can be purchased through the publisher (American Medical Association). The Centers for Disease Prevention and Control provides information online regarding overweight trends for children and adolescents. This information is available at: http://www.cdc.gov/nccdphp/dnpa/obesity/trend/index.htm (Abstract by Senauer, 2007)

29. ***As children move into their teens they are less physically active.*** In this study, P.R. Nader and colleagues investigate physical activity patterns in youth from 9 to 15 years of age. The authors collected physical activity data using accelerometers for 1,032 youth over a 6-year period (starting when the children were 9 years old), as well as height, weight, and demographic information. Nader and colleagues were particularly interested in the amount of time youth engaged in moderate-to-vigorous physical activity (MVPA) as experts currently recommend that youth engage in at least 60 minutes per day of MVPA. In analyzing the data, the authors found that youth spent significantly less time engaged in MVPA as they got older. For example, at 9 years of age, youth engaged in MVPA for about 3 hours a day on weekdays and weekends, whereas at 15 years of age, adolescents engaged in MVPA for 49 minutes a day on weekdays and 35 minutes a day on weekends. Consequently, the percentage of children who met the recommended activity guidelines of 60 minutes of MVPA per day decreased significantly with age. While almost all 9- and 11-year-old children met the guidelines, only 31% of 15 year-olds met the guidelines on weekdays and only 17% of 15 year olds met the guidelines on weekends. Nader and colleagues found that boys tended to be more active than girls and that girls fell below the recommended activity guidelines at a younger age than boys (13.1 years versus 14.7 for weekdays and 12.6 years versus 13.4 for the weekends). The authors conclude by discussing study limitations and future research needs, including investigation into the amount of MVPA needed to positively impact child health and the environmental factors that impact MVPA.
Nader, P. R., Bradley, R. H., Houts, R. M., McRitchie, S. L., & O'Brien, M. (2008). "Moderate-to-vigorous physical activity from ages 9 to 15 years." Jama - Journal Of The American Medical Association, 300(3), 295-305. (Abstract by Senauer, 2008)

30. ***Reduced teen physical fitness reported in Texas.*** A 2008 Texas survey appears to support the JAMA report (above) that physical fitness decreases in the teen years. A press release announcing preliminary results of the survey announced that a physical fitness assessment of almost 2.6 million Texas indicate that fitness levels decline with each passing grade level. The release states that this finding "corresponds with decreasing emphasis on physical education in upper grades." A general decline of physical activity outdoors and

indoors of teens may also be a factor. *(The press release for this assessment can be found online at: http://www.tea.state.tx.us/press/08fitnessresults.pdf)*

31. ***Canadian children receive an "F" in physical activity.*** For the past five years, the organization Active Healthy Kids Canada has created an annual report card on the many factors impacting children's physical activity in Canada. In developing their report card, the organization analyzes current data and literature related to physical activity. With regard to physical activity levels, Canadian children were given an "F" this year as 87% of children did not meet Canada's physical activity guidelines of 90 minutes of physical activity a day, however, the proportion of children meeting the guidelines increased from 9% in 2005/2006 to 13% in 2007/2008. In their report, the organization also reviews research concerning children's screen time behavior, organized sport and physical activity participation, active play, and active transportation, as well as disparities among children with regard to physical activity. In addition, the organization discusses research related to influential factors, including schools, family and peers, the community and built environment, and health policy. This report provides a comprehensive and valuable look at the many issues impacting children's physical activity levels. *Active Healthy Kids Canada. (2009). Report card on physical activity for children and youth. Active Healthy Kids Canada. This report is available online at: http://www.activehealthykids.ca/ReportCard/2009ReportCardOverview.aspx (Abstract by Senauer Loge, 2009)*

32. ***Study links green spaces to children's health.*** In this study, the researchers speculated that neighborhood greenness might serve as an indicator of children's access to spaces that promote physical activity or increased time outside. As reported in ScienceDaily, October 29, 2008: "In the first study to look at the effect of neighborhood greenness on inner city children's weight over time, researchers from the Indiana University School of Medicine, Indiana University-Purdue University Indianapolis, and the University of Washington report that higher neighborhood greenness is associated with slower increases in children's body mass over a two year period, regardless of residential density. 'Previous work, including our own, has provided snap shots in time, and shown that for children in densely populated cities, the greener the neighborhood, the lower the risk of obesity. Our new study of over 3,800 inner city children revealed that living in areas with green space has a long term positive impact on children's weight and thus health,' said Gilbert C. Liu, M.D., senior author of the new study which appears in *the American Journal of Preventive Medicine*. Dr. Liu is assistant professor of pediatrics at the IU School of Medicine and a Regenstrief Institute affiliated scientist. The researchers examined the medical records of 4,000 three- to sixteen-year-old children that lived in Marion County, Indiana, received care from a particular clinic network between 1996 and 2002, had height and weight measurements for two consecutive years, and lived at the same

residential address for at least two years. Researchers geo-coded each participant's address using a Geographic Information System and measured greenness at these locations using satellite images and a vegetation index. In analyzing the study data, Bell and colleagues found that the amount of vegetation in a child's neighborhood was inversely correlated with their Body Mass Index (BMI) score at the year two measurement. That is, in general, the more vegetation a child had in their neighborhood, the lower their body weight changes. The researchers also found that children in more vegetated settings were less likely to have a higher BMI over 2 years as compared to children in less vegetated settings. Importantly, Bell and colleagues controlled for a number of other factors in their analyses, such as residential density. While the study is observational and thus cannot causally link neighborhood greenness and body weight changes, this research highlights the role that neighborhood vegetation could play in policies and programs aimed at preventing childhood obesity. *Bell, J. F., Wilson, J. S., & Liu, G. C. (2008). Neighborhood greenness and 2-year changes in Body Mass Index of children and youth. American Journal of Preventive Medicine, 35(6), 547-553. This study may be available in a library near you or can be purchased online through the publisher at: http://www.ajpm-online.net/ (Abstract adapted from Senauer Loge, 2009)*

33. ***Many young children do not meet health recommendations in terms of their physical activity and screen time behavior.*** To help prevent childhood obesity, health agencies currently recommend that children engage in no more than 2 hours of screen time per day and are active for at least 60 minutes per day. In this study, Anderson and colleagues estimated the percentage of children in the US that have low levels of active play, high levels of screen time, and both low levels of active play and high levels of screen time. The authors also examined whether these behaviors were associated with children's age, gender, race/ethnicity, and weight. Anderson and colleagues defined "low levels of active play" as a child who plays less than 7 times per week in a way that makes him/her sweat and breathe hard and "high screen time" as a child who watches television or videos or uses a computer for more than 2 hours per day. The authors analyzed data for nearly 3,000 four- to eleven-year-old children that were collected during a large, nationally representative study from 2001 to 2004 (the National Health and Nutrition Examination Survey or NHANES). As part of this survey, each child's weight and height was measured and an adult (most often a parent) responded to interview questions about their child's active play and screen time behaviors and provided demographic information. In analyzing the data, Anderson and colleagues found that about 37% of all children had low levels of active play, 65% had high levels of screen time, and about 26% had both low levels of active play and high levels of screen time. Among their many results, the authors also found that children who were older in age, female, non-Hispanic black, and had a high body mass index were more likely to have both low active play and high screen time levels. Importantly,

Anderson and colleagues consider their estimates of children with low levels of active play and high levels of screen time to be conservative. While this study is cross-sectional and therefore no causal associations can be made, it provides important information regarding children's active play and screen time behaviors that can help inform health policies and programs. (Author Affiliation: Anderson is with The Ohio State University of Public Health. Economos and Must are with Tufts University.) *Anderson, S. E., Economos, C. D., & Must, A. (2008). Active play and screen time in US children aged 4 to 11 years in relation to sociodemographic and weight status characteristics: a nationally representative cross-sectional analysis. BMC Public Health, 8, 13. This study may be available in a library near you or can be purchased online through the publisher at: http://www.biomedcentral.com/bmcpublichealth/ (Abstract by Senauer Loge, 2009)*

34. ***Many preschoolers do not achieve recommended physical activity levels.*** Tucker reviews 39 studies published between 1986 and 2007 on the physical activity levels of preschool-aged children. She reviews the literature in terms of guidelines put forth by the National Association for Sport and Physical Education, which recommends that preschool children engage in at least 60 minutes of physical activity and up to several hours of unstructured play each day. In examining the literature, Tucker found that almost half of preschool-aged children do not engage in 60 minutes of physical activity a day. Importantly, she notes that this is a conservative estimate as it does not include information on unstructured play. In addition, Tucker found that male children were more active than female children. In concluding her review, she identifies the need for interventions that support physical activity, especially in females, and more uniform assessment and reporting methods to facilitate understanding and comparison across studies. Tucker also highlights the important role of early childhood educators, parents, and teachers in promoting children's healthy physical activity levels. *(Author Affiliation: Tucker is with the University of Western Ontario in Canada.) Tucker, P. (2008). The physical activity levels of preschool-aged children: a systematic review. Early Childhood Research Quarterly, 23(4), 547-558. This study may be available in a library near you or can be purchased online through the publisher at: http://www.elsevier.com/wps/find/journaldescription.cws_home/620184/description (Abstract by Senauer Loge, 2009)*

35. ***Physical activity declines between the ages of 3 and 4 to 5 years.*** We currently know very little about how children's physical activity changes over time. In this study, Taylor and colleagues followed 3- to 5-year-old children to investigate patterns of physical activity and inactivity. Over 200 children from Dunedin, New Zealand participated in this study. Each year researchers measured children's height and weight, children and their parents wore accelerometers to assess physical activity, and parents completed a questionnaire regarding their children's physical activity and inactivity. In analyzing the data, Taylor and colleagues found that children spent about 90 minutes a day engaged in screen time and an additional 90 minutes a day engaged in other sedentary activities. With

regard to physical activity levels, the researchers found that children's physical activity was significantly reduced at 4 and 5 years of age as compared to 3 years of age. For example, children's time in moderate to vigorous activity dropped nearly 50% between the ages of 3 and 4. In investigating factors that might influence children's physical activity, Taylor and colleagues found that day of the week, season, gender, hours of childcare, and birth order were not significant influences, but that the father's activity level had a small but significant influence on children's physical activity. This study is one of the few longitudinal studies with a fairly large sample size that has been conducted to date and provides an important contribution to our understanding of activity in 3- to 5-year-old children. *(Author Affiliation: The authors are with the University of Otago in New Zealand.) Taylor, R. W., Murdoch, L., Carter, P., Gerrard, D. F., William, S. M., & Taylor, B. J. (2009). Longitudinal study of physical activity and inactivity in preschoolers: The FLAME Study. Medicine and Science in Sports and Exercise, 41(1), 96-102. This study may be available in a library near you or can be purchased online through the publisher at: http://journals.lww.com/acsm-msse/pages/default.aspx (Abstract by Senauer Loge, 2009)*

36. ***Many US children are deficient in vitamin D, primarily produced by exposure to sunlight.*** Vitamin D is primarily produced in the skin after exposure to sunlight and is essential for calcium absorption and may be important to numerous other body processes. In this study, Kumar and colleagues investigated the prevalence of vitamin D deficiency among US children and whether vitamin D deficiency is associated with cardiovascular risk factors. The researchers analyzed data for nearly 10,000 children from the 2001-2004 National Health and Nutrition Examination Survey (NHANES), a nationally representative survey of the U.S. population where participants were interviewed and given physical examinations. In analyzing the data, Kumar and colleagues found that 9% of 1- to 21-year-old children were vitamin D deficient, representing 7.6 million U.S. children, and 61% were vitamin D insufficient, representing 50.8 million US children. In examining factors associated with vitamin D deficiency, researchers found that children who were older, female, non-Hispanic black or Mexican American, obese, drank milk less than once a week, did not take vitamin D supplements, and were engaged in more than 4 hours of screen time a day, were more likely to be vitamin D deficient. In addition, Kumar and colleagues found that vitamin D deficiency was associated with a number of cardiovascular risk factors, including higher systolic blood pressure and higher lipoprotein cholesterol, when compared to children without vitamin D deficiency. While this study may be limited due to its cross-sectional design, Kumar and colleagues' work using a large, nationally representative sample provides valuable information on an understudied topic. *(Author Affiliation: Kumar, Kaskel, and Melamed are with the Albert Einstein College of Medicine in New York. Muntner is with the Mount Sinai School of Medicine in New York. Hailpern is with the Centers for Disease Control and Prevention.) Kumar, J., Muntner, P., Kaskel, F. J., Hailpern, S. M., & Melamed, M. L. (2009). Prevalence and associations of 25-Hydroxyvitamin D deficiency*

in US children: NHANES 2001-2004. Pediatrics(August 3). This study may be available in a library near you or can be purchased online through the publisher at: http://www.jpeds.com/ (Abstract by Senauer Loge, 2009)

37. ***Indoor lifestyle and rise of myopia.*** In recent decades, myopia or nearsightedness has become increasingly common in young children. While the cause(s) of myopia remain unknown, environmental factors are thought to play an important role. (The fact that outdoor activities seem linked to myopia suggests that a lack of outdoor play may be a factor in the increase in myopia, though the authors of this study do not make that statement.) Using data from the Sydney, Australia Myopia study, after adjusting for a number of potentially confounding factors (e.g., parental myopia and ethnicity), Rose and colleagues found that higher levels of total time spent outdoors were associated with a lower prevalence of myopia among 12-year-olds. The authors found that 12-year-olds with the highest levels of near work activity and lowest levels of outdoor activity were two to three times more likely than their peers to develop myopia, whereas 12-year-olds with the lowest levels of near work activity and highest levels of outdoor activity were less likely than their peers to develop myopia. The authors also found that participation in sports did not seem to be a significant factor in explaining this protective effect. Rose and colleagues suggest that light intensity may be an important factor in explaining the impact of outdoor activity on the development of myopia and that additional research is needed to help understand this relationship. *Rose, K. A., Morgan, I. G., Ip, J., Kifley, A., Huynh, S., Smith, W., et al. (2008). Outdoor activity reduces the prevalence of myopia in children. Ophthalmology, 115(8), 1279-1285. This study may be available in a library near you or can be purchased online. (Adapted from Abstract by Senauer, 2008)*

The relationship between lack of knowledge of nature and lack of experience in natural environments: *The studies highlighted below indicate that many of today's children know very little about their environment. One possibility is that biodiversity has decreased where children live; another possibility is that many children's lack of knowledge about common plants and animals may indicate that many children have little or no meaningful direct experience with local biodiversity, whether their play or learning is inside or outside.*

38. ***Children know more about Pokémon than common wildlife.*** In 2002, a British study discovered that the average eight-year-old was better able to identify characters from the Japanese card trading game Pokémon than native species in the community where they lived: Pikachu, Metapod, and Wigglytuff were names more familiar to them than otter, beetle, and oak tree. *(Balmfold, Clegg, Coulson and Taylor, 2002).*

39. ***Children have lost touch with the natural world and are unable to identify common animals and plants, according to a recent study by BBC Wildlife Magazine.*** 700 children between the ages of 9 and 11 from 17 schools in Bristol (United Kingdom) were asked to identify a number of local wild species. The magazine also asked participants a number of questions related to wildlife and their activities more generally. While 70% of children could correctly identify blackberry and magpie, only 8% could identify goldfinch and 12% a primrose. Additional research is needed to better understand this study's findings and whether or not these numbers might represent a significant lack of or decline in environmental knowledge. The study attracted widespread attention in the UK and abroad, including a story in The Independent, which reported: "The study also found that playing in the countryside was children's least popular way of spending their spare time, and that they would rather see friends or play on their computer than go for a walk or play outdoors….Sir David Attenborough warned that children who lack any understanding of the natural world would not grow into adults who cared about the environment." "The wild world is becoming so remote to children that they miss out," he said, "and an interest in the natural world doesn't grow as it should. Nobody is going protect the natural world unless they understand it." Fergus Collins, of BBC Wildlife Magazine, said the results "reinforce the idea that many children don't spend enough time playing in the green outdoors and enjoying wildlife – something older generations might have taken for granted." *Attenborough alarmed as children are left flummoxed by test on the natural world, by Sarah Cassidy, Education Correspondent, The Independent, Friday, 1 August 2008.*

40. ***A 2009 UK survey found that children have difficulty identifying plants and animals, and that parents worry that their children spend too much time indoors.*** As reported in by Daily Mail Reporter: "Four out of ten children can't tell the difference between a wasp and a bee…. In a survey of 1,600 children, researchers found 37 per cent of youngsters aged between five and ten didn't know what a bee looked like - with one in three mistaking it for a wasp. Incredibly, three per cent picked 'fly' when shown a picture of a bee. Children were also baffled by the difference between rodents….And nearly two thirds also struggled to tell a toad from a frog. The children surveyed were unsure when it came to larger animals too. One in 20 had no idea that a polar bear lives in the frozen wastelands of the North Pole. Yesterday Dr. Ahmed Djoghlaf, the Executive Secretary of the Convention on Biological Diversity, said: 'The survey results show that children's knowledge of biodiversity is in decline. 'We need future generations to be more engaged and aware in order to halt its loss."…Children's knowledge was no better when it came to plants - although girls were much better at identifying flowers than boys …. Researchers also questioned 1,500 parents about their children's

knowledge of biodiversity. It found a staggering seven in ten parents are worried that their child does not know enough about the natural world. Over two-thirds of parents (69 per cent) are concerned that their children spend too much time indoors playing computer games. Over half of children (52 per cent) spent under two-hours per day playing outdoors. About three quarters of parents (73 per cent) believe their child spends less time playing outside than they did when they were the same age. Most said they spent more than 40 per cent as much time outdoors when they were young as their children do now. The study was carried out by aircraft manufacturer Airbus to raise children's awareness of biodiversity." *Daily Mail Reporter, 03rd September 2009.*

41. ***UK teen-age, advanced-level biology students know very few common plants.*** In this study, Anne Bebbington tested nearly 800 advanced-level biology students (secondary school students in the United Kingdom (UK) who are generally 16-17 years of age) on their ability to identify 10 common wildflowers that were illustrated in color on a sheet of paper. Interestingly, she found that none of these students could name all 10 wildflowers and the vast majority of students (86%) could not name more than three common wildflowers. Ms. Bebbington also tested Post Graduate Certificate of Education students and teachers, but the sample sizes for both of these groups were too small to conduct comparative analyses. In closing, Ms. Bebbington discusses how science is taught in primary and secondary schools in the UK and what implications this study may have for education. Importantly, she highlights the role of identification and how it is not an end in itself—in fact it is just the beginning. Knowing the name of organisms (in this case wildflowers) can prompt students to ask questions and learn about organisms and their environments. *Bebbington, A. "The Ability of A-level Students to Name Plants." Journal of Biological Education, 39(2), 62-67, 2005. This study is available online at: http://www.iob.org/general.asp?article=404.xml&request=downloads/234.pdf (Abstract by Senauer, 2007)*

42. ***US and Japanese researchers link children playing in urban areas may experience lower levels of biological diversity.*** In this study, Dr. Will Turner and colleagues measured biodiversity in five diverse metropolitan areas by calculating species diversity (birds or ferns) in neighborhoods, using the mean biological diversity of all neighborhoods as a baseline. They found that the majority of people in urban areas live with impoverished biodiversity. For example, of the 4.4 million people who lived in the four cities they investigated with bird data, 73.2% of them lived in areas that had biodiversity levels below the baseline. *Turner, W. R., Nakamura, T., & Dinetti, M. "Global Urbanization and the Separation of Humans from Nature. Bioscience, 54(6), 585-590, 2004. This study may be available in a library near you or can be purchased through the publisher (American Institute of Biological Sciences) at: http://www.aibs.org/bioscience/*
(Abstract by Senauer, 2007)

43. ***In Israel, children are less likely than adults to identify natural outdoor areas as significant to them.*** Researchers revealed that nearly all adults surveyed in 1991 indicated that natural outdoor areas were the most significant environments of their childhood, while less than half of children ages eight to eleven shared that view. *Rachel Sebba, "The Landscapes of Childhood: The Reflection of Childhood's Environment in Adult Memories," Environment and Behavior, Vol. 23, No. 4, 395-422 (1991)*

44. ***Children and adults in Switzerland know little about biodiversity.*** Lindemann-Matthies and Bose interviewed and surveyed over 350 potentially more "biodiversity-knowledgeable" youth and adults in Switzerland to better understand people's knowledge of biodiversity. In analyzing the study data, researchers found that 60% of study participants had never heard the term biodiversity. With regard to grammar school students, however, the percentage was higher with 77% of students reporting to have never heard about biodiversity. Lindemann-Matthies and Bose found that for those participants who had heard the term biodiversity, the media, rather than school education, was identified as a provider of biodiversity information. In addition, researchers found that participants highly overestimated plant species richness in Switzerland and worldwide. Importantly, Lindemann-Matthies and Bose found that most participants were interested in biodiversity issues and thought that it was important. While this study had a relatively small sample size, it demonstrates that despite the increased attention biodiversity has received from the environmental research and policy communities, many people in Switzerland are still unfamiliar with biodiversity. To enhance biodiversity education and conservation, Lindemann-Matthies and Bose suggest the need to reconnect people to nature, promote more in-depth knowledge of biodiversity, and encourage people to take environmentally-friendly actions. *(Author Affiliation: The authors are with the University of Zurich in Switzerland.) Lindemann-Matthies, P., & Bose, E. (2008). How many species are there? public understanding and awareness of biodiversity in Switzerland. Human Ecology, 36(5), 731-742. This study may be available in a library near you or can be purchased online through the publisher at: www.krepublishers.com/...Journals/.../JHE-00-0-000-000-1990-1-Cover.htm (Abstract by Senauer Loge, 2009)*

45. ***Adolescents' environmental concerns have generally declined since the early 1990s.*** Wray-Lake and colleagues describe and analyze trends in environmental attitudes, beliefs, and behaviors of nearly 10,000 adolescents from 1976 to 2005. Researchers examined data from the Monitoring the Future study, a survey that has been conducted annually among a nationally representative sample of U.S. high school seniors. As part of this survey, a wide range of information is gathered from adolescents, including information about their conservation behaviors; attitudes toward consumer, government, and personal responsibility for the environment; and resource scarcity. In examining trends in adolescents' environmental concerns over the past three decades, overall,

the researchers found increases during the early 1990s and declines over the remainder of the last three decades. For example, researchers found steep declines in adolescents' willingness to engage in conservation behaviors, such as reducing their electricity or heat usage or driving less. In addition, Wray-Lake and colleagues found that adolescents were more likely to support consumer and government responsibility to protect the environment than to take personal action. The researchers also conducted some preliminary explorations of associations between different trends, as well as materialistic values and technological beliefs. Among their findings, Wray-Lake and colleagues reported parallel trends for resource scarcity and conservation behavior and negative associations between materialism and personal environmental responsibility and conservation. The researchers discuss observed trends as they relate to adult opinions and specific historic events and time periods, such as the 1970s energy crisis and different presidential administrations. Wray-Lake and colleagues highlight the importance of examining and understanding young people's environmental concerns and suggest areas for future research. While this study may be limited due to the specific conservation behaviors investigated, it is unique and provides a valuable contribution to the literature in that it examines adolescents' environmental concerns among a nationally representative sample of youth over time. *(Author Affiliation: The authors are with The Pennsylvania State University.) Wray-Lake, L., Flanagan, C. A., & Osgood, D. W. (2009). Examining trends in adolescent environmental attitudes, beliefs, and behaviors across three decades. Environment and Behavior(May 5). This study may be available in a library near you or can be purchased online through the publisher at: http://eab.sagepub.com/ (Abstract by Senauer Loge, 2009)*

Portions of this document were adapted and/or excerpted from the following C&NN resources:

Charles, C. (2007). *C&NN Research and Studies, Volume One*. Santa Fe: Children & Nature Network.

Senauer, A. (2007). *C&NN Research and Studies, Volume Two*. Santa Fe: Children & Nature Network.

Senauer, A. (2008). *C&NN Research and Studies, Volume Three*. Santa Fe: Children & Nature Network.

Senauer Loge, A. (2009). *C&NN Research and Studies, Volume Four*. Santa Fe: Children & Nature Network.

Additional Resources:

Kahn, Peter H., Jr., and Kellert, S. R. (2002) *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. Cambridge, MA: MIT Press.

Kellert, S. R. (2005). *Building for life: Designing and understanding the human-nature connection.* Washington, D.C.: Island Press.

Louv, Richard. (2008, 2005). *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder. Chapel* Hill: Algonquin Books.

Moore, R., & Marcus, C. (2008). Healthy planet, healthy children: Designing nature into the daily spaces of childhood. *Biophilic design: The theory, science and practice of bringing buildings to life*, 153 - 203. Hoboken, NJ: John Wiley & Sons.

Cheryl Charles, Ph.D., is the president and CEO of the Children & Nature Network (C&NN). Richard Louv is the chair of C&NN and author of "Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder," and coined the nonmedical term that describes the implications of alienation from the natural world for children's health and well-being.

For additional information about international efforts to connect children to nature, please see the Web site for the Children & Nature Network (http://www.childrenandnature.org).

For abstracts of an expanding body of scientific literature on children and nature, please see C&NN's Research, Resources and Publications (http://www.childrenandnature.org/research/).