Written Testimony of

Dr. Oliver R. W. Pergams

Director, Red Rock Institute, Inc.

Conservation Biologist, University of Illinois at Chicago

Before the Subcommittee on Early Childhood, Elementary, and Secondary Education

U.S. House of Representatives Committee on Education and Labor

April 22, 2008

Chairman Kildee, Congressman Sarbanes, honorable members of the Subcommittee, and Governor O'Malley: my name is Dr. Oliver Pergams. I am a Director of Red Rock Institute, a scientific research foundation, and am a conservation biologist at the University of Illinois at Chicago. Science is a second career for me: my first career was in the financial markets, beginning as a bank foreign exchange trader and ending as owner of a commodities trading company. I hope therefore to bring a little broader perspective.

It is an honor for me to appear before you today to share our research on the declining percentage of Americans visiting nature. I will share my thoughts on what this trend means for our children's health, and for their environmental attitude as adults. I will emphasize research showing the most effective way to instill an appreciation for nature is through hands-on nature experiences, incorporated into elementary environmental education. Lastly, I will speak briefly on resulting economic benefits.

I. Declining Percentage of Nature-Based Recreation

Our research published Feb. 2008 shows that people in the US and other developed nations are spending far less time in nature than ever before[1]. This research is included as an attachment to my written testimony. With colleague Dr. Patricia Zaradic, I tested 16 measures of nature participation related to visitation of various types of public lands in the US and other countries; number of various types of game licenses issued; and amount of time spent camping, backpacking, or hiking. The US activities with the greatest participation were visits to US State Parks, US National Parks, and US National Forests. All three visitation rates are in downtrends and are declining on average between 1% and 3% per year.

[1] Pergams, O. R. W. and P. A. Zaradic. 2008. Evidence for a fundamental and pervasive shift away from nature-based recreation. Proceedings of the National Academy of Sciences USA 105:2295-2300.

- *The longest and most complete of the 14 US nature recreation datasets show that ongoing declines in nature participation typically began between 1981 and 1991, are losing on average over 1% per year, and have lost between 18% and 25% to date. There is no longer any real doubt that the percentage of people involved in most nature-based recreation is in long-term decline.*

II. Benefits of Nature-Based Environmental Education

The first benefit I'd like to talk about is environmental attitude. Our 2007 review of related research[2] suggests that direct contact with nature, especially as children, is the most critical influence on later attitude toward the environment[3, 4]. Our article is included as a second attachment. Family vacations and time with family and other mentors outdoors are a major influence on later environmental attitude. Environmental education is also important, but to a lesser degree than direct actual experience of natural areas[4, 5]. It is ideal is when exposure to nature occurs in the presence of a knowledgeable mentor or teacher. Such a teacher answers questions and helps to convert the rich experience of nature to knowledge and increased curiosity in the student. Direct contact with "wild" nature (such as hiking, playing in the woods, camping, hunting, or fishing), and (to a lesser extent) "domesticated" nature (such as gardening or pet care), before age 11, has been shown to be particularly important in shaping environmental attitudes and behaviors in adulthood[4]. This research is very important to today's proceedings: it means that:

- *While classroom environmental education of children is important and absolutely necessary, incorporating as many hands-on nature experiences as possible is crucial. These experiences should be with wild nature if at all possible, and with domestic nature as second choice.*

Next I'd like to talk about the effects of nature, or lack of nature, on children's development. Three ways of experiencing nature have been described[6]. Direct experience is undirected play in nature, for example in a forest, neighborhood park, backyard, or even a vacant lot. Indirect experience includes

[2] Zaradic, P. A. and O. R. W. Pergams. 2007. Videophilia: Implications for childhood development and conservation. Journal of Developmental Processes 2:130-144.
[3] Bögeholz, S. 2006. Nature experience and its importance for environmental knowledge, values and action: Recent German empirical contributions. Environmental Education Research, 12, 65–84.
[4] Wells, N. M., & Lekies, K. S.(2006. Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. Children, Youth and Environments, 16, 1–24.
[5] Chawla, L. 1999. Life paths into effective environmental action. Journal of Environmental Education, 31, 15–26.
[6] Kellert, S. R. 2002. Experiencing nature: Affective, cognitive, and evaluative development in children. In P. H. Kahn, Jr. & S. R. Keller (Eds.), Children and nature: Psychological, sociocultural, and evolutionary investigations. (pp. 117–152). Cambridge, MA: The MIT Press.

zoos, nature centers, aquariums, and museums. Vicarious experience is without actual physical contact with nature; for example art, photographs, videos, and webcams.

Direct experience with nature plays the most significant role in children's cognitive and evaluative development. Direct experience of nature offers a multitude of continuously changing sights, sounds, smells, and touches that promote a wide range of adaptive and problem solving responses, alertness, and attention. The more structured, indirect experiences of nature do not require the same level of spontaneous engagement and do not have the same developmental benefits. The least engaging and spontaneous type of nature contact is vicarious experience through electronic media. This research is also very important to today's proceedings: it means that:

- *The nature experiences incorporated should be direct experiences if at all possible, with indirect experiences second choice, and vicarious experiences a very distant third choice. The presence of a teacher or mentor is still necessary.*

Just as exposure to nature has positive effects, lack of exposure has negative effects. Children under 13 living in the United States spend on average only about half an hour of unstructured time outdoors each week[7]. Research suggests that this lack of nature exposure is leading to many developmental problems. For example, 5-year-olds limited in playing outdoors exhibited poorer social, behavioral, and motor skills and had fewer playmates than children who played more outdoors[8]. Children attending a day care center surrounded by orchards, pastures, and woodlands (and where the children went outdoors every day regardless of weather) had better motor coordination and greater attention capacity than did children who attended an urban day care center surrounded by tall buildings[9]. Children who moved to housing with more nature nearby tended to have higher levels of cognitive functioning and focus than children who moved to housing with less nature[10]. Activities conducted in natural green settings tended to lower the symptoms of children with ADD/ADHD and raised self-esteem[11].

[7] Hofferth, S., & Sandberg, J. 2001. 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? Oxford, England: Elsevier Science.
[8] Hüttenmoser, M. 1995. Children and their living surroundings: Empirical investigations into the significance of living surroundings for the everyday life and development of children. Children's Environments, 12, 403–413.
[9] Grahn, P., Mårtensson, F., Lindblad, B., Nilsson, P., & Ekman, A. 1997. Ute på dagis. Stad and Land, Nr. 145 [Outdoor daycare. City and country]. Hässleholm, Sverige: Norra Skåne Offset.
[10] Wells, N. M. 2000. At home with nature: The effects of nearby nature on children's cognitive functioning. Environment & Behavior, 32, 775–795.
[11] Taylor, A. F., Kuo, F. E., & Sullivan, W. C. 2001. Coping with ADD: The surprising connection to green play settings. Environment and Behavior, 33, 54–77.

III. Economic Benefits of Nature-Based Environmental Education

We have seen that elementary environmental education and hands-on nature experiences for children will increase interest in nature and affirm environmental attitudes. This in turn will have enormous and beneficial impacts on our use of nonrenewable resources and on our economy. The reduction in health costs relating to increased outdoor exercise will be substantial. Increased interest in nature would raise attendance at our great public lands, and reverse the negative trend in US nature-based tourism in general.

In addition, we must consider that a downward trend in the quality of science education has emerged as a national crisis. The percentage of graduate students in science and engineering has declined steadily since 1993. Meanwhile, imports of science and engineering brainpower are up almost 40 percent. We must reverse this trend in order to remain competitive in the global economy.

IV. Closing

In closing, I recognize that implementing nature-based environmental education will not be easy and will take strong political will and courageous leadership. But I firmly believe that our efforts, if we succeed, will pay rich dividends for our nation's future generations.

Thank you again for this opportunity to testify. I welcome your questions on these topics.

Attachments

1. Pergams, O. R. W. and P. A. Zaradic. 2008. Evidence for a fundamental and pervasive shift away from nature-based recreation. Proceedings of the National Academy of Sciences USA 105:2295-2300.
2. Zaradic, P. A. and O. R. W. Pergams. 2007. Videophilia: Implications for childhood development and conservation. Journal of Developmental Processes 2:130-144.

Evidence for a fundamental and pervasive shift away from nature-based recreation

Oliver R. W. Pergams*† and Patricia A. Zaradic‡

*Department of Biological Sciences, University of Illinois, 845 West Taylor Street, Chicago, IL 60607; and ‡Environmental Leadership Program, Delaware Valley, 116 Petrie Avenue, Bryn Mawr, PA 19010

Edited by Gretchen C. Daily, Stanford University, Stanford, CA, and approved December 17, 2007 (received for review October 17, 2007)

After 50 years of steady increase, *per capita* visits to U.S. National Parks have declined since 1987. To evaluate whether we are seeing a fundamental shift away from people's interest in nature, we tested for similar longitudinal declines in 16 time series representing four classes of nature participation variables: (*i*) visitation to various types of public lands in the U.S. and National Parks in Japan and Spain, (*ii*) number of various types of U.S. game licenses issued, (*iii*) indicators of time spent camping, and (*iv*) indicators of time spent backpacking or hiking. The four variables with the greatest *per capita* participation were visits to Japanese National Parks, U.S. State Parks, U.S. National Parks, and U.S. National Forests, with an average individual participating 0.74–2.75 times per year. All four time series are in downtrends, with linear regressions showing ongoing losses of −1.0% to −3.1% per year. The longest and most complete time series tested suggest that typical declines in *per capita* nature recreation began between 1981 and 1991, are proceeding at rates of −1.0% to −1.3% per year, and total to date −18% to −25%. Spearman correlation analyses were performed on untransformed time series and on transformed percentage year-to-year changes. Results showed very highly significant correlations between many of the highest *per capita* participation variables in both untransformed and in difference models, further corroborating the general downtrend in nature recreation. In conclusion, all major lines of evidence point to an ongoing and fundamental shift away from nature-based recreation.

natural areas visitation | nature deficit disorder | recreational choices | biodiversity conservation | videophilia

Our recent work has shown that after 50 years of steady increase, *per capita* visits to U.S. National Parks have declined since 1987(1–3) (papers accessible at www.videophilia.org; Fig. 1 this article). Before this, *per capita* National Park visits had increased from 1939 (the start of available data) until 1987. This 50-year period is remarkable for its steady increase and only minor dips and jumps in the face of World War II, changing demographics, and economic depressions, recessions, innovation, and invention. The ensuing period after the 1987 breakpoint is equally notable for its steady and consistent decline in visits. We went on to test various potentially causal variables, including videophilia, gas prices, foreign travel, extreme outdoor recreation, family incomes, government funding, and park capacity (overcrowding).

After publication, we had a huge reader and media response. Many comments pointed to factors specific to U.S. National Parks (historic admission fees, decaying infrastructure, reduced interpretive staff, etc.) as contributing to the decline. Other comments pointed to other natural areas taking away National Park market share [e.g., Bureau of Land Management (BLM) or National Forest lands allowing ATVs or snowmobiles, which National Parks do not). Finally, some readers cited the increase in outdoor adventure goods sales as indication that National Parks were an exception and that participation in outdoor wilderness activities must be on the rise.

We, however, hypothesized that U.S. National Park visits are a good proxy for how much people are visiting nature in general and that we would likely find similar longitudinal declines in visitation to other natural areas and reduced participation in other nature-related activities. This work tests that hypothesis. If it is indeed the case that people are, on average, visiting other natural areas less, it becomes likely that factors specific to U.S. National Parks are not responsible for the decline. If we are also seeing declines in the majority of other nature-related activities, it becomes quite likely that we are seeing a fundamental shift away from people's interest in nature.

If this is the case, it is of enormous importance. Kellert (4) describes human cultural learning and experience as exerting a fundamental shaping influence on the content, direction, and strength of people's nature-related values. Similarly, it has been found that environmentally responsible behavior results from direct contact with the environment (5) and that people must be exposed to natural areas as children if they are to care about them as adults (6). Extended periods spent in natural areas, as well as creating a role model, seem to create the most environmentally responsible behavior (7) and increased involvement in biodiversity conservation (8). Moreover, as today's adult role models spend less time in nature, this generation of children is also likely to follow suit.

Declining nature participation has crucial implications for current conservation efforts. We think it probable that any major decline in the value placed on natural areas and experiences will greatly reduce the value people place on biodiversity conservation. Accordingly, it becomes less likely that attempts to raise public awareness of the current biodiversity crisis (9) will succeed. In the long-term, conserving biodiversity may depend on our appreciation of nature's intrinsic value (10, 11). However, given infrequent experiences of nature's aesthetics and increasing reliance on dwindling ecosystem products, conservation efforts based on nature's intrinsic value will likely prove less successful in the short term than incorporating an ecosystem services approach (12–14).

Results

A graph of *per capita* visitation to various world public lands is given in Fig. 1. NPV and JapanNPV are large, complete datasets, and even a cursory glance discerns recent downtrends within them. There is a similar (and even steeper) recent downtrend in SPV, but missing data prevent one from ascertaining the exact peak. Recent downtrends also seem likely in NFV and BLMV, but they are missing more data, and one cannot be certain.

A graph of *per capita* hunting licenses (Hunting, range 1950–2005, $n = 52$) duck stamps (Ducks, 1935–2006, $n = 72$), and fishing licenses (Fishing, 1950–2005, $n = 53$) is given in

Author contributions: O.R.W.P. and P.A.Z. designed research, performed research, analyzed data, and wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

†To whom correspondence should be addressed. E-mail: pergams@uic.edu.

This article contains supporting information online at www.pnas.org/cgi/content/full/0709893105/DC1.

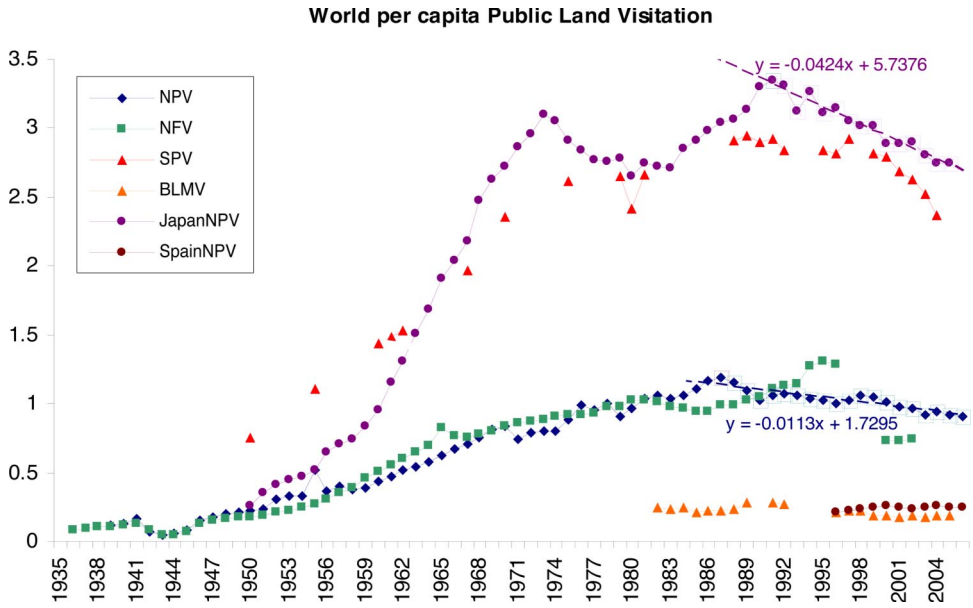


Fig. 1. Annual *per capita* visitation to the various U.S. and international public lands in this study. Included were U.S. National Parks (variable NPV, range of time series 1939–2006, $n = 68$), U.S. State Parks (SPV, 1950–2003, $n = 24$), U.S. National Forests (NFV, 1939–2002, $n = 61$), U.S. Bureau of Land Management sites (BLMV, 1982–2005, $n = 20$), Japanese National Parks (JapanNPV, 1950–2005, $n = 56$), and Spanish National Parks (SpainNPV, 1996–2006, $n = 11$). Linear regressions for declines from identifiable peaks in NPV (1987) and JapanNPV (1991) are represented by lines and equations.

supporting information (SI) Fig. 3. Fishing and Ducks both show downtrends. Although Hunting shows a high in 1983, a linear regression from 1983 to 2005 is insignificant ($P = 0.582$).

Recent downtrends and probable peaks are detailed in SI Table 4. The range in peak years for the five time series was 1953–2000 (mean = 1982): however, three of five variables (NPV, Fishing, and JapanNPV) peaked within 1981–1991 (mean = 1986). Ducks peaked much earlier than the other variables, in 1953. The range of decline since each peak in percentage terms was −18% to −66% (mean = −30%). However, four of five variables (excluding Ducks) showed a total decline within −18% to −25%. Also, the five variables showed a rate of annual decline ranging −1.0% to −3.6% (mean = −1.7%), but four of five variables had declined −1.0% to −1.3% annually (mean = −1.2%, SI Fig. 4). Also, the estimated peak of the incomplete State Park series is 1990, with an estimated decline from that peak of −1.2% per year (SI Fig. 4). Spanish NPV (SpainNPV, range of time series 1996–2006, $n = 11$) shows no discernible trend, but the time series is quite short. In sum, most reliable long-term *per capita* visitation measures of nature recreation peaked between 1981 and 1991, are declining at approximately −1.2% per year, and total to date −18% to −25%. Because of the very large difference in *per capita* participation represented by some of these nature outlets, we show the relative rankings of individual participation (Fig. 2).

In Table 2, we present the results of raw data and difference model comparisons using all data available to us. Spearman's ρ for U.S. and Japan visitation correlations in raw form ranges from 82% to 93% and in difference models ranges from 38% to 76%. Fishing and Hunting are also very highly correlated, and we examine this further in SI Table 5. Interestingly, Ducks are highly negatively correlated with hunting, because Ducks peaked in 1953 and has been declining since, whereas Hunting rose until 1983.

With the exception of Spain, for which we have only a relatively short time series, 15 of 16 comparisons among public land use in the U.S. and Japan are positively correlated. Fourteen of 16 comparisons are highly correlated (with 11 of the 14 having P values <0.0005). Moreover, six highly positively correlated public lands time series comparisons are also correlated in percentage year-to-year changes in visitor use.

In Table 3, we consider more specifically comparisons of public land use and survey results of nature recreation choices, revealing the nature recreation choices most closely correlated with declining *per capita* public land use. Decline in fishing licenses correlates with declining visitors at all U.S. public lands for which we have short-term data (NPV, SPV, and BLMV), as do the Mediamark survey results for camping in National Parks and National Forests (see also SI Fig. 5). Also, fishing and camping (according to the Mediamark survey results) are positively correlated with each other. This is especially notable because both fishing and camping have high *per capita* participation rates relative to all other nature recreation choices (Fig. 2).

In contrast to fishing and camping, correlation of hiking and backpacking suggests a countertrend to the general decline in nature recreation participation. Many of the backpacking and hiking time series are positively correlated with each other and

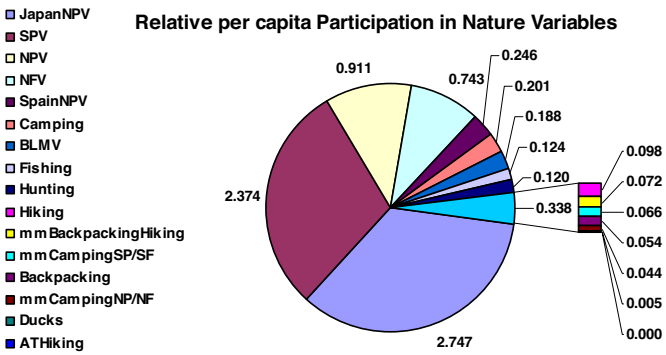


Fig. 2. Annual *per capita* participation for all 16 of the nature recreation variables included in any part of our analysis. See Table 1 for a complete description of variables and sources. None of the variables are mutually exclusive nor are they exhaustive. The figure is meant merely to compare relative *per capita* participation in the recreation choices we address.

Table 1. Variables used in this article

Data	Variable	Period	*N*	Definition	Source
Public lands visitation	BLMV	1982–2005	19	(Total recreational visits to all U.S. BLM properties)/(total U.S. population)	U.S. Bureau of Land Management and www.census.gov
	JapanNPV	1950–2005	56	(Total recreational visits to all Japanese national parks)/(total Japanese population)	Japanese government and www.stat.go.jp/data/chouki/zuhyou/02-01.xls
	NFV	1939–2002	61	(Total recreational visits to all U.S. national forests)/(total U.S. population)	U.S. National Forest Service and www.census.gov
	NPV	1939–2005	67	(Total recreational visits to all U.S. NPS properties)/(total U.S. population)	www2.nature.nps.gov/stats and www.census.gov
	SpainNPV	1996–2006	11	(Total recreational visits to all Spanish national parks)/(total Spanish population)	Spanish government and www.populstat.info/Europe/spainc.htm
	SPV	1950–2003	24	(Total recreational visits to all U.S. state parks)/(total U.S. population)	Statistical Abstracts of the USA www.census.gov/statab/www and www.census.gov
Game licenses	Ducks	1935–2006	72	(Total no. of duck stamps issued)/(total U.S. population)	Ducks Unlimited and www.census.gov
	Fishing	1950–2005	53	(Total no. of fishing licenses issued)/(total U.S. population)	Statistical Abstracts of the USA www.census.gov/statab/www and www.census.gov
	Hunting	1950–2005	52	(Total no. of hunting licenses issued)/(total U.S. population)	Statistical Abstracts of the USA www.census.gov/statab/www and www.census.gov
Camping	Camping	1970–2003	15	(No. of people surveyed that went camping anywhere over the past year)/(total no. of people surveyed)	Statistical Abstracts of the USA www.census.gov/statab/www and www.census.gov
	mmCampingNP/NF	1988–2005	18	(No. of people surveyed that went camping in national parks or forests over the past year)/(total no. of people surveyed)	Mediamark, Inc.
	mmCampingSP/SF	1988–2005	18	(No. of people surveyed that went camping in state parks or forests over the past year)/(total no. of people surveyed)	Mediamark, Inc.
Backpacking/hiking	ATHiking	1935–2005	71	(No. of hikers completing all 3,500 km of the Appalachian Trail)/(total U.S. population)	www.appalachiantrail.org/hike/thru_hike/facts.html and http://www.census.gov
	Hiking	1970–2003	16	(No. of people surveyed that went hiking anywhere over the past year)/(total no. of people surveyed)	Statistical Abstracts of the USA www.census.gov/statab/www and www.census.gov
	Backpacking	1972–2003	15	(No. of people surveyed that went backpacking anywhere over the past year)/(total no. of people surveyed)	Statistical Abstracts of the USA www.census.gov/statab/www and www.census.gov
	mmBackpackingHiking	1988–2005	18	(No. of people surveyed that went backpacking or hiking anywhere over the past year)/(total no. of people surveyed)	Mediamark, Inc.

negatively correlated with both fishing and U.S. public land use. Although there does seem to be an increasing trend in choosing backpacking and hiking, their relative *per capita* participation is so much smaller than fishing and camping that their tiny relative increases cannot offset the overall decline in nature-related recreation activities.

Discussion

Rather than being an anomaly restricted to National Parks, our results suggest a fundamental and pervasive decline in nature recreation. Both survey and visitor data detected similar declines during approximately the same time frame. Long-term nature use datasets suggest the typical decline so far is −18% to −25%, started 1981–1991, and is declining −1.0% to −1.3% per year (SI Table 4; Fig. 1, and SI Figs. 3 and 4). These similarities and the high correlation among various public land visitation variables (Tables 2 and 3) corroborate a general longitudinal decline in visitation to natural areas, rather than an isolated decline in U.S. National Park visits.

Moreover, the trend in declining nature extends beyond U.S. political and cultural boundaries. Japan's 56 years of *per capita* National Park visitor data were among the most highly corre-

Table 2. Results of short-term (1988–present) and long-term (entirety of available data) correlation comparisons among longitudinal visitor data at public lands in the U.S. and abroad

	Short-term comparisons of time series					
Long-term	NPV	NFV	SPV	BLMV	JapanNPV	SpainNPV
NPV	RC	NA	0.851 <0.0005**	0.833 <0.0005**	0.670 0.002**	NS
NFV	**0.931, 0.494** **<0.0005**, <0.0005****	RC	NA	NA	NA	NA
SPV	0.928 <0.0005**	0.777 <0.0005**	RC	**0.881, 0.762** **<0.0005**, 0.028***	0.758 0.002**	NS
BLMV	0.644 0.002**	0.653 0.011*	**0.881, 0.762** **<0.0005**, 0.028***	RC	0.815 <0.0005**	NS
JapanNPV	**0.824, 0.380** **<0.0005**, <0.0005****	**0.857, 0.571** **<0.0005**, <0.0005****	**0.928*, 0.636** **<0.0005**, 0.011***	NS	RC	−0.709 0.022*
SpainNPV	NS	−1.000 <0.0005**	NS	NS	−0.709 0.022*	RC

Results of short-term comparisons are given above the diagonal formed by redundant comparisons (RC), and long-term comparisons are given below that diagonal. Correlation coefficients and *P* values are reported for significant correlations; cells marked "NS" indicate no significant result. Where time series were significantly correlated in both raw and difference model form, data are in bold type and split; the raw (*Left*) and difference model (*Right*) results are given. *, significant at the 0.05 level; **, significant at the 0.01 level. National Forest data were unavailable or unreliable for the majority of the short-term timeframe, so no short-term correlations were tested (NA).

lated with all of the long-term U.S. public land data, both in untransformed and difference model comparisons (Table 2). Spain's National Park data were limited to post-1995, well after declines detected in most of our other longer term datasets. Compared with the U.S. and Spain, the Japanese visit their National Parks much more frequently (over three times a year on average at peak compared with just over once a year for Americans at U.S. National Parks and approximately once every 4 years for Spanish citizens in Spain, Fig. 2). Japanese National Park visitation trends are extraordinarily similar to those for Americans in U.S. state parks (Fig. 1, Table 2: ρ_S 0.928, $P < 0.0005$); perhaps because of Japan's smaller size; Japan's National Parks are more readily accessible.

United States National Forest and U.S. National Park data stand out among the most highly correlated time series for both correlation coefficient and length (Table 2, ρ_S 0.931, $P < 0.0005$, $n = 61$). Discounting the probably inflated National Forest visitor data in the mid-1990s, both U.S. National Park and National Forest visitors show steady increases for 50–55 years, before a considerable decline. Even given the differences in counting methods and missing years of visitor data in the late 1990s, it is remarkable that the last time the National Forests saw *per capita* visitors as low as 2002 was almost 40 years earlier (Fig. 1).

The majority of U.S. nature exposure as detected in our data are through State Park visits (Fig. 2). Although nationally reported numbers for State Park visits are sporadic, the last 15 years of data suggest a decline similar to Japan's National Parks (approximately −19% total and −1.3% annually). The decline in visits to Bureau of Land Management properties, although a

Table 3. The results of short-term (1988–present) comparisons of public land use and survey results of nature recreation choices

	U.S. public land			Nature recreation choices						
Recreation choice	NPV	SPV	BLM	Camp	mmCamping NP/NF	mmCamping SP/SF	Backpacking	Hike	mmBackpacking Hiking	ATHike
Fishing	0.820 <0.0005**	0.829 <0.0005**	0.811 <0.0005**		0.620 0.006**	0.611 0.007**	−0.615 0.033*		−0.641 0.004**	−0.862 <0.0005**
Hunting							−0.895 <0.0005**			−0.507 0.032*
Ducks									0.608 0.010**	
Camping				RC						
mmCamping NP/NF	0.529 0.024*	0.631 0.016*	0.591 0.026*		RC					−0.546 0.019*
mmCamping SP/SF	0.577 0.012*					RC				
Backpacking							RC		0.699 0.011*	0.678 0.015*
Hiking								RC		
mmBackpacking Hiking			−0.565 0.035*						RC	0.717 0.001**
ATHike	−0.777 <0.0005**	−0.767 0.001**	−0.846 <0.0005**							RC

Results of short-term comparisons are given above the diagonal formed by redundant comparisons (RC). None of these comparisons were significantly correlated in both raw and year-to-year percentage changes. Blank cells indicate no significant result. *, significant at the 0.05 level; **, significant at the 0.01 level.

much smaller component of U.S. nature exposure, is highly correlated with both the overall trend and year-to-year declines in State Park visits (SI Table 6).

U.S. longitudinal public surveys from two market survey sources independently corroborate the decline reported from park visitor counts (SI Fig. 5). The range of U.S. data included in our comparisons covers all public nature spaces for which national visitor use is available. The fact that all of these U.S. public land time series (as well as Japan's) are among the most highly correlated (Table 2 and SI Table 6) suggests that public nature spaces in the U.S. and Japan are similarly responding to changes in nature participation (Fig. 1 and SI Fig. 4). Moreover, the many short-term correlations in declining public land use in the U.S. and Japan (Table 2, SI Table 6, and SI Fig. 4) suggest that there has been a fundamental and general national and potentially international shift in people's participation in nature recreation over the last 20 years.

Camping data from two market survey sources independently corroborate the decline reported from park visitor counts (Table 3 and SI Fig. 5). The Mediamark camping survey questions refer specifically to camping within National Parks and Forests or State Parks and Forests. Further, the decline in annual camping as detected by both Mediamark surveys was correlated with the decline in National Park visitors. Mediamark survey results for declining camping in National Parks and Forests was also correlated with State Park visitors (Table 3). The consistency between survey results and the trends in public lands visitors suggest that declines detected in the visitor data are not due to changing counting methods by the parks but rather represent actual visitor declines.

Camping is the largest recreation component of the *per capita* pie chart, a choice for approximately one in five Americans, more popular in *per capita* participation than hunting or fishing (Fig. 2). As such, a trend of fewer and fewer Americans going camping is especially notable. Along with the Mediamark annual surveys, data surveying the frequency of camping in any venue (Camping in SI Fig. 5) also suggest a decline since 1987. These survey and visitor data together suggest that rather than a change in recreation venue, we are detecting a real shift away from nature as a recreation choice.

The range of *per capita* participation in all variables is very large: Each Japanese individual visits a National Parks on average 2.747 times per year (351 million visits total), whereas each U.S. individual finishes the Appalachian Trail on average 0.000002 times per year (<700 visits total), or six orders of magnitude less. It is therefore important to realize that although all of these trends are of interest, some of them involve many more people than others and are much more important when discussing national or global trends. The only countertrends to nature use decline come from a small minority of hikers and backpackers. Survey data suggest that hiking in all venues increased from 0.08 *per capita* participation in 1987 to 0.098 in 2002. Most of the hiking and backpacking participation survey results were negatively correlated with the general decline in nature recreation (Table 3). The small but steady growth in the hiking and backpacking market may reflect some individuals that were previously campers choosing day hikes instead.

Fishing and hunting were next in popularity after camping (Fig. 2). They are closely correlated (SI Table 5) and both increased in popularity until the early 1980s (SI Fig. 3). Hunting has managed to hang onto most of its market share since its1983 high; however, fishing has experienced a considerable *per capita* decline (−25% from its 1981 peak, an average of −1.0% a year). This may be related to various overfishing and pollution issues decreasing access to fish populations, contrasted with exploding deer populations (largely due to anthropogenic effects). The decline in fishing is highly correlated with the decline in visitors to U.S. public lands since 1987 (Table 3). The U.S. duck stamps time series is a subset of the much larger U.S. hunting licenses (*per capita* participation 0.005 vs. 0.120). Duck hunting regulations are often more complex, have higher equipment costs (decoys, boats, and dogs), and require access to relatively rare habitat (wetlands) than many other forms of hunting (S. Stephens, Ducks Unlimited, personal communication). This may in turn relatively deter recruitment of young duck hunters (15). We would further speculate that although the number of ducks in the U.S. has only recently increased [e.g., +14% in 2007 (16)], the number of deer has been exploding for a long time (17).

In conclusion, all major lines of evidence point to a general and fundamental shift away from people's participation in nature-based recreation. The cultural shift away from nature recreation appears to extend outside of the U.S. to at least Japan, and the decline appears to have begun 1981–1991. The root cause may be videophilia, as our previous work suggests (2, 3). Other factors may be responsible, but they would have to be large enough in scale and impact, and timely enough in instigation, to generate this type of shift. Regardless of the root cause, the evidence for a pervasive and fundamental shift away from nature-based recreation seems clear.

Materials and Methods

We examined as many variables having to do with nature visitation and nature-related activities as possible and determined whether they, like U.S. National Park visits, declined over time. We chose those variables that (*i*), like U.S. National Park visits, were actual and/or estimated counts of actual visits to natural areas or (*ii*) were surveys asking people about actual participation in nature-related activities and (*iii*) were time series of annual data.

Our first preference was for actual visitation data to separate intent from action. Surveys of people's intent to perform any activity in the future (including visit natural areas) have similar difficulties, and their memories of past activities may be grossly in error (18–20). We chose visitation variables for which we were able to obtain time series going back to at least 1988 (the start of the U.S. National Park visitation decline) and preferably back to the 1930s (the start of U.S. National Park visitation data). We also required that the variables be national in scope to keep all scales similar and remove regional effects.

In addition, we searched for international data from countries large enough and wealthy enough to use their national parks in similar ways as the United States. We used World Bank data to identify countries with the highest gross national income (GNI) and then identified the 12 countries with the greatest geographic area (SI Table 7). We then requested annual national park visitation data for each country. Unfortunately, only 3 of the 12 countries (Australia, Japan, and Spain) contacted provided data, although Canada, England, and Norway responded to state that their data were not available. Furthermore, Australia provided data for only two of its eight states and territories, Queensland and Western Australia. Because these data might be subject to regional variation and so might not represent a national trend, we did not use them. We also requested and received time series of visitation to other types of public land in the U.S. The result is that the following visitation variables are included in our analysis: *per capita* annual recreational visits to U.S. National Parks, U.S. National Forests, U.S. Bureau of Land Management (BLM) sites, all U.S. State Parks, and national parks in Japan and Spain.

Hunting and fishing licenses are purchased annually, are relatively well documented, and are another long-term measure of nature use. We included *per capita* fishing and hunting licenses, as well as duck stamps. We also used *per capita* hikers completing the 3,500 km of Appalachian Trail.

In all cases, we used all years of data supplied to us, with the following exceptions. We truncated BLM visitation data to 1982–2005. Data exist for 1975–1981, but BLM personnel (T. McDonald, personal communication) advised that although 1982 and later data were based on reported use at fee sites and recreation concessions, data before 1982 were not, and were much less reliable. Also, it should be noted that BLM data were not available for 1990 and 1993–1995; this is not our omission.

National Forest 1939–1964 data exist as number of visitors, but 1965–1996 data exist as 12-hour visitor days. The 1964–1965 transition appears fairly seamless (Fig. 1), suggesting the average National Forest visit at that time was just over 1 day. However, the classification of more special recreation sites within National Forests during the later 1990s resulted in double counting of visitors, and visitor-day values were inflated (S. Foley, U.S. Forest Service, personal communication). Also, during 1997–1999, no visitor data are available because the Forest Service, aware of these issues, coordinated visitor

counting methods between sites. After this, 2000–2002 values are presented as visitor days (similar to those before 1965). We felt enough confidence in 60 years of visitor data (1936–1993, 2000–2002) to include these in long-term comparisons.

We also acquired 1988–2003 annual U.S. survey data for average frequency of (*i*) overnight camping, (*ii*) backpacking, and (*iii*) day hiking, all in any natural area. In addition, we purchased data for several outdoor recreation variables during the period of the NPV decline (1988–2005) from Mediamark Research, Inc. These data consisted of (*i*) number of individuals that camped in a National Park or Forest, (*ii*) camped in a State Park or Forest, and (*iii*) that went backpacking or hiking, all in the last 12 months. The last variable was very similar to the more general backpacking and hiking variables but combined both and was obtained via a different survey series.

All variables are presented in Table 1. The table gives the abbreviations of the variables, their descriptions, how they were calculated, the periods for which we were able to obtain higher-confidence data (in range of years), and the source(s) of these data. When possible, hyperlinks are included to bring the reader directly to these data.

Our analyses consisted of visual, numeric, regression, and correlation analyses. Our visual analyses began with identification of probable peaks in the time series. Our criteria for inclusion were (*i*) that the time series had at least 50 data points (years of data) and (*ii*) that the time series was complete, especially in the vicinity of all possible peaks. Qualifying time series were NPV, Fishing, Ducks, JapanNPV, and U.S. Appalachian Trail thru hikers (ATHiking, range of time series 1935–2005, $n = 71$. ATHiking was anomalous in that the population of the time series was very small, $<$700 people in any given year. The other four time series had populations ranging from the millions to hundreds of millions. Although the U.S. State Park data are incomplete, State Park visits have the largest U.S. *per capita* public land participation. Because it is such an important component of U.S. nature use, we used the known high point for U.S. State Park visits (1990) to calculate an approximate rate of decline.

We also ranked all variables according to the amount of *per capita* participation in each. Our purpose in doing so was to evaluate the relative participation of people in each activity: Those activities with high *per capita* participation would be of more importance in evaluating whether a general trend exists than those in which few people participated.

Our previous works suggest the late 1980s as the start of the decline in nature recreation, and so we chose to examine more closely the trend in nature recreation choices from 1988 onward. We refer to comparisons during this 18- to 19-year period as short-term comparisons.

All statistical analyses were conducted with SYSTAT v. 11 (21) or SPSS v. 15 (22). Data were examined for normality of distribution through inspection of normal probability plots (23) and Lilliefors test (24). Most of the variables were not normally distributed, so Spearman rank-order correlation analyses were performed on all variables.

Because relatively constant trends in the entirety of the various time series could be responsible for part of any correlation found (heteroskedacticity, or lack of equal variance), we sought to remove this potential artifact by examining short-term linkages. To do so, we performed Spearman correlations on the percentage change from year to year of all variables in comparisons of difference models. To compare the trend and velocity of change in nature use, we compared the slopes of linear regressions of variables.

ACKNOWLEDGMENTS. We thank Peter Kareiva and The Nature Conservancy for providing support for this research. We thank Scott Stephens of Ducks Unlimited for duck stamps data and useful discussions.

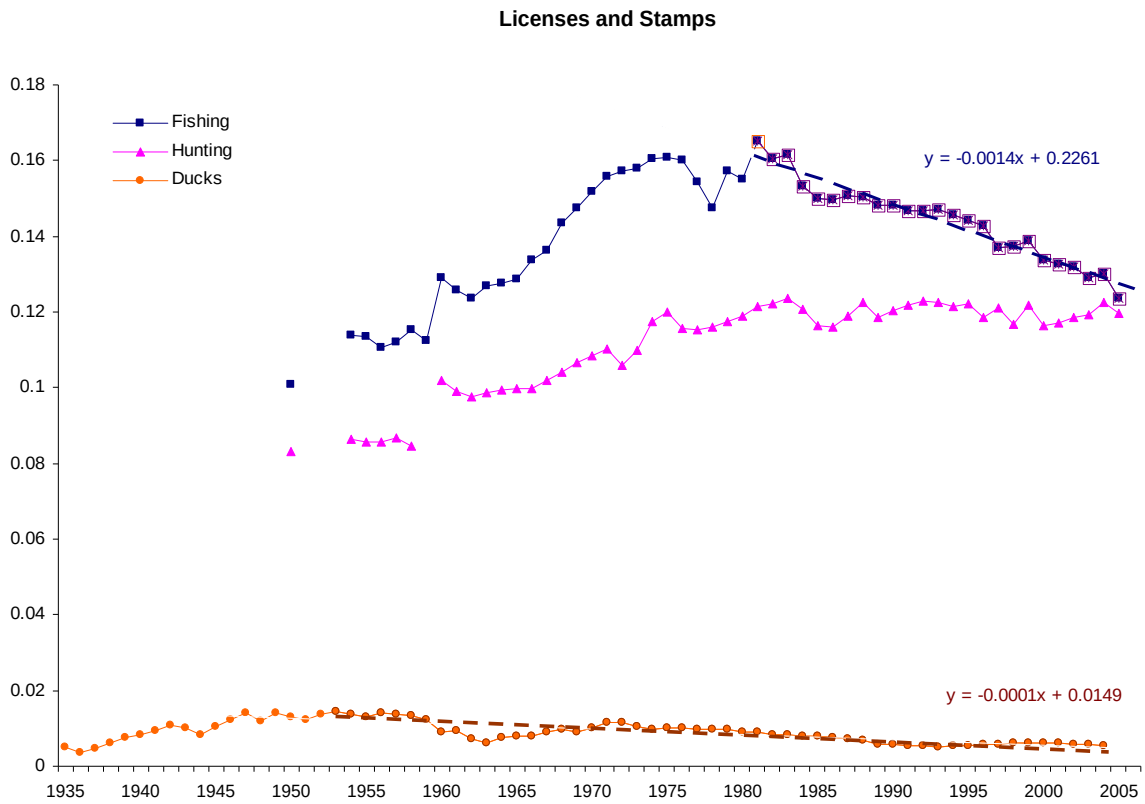
1. Pergams ORW, Czech B, Haney JC, Nyberg D (2004) Linkage of conservation activity to trends in the U.S. economy. *Conserv Biol* 18:1617–1623.
2. Pergams ORW, Zaradic PA (2006) Is love of nature in the U.S. becoming love of electronic media? 16-year downtrend in national park visits explained by watching movies, playing video games, internet use, and oil prices. *J Environ Manage* 80:387–393.
3. Zaradic PA, Pergams ORW (2007) Videophilia: Implications for childhood development and conservation. *J Dev Processes* 2:130–144.
4. Kellert S (1996) *The Value of Life: Biological Diversity and Human Society* (Island Press, Washington, DC).
5. Hungerford H, Volk T (1990) Changing learner behaviour through environmental education. *J Environ Educ* 21:8–21.
6. Duda MD, Bissell SJ, Young KC (1998) *Wildlife and the American Mind: Public Opinion on and Attitudes Toward Fish and Wildlife Management* (Responsive Management, Harrisonburg, VA).
7. Matthews BE, Riley CK (1995) Teaching and evaluating outdoor ethics education programs. *National Wildlife Federation* (ERIC Document Reproduction Service No. ED 401 097, Vienna, VA).
8. Chawla L (1998) Significant life experiences revisited: A review of research on sources of environmental sensitivity. *Environ Educ Res* 4:369–382.
9. Millenium Ecosystem Assessment (2005) *Ecosystems and Human Well-being: Synthesis.* (Island Press, Washington, DC).
10. McCauley DJ (2006) Selling out on nature. *Nature* 443:27–28.
11. McCauley DJ (2006) McCauley replies. *Nature* 443:28.
12. Marvier M, Grant J, Kareiva P (2006) Nature: Poorest may see it as their economic rival. *Nature* 443:28.
13. Reid WV (2006) Nature: The many benefits of ecosystem services. *Nature* 443:28.
14. Costanza R (2006) Nature: Ecosystems without commodifying them. *Nature* 443:28.
15. Babcock M (2007) Fewer hunters: Ducking trend with clinics (*Great Falls Tribune Online* published 9/6/07 (http://www.greatfallstribune.com/apps/pbcs.dll/article?AID=/20070906/LIFESTYLE05/709060321) and accessed 9/21/07.
16. Ducks Unlimited. (2007) Duck numbers up slightly overall (Webpage published 7/11/07 (http://www.ducks.org/news/1305/Ducknumbersupslightl.html) and accessed 9/21/07.
17. Stromayer KAK, Warren RJ (1997) Are overabundant deer herds in the Eastern United States creating alternate stable states in forest plant communities? *Wildlife Soc B* 25:227–234.
18. Groves RM (1987) Research on survey data quality. *Public Opin Qt* 51:S156–S172.
19. Fowler FJ (1995) *Improving Survey Questions: Design and Evaluation: Applied Social Research Methods* (Sage, Thousand Oaks, CA).
20. Groves RM (2004) *Survey Errors and Survey Costs. Wiley Series in Survey Methodology* (Wiley–Interscience, New York), Ed New.
21. SPSS, Inc (2003) *SYSTAT v. 11.0.* (SPSS, Chicago).
22. SPSS, Inc (2006) *SPSS v. 15.0 for Windows.* (SPSS, Chicago).
23. Afifi A, Clark VA, May S (2004) *Computer-Aided Multivariate Analysis* (Chapman and Hall/CRC, London), 4th Ed.
24. SPSS, Inc (1998) *SYSTAT v. 9.0. Statistics II* (SPSS, Chicago).

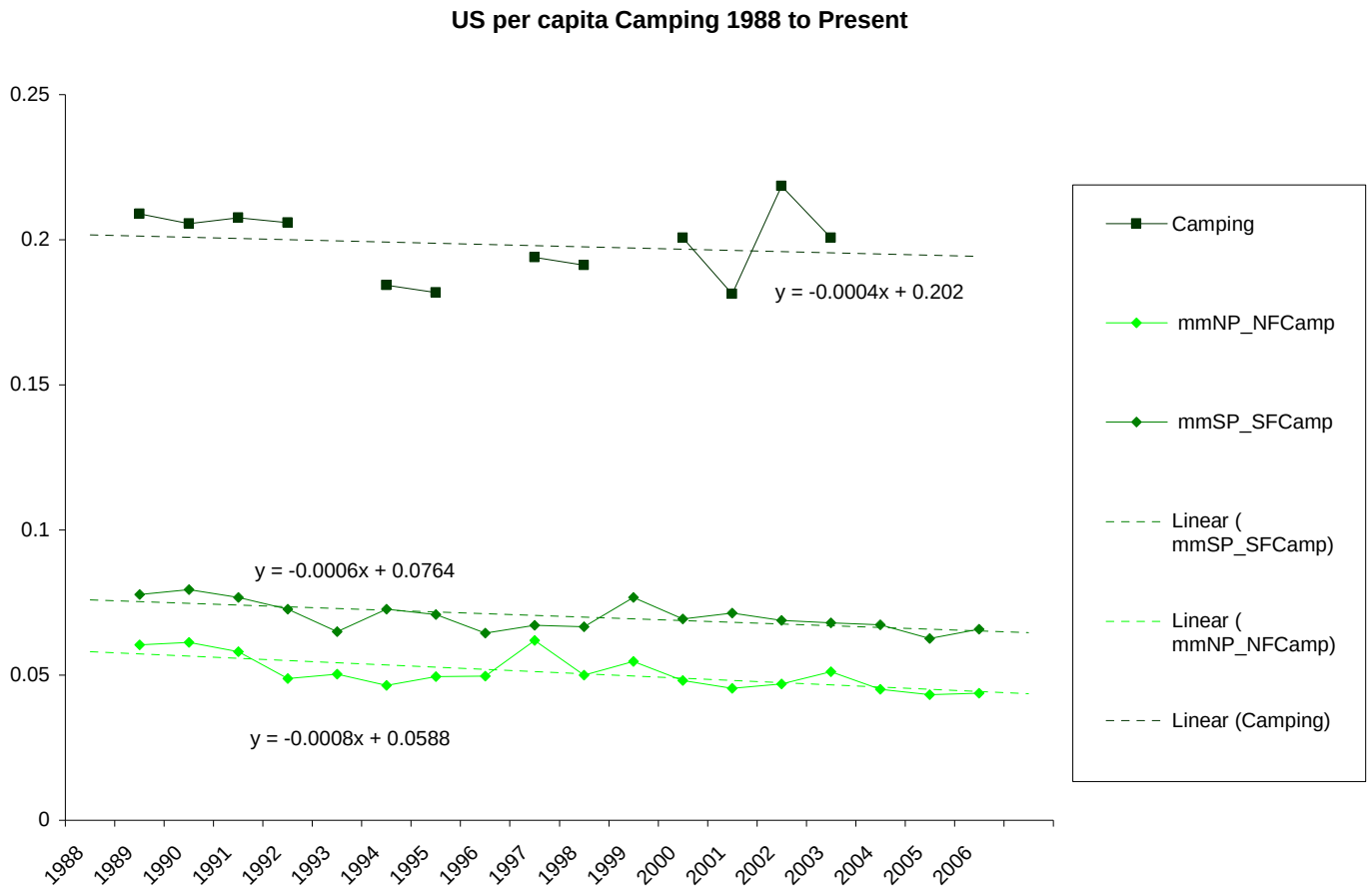
Supporting Figure Legends

Fig. S1. Annual *per capita* fishing licenses (variable Fishing, 1950-2005, 53), hunting licenses (variable Hunting, range of time series 1950-2005, N = 52), and duck stamps (Ducks, 1935-2004, 70). Linear regressions with accompanying equations are included for declines from identifiable peaks in Fishing (1981) and Ducks (1953).

Fig. S2. US *per capita* participation in camping as determined from annual survey data. Linear regressions with equations are included for comparison of slopes. Prefix mm indicates survey data obtained from Mediamark. Included are annual data for *per capita* participation in overnight camping at any nature site (Camping), camping at National Parks and National Forests (mmCampingNP/NF), and camping at State Parks and State Forests (mmCampingSP/SF).

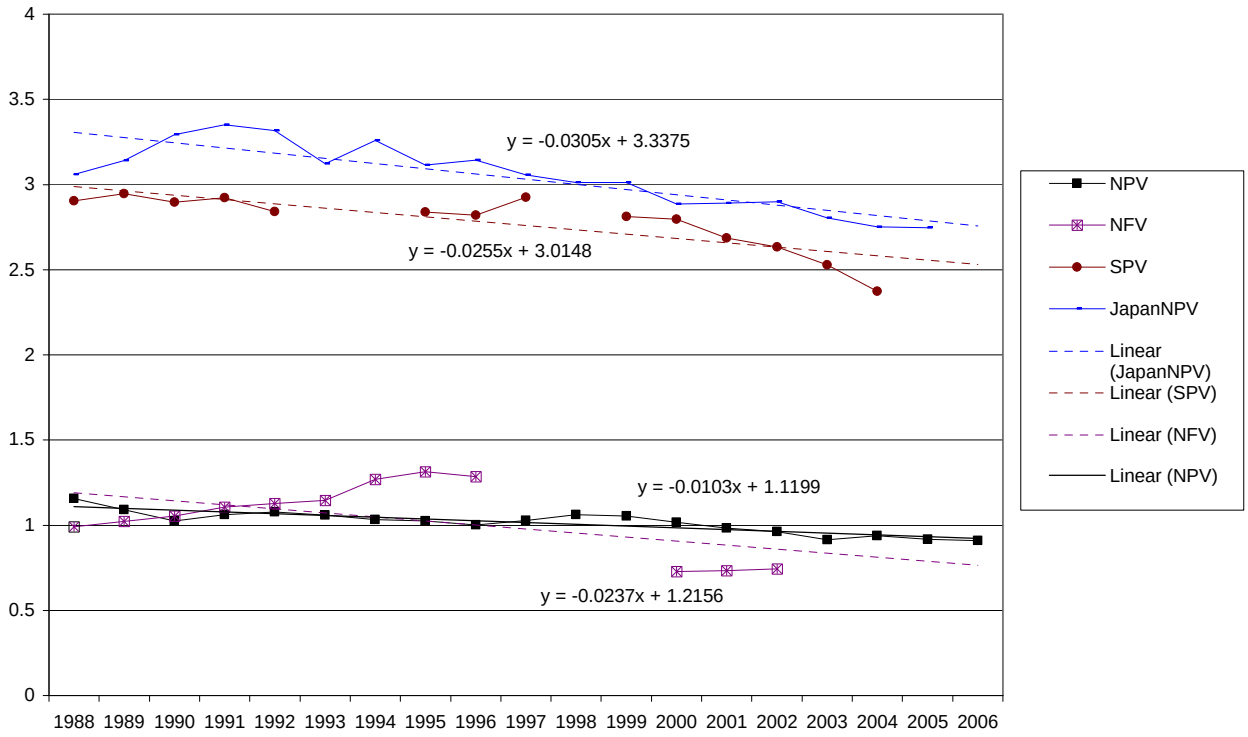
Fig S3. Nature variables with the greatest *per capita* participation as identified from Fig. 2. Linear regressions with equations are included for comparison of slopes. Included are annual *per capita* US National Park visits (NPV), US National Forest visits (NFV), US State Park visits (SPV) and visits to Japan's National Parks (JapanNPV).


Licenses and Stamps
Fishing
Hunting
Ducks
y = -0.0014x + 0.2261
y = -0.0001x + 0.0149
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005


US per capita Camping 1988 to Present
0.25
0.2
0.15
0.1
0.05
0
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
y = -0.0004x + 0.202
y = -0.0006x + 0.0764
y = -0.0008x + 0.0588
Camping
mmNP_NFCamp
mmSP_SFCamp
Linear (mmSP_SFCamp)
Linear (mmNP_NFCamp)
Linear (Camping)

Nature Variables 1988 to Present

(variables with greatest per capita)



Supporting Tables

Table S1. The thirteen largest of high GNI (gross national income) countries. We used the World Bank definition of high income countries. Those countries for which we were able to obtain sufficient data to analyze are shaded.

GNI	Area	Country
2	61	Norway
7	3	United States
9	55	Sweden
11	62	Japan
12	79	United Kingdom
13	65	Finland
18	48	France
19	63	Germany
20	2	Canada
21	6	Australia
26	71	Italy
31	75	New Zealand
33	51	Spain

Table S2. High-probability peaks in long-term *per capita* nature recreation time series. Only those time series are included for which the completeness of data and length of the time series (at least 50 years) made us confident that we had identified the peak. ATHiking is based on a much smaller population of participants than the other time series.

Variable	**Peak Year**	**Last Year of Data**	**% Decline Since Peak**	**% Annual Decline**	**Data Points (N)**
Ducks	1953	2006	66	1.2	72
Fishing	1981	2005	25	1.0	53
NPV	1987	2006	23	1.2	68
JapanNPV	1991	2005	18	1.3	56
ATHiking	2000	2005	18	3.6	71

Table S3. Most highly correlated time series. Two Spearman correlations were performed: 1) pairwise comparisons of raw data in time series, and 2) comparisons of annual year-to-year % changes in a difference model. All data available to us were used. Variables in this table represent all those among our time series comparisons that were significantly correlated by both methods.

Variable 1	**Variable 2**	**Raw Data**			**Difference Model**		
		rho$_S$	**P**	**N**	**rho$_S$**	**P**	**N**
NPV	NFV	0.931	<0.0005	61	0.494	<0.0005	59
SPV	JapanNPV	0.928	<0.0005	25	0.636	0.011	15
SPV	BLMV	0.881	<0.0005	12	0.762	0.028	8
NPV	JapanNPV	0.824	<0.0005	56	0.380	<0.0005	55
NFV	JapanNPV	0.857	<0.0005	50	0.571	<0.0005	48
Fishing	Hunting	0.530	<0.0005	52	0.475	0.001	49

Table S4. {Correlations among longitudinal fishing, hunting, and duck license data. The results of short-term (1988-present) and long-term (entirety of available data) time series comparisons. Results of short-term correlation comparisons among these data are given in the upper half of the table, long-term comparisons in the lower half of the table. Shaded cells represent redundant comparisons and are left blank. Correlation coefficients and p values are reported for time series comparisons that are significantly correlated, blank cells indicate no significant result. Where time series were significantly correlated in both their raw form and in annual year-to-year % changes, cells are highlighted yellow, split and the raw (left) and then difference model (right) results are given. Flags indicate levels of significance for a 2 tailed test (* significant at the 0.05 level, ** significant at the 0.01 level).

	Short-term comparisons of time series.			
Long-term	**Fishing**		**Hunting**	**Ducks**
Fishing				
Hunting	**0.530** **<0.0005****	**0.475** **0.001****		
Ducks			**-0.663** **<0.0005****	

Volume 2, Issue 1 Spring 2007

The Journal *of* Developmental Processes

JDP FORUM

Videophilia: Implications for Childhood Development and Conservation

Patricia A. Zaradic (Corresponding author)
Biology Department
Bryn Mawr College
pzaradic@brynmawr.edu

Oliver R.W. Pergams
Department of Biological Sciences
University of Illinois at Chicago
pergams@uic.edu

Abstract: *Direct experience with nature is the most highly cited influence on environmental attitude and conservation activism. Yet our research (using U.S. national park visits as a proxy) suggests a trend away from interactions with nature and a concurrent rise in the use of electronic entertainment media. We suggest this trend represents evidence of a fundamental shift away from "the innate tendency to focus on life and lifelike processes," or "biophilia" (Wilson, 1984) to "videophilia." We define videophilia as "the new human tendency to focus on sedentary activities involving electronic media." Increasing use of electronic media has been implicated in negative psychological and physical effects, including obesity, loneliness, depression, and attentional problems. Internet use at home is shown to have a strong negative impact on time spent with friends and family as well as time spent on social activities. Outdoor play and nature experience have proven beneficial for cognitive functioning, reduction in symptoms of ADD, increase in self-discipline and emotional well being at all developmental stages. Yet, in contrast to the hours spent per child per week in front of electronic entertainment, children living in the United States reportedly spend on average only 30 minutes of unstructured time outdoors each week. Virtual nature, which we here define as "nature experienced vicariously through electronic means," has potential conservation benefits such as providing unprecedented access to natural areas for many people. However, accessing virtual nature, particularly through electronic media, appears to reduce direct contact with nature. Virtual nature experiences tend to sensationalize nature's hazards and habitats, generating the perception that local natural areas are simultaneously dangerous and lackluster. In contrast, direct experiences of nature tend to be neither particularly hazardous nor momentously spectacular, but evidently intrinsically important to both development and conservation.*

Introduction

The greatest threat to conservation and to the environmental legacy represented by the U.S. national park system may be more subtle than bulldozers and chainsaws. A review of studies on attitude toward the environment suggests that direct contact with nature, especially as children, is the most critical influence on later attitude toward the environment (Bögeholz, 2006; Wells & Lekies, 2006). Family vacations and spending time with family and other mentors outdoors are cited as a major influence on later environmental attitude and activism (Chawla, 1998). Yet for the period 1987–2003 per capita visits to national parks (America's iconic family nature vacation) steadily declined as shown in Figure 1 (Pergams, Czech, Haney, & Nyberg, 2004; Pergams & Zaradic, 2006b), with this trend continuing at least through 2005 (Pergams & Zaradic, 2006a).

Teachers, environmental education, and exposure to nature through other venues (such as reading about nature) are credited with influencing environmental sensitivity, but to a much lesser degree than direct actual experience of natural areas (Chawla, 1998, 1999; Duda et al. 2003; Kahn & Kellert, 2002; Wells & Lekies, 2006). Similarly, direct sustained contact with nature best cultivates children's environmental knowledge and concern (Vaske & Kobrin, 2001; Fisman, 2005). Direct experience with nature appears to uniquely affect childhood development as compared to other types of nature encounters.

Kellert (2002) describes three modes of experiencing nature: direct, indirect, and vicarious. Direct experience involves actual physical contact with natural settings and nonhuman species. This is the spontaneous play in a forest, creek, neighborhood park, backyard, or even vacant lot. Although these settings are affected by human manipulation to some degree, they function largely independent of human intervention. Indirect experience of nature involves physical contact but in a much more controlled and restricted setting. Examples include zoos, nature centers, aquariums, natural history and science museums, and domesticated animals such as cats and dogs. Vicarious experience of nature occurs in the absence of actual physical contact with the natural world. Nature in this form ranges from stylized and symbolic art to photographs, videos, and virtual webcam tours of natural areas.

A comparative review by Kellert (2002) suggests that of the three modes of contact, direct experience with nature plays the most significant role in cognitive and evaluative development. Direct experience of nature offers a multiplicity of sights, sounds, smells, and tactile stimuli shifting continuously in space and time. The spontaneity and complexity of these sensory experiences engage a wide range of adaptive and problem solving responses, requiring alertness and attention (Sebba, 1991). In contrast, the more structured, indirect experiences of nature do not require the same level of spontaneous engagement and do not exert the same types of long-term developmental impacts on children (Kellert, 2002; Pyle, 2002). Similarly, Wells and Lekies (2006) found that direct contact with "wild" as compared to "domesticated" nature before age 11 is a particularly potent pathway to shaping environmental attitudes and behaviors in adulthood. Indirect experiences may exert the greatest positive effect in conjunction with direct encounters in familiar natural settings (Kellert, 2002). The

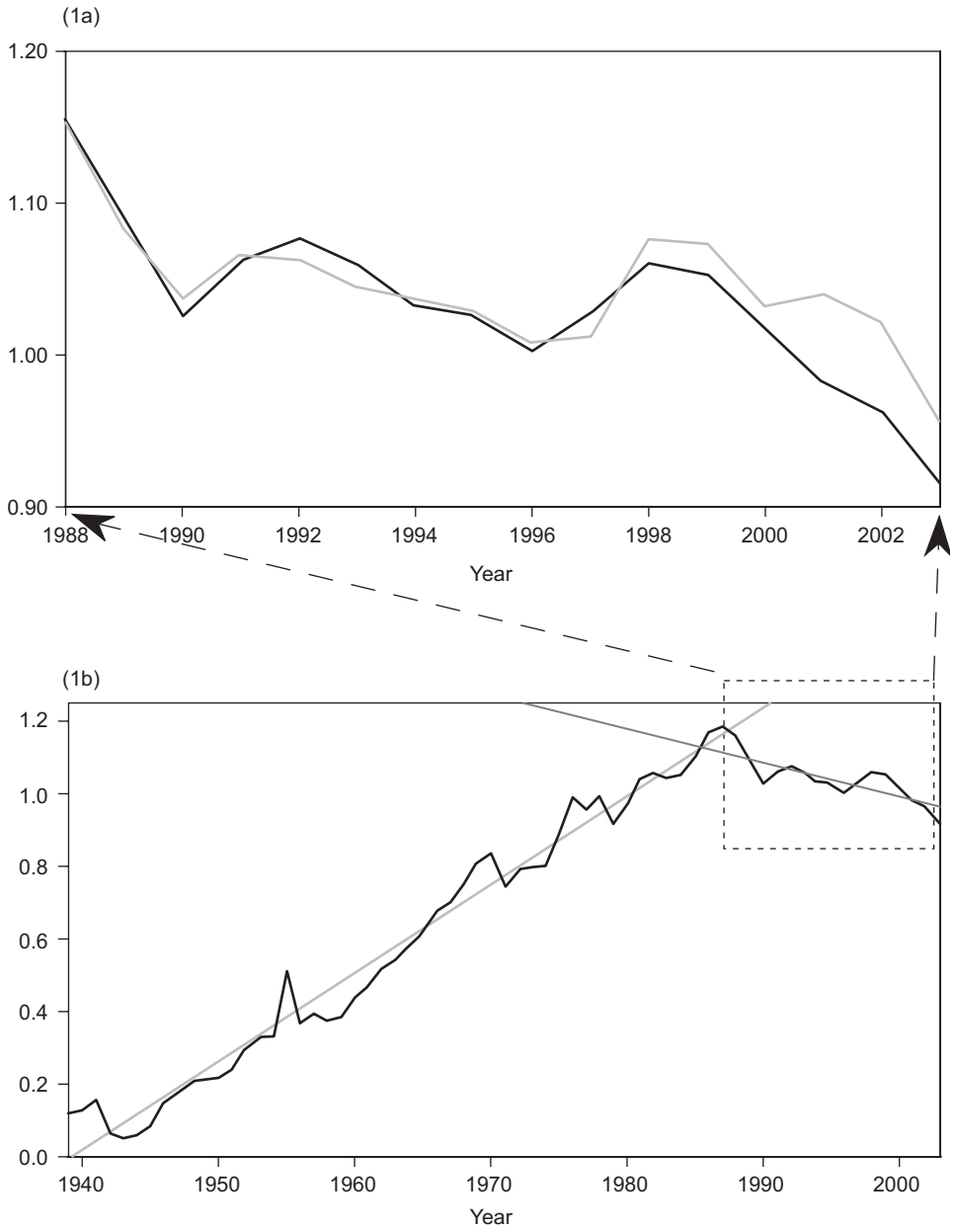


FIGURE 1a. The attendance portion of the graph from 1988 until 2003 in the dashed box is expanded to show both the actual attendance data (black) and the multiple linear regression model (grey) of four entertainment media variables and oil prices. Reprinted from Pergams and Zaradic (2006) with permission.

FIGURE 1b. Per capita U.S. national park attendance from 1939 until 2003 is graphed in black. In light grey is a linear regression calculated using park attendance between 1939 and 1987; and in dark grey, from 1988 until 2003.

least sensory engaging and spontaneous type of nature contact, vicarious experience through an electronic outlet, is becoming more prevalent. More families live in or near urban settings with more time committed to wage earning (Duda et al., 2002). Internet, video game, and home movie use continues to increase dramatically as direct contact with nature via outlets such as national parks decreases (Pergams & Zaradic, 2006a). What are the long-term impacts of this trend for childhood development and conservation?

Videophilia and National Parks

Our research results suggest the trends do not bode well for direct interactions with nature. After fifty years of steady increase, per capita visits to U.S. national parks (the quintessential family vacation) have declined since 1987 (Pergams & Zaradic, 2006a).[1] Prior to this, per capita national park visits increased from 1939 (the start of available data) until 1987. This fifty-year period is remarkable for its steady increase and only minor dips and jumps in the face of World War II, changing demographics, and economic depressions, recessions, innovation, and invention. After fifty years of steady visitation increase, there is an equally steady decline, from 1987 until today, coincident with the rise in electronic entertainment media (Pergams & Zaradic, 2006a).

Along with several electronic entertainment media variables (hours of TV, video games, theatre, home movies, and Internet), we compared the decline in per capita visits to a set of indicators representing alternate recreation choices and potential constraints. The other recreation choices included foreign travel, and more extreme nature experiences such as hiking the entire 3500 km Appalachian Trail. The possible constraints to the number of visitors included the average number of vacation days, median family income, aging baby boomers, federal funding to the National Park Service, park capacity at the most popular parks, and the price of oil (as a proxy for the cost of driving to and through the parks).

We used correlation analysis to consider the relationship of each of our chosen variables with the decline in national park visits. Park capacity was examined separately by graphical comparison to the decline in visitorship and was rejected as limiting since both total overnight stays and visits at the seven most popular parks rose well into the mid-1990s. There was no significant correlation of mean number of vacation days, indicating available vacation time is probably not a factor. Aging of baby boomers was also rejected as they are only now reaching retirement age, and thus during the period of visitation decline were still of prime family vacation age. Federal funding was rejected as a factor as funding to the park service increased during this period. However, it should also be noted that the costs of visiting parks need to be seen against a backdrop where the costs of all government services are being passed along to users, at a time when many potential users are experiencing declining real incomes. Income was significantly positively correlated with foreign travel, but negatively cor-

1. The full paper is accessible at www.videophilia.org.

related with national park visits, suggesting that wealthier sectors of the population may eco-tour outside of the United States.

In an ancillary analysis, trend effects were removed by comparing only the percentage of year-to-year changes. Home movies and oil prices were still significantly correlated with national park visits.

Finally, those raw variables that demonstrated a significant relationship with national park visits (i.e., television, home movies, theatre, video games, Internet use, oil prices, Appalachian trail hikers, and money spent on foreign travel) were used as independent variables in an automatic backward stepwise multiple linear regression to model the decline in visits.

Of the variables we considered, only the four more recently popularized electronic media variables (home movies, theatre, video games, and Internet use), together with the price of oil were significant in generating the closest multilinear fit with the data, explaining 97.5% of the 16 year decline in per capita U.S. national park visits (multiple $r^2 = 0.950$, adjusted multiple $r^2 = 0.925$, SE = 0.015, $F = 37.800$, $P < 0.0001$, Fig. 1). Significant entertainment media effects were per capita hours spent watching home movies ($P = 0.0003$), playing video games (P=0.0066), on the Internet ($P = 0.0012$) and in movie theatres ($P = 0.0195$). Variables rejected as not significant to the step-wise multiple linear regressions were per capita hours spent watching television, Appalachian Trail hiking, and foreign travel. Finally, oil prices also have a significant effect in explaining national park visits ($P = 0.0009$).

Although we wish we could predict the stock market as successfully as our multilinear model predicts the decline in national park visits, correlation is of course not causation. We have five rejoinders. First and most broadly, we are generating a plausible hypothesis with the hopes that further research will test our model. The preliminary mode of testing support for our hypothesis is correlation, in an ecological analysis. Second, one part of our analysis removed trend effects by comparing the percentage of year-to-year changes rather than comparing raw values. Two variables were significantly correlated with the percentage of year-to-year changes in park visits: hours spent watching home movies and oil prices. Third, we must note that a raw r value of 97.5% in a multiple linear regression denotes a huge amount of explanatory power. The two factors significant in percentage of year-to-year change correlations also led the way in explaining this regression (hours spent watching home movies with $P = 0.0003$ and oil prices with $P = 0.0009$), but the other three factors were not far behind. It is a little hard to imagine logically related factors with this much explanatory power being totally devoid of causal connection. Fourth, the media variables we consider are logically related to national park visits, in that all are competing for our limited time. Last, home video game and Internet use essentially came into existence around the time park visitation started declining, and this increases the likelihood of causality.

We think it likely that national park visits are simply a proxy for how much people in the United States are associated with nature in general, and that further research will find the same longitudinal declines in other nature-related activities. We intend to pursue such research. If this is indeed the case, this paradigm shift has huge conservation and childhood development implications. We may well be seeing evidence of a fundamental shift away from “the innate tendency to focus on life and lifelike

processes," or biophilia (Wilson, 1984; elaborated with Kellert, 1993; Kahn, 1997), to videophilia. Moreover, adult attitudes toward the environment are often nurtured through family vacations and spending time outdoors with family and mentors (Chawla, 1998). If parents, mentors, and children are indeed spending less recreational time in nature, the implications for conservation and impacts on childhood development may be compounded in future generations.

A Sedentary Society

Increasing time spent in sedentary indoor media activities has been implicated in the decline in time available for outdoor physical activities (Skidmore & Yarnell, 2004; Fotheringham, Wonnacott, & Owen, 2000; Utter, Neumark-Sztainer, Jeffery, & Story, 2003). An increasingly sedentary lifestyle in the United States is one of the explanatory factors in the rise in obesity (Flegal, Carroll, Ogden, & Johnson, 2002; Skidmore & Yarnell, 2004). Frequency of being overweight and obesity in U.S. children older than six and adolescents has doubled in the last two to three decades (Deckelbaum & Williams, 2001). Moreover, the spread of this sedentary behavior is resulting in similar doubling rates of obesity in developing countries (Deckelbaum & Williams, 2001). Even younger children are at risk because of this increasingly sedentary lifestyle, with more than 22 million children under 5 years of age overweight across the world (Deckelbaum & Williams, 2001).

Adult activity choices are significant for childhood development because children often depend on adults both for access to nature and as role models for recreational choices. Dong, Block, and Mandel (2004) provide an index of how much energy we currently spend on various activities during a 24-hour day in our sedentary society. In the period 1992–1994, 7,515 adults (weighted to be representative of the contiguous 48 states) were surveyed to create a detailed report of each activity performed in the previous 24 hours. An energy expenditure index was created by multiplying duration and intensity of each activity by each individual and summing across all individuals. The top five ranked activities (representing 42.9% of all energy expended) are reprinted in Table 1. "Watching TV/movie, home or theater" and "Activities performed while sitting quietly" (presumably including time on the Internet and playing video games) were together 14.4% of the total. The study was not designed to compare indoor vs. outdoor activities, but it is still interesting that the two clearly outdoor recreational activities ("Fishing and Hunting" and "Gardening") were together only 1.5% of the total, and ranked 22nd and 27th respectively. Given the activity choices adults are making, it should be of no surprise that children are also spending less time in outdoor recreation as compared to time in front of a video screen.

Children and Videophilia

American Academy of Pediatrics guidelines recommend zero hours/day of screen time for children less than 2 years old and 2 hours/day for older children. The guide-

Table 1. Energy Expended in Key Activities

Data reprinted from Table 2 of Dong et al. (2004), which provides an index of how much energy we currently spend on various activities during a 24-hour day in our sedentary society. The top five ranked activities represented 42.9% of all energy expended. Activities relevant to videophilia are in **bold**.

Rank	Activity	% of Total Score	Cumulative %	# of People
1	Driving car	10.9	10.9	6,574
2	Job: Office work, typing	9.2	20.1	2,094
3	**Watching TV/movie, home or theater**	**8.6**	28.8	**5,919**
4	Taking care of child/baby (feeding, bathing, dressing)	8.4	37.2	6,545
5	**Activities performed while sitting quietly**	**5.8**	42.9	**4,086**

Table 2. Activities Engaged in by Young Children

Data reprinted from Charts 1 and 6 of Rideout et al. (2005), a 2003 survey of 1000 parents of the parents of young children aged 0.5–6 years. Values below, related to videophilia, represent what % of young children of different age groups performed the activities listed in a typical day.

Activity	% of Children <2 Years Old	% of Children 0.5–6 Years Old (Total Sample)
Use any screen media	68	83
Watch TV	59	73
Watch home movies	42	73
Use a computer	5	18
Play video games	3	9

lines also recommend that there are no electronic media at all in young children's rooms. In contrast, in a 2003 survey of 1000 parents of the parents of young children aged 0.5–6 years, Rideout, Vandewater, and Wartella (2005) had a number of startling findings. Table 2 is taken from Charts 1 and 6 of the study, and represents the percentage of young children of different age groups that performed the activities listed in a typical day. Forty-three percent of children less than 2 years old watch television every day, and 26% have a television in their bedroom. Sixty-eight percent of children less than 2 years old spend more than two hours a day using screen media. The larger sample (children aged 0.5–6 years) used screen media a little under two hours a day. Almost all homes (95%) with children 0.5–6 years old had at least one VCR or DVD player, and 27% of children had one in their bedroom. On average, these children spend 40 minutes a day watching movies at home, with 25% watching videos every day. Video games still seem to start a little later, but by age 4–6, 50% of children play them, and 25% play several times a week or more, with an average time played of a little over an hour per day.

Children and the Natural Environment

Research has recently begun to explore children's relationships to the natural environment. Children under 13 living in the United States reportedly spend on average only about half an hour of unstructured time outdoors each week, consisting of gardening, boating, camping, picnicking, pleasure drives, walking, and hiking (Hofferth & Sandberg, 2001). Bartlett (1997) describes behavioral and emotional problems as a result of lack of opportunity to play outside. Hüttenmoser (1995) found that 5-year-old children, limited in playing outdoors by automobile traffic, exhibited poorer social, behavior, and motor skills and had fewer playmates than children not so limited. Grahn, Mårtensson, Lindblad, Nilsson, and Ekman (1997) found that children attending a day care facility surrounded by orchards, pastures, and woodlands (and where the children went outdoors every day regardless of weather) had better motor coordination and greater attention capacity than did children who attended an urban day care center surrounded by tall buildings. Wells, in one of the few studies to employ a longitudinal design (2000), found that children who moved to housing with more nature nearby tended to have higher levels of cognitive functioning than children who moved to housing with less nature. Taylor, Kuo, and Sullivan (2001) found that activities in green settings tend to lower the symptoms of children with ADD. Taylor, Kuo, and Sullivan (2002) also examined the effect of nearby nature on girls aged 7 to 12 living in Chicago public housing. The relative naturalness of window views was predictive of the girls' self-discipline, as defined by ability to concentrate, inhibit impulses, and delay gratification.

Wells and Evans (2003) interviewed 337 rural third, fourth, and fifth graders to determine whether vegetation near their homes provided a buffer to stressful situations such as family relocation, being picked on or punished at school, or being subject to peer pressure. The children's emotional well-being was assessed by both the children themselves and their parents. Stressful life events had less impact on psychological distress under "high nature" conditions than under "low nature" conditions. This buffering appears to be greatest for those at most risk: those experiencing the highest levels of life stress.

Early TV and ADD

Christakis, Zimmerman, DiGiuseppe, and McCarty (2004) applied logistic regression to the National Longitudinal Survey of Youth, containing data for some 2600 children at ages 1 and 3. The hypothesis tested was that early television viewing (at ages 1 and 3) is associated with attentional problems at age 7. Children watched an average of 2.2 hours (SD: 2.91) of television per day at age 1 and 3.6 hours (SD: 2.94) of television per day at age 3. They corroborated the hypothesis even after controlling for a number of potentially confounding factors, including prenatal substance abuse, gestational age, maternal psychopathology, and socioeconomic status. A 1-SD increase in the number of hours of television watched at either age 1 or age 3 was associated with a 28% increase in the probability of having attentional problems at age 7.

The developmental physiological mechanisms speculated to be responsible relate to the rapid development of the brain in young children. Environmental variables, including visual and auditory experiences, are thought to greatly influence the number and density of neuronal responses (Turner & Greenough, 1985; Greenough, Black, & Wallace, 1987; Wallace, Kilman, Withers, & Greenough, 1992). However, in contrast to the pace with which real life unfolds, television can rapidly portray changing scenes and events. Also, this speed of portrayal is not at all chronologically constant, but rather in itself varies greatly from moment to moment, scene to scene, show to show, movie to movie. Thus, this unevenness and rapidity in depicting the passage of time, during the critical period of synaptic development in early childhood, is speculated to affect the number and density of neuronal responses (Christakis et al., 2004). Though no similar research exists specifically for video games or movies, given their similarity one would be surprised if the same factors did not apply.

Internet and Socialization

One of the major trends in electronic media is the increase in use by children of younger ages. The National Center for Education Statistics (DeBell, 2005) provides a weighted sample representing approximately 58.3 million children age 3 and older in nursery school through the 12th grade in October 2003. A survey of this sample describes the use of computer and Internet technologies by age group: 67 percent of children in nursery school were already computer users, as were 80 percent of those in kindergarten. About one-quarter (23%) of nursery school children were already Internet users, rising to about 32% in kindergarten. By high school, nearly all students (97%) use computers and a large majority (80%) use the Internet (USDE, 2005).

The exponential rise in Internet use over a mere two decades from its initial availability offers little time to study its long-term developmental effects. However, these trends in adult Internet use at home clearly must have direct implications on time spent interacting with children, and indirect implications for parents as role models and gatekeepers of children's recreation choices. Nie and Hillygus (2002a) explore the effects of the Internet on interpersonal communication and sociability, collecting data from time diaries of their subjects. Internet use at home (but not at work) is shown to have a strong negative impact on time spent with friends and family as well as time spent on social activities. Similarly, Internet use during weekend days is more strongly related to decreased time spent with friends and family and on social activities than Internet use during weekdays. The relationship is highly significant: for every hour spent online at home or on the weekend, there is a corresponding 41 minutes less spent with family members ($\beta = -0.69$, t-stat = –6.65, $p < 0.001$). Nie and Hillygus (2002b) refine the parameters of this reallocation: in other words, what activities are affected, rather than in whose company they are performed. Not surprisingly, Internet time seems to be reallocated most from discretionary activities, especially social activities, hobbies, reading for pleasure, and television viewing. However, Internet time is also reallocated from nondiscretionary activities such as housework and childcare, especially by heavy ($\geq$61 minutes/day) Internet users. These findings seem to strongly corroborate the hypothe-

sis that the Internet has created a shift in people's time allocation away from family and friends, and that this loss of time is suffered by a wide spectrum of specific activities.

Kraut et al. (1998) examine the social and psychological impacts of the introduction of the Internet to a household. The behaviors of 169 people in 73 households were tracked over the first 1–2 years of Internet use. Again, greater use of the Internet was associated with declines in communication with family members and in reduced social contact outside the home. In addition, increased Internet usage was associated with increases in loneliness and depression.

Media and Fear

Television and other electronic media probably provide most incidental information about nature (Bixler & Carlisle, 1994). As well as transmitting neutral information about nature, media depiction of nature's hazards can teach fear. Fears of evolutionarily relevant natural dangers such as snakes and spiders seem easier to acquire and harder to extinguish than fear of post-technological dangers such as cars and guns (Heerwagen & Orians, 2002). Children exposed to realistic media depictions of life-threatening events, such as fire and drowning, report feeling more at risk to those events and less likely to engage in activities related to the depicted tragedies (Bixler & Carlisle, 1994). Hence, media depictions of nature tend to focus on and sensationalize nature's hazards, promoting the perception that natural areas are dangerous.

Similarly, for parents, sensationalism in the media has greatly reinforced paranoia over children being abducted while playing outdoors. Finkelhor, Hootaling, and Sedlak (1992) report 200–300 stereotypical criminal child kidnappings per year (approximately 0.00008% of the population), as opposed to the tens of thousands per year suspected in the public imagination. The best inoculation against inaccurate and sensationalized depictions of nature is an accurate frame of reference for nature built from early firsthand experiences (Bixler & Carlisle, 1994).

Children's firsthand experience in natural settings plays an important role in developing environmental attitudes and preferences for nature (Heerwagen & Orians, 2002). Without early and regular exposure to nature, urban dwellers find the unfamiliarity of wilderness settings uncomfortable and overwhelming (Bixler & Carlisle, 1994), preferring built settings to natural environments (Heerwagen & Orians, 2002).

Biophilia must be nurtured to truly take hold (Verbeek & de Waal, 2002). Active behaviors that require direct involvement with live animals, such as fishing, hunting, and bird watching lead to the most consistent environmental attitude and knowledge (Duda et al., 2003). Values such as reverence and respect for nature appear to be derived in part from direct involvement (Matthews & Riley, 1995; Duda et al., 2003).

Conservation and Virtual Nature

One of the most potentially controversial issues pertaining to videophilia is the issue of "virtual nature," here defined as "nature experienced vicariously through elec-

tronic means." What are the costs? What are the benefits? For there are indeed (at least in theory) benefits. Certainly, the Internet has provided unprecedented access to natural areas for many people. From a viewpoint solely focused on *Homo sapiens*, some of the relaxing and educational aspects of nature can in fact be delivered through vicarious experience (Ulrich, 1993; Levi & Kocher, 1999) on a video screen, or as technology advances, through a virtual reality space. An example is the National Park Service webcam showing Old Faithful in Yellowstone National Park (National Park Service, 2006). In particular, children, not able to travel to the Amazon rainforest or Old Faithful on their own, can do so online without the need for a car, plane, or parent. Bugs, snakes, spiders, predators, and pests can all be left behind in virtual nature. There is even a little something for conservationists: endangered species and sensitive sites can be visited with little or no impact on habitat via webcam, and there is greatly reduced maintenance of natural areas when they do not have any real visitors. Lastly, whether or not we believe in the potential benefits of videophilia to conservation, we must unfortunately at least admit the possibility that the very strong current increase in videophilia (Pergams & Zaradic, 2006a) is a juggernaut in whose way we cannot stand. This might leave virtual nature as the best related conservation option.

The potential costs of virtual nature to conservation are, of course, huge, and may be compounded in future generations. Environmental awareness, primarily nurtured through parents and adult mentors while outdoors (Chawla, 1998), may be the cost of replacing real nature with virtual nature, and this possibility should not be underestimated. Moreover, today's children are tomorrow's parents, but potentially with greatly decreased connection to nature. If children experience Old Faithful primarily through a webcam, where is the nurturing connection that in the past was provided by the sharing the experience with family or an adult mentor? If parents and children are sharing the experience of virtual nature, will the nurturing connection be to the subject matter (nature) or to the media (the virtual experience)? From a conservation context, will they still go to see it in real life? Will they still pay their tax dollars to maintain Yellowstone?

Lacking direct experience of our natural environment, we lack the most immediate feedback of our impact on nature. When experiencing nature vicariously, we may not be aware of the sensory experiences we are missing through the virtual medium, but the real nature we leave outside continues to receive the footprint of our presence on the planet. If we spend our recreational time on virtual tours, do we still pick up litter at our local parks? Or do we opt for solutions consistent with our simulated experience of nature? In Los Angeles, it was proposed to replace highway median plantings with plastic trees, rather than to deal with the larger issue of air pollution (Levi & Kocher, 1999). In the long run, spending less time in real nature seems likely to speed the onset of environmental generational amnesia. This psychological phenomenon, described by Kahn (2002), is the tendency for each generation in its youth to take the existing environmental conditions as normal, even though with each ensuing generation the amount of environmental degradation increases.

If we generationally redefine normal conditions, we might well increasingly use experiences of vicarious nature as our benchmark rather than the local environment. A study of the effects of simulated experience through commercially available nature images suggests this type of vicarious contact with spectacular natural environments

increases support for national parks and forests, but decreased support for preservation and acquisition of local natural areas (Levi & Kocher, 1999). Thus, vicarious nature experiences tend to sensationalize nature's spectacular habitats, generating the perception that local natural areas are relatively lackluster.

Given that the frequency of direct contact with nature depends on local availability (particularly for children, due to their dependence on caregivers for access), the devaluing of local natural areas as compared to sensationalized virtual views of nature seems likely to further reduce direct experiences, and perforce increase our reliance on vicarious nature experiences. Moreover, the recent decline in per capita visits to national parks (Pergams, Czech, Haney, & Nyberg, 2004; Pergams & Zaradic, 2006a) suggests that although vicarious exposure to spectacular habitats may increase the perceived value of national parks, this increased value does not translate to increased direct experiences. In fact, the results of our research suggest just the opposite, that increased use of virtual electronic media is significantly correlated with decreased direct experiences with national parks (Pergams & Zaradic, 2006b). Concurrent with the almost 25% decline in national park visits, Internet use increased from none in 1987 to a per person annual average of 174 hours by 2003 and average overall annual electronic media use (i.e., home movies, theatre movies, video games, and Internet use) rose by an average of 327 hours per person (Pergams & Zaradic, 2006a). Thus virtual access to nature is, in our data, already very strongly associated with loss of direct contact with actual nature. In other words, visiting Old Faithful on the web more seems to result in visiting Old Faithful in person less.

Conclusion

Direct experience with nature is the most highly cited influence on environmental attitude and conservation activism. Yet our research suggests a trend away from interactions with nature and a concurrent rise in videophilia, the new human tendency to focus on sedentary activities involving electronic media. Videophilia has both direct and indirect implications for childhood development and the future of conservation.

Most directly, increasing videophilia has been implicated to yield negative psychological and physical effects. Some of the negative effects are linked to the sedentary nature of videophilia and reduced time available for outdoor physical activities and nature experiences. Conversely, outdoor play and nature experience have proven beneficial for cognitive functioning, reduction in symptoms of ADD, increase in self discipline, and emotional well being at all developmental stages. Other detrimental effects of videophilia seem to be more related to its potential for isolation and much faster pace than real time. High levels of children's electronic media consumption are correlated with attentional problems and increases in loneliness and depression.

Potentially more complex are the implications of virtual nature. Virtual nature, here defined as "nature experienced vicariously through electronic means," has some potential benefits, particularly for children who are dependent on adults for access to many natural areas. Although a sedentary, videophilic outlet, the Internet provides unprecedented access for children to natural areas, delivering some of the relaxing

and educational aspects of nature vicariously. Yet, given increasing Internet use by younger children, virtual nature appears to directly compete with time previously allocated to the more beneficial, direct contact with the outdoors. In addition, virtual nature experiences may further discourage direct contact with local nature by sensationalizing nature's hazards and habitats, generating the perception that local natural areas are simultaneously both dangerous and lackluster.

Ultimately, to more conclusively resolve the long-term impact of videophilia, further research is needed to answer the questions of exactly what videophilia means to a) children's development, b) their success and happiness as adults, and c) specifically, their environmental consciousness. We propose the initiation of a large-scale longitudinal study to determine the effects of videophilia on children's development and future outcomes. Such research would follow controlled groups of children from birth to adulthood, and quantify differences in as many areas as possible, correlated to exposure to nature and/or videophilia. Physical and mental health, educational achievement, career choices, and economic success as adults, would all be among areas considered in addition to environmental awareness. The proposed research would require the cooperation of a number of experts from a wide variety of fields. As daunting as the proposal might seem, children are already exposed, at earlier and earlier developmental stages, to an uncontrolled videophilia treatment. More daunting is the prospect of today's children (tomorrow's parents) in a culture devoid of contact with the evolutionary driver and life-support system that is our natural world.

Acknowledgments

The authors thank *The Journal of Developmental Processes* Editor Barbara King for commissioning this work. The authors also thank their immediate families for their support: Bill, Katherine, Jacob, and Peter (PAZ); and Valerie, Alex, Rosa, and Matthias (ORWP). This work was partially funded by an NSF Biocomplexity Grant 0216560 entitled "Agrarian Landscapes in Transition" to Charles Redman, with Peter Kareiva co-PI.

References

Bartlett, S. N. (1997). No place to play: Implications for the interaction of parents and children. *Journal of Children and Poverty*, *3*, 37–48.

Bixler, R. D., & Carlisle, C. L. (1994). Observed fears and discomforts among urban students on field trips to wildland areas. *Journal of Environmental Education*, *26*, 24–33.

Bögeholz, S. (2006). Nature experience and its importance for environmental knowledge, values and action: Recent German empirical contributions. *Environmental Education Research*, *12*, 65–84.

Chawla, L. (1998). Significant life experiences revisited: A review of research on sources of environmental sensitivity. *Journal of Environmental Education*, *29*, 11–21.

Chawla, L. (1999). Life paths into effective environmental action. *Journal of Environmental Education*, *31*, 15–26.

Christakis D. A., Zimmerman, F. J, DiGiuseppe, D. L., & McCarty, C. A. (2004). Early television exposure and subsequent attentional problems in children. *Pediatrics*, *113*, 708–713.

DeBell, M. (2005). *Rates of computer and Internet use by children in nursery school and students in kindergarten through twelfth grade*. (NCES No. 2005-111). U.S. Department of Education. Washington, DC: National Center for Educational Statistics.

Deckelbaum, R. J. & Williams, C. L., (2001). Childhood obesity: The health issue. *Obesity Research*, *9*, S239–S243.

Dong, L., Block, G., & Mandel, S. (2004). Activities contributing to total energy expenditure in the United States: Results from the NHAPS Study. *International Journal of Behavioral Nutrition and Physical Activity*, *1,* 1–11.

Duda, M. D., De Michele, P. E., Zurawski, C., Jones, M., Yoder, J. E., Testerman, W., Lanier, A., Bissell, S. J., Wang, P., Herrick, J. B., & Marshall, J. (2003). Factors relating to hunting and fishing participation among the nation's youth. Harrisonburg, VA: Responsive Management.

Finkelhor, D., Hootaling, G., & Sedlak, A. (1992). The abduction of children by strangers and nonfamily members: Estimating the incidence using multiple methods. *Journal of Interpersonal Violence*, *7*, 226–243.

Fisman, L. (2005). The effects of local learning on environmental awareness in children: An empirical investigation. *The Journal of Environmental Education*, *36*, 39–50.

Flegal, K. M., Carroll, M. D., Ogden, C. L., & Johnson, C.L. (2002). Prevalence and trends in obesity among U.S. adults. (1999–2000). *Journal of the American Medical Association*, *288,* 1723–1727.

Fotheringham, M. J., Wonnacott, R. L., & Owen, N. (2000). Computer use and physical inactivity in young adults: Public health perils and potentials of new information technologies. *Annals of Behavioral Medicine, 22*, 269–275.

Grahn, P., Mårtensson, F., Lindblad, B., Nilsson, P., & Ekman, A. (1997). Ute på dagis. Stad and Land, Nr. 145 [Outdoor daycare. City and country]. Hässleholm, Sverige: Norra Skåne Offset.

Greenough, W. T., Black, J. E., & Wallace, C. S. (1987). Experience and brain development. *Child Development*, *58*, 539–559.

Heerwagen, J. H., & Orians, G. H., (2002). The ecological world of children. In P.H. Kahn, Jr. & S. R. Keller (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations.* (pp. 29–64). Cambridge, MA: The MIT Press.

Hofferth, S., & Sandberg, J. (2001). 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?* Oxford, England: Elsevier Science.

Hüttenmoser, M. (1995). Children and their living surroundings: Empirical investigations into the significance of living surroundings for the everyday life and development of children. *Children's Environments*, *12*, 403–413.

Kahn, Jr., P. H. (1997). Developmental psychology and the biophilia hypothesis: Children's affiliation with nature. *Developmental Review*, *17*, 1–61.

Kahn, Jr., P. H. (2002). Children's affiliations with nature: structure, development, and the problem and environmental generational amnesia. In P.H. Kahn, Jr. & S. R. Keller (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 93–116). Cambridge, MA: The MIT Press.

Kellert, S. R. & Wilson, E. O. (1993). *The biophilia hypothesis*. Washington DC: Island Press.

Kellert, S. R. (2002). Experiencing nature: Affective, cognitive, and evaluative development in children. In P. H. Kahn, Jr. & S. R. Keller (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations.* (pp. 117–152). Cambridge, MA: The MIT Press.

Kraut, R., Lundmark, V., Patterson, M., Kiesler, S., Mukopadhyay, T., & Scherlis, W. (1998). Internet paradox: A social technology that reduces social involvement and well-being? *American Psychologist*, *53*, 1017–1031.

Levi, D., & Kocher, S. (1999). Virtual nature: The future effects of information technology on our relationship to nature. *Environment and Behavior*, *31*, 203–226.

Matthews, B. E., & Riley, C. K. (1995). *Teaching and evaluating outdoor ethics education programs*. Vienna, VA: National Wildlife Federation. (ERIC Document Reproduction Service No. ED401097)

National Park Service. (2006). The Official Website of Yellowstone National Park—The Old Faithful WebCam. Website accessed 10/23/06 at http://www.nps.gov/archive/yell/oldfaithfulcam.htm

Nie, N. H., & Hillygus, D. S. (2002a). The impact of Internet use on sociability: Time-diary findings. *IT&Society*, *1,* 1–20. Retrieved September 18, 2006, from http://www.itandsociety.org.

Nie, N. H., & Hillygus, D. S. (2002b). Where does Internet time come from? A reconnaissance. *IT&Society*, *2*, 1–20. Retrieved September 18, 2006, from http://www.itandsociety.org.

Pergams, O. R. W., Czech, B., Haney, J. C., & Nyberg. D. (2004). Linkage of conservation activity to trends in the U.S. economy. *Conservation Biology*, *18*, 1617–1623.

Pergams, O. R. W., & Zaradic, P. A. (2006a). [Decline of *per capita* visits to national parks in period 1987–2005] Unpublished raw data.

Pergams, O. R. W., & Zaradic, P. A. (2006b). Is love of nature in the United States 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, 387–393.

Pyle, R. M. (2002). Eden in a vacant lot: Special places, species and kids in the neighborhood of life. In P.H. Kahn, Jr. & S. R. Keller (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations.* (pp. 305–328). Cambridge, MA: The MIT Press.

Rideout, V. J., Vandewater, E. A., & Wartella, E. A. (2003). Zero to six: Electronic media in the lives of infants, toddlers, and preschoolers. (Publication No. 3378). Menlo Park, CA: Kaiser Family Foundation.

Sebba, R. (1991). The landscapes of childhood: The reflection of childhood's environment in adult memories and in children's attitudes. *Environment and Behavior*, *232*, 395–422.

Skidmore, P. M. L., & Yarnell, J. W. G. (2004). The obesity epidemic: Prospects for prevention. *QJM: An International Journal of Medicine*, *97*, 817–825.

Taylor, A. F., Kuo, F. E., & Sullivan, W. C. (2001). Coping with ADD: The surprising connection to green play settings. *Environment and Behavior*, *33*, 54–77.

Taylor, A. F., Kuo, F. E., & Sullivan, W. C., (2002). Views of nature and self-discipline: Evidence from inner city children. *Journal of Environmental Psychology*, *22*, 49–63.

Turner, A. M., & Greenough, W. T., (1985). Differential rearing effects on rat visual cortex synapses. I. Synaptic and neuronal density and synapses per neuron. *Brain Research*, *329*, 195–203.

Ulrich, R. S., (1993). Biophilia, biophobia, and natural landscapes. In S. R. Kellert & E. O. Wilson (Eds.), *The biophilia hypothesis*. Washington, D.C.: Island Press.

Utter, J., Neumark-Sztainer, D., Jeffery, R., & Story, M. (2003). Couch potatoes or French fries: Are sedentary behaviors associated with body mass index, physical activity, and dietary behaviors among adolescents? *Journal of the American Dietetic Association*. *103*, 298–1305.

Vaske, J. J. and Kobrin, K. C. (2001). Place attachment and environmentally responsible behavior. *The Journal of Environmental Education*, *32*, 16–21.

Verbeek, J. H., & de Waal, F. B. M. (2002). The primate relationship with nature: Biophilia as a general pattern. In P. H. Kahn, Jr. & S. R. Keller (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations.* (pp. 1–28). Cambridge, MA: The MIT Press.

Wallace, C. S., Kilman, V. L., Withers, G. S., & Greenough, W. T. (1992). Increases in dendritic length in occipital cortex after 4 days of differential housing in weanling rats. *Behavioral Neural Biology*, *58*, 64–68.

Wells, N. M. (2000). At home with nature: The effects of nearby nature on children's cognitive functioning. *Environment & Behavior*, *3*2, 775–795.

Wells, N. M., & Evans, G. W. (2003). Nearby nature: A buffer of life stress among rural children. *Environment and Behavior*, *3,* 311–330.

Wells, N. M., & Lekies, K. S. (2006). Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Children, Youth and Environments*, *16*, 1–24.

Wilson, E. O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.