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

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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

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

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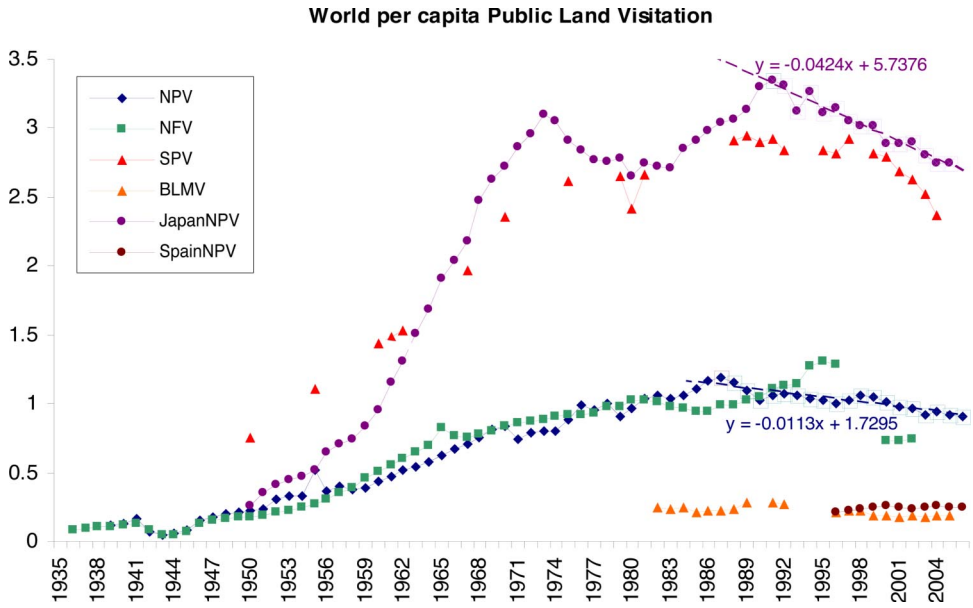

Fig. 1. Annual *per capita* visitation to the various U.S. and international public lands in this study. Included were U.S. National Parks (variable NPV, range of time series 1939–2006, $n = 68$), U.S. State Parks (SPV, 1950–2003, $n = 24$), U.S. National Forests (NFV, 1939–2002, $n = 61$), U.S. Bureau 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

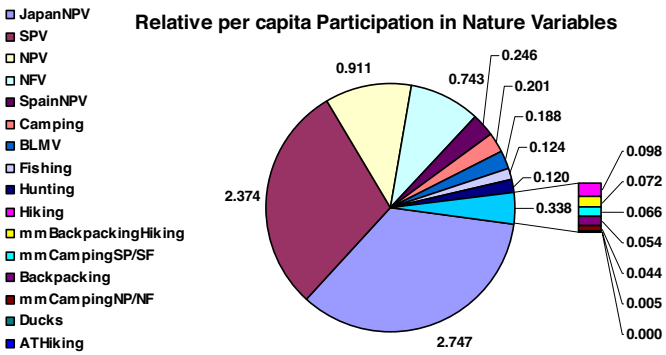

Fig. 2. Annual *per capita* participation for all 16 of the nature recreation variables included in any part of our analysis. See Table 1 for a complete description of variables and sources. None of the variables are mutually exclusive nor are they exhaustive. The figure is meant merely to compare relative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

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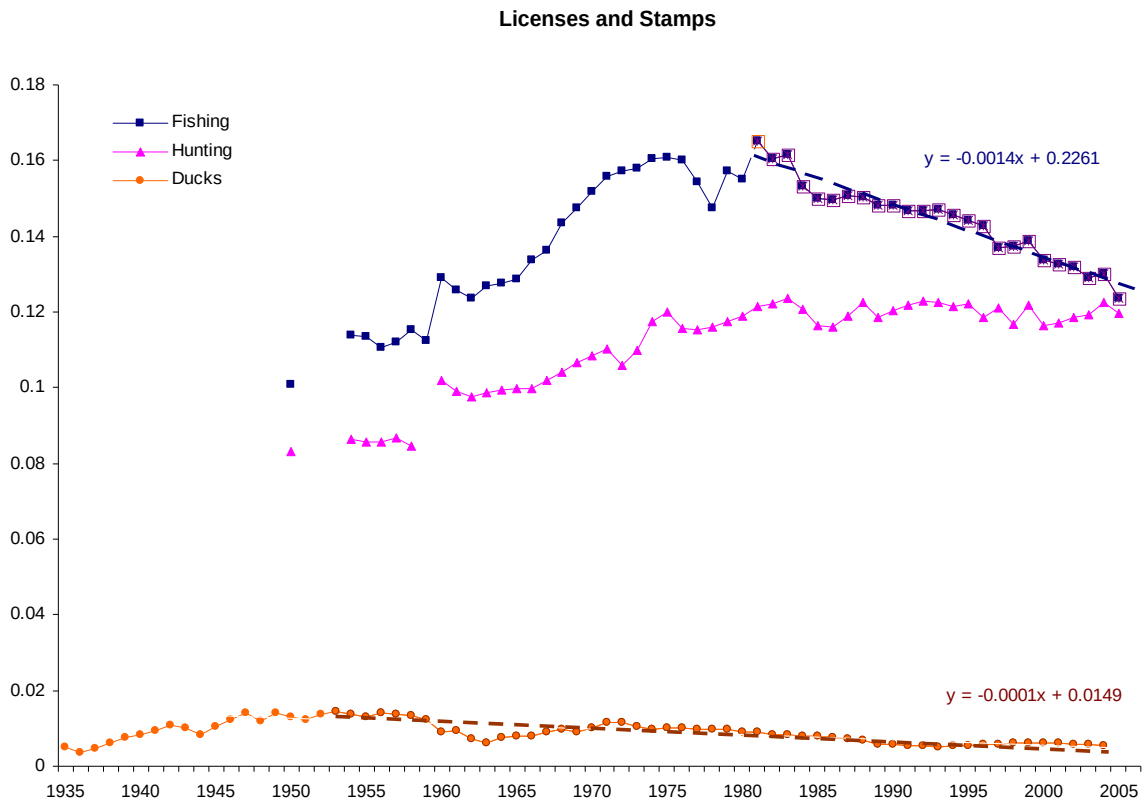
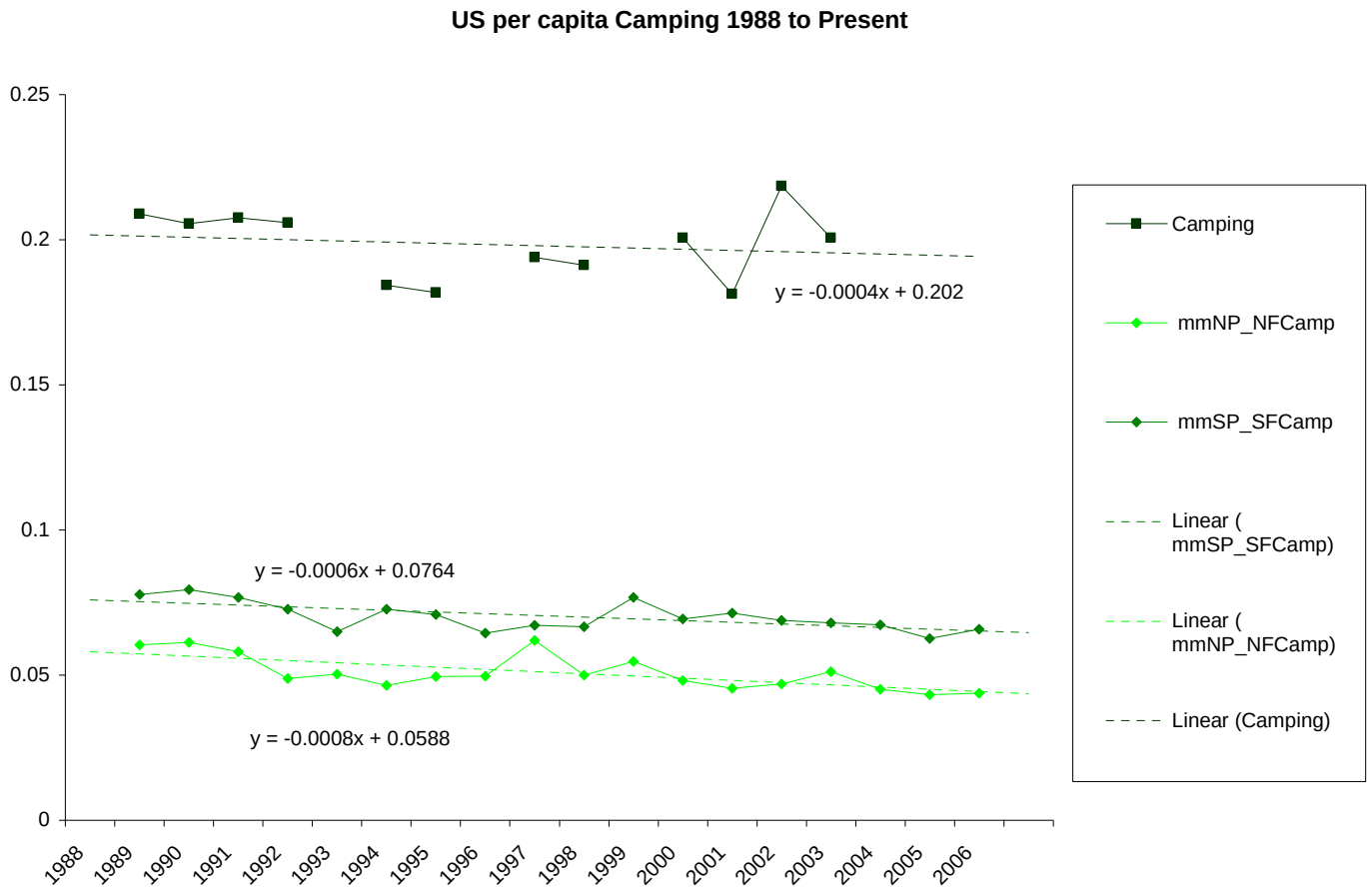
Supporting Figure Legends

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).

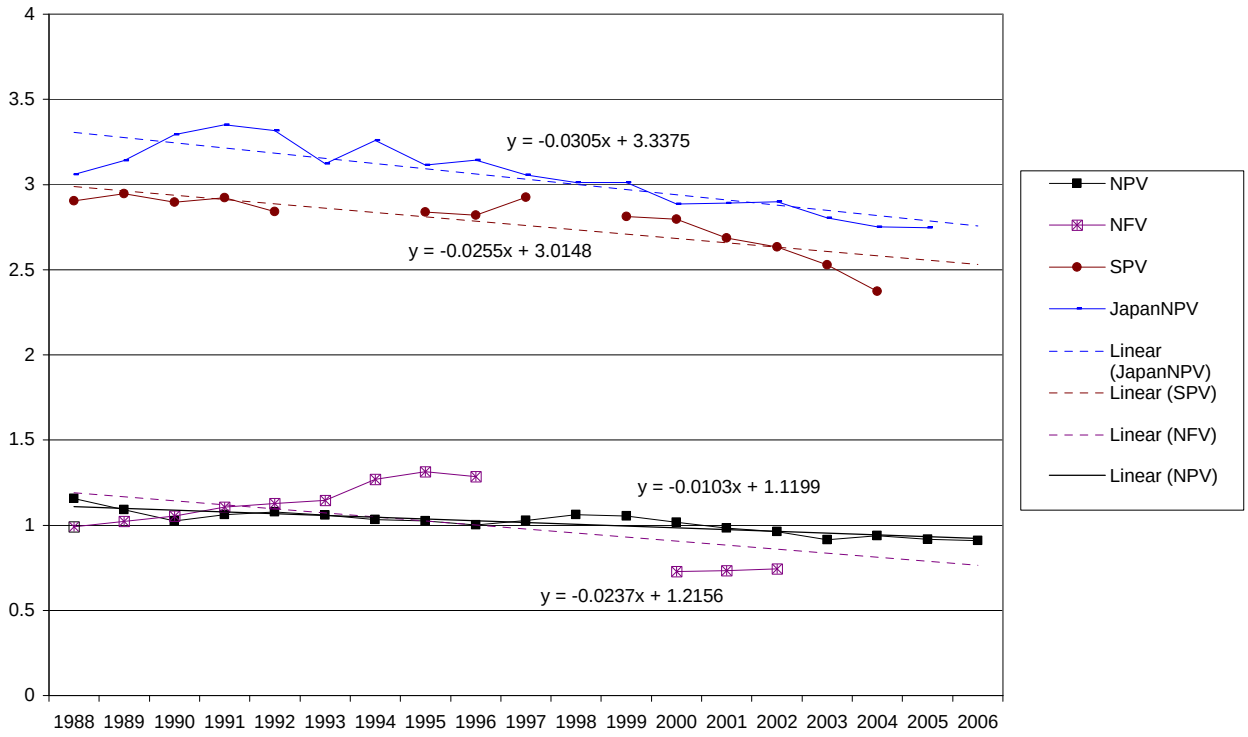
Fig S3. Nature variables with the greatest *per capita* participation as identified from Fig. 2. Linear regressions with equations are included for comparison of slopes. Included are annual *per capita* US National Park visits (NPV), US National Forest visits (NFV), US State Park visits (SPV) and visits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