Contributions of the US state park system to nature recreation

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Nature recreation in the United States concentrates in publicly provided natural areas. They are costly to establish and maintain, but their societal contributions are difficult to measure. Here, a unique approach is developed to quantifying nature recreation services generated by the US state park system. The assessment first uses data from five national surveys conducted between 1975 and 2007 to consistently measure the amount of time used for nature recreation. The surveys comprise two official federal surveys and their predecessors. Each survey was designed to elicit nationally representative, detailed data on how people divide their time into different activities. State-level data on time use for nature recreation were then matched with information on the availability of state parks and other potentially important drivers of recreation, so that statistical estimation methods for nonexperimental panel data (difference-in-differences) could be used to examine the net contribution of state parks to nature recreation. The results show that state parks have a robust positive effect on nature recreation. For example, the approximately 2 million acres of state parks established between 1975 and 2007 are estimated to contribute annually 600 million hours of nature recreation (2.7 h per capita, approximately 9% of all nature recreation). All state parks generate annually an estimated 2.2 billion hours of nature recreation (9.7 h per capita; approximately 33% of all nature recreation). Using conventional approaches to valuing time, the estimated time value of nature recreation services generated by the US state park system is approximately $14 billion annually.

ecosystem services | measurement | valuation | panel regression

Nature recreation in the United States concentrates in publicly provided natural areas. These areas are costly to establish and maintain, but their societal contributions are difficult to measure. This is an important limitation, because public recreation resources such as state parks comprise substantial real estate investments and require considerable operation and management expenditures. For example, the operation and maintenance of state parks currently requires approximately $2.3 billion annually (1). Moreover, several states, including Arizona, California, Nevada, and New York are currently considering or have already decided to temporarily close some or even all of their nature parks to cut expenses in a difficult economy (e.g., refs. 2, 3). The scale of proposed budget cuts is considerable. For example, in 2009 the state of Washington roughly halved the operating budget of state parks—from $100 million to $48 million—with further cuts scheduled for 2011–2013 (4). Federal government, also an important supporter of outdoor recreation, similarly is under pressure to reduce spending.

Although spending cuts and park closures may be inevitable, information on their consequences often is not available. This impedes and at worst completely prevents systematic assessments of different policy alternatives to support decisions. The lack of information on the magnitude and value of nature recreation services provided by public recreation resources also more generally reflects the measurement challenges, which limit the broader adoption of an ecosystem services approach to ecosystem management (5–7). The importance of improving the current understanding of nature recreation also is highlighted by recent studies arguing that the popularity of nature recreation may be "fundamentally and pervasively" declining (8, 9).

The main goal of the present study was to estimate the net contribution of the US state park system to nature recreation as a whole and thereby provide an improved basis for the management and public policy decisions regarding nature recreation resources. Developing a unique approach, this study concentrates on examining data on nature recreation activities from five nationally representative, rigorous time use surveys conducted between 1975 and 2007. These surveys include the 2003 and 2007 American Time Use Survey (ATUS) (10), an official federal statistical survey, and its predecessors conducted in 1975, 1985, and 1993 (11). These surveys offer detailed descriptions of the daily activities elicited from a sample of individuals, and their data comprise a sample from the annual national time budget.

Drawing from time use survey data concerning more than 46,000 individuals, this study first constructs a comprehensive and consistent measure of nature recreation between 1975 and 2007 in each of the US states. Data on time use for nature recreation are then matched with corresponding information on the availability of state parks and other potentially important drivers of nature recreation. Thereafter, panel data estimation methods (difference-in-differences), which have been developed in econometrics to examine nonexperimental data (12–14), are adopted to estimate the contribution of state parks to overall nature recreation. The estimation approach controls for the innate differences between different states in the availability of recreation resources and the popularity of nature recreation. The estimation model also controls for the availability of federal lands and many other potentially important drivers of nature recreation, such as the demographic composition of each state. After several rigorous robustness checks, the main statistical estimation results are used to assess the volume of nature recreation generated by the US state park system. Finally, conventional approaches to valuing recreation time (15) are adopted so that the potential time value of nature recreation generated by the US state park system can be illustrated.

One important difficulty in measuring the net contributions of specific recreation resources, such as state parks, on overall recreation is that recreation can be practiced in many environments, and the availability of specific resources potentially affects recreation everywhere. For example, how much the closing of a park, or a set of parks, will reduce recreation will depend on how much of the recreation in the closed area shifts to recreation elsewhere vs. is reallocated to nonrecreation activities. Similarly, new parks attract recreation, but some of this activity may represent a shift away from other nature areas rather than correspond to a genuine increase in overall recreation. Here, the approach directly addresses the above measurement difficulty by estimating the net contribution of state parks to overall nature recreation, given the behavioral adjustments associated with people possibly shifting

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Table 1. Estimated regression coefficient of the variable "parks density per capita" on the amount of nature recreation, by estimation data set

Estimation data set*	Coefficient	SE	*t* value†	*P* value	Observations	Estimated elasticity
Full panel 1975–2007	1.971	0.950	2.070	0.0440	163	0.41
Full panel 1975–2003	3.043	0.986	3.080	0.0040	120	0.63
Balanced panel 1975–2007	2.000	1.048	1.910	0.0650	136	0.41
Balanced panel 1975–2003	2.732	1.348	2.030	0.0510	102	0.56

Unit of analysis is a state; the dependent variable is the natural logarithm of time use for nature recreation, on average per person by state; estimated using a fixed-effects panel model.
*Full panel comprises 47 states (all lower 48 states except New Hampshire because of missing data); balanced panel comprises 37 states for which no missing data exist for any of the years 1975, 1993, 2003, and 2007.
†Robust SEs clustered at the state level.

between different recreation resources and alternative uses of time.

The approach developed in this study is particularly well suited for examining state parks. The total number of state park areas in the lower 48 states increased from approximately 3,800 in 1975 to more than 6,600 in 2007, with the corresponding acreage rising from approximately 8.5 million in 1975 to approximately 10.5 million acres in 2007. The establishment of thousands of new state parks at different locations and different points in time creates temporal and geographic variations in the public's access to state parks. These variations neither show distinct trends nor are systematically driven by the popularity of nature recreation [*SI Appendix*, SI Section 6 (regression analyses) and Figs. SI1.1–SI1.6]. Therefore, the resulting spatial and temporal variations in the access to state parks are similar to natural experiments, which can help consistently gauge how changes in the availability of state parks impact nature recreation. Moreover, several assessments indicate that the vast majority, approximately 85–90%, of the visits to state parks are made by in-state residents.* The results from this study also suggest that although changes in the availability of state parks in a specific state have a robust effect on nature recreation by the residents of that state, nature recreation is not statistically significantly affected by the availability of state parks in the nearby out-of-state areas. Therefore, the effects of state parks are well captured by examining the contribution of state parks to nature recreation by in-state residents, which is the approach here.

Results

Statistical Evidence on the Impact of State Parks on Nature Recreation. The first results ascertain a quantitative relationship between the availability of state parks and nature recreation in a given state. This finding is established by the results from panel regression analyses, which predict state-level observations on changes in the nature recreation per capita (hours of nature recreation per person per week, on average, log-transformed) during a time period as a function of changes in the availability of state parks in each state during the same time period, while also controlling for other potential observed and unobserved drivers of nature recreation (Table 1). Different models using alternative estimation datasets consistently estimate a positive and statistically significant coefficient for the variable "parks density per capita" (acres of state parks per acre of land per hundred thousand people). The coefficient estimate varies between 1.971 and 3.043, and estimates from alternatives datasets are not statistically significantly different from each other. The variable "parks density per capita" is chosen to measure the availability of state parks from several alternative variable specifications examined (*Methods*).

The panel regression models in this study extensively control for potentially important and possibly confounding factors within and between states, including time-invariant baseline differences between the different states (state-level fixed effects), a common time trend, as well as observable variation in age, education, race, employment status, and the amount of leisure. Importantly, the estimation model also controls for the availability of other potential recreation areas, such as access to federal lands and state parks in the neighboring states (*Methods*; for full estimation results, *SI Appendix*, Table SI-1). The coefficient estimate based on all states and all years of data (1.971; Table 1) serves as the primary statistical estimation result. It is based on the most extensive data and, relative to the main alternative estimates, represents a conservative appraisal of the impact of state parks on recreation.

The estimation results indicate that the elasticity of time use for nature recreation with respect to "parks density per capita" ranges between 0.41 and 0.63 (Table 1). The elasticity estimates mean that, for example, a 10% increase in park density per capita increases time use per capita for nature recreation by approximately 4% to 6%.

Using alternative estimation approaches—a censored regression model with state-level fixed effects, and a differenced estimation equation—additionally confirmed that the results in Table 1 are robust (*SI Appendix*, Table SI-2, estimation methods 1 and 2). (Moreover, additional robustness checks examined whether state parks might also affect time use for physically active recreation in nonnatural environments. As one might expect, these analyses indicated that state parks have no statistically significant associations with non–nature-based physically active recreation.) Besides being robust to the estimation dataset and approach, results in Table 1 in general are not sensitive to the exclusion or inclusion of specific variables or groups of variables in the model.

The above results indicate that changes over time in the availability of state parks have a robust effect on nature recreation per capita. Keeping everything else equal, increasing the acreage of state parks in a state systematically increases nature recreation per capita in that state. Similarly, a growing state population in the absence of a corresponding increase in state parks reduces nature recreation per capita. The magnitude of the contribution of state parks to nature recreation is illustrated below by the assessments, which examine benefits from the expansion of state parks between 1975 and 2007 and from all of the state parks.

Expansion of the State Park System Between 1975 and 2007. Between 1975 and 2007, approximately 3,000 new parks totaling approximately 2 million acres were established in the contiguous United States, increasing the total area of the state park system by nearly one quarter. Here, this expansion of the state parks is estimated to contribute approximately 9.2% percent of all current time use for nature recreation (Table 2 and SI Dataset "Data and Policy Assessment"). Overall in the United States, this equals annually approximately 600 million additional hours of nature recreation, or approximately 2.7 h of nature recreation per capita. These estimates were obtained by first predicting state-level time use for nature recreation using the current availability of state parks and population as the baseline, and then predicting a counterfactual scenario using current population and the availability of parks in 1975. The baseline and alternative scenario were calculated separately for each state, and a national-level estimate was obtained

*Texas Parks and Wildlife Department reports that 88% of visits to state parks are made by Texas residents (16). In California, the percentage of in-state visitors to state parks is similarly 88% (17). Minnesota Department of Natural Resources estimates that approximately 84% of visitors to Minnesota state parks come from in-state (18).

as a state-population weighted average of the state-level predictions.

Valuing recreation time monetarily requires determining the opportunity cost of time (*Methods*). (There is broad debate regarding how to best measure the opportunity cost of time, but this study is not intended to enter that discussion. A frequently used approach is chosen instead, because it well illustrates the potential time value of recreation.) A conventional and commonly adopted approach—recreation time is valued at one third the wage rate—is used here to illustrate the potential magnitude of time value of recreation (15).[†] Using state-level information from the US Bureau of Labor Statistics on the average civilian wage rate in combination with the state-level estimates of the contribution of state parks to nature recreation, the estimated time value of the nature recreation generated by the expansion of state parks between 1975 and 2007 is approximately $3.85 billion, or $17 per person, annually. The time value estimate refers to the entire study population (18 y of age or older) in the contiguous United States (approximately 226.2 million in 2007, according to the US Census).

Entire US State Park System. Assuming that the estimated relationship between state parks and nature recreation also holds for approximating the recreation services generated by all state parks (this requires extrapolation out of variation available in the estimation samples), approximately 33.4% of current time use for nature recreation can be attributed to the US state park system (Table 2). (Predicting impacts from the entire US state park system first involves predicting state-level time use for nature recreation using current population and the current availability of parks. This estimate is then compared with the prediction when no state parks are available.) This equals annually approximately 9.7 h of nature recreation per capita, or approximately 2.2 billion hours of nature recreation in total in the United States. The estimated time value of nature recreation generated by the entire US state parks system is approximately $14 billion annually (approximately $62 per person, on average).

Trends in Time Use for Nature Recreation. Geographical variation in time use per capita for nature recreation is illustrated for 2003–2007 in Fig. 1. Nature recreation is especially popular in the northwestern and northeastern United States. Parts of southeast and south-central United States also stand out with their relatively high time use for nature recreation.

Summaries from individual-level data from the original time use surveys show that the percentage of the population active in nature recreation steadily declined between 1975 and 1993 but has since stayed relatively constant or slightly increased. Whereas in 1975 approximately 4.6% of the population was active in nature recreation—their time use for nature recreation was greater than zero during the survey recall period—the percentage of active participants of the total population dropped to 3.1% by 1985 and to 2.2% by 1993 (Fig. 2). The trend thereafter is flat or mildly increasing, with 2.4% and 2.6% participating in nature recreation in 2003 and 2007, respectively. These participation estimates refer to the percentage of the population for whom time use for nature recreation was nonzero during the 24-h survey recall period. Although such data well predict the relative popularity of nature recreation over time, participation rates would be higher had the recall period been a month or a year.

Table 2. Estimated nature recreation services by the US state parks*

Estimated effect	Expansion 1975–2007 (approximately 2.0 million acres)	All parks (approximately 10.5 million acres)
Share of all current nature recreation contributed (%)	9.2	33.4
Per person, annually		
Hours of nature recreation	2.7	9.7
Estimated time value (US$)	17.00	62.10
In the contiguous United States, annually		
Hours of nature recreation (millions), total	602	2,194
Estimated time value (millions), total (US$)	3,851	14,037

*In the contiguous United States.

In 1975, US individuals spent, on average, 0.79 h per person per week on nature recreation (Fig. 3). This estimate declines to approximately 0.59 and 0.57 h by 1985 and 1992, respectively, and then changes to 0.48 and 0.51 h by 2003 and 2007. Although a consistent, moderate downward trend is apparent in Fig. 3, the estimates of average time use are not statistically significantly different between different years. The 95% confidence interval of the 1975 mean estimate contains or borders (2003) the upper bound of the confidence interval of the mean estimates for 1985–2007 (*SI Appendix*, Table SI-3).

Discussion

This study shows that providing the public with access to nature generates observable and measurable impacts on the popularity of nature recreation. The results suggest that the nature recreation services provided by the US state park system are considerable and that their time value may be considerably greater than the corresponding operation and management expenses. For example, the estimated recreation services from the 2 million acres of state parks established between 1975 and 2007—approximately one-fifth of the total acreage of state parks—may already exceed the currently reported operation and management costs of the entire US state park system ($3.85 billion vs. $2.3 billion, annually). (However, note that the $2.3 billion operation and management cost estimate refers to budgetary outlays without accounting for the capital costs associated with the state parks, which also need to be included in benefit–cost comparisons.) In total, the entire US state parks system is estimated to generate approximately 2.2 billion hours of nature recreation with an estimated time value of approximately $14 billion, annually.

The above estimates denote the annual flow of nature recreation attributed to the US state park system. The net present value of these annual flows is required to project the total contributions of state parks. For example, using a 10% discount rate and an infinite horizon (parks typically are established as permanent), the estimated total net present amount of nature recreation associated with the entire US state park system equals approximately 22 billion hours and has an estimated total time value of approximately $140 billion.

By examining nature recreation between 1975 and 2007 in the United States, this study operates at large temporal and spatial scales. This scaling is necessary when using variation between different time periods and US states to measure the impacts of state parks on nature recreation. The scaling also helps evaluate large-scale changes in the availability of recreation resources, such

[†]Several factors suggest that the approach to valuing time here is conservative. First, one third the wage rate represents the lower end of the opportunity cost of time in the current literature. Second, studies specifically focused on estimating the opportunity cost of time in nature recreation find that it is, on average, somewhat greater than one third the wage rate (19, 20). Third, the measure of nature recreation in this study excludes travel time associated with nature recreation (data on travel time associated with recreation are not available for 1975 or 1993). Adding travel time associated with nature recreation would increase the total time associated with outdoor recreation. Fourth, participants to nature recreation, on average, tend to have relatively high incomes (e.g., ref. 21). This study predicts the opportunity cost of time from the average wage rate of the general population, although it is likely lower than the average wage rate of participants in nature recreation. Fifth, one third the wage rate is conventionally used for measuring the opportunity cost of travel time, whereas this study measures time spent in outdoor recreation, which plausibly may be higher than that of travel.

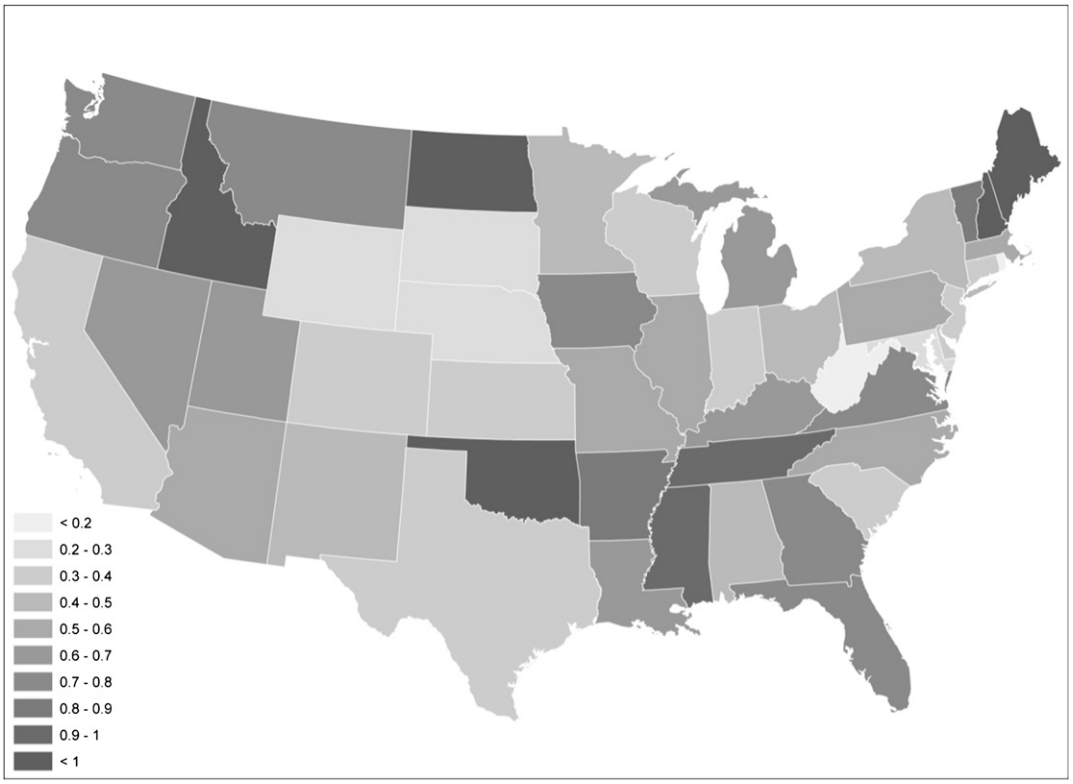

Fig. 1. Time use for nature recreation in 2003–2007 by state (hours per person per week, on average).

as the expansion of the US state park system since 1975. Nevertheless, a large-scale assessment also necessarily ignores potentially important nuances. For example, this study examines the impacts of the availability of state parks on average, although parks in all likelihood vary in their contribution to nature recreation. Therefore, the effects of a specific park on nature recreation may be smaller or greater than the average, even considerably. The existing literature on outdoor recreation also suggests this, providing a multitude of examples of how the characteristics of a recreation area influence its attractiveness to people (15).

Time use data suggest that nature recreation per capita may have declined since 1975. However, although people, on average, use less time for nature recreation than in 1985 or 1993, the percentage of the population participating in recreation has stayed relatively constant or even moderately increased since the 1990s. Therefore, the basic popularity, as measured by the percentage of population active in nature recreation, may have remained relatively stable, whereas those active in nature recreation could have reduced the total amount of time per person spent in nature recreation. Multiple factors could contribute to this, including potentially increased competition between alternative uses of time, new forms of leisure activities such as digital entertainment, and changes in the overall availability of leisure (22).

Finally, nature recreation represents a partial assessment of the full range of ecosystem services produced by natural areas. Examples of other potentially relevant ecosystem services include carbon sequestration and storage, contributions to surface and groundwater services, and benefits from preserving endangered and threatened species and supporting biodiversity more generally. A full assessment of ecosystem services from state parks and other nature areas should also consider these nonrecreation contributions.

Methods

Time Use Data. Time use data regarding nature recreation come from five rigorous time use surveys conducted in 1975, 1985, 1993, 2003, and 2007 (Table 3 and refs. 10, 11, and 22). These individual-level surveys elicited data on overall time use—not just nature recreation—including hundreds or even thousands of different potential activities. The 1975 and 1985 surveys were

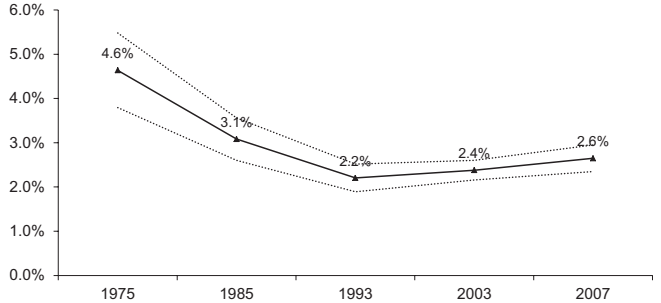

Fig. 2. Percentage of population with nonzero time use for nature recreation, 1975–2007 (sample mean and 95% confidence interval).

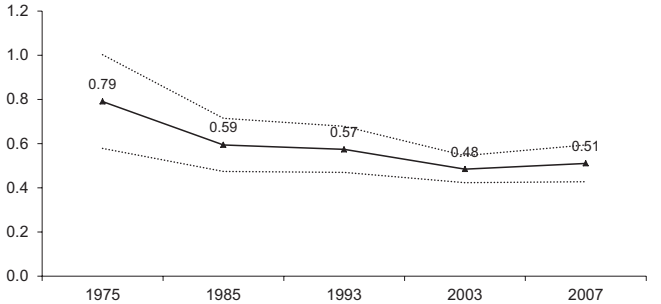

Fig. 3. Time use for nature recreation 1975–2007, hours per week per person (sample mean and 95% confidence interval).

conducted by Survey Research at the University of Michigan; the 1993 survey was conducted by Survey Research Center at the University of Maryland; and the 2003 and 2007 surveys are part of the annual ATUS. ATUS is an official federal survey, which has been conducted since 2003 by the US Census for the US Bureau of Labor Statistics. More information on the time use surveys and other data underlying this study are provided in *SI Appendix*.

Although some of the surveys elicited data from individuals younger than 18 y, others sampled only the adult population. To keep the data consistent across different surveys, all individuals younger than 18 y are excluded here. As a result, this study uses a total of 46,020 observations between 1975 and 2007. Because certain subpopulations were either over- or underrepresented relative to their share of the US population, data from each survey need to be reweighted to obtain accurate aggregate predictions regarding the distribution of the annual national time budget into different activities. Population weights assign each individual a unique weight that reflects the share of the US population represented by that observation in the year of the survey. In addition, for example, the 2003 and 2007 surveys sampled weekend and weekdays in equal proportions. This ensures collecting rich data on both weekends and weekdays (general time use patterns are distinct on weekends and weekdays) but requires that day weights are used when constructing national-level projections from individual-level data, such as the estimates presented in Figs. 2 and 3.

Classifications and categories described in the original coding manuals were used to match data from different surveys and to construct a comprehensive and consistent measure of nature recreation. Nature recreation activities are classified in the 1975 and 1993 surveys as "outdoor recreation" as a separate category from physically active sports. The 2003 and 2007 data include specific categories for different types of nature recreation, such as hiking, camping, fishing, hunting, rock climbing, cross-country skiing, and so forth, and these categories are aggregated here to compile a comprehensive measure of nature recreation (*SI Appendix*). With the exception of the 1985 survey, each survey also lists the home state of the respondent. It is used here to match data on time use with data on state parks.

Data on State Parks and Federal Lands. Data on state parks and recreation areas by state in 1975, 1993, 2003, and 2007 were obtained from the National Association of State Park Directors (NASPD), which is a widely used source for state park statistics (23, 24). (For Maine, NASPD has no data for 1975; I use the 1977 data instead. In addition, only 2 y of data exist for New Hampshire, and data from different publications vary regarding those 2 y. Therefore, New Hampshire is excluded from the data.) Data on the availability of federal lands by state in each study year are from the US Statistical Abstracts, published by the US Census Bureau (25).

Estimation Datasets. Four alternative estimation data sets are used for robustness. They are constructed as a combination of (*i*) years 1975–2003 or 1975–2007, and (*ii*) a full or balanced panel of states. The full panel comprises 47 states in the lower continental United States (all lower 48 states except New Hampshire, which is excluded for data insufficiencies) but has some missing observations. The balanced panel includes the 37 states for which no data are missing.

Estimating the Effect of State Parks on Nature Recreation. The statistical analysis uses panel data estimation methods and the difference-in-differences framework (12–14). The basic approach also is motivated by the methods in Chay and Greenstone (26) to evaluate the effects of air quality on housing prices. The variation across states and time periods in both time use for nature recreation and the availability of state parks helps identify the effect of state parks on nature recreation. The estimation model controls for potentially confounding unobservable and observable factors, including potential innate differences between different states in the propensity of population to engage in nature recreation. Regarding observables, the estimated models use all available data from time use surveys to control for factors such as basic demographics (age, race), education, employment status (working full-time, working part-time, retired, student, unemployed, homemaker), and the amount of leisure. In addition, the estimated models control for the availability of federal lands in each state and the availability of state parks in the neighboring states.

The estimation equation is specified as follows:

$$\ln(y_{it}) = \alpha_i + x_{it}\beta + Z_{it}\beta_z + \gamma t + \delta_t + \varepsilon_{it}, \quad [1]$$

where y_{it} denotes the average amount of time used per week for nature recreation per person in state i in year t ($t = 1, 2, \ldots, T$). Parameter α_i is a state-level fixed effect (constant) to control for the innate differences between states in the propensity of populations to recreate outdoors. Variable x_{it} denotes the availability of state parks (per acre per capita; see below) in state i in year t; Z_{it} is a matrix of other observable exogenous variables, such as demographics, education, employment statistics, and access to other public lands (see the paragraph above) in state i in year t; γ is the time trend parameter; δ_t is an annual fixed effect; and ε_{it} denotes prediction errors. To account for the possibility of a remaining error correlation, SEs are clustered at the state level (27).

The coefficients of the model (Eq. **1**) can be estimated using fixed effects or in first-differenced form under different exogeneity assumptions. The analysis here primarily uses a fixed-effects estimator, which is more efficient in the absence of endogenous regressors. Regardless, the robustness of the results is evaluated using multiple methods. In addition to examining fixed-effects models and first-differenced estimation, the use of censored regression and alternative estimation samples were examined (*SI Appendix*, Table SI-2). The duration of the panel data are a maximum of four time periods (1975, 1993, 2003, and 2007) or three differences (1975–1993, 1993–2003, and 2003–2007). The 1985 data do not include state identifiers and are therefore excluded from the state-level analysis.

The availability of state parks in the neighboring states is measured in the main specification by the availability of out-of-state state parks within a 150-mile radius from the population-weighted centroid of each state. (ArcGIS was used for calculating this measure of the availability of out-of-state state parks.) When multiple states were situated within the 150-mile radius, a weighted average was calculated using the area of each neighboring state within the circle defined by the radius. Using the average availability of state parks in the neighboring states (regardless of the distance to the neighboring states) also was examined. The results show that the estimated effect of state parks on nature recreation is robust to alternative measurement of the availability of state parks in the neighboring states (*SI Appendix*, Table SI-2, estimation method 3). The robustness checks also examined using a heterogeneous time

Table 3. Description of time use surveys

Survey	Year	Administrator (funding)	No. of observations	Response rate (%)	Field work period, other notes
Americans' Use of Time	1975	Survey Research, University of Michigan (NSF, US Department Health, Education, and Welfare)	2,394	72	October 1975–November 1976, targeted adult (18+ y) population. Panel survey with four waves, the first wave included here
Americans' Use of Time	1985	Survey Research, University of Michigan (NSF, AT&T)	4,939	51	January 1985–December 1985, targeted past secondary school age (10+ y) population. Only 18 y or older are included in this study
National Human Activity Pattern Survey	1993	Survey Research Center, University of Maryland (US EPA)	7,322	63	September 1992–October 1994, targeted individuals of any age. Only 18 y or older are included in this study
ATUS	2003	Bureau of Labor Statistics	19,759	58	Continuous throughout the year, targeted 15 y or older population. Only 18 y or older are included in this study
ATUS	2007	Bureau of Labor Statistics	11,606	53	Continuous throughout the year, targeted 15 y or older population. Only 18 y or older are included in this study

Total number of observations is 46,020. NSF, AT&T, and US EPA denote the National Science Foundation, American Telephone and Telegraph Company, and the US Environmental Protection Agency, respectively.

trend (instead of uniform) by estimating separate time trend parameters γ for each of the four US Census regions (Northeast, Midwest, South, and West), finding the results robust to alternative assumptions *SI Appendix*, Table SI-2, estimation method 4). (The estimated coefficients are robust to specifying a region-specific time trend, but as expected this approach inflates the estimated standards errors.)

Valuing Recreation Time. Estimating the monetary value of time use for nature recreation requires determining the opportunity cost of time in nature recreation. The precise opportunity cost of time likely varies by person and by activity, and pinpointing the time value of recreation therefore would require intricate assessments of people engaged in recreation, their alternative uses of time, and subjective values associated with them. Such assessments are beyond the scope of this study and not available beyond a few specific studies focused on the methodological aspects of valuing recreation time in a specific context (e.g., refs. 19 and 20). Here, the potential time value generated by state parks is illustrated by drawing from a conventional approach in the economics of outdoor recreation to the measurement of the opportunity cost of time (15, 28). In that literature, it is common to value time at a fraction of the wage rate, and the typically chosen fraction of the wage rate is either one-third or half, with some applications using a full wage rate. Empirical studies focused on valuing recreation time also generally support the range between one-third and half the wage rate, possibly even the higher end of this range (19, 20).The lower end of the range—one-third the wage rate—is chosen here for the sake of caution. Assuming a higher fraction of the wage rate to value the opportunity cost of time would proportionally increase the estimated time value of nature recreation, whereas assuming a lower fraction would proportionally reduce it.

Preliminary Analyses to Support Estimation. One potential empirical concern was that the availability of state parks could be endogenous (the popularity of nature recreation in a state would determine the availability of state parks in that state), which could bias the estimation of all coefficients. This was addressed in multiple ways. First, the chosen estimation framework is specifically designed to control for any inherent, time-invariant, and unobservable differences between different states. These differences plausibly could entail endogenous relationships between the availability of state parks and the popularity of nature recreation. Controlling for these differences, the estimation model examines variations relative to the state-specific baselines of both the popularity of nature recreation and the prevalence of recreation resources.

Second, because bias resulting from potentially remaining endogeneity could nevertheless arise if the unobservable temporal variations in the availability of state parks and nature recreation were driven by the same factors, this study statistically examined whether the availability of state parks (or its trend) may be systematically driven by nature recreation (or its trend). For robustness, these assessments used multiple models including many different variable specifications and sets of predictor variables. Three different measures of the availability of state parks (acres of parks per acre, acres of parks per capita, acres of parks per acre per capita) and their log-transformations were examined in these assessments. If the availability of state parks would be driven by the popularity of nature recreation, then the availability of state parks would be endogenous and not suitable as such for predicting the contribution of state parks to nature recreation.

Two separate sets of assessments examined whether the availability of parks is endogenous. The first set of assessments examined whether the availability of state parks—its absolute measure in a given year—was affected by the popularity of nature recreation in the previous period. The second set of assessments focused on the time trends by examining whether changes in the availability of state parks (its difference within a time period) were driven by the recent temporal trend in the popularity of nature recreation (its difference within the previous time period). These assessments involved altogether 60 different model estimations comprising a full range of possible variable and model specifications intended to detect the potentially endogenous regressor. However, none of model results suggested that the availability of state parks is systematically driven by the popularity of nature recreation. Within the estimation framework of this study, the availability of state parks is therefore considered exogenous (*SI Appendix*).

Preliminary analyses also examined three main alternatives to measuring the availability of state parks: (*i*) "park density" (acres of parks per acre of land), (*ii*) "parks per capita" (acres of parks per capita), and (*iii*) "park density per capita" (acres of parks per acre of land per capita). The first measure focuses on the spatial density of state parks regardless of how many people potentially use them. The second measure focuses on the acreage of state parks per capita. The third measure accounts for the combined effect of the spatial density of state parks and the population potentially using them. This combined effect could be relevant for at least two reasons: first, many parks can be accessed only for a fee, and overnight visits and activities such as camping, fishing, and hunting may be limited by the number of entry permits or licenses; and second, the number of potential park users may be associated with congestion, and increases in population may limit individual access to parks even if the acreage of parks remains unchanged. Using multiple model specifications including different possible combinations of the above variables *i–iii* estimated both independently and jointly, the estimation results did not suggest a statistically significant relationship between "park density" or "parks per capita" and nature recreation, but indicated a consistent and robust relationship between the variable "park density per capita" and nature recreation. Therefore, results are shown only regarding the variable "park density per capita." The estimation rescales the "park density per capita" variable so that it denotes the spatial density of parks per every 100,000 people living in a state. This facilitates easy interpretation of estimation results, but it does not otherwise change them.

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