

# Valuing the Recreation Uses of Natural Resources: The Travel Cost Method<sup>1</sup>

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Florida contains a multitude of natural resource systems (rivers, springs, estuaries, forests, reefs, and beaches) that are used by people for a variety of recreational activities (including fishing, boating, diving, hunting, riding, hiking, and camping). In fact, the Florida Park Service is one of the largest in the country, containing 161 state parks, 10 state trails that span nearly 800,000 acres, and 100 miles of beaches (<http://www.dep.state.fl.us/parks/>). In addition, the Florida Fish and Wildlife Conservation Commission (FWC) manages the largest wildlife management area in the United States. More than 5 million acres of land provide additional outdoor recreation opportunities (<http://myfwc.com/viewing/recreation/>).

According to the Outdoor Industry Association, 51% of Florida residents participate in outdoor recreation each year. In 2011–2012, outdoor recreation in Florida generated \$38.3 billion in consumer spending (5.9% of the national total), 329,000 jobs (5.4%), \$10.7 billion in wages and salaries (26.8%), and \$2.5 billion in state and local tax revenues (6.3%) ([http://www.outdoorindustry.org/images/ore\\_reports/FL-florida-outdoorrecreationconomy-oia.pdf](http://www.outdoorindustry.org/images/ore_reports/FL-florida-outdoorrecreationconomy-oia.pdf)). The Florida Department of Environmental Protection estimated that, based on Fiscal Year 2010–2011 data, the Florida state park system generated 19,347 jobs and over \$61 million in state sales taxes (<http://www.nasorlo.org/wp-content/uploads/2011/11/FPS-2010-2011-Economic-Impact-Assessment1.pdf>). The Florida Department of Environmental Protection also estimated that state parks in Florida generated \$970 million in expenditures in local economies by non-local park visitors and by park operations.

Further, a survey conducted by the US Fish and Wildlife Service (US Department of the Interior et al. 2011) showed that in 2011 6.4 million people (both residents and non-residents of Florida aged 16 years or older) fished, hunted, or engaged in wildlife-watching activities in Florida. In total, 242,000 people hunted, 3.1 million people went fishing, and 4.3 million people watched wildlife in Florida in 2011. These individuals spent \$9.0 billion on wildlife recreation in Florida in 2011, comprised of \$4.8 billion in trip-related expenditures, \$2.7 billion in equipment expenditures, and

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\$1.5 billion in expenditures on licenses, contributions, land ownership and leasing, and other items (US Department of the Interior et al. 2011).

The above statistics provide evidence that outdoor recreation in Florida generates economic value, but these data do not capture the full recreation value of Florida's natural resources. Fees for recreational use of resources (such as park entrance fees and hunting and fishing license fees), and tax revenues, income, and employment generated by nature-based recreation only capture part of the economic value of natural resource systems. Market data provide incomplete information about the relationship between the recreation value of natural resource systems and the characteristics of these resource systems, including resource degradation and resource management decisions (for instance, rates of timber harvesting, and water allocation and extraction decisions that change in-stream flows) (Freeman 2003).

Another EDIS publication ("[Measuring the Economic Value of the Environment and Natural Resources](#)") introduces the concept of total economic value of natural resources, which includes the recreation-based value of resources. As noted in that publication, various survey-based methods are available to measure the economic value of natural resources when market-based data are insufficient to capture the total benefits that society derives from natural resources. The travel cost model (TCM) of recreation demand is a survey-based method that was developed to estimate the recreation-based use value of natural resource systems. The TCM may be used to estimate the value of

1. recreation services provided by natural resource systems;
2. a new or lost recreation site; and
3. changes in the quality of recreation sites or natural resources systems (Freeman 2003).

Typically, the TCM is applied to valuation of recreation sites like national parks and other protected areas, sporting sites such as hunting and fishing sites, and archaeological and cultural sites such as museums.

The TCM recognizes that the value individuals place on a recreation site may be inferred from the costs they incur to visit the site. The *implicit* price of using a recreation site is not only the entry fee but also the monetary and time costs of traveling to the site. Different individuals face different travel costs for each site. And each individual faces different travel costs for different sites that s/he may choose to visit.

By observing individuals' choice of which recreation sites to visit and how these choices relate to the implicit prices of visiting different sites (and the environmental quality of the sites), economists are able to value recreation sites (and changes in the quality of recreation sites). To summarize, estimating travel costs allows economists to calculate the recreation-based use value of natural resource systems and the value of changes in the quality of these systems (Freeman 2003).

The TCM approach may be applied in cost-benefit analysis<sup>1</sup> and in natural resource damage assessments where recreation values are relevant (e.g., the loss of recreational fishing, boating, and diving areas owing to an oil spill). Because the approach is based on people's observed behavior, it is most appropriately used to estimate one type of use value<sup>2</sup>—in this case recreation use value.

Below I summarize and synthesize economic texts on the TCM by Hanley and Spash (1993) and Freeman (2003), two key textbooks that discuss the design and implementation of the TCM, analysis of TCM data, and potential limitations of the TCM in estimating the recreation use value of natural resources.<sup>3</sup> I also provide an overview of a case study in which the TCM was used to estimate the nature-based recreation use value of the Apalachicola River Region in Florida (Shrestha et al. 2007).

## The Basic Travel Cost Model

The TCM allows economists to estimate the recreation use value of a site by estimating and aggregating individuals' recreation use values for the site. For each individual, the recreation use value of a site depends on

- total time spent at the site (or number of visits to the site);
- round-trip travel time (which increases with the distance that the individual lives from the site);
- monetary cost of the trip (including the admission fee and the monetary costs of travel); and
- the environmental quality of the site (which may be measured using both secondary data and visitors' perceptions of environmental quality).

The TCM recognizes that individuals face both budget and time constraints. Specifically, allocating money to traveling to the recreation site reduces the total amount of money (or income) that the individual has to spend on other goods and services. Similarly, allocating time to traveling to the site for recreation reduces the amount of time that the individual has available for other activities, including work, chores, and leisure. The money and time costs of

visiting a recreation site provide an estimate of the value that individuals place on the recreation site, i.e. time and money people are willing to spend visiting the site because they value the site. The price of visiting a site consists of the admission fee, the monetary cost of travel to the site, the cost of time spent traveling to the site, and the cost of time spent at the site. The aggregate value of the recreation site is the discounted present value<sup>4</sup> of the flow of recreation benefits to the individuals who visit the site.

The TCM may also be used to estimate the recreation value of changes in environmental quality. The TCM recognizes that the number of visits made to a site increases as the environmental quality of the site improves. Improved fishing because of improved water quality or improved in-stream flows will result in more fishing trips to the site. Alternatively, the number of visits to the site will decrease as the site becomes degraded. Poor beach quality because of pollution, development, or erosion will reduce visits to beaches. The basic TCM may also be used to estimate the cost of lost access to a site, such as beach closures due to an oil spill, a fish consumption advisory that closes a lake for fishing, or development that eliminates a wildlife viewing area. Alternatively, the basic TCM may be used to estimate the value of a change in the cost of access to a site because the entry fee has changed, for instance, or because a new entrance to the site has been opened.

Typically, TCM analysis is based on data collected through the implementation of a survey.<sup>5</sup> There are several key steps in estimating a basic TCM:

1. Select site(s).
2. Define recreational uses of the site and the recreation season.
3. Develop a sampling strategy.
4. Specify model.
5. Design and implement TCM survey.
6. Measure travel costs and access values.

## Site Selection

The first stage of a TCM is to clearly define the site that is to be valued (e.g., a park, lake, wilderness area, or beach). Although the boundaries of the site may be clearly delineated in some cases (a national or state park), in other cases (a beach or river segment, for instance), care must be taken in defining the boundaries of the study site. Government

agencies, park services, and tourist bureaus may have literature and maps that are useful in defining a site and providing visual aids when administering TCM surveys.

## Definition of Recreational Uses and the Season

Recreational uses of the site and the season to be studied (e.g., a fishing or hunting season) must also be clearly defined. At this point the researcher should decide whether the objective is to focus on a single recreational activity or whether multiple uses of the recreation site will be studied (fishing, swimming, boating, and bird watching on a lake, for example). If more than one recreational activity is being studied, then separate demand functions (and recreation use values) should be estimated for each activity. Certain activities such as hunting and fishing have clearly defined seasons, and other activities like hiking have no specific seasons. When creating a TCM survey, the researcher should carefully define the season for each recreational activity.

## Develop a Sampling Strategy

The TCM survey should be administered to individuals who use or may use the recreation site. However, care must be taken in sampling users of the recreation site. If the survey is administered on-site, then recreationists at the site are randomly selected to complete an oral or written survey. The advantages of on-site sampling are that users of the site are directly sampled and survey costs tend to be lower. A disadvantage of on-site sampling is that people who did not visit the site during the implementation of the survey are not included in the sample. On-site sampling is subject to *endogenous stratification* and *avidity bias*. “Endogenous stratification” refers to the fact that on-site sampling focuses on site choice for recreationists who use the site, which is not the same as sampling the population of individuals who engage in this recreational activity (e.g., anglers). As such, on-site survey data may not reflect the site choices of the true population of recreationists. “Avidity bias” is a selection bias, whereby more frequent users of the site are oversampled. The attributes of more avid users of a recreation site may not be representative of the attributes of the population of recreationists. On-site sampling may result in overestimation of the value of the recreation site (Hindsley et al. 2011).

The alternative is to use an off-site sampling strategy. The TCM survey is sent to individuals from the general population, which includes both users and non-users of the recreation site, or participants and non-participants in the recreational activity (e.g., hunting). One advantage of

off-site sampling is that it allows the researcher to estimate the travel cost for the site at which an individual will no longer visit the site. Off-site sampling also allows for random sampling of the population of users and potential users of the site and avoids the selection biases associated with on-site sampling. However, off-site sampling is costly because of low response rates to surveys and the need to survey sufficient users of the site to obtain travel costs for the site. The other main disadvantage of this sampling strategy is that it may be difficult to determine the geographic area over which to administer the survey, especially for recreation sites like national parks that have national or global appeal.

## Model Specification

Before designing a TCM survey, the researcher must determine which variables must be included in the TCM model. This step is often overlooked, which leads to poorly designed surveys. *Survey design depends on model specification.* At a minimum, TCM surveys should collect information on total time spent at the site (or number of visits to the site), round-trip travel time, monetary cost of the trip (including the admission fee and the monetary costs of travel), recreational activities at the site, and demographic variables. Key demographic variables (including gender, age, education, and income) are important for estimating empirical models. Questions about individuals' perception of environmental quality at the site may also be included in the survey. It is also important to consider substitute activities for the recreational activity being studied, to ensure that the recreation use value of the site is not overestimated.

## Design and Implement TCM Survey

Each basic TCM survey contains four key sections:

1. *Introduction*: the person asking the survey questions (called the enumerator) identifies his or her affiliation, explains the purpose of the study, and provides assurances (including confidentiality) to keep respondents engaged in the survey.
2. *Trip count*: the enumerator asks questions to ascertain the number of times the individual visited the site over the designated period of time (or season).
3. *Most recent trip*: the enumerator asks how much time the respondent spent on-site, the number of people who shared the travel experience, other expenses that were incurred during the trip, and the overall trip experience (e.g., the number of fish caught).

4. *Respondent demographics*: the enumerator asks questions to determine the respondent's demographic and household characteristics.

When designing the TCM survey, bear in mind that trip recall and trip categorization are of critical importance in obtaining accurate data. Narrower questions about the most recent trip to the site are likely to generate more accurate information than broader questions about previous trips to the site or all trips to the site over the designated period of time.

On-site surveying precludes the collection of information about trips that may still be taken by the respondent to the site that season. There are two ways to correct for this. Either the respondent may be asked to estimate how many more times they will visit the site during the season or the number of trips the respondent will make may be extrapolated from the number of visits they have already made to the site.

It is also important to isolate side trips to the site and trips originating from destinations other than the respondent's home, in order to accurately measure trip costs. Usually, trip costs for side trips should not include costs of traveling from the respondent's home to the destination from which they made the side trip to the recreation site. If a person visits a recreation site during a business conference, then the travel costs for the conference should not be included in the TCM. However, if an individual travels to accommodation in the vicinity of the recreation site, with the specific objective of visiting the recreation site as part of his or her vacation, then a share of the travel costs to reach the holiday accommodation should be included in the TCM (depending on the extent to which the visit to the site motivated the individual's travel decisions).

## Measure Travel Costs and Access Values

Travel costs are measured as the sum of transit expenses, access fees (e.g., daily entry fees for a site), equipment costs (bait, tackle, rods, and use of a boat for a fishing trip, for instance), and time costs (including time spent traveling to the recreation site and time spent in the recreational activity). Access values for the site may then be calculated as either the mean seasonal value per person or for the population, or as a value per trip per person.

Several assumptions may be made when estimating travel costs:

- Transit expenses should be estimated as the per-mile cost of driving multiplied by miles traveled plus toll costs. The

per-mile costs of driving will vary by vehicle. Researchers may use estimates by the US Department of Transport or the American Automobile Association to determine the average cost of operating a vehicle. Researchers also need information on the origin of the trip to the recreation site to estimate miles traveled. If several people travel together on the trip, then they may share costs, and this should also be taken into account in estimating transit costs.

- Equipment costs should be estimated with care. If the equipment is a consumer durable that will be used for multiple recreational trips, like a fishing rod or a boat, then the cost of the equipment may be imputed using rental fees for comparable equipment. If the cost of the consumer durable is a negligible part of travel costs, then it may be omitted from total travel costs.
- The basic TCM assumes that all visits take the same length of time, which allows the modeler to use number of visits to the site as a proxy for total time spent at the site. But if each visit is of a different duration, then the appropriate measure is total time spent at the recreation site for a given period of time (e.g., the fishing or hunting season).
- Time costs are the most difficult portion of travel costs to estimate. The value of time is usually assumed to be the wage rate, although the after-tax wage rate is a more accurate estimate. However, individuals may be retired, unemployed, underemployed, or self-employed, in which case the wage rate cannot be determined. Moreover, researchers may choose to measure the value of leisure time as a fraction of the imputed hourly wage (between 1/3 and 1).

It is assumed that the individual places neither positive nor negative value on travel time. In other words, people neither enjoy the time spent traveling to the site nor are they frustrated by this travel time. So the cost of travel time is estimated as the number of hours spent traveling multiplied by the hourly wage rate (or a fraction thereof). But if people are frustrated by the trip, perhaps because of congestion or poor road conditions, then this additional cost should be factored into the calculation of time costs: the hourly cost of travel is the wage-based time cost plus a premium for the discomfort of the trip. Alternatively, if people enjoy the travel because of the scenic beauty of the trip, then the cost of travel time is lower because the person benefits from the travel: the hourly cost of travel is the individual's wage-based time cost minus the value of enjoying the trip.

## Multi-Site Travel Cost Models

Although the basic TCM is comparatively simple to estimate, there are a number of limitations to this model. The model assumes that each trip to the site is purely for the purpose of visiting the site. If the trip involves visits to more than one site, then travel costs should be allocated between these sites. Assuming that all travel costs should be used to value a single site for a multi-site trip overestimates the value of that site.

Moreover, the single-site model makes the implicit assumption that there are no alternative or substitute sites that the individual may visit. But if there are alternative sites that the individual may visit, then their decision to visit the study site will be a function of the different travel costs and levels of environmental quality for the study site and the alternative sites. Omitting the implicit prices of alternative recreation sites from the model will introduce bias into the model. The key difficulty for researchers is to determine which alternative sites to include in a more complex model. Unfortunately, there is no correct answer on which sites to include and exclude from the analysis.

The multi-site model explicitly addresses “substitution effects,” a term that describes how users may substitute between recreation sites based on the sites’ recreational uses and other characteristics. Addressing substitution effects allows the multi-site model to capture the complexities of recreational behavior by incorporating the prices for multiple sites in the analysis. The multi-site model may be used to examine whether people decide to engage in a particular recreational activity and which site they choose if they do decide to engage in the activity. Accordingly, the multi-site model allows researchers to analyze how specific site characteristics (e.g., site amenities, fish catch rate) influence the choice to visit that site, which allows the researcher to estimate how valuable those site characteristics are to the individual. The researcher may also determine how individuals evaluate different site characteristics and travel costs in order to make a site selection.

However, as the number of sites included in the model increase, the difficulties in obtaining required data and specifying and estimating the model also increase.

Researchers must exercise their judgment in determining which sites to include in the analysis, subject to data and empirical limitations. For example, one individual may use one site primarily for fishing and a second site primarily for swimming. Both activities may be affected by changes in water quality. But if the objective of the analysis is to

determine how the fishing value of various recreation sites is affected by changes in water quality, then the appropriate sites to include in the analysis are those sites at which the individual fishes, rather than sites at which the individual swims. The individual should be asked to indicate other sites at which s/he fishes.

## Nature-Based Recreation in the Apalachicola River Region

From September 2000 to February 2001, Shrestha et al. (2007) implemented a basic TCM survey at five recreation areas in the Apalachicola River region: St. Vincent National Wildlife Refuge, Tate's Hell State Forest, Apalachicola River Wildlife and Environment Area (WEA), Apalachicola National Forest, and St. George Island State Park. These five areas vary in terms of level of development (or naturalness), access, and recreation opportunities (Table 1). The least developed of these sites, St. Vincent National Wildlife Refuge, may only be accessed by boat and during daylight hours, whereas St. George Island State Park is the most frequently visited and developed site. The objective of the TCM was to value nature-based recreation in the Apalachicola River Region.

Shrestha et al. (2007) used on-site sampling at the five different sites. However, the TCM data were collected in two phases. During the first phase, every second visitor at least 18 years of age was selected by a trained interviewer for an initial interview that was used to collect the respondent's contact information and information about the purpose of the trip. During this first phase, respondents were provided with a survey questionnaire packet, which included a cover letter, pencil, postage-paid return envelope, and the questionnaire. The TCM questionnaire included a series of questions about respondents' most satisfying recreational activities, their travel costs (transportation costs, fees, lodging, food, and miscellaneous out of pocket expenses), their preferences for nature-based recreation settings, and their socioeconomic information. Respondents were asked to complete the questionnaire and to mail it back to the research team within 2 weeks. During the second phase of the data collection effort, three reminder cards were sent to respondents to request that they complete and return the questionnaire. In total, of the 428 surveys that were administered, 263 surveys were completed for a response rate of 61 percent.

Shrestha et al. (2007) estimated a model in which they regressed (compared) the number of trips that respondents made in a given year to each site against the following

variables: travel cost, time spent on site, a naturalness variable for the site that ranged from totally undeveloped to highly developed, site characteristics, recreational activities that respondents' rated as most satisfying, gender, age, education and income. Based on this model, Shrestha et al. (2007) estimated that, on average, visitors to these five sites obtain \$74.18 per day in consumer surplus<sup>7</sup> from nature-based recreation. When aggregated across sites and the number of visits to these sites, their results suggest that nature-based recreation in the Apalachicola River region generates \$484.56 million in use value (Table 2).

Shrestha et al. (2007) concluded that there is high demand for pristine natural areas for recreational visits in the Apalachicola River region of Florida. They further argued that based on the TCM results, managers could increase recreational visits to the Apalachicola River region by providing increased opportunities for nature-based recreation in pristine areas, rather than by investing in infrastructure.

## Conclusions

The travel cost method (TCM) may be used to estimate the recreation use value of natural resources or a recreation site. Typically, the TCM requires the design and implementation of a survey, although secondary data (including visitor records for a site) may be used to approximate the recreation use value of a site. Like all survey-based approaches to environmental valuation, TCM surveys will be useful only if they are carefully designed and implemented, and only if the data is analyzed carefully and accurately to ensure that estimates of economic value are as reliable as possible. Assumptions made during the estimation procedure and limitations of the data and analysis should be noted in reports of the results.

Despite the limitations it shares with all survey-based approaches, the TCM nonetheless provides the means to demonstrate the use value to society of nature-based recreation, including the value of providing, maintaining, or improving the quality of outdoor or nature-based recreation opportunities. The TCM may also be used to support policies or programs to preserve sites that provide recreation use value, as opposed to converting these sites to other uses such as development, if the recreation use value of the site exceeds the value of other uses of the site. The TCM may also be used to augment data on employment and revenues generated by recreation sites.

## Notes

<sup>1</sup>When analyzing environmental problems, economists consider both the benefits and costs of actions. If benefits exceed costs, then economic theory supports that action (i.e., it is cost-benefit justified). Cost-benefit analysis is explained in [The Use of Cost-Benefit Analysis in Environmental Policy](#).

<sup>2</sup>“Use value” is defined as the direct value that people derive from resources. Use value is explained in greater detail in [Measuring the Economic Value of the Environment and Natural Resources](#).

<sup>3</sup>See also Tietenberg and Lewis (2009) and King and Mazzotta (2000) (available at [http://www.ecosystemvaluation.org/travel\\_costs.htm](http://www.ecosystemvaluation.org/travel_costs.htm)) for a summary of the TCM.

<sup>4</sup>Present value calculations incorporate the value of money over time by recognizing that \$1 in the future is worth less than \$1 today. The process of calculating the present value of money is termed discounting. The concepts of discounting and present value are explained in [The Use of Cost-Benefit Analysis in Environmental Policy](#).

<sup>5</sup>It is possible to conduct a simple zonal travel-cost approach—using mostly secondary data, with some simple data collected from visitors—to estimate the recreation use value of a site. The researcher uses information on the number of visits to the site from different distances and estimates the travel and time costs incurred in traveling that distance to the site. To conduct a simple zonal travel cost analysis, the researcher (1) defines a set of zones surrounding the site (e.g., concentric circles around the site or geographic divisions such as counties); (2) collects information on the number of visitors from each zone and the number of visits made in the last year (e.g., using site records of the number of visitors and their zip code); (3) calculates total visits per zone over the last year; (4) calculates the average round-trip travel distance and travel time to the site for each zone in order to estimate the travel cost per trip for each zone; and (5) constructs the demand function for visits to the site to derive the recreation use value of the site to visitors. This approach does not require the implementation of a detailed survey questionnaire, which reduces the cost of the TCM, but it has limited use in valuing a change in the quality of a recreation site, and it will likely omit important determinants of recreation use value ([http://www.ecosystemvaluation.org/travel\\_costs.htm](http://www.ecosystemvaluation.org/travel_costs.htm)).

<sup>6</sup>The information presented in this section is derived from two textbooks, namely Hanley and Spash (1993) and Freeman (2003).

<sup>7</sup>Consumer surplus is the “value of a good or service to consumers above the price they have to pay for it. [It is] calculated as the area under the demand curve that lies above the price the consumer pays” (Tietenberg and Lewis 2009, 624).

## Further Reading

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Table 1. Characteristics of the Recreation Areas in the Apalachicola River Region.

Recreation Area	Landscape	Size	Facilities/Activities
St. Vincent National Wildlife Refuge	barrier island	12,358 acres	hiking trails
Tate's Hell State Forest	swamp	150,000 acres	1 designated hiking trail all-terrain vehicle trails 1 concrete boat launch with a wooden dock primitive camping sites in designated areas
Apalachicola River WEA	marsh floodplain forest pine flatwoods	60,000 acres	observation tower picnic area concrete boat ramps primitive camping
Apalachicola National Forest	forest	564,000 acres	trailheads, hiking, hunting, fishing, boating developed recreation areas (picnicking) primitive & developed camping Fort Gadsden (national historic site)
St. George Island State Park	island	1,962 acres	swimming, beach activities, boardwalks, picnic shelters along beach developed camping (electrical hookups) primitive camping nature trails & interpretive tours youth camp 2 concrete boat launches for motorboats or canoe/ kayaks bike, drive, or walk along paved road through center of the park

Table 2. Economic Value of Nature-Based Recreation in Apalachicola River Region.

Recreation site	Response rate (%)	Annual visits <sup>a</sup>	Recreation value (\$ in thousands)
St. Vincent NWR	74	8,000	6,302
Tate's Hell State Forest	45	5,000	3,939
Apalachicola River WEA	45	66,217	52,163
Apalachicola National Forest	57	393,400	309,903
St. George Island State Park	68	142,500	112,255
Total		615,117	484,562

<sup>a</sup> Average trip length is 10.62 days based on survey data.  
Source: Shrestha et al. (2007)