CHAPTER 11
Nature-based tourism and recreation
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11.1 Nature-based tourism and recreation values in context

International tourism and recreation generated over $1 trillion in receipts in 2007 (roughly equivalent to South Korea’s 2007 gross domestic product; World Tourism Organization 2008). Environmental attributes of tourism sites are important in determining visitation rates and the value of tourism and recreation. For example, the earliest writings on tourism emphasize the environment quality at seaside resorts, parks, and wilderness areas (Towner and Wall 1991). National parks are often located in areas with photogenic biodiversity (e.g., Serengeti National Park in Tanzania and Krueger National Park in South Africa) or areas of scenic beauty (mountains, coasts, etc.). Many forms of recreation require natural amenities (clean water for swimming, species diversity for birdwatching). By providing the natural features that attract tourists, ecosystems provide a tourism and recreation service.

Tourism generally refers to travel for pleasure and typically involves overnight stays away from home. Recreation typically refers to activities that occur over part or all of a single day (e.g., hiking or fishing) that may take place during a tourism trip or as a day trip from home. For simplicity in this chapter we use “tourism” as the general category for both recreation and tourism.

Economists have developed a variety of techniques for assessing the economic value of tourism (Champ et al. 2003; Phaneuf and Smith 2005; Bockstael and McConnell 2007) and how the value of tourism is affected by changes in the supply of environmental attributes (Phaneuf and Smith 2005). In this chapter a site’s environmental attributes include its quantity and quality of ecological processes such as water delivery and cleanliness, biodiversity, quality and diversity of habitat, net primary productivity, etc. Tourism dynamics, however, are not explained solely by environmental attribute supply. Tourism valuation models are essentially models of human behavior applied to the decisions of where, when, and how to engage in tourism. As such, the value that a tourist places on a particular site will depend on his/her personal characteristics (including past behavior and social interactions), the local geography (including distance and cost of accessing sites as well as the presence of substitute tourism sites) and the individual’s perception of congestion, environmental quality, and other site-level attributes.

The value of nature-based tourism in various parks, landscapes, or regions has been estimated in a large number of economic studies (Phaneuf and Smith 2005). Most of these studies have involved primary data collection. However, if a tourism site or landscape has not been the focus of a detailed economic analysis, which represents the majority of cases, we have to rely on secondary data (e.g., data collected by government agencies) to assess tourism values. Unfortunately, these secondary datasets often leave out key variables required for understanding the linkages between visitation rates and characteristics of sites such as their environmental attributes.

Here, we outline the conceptual basis for assessing the values people place on engaging in tourism activities across a landscape and develop methods that increase in sophistication with increased data availability. Each potential tourism
site has environmental characteristics that influence the attractiveness of tourism at the site. Tourism tends to increase with improvement in environmental characteristics but is also influenced by the distance of sites from tourists’ starting location, availability of substitute tourism sites and other factors. To isolate the effect of the environment on tourism use and value, we need to construct models that control for these other influences. (We use the term “tourism use” instead of “tourism demand,” the term of choice in the valuation literature, to remain consistent with the taxonomy of ecosystem services presented in this book; see Chapter 3.)

We present three methods for assessing tourism use and values in a landscape. In tier 1 we present a mapping methodology for spatially representing important tourism areas. Overlaying these site maps on maps of environmental attributes displays spatial correlations between tourism use and environmental attributes. The tier 2 model provides a more theoretically appropriate mechanism for measuring the change in tourism use and value given marginal changes in environmental attributes on the landscape. Tier 2 models can be used to approximate the change in tourism values under future scenarios of land use/land cover (LULC) vis-à-vis the current landscape. We conclude with a discussion of the state-of-the-art tourism valuation models (tier 3). In these models individuals examine the attributes of alternative destinations and choose the destination that generates the highest utility (Train 2003; Phaneuf and Smith 2005). In principle this approach can capture linkages among environmental attributes, substitute sites, substitute activities, demographic factors affecting value and other aspects of tourism valuation, though practical complexities and data requirements are both high.

11.1.1 Major social and environmental processes that affect tourism values

In general, the value of a tourism site will increase as the quantity or quality of environmental attributes at the site increases. For example, the value of a site visit for a bird watcher increases in the abundance and diversity of species, for an angler with cleaner water and fish stocking, and for a beachgoer with improved water quality. Figure 11.1 outlines the relationships between individual tourists, tourism destinations, and four factors that form the main components of the linkages between tourism, the environment, and value: environmental attributes, tourism site infrastructure, costs of visiting sites (illustrated by travel distance) and the availability of substitutes. Figure 11.1 provides an example with two cities where individual tourists live, and two tourism sites. At each tourism site environmental attributes and infrastructure affect the attractiveness of the site and thereby influence the number of trips taken and/or the choice to visit site A versus site B. The costs of visiting a site, captured in the travel distances, and the availability and impact of substitute sites complete the characterization.

In assessing the value of a change in environmental attributes, consider a base case in which all of the tourists visit the closest site, site A for city 1 tourists and site B for city 2 tourists. Suppose the quality of the water in the river that flows through site A improves. The improved water quality increases the attractiveness of site A, thereby increasing the total number of trips from residents of city 1. In addition, some residents from city 2 may now be willing to travel further to enjoy the improved supply of water quality at site A. Both the increase in number of visits from residents of city 1 and the change in site choice by residents of city 2 are reflections of the value of the improvement in an environmental attribute at site A.

Figure 11.1 also presents some of the complexities associated with the measurement of tourism values. The assessment of value depends on modeling the choice of sites and/or number of trips by residents of cities 1 and 2. Predicting trips requires information on the characteristics of these residents (income, perceptions of site attributes, etc.), environmental and infrastructure attributes, cost of trips (travel distances, time costs) and substitute sites. In Figure 11.1 the set of substitutes is defined as the two sites A and B. In reality, there may be hundreds of substitute sites. Information about the spatial location and costs associated with travel to each of these sites from the relevant residence zones is necessary for predicting trips. Finally, the model of tourism should be able to translate changes in environmental attributes (e.g., water quality/quantity, species
abundance and composition) into impacts on site attractiveness and the subsequent impact on number of trips or site choice.

11.2 Tier 1 tourism supply and use model

Creating a complete model of tourism that incorporates all the dimensions discussed above requires more data than are typically available. In the tier 1 tourism model we start with a more modest aim that requires much less data. We use maps to plot and characterize the current spatial pattern of nature-based tourism across the landscape. We measure use of a site for tourism activities with the number of visits to the site. We compare tourism use with several categories of site features and characteristics, including environmental attributes, site infrastructure (e.g., campgrounds), and site accessibility (e.g., proximity to population centers, roads, airports). By overlaying these data layers we can correlate use of a site for tourism activities with its supply of environmental attributes. For example, is recreational fishing particularly popular at sites with the cleanest water in a landscape?

The main strength of tier 1 is that it gives a picture of the current state of nature-based tourism on the landscape and only requires relatively easily collected data to implement. The tier 1 data can also form the basis of the data collection efforts needed to run a tier 2 analysis. In interpreting tier 1 results, it is important to note that spatial correlation in tourism and environmental attributes does not imply causality. Further investigation with more detailed data and analytical techniques, such as those developed in tier 2 and tier 3 approaches, are needed to fully disentangle the effects of environmental attributes from other factors such as site accessibility and availability of substitute sites.

11.2.1 Developing tier 1 maps

The tier 1 approach involves compiling and overlaying five categories of data to investigate the spatial relationship between use of sites for tourism, environmental attributes, and landscape features.
The first data layer includes the sites that provide tourism opportunities. Tourism sites can include national, provincial, state, county, or privately held parks and recreation areas. In some cases, tourism activities are not restricted to easily defined places on the landscape. Some tourism activities take place across a broad region or landscape. For example, duck hunting occurs on private and public land throughout the Prairie Pothole Region of the Midwest USA. To account for this type of activity we may subdivide the landscape into zones to identify the portions of the landscape where diffuse tourism activity is more and less popular.

The second data layer maps visitation data. Visitation data can be measured a number of ways: site visits per unit time (where one person can register multiple visits over the course of the time period), number of visitors to the site per unit time, visitor days per unit time (the sum of all visitors’ length of stay in days), number of visitors purchasing entrance permits per unit time, etc. Stratifying visit data by visitor place of origin, reason for visit, and time allows more detailed and comprehensive analysis. For example, stratifying visitors by international and domestic origin can show differences in visitation rates by cost (on average, international visitors pay much more to tour than domestic tourists). We discuss a way of placing a monetary value on the annual number of visits in Section 11.4 below.

The third data layer maps information on environmental attributes and other landscape features at sites. For example, does the site include a lake that would be a draw for swimming or fishing, major changes in elevation good for hiking or dramatic views, habitat for charismatic species that are a draw for wildlife viewing? High water quality, sufficient water flow, and abundant game fish are vital for certain stretches of rivers if they are to provide tourism value via recreational fishing.

The fourth data layer maps information on important infrastructure at each site. Infrastructure important for determining tourism site visits includes roads, hiking trails, lodges, camping sites, and interpretative facilities.

The fifth data layer maps major transportation infrastructure and urban areas. With these data we can calculate distance and travel time from urban areas to each tourism site.

### 11.2.2 Example application of tier 1: Willamette Basin, Oregon, USA

We applied the tier 1 approach to tourism in the state parks of the Willamette Basin, Oregon, USA. The Willamette River and the Basin’s major highways and cities are located in the Basin’s valley floor (Figure 11.2A). Most state parks lie near cities and are on the main stem of the Willamette River or one of its tributaries; a few parks are in the Cascade mountain range on the eastern side of the Basin (Figure 11.2A).

Figures 11.2b through 11.2d present maps of environmental attributes and other features in the Basin (ODFW 2005; OCEO 2008; PNW-ERC 2008). The state parks in the Basin with the most day visitors (not deconstructed by activity) are located in the Cascade Mountains and offer outstanding scenic attractions or recreation opportunities (Figure 11.3a). Silver Falls State Park, which contains many large waterfalls, had the most visits in 2004 even though its aggregate distance to the Basin’s cities was more than most other state parks.

Detroit Lake State Park, higher up in the Cascades than Silver Falls and of greater distance from cities, was the most popular destination in the Basin for overnight camping (an activity that is generally more costly than a day visit, given the time requirements and the price of camping permits; see Figure 11.3b). Many sites in the northeast corner of the Basin (and just outside the Basin along the Columbia River) were popular tourism destinations both because they are close to the largest urban center in the Basin (Portland) and feature the spectacular scenery around Mount Hood and the Columbia River Gorge.

The greater use of nature-based tourism in the northeast corner of the Basin is also reflected in hunting data. The Santiam hunting region (the region that includes Mount Hood National Forest, Silver Falls State Park, Detroit Lake State Park, and part of the Columbia River Gorge) is the most popular region for big game hunting, with 127 446 hunter days in 2004 (see Figure 11.4a).
Figure 11.2  Willamette Basin state parks and landscape features, characteristics, and environmental attributes. Major landscape features and characteristics and state parks in the Basin (a; OGED 2008, PNW-ERC 2008, site data provided by Terry Bergerson, Oregon Parks and Recreation Department). Some access sites to the Willamette Greenway, a bicycle path, are considered state parks. The map of hillshade (b) in the Basin (PNW-ERC 2008) indicates areas of significant elevation changes. The map of landcover in the Basin circa 2000 (c; PNW-ERC 2008). The gray gradient in (d) represents an area’s marginal biodiversity value (MBV) score for 24 at-risk vertebrates, a tier 2 measure of biodiversity supply (see Chapter 8): the darker the parcel the greater the share of the 24 species’ total habitat on the landscape found in the parcel (see Hulse and Baker 2002 and Nelson et al. 2009 for details).
All of this suggests that any changes in the supply of environmental attributes or transportation infrastructure in the northeast corner of the Basin may have the greatest impact on tourism use and value in the Basin. Interestingly, this area is expected to experience major forest cover transitions over the next 100 years due to climate change (see Chapter 18).

One way to relate use of a site for tourism to environmental attributes at state parks is to overlay the site map with maps of these attributes. To illustrate this point, we construct a biodiversity supply map using the tier 2 biodiversity model (see Chapter 8), based on the habitat preferences of 24 terrestrial vertebrates that are habitat-limited in the Basin (Nelson et al. 2009). Many of the state parks on the Basin floor align spatially with some of the most valuable habitat areas in the Basin (see Figure 11.2d). However, only camping visit rates are correlated with areas that supply the greatest share of habitat for these 24 at-risk species, whereas day visit rates are not (see Figure 11.5). These correlates may change, however, as the roster of species analyzed changes. Similar analyses can be performed for other environmental attributes of interest.

11.3 Tier 2 tourism supply and use model

The tier 1 tourism methodology has two major shortcomings. First, we cannot quantify how the supply of environmental attributes at a site affects the overall tourism experience and its value at the site. In addition, the tier 1 analysis cannot explicitly estimate how changes on the landscape could change tourism activity or value. For example, does a future LULC and land management scenario reduce environmental attribute supply across portions of the landscape, and would this change impact tourism at particular sites? Or, are new roads or airports being built to facilitate access to a tourism site? An additional challenge comes from evaluating the addition of a new tourism site. A new tourist site is a substitute that could siphon some
use from existing sites but it could also make tourism on its host landscape more attractive overall and increase the landscape’s overall tourism use and value.

In tier 2 we develop a relatively simple model that predicts annual visitor days at each tourism site (or region) as a function of the site’s (1) environmental attributes; (2) infrastructure; (3) amenities; (4) distance to relevant population centers; and (5) spatial distribution of potential substitutes. We can use this model to predict the expected changes in visitor days at each tourist site on the landscape due to expected changes in any of these five explanatory landscape variables. In Section 11.4, we discuss a way to place a monetary value on (1) the annual number of visits to a site and (2) the change in the annual number of visits to a site due to a change on the landscape.

11.3.1 The visits model

The tier 2 model estimates the annual number of visitor days or visits (hereafter, “visits”), to tourism sites as a function of several landscape variables. Environmental attribute and infrastructure variables are site specific and directly affect visitation. The costs of visiting a site depend on the location of the tourists relative to the sites and the activities participated in at the site. To capture costs we examine the proximity of population centers to the site to develop an index of visitation cost for each type of tourism activity. The availability and impact of
substitutes depends on the spatial location of the site and potential substitute sites, as well as the supply of environmental attributes, infrastructure, and activity opportunities of the competing sites. We illustrate how an index can be constructed to assess the impact of substitutes.

In tier 2 we model the number of annual visits to each site \( q \) to participate in a combination of activities \( a \) by tourist type \( \omega \), represented as \( T_{qa\omega} \), as a function of a vector of environmental attributes at \( q \) that could impact participation in \( a \) (\( E_{qa\omega} \)), a vector of infrastructure variables at \( q \) that could impact participation in \( a \) (\( X_{qa\omega} \)), the relative cost of visiting the site \( q \) to participate in activity combination \( a \) (\( G_{qa\omega} \)), and an index of substitute sites that provide an opportunity to participate in \( a \) (\( S_{qa\omega} \)).

\[
T_{qa\omega} = f(E_{qa\omega}, X_{qa\omega}, G_{qa\omega}, S_{qa\omega}),
\]

where \( a = 1, 2, \ldots, A \) indexes any combination of activities, e.g., \( a = \{ \text{fishing}; \text{camping}; \text{hiking}; \text{fishing and camping}; \text{fishing and hiking}; \ldots; \text{fishing, camping and hiking} \} \). We deconstruct visits by activities because explanatory variables can affect participation for each activity differently. Further, different types of tourists can react to site attributes and costs differently. Here and throughout, these models can be simplified if we do not have sufficient data to stratify tourism visits or activities. Doing so involves dropping subscripts \( a \) and/or \( \omega \) and modeling the total number of annual visits to each site \( q \) (i.e., \( q\omega \), \( qa \), or simply \( q \)).

The vector of environmental attributes (\( E_{qa\omega} \)) includes biodiversity, scenic overlooks, boating opportunities, etc., while the vector of infrastructure variables (\( X_{qa\omega} \)) can include campgrounds, bathrooms, hiking trails, etc. The costs of visiting site \( q \) to participate in activity combination \( a \) (\( G_{qa\omega} \)) will depend on the distance of the site to population centers and the costs of participating in activity combination \( a \). An index that uses the distance from all relevant population centers to \( q \) is one way to determine the relative cost of visiting a site to participate in activity combination \( a \),

\[
G_{qa\omega} = (1 - \beta_{qa\omega})g_{qa\omega} + \beta_{qa\omega} \sigma \sum_{i=1}^{I} C_{u_i} h(d_{i\omega}),
\]

where \( g_{qa\omega} \) is a fixed cost of participating in activity combination \( a \) at site \( q \) (e.g., an entrance or participation fee), \( \sigma \) is a scalar, \( C_{u_i} \) is the number of people that might participate in activity combination \( a \) at site \( q \) that are from population center \( i \), \( h(d_{i\omega}) \) is an increasing function of the distance from population center \( i \) to site \( q \), and \( \beta_{qa\omega} \in [0, 1] \) is used to weight the relative importance of fixed participation costs versus relative travel costs in the cost index of.
participating in activity combination \( a \) at site \( q \). A commonly used form for \( h(d_{ik}) \) is \( e^{d_{ik}} \) with \( 0 < \rho \leq 1 \). In general, as the aggregate distance to site \( q \) increases (weighed by \( C_{a} \)) the greater the average cost of visiting site \( q \). In Eq. (11.2), population centers that have a greater number of people that might participate in \( a \) are given more weight in the determination of \( G_{a} \).

The use and value of a tourism site for activity combination \( a \) will tend to be lower if there are nearby substitute sites for \( a \). We illustrate a method for measuring the impact of substitute sites on the use and value of a given site \( q \) for activity combination \( a \). Our proposed index, \( S_{aq}^{e} \), is a function of environmental attributes and infrastructure at nearby sites weighted by the difference in distance that these sites are from population centers,

\[
S_{aq}^{e} = \sum_{k \in N_{qa}} \sum_{a \in N_{aq}} C_{a} \times y(EA_{a}) \times z(X_{a}) \times e^{-\frac{(d_{ik} - \gamma a)}{\rho}}, \quad (11.3)
\]

where \( q \) is a site suitable for activity combination \( a \), \( N_{aq} \) is the set of tourism sites in \( q \)'s “neighborhood” that provide opportunities to participate in activity combination \( a \) (neighborhood sites are indexed by \( k \)), population center \( i \) is in \( N_{aq} \) if population center \( i \) could supply people for \( a \) in the area formed by \( N_{aq} \), \( y(EA_{a}) \) is an increasing function in \( k \)'s environmental attributes that affect \( a \), \( z(X_{a}) \) is an increasing function in \( k \)'s infrastructure that affects \( a \), \( d_{ik} \) is as above, \( d_{ik} \) is the distance from population center \( i \) to site \( k \), and \( \gamma \) is a scalar. The distance to alternate sites is a proxy for the cost of using these sites.

A higher \( S_{aq}^{e} \) indicates more competition from rival sites for use of site \( q \) for activity combination \( a \). All else equal, \( S_{aq}^{e} \) increases with (1) the number of alternate sites \( k \) in site \( q \)'s neighborhood \( N_{aq} \), (2) the number of population centers \( i \) in \( N_{aq} \), (3) the environmental attributes and infrastructure in alternate sites \( k \) in \( N_{aq} \), and (4) increasing distance from \( i \) in \( N_{aq} \) to \( q \) vis-à-vis the distance from \( i \) in \( N_{aq} \) to the set of rivals \( k \).

The extent of site \( q \)'s neighborhood \( N_{aq} \) should be given by the furthest someone would travel to participate in activity \( a \). For example, if \( a \) is a wildlife safari, an activity that people will travel around the globe to participate in, then \( q \) should be a site that provides safari tourism and \( N_{aq} \) should include all other sites in the world that provide safari tourism and all of the world’s major urban centers. On the other hand, if we are modeling recreational stream fishing (typically a one day activity) then \( N_{aq} \) should only include alternative stream sites a few hours from \( q \)'s stream and urban centers that are a few hours from \( q \). Defining \( N_{aq} \) for such a local recreation market is illustrated in Figure 11.6.

### 11.3.2 Estimating a visits model

Assuming we have data on tourist visits to sites and information on the independent variables described above, we can estimate Eq. (11.1) across all potential sites for each combination of activity and tourist type, using standard regression techniques. Or,
given that all activities in a site will be affected by similar unobserved factors (e.g., the macroeconomic conditions in the demonstration site’s country, the macroeconomic conditions in the countries that supply the tourists, country stability), it may be most appropriate to pool all activity and tourist type models. A promising technique for this approach is the seemingly unrelated regression framework (see Greene (2003) for details). In Section 11.4.1 we fit Eq. (11.1) to data for the Willamette Valley in Oregon, USA.

11.4 Tier 1 and 2 Use Value

A monetary value of tourism at each site can be generated by multiplying the number of observed (tier 1) or estimated (tier 2) visits by an average value per visit (or visitor day). The value of a tourist visit to a site equals the benefit generated by this visit over and above the costs of this visit. This measure of value is known as consumer surplus (Loomis 2005). In general, consumer surplus can vary by site, type of tourist, and tourist activity. By aggregating the consumer surplus generated by each visit to a site over the course of a year we calculate a site’s annual consumer surplus generated by each visit to a site. By aggregating the consumer surplus generated by each tourist, and tourist activity. By aggregating the consumer surplus generated by each visit to a site over the course of a year we calculate a site’s annual consumer surplus generated by each visit to a site.

The landscape-level annual value of tourism and annual change in the value of tourism due to changes in environmental quality is given by summing AVT and ΔAVT, respectively, across all q on the landscape.

Finally, we can replace V in the equations above with other values of interest, for example, expenditures in the region by tourists participating in activity combination a at site q, to generate other tourism-related economic information (e.g., the economic impacts on local businesses). See this chapter’s text box (Box 11.1) for a discussion on tourism revenues generated by visits to Tambopata, Peru.

If we do not have consumer surplus estimates for the site we are studying, we may be able to use a consumer surplus estimate from a valuation study of a similar region as a proxy (for example, using an estimate of recreation values per day generated by a study in a nearby state). As noted in Chapter 3 there are limitations to benefits transfer approaches, thus primary studies are preferable. In this case we only transfer the value per unit of recreation activity (days, trips). For behavioral response (visits) to changes on the landscape, we use a locally calibrated

\[
\Delta^T_{qa} = f_n(\Delta EA_q, X_q, G_q, \Delta S_q), \tag{11.5}
\]

where \( f_n \) indicates the regression-estimated Eq. (11.1) for combination a, \( \omega \), and \( \Delta S_q \) indicates any change in the substitute index due to the change in \( \Delta EA_q \) (a change on the landscape that changes EA at q could also change EA at some other q). \( \Delta EA_q \) can include just one change (e.g., the change in water quality at q) or multiple changes (e.g., the change in water delivery and quality at q). We can also measure \( \Delta^T_{qa} \) due to changes in \( X_q \) and \( G_q \).

The expected change in monetary value at site q due to the change in \( \Delta^T_{qa} \), is,

\[
\Delta AVT_q = \sum_{a=1}^{A} \sum_{\omega=1}^{Q} [\hat{V}_{qoa}(\Delta^T_{qa} + T_{qa})] - [V_{qoa} T_{qa}], \tag{11.6}
\]

where \( \hat{V}_{qoa} \) represents the new value per trip after the change in environmental attributes on the landscape.

The expected change in monetary value at site q due to the change in \( \Delta^T_{qa} \), is,

\[
\Delta AVT_q = \sum_{a=1}^{A} \sum_{\omega=1}^{Q} [\hat{V}_{qoa}(\Delta^T_{qa} + T_{qa})] - [V_{qoa} T_{qa}], \tag{11.6}
\]
The province of Madre de Dios in south-east Peru, an Amazonian frontier region bordering Bolivia and Brazil, is renowned amongst scientists for its biologically and culturally rich landscape. One area of this region in particular, known as Tambopata, is now also firmly entrenched in the minds of international travellers as the quintessential Amazon rainforest destination, attracting 39,565 ecotourists in 2005. Tambopata’s growing popularity is largely the result of (i) ease of access, only a 30-minute flight from Cusco (the gateway city to Machu Picchu) to Puerto Maldonado (the gateway town to Tambopata) followed by a few hours of river travel in motorised canoe; (ii) the proximity to two large protected areas, the Tambopata National Reserve (TNR, 274,690 ha) and the Bahuaja-Sonene National Park (BSNP, 1,091,416 ha); (iii) a healthy natural ecosystem showcasing primates, giant otters, macaws, and other charismatic fauna; (iv) intact oxbow lakes and clay-licks that concentrate fauna in predictable ways; (v) a choice of 37 ecotourist establishments (lodges), from 100-bed operations to small research stations and village guesthouses; and (vi) spending on international marketing by the larger lodges. In 2005, ecotourists spent a total of US$11.6 million to visit Tambopata, of which US$5.9 million were lodge revenues, US$5.2 million were airline revenues for airfares between Cusco and Puerto Maldonado, and US$0.5 million were TNR entrance fees and airport taxes. US$3.8 million (32.5%) of these revenues were in turn spent locally, in that the first-order transaction took place in Tambopata. This local spending could be further divided into low (12.2%, e.g., local staff, produce) and high leakage (20.3%, e.g., gasoline, boat motors) to the national economy. The TNR entrance fees exceeded the local park management budget, allowing US$172,530 to be transferred to the national budget. In 2005, the lodges earned a combined, after-tax profit of US$844,472. Additional (but only partly quantified) profits were distributed to some of the lodge owners in the form of above-market wages, possibly as much as doubling the above profit figure. High levels of profitability, and the expectation of future profits, have created the incentive and the means for lodge owners to protect their businesses by protecting forest cover. Many lodges have taken advantage of government legislation, passed in 2002, that lets private businesses lease public forest outside of protected areas as concessions, for renewable 40-year terms. By 2005, lodges had taken control of 32,477 ha, with 90% of this area acquired by the four most profitable operators, together managing 8 lodges. Another 16,159 ha have been provisionally awarded as of early 2008, totalling 48,636 ha. Eight other lodges own and manage <100 ha each. In 2005, the pre-tax profit value of lodge-controlled lands corresponding to 12 fully operational lodges (for which economic and land-use data were available) was US$38.9 ha\(^{-1}\) [US$1,238,002/31,807 ha]. This figure exceeds the 2005 pre-tax profit value of titled lands, covering 10,251 ha, that were managed by 200 generalist rural households for agriculture, fruit production, animal husbandry (cattle ranching, chickens, and pigs), and timber extraction, which was calculated at US$27.1 ha\(^{-1}\) [US$277,472/10,251 ha]. However, when it comes to those households that specialize in a given land use (>50% of household revenues), unsustainable cattle ranchers (with stocking rates >3.5 animals ha\(^{-1}\), \(N = 4\)), who owned 262 ha, extracted a pre-tax profit value of US$39.0 ha\(^{-1}\), whilst sustainable cattle ranchers (stocking <3.5 animals ha\(^{-1}\), \(N = 15\)), who owned 1,154 ha, extracted US$35.8 ha\(^{-1}\). We note, though, that cattle ranchers are generally located within 2 km of a road, for ease of transport, which limits the land area where this activity would compete with tourism. For households specialized in timber extraction or annual agriculture (i.e., rice, maize, manioc, and bananas), the pre-tax profit value of land is US$35.7 ha\(^{-1}\) and US$21.3 ha\(^{-1}\), respectively. We expect that specialist producers, especially unsustainably stocked ranchers, will suffer reduced profits in the future as productivity drops, which should lower the present value of their profit stream below that expected for tourism. Our comparisons are also conservative in that we do not include the above-market-rate wages paid to lodge owners. One stated motive for lodges acquiring forest concessions is to exclude competitors from primary...
forest with valuable touristic features such as trail networks, oxbow lakes, and clay-licks. Another motive is that titles and concessions provide lodges with state-legitimized claims to forest parcels that they can defend via the legal system or direct action. Lodges have successfully sued and evicted loggers and miners from their concessions and have entered into benefit-sharing agreements with neighboring communities to cease extraction and hunting. Two lodges have entered into a joint venture with a community-based ecotourism project in return for monitored agreements to maintain forest cover and limit hunting in and around the proposed ecotourism concession (Figure 11.A.1, “B”). In one notable episode in 2007, the ecotourism industry added its weight to lobbying by Peru’s conservation community and successfully reversed a government proposal to de-gazette a portion of the BSNP for oil exploration. The most serious threat to Tambopata’s biodiversity is yet to come, however. In 2005, the government of Peru secured US$892 million to pave the Interoceanica Sur Highway, a westerly extension of the Trans-Amazon Highway that will connect Brazil to the Pacific Ocean. The highway will be completed in 2009 and will encourage deforestation along its length, thus directly threatening the lodges, which are on average only 18 km (8–62 km) from the highway, within the 50-km deforestation zone associated with paved roads in the Brazilian Amazon. Based on current behavior, Tambopata’s ecotourism industry has the incentive and the means to continue protecting and even expand their concession holdings, but computer simulations indicate that even if lodges successfully maintain their concessions, deforestation will proceed through the unprotected gap between the two ecotourism clusters (Figure 11.A.1, “A”), ultimately threatening many of the lodges by degrading connectivity to the TNR. The gap area is less suitable for tourism, as it lacks oxbow lakes, so conservation in this section will require public investment, perhaps bolstered by collective action among the lodges.
production function (Eq. (11.1)). Loomis (2005) provides estimates of consumer surplus for US nature-based recreation and tourism, and Shrestha and Loomis (2001) provide estimates in other parts of the world. A roster of tourism consumer surplus databases is provided at http://recvaluation.forestry.oregonstate.edu/brief_history.html. Defenders of Wildlife and Colorado State University have constructed a “Toolkit” for benefit transfer that includes databases, meta-analyses and visitor use models: http://dare.colostate.edu/tools/benefittransfer.aspx. Finally, a database of values from around the world, called the Environmental Valuation Reference Inventory, can be found at http://www.EVRI.ca. The reader should be aware, however, and as we emphasize in Chapter 3, the evidence on the extent to which environmental benefit measures are transferable is mixed at best (Navrud and Ready 2007).

11.4.1 Example of tier 2 using data from the Willamette Basin

In this example we illustrate the estimation of a tier 2 visitation model and the value of a change in environmental attributes in state parks in the Willamette Basin. This model is very similar to the approach that Hill and Courtney (2006) use to estimate the effect of changes in landscape variables on visits to public and private forests in Great Britain.

First, we use Eq. (11.1) and data from 41 Willamette Basin state parks to assess the role of environmental attributes, infrastructure, and park location, on visitation rates. The model used in this example is a simplified form of Eq. (11.1) for two reasons: (1) visitation data are not stratified by activity combination or tourist type, and (2) we did not model a substitution effect (5). We explain the number of visits to state park $q$ in 2004, $T_q$, with seven factors. For the EA vector, we include presence/absence for four environmental attributes: (1) fishing possibilities, (2) wildlife viewing possibilities, (3) canyon features, and (4) boating facilities. We assume that a park with canyon features has dramatic views and good hiking opportunities. For the X vector, we include two infrastructure variables: the area of the park (assuming that larger sites have more access points and may support more visits before becoming congested), and the presence/absence of historic sites. For $G$, we approximate the overall cost of accessing each site with a variable that measures the population living within 20 miles of the park (i.e., $C_u$ in Eq. (11.2) is replaced by $C_q$, the population living within 20 miles of $q$, $\sigma = 1$, $e^{\sigma \epsilon} = 1$ for all $i, q$, and $\beta_a = 1$ for all $q$).

We estimate the visitation model with ordinary least squares regression (Table 11.1). Fishing and wildlife opportunities are highly related (i.e., parks tend to have both or neither), so we estimate the model twice, once with each of these variables included. We found that canyon features increase park visitation. Somewhat surprisingly, fishing and wildlife viewing opportunities do not explain visitation in a statistically significant manner. Parks that are less costly for more people to access (as indicated by population around the park) are used more. Based on these results one might assume that important environmental attributes do not contribute to tourism use. What is more likely is that there is relatively little variation in these variables over the sites, particularly when they are measured using coarse indicators like presence/absence. This lack of variation in ecosystem-based variables is a common challenge in econometric studies of this type (e.g., Adamowicz et al. 1994). Improved information on levels of environmental attributes will help alleviate these problems.

Though this illustrative model is fairly simple, it reveals a great deal about the marginal value of environmental attributes at state parks in the Basin. For example, if a site that currently supports boating experienced a change in water delivery and/or quality to the degree that boating could no longer be supported, then, all else equal, the average site is predicted to lose between 65,000 (model 1) and 97,000 (model 2) visitors a year (the average $\Delta T$ across all sites given the loss of boating). Given that the average visitation rate at the parks is about 200,000 visitors per year, this is a substantial loss. If we could obtain a measure of the consumer surplus in the Basin before and after a potential loss of boating in a state park, given by $V_q$ and $\hat{V}_q$, respectively, we could derive coarse estimates of lost value using Eq. (11.6).
11.5 State-of-the-art tourism model

The limitations associated with the simple overlay approach in tier 1 or regression model approach in tier 2 point to the utility of the development of state-of-the-art or tier 3 models. Tier 3 begins with the individual tourist as the core unit of analysis, and models human behavior from the standpoint of the decision on where and when to visit, rather than as a statistical analysis of aggregate visitation rates at parks. Note that the notation used in this section deviates somewhat from that above in order to be consistent with the published literature.

Consider an individual living in the Willamette Basin. This individual has a set of available choices of state parks, as well as other tourism and recreation options within and outside the Basin. The individual also has other non-tourism options competing for her time. The individual is assumed to make choices of how many tourism and recreation trips to make (in a season or a year) as well as the trip destination.

The basis for these choices is a preference function that is defined on characteristics of the individual (income, family size, etc.) as well as the attributes of the available options (distance to the parks, attributes at the parks, etc.). Two types of models have been examined in the literature: the Kuhn–Tucker model (Phaneuf 1999; Phaneuf et al. 2000) and the random utility model, or RUM (see Phaneuf and Smith 2005).

The Kuhn–Tucker model assumes that the individual obtains utility from a set of trips to recreation sites where \( q = 1, \ldots, Q \) indexes the set of sites available and \((x_1, \ldots, x_Q)\) indicates the number of visits to each site. Associated with these sites is a set of attributes \((b_1, \ldots, b_Q)\) where each element \( b \) contains a number of characteristics of the sites, including those related to environmental attributes. The individual’s preference function includes a set of “other” activities that generate utility (all other activities are accumulated into a single element \( z \)). This results in a preference function \( U(x_1, \ldots, x_Q, b_1, \ldots, b_Q, z) \). The individual \( n \) is

### Table 11.1
Ordinary least squares regression model of annual visits to Oregon State Parks

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient (t-stat)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1</td>
</tr>
<tr>
<td>Constant</td>
<td>36,870.47</td>
</tr>
<tr>
<td></td>
<td>(1.34)</td>
</tr>
<tr>
<td>Area of park (in km²)</td>
<td>14,328.77</td>
</tr>
<tr>
<td></td>
<td>(3.72)*</td>
</tr>
<tr>
<td>Population (in thousands) within 20 miles of park</td>
<td>109.68</td>
</tr>
<tr>
<td></td>
<td>(2.13)**</td>
</tr>
<tr>
<td>The presence of a historical site at the park (HISTST, 0/1 indicator variable)</td>
<td>155,545.83</td>
</tr>
<tr>
<td></td>
<td>(2.66)*</td>
</tr>
<tr>
<td>The presence of canyons as a natural feature of the park (CANYONS, 0/1 indicator variable)</td>
<td>222,907.70</td>
</tr>
<tr>
<td></td>
<td>(3.24)*</td>
</tr>
<tr>
<td>The opportunity for boating (BOATING, 0/1 indicator variable)</td>
<td>64,352.87</td>
</tr>
<tr>
<td></td>
<td>(1.58)**</td>
</tr>
<tr>
<td>The opportunities for wildlife viewing including birdwatching and other wildlife (WILDLFW, 0/1 indicator variable)</td>
<td>29,581.59</td>
</tr>
<tr>
<td></td>
<td>(0.78)</td>
</tr>
<tr>
<td>The opportunities for fishing (FISHING, 0/1 indicator variable)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.78</td>
</tr>
<tr>
<td>( R^2 )-adjusted</td>
<td>0.74</td>
</tr>
<tr>
<td>( N )</td>
<td>41</td>
</tr>
</tbody>
</table>

* Significant at a 0.01 level.  
** Significant at a 0.05 level.  
*** Significant at a 0.15 level.
assumed to maximize utility ($U_n$) subject to income ($m$) over the period and the prices of accessing the recreation alternatives ($p_1, \ldots, p_Q$) usually travel cost plus the opportunity cost of time plus site access costs) as well as the price of the "good" $z$ (which is normalized to unity). The individual maximizes utility by choosing the number of trips to each site $q$, given by $x_1, \ldots, x_Q$ where some or all $x$ can be 0:

$$\max_{x_1, \ldots, x_Q, z} U(x_1, \ldots, x_Q, b_1, \ldots, b_Q, z)$$  \hspace{1cm} (11.7)

Subject to $p'x + z = m$.

The model provides estimates of the relationship between travel costs, attributes, income (and other demographic characteristics) and the frequency of visits to each of the defined alternatives. Typically, $x_q^n$, the number of visits to $q$ that solves problem (11.7), will decrease as the environmental attributes at $q$ decreases, all else equal.

The random utility model (Phaneuf and Smith 2005) examines the individual’s choice on a particular occasion (a single trip). Rather than assessing the number of trips, the utility or satisfaction associated with visiting an alternative is described as a function of the travel costs and site environmental and infrastructure attributes (and potentially individual specific characteristics such as income, demographics, etc.). The utility (or preference) function for the choice to visit to site $q$ (from individual $n$’s viewpoint) takes the form:

$$V_{nq} = V(m - p_q, b_q).$$  \hspace{1cm} (11.8)

A common approach is to model the probability of individual $n$ visiting a particular alternative $q$ (or $0 \leq \pi_{nq} \leq 1$) as

$$\pi_{nq} = \frac{e^{V_{nq}}}{\sum_{l=1}^{Q} e^{V_{nl}}},$$  \hspace{1cm} (11.9)

where the $V_{nq}$ function would have to be estimated using observed data in a regression analysis (Train 2003).

Equation (11.9) expresses the probability that an individual visits a particular alternative (on a particular choice occasion—e.g., a day, a week) as a function of the attributes and prices. If the supply of a desirable environmental attribute at site $q$ declines then the probability of choosing site $q$ for tourism declines. According to Eq. (11.9), as quality declines at one site, visitation will increase at other sites. This addresses one of the major limitations of the tier 2 model: the difficulty with satisfactorily modeling substitutability when explaining tourism visits (the index $S_{aq}$). Further, because this model incorporates the preferences of the individuals in the conditional indirect utility function ($V$) it can also be used to calculate the economic value of the change directly. In this case the value of the decline at site $q$ is given by the amount of money it would take to make person $n$ as well off as they were before the change at $q$; this can be calculated using the utility expression in (11.8) over the entire set of sites available. The relatively simple model can be combined with ecological models that describe the linkages between attributes to create an integrated ecological—economic model. An example of such a model is Naidoo and Adamowicz (2005) in which a behavioral model of tourism site choice is integrated with an ecological model of landscape change and bird diversity.

There have been many significant advances in the modeling framework outlined above. Some of the most significant include: (1) accounting for unobserved attribute effects in the model (Murdock 2006); (2) incorporation of congestion into the model as an example of interdependence between tourists (Timmins and Murdock 2007); (3) the incorporation of time (habits, variety seeking) into the framework (e.g., Swait et al. 2004); (4) inclusion of preference heterogeneity among tourists (Scarpa et al., forthcoming; Boxall and Adamowicz 2002; Train 1998, 2003); and (5) the development of models that account for different alternatives in the choice set or set of sites that a tourist considers (Haab and Hicks 1997; von Haefen 2008) as well as a host of other advances in the modeling of choice data.

### 11.6 Limitations and next steps

We have outlined three approaches (tiers 1, 2, and 3) for assessing the value of nature-based tourism and recreation on the landscape and the changes in value that could be expected with a change in environmental attributes on the landscape.
Tier 1 provides an assessment of observed visitation rates to sites. If information on the value of a unit of visitation is available from other studies (benefits transfer) then these visitation rates can be used to approximate measures of economic value. The tier 1 methodology does not specify a relationship between changes in environmental attributes and changes in tourism value nor does it disentangle effects on visitation rates from environmental attributes, infrastructure, distance to population centers, and availability of substitute sites.

Tier 2 approximates visitation behavior by developing a statistical relationship between visitation and attributes at the sites. This approach can provide additional insight into the changes that may be expected in visitation rates and values if environmental attributes change on the landscape. Tier 2 approaches, however, suffer from several limitations.

First, the required data are usually highly correlated, and attributes often do not vary strongly among sites. Sites with good fishing quality also tend to have boating, picnicking, and other facilities. And sites often share many features, precluding the opportunity to identify the impact that these features have on visitation rates. Identifying the impact of the change in environmental attributes in such cases will be difficult. Increasing the number of parks or expanding the spatial extent of the range of parks may help, but these actions will also increase the complexity of the research task.

Second, there are few linkages to information about the tourists. Only the potential tourism population is included in the model. Factors such as specific travel and time costs of visiting (instead of an index), incomes, experience levels of the tourists, the substitution between tourism and other uses of time, and other demographic features are not included.

Third, tier 2 models will generally rely on benefits transfer procedures to provide estimates of economic value rather than estimating the values from the population of interest. Evidence on the applicability of values from one site to others is decidedly mixed, but may be the only option (Navrud and Ready 2007).

Finally, the models described here are static and do not reflect trends in preferences, demographics or other factors that might influence visitation rates. For example, Pergams and Zaradic (2006, 2008) argue that there have been widespread declines in nature-based recreation visits. Meanwhile Balmford et al. (2009) find that visits to protected areas in most parts of the world are in fact increasing. These are clearly areas for further research.

Tier 3 generates value estimates based on the behavior of the individuals. It is a fully integrated model of tourism and the environment. However, it is also very demanding in terms of data requirements and familiarity with sophisticated modeling techniques. As the model is individual based it requires information on the individual’s residential location (for the determination of travel and time costs), the set of sites the individual considers when planning trips, as well as information on the attributes of the sites. There are several “scale” issues including assessment of the relevant geographical scale (how large is the area that is relevant for the demand for recreation tourism at a particular site) and the relevant time scale (is an annual time scale appropriate for decision making or are the trips more seasonal or perhaps a one-every-5-years type of trip; is there a broad trend of declining participation in recreation and preferences for nature?). Only a few regions will have the data available for such analysis.

Ideally the data for tier 3 models would be collected from general population surveys. Data collection of this type could provide excellent sampling properties and would provide information on the total number of visits taken by a population as well as the sites selected. However, such data are rarely collected. An alternative is to sample at the recreation sites and collect information on the participants. This is known as choice-based sampling (Ben-Akiva and Lerman 1985) and is commonplace in the transportation demand literature. This approach may provide the most practical solution for the development of tier 3 models.

An additional area that has not been investigated to any great extent is the feedback between visitation rates, congestion and environmental quality. There has been some assessment of the role of congestion in nature-based tourism, and examination
of the impact of tourism on environmental quality, but little examination of the three elements jointly. These issues as well as the continuing evolution of niche markets for tourism and emerging trends form the basis for a rich research agenda.

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References


