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Research article

Valuing urban open space using the travel-cost method and the implications of measurement error

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ABSTRACT

Urbanization has placed pressure on open space within and adjacent to cities. In recent decades, a greater awareness has developed to the fact that individuals derive multiple benefits from urban open space. Given the location, there is often a high opportunity cost to preserving urban open space, thus it is important for both public and private stakeholders to justify such investments. The goals of this study are twofold. First, we use detailed surveys and precise, accessible, mapping methods to demonstrate how travel-cost methods can be applied to the valuation of urban open space. Second, we assess the degree to which typical methods of estimating travel times, and thus travel costs, introduce bias to the estimates of welfare. The site we study is Taylor Mountain Regional Park, a 1100-acre space located immediately adjacent to Santa Rosa, California, which is the largest city (~170,000 population) in Sonoma County and lies 50 miles north of San Francisco. We estimate that the average per trip access value (consumer surplus) is $13.70. We also demonstrate that typical methods of measuring travel costs significantly understate these welfare measures. Our study provides policy-relevant results and highlights the sensitivity of urban open space travel-cost studies to bias stemming from travel-cost measurement error.

1. Introduction

Increases in urbanization and urban sprawl have led to increased pressure on urban open space, and greater attention payed to the role of open space in the urban environment (e.g., Johnson, 2001; Thompson, 2002). It is widely acknowledged that urban open space provides a suite of amenities, most of which are not directly valued in markets, that should be considered in cost-benefit analyses associated with development decisions (Brander and Koetse, 2011; Johnson, 2001; Kong et al., 2007; More et al., 1988; Wolf, 2004; Wu and Plantinga, 2003). In particular, conservation of large natural areas in close proximity to cities can provide a compelling value proposition when compared to either small urban parks or large remote ones. They give large numbers of people access to a wide variety of recreational opportunities, including such activities as hiking, trail running, cycling, and horseback riding, that require large areas. Further, such spaces provide values particularly associated with extensive, intact landscapes, such as scenic views, biodiversity conservation, protection of watersheds, and climate stabilization. However, they also involve larger land costs, as the opportunity cost of urban and peri-urban land is much greater than remote land. Therefore, valuation of such landscapes is critically important to efficient development of the urban landscape.

The fact that there are not explicit markets for the amenities urban open spaces provide complicates the cost-benefit analysis associated with urban planning (Wolf, 2004). There are several tools commonly used to assign monetary values to non-market environmental amenities, each of which has its strengths and weaknesses. Heretofore, the most common methods for assessing the value of urban open space have been contingent valuation or hedonic pricing (Brander and Koetse, 2011). The strength of these methods is that both can be designed to capture the full amenity value of the study site. However, numerous criticisms have been leveled at the incentive-compatibility (and other) issues associated with responses to contingent valuation surveys (e.g., Arrow et al., 1993; Diamond and Hausman, 1994), and hedonic pricing

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methods require high-quality data on residential housing markets and strong *ceteris paribus* assumptions. The travel-cost method, however, is all but absent from the literature on the valuation of urban open space (exceptions include Dwyer et al., 1983; Iamtrakul et al., 2005; Liu et al., 2014).

The travel-cost method is used to estimate site-level demand for recreation by modeling the relationship between visitation and the implicit price of visiting the site (the travel cost).[1] Identification of a demand curve hinges, in part, on sufficient covariation between visitation and travel costs. For this reason, the travel-cost method has been used extensively in the context of more remote recreational open space (e.g., state and national parks), where there is ample variation in the cost visitors incur to reach the sites due to their varying points of origin (e.g., Bin et al., 2005; Fleming and Cook, 2008; Liston-Heyes and Heyes, 1999; Mendes and Proença, 2011). Urban open space, on the other hand, tends to draw visitation from relatively proximal populations, raising concerns regarding sufficient variation in visitor points of origin necessary for inference (More et al., 1988). Further limiting the use of the travel-cost method in the urban setting are the methods by which travel costs have tended to be estimated in the past. Travel costs are estimated as a function of, among other factors, time spent traveling to and from the site (Bockstael et al., 1987; Cesario, 1976; Smith et al., 1983). Thus estimated travel costs depend critically on how one locates points of origin, and models distance and travel time to the site. Computational difficulty and the inaccessibility of geographic information systems (GIS) in the past have led to many studies that define point of origin using coarse geographic boundaries (e.g., counties or zip codes) and travel distance and times that are calculated using Euclidian measurements and assumptions about average travel speeds (Bateman et al., 2002, 1999; Brainard, 1999). Such coarse measures will inherently introduce measurement error to the data, and thus bias into the estimator. That bias will likely be more pronounced in data where the mismeasurement (in distance and travel time) is proportionally large in comparison to the overall measurement. In other words, bias will likely be larger in the urban setting. For example, suppose that point of origin is defined as the geographic center (centroid) of a zip code and that the average distance measurement error across zip codes is a constant. Clearly measurement error (and thus bias) will be proportionally larger for visitors that live nearer to the site, a common attribute of urban open space.[2] Therefore, accurate measures of travel distance and cost are particularly important in the urban setting.

We use single-site travel-cost methods to estimate the recreational value of Taylor Mountain Regional Park, a large open space that abuts the city of Santa Rosa in northern California. We address concerns regarding sufficient variation and bias stemming from measurement error by using exact residential location as a measure of visitors' point of origin and highly-precise, easily-accessible methods of measuring travel distance and time, based on Google Maps. We estimate per-trip consumer surplus to be $13.70, on average, which translates to a yearly total consumer surplus of approximately $1.5M. In addition, we compare our primary consumer surplus estimates to those that would be estimated through measurement methods that have typically been employed in travel-cost studies. Specifically, we calculate additional consumer surplus measures by: (1) using the Euclidean distance from visitors' zip code centroids to Taylor Mountain, and various assumptions about average travel speed, and; (2) using zip code centroids as visitors' point of origin, and measurements of travel distance and time to Taylor Mountain based on Google Maps. The first additional analysis mimics the methods that originated prior to the widespread use of GIS, but still persist in research in recent decades (e.g., Bin et al., 2005; Grossmann, 2011; Layman et al., 1996; Mendes and Proença, 2011, for discussion see Bateman et al., 1999; Brainard, 1999). The second mimics more advanced uses of GIS to measure travel distance and time suggested by (Bateman et al., 2002) when exact residential location is unknown. We demonstrate that both of those methods significantly understate the estimated recreational value, which implies that both precise GIS measures and precise point-of-origin measures are necessary for unbiased travel-cost estimates in the urban setting, and likely elsewhere.

2. Background and design

2.1. Site background

Santa Rosa, California, is a city of approximately 170,000 located 50 miles north of San Francisco (see Fig. 1). It is situated in Sonoma County, which has an unusual mechanism for funding the acquisition of open space. The county levies a 0.25 percent sales tax and uses the proceeds to buy property and conservation easements via a public agency called the Sonoma County Agricultural Preservation and Open Space District (SCAPOSD). Much of the land acquired is transferred to either California State Parks or Sonoma County Regional Parks. Among SCAPOSD's objectives is to extend the benefits of open space to lower-income and minority communities. Urban open space is one approach to accomplish that goal.

The Taylor Mountain Regional Park and Open Space Preserve represents a large investment in land conservation near the urban core of Santa Rosa. Between 1995 and 2011, SCAPOSD invested $26 million to acquire the 1100 acres of land. It is one of the larger public open spaces in the area and a defining visual feature of Santa Rosa's landscape. Currently, Taylor Mountain has over five miles of unpaved, multiple-use trails, with plans for the development of 17 additional miles under the master plan (Ferber and Mkay, 2011). Taylor Mountain also has one of only three public 18-hole disc golf courses in Sonoma County and it is the closest course to the major population center of Santa Rosa. Its amenities, proximity, and terrain make Taylor Mountain a popular destination for hikers, runners, disc golfers and equestrians.

There are two entrances to Taylor Mountain, both of which require a parking fee. The fee can be paid on a daily basis ($7) or through the purchase of an annual Regional Park Pass ($69, with discounts for certain user groups). The primary entrance (near Kawana Springs Road) is the older of the two and provides access to two trailheads and the disc golf course. The second entrance (off Petaluma Hill Road) was opened in 2015 and offers access to a single trailhead, which connects to the primary trail system. There are a number of road-side parking spots that lie outside of the Kawana Springs entrance, allowing visitors to avoid paying parking fees. Such an option is not available at or near the Petaluma Hill Road entrance.

The two most popular activities at Taylor Mountain are walking/hiking and disc golf (see Table 1). Based on this and the attributes of Taylor Mountain, we define Annadel State Park (Annadel) and Crane Creek Regional Park (Crane Creek) as potential substitute

[1] Given the primary focuses of this study, we do not provide a formal survey of the travel-cost method. However, the interested reader can find in-depth surveys of the method, and citations of numerous papers from the literature in Champ et al. (2003) and Ward and Loomis (1986).

[2] Similar concerns over lack of *variation* in the urban setting can also be illustrated through use of a logical extreme. If we suppose that point of origin is defined by the geographic center of a county, one might find that all visitors would be defined by a single point of origin. Thus eliminating all variation in travel distance and reducing variation in travel cost.

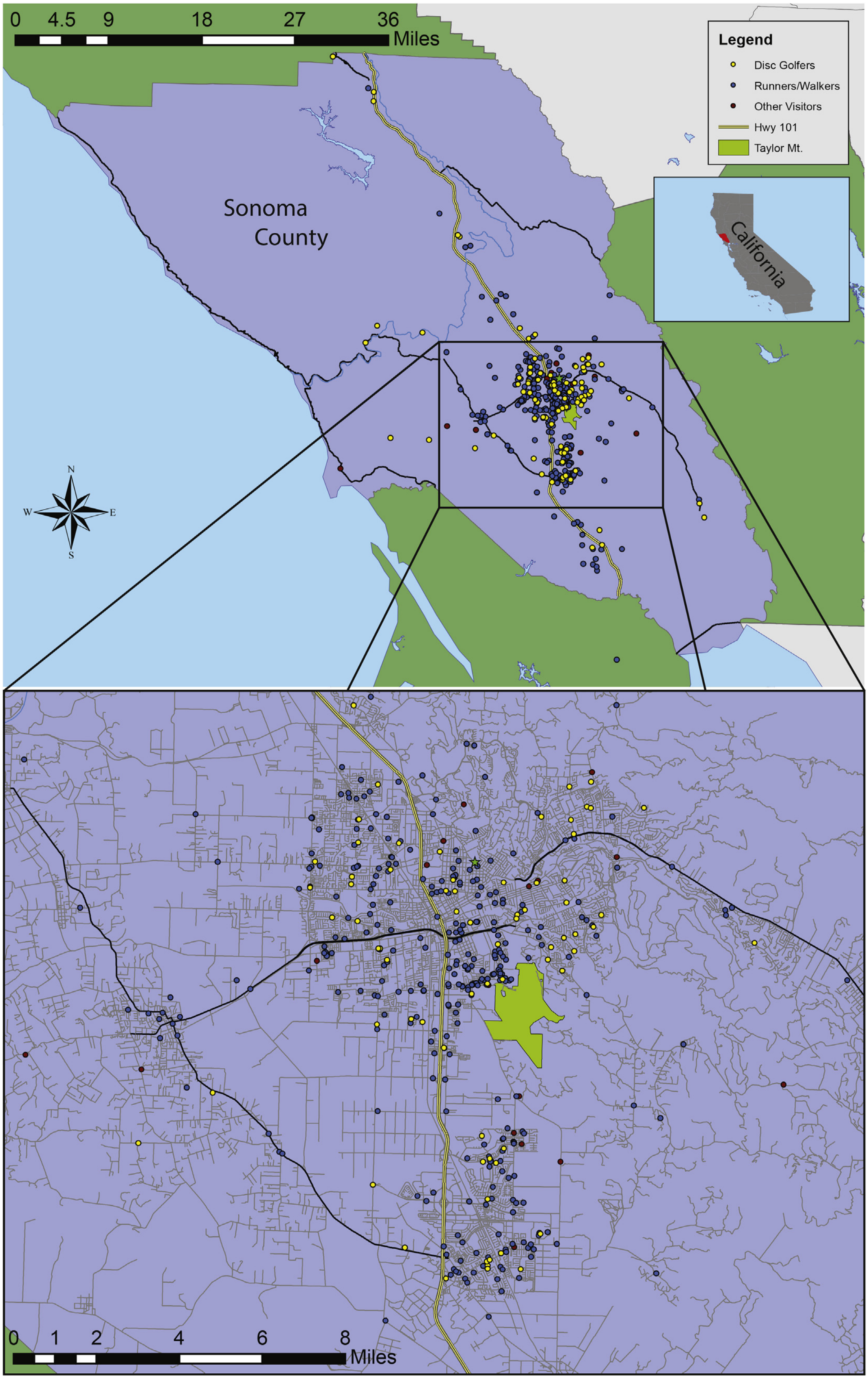

Fig. 1. Locations of Taylor Mountain Regional Park and households of visitors in the sample.

Table 1
Summary statistics from 439 survey responses. Household location calculations are based on our primary method of measurement.

Variable	Mean	Median	St. Dev.	Min	Max
Visitation					
Visits to TM in past year	32.772	10	52.654	1	365
Visits to Crane Creek	4.265	0	13.122	0	150
Visits to Annadel	13.061	2	28.051	0	200
Household Location					
Dist. to Taylor Mt. (miles)	6.634	5.233	5.905	0.67	41.944
Dist. to Annadel (miles)	10.146	8.488	6.245	1.043	45.325
Dist. to Crane Creek (miles)	11.46	10.144	6.086	1.849	50.666
Primary Activity					
Visit for Disc Golf	0.198	0	0.399	0	1
Visit to Mountain Bike	0.016	0	0.125	0	1
Visit to Run	0.075	0	0.264	0	1
Visit to Walk/Hike	0.683	1	0.466	0	1
Primary Reason for Choosing Taylor Mountain					
Trail Length	0.084	0	0.278	0	1
Trail Quality	0.112	0	0.315	0	1
Disc Golf Course	0.185	0	0.388	0	1
Vistas	0.171	0	0.377	0	1
Proximity to Residence	0.292	0	0.455	0	1
Transportation					
Car	0.882	1	0.324	0	1
Bike	0.025	0	0.156	0	1
Walk	0.094	0	0.292	0	1
Demographics					
Household Income	$79.4k	$62.5k	$52.1k	$3.9k	$200k
Female	0.412	0	0.493	0	1
Age	40.593	39	15.033	14	88
Number of Children	1.048	0	1.305	0	6
Hispanic	0.169	0	0.375	0	1
White	0.719	1	0.45	0	1
Married	0.478	0	0.5	0	1
Education					
High School Degree	0.084	0	0.278	0	1
Some College	0.255	0	0.436	0	1
Associates Degree	0.112	0	0.315	0	1
Bachelor's Degree	0.314	0	0.465	0	1
Some Graduate School	0.027	0	0.163	0	1
Master Degree	0.116	0	0.321	0	1
PhD or Equivalent	0.039	0	0.193	0	1
Employment					
<20 h/week	0.071	0	0.257	0	1
20-39 h/week	0.192	0	0.394	0	1
>40 h/week	0.578	1	0.495	0	1
Unemployed	0.021	0	0.142	0	1
Retired	0.096	0	0.295	0	1
Party Affiliation					
Democrat	0.498	0	0.501	0	1
Green Party	0.041	0	0.199	0	1
Independent	0.107	0	0.31	0	1
Republican	0.084	0	0.278	0	1

sites. By road, the nearest entrance to Annadel is less than 5 miles from the Kawana Spring entrance at Taylor Mountain. Annadel (~5000 acres) is significantly larger than Taylor Mountain, but the parks share similar topology and trail structure, which draw visitors for hiking, walking and biking. Crane Creek (128 acres) is much smaller than Taylor Mountain, but contains the nearest (~10 miles by road) public or private 18-hole disc golf course.

2.2. Study design

Our study design highlights our two primary goals. The first is to obtain a robust estimate of the recreational value of Taylor Mountain Regional Park. The second is to investigate the potential for bias associated with common methods of measuring travel distance and time. As mentioned previously, sufficient variation and mitigation of bias require accurate measures of the opportunity cost of traveling to and from the site. The most substantial component of the opportunity cost of visitation in most studies tends to be the time spent traveling to and from the site (Brainard, 1999).[3] Therefore, it is particularly important to ensure the accuracy of travel-cost measures, especially in the urban setting. Two aspects of our study design allow us the highest level of precision possible in measuring the time Taylor Mountain visitors spend en route, thus mitigating concerns regarding measurement error and sufficient variation in the data. First, in our survey we ask respondents to provide, at best, their residential address or, at worst, the location of the nearest intersection to their residence.[4] We then use this spatial information in conjunction with Google Maps to calculate precise driving distances and times based on Google Maps' router (see Travel cost section below for further details). Further, by automating repeated GIS calculations we are able to compare those results to the welfare estimates that result from using zip-code centroids (as opposed to specific address information) as a point of origin, and of various assumptions on the way in which visitors travel.

2.3. Survey design

We designed an on-site survey composed of three sections (A, B, and C). Section A elicited information on the number of visits in the past year, primary recreational activities, attitudinal information regarding park amenities, mode of transportation, access fees, and household location. Section B asked visitors about their perception of Taylor Mountain's environmental impacts. Finally, section C elicited demographic information. Section C contained numerous sensitive demographic questions regarding race, age, employment, income, and political affiliation. In order to ensure accuracy of response to these questions, enumerators asked users to fill out Section C independently in the presence of the enumerator. The survey was piloted twice in small groups in addition to a multi-day on-site pilot during which approximately 100 surveys were collected. See Appendix for full survey.

2.4. Survey implementation

Surveying was conducted across four weeks in October of 2015. During that period, enumerators were on site in five hour shifts between 7am and 5pm. Surveys were collected every other weekday, so that each day of the work week was sampled twice, and during three full weekends for a total of 16 collection days. During all survey sessions, groups of survey collectors were located at the two entrances to Taylor Mountain: Kawana Springs (KS, the primary entrance) and Petaluma Hill Road (PH). In addition to collecting surveys, research assistants kept records of total survey time and number of visitors in each party for all visitation occurrences. These data were used in conjunction with data from the Sonoma County Regional Parks office to estimate yearly visitation volume.

Based on volume of visitors, and to facilitate these two tasks, two research assistants were positioned at the KS entrance during the week and three on the weekends, while one research assistant was positioned at PH during all sessions. Visitors were approached as they entered the park and each survey generally took less than five minutes to complete. Prior to administering the survey, visitors received a brief description of the study and were provided

[3] Inclusion versus exclusion of time spent on-site has long been discussed and debated in the literature (e.g., Ward and Loomis, 1986). We do not consider time spent on-site in our opportunity cost measure, which likely leads to conservative estimates of consumer surplus.

[4] Of the 470 valid addresses we received during the survey process, 229 users provided specific street addresses.

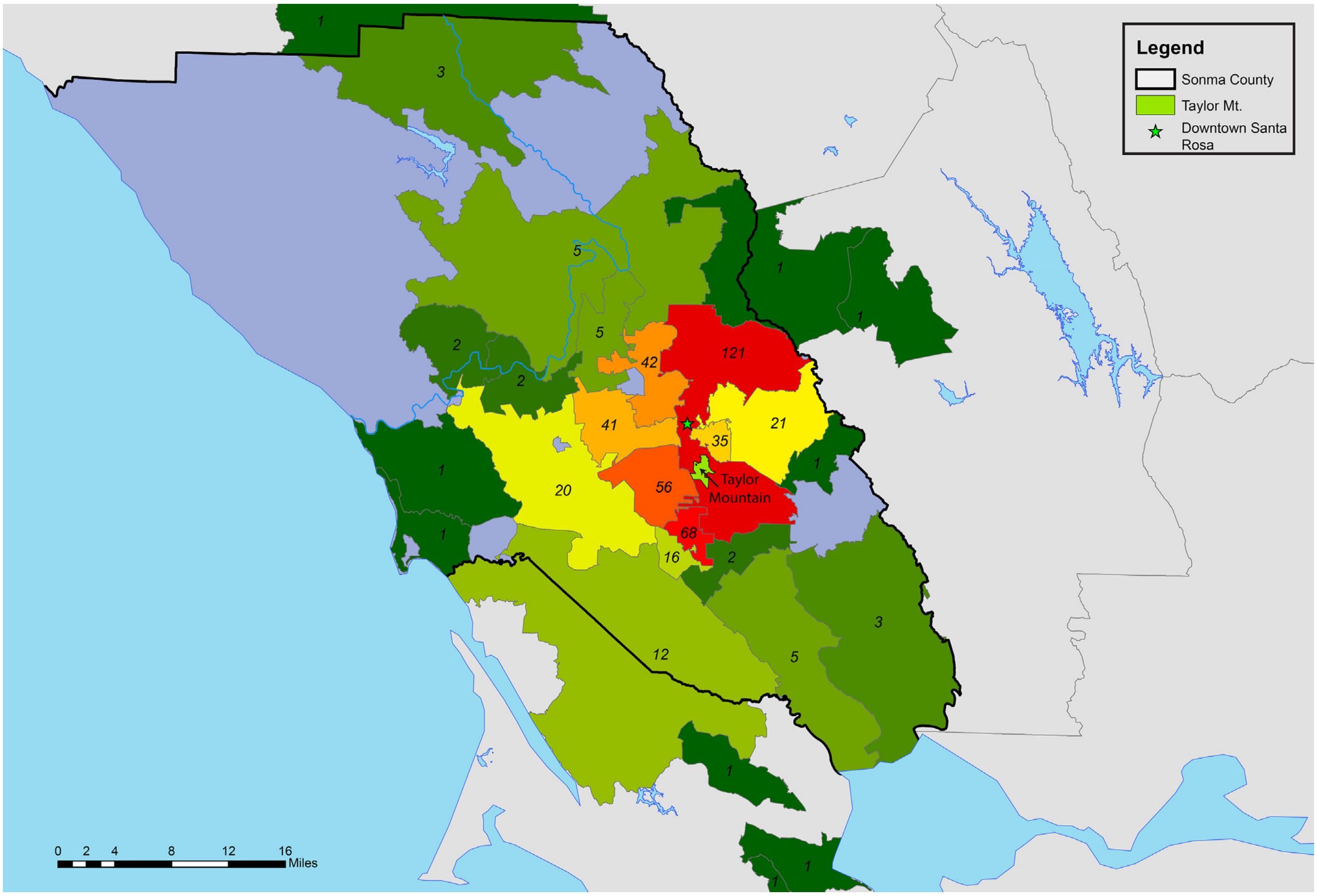

Fig. 2. Visitors' household location according to zip-code boundaries. The numbers represent the number of visitors within the sample that originated from the respective zip code.

information regarding confidentiality. Visitors who declined to respond were offered a mail-in survey.

3. Data

We collected a total of 510 surveys, of which 381 were collected from KS (6 of those were mail-in surveys) and 129 were collected from PH. Our final sample for analysis comprises 439 visitor observations. Observations were dropped for the following reasons: 38 visitors provided unusable information on residential location or transportation method; 23 visitors did not provide sufficient information on income[5]; nine visitors' one-way travel time was greater than one hour and thus were considered outliers in our sample, and; one observation was dropped due to a recording error in which number of visits was omitted from the record on a survey.

3.1. Travel costs

Per-trip travel cost (tc_i) for each visitor i is calculated as the sum of foregone wage costs (wc_i), vehicle operation costs (oc_i), and parking costs (pc_i)

$$tc_i = wc_i + oc_i + pc_i. \tag{1}$$

Per-trip wage costs are calculated by multiplying a fraction (30% in this case) of estimated hourly income by the round trip travel time[6]

$$wc_i = \left(0.3 \cdot \frac{y_i}{2000}\right)\left(2 \cdot \frac{time_i}{60}\right), \tag{2}$$

where y_i is annual household income as reported by visitors and $time_i$ is the one-way travel time, in minutes, from residence to Taylor Mountain (see next section for details on travel time measurement).

Round trip vehicle operation costs are based on travel distance from point of origin to Taylor Mountain ($miles_i$) and 2015 per-mile operating cost (vc_j) estimates provided by the Automobile Association of America (AAA) for various types of vehicles (indexed by type, j)

$$oc_i = 2^* vc_j{}^* miles_i, \tag{3}$$

where operating costs (expressed in US dollars) depend on vehicle

[5] Visitors provided information on household income based on various income brackets. Final household income is measured as the midpoint income within each bracket. In the full sample, 80 visitors did not provide information on household income. For 57 of those 80 observations we were able to impute household income using a regression-based wage equation. The other visitors did not provide sufficient information for us to impute wages, thus those observations were dropped from the final sample.

[6] The weight on income is somewhat arbitrary. However, using a weight of approximately one-third is relatively common (e.g., Champ et al., 2003; Kinghorn et al., 2014; Mendes and Proença, 2011; Peter E.T. Edwards et al., 2011; Sardana et al., 2016). Hourly income is estimated by dividing yearly income by 2,000, which is a common assumption on average number of hours worked per year (e.g., Layman et al., 1996; Sardana et al., 2016).

type (j)

$$vc_j = \begin{cases} 0.464 & \text{if } j = \text{small sedan} \\ 0.61 & \text{if } j = \text{medium sedan} \\ 0.75 & \text{if } j = \text{large sedan} \\ 0.773 & \text{if } j = \text{SUV} \\ 0.653 & \text{if } j = \text{minivan} \\ 0.681 & \text{if } j = \text{other}. \end{cases} \quad (4)$$

Per-trip parking costs (pc_i) depend in part on whether or not the visitor chooses to park in Taylor Mountain lots. Near the KS entrance, there are a number of free parking spaces that lie just outside park boundaries. Further, for visitors that choose to park in designated areas within the park, parking costs depend on whether the visitor has a regional park pass or pays the daily parking fee. Final per-trip parking costs are calculated as[7]

$$pc_i = \begin{cases} \$0 & \text{if don't pay} \\ \$7 & \text{if day pass} \\ \$0 & \text{if regional pass}. \end{cases} \quad (5)$$

3.2. Measuring travel distance and time

In our travel-cost equation (1), wage costs (wc_i) and operation costs (oc_i) are a function of travel time and travel distance, respectively. Thus the way in which we assign a point of origin for each visitor and the assumptions/calculations of travel time will affect our measures of travel cost and, in turn, our welfare measures. We use three different general strategies, each of which uses different combinations of measurements and/or assumptions. The goal of our ***primary*** specification is to estimate the most accurate measures of consumer surplus associated with recreational activities at Taylor Mountain. The two other strategies are designed to assess the biases associated with more traditional methods that have been employed in the travel-cost literature. In our ***linear zip code*** specification, we define point of origin for each visitor as the centroid of the zip code in which they reside. We then calculate the Euclidean distance from that centroid to Taylor Mountain. Finally, we make various assumptions regarding average travel speed in order to estimate travel time. In our ***route-based zip code*** specification, we again assign point of origin for each visitor as the centroid of the zip code in which they reside. However, unlike the linear specification, we then calculate travel distance and time based on a Google Maps router.

3.2.1. Primary specification

We convert all residential address information provided by visitors to an exact longitude/latitude coordinate using Google Maps. We then use the gmapsdistance package (Melo and Zarruk, 2016) in R 3.2.0 and iterate across all respondents' address coordinates and calculate accurate driving distances and times to Taylor Mountain, and the two substitute sites, Annadel State Park, and Crane Creek Regional Park. The gmapsdistance function allows relatively large quantities of route data to be calculated in an automated process by accessing Google's routing algorithm via an application program interface (API) within R. As a result, we have precise information on travel distance and time based on optimal route choice for each mode of transportation.[8]

3.2.2. Linear zip-code specification

Using ArcGIS 10.3, we overlay zip-code boundaries on visitors' residential location. Similar to past travel-cost studies, each visitor is assigned a point of origin based on the centroid of the zip code in which they reside. Distance to Taylor Mountain, Annadel, and Crane Creek are then calculated based the linear distance between the centers of the zip codes and the respective parks. Travel time (in minutes) is then based on a simplifying equation

$$time_{i,zip} = \frac{dist_{i,zip}}{MPH} \cdot 60, \quad (6)$$

where $dist_{i,zip}$ is the linear distance from the center of the individual's zip code of residence to the respective park, and MPH is the assumed average speed of travel. The ratio of distance to assumed speed, a per-hour measure, is multiplied by 60 to obtain travel time in minutes, which can then be plugged into equation (2) in order to calculate wage costs. In our econometric specifications we vary the assumed MPH to assess the impact of such assumptions on consumer surplus estimates. Equation (6) highlights several ways in which measurement error is introduced to such an analysis: the zip code is an approximation of residential location; the $dist_{i,zip}$ is an approximation of the distance from the zip code to the site, and; MPH is an approximation of the speed at which visitors travel.

3.2.3. Route-based zip code specification

For the route-based zip-code strategy we again define the point of origin as the visitor's zip-code centroid. However, we then use gmapsdistance to measure travel distance and times based on Google Maps router. This method is designed to approximate the suggestions of previous researchers (Bateman et al., 2002, 1999; Kong et al., 2007), and a situation in which researchers have the ability to process data with GIS but lack precise information on point of origin.

4. Results

4.1. Taylor Mountain visitors

Table 1 provides summary statistics for all 439 visitor observations used in the final analyses.

4.1.1. Visitation

The average number of self-reported visits in the past year is 32.8. Fig. A1 illustrates that 50% of respondents visited Taylor Mountain 10 or fewer times in the past year, 90% of respondents visited 100 or fewer times in the past year, and ~16% averaged one or more visits per week. Taylor Mountain visitors also visited the substitute parks, Annadel and Crane Creek, on average 13.5 and 4.2 times in the past year, respectively.

4.1.2. Location

The geographic location of each visitor can be seen in Fig. 1. On average, visitors live within ~6.5 miles of Taylor Mountain and 50% of visitors live within ~5 miles of the park. These numbers reflect the fact that proximity was the most commonly cited attribute (29%) that drew visitors to Taylor Mountain. Fig. 2 shows the location of visitors according to the zip-code boundaries within which they reside. Comparison of Figs. 1 and 2 makes clear the variation in location that is lost by using zip codes to define residential location. Indeed, approximately 70% of the visitors reside in only five zip codes, and over 90% of visitors reside in only 10 zip codes.

[7] We treat payments for regional park passes as a sunk cost, making the effective marginal cost of parking $0 for those visitors.

[8] The one potential source of measurement error using this method stems from the fact that our calculations do not consider traffic conditions during the period of travel.

Table 2
Regression results from our primary measurement specification. Columns 1–3 present results from poisson regressions with various control variable specifications. Columns 4–6 present results from negative binomial regressions with various control variable specifications. All regressions account for zero truncation and endogenous stratification.

Dependent Variable: Number of Visits in Past Year						
Variables	Poisson			Truncated Negative Binomial		
	(1)	(2)	(3)	(4)	(5)	(6)
Travel Cost TM	−0.0329***	−0.0626***	−0.0630***	−0.0300***	−0.0697***	−0.0730***
	(0.000736)	(0.00117)	(0.00122)	(0.00227)	(0.00441)	(0.00463)
Travel Cost Annadel		0.0207***	0.0174***		0.0412***	0.0391***
		(0.00114)	(0.00119)		(0.00559)	(0.00585)
Travel Cost Crane Creek		−0.000513	0.00193***		0.00450	0.00515
		(0.000608)	(0.000637)		(0.00385)	(0.00371)
Income (1000s)		0.00481***	0.00419***		0.00168	0.00239**
		(0.000204)	(0.000214)		(0.00105)	(0.00121)
Constant	4.049***	3.661***	3.399***	−11.21***	−8.358	−10.52
	(0.0137)	(0.0170)	(0.0456)	(0.0683)	(26.94)	(76.89)
Additional Controls			Yes			Yes
Observations	439	439	439	439	439	439
AIC	24887.15	22152.69	20810.14	3801.91	3638.09	3588.79
Alpha				1.62***	1.41***	1.30***

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.1.3. Activities

The two most popular activities of our respondents are running/walking/hiking (76.3%), and disc golf (20.1%).

4.1.4. Travel costs

The average per-trip travel cost for visitors was $23.89. Fig. A2 illustrates that, similar to the distribution on visitation, travel costs are highly right-skewed. 50% of visitors incur per-trip travels costs that are less than ~$17 and 90% of visitors incur per-trip travels costs less than ~$47.

4.1.5. Demographics

The two most common categories of race reported were white (71.9%) and Hispanic (16.9%). The average age was 40.6 and 41.2% of respondents were female. Average and median household income were reported as $79.4k and $62.5k, respectively. The median household income in Sonoma County, as reported by the US Census Bureau, is ~$63k. This suggests that our sample exhibits similar characteristics to the population.

4.2. Regression results

Demand for *visits* to a single recreation site *p* is modeled generally as[9]

$$visits_p = f(tc_p, tc_s, y, x), \tag{7}$$

where tc_p are travel costs to the primary site, tc_s are travel costs to substitute sites, y is income, and x represents other demographic and individual characteristics that affect recreational demand (Champ et al., 2003). Empirical estimation of (7) using count data, such as visitation to Taylor Mountain, typically rely on poisson or negative binomial regression estimators. However, when overdispersion is present in the outcome results from the poisson estimator will be biased. Further complicating our estimation is the fact that our on-site sample introduces zero truncation (we do not sample individuals from the population that do not visit Taylor Mountain) and endogenous stratification (frequent visitors will be disproportionately represented in the sample) into the data. Both of these issues may introduce bias into the estimates if left unaccounted (Benson et al., 2013; Champ et al., 2003; Egan and Herriges, 2006; Kinghorn et al., 2014; Martínez-Espiñeira et al., 2008).

Table 2 presents results from allot poisson (columns 1–3) and negative binomial (columns 4–6) specifications, all of which account for zero truncation and endogenous stratification.[10] We find significant overdispersion in all specifications (the alpha parameter in Table 2) and thus rely on interpretations from the negative binomial specifications. However, we find qualitatively and statistically similar results across all similar (in terms of controls) poisson and negative binomial specifications. Our primary interpretations and welfare measures are based on the negative binomial results in column 6, which include all controls (see Table A1 for full results including parameter estimates on all controls).

In addition to our primary specification, we present results from similar regressions that test for heterogeneity in consumer surplus across use types, and various estimates based on the zip-code calculations mentioned in the previous section. We use the latter analyses to demonstrate that measurement error associated with use of zip-code location leads to bias in the welfare estimates. All these estimates are based on negative binomial regressions that account for zero truncation and endogenous stratification.

4.2.1. Primary specification

Results from the primary specification can be found in column 6 of Table 2. We find the negative relationship between visitation and travel cost is significant, indicating that we have estimated a downward-sloping demand curve. All other coefficients are of the expected sign. In particular, the coefficients on the substitute sites and income are positive. Only the coefficient on travel cost to Crane Creek is statistically insignificant.

Table 3 provides various estimates of consumer surplus associated with Taylor Mountain visitation. All estimates of consumer

[9] Because visitation to Taylor Mountain is localized, we use a single-site travel-cost model. We found no evidence in our survey results or in discussions with visitors to support the idea that trips to Taylor Mountain included visits to alternative sites.

[10] In the poisson specifications endogenous stratification and zero truncation are accounted for by replacing $visits_i$ with $visits_i - 1$ (Champ et al., 2003; Egan and Herriges, 2006; Englin and Shonkwiler, 1995). In the negative binomial specifications we use NBSTRAT in Stata 14.2 following Martínez-Espiñeira et al. (2008). All regressions are performed using Stata 14.2. See Table A1 for full results on additional controls (columns 3 and 6).

Table 3
Consumer surplus calculations based on primary specification.

	Point Estimate	95% Confidence Interval	
		Lower	Upper
Mean CS_i/visit	$13.70	$12.17	$15.65
Total CS/year	$1,480,782.42	$1,315,410.37	$1,691,550.73
Discount Rate	Present Value of Future Benefits		
1%	$148,078,242.44	$131,541,037.26	$169,155,072.56
3%	$49,359,414.15	$43,847,012.42	$56,385,024.19
5%	$29,615,648.49	$26,308,207.45	$33,831,014.51

surplus are based on Adamowicz et al. (1989), who show that per-trip consumer surplus in the negative binomial (or poisson) model can be estimated $\frac{1}{-\beta_{tc}}$, where β_{tc} is the coefficient on travel cost to Taylor Mountain (see also Benson et al., 2013; Champ et al., 2003; Kinghorn et al., 2014). We estimate the per-trip consumer surplus to be $13.70 ($CS_i$ in Table 3). Based on the per-trip estimate and information on aggregate visitation, we can estimate the total yearly consumer surplus attributable to recreation at Taylor Mountain. Sonoma County Regional Parks reported 6117 day passes purchased at Taylor Mountain in the previous year (July 1, 2014 through June 30, 2015). Based on our survey we know that only 15.1% of visitors who drive to Taylor Mountain purchase a day pass. From this we can infer that the total number of vehicles that traveled to Taylor Mountain in the past year was 40,406 (43.7% used a season pass and 29.4% parked outside the park entrance). Visitors who traveled to Taylor Mountain in a vehicle reported, on average, a total of 2.29 individuals in their party. Thus, we estimate that 92,531 visitors arrived by car in the past year. Using similar methods, we estimate that 3096 visitors arrived by bike and 4433 arrived on foot, which implies that total visitation to Taylor Mountain in the past year was 108,086.

Combining this estimate of total visitation with the estimate of per-trip individual consumer surplus, we estimate the total consumer surplus at $1,480,782 with lower and upper bounds of $1,315,410 and $1,691,550, based on uncertainty in the regression model.

Finally, Table 3 includes present value calculations of the future stream of benefits from recreation at Taylor Mountain in perpetuity given various discount rates. These calculations should be viewed as very conservative lower-bound estimates because they are made under the assumption of constant future recreational demand at Taylor Mountain. The area has only been made accessible to the public in the last three years and only 40% of the park is accessible, thus visitation may well be on an upward trend.

4.2.2. Zip code analyses

We input the calculations outlined in Sections 3.2.2 and 3.2.3 into the same negative binomial regression, along with the same controls, used in the primary specification (from Table 2). Table 4 shows how each zip-code method affects the distribution of travel time (columns 2–6) as compared to the methodology employed in our primary analysis. Table 4 also shows how these methods affect estimates of the relationship between travel costs and visitation to Taylor Mountain (column 7, the coefficient on travel cost to Taylor Mountain) and consumer surplus measures (column 8).[11] Coefficients in column 7 of Table 4 demonstrate that all assumptions on average speed in the linear zip code method, and the route-based method (from the respective rows in Table 4), produce estimates that are significantly different from the primary specification.[12] These differences lead to downward bias on the estimates of per-trip consumer surplus (column 8). Indeed, half of these welfare estimates are over 40% lower than the primary estimate (column 9), and even the closest approximation (which uses an unlikely 10 mph assumption) is still ~20% lower than the primary estimate (column 9). Importantly, the average speed assumptions that would most likely be chosen for this setting (25–35 mph) differ from the primary specification by upwards of 40%. Furthermore, while the route-based method performs better than most of the linear distance methods, the consumer surplus measure is still significantly understated.

It is interesting to note that, regardless of the assumption on average speed, all the coefficients on travel cost to Taylor Mountain remain statistically significant. Recall that one of the *a priori* concerns related to using the zip-code method was that there might not be enough variation in travel costs for purposes of inference because within-zip-code variation is lost. This concern over statistical precision does not play out in our data. However, we find that our second concern regarding the measurement error associated with the zip-code methods is certainly an issue and leads to significant downward bias in our welfare estimates.

4.3. Robustness

4.3.1. No imputed incomes

In our primary analysis, 57 of the observations have household wages that we imputed. To ensure that our imputations are not somehow driving or biasing our results, we rerun our primary specification without the imputed wages (see Table A2). The regression coefficients from this additional regression are qualitatively and statistically no different from those in the primary analysis. Therefore, we are confident that our wage imputations are not biasing our results.

4.3.2. Dropping first-time visitors

Given that Taylor Mountain is a relatively new park, we encountered a number of first-time visitors during our survey process (65 of the observations in the final data set represent first-time visitors). We acknowledge the fact that first-time visitors may be systematically different from other visitors so we rerun the primary specification after dropping these observations. The results in Table A2 are very similar to the primary specification. The primary coefficient measuring the relationship between visitation and travel cost to Taylor Mountain is slightly smaller in absolute terms (i.e., larger welfare estimates), but not statistically so. Again, we are confident that first-time visitors are not driving our results.

4.3.3. Heterogeneous demand

Different user types may have different demand structures for recreational visitation. Heterogeneous demand will lead to heterogeneous response to policy changes that affect a recreational site. Thus it is important for planners to understand such differences. We use interaction terms within our primary specification to test for heterogeneous demand across the two primary user types: hikers/walkers (68%) and disc golfers (20%). Table A3 presents results in which we interact travel costs to Taylor Mountain (price) with those two activities, respectively, thus coefficients on the interaction terms are in comparison to *other* activity types. We find

[11] Results in column 7 of Table 4 represent the coefficient on travel cost to Taylor Mountain stemming from a regression specification that mimics the primary specification in column 6 of Table 2 and Table A1. All regressions are negative binomials that account for zero truncation and endogenous stratification.

[12] Note that none of the 95% confidence intervals on the zip-code specifications overlap with those from the primary specification.

Table 4
Comparison of primary results (bottom row) to results based on zip code point of origin. Each of the first six rows presents distribution of travel time estimates (columns 2–5), regression results (for the primary coefficient on travel cost to Taylor Mountain, column 7), estimated per-trip consumer surplus (column 8), and a comparison to the primary consumer surplus estimates (column 9), based on different assumptions on average travel speed for the linear zip code specification. The seventh row presents the same information for the route-based zip code specification.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Average MPH	Distribution of Travel Time Calculations (minutes)					Primary Coeff.	Mean CS_i/visit	Percent Diff.
	Mean	Median	SD	Min	Max			
55	5.67	3.56	5.02	1.34	45.4	−0.1364	$7.33	46.51%
45	6.93	4.35	6.14	1.64	55.49	−0.1349	$7.42	45.88%
35	8.91	5.59	7.89	2.1	71.34	−0.1321	$7.57	44.74%
25	12.47	7.83	11.05	2.94	99.88	−0.1262	$7.92	42.18%
15	20.79	13.04	18.42	4.9	166.47	−0.1104	$9.06	33.89%
10	31.18	19.57	27.63	7.36	249.7	−0.0910	$10.98	19.83%
Route-Based	28.94	17.58	30.9	10.8	122.3	−0.1154	$8.67	36.74%
Primary	17.71	14.75	9.75	3.37	56.58	−0.0730	$13.70	–

that walkers/hikers are more responsive to the price than other user groups, and a simple test of equality of coefficients indicates that walkers/hikers are more responsive to price than disc golfers as well. This makes sense when one considers the fact that substitutes for walking are more readily available (e.g., community parks and neighborhoods) than for the other activities in which Taylor Mountain visitors engage. We further explore the potential drivers of the heterogeneity in demand by examining some of the key attributes of the top two user types. Table A4 provides summary statistics for each user type and p-values from a Welch's *t*-test for differences in mean values between the two groups. We find that there is no statistical difference between the two groups other than average distance to Taylor Mountain.

5. Discussion

Our results indicate that the way in which travel time and distance are calculated is critical to the measurement of recreational consumer surplus in the urban setting. Clues to why all the zip code point-of-origin strategies underestimate the welfare associated with Taylor Mountain can be found in Table 4. In comparison to the primary specification, the difference in *distance* to Taylor Mountain based on the linear zip code specification is not stark (linear zip-code method: mean = 5.197, median = 3.261, sd = 4.604, min = 1.226, max = 41.617, see Table 1 for statistics from primary specification). However, Table 4 shows that the similarity in distributions of travel time and welfare measures between the two methods is lacking, and highly dependent on the assumption one places on average speed. It is worthwhile to note that the mean travel time matches the primary method most closely when average speed is assumed to be 15 mph, an assumption that is unlikely to be made *a priori*. However, under this assumption the upper tail of the distribution is extreme by comparison because such a slow assumed speed will tend to exaggerate bias for those the live farther from the site. In fact, there is no assumed speed that leads to similarity in the distributions of travel time between the two methods. Assumed speeds that do well in matching the spread of the distributions perform poorly on measures of central tendencies, and *vice versa*.

We see slightly different issues in the route-based zip code specification. When compared to the primary *distance* measures, we find that the measures of central tendency and range are larger, whereas dispersion is quite similar (route-based zip code method: mean = 8.611, median = 7.007, sd = 5.826, min = 3.819, max = 55.908). However, the location of point of origin leads to routes, as measured by Google Maps, that result in a much different distribution of travel time, as seen in Table 4. As a result, the route-based zip code method does not perform well in comparison to the primary specification and significantly understates welfare measures.

6. Conclusion

As urban areas encroach upon open space, it becomes increasingly useful to provide defensible economic bases for conserving open space within, and adjacent to, urban populations. However, given their proximity to visitors, previous studies of urban open space have tended to focus on hedonic or stated-preference valuation methods. Using the most precise methods available to measure travel time, we conduct a travel-cost analysis to estimate the recreational value of Taylor Mountain Regional Park, a 1100-acre park that lies adjacent to Santa Rosa, California (population ~170,000) approximately 45 min north of San Francisco. We find a statistically significant relationship between visitation and travel cost, which leads to consumer surplus estimates of $13.70 per trip. This translates to approximately $1.5M in total yearly consumer surplus. We find that these results are robust to numerous specifications and robustness checks.

It is difficult to compare these findings to others from the literature. The only recent studies to use the travel-cost method to estimate the value of urban parks are from eastern Asian countries (Iamtrakul et al., 2005; Liu et al., 2014). Liu et al. (2014) estimate per-trip consumer surplus to an urban park in Taipei City, Taiwan, to be approximately $8 (USD). However, the large differences in location and visitor attributes call into question the comparability of those results to ours. The study most similar to ours from the United States was conducted the 1980's and values visitation to several Chicago parks at between approximately $11/trip and $20/trip (in 2015 inflation adjusted USD, Dwyer et al., 1983). However, there are significant methodological differences between that study and ours, which again makes comparability difficult.

We provide the highest level of precision possible in measuring travel costs by surveying and mapping visitors' exact residential location. We use this information to gain precise measures of travel distances and times using a Google Maps API within R. Traditionally, travel-cost studies have assigned visitors' residential location based on zip-code (or county) information. We note two concerns regarding the use of zip codes as opposed to specific residential locations: loss of within-zip-code variation may diminish statistical precision, and; zip code approximation and linear distance measurements ignore road networks and can lead to measurement error. We compare results from similar regression models using these two methods of measuring travel distance and time. In our data, we find that there is sufficient variation to measure statistically significant relationships (the first concern). However, there is significant bias in the coefficient estimates that measure the relationship between visitation and travel cost (the second concern). Indeed, depending on the assumptions made regarding average travel speed from zip code of residence, some of the zip-code welfare estimates are over 40% lower than those from the primary analysis (using the precise residential location). These biases are more than double those found by Bateman et al. (1999) for a regional site in the UK using a method similar to ours. This serves to confirm our expectations that travel-time measurement error should be of particular concern in the urban setting. Furthermore, we find that these biases remain even when we use the Google API to map accurate routes from the zip-code centroids. Our findings highlight the fact that similar biases might be present in previous studies that use zip codes as an approximation for residential location, though we believe that bias would be smaller in studies where visitors are traveling from, on average, greater distances.

Our study serves to demonstrate that the recreational value of urban open space can be measured using the travel-cost method. Importantly, our results indicate that accuracy in the measurement on travel distance and time is crucial to the accuracy of welfare measures, especially in the urban-open-space setting where visitors live relatively close to the site. Accurate measures of the value of urban open space will become increasingly more important as available land diminishes and planners need credible means of justifying investments in urban open space. In the case of Taylor Mountain, we believe that our welfare measures are an understatement of what they will be in the years to come. Taylor Mountain is in the fledgling stages of its master plan. In the coming decade, trail networks will be expanding and numerous amenities will be added, which is likely to lead to increased visitation. A caveat on our study, which is true of any travel-cost study, is that the recreational value we measure is but one of the myriad benefits that Taylor Mountain provides. Indeed, to gain a more holistic valuation of Taylor Mountain, future studies would need to include stated preference and quasi-experimental approaches to assess existence and additional ecosystem service values.

Acknowledgements

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Appendix

Tables

Table A1
Full results from primary regression specifications. All specifications account for zero truncation and endogenous stratification. All variables marked with (A) represent attributes that visitors indicated as a draw to Taylor Mountain.

Dependent Variable: Number of Visits in Past Year						
Variables	Poisson			Truncated Negative Binomial		
	(1)	(2)	(3)	(4)	(5)	(6)
Travel Cost TM	−0.0329***	−0.0626***	−0.0630***	−0.0300***	−0.0697***	−0.0730***
	(0.000736)	(0.00117)	(0.00122)	(0.00227)	(0.00441)	(0.00463)
Travel Cost Annadel		0.0207***	0.0174***		0.0412***	0.0391***
		(0.00114)	(0.00119)		(0.00559)	(0.00585)
Travel Cost Crane Creek		−0.000513	0.00193***		0.00450	0.00515
		(0.000608)	(0.000637)		(0.00385)	(0.00371)
Income (1000s)		0.00481***	0.00419***		0.00168	0.00239**
		(0.000204)	(0.000214)		(0.00105)	(0.00121)
Non-White			−0.226***			−0.188
			(0.0215)			(0.129)
Bachelors or Higher			−0.0961***			−0.265**
			(0.0193)			(0.121)
Vote Democrat			0.0519***			0.264**
			(0.0176)			(0.106)
Male			0.0864***			0.106
			(0.0190)			(0.113)
Trail Length (A)			0.280***			0.205
			(0.0520)			(0.253)
Trail Qualtiy (A)			0.917***			1.043***
			(0.0458)			(0.246)
Disc Golf (A)			0.518***			0.897***
			(0.0453)			(0.221)
Vistas (A)			−0.0480			−0.0711
			(0.0489)			(0.225)
Proximity (A)			0.242***			0.168
			(0.0443)			(0.210)
Natural Beauty (A)			0.518***			0.613**
			(0.0544)			(0.295)
Solitude (A)						

(*continued on next page*)

Table A1 (*continued*)

Dependent Variable: Number of Visits in Past Year						
Variables	Poisson			Truncated Negative Binomial		
	(1)	(2)	(3)	(4)	(5)	(6)
			0.134			0.163
			(0.0881)			(0.442)
Lack of Congestion (A)			−1.982***			−1.183
			(0.410)			(0.777)
Constant	4.049***	3.661***	3.399***	−11.21***	−8.358	−10.52
	(0.0137)	(0.0170)	(0.0456)	(0.0683)	(26.94)	(76.89)
Observations	439	439	439	439	439	439
AIC	24887.15	22152.69	20810.14	3801.91	3638.09	3588.79
Alpha				1.62***	1.41***	1.30***

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A2
Results from the income and first-time visitor robustness analyses. The first column of coefficients presents the results from the primary specification when all observations with imputed incomes are dropped from the sample. The second column of coefficients present the results from the primary specification when all first-time visitors are dropped from the sample. The final eight variables (marked by (A)) represent attributes that visitors indicated as a draw to Taylor Mountain.

Dependent variable: # of visits in past year		
Variables	Coefficients	
	No Imputed Incomes	Drop Single Visits
Travel Cost TM	−0.0727***	−0.0648***
	(0.00514)	(0.00556)
Travel Cost Annadel	0.0382***	0.0362***
	(0.00641)	(0.00656)
Travel Cost Crane Creek	0.00476	0.00377
	(0.00398)	(0.00391)
Income (1000s)	0.00303**	0.00188
	(0.00128)	(0.00126)
Non-White	−0.169	−0.219
	(0.138)	(0.138)
Bachelors or Higher	−0.243*	−0.311**
	(0.130)	(0.128)
Vote Democrat	0.209*	0.184
	(0.114)	(0.112)
Male	0.114	0.115
	(0.121)	(0.121)
Trail Length (A)	−0.0592	0.0566
	(0.274)	(0.277)
Trail Qualtiy (A)	0.912***	0.946***
	(0.255)	(0.274)
Disc Golf (A)	0.793***	0.598**
	(0.231)	(0.242)
Vistas (A)	−0.0475	−0.136
	(0.234)	(0.251)
Proximity (A)	0.159	0.117
	(0.221)	(0.236)
Natural Beauty (A)	0.606*	0.397
	(0.313)	(0.312)
Solitude (A)	0.101	0.0676
	(0.444)	(0.475)
Lack of Congestion (A)	−1.129	−0.954
	(0.987)	(0.881)
Constant	−8.101	−8.258
	(22.73)	(46.27)
Observations	383	374
AIC	3163.67	3315.15

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A3
Test for heterogeneous demand.

Dependent variable: # of visits in past year	
Variable	Coefficient
Travel Cost (TC) TM	−0.0579***
	(0.00965)
TCTM*Disc Golf	0.00567
	(0.00998)
TCTM*Walk/Hike	−0.0375***
	(0.0101)
Travel Cost Annadel	0.0352***
	(0.00590)
Travel Cost Crane Creek	0.000993
	(0.00352)
Income (1000s)	0.00427***
	(0.00121)
Non-white	−0.0884
	(0.123)
Bachelors or higher	−0.0857
	(0.116)
Vote Democrat	0.126
	(0.106)
Male	−0.000478
	(0.112)
Visit Disc Golf	−0.0303
	(0.259)
Visit Walk/Hike	0.179
	(0.230)
Constant	−7.927
	(25.03)
Observations	439
AIC	3577.9

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A4
Attributes of primary user groups. P-values are from a Welch's *t*-test for difference in mean values between the two groups.

Variable	Mean Values		p-value
	Disc Golf	Walk/Hike	
Visits	34.77	30.843	0.599
	[34.149]	[56.668]	
Distance	8.563	6.281	0.007
	[7.707]	[5.138]	
Income	78,815.55	81,307.13	0.902
	[54,997.54]	[51,805.09]	
Democrat	0.425	0.525	0.132
	[0.497]	[0.500]	
Bachelor's Degree	0.368	0.313	0.248
	[0.485]	[0.464]	
n	87	352	

Notes: [standard deviation].
P-values from Welch's *t*-test of difference in means.

Figures

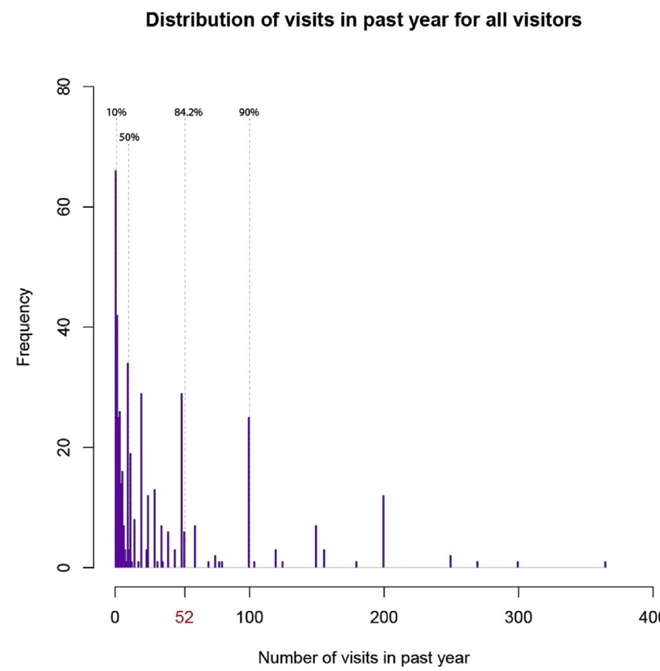

Fig. A1. Histogram of reported visits over the past year. Dashed lines represent percentiles of the distribution, as labeled. The data indicate that approximately 84% of those surveyed visited 52 or fewer times in the previous year (1 or fewer times per week, on average).

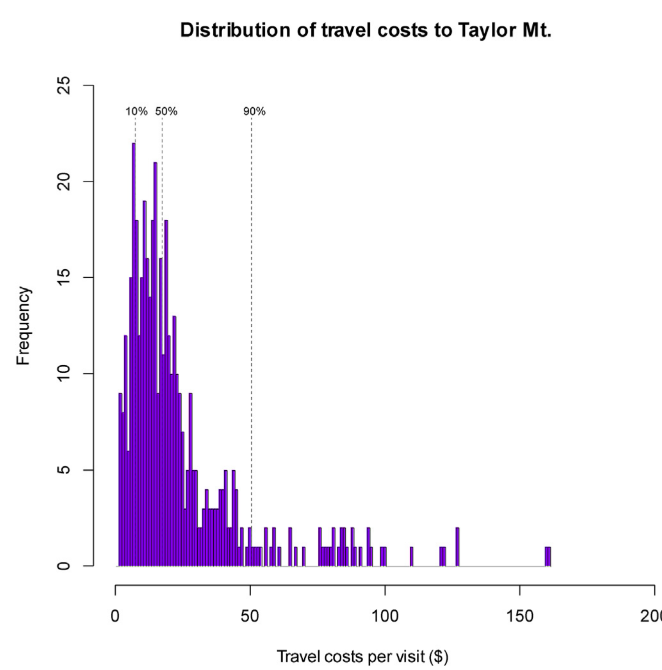

Fig. A2. Histogram of travel costs. Dashed lines represent percentiles of the distribution, as labeled.

Survey

Preliminaries		
Location (Entrance):	Time:	Date:
Name (Interviewer):	Name (Data Entrant):	

Introduction

Good *time of day* my name is ___________, I am working with Sonoma State University, and the Sonoma County Agricultural Preservation and Open Space District. We are interested in gathering information on various aspects of how people use Taylor Mountain Park and would appreciate your participation in this short survey, which should take no longer than 5 minutes. All of the answers you provide will remain private and anonymous, and the information will be used solely for research purposes. You will never be contacted or solicited as a result of participating in this survey. Would you be willing to participate?

Section A- Primary TCM Questions

1. To the best of your recollection, how many times have you visited Taylor Mountain in the past year?

   Number:_____________

2. We understand that you might engage in multiple activities during your visits to Taylor Mountain, but we would like to know what your most common, or primary, activity is when you visit. In general what is your primary activity when you visit Taylor Mountain?
   - ☐ 1.Disc Golf
   - ☐ 2.Mountain Biking
   - ☐ 3.Running
   - ☐ 4.Walking/Hiking
   - ☐ 5.Horseback Riding
   - ☐ 6.Bird Watching
   - ☐ 7.Picnic
   - ☐ 8.Other_________________________

3. To the best of your recollection, how many times have you visited the following parks in the past year and what was your primary activity at each?

   1.Crane Creek_____________________________

   2.Annadel________________________________

4. What is the primary characteristic of Taylor Mountain that influences your decision to visit?
   - ☐ 1.Trail length
   - ☐ 2.Trail quality
   - ☐ 3.Disc Golf Course
   - ☐ 4.Vistas/Views
   - ☐ 5.Proximity to your residence
   - ☐ 6.Natural resources (trees, creeks, flowers, wildlife, etc.)
   - ☐ 7.Solitude
   - ☐ 8.Lack of Congestion
   - ☐ 9.______________________________

5. What form of transportation do you use to get to Taylor Mountain?
   - ☐ 1.Car
   - ☐ 2.Bike
   - ☐ 3.Walk
   - ☐ 4.Other_________________________

6. If car, what type of vehicle? (or skip to 7.):
   - ☐ 1.Small sedan
   - ☐ 2.Medium sedan
   - ☐ 3. Large sedan
   - ☐ 4. SUV/Truck
   - ☐ 5. Minivan
   - ☐ 6. _______________________________

7. Do you typically pay for parking when you visit Taylor Mountain?
   - ☐ 1.Yes
   - ☐ 2.No
   - ☐ 3.Regional Park Pass

8. What is the typical number of people in you party, including yourself?

   ____

9. An important aspect of this study involves understanding from where Taylor Mountain visitors come. In order to calculate the distance you travel to get to Taylor Mountain, we would like to record your address. This information will remain completely private and will only be used for the purpose of this study (you will not be contacted as a result of providing your address). If you are not comfortable providing your address, we would appreciate you sharing the road intersection that is nearest your house:

   ____

   ____

   ____

Section B- We are interested in understanding your attitudes and perceptions related to some of the non-recreational services that Taylor Mountain potentially provides.

1. What is your opinion of how preserving Taylor Mt. as open space impacts the following services?

a. Clean air:
1.No Impact ○ 2. Helps ○ 3. Don't Know ○

b. Global climate:
1.No Impact ○ 2. Helps ○ 3. Don't Know ○

c. Clean water:
1.No Impact ○ 2. Helps ○ 3. Don't Know ○

d. Groundwater recharge:
1.No Impact ○ 2. Helps ○ 3. Don't Know ○

e. Soil erosion control:
1.No Impact ○ 2. Helps ○ 3. Don't Know ○

f. Plant and animal diversity:
1.No Impact ○ 2. Helps ○ 3. Don't Know ○

g. Culture in the community:
1.No Impact ○ 2. Helps ○ 3. Don't Know ○

2. Which of the preceding services do feel is the most relevant here at Taylor Mt.?
☐ ____________________

3. How does the view of Taylor Mt. *from outside the park* affect your well-being**?**
1.No Impact ○ 2. Positive Impact ○ 3. Don't see it ○

4. If you could make one change to Taylor Mountain, what would you do?
____
____
____

5. Are you aware of who purchased the land necessary to make Taylor Mountain a public park?
☐ Yes:__________________________
☐ No

6. Are you aware of who owns and operates Taylor Mountain?
☐ Yes:__________________________
☐ No

7. How aware are you of the Sonoma County Agricultural Preservation and Open Space District and what they do?
☐ 1.Yes, I've heard of them
☐ 2.Yes, I've heard of them and know what they do
☐ 3.No, I haven't heard of them

8. (If 2 on B.6) Overall, do the investments of SCAPOSD have a net positive or negative impact on Sonoma County?
☐ 1.Positive
☐ 2.Negative

Section C- Demographic Information- An important aspect of this study is understanding some of the characteristics of Taylor Mountain visitors. We ask that you please fill out this demographic survey. Again, this information will remain completely private and anonymous.

1. Sex:
   - ☐ 1.Female
   - ☐ 2.Male
   - ☐ 3.Decline to Answer
2. Age:______________________
3. Race:
   - ☐ 1.Hispanic or Latino
   - ☐ 2.American Indian or Alaskan Native
   - ☐ 3.Asian
   - ☐ 4.Black or African American
   - ☐ 5.Native Hawaiian or Other Pacific Islander
   - ☐ 6.White
   - ☐ 7.Other
   - ☐ 8.Decline to Answer
4. Marital Status:
   - ☐ 1.Married
   - ☐ 2.Single
   - ☐ 3.Decline to Answer
5. Number of Children:___________________
6. Highest Level of Education:
   - ☐ 1.No High School
   - ☐ 2.Some High School
   - ☐ 3.High School Graduate
   - ☐ 4.Some College
   - ☐ 5.Associates Degree
   - ☐ 6.Bachelor Degree
   - ☐ 7.Some Graduate
   - ☐ 8.Masters or Equivalent
   - ☐ 9.Doctorate or Equivalent
7. Occupation:__________________________

   ____
8. Employment:
   - ☐ 1.Employed: less than 20hrs/week
   - ☐ 2.Employed: 20-39hrs/week
   - ☐ 3.Employed: 40hrs/week or more
   - ☐ 4.Not employed, looking
   - ☐ 5.Not employed, not looking
   - ☐ 6.Disabled, not able to work
   - ☐ 7.Retired
   - ☐ 8.Decline to Answer
9. Yearly Household Income:
   - ☐ 1.Less than $20,000
   - ☐ 2.$20,000-$34,999
   - ☐ 3.$35,000-$49,999
   - ☐ 4.$50,000-$74,999
   - ☐ 5.$75,000-$99,999
   - ☐ 6.$100,000-$149,999
   - ☐ 7.$150,000-$199,999
   - ☐ 8.$200,000 or more
   - ☐ 9.Decline to Answer
10. Do you vote on a regular basis?
    - ☐ Yes
    - ☐ No
11. With which political party do you ***most closely*** affiliate?
    - ☐ 1.Democrat
    - ☐ 2.Green
    - ☐ 3.Independent
    - ☐ 4.Republican
    - ☐ 5.Tea Party
    - ☐ 6.Other
    - ☐ 7.Decline

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