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Examining State Dependence and Place Attachment Within a Recreational Fishing Site Choice Model

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Many contexts including the fidelity that recreationists have for sites may affect the choices of recreational sites by individuals. This study expands the choice model research on state dependence by examining state dependence at site and larger spatial scales. Analyses of recreational fishing site choices by anglers from northern Ontario, Canada suggest that anglers exhibit state dependence at both the site and larger spatial scales. Attempts to understand the importance of state dependence through self reports of place attachment dimensions among the anglers provided mixed results. No significant relationships were found between place identity and the importance of site or spatial state dependence to anglers. While having no significant effect on site state dependence, place dependence was positively associated with the importance of spatial state dependence among approximately 65% of the anglers. Evidently, anglers who viewed themselves as dependent upon a fishing area were more likely to take their fishing trips in a constrained space than were other anglers. These conclusions are influenced by the difference between the larger spatial scale for the place attachment questions (i.e., favorite fishing area) than for the choice model (i.e., fishing site).

KEYWORDS: *Behavior, choice model, place attachment, recreational fishing, state dependence.*

Introduction

Understanding and predicting the behaviors of recreationists are important areas of enquiry. This information can assist resource and recreation managers with providing recreational opportunities and managing recreational experiences. The predictions also help managers to understand the potential implications of changes to recreational resources before implementing these changes.

Choice models are a popular approach to provide information about the behaviors of recreationists. Choice models combine behavioral theories

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of decision-making (utility maximization) and modeling (random utility theory) with a statistical approach to develop flexible forecasting models. Utility for choice alternatives (e.g., sites) is determined from some integration of preferences for various attributes that describe an alternative. While utility is assumed to be deterministic for a decision-maker, researchers cannot assume to understand all aspects of utility for each alternative and individual.[1] This acknowledgement of uncertainty by researchers leads to choice models that forecast choices probabilistically.

Site choice models provide forecasts about changes to site use and to the economic value of the activity arising from different management scenarios. Consequently, researchers have used these choice models to study many recreational activities including: boating (Siderelis & Attarian, 2004), fishing (Swait, Adamowicz, & van Bueren, 2004), jet skiing (Hagerty & Moeltner, 2005), hunting (Herriges & Phaneuf, 2002), rock climbing (Grijalva, Berrens, Bohara, Jakus, & Shaw, 2004) and other activities.

Different contexts will likely impact site choice decisions by recreationists. These various contexts are typified by inter and intra personal contexts. Inter personal contexts arise since people have different preferences for attributes of recreational sites. These varying preferences may lead to different recreational site choices among individuals. For example, while some people may prefer hiking on developed trails, other people may prefer less developed hiking trails. Researchers have devised many methods to account for this preference heterogeneity including market segmentation, latent class, and random parameters approaches (see Boxall and Adamowicz (2002) for a review).

Intra personal contexts arise when factors such as social group, time, and space affect the choices of individuals. While an individual who is traveling with friends may prefer to canoe on a river with white water, this same individual may avoid white water when paddling with young children. Consequently, preferences of an individual are more dynamic under intra than inter personal contexts.

One intra personal context receiving some investigation by researchers using choice models is state dependence (Heckman, 1981). State dependence arises when a choice of an alternative affects that individual's decision to choose the same alternative in the future. For example, consider an individual who takes a canoe trip. Under identical conditions for a river and an individual, we would expect the same likelihood of this individual choosing this particular river on any trip occasion. If this likelihood of choice increases simply due to a past trip to this river, state dependence is present. In this instance, the experience of the canoe trip has somehow increased the attractiveness of the river for a future canoeing trip. Research on state dependence and outdoor recreation (e.g., Moeltner & Englin, 2004; Prov-

[1]The emphasis on utility for guiding individual behaviors is a simplification of the actual behavioral processes.

encher, Barenklau, & Bishop, 2002; Swait et al., 2004) suggests that past site choices may affect the timing and locations of future trips by these same individuals.

Researchers have problems assessing whether this state dependence arises from model misspecification or from a substantive process (Heckman, 1981). Misspecified state dependence arises when visitation to a recreational site does not alter one's preference for the site. Any finding of state dependence in these cases arises from the researcher's inability to estimate the utility of recreational sites for all individuals. For example, omitting an important site attribute from a choice model may lead to a spurious finding of state dependence.

Substantive state dependence arises when past visits do affect preferences for the sites. The change in preferences may lead to habituation in choices of sites. This habituation complicates typical forecasts from site choice models by requiring knowledge of previously chosen sites when predicting future site choices (i.e., intra personal context). Past research (Hunt, 2006) suggests that including such intra personal contexts may increase the predictive validity from model forecasts.

Place attachment provides one possible substantive reason why preferences for sites may change after an individual visits a site. Place attachment is an overarching concept that represents a bond between people and their environment (Moore & Graefe, 1994). This bond develops through the meanings that individuals attach to places and, consequently, the attachment of individuals to these meanings (Stedman, 2002). While place attachment consists of several dimensions (Bricker & Kerstetter, 2000; Davenport & Anderson, 2005; Kyle, Graefe, & Manning, 2005), most recreational research examines identity and dependence dimensions (e.g., Kyle, Bricker, Graefe, & Wickham (2004)).

Place identity describes how individuals associate themselves with places. Individuals define themselves through their relations to physical settings (Moore & Graefe, 1994) and the meanings they attach to the settings (Stedman, 2002). Dimensions of self such as ideas, beliefs, preferences, feelings, values, goals, behavioral tendencies and skills become associated with the physical environment (Proshansky, Fabian, & Kaminoff, 1983). This association reflects the value of settings to individuals for emotional and symbolic reasons (Moore & Graefe).

Place dependence focuses on the functionality of an area to individuals (Stokols & Shumaker, 1981). This functionality may relate to the ability of an area to provide economic or leisure opportunities. Consequently, place dependence partly relates to the substitutability of other places for the place in question. Moore and Graefe (1994) also suggest that place dependence arises more quickly than does place attachment and dependence relates to experience and accessibility dimensions.

Past research suggests associations among individuals' place attachment and experience use history with recreational sites (Hailu, Boxall, & McFarlane, 2005; Hammit, Backlund, & Bixler, 2004). Use history refers to the past experience (e.g., visitation, years of experience) that individuals have with particular recreational areas. While Hammit et al. suggest that experience use history increases place dependence and place identity for recreational areas, Boxall et al. suggest the reverse, that place identity increases use of recreational sites. Despite these concerns about causality, the research suggests positive associations among these concepts. Since experience use history increases with visits to a recreational area, the use history concept is similar to state dependence. Therefore, one expects that substantive state dependence should be related to dimensions of place attachment.

Despite the expected link between state dependence and place attachment, the author is not aware of any study that has examined this link within a site choice model. Additionally, past choice modeling research has also only examined the state dependence construct at the site scale. The vast amount of research that shows the importance of space on site substitution (e.g., Bolduc, Fortin, and Gordon (1997)) intimates that state dependence may exist at different spatial scales. To account for two spatial scales, the labels "site" and "spatial" state dependence are used throughout the paper. Site state dependence refers to the likelihood of an individual visiting the same site as was previously chosen. Spatial state dependence refers to the likelihood of an individual visiting a site in close spatial proximity to a previously chosen site.

This study focuses upon these two omissions from past research. The paper examines whether site and spatial state dependence help to explain the actual fishing sites chosen by northern Ontario anglers. This paper also investigates whether self evaluations of place identity and place dependence provide a substantive argument for the presence of site and spatial state dependence among the anglers.

The remainder of the paper is organized as follows. The next section describes the data and methods used in this analysis. The third section illustrates the results of the statistical analyses. The final section discusses the implications of the results.

Data and Methods

The data come from an angling diary conducted with northern Ontario residents from Thunder Bay, Canada. A consultant was hired to recruit anglers into a diary program that covered trips from April 1 to September 30, 2004. Random telephone calls were made to residents of the Thunder Bay area through phone lists provided by the consultant. The consultant asked to speak to the individual from the household aged 18 years or older with the nearest birth date to the date of the call. Individuals were next asked to complete a short telephone survey by phone. While no information was collected upon reasons why individuals did not complete the short telephone survey, anecdotal information from the consultant suggests that many of these individuals did not participate in fishing. After this survey, the individual was asked if he or she would participate in the angling diary program.

Of the 933 anglers who completed the telephone survey, 655 anglers agreed to the diary program for an initial response rate of 70.2%.

The diaries were administered by mail in three waves that each covered two months of fishing information. The participants were initially mailed the diary along with a small token of appreciation (i.e., a fishing lure). After each two-month period, the participants were asked to return their diary and were mailed a new diary. Postcards and telephone calls were used to remind participants to return their diaries. Near the end of the data collection, the sample was divided into two groups. The group that was providing angling diary information was contacted by mail. For the participants who had not returned their earlier two diaries, a consultant was hired to collect an abridged set of angling diary and other information for the six months without data. These approaches led to a sample of 142 responses for this study.

Within the diary that covered the August and September fishing trips, a set of rating questions from the place attachment scale of Williams, Anderson, McDonald, and Patterson (1995) was included (see Table 1 for a list of scale items). The questions asked individuals to rate their agreement or disagreement for various statements about their favorite fishing area (i.e., a larger spatial scale than site). A fishing area rather than site was chosen to

TABLE 1
Mean Agreement Ratings (+2 to −2) and Principal Component Loadings (Varimax Rotation) for Statements Relating to Place Identity and Dependence with Favorite Fishing Area

Statement	Mean Rating	Place Identity (Loading)	Place Dependence (Loading)
This area is very special to me	1.01	0.845	
I am very attached to this area	0.85	0.844	
This area means a lot to me	0.79	0.839	
I feel like this area is part of me	0.88	0.809	
I identify strongly with this area	0.84	0.796	
Visiting this area says a lot about who I am	0.22	0.674	0.453
I get more satisfaction out of visiting this area than from visiting any other area	0.68	0.646	0.500
I would enjoy fishing in a different area just as much as I enjoy fishing here	0.61		−0.753
I would not substitute any other area for the fishing I do here	−0.14		0.717
No other area can compare with this area	0.12	0.464	0.688
Fishing in this area is more important than fishing in any other area	0.21	0.459	0.678
This area is the best place for fishing	0.41		0.663
Variation explained		40.9%	27.7%

assess the important role of resource substitution (Shelby & Vaske, 1991) among the various fishing sites.

Non-response bias was assessed by comparing the telephone survey responses from the 142 diary respondents with those responses from the remaining 791 (933 − 142) anglers who were initially contacted. The diary respondents were significantly more likely to own boats ($\chi^2 = 15.82$, $df = 2$, $p < 0.001$), outboard motors ($\chi^2 = 18.60$, $df = 2$, $p < 0.001$), four wheel drive trucks ($\chi^2 = 5.54$, $df = 2$, $p = 0.063$), fish during ice season ($t = -2.13$, $df = 212$, $p = 0.034$), and prefer lake trout over walleye ($\chi^2 = 9.68$, $df = 3$, $p = 0.021$) than were non-respondents. No significant differences in response patterns existed among the anglers for reported days fished in past year ($t = -1.62$, $df = 931$, $p = 0.105$), years fished ($t = -1.24$, $df = 931$, $p = 0.214$), age ($t = -0.96$, $df = 931$, $p = 0.339$), and ownership rates for canoes ($\chi^2 = 0.86$, $df = 2$, $p = 0.650$), two wheel drive trucks ($\chi^2 = 2.88$, $df = 2$, $p = 0.237$), and all terrain vehicles ($\chi^2 = 1.66$, $df = 2$, $p = 0.437$). Since the sample does not appear to exhibit avidity or experience-related biases, no adjustment was made for non-response bias.

The 142 anglers reported taking 1,777 fishing trips from April 1 to September 30, 2004. Two criteria were used to narrow this sample of trips. First, since trips during April may have included both ice and open water fishing, only fishing trips that occurred after May 1 were included. Second, only two contexts for the fishing trips were included. Day fishing trips that were neither to private accommodation nor part of a longer trip from home were included. Besides these criteria, multiple day trips were included if they were less than seven days in duration and were for the primary purpose of recreational fishing. These criteria reduced the fishing trips to 845 for an average of 5.9 trips per respondent.

The narrowed context of fishing trips used by this study should reduce the importance of site state dependence among the anglers. While researchers suggest that individuals with cottages (i.e., second homes) are attached to their cottage places (Kaltenborn, 1997; Stedman, 2002), the trips to cottages were removed from this analysis for several reasons. First, one cannot easily estimate the attributes that lead cottagers to take fishing trips on water bodies adjacent to their cottages. Even primary fishing trips will include some other secondary purposes when choosing a cottage site (e.g., a fishing trip is taken and the individual brings supplies to his/her cottage). Second, there are concerns that the decision to purchase a cottage may partially depend upon preferences for fishing. This dependency makes it difficult to estimate a choice model (i.e., endogeneity concerns). Finally, the study concentrated on the context of fishing and not a general relationship between individuals and places.

Fishing sites were considered available to anglers if they met a few criteria. First, the water body or a nearby water body with a portage route was required to be accessible by road or trail. Access trails and roads to the various Thunder Bay waters were identified from local knowledge of anglers. Field visits to each fishing site verified the existence of the access trails and roads. Second, the water bodies must have a game fish present (e.g., walleye, lake trout, brook trout, rainbow trout, northern pike, smallmouth bass, etc.). Finally, sites greater than 250km from Thunder Bay were not included.

From the literally tens of thousands of water bodies in the Thunder Bay area, 429 fishing sites were identified for area anglers (see Figure 1). While this number of alternatives is very large, field visits showed recent use at all of these sites. Furthermore, the requirement of road, trail or popular portage accessibility prevented the inclusion in the model of almost 300 additional water bodies that have surface areas greater than 100 ha. Two additional alternatives representing trips outside the study area and trips to unknown locations within the study area were also included. The second of these alternatives was necessary as some anglers recorded trips to water body names that were unknown to the researchers (e.g., a different name used for a lake). Each angler was assumed to make a choice among the 431 fishing sites on every occasion when he or she fished.

Attributes used for the choice model included: cost, fishing quality, facility development, and regulation themes. These themes are consistent with many past choice model studies of recreational fishing (Hunt, 2005). Specific

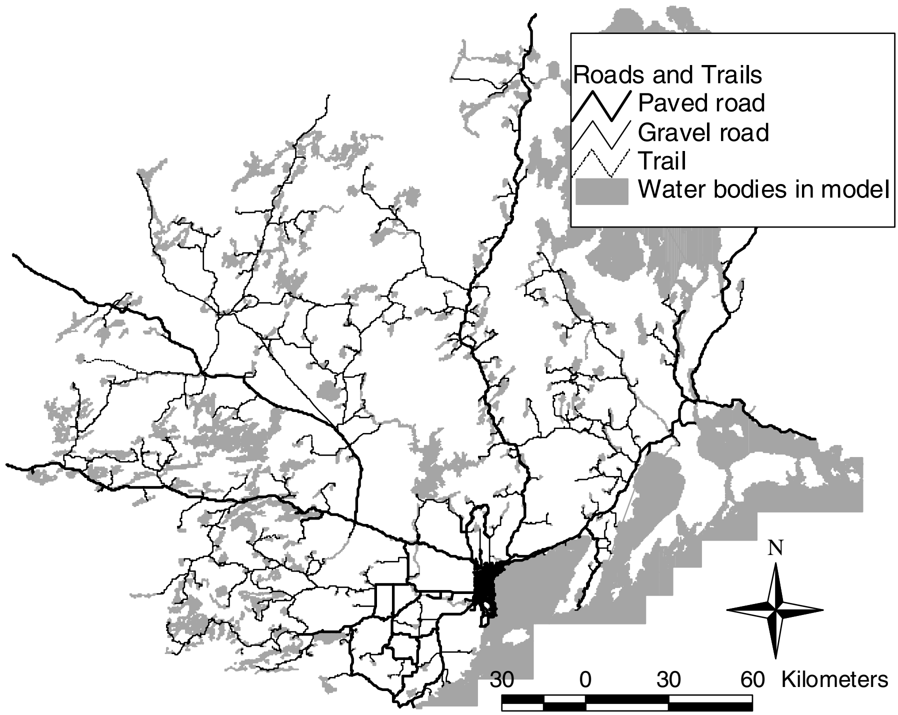

Figure 1. Accessible water bodies in the Thunder Bay, Canada area.

measures for cost focused on travel distance, travel distance by poor quality gravel roads and trails, and portage accessible fishing sites. Poor quality gravel roads are single lane gravel roads that were not maintained at time of field inspection.

Fishing quality measures included the presence and legality of catching and keeping popular fish species, the reported catch rates of rainbow trout, and the expected catch rate of walleye. A tobit model was used to predict the expectations that each angler would have for catching walleye at each fishing opportunity (see Hunt (2006) for details). The tobit model, which is similar to a regression model, formally accounts for censoring of the dependent variable (i.e., reported and forecasted walleye catch rates cannot take on negative values).

Facility development was measured through the presence and quality of boat launches and the cottage development around the waterbody. Regulations enter the model through the legality of catching and keeping popular fish species on a given trip to a water body. Finally, measures relating to the size of the water body, and the number of access points on a water body were included. These two attributes relate to an anglers' awareness of the fishing site.

Site state dependence was assessed by comparing whether a fishing site was identical to the previously chosen site by the angler. Spatial state dependence accounts for the distance between current and previously chosen fishing sites. Initial attempts to populate this attribute involved measuring the distance from a site to the previously chosen site. This initial measure was strongly correlated with travel distance from an angler's residence. To reduce this collinearity, a relative measure for spatial state dependence was employed. Equation 1 shows that spatial state dependence (*SP_STATE*) for fishing site j was based on the distance (d) between site j and the previously chosen site (i) divided by the distance between site i and its nearest neighbor (k). Consequently, higher levels of spatial state dependence would result in a negative parameter estimate for this measure.

$$SP\_STATE_j = \frac{d_{ij}}{\min(d_{ik})} \tag{1}$$

Latent measures of importance for the place identity and place dependence constructs for a fishing area were distilled from a principal components analysis. This analysis was based on the agreement ratings of anglers for the statements in the place attachment scale. Problems linking fishing areas to specific fishing sites, led this study to adopt a simple approach to examine the effects of place attachment on site and spatial state dependence. The site and spatial state dependence measures were interacted with the principal component scores for the identity and dependence constructs. Anglers who were more attached to fishing areas were assumed to take more fishing trips to the same and other nearby sites than would other anglers. This assumption would lead those anglers with greater place attachment to exhibit stronger site and spatial state dependence than would other anglers. While not direct, this approach was suitable to assess some aspects of place attachment on the importance of site and spatial state dependence to anglers within this site choice model.

All choice models assume that while individuals maximize utility, researchers cannot understand all aspects of utility. This uncertainty leads researchers to separate utility into systematic and unobservable components. The unobservable utilities provide the stochastic element that produces a probabilistic forecasting model. A multinomial logit model (see equation 2) arises by assuming that the joint distribution of differenced unobserved utilities among the alternatives is independently and identically distributed according to a type I extreme value distribution.

$$P_n(i) = \frac{e^{\mu(\mathbf{X}_{in}\boldsymbol{\beta})}}{\sum_{j=1}^{J} e^{\mu(\mathbf{X}_{jn}\boldsymbol{\beta})}}, \; i \in C_n, \; \forall j \in C_n \tag{2}$$

The probability (P) of individual n selecting alternative i from a set of alternatives (C_n) relates to several elements (see equation 2). The $\mathbf{X_{in}}$ represents measures of attributes (e.g., travel distance, fishing quality) for each alternative and individual. The $\boldsymbol{\beta}$ values are parameters, which are estimated, that weight the attribute measures in a utility metric. The μ term, which is related to the variance of the type I extreme value error term, is restricted to one without consequence on model estimation. The probability equals the exponent of the systematic utility ($\mathbf{X_{in}}\boldsymbol{\beta}$) for alternative i divided by the sum of these terms for all alternatives.

Since the latent measures for place identity and dependence contain error, their inclusion in a choice model complicates the analysis. To reduce the mixing of the unobserved utilities with these measurement errors, a random parameters logit model was estimated (see equation 3). This equation[2] contains all of the same elements from equation 2 with the additional elements of ζ and $\boldsymbol{\beta}^*$.

$$P_n(i) = \int_{\zeta=+\infty}^{-\infty} \frac{e^{\mu(\mathbf{X_{in}}\boldsymbol{\beta}+\mathbf{X_{in}}\boldsymbol{\beta}^*\boldsymbol{\zeta}_\mathbf{n})}}{\sum_{j=1}^{J} e^{\mu(\mathbf{X_{jn}}\boldsymbol{\beta}+\mathbf{X_{jn}}\boldsymbol{\beta}^*\boldsymbol{\zeta}_\mathbf{n})}} f(\boldsymbol{\zeta})\partial\boldsymbol{\zeta}, \; \forall j \in C_n \tag{3}$$

The random parameters logit allows researchers to account for individual, but unknown, variations in the strength and sign of parameter estimates ($\boldsymbol{\beta}$) for the independent variables ($\mathbf{X_{in}}$). These variations are captured by treating the parameter estimates for independent variables as random variables ($\boldsymbol{\zeta}$). By specifying distributions for the random variables (e.g., normal), the researcher can estimate parameters that identify both the central ten-

[2]Equation 2 arises from a family of models known as mixed logit models (see Train (2003) for further information).

dency ($\boldsymbol{\beta}$) and dispersion of the random variables ($\boldsymbol{\beta}^*$). The measures of central tendency ($\boldsymbol{\beta}$) provide information about the average importance of the independent variables ($\mathbf{X}_{in}$) to the systematic utility. The measures of dispersion ($\boldsymbol{\beta}^*$) (i.e., standard deviation) provide information about the degree to which the importance of the independent variables varies over the population of respondents.

The inclusion of the random variables ($\boldsymbol{\zeta}$) complicates estimation of equation 3. One must account for the likelihood that these random variables may take values ranging from minus infinity to infinity (i.e., the probability density function for the random variables). Estimation approaches such as simulated maximum likelihood or hierarchical Bayesian estimation are used to estimate the $\boldsymbol{\beta}$ and $\boldsymbol{\beta}^*$ from the model (see Train (2003) for details).

This application uses random variables for the parameter estimates from the interactions of the place attachment and state dependence measures. It is assumed that these four random variables arise from independent normal distributions.

Results

This section provides information about the latent measures for place identity and place dependence constructs. This information is followed by the estimation results from the revealed preference choice models (i.e., random utility models).

Anglers were asked to rate 12 statements about place identity and dependence dimensions on a five point scale from strongly disagree (−2) to strongly agree (+2). For each statement, the angler provided ratings for their favorite fishing area and not a specific fishing site. A principal component analysis with varimax rotation was conducted to distil the latent place identity and dependence components from these statements. While some of the statements were associated with both components, the results of the principal component analysis followed expectations (see Table 1).

The identity component was associated with statements about the importance of the area to the individual. The dependence component was associated with statements about the functional ability of the area for fishing. Partly due to the large number of fishing site alternatives, the participants more often agreed with statements about identification than with dependence. The importance of place identity and dependence for each angler was estimated through regression scores from the principal component analysis.

Table 2 describes the labels and attributes used in the choice models. Several additional alternative specific constants along with the intercepts were included to ensure that the choice model reproduces the observed choices for these alternatives.[3] Without much other information about trips outside and to unknown sites within the study area, these alternatives

[3]These alternative specific constants, which are not shown in the estimated model, are available from the author.

TABLE 2
Labels and Descriptions of Attributes Included in the Fishing Site Choice Models

Label	Description
OUTSIDE	Trips taken outside of study area (1, 0)
UNKOWN	Trips taken to unknown locations within the study area (1, 0)
A_WALL	Availability of walleye (0, 1)
A_BASS	Availability of smallmouth bass (0, 1)
A_LTROUT	Availability of lake trout (0, 1)
A_BTROUT	Availability of brook trout (0, 1)
A_BSTR	Availability of smallmouth bass and any type of trout species (0, 1)
E(W_CUE)	Estimated walleye catch rate per one hour of fishing
RT_CUE	Average reported rainbow trout catch rate per one hour of fishing
LN_WAREA	Natural logarithm of area of fishing waters (ha)
T_DIST	Travel distance from origin to destination waters (km)
R_PQGR	Travel distance along a poor quality gravel road (km)
R_TRAIL	Travel distance along a trail (km)
PORTAGE	Whether or not fishing alternative is accessed by a popular portage (0, 1)
BT*GDLN	Presence of good boat launch (0, 1) times whether trip was taken from boat (1, −1)
BT*NOLN	Presence of no boat launch (0, 1) times whether trip was taken from boat (1, −1)
COTTAGE	Presence of significant cottage development (Thunder Bay)
LN_UNAC	Natural logarithm of unique access points
STATE	Site state dependence (1 if same as last trip, −1 if different)
SP_STATE	Spatial state dependence (see equation 1)
MD*XXX	Interaction between attribute *XXX* and whether the trip was a multiple or day trip (1, −1)
PI*XXX	Interaction between place identity measure and state dependence measure XXX
PD*XXX	Interaction between place dependence measure and state dependence XXX

were modeled solely from alternative specific constants (OUTSIDE and UNKNOWN).

To account for the different preferences that anglers would have for boat launches, boat use was interacted by the quality of the boat launch. The model included good quality boat launches (BT*GDLN) and no boat launch types (BT*NOLN). Since one may view water area and access points as aggregated fishing alternatives, it is appropriate to use the logarithm of these measures (Ben-Akiva & Lerman, 1985). The models also included significant interactions between day and multiple day trip contexts and the various attributes (MD*). While other approaches for modeling day and multiple day trips exist (e.g., Shaw and Ozog (1999)), the use of significant interactions does account for variations in preferences for attributes among day and multiple day trips.

The first two choice models in Table 3 employ a multinomial logit model (equation 2) since they do not include the interactions between state dependence and place attachment dimensions. The third model is a random parameters logit (equation 3) that estimates parameters for both the median and standard deviation for the place attachment and state dependence interactions. This random parameters logit model for panel data (i.e., data with observations across and within people) was estimated with GAUSS 7.0 and MaxLik 5.0 subroutine from freely available computer code.[4]

The first choice model in Table 3 ignores site and spatial state dependence. The model fits the observed choice data well with an adjusted ρ^2 of 0.267.[5] The results followed intuition, as the choice of a fishing site by anglers was deterred by increasing travel distance (T_DIST), cottage development (COTTAGE), areas accessible through trails or portages (R_TRAIL and PORTAGE), and sites without boat launches (BT*NOLN). Increasing the availability and abundance of sport fish species (A_WALL, A_BASS, A_LTROUT, A_BTROUT, E(W(CUE)), and RT_CUE), the size of the water body (LN_WAREA), and the number access points (LN_UNAC) were positively associated with fishing site choice.

A few differences in importance of attributes existed among day and multiple day trips. Multiple day trips were more likely to occur outside the study area (MD*OUTSIDE), to unknown locations (MD*UNKNOWN) and to fishing sites further away (MD*T_DIST) than were day trips. Anglers taking multiple day trips were also more influenced by walleye catch rates and the availability of smallmouth bass and less influenced by the availability of walleye than were anglers who took day trips.

The inclusion of the site and spatial state dependence attributes (STATE and SP_STATE) led to a strong improvement to the model as exhibited by the reduction to the log likelihood (LL) and the increase to the adjusted ρ^2 to 0.401 for the second model in Table 3. The highly significant STATE attribute suggests that many anglers continuously chose the same fishing sites. The significant and negative SP_STATE attribute implies that anglers exhibited some state dependence to an area as fishing trips were taken in closer proximity to past fishing trips than one would expect by chance.

The third model in Table 3 contains all interactions between measures for place identity and dependence and the two state dependence measures. Both median and standard deviation estimates are provided for the interaction effects that were assumed to be normally distributed. None of the central tendency estimates for the place identity interactions (PI*STATE and PI*SP_STATE) were significantly different from zero. The standard deviation estimates (PI*STATE(sd) and PI*SP_STATE(sd)) were, however, significantly

[4] This code from Kenneth Train is accessible from http://elsa.berkeley.edu/Software/abstracts/train0296.html.

[5] The adjusted ρ^2 statistic equals one minus a numerator (log likelihood of the model (LL (β)) minus the number of parameters) divided by the log likelihood of the model arising from chance (LL (β = 0)).

TABLE 3
Site Choice Model Estimates for Thunder Bay Anglers

	Model 1		Model 2		Model 3	
Label	Parameter Estimate	t-value	Parameter Estimate	t-value	Parameter Estimate	t-value
OUTSIDE	5.524***	14.19	5.015***	12.42	4.817***	11.68
MD*OUTSIDE	2.936***	9.45	2.736***	8.34	2.838***	8.55
UNKNOWN	5.346***	13.94	4.908***	12.46	4.692***	11.62
MD*UNKNOWN	1.505***	4.96	1.632***	4.96	1.670***	5.19
A_WALL	0.832**	2.80	0.684**	2.80	0.556*	1.77
MD*A_WALL	−0.480**	−2.04	−0.545**	−2.21	−0.468*	−1.81
A_BASS	0.724***	4.91	0.747***	4.82	0.747***	4.59
MD*A_BASS	0.493***	4.27	0.541***	4.36	0.377***	2.89
A_LTROUT	1.129***	7.98	0.984***	6.38	1.034***	6.40
A_BTROUT	1.547***	7.49	1.441***	6.91	1.433***	6.72
A_BSTR	−0.763***	−4.26	−0.723***	−3.74	−0.678***	−3.40
E(W_CUE)	1.203***	7.19	1.100***	6.24	1.178***	6.35
MD*E(W_CUE)	0.632***	4.20	0.579***	3.62	0.495***	2.95
RT_CUE	4.626***	15.31	4.055***	13.04	3.698***	10.60
LN_WAREA	0.320***	8.43	0.278***	7.04	0.307***	7.32
T_DIST	−0.017***	−14.18	−0.013***	−10.28	−0.014***	−10.18
MD*T_DIST	0.008***	7.98	0.008***	6.95	0.008***	7.14
R_PQGR	−0.002	−0.10	−0.001	−0.01	0.001	0.02
R_TRAIL	−0.138**	−2.10	−0.119*	−1.87	−0.122*	−1.90
PORTAGE	−1.205**	−2.05	−1.179**	−2.01	−1.162**	−1.98
BT*GDLN	0.777***	7.45	0.675***	6.15	0.675***	5.99
BT*NOLN	−0.765***	−4.30	−0.741***	−4.08	−0.753***	−3.93
COTTAGE	−1.470***	−6.20	−1.230***	−5.04	−1.872***	−5.75
LN_UNAC	0.666***	5.87	0.543***	4.52	0.505***	4.01
STATE			1.932***	36.85	1.704***	20.70
SP_STATE			−0.006***	−3.38	−0.021***	−4.89
PI*STATE					−0.092	−0.78
PI*STATE (sd)					0.715***	4.42
PI*SP_STATE					−0.001	−0.14
PI*SP_STATE (sd)					0.016***	3.20
PD*STATE					0.037	0.30
PD*STATE (sd)					0.612***	3.61
PD*SP_STATE					−0.009***	−2.56
PD*SP_STATE (sd)					0.023***	4.07
LL ($\boldsymbol{\beta} = 0$)		−5125.86		−5125.86		−5125.86
LL ($\boldsymbol{\beta}$)		−3723.65		−3037.05		−2977.58
Adjusted ρ^2		0.267		0.401		0.411

$*p < 0.10$, $**p < 0.05$, $***p < 0.01$.

different from zero. Consequently, about an equal percentage of anglers with reported high levels of place identity exhibited habit forming or variety seeking behaviors. A similar finding for the site state dependence and place dependence (PD*STATE and PD*STATE(sd)) interaction was found. Again, about an equal percentage of anglers with high levels of place dependence exhibited habituation or variety seeking for a single fishing site. A significant and negative relationship was observed for the spatial state dependence and place dependence (PD*SP_STATE) interaction. The standard deviation for this interaction (PD*SP_STATE(sd)) was also significantly different from zero. Consequently, about 65%[6] of anglers with high levels of place dependence exhibited a tendency to take fishing trips in close proximity to sites of past trips. The remaining 35% of anglers exhibited variety seeking behaviors over space.

Discussion

Researchers are increasingly attempting to understand how context affects the site choices of recreationists. While many methods exist to account for inter personal contexts, choice model researchers have paid far less attention to intra personal contexts. This omission is curious since the behavior of a recreationist is affected by the unique context he or she faces.

One intra personal context that has received a modicum of recreation research in choice modeling is state dependence. Researchers such as Moeltner and Englin (2004) have found that an individual is more likely than by chance to choose the same recreational site that he or she had previously chosen. It is, however, often difficult to disentangle whether evidence of state dependence arises from a substantive change in preferences for sites or from the limited understanding of the choice process by researchers (i.e., model misspecification) (Heckman, 1981).

Linking the importance of site state dependence with latent measures such as importance of place attachment provides one avenue for researchers to assess whether individuals have changed their preferences for previously visited sites. While evidence suggests that place attachment is linked to behavioral intentions (e.g., Stedman, 2002; Kyle et al., 2004) and associated with experience use history (Hailu et al., 2005; Hammitt et al., 2004), the author is not aware of any choice modeling study on the ways that place attachment affects site choices.

The study also assessed the importance of state dependence at site and larger spatial scales. The inclusion of a scale beyond a site was another novel contribution of this research. Spatial state dependence of sites was expected to be important since many researchers have found that the substitutability

[6] This percentage represents those respondents who were predicted to have values of less than zero for this interaction effect. The value is calculated from the cumulative density function of the normal distribution with a z score of 0.387 (i.e., $(0 - (-0.009))/(0.023)$ from the parameter estimates in Table 3).

among alternatives is related to the proximity of the alternatives (Bolduc et al., 1997).

This study of fishing site choices by northern Ontario anglers provided support for both intra personal contexts of site and spatial state dependence. The very strong site state dependence context implied that anglers take many more trips to the same fishing sites than one would expect by chance. The significant spatial state dependence context suggested that many anglers take their fishing trips in closer proximity to past trips than one would expect by chance.

Despite the significant findings for site and spatial state dependence, it is difficult to assess whether these findings arose from a misspecified model or from a substantive process. To test one possible substantive process, the site and spatial state dependence parameters were interacted with the importance of place identity and dependence to the anglers. There was no significant relationship between the median importance of site state dependence of an angler and the importance of place identity or place dependence. However, there was a significant degree of variation in this importance over the population of anglers. These results suggest that this particular investigation of place attachment provided little rationale for the presence of substantive site state dependence.

For spatial state dependence, the results were mixed. While no significant relationship existed between the importance of spatial state dependence and place identity, a significant and positive relationship was found between spatial state dependence and place dependence.[7] The significant result provides some evidence of a substantive process that leads to the presence of spatial state dependence. If anglers believe that a fishing area has no real substitute, about two-thirds of these anglers will choose fishing sites in a more constrained geography than will other anglers.

Past research supports the results that state dependence was associated with place dependence but not place identity. Place dependence arises more quickly to recreationists than does place identity (Moore & Graefe, 1994). Consequently, anglers who visit a fishing area or site may quickly develop a functional dependence on that area or site. One would expect that measures of state dependence that focus on the previous fishing trip will be associated with place dependence before place identity.

This study represents an initial attempt to link aspects of site and spatial state dependence observations with the place attachment concept. Additional research is required to assess the reliability of these research findings. Future work should also attempt to shed the limitations of this study. For example, this study indirectly related place attachment to site and spatial state dependence. There was no explicit consideration for the place attachment that anglers have for all fishing sites and areas. Researchers may wish

[7] The sign of the interaction parameter estimate was negative since spatial state dependence was inversely related to utility.

to garner place identity and dependence measures for a variety of recreational sites and link these measures to specific recreational sites. This limitation may help to explain the lack of relationship in this study between the place identity and dependence dimensions and the importance of site state dependence.

Researchers may also wish to examine the importance of site and spatial state dependence from perspectives beyond place attachment. For example, Nedungadi (1990) discussed the importance of priming alternatives to decision-makers (e.g., the use of advertising to increase the likelihood of choice for a specific alternative). It is possible that site state dependence may arise from the priming that occurs when an individual chooses a fishing site. Future choices of fishing sites may occur at the sites that were last visited (i.e., primed sites). Limited awareness of fishing sites may also lead to spurious site and spatial state dependence. Awareness may affect trip behaviors by constraining anglers to take trips from a limited geographical area. In this study, the relationship between place dependence and spatial state dependence suggested that spatial state dependence at least partially arose from a substantive effect. Anglers may also be only partially aware of attributes at fishing sites that are revealed through visits (Meyer, 1980). Consequently, anglers may exhibit site state dependence from an individual's learning of the fishing site from past visits.

Implications

The study provides several important implications for managing recreation resources. First, the identification of spatial state dependence within this study suggests that some anglers take fishing trips within confined spatial areas. When attempting (e.g., closure or regulation) to reduce ecological impacts at a fishing site, managers must be mindful that affecting fishing participation at one site may increase use at nearby sites. This increased use may lead to ecological impacts at these nearby sites. Consequently, understanding spatial state dependence may help to reduce the likelihood that management actions will result in negative and unforeseen consequences.

The potential importance of site state dependence is also important for managers to consider. Understanding an angler's habituation with a fishing site may explain seemingly odd patterns of angling behaviors. For example, some anglers may continue to fish at sites that become degraded over time despite the availability of other better quality sites. This habituation can lead to greater ecological impacts at fishing sites than would be expected without considering the effects of state dependence (i.e., as fishing sites become poorer in quality, one expects anglers to move from that fishing site).

Finally, the study demonstrates the importance of using methods and concepts from multiple disciplinary perspectives in the social sciences. By using concepts related to place attachment, it is possible to validate and understand the importance of state dependence measures. In this application, the functional relationship between anglers and their favorite fishing areas leads to a more constrained choice of sites by anglers. This tendency for anglers to take trips within a constrained area may be alleviated if managers can convince anglers about the quality of other angling opportunities. However, if the relationship among state dependence was associated with place identity, it would be much more difficult for managers to alter behaviors of anglers.

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