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Angler preferences and satisfaction in a high-threshold bucket-list recreational fishery

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ABSTRACT

It is important to understand recreational anglers' motivations for fishing in order to predict when, where, and how they interact with species that can be sensitive to overfishing. So far, few studies have investigated angler motivation in recreational fisheries that are extremely distant from their angler population, require specialized angler skill, and pose other barriers to participation like high travel and equipment costs. We collectively refer to these as "high-threshold" fisheries and explore angler motivation and its implications for anglers' decision-making in one particularly remote example, the Mongolian fly fishery for endangered taimen, *Hucho taimen*, the largest salmonid in the world. We used a mixed-methods approach that enriched discrete choice experiments with in-depth qualitative interview data to investigate anglers' motivations for participating in the taimen fishery, their satisfaction with the fishing experience, and their stated interest in participating in the fishery in the future. We found that anglers preferred fewer high-quality, trophy-sized fish to a higher catch rate of smaller taimen, but that activity-general factors like the opportunity to travel to an "exotic" wilderness destination were also highly motivating. The anglers we sampled were all first-time taimen fishermen and many were bucket-list anglers who sought a wide variety of fishing tourism experiences throughout their lifetime and therefore and had no intention to return to the taimen fishery. Instead, these fishermen selected their future trips from among a set of similarly remote, specialized, and costly fisheries throughout the world, especially in developing countries. We argue that these high-threshold fisheries should not be studied in isolation but instead would benefit from a unified research approach that accounts for their unique traits and shared angler population.

1. Introduction

Recreational anglers are the primary users of many freshwater fish stocks and can provide significant economic, social, and environmental benefits (Arlinghaus et al., 2002; Parkkila et al., 2010). Recreational fisheries can be important economic engines at the local and regional scale (Hyder et al., 2018) and they engage an estimated 220 million people worldwide (World Bank, 2012), not to mention accounting for a significant fraction of the global fish harvest (Cooke and Cowx, 2004). They also present unique management challenges. Fishing effort in recreational fisheries tends to be geographically diffuse and to include diverse targets and gear types even within a single fishery (Arlinghaus et al., 2014; Post et al., 2002). These factors can make it difficult to collect accurate catch statistics, enforce regulations, and predict how biological and regulatory changes might impact future effort. A large body of literature and theory has emerged to address these challenges and especially to understand the dynamics that control angler effort. For instance, many researchers have modeled angler behavior as a predator-prey interaction in which anglers intensify their effort when they encounter rich patches of "prey," causing effort to equalize across a landscape (Johnson and Carpenter, 1994; Post et al., 2008; Wilson et al., 2016).

This understanding of anglers as human predators works well in fisheries where anglers are uniformly catch-oriented to the exclusion of other goals, but many fisheries cater to a spectrum of anglers who range from catch-oriented to trophy-seeking to casual recreationists (Arlinghaus et al., 2008; Bryan, 1977; Magee et al., 2018). In these fisheries, the connection between current fishery status and future fishery participation is more complex. Anglers are motivated by a diverse set of factors that include not only their preferred catch rate and target species but also activity-general elements that are common to many forms of outdoor recreation, such as experiencing nature,

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enjoying solitude, and socializing (Arlinghaus, 2006; Oh and Ditton, 2008; Oh et al., 2013). These preferences and motivations set the expectations that determine anglers' satisfaction and consequently their future fishing effort (Arlinghaus, 2006). Therefore, if anglers are motivated to fish partly or primarily by activity-general characteristics of the activity, their satisfaction may depend heavily on factors other than the number and perceived quality (size, species, etc.) of the fish they catch (Curtis and Breen, 2017; Fedler and Ditton, 1994; Greiner et al., 2016). For instance, a recent study of angler satisfaction in a German multispecies fishery found that the contribution of catch-related factors to satisfaction plateaued above a certain threshold for most species, demonstrating that catch provides diminishing returns in satisfaction (Beardmore et al., 2015). In another case, 90% of surveyed anglers reported that they would be satisfied with a trip even if they did not catch any fish. These minimally catch-oriented anglers instead valued "relaxing in the outdoors at the water side and fishing in pleasant company" (Arlinghaus, 2006).

Random utility theory provides one framework for understanding this heterogeneity in preferences and weighing the relative importance of different catch-related and activity-general factors (Aas et al., 2000; Hunt, 2005). The theory states that anglers choose fishing options by subconsciously integrating the costs and benefits of different options in a way that maximizes their overall utility, or benefit, from the fishing opportunity. This utility metric includes a set of deterministic components that can be measured by the researcher and a stochastic term that represents individual variation in taste, missing variables, and other unmeasured factors (Train, 2002). Studies that use the framework of random utility theory draw on stated or revealed preference data to characterize the utility of different options and the marginal contribution of each aspect of an option to its overall utility (Hunt, 2005). Discrete choice experiments used to elicit anglers' stated preferences can incorporate a wide variety of catch-related preferences and activity-general factors like travel costs and crowding by other recreationists (e.g. Beardmore et al., 2015). Combining these stated preference surveys with qualitative methods such as in-depth interviews and focus groups is less common, but this mixed-method approach can draw an even more nuanced picture of fishermen's preferences and behavior (Carr and Heyman, 2016; Magee et al., 2018).

The angler preference literature that uses this framework is dominated by studies that investigate anglers' decision-making in local- or regional-scale fisheries that include a range of generalist and specialized anglers (e.g. Duffield et al., 2012; Arlinghaus et al., 2014; Curtis and Breen, 2017). However, few studies investigate the behavior of anglers in distant, high-cost recreational fisheries that require specialized angler skill, where one can expect different relationships between catch and participation simply because the commitment required to participate is so high (but see Nguyen et al., 2013; Pinder and Raghavan, 2013). In many of these fisheries, the targeted fish are highly desirable for their size, appearance, or behavior, attracting avid and generally wealthy anglers from around the world. These fisheries often require highly skilled fishing techniques and specialized gear and have either formal regulations or informal norms that enforce catch-and-release practices. One example is the bonefish (*Albula vulpes*) fisheries of the Caribbean, which provide millions of dollars annually to local economies and are primarily catch-and-release (Adams et al., 2014). Bonefish are highly valued by international sport fishermen for their speed and aggressive behavior when hooked, such that a single bonefish has been estimated to be worth US$3500 to the local economy (Santos et al., 2017). Other examples include peacock bass (*Cichla* spp.) in the Amazon (Holley et al., 2008), tigerfish (*Hydrocynus vittatus*) in Africa (Smit et al., 2009), mahseer (*Tor spp.*) in India (Pinder and Raghavan, 2013), and high-cost pelagic trophy fisheries for marlin, tuna, and other highly migratory species (Duffield et al., 2012). Collectively, we categorize these fisheries as "high-threshold" fisheries, where economic, biological, and social factors combine to raise the barriers required to participate.

In northern Mongolia, abundant populations of taimen (*Hucho taimen*) attract wealthy fly fishermen willing to pay up to US$7000 per week, excluding travel costs, for the chance to catch the largest salmonid in the world (Jensen et al., 2009). Taimen can reach lengths of up to two meters and weigh up to 100 kg, and at about one meter total length they undergo an ontogenetic shift that enlarges the head and jaw disproportionately to the body (Holcik et al., 1988). This large size, unusual appearance, and status as the world's largest salmonid make them a valued target for some highly specialized recreational anglers. Many of these anglers travel to Mongolia with dedicated fly-fishing outfitting companies. The large size and selective feeding behavior of taimen combine to make them hard to catch on fly fishing gear, inspiring fishing guides to call them "the fish of a thousand casts." The high cost, low catch rate, and specialized skills required of anglers in the international taimen fishery make it an excellent place to investigate the preferences and behavior that characterize anglers in such high-threshold recreational fisheries.

This study investigates the preferences, satisfaction, and behavior of international anglers in the taimen fishery in northern Mongolia. Using a mixed-methods approach that enriches discrete choice methodology with in-depth qualitative interview data, we ask the following three general questions: 1) What factors contribute to anglers' motivation to participate in the taimen fishery, and what preferences do they have for their taimen fishing experience? 2) Based on these motivating factors, are sampled anglers generally satisfied with their experience in the taimen fishery, and what factors drive satisfaction most strongly? And finally, 3) How does satisfaction translate into future participation; namely, do satisfied anglers express more interest in a return trip?

2. Methods

2.1. Study system

This study focuses on recreational taimen fishing in the Eg-Uur watershed in northern Mongolia, which is remote and relatively pristine (Gilroy et al., 2010). The watershed is located primarily in the Khövsgöl, Bulgan, and Selenge provinces in the transition zone between Mongolia's steppe ecosystem and Siberian taiga forest. The Eg River, and its tributary, the Uur River, drain into the transboundary Selenge River, the largest tributary of Lake Baikal (Fig. 1). The rivers support a fish community dominated by the salmonids lenok (*Brachymystax lenok*) and Arctic grayling (*Thymallus arcticus arcticus*), with taimen as the apex predator (Mercado-Silva et al., 2008). Taimen are relatively long-lived, large-bodied omnivorous fish with extensive habitat needs; some individuals have been observed to traverse home ranges of over 100 km (Gilroy et al., 2010; Kaus et al., 2016). Mongolian rivers like the Eg, Uur, and Selenge have historically served as refuge habitat for taimen because of Mongolia's limited culture of fishing and fish consumption (FAO, 2007). However, in the mid-1990s, the first foreign outfitting companies began bringing fly fishermen to Mongolia to fish for taimen (D. Vermilion, pers. comm.). Now, taimen are the primary object of a growing recreational fishery that includes both foreign fly fishermen (Vander Zanden et al., 2007) and, increasingly, Mongolian fishermen (Chandra et al., 2005). The American and European-based outfitting companies that cater to many of these foreign fly fishermen enforce strict catch-and-release policies, while Mongolian recreational anglers vary in their adherence to catch-and-release practices.

Taimen are IUCN Red Listed throughout their range because of overfishing and habitat degradation (Hogan and Jensen, 2013), and Mongolian law prohibits the harvest and consumption of taimen. Research has shown that purely catch-and-release fishing for taimen can be sustainable, but that even limited consumptive fishing could lead to local extirpation of taimen populations (Jensen et al., 2009). As a result, foreign outfitting companies and Mongolian conservation activists have found common cause in supporting catch-and-release angling by foreigners, which provides economic revenues to rural, isolated areas, and

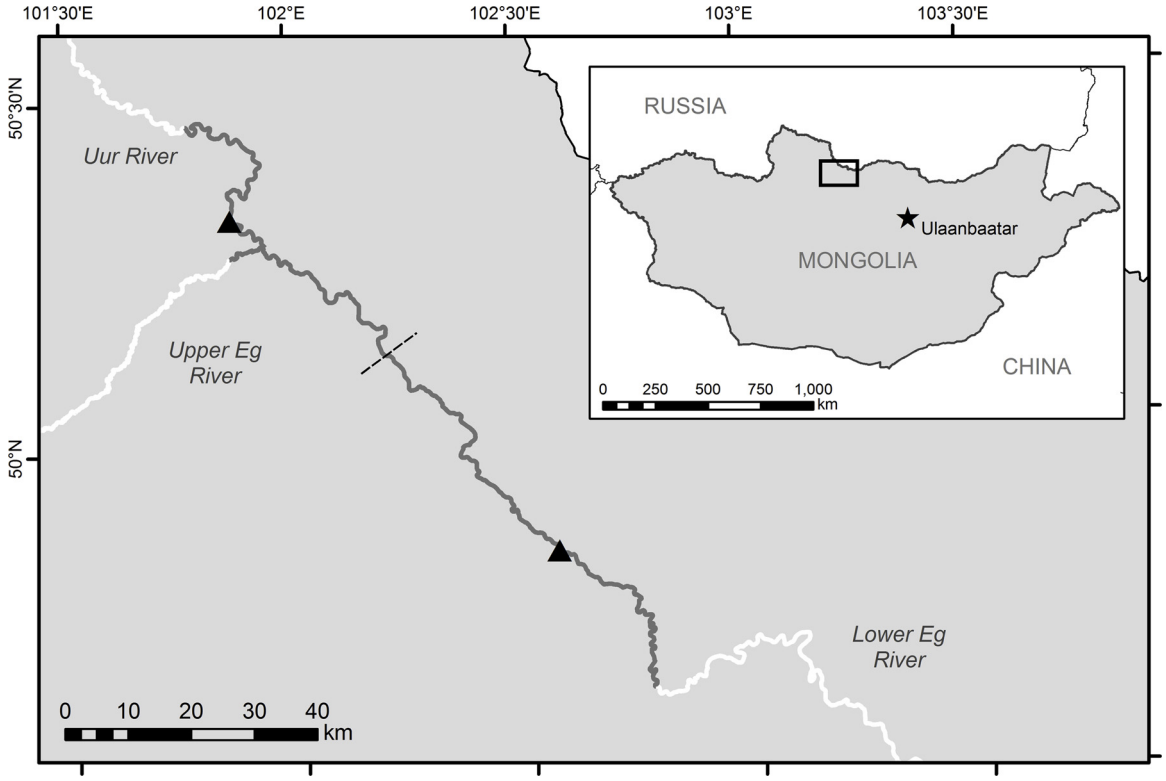

Fig. 1. Study sites. Map of the Eg and Uur Rivers in northern Mongolia's Eg-Uur watershed showing the two fishing camps where research was conducted (black triangles). The Sweetwater/Hovsgol Travel companies have exclusive rights to fish the river section emphasized in grey, which occupies a total of 219 river kilometers. The black dotted line marks the boundary between waters fished by the upper camp (109 river km) and lower camp (110 river km).

thus discourages consumptive fishing by local herders and urban, middle-class Mongolians. The outfitting companies provide funding to several non-profit conservation organizations for research and enforcement of Mongolia's fishing laws and permitting regulations. These efforts have been concentrated in the Eg-Uur watershed, which was also one of the earliest areas of Mongolia to see foreign fly-fishing effort. As a result, the watershed has become known for its abundant taimen population.

2.2. Research sites and study population

Fieldwork was conducted throughout the six-week 2017 fishing season (August to October) at two fishing camps operated by the Mongolian-run Hovsgol Travel Company in partnership with the American-based Sweetwater Travel Company. One camp is located on the Uur River, 9 km above its confluence with the Eg, and the other is located 89 km downstream of the Eg-Uur confluence on the Lower Eg (Fig. 1). Data were collected for approximately three weeks at each camp to ensure roughly equal sampling of respondents. The two fishing camps hosted 60 clients over the 6-week fishing season, of which 38 overlapped with the research team. Of these 38 anglers, 30 completed paper surveys and 26 participated in semi-structured interviews for a 79% and 68% response rate, respectively. An additional angler who had recently completed a fishing trip at another camp completed a survey and interview at the travel company's headquarters in Ulaanbaatar. Although the 60-person sampling frame is small in absolute numbers, so is the overall population of foreign anglers who fly-fish for taimen in Mongolia each year. This research protocol was approved by the Rutgers Institutional Review Board (Protocol #E17-714).

2.3. Survey design and implementation

Anglers were surveyed using a brief (15 min) paper survey instrument that included two components: 1) a series of six discrete choice scenarios designed to elicit preferences and motivations for participating in a Mongolian fishing trip, and 2) questions about respondent's demographic characteristics (e.g., age, location, and past fishing trips) and fishing experience. Discrete choice experiments (DCEs) present respondents with multiple hypothetical scenarios involving tradeoffs between desired attributes of an experience and ask them to rank or choose their most preferred option (Train, 2002). These data allowed us to assess the relative importance of different attributes of the experience to respondents, analyze decision-making, and evaluate the utility of different options. In this case, anglers were presented with three options within each scenario: two alternative fishing trips that varied in the number of taimen caught and the size of the largest fish, and a third option in which they did not travel to Mongolia to fish, following the survey design of Carter and Liese (2012). The size attribute had six levels, ranging from 0 cm (i.e., no fish caught) to 150 cm, which were presented in both centimeters and inches (Table S1). The catch attribute had seven levels ranging from zero taimen (no fish caught) per week to eighteen, representing a maximum catch rate of about three fish per day. Attribute levels were developed to represent the whole range of outcomes possible on a taimen fishing trip based on our knowledge of the fishery. We chose to include only two attributes because we anticipated a small pool of respondents, which would limit our sample size and force us to focus on a small number of attributes of high interest. Although including a cost attribute would have enabled us to estimate anglers' willingness to pay (WTP) for a taimen fishing experience, we deemed the tradeoff between size and catch rate in anglers' preferences to be a higher research priority for this fishery given the high WTP already demonstrated by taimen anglers.

Anglers were asked to select the best and worst alternatives (Fig. 2), allowing for a full ranking of the three alternatives as implemented by Lew and Larson (2012). Discrete choice experiments often do not use a full factorial design because the number of unique combinations would

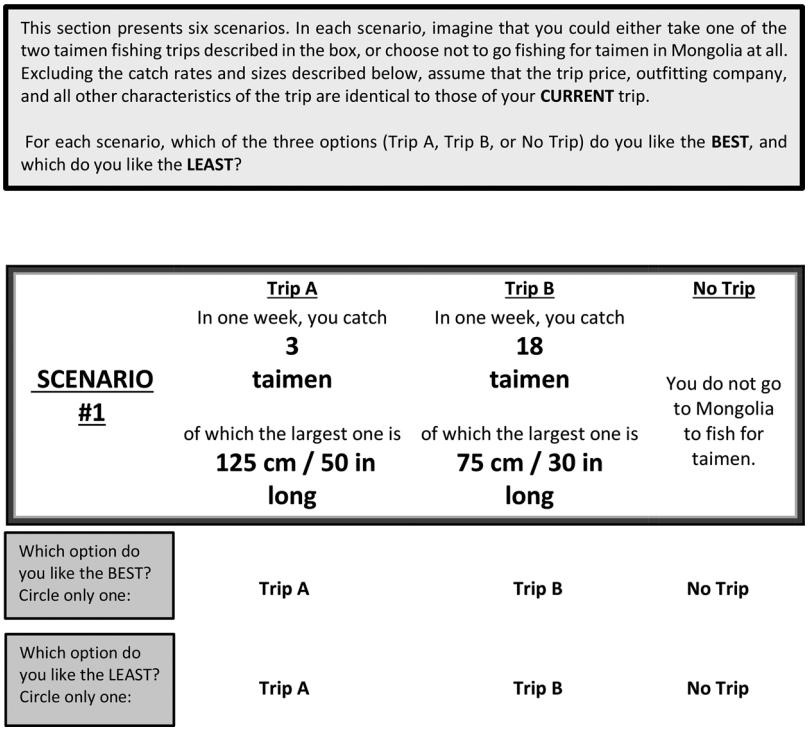

Fig. 2. Sample discrete choice scenario.

be prohibitively large (Fox, 2007; Kuhfeld, 2010). In this case, a fractional factorial design was developed from a full factorial design representing the entire set of combinations of attribute levels. Illogical choices within the full factorial design (i.e., a catch rate of zero with a non-zero maximum size) were then discarded. Since most of the remaining scenarios were non-informative in that they possessed a logically superior option that was better in terms of both size and catch (e.g., a choice between 10 fish with a maximum size of 100 cm versus five fish at 50 cm), we followed Train et al. (1987) in narrowing down our fractional design to focus on the scenarios that presented informative choices. Scenarios were divided into "control" scenarios (those with an obviously superior option as described above) and "experimental" ones that present a meaningful tradeoff (e.g., a choice between 10 fish with a maximum size of 50 cm and two fish with a maximum size of 100 cm). Thirty unique survey variants were developed in order to include all of the experimental scenarios. Each survey variant included five experimental scenarios and one control scenario, selected from the large pool of potential control scenarios, to screen for survey fatigue and respondent disengagement.

Survey disengagement is a well-established concern in the implementation of discrete choice experiments (Petrik et al., 2013), and the interview portion of this project, combined with the inclusion of control questions, provided a unique opportunity to address this potential source of bias. To take advantage of this opportunity, respondents who failed the control scenario (n = 3) or displayed preferences that were notably different from the majority of survey responses (n = 7 out of 31) were asked about their DCE responses during the interview stage. One angler revealed that he had failed the control due to disengagement and his responses were removed from the data. The other two anglers who failed the control revealed that they had misunderstood the survey questions in an easily resolved way (circled their best and second-best choices instead of best and worst), and their responses were amended to reflect this. The remainder were asked about their responses because their choices suggested unusual preferences which could be profitably explored in the qualitative interview phase, like the frequent choice of the "no trip" option even when catch rates were high. These respondents' clarifications were included in the interview data but did not affect the DCE analysis in any way.

Surveys were distributed at the beginning of the anglers' trip and anglers completed them at their leisure throughout the fishing week. Some completed and returned them immediately, and some returned them when they left a week later. The day that anglers returned the survey did not have a significant effect on their choices and did not improve the model fit (Table 1).

2.4. Semi-structured interviews

In-person, semi-structured interviews were conducted with anglers to expand on discrete choice experiment results. An interview guide was designed based on 10+ years of experience working on the Mongolian taimen fishery and following best practices in qualitative research techniques (Roller and Lavrakas, 2015). The guide was modified several times in the field to address unforeseen circumstances and saturation of some interview questions (that is, reaching a point when no new insights emerge from further responses) (Appendix). Interviews were conducted at both fishing camps and during breaks on the river during the fishing day. Most interviews lasted 15 to 30 min, with outliers ranging from 8 min to over an hour. All interviews were audio

Table 1
Candidate models with explanatory variables, number of parameters (K), log likelihood (LL), Akaike Information Criterion (AIC) score, and difference in AIC score relative to the model with the lowest AIC score (ΔAIC). Models with a ΔAIC < 2 are similarly supported.

Model	K	LL	AIC	ΔAIC
size + ln(catch) + size * ln(catch)	5	−163.1	336.1	0
size + catch + size * catch	5	−164.6	339.1	3
size	3	−167.3	340.6	4.5
size + catch + trip-day + size* catch	7	−163.4	340.7	4.6
size + ln(catch)	4	−167.2	342.3	6.2
size + catch	4	−167.2	342.4	6.3
catch	3	−188.4	382.8	46.7

recorded and transcribed by a professional transcriber, following which the transcripts were checked for accuracy by the researchers. Twenty-six interviews were conducted in English and one was conducted in French; this was translated and transcribed by a native English speaker with an advanced degree in French.

2.5. Additional data sources

A researcher accompanied anglers and guides throughout the fishing day for 26 of the 43 days of the fishing season and recorded catch and effort data in units of angler hours per day. Limited catch logs were also maintained by some fishing guides. These were used to estimate the size structure of captured taimen. Unstructured key informant interviews were conducted with fishing guides and outfitting company staff members (n = 8) to assess longer-term fishery dynamics.

2.6. Data analysis

2.6.1. Modeling angler preferences

A multinomial logit model was fit to anglers' ranked choices using the *mlogit* package (Croissant, 2018) in R v.3.4.3 (R Core Team, 2017). Candidate models included catch, size, both catch and size, and an interaction term between catch and size as parameters. One candidate model included a natural log-transformed catch rate and natural log transformation of the catch component in the catch-size interaction term because the observed data showed a diminishing effect of catch rate on utility (Fig. 3) and other studies have found diminishing returns of high catch rate (Beardmore et al., 2015). We also included trip day as an individual-specific variable to test whether the day the survey was returned affected anglers' responses. Models were competed using Akaike's Information Criterion (AIC; (Akaike, 1974) (Table 1). Individual-specific parameters like fly fishing experience and days fished per year (a proxy for angler avidity) were not included because the interview portion of the project allowed us to explore the importance of these characteristics in a richer, albeit more qualitative, way, and because drawing valid conclusions about these parameters in DCE analysis generally requires larger sample sizes (Louviere et al., 2000: 110).

2.6.2. Qualitative analysis of interview responses

Interviews were coded for themes using the qualitative coding software NVivo 12.1.0 (NVivo qualitative data analysis Software; QSR International Pty Ltd. Version 12, 2018).

Themes used for this analysis were divided into the general categories of angler demography, angler preferences/satisfaction, and trip choice, and sub-themes were developed inductively during the coding process; that is, guided by the themes that emerged throughout participants' responses rather than a priori assumptions about which factors would be important (Roller and Lavrakas, 2015). References to angler preference subthemes were quantified by their frequency in responses to questions about angler *motivation* (e.g., "What appealed to you about coming to Mongolia to fish for taimen?") and *satisfaction* (e.g, "How do you feel about the trip so far?"). These preference themes were identified as either catch-related or activity-general. Anglers were also classed into groups based on their expressed interest in returning to the fishery in future years.

3. Results

3.1. Angler demography

Surveyed anglers were primarily male (87%), white (100%), and middle-aged, with a median age of 52. The majority (51%) had a professional degree, with another 32 percent possessing a bachelor's degree or some college education. Forty percent of anglers were American, 23 percent were European, and the rest were from Canada, Australia, and Morocco. Key informant interviews with fishing guides suggest that the majority of Sweetwater's clientele are American, although the outfitter sometimes hosts large groups of anglers from countries not represented in this sample, such as Russia. Angler experience and avidity, as measured by frequency of fishing (Beardmore et al., 2015; Ferter et al., 2013), varied widely among surveyed anglers.

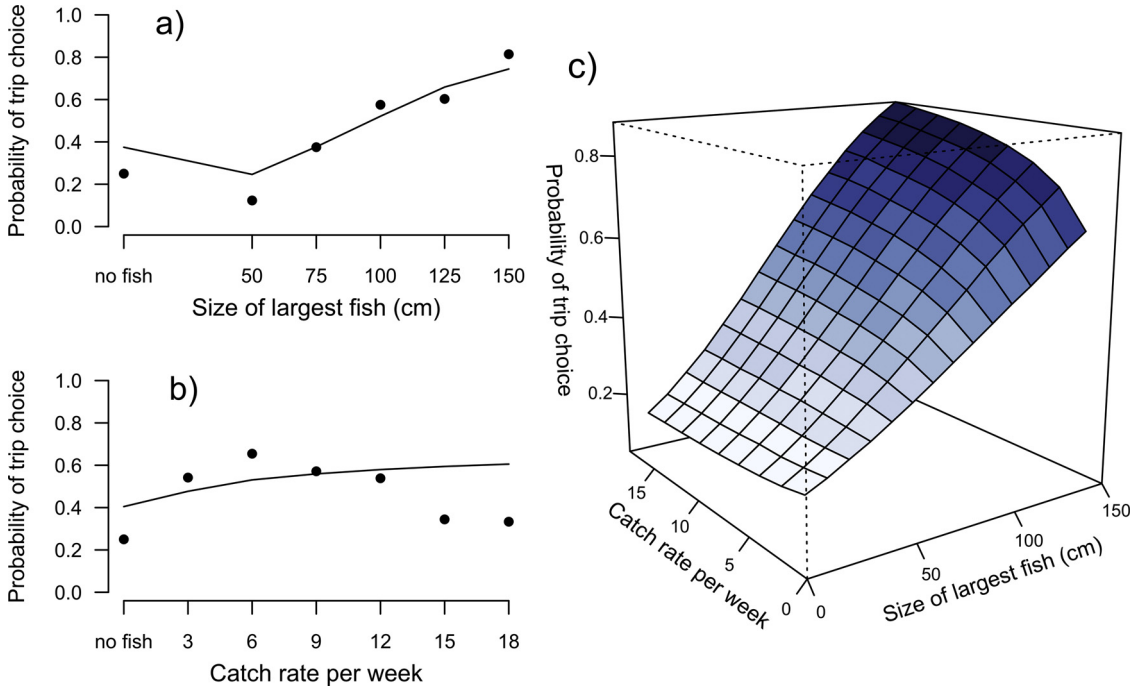

Fig. 3. Discrete choice model results. The marginal effect at the mean of (a) size of largest fish available and (b) expected catch rate per week on the predicted probability that anglers will choose a trip option in a discrete choice experiment. The black points show the observed proportion of trips selected with each level of the size and catch rate attributes. Panel c) shows the predicted probability of trip choice based on the interaction between size of largest fish and catch rate per week (deeper blues indicate higher probabilities of selection).

Table 2
List of parameters in best-fit model with the parameter estimates, standard error, p-values, and significance.

	Parameter	Attribute	β	Std. Error	Pr(> |z|)
Alternative-specific coefficients	generic trip intercept		0.0712	0.1673	0.6703
	no-trip intercept	no trip	−2.2739	0.9778	0.0200*
Generic coefficients	size	size of largest fish caught	0.0140	0.0039	0.0003***
	Ln(catch)	catch rate per week	−0.2195	0.1108	0.0475*
	size x ln(catch)	interaction between catch rate and size	0.0066	0.0024	0.0054**
N = 180	McFadden R^2: 0.475				

* Significant to $p < 0.05$.
** Significant to $p < 0.01$.
*** Significant to $p < 0.001$.

The median angler had 30 years of fishing experience and 18 years of fly-fishing experience; however, several were novices who had never fly fished before and a few had over 50 years of experience as fly fishermen. The surveyed anglers spent an average of 29 days per year fishing (interquartile range = 14–38 days). All the anglers in the surveyed population were first-time taimen fishermen, although guide interviews indicate that typically about 25 percent of Sweetwater's clientele are repeat visitors.

3.2. Angler preferences and motivation

The best fit model included size of largest fish, natural log-transformed catch rate, and an interaction term between size and natural log-transformed catch (Table 1). The size term, catch term, and the interaction term were statistically significant ($p = 0.000$, $p = 0.048$, and $p = 0.005$ respectively), as was the intercept for the no-trip option ($p = 0.002$) (Table 2). The no-trip intercept represents the utility of not traveling to Mongolia to fish compared to a trip with the lowest levels of each attribute—that is, a trip in which no fish are caught. The mean probability of choosing a trip with a catch rate of six fish per week and a maximum size of 50 cm was 0.32, while the mean probability of choosing a trip with a catch rate of 12 and a largest fish of 100 cm was 0.63, an increase of 31%. Doubling only the maximum fish size while maintaining the catch rate at six fish per week moderated this impact to some degree, increasing the probability of choosing a trip by only 24% instead of 31%. In contrast, doubling the expected catch rate while maintaining the size of largest fish constant at 50 cm increased the probability of choosing an option by only two percent. Overall, the effect of catch rate was low at small maximum fish size and stronger at high maximum fish size (Fig. 3c). The best fitting model had a McFadden's Pseudo R^2 value of 0.475. McFadden's Pseudo R^2 is analogous to a standard R^2 statistic but generally produces lower values (Ben-Akiva and Lerman, 1985). This is considerably better than the 20% standard of fit proposed as a benchmark in Hensher and Johnson (1981:50).

In interviews, anglers' discussion of their motivations for traveling to Mongolia confirmed and expanded on this result. Anglers were motivated by catch quality over catch rate, with quality defined mostly by size but also by the interaction between size and other factors, such as the way the fish fought on the line. As one 49-year-old Canadian angler said, "If the largest you catch is 30 inches and you get a dozen fish, that wouldn't be enough to motivate me…they're cool fish, but there's not a spectacular run, there's not a spectacular jump. Frankly, you're handlining in a 30-inch fish…you're basically just dragging them in." Overall, anglers expressed a desire for 40- to 50-inch (100- to 125-cm) "trophy"-sized fish in interviews; this size class represents the 98th percentile of the fish caught during the season (Supplemental Fig. 1). Catch rate expectations were more heterogeneous, but most anglers expected to hook one or two fish per 8 -h fishing day. Anglers were split between being frustrated with these low catch rates and valuing the fish more highly because they were difficult to catch. One 53-year-old British angler who typified the latter view said that landing a fish is more enjoyable when "you [have] to work a bit harder, wade a bit deeper, cast a bit further, fight the weather."

More broadly, interviews reflected anglers' interest in a variety of catch-related motivators beyond size and catch rate, as well as in factors related to the overall experience of the trip. Slightly over half of anglers' references to their *motivation* for traveling to Mongolia mentioned these catch-related factors, which included not only taimen size and catch rates, but also being able to catch a diversity of species and the desire to catch specific species (primarily taimen, but also lenok, Arctic grayling, and northern pike) (Fig. 4). Anglers valued taimen in particular for its size, its aggressiveness, its "interesting-looking" morphology, its evolutionary lineage as an "ancient fish," and its status as the "largest salmonid in the world." Although a few anglers mentioned taimen's rarity and endemism as a draw, many did not know that the species was endangered, and its conservation status was not a factor in their fishing decision: "I didn't know if there were a million fish a mile, or two, no idea. I don't know any more now." Some even assumed that if anglers knew taimen's conservation status, it would be a less appealing target. As one 48-year-old British fisherman speculated, it would hurt the operators' interest to share the information because "they're going to want people to think, there's loads of them: you're going to come, you're going to catch loads every day, and they're going to be huge."

Interview responses revealed that a nuanced interaction between

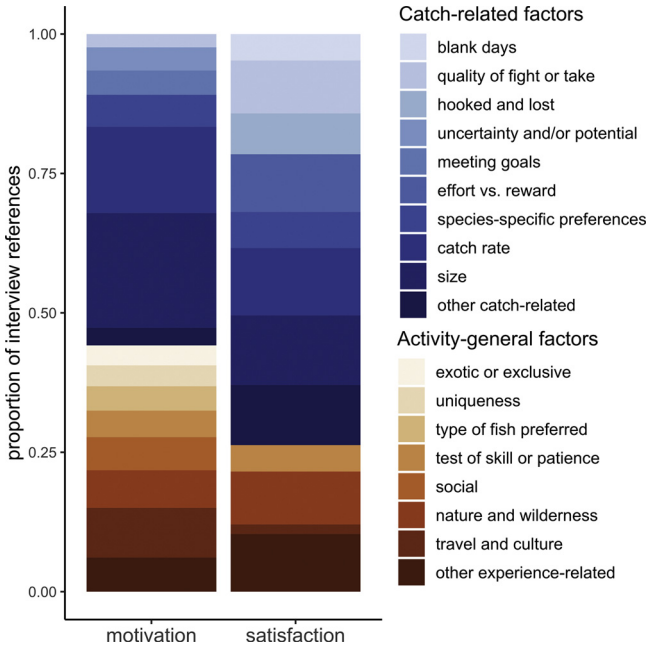

Fig. 4. Interview themes related to angler motivation and satisfaction. Proportion of interview text that refers to catch-related (blue) and activity-general (orange) themes in responses to questions about angler motivation and satisfaction.

catch-related factors and aspects of the broader trip experience combined to draw anglers to the taimen fishery. These activity-general motivating factors included the social aspect of fishing with friends, the lure of travel to an exotic or "pristine" wilderness destination, and the experience of a novel culture. Anglers mentioned these activity-general factors almost as often as their catch-related expectations and motivations for the trip; approximately 44 percent of motivation-related references fell in this group (Fig. 4). Thus, the very aspects of the taimen fishery that create barriers to participation—its distance, its remoteness, and its skill requirements—were also strong motivators for many anglers. As one 72-year-old American angler said, "Probably, if these taimen were in Bakersfield, California, I wouldn't go there. But because they're in Mongolia—there's a certain flair where people say, 'Where're you going?' and you say, 'I'm going to Mongolia'—their eyes kind of light up and they go, 'Oh, that's cool.'" For some anglers, these factors even outweighed their interest in trophy-sized taimen. One 56-year-old American fisherman had recently begun fly fishing and spoke passionately about his new sport. He said, "It's not about catching fish, it's about fishing. It's about the challenge. Can you get everything lined up to where you can get that hit? You know, get the fly in the right place, in the right fashion, at the right time? So it's cool [that] there's big fish here, but I would have come if there weren't big fish. I would have come if it were just lenok and grayling."

3.3. Angler satisfaction

A different set of catch-related factors emerged in interviews when anglers spoke about their *satisfaction* with their ongoing trip, rather than their *motivation* for taking it. The size and number of fish that they had caught still mattered, but for many, catching a single taimen was enough to fulfil their goals for the trip: one seventy-year-old British fisherman said, "If I don't catch another taimen, I'm not going to go home and say to friends and family, 'Well, that was a waste of time, I only caught one taimen.'" A minority were frustrated by the pace or difficulty of the fishing, and especially by "blanking" or "skunking"—the experience of spending a day on the water without encountering any fish. One Australian angler, who came with a group of friends who were all finding the fishing more difficult than they expected, said on his fourth evening: "After the first day, I didn't take a fish. And I thought, my god, these are the fish of ten thousand casts. People said to me, how's your day? And I said, look, it was a beautiful day, in that you're out there and enjoying the environment, the wilderness, but it was really a hard day's fishing…very, very different to my anticipation and expectation of coming here." For him, the frustration of going multiple days without seeing a fish on the line outweighed the experience of "enjoying the environment, the wilderness." Overall, as typified by this interview, catch-related themes like this one dominated anglers' responses to questions about *satisfaction,* while activity-general themes were secondary. This contrasted with their responses about *motivation,* where catch-related and activity-general themes were almost equally prominent (Fig. 4).

3.4. Anglers' intentions to return

The model indicated significant negative utility for the alternative of not traveling to Mongolia to fish for taimen ($p = 0.02$), showing that anglers strongly preferred even an unsuccessful taimen fishing trip to no trip (Table 2). This would be a surprising result in many catch-oriented recreational fisheries, but the high prevalence of activity-general motivations in the taimen fishery revealed by the interview data suggest that it is realistic for taimen anglers to have a positive utility for a Mongolia fishing trip even if they catch no fish. However, this tolerance for unsuccessful trips did not translate into equivalent interest in future taimen trips. In interviews, only one angler expressed a definite intention to return to Mongolia to fish. Of the rest, thirteen said they would not return, eleven said they might under the right circumstances, and one was undecided (Fig. 5).

Fig. 5. Angler attitudes to a return trip. Bar plot showing the frequency of different attitudes to taking a return trip to Mongolia as expressed in interviews. On the right are selected quotes representative of each attitude.

The anglers who stated some intention to return mostly did so in vague terms, or only if certain conditions were met; for instance, if their children or friends became interested in the trip, or if they could expect better fishing in the future. Some weighed their mixed satisfaction with the experience against the longer-term population dynamics described by the guides, like one 53-year-old Welsh fisherman who had been frustrated with several "blank" days before catching four taimen in the span of an hour, including a 42-inch trophy fish: "I get the sense that this week has been quite slow compared to what the guides normally expect. And so I wouldn't come back to repeat the week, but I would be interested in coming back to something that [had] more action, and bigger fish around."

The anglers who said they would not return were mostly bucket-list travelers; that is, those who wished to collect a variety of experiences and achievements during their lifetime (Thurnell-Read, 2017), and who therefore rarely traveled to the same place twice regardless of their satisfaction with a particular fishing destination. One 53-year-old Englishman typified the bucket-list view: "Probably, I won't ever come back. Too big a world, too many places. And there's a finite amount of time physically I can do it, because this [kind of fishing] is quite a physical job; I won't be on this water when I'm seventy years old. [So] I don't go on holiday anywhere twice in my life." While overcoming logistical and physical challenges was part of his motivation for this first trip—"the fishing is the bit you do on the river, [but] there's [also] the traveling to it, preparing for it, planning for it, trying new places, new airports"—those same challenges posed a high barrier to a second trip.

As evident above, many anglers felt that the time and resources for a second trip could just as well go toward another bucket-list destination. They had many destinations to choose from; the more avid and experienced anglers in the study group participated in a wide range of recreational fisheries around the world. Common targets were bonefish and tarpon (*Megalops atlanticus*) in the Caribbean, sea run brown trout (*Salmo trutta*) in Patagonia, tropical reef fish like milkfish (*Chanos chanos*) and giant trevally (*Caranx ignobilis*) in the Seychelles, and a variety of salmonids in Alaska, Canada, and northern Europe. Some bucket-list anglers saved money to travel every two or three years, while others took expensive international trips multiple times a year to

a mix of old and new destinations. Though these anglers' target species were diverse, they were united in being large, visually unusual, aggressive, and best caught on specialized fly-fishing gear. They were also found in a range of scenic destinations in remote parts of low-income countries where anglers could experience a "human culture that is outside your normal experience, a long way from civilization." These traits matched the activity-general factors that motivated anglers to fish for taimen in Mongolia.

4. Discussion

This paper aims to investigate anglers' motivations for participating in a remote, high-threshold recreational fishery and to understand how these motivations could impact future fishery participation. We found a strong link to the "bucket list" cultural phenomenon (Thurnell-Read, 2017), where anglers were motivated largely by the prospect of accumulating a novel and exotic travel experience to catch an unusual fish. The size and morphological traits of the fish contributed to its appeal, while its perceived abundance and catchability were less important. This focus on size over expected catch rate adds to a growing literature assessing the catch-related preferences of anglers across a diverse range of fisheries (Hunt et al., 2019) and provides important information for guiding fishery-specific management, because strategies that maximize catch often require giving up size and vice versa (Hansen et al., 2015). More broadly, the importance of this "one and done" travel and fishing experience to anglers' motivations meant that satisfaction with the fishing itself was, for many anglers, a poor predictor of future participation in the fishery. The majority of anglers did not intend to return to the taimen fishery, and even those who expressed some interest in future participation were not strongly motivated to do so. We found that the high barriers to entry in the taimen fishery, especially its difficult logistics and physical demands, contributed to the appeal of a single trip but discouraged anglers from seeking out further experiences.

This finding contrasts with our usual understanding of angler participation in recreational fisheries as a functional response by individual anglers to their past experiences of catching fish "prey," mediated by the mechanism of satisfaction or dissatisfaction with prior fishing trips (Johnson and Carpenter, 1994). There has been a trend toward emphasizing specific catch-related goals and catch satisfaction, rather than general fishing motivations, as the primary drivers of future fishing effort (e.g. Robert Arlinghaus, 2006; Beardmore et al., 2011). However, our results show that in some contexts, anglers' general motivations for fishing, or for taking a particular kind of fishing trip, can be crucial to understanding their future fishery participation. In settings like the Mongolian taimen fishery, the desire to experience a bucket-list vacation and encounter a unique fish can outweigh expected catch rates and the availability of trophy fish in driving participant behavior. Therefore, we must tailor our theoretical assumptions about angler behavior and participation to the individual fisheries we study and especially to the goals and demography of participants, as previously argued by Beardmore et al. (2015).

Our study represents a first step toward filling a gap in the conceptual scope of the angler satisfaction literature. There is a large body of research on the relationship between angler site choice and travel distance, recently reviewed by Hunt et al. (2019), but few studies focus on fisheries characterized by extreme travel distances, difficult logistics, high costs, and intensive skill requirements. The Mongolian taimen fishery provides an excellent example of this high-threshold dynamic, given that the average angler surveyed here traveled thousands of kilometers to participate and paid approximately US$7000 plus travel expenses for a week of fishing. Additionally, its participants have access to a network of similar high-threshold bucket-list fisheries throughout the world, including sea run brown trout in Argentina, the salmon fisheries of Alaska and Canada, and tropical reef fisheries in the Caribbean and the Indian Ocean. The variety of options available to these anglers suggests that participation in a fishery like Mongolia's taimen fishery is best modeled not as a binary choice between participation and non-participation but as a multivariate decision about how to allocate fishing days among a set of globally distributed fishing options. Consequently, future participation in the taimen fishery, and other fisheries like it, may depend just as much on difficult-to-measure climatological and geopolitical factors as they do on maintaining abundant populations of the target species, as posited in the metacoupling framework proposed by Liu (2017). Water conditions in Argentina, the length of hurricane season in the Bahamas, and volatility in global financial markets, to give a few examples, could all have unseen ramifications for the year-to-year fishing effort in the Mongolian taimen fishery halfway around the world.

These dynamics are worth investigating because fishery participation by international anglers can have important local-scale economic and conservation consequences. Many high-threshold fisheries are in remote rural areas, meaning that the fisheries are significant economic drivers in places with few other sources of employment and income (Zwirn et al., 2005). But if fishery participation is in fact driven by global forces, these economic benefits could be unstable, causing unintended consequences like the employment precarity observed among tourist industry employees in the Seychelles (Lee et al., 2015). In addition, these specialized catch-and-release sport fisheries are particularly suited to being channeled into conservation solutions, as described by Cooke et al. (2016), because of the wealth and avidity of their participants and the resource stewardship norms that often accompany catch-and-release practices. One example is the growing fishery for mahseer (*Tor* spp.) in southern India, where catch-and-release angling organizations that place high value on this large and aggressive species have supported research and retrained former poachers as fishing guides (Pinder et al., 2015; Pinder and Raghavan, 2013; Raghavan et al., 2011). But if fishery participation by wealthy international anglers varies greatly from year to year, funding and human capital for these efforts will fluctuate as well, and the community of anglers may be too fragmented to share the social norms and best practices that enable good conservation outcomes.

Fisheries that attract bucket-list anglers pose particular sampling and generalizability challenges in human dimensions research because they possess a high proportion of anglers who, by definition, are unlikely to return. Much of the angler satisfaction and recreational fishing participation literature describes—or assumes—a relationship between future effort and aspects of the angler experience on previous fishing trips (Johnson and Carpenter, 1994). The bucket list angler has no plans to return, regardless of the experience, and the current pool of bucket list anglers will not necessarily reflect the demography and decision-making process of future participants. Therefore, the population of potential anglers for a fishery of this type is inherently diffuse and poorly defined, requiring researchers to reach for creative sampling and data collection methods to understand and anticipate future fishery participation. One possible avenue is to compensate by collecting richer data on the sampling pool that is available, for instance by combining conventional surveys with qualitative techniques like focus groups and interviews. This approach has been used extensively to inform and enrich discrete choice experiment results in health (Coast and Horrocks, 2007), transportation (Pineda Jaramillo et al., 2016), and other fields (Que et al., 2017). However, there are still relatively few examples of research combining discrete choice methods and semi-structured interviews in fisheries, especially in a recreational context (Carr and Heyman, 2016). In addition, the examples that do exist tend to use interviews mostly to gather quantitative data or guide survey development (e.g Ward et al., 2013). While this is a useful approach, it does not take advantage of the key strength of qualitative data: the rich insight it provides into the thoughts and motivations of others (Weiss, 1995). Our approach of pairing surveys with simultaneous in-depth interviews allowed us to harness this strength and compensate for the limited sample size by gathering rich, in-depth data from each individual participant using mixed quantitative-qualitative methods.

5. Conclusion

In summary, we found that anglers are motivated to fish for taimen in Mongolia by a mix of catch-related and activity-general factors, particularly the size and morphology of the species and the chance to fish in a destination perceived as an exotic, pristine wilderness. Many anglers were bucket-list travelers who rarely fished in the same place twice but instead allocated their fishing effort among a variety of expensive, remote, and specialized fisheries for unusual fish, often in developing countries. We collectively label these fisheries as "high-threshold" fisheries because of the barriers to participation posed by their location, cost, skill requirements, and other factors. We argue that the populations of anglers who surmount these barriers are qualitatively different from their counterparts in more accessible fisheries and that fisheries with these traits require research approaches that recognize the unique niche they occupy. Such study is especially urgent since many of these high-threshold fisheries are in developing countries with little funding for proactive research and fishery management, leaving scientists at risk of "following fisheries around" (Neis, 2011) and focusing attention only where crises have already occurred.

CRediT authorship contribution statement

Abigail S. Golden: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing - original draft, Visualization, Project administration, Funding acquisition. **Christopher M. Free:** Methodology, Software, Validation, Writing - review & editing, Visualization. **Olaf P. Jensen:** Conceptualization, Writing - review & editing, Supervision, Funding acquisition.

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Appendix A. Supplementary data

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