ECONOMICS OF THE OKLAHOMA PADDLEFISH FISHERY

FINAL REPORT

PREPARED FOR:
PADDLEFISH RESEARCH CENTER
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SUMMARY

- We analyzed paddlefish angler expenditure and travel data to measure the economic impacts and economic value of the fishery.

- Paddlefish anglers' trip expenditures have an annual economic impact of $18.2 million.

- Each year spending by paddlefish anglers generates $449,087 in state sales tax revenue.

- Based on anglers' stated willingness to pay, the economic value of the paddlefish fishery in Oklahoma is worth $12.7 million per year.

- We also used data from fishing trips and a choice experiment to measure the effect of a hypothetical catch-and-release rule. Our model predicts that if catch-and-release was applied statewide the number of fishing trips would fall to slightly more than half of the current level.

INTRODUCTION

The importance of paddlefish as a game species in Oklahoma can be measured in two ways. First, fishing for paddlefish is a popular sport and a source of food. This makes the species valuable to individual anglers and a significant share of the fishing community. Second, paddlefish affect local economies by drawing in anglers whose spending on fishing-related goods and services is a source of business income. These two aspects make paddlefish an important resource to anglers and non-anglers alike.

Paddlefish are managed as a limited harvest fishery in Oklahoma. The species is susceptive to overharvesting, and maximizing sustainable productivity requires careful management. Despite historically low catch rates, the number of paddlefish anglers is growing rapidly. The Oklahoma Department of Wildlife Conservation (ODWC) observed repeated annual increases in the number of paddlefish anglers between 2008 (13,098 anglers) and 2014 (22,649 anglers)—an increase of over 70%–despite a decline in the annual bag limit to two fish in 2014 (Jager 2016). Additional restrictions may become necessary if harvest pressure continues to increase.

This report summarizes research conducted as part of a grant from the ODWC and the Paddlefish Research Center (PRC) to measure the economic importance of Oklahoma's paddlefish fishery. The goal of this project is to provide a richer understanding angler behavior and the fishery's contribution to local economies. The specific aim of this report is to provide economic information that complements on-going human dimensions and biological paddlefish research.

This project measured the economic impact of the paddlefish fishery in Oklahoma and its economic value to anglers. This information was acquired through an input-output model of economic activity and an econometric model of willingness to pay. The former provides estimates of the effect of the fishery on local economies. The latter is used to measure the fishery's value to an individual angler or a group of anglers. The estimate of the value of the fishery was developed through a direct elicitation method (by asking anglers how much they are willing to pay to access the fishery).

The models developed using the project data can be used as source of information about the effects of management on the "demand side" of the fishery. Although examining management scenarios was not a project objective, one application is presented below to demonstrate the potential of this research.

ECONOMIC IMPACT AND ECONOMIC VALUE

This report provides information on the economic importance of the paddlefish fishery using two different metrics: economic impact and economic value. This section describes these two metrics.

Economic impact is based on the amount of spending brought into a region associated with an activity, such as a fishing trip. This spending affects income levels, jobs and tax revenues within a region. Economic impact analysis uses input-output modeling to identify changes in expenditure flows through an economy. This analysis often identifies regional multiplier effects, where a dollar of direct spending generates additional spending within the region. For example, an angler's spending on gas and bait causes gas stations and bait shops to purchase more from wholesalers; if these "indirect" purchases are carried out within the region of the fishing site, then there is a corresponding expenditure multiplier effect. Similarly, if the owners of the gas station and bait shops earn more income from the angler's spending and use that income to purchase local goods and services, there are "induced" purchases that add to the multiplier effect. The regional economic impact of recreational fishing is calculated by multiplying the number of anglers that travel to a region with the average spending of these anglers, and then the multiplier.

Economic value (often referred to simply as "value") is the maximum amount a consumer is willing to pay for a good or experience. The economic value of a fishing trip is therefore the most an angler is willing to pay to take the trip, or the trip cost where they would be nearly indifferent between taking the trip or not going fishing. In general, goods are only consumed or purchased by someone if the cost is less than what that person is willing to pay. Economists refer to the difference between economic value and cost as the consumer's surplus or net economic value. For example, if an angler has to spend $25 on gas and bait to take a fishing trip, but they were willing to pay up to $100 on gas and bait, then the net economic value of the trip to the angler is $75. Estimates of net economic value are useful in measuring the gains from environmental management decisions and can be used in cost-benefit analysis. For example, if the cost of adding a fishing dock to a lake is $100,000 but the sum of the net economic values from all of the fishing trips drawn to the lake (at present and into the future) as a result of the dock is $150,000, then cost-benefit analysis suggests society is better off building the dock.

Although economic impact and economic value are both usually denominated in terms of money, they are different measures. The simple distinction is that economic impact is spending related to an activity brought into a region, which may be offset by forgone spending in other regions, whereas economic value is a measure of the welfare benefits to individuals from an activity. Furthermore, economic impact analysis can be used to predict how a regional economy will change as a result of an activity, while cost-benefit analysis can be used to determine whether society is better off doing one activity versus doing nothing (or an alternative activity).

METHODS

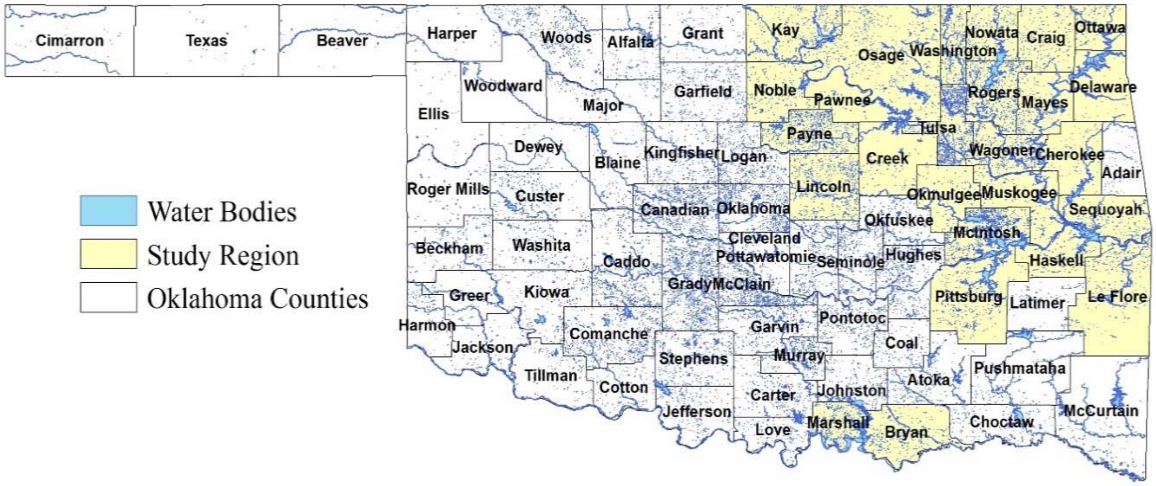
Economic impact analysis

We used an input-output model of paddlefish angler spending to estimate the economic impacts of the fishery, and how spending brought into the region affects incomes, jobs and tax revenues.

The input-output model was developed using the software IMPLAN and 2014 county-level data. IMPLAN uses an inter-industry matrix to track the flow of expenditures originating in one economic sector to other economic sectors. Sector linkages can produce regional multiplier effects, where a dollar of direct spending generates additional spending within the region. The size of multiplier effects depends on the geographic scope of the activity under scrutiny and the scale and spatial scope of sector linkages. Multiplier effects include “indirect” effects and “induced” effects. For example, an angler’s spending on gas and bait causes gas stations and bait shops to purchase more from wholesalers; if these “indirect” purchases are carried out within the region of the fishing site, then there is a corresponding expenditure multiplier effect.

For the purposes of this study, angler spending was extrapolated from expenditure data collected as part of a broader survey of paddlefish permit holders conducted by ODWC in 2015. Anglers were asked to report their spending on food, transportation, lodging, gear purchased, boat rental and guide services, government fees/licensing, and other for their most recent fishing trip. The geographic scope of the analysis includes all counties around the primary paddlefish fishing sites, as indicated by the counties shaded yellow in Figure 1. These data are discussed in more detail below in the results section, beginning on page 12.

Figure 1. Counties included in the study region.



Economic valuation

We used contingent valuation (CV) to measure the economic value of the fishery. Specifically, we used a payment card-style CV method to directly elicit the lower-bound economic value that an angler has for access to paddlefish fishing. In this method, an individual is presented with a resource, explained the need to pay for the resource, and asked to indicate from among a list of amounts the maximum they are willing to pay for the resource of interest (Haab and McConnell 2002). The following question was asked in the 2015 mail survey of paddlefish permit holders for this purpose:

> The costs of a fishing trip tend to change over time, for example, due to changes in the price of gas and supplies. For the most recent trip taken to fish for paddlefish in Oklahoma, what is the maximum you would be willing to pay in gas and other fishing costs and still take the trip, rather than stay home and not fish at all?

Respondents then had the option to choose one of twelve values, including $10, $20, $30, $40, $50, $75, $100, $125, $150, $200, $300 and $500. The basic idea behind this type of payment mechanism is that anglers must spend money to go fishing, which can be used to measure anglers' maximum willingness to pay for paddlefish fishing. The structure of this question allows us to use the responses to measure the economic value of a fishing trip for paddlefish.

We use a Turnbull non-parametric approach to estimate the economic value of a trip. This provides a lower bound estimate of the actual value (Haab and McConnell 2002). This estimator is

$$Value_{CV} = \frac{1}{T}\sum_{k=1}^{12} t_k T_k \tag{1}$$

where T is the total number of respondents, $t_1,\ldots,t_{12}$ are the 12 payments arranged in ascending order, and T_k is the number of respondents who pick t_k, k=1,…,12.

The payment card CV method is easy to implement in practice. A weakness of this method is that the range of amounts offered could influence the response (Mitchell and Carson 1989). For some individuals, the maximum amount on the card may be lower than their maximum willingness to pay. The smallest and largest amounts or the range could also bias responses in a manner that leads to reported values that move away from the actual value toward a value, say, in the middle of the range.

Using the CV method, the economic value of a season of paddlefish fishing is calculated by multiplying the amount from equation (1) by the aggregate number of paddlefish fishing trips in a year. Note that this is not a measure of consumer surplus because the CV question frames the payment as a gross amount, rather than a net amount—i.e. how much a respondent is willing to pay in addition to what s/he already pays. However, net economic value can be calculated by subtracting the average trip cost from equation (1). Because the Turnbull estimator provides a lower-bound estimate of economic value, presumably the estimate of net economic value will be a lower bound, too.

Effects of catch-and-release

We used a participation and site choice model (Haab and McConnell 2002) of recreational fishing the measure the effect of catch-and-release on demand for the fishery.

Site choice models of recreation demand explain observed trip patterns in terms of the attributes a trip-taker would experience at different sites. An angler's site choice reveals their preference for site attributes, and how much they are willing to spend (in terms of travel cost). These models can be generalized to include an outside alternative to not fish. Our model includes this no-fish option. In brief, an individual angler i who chooses alternative j (which could be to not go fishing) on choice occasion t gets a value of

$$\begin{aligned} U_{ijt} &= V_{ij} + \varepsilon_{ijt} \\ &= \rho\left(y_i - p_{ij}\right) + \beta_i q_{ij} + \varepsilon_{ijt} \end{aligned} \tag{2}$$

where y_i is the angler's income, p_{ij} is the travel cost to the site, q_{ij} is a vector of other relevant site attributes and ε_{ijt} accounts for random factors. The vector of site attributes includes variables for daily catch, dummy variables for river, the presence of the catch-and-release rule, and interactions between these three variables and indicator for boat use and a count of years fishing experience. The coefficients represented by Greek letters are parameters to be estimated. These parameters indicate the relative contribution of each attributes to the angler's choice and therefore the angler's overall satisfaction from that choice.

The model is estimated and parameterized using a combination of revealed preference (RP) and stated preference (SP) fishing trip data. RP data is information about actual trips. SP data comes from hypothetical choices. In the survey, anglers could indicate how many actual trips they took among sixteen regions in Oklahoma (Figure 2), not including a write-in option. Each of these regions is a fishing site in the choice model. The sample includes anglers who intentionally bought a license but who did not fish. In a repeated site choice model, the season is divided into a series of *choice occasions*. In each occasion, anglers decide whether to take a trip, and if so, where to fish. We developed a model that divides the season into 5 choice occasions. This required that we truncate the trips of about 10% of respondents (Shaw and Ozog 1999). Of the respondents who fished at least once, the median number of trips was 2 and the average was 3.9.

The hypothetical trip data was collected from a choice experiment (CE) in the 2015 survey. In the CE, respondents were asked to indicate their preference among three alternatives—two paddlefish sites and a no-fish, stay-at-home option. The CE question described the fishing alternatives with four attributes: daily catch, keep limit (a catch-and-release rule), the type of water body and distance from the angler's home (Figure 3).

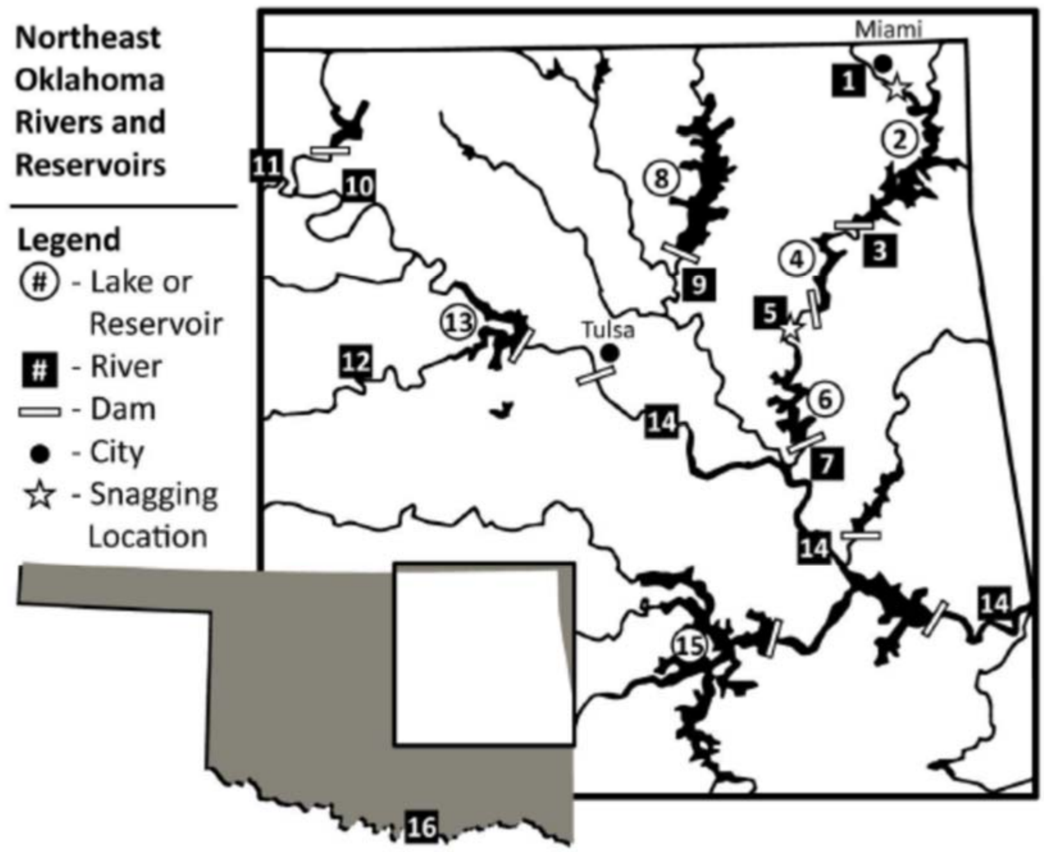


Figure 2. Oklahoma's paddlefish regions.

5. Suppose you are trying to decide whether to fish for paddlefish and there are two sites from which to choose. The sites have different characteristics as shown in the table, but otherwise they are the same (they have the same scenery and the same number of anglers). Please compare the sites and check one box to indicate if you prefer Site A, Site B or to stay home.

	Site A	Site B	Stay Home
Typical daily paddlefish catch	10	20	I would prefer to stay home if these were my only choices.
Paddlefish daily keep limit	0	1	
Water body type	lake	river	
Miles from your home	5	125	
Which would you choose?	☐	☐	☐

Figure 3. A trial version of the choice experiment developed for the 2015 paddlefish angler survey.

Parameterizing the site choice model with either RP or SP data each has advantages and disadvantages. The SP data contains information about only one choice occasion, so it cannot be used to model repeated site choices. However, the SP data has variation in the daily keep limit, and can be used to identify the effects of a catch-and-release rule on participation and site choice. The RP data cannot be used to measure the effects of catch-and-release on the demand for paddlefish fishing. To overcome the weaknesses in both types of data, and specifically to predict the effects of catch-and-release on behavior, this report uses a model developed from pooled SP and RP data.

Model estimation that combines actual and hypothetical data has gained widespread acceptance in economic research. Ideally, combined data should be gathered in the same behavioral context, but when the preference structure that generates the actual data and the hypothetical data is different simple estimation of the unified behavioral model may be inappropriate. This could be the case with the paddlefish trip data because, among other differences, the RP data comes from a choice set of 16 fishable alternatives plus the no-fish option, while the SP data comes from a choice set of 2 alternatives plus the no-fish option. The existing literature notes that the analyst must control for differences in the error variance or “scale factor" between the actual and hypothetical choice occasions when estimating choice models with a conditional or generalized multinomial logit. This allows the modeler to control for the fact that one data set may be "noisier" than the other. In the case of the conditional logit, the probability of choosing *j* is

$$prob_i(\text{choose } j) = e^{V_{ij}/\sigma_m} \Big/ \sum_{k=1}^{A_m} e^{V_{ik}/\sigma_m} \quad (6)$$

where σ_m is the scale factor. In estimating a discrete choice model on the combined data we allow the scale factor to differ between *m* = RP, SP. It is not possible to separately identify σ_{RP} and σ_{SP}, so we estimate the relative scale parameter on the RP choice occasions. See the manuscript by Cha and Melstrom (2017), which is attached to this report, for complete details on the model used in this report.

Using the model developed from the combined RP and SP data, we predict changes in site choice if the daily keep limit was reduced to zero 1) at the Miami fishing location and 2) statewide.

DATA

The ODWC provided us data from the 2015 paddlefish angler survey (Jager 2016). For the 2015 survey, 12,000 randomly-selected fishing license holders were mailed a pre-notification postcard, followed in a few days by a questionnaire and cover letter with a postage-paid reply envelope, with a second mailing to non-respondents a few weeks later. A large mailing sample is necessary because a significant portion of permit holders unintentionally received a permit with no interest in participating in the fishery. The response rate was 20%, of which 40% indicated unintentionally receiving their permit and 32% reported fishing for paddlefish in the previous season. The ODWC partly attributes the low response rate to the indifference of unintentional permit holders to respond to the survey.

The survey collected expenditure data about respondents' most recent trip. Anglers who omitted any response to this question were excluded from the analysis; that is, we did not assume non-response implied zero spending. However, among respondents who reported spending in at least one category, we assumed that spending in the unmarked categories was zero.

We modified the RP data of a few respondents. We found that we were able to reallocate nearly every trip recorded in the write-in option to one of the 16 sites in the model. We dropped respondents who indicated that they unintentionally received a license. We also dropped respondents who traveled from a state other than Oklahoma, Arkansas, Kansas and Missouri, i.e. long-distance travelers. We retained respondents who intentionally received a license but did not take a trip.

Both the RP and the SP data included information about travel distance, daily catch, and whether the site was a lake or river. A travel cost variable was constructed using travel distance, per mile driving cost and wage rate (to account for the cost of their time) information. Travel distance and time were estimated from anglers' home zip code to the site zip code using PC*Miler software. An angler's wage rate was estimated using the household income level they reported in the survey. The midpoint of each respondent's income category from one of six possible categories on the questionnaire was taken as their income level. The sample average income was used for anglers who did not report their income. We then used one-third of this income divided by 2000 to proxy for the cost of travel time (Melstrom et al. 2015). We assumed a driving cost of $0.28 per mile and a driving speed of 45 miles per hour. Finally, travel costs were calculated as round-trip distance in miles times per mile driving costs plus the opportunity cost of travel multiplied by travel time.

For the RP data, daily catch was calculated as the average reported catch at each site. The relative effect of a site being a river versus a lake was captured by a dummy variable for rivers.

Respondents saw different levels of the fishing site attributes in the CE. Daily catch could be 4, 8, 12 or 16 fish, the keep limit was either 0 or 1, water body type was described as river or lake, and distance could be 25, 50, 75, 100 or 125 miles. To construct the CE scenarios, the levels were arranged into a full factorial design and the two fishing alternatives were randomly paired together. This produced 96 versions of the choice experiment (Hensher et al. 2015). Each survey contained a single CE.

RESULTS

Economic impact analysis

Anglers were asked how much money they spent for the purpose of their most recent fishing trip to one of 16 sites in Oklahoma; 481 surveys contained usable expenditures data. However, 665 respondents did indicate their length of trip, and 57.6% indicated that their trip was 1 day or less; trips are classified as either day or overnight trips, as the expenditure profile is different across these groups. One would expect that overnight trips would yield higher expenditure levels, not just because of lodging expenses but because they drive longer distances and have larger food expenditures. Similarly, two-thirds of all respondents (943) provided their home zip code as being outside of the study region – the yellow shaded counties in Figure 3[1]. (The study area is defined as those counties around the primary paddlefish fishing sites, and it includes the following counties: Bryan, Cherokee, Craig, Creek, Delaware, Haskell, Kay, LeFlore, Lincoln, Marshall, Mayes, McIntosh, Muskogee, Noble, Nowata, Okmulgee, Osage, Ottawa, Pawnee, Payne, Pittsburg, Rogers, Sequoyah, Tulsa, Wagoner and Washington.) Based upon these proportions, the survey responses are projected to reflect total expenditures associated with paddlefish fishing trips. We estimate a total of 88,672[2] trips for paddlefish fishing occurred in 2015; of these, we estimate 59,178 are by out of region (or nonlocal) anglers, and 34,083 were day trips and 25,095 were overnight trips.

The expenditure information is categorized into transportation (gas, car rentals), food and beverages, lodging (motels, camping), bait and fishing gear, boat rentals and guide services, government fees (includes boat stickers, launch fees, and fishing licenses) and other expenditures (includes other activities pursued while in Oklahoma for paddlefish, such as gaming at a casino). Descriptive statistics of the fishing trip expenditures broken down by category are reported in Table 1. On average, a paddlefish angler on an overnight trip would spend $71 on food, $83 on lodging, $55 on gear, $53 on boats and/or a guide, $87 on gas, $1 on government fees, and $4 for other items. In contrast, an angler on a day trip will spend on average $22 on food, $8 on lodging, $32 on gear, $34 on boats and/or a guide, $37 on gas, $2 on government fees, and $2 on other items.

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[1] Economic impact analysis assumes that all expenditures included in the analysis originate from outside of the region of study, and therefore represent new expenditures in the study region's economy; residents' expenditures related to paddlefish fishing would already be included in the model, so including their expenditures in the analysis is a form of double-counting.

[2] Calculated as total permits issued × % who intended to buy permit /100 × average annual trips of intentional permit holders: 84,362 × 0.602 × 1.746 = 88,672.

Table 1. Paddlefish anglers' expenditures by trip duration.*

	Overnight Trips			Day Trips		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Food	$71	$0	$500	$22	$0	$200
Lodging	$83	$0	$1,200	$8	$0	$300
Gear	$55	$0	$350	$32	$0	$1,200
Boat Rentals/Guides	$53	$0	$600	$34	$0	$350
Transportation	$87	$0	$800	$37	$0	$400
Government	$1	$0	$55	$2	$0	$60
Other	$4	$0	$400	$2	$0	$500

Estimating the economic impact of paddlefish fishing in Oklahoma requires several assumptions. First, we assumed that any paddlefish fishing trip would have gone to an out-of-state paddlefish fishing site had Oklahoma not had paddlefish. Second, we assumed that the average expenditure for all paddlefish anglers is equivalent to the average expenditure from the survey. Third, we utilized the estimates of day and overnight trips based upon the survey responses, implicitly assuming that these are representative of the paddlefish angler population, and an estimate of total trips derived later in this report. Based upon the above stated assumptions, Table 2 presents the estimated expenditures used in this analysis.

Table 2. Annual expenditures in the study region from out-of-region paddlefish anglers

	Overnight trips	Day trips
Food	$1,786,086	$766,068
Lodging	$2,089,455	$287,708
Gear	$1,381,986	$1,075,344
Boat Rentals/Guides	$1,319,014	$1,161,084
Transportation	$2,188,662	$1,277,845
Government	$25,095	$54,187
Other[3]	$110,231	$75,888
Total	$8,900,528	$4,698,124

While the total expenditure of Table 2 represents spending in Oklahoma due to paddlefishing, they do not equal the direct impact values in Tables 3 and 4; this is due to retail margining. Retail margining refers to the fact that the gasoline or fishing gear purchased were not produced in the retail stores in which they were purchased; instead, a retail store is really providing a convenient service by selling the products in a desirable location. The retail mark up, then, represents the price consumers are willing to pay for the convenience and/or experience of going to a store and purchasing the item immediately (i.e., one does not have to wait for the product to be shipped and often the product can be compared to

[3] These expenditure estimates were generated averaging reported "other" expenditures across all respondents.

others before purchasing). The direct impact in Tables 3 and 4 represents only the retail markup charged by the stores and does not include the cost to manufacture the products themselves; so of the reported $4.7 and $8.9 million in expenditures from the anglers making day or overnight trips, respectively, only $2.2 and $4.6 million represents amounts that remain in the study region. The indirect impacts, $0.9 or $1.8 million, in Tables 3 and 4 represents the additional goods and services that are purchased locally by the stores in order to provide the fishing gear, food, lodging and gasoline for purchase, such as the lease amounts paid by the stores and the electricity they consume. The induced impacts, $2.8 and $5.8 million, of Tables 3 and 4 represents the spending induced by wages earned at the stores where fishing gear, food and gasoline were sold. Summing the direct, indirect and induced impacts together yields the total impact, as reported in the last column of Tables 3 and 4, or $5.9 and $12.3 million.

Table 3. Economic impact of estimated paddlefish fishing day trip expenses in Oklahoma.

	Employment	Labor Income	Output
Direct Effect	37.1	$787,529	$2,244,508
Indirect Effect	5.9	$264,568	$892,963
Induced Effect	22.2	$1,023,144	$2,782,646
Total Effect	65.1	$2,075,240	$5,920,118

Table 4. Economic impact of estimated paddlefish fishing overnight trip expenses in Oklahoma.

	Employment	Labor Income	Output
Direct Effect	70.0	$1,502,419	$4,684,669
Indirect Effect	12.2	$551,612	$1,820,170
Induced Effect	46.1	$2,131,569	$5,775,358
Total Effect	128.2	$4,185,600	$12,280,197

State sales taxes collected from persons fishing was collected on the non-margined expenditures, or the amount reported in Table 2, plus a proportion of the induced impact, which represents household spending, from Tables 3 and 4. Sales taxes are only collected on goods and services, at a rate of 4.5%. (Cities and counties may also levy sales taxes, but our analysis is limited to the impact on state government revenues.) The following categories, then, are subject to sales tax for this analysis: food, lodging and gear. (Boat rentals are also subject to sales taxes, but guide services dominate the expenditures in this category, and services are not subject to sales tax. Also, "other" is dominated by services not subject to sales taxes, like casino gambling, so we exclude this category also from the sales tax generation calculation. Gasoline sales are also not subject to sales tax.) To calculate the estimated sales taxes generated by the induced impacts, it is assumed that 30.3%[4] of output is spent on taxable items; therefore, we assume that $2,593,075 of the induced output is subject to sales taxes. Table 5 presents the estimated amounts, by category, of sales taxes collected due to paddlefish trips to Oklahoma. In total, an estimated $449,087 of sales tax revenue is generated due to paddlefish trips.

Table 5. Estimated sales tax collections due to paddlefish angler expenditures.

	Sales Tax Generated
Food	$114,847
Lodging	$106,972
Gear	$110,580
Induced Impact	$116,688
Total	$449,087

[4] This proportion is derived by estimating total sales subject to sales tax (dividing total sales tax collections for June 2015, available from the Oklahoma Tax Commission) and dividing total sales by total personal income in 2015 from the United States Bureau of Economic Analysis.

Economic valuation

The willingness to pay response percentages are reported in Table 6. After excluding unintentional permit holders, the number of usable responses for this analysis is 663. More than 50% of these anglers say the maximum they are willing to pay is $100 or more. The estimator in equation (1) implies a trip value of $160. The average travel cost to visited sites in the sample is $21. This implies the net economic value of a trip is $143 on average. Based on the estimate of 88,672 paddlefish fishing trips in 2015, and using the value of a trip from the CV method, we estimate that the economic value of the fishery is about $12.7 million.

Table 6. The amounts respondents' picked in the payment card question

Amount ($)	Share of respondents (%)	Cumulative share (%)
10	2.41	2.41
20	4.68	7.09
30	4.37	11.46
40	5.43	16.89
50	13.57	30.47
75	7.99	38.46
100	16.14	54.60
125	2.11	56.71
150	8.30	65.01
200	11.76	76.77
300	12.37	89.14
500	10.86	100.00

To put this value into context, Melstrom et al. (2015) estimate the average net economic value of a sportfishing trip in Oklahoma is $60. The value of the paddlefish fishery compares favorably with the most popular fisheries in the state. Approximately 148,000 fishing trips go to Lake Thunderbird in a year, which implies that the annual net economic value of the Thunderbird fishery is $8.9 million. Approximately 385,000 fishing trips go to Grand Lake in a year, which implies that the annual net economic value of the Grand Lake fishery is $23.1 million.

Effects of catch-and-release on demand

We next used a participation and site choice model estimated on the combined RP-SP data in Cha and Melstrom (2017) to predict changes in site choice if a catch-and-release rule was applied to one or more sites. First, we would like to note that in the CE anglers did not entirely avoid the sites with a catch-and-release rule. About 50% of the CEs included one site with catch-and-release, while about 25% had catch-and-release at both sites. However, about 33% of the time anglers preferred the catch-and-release site over the site with a keep limit or the no-fish option.

Table 7 shows the percentage of trips taken to each alternative, including the no-fish alternative, predicted by the model. The predictions are made for three scenarios: (1) status quo conditions, (2) requiring catch-and-release fishing at the Neosho River site and (3) requiring catch-and-release fishing at all sites.

The model predicts the number of trips to site 1 will decrease by a little more than half when catch-and-release is required at that site. Specifically, the model predicts the percentage of trips taken to site 1 will fall from 11% to 5% after the introduction of catch-and-release. The model also predicts about half of the 6% of trips which are diverted from the Neosho River due to catch-and-release regulations will go to other sites, rather than exiting the fishery.

The model predicts a larger percentage of trips will not be taken if catch-and-release is required at all sites. Compared with current conditions, the model predicts the share not fishing on a given choice occasion will increase from 61% to 78% if catch-and-release is carried out statewide, which implies that the number of total fishing trips taken for paddlefish will fall to slightly more than half of the current level.

Table 7. Percentage of trips going to each alternative – actual and predicted for three scenarios. We assume each paddlefish angler has five opportunities to go fishing for paddlefish in the year.

Site	Actual visits	Predictions		
		Status quo	Catch-and-release at Site 1	Catch-and-release statewide
Neosho River above Grand Lake	13.0%	10.5%	4.8%	5.9%
Grand Lake	4.5%	3.6%	3.9%	2.0%
Grand River below Grand Lake	3.3%	2.7%	2.9%	1.5%
Hudson Lake	0.6%	0.5%	0.5%	0.3%
Grand River below Hudson Lake	12.2%	9.5%	10.2%	5.4%
Fort Gibson Lake	2.6%	2.1%	2.2%	1.2%
Grand River below Fort Gibson Lake	2.8%	2.2%	2.4%	1.3%
Oolohah Lake	0.2%	0.1%	0.2%	0.1%
Verdigris River below Oologah Lake	1.0%	0.8%	0.8%	0.4%
Arkansas River above Keystone Lake	2.6%	2.1%	2.2%	1.2%
Salt Fork River	0.6%	0.4%	0.5%	0.2%
Cimarron River	0.3%	0.2%	0.2%	0.1%
Keystone Lake	0.9%	0.6%	0.7%	0.4%
Arkansas River below Keystone Lake	1.3%	1.0%	1.1%	0.6%
Eufaula Lake and tributaries	0.4%	0.2%	0.2%	0.1%
Texoma Lake and tributaries	0.4%	2.4%	2.6%	1.4%
No-fish	53.7%	61.0%	64.6%	77.9%
total	100.0%	100.0%	100.0%	100.0%

CONCLUSION

The contribution of the paddlefish fishery to Oklahoma is economically significant. Angler expenditures generate economic output of $18.2 million each year. This output supports 193 jobs and $449,087 in state sales tax revenue. To individual anglers, the average economic value of a trip is $143. In addition, we found demand for the fishery would be negatively affected by catch-and-release, but that this effect varies in proportion to the number of affected sites. If catch-and-release is established at only one or a few sites, the total effect on participation will be modest.

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