

Analyzing State Fishing License Sales Trends:

An analysis of state and national trends in fishing license sales from 1991 to 2016

May 2019



RECREATIONAL
BOATING & FISHING
FOUNDATION



SOUTHWICK
ASSOCIATES



Prepared by Southwick Associates

Executive Summary

The national trend in fishing participation shows an increase in license sales during recent years, but not every state has shared in this growth. Some states have grown sportfishing participation at a rate that outpaces population growth, while other states have struggled to increase fishing participation. While there are many different factors that affect a state's fishing participation rate, there are common factors for growth shared by many states.

This project employs multivariate approaches for 12 states to identify which factors had the greatest positive and negative effects on fishing participation rates over a 25-year period. By determining which factors drive increases and decreases across states and then identifying those that can be influenced by state recruitment, retention and reactivation (R3) efforts, we can improve R3 approaches and strategies resulting in greater license sales and participation.

Most states that have increased fishing participation rates over the past 10 years have created wide-reaching R3 programs, often with coordinated marketing and communications strategies. In addition to R3 programs of this nature, implementing multi-year licenses and licenses valid for one year from the date of purchase positively affected every state in which they were implemented, including states with overall declining trends. Although not all findings are statistically significant, these factors analyzed here have a positive impact on participation rates, showing that there are actions that can be taken by any state in order to positively affect license sales and participation rates even in states with overall declining participation.

Ramping up large scale R3 efforts, simplifying license structures, and offering multi-year and 365-day licenses would likely increase fishing participation rates in many states. Responsive programming that addresses the needs of a state, such as meeting an urbanizing population with urban fishing initiatives, will have the greatest impact. Furthermore, there are likely other approaches that were not tested in this project that are worthwhile. While there are no guarantees that all of these will work in every state, these insights will help steer states' efforts and foster the growth of sportfishing participation.

Table of Contents

Executive Summary.....	i
Table of Contents	ii
List of Tables.....	iii
List of Figures	iii
Introduction	1
Methodology	2
Region of Study.....	2
Definitions	3
Results	6
Variables of Interest.....	7
Dependent Variable	7
License Variables.....	7
Regulatory Variables.....	8
Environmental.....	9
Economic	10
Other	11
State Models - Detailed Results.....	12
Arizona	13
Connecticut.....	15
Florida.....	17
Georgia.....	19
Idaho.....	21
Indiana.....	23
Kansas	25
Mississippi.....	27
Missouri.....	29
Pennsylvania	31
Wisconsin	33
Wyoming.....	35
Conclusion.....	37
References	39

List of Tables

Table 1. Overview of Variables	6
--------------------------------------	---

List of Figures

Figure 1. Region of Study.....	2
Figure 2. Fishing Participation in Arizona, 1991 to 2016	14
Figure 3. Fishing Participation in Connecticut, 1991 to 2016	16
Figure 4. Fishing Participation in Florida, 2001 to 2016	18
Figure 5. Fishing Participation in Georgia, 1991 to 2016.....	20
Figure 6. Fishing Participation in Idaho, 1991 to 2016	22
Figure 7. Fishing Participation in Indiana, 1991 to 2016	24
Figure 8. Fishing Participation in Kansas, 1991 to 2016	26
Figure 9. Fishing Participation in Mississippi, 1991 to 2016.....	28
Figure 10. Fishing Participation in Missouri, 1991 to 2016	30
Figure 11. Fishing Participation in Pennsylvania, 1991 to 2016	32
Figure 12. Fishing Participation in Wisconsin, 1991 to 2015.....	34
Figure 13. Fishing Participation in Wyoming, 1991 to 2016.....	36

Introduction

From 2011 to 2016, the number of licensed anglers in the United States increased by 2 million anglers, from 28 million to almost 30 million.¹ During the same time, the national fishing participation rate, which describes the percent of the population that holds a valid fishing license, increased from 8.95% to 9.40%. However, while the nation is increasing overall participation, some states are not experiencing this growth in anglers. Across the U.S., changes in fishing participation are occurring in different directions and with different magnitudes. The focus of this project is to understand which factors, if any, can be shown to have significant positive effects on fishing participation, so that all states may understand the tools available to achieve long term, sustainable growth in fishing participation.

Many factors external to a state's governing agency contribute to changes in fishing participation within a state. For example, environmental conditions, including temperature and precipitation, affect anglers' decisions about whether to participate in fishing during a given year. Additionally, economic and demographic factors, such as unemployment rates, levels of disposable income, and the average age of a state's population, can all affect fishing participation.

While many external elements influence fishing participation, there are many controllable factors that can affect change from within governing bodies. The structure of the fishing license market, a state's recruitment, retention and reactivation (R3) programming efforts, and the suite of fishing licenses offered can all affect fishing participation. Of the twelve states analyzed in this project, half had enacted a large-scale R3 program; all of the R3 programs analyzed had a positive impact on their respective state's fishing participation rate. Both states that incorporated 365-day licenses valid for one year from the date of purchase were positively impacted by this implementation, as were the six states that began offering multi-year or lifetime license options.

This project was organized and funded by the Recreational Boating & Fishing Foundation (RBFF), with additional funding support from the American Sportfishing Association and the National Marine Manufacturers Association.

¹ <https://wsfrprograms.fws.gov/subpages/licenseinfo/fishing.htm>

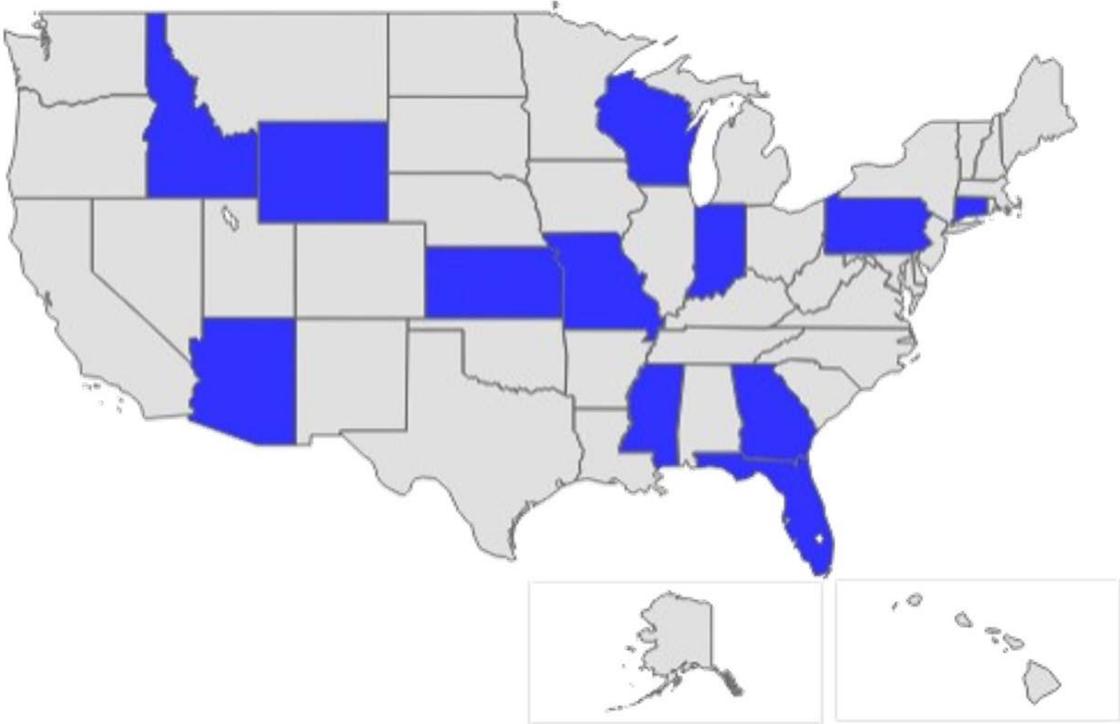
Methodology

To analyze the factors that affect fishing participation rates, time series regression analyses were conducted with selected states for the years 1992 through 2016.² The variables included in each model are compared in the following section, detailing the direction and magnitude of their effects in the appropriate states.

Region of Study

Twelve states were selected to represent different rates of growth or decline in the number of licensed anglers. These states include Arizona, Connecticut, Florida, Georgia, Idaho, Indiana, Kansas, Mississippi, Missouri, Pennsylvania, Wisconsin, and Wyoming.

Figure 1. Region of Study



² Data were collected for the years 1991 through 2016, but the inclusion of lagged variables limits the years of analysis to 1992 through 2016.

Definitions

The following paragraphs describe terms and concepts that are key to this analysis.

Participation is defined as the rate of participation within a state. The number of participants within a state is estimated using the U.S. Fish and Wildlife Service's annual certified fishing license historical reports, while state population estimates are generated by the U.S. Census Bureau. The key pieces of data from these reports include the number of paid resident and nonresident license holders in each state and the gross cost of all licenses, tags, permits and stamps that they purchased. The data provide consistent measures of fishing participation and the average expenditure for licenses, but the data do not distinguish between resident and nonresident sportsmen or individual license types. Since the goal of the project is to examine the factors that drive overall participation, these data are suitable for this purpose. The models are not intended to determine factors that affect sales of individual types of licenses or estimate the price elasticity for specific licenses, tags, permits or stamps. Rather, the models are intended to indicate which factors affect overall license sales trends across all fishing licenses in the past 25 years.

Regression models are built upon conventional economic theory, suggesting that many common factors should consistently be found to influence license demand (sales), thereby affecting angler participation rates. These common factors typically include economic measures, such as average income and license prices, and demographic factors, such as population and age. Many state-specific factors can also impact the number of licensed anglers at specific points in time, such as the restructuring of license offerings, the introduction of new R3 programs, and the offering of new license types. The common factors that appear in most demand models and the rationale for their inclusion are listed below.

- **License fees.** Price is understood to be an explaining factor in the demand for virtually any good or service.
- **Disposable Income.** The rationale for including household disposable income in a demand model is very strong. For normal products, when income rises, more of the product is consumed or purchased.
- **Persistence.** Factors, such as habits, experiences, culture, and equipment, tend to influence persistence in participation. If someone has acquired a fishing license, a boat, and other fishing gear, then he or she is more likely to fish the following year. Including this persistence effect, often captured in a model by use of a one-period lagged dependent variable, is a common approach in time series studies such as this. The persistence effect in this model suggests that the participation rate in this year is partially dependent on the participation rate of the previous year.

- **Environmental factors.** Factors such as temperature, precipitation, and other natural events can explain trends in fishing participation rates.
- **Other factors.** Many other factors impact fishing participation but cannot be exactly accounted for through specific explanatory variables. Since some of these factors are changing over time, one method is to use a trend variable to capture the effect of the missing variables.

Considerations for the development of the statistical models used in this report are described below:

- **Real and nominal prices.** All license fees, as well as measures of household disposable income and gas prices, have been adjusted to reflect real prices, thus removing the impact of inflation within each year of analysis. While it is not usual to mix nominal and real prices in a demand model, there are exceptions. One exception is for items that do not experience regular price changes. Some products experience regular price changes and consumers to some extent expect price variation. However, in other cases, prices tend to be fairly “sticky” and not move much; this is sometimes referred to as sticky prices. In cases when sticky prices do change, it is often inordinately noticed by the consumer. For example, it is common for fishing license fees to be fixed for several years, and then increase by 10 percent or more. This often produces what might be called a “nominal price shock” causing a noticeable drop in demand. In cases such as this, there is reason to include both a real price variable, as well as an indicator variable to account for these nominal price changes.
- **Issues regarding statistical significance in regression models.** When a variable does not vary throughout the years of analysis, that variable may fail to be statistically significant ($p \leq .05$). Consider the extreme case of a variable, such as fishing license price, that does not vary whatsoever. In this case, including fishing license price in a regression model situated to explain the variation in license sales trends would yield statistical insignificance, essentially creating a second constant variable. While cases of this extreme are not usual, variation in license prices do not typically vary significantly over time. Thus, it is somewhat common for license prices to be determined statistically insignificant as an explanatory variable when estimating demand. This is not to say that price is not relevant, but the statistical insignificance of the price results from a lack of variation in the price over the years of analysis.
- **Issues regarding serial correlation in regression models.** In economic models that measure change over time, serial correlation describes the process by which the dependent variable (angler participation rate) becomes largely dependent only on the lagged version of itself instead of the independent variables, limiting the ability of a model

to properly measure the effects of environmental, economic, and other independent variables. To address these issues of serial correlation, Prais-Winsten estimation was used to increase the efficiency of the models. This estimation method transforms the data to correct for the serial correlation across error terms. In addition, the Durbin-Watson statistic is included in each state's regression output to evaluate the effectiveness of this approach. The Durbin Watson test for serial correlation reported for each model shows that the statistic for every model falls within the acceptable range of 1.5 to 2.5, which is often considered an acceptable range for the types of models used for these analyses (Field, 2018). It is therefore unlikely that serial correlation in these analyses would result in variables incorrectly appearing as significant in these models.

- **Statistical efficiency with aggregated data.** In regression models, there is a limit to the number of variables that can be included to uncover variables with statistical significance. Thus, there will never be a perfect model, as it involves selecting the best subset of the variables based on economic theory and statistical fit; this is the nature of the model, where a complex and changing phenomena is being modeled with aggregated data. There is also the potential issue of multicollinearity where many things are moving together and has the effect of confounding the model.

Results

Table 1 below describes the data included in the various state models. Variables included in a given state’s model are denoted with their respective sign, while blank cells indicate that a given variable did not prove to be statistically relevant to that state’s best-fitting model.

Table 1. Overview of Variables

	AZ	CT	FL	GA	ID	IN	KS	MS	MO	PA	WI	WY
365-Day Licenses	(+)							(+)				
Annual Avg Temp			(-)								(+) n	(+)
Average Age	(-)					(-) *		(-)				
Building Permits				(+)		(-)						
Change to Counting				(+)								
Change to License Structure	(+)					(-) n						
Disposable Income	(-)	(-)	(+)	(-)			(-)	(-)	(-)	(-)	(-) *	(-)
Labor Force Participation				(-)	(-) n							
Lag Angler Part Rate	(+)		(-) n		(+)	(+)	(+)		(+) *	(+)	(+)	(+) *
Lag Annual Rainfall									(+) n			
Lag License Price								(-)				
Large Inc Price							(-)					
License Price	(-)	(-)	(-) n	(-)	(-) n	(-)	(-)	(-) n	(-) n	(-)	(-) n	(-) n
Multi-Year Licenses			(+) n		(+) n		(+) n	(+) n	(-) n	(+)		(+) n
Natural Event	(-) *	(+)							(-)			(-) n
Nominal Gas Price		(-) *				(-)						
Online Sales			(-)		(-) n	(-) n					(-) *	(+) n
R3 Effort	(+) *	(-) n	(+) n	(+)		(+) n	(+) n					
Unemployment Rate		(+)								(+) *		

“(+)” positive and significant at $\alpha \leq 0.05$ level

“(-)” negative and significant at $\alpha \leq 0.05$ level

“(+) *” positive and significant at $0.05 < \alpha \leq 0.1$ level

“(-) *” negative and significant at $0.05 < \alpha \leq 0.1$ level

“(+)n” positive and significant at $\alpha > 0.1$ level

“(-)n” negative and significant at $\alpha > 0.1$ level

Variables of Interest

The following variables had an impact in at least one state model. The occurrences of each variable, as well as simple descriptive statistics, accompany each description.

Dependent Variable

Angler Part Rate – Angler participation rate is defined as the percent of the population that purchased a fishing license in any given year. State population estimates were generated by the U.S. Census Bureau.³ The number of licensed anglers within a state for each year of analysis was collected through the US. Fish and Wildlife Service’s Wildlife and Sport Fish Restoration Program.⁴ These data, once collected, were verified by state-level personnel in each state in order to ensure the accuracy of the figures.

License Variables

License Price – The average price of fishing licenses, estimated using total certified licenses and total license revenue, normalized to 2016 dollars.

This variable was included in the models for all 12 states. In every state model presented here, increases in the price of fishing licenses resulted in a decrease in angling participation, but the variable was not statistically significant in some states.

Lag License Price – Lagged variable indicating real (inflation-adjusted) price of fishing licenses the previous year.

The license price for the previous year was included in the Mississippi model. The significant result indicates greater lagged license prices are associated with decreases in fishing participation.

Large Inc Price – Indicator variable representing more than a 20% change in the nominal cost of fishing privileges. This indicator variable identifies any “nominal price shocks” resulting from large adjustments made to “sticky prices”, as discussed earlier in the *Definitions* sub-section.

This statistically significant variable was used in the regression model for Kansas and resulted in decreases in participation.

Lag Angler Part Rate – Lagged variable indicating the percent of the population that participated in fishing the previous year.

This measure of angling participation was included in nine state models. It was not included for Connecticut, Georgia, or Mississippi. The variable is a statistically significant variable for fishing

³ <https://www.census.gov/data/tables/2017/demo/popest/state-total.html>

⁴ <https://wsfrprograms.fws.gov/subpages/licenseinfo/fishing.htm>

participation in Arizona, Idaho, Indiana, Kansas, Pennsylvania, and Wisconsin, and has a positive coefficient in all states except Florida.

Regulatory Variables

The following variables were included in some state models. While many states included in this analysis have enacted the regulations or programming described below, the modeling efforts of this project are only able to measure changes that took place during the years of analysis.

R3 Effort - Indicator variable for large-scale R3 Efforts being introduced.⁵

The R3 Effort indicator was included in the models for six states. The R3 Effort coefficient indicates the efforts resulted in increases in participation in Arizona, Connecticut, Florida, Georgia, Indiana, and Kansas. The variable is statistically significant at the $\alpha=0.05$ level in Georgia, and the $\alpha=0.10$ level in Arizona and Indiana.

Many states maintain R3 programming in many forms. Family fishing days, fishing rodeos, and other clinics are meaningful parts of a state's R3 Efforts. However, the projects identified by this project to be effective in increasing the statewide fishing participation rate are those that are large in scale, and typically include coordinated marketing and communications strategies.

365-day Licenses – Indicator variable for the introduction of 365-day fishing licenses that are valid for one year from the date of purchase.

This variable was included in the Arizona and Mississippi models. Results signify that the introduction of 365-day licenses is associated with increases in angling participation and is a statistically significant predictor of participation in both states.

Multi-Year Licenses – Indicator variable for the introduction of multi-year or lifetime licenses.

The indicator for the introduction of multi-year licenses was included in the regression models for Florida, Idaho, Kansas, Mississippi, Pennsylvania, and Wyoming. Results show increases in

⁵ The regression models used in these analyses measure the effects of changes in the independent variables and are therefore unable to account for ongoing efforts. Because of this, the models are not able to account for events that were ongoing before 1991 since there is no visible change in the data. Many R3 programs in Pennsylvania, the *Connecticut Aquatic Resources Education Program* in Connecticut, and other programs in other states have been in place since before 1991; the omission of these programs from these analyses does not indicate any lack of importance but is merely a limitation of the methodology.

fishing participation rates are associated with the introduction of multi-year licenses in each of these states, but the findings are not statistically significant for all states.

Online Sales – Indicator variable for the introduction of online sales of fishing licenses.

The introduction of the option to purchase fishing licenses online was included in the models for five states. This variable is associated with slight decreases in angling participation rate in Florida, Idaho, Indiana, and Wisconsin, though the result is statistically significant only in the Florida model. This finding is counterintuitive to most, since the added convenience of online license sales would typically suggest an increase in sales; however, the measured decreases may be due to a shift in the way that license sales were reported and certified.

The coefficient for online fishing license sales in Wyoming is positive but not statistically significant.

Change to License Structure – Indicator variable for a change in fishing license/permits structure (e.g., changes in the type(s) or number of licenses offered or required).

Regression models for Arizona and Indiana included this indicator of a change to the fishing license structure. The statistically significant result for Arizona indicates the change in structure is related to increases in angling participation rates. The coefficient is not statistically significant for Indiana.

Environmental

Lag Annual Rainfall – The average amount of rainfall in the state for the previous year.

This variable was included in the Missouri model. The amount of rainfall in the previous year has a positive, but not statistically significant, coefficient.

Annual Avg Temp – The average temperature in the state for the year.

Decreases in average temperatures in Florida and increases in temperature in Wyoming and Wisconsin are associated with increases in fishing participation rates, though the finding is not statistically significant in the model for Wisconsin.

Natural Event – Indicator variable for a natural event.

The occurrence of a natural event was included in the models for Arizona, Connecticut, Missouri, and Wyoming. These events are related to the wildfires (AZ), the reopening of fisheries (CT), flooding (MO), and abnormally cold temperatures (WY). While other states may have natural events (i.e. hurricanes in FL), their persistence prevents modelling efforts from measuring their effect. Each event is discussed further in the detailed results section for each state.

Economic

Unemployment Rate – The percentage of the state’s labor force that is unemployed.

Increases in the unemployment rate are associated with increases in fishing participation rates for both Connecticut and Pennsylvania, but the coefficient is not statistically significant for Pennsylvania.

Labor Force Participation – The percentage of a state’s population that is at least 16 years of age who either are employed or are seeking employment.

Decreases in labor force participation result in increases in angling participation rates for Georgia and Idaho as individuals not working or seeking work are finding themselves with relatively more free time to fish.

Disposable Income – The statewide average of the net income of households or individuals available to spend, save, or invest after accounting for income taxes.

The disposable income measure was included in 10 of the state models and is a statistically significant predictor of fishing participation rates in nine of them. Greater levels of disposable income predict increased fishing participation rates for Arizona, Connecticut, Florida, and Pennsylvania, but decreased participation rates for Georgia, Kansas, Mississippi, Missouri, and Wyoming. The coefficient for disposable income also was negative, but not statistically significant, for Wisconsin.

Nominal Gas Price – The national average price of gasoline.

Increases in nominal gas prices are associated with decreases in fishing participation rates for Connecticut and Indiana, but the result is not statistically significant for Connecticut.

Building Permits – The number of housing units authorized by building permits.

This measure is used to approximate economic growth within a state, as a healthy economy will lend itself to new businesses and residential units being built. The number of building permits issued had a statistically significant, though slight, positive impact for both Georgia and Indiana.

Other

Change to Counting – Indicator variable for a change in the way the number of fishing licenses sold is tracked by the USFWS certification process.

A change to the fishing license counting procedure resulted in a statically significant increase in levels of angling participation for Georgia. This is the result of the process by which states certify the number of anglers and fishing licenses sold.

Average Age – The average age, in years, of state residents.

Findings indicate that fishing participation rates decline as the average age of the state population increases in Arizona and Mississippi. The average age coefficient also is negative for Indiana, but it is not a statistically significant variable.

State Models - Detailed Results

The states included in this study experienced a range of differences in fishing participation rates between 1991 and 2016. Some states saw consistent, and sometimes sharp declines in the participation rates through almost the entire period of 1991 through 2010, though the decline started a little late in some states. However, many states deviated from that pattern of participation rate decline since 2010. While Mississippi, Missouri, and Wyoming have seen decreases in participation rates since 2010, all other states have experienced relatively unchanged or increased rates of fishing participation. The following sub-sections each detail the results of the state-specific regression models.

Arizona

Highlights

R3 Effort – Beginning in 2005, Arizona’s implementation of the “Fish Arizona” campaign successfully sought to promote sportfishing across the state.

365-day Licenses – Arizona switched to 365-day licenses in 2014, allowing anglers to purchase a license valid for one year from the date of purchase. This offering increased fishing participation in the year of implementation and all subsequent years, as anglers are able to more easily realize the full potential of a year of fishing.

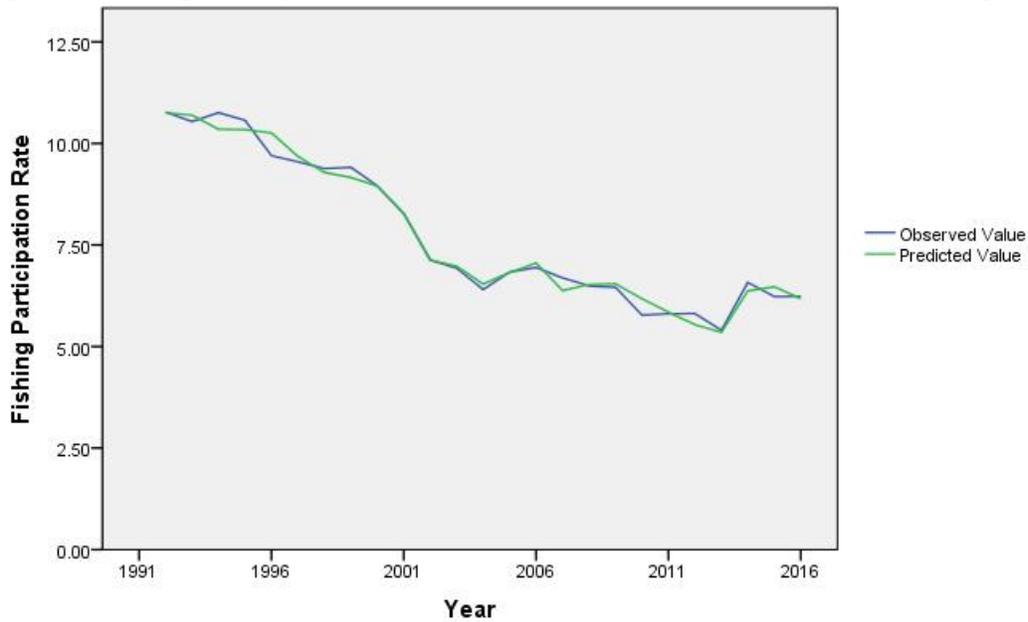
Change to License Structure - In 2014, Arizona repackaged many license offerings, consolidating privileges to simplify the state’s license market and offering a greater value to customers. Overall, this market simplification affected positive change in the state fishing participation rate.

Discussion

Between 2007 and 2016, fishing participation in Arizona decreased from 6.69% to 6.23%, reflected in Figure 2 below. During the same time period, the state's population increased from 6.17M to 6.8M. Many factors have affected Arizona's fishing participation since 1991, including changes to the structure of the fishing license market, the introduction of 365-day Licenses (valid for one year from the date of purchase), and the implementation of large scale R3 programming. Specifically, the change to the license structure refers to Arizona’s 2014 license suite modification that consolidated the number of available fishing licenses from 46 to 10. While the license offerings were consolidated into fewer packages, these licenses were comprised of greater fishing privileges, which generated a greater value for customers and resulted in an increase in angling participation. Additionally, fishing participation increased as the result of Arizona’s large-scale, integrated R3 Effort “Fish Arizona” which was implemented in 2005.

Arizona has long dealt with drought and wildfire conditions, which can both affect fishing participation. While periods of drought and wildlife have occurred periodically throughout the years of analysis, the occurrence of the Rodeo-Chediski Fire in 2002 resulted in a measurable decrease in fishing participation.

Figure 2. Fishing Participation in Arizona, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.982	2.090

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	38.085	9.16	4.16	0.001
License Price	-0.117	0.04	-2.60	0.020
Lag Angler Part Rate	0.510	0.13	4.00	0.001
Average Age	-0.711	0.19	-3.82	0.002
Natural Event	-0.610	0.32	-1.93	0.072
Disposable Income	-2.20E-04	0.00	-3.81	0.002
R3 Effort	0.737	0.35	2.10	0.053
365-day Licenses	2.553	0.57	4.48	0.000
Change to License Structure	1.048	0.31	3.35	0.004

Connecticut

Highlights

R3 Effort (a) – Connecticut’s 2013 and 2014 efforts to reactivate anglers by utilizing RBFF’s existing suite of tools may have positively affected fishing participation rates, but this is not a statistically significant finding. The program targeted anglers who had not renewed their fishing license for at least one year and encouraged them to buy a fishing license.

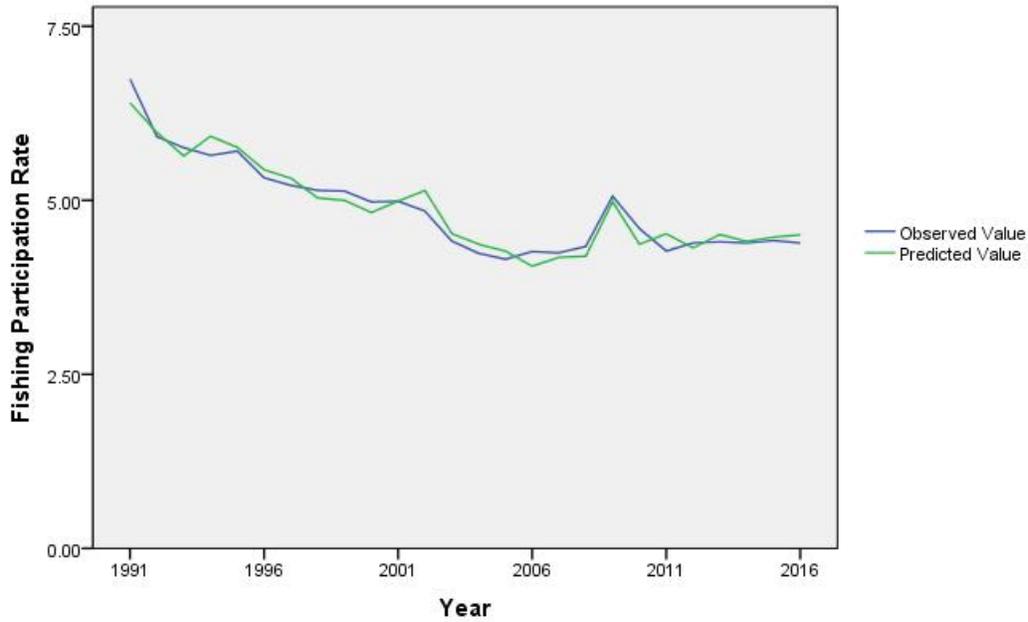
R3 Effort (b) – Urban fishing programs in CT have played a role in the state’s recent increasing fishing participation rate. The urban fishing efforts captured by this variable may have impacted the local areas where they took place, but they were not likely impactful at the state level.

Natural Event – The once depleted Atlantic striped bass population was fully restored in 1995, allowing this fishery to reopen. This generated growth in fishing participation, as more resident and nonresident anglers were able to target striped bass.

Discussion

Between 2007 and 2016, fishing participation in Connecticut increased from 4.25% to 4.42%, reflected in Figure 3 below. During the same time period, the state's population increased from 3.53M to 3.59M. Many factors have affected Connecticut's fishing participation since 1991, including license prices and multiple large scale, coordinated R3 Efforts. License prices have a significant and negative relationship with license participation; participation tends to decrease as license fees increase. The nominal price of gas, a variable that approached statistical significance, has a similar effect in that increases in gas prices are associated with decreases in participation. Both disposable income and the unemployment rate are significant positive predictors of angling participation. In 1995, the once depleted Atlantic striped bass population was declared fully restored 11 years after Connecticut was required to comply with the conservation plan outlined by the Striped Bass Act; this contributed to an increase in participation rates, with the variable presented here as “Natural Event”. Although not statistically significant, two R3 Efforts were implemented by Connecticut during the years of analysis. The state worked with RBFF in order to reactivate lapsed anglers in 2013 and 2014 with RBFF’s *Lapsed Angler Program*, recorded here as R3 Effort (a). Additionally, significant efforts were made to increase urban fishing efforts in 2007 and 2014, recorded here as R3 Effort (b).

Figure 3. Fishing Participation in Connecticut, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.820	1.768

	Coefficient	Std. Error	t-score	Significance
(Constant)	8.761	0.66	13.27	0.000
License Price	-0.093	0.02	-5.37	0.000
Disposable Income	-4.52E-05	0.00	-3.08	0.007
Nominal Gas Price	-0.330	0.11	-3.03	0.008
Unemployment Rate	0.167	0.04	4.51	0.000
Natural Event	0.417	0.18	2.33	0.032
R3 Effort(a)	0.072	0.25	0.29	0.778
R3 Effort(b)	0.026	0.18	0.15	0.885

Florida

Highlights

R3 Effort – Beginning in October 2015, Florida offered license buyers the ability to auto-renew their fishing license. While not statistically significant, this variable measures the possible impact of Florida’s efforts to cut down on lapses in license purchases for both resident and nonresident anglers. The results of a project-specific analysis can be found online.⁶

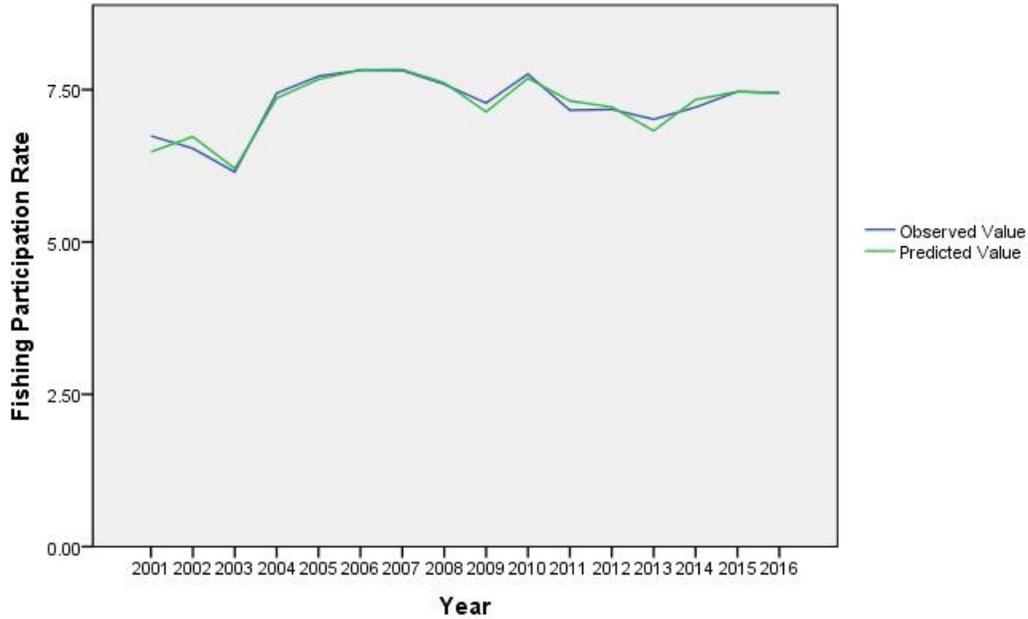
Multi-Year Licenses – Florida began offering 5-year fishing licenses in 2002, which may have had a lasting positive effect on the statewide fishing participation rate.

Discussion

Between 2007 and 2016, fishing participation in Florida decreased from 7.81% to 7.47%, reflected in Figure 4 below. During the same time period, the state's population increased from 18.37M to 20.27M. Many factors have affected Florida's fishing participation since 1991, including R3 programming and the introduction of multi-year licenses. The introduction of 5-year licenses in 2002 affected an increase in fishing participation rates, labeled here as “Multi-Year Licenses”, although these findings are not statistically significant. Similarly, Florida began an auto-renew license program in late 2015, denoted in this model as R3 Effort, which increased the fishing participation rate, but this finding is also not statistically significant.

⁶ <http://www.southwickassociates.com/do-license-auto-renew-options-improve-revenues-for-state-agencies/>

Figure 4. Fishing Participation in Florida, 2001 to 2016 and the results of a regression model.⁷



Adjusted R Square	Durbin-Watson
0.946	2.395

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	13.105	3.71	3.53	0.010
License Price	-0.004	0.03	-0.15	0.889
Lag Angler Part Rate	-0.037	0.11	-0.35	0.738
Disposable Income	2.73E-04	0.00	6.04	0.001
Multi-Year Licenses	0.267	0.25	1.08	0.318
Online Sales	-1.238	0.24	-5.16	0.001
Annual Avg Temp	-0.230	0.05	-4.55	0.003
R3 Effort	0.085	0.29	0.30	0.774

⁷ This analysis included only 15 years (from 2001 to 2016) due to data issues in the years 1991 to 2000.

Georgia

Highlights

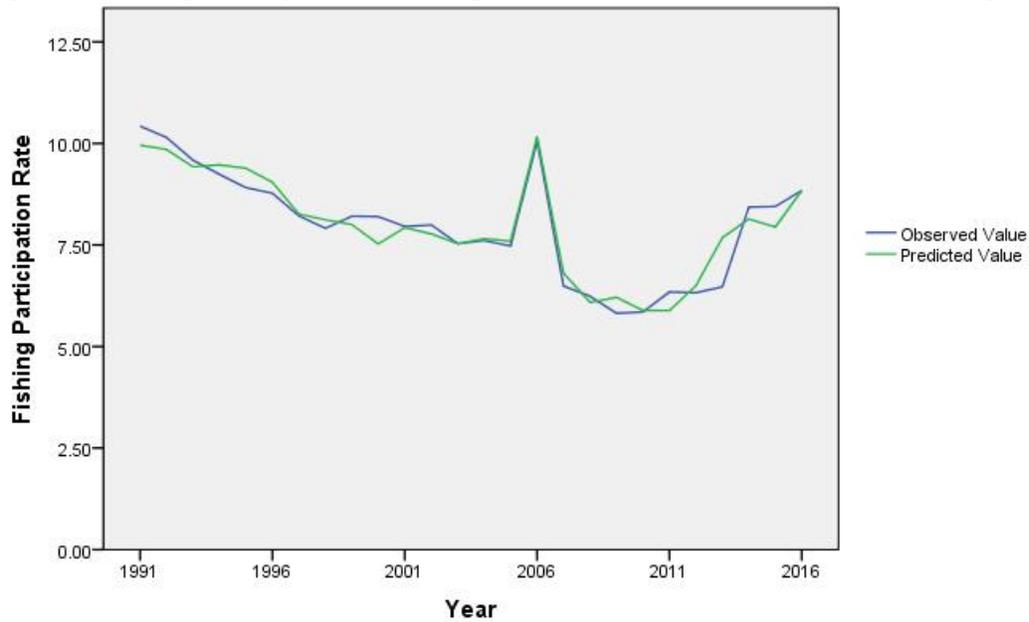
R3 Effort – Using fishing license sales data, Georgia took advantage of RBFF’s existing marketing toolbox to use proven practices to target lapsed anglers through email campaigns. These email campaigns successfully reactivated short-term lapsed anglers as well as those with a lapse of greater than five years. The results of an analysis of this project are available online.⁸

Discussion

Between 2007 and 2016, fishing participation in Georgia increased from 6.49% to 8.45%, reflected in Figure 5 below. During the same time period, the state's population increased from 9.35M to 10.2M. Many factors have affected Georgia's fishing participation since 1991, including economic conditions and R3 Efforts. Participation generally decreases as license prices increase, and the number of building permits has a slight positive impact on participation. Angling participation increases slightly as both disposable income and labor force participation decrease. Importantly, results show that Georgia’s R3 Efforts such as the 2016 email campaign, are associated with increases in fishing participation. The “Change to Counting” variable reflects a change in guidance from USFWS regarding the license certification process, which allowed Georgia to certify relatively more anglers in 2006. In the following year, the USFWS certification guidance returned to the pre-2006 terms.

⁸ <http://www.takemefishing.org/getmedia/3e835e35-cbcb-4424-bf85-2c358ac7915d/Georgia-DNR-R3-Through-Data-and-Email-FINAL.pdf>

Figure 5. Fishing Participation in Georgia, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.835	1.731

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	41.500	6.27	6.61	0.000
License Price	-0.323	0.09	-3.73	0.002
Building Permits	3.29E-05	0.00	5.42	0.000
Labor Force Participation	-0.285	0.13	-2.27	0.036
Change to Counting	2.819	0.45	6.32	0.000
Disposable Income	-5.2E-04	0.00	-9.18	0.000
R3 Effort	1.120	0.50	2.25	0.037

Idaho

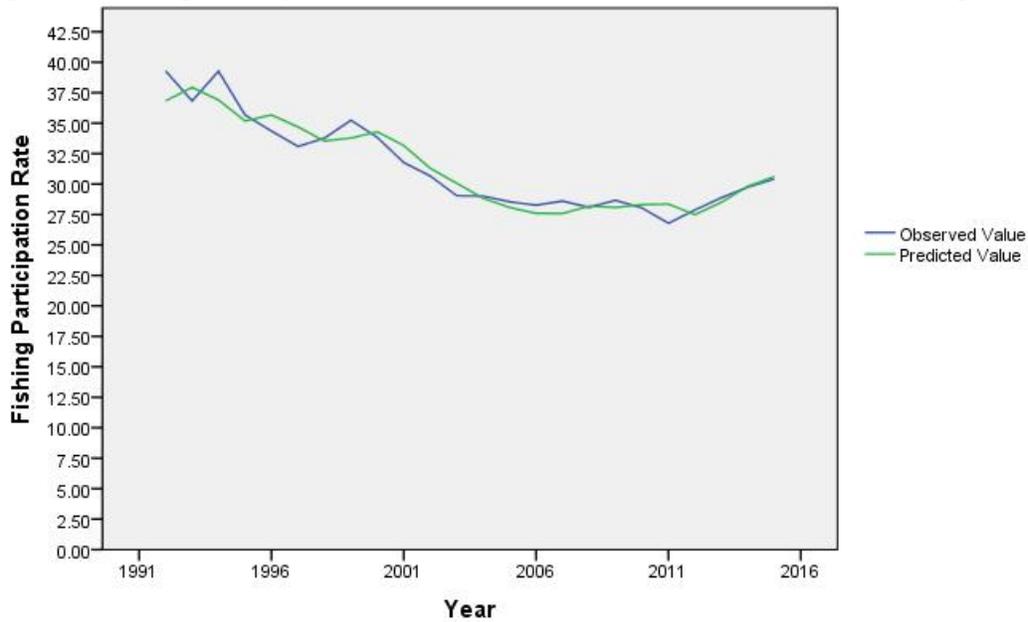
Highlights

Multi-Year Licenses – The 2013 introduction of multi-year licenses is likely to have positively impacted the fishing participation rate in Idaho. Both lifetime licenses and 3-year licenses were added to the license suite for Idaho, helping to reduce angler churn.

Discussion

Between 2006 and 2015, fishing participation in Idaho increased from 28.27% to 30.42%, reflected in Figure 6 below. During the same time period, the state's population increased from 1.47M to 1.65M. Many factors have affected Idaho's fishing participation since 1991, including license prices and the introduction of multi-year licenses. The lagged angler participation rate suggests that participation trends generally are similar from year to year. Although the other four variables in the model are not statistically significant, the introduction of 3-year multi-year licenses and lifetime licenses in 2013 is associated with an increase in angling participation, while the availability of online sales and increases in both labor force participation and license prices result in decreases in participation.

Figure 6. Fishing Participation in Idaho, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.933	1.847

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	14.434	11.44	1.26	0.224
License Price	-0.182	0.12	-1.47	0.161
Lag Angler Part Rate	0.990	0.07	13.90	0.000
Labor Force Participation	-0.216	0.23	-0.95	0.357
Multi-Year Licenses	0.644	0.82	0.78	0.446
Online Sales	-2.344	1.40	-1.67	0.112

Indiana

Highlights

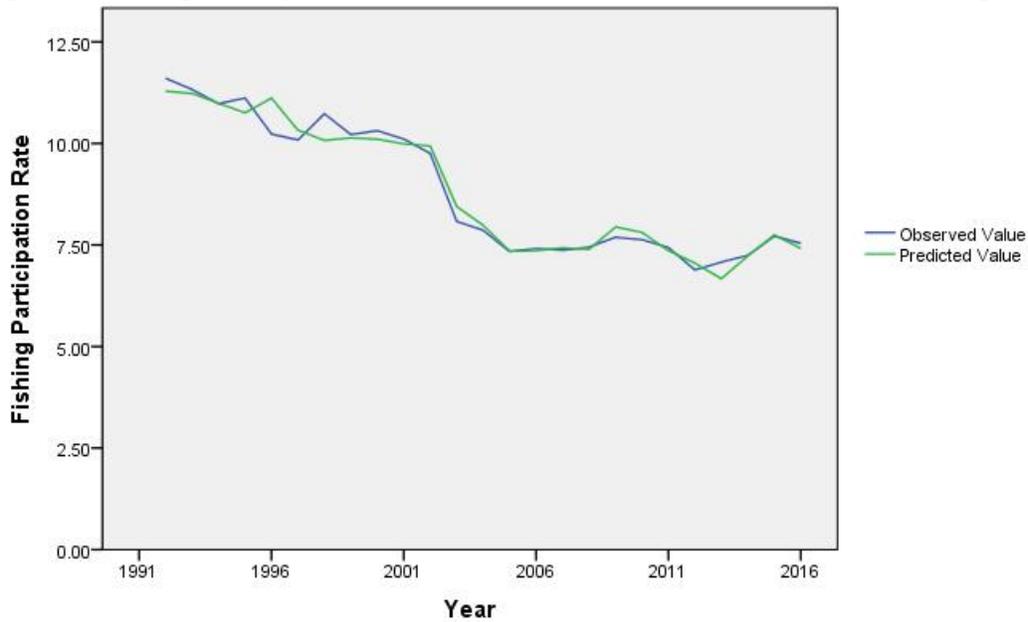
R3 Effort – Beginning in 2013, Indiana’s urban fishing initiative increased the fishing participation rate across the state. This program “Go FishIN in the City”, provided shore fishing opportunities for anglers that live in heavily populated urban areas. With the help of local partners, the Indiana Department of Natural Resources intensively stocked catchable size channel catfish and rainbow trout throughout the year in small city lakes.

Change to License Structure – Many states do not require senior citizens to purchase a fishing license after a certain age. When Indiana began requiring senior citizens to purchase fishing license in 2008, the effect on fishing participation rates was likely negative, although this finding is not statistically significant.

Discussion

Between 2007 and 2016, fishing participation in Indiana increased from 7.37% to 7.72%, reflected in Figure 7 below. During the same time period, the state's population increased from 6.38M to 6.61M. Many factors have affected Indiana's fishing participation since 1991, including demographic variables, environmental conditions, and R3 Efforts. The number of building permits issued, an approximation of economic growth, shows that participation goes up slightly as the number of building permits increase. The positive coefficient for Indiana’s R3 efforts (e.g., the urban fishing program that began in 2013) describes an increase in participation. The “Change to License Structure” refers to a 2008 movement to begin requiring senior citizens to purchase fishing licenses, which had not been necessary beforehand; it is not likely that this had much effect on participation rates.

Figure 7. Fishing Participation in Indiana, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.963	2.059

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	30.089	10.38	2.90	0.011
License Price	-0.086	0.03	-3.04	0.008
Lag Angler Part Rate	0.489	0.16	3.10	0.007
Average Age	-0.614	0.25	-2.48	0.025
Building Permits	-3.54E-05	0.00	-2.67	0.017
R3 Effort	0.593	0.32	1.83	0.088
Nominal Gas Price	-0.475	0.22	-2.12	0.051
Online Sales	-0.817	0.49	-1.66	0.118
Change to License Structure	-0.052	0.43	-0.12	0.906

Kansas

Highlights

R3 Effort – Working with “Fishing’s Future”, a non-profit agency, Kansas was able to increase fishing participation rates. Beginning in 2012, this R3 effort mobilized volunteers across the state to engage new anglers in the sport. Now, more than 500 volunteers are working to grow fishing across Kansas. Although this finding is not statistically significant, this R3 effort by Kansas can likely be cited as one factor that increased the state’s fishing participation.

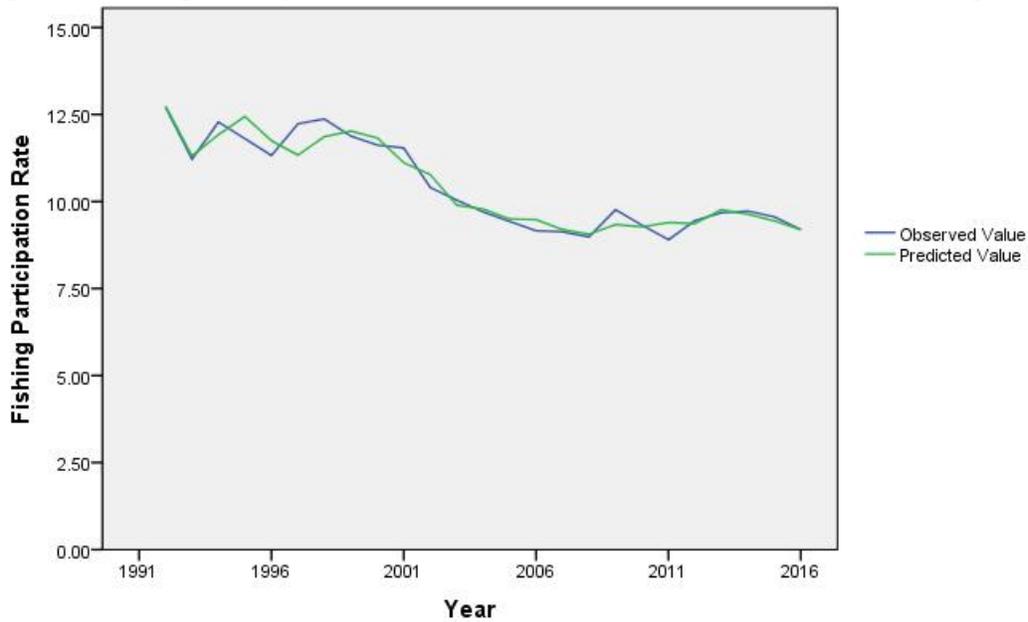
Multi-Year Licenses – In 2016, Kansas introduced 5-year licenses to their suite of license offerings. Although lifetime licenses were already offered at this time, the establishment of a 5-year license had a positive effect on state fishing participation rates.

Large Inc Price – Nominal price increases of over 20% in 1993 caused a decrease in the fishing participation rate across the state. Because the nominal prices for fishing licenses often go many years unchanged, a sudden shock to the price structure can easily cause a negative reaction from anglers in the license market.

Discussion

Between 2007 and 2016, fishing participation in Kansas increased from 9.13% to 9.56%, reflected in Figure 8 below. During the same time period, the state's population increased from 2.78M to 2.91M. Many factors have affected Kansas's fishing participation since 1991, including license prices, R3 efforts, and the introduction of 5-year licenses in 2016. The significance of the lagged angler participation rate suggests that the participation rate in any given year is dependent on the previous year; however, nominal license prices increases of more than 20% in 1993 resulted in a large negative impact. The R3 Effort finding indicates that large-scale R3 efforts, such as the 2012 non-profit volunteer partnership to teach people about fishing opportunities in Kansas and the urban fishing campaign implemented in 2016, have likely resulted in increases in angling participation, although this variable is not statistically significant.

Figure 8. Fishing Participation in Kansas, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.932	2.214

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	13.096	3.05	4.29	0.000
License Price	-0.224	0.05	-4.55	0.000
Lag Angler Part Rate	0.767	0.11	7.03	0.000
Disposable Income	-1.77E-04	0.00	-4.07	0.001
R3 Effort	0.470	0.31	1.52	0.147
Large Inc Price	-1.533	0.46	-3.33	0.004
Multi-Year Licenses	0.937	0.59	1.58	0.131

Mississippi

Highlights

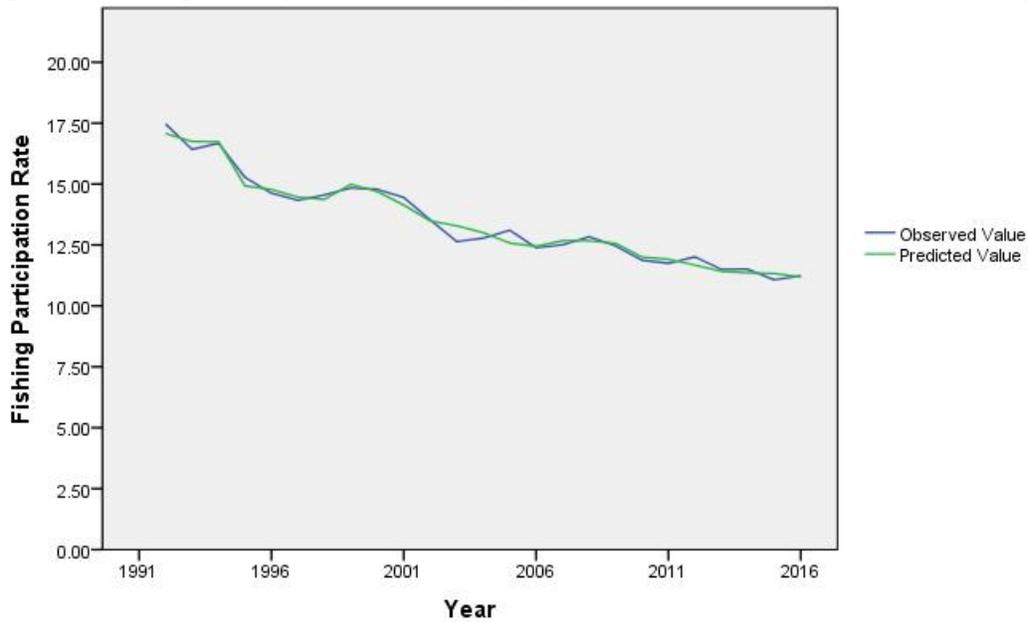
Multi-Year Licenses –Mississippi was likely able to grow fishing participation in the state by beginning to offer lifetime licenses in 1998, although this finding is not statistically significant. Anglers who hold lifetime licenses do not churn out of the license market like those anglers who purchase annual licenses.

365-Day Licenses –Mississippi moved to a 365-day license structure in 2007, which had a statistically significant positive effect on the fishing participation rate. These licenses, which are valid for one year from the date of purchase, allow anglers to get the maximum usage out of a license as opposed to purchasing licenses that may only be valid for the remainder of a license year.

Discussion

Between 2007 and 2016, fishing participation in Mississippi decreased from 12.51% to 11.07%, reflected in Figure 9 below. During the same time period, the state's population increased from 2.93M to 2.99M. Many factors have affected Mississippi's fishing participation since 1991, including economic conditions, the introduction of multi-year licenses, and the introduction of 365-day Licenses. The 1998 introduction of lifetime licenses (reported here as “Multi-Year Licenses”) had a positive effect on the fishing participation rate, as did the 2007 shift to 365-day Licenses that are valid for one year from the date of purchase. Taken together, these results indicate that fishing participation tends to go down as price increases, and sales generally go up after the introduction of consumer benefits, such as 365-day Licenses.

Figure 9. Fishing Participation in Mississippi, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.981	2.249

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	52.660	4.60	11.45	0.000
License Price	-0.029	0.07	-0.43	0.670
Lag License Price	-0.286	0.06	-4.86	0.000
Disposable Income	-4.99E-04	0.00	-5.95	0.000
Average Age	-0.590	0.16	-3.61	0.002
Multi-Year Licenses	0.405	0.27	1.48	0.156
365-day Licenses	0.533	0.23	2.35	0.031

Missouri

Highlights

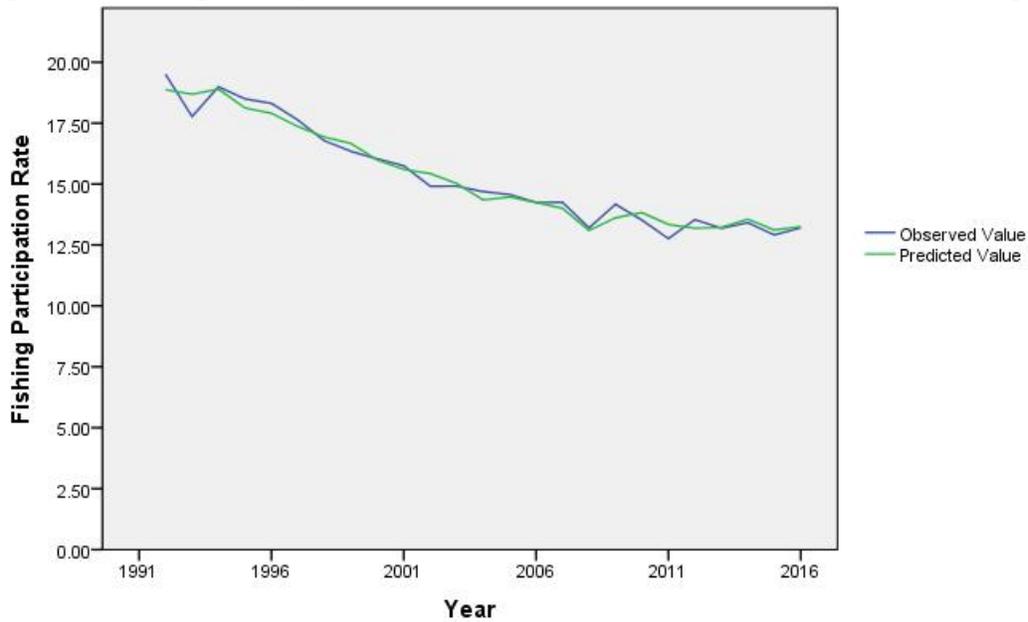
Natural Event – While many anglers will continue to purchase fishing licenses and participate in fishing activities during years with poor weather conditions, others will choose to forgo fishing participation and purchases. Flooding and abnormally cold temperatures in both 2008 and 2011 negatively affected the fishing participation rates in Missouri.

Lag Annual Rainfall – Much in the same way that anglers will not buy a license in a year with bad weather, some anglers' decision to purchase a license can be influenced by the weather conditions of the previous year. If a given year is marked by poor weather conditions, anglers may choose not to participate in fishing activities in the following year, fearing a continuation of bad weather, and vice versa. In Missouri, the previous year's rainfall had an effect on fishing participation rates such that a year of low precipitation would be followed by a year of low fishing participation, while the opposite is also true.

Discussion

Between 2007 and 2016, fishing participation in Missouri decreased from 14.25% to 12.91%, reflected in Figure 10 below. During the same time period, the state's population increased slightly from 5.89M to 6.07M. Many factors have affected Missouri's fishing participation since 1991, including environmental and economic conditions. Flooding and abnormally cool temperatures in 2008 and 2011, reported here as “Natural Event”, caused a decrease in license sales. The introduction of lifetime licenses in 1996 is associated with a slight decrease in fishing participation rates, but this is not a statistically significant finding.

Figure 10. Fishing Participation in Missouri, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.979	2.068

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	24.169	8.80	2.75	0.013
License Price	-0.007	0.09	-0.08	0.941
Lag Angler Part Rate	0.378	0.20	1.91	0.072
Natural Event	-0.731	0.32	-2.30	0.034
Disposable Income	-4.45E-04	0.00	-2.77	0.013
Lag Annual Rainfall	0.020	0.01	1.54	0.142
Multi-Year Licenses	-0.237	0.30	-0.78	0.444

Pennsylvania

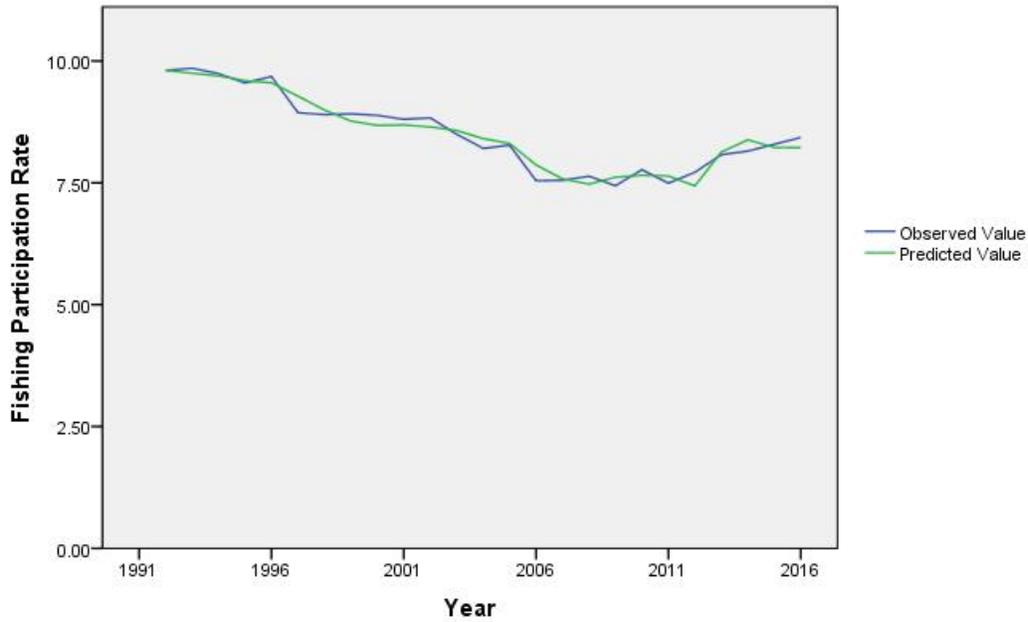
Highlights

Multi-Year Licenses – Pennsylvania began offering 3- and 5-year licenses in 2013, which had a significant, lasting positive impact on fishing participation rates. When priced correctly, multi-year licenses of this kind can help mitigate angler churn and increase the ease with which an angler can go fishing.

Discussion

Between 2007 and 2016, fishing participation in Pennsylvania increased from 7.55% to 8.29%, reflected in Figure 11 below. During the same time period, the state's population increased from 12.56M to 12.79M. Many factors have affected Pennsylvania's fishing participation since 1991, including economic conditions and the introduction of multi-year licenses. Because Pennsylvania's R3 efforts are largely ongoing efforts that have been in place since before the years of analysis, they are not measured in this model. The 2013 introduction of 3-year, 5-year, and 10-year licenses are related to increases in levels of participation rates, and angler participation tends to fluctuate with similar patterns from year to year. Disposable income is also statistically significant, with slight increases in angling participation being associated with increases in levels of disposable income.

Figure 11. Fishing Participation in Pennsylvania, 1991 to 2016 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.965	2.048

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	8.918	2.33	3.83	0.001
License Price	-0.073	0.03	-2.76	0.013
Lag Angler Part Rate	0.479	0.13	3.77	0.001
Multi-Year Licenses	0.676	0.15	4.62	0.000
Disposable Income	-9.68E-05	0.00	-3.20	0.005
Unemployment Rate	0.045	0.03	1.75	0.097

Wisconsin

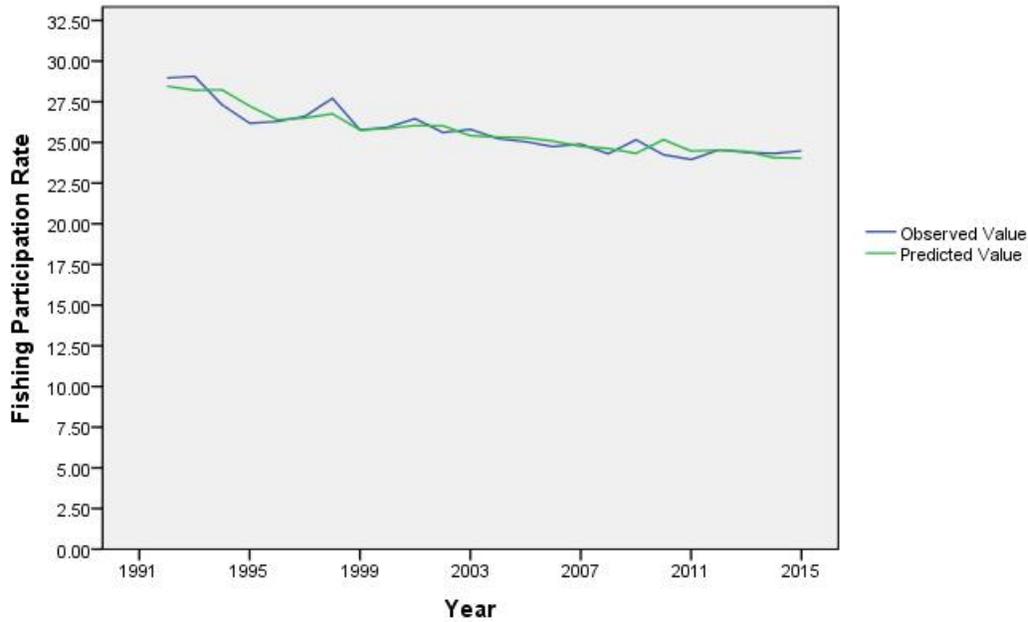
Highlights

Lag Angler Part Rate – Wisconsin’s fishing participation rate in any given year relies heavily on the trend in the previous year. Because anglers have already invested in fishing equipment and accessories, anglers are driven to participate each year after making that investment. However, the converse of this effect is that any interruption in annual license purchases reduces the likelihood that an angler will return to participating in the future.

Discussion

Between 2006 and 2015, fishing participation in Wisconsin decreased from 24.74% to 24.48%, reflected in Figure 12 below. During the same time period, the state's population increased from 5.58M to 5.76M. Many factors have affected Wisconsin's fishing participation since 1991, including economic and environmental factors. With some exceptions, fishing participation rates tend to move in the same direction from one year to the next; this is measured with the “Lag Angler Part Rate” variable. Although the remaining four variables are not statistically significant, the coefficients suggest that increases in license price, levels of disposable income, and the introduction of online license sales are associated with decreases in overall participation, while increases in annual average temperatures result in fishing participation growth.

Figure 12. Fishing Participation in Wisconsin, 1991 to 2015 and the results of a regression model.



Adjusted R Square	Durbin-Watson
0.797	1.922

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	16.238	9.32	1.74	0.100
License Price	-0.051	0.09	-0.57	0.579
Online Sales	-1.364	0.71	-1.93	0.071
Disposable Income	-1.99E-04	0.00	-1.86	0.080
Lag Angler Part Rate	0.512	0.22	2.34	0.032
Annual Avg Temp	0.104	0.08	1.30	0.211

Wyoming

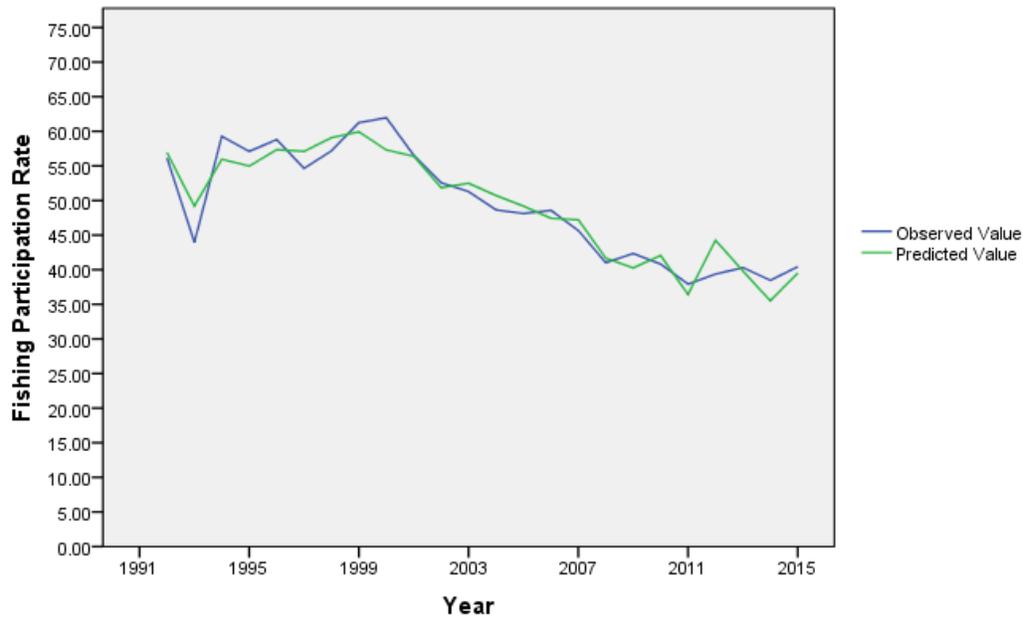
Highlights

Multi-Year Licenses – Lifetime fishing licenses were introduced to the Wyoming fishing license market in 1996. This introduction likely had a positive impact on fishing participation rate, as anglers with lifetime licenses do not churn out of the license market like those anglers who purchase annual licenses; however, this finding is not statistically significant.

Discussion

Between 2006 and 2015, fishing participation in Wyoming decreased from 48.6% to 40.4%, reflected in Figure 2 below. During the same time period, the state's population increased from 523K to 586K. Many factors have affected Wyoming's fishing participation since 1991, including environmental factors, such as temperature, as well as the introduction of multi-year licenses. None of the participation or license-related variables are statistically significant, though the coefficients do suggest an expected decrease in sales with increases in prices, increases in sales with the introduction of multi-year licenses and online license sales, and overall consistency in angler participation trends from year to year. Another non-significant result is the decrease in participation associated with the occurrence of an abnormally cold year in 2011, represented in the model as “Natural Event”.

Figure 13. Fishing Participation in Wyoming, 1991 to 2015 and the results of a regression model.



<i>Adjusted R Square</i>	<i>Durbin-Watson</i>
0.913	2.104

	Coefficient	Std. Error	t-score	Significance
<i>(Constant)</i>	-33.522	27.44	-1.22	0.241
License Price	-0.028	0.21	-0.13	0.895
Lag Angler Part Rate	0.320	0.17	1.91	0.076
Disposable Income	-8.35E-04	0.00	-4.03	0.001
Annual Avg Temp	2.294	0.61	3.79	0.002
Natural Event	-2.268	3.21	-0.71	0.491
Multi-Year Licenses	3.218	2.29	1.41	0.180
Online Sales	2.354	3.39	0.69	0.498

Conclusion

Variables used in the models vary by state because the fishing participation rate is affected by different factors in each state. Furthermore, some factors have different impacts on participation across states, while others are relatively consistent when used in models for different states. Lagged angler participation rate, a measure of persistence, is positively associated with fishing participation in all of the models for which it is statistically significant. This finding is common for time series research, especially when exploring outdoor recreation such as fishing, since individuals who obtain the necessary permits, knowledge, and equipment to participate in one year are more likely to participate the next year (Southwick Associates, 2013). These results also indicate that increases in license prices result in decreased angling participation. This finding, combined with the negative impact of nominal gas prices, is consistent with previous research that indicates a decline in fishing participation as costs of the activity increases (Beardmore, Haider, Hunt, & Arlinghaus, 2013; Fedler & Ditton, 2001; Southwick Associates, 2013; Sutton, Stoll, & Ditton, 2001).

Most importantly, the three variables measuring changes in license structures also have uniform effects when results are statistically significant. Specifically, the introduction of 365-day fishing licenses that are valid for one year from the date of purchase, the offering of multi-year license options, and changes to the license structure all result in increases in levels of fishing participation. These results are consistent with previous research showing that, in general, increases in license sales are related to making the license-buying process more convenient or easier to understand for users (Bacchiocchi, Barker, de Jong, Rainero, & Vargas, 2017; Fedler & Ditton, 2001; Schroeder, Fulton, Nemeth, Sigurdson, & Walsh, 2008).

Even when not statistically significant, the indicator variable for R3 efforts has a positive impact on levels of fishing participation for five of the six state models in which it was included. It is important to note two substantial facts regarding the R3 Effort variable used in this report. First, just because an R3 Effort variable is not included in a state's model does not mean the state does not have large-scale R3 efforts or that the efforts are not working. For example, Pennsylvania's R3 efforts have been in place for a long time, but they were not a part of the best fitting regression model for the time period considered in this study as there was no way for the models to account for this. Second, statistical non-significance of an R3 Effort predictor does not mean that the efforts in that state are not helpful. Rather, this could mean that efforts have not been in place long enough to measure a statistically significant effect, are not a scale large enough to affect fishing participation rates statewide, or there may be multiple efforts starting and stopping frequently enough that the models are unable to recognize them given all the other factors driving participation. In order to gain a better understanding of how each R3

effort is affecting a state's fishing participation rate, state-level analyses of fishing license sales and R3 efforts would need to be conducted.

Although data used for these analyses were based on information for all fishing licenses (not specific types of licenses, tags, permits, or stamps) in each of the 12 states, there are some factors that have relatively consistent impacts on fishing participation rates across states regardless of state participation trends. Such findings help to generate recommendations that can be taken by any state in order to positively affect license sales and participation rates. Future state-level analyses would benefit from including differentiations among specific types of fishing licenses, tags, permits, or stamps, as well as specific license prices, the bundling of multiple licenses, and movement within a license market from one license to another, to provide a more detailed understanding of the variables used in these models and other factors affecting license sales and fishing participation rates. In the meantime, agency personnel should not be discouraged and realize that efforts to increase fishing participation, even in states with decreases in participation, are likely preventing greater declines. When it comes to R3 efforts, states should foster large-scale efforts when possible, then test, evaluate, improve, and grow. While there is no guarantee that regulatory changes or additional R3 efforts will work in every state, there is a guarantee of no success when nothing is done.

References

- Bacchiocchi, S., Barker, Q., de Jong, M., Rainero, M., & Vargas, M. (2017). *A recreational fishing license program: What's the catch? Structuring and managing license fees to achieve financial stability*. Worcester, MA: Worcester Polytechnic Institute.
- Beardmore, B., Haider, W., Hunt, L. M., & Arlinghaus, R. (2013). Evaluating the ability of specialization indicators to explain fishing preferences. *Leisure Sciences*, 35(3), 273-292.
- Fedler A. J., & Ditton, R. B. (2001). Dropping out and dropping in: A study of factors for changing recreational fishing participation. *North American Journal of Fisheries Management*, 21, 283–292.
- Field, A. (2018). *Discovering statistics using IBM SPSS Statistics (5th ed.)*. Sage, London.
- Schroeder, S. A., Fulton, D. C., Nemeth, M. I., Sigurdson, R. E., & Walsh, R. J. (2008). Fishing in the neighborhood: Understanding motivations and constraints for angling among Minneapolis-St.Paul, Minnesota metro residents. *American Fisheries Society Symposium*, 67, 1-19.
- Southwick Associates. (2013). *Hunting and fishing participation: Regression analysis of national and state trends*. Fernandina Beach, FL: Southwick Associates
- Sutton, S. G., Stoll, J. R., & Ditton, R. B. (2001). Understanding anglers' willingness to pay increased fishing license fees. *Human Dimensions of Wildlife*, 6, 115–130.