



The Economic Contribution of the Private, Recreation-Based Aquaculture Industry in the Western United States

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Executive Summary

Objectives and Purpose of Study: The primary objective of this project is to develop information about the economic contributions of the Aquacultural Suppliers of Recreational Fisheries (ASRF) industry in the western United States. Sampling frames were developed for the ASRF industry, their direct customers, and for ASRF-induced recreational anglers in the western United States. Using these sampling frames, expenditure and sales data were collected from the three populations. The collected data were integrated into input-output models in order to estimate the total economic contribution of the ASRF industry in the western United States.

Survey Procedures and Response Rate: Sampling frames were developed with the help of local and state-level permitting agencies and industry advisors. These sampling frames include a broad sample base in order to generate the most generalizable results possible. Surveys were administered in accordance with the Dillman Tailored Design Method (Dillman, 2000) to all three populations: ASRF producers, their direct customers, and recreational anglers. Survey distribution occurred between January 2008 and January 2010. Over this two year period, nearly 3000 individuals were contacted and data from nearly 1500 individuals was gathered. While ASRF producers and their direct customers were sampled via a mail survey, anglers were often intercepted in person in order to facilitate higher response rates. Table E-1 summarizes the survey distribution process for the three groups.

Table E-1: Response Rates and Administration Dates by Survey

	Dates Administered	Surveyed Individuals	Excluded Individuals*	Respondents	Response Rate
ASRF Survey	1/08 - 12/09	418	245	52	30%
ASRF Customer Survey	11/09 - 1/10	686	94	260	44%
Colorado Private Fishery Angler Survey	6/09 - 11/09	366	11	222	63%
Colorado Public Fishery Angler Survey	6/09 - 11/09	873	0	489	56%
California Angler Survey	7/09 - 9/09	613	0	359	59%

*Excluded for reasons including not in business, not an angler, and undeliverable address

Primary Findings

ASRF Producers

- A typical ASRF business is operated by a 55-year old married man who has been in the business over 20 years. Gross sales for ASRF businesses average \$330,000 annually (although sales are much higher for a few businesses but lower for a majority of businesses).
- There are a maximum of 173 ASRF producers in the Western United States. These businesses do \$53.2 million in direct recreational fish sales annually.
 - Every dollar of ASRF products sold results in an additional \$.85 in indirect and induced economic activity in the Western region. Every million dollars sold supports 30 full-time jobs.

ASRF Customers

- ASRF customers come in many forms, including private backyard ponds, private dude ranches, private fishing clubs, homeowners' associations, fee-fishing operations, and public waters. The average ASRF customer purchases \$2,656 in ASRF products and attributes \$13,593 of annual sales to the purchase of these products.

- The ASRF industry supports over 20,000 privately-stocked fisheries in the Western region. These customers' sales amount to \$272 million annually.
 - Every dollar of ASRF customer sales results in an additional \$.79 in indirect and induced economic activity in the Western region. Every million dollars sold supports 41 full-time jobs.

Anglers

- California Anglers spend an average of \$180 on a typical fishing day on items such as airfare and gasoline, while Colorado anglers spend \$135. The average sampled angler spends \$150 per day within the Western United States.
- Angler days induced by ASRF fish stocking total 6.99 million annually. Total direct ASRF-induced angler expenditures total \$1.04 Billion annually in the Western region.
 - Every dollar of Angler expenditures leads to an additional \$.83 of economic activity in the region. Every million dollars of angler expenditures support 36 full-time jobs.

Total Economic Contribution

- Accounting for all ASRF industry-related spending (including direct ASRF expenditures, expenditures from first point-of-sale customers attributable to fish stocking activity, and angler activity) yields an estimated total of \$1.913 billion in annual expenditures in the Western Region.
- The multiplier effect of ASRF-induced angler expenditures results in 26,000 full-time jobs in the Western United States.

- Accounting for the forward and backward linkages ASRF production, every dollar of direct ASRF producer sales is associated with a total of \$35.92 in annual within-region output.
- The forward and backward linkages of every million dollars of ASRF Sales supports 492 full-time jobs in the Western United States.
- With most of the producers concentrated in California, Colorado, Oregon, Utah and Washington, the geographic distribution of the ASRF industry's impact is not uniform. Nearly half of the total economic contribution of the ASRF industry accrues within California.

The Economic Contribution of the Private, Recreation-Based Aquaculture Industry in the Western United States

1. Introduction and Problem Statement

Recreational fishery managers are often faced with challenges regarding decisions on how to manage a particular fishery, recognizing that in some rural areas, economies may depend almost exclusively on tourism dollars generated from that fishery. Rising population levels have led to increased pressure on fisheries, leading managers to implement various management strategies in order to maintain fishery quality, including restricting fishing techniques, restricting terminal tackle or bag limits, and stocking fish. In the United States, augmenting fish populations by stocking hatchery-reared fish is common practice, with 3.5 million catchable trout, 58 million warm-water and 13 million sub-catchable cold-water species stocked in Colorado alone each year by the Colorado Division of Wildlife (CDOW, 2010a).

In fact, much of the 45 billion in retail sales that recreational fishing generates annually in the United States (ASA, 2008) is supported by fish stocking programs which augment fishing quality and encourage angler trips to local and distant fisheries. For example, Caudill (2005) found that the US Fish and Wildlife Service (USFWS) stocked 9.4 million rainbow trout in 2004 and that for each dollar of fish produced in USFWS hatcheries, \$32 dollars of economic activity was generated in local and regional economies.

While most people are aware of federal and state fish stocking agencies such as the USFWS or state-level fish and game departments, few are aware of the private aquaculture businesses which supply fish for both private and public fisheries. These businesses provide fish for thousands of privately-stocked bodies of water in the Western United States, including municipal, county, and state public waters, private fishing clubs and dude ranches, fee fishing ponds, and private land. Not

only are privately stocked fisheries utilized by lifelong members and affiliates, but they also supplement the fishing opportunities for other anglers provided by state and federal fisheries. The stocking of fish in public and private waters encourages tourism, which in turn stimulates the economies of the rural communities adjacent to these waters.

There has been very little research documenting the economic contributions or impacts of any portion of the aquaculture industry in any country, and to date, no studies have investigated the economic contributions of that portion of the industry related to support of recreational freshwater fishing (although Váradi, 2001 provides background of the relationship between inland aquaculture and fisheries in Europe).

Economic impacts are usually calculated using input-output models, such as IMPLAN, which trace the forward linkages of exogenous expenditures on inputs using matrices of linked sectors calibrated to a specific region. Examples of this technique as applied to aspects of aquaculture production include investigations of the regional economic impact of the farmed-shrimp industry in India (Reddy, Reddy, and Kumar, 2004) and southern Honduras (Stanley, 2003) in a development context and the contributions of the pet turtle industry to the Louisiana economy (Hughes, 1999). Several studies have used similar regional techniques to estimate the economic impacts of entire fisheries from the demand side by using angler expenditures to trace through the impact of the fishery, including the recreational bluefin tuna fishery in Hatteras, NC (Bohnsack, et al., 2002) and a largemouth bass fishery at Lake Fork, TX (Chen, Hunt, and Ditton, 2003).

To date, however, the role and economic impact of the aquacultural suppliers of recreational fish (ASRF) industry on the Western United States has not been assessed in detail. In order to address this gap in the literature, this report documents the total economic contribution of the ASRF industry in this region. Furthermore, this report provides information which future researchers can

utilize to follow and document trends in the industry. Understanding the economic contribution of the ASRF industry is important to legislators and policymakers who endeavor to create rules and regulations pertinent to the ASRF industry, since these rules and regulations may affect their local or regional economy.

While many other economic reports refer to “economic contributions” as “economic impacts,” it should be noted here that there is a critical difference. Economic *contribution* analysis does not take into account potential substitution opportunities that may exist in the absence of an industry. For example, if the ASRF industry ceased to exist, producers may enter into other agricultural or industrial/commercial industries, while anglers might fish public, non-stocked fisheries or take advantage of alternative recreational opportunities. As such, economic contribution analysis typically overstates potential contraction of the regional economy were an industry simply cease to exist. Economic *impact* analysis, on the other hand, ideally accounts for substitution possibilities.

This study evaluates the economic contribution of ASRF producers for two reasons. First, most other studies report economic contribution figures and the economic contribution of the ASRF industry provides a seamless comparison between the ASRF industry and other industries. Second, in the short run, it is likely that ASRF producers, their customers, and anglers will have difficulty transitioning into other industries and recreational opportunities. In the very short run, the economic contribution of the ASRF industry may be a good measure of the effect of a hypothetical removal of ASRF production. As such, the economic impacts of that industry are left to future research.

This report proceeds as follows. The following section outlines the sampling frame and data collection of ASRF producers, ASRF customers and recreational anglers. Next is a section detailing the theoretical basis and methodological approach of the economic contribution model. Summary

statistics on the three surveyed groups follow, as well as results on the direct expenditures resulting from ASRF production, economic multipliers, and the total economic contribution of the ASRF industry. Finally, a brief section draws conclusions for policymakers.

2. Data Collection and Sampling Frame

In order to assess the magnitude of the forward and backward linkages associated with the private recreation-based aquaculture industry, three entities were surveyed: the potential population of the ASRF industry, a sample of their first point-of-sale customers, and a sample of anglers. The producer and customer surveys asked questions regarding operational information (e.g. production technology), sales information (e.g. location and volume of sales, as well as species sold), cost information (e.g. labor and material costs), and business information (e.g. proprietary income). The angler survey asks how much anglers spent on their most recent trip in a number of expenditure categories within and outside of the western region. Versions of these surveys, along with supplemental materials, can be found in appendices B-K.

2.1 ASRF Producer Survey

Researchers at CSU created a survey instrument which was used to collect data from the ASRF industry. The survey was consistent with previous instruments used for research which quantified the economic contribution of other industries. Surveys were administered, according to the Dillman Tailored Design Method (Dillman, 2000) to all permitted potential ASRF producers between March and December, 2008. The population was derived from state aquaculture permit holder lists, and the names and addresses of these businesses are publicly available. The Western United States is defined as Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

As finfish farming is illegal under Alaska Statute 16.40.210 unless farmed by a non-profit ocean-based salmon ranch, Alaska does not have any producers that fit into the for-profit ASRF category. The large scale Alaska salmon hatchery system, for example, which produces fish which are harvested by both commercial and sport fishermen, is operated by non-profit associations. Although some surveys were sent to producers in this state, as there are no for-profit private recreation based fish hatcheries in Alaska producing primarily fish for stocking recreational fisheries, Alaska is excluded from the economic analysis (though surveys were initially sent to Alaskan producers). A brief summary of secondary research related to the Alaska system is presented in Appendix L.

For the remaining Western states, the survey process of ASRF producers involved sending an introductory letter, followed by a survey and a detailed explanation of the study. This was followed by a thank you/reminder post card, which was then followed by a second copy of the survey. All survey packets included a pre-paid envelope for return mail. Finally, for all producers who had not yet responded, a phone call was made to encourage participation in the survey process. In general, this process is termed the Dillman Tailored Design Method (Dillman, 2000). The survey instrument and relevant materials are provided in Appendices B-C.

State-level permit lists, list sources, and the number of permit holders by state is summarized in table 1 below. In total, 418 permit-holding producers were identified. Of these, 245 producers were found to not actually be in the ASRF business, either through phone calls, mail correspondence, or consultation with industry advisors. This left 173 potentially active producers, of which 52 actually completed a survey, yielding a minimum 30% response rate. This is a low estimate of response rate, since the 173 possible producers may not have all been active producers

in 2007. See Bond et al. (2010) for further discussion of response rates of agricultural producers relative to the general public.

Table 1: Identified Producers By State

State	Active Permits	Not in Business	Potential Businesses	ASRF Source of Information
Alaska	77	77	0	Department of Fish and Wildlife
Arizona	15	11	4	Department of Agriculture
California	154	84	70	Department of Fish and Game
Colorado	45	22	23	Colorado Aquaculture Association
Idaho	11	1	10	Department of Agriculture
Montana	8	3	5	Department of Fish, Wildlife, and Parks
Nevada	7	4	3	Division of Wildlife
New Mexico	1	0	1	Mike Sloane, New Mexico State University Extension
Oregon	31	13	18	Department of Fish and Wildlife
Utah	24	12	12	Department of Agriculture and Food
Washington	41	18	23	Department of Fish and Wildlife
Wyoming	4	0	4	Department of Fish and Game
Total	418	245	173	

The number of producers per state aligns with the most recent census of aquaculture, where the majority of facilities in the west exist in Washington, California, Oregon, Idaho or Colorado (USDA, 2006).¹ Also aligning with the data collected in this study, the census of aquaculture also indicates that the majority of sportfish producers in the United States, particularly in the West, produce trout. Furthermore, the summary statistics from our sample regarding farm size, annual sales, as well as the distribution of sales across producers are consistent with other agriculture studies' findings in the Western United States, potentially mitigating any concern regarding sample

¹ Differences between this study and the census of aquaculture may exist because this study focuses only on fish produced for recreational purposes.

selection bias (please refer to section 4.1.1). For example, Lubben et al. (2006) report that only 10% of agricultural operations do more than \$250,000 in sales annually, and that most agricultural producers derive half or less of their household income from their agricultural operation. These numbers, along with nearly all demographic features of agricultural producers surveyed in that study, align with the results of this study.

2.2 ASRF Customers

The second surveyed subpopulation was ASRF first point-of-sale customers, who were contacted between November 2009 and January 2010.² An ideal sampling frame would have involved privately stocked fisheries from all WRAC states. This would ensure a sample of ASRF customers which aligned with our sample of ASRF producers, and would have potentially mitigated any concern regarding sample selection bias. However, no publicly-available lists of these customers are readily available. As such, a list of 686 potential buyers was compiled through the cooperation of several ASRF producers in Colorado.³ These customers included all identified categories of potential buyer, including private fishing clubs, dude ranches, homeowners' associations, municipalities, state parks, fee-fishing ponds, and private landowners. However, there may still be some sample selection bias. ASRF producer data reveals that sales to public recreational fisheries comprise 67% of total gross sales of ASRF products. This statistic is driven primarily by a few large producers in California, although many other producers in other states sell to public recreational outlets (see section 4 of this document for discussion of sales outlets). The sample of ASRF customers is mostly private fisheries: only 3% of respondents are public sites. The assumption made in this report is that this sample is representative of the population of ASRF customers and that the cost structure of public sites is relatively similar to that of private sites, but

² Researchers at CSU developed the survey with the help of Rebecca Cooper, Liley Fisheries, and Ken Cline.

³ These firms include Cline Trout Farms, Liley Fisheries and E & J Fish Farms.

indeed this may be an item of contention. Due to the lack of information that the data affords regarding public sites, no statement can be made regarding what sort of biases this may confer.

Table 2 illustrates the types of respondents to the survey (industry advisors confirmed that these ratios aligned with the original sampling frame).

Table 2: Types of ASRF Customers who Responded to the Survey

River-Based Private Dude Ranch	5%
Lake-Based Private Dude Ranch	7%
River-Based Private Fishing Club	6%
Lake-Based Private Fishing Club	12%
Fee Fishing Ponds	3%
HOA	17%
Private Backyard Ponds	50%
Other	2%

Data from this sample was collected via an augmented Dillman Tailored Design Method (Dillman, 2000) by first mailing an introductory postcard which had a return address and business icon of the aquaculture facility which provided the name and address of the customer. This postcard was intended to provide name recognition and credibility to the study, as well as encourage customers to respond. The second mailing was a pair of letters, one from Colorado State University and another from the Colorado Aquaculture Association, which once again encouraged individuals to participate, stating that this study will document the economic contribution of their sector. This letter was followed with a survey and a cover letter, then a postcard, and for those who hadn't responded to the first survey after 2 weeks, a second survey. The survey and additional associated documents are presented in Appendices D-E.

Of the 686 surveys originally mailed, 74 respondents' addresses were undeliverable and 20 responded that they were no longer operating a fishery of any type and had not stocked fish recently. Of the remaining 592 potential respondents, 260 mailed their survey back for a response

rate of 44%. Cross referencing survey respondents' names with industry advisor lists reveals that our sample of 260 is representative of the 686 originally surveyed.

2.3 Recreational Anglers

The third subpopulation was of anglers in Colorado and California.⁴ Anglers are the final users of recreation-based aquaculture products. In order to generate the broadest and most representative sample possible, surveys were distributed to anglers at a variety of sites in order to capture differences in expenditure patterns. In both states, all sites fall within a region of analysis which was identified by several key features. First, the region must contain many types of recreational fisheries, including private and public ponds, lakes, reservoirs, streams, and rivers. This also includes private ranches, private fishing clubs, municipalities, homeowner's associations, and other private property. Second, the regions must be small enough that an angler could potentially substitute to almost any other fishery within the region in the absence of his preferred fishery. Third, the regions are large enough to be adjacent to both large population centers and rural areas in order to provide the most generalizable depiction of the economic effects of the ASRF industry. Collecting data from anglers at many different types of sites allows for identification of substitution patterns by anglers across fisheries (e.g. from private to public sites) that may occur in the absence of the ASRF industry in order to better assess the effect that changes in ASRF production levels has on recreational anglers' economic activity. Study region maps can be found in Appendices H and K.

During the summer and fall of 2009, anglers at 53 private and public fisheries were surveyed in order to obtain the most representative sample possible. Surveys were distributed in person on site in most cases. Anglers were asked for their address and told that their participation would

⁴ A project funded by the USFWS in the Department of Agriculture and Resource Economics at CSU also endeavored to answer many of the same questions as this project in the context of Federal fish stocking. As such, the USFWS project was able to utilize the ASRF angler survey instrument. Funding from the USFWS project was leveraged along with WRAC money in order to gain access to a more robust sample which would otherwise have been unattainable without access to this supplemental funding.

automatically enter them into a raffle for gift certificates to Cabela’s (an outdoor equipment retailer). They were handed a survey and a pre-stamped return envelope. We mailed a thank you/reminder postcard 10 days after the first contact, and a second survey a week later for any who had not yet responded.

In some cases, anglers were members of private clubs and on-site sampling was not appropriate. In these cases, surveys were mailed according to the Dillman Tailored Design Method (Dillman, 2000) including an introductory letter, followed by a survey, then a postcard and a second survey. In a few cases, fishing club owners did not feel comfortable distributing the names of their anglers, so these owners distributed the survey materials by mail for us, as with the ASRF customer survey. Some private fishery operators distributed surveys personally on-site. The survey instrument and related materials are presented in Appendices F-K.

Surveys were distributed to 873 public fishery anglers and 355 private fishery anglers in Colorado, with 489 respondents to the public survey and 222 respondents to the private survey for an overall response rate of 58%. An additional 613 surveys were distributed to California public sites, with 359 surveys returned for a response rate of 58.5%. These response rates are consistent with other surveys of anglers (e.g. Loomis, 2006).

Summary information regarding the subpopulation surveys is presented in Table 3.

Table 3: Response Rates and Administration Dates by Survey

	Dates Administered	Surveyed Individuals	Excluded Individuals*	Respondents	Response Rate
ASRF Survey	1/08 - 12/09	418	245	52	30%
ASRF Customer Survey	11/09 - 1/10	686	94	260	44%
Colorado Private Fishery Angler Survey	6/09 - 11/09	366	11	222	63%
Colorado Public Fishery Angler Survey	6/09 - 11/09	873	0	489	56%
California Angler Survey	7/09 - 9/09	613	0	359	59%

*Excluded for reasons including not in business, not an angler, and undeliverable address

3. Methodology

3.1 General Approach

This report estimates the forward and backward linkages of the ASRF industry in order to assess its total economic contribution to the Western United States. Forward linkages are the dollars spent by users of ASRF products such as privately stocked fisheries and anglers. Backward linkages, on the other hand, are dollars spent by the ASRF industry on inputs supplied by various industries (e.g., feed producers, insurance companies, automobile manufactures, etc...) and individuals (e.g., labor). Estimates of the relevant flows are calculated from three separate surveys of distinct populations related to the ASRF industry: producers within the industry, first point-of-sale customers of these producers (e.g., private fisheries, state and local governments, etc.), and anglers. The calculation of spending flows by this latter group is similar to the approach adopted by Caudill (2005), although in that study it was assumed that all anglers who visit a site do so as a result of fish stocking. The current study, however, accounts for the fact that many anglers would likely visit a site and spend dollars on recreation even if fish stocking did not occur. In that sense, this study generates a more conservative estimate of the economic contribution of fish stocking.

To estimate total economic contributions, the following methodology is employed. First, the total dollars spent by end users of ASRF products, or the forward linkages of ASRF products, is estimated using survey data (see section 3.2). Then, the total *backward* linkages of these and ASRF industry direct expenditures are traced through the Western economy using input-output models. Often, these linkages are reported in the form of multipliers, which indicate the amount of economic activity generated for a given amount of sales of a particular product. For example, a multiplier of 1.8 for the ASRF industry indicates that for every dollar spent on ASRF products, \$1.80 is generated in the regional economy. These multipliers are used to calculate the total economic contribution of the ASRF industry.

IMPLAN input-output software is used in this study to account for the backward linkages of ASRF induced expenditures. IMPLAN was originally developed by the US Forest Service but was made available to the public in 1988 by the Department of Agricultural Economics at the University of Minnesota. Currently, IMPLAN is updated and distributed by Minnesota IMPLAN Group. IMPLAN uses data for industries within a region to generate linear production functions which relate the amount of final demand for a particular sector's products with the amount of inputs required to achieve that level of final demand. Formally:

$$(1) \quad Y = (I - A) * X,$$

where Y represents the final demand for goods, I is an identity matrix, X is a vector of inputs and A is a matrix of technical coefficients which link inputs to outputs in all sectors. Solving for X yields

$$(2) \quad X = (I - A)^{-1} * Y$$

which yields the amount of input, X, needed to satisfy final demands, Y. $(I-A)^{-1}$ is the matrix of technical interdependence coefficients which measure direct and indirect levels of inputs needed to achieve final demand Y.

For this study, Y represents expenditures on goods and services resulting from ASRF stocking. The matrix of technical coefficients in IMPLAN is used to impute X, which is the amount of total economic activity resulting from changes in final demands of anglers in the absence of ASRF fish stocking. This is done by hypothetical removal of the ASRF industry from the Western economy, and therefore a hypothetical removal of ASRF stocking induced expenditures.

Input output modeling makes several assumptions which may not be appropriate in this instance. For a more thorough review of input-output analysis and its major shortcomings, please see Miller and Blair (2009). First, the production relationships built into the A matrix are assumed to be *Leontief*, implying fixed proportionality in inputs. This can be explained best with an example. In the case of the ASRF producer industry, producers purchase inputs such as feed and gasoline.

Perhaps an economist wishes to predict the economic effect of simulating a doubling in the size of that industry, so she doubles Y , the final demand for ASRF products. Input-output models assume that along with the doubling of the ASRF industry size, ASRF producers will demand exactly twice the amount of feed and gasoline as before. This may make sense for feed, since doubling the fish requires roughly double the food, but it is likely that there will be economies of scale in terms of gasoline, where a producer can use the same truck and simply add fish. In terms of other inputs, such as electricity, there may be diseconomies of scale. Input-output analysis assumes constant returns to scale over all inputs for all ranges of production.

Another potential shortcoming of input-output analysis is that it does not account for changes in prices. For example, if strong government regulations were to reduce the size of the ASRF industry by 75%, it is likely that the price of ASRF products would go up. If the ASRF industry suddenly doubled in size, prices of ASRF products would likely go down. IMPLAN models assume that per-unit relative prices, and thus expenditures, are constant.

Finally, input-output models do not account for substitution of expenditures (Loomis, 2006, Bastian, 2004). For example, economic contribution figures are often interpreted as economic *impacts*, implying that without a certain industry, the amount of economic activity occurring in a region would be reduced by the economic contribution of that industry. In the case of the ASRF industry, one might assume that an economic contribution of \$2 billion annually implies that without the ASRF industry, \$2 billion would disappear from the region. In fact, this is not necessarily true: many of the dollars spent by recreational anglers, in the absence of privately stocked fisheries, would be spent elsewhere within the region. However, the items on which those dollars are spent will be different in the absence of the ASRF industry, and some sectors (for example ASRF customers) may actually bear the burden of an exodus of angler dollars.

Despite these drawbacks, IMPLAN is a standard tool used to trace spending flows throughout a regional economy, and since the results of this report will likely be compared with other similar reports, it is important to maintain consistency in order to facilitate efficient policy recommendations. As such, IMPLAN is used for the contribution analysis presented here.

3.2 Forward Linkage Construction

3.2.1 ASRF Industry

The first step of the forward linkage construction is to estimate total ASRF industry sales. This is calculated by multiplying the average sales of our sampled firms (see section 4.1.1) by the total number of firms in the industry, which is estimated as outlined in section 2 of this document.

Formally:

$$(3) \quad S^P = P \cdot \frac{\sum_{i=1}^p s_i^P}{p},$$

where S^P is total industry sales, P is the estimated total number of private hatcheries in ASRF, p is our sample size and s_i^P is the sales dollars of individual firms in our sample.

Implicitly, this calculation implies that the recovered sample is representative of all ASRF

firms in the industry (i.e., $\frac{\sum_{i=1}^p s_i^P}{p}$ is the true industry average), and that the estimate of potential

ASRF industry size (P) is accurate. As only a sample of the population was recovered, and this sample may suffer from self-selection bias, these statistics are necessarily measured with error.

However, in the absence of additional information, they are the best estimates available.

Furthermore, given the assumptions of fixed-proportion input-output models, output and employment multipliers are independent of the overall scale (P) of the industry.

3.2.2 ASRF Customers

The next step is to infer the number of ASRF first point-of-sale customers. While the total number of ASRF customers is uncertain, the amount that the average sampled customer spends on ASRF products is known. Using total ASRF industry sales from equation (1) above, and assuming that the sample of ASRF customers is representative of the ASRF customer population (see section 2.2 for discussion), total ASRF industry sales are divided by individual customer purchase amounts to infer the number of ASRF customers as follows:

$$(4) \quad C = S^P / \frac{\sum_{k=1}^c e_k^c}{c},$$

where C is the total number of ASRF customers, e_k^c is individual sampled customer annual expenditure on ASRF products and c is our sample size of ASRF customers.

Survey data for each ASRF customer includes annual gross sales and expenditures, the percentage of these sales attributable to fishing, and the percentage of fishing sales attributable to stocked fishing. These self-reported figures are used to estimate the amount of gross sales and expenditures attributable to stocked fishing as follows:

$$(5) \quad S^{CSF} = C \cdot \frac{\sum_{k=1}^c (s_k^c \cdot \zeta_k \cdot \psi_k)}{c},$$

where S^{CSF} is total stocked fishing related sales of ASRF customers, s_k^c is the gross sales of individual ASRF customers, ζ_k is the percentage of sales attributable to fishing and ψ_k is the percentage of fishing sales attributable to stocked fish.

These calculations are based on two strong assumptions. First, it is assumed that survey respondents are able to approximate ζ_k and ψ_k with a reasonable degree of accuracy. This may be a difficult task given that many of these customers are not solely fishing-based operations; many are

general dude ranches or private clubs which offer other recreation services such as scenic viewscapes, horseback riding and hunting, and may not be able to accurately estimate the appropriate shares.

The second assumption, closely related to the first, is that sales derived from fish stocking are separable from other sales. For example, a dude ranch proprietor with \$1 million in annual sales may state in his survey that she derives 30% of those sales from fish stocking. This analysis assumes that in the absence of ASRF fish stocking, that proprietor would still draw \$700,000 in annual sales from his other services. This may be an *overstatement* of the importance of the ASRF industry since the dude ranch proprietor might be able to offer more horseback riding and hunting opportunities in order to supplement the lost income from fish stocking. On the other hand, the \$300,000 loss may also be an *understatement* of the losses associated with the absence of the ASRF industry, as the dude ranch customers who hunt might simply enjoy the thought of a full-service ranch which includes fishing. In other words, without fish stocking, the dude ranch might lose much of its general appeal. As such, and in the absence of additional information, we assume that proprietors are the best judge of the proportion of revenues attributable to stocked fish, and that errors in this proportion across the sample are distributed symmetrically around zero. Again, however, it should be noted that the multipliers associated with first point-of-sale customers are independent of the scale of S^{CFS} .

3.2.3 ASRF Induced Anglers

To estimate the number of angler days generating these sales, the average amount of money that the mean angler spends on-site in a day is used. Dividing total stocked-fishing related revenue by the amount of money spent by an angler in a typical day on-site, the number of privately-stocked-induced angler days in a year at all ASRF customer sites is estimated by:

$$(6) \quad AD = C \cdot \frac{\sum_{k=1}^c \left(\frac{S^{CSF}}{e_k^a} \right)}{c},$$

where AD represents ASRF-induced angler days and e_k^a represents on-site daily angler expenditure for ASRF customer k . This assumes that all stocked-fishing-induced sales come from anglers.

Some ASRF customers do not have any sales (e.g. private backyard pond owners). For these customers, we utilize a separate survey question which simply asks how many anglers visit the site annually. We assume here that all angler visits are due to stocked fishing and that survey respondents interpreted the annual angler question as annual angler days. This is for three reasons: 1) we have no other prior since we have no data on angler visitation patterns at private ponds with no sales; 2) it may be difficult for a non-sales fishery manager to retrospectively differentiate between two anglers coming for one day each or one angler coming for two days; and 3) the average privately stocked fishery with sales has *fewer* angler days (only 21% of total angler visitors) than stated anglers due to the fact that most angler days are not attributable to fish stocking. If we assumed that 100% of angler days were attributable to fish stocking for ASRF customers with sales, our data indicates that these producers interpreted “annual angler visitors” as “annual angler days.”

From these components, total angler expenditures are simply daily angler expenditures multiplied by the total number of angler days. Only primary-destination angler expenditures are used for this part of the analysis, since it is unknown what portion of secondary or tertiary-purpose anglers’ expenditures are attributable to fishing:

$$(7) \quad \text{AnglerExpenditures} = \text{AnglerDays} * \text{DailyExpenditures}.$$

4. Results

4.1 Summary Statistics from the Surveyed Populations

4.1.1 ASRF Producers

A typical ASRF business is operated by a 55-year old married man who has been in the business over 20 years. Gross sales for ASRF businesses average \$330,000 annually (although sales are much higher for a few businesses but lower for a majority of businesses). Finally, income from aquaculture typically constitutes about half of household income, with many producers indicating through phone conversations that they are involved in some other agricultural activity for supplemental income. Table 4 summarizes the demographic statistics of survey respondents.

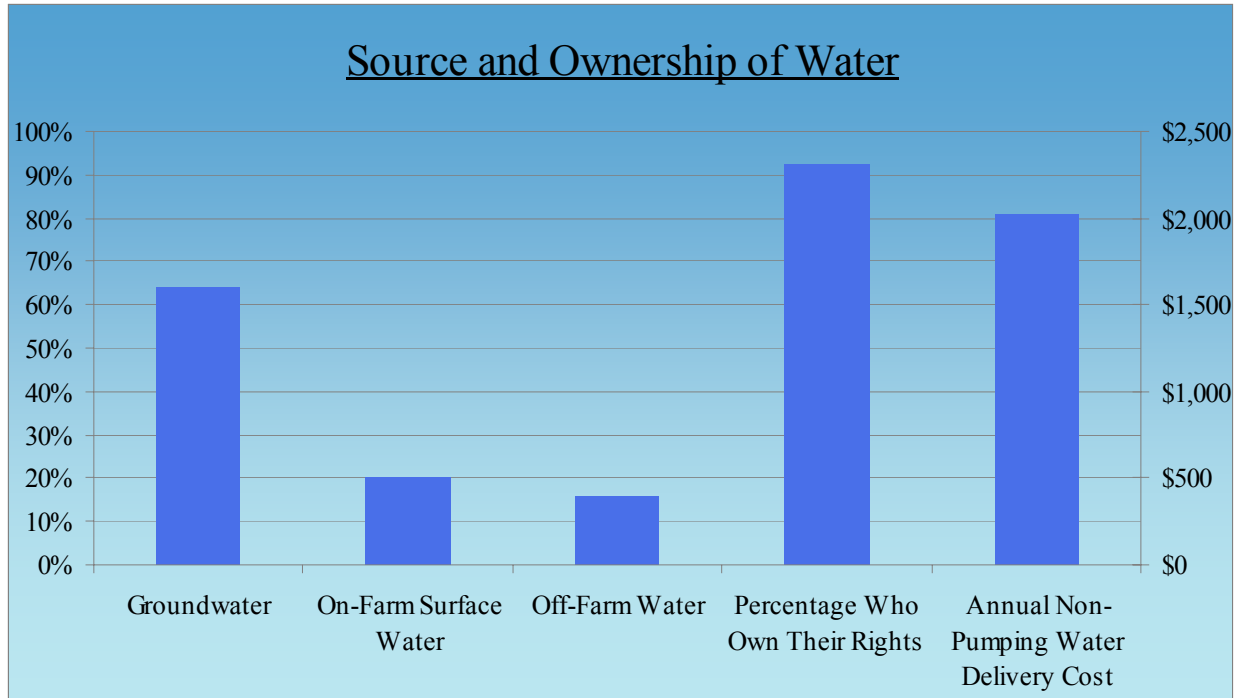
Table 4: Demographic Statistics

Variable	Average	Standard Deviation	Minimum	Maximum
Age	55	13	30	85
% Male	90%	n/a	n/a	n/a
Years in ASRF Business	22	13	1	60
Years in Aquaculture in General	23	13	4	60
Size of Household (Persons)	3.3	2	1	8
% Married	88%	n/a	n/a	n/a
% Who Live On-Site	80%	n/a	n/a	n/a
Earnings as a % of Total Income	45%	37%	-1%	100%

Water in many regions in all western states is becoming increasingly scarce as population growth encourages development and ultimately municipal purchase of water rights from agricultural uses. Most ASRF producers (64%) use ground water, with 20% of producers using on-farm surface water, and 16% of producers using off-farm water (from any of the following sources: federal supplier, irrigation district, mutual or private water, cooperative or neighborhood ditches, commercial company, or municipal or community system). Regardless of use, 93% of water rights

are owned by ASRF producers (the remainder being leased). Average non-pumping water delivery costs reach \$2000 annually. Figure 1 summarizes water use behavior among ASRF producers.

Figure 1: Water Usage and Ownership



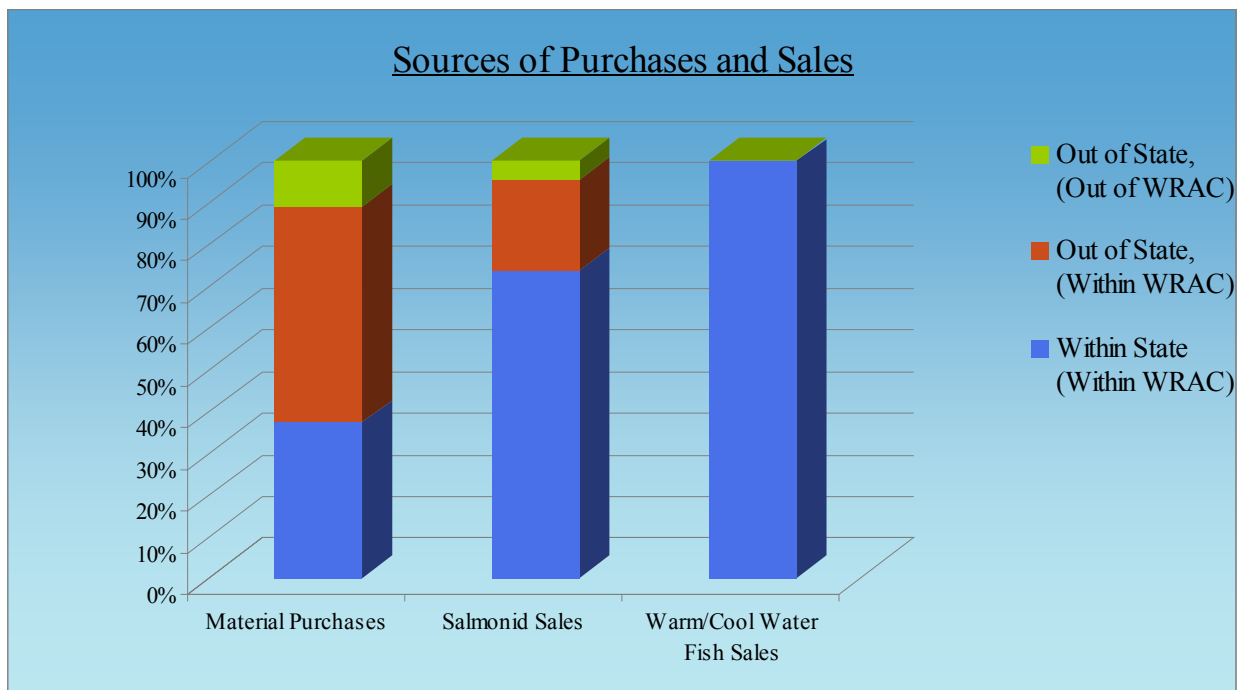
Most WRAC-region producers (nearly half) are located in California. This makes sense given the climate and population of that state. Colorado, Oregon, and Washington are home to the vast majority of the remainder of potential ASRF businesses. There were no completed surveys from Arizona, and several Arizona permit holders indicated that they are in the food-fish aquaculture businesses, farming fish such as Tilapia due to the warmer weather and water. A breakdown of the number of potential producers by state can be found in table 1.

Ultimately, this study endeavors to estimate the economic contribution associated with ASRF production. This economic contribution can be estimated in part by tracing the flow of expenditures back “up the supply chain” of the ASRF industry. For example, ASRF producers purchase feed and equipment, the equipment manufacturer purchases parts, the part manufacturer

purchases raw materials, etc. High levels of local or regional economic activity are generated by high proportions of purchases and sales in-state or in-region. Conversely, if most purchases and sales are done out of the region, low amounts of local or regional economic activity are generated.

Figure 2 indicates that most purchases and sales are done in-state or in-region. Sales are divided into salmonids and warm/cool water species, although later they will be re-aggregated for modeling purposes. Eighty-nine percent of material purchases, such as fish, eggs, feed, or other depreciated expenditures, are made in state or in the Western region. Ninety-five of salmonids are sold in-state or in the Western region and 100% of warm and cool water fish are sold in state. These high percentages of in-region trade may be due to the high transportation costs associated with aquaculture products, and ultimately result in high economic contribution estimates.

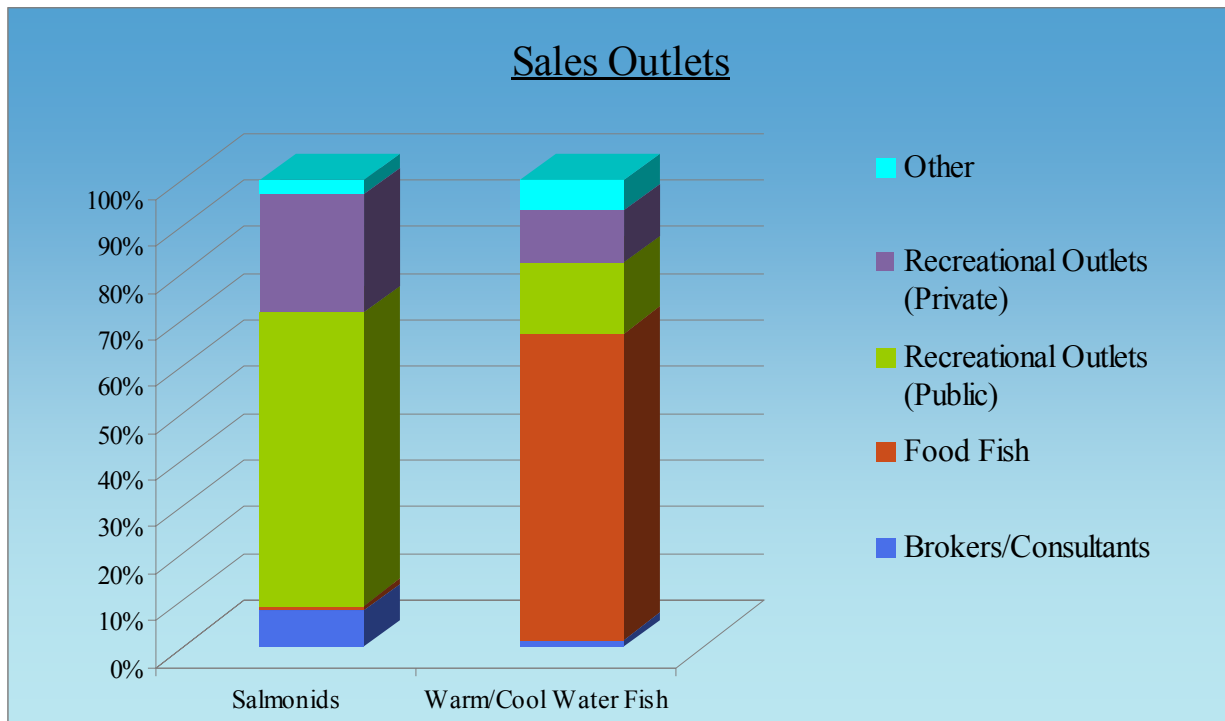
Figure 2: Location of purchases and sales



For ASRF producers in our sample, many sales outlets are available. Producers may sell their fish to public or private recreational outlets, or they may sell their fish to a broker, who in turn sells to some recreational outlet. Fish may also be sold as food items. For example, ASRF producers

who sell warm water fish generate 65% of their sales dollars from food fish sales. 88% of salmonids, conversely, are sold to either private or public recreational outlets. In most cases, these are Rainbow or Brown Trout. Only a small percentage of fish are sold to brokerages (8% and 16% for salmonids and warm/cool water fish, respectively). Figure 3 summarizes the sales outlets for salmonids and for warm and cool water fish.

Figure 3 Sales Outlets

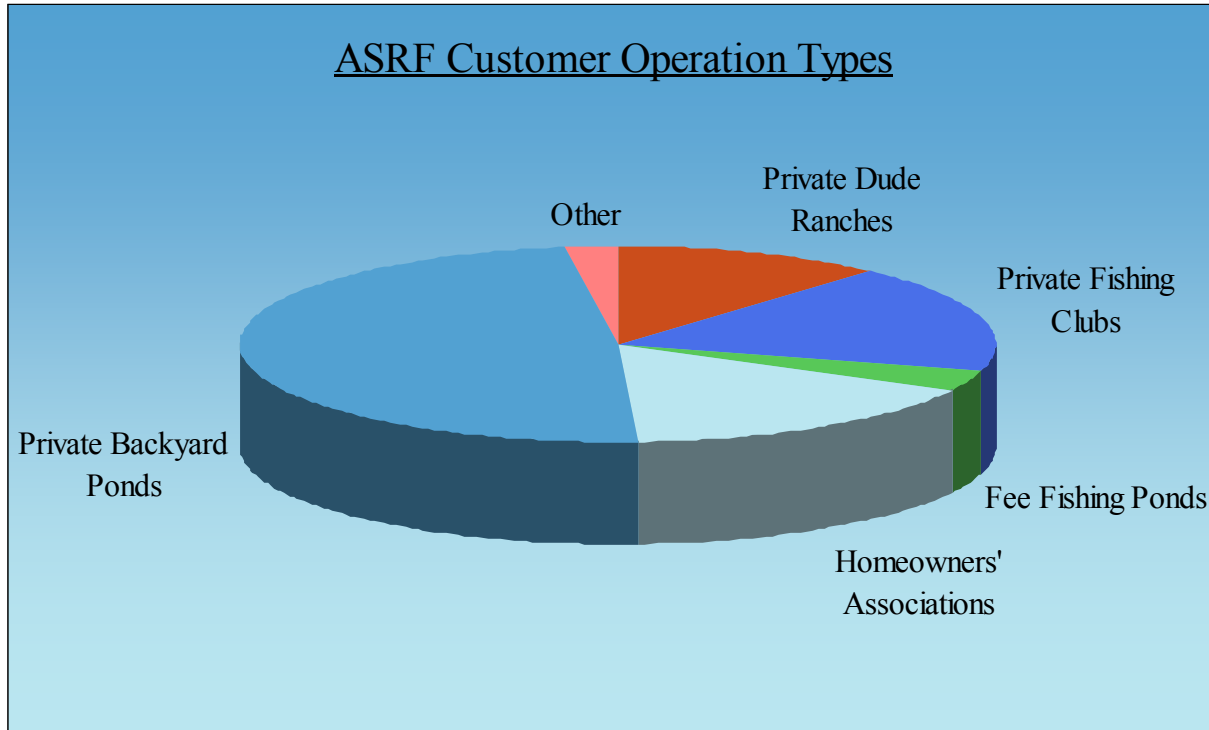


4.1.2 ASRF Customers

For the modeling component of this study, all ASRF customers are aggregated together. However, it is interesting to explore some of the differences between two groups of ASRF customers. Many customers are businesses themselves, purchasing fish from ASRF producers and subsequently selling these fish, along with a package of recreation services, to anglers. However, many ASRF customers purchase fish for their own recreational purposes, stocking fish in backyard ponds for use by friends or family. Figure 4 illustrates the percentages of various types of ASRF

customers as indicated on the survey of ASRF customers. Note that nearly 50% are private ponds (no sales). The remaining 50% is divided between private dude ranches and fishing clubs, fee-fishing ponds and homeowners' associations.

Figure 4: ASRF Customer Types



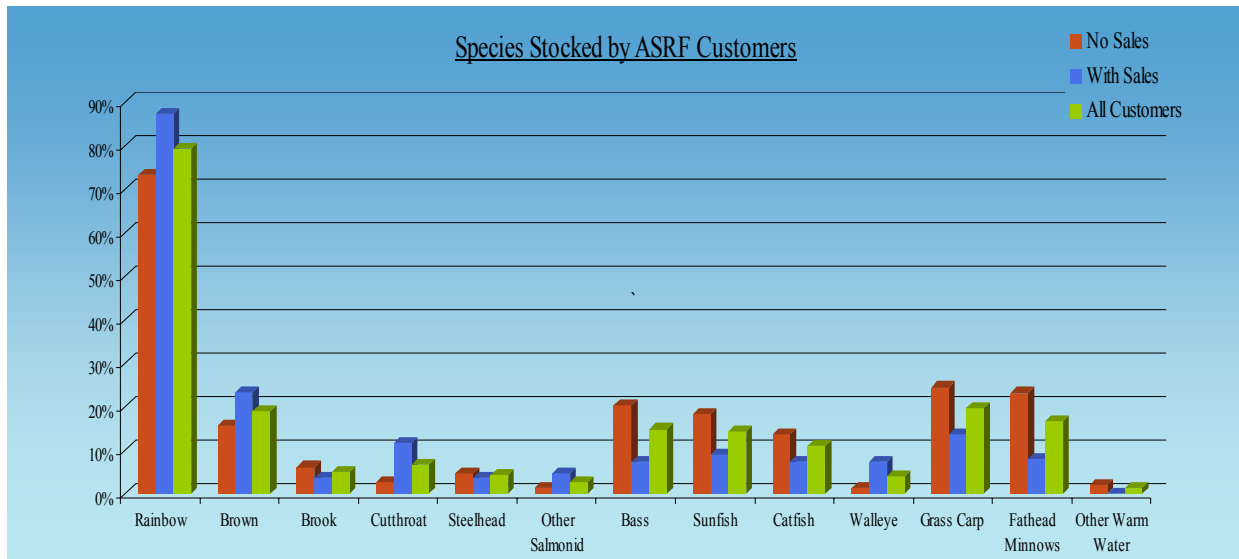
The typical respondent to the ASRF customer survey is a 60 year old married man with a college education and 13 years of experience. He still has one child at home, and in many cases either his wife or his child are contributing to household expenses. Most live on site, with 5% of their annual income is derived from fish-stocking related services. For the remainder of this section, ASRF customers are divided into two categories: with sales and without sales. These will later be re-aggregated to facilitate modeling. ASRF customer demographic statistics can be seen in table 5.

Table 5: ASRF Customer Demographic Statistics

	Average	Standard Deviation	Minimum	Maximum
<u>No Sales</u>				
Age	60.73	11.91	27	94
% Male	92%	n/a	n/a	n/a
Years of Experience	12.39	13.21	0	55
Years of Education	16.01	2.19	9	19
Household Members	2.75	1.49	1	11
Contributing Members	1.70	0.79	0	5
% Married	90%	n/a	n/a	n/a
% With Home On Site	65%	n/a	n/a	n/a
% of Income from Fishery	0%	0%	0%	0%
<u>With Sales</u>				
Age	56.50	12.19	88	24
% Male	86%	n/a	n/a	n/a
Years of Experience	13.27	11.42	0	64
Years of Education	15.52	2.12	12	19
Household Members	2.95	1.44	1	8
Contributing Members	1.63	0.76	0	6
% Married	88%	n/a	n/a	n/a
% With Home On Site	50%	n/a	n/a	n/a
% of Income from Fishery	12%	26%	0%	100%
<u>All Customers</u>				
Age	58.51	11.49	94	24
% Male	90%	n/a	n/a	n/a
Years of Experience	12.79	12.43	0	64
Years of Education	15.80	2.17	9	19
Household Members	2.84	1.47	1	11
Contributing Members	1.67	0.78	0	6
% Married	89%	n/a	n/a	n/a
% With Home On Site	59%	n/a	n/a	n/a
% of Income from Fishery	5%	18%	0%	100%

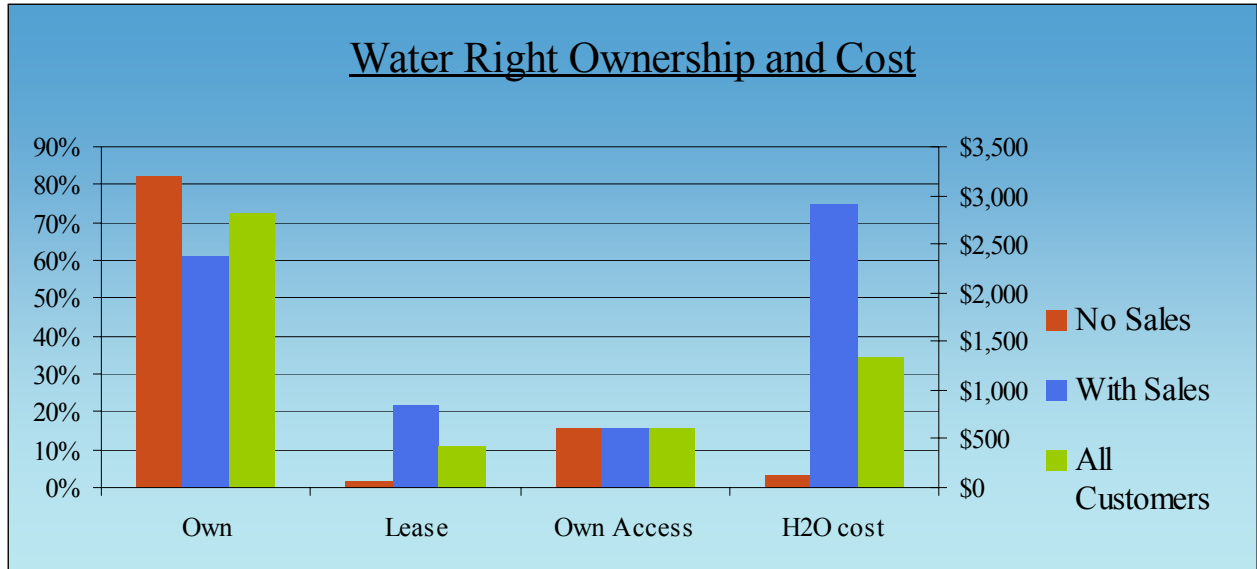
80% of the respondents to the ASRF customer survey indicate that customers stock Rainbow Trout, which makes sense given that this is one of the most aggressive and hardy fish available for stocking in a variety of waters and climate zones (Halverson, 2010). The next most popular fish is brown trout, with only 20% of ASRF customers stocking this fish. Respondents also reveal that there is no single warm/cool water species that dominates stocking lists. Grass Carp and Fathead Minnows, often used for pest control, are stocked by nearly 20% of ASRF customers, while Bass and Sunfish (e.g. Crappie, Bluegill) are stocked by 15%. Other species stocked by ASRF customers include Catfish and Walleye. Stocking information by species can be found in figure 5.

Figure 5: Species Stocked



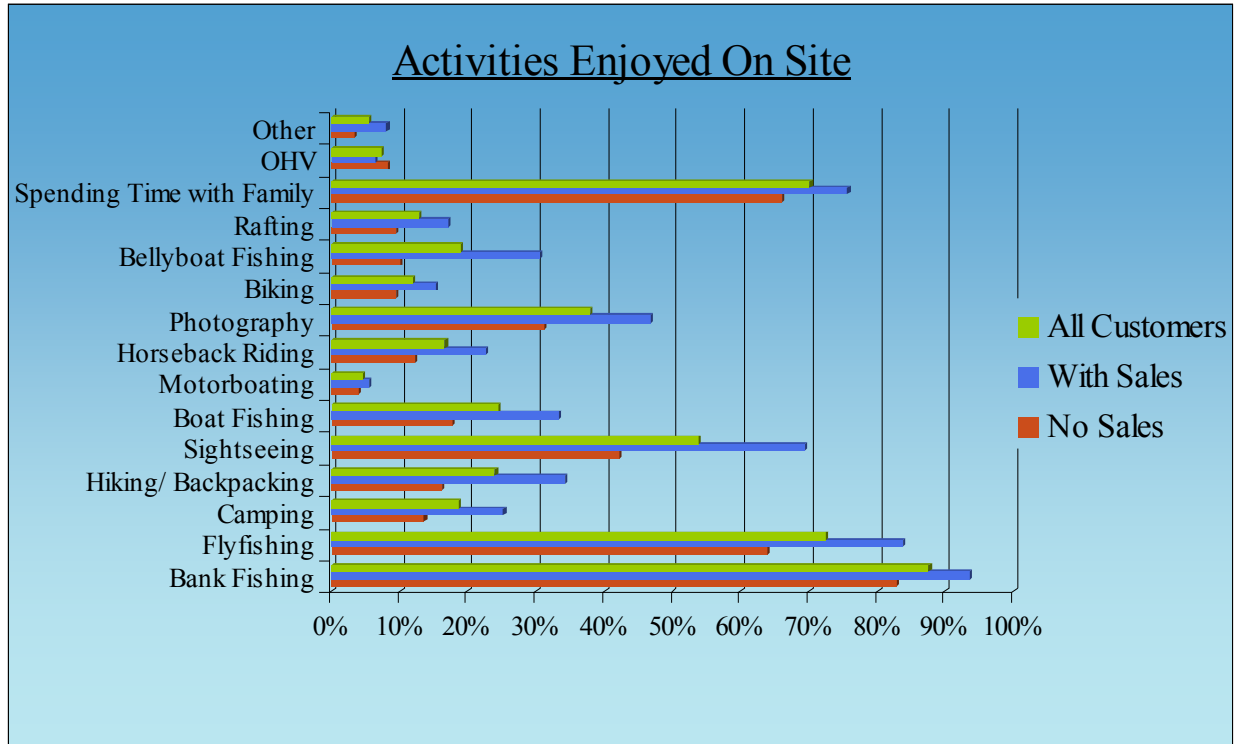
As with ASRF producers, water is probably the most important input (besides fish) to privately-stocked fishing operations. Most ASRF customers own their water rights, although nearly 40% of ASRF customers with sales either lease or own access to water. For these operations, annual non-pumping water delivery costs reach nearly \$3000 annually. Water rights and water cost information is displayed in figure 6.

Figure 6: ASRF Customer Water Rights



Anglers enjoy a variety of amenities at privately stocked fisheries. Many anglers simply enjoy spending time with friends and family in a scenic setting. Other anglers enjoy flyfishing, particularly at sites with sales. Bank fishing is a ubiquitous activity at privately stocked fishing sites: due to the nature and size of these businesses, the properties are often relatively small and do not afford opportunities for activities such as high-speed motor boating. Nonetheless, many privately stocked fishing operations provide other activities such as rafting, biking, horseback riding, and camping. The percentage of ASRF customers providing a variety of amenities is summarized in figure 7.

Figure 7: Activities enjoyed at ASRF customer sites



4.1.3 Anglers

The survey of anglers suggests that those intercepted at private fisheries are older, more likely to be retired, and receive a higher income than their public fishery counterparts. The average age of anglers at private fisheries is just over 60, compared with 53 and 50 for Colorado public and California anglers, respectively. Anglers at private fisheries also have an average of 15.77 years of education (a 4-year bachelor’s degree is 16 years), compared with 14.8 and 14.2 for Colorado and California public fishery anglers, respectively. Most of the private fishery anglers surveyed are members of a private fishing club, with only small percentages of public fishery anglers being members. Most anglers at all types of site are male. These numbers can be seen in table 6.

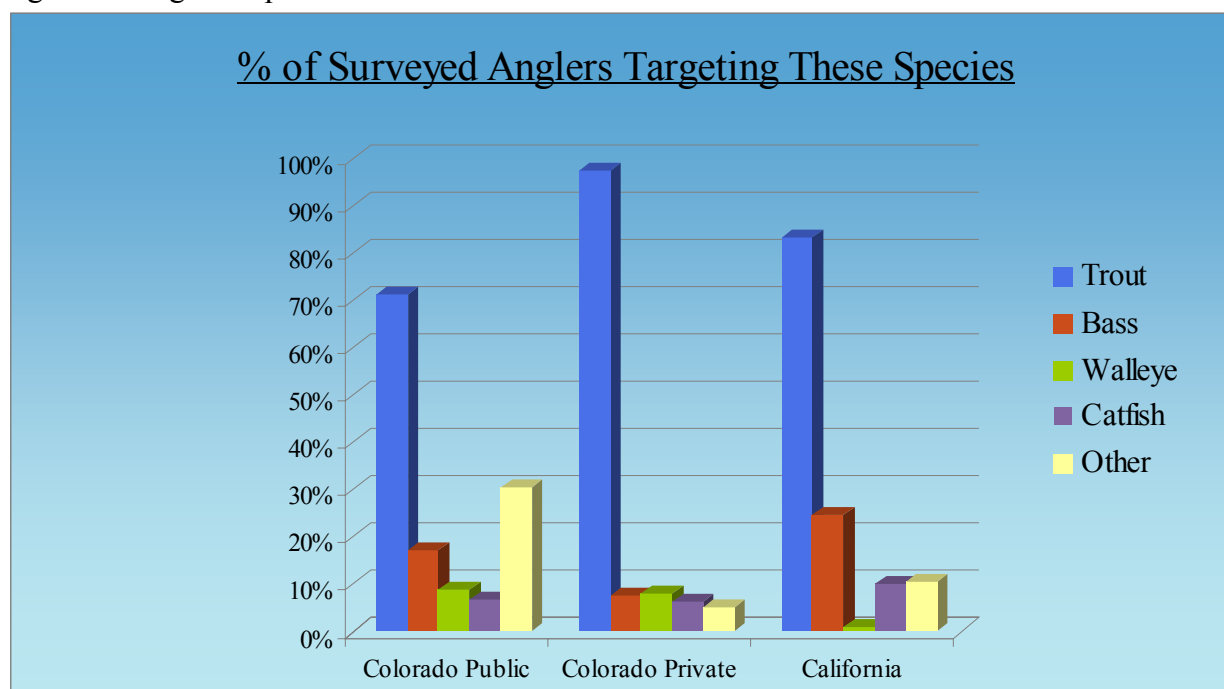
Table 6: Angler Demographic Statistics

	Average	Standard Deviation	Minimum	Maximum
<u>Colorado Public Anglers</u>				
% Male	88%	n/a	n/a	n/a
% Employed	77%	n/a	n/a	n/a
% Retired	31%	n/a	n/a	n/a
% Private Fishing Club Member	5%	n/a	n/a	n/a
Age	50	14	83	21
Years of Education	15	2	6	19
Income	\$76,207	\$37,404	\$20,000	\$500,000
<u>Colorado Private Anglers</u>				
% Male	89%	n/a	n/a	n/a
% Employed	62%	n/a	n/a	n/a
% Retired	46%	n/a	n/a	n/a
% Private Fishing Club Member	79%	n/a	n/a	n/a
Age	60	13	89	15
Years of Education	16	2	12	19
Income	\$97,517	\$38,664	\$20,000	\$500,000
<u>California Anglers</u>				
% Male	91%	n/a	n/a	n/a
% Employed	70%	n/a	n/a	n/a
% Retired	32%	n/a	n/a	n/a
% Private Fishing Club Member	7%	n/a	n/a	n/a
Age	53	15	88	17
Years of Education	14	2	6	19
Income	\$78,000	\$38,775	\$20,000	\$500,000
<u>All Anglers</u>				
% Male	89%	n/a	n/a	n/a
% Employed	71%	n/a	n/a	n/a
% Retired	35%	n/a	n/a	n/a
% Private Fishing Club Member	22%	n/a	n/a	n/a

Age	53	15	89	15
Years of Education	15	2	6	19
Income	\$80,778	\$38,736	\$20,000	\$500,000

Anglers surveyed at all types of site primarily target trout. This is not surprising, given the fact that more trout are stocked in the United States than any other fish (Halverson, 2010). Furthermore this aligns both with the survey of ASRF producers (section 4.1.1) and with ASRF customers (section 4.2.1). Other targeted species include bass, walleye, and catfish. A few other species noted on survey forms were Sturgeon, Striped Bass, Arctic Char and Grayling, Perch, Crappie, Bluegill and other Sunfish, Muskie, Pike, Kokanee Salmon, Crawfish and Wiper. None of these targeted species represent a large constituency among the sample of anglers. Targeted species by region are displayed in figure 8.

Figure 8: Targeted Species



Although catching fish is undoubtedly one of the primary draws of the fishing experience, there are many other activities that attract anglers to a particular site. Spending time and fishing

with friends and family at a peaceful and clean site while viewing scenery characterize a typical angler’s desires and expectations from a fishery. Other important aspects include on-site amenities (e.g. restrooms) and catching large numbers of fish. Things that are not too important to anglers are fishing near skilled anglers, rafting, off highway vehicle usage and horseback riding. These results are illustrated in figures 9 and 10.

Figure 9: Angler Activities

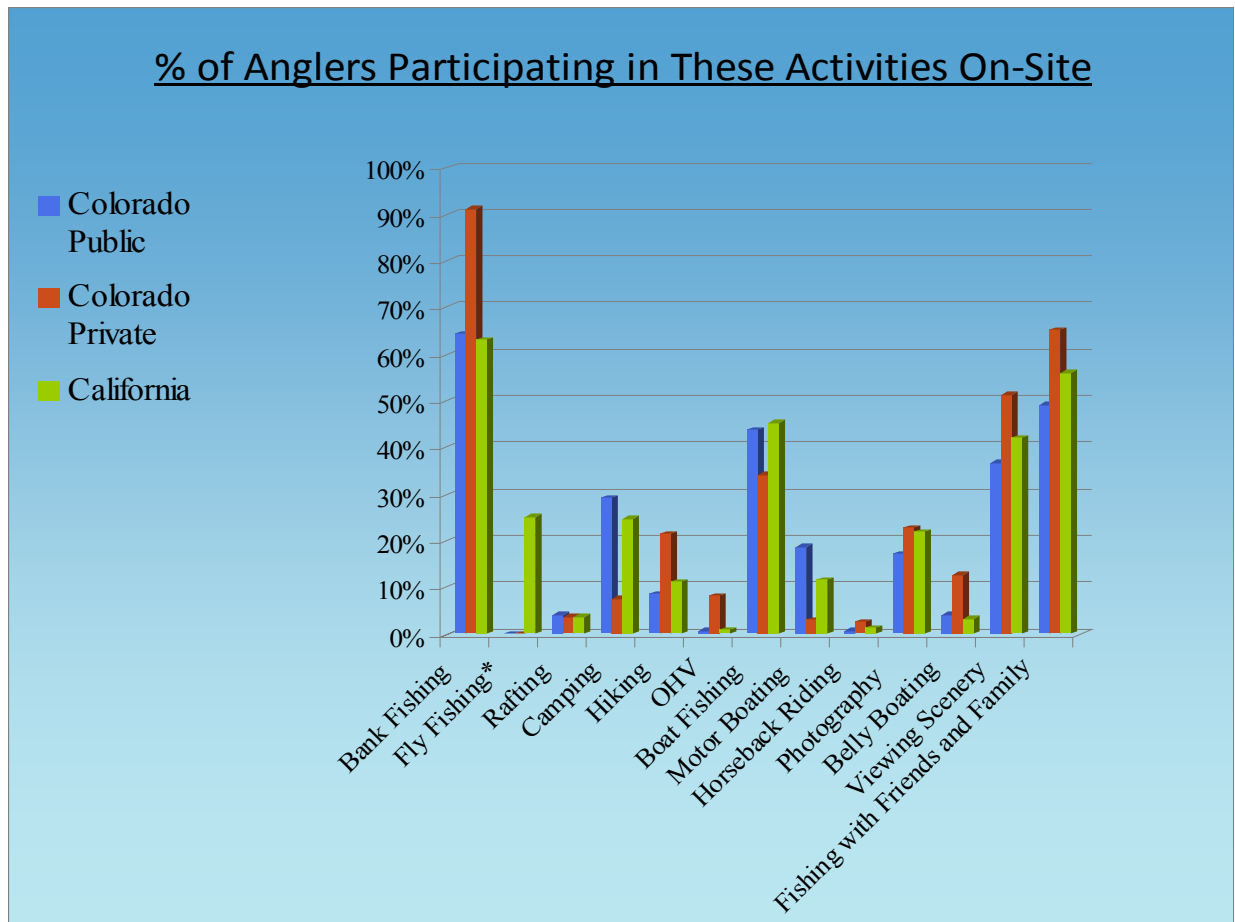
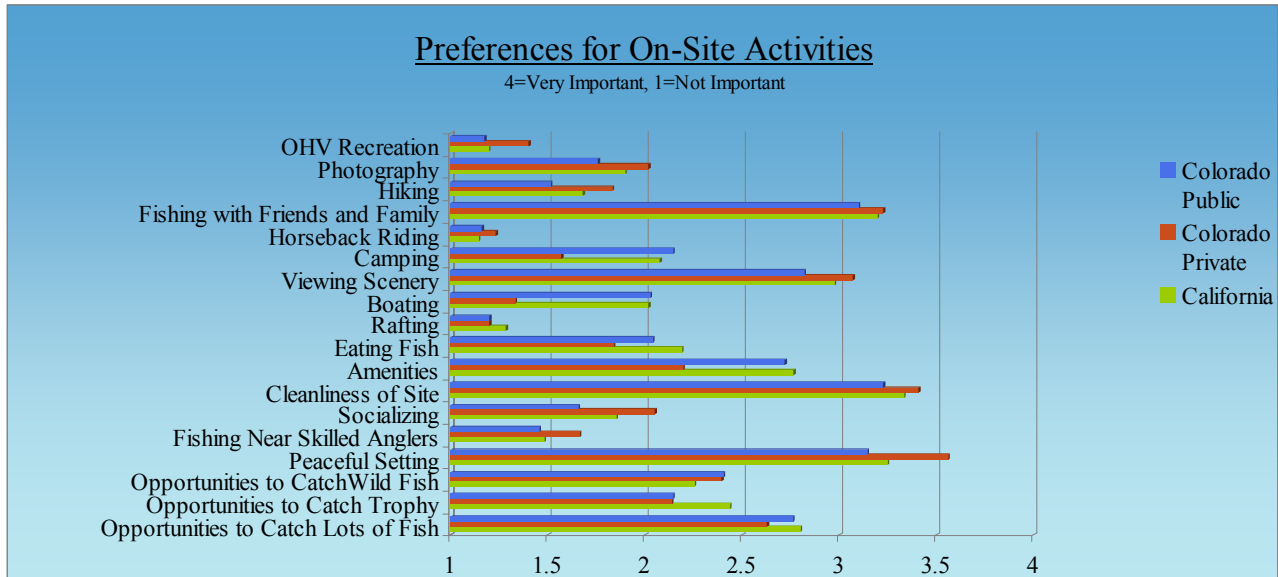
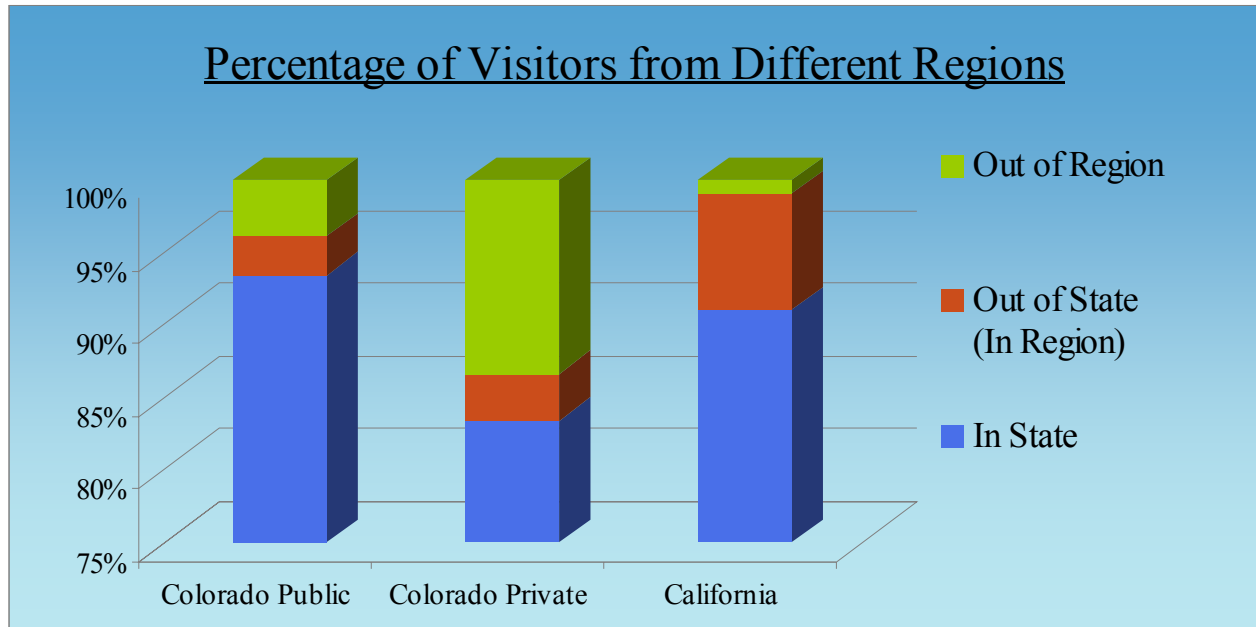


Figure 10: Angler Preferences



Although this study documents the economic contribution of ASRF stocking, the economic impact of ASRF stocking, which may be of interest for future research, depends largely on the number of dollars “imported” into the region by out-of-region anglers. While most anglers stay in-state for their fishing experiences, many anglers come from out-of-state and even out-of-region to visit private fisheries in Colorado (13.4% of Colorado private fishery anglers are from outside of the Western Region). These numbers are in stark contrast to the number of Colorado public anglers from out of region (3.9%) and to the number of California anglers from out of region (0.9%). Although it is not the focus of the present analysis, the difference between origins of private and public fishery anglers may have implications in terms of the economic *impacts* of those fisheries. These numbers are illustrated in figure 11.

Figure 11: Import Dollars from Recreational Fisheries



4.2 Production Functions and Multipliers

Using sales and expenditure data from the three surveys, two new sectors are constructed in IMPLAN: one for ASRF producers and another for ASRF customers. The production functions for these sectors map a dollar of sales of a particular product into a set of expenditures on supplies, equipment and personnel. Results are often reported in the form of economic multipliers. Economic multipliers indicate the magnitude of the “ripple effect” which is generated in a local or regional economy from the economic activity of one industry. An output multiplier of 1.85 for the ASRF industry, for example, means that for every \$1.00 of fish sold, \$1.85 is generated in the local or regional economy. Employment multipliers indicate the amount of jobs that are generated in a local or regional economy for every one job generated in the ASRF industry.

Multipliers are composed of three effects: the direct effect, the indirect effect, and the induced effect. Direct effects come directly (and only) from the industry of analysis. For example, every dollar spent on ASRF products corresponds (by definition) to one dollar of output (sales) of the ASRF industry. Indirect effects come from the fact that ASRF producers spend money on items such as fish feed, trucks, gasoline, etc. Thus, the sales of the ASRF industry also contribute to sales of the industry which supplies it. Finally, the induced effect comes from the fact that employees spend their wages on various things in their local or regional economy. All of these effects are combined to form the Type SAM (Social Accounting Matrix) multiplier.

This section summarizes the production functions and multipliers of all three surveyed populations: ASRF producers, ASRF customers, and recreational anglers. The information contained in these multipliers is used in the calculation of the total economic contribution of the ASRF industry.

4.2.1 ASRF Producers

While average industry figures are used for the model built into IMPLAN, it is important to note the significant differences in scale among ASRF producers. Figures 12 and 13 demonstrate the fact that the distribution of sales is skewed towards the high end. For example, if there are three producers, with two producing \$100,000 per year in sales, and the third producing \$2.8 million per year in sales, the average between the three will be \$1 million per year. However, the median producer only produces \$100,000 per year. This type of skewed distribution exists in our sample, where the median producer sells between \$100,000 and \$150,000 annually and the mean (or average) producer may sell upwards of \$500,000 of fish per year.

Furthermore, 68% of producers in our sample only produce one type of fish, either salmonid or warm and cool water fish. Therefore, those producers who do not produce or sell any warm or

cool water fish will “pull down the average.” In other words, including all producers in the average, even if only half of those producers actually produce salmonids (the other half would reflect \$0.00 in salmonid sales) would seem to indicate that salmonid sales are lower than they actually are for salmonid producers. As such, four statistics are provided: the average and median of a particular fish category for all producers, and the average and median for only those producers who produced that type of fish. Note that some producers generate income from both types of fish.

Figures 13 and 13 outline the breakdown of sales by category, including catchables, sub-catchables, and trophy size fish. Generally speaking, catchables dominate sales, with two-thirds of salmonid sales and three-fourths of warm/cool water sales coming from these fish. Trophy size fish (fish greater than 16”) are the second largest category for salmonids, with 10% of sales coming from these fish. For warm/cool water species, sub-catchables (fish that are stocked and expected to grow into catchable size) are the second largest category, constituting 10% of sales.

Figure 12: Breakdown by Category for Salmonids

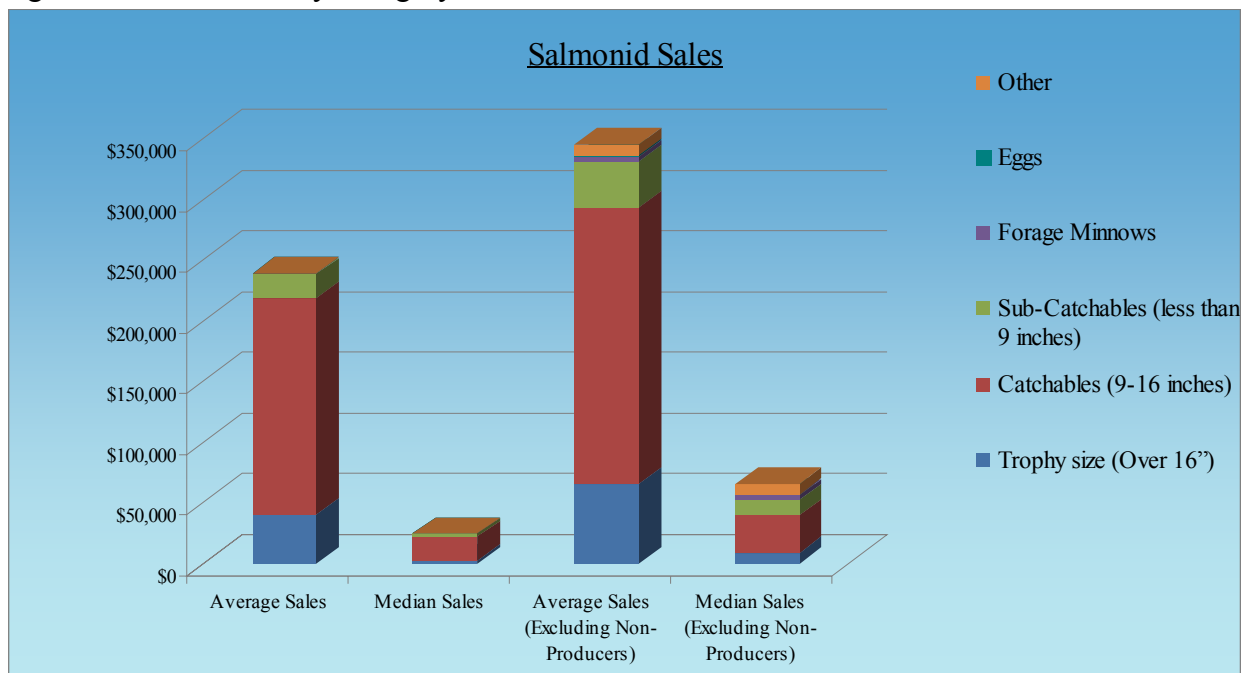
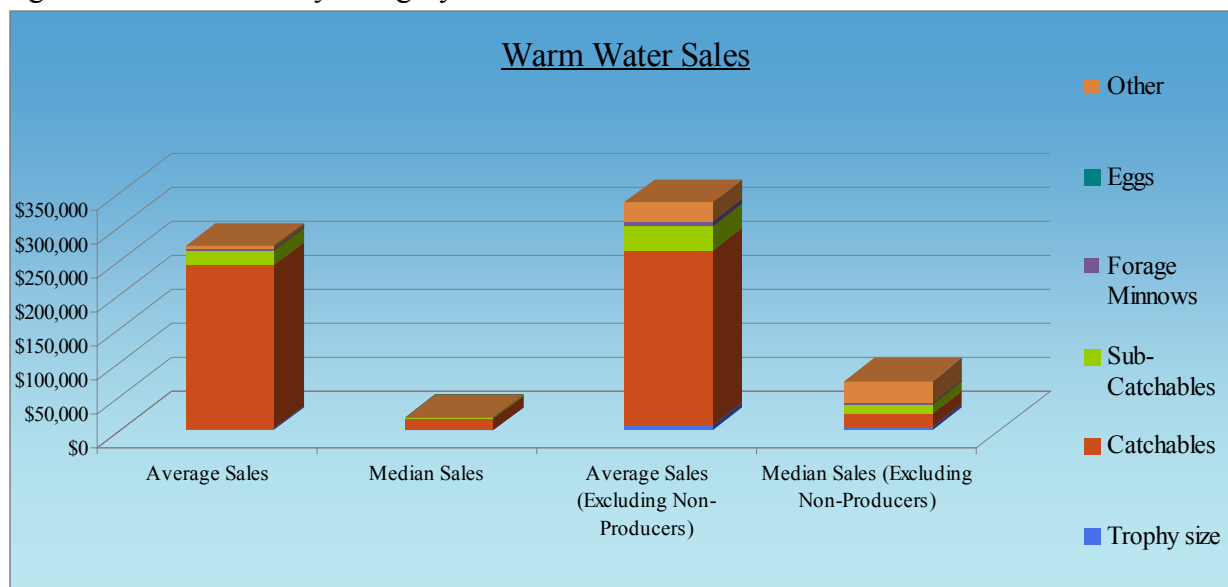


Figure 13: Breakdown by Category for Warm and Cool Water Fish



All producer data is aggregated into a single production function which is built into IMPLAN. For every amount that is inputted into the new “ASRF Producer” sector, the “Other Animal Production” sector, which originally included ASRF producers, is reduced by that same amount in order to keep the same economy-wide output and employment levels. The specific per-producer averages (excluding food fish) used in model construction are given in table 7. Of the \$330,000 in gross annual sales, \$120,000 goes towards non-depreciated expenditures such as fish and eggs, feed, electricity, and gasoline. Labor expenditures just exceed \$90,000 annually, including wages, benefits and labor taxes. \$75,000 is spent annually on the purchase, maintenance and lease of buildings, fish production facilities, equipment and transportation equipment. Finally, proprietors net only \$45,000 annually. This makes sense, given that the average ASRF producer

only derives 50% of his annual income from his ASRF operation. Note that the high standard deviations relative to the means of each expenditure category indicate a large variation in scale among ASRF producers in the region.

Table 7: ASRF Production Function

Category	Average Annual Expenditures	Standard Deviation	Absorption Coefficient*
Fish and Eggs	\$23,041	\$83,605	0.070
Feed	\$41,439	\$90,718	0.125
Electricity	\$10,220	\$21,596	0.031
Natural Gas/Propane	\$572	\$1,600	0.002
Other Utilities	\$2,484	\$10,498	0.008
Gasoline	\$9,079	\$25,831	0.027
Chemicals/Supplies and Oxygen	\$6,564	\$23,238	0.020
General Consumable Supplies	\$2,206	\$6,452	0.007
Shipping and Distribution	\$9,823	\$31,747	0.030
Non Labor Insurance	\$4,041	\$10,357	0.012
Licences/Permits/Inspection Fees	\$1,778	\$4,736	0.005
Marketing and Advertising	\$1,340	\$4,190	0.004
Other	\$2,610	\$11,910	0.008
Non-Shipping Depreciated Vehicle Expenses	\$2,779	\$6,661	0.008
Total Non Depreciated Expenditures	\$117,977		
Buildings, Fish Production Facilities, General and Transportation Equipment	\$74,966	\$16,383	
Labor Expenditures	\$92,772	\$173,915	
Proprietary Income	\$45,144	\$33,795	
Sales	\$330,858	\$40,291	
Employment	7.15	8.59	
Total ASRF Producers	173		
Aggregate Sales	\$57,238,415		
Aggregate Employment	1,237		

*This is the percentage of total direct sales revenue that is spent on non-depreciated expenditures. The sum of all absorption coefficients is often referred to as the “gross absorption coefficient.”

Using the production function above, IMPLAN traces through the backward linkages of ASRF expenditures to generate economic multipliers, which are summarized in table 8 for the ASRF industry. For every dollar spent on ASRF products, \$1.85 is generated in the Western Economy. This is due to the direct effect of the \$1 to ASRF producers, the indirect effect of \$.35 to input suppliers, and the induced effect of spending by employees and proprietors. Likewise, every million dollars of ASRF sales results in 21.61 full-time jobs in the Western economy. Finally, for every full-time job supported by the ASRF industry directly, .37 additional jobs are supported throughout the economy.

	Direct Effect	Indirect Effect	Induced Effect	Total Effect	Type SAM Multiplier
ASRF Output	1.00	0.35	0.50	1.85	1.85
ASRF Employment*	21.61	4.21	3.72	29.54	1.37

*Employment effects are reported per \$1,000,000 of gross sales

Given the unique nature of the Western states, it is unlikely that the economic effects of the ASRF industry will be distributed uniformly across the region. Indeed, only one producer was identified in New Mexico, while 70 were identified in California. While it is impossible to use state level data in states like New Mexico (since in some cases no data exist), region-level data can be used to construct individual state-level production functions and generate state-level multipliers. These multipliers can be found in table 9.

Most state-level multipliers are lower than region-level multipliers due to leakages of dollars out of state. However, due to the nature of inter-industry trade in Colorado, Utah and Oregon, multipliers are actually higher than they are at the region level. For every dollar spent in Utah on Utah-grown fish, \$1.87 is generated in that state. This is in contrast to Wyoming, where every dollar of sales only generates \$1.70 in that state.

Table 9: Geographic Differences Using Region-Average Production Functions

		Direct Effect	Indirect Effect	Induced Effect	Total Effect	Type SAM Multiplier
Arizona	Output	1.00	0.31	0.43	1.74	1.74
	Employment	21.66	3.70	3.59	28.95	1.34
California	Output	1.00	0.29	0.44	1.73	1.73
	Employment	21.66	3.16	3.02	27.84	1.28
Colorado	Output	1.00	0.40	0.45	1.85	1.85
	Employment	21.66	4.69	3.69	30.04	1.39
Idaho	Output	1.00	0.40	0.37	1.77	1.77
	Employment	21.66	3.99	3.82	29.48	1.36
Montana	Output	1.00	0.39	0.34	1.73	1.73
	Employment	21.66	6.00	3.46	31.12	1.44
Nevada	Output	1.00	0.25	0.31	1.56	1.56
	Employment	21.66	3.12	2.51	27.30	1.26
New Mexico	Output	1.00	0.33	0.38	1.71	1.71
	Employment	21.66	4.26	3.69	29.61	1.37
Oregon	Output	1.00	0.39	0.43	1.82	1.82
	Employment	21.66	6.94	3.93	32.53	1.50
Utah	Output	1.00	0.40	0.47	1.87	1.87
	Employment	21.66	6.41	4.24	32.31	1.49
Washington	Output	1.00	0.29	0.43	1.71	1.71
	Employment	21.66	3.87	3.28	28.82	1.33
Wyoming	Output	1.00	0.41	0.29	1.70	1.70
	Employment	21.61	5.84	2.67	30.12	1.39

While using region-level data may be the safest way to create production functions at the state level in IMPLAN, there may be sufficient data to create unique production functions in several

states on the basis of average state-level responses to the ASRF industry survey. California, Colorado, Oregon, Utah, and Washington had 18, 7, 7, 6, and 6 survey respondents, respectively (with the next states, Montana and Idaho, only having 3 respondents). These 5 states have very different features from each other (table 10), and as such data from these respondents is used to create unique state-level production functions in IMPLAN, and multipliers from these models are summarized in table 11 (one caveat is that the Washington production function utilized region-level employment figures due to insufficient state-level data). The multipliers exhibited in Table 11 are different than the ones in Table 9 due to the fact that different production functions were used. In the authors' option, the most robust set of multipliers are those in table 9 because they are less susceptible to sample-selection bias.

Table 10: State Average Production Functions

	California	Colorado	Oregon	Utah	Washington
Fish and Eggs	\$28,166	\$170,240	\$3,499	\$15,062	\$6,562
Feed	\$101,473	\$103,246	\$16,232	\$9,663	\$11,005
Electricity	\$20,721	\$42,013	\$875	\$1,991	\$1,771
Natural Gas/Propane	\$1,073	\$3,058	\$0	\$493	\$0
Other Utilities	\$7,435	\$2,631	\$0	\$783	\$0
Gasoline	\$24,045	\$17,921	\$854	\$1,548	\$2,314
Chemicals/Supplies and Oxygen	\$13,757	\$30,911	\$773	\$994	\$506
General Consumable Supplies	\$5,714	\$4,048	\$393	\$590	\$788
Shipping and Distribution	\$24,192	\$20,615	\$10,629	\$33	\$28
Non Labor Insurance	\$10,600	\$10,395	\$214	\$302	\$884
Licences/Permits/Inspection Fees	\$4,574	\$2,039	\$1,116	\$1,135	\$563
Marketing and Advertising	\$2,348	\$7,112	\$152	\$30	\$676
Other	\$3,075	\$23,538	\$246	\$501	\$29
Non-Shipping Depreciated Vehicle Expenses	\$6,756	\$4,278	\$549	\$470	\$2,384
Total Non Depreciated Expenditures	\$253,929	\$442,044	\$35,532	\$33,596	\$27,509
Labor Expenditures	\$199,364	\$172,953	\$65,002	\$5,178	\$23,686
Proprietary Income	\$124,452	-\$13,882	-\$6,174	-\$3,771	\$29,191
Buildings, Fish Production	\$207,675	\$90,669	\$36,809	\$28,907	\$4,086

Facilities, General and Transportation Equipment	7.82	5.97	4.75	5.65	1.83
Employment	\$785,420	\$691,785	\$131,169	\$63,910	\$84,472
Sales					

Table 11: Geographic Differences Using State-Average Production Functions

		Direct Effect	Indirect Effect	Induced Effect	Total Effect	Type SAM Multiplier
California	Output	1.00	0.24	0.42	1.67	1.67
	Employment	9.93	1.81	2.96	14.71	1.48
Colorado	Output	1.00	0.42	0.28	1.70	1.70
	Employment	8.65	3.54	2.31	14.50	1.68
Oregon	Output	1.00	0.27	0.41	1.68	1.68
	Employment	36.21	4.72	3.73	44.66	1.23
Utah	Output	1.00	0.36	0.08	1.44	1.44
	Employment	88.41	8.14	0.72	97.26	1.10
Washington	Output	1.00	0.16	0.56	1.72	1.72
	Employment	21.93	2.01	4.49	28.42	1.30

4.2.2 ASRF Customers

Average ASRF customer expenditure figures are used to create the ASRF customer sector in IMPLAN. As discussed in section 3, annual expenditures and sales are multiplied by the reported percentage of sales attributable to stocked fishing. Table 12 summarizes this production function. For every amount that is inputted into the new “ASRF Customer” sector, the “Other Recreation Industries” sector, which originally included ASRF customers, is reduced by that same amount in order to keep the same economy-wide output and employment levels. Most expenditures are categorized as depreciated and non-depreciated inputs. Non-depreciated inputs include fish, non labor insurance, food (for customers), feed (for fish) and electricity. Depreciated expenditures

include maintenance, purchase and lease costs of buildings and facilities. In an accounting sense, the average ASRF customer takes a loss annually from his fishing operation, primarily due to the fact that half of these customers have no sales. Rather, they purchase fish for their own enjoyment and do not anticipate profits from their operation.

Table 12: ASRF Customer Production Function in IMPLAN

IMPLAN Category	Annual Expenditures	Standard Deviation	Absorption Coefficient
ASRF	\$2,656	\$8,786	0.195360
Feed	\$245	\$1,981	0.018008
Chemicals	\$199	\$1,086	0.014654
General Supplies	\$48	\$378	0.003542
Electricity	\$341	\$1,610	0.025090
Natural Gas/ Propane	\$74	\$513	0.005452
Other Utilities	\$194	\$1,560	0.014272
Food	\$982	\$12,694	0.072231
Fishing Equipment	\$72	\$351	0.005299
Vehicle Expenses	\$145	\$942	0.010687
Gasoline/ Diesel	\$172	\$833	0.012617
Marketing	\$300	\$2,028	0.022091
Licenses/ Permits	\$88	\$477	0.006457
Non Labor Insurance	\$551	\$3,420	0.040513
Other	\$873	\$6,719	0.064217
Total Non-Depreciated Expenditures	\$6,939		0.510489
Other Property Income	\$6,986	\$67,824	
Labor Expenditures	\$2,975	\$14,096	
Proprietor Income (residual)	-\$3,306	n/a	
Sales	\$13,593	\$60,210	
Employment	0.43	1.32	
Total ASRF Customers	20,053		
Aggregate Sales	\$272,588,780		
Aggregate Employment	8,658		

Multipliers for the ASRF customer sector in the Western region can be found in table 13. Every dollar spent on ASRF customer products results in \$1.79 being generated in the regional

economy. Furthermore, as this industry is labor-intensive, every million dollars of ASRF customer sales directly supports 32 full-time jobs annually. Due to the indirect and induced effect, every job directly supported by the ASRF customer sector implies an additional .28 jobs in the region.

Table 13: ASRF Customer Multipliers

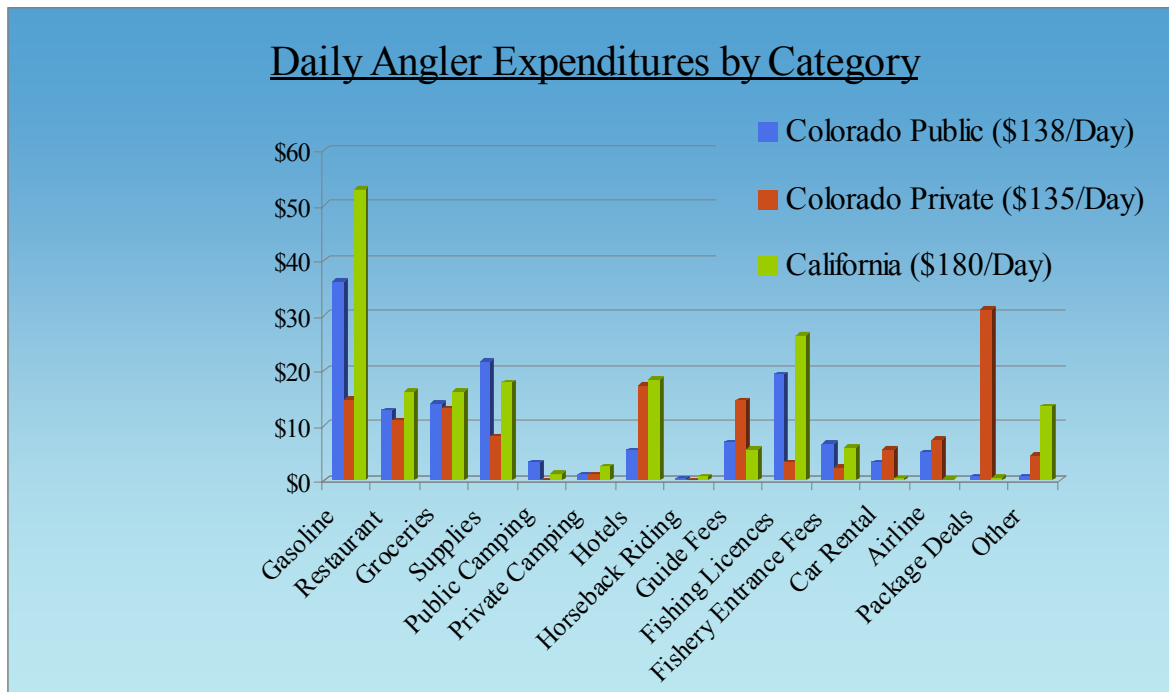
	Direct Effect	Indirect Effect	Induced Effect	Total Effect	Type SAM Multiplier
ASRF Customer Output	1.00	0.61	0.17	1.79	1.79
ASRF Customer Employment	31.76	7.76	1.27	40.80	1.28

4.2.3 Anglers

Anglers spend their money on a variety of items on a typical fishing day. The typical private fishery angler spends the bulk of his money on package deals, guide fees and hotels. Conversely, the typical public fishery angler spends most of his money on gasoline, licenses and supplies. As fishing licenses are not required at many private sites, anglers at private fisheries can enjoy fishing without the added upfront cost of \$31 or \$41.50 for Colorado and California, respectively (CDOW, 2010b, CDFG, 2010).⁵ Although California anglers spend a bit more overall than do Colorado anglers, gasoline expenditures of California anglers dwarf those of Colorado anglers. Colorado Anglers, on the other hand, spend more money on airfare and rental cars. Figure 14 demonstrates the different types of expenditures of the three surveyed angler groups.

⁵ Fishing license expenditures per day are not the same as annual license costs.

Figure 14: Angler Expenditures



Expenditures from all three angler groups are averaged and aggregated into sales categories that align with IMPLAN sectors. Table 14 gives the amount spent by the average angler in a typical day in a variety of these categories.

Table 14: Daily Angler Expenditures by Category

<u>Colorado Public Anglers</u>	Average	Standard Deviation
ASRF Customers	\$38.98	\$194.20
Groceries	\$8.87	\$21.71
Gasoline	\$36.12	\$74.39
Other	\$14.22	\$89.56
Airline	\$5.13	\$61.55
Rental Car	\$3.40	\$35.22
Horse	\$16.96	\$100.87
Hotel	\$3.46	\$19.50
Camp	\$2.81	\$18.31
Restaurant	\$8.03	\$28.13
Total	\$137.98	
<u>Private Anglers</u>		
ASRF Customers	\$38.98	\$255.34
Groceries	\$12.16	\$41.05
Gasoline	\$14.75	\$33.81
Other	\$11.90	\$66.47
Airline	\$7.45	\$48.84
Rental Car	\$5.76	\$34.44
Horse	\$16.65	\$88.68
Hotel	\$15.97	\$79.88
Camp	\$1.23	\$8.30
Restaurant	\$10.15	\$36.03
Total	\$135.00	
<u>California Public Anglers</u>		
ASRF Customers	\$38.98	\$139.70
Groceries	\$11.78	\$22.56
Gasoline	\$52.79	\$262.82
Other	\$22.96	\$50.91
Airline	\$0.28	\$3.14
Rental Car	\$0.53	\$4.93
Horse	\$24.05	\$86.92
Hotel	\$13.39	\$69.71
Camp	\$2.93	\$11.01
Restaurant	\$11.82	\$49.12
Total	\$179.51	
<u>All Anglers</u>		
ASRF Customers	\$38.98	\$272.86

Groceries	\$10.43	\$26.53
Gasoline	\$36.24	\$155.52
Other	\$16.57	\$130.82
Airline	\$4.22	\$52.39
Rental Car	\$3.08	\$31.97
Horse	\$19.22	\$110.18
Hotel	\$8.61	\$52.35
Camp	\$2.61	\$16.65
Restaurant	\$9.63	\$40.94
Total	\$149.58	

Using the information in table 14, four scenarios are simulated, one each using the daily expenditure patterns of Colorado public anglers, Colorado private anglers, California anglers, and all anglers aggregated together. Each scenario simulates a hypothetical removal of angler dollars from the Western Region. Then, the effect of a removal of one dollar of angler expenditures is reported in the form of output and employment multipliers, just as in the previous two sections. On average, every dollar spent by anglers results in an additional \$.83 cents generated in the region, and every million dollars spent by anglers directly results in 18.36 jobs (25.07 jobs when accounting for the multiplier effect). This information is summarized in table 15.

Table 15: ASRF Industry, ASRF Customer and Angler Multipliers

		Direct Effect	Indirect Effect	Induced Effect	Total Effect	Type SAM Multiplier
All Anglers	Output	1.00	0.41	0.41	1.83	1.83
	Employment	18.36	3.64	3.07	1.37	1.37
Private Anglers	Output	1.00	0.45	0.41	1.85	1.85
	Employment	18.72	3.91	3.02	1.37	1.37
CA Public Anglers	Output	1.00	0.39	0.43	1.82	1.82
	Employment	23.57	4.47	4.23	1.37	1.37
CO Public Anglers	Output	1.00	0.42	0.41	1.83	1.83
	Employment	19.04	3.83	3.07	1.36	1.36

4.3 Forward Linkages and Total Economic Contribution of the ASRF Industry

Table 7 shows the level of sales, jobs, and expenditures at an aggregated industry level for the ASRF industry (not including the sales of food fish). These numbers are found by multiplying the average levels (from above) by the total number (173) of potential individual ASRF businesses.

Since our data collection process revealed that no more than 173 permitted producers exist in the Western United States, 173 producers are assumed to exist. While this is not the most conservative estimate, we did make phone calls to nearly all of the original 418 permitted businesses (see table 1) with potential to participate in the ASRF industry. For those firms which could not be contacted, their information was cross-referenced with state-level permit lists and industry advisors which helped us eliminate, we believe, nearly all non-ASRF producers. Average sales data in conjunction with our estimate of 173 total producers and equation (3) above results in a mean estimate of \$57.2 million in ASRF direct sales annually.

Mean annual expenditures of ASRF customers on ASRF products is approximately \$2656 annually. Since ASRF industry sales total \$57.2 million, but only \$53.2 million to non-ASRF customers (some producers buy from other producers), we predict, using equation (4), that there are approximately 20,053 ASRF customers in the Western United States. Therefore, while ASRF customers purchase only \$53.2 million of ASRF products, equation (5) predicts that the availability of those products is estimated to create \$272.6 million in direct sales to anglers.

Using equation (6), we estimate that there are 6.99 million ASRF supported angler days in the Western United States. This is in contrast to Caudill (2005) which assumes that *all* angler expenditures are due to stocked fishing. This study accounts for ASRF customers reported percentage of sales attributable to stocked fishing. Our ASRF customer survey indicates that anglers spend an average of \$38.98 in a typical day at a private fishery. However, our angler survey reveals that anglers in fact spend \$149.58 on a typical fishing day.⁶ This is due to airfare, gasoline, groceries, etc. As such, there are shocks to other industries, such as petroleum refineries, which would occur as a result of a hypothetical removal of the ASRF customer industry, as seen in table

⁶ Note that the difference between the \$38.98 and \$149.58 represents off-site expenditures in the case of the latter. Of course, these estimates were derived from different subsamples and survey instruments.

14. The direct expenditures by the 6.99 million privately stocked fish induced angler days is estimated to be 1.046 billion annually, with \$272.6 million of this going to ASRF customers.

The total economic contribution of the ASRF industry is calculated by tracing the backward linkages of a complete hypothetical exodus of ASRF industry-induced angler expenditures from the region in IMPLAN. ASRF industry-induced angler expenditures amount to \$1.04 billion dollars annually in the Western United States, but these direct expenditures lead to many indirect and induced effects throughout the economy.

Tables 16 and 17 outline the total output and employment generated from the presence of ASRF industry-induced angler expenditures, including the contributions from the industries that supply the ASRF producers, the companies which use ASRF-produced fish for stocking (adjusted for the share of expenditures relevant to this part of their business), and (most significantly) the expenditures of the anglers themselves. In addition, the induced effects include the additional sales generated when employees of these industries spend their income within region.

Table 16 provides estimates of the total output and employment contributions of forwardly-linked industries related to ASRF. The \$53.25 million dollars of direct sales of ASRF products leads to a total of nearly \$2 billion dollars in economic activity in the Western Region of the United States. This translates into a multiplier of 35.92: For every \$1 of sales of ASRF products, \$35.92 dollars is generated in the region. Furthermore, 26,229 full-time jobs are supported by the presence of this industry. An employment multiplier of 492 in this instance means that for every one million dollars of ASRF sales, nearly 492 full-time jobs are supported in the region.

Table 16: Output and Employment Contribution of ASRF Industry in the Western United States

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Total ASRF Sales	\$53,251,888			
Total Output ^a	\$1,046,112,040	\$433,387,530	\$433,571,367	\$1,913,070,968

Total Employment ^a	19,205	3,810	3,214	26,229
Output Multipliers ^b	19.64	8.14	8.14	35.92
Employment Multipliers ^c	360.64	71.55	60.35	492.54

^aDerived from ASRF induced Angler Expenditures

^bDollars of economic activity per dollar of *ASRF producer* output.

^cJobs per million dollars of *ASRF producer* output.

Table 17 provides similar output/sales information, disaggregated into the three customer groups. Note that each forward linkage (reading across table columns) necessarily includes the backwardly-linked category to its left. For example, the last row of the column labeled “ASRF Direct Customers” includes \$98.4 million of total economic activity attributable to backward linkages related to ASRF producers (read from the last row of the “ASRF Producers” column).

Table 17: Forward and Backward Linkages of ASRF Production

	ASRF Producers	ASRF Customers	Direct	Industries Selling to Anglers Who Target ASRF Fish
<i>Example of a Firm in This Category</i>	Trout Grower Selling Fish to Recreational Fishery	Dude Ranch Offering Stocked Fishing Opportunity	Offering Fishing	Restaurant Selling Breakfast to Angler
Estimated Direct Sales of These Businesses	\$53.2 million	\$272 million		\$1.04 billion
<i>Example Expenditure Category by these Businesses</i>	Feed Producer Supplying Trout Farm	Accountant Employed by Ranch	Dude	Local Restaurant Employee Wages
Estimated Sales in Other Industries Resulting from Purchases by These Businesses	\$45.2 million	\$215 million		\$873 million

Estimated Sales to Businesses	Total Attributable to These	\$98.4 million	\$487 million ^a	\$1.91 billion ^b
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^a Includes ASRF Producer Induced Expenditures

^b Includes ASRF Customer Induced Expenditures

Several industries are affected more severely than others. Tables 18 and 19 outline the top 10 industries affected in terms of output and employment by the presence of the ASRF industry. ASRF customers rank first, but closely following is gasoline stations, grocery stores, and sporting goods stores.

Table 18: Top 20 Output Sectors Impacted by ASRF Industry

Implan Sector	Direct Effect	Indirect Effect	Induced Effect	Total Effect
ASRF Customers	\$272,584,992	\$1,472	\$530	\$272,587,008
Retail Stores - Gasoline stations	\$253,421,792	\$5,298,656	\$2,512,971	\$261,233,424
Other amusement and recreation industries	\$134,425,200	\$250,688	\$864,033	\$135,539,920
Retail Stores - Sporting goods- hobby- book a	\$115,894,096	\$1,670,008	\$1,364,032	\$118,928,136
Food services and drinking places	\$67,328,944	\$24,467,128	\$19,331,830	\$111,127,904
Retail Stores - Food and beverage	\$72,927,296	\$323,632	\$6,848,629	\$80,099,560
Hotels and motels- including casino hotels	\$60,216,940	\$1,492,100	\$2,611,155	\$64,320,196
ASRF Industry	\$0	\$57,238,764	\$3,054	\$57,241,820
Real estate establishments	\$0	\$33,062,216	\$19,987,742	\$53,049,960
Imputed rental activity for owner-occupied dw	\$0	\$0	\$45,804,324	\$45,804,324
Total	\$1,046,112,040	\$433,387,530	\$433,571,367	\$1,913,070,968

Table 19: Top 10 Employment Sectors Impacted by ASRF Industry

Implan Sector	Direct Effect	Indirect Effect	Induced Effect	Total Effect
ASRF Customers	8658	0	0	8658
Retail Stores - Gasoline stations	2519	53	25	2597
Retail Stores - Sporting goods- hobby- book a	2369	34	28	2431
Other amusement and recreation industries	2302	4	15	2321
Food services and drinking places	1159	421	333	1913
ASRF Industry	0	1237	0	1237
Retail Stores - Food and beverage	1026	5	96	1127
Hotels and motels- including casino hotels	568	14	25	607
Real estate establishments	0	194	117	311
Transit and ground passenger transportation	293	3	11	307
Total	19,205	3,810	3,214	26,229

5. Conclusions

For people not native to the region, the Western United States represents the frontier of adventure. Recreational fishing is no small part of this image, with Rocky Mountain Trout, wild coastal salmon runs, and Southern California world-record largemouth bass creating opportunities for anglers to test their skills and connect with nature. This recreational industry also supports billions of dollars of sales and hundreds of thousands of jobs in that region. The private, recreation-based aquaculture industry supports a substantial portion of this economic activity.

The Aquacultural Suppliers of Recreational Fish (ASRF) producers in the Western United states are typically small businesses, on average grossing only \$330,000 annually in recreational fish sales. That there are no more than 173 of these small businesses may lead policymakers to

overlook this industry as an insignificant component of their economy. However, these 173 producers support over 20,000 privately-stocked fisheries and nearly 7 million angler days. Results show that for every dollar spent on ASRF products, \$36 dollars of activity and are generated and that for every million dollars of ASRF sales, nearly 500 jobs are supported in the region. The aggregate contribution of this industry that sells \$53.2 million worth of fish is estimated to be nearly \$2 billion annually.

Much of this economic activity is concentrated in the more populated sections of the region. Colorado, California, Oregon, Utah and Washington hold the greatest amount of recreation-based private aquaculture firms. Nearly half of all producers are located in California. Although this makes sense, given the large economic contribution of this industry, legislators in other states such as Montana and Wyoming may want to consider further promotion of this industry.

The challenge for Western policymakers is to weigh the costs and benefits of policies which may put a damper on ASRF production. With pressure on state governments to reduce pressure on larger, more influential industries, the ASRF industry may face increased regulations with regards to permitting, disease mitigation, endangered species and stocking policies. However, it is important to recognize that these regulations may have adverse effects on the regional economy. Accounting for these regional economic effects will foster enhanced efficiency and welfare not only for the ASRF industry, but for their customers, recreational anglers, and the general economy of the Western United States.

The estimates of economic contribution reported in this study are based on primary data collected via mail survey, calculations of the size of the industry based on this data (assuming representativeness), and the assumptions made regarding the structure of the regional economy embedded with the fixed-production coefficient IMPLAN model. While every effort was made to

represent the major backward and forward linkages of the ASRF industry in accordance with best practice and standard economic theory, there are a variety of potential sources of error associated with these estimates, including sampling bias (via self-selection), statistical variability, sensitivity to outliers, non-constant returns to scale or input substitutability in fish production and other industries, etc. It is not possible to formally estimate the statistical reliability of the estimates presented here; however, differences in scale assumptions of any of the three subpopulations can be reasonably represented using the multipliers presented in the previous section, though these, too, may be subject to error. Furthermore, extrapolation of these results, including multipliers, to regions or sub-regions not presented in the text is not advisable given differences in regional economic structure, including the proportion of each industry's and aggregate household expenditures that are assumed to stay within region.

In addition, we make no claim as to economic *impact* of the ASRF and supporting industries as defined above in the introductory section, as we have little to no information about the potential for substitution production activities in the case of the various industries involved, as well as the recreational substitution patterns of anglers in the Western United States. Rather, we simply estimate the total expenditures related to the ASRF industry, and trace their flow through the regional economy. Indeed, as one includes more forward linkages in the analysis, the potential for error in raw data increases (as budget constraints force a smaller sample relative to the overall population), and the certainty of the connection between expenditure flows and the ASRF industry itself becomes more tenuous (e.g., as a result of joint production activities that may or may not be directly attributable to stocked fish). Nevertheless, we believe that both our data collection and economic contribution methodologies are sound, and place the economic contributions of the ASRF industry in reasonable context.

Finally, although this study accounts for the total economic contribution of the ASRF industry, it should be noted that this is not the only indicator of economic importance. Economic value, often referred to as “consumer surplus,” is the difference between an individual’s maximum willingness to pay and what he or she actually needs to pay for some good. In the case of privately stocked fishing, anglers may derive many millions of dollars worth of satisfaction over and above what they actually paid at the ASRF customer site. This is different from the economic contribution of the ASRF industry, which merely tracks the amount of output dollars and jobs that come as a result of the presence of that industry. This economic value is a direct measure of the welfare induced by the presence of the ASRF industry, and future analysis should endeavor to account for this value in order to elucidate the true economic benefits of the ASRF industry to the Western United States.

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Appendix A: Project Collaborators

WRAC PROJECT TITLE: Economic Impacts of Private Sector Aquaculture-Based Recreational Fishing in the Western USA

PARTICIPANTS: (* indicates funded participants)

PRINCIPAL INVESTIGATOR	Dr. Craig A. Bond*	Colorado State University
CO-PRINCIPAL INVESTIGATORS	Dr. Steve Davies*	Colorado State University
	Dr. John Loomis*	Colorado State University
	Dr. Y. Hossein Farzin	University of California, Davis
	Dr. Andrew Seidl*	Colorado State University
TECHNICAL ADVISOR	Dr. Gunnar Knapp	University of Alaska, Anchorage
COLLABORATORS	Dr. Fred Conte	University of California, Davis
	Dr. John Boren	New Mexico State University
	Gary Fornshell	University of Idaho
	Dr. Kevin Fitzsimmons	University of Arizona
	Dr. Chris Myrick	Colorado State University
	Daniel Deisenroth*	Colorado State University
	Timothy Rakitan*	University of California, Davis
	Jay Griebbling*	Colorado State University
PRINCIPAL INVESTIGATOR RESPONSIBLE FOR OUTREACH	Dr. Andrew Seidl*	Colorado State University
INDUSTRY ADVISORS	Ken Cline and Rebecca Cooper	

Appendix B: Producer Survey Cover Letter



Department of Agricultural and
Resource Economics
Fort Collins, Colorado 80523-1172
(970) 491-6325
FAX: (970) 491-2067
<http://dare.colostate.edu/>

Dear Aquacultural Producer,

In 2006, with producer support, the Western Regional Aquaculture Center sponsored a project to assess the economic contribution of the Aquacultural Suppliers of Recreational Fishing (ASRF), an industry that has not previously had its role and economic impact on the region assessed in detail. Completion of this project requires assistance from all ASRF producers during the information gathering process. It is imperative that the survey results reliably represent the broadest possible activity of ASRF producers, so your input is valuable. This project will be administered by the Department of Agricultural and Resource Economics at Colorado State University in conjunction with participation of faculty members throughout the Western United States. The participants include faculty from the University of Arizona, University of California, Davis, University of Idaho, and New Mexico State University.

The survey will examine the range of activities undertaken by ASRF producers and determine major issues facing the industry. In this survey, we ask first about the general size of your operations, and then we ask about a variety of sales outlets and locations. These questions are followed by questions regarding costs incurred within your operation and the values and purchases of a variety of assets. A clear, research-based understanding of the contribution of the ASRF industry will permit the best possible demonstration of your economic value to the Western region. All information gathered in this survey will be managed according to CSU's strict confidentiality requirements during and after the completion of this project.

While your participation in this survey research is of great importance to us, we would like to ensure you that your participation is voluntary. Your responses will be held in strict confidence and reported only in aggregated form. There are no known risks to your participation in this survey. It is not possible to identify all potential risks in research procedures, but we have taken reasonable safeguards to minimize any known and potential, but unknown, risks.

To complete the survey, please use 2007 data for your financial, marketing, and business size information. Those producers completing the survey are eligible to receive copies of the completed survey results, with appropriate disclosure and confidentiality dimensions in place. If this survey does not actually apply to you, simply write a brief explanation on the survey and return it in the enclosed pre-paid envelope.

For more information about this project, please contact Dr. Craig Bond at 970-491-6951, or by email at Craig.Bond@colostate.edu

Sincerely,

Dr. Craig Bond
Principal Investigator

The Economic Contribution of the Aquacultural Suppliers of Recreational Fish



How Important Are You to Your Local Economy?

Section A: General Operational Questions

Aquaculture producers vary substantially in scale and scope and may use a great variety of technologies. In order to better understand the variety of aquaculture producers in the west, we need to ask questions about your operation.

1. Please indicate your production and sales levels for salmonids (trout, salmon, etc.) and for your warm/cool water species (in terms of **sales dollars for 2007**). (If you do not produce or sell warm/cool water fish, please leave these sections blank. If you do not produce or sell Salmonids, please leave these sections blank.)

- **Salmonids**

Production Levels: _____ (Lbs/Year) Sales \$ _____
Brokered Levels: _____ (Lbs/Year) Sales \$ _____

- **Warm/Cool Water Species**

Production Levels: _____ (Lbs/Year) Sales \$ _____
Brokered Levels: _____ (Lbs/Year) Sales \$ _____

2. Which **methods of production** did this operation use for Salmonids and Warm/Cool Water Species in 2007? This does not apply to brokered fish. Please enter total water area or volume for each method used, and check the box in the species column corresponding to the species that use this technology. You may indicate one or both species for each technology.

Methods of Production					
Technology	Average Flow Rate: GPM if applicable	Salmonids, Warm/Cool Water Species, or both (check boxes as apply)		Size	Unit
		Salmonid	Warm/Cool Water		
Still Ponds	████████				Surface Acres
Flow Through Ponds				████	████████████████
Flow Through Raceways				████	████████████████
Flow Through Tanks				████	████████████████
Cages	████████				Total Volume Cu. Ft.
Net Pens	████████				Total Volume Cu. Ft.
Closed Re-Circulation Tanks	████████				Gallons
Other					Specify Unit

3. How many species of Salmonid and Warm/Cool Water fish did you produce/sell in 2007?

Total # of Salmonids: _____ Total # of Warm/Cool Water Fish Species: _____

Section B: Sales Information

This section applies both to brokers and to producers. Please tell us about the sales of your Salmonids and your Warm/Cool Water Species. If you do not produce or broker warm/cool water fish, please leave these sections blank. If you do not produce or broker Salmonids, please leave these sections blank.

Salmonids			
Size Category	Amount		Sales (Dollars)
	Trophy size (Over 16")		
Catchables (9-16 inches)		Pounds Live Weight	\$
Sub-Catchables (less than 9 inches)		Count	\$
Forage Minnows		Count	\$
Eggs		Count	\$
Other (Please Specify _____)		Other (Specify)	\$

Warm/Cool Water Species			
Size Category	Amount (Circle pounds OR count)		Sales (Dollars)
	Trophy size (Indicate Size _____)		
Catchables (Indicate Size _____)		Pounds Count	\$
Sub-Catchables (Indicate Size _____)		Pounds Count	\$
Forage Minnows		Pounds Count	\$
Eggs		Pounds Count	\$
Other (Please Specify _____)		Other (Specify)	\$

What percent of your production reported by species in item 1 was sold to each of the following SALES OUTLETS from January 1 through

To Whom Do You Sell Your Salmonids?						
Percent of value of Salmonids sold as:	Brokers/ Consultants	Food Fish	Recreational Outlets (Public)	Recreational Outlets (Private)	Other (specify) _____	Total
Trophy size (Over 16")	%	%	%	%	%	100%
Catchables (9-16 inches)	%	%	%	%	%	100%
Sub-Catchables (less than 9 inches)	%	%	%	%	%	100%
Forage Minnows	%	%	%	%	%	100%
Eggs	%	%	%	%	%	100%
Other (Please Specify _____)	%	%	%	%	%	100%

December 31, 2007? **Note: The values in each ROW should sum to 100.**

To Whom Do You Sell Your Warm/Cool Water Fish?

Percent of value of warm/cool water fish sold as:	Brokers/ Consultants	Food Fish	Recreational Outlets (Public)	Recreational Outlets (Private)	Other (specify) _____	Total
Trophy size (Indicate Size _____)	%	%	%	%	%	100%
Catchables (Indicate Size _____)	%	%	%	%	%	100%
Sub-Catchables (Indicate Size _____)	%	%	%	%	%	100%
Forage Minnows	%	%	%	%	%	100%
Eggs	%	%	%	%	%	100%
Other (Please Specify _____)	%	%	%	%	%	100%

Could you please estimate the location of your buyers? (Please estimate the percentage of sales within your state and outside of your state for each species)

1. Please indicate the percentage of Salmonids you sell in state, out of state within WRAC* and out of state outside of WRAC.

Within your state: _____% Out of State (Within WRAC) _____% Out of State (Non-WRAC) _____%

2. Please indicate the percentage of Warm/Cool Water fish you sell in state, out of state within WRAC* and out of state outside of WRAC.

Within your state _____% Out of State (Within WRAC) _____% Out of State (Non-WRAC) _____%

3. Now, please break out the categories and describe what percentage, within each category, are sold to the following outlets:

How much do you sell in state? Out of state?					
Percent of value of fish sold to outlet as:	Brokers/Consultants	Food Fish	Recreational Outlets (Public)	Recreational Outlets (Private)	Other (specify) _____
Salmonids					
<u>Within Your State</u>	%	%	%	%	%
<u>Out of State (Within WRAC*)</u>	%	%	%	%	%
<u>Out of State (Non-WRAC*)</u>	%	%	%	%	%
<u>Total</u>	100%	100%	100%	100%	100%
Warm/Cool Water Species					
<u>Within Your State</u>	%	%	%	%	%
<u>Out of State (Within WRAC*)</u>	%	%	%	%	%
<u>Out of State (Non-WRAC*)</u>	%	%	%	%	%
<u>Total</u>	100%	100%	100%	100%	100%

*The Western Regional Aquaculture Center (WRAC) is an organization of twelve states (Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming) which cooperate in order to provide quality resources for aquaculture producers in those states.

Section C: Costs

1. Labor Expenditure Information

For the following table, please indicate the number of workers in employed in each category in 2007. Please do NOT include seasonal workers:

Labor Expenditure Information					
	Number of Workers	Average Hours per Week	Total Annual Wages	Benefits (% of total Wages)	Taxes and Insurance (% of total wages)
Hired Labor (Non-Family)			\$	%	%
Self Labor	1		██████	██████	██████
Family Labor			██████	██████	██████

1. Do you hire seasonal workers?

NO

YES

2. If you answered YES to number 1, please tell us a little more about these employees:

a. Average number of Seasonal Employees hired annually
_____ employees

b. Percentage of seasonal workers who are also Family Members:
_____ %

c. Seasonal employee Average Hours Worked per week:
_____ hours/week

d. Please circle the months during which you typically employ seasonal workers:

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

2. Material and Energy Expenditure Information for 2007

Please indicate your source of material purchases. The values in each Column should sum to 100.

Source of Material Purchases				
<u>Source</u>	Sub-Catchables/ Forage Minnows	Eggs	Feed Purchases	Fish for Resale
Producers Within your state	%	%	%	%
Out of State Producers (Within WRAC)	%	%	%	%
Out of State Producers (Non-WRAC)	%	%	%	%
Total	100%	100%	100%	100%

Please give us the annual, total expenditure for the following material inputs in your Aquacultural Suppliers of Recreational Fish (ASRF) business.

Non Depreciated Expenditures		
Sub Catchables/Forage Minnows	\$	Pounds _____
Eggs	\$	Count _____
Feed	\$	Pounds _____
Fish for Resale (Brokerage)	\$	Pounds _____
Chemicals/Supplies	\$	
Oxygen	\$	
General Consumable Supplies (e.g. nets)	\$	
Electricity	\$	
Natural gas/propane	\$	
Other Utilities	\$	
Non-Shipping Depreciated Vehicle Expenses (non-fuel)	\$	
Gasoline	\$	
Marketing and Advertising	\$	
Shipping and Distribution	\$	
Licenses/Permits/Inspection Fees	\$	
Non-Labor Insurance	\$	
Other _____	\$	

3. Depreciated Expenditures

Could you please give *annual* expenditures for 2007 on **equipment** (e.g. Feeders, Graders, Filtration, Pumps, Small Equipment, etc.), **buildings and structures** (e.g. Storage Sheds), **fish production facilities** (e.g. Ponds, Raceways, etc.), and **transportation equipment** (e.g. trucks, tanks, etc.)

Depreciated Expenditures			
	Purchase	Maintenance	Lease
Equipment	\$	\$	\$
Buildings and Structures	\$	\$	\$
Fish Production Facilities	\$	\$	\$
Transportation Equipment	\$	\$	\$

4. Water Expenditures

1. What is your source of water? (Percentages should sum to 100%).

_____ % **Groundwater** (Water from closed springs, underground drainlines, or a well or wells located on this farm or another farm)

_____ % **On-Farm Surface Water** (Surface supply not controlled by a water supply organization [stream, drainage ditch, lake, pond, open spring, or reservoir on or adjacent to this farm])

_____ % **Off-Farm Water** (Federal supplier; irrigation district; mutual, private; cooperative, or neighborhood ditches; commercial company or municipal or community system)

2. What is the proportion of water that you used in 2007 do you own? Lease?

Own _____ % Lease _____ %

3. What are your annual non-pumping water delivery costs?

\$ _____

Section E: Business Information

Please answer the following questions regarding your household and personal characteristics:

1. In what year were you born? _____

2. Gender: Male _____ Female _____

3. Years in Business as Supplier of Recreational Fish: _____ (years)

4. Years in Business in Aquaculture in General: _____ (years)

5. Size of Household: _____ (Persons)

6. Marital Status (check one): Single _____ Married _____

7. Is your home located at the same site as your business? (Circle one)

Yes

No

8. If you circled "No" in number 7, please tell us the zip code where you live:

Zip Code _____

9. The earnings from your labor and profits in this ASRF business represent what percentage of your total household income? _____ %

Thank you for taking the time to fill out this survey! If you have any comments or concerns, please contact Dr. Craig Bond at 970-491-6951, or by email at Craig.Bond@colostate.edu. You can also visit our website at <http://dare.colostate.edu/wracimpact.html>

Appendix D: Customer Survey Cover Letter



Department of Agricultural and
Resource Economics
Fort Collins, Colorado 80523-1172
(970) 491-6325
FAX: (970) 491-2067
<http://dare.colostate.edu/>

Dear Private Fishery Operator,

In 2006, with support from the aquaculture industry, the USDA sponsored a project to assess the economic contribution of the private fishing industry in the Western United States. The private fishing industry is one that has not previously had its role and economic impact on the region assessed in detail.

This project will be administered by the Department of Agricultural and Resource Economics at Colorado State University, in conjunction with participation of faculty members throughout the Western United States. The participants include faculty from the University of Arizona, University of California, Davis, University of Idaho, and New Mexico State University.

The survey will examine the range of activities undertaken by private fisheries in Colorado. The results of this project will demonstrate exactly how important you and your industry are to the economy. As stated in a previous letter, policymakers will be able to use this information in order to potentially look more favorably upon your industry. All information gathered in this survey will be managed according to CSU's strict confidentiality requirements during and after the completion of this project.

To complete the survey, please use 2008 data. If you have any questions or concerns, you can visit our website at <http://dare.colostate.edu/privatefisheryimpact.aspx>. If you have any additional questions, please feel free to contact our project manager, Dr. Craig Bond, at 970-491-6951, or by email at Craig.Bond@colostate.edu

Sincerely,

Dr. Craig Bond
Principal Investigator

The Economic Contribution of Private Fisheries in the Western United States



How Important Are You to Your Local Economy?

Section A: General Operational Questions

Private fishing operations vary substantially in scale and scope. In order to better understand the variety of private fisheries in the west, we need to ask questions about your operation. Your responses will be held in strict confidence and reported only in aggregated (average) form.

4. Which types of Salmonid and Warm/Cool Water fish did you **stock** in 2008?

Salmonids:

- Rainbow Trout Brown Trout Brook Trout Cutthroat Trout
 Steelhead Other (Specify) _____

Warm/Cool Water Species:

- Bass Bluegill/Crappie Catfish Walleye Grass Carp Sturgeon
 Fathead Minnows Mosquitofish Other (Specify) _____

5. What sort of fishing operation did you operate in 2008? Please **check all boxes that apply**, and please indicate the size of the water body/bodies at your location.

Type of Operation				
Fishing Waters	Salmonids, Warm/Cool Water Species, or both (please <i>check boxes</i>)		Total Size	Unit
	Salmonid	Warm/Cool Water		
Private Dude Ranch (River or Stream-Based)	<input type="checkbox"/>	<input type="checkbox"/>		Miles of Stream or River fished
Private Dude Ranch (Lake or Pond Based)	<input type="checkbox"/>	<input type="checkbox"/>		Surface Acres of Lake or Pond
Private Fishing Club (River or Stream-Based)	<input type="checkbox"/>	<input type="checkbox"/>		Miles of Stream or River fished
Private Fishing Club (Lake or Pond Based)	<input type="checkbox"/>	<input type="checkbox"/>		Surface Acres of Lake or Pond
Fee-Fishing Pond (U-Fish)	<input type="checkbox"/>	<input type="checkbox"/>		Surface Acres of Pond
Homeowner's Association	<input type="checkbox"/>	<input type="checkbox"/>		Surface Acres of Lake or Pond
Other (e.g. your own private land) Please Specify: _____	<input type="checkbox"/>	<input type="checkbox"/>		Specify Unit

6. Approximately how many anglers visited your operation during 2008?: _____

4. What activities are typically enjoyed at your fishery (check all that apply)?:

- Fishing from Bank/Wading Fishing from a Boat Belly Boat Fishing
 Flyfishing Motorized Boating Rafting, Kayaking, Canoeing
 Camping Horseback Riding Fishing with Family/Friends
 Hiking/Backpacking Photography OHV Recreation (e.g. 4x4)
 Viewing Scenery and Wildlife Biking Other, please describe: _____

Section B: Regional Economic Activity

The Western Region, as defined by the Western Regional Aquaculture Center (WRAC), includes the following 12 states: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming.

Could you please estimate the percentage of your 2008 anglers that live within your state, the percentage that live out of state but within the Western Region, and the percentage of anglers that live outside of the Western Region?

How many anglers are from in state? Out of state? Out of Region?							
Angler Home Locations	Percentage of anglers from these locations						
Anglers from within your state	<input type="checkbox"/> 0%	<input type="checkbox"/> 1-20%	<input type="checkbox"/> 21-40%	<input type="checkbox"/> 41-60%	<input type="checkbox"/> 61-80%	<input type="checkbox"/> 81-99%	<input type="checkbox"/> 100%
Anglers from out of State (but within Western Region)	<input type="checkbox"/> 0%	<input type="checkbox"/> 1-20%	<input type="checkbox"/> 21-40%	<input type="checkbox"/> 41-60%	<input type="checkbox"/> 61-80%	<input type="checkbox"/> 81-99%	<input type="checkbox"/> 100%
Anglers from out of State (and outside of the Western Region)	<input type="checkbox"/> 0%	<input type="checkbox"/> 1-20%	<input type="checkbox"/> 21-40%	<input type="checkbox"/> 41-60%	<input type="checkbox"/> 61-80%	<input type="checkbox"/> 81-99%	<input type="checkbox"/> 100%
Total	100%						

Please indicate your source of material purchases. Non-applicable categories should be left blank. The values in each column should sum to 100%.

Source of Feed and Fish Purchases				
Source	Feed	Sub-Catchables/ Forage Minnows/Weed Control Fish	Catchable Fish	Trophy Size Fish
Producers from <u>within your state</u>	%	%	%	%
Producers from <u>out of State</u> (but within Western Region)	%	%	%	%
Producers from <u>out of State</u> (and outside of the Western Region)	%	%	%	%
Total	100%	100%	100%	100%

Section C: Sales Information

1. What was your gross revenue in 2008? _____
2. In the table below, please indicate the percentage of sales derived from the following categories (If a particular category does not apply to you, please write an "X"):

Percentage of Sales from Major Categories	
<u>Item</u>	Percentage of Sales
Entrance Fees/Rod Fees/Guest Permits	N/A
Entrance/Rod fees or permits for Salmonid Fishing	%
Entrance/Rod fees or permits for Warm/Cool water fishing	%
General entrance fees, or fees unrelated to fishing	%
Annual Membership Dues	%
Lodging	%
Guiding Services	%
Fishing Equipment/Boat Rentals or Bait Sales	%
Food (e.g. snacks, sodas, or meals)	%
Non-Fishing Recreational Services (e.g. horseback riding)	%
Miscellaneous Retail (e.g. gift shop)	%
Other (Specify)	%
Package Deals (including any of the above activities) (Please do not "double count" sales from above categories)	%
<u>Total</u>	<u>100%</u>

3. What percentage of your operation's total sales is attributable to **fishing**? This may include fishing items such as guiding services and equipment rentals, as well as non-fishing items that only exist as a result of your fishing operation, such as lodging and food.
 0% 1-20% 21-40% 41-60% 61-80% 81-99% 100% Comments?: _____
4. What percentage of your fishing related sales is attributable to **Stocked** (i.e. hatchery) fish?
 0% 1-20% 21-40% 41-60% 61-80% 81-99% 100% Comments?: _____
5. On average, how much does a **typical angler** spend per day at your operation?
 _____ \$/day

Section D: Costs

1. Water Expenditures

4. What is the proportion of water that you used in 2008 do you own? Lease? Own Access?
 Own _____% Lease _____% Own Access _____%
5. What are your annual non-pumping water delivery costs (e.g. lease costs, ditch fees, etc.)? Pumping costs are addressed in section 3.

\$ _____

2. Labor Expenditure Information

For the following table, please indicate for 2008 the **total** number of workers in employed in each category. This is not restricted to your fishing operation. Please do NOT include seasonal workers:

Labor Expenditure Information					
	Number of Workers	Average Hours per Week	Total Annual Wages	Benefits (% of total Wages)	Taxes and Insurance (% of total wages)
Hired Labor (Non-Family)			\$	%	%
Self Labor	1				
Family Labor					

Now, please tell us a bit about your hiring of seasonal workers.

3. Do you hire **seasonal workers** (circle one)?

NO (*Skip to Section 3*)

YES

4. If you answered YES to number 1, please tell us a little more about these employees:

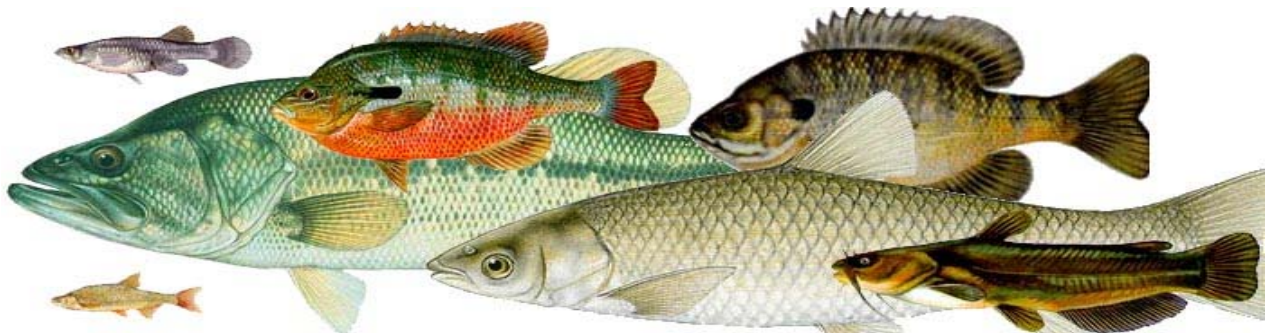
a. Average number of Seasonal Employees hired annually
_____ employees

b. Percentage of seasonal workers who are also Family Members:
_____ %

c. Seasonal employee Average Hours Worked per week:
_____ hours/week

d. Please circle the months during which you typically employ seasonal workers:

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec



3. Material and Energy Expenditure Information for 2008

Please indicate whether or not you purchase items from the categories in the table below **for your fishing operation**. If you do purchase items within a category, please indicate the total cost of those items.

Operational (Non Depreciated) Expenditures		
Material	Buy? Y / N (Yes/No, Circle One)	Total Cost
Trophy Size Fish	Y / N	\$
Catchable Fish	Y / N	\$
Sub-Catchable Fish, Forage Minnows, and Weed Control Fish	Y / N	\$
Feed	Y / N	\$
Chemicals/Supplies	Y / N	\$
Oxygen	Y / N	\$
General Consumable Supplies (e.g. nets)	Y / N	\$
Electricity (including pumping/aeration costs)	Y / N	\$
Natural gas/propane	Y / N	\$
Other Utilities	Y / N	\$
Food (for customers)	Y / N	\$
Equipment, bait, etc. (for customers)	Y / N	\$
Non-Shipping Depreciated Vehicle Expenses (non-fuel)	Y / N	\$
Gasoline/Diesel	Y / N	\$
Marketing/Advertising/Mailings	Y / N	\$
Licenses/Permits/Inspection Fees	Y / N	\$
Non-Labor Insurance	Y / N	\$
Other (Please Specify) _____	Y / N	\$
Total		\$

4. Depreciated Expenditures

Could you please give *annual* expenditures for 2008 **for your fishing operation** on equipment (e.g. Feeders, Graders, Pumps, Small Equipment, etc.), buildings and structures (e.g. Storage Sheds), fish habitat facilities (e.g. ponds, streams, etc.) and land.

Capital (Depreciated) Expenditures			
	Purchase	Maintenance	Lease
Equipment	\$	\$	\$
Buildings and Structures	\$	\$	\$
Fish Habitat Facilities	\$	\$	\$
Land	\$	\$	\$

Section E: Business Information

Please answer the following questions regarding your household and personal characteristics. Your responses will be held in strict confidence and reported only in aggregated form:

10. What is your role at this operation (check all that apply)?

- General Manager Owner Other (Specify) _____

11. In what year were you born? 19 _____

12. Are you? Male Female

13. Years in a private fishing operation: _____(years)

14. Your highest level of formal education? (Please circle one)

Elementary School	Jr. High or Middle School	High School	Associates Degree	College (B.S./B.A) or Technical School	Graduate or Professional School
------------------------------	--------------------------------------	------------------------	------------------------------	---	--

15. How many members are in your household: _____ (persons)

16. How many household members contribute to paying the household expenses?
_____ (persons)

17. Marital Status (check one): Single Married

18. Is your home located at the same site as your fishing operation? (Check one)

- Yes No

19. If you circled "No" in number 9, please tell us the zip code where you live:

Zip Code _____

20. The earnings from your labor and profits in your private fishing operation represent approximately what percentage of your total household income? _____%

Thank you for completing the survey!

Please place your survey in the enclosed stamped return envelope and drop it in the mail. If you have any comments or concerns, please feel free to write on the back of this page.

COMMENTS?

Please feel free to write any comments you have about private fisheries in the Western United States. When you are finished, please place the survey in the stamped return envelope and mail it back to us. If you have any additional questions or concerns, please visit our website at <http://dare.colostate.edu/privatefisheryimpact.aspx>



Department of Agricultural and Resource Economics
Campus Delivery 1172
Fort Collins, CO 80523-1172

Appendix F: California Angler Survey Cover Letter



Department of Agricultural and
Resource Economics
Fort Collins, Colorado 80523-1172
(970) 491-6325
FAX: (970) 491-2067
<http://dare.colostate.edu/>


Dear Angler,

Thank you for agreeing to participate in this study. The purpose of this study is to help managers improve fishing in California. Answering the survey will only take a few minutes, but will greatly aid fisheries managers in their decisions regarding your favorite fishing areas in California.

To complete the survey, please refer to your most recent trip (where you were handed this survey). Your responses are important to us whether this is the first time you have fished here or the hundredth time. We want to hear what you think about your fishing trip here!

When you have completed the survey please mail it back to us in the enclosed postage paid stamped return envelope.

Your responses will be held in strict confidence and all results are reported only in summary form. While your responses to this survey are completely confidential and your name will NOT be associated with your survey responses, those who complete the survey will be **entered into a**

drawing for one of five \$100 gift certificates to  **redeemable at one of their stores or their website.**

The results of the survey will be posted on the Colorado State University Department website (<http://dare.colostate.edu/anglersurvey.html>) next fall. This website also provides answers to frequently asked questions about the survey. However, if you have any questions whatsoever, please feel free to contact one of our project managers, either Dr. Craig Bond at Craig.Bond@colostate.edu, or Dr. John Loomis at John.Loomis@colostate.edu.

Thank you again for your willingness to complete the survey and we look forward to receiving it.

Sincerely,

Dr. Craig Bond
Assistant Professor, CSU
Project Manager

Dr. John Loomis
Professor, CSU
Project Manager

Your Fishing Trip in California



How can we make it better?

**Colorado
State**
University

UC DAVIS
UNIVERSITY OF CALIFORNIA

Thank you for agreeing to complete this survey. Your answers will be quite helpful to the groups that manage and support recreational fishing in California. In this survey, when we refer to a **trip** we mean a trip

from home to the water body and back again. Thanks again, and we look forward to receiving your survey in the enclosed stamped envelope.

Section A. Please tell us about your trip to the water body (lake, reservoir, pond, river or stream) where you received this survey.

1. What was the name of the town nearest to the water body where you received this survey?

Name of town: _____

2. How many trips in the past 12 months did you make to the **water body** where you received this survey?

_____ #Annual Trips

3. What species of fish were you targeting on **this trip** (check or list all that apply)?

Trout Bass Walleye Catfish Other _____

4. What was the total amount of time you spent on this trip visiting the water body where you received this survey (including all activities such as fishing, boating, camping, hiking, etc.)?

_____ # of hours or _____ # of days

4a. What was the amount of time that was spent **actually fishing** at this location on this trip?

_____ # of hours fished or _____ # of days fished

4b. During your **trip** to this water body, how many fish did you catch and how many did you keep?

_____ # of fish caught and _____ # of fish kept

4c. How many of these fish were species that you were **targeting**?

_____ # of **target** fish caught and _____ # of **target** fish kept

4d. If you visited more than one water body during this trip, what was the total amount of time spent visiting all the water bodies on this trip from home?

_____ # of hours or _____ # of days

5. Please check the activities **you** participated in during this **trip** from home at the location where you received the survey (check all that apply):

- | | | |
|---|---|--|
| <input type="checkbox"/> Fishing from Bank/Wading | <input type="checkbox"/> Fishing from a Boat | <input type="checkbox"/> Belly Boat Fishing |
| <input type="checkbox"/> Flyfishing | <input type="checkbox"/> Motorized Boating | <input type="checkbox"/> Rafting, Kayaking, Canoeing |
| <input type="checkbox"/> Camping | <input type="checkbox"/> Horseback Riding | <input type="checkbox"/> Fishing with Family/Friends |
| <input type="checkbox"/> Hiking/Backpacking | <input type="checkbox"/> Photography | <input type="checkbox"/> Other, please describe: _____ |
| <input type="checkbox"/> OHV Recreation (e.g. ATV, 4x4) | <input type="checkbox"/> Viewing Scenery and Wildlife | _____ |

5a. If you checked more than one activity, which of these activities was the most important reason for your trip to this water body? Most Important Activity _____

6. Was your trip to this water body: (check only one):

- the primary purpose or sole destination of your trip from home?

one of many equally important reasons or destinations for your trip from home?

just an incidental stop on a trip taken for other purposes or to other destinations?

7. What were your primary methods of travel to this water body (circle all that apply):

Car/Truck RV Airplane Other _____

8. What was the one-way **travel time** from your home to the water body where you received this survey?

_____ # hours _____ # minutes

9. What was your one-way **travel distance** from your home to this water body?

_____ # one-way miles

10. Including yourself, what was the number of **adults** and **children** in your group that traveled on this trip?

_____ # of **adults** in your group and _____ # of **children** in your group

11. How crowded did you think the water body was where you received this survey? Please circle one number representing how crowded it was.

Not at All Crowded 1 2 3 4 5 6 7 8 9 10 Extremely Crowded

Please tell us about the importance level of several features of the water body **where you received this survey.**

Important Aspects of Your Most Recent Trip				
<i>Please circle one number for each item</i>	Importance for your decision to visit this water body			
	Not Important/ Not Applicable	Somewhat Important	Important	Very Important
Opportunities to catch many (large #'s) of fish	1	2	3	4
Opportunities to catch trophy-sized fish	1	2	3	4
Opportunities to catch wild fish	1	2	3	4
Enjoying peace and solitude (without crowding)	1	2	3	4
Fishing near skilled anglers/fishermen	1	2	3	4
Socializing with other anglers/fishermen	1	2	3	4
Cleanliness of site	1	2	3	4
Amenities such as restrooms and parking	1	2	3	4
Catching fish to eat	1	2	3	4
River rafting/canoeing/kayaking	1	2	3	4
Motorized Boating	1	2	3	4
Viewing Scenery and Wildlife	1	2	3	4
Camping	1	2	3	4
Horseback Riding	1	2	3	4
Fishing with Family/Friends	1	2	3	4
Hiking/Backpacking	1	2	3	4
Photography	1	2	3	4
OHV Recreation(e.g. ATV, Dirt Bike, 4x4)	1	2	3	4
Other activities: Please list	1	2	3	4

Section B. Most Recent Trip Expenditures (Please skip this section if you did not travel to the site where you were handed this survey (for example, the site was on your own property or on property owned by your homeowner's association).

Please indicate the amount you and members of your group with whom you shared expenses (e.g., other family members, traveling companions) spent on each category on the **trip** during which you were given the survey. Note: The Western Region of the United States is comprised of twelve states (Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming).

Expenses on Your Most Recent Trip		
Trip Expense	Amount spent ON THIS TRIP in California	Amount spent ON THIS TRIP outside of California (but still in the Western Region)
Gas & Oil for Auto &/or Boat	\$	\$
Food/drink: restaurants	\$	\$
Food/drink: grocery stores	\$	\$
Supplies/fishing tackle/bait/other retail	\$	\$
Camping on Public Lands	\$	\$
Camping at Private Areas	\$	\$
Hotel/motel	\$	\$
Equipment rental	\$	\$
Guide fees	\$	\$
Fishing License	\$	\$
Fishing Entrance/Catch/Access Fees	\$	\$
Rental car	\$	\$
Airline ticket	\$	\$
Fishing Club/Dude Ranch Package Deals (<u>Please do not “double count” expenses from above categories</u>)	\$	\$
Other; Please List	\$	\$

1. Including yourself, how many people in your group shared these expenses on this most recent trip?

_____ # of persons in your group sharing expenses

2. As you know, some of the costs of travel such as gasoline, hotels and restaurant meals often increase. If your share of the **total cost** of this most recent trip had been \$_____ **higher**, would you have made this trip to the water body where you received this survey?

Circle one: YES NO

3. Did you use a motorized boat on the trip where you were handed this survey? Yes No

3a. If Yes, did you rent your boat, do you own your boat, or do you borrow a boat for free?

Rent Own Borrow for Free

3b. If you Own a boat, do you dock your boat at a marina or did you trailer your boat to this site?

Marina Trailer

Section C: Fisheries Management and Annual Recreation Trips

Suppose managers were no longer managing this water body for recreational fishing, and catch rates were to go down by half or 50% (with everything else unchanged). Please indicate how you would respond to this change in catch rates and fill in your estimate of the change in the number of trips (if any).

Would your decision to visit this water body change if you had half (-50%) the daily catch rate of your targeted species that you experienced on this trip?

- Yes, I would **decrease** my fishing trips to this water body by (#) _____ fewer trips per year.
- Yes, I would **increase** my fishing trips to this water body by (#) _____ more trips per year.
- No, I would **not change** my fishing trips to this water body.

1. During which of the following months do you typically go fishing in a typical year (Circle all that apply)?

January February March April May June July August September October November December

2. On a scale of 1 to 10, how would you *rate your skill level* as an angler (Please circle one number)?

Little or No skill at all 1 2 3 4 5 6 7 8 9 10 Extremely Skilled/Professional

For the purposes of this survey, the Western Region of the United States is comprised of twelve states (Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming).

3. About how many total *outdoor recreation* trips do you take each year to areas **within** the western US?

_____ Annual # of trips

4. About how many total *outdoor recreation* trips do you take each year to areas **outside** the western US?

_____ Annual # of trips



Section D: Season Trip Information

This information on your annual visitation is important to fishing managers in deciding how to manage your fisheries, so please enter the total number of trips from home and the number of days you spent fishing at the following freshwater water bodies during the last year. **Please refer to the enclosed map for water body**

locations and study region in California. By public waters we mean county, state or federal lakes, reservoirs, ponds or rivers such as those on National Forest land, in National Parks, on National Wildlife Refuges, and on California Department of Fish and Game natural resources properties. Other private waters include waters on private land that do not fit into listed categories such as your own private property or homeowner's association (HOA) property.

How many fishing trips did you take primarily for the purpose of fishing during the last 12 months to the following locations? How much time did you spend?

Water Bodies in California, Within Study Region on Enclosed Map

	# of Trips	# of Days		# of Trips	# of Days
American River			Mammoth Lakes Basin		
Bridgeport Reservoir			Merced River		
Camanche Reservoir			Mokelumne River		
Caples Lake			New Hogan Reservoir		
Carson River			New Malones Lake		
Convict Lake			Pardee Lake		
Crowley Lake			Other Public Rivers		
Don Pedro Reservoir			Other Public Streams (Small streams, brooks, creeks, etc.)		
Donner Lake			Other Public Lakes or Reservoirs		
Hot Creek			Other Public Ponds		
June Lake Loop			Private Ranches/Dude Ranches		
Lake Amador			Fishing Clubs		
Lake McClure			Fee-Fishing Ponds (U-Fish)		
Lake Tahoe			Other Private Waters (e.g. HOA)		

Water Bodies in California, but Outside Study Region

	# of Trips	# of Days
Public Waters		
Private Ranches/Dude Ranches		
Fishing Clubs		
Fee Fishing Ponds (U-Fish)		
Other Private Waters (e.g. HOA)		

Water bodies in AZ, NV and OR

	# of Trips	# of Days
Public Waters		
Private Ranches/Dude Ranches		
Fishing Clubs		
Fee Fishing Ponds (U-Fish)		
Other Private Waters (e.g. HOA)		

Water bodies in AK, CO, ID, MT, NM, UT, WA and WY

	# of Trips	# of Days
Public Waters		
Private Ranches/Dude Ranches		
Fishing Clubs		
Fee Fishing Ponds (U-Fish)		
Other Private Waters (e.g. HOA)		

Water bodies OUTSIDE of these states

	# of Trips	# of Days
Public Waters		
Private Ranches/Dude Ranches		
Fishing Clubs		
Fee Fishing Ponds (U-Fish)		
Other Private Waters (e.g. HOA)		

Section E. Please tell us something about yourself.

These last few questions will help us in evaluating how well our sample represents visitors to the area. **Your answers will be kept strictly confidential and will only be used for the analysis of this study. Statistics will only be reported in aggregate (average) form, and you will not be identified in any way.**

1. Are you? Male Female
2. In what year were you born? 19____
3. Are you employed? Yes (Go to #3a.) No (Skip to #3d.)
 - 3a. Do you work part time or full time? Full-time Part-time
 - 3b. Do you take time off from work to participate in outdoor recreation? Yes No
 - 3c. How many weeks of paid vacation do you receive each year? # ____ of weeks (Go to #4.)
 - 3d. Are you retired? Yes No
4. What is your zip code? _____
5. Are you a member of a fishing, hunting or sportsman's organization? Yes No
6. Are you a member at a Private Ranch/ Dude Ranch or Fishing Club? Yes No
 - 6a. If Yes, what are your annual dues? \$ _____ Annually
7. Are you a member of a homeowner's association (HOA)? Yes No
 - 7a. If Yes, what are your annual dues? \$ _____ Annually
 - 7b. Are you on a decision-making group for your HOA? Yes No
8. Your highest level of formal education? (Please circle one)

Elementary School	Jr. High or Middle School	High School	Associates Degree	College (B.S./B.A) or Technical School	Graduate or Professional School
------------------------------	--------------------------------------	------------------------	------------------------------	---	--
9. How many members are in your household? ____ persons
10. How many household members contribute to paying the household expenses? ____ persons
11. Including these people, what was your approximate household income from all sources (before taxes) last year?

<input type="checkbox"/> less than \$19,999	<input type="checkbox"/> \$20,000-\$29,999	<input type="checkbox"/> \$30,000-\$39,999
<input type="checkbox"/> \$40,000-\$59,999	<input type="checkbox"/> \$60,000-\$79,999	<input type="checkbox"/> \$80,000-\$99,999
<input type="checkbox"/> \$100,000-\$149,999	<input type="checkbox"/> \$150,000-\$299,999	<input type="checkbox"/> more than \$300,000

Thank you for completing the survey!

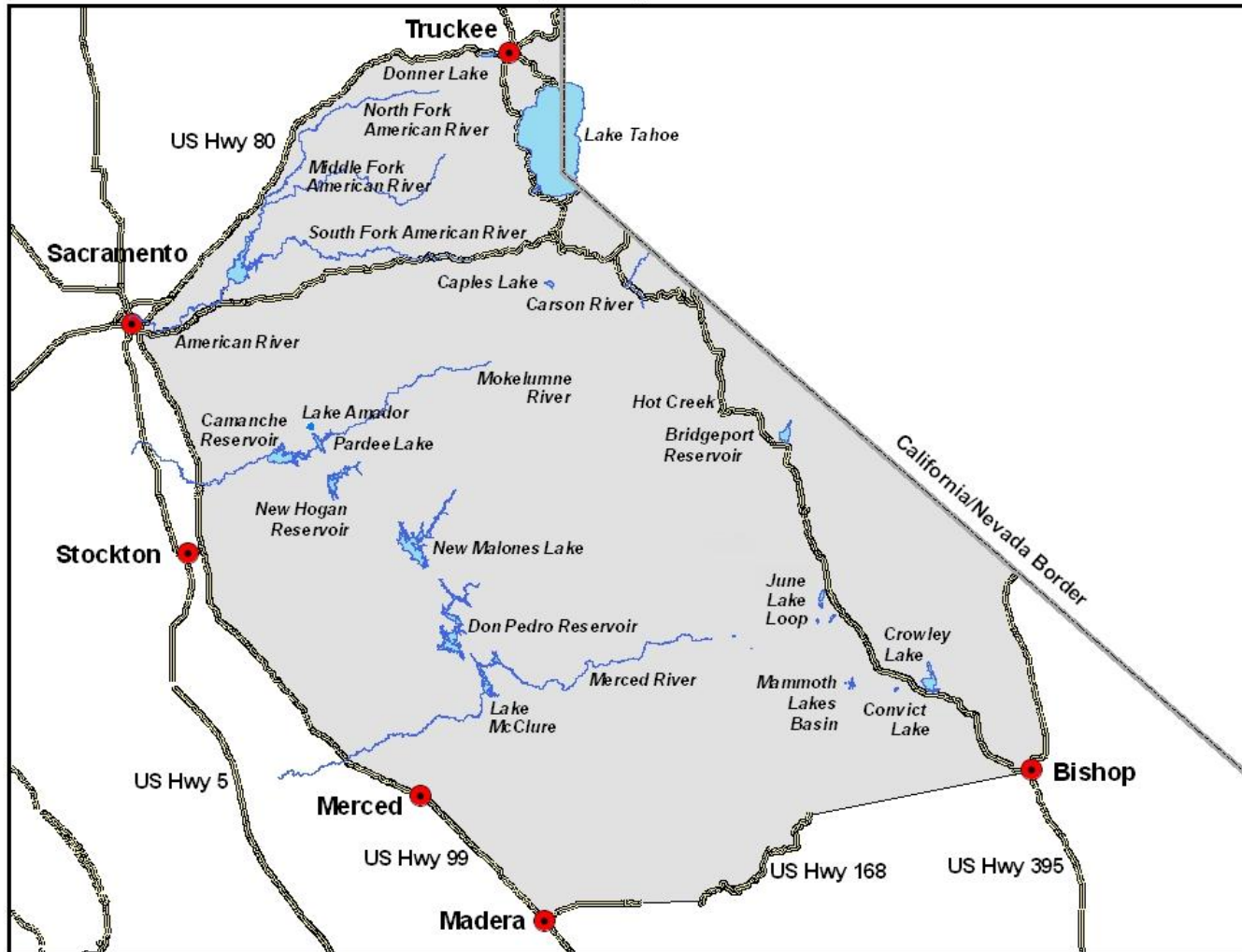
COMMENTS?

Please feel free to write any comments you have about fisheries management in the western United States. When you are finished, please place the survey in the stamped return envelope and mail it back to us. If you have any additional questions or concerns, please visit our website at <http://dare.colostate.edu/anglersurvey>



Department of Agricultural and Resource Economics
Campus Delivery 1172
Fort Collins, CO 80523-1172

Your Fishing Trips in California



*Study Region is shaded

Appendix I: Colorado Angler Survey Cover Letter



Department of Agricultural and
Resource Economics
Fort Collins, Colorado 80523-1172
(970) 491-6325
FAX: (970) 491-2067
<http://dare.colostate.edu/>

Dear Angler,

Thank you for agreeing to participate in this study. The purpose of this study is to help managers improve fishing in Colorado. Answering the survey will only take a few minutes, but will greatly aid fisheries managers in their decisions regarding your favorite fishing areas in Colorado.

To complete the survey, please refer to your most recent trip (where you were handed this survey). Your responses are important to us whether this is the first time you have fished here or the hundredth time. We want to hear what you think about your fishing trip here!

When you have completed the survey please mail it back to us in the enclosed postage paid stamped return envelope.

Your responses will be held in strict confidence and all results are reported only in summary form. While your responses to this survey are completely confidential and your name will NOT be associated with your survey responses, those who complete the survey will be **entered into a**

drawing for one of five \$100 gift certificates to  **redeemable at one of their stores or their website.**

The results of the survey will be posted on our Department website (<http://dare.colostate.edu/anglersurvey.html>) next fall. This website also provides answers to frequently asked questions about the survey. However, if you have any questions whatsoever, please feel free to contact one of our project managers, either Dr. Craig Bond at Craig.Bond@colostate.edu, or Dr. John Loomis at John.Loomis@colostate.edu.

Thank you again for your willingness to complete the survey and we look forward to receiving it.

Sincerely,

Dr. Craig Bond
Project Manager

Dr. John Loomis
Project Manager

Your Fishing Trip in Colorado



How can we make it better?

**Colorado
State
University**

Thank you for agreeing to complete this survey. Your answers will be quite helpful to the groups that manage and support recreational fishing in Colorado. In this survey, when we refer to a **trip** we mean a trip

from home to the water body and back again. Thanks again, and we look forward to receiving your survey in the enclosed stamped envelope.

Section A. Please tell us about your trip to the water body (lake, reservoir, pond, river or stream) where you received this survey.

1. What was the name of the town nearest to the water body where you received this survey?

Name of town: _____

2. How many trips in the past 12 months did you make to the **water body** where you received this survey?

_____ #Annual Trips

3. What species of fish were you targeting on **this trip** (check or list all that apply)?

Trout Bass Walleye Catfish Other _____

4. What was the total amount of time you spent on this trip visiting the water body where you received this survey (including all activities such as fishing, boating, camping, hiking, etc.)?

_____ # of hours or _____ # of days

4a. What was the amount of time that was spent **actually fishing** at this location on this trip?

_____ # of hours fished or _____ # of days fished

4b. During your **trip** to this water body, how many fish did you catch and how many did you keep?

_____ # of fish caught and _____ # of fish kept

4c. How many of these fish were species that you were **targeting**?

_____ # of **target** fish caught and _____ # of **target** fish kept

4d. If you visited more than one water body during this trip, what was the total amount of time spent visiting all the water bodies on this trip from home?

_____ # of hours or _____ # of days

5. Please check the activities **you** participated in during this **trip** from home at the location where you received the survey (check all that apply):

- | | | |
|--|--|--|
| <input type="checkbox"/> Fishing from Bank/Wading | <input type="checkbox"/> Fishing from a Boat | <input type="checkbox"/> Belly Boat Fishing |
| <input type="checkbox"/> Rafting, Kayaking, Canoeing | <input type="checkbox"/> Motorized Boating | <input type="checkbox"/> Viewing Scenery and Wildlife |
| <input type="checkbox"/> Camping | <input type="checkbox"/> Horseback Riding | <input type="checkbox"/> Fishing with Family/Friends |
| <input type="checkbox"/> Hiking/Backpacking | <input type="checkbox"/> Photography | <input type="checkbox"/> Other, please describe: _____ |
| <input type="checkbox"/> OHV Recreation (e.g. ATV, Dirt Bike, 4x4) | _____ | |

5a. If you checked more than one activity, which of these activities was the most important reason for your trip to this water body? Most Important Activity _____

6. Was your trip to this water body: (check only one):

- the primary purpose or sole destination of your trip from home?

- one of many equally important reasons or destinations for your trip from home?
- just an incidental stop on a trip taken for other purposes or to other destinations?

7. What were your primary methods of travel to this water body (circle all that apply):

Car/Truck RV Airplane Other _____

8. What was the one-way **travel time** from your home to the water body where you received this survey?

_____ # hours _____ # minutes

9. What was your one-way **travel distance** from your home to this water body?

_____ # one-way miles

10. Including yourself, what was the number of **adults** and **children** in your group that traveled on this trip?

_____ # of **adults** in your group and _____ # of **children** in your group

11. How crowded did you think the water body was where you received this survey? Please circle one number representing how crowded it was.

Not at All Crowded 1 2 3 4 5 6 7 8 9 10 Extremely Crowded

Please tell us about the importance level of several features of the water body **where you received this survey.**

Important Aspects of Your Most Recent Trip				
<i>Please circle one number for each item</i>	Importance for your decision to visit this water body			
	Not Important/ Not Applicable	Somewhat Important	Important	Very Important
Opportunities to catch many (large #'s) of fish	1	2	3	4
Opportunities to catch trophy-sized fish	1	2	3	4
Opportunities to catch wild fish	1	2	3	4
Enjoying peace and solitude (without crowding)	1	2	3	4
Fishing near skilled anglers/fishermen	1	2	3	4
Socializing with other anglers/fishermen	1	2	3	4
Cleanliness of site	1	2	3	4
Amenities such as restrooms and parking	1	2	3	4
Catching fish to eat	1	2	3	4
River rafting/canoeing/kayaking	1	2	3	4
Motorized Boating	1	2	3	4
Viewing Scenery and Wildlife	1	2	3	4
Camping	1	2	3	4
Horseback Riding	1	2	3	4
Fishing with Family/Friends	1	2	3	4
Hiking/Backpacking	1	2	3	4
Photography	1	2	3	4
OHV Recreation(e.g. ATV, Dirt Bike, 4x4)	1	2	3	4
Other activities: Please list	1	2	3	4

Section B. Most Recent Trip Expenditures (Please skip this section if you did not travel to the site where you were handed this survey (for example, the site was on your own property or on property owned by your homeowner's association).

Please indicate the amount you and members of your group with whom you shared expenses (e.g., other family members, traveling companions) spent on each category on the **trip** during which you were given the survey. Note: The Western Region of the United States is comprised of twelve states (Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming).

Expenses on Your Most Recent Trip		
Trip Expense	Amount spent ON THIS TRIP in Colorado	Amount spent ON THIS TRIP outside of Colorado (but still in the Western Region)
Gas & Oil for Auto &/or Boat	\$	\$
Food/drink: restaurants	\$	\$
Food/drink: grocery stores	\$	\$
Supplies/fishing tackle/bait/other retail	\$	\$
Camping on Public Lands	\$	\$
Camping at Private Areas	\$	\$
Hotel/motel	\$	\$
Equipment rental	\$	\$
Guide fees	\$	\$
Fishing License	\$	\$
Fishing Entrance/Catch/Access Fees	\$	\$
Rental car	\$	\$
Airline ticket	\$	\$
Fishing Club/Dude Ranch Package Deals (<u>Please do not “double count” expenses from above categories</u>)	\$	\$
Other; Please List	\$	\$

1. Including yourself, how many people in your group shared these expenses on this most recent trip?

_____ # of persons in your group sharing expenses

2. As you know, some of the costs of travel such as gasoline, hotels and restaurant meals often increase. If your share of the **total cost** of this most recent trip had been \$_____ **higher**, would you have made this trip to the water body where you received this survey?

Circle one: YES NO

3. Did you use a motorized boat on the trip where you were handed this survey? Yes No

3a. If Yes, did you rent your boat, do you own your boat, or do you borrow a boat for free?

Rent Own Borrow for Free

3b. If you Own a boat, do you dock your boat at a marina or did you trailer your boat to this site?

Marina Trailer

Section C: Fisheries Management and Annual Recreation Trips

Suppose managers were no longer managing this water body for recreational fishing, and catch rates were to go down by half or 50% (with everything else unchanged). Please indicate how you would respond to this change in catch rates and fill in your estimate of the change in the number of trips (if any).

Would your decision to visit this water body change if you had half (-50%) the daily catch rate of your targeted species that you experienced on this trip?

- Yes, I would **decrease** my fishing trips to this water body by (#) _____ fewer trips per year.
- Yes, I would **increase** my fishing trips to this water body by (#) _____ more trips per year.
- No, I would **not change** my fishing trips to this water body.

5. During which of the following months do you typically go fishing in a typical year (Circle all that apply)?

January February March April May June July August September October November December

6. On a scale of 1 to 10, how would you *rate your skill level* as an angler (Please circle one number)?

Little or No skill at all 1 2 3 4 5 6 7 8 9 10 Extremely Skilled/Professional

For the purposes of this survey, the Western Region of the United States is comprised of twelve states (Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming).

7. About how many total *outdoor recreation* trips do you take each year to areas **within** the western US?

_____ Annual # of trips

8. About how many total *outdoor recreation* trips do you take each year to areas **outside** the western US?

_____ Annual # of trips



Section D: Season Trip Information

This information on your annual visitation is important to fishing managers in deciding how to manage your fisheries, so please enter the total number of trips from home and the number of days you spent fishing at the following water bodies during the last year. **Please refer to the enclosed map for water body locations and**

study region in Colorado. By public waters we mean county, state or federal lakes, reservoirs, ponds or rivers such as those on National Forest land, in National Parks, on National Wildlife Refuges, and on Colorado Division of Wildlife or natural resources properties. Other private waters include waters on private land that do not fit into listed categories such as your own private property or homeowner's association (HOA) property.

How many fishing trips did you take primarily for the purpose of fishing during the last 12 months to the following locations? How much time did you spend?

Water Bodies in Colorado, Within Study Region on Enclosed Map

	<u># of Trips</u>	<u># of Days</u>		<u># of Trips</u>	<u># of Days</u>
Arkansas River			Poudre River		
Big Thompson River			Pueblo Reservoir		
Blue Mesa Reservoir			Ridgeway Reservoir		
Blue River			Spinney Mountain Reservoir		
Crawford Reservoir			Steamboat/Pearl Lakes		
Dowdy / Parvin / West Lakes			Yampa River		
Emerald Lakes			Other Public Rivers		
Fryingpan River			Other Public Streams (Small streams, brooks, creeks, etc.)		
Grand Lake / Lake Granby			Other Public Lakes or Reservoirs		
Grand Mesa Lakes			Other Public Ponds		
Gunnison River			Private Ranches/Dude Ranches		
Harvey Gap / Rifle Gap			Fishing Clubs		
Horseshoe Lake / Martin Lake / Lathrop State Park			Fee-Fishing Ponds (U-Fish)		
McPhee Reservoir			Other Private Waters (e.g. HOA)		

Water Bodies in Colorado, but Outside Study Region

	<u># of Trips</u>	<u># of Days</u>
Public Waters		
Private Ranches/Dude Ranches		
Fishing Clubs		
Fee Fishing Ponds (U-Fish)		
Other Private Waters (e.g. HOA)		

Water bodies in AZ, NM, UT and WY

	<u># of Trips</u>	<u># of Days</u>
Public Waters		
Private Ranches/Dude Ranches		
Fishing Clubs		
Fee Fishing Ponds (U-Fish)		
Other Private Waters (e.g. HOA)		

Water bodies in AK, CA, ID, MT, NV, OR and WA

	<u># of Trips</u>	<u># of Days</u>
Public Waters		
Private Ranches/Dude Ranches		
Fishing Clubs		
Fee Fishing Ponds (U-Fish)		
Other Private Waters (e.g. HOA)		

Water bodies OUTSIDE of these states

	<u># of Trips</u>	<u># of Days</u>
Public Waters		
Private Ranches/Dude Ranches		
Fishing Clubs		
Fee Fishing Ponds (U-Fish)		
Other Private Waters (e.g. HOA)		

Section E. Please tell us something about yourself.

These last few questions will help us in evaluating how well our sample represents visitors to the area. **Your answers will be kept strictly confidential and will only be used for the analysis of this study. Statistics will only be reported in aggregate (average) form, and you will not be identified in any way.**

1. Are you? Male Female
2. In what year were you born? 19_____
4. Are you employed? Yes (Go to #3a.) No (Skip to #3d.)
 - 3a. Do you work part time or full time? Full-time Part-time
 - 3b. Do you take time off from work to participate in outdoor recreation? Yes No
 - 3c. How many weeks of paid vacation do you receive each year? # _____ of weeks (Go to #4.)
 - 3d. Are you retired? Yes No
4. What is your zip code? _____
5. Are you a member of a fishing, hunting or sportsman's organization? Yes No
6. Are you a member at a Private Ranch/ Dude Ranch or Fishing Club? Yes No
 - 6a. If Yes, what are your annual dues? \$ _____ Annually
7. Are you a member of a homeowner's association (HOA)? Yes No
 - 7a. If Yes, what are your annual dues? \$ _____ Annually
 - 7b. Are you on a decision-making group for your HOA? Yes No
8. Your highest level of formal education? (Please circle one)

Elementary School	Jr. High or Middle School	High School	Associates Degree	College (B.S./B.A) or Technical School	Graduate or Professional School
------------------------------	--------------------------------------	------------------------	------------------------------	---	--
9. How many members are in your household? _____ persons
10. How many household members contribute to paying the household expenses? _____ persons
11. Including these people, what was your approximate household income from all sources (before taxes) last year?

<input type="checkbox"/> less than \$19,999	<input type="checkbox"/> \$20,000-\$29,999	<input type="checkbox"/> \$30,000-\$39,999
<input type="checkbox"/> \$40,000-\$59,999	<input type="checkbox"/> \$60,000-\$79,999	<input type="checkbox"/> \$80,000-\$99,999
<input type="checkbox"/> \$100,000-\$149,999	<input type="checkbox"/> \$150,000-\$299,999	<input type="checkbox"/> more than \$300,000

Thank you for completing the survey!

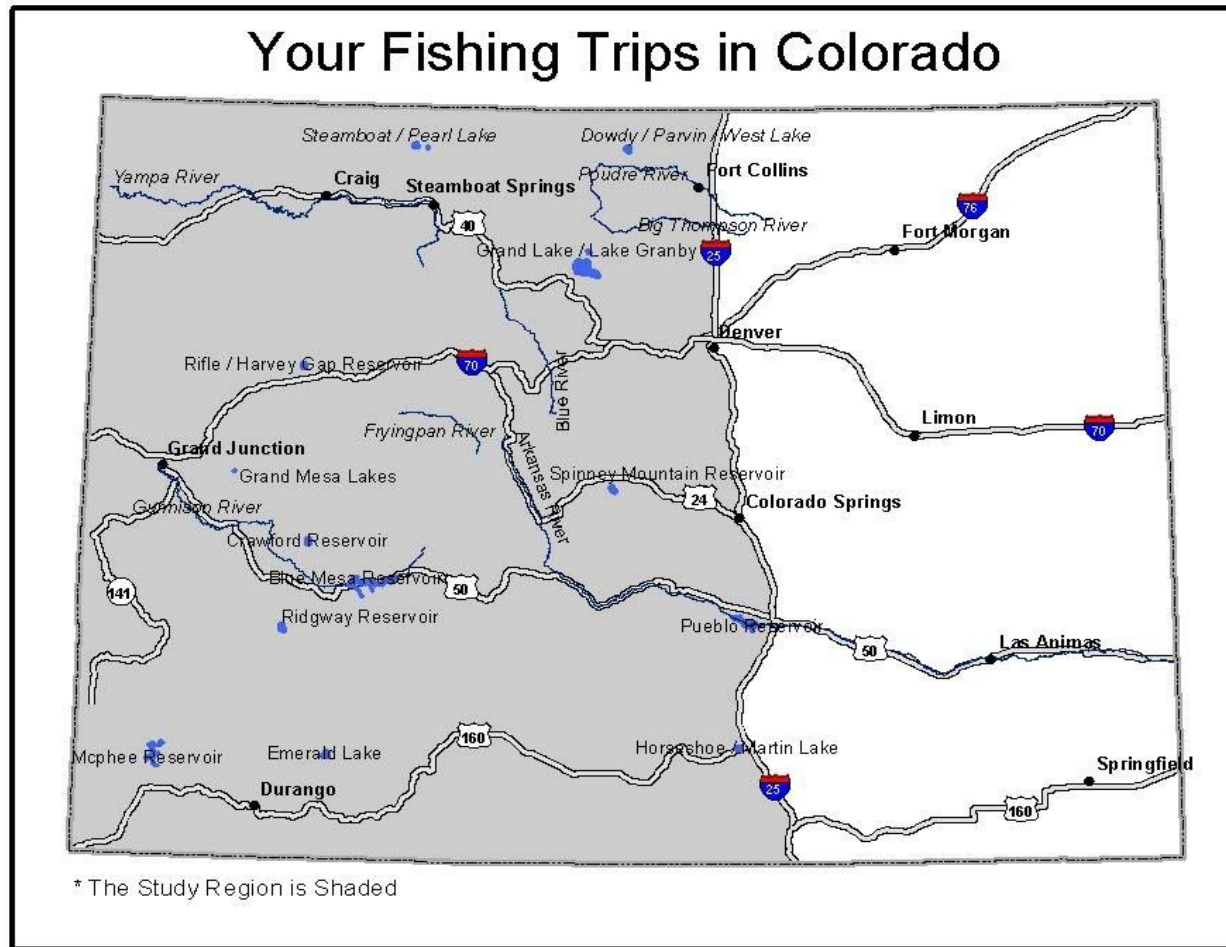
COMMENTS?

Please feel free to write any comments you have about fisheries management in the western United States. When you are finished, please place the survey in the stamped return envelope and mail it back to us. If you have any additional questions or concerns, please visit our website at <http://dare.colostate.edu/anglersurvey>



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Appendix K: Colorado Angler Study Area Map



Appendix L: Alaska

1. Introduction

The Western Regional Aquaculture Center (WRAC region) is comprised of 12 states: Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington and Wyoming. However, in Alaska it is illegal to operate a for-profit finfish aquaculture operation (under Alaska Statute 16.40.210). The reason is that the fish stocked in Alaska are anadromous and stocked primarily for commercial purposes, and returns to fish stocking are generally a common property resource (White, 2010). In spite of the fact that these fish are stocked primarily for commercial harvest, there are additional benefits to the Alaskan sport fisheries. Salmon which are stocked and not harvested by commercial fishermen serve to augment natural populations and boost angler catch rates, potentially increasing sportfishing-related economic activity. As the purpose of this WRAC-funded report is to identify and quantify the economic contribution of the for-profit Aquacultural Suppliers of Recreational Fish (ASRF), Alaska's hatcheries are excluded from the analysis.

This appendix is provided as supplementary material, with the following objectives. First, this appendix summarizes some of the key literature pertaining to aquaculture of recreational fish in Alaska. Second, utilizing previously published information about the economic contribution of sport fisheries in Alaska, as well as the magnitude of the harvest derived from hatchery fish, this appendix presents an estimate of the economic contribution of recreational fish hatcheries in Alaska. Finally, suggestions are made with regards to future research on Alaska's hatchery program and its economic contribution to the Western region.

2. Sportfishing and Alaska's Hatchery System

The most updated report on the Alaska salmon enhancement program was composed by White (2010). Jennings et al. (2010b) provides the most recent report on sportfishing in general in Alaska. This short section summarizes some of the key findings in these studies.

As there are no for-profit hatcheries in Alaska, only strictly regulated non-profit or government operated hatcheries exist in that state. Over half of these hatcheries (20) are privately owned and operated, while most of the remaining are either state owned or state owned and operated. Three hatcheries are owned and operated by either the federal government or the Bureau of Indian Affairs. These hatchery operations are only allowed to harvest sufficient levels of fish to cover the costs of operating the hatcheries. There are also various streamside incubation projects which augment fish populations at a low cost.

Hatcheries play an important role in both commercial and recreational fisheries. In aggregate, these hatcheries released 1.464 billion fish into Alaska waters during 2009 (most recent data available). 45.071 million adult fish returned from previous releases and were harvested during the 2009 fishing season. Of the 45 million harvested, 259,640 were harvested by sport anglers, 28 million were harvested in commercial fisheries, and 17 million were harvested for cost recovery, broodstock or subsistence. Hatchery-reared fish constituted 18% of all commercially harvested salmon in 2009. Although sportfishing data is not available for 2009, during 2008, 11% of all sportfish and 21.5% of all salmonid harvests were attributable to hatchery-reared fish (Jennings et al., 2010b, and White, 2009). Furthermore, annual return and harvest of hatchery-reared fish has stayed consistent over the past several years (see White, 2008, 2009, 2010), and is projected to be 51 million in 2010.

In 2009, the commercial harvest of hatchery-reared salmon yielded \$62 million in exvessel value, or 18% of total exvessel catch value in that state. Indeed the primary objective of

the Alaska salmon enhancement program is to augment the returns to commercial fishing. However, while White (2010, 2009) links commercial harvest of salmonids with exvessel value, no such linkage exists with hatchery-reared fish and recreational economic contributions to the state of Alaska. The following section outlines an approach to estimate the economic contribution of sport harvest of hatchery-reared fish in Alaska.

3. Economic Contribution of Recreational Fish Production in Alaska

3.1 Stocked Fish Induced Angler Contributions

Southwick et al. (2008) estimate the economic contribution of sport fisheries in Alaska. The authors of that study estimate that 475,534 anglers spent 2,539,818 days fishing in Alaska in 2007.^{7,8} Total angler expenditures were reported as \$1,385,788,070 in that year, with multiplier effects resulting in a total economic contribution of \$1,607,593,685. The authors estimate that the 2.5 million angler days in 2007 supported 15,879 full-time jobs. Unfortunately, this study does not draw a link between this economic activity and fish stocking.

Jennings et al. (2010) report that in 2007, 7,234,233 fish were caught and 3,032,493 were harvested by sport anglers in Alaska. Salmonids constituted 68.1% of the fish caught and 56.6% of the fish harvested in that year. The assumption in this appendix is that the \$1.6 billion dollar economic contribution of sport fishing in Alaska results from the 3.03 million fish harvested.

While anglers certainly have expenditures related to the remaining 4 million fish caught and

⁷ Jennings et al. (2010a) estimate that 2,543,674 angler days were supported by Alaska sport fisheries in 2007. Furthermore, many of the authors on Jennings et al. (2010a) are also authors on Southwick et al. (2008). Although Jennings et al. (2010a) may provide more updated numbers, this study elects to use the numbers presented in Southwick et al. (2010) in order to be consistent with the economic contribution numbers presented in that study. While the numbers presented in the two studies are only different by a factor of 0.15%, the formulas provided above could be used with the Jennings et al. (2010a) numbers to estimate a slightly different economic contribution of sportfishing and/or stocked fishing, depending on the assumptions one makes.

⁸ Southwick et al. (2008) and Jennings et al. (2010a) both provide estimates for 2007 Alaska sportfishing. Alaska Fish and Game presents reports about the state of sportfishing in Alaska on an annual basis. However, these reports have a 2-3-year lag, such that the most recent study evaluates sportfishing in 2008. Although there are more recent data on the salmon enhancement program in Alaska (e.g. White, 2010, White, 2009, Jennings, 2010b), this part of the analysis utilizes the data presented in White (2008) in order to be consistent with the year of analysis of the Southwick et al. (2008) study.

released, data from the Alaska salmon enhancement program only provides information about harvested fish. It is likely, however, that released fish are proportional to harvested fish, and as such, the number of harvested hatchery-reared fish in a given year is a good proxy for total hatchery-reared fish caught and thus for economic activity. In other words, for every harvested hatchery-reared fish, there are probably other released hatchery-reared fish that are not directly accounted for but which contribute to Alaska's economy. The analysis that follows implicitly accounts for these fish.

The Alaska salmon enhancement program produces many types of salmonid for commercial and recreational purposes, including chinook, coho, pink, chum and sockeye salmon; rainbow trout, arctic char and arctic grayling (White, 2008, 2009, and 2010). Most of the salmon which survive to adulthood are harvested in commercial fisheries. However, in 2007, 345,564 of the total sport harvest was hatchery-reared fish (White, 2008).

Using estimates of total sport harvest in 2007 from Jennings et al. (2007) and estimates of the total economic contribution of sport harvest from Southwick et al. (2008), an estimate of the economic contribution of each fish harvested can be estimated as follows:⁹

$$(1) \quad C_{ft}^o = \frac{C_t^o}{H_t}$$

where C_{ft}^o represents the economic contribution per fish in terms of output (o) generated in Alaska, H_t represents the total harvest in year t , and C_t^o represents the total economic contribution of the sport fishery in year t . Likewise, jobs per fish can be estimated as follows:

$$(2) \quad C_{ft}^j = \frac{C_t^j}{H_t}$$

⁹ This assumes that economic contributions to fisheries are linear. In other words, each fish is worth the same in terms of economic activity as the previous fish and as the next fish.

where j indexes jobs as opposed to output.

Using equations 1 and 2, and data from Southwick et al. (2008) and Jennings et al. (2010), each fish harvested is estimated to generate \$530.12 in output and .00524 jobs.¹⁰ Finally, in order to estimate the economic contribution of *stocked* fishing in Alaska, we utilize the following formulas:

$$(3) \quad C_{sft}^0 = C_{ft}^0 \cdot H_{st}$$

$$(4) \quad C_{sft}^j = C_{ft}^j \cdot H_{st}$$

Where C_{sft}^0 and C_{sft}^j index the total output and full-time jobs, respectively, supported by stocked fishing and H_{st} indexes the harvest of stocked fish in a given year. Using these formulas, the economic contribution of stocked fishing in Alaska derived from angler expenditures is 1809.47 full-time jobs and \$183,191,356 of economic activity.

3.2 Hatchery Induced and Total Economic Contributions

Missing from this analysis is the direct economic contribution of the fish hatcheries in Alaska. For example, while each fish may generate \$530 in *consumption*, producing enough fish to result in one harvested adult fish may yield additional jobs and output in the Alaska economy. The most recent study evaluating the economic contribution of Alaska's fish hatcheries is McDowell Group (2010). This study documents the direct economic impact of hatcheries in the southeast region of Alaska. The authors estimate that hatcheries in the southeast region of Alaska generate \$32.4 million in economic activity and support 179 full-time jobs annually. This study does not, however estimate the amount of jobs and output generated from the *sport* harvest of

¹⁰ This assumes that all fish species harvested in the 2007 Alaska sport fishery generate the same amount of output and jobs per fish. A small portion of harvested fish, however, are species such as razor clams. While it is unlikely that the razor clam harvest is worth as much as the harvest of a Chinook salmon, it is also unlikely that a chum salmon (a.k.a. "dog" salmon) harvest is worth as much as a large halibut harvest. As such, the average contribution of a harvested fish is used to impute the total contribution of all hatchery-reared fish.

hatchery-reared fish. Furthermore this study does not estimate the economic contributions of all hatcheries in Alaska.

Utilizing data from White (2009), the amount of economic activity attributable to stocking operations on a per-fish basis can be estimated.¹¹ In the southeast region of Alaska, 522,880,000 fish were released in 2008, resulting in a total harvest of 9,965,209 fish (White, 2009).¹² Of the nearly 10 million harvested hatchery-raised fish in that region, only 50,261 were harvested by sport anglers. The amount of output and jobs attributable to the production of sport fish is found as follows:

$$(5) \quad C_{pft}^o = C_{pt}^o / H_t$$

$$(6) \quad C_{pft}^j = C_{pt}^j / H_t$$

Where C_{pt}^o and C_{pt}^j represent the total amount of output and jobs, respectively, generated by fish production in time period t in southeast Alaska. C_{pft}^o and C_{pft}^j represent the amount of output and jobs, respectively, on a per-harvested-fish basis generated by fish production facilities in time t in southeast Alaska.

Using data from McDowell (2010) and White (2009), total output per harvested hatchery-reared fish is \$3.25 in the southeast region of Alaska. The total amount of jobs per harvested hatchery-reared fish is .000018 in that region.¹³ Assuming that production costs in the remainder of the state are similar to those in southeast Alaska, the total 345,564 hatchery-reared fish harvested in Alaska are estimated to generate, via equations (7) and (8), 4.66 full-time jobs and

¹¹ McDowell (2010) reference data from 2008, as does White (2009). However, total sport harvest data is only available as late as 2007. This appendix assumes that the ratio of dollars and jobs generated per fish by aquaculture production is the same in 2008 as it was in 2007.

¹² The southeast region is referenced in order to align with the study in McDowell.

¹³ This assumes that the hatchery-reared fish harvested in the southeast region come from hatcheries in the southeast region, and that fish which are reared in the southeast region of Alaska are only harvested in that region. This assumption is defensible, however, given the anadromous nature of the salmon produced.

\$844,170 in that state through the direct, indirect, and induced effects of Alaska aquaculture producers.

$$(7) \quad C_{Apft}^o = C_{pt}^o \cdot H_{st}$$

$$(8) \quad C_{Apft}^j = C_{pt}^j \cdot H_{st}$$

C_{Apft}^o and C_{Apft}^j represent the direct, indirect, and induced effects on output and employment of the hatchery production of sport-harvested fish in Alaska. Combined with the output and jobs generated from angler expenditures, the economic contribution of hatchery-reared, sport-harvested fish to the state of Alaska is \$184,035,525 and 1814.13 full time jobs. A summary of these results can be found in table A-1.

Table A-1: Economic Contribution Of Hatchery-Reared, Sport-Harvested Fish Production in Alaska

Category	Contribution Type	Total Fish Harvested	Economic Contribution
All Sport Fish Harvested	Output	3,023,493	\$1,607,593,685
(Not Including Hatchery Economic Contributions)	Employment (Full-Time Jobs)	3,023,493	15,879
Hatchery-Reared Sport Harvested	Output	345,564	\$183,191,356
(Not Including Hatchery Economic Contributions)	Employment (Full-Time Jobs)	345,564	1,809
Hatchery-Reared Sport Harvested	Output	345,564	\$184,035,525
(Including Hatchery Economic Contributions)	Employment (Full-Time Jobs)	345,564	1,814

4. Extensions and Recommendations for Future Research

The analysis above presents a rough estimate of the economic contribution of the sport harvest of hatchery-reared fish in Alaska using secondary data from several studies commissioned by either the Alaska Department of Fish and Game or various Alaska aquaculture associations. However, a more detailed analysis could document the differences in economic contribution derived from the sport targeting of different species of fish. The analysis above

assumes that all fish contribute the same amount to the Alaska economy, whether they be chinook salmon, pacific halibut, or razor clams. As there are no recreational halibut or clam hatcheries in Alaska, a proper linkage of hatchery rearing and sportfishing would require a detailed analysis of the economic contribution of salmonid fishing in Alaska.

Furthermore, the analysis above assumes that anglers are indifferent between hatchery-raised and wild fish. Whether this is true is an open question that may or may not affect the final economic contribution of \$184 million and 1814 jobs to Alaska attributable to stocked fishing.

Finally, the analysis above assumes that a reduction in fish stocked will result in a proportional reduction in catch rates *and* a proportional reduction in angler days. Both of these assumptions are debatable, but state-of-the-art economic models can answer this question directly. However, these economic models require additional data not available in the secondary literature, and a further exposition of the validity of these assumptions would require the gathering of additional primary data. Nonetheless, the analysis above provides rough estimates of the previously unpublished economic contribution of the non-profit Alaskan fishery enhancement program.

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