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# Economic Development Report

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## THE AQUACULTURAL SUPPLIERS OF RECREATIONAL FISH (ASRF): A LOOK AT THE FRESHWATER RECREATIONAL FISH INDUSTRY IN THE WESTERN UNITED STATES

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### *Introduction*

In 2006, with producer support, the Western Regional Aquaculture Center (WRAC) sponsored a project to assess the economic contribution of the Aquacultural Suppliers of Recreational Fishing (ASRF) in the Western United States. To date, the industry has not previously had its role and economic impact on the region assessed in detail. 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.

This analysis requires input from ASRF producers. In 2008, a survey of ASRF producers was conducted, and results have been compiled. The survey examines the ranges of activities undertaken by ASRF producers, as well as the general cost structure of the ASRF industry. This information is used to estimate the economic contribution of the ASRF industry in the Western United States.

This project is being 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 following document presents summary statistics regarding the ASRF industry, as well as a preliminary estimate of the economic contribution of this industry to the Western United States.

### *Section 1: Survey Methodology*

Surveys were administered, according to the Dillman Total Design Method, to all permitted ASRF producers (each state requires ASRF producers to renew an aquaculture permit annually, and the names and addresses of these businesses are publicly available) in the Western United States during 2008. The states with producers who received surveys included Alaska, Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

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(WRAC states). However, we discovered early that Alaska did not have any for-profit ASRF producers, and as such Alaska is excluded from this part of the economic contribution analysis.

The survey process 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.

This survey asked questions regarding 2007 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). This information is used to estimate the economic contribution associated with recreational fish sales. Throughout this document, we divide sales into two categories: Salmonids (including Brown, Brook, and Rainbow Trout, Whitefish, Grayling, Salmon, etc.) and Warm/Cool Water Species (including Striped, Largemouth, and Smallmouth Bass, Sturgeon, Sunfish, Catfish, etc.).

### Response Rate

In total, 418 permit-holding producers were identified. Of these, 241 producers indicated that they were not

actually in the ASRF business. This left 173 potentially active producers, of which 52 actually completed a survey, implying a 30% response rate. Notice that this is a low estimate of response rate, since the 173 possible producers may not have all been active producers in 2007. This response rate may seem low relative to on-site-distributed recreation surveys (e.g. 88% response rate in Deisenroth et al. [2009]), but it is actually high relative to mail-back agricultural surveys (e.g. 7.9% in Davidson [2009], 25% in Lubben et al. [2006]). 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 and aquaculture studies' findings in the Western United States, potentially mitigating any concern regarding sample selection bias (e.g. Lubben et al. [2006] and NASS [2002]). Response rates are summarized in figure 1.

### Section 2: Personal and Farm Data

#### Demographic Statistics

A typical ASRF producer is a 55 year old man who has been in business for over 20 years. He is most likely married, and has at least one, perhaps two, children still living at home. Perhaps due to the daily monitoring required at an aquaculture facility, most ASRF producers choose to live on-site. Finally, income from aquaculture typically constitutes about half of the household income, with many producers indicating through phone conversations that they are involved in some other

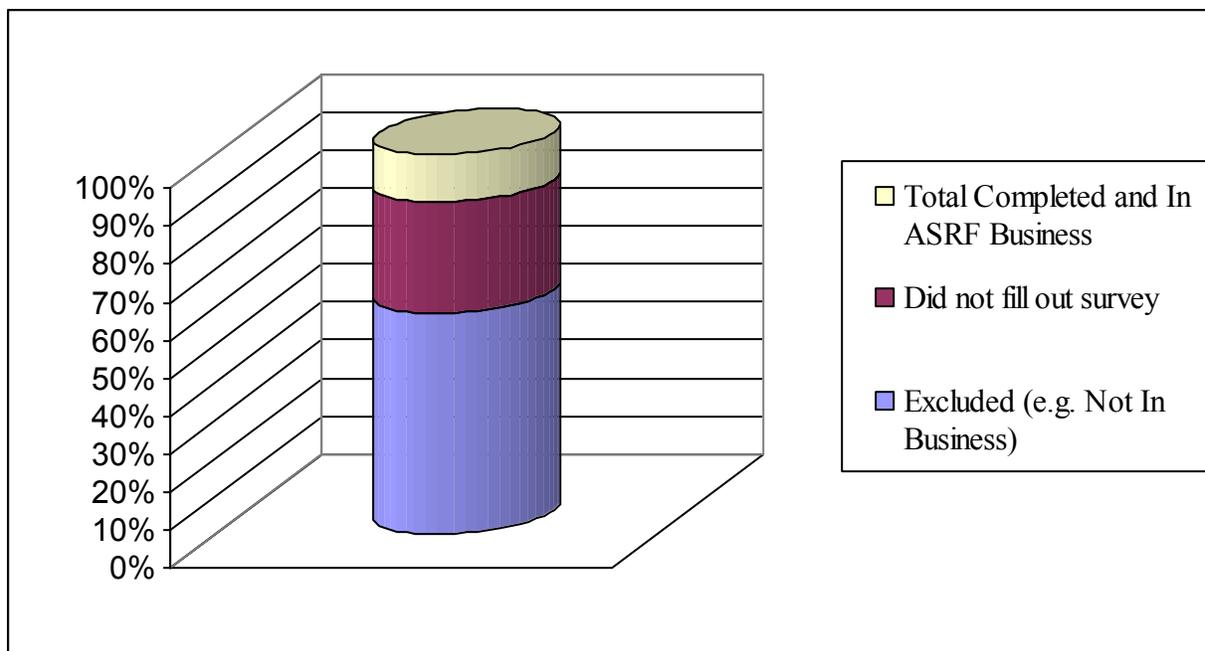


Figure 1: Survey Response Rate

agricultural activity for supplemental income. Table 1 summarizes the demographic statistics of survey respondents.

### Sources of Water and Water Rights

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 groundwater, 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).

Figure 2 summarizes water use behavior among ASRF producers.

### Geographic Distribution of ASRF Producers

Most 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. Permit information, along with the source of that information, is summarized in table 2.

**Table 1: Demographic Statistics**

Age	55
% Male	90%
Years in ASRF Business	22 Years
Years Working in Aquaculture in General	23 Years
Size of Household (Persons)	3.3 Persons
% Married	88%
% Who Live On-Site	80%
Earnings as a % of Total Income	45%

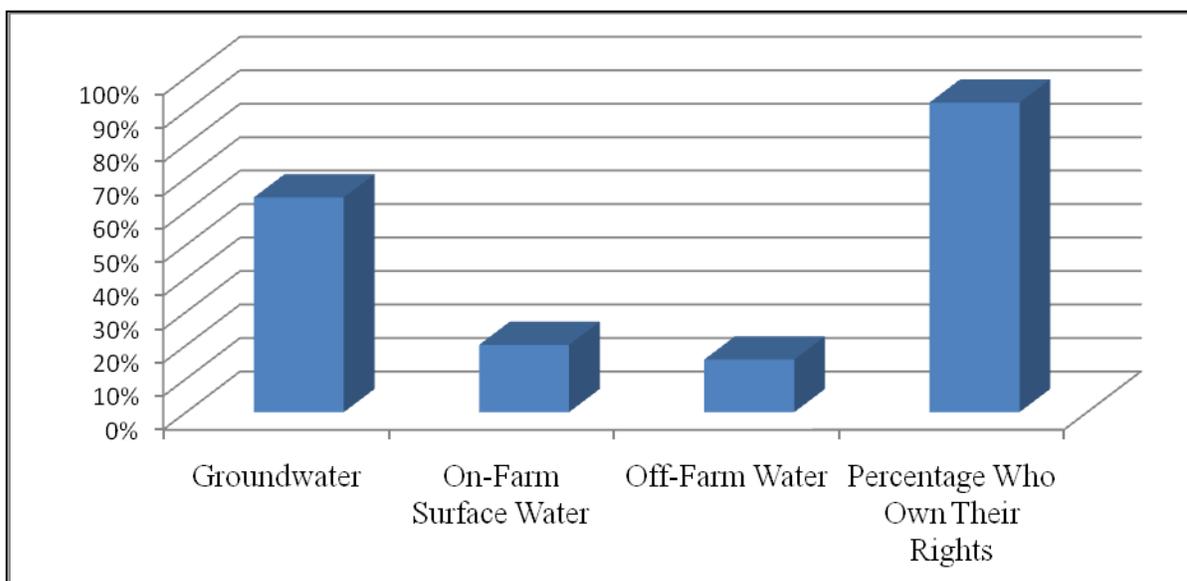


Figure 2: Water Usage and Ownership

**Table 2: Identified Producers By State (#)**

State	Active Permits	Not in Business	Potential ASRF Businesses	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
<b>Total</b>	<b>418</b>	<b>245</b>	<b>173</b>	

\*Only shellfish and non-profit producers were identified in this state.

*Section 3: Purchase and Sales Location Information*

**Location of Purchases and Sales**

Ultimately, this study endeavors to estimate the economic contribution associated with ASRF production. This economic contribution can be estimated 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 3 indicates that most purchases and sales are done in-state or in-region. Sales are divided into Salmonids and Warm/Cool Water species. 89% of material purchases, such as fish, eggs, feed, or other depreciated expenditures, are made in state or in the Western region. 95% 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 may come from the high transportation costs associated with aqua-

culture products, and ultimately result in high economic contribution estimates.

**Sales Outlets**

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 4 summarizes the sales outlets for Salmonids and for warm and cool water fish.

*Section 4: Sales Information*

**Sales and Brokered Levels**

Figures 5 and 6 demonstrate the fact that the distribution of sales is skewed towards the high end. For example, if there are three producers, with two producing

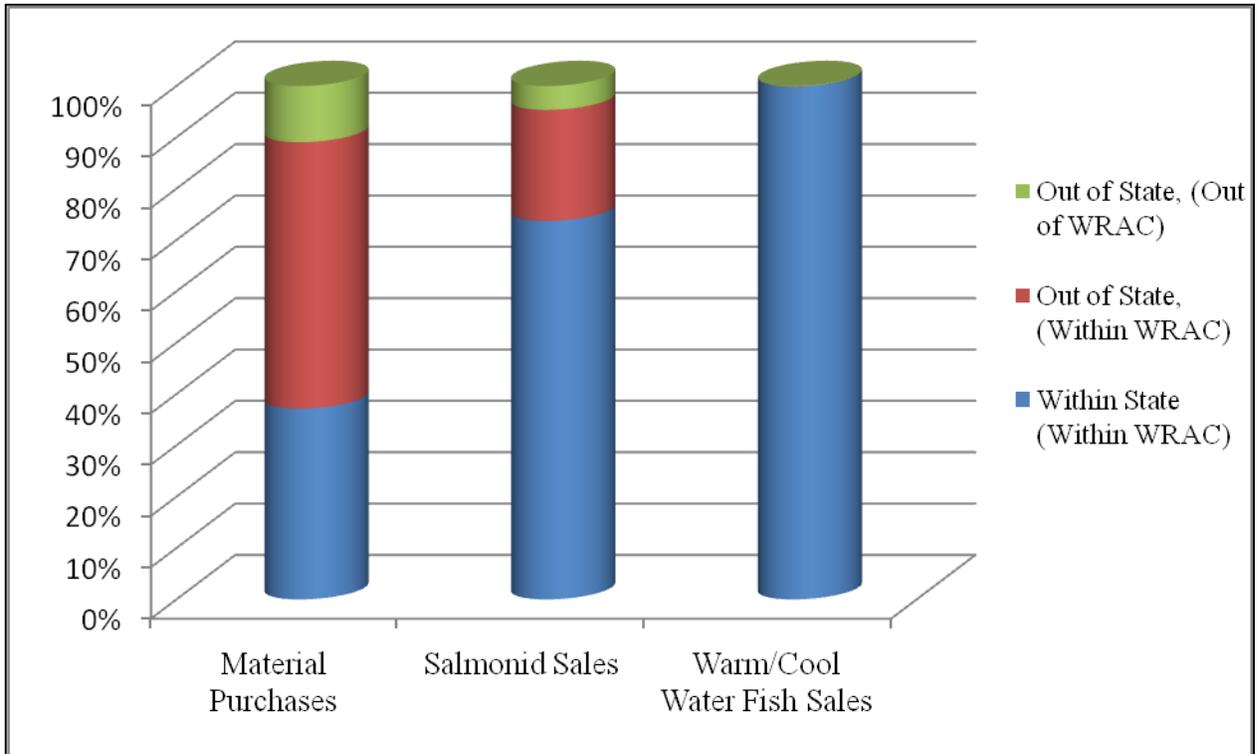


Figure 3: Location of purchases and sales.

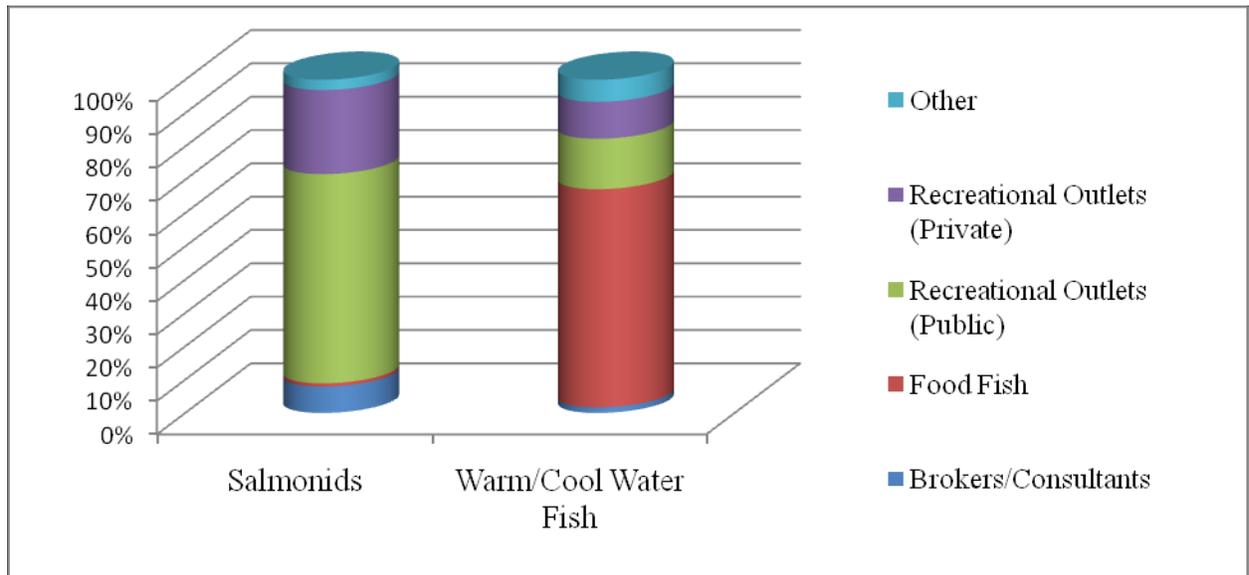


Figure 4: Sales Outlets.

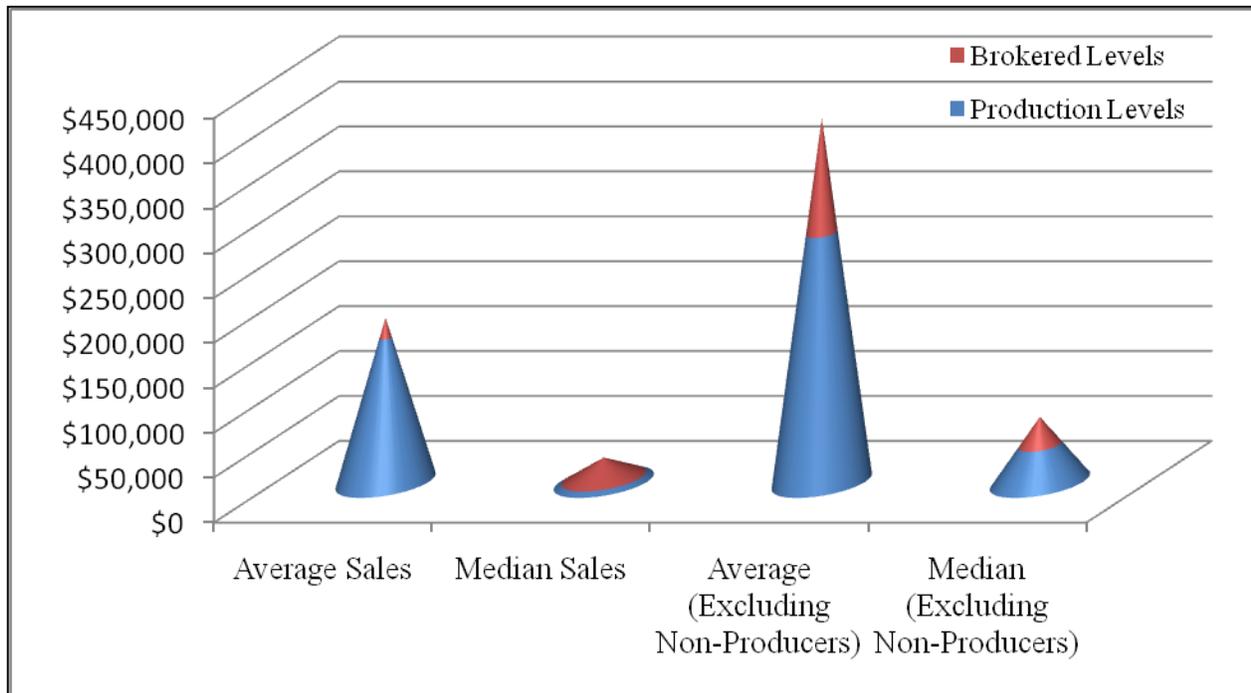


Figure 5: Sales and Brokered Levels of Salmonids.

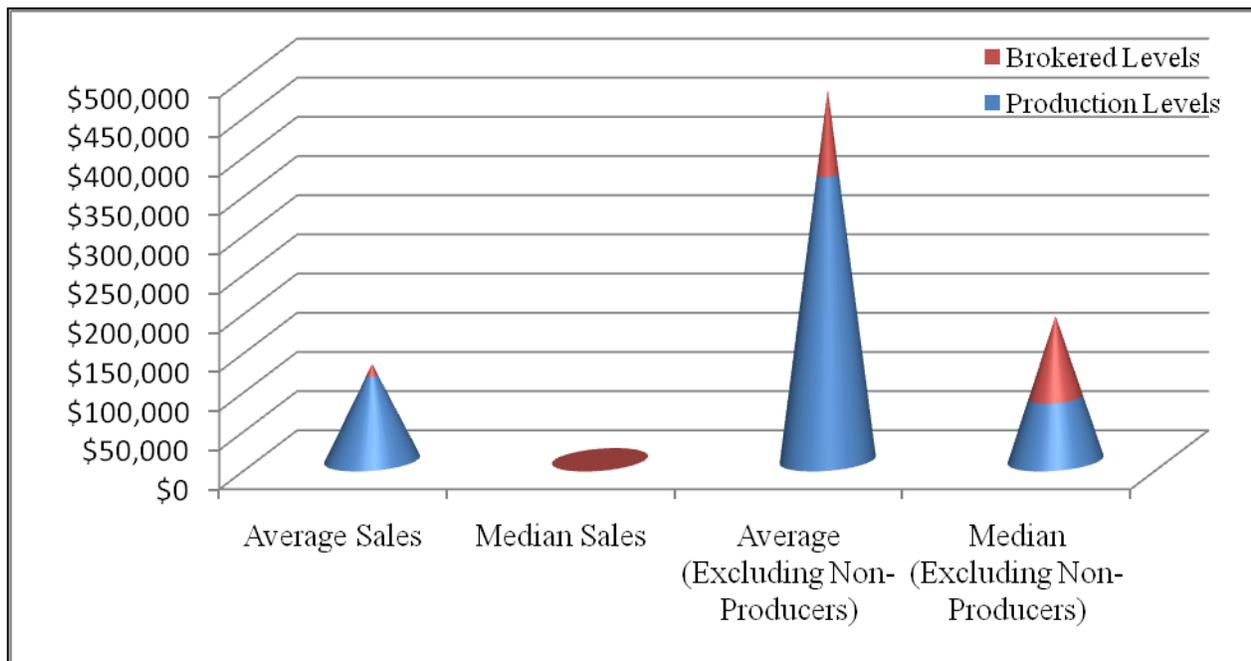


Figure 6: Sales and Brokered Levels of Warm and Cool Water Fish.

\$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.

### Breakdown by Sales Category

Figures 7 and 8 outline the breakdown of sales by category, including catchables, sub-catchables, and trophy size fish. These are broken down as in the previous fig-

ures into four statistics: 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. 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. Notice that some quantities in these figures may differ from those in the previous figures due to producer survey response error or omission of information.

### Section 5: Economic Contribution of the ASRF Industry

#### Industry Level Statistics

Table 3 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. (Notice that there are 173 potential businesses, not 173 verified businesses. As a result, the subsequent estimates may overestimate the true population figures. Refer to Section 1 for an explanation of this.)

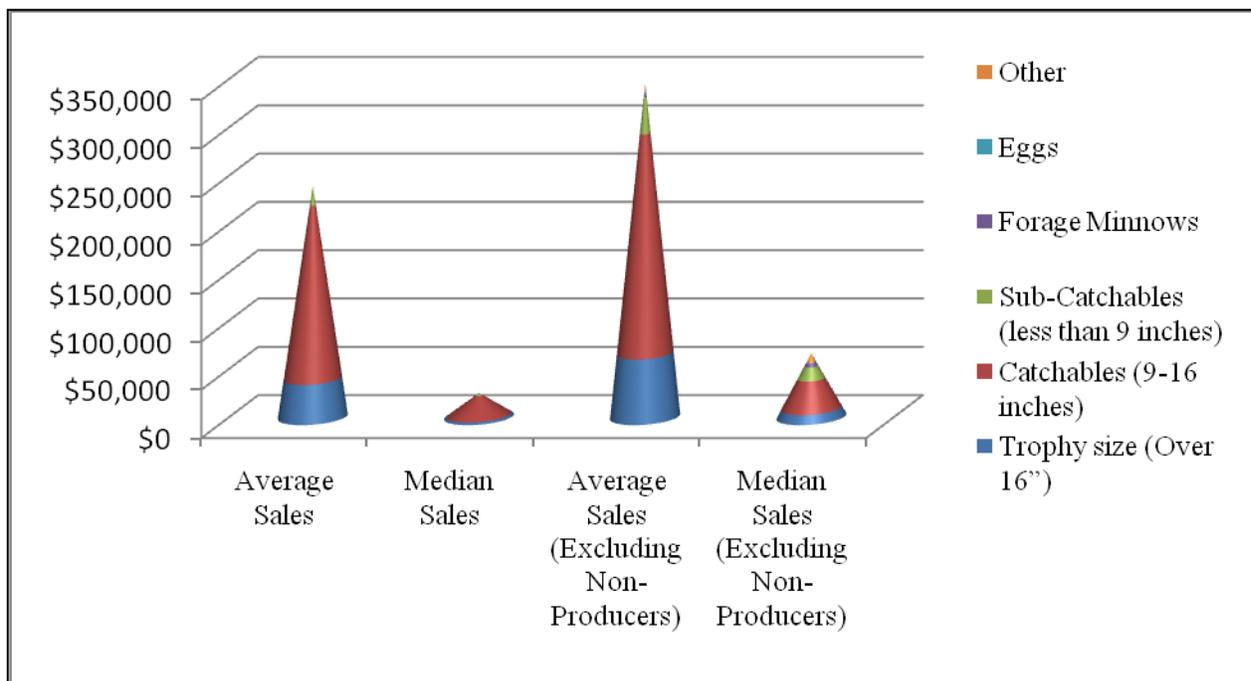


Figure 7: Breakdown by Category for Salmonids.

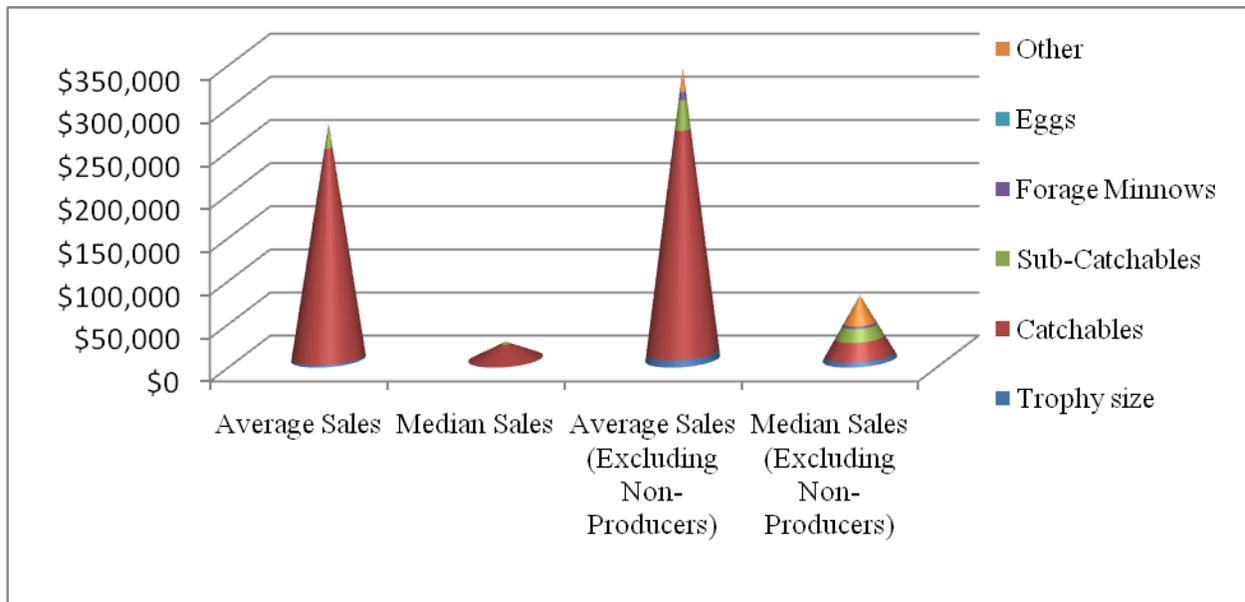


Figure 8: Breakdown by Category for Warm and Cool Water Fish.

Table 3: Industry Annual Levels

Total Sales	\$57,238,415
Total Jobs	1,237
Material Expenditures	\$23,948,134
Other Property Income	\$12,743,225
Labor Expenditures	\$12,737,101
Proprietary Income	\$7,809,955

Material expenditures include dollars spent on non-depreciated items, with fish feed, the largest material expenditure, constituting nearly 13% of total expenditures. Other property income includes rent or lease dollars spent on buildings, equipment and facilities, with 11% of total expenditures going towards the purchase, maintenance, or lease of fish production facilities (the largest expenditure in this category).

The ASRF producers in our sample indicate that their business is labor intensive, with over one-third of expenditures going towards labor or proprietary income. These expenditures lead to a large “induced effect,” which is the economic contribution of the

ASRF industry that comes from the spending patterns of employees and proprietors.

### 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 1.89 for the ASRF industry, for example, means that for every \$1.00 of fish sold, \$1.89 is generated in the local or regional economy. Employment multipliers indicate the amount of jobs that are generated from the presence of 1 million dollars of ASRF activity (or in the case of the type SAM

employment multiplier, from the presence of 1 full-time ASRF job).

Multipliers are estimated using models of regional economies known as input-output models. In the case of this study, IMPLAN input-output software is used. 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 pre-existing data of other industries that sell supplies to the ASRF industry to trace exactly how much economic activity is generated for every dollar spent on a particular supplier (e.g. a feed producer). This logic is applied to all suppliers to the ASRF industry, including labor (while laborers do not have any “inputs” per se, they do spend their wages on things like groceries, gasoline, housing, etc.).

Multipliers are composed of three effects: the direct effect, the indirect effect, and the induced effect. Direct effects come directly (and only) from the ASRF industry. For example, for every dollar spent on ASRF products, only one dollar is directly attributable to the ASRF industry. Indirect effects come from the fact that the ASRF industry spends money on items such as fish feed, trucks, gasoline, etc. These businesses which supply inputs to the ASRF industry also benefit from ASRF production. 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 multiplier (SAM stands for Social Accounting Matrix).

As stated in the survey methodology section of this document, the region of analysis for this economic contribution analysis is all WRAC states excluding Alaska.

Table 4 decomposes the type SAM multiplier into direct, indirect, and induced effects for both output and employment. Notice in the case of the output multipliers, numbers are reported as a function of every dollar

spent on ASRF products. For example, the indirect multiplier of .43 says that for every dollar spent on ASRF products, \$.43 cents are generated in the industries that supply inputs for the ASRF industry. For the employment multipliers, however, numbers are reported as a function of every million dollars spent on ASRF products. For example, the direct employment multiplier says that for every million dollars spent on ASRF products, 21.61 jobs are created in the ASRF industry. The type SAM multiplier in this case is reported as a function of ASRF jobs, i.e. for every 1 job created in the ASRF industry, .36 jobs are created elsewhere in the local or regional economy.

### **Economic Contribution of the ASRF Industry in the Western United States**

Using the numbers from the previous sections (i.e. the total dollars spent on ASRF products, and the output multiplier), we can make an approximation regarding the economic contribution of the ASRF industry in the Western United States. The same is true for the total number of jobs generated in the Western United States as a result of the business of the ASRF industry.

Notice that this only includes the direct, indirect, and induced effects of the ASRF industry, which are collectively called “backwards linkages.” In other words, this only takes into account the effects of the supply chain of the ASRF industry, as well as the ASRF industry itself. However, this does not account for dollars spent on recreational angling, for example, which certainly is influenced by the presence of the ASRF industry (collectively called “forward linkages”).

Based on the numbers above, we estimate that the ASRF industry generates roughly \$110 million dollars of economic activity annually in the Western United States. Furthermore, we estimate that the ASRF industry supports approximately 1682 full time jobs in the Western United States.

This economic activity is distributed across a wide range of activities from insurance carriers to private

**Table 4: Economic Multipliers**

	Direct	Indirect	Induced	Type SAM Multiplier
Output Multipliers	1.00	0.43	0.46	1.89
Employment Multipliers	21.61	4.34	3.40	1.36

**Table 5: Economic Activity Generated Annually in Top 20 Industries from ASRF Industry Activity**

ASRF	\$57,238,415
Animal Production- Except Cattle and Poultry	\$3,663,641
Insurance Carriers	\$2,769,766
Imputed Rental Activity for Owner-Occupied Dwellings	\$2,640,471
Petroleum refineries	\$2,487,060
Transport by truck	\$1,828,396
Wholesale trade businesses	\$1,669,283
Electric Power Generation- Transmission	\$1,449,112
Securities- Commodity Contracts- Investments	\$1,435,740
Real Estate Establishments	\$1,371,088
Food Services and Drinking places	\$1,144,972
Offices of Physicians- Dentists- and Other Health Services	\$1,130,400
Private Hospitals	\$936,488
Monetary Authorities and Depository Credit Industries	\$836,496
Other State and Local Government Enterprises	\$808,376
Automotive Repair and Maintenance- Except Car	\$641,514
Extraction of Oil and Natural Gas	\$592,227
Insurance Agencies- Brokerages- and Related Agencies	\$569,294
All Other Chemical Product and Preparation	\$545,422
All Other Miscellaneous Professional- Scientific	\$497,016

hospitals. This is because dollars spent on inputs for the ASRF industry are again spent on inputs to those industries. As such, nearly every industry gains from the presence of the ASRF industry. The top 20 industries which are affected by the presence of the ASRF industry are listed in table 5, along with the economic activity generated in each industry that is derived from ASRF production.

As stated earlier in table 2, the direct effect of the ASRF industry is roughly 57 million annually. Other major industries, such as petroleum refineries, are affected through the indirect effect of the ASRF industry, or the dollars spent on inputs to ASRF production. The induced effect, or dollars spent from wages or proprietor income, is exhibited in industries such as offices of physicians and private hospitals.

#### *Conclusion*

This document summarizes several key pieces of information regarding the ASRF industry in the Western

United States, including annual sales information and cost structure. Using this information, we estimate that roughly \$110 million dollars of economic activity, along with 1682 full-time jobs, are generated annually from the presence of the ASRF industry in the Western United States.

These figures only account for the backwards linkages associated with ASRF spending on inputs and labor. Forward linkages, which account for the economic activity generated from the usage of ASRF products (for example by private or public fisheries and by recreational anglers), are not accounted for in input-output models. As such, the current estimate of economic activity and full-time jobs created as a result of the presence of the ASRF industry is likely to be an understatement of the total economic contribution of this industry.

Research that will be conducted throughout the remainder of 2010 will account for the money spent in private fisheries and in recreational angling in order to create a

more complete representation of the total economic contribution of the ASRF industry.

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