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THE TOTAL ECONOMIC CONTRIBUTION OF THE PRIVATE, RECREATION-BASED AQUACULTURE INDUSTRY IN THE WEST: A SUMMARY ¹

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I. Introduction and Problem Statement

The private, recreation-based aquaculture industry (often referred to as the aquacultural suppliers of recreational fish, or ASRF industry) provides fish for recreational outlets such as private fishing clubs and dude ranches, public reservoirs and streams, and private backyard ponds. Although most people know about the *public* stocking agencies such as the United States Fish and Wildlife Service and state-level wildlife agencies, not much information has been documented about the ASRF industry.

Recently, many organizations have taken action to *restrict* fish stocking in the Western United States ⁴ (Halverson, 2010). In California, for example, Pacific Rivers Council and the Center for Biological Diversity filed lawsuits against the California Department of Fish and Game, accusing the agency of harming native and endangered species with its fish stocking policy [ICF Jones and Stokes, 2010]. Pacific Rivers Council and the Center for Biological Diversity

won the lawsuits, and the resulting Environmental Impact Statement's (EIS) preferred alternative (new management plan) involves altering both public *and private* stocking regulations. The EIS did contain a short section with estimates of the economic impact of these regulations, but there was nearly no information about the *private* recreation-based aquaculture industry in that state. In fact, to date, no information about the economic scope or contribution of the ASRF in the Western United States has been documented.

In order to address this gap in the literature, between 2007 and 2010, researchers in the Department of Agricultural and Resource Economics at Colorado State University and at UC Davis collected data from ASRF producers, their direct customers (recreational fisheries), and recreational anglers in the Western United States. This data was compiled and, in conjunction with IMPLAN input-output software, was used to estimate the economic contribution of the ASRF industry in that region. The results of this exercise are presented in Deisenroth and Bond (2010), but are

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⁴ The Western Region, as defined by the Western Regional Aquaculture Center, is defined as those states west of the Colorado-Kansas border, excluding Hawaii. The region defined here is more restrictive in that it excludes Alaska, since no for-profit ASRF producers exist in that state.

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summarized here in order to increase exposure to the general public. However, where more detail is desired, please feel free to reference Deisenroth and Bond's final report at <http://dare.colostate.edu/tools/aquaculture.aspx>.

2. Data Collection and Scope of the ASRF Industry

Data was collected first from ASRF producers in the Western United States. Surveys were created to gather information about production, sales, and expenditures, as well as demographic characteristics of producers. Information from State-Level permitting agencies was used to ascertain that not more than 173 active producers in that region. Table 1 indicates the number of active producers by state, as well as the source of information for the study. Surveys were

mailed to all active producers, and 52 responded for a response rate of 30%.

In order to capture the full economic contribution of the ASRF industry, similar information was collected from both the industry's direct customers (privately-stocked recreational fisheries) and recreational anglers. This is because the economic activity of anglers (i.e. the purchase of gasoline required to access the fishery) can be directly linked to the presence of the private fishery, which is of course directly linked to the availability of privately produced fish. Surveys were distributed to an extensive list of private fisheries in Colorado (where industry advisors were able to help researchers identify these fisheries) and anglers in Colorado and California. Table 2 summarizes the survey distribution characteristics including number of individuals surveyed and response rates.

Table 1: Identified Producers By State

State	Active	Not in	Potential 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	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	

Table 2: Response Rates and Administration Dates by Survey

	Dates Adminis- tered	Surveyed Individuals	Excluded Individuals*	Response Respondents	Response Rate
ASRF Survey	1/08 - 12/09	418	245	52	30%
ASRF Customer Survey	11/09 - 1/10	686	94	260	44%
Angler Survey	6/09 - 11/09	1,852	11	1070	58%

* Excluded for reasons including not in business and undeliverable address.

3. ASRF Producer Characteristics

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 and 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 3 summarizes the demographic statistics of survey respondents.

4. Sales and Expenditure Information

The average ASRF producer sells \$330,000 of his product to private fisheries every year. The largest group of customers is private landowners who have a pond or stream on their property and stock fish for their own recreational use. However, by volume, it is most likely that the bulk of sales by volume went to dude ranches, fishing clubs, and homeowners' associations.⁵ Figure 1 summarizes the various types of ASRF customers in the Western United States.

Table 3: 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%

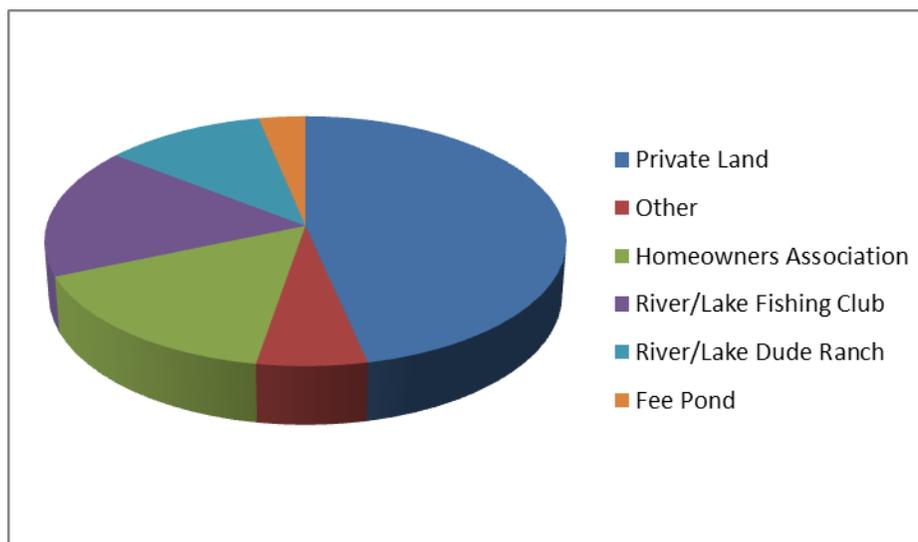


Figure 1. ASRF Customer Types

⁵ The producer survey did not ask producers about specific portions of sales to various private recreational outlets.

With the money generated from these sales, ASRF producers purchase many inputs for their aquaculture operation. The largest category of expenditures is non-depreciated inputs, which includes food (for fish), electricity, gasoline, etc. The next largest input is labor, with the average producer spending nearly \$93,000 annually on just over seven employees. Nearly \$75,000 goes to depreciated expenditures such as the payments and maintenance of buildings and facilities, and proprietors on average net just over \$45,000 annually (which, on average, is 50% of their annual income). Assuming 173 of these producers are currently in business, the entire ASRF industry sells \$57.2 million of their products every year, and \$53.2 million goes directly to recreational outlets (ASRF producers often purchase products from their own industry as inputs to production,

such as fish fry or fish-based fish food). Table 4 summarizes the production information of producers who responded to the survey.

Likely due to the difficulties associated with transporting live fish, most producers sell their products to in-state and in-region customers. Furthermore, most of the inputs to fish production are also purchased in-state. The next section describes the *multipliers* associated with various productive activities, or the amount of money generated within a particular region for every dollar of product sold. The high amount of in-region commerce associated with the ASRF industry's production helps to increase the multiplier associated with that industry. Figure 2 illustrates the percentage of sales and expenditures that occur within and outside of the Western Region.

Table 4: ASRF Annual Production Data

Category	Average Annual Amount
Total Non-Depreciated Expenditures ^a	\$117,977
Buildings, Fish Production Facilities, General and Transportation Equipment	\$74,966
Labor Expenditures	\$92,772
Proprietary Income	\$45,144
Sales	\$330,858
Employment	7.15
Total ASRF Producers	173
Aggregate Sales	\$57,238,415
Aggregate Employment	1,237

^a Including fish and eggs, feed, supplies, etc.



Figure 2. Location of purchases and sales.

5. Economic Contributions

5.1. Backward Linkages

As stated earlier, economic contributions are often reported in the form of *multipliers*. A multiplier of 1.85, for example, indicates that for every dollar of ASRF product sold to direct customers, an additional \$.85 cents is generated in the regional economy. In this case, the region of analysis is the Western United States. Focusing only on the economic activity of the ASRF *industry*, and ignoring the economic activity of both ASRF customers and recreational anglers, the multiplier associated with ASRF production in the Western United States is 1.85. The additional \$.85 cents generated comes from the money spent by ASRF producers on *inputs* to production, which is often referred to as the “backward linkages” of the ASRF industry.

Table 5 summarizes the backward linkages of the ASRF industry in the West. Notice that the “Direct Effect” is the dollar spent directly on ASRF products,

the “Indirect Effect” is the money generated by purchasing various inputs to production, and the “Induced Effect” is the money generated from spending of labor and proprietary income on various household items. Notice also that for every million dollars of ASRF product sold, nearly 30 full-time jobs are supported in the Western Region.

5.2. Forward vs. Backward Linkages

As mentioned in the introduction of this report, researchers collected data not only from ASRF producers, but also from their direct customers and from recreational anglers. The reason is that these sectors are indirectly supported by the ASRF industry, and their economic activity can be traced back to the ASRF industry’s presence. Figure 3 demonstrates the how failing to account for the “forward linkages” of ASRF production, or the money generated on the *usage* of a ASRF products, can lead to an underestimate of the economic contribution of that industry.

Table 5: ASRF Industry Backward-Linkage Multipliers

	Direct Effect	Indirect	Induced	Total Effect
ASRF Output	1.00	0.35	0.50	1.85
ASRF Employment ^a	21.61	4.21	3.72	29.54

^a Employment effects are reported per \$1,000,000 of gross sales.

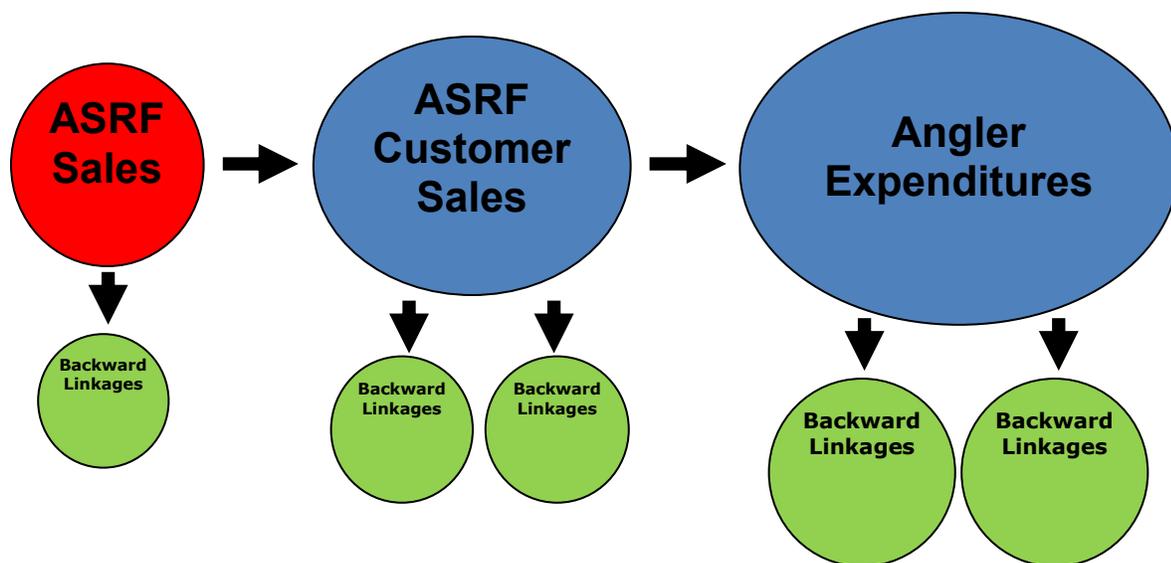


Figure 3. Forward and Backward Linkages of the ASRF Industry.

Table 6 summarizes only the backward linkages of both the ASRF customer sector and of recreational angler expenditures in the West. The numbers look very similar, and their interpretation is nearly identical, to the numbers in table 5. The angler numbers in table 6, however, should be interpreted as “for every dollar spent by recreational anglers on their fishing trip, an additional \$.83 cents is generated in the Western Region.”

6. The Total Economic Contribution of the ASRF Industry in The West

6.1. Contributions vs. Impacts

Many economic studies report the economic “impact” of a particular sector. Economic impacts of various industries reflect the amount of money that is *created* in a region because of the presence of that industry. An impact of, for example, \$1 million dollars for a particular industry in a particular region implies that if

that industry were to leave the region, 1 million dollars of output would also leave the region.

Contribution analysis, in contrast, merely traces the flows of expenditures that are associated with a particular industry. So if the economic contribution of a particular industry in a particular region is \$1 million dollars, little can be said about what would happen if that industry were to leave the region. However, much can be said about the scope of the industry and the amount of other sectors that are affected by that industry through backward and forward linkages. The present study estimates the economic *contribution* of the ASRF industry in the Western United States, and should not be interpreted as an economic *impact* study.

6.2. Total Economic Contributions

Figure 4 demonstrates that while anglers spend roughly \$150 dollars per day to visit private fisheries

Table 6: ASRF Customer Backward-Linkage Multipliers

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
ASRF Customer Output	1.00	0.61	0.17	1.79
ASRF Customer Employment	31.76	7.76	1.27	40.80
Angler Output	1.00	0.41	0.41	1.83
Angler Employment	18.36	3.64	3.07	25.07

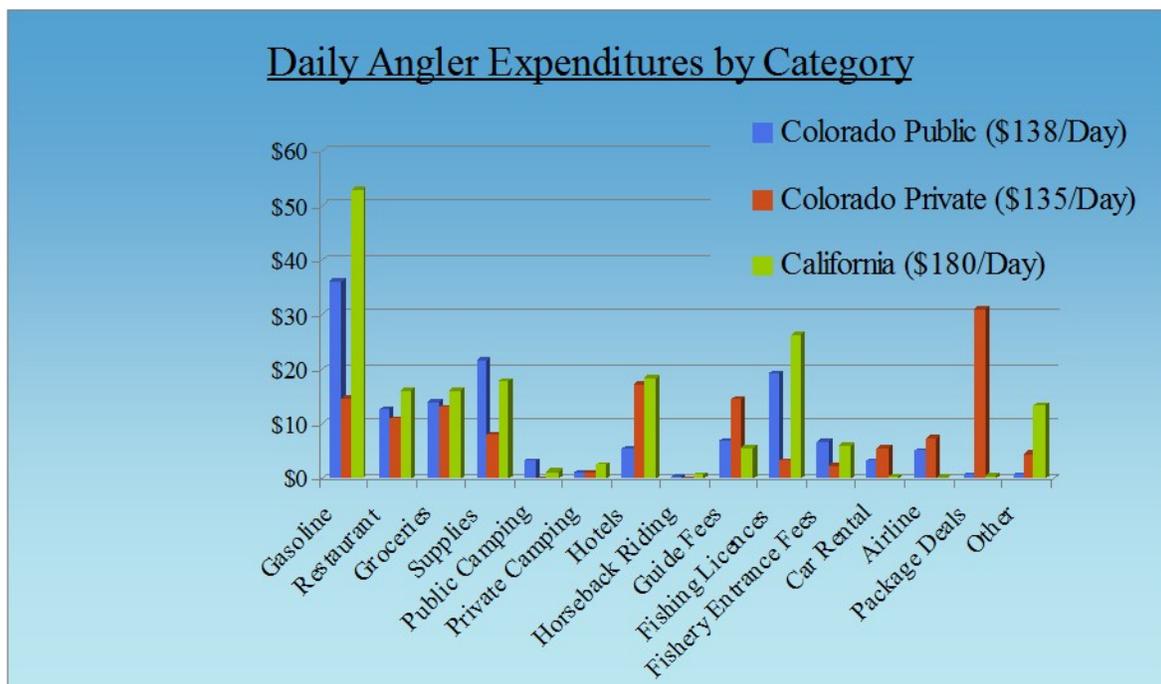


Figure 4. Angler Expenditures.

(and target privately-produced fish), most of their expenditures are on non-fishing related items such as gasoline and groceries. This is roughly equivalent to the “Backward Linkage” bubbles just below “Angler Expenditures” in figure 3. However, since these expenditures are made in order to access privately stocked fish, their presence can be traced back to the presence of the ASRF industry.

Using this logic, as well as survey information regarding total numbers of anglers and private fisheries, the total economic contribution of the ASRF industry in the Western United States can be inferred. The 173⁶ producers in the Western US sell roughly \$53.2 million of their product to direct customers (private fisheries). These private fisheries in turn sell the opportunity to catch these fish to anglers. The total sales of ASRF customers is estimated to be \$273 million every year in the West. Then, anglers who visit these fisheries and spend this \$273 million to target these fish also spend money on non-fishery-related items such as gasoline and groceries (figure 4). In total, due to the \$53.2 million of ASRF stocking, anglers spend roughly \$1.05 billion annually to target these fish.

Finally, as indicated in table 6, there are *backward linkages* associated with these angler expenditures. Some of these backward linkages include ASRF customers and producers, while others include money filtered through restaurants and convenience stores. In total, with the multiplier effect, the economic contribu-

tion of these angler expenditures is \$1.91 billion, all of which can be traced back to the ASRF industry’s production. This is also known as the *forward linkages* of ASRF production. Furthermore, this \$1.91 billion of economic activity supports over 26,000 full-time jobs annually (table 7).

7. Summary and Conclusion

To date, little has been documented about the ASRF industry in the Western United States. Given the current disposition of various interest groups to either reduce or eliminate fish stocking, information about this industry will be useful to inform policy creation and/or elimination. This study summarizes the scope, characteristics, and economic contribution of the ASRF industry in the Western region. Roughly 173 ASRF producers actively produce fish west of the Colorado-Kansas border, and their sales to direct customers amount to roughly \$53.2 million every year. Those private fisheries which purchase these ASRF products sell roughly \$273 million in services to recreational anglers, and anglers spend roughly 1.04 billion annually targeting fish in these fisheries. Accounting for multiplier effects, the angler-expenditure induced economic contribution of the ASRF industry in the Western United States is just over \$1.9 billion annually. In other words, for every \$1 dollar of ASRF products sold, nearly \$36 dollars is generated in the Western regional economy. Furthermore, for every \$1,000,000 of ASRF product sold, nearly 500 full-time jobs are supported.

Table 7: Output and Employment Contribution of ASRF Industry in the Western

	Direct Effect	Indirect Effect	Induced Effect	Total Effect
Total ASRF Sales	\$53.2 Million			
Total Output ^a	\$1.05 Billion	\$433.4 Million	\$433.6 Million	\$1.91 Billion
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

^a Derived from ASRF induced Angler Expenditures.

^b Dollars of economic activity per dollar of *ASRF producer* output.

^c Jobs per million dollars of *ASRF producer* output.

⁶ No more than 173 producers exist, but 173 producers are assumed to exist for this analysis.

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