CHAPTER 2

INDUSTRY PROFILE

Aquaculture is broadly defined as the farming or husbandry of fish, shellfish, and other aquatic animals and plants, usually in a controlled or selected environment (Becker and Buck, 1997). EPA is developing effluent limitations guidelines and standards for concentrated aquatic animal production facilities, that is, plant production facilities are not included. In this chapter, the term "aquaculture" has both the extended (aquatic animal and plant) and limited (aquatic animal only) meanings, depending on the context of the word.

An industry profile provides background information necessary to understand and characterize the industry being examined. When completed, it develops a baseline against which to evaluate the economic impacts to the industry as a result of compliance with any proposed requirements developed by the Agency. This chapter briefly describes the range in the entire U.S. aquatic animal production industry. The commercial sector, alone, produced nearly $1 billion in goods in 1998 (USDA, 2000a). The remainder of this document focuses on the subset of concentrated aquatic animal production facilities that EPA considers within the scope of the proposed effluent guideline.

The aquatic animal production industry is one marked by substantial public as well as private activity. This chapter begins with a general discussion of the government and private roles in aquaculture. The economic characteristics of the owner/operator of a production system vary greatly depending on whether it is a non-commercial or commercial venture. Hence, each of the subsequent sections—geographic distribution of facilities, the major species produced, economic value of production organizational structure, small entity definitions, market structure, and international trade—discusses public and private operations separately. Large supporting tables are located in Appendix A.

2.1 PUBLIC/PRIVATE ROLES IN AQUACULTURE

2.1.1 Federal

The National Aquaculture Act of 1980 provides for a national policy to encourage the domestic aquaculture industry and established the interagency Joint Subcommittee on Aquaculture (JSA). JSA is a statutory committee that reports to the National Science and Technology Council (NSTC) committee on science. NSTC, in turn, operates under the White House Office of Science and Technology Policy.[1]

The United States Department of Agriculture (USDA), the Commerce Department, and the Interior Department all have roles in the aquaculture industry. USDA focuses primarily on private aquaculture production, while the other two agencies concentrate more on public aquaculture production for recreational fishing and ecosystem restoration. JSA serves as a federal government-wide coordinating group among these and other agencies.

The Agriculture and Food Act of 1981 authorized USDA to establish regional aquaculture research centers (Title XIV, P.L. 97-98).[2] USDA also collects information (Economic Research Service, National Agricultural Statistics Service), provides assistance under farm lending programs and the Commodity Credit Corporation (CCC) credit guarantee programs, and promotes exports through the market access program.

Two branches within the Commerce Department's National Oceanic and Atmospheric Administration are concerned with aquaculture activities—the National Marine Fisheries Service (NMFS) and the National Sea Grant College Program. NMFS administers the Saltonstall-Kennedy grant program to fund research related to the harvesting, processing, and marketing of fisheries products. NMFS also supports four regional Fisheries Science Centers[3] to help restore depleted fish stocks and

---

[1]This description is based on Becker and Buck, 1997.

[2]University of Massachusetts, Mississippi State University, Michigan State University, the University of Washington, and the Oceanic Institute (Hawaii).

[3]Southeast (Galveston, TX), Northwest, Northeast, and Alaska.

establish sustainable fisheries. The National Sea Grant Program funds aquaculture research projects at universities.

The Interior Department's Fish and Wildlife Service (FWS) operates a system of fish hatcheries and conducts fish research. Among its roles and responsibilities, FWS operates six Fish Technology Centers[4] for developing fish culture techniques and recovering endangered species and nine Fish Health Centers for research. FWS also operates the 66-facility National Fish Hatchery System to conserve, restore, enhance, and manage the Nation's fishery resources and ecosystems for the benefit of future generations. Table A-1 lists the FWS facilities (FWS, 2000a-c).

2.1.2 State

Every state has an agency to administer state natural resources, including fisheries. Many states operate fish hatcheries for stocking recreational fisheries. FWS maintains a memoranda of understanding with state fisheries to manage resources on U.S. Forest Service lands within the state (Epifanio, 2000). FWS distributes some of its hatchery production to various states. Many states have agreements with other states and Tribal governments to enable interjurisdictional management of shared resources. Based on Epifanio (2000) and individual state websites, EPA identified 369 coldwater propagation facilities nationwide and 53 warmwater hatcheries in 15 states (see Table A-2). EPA identified a total of 53 warmwater facilities in 15 states. An additional 78 facilities in 12 states could not be classified as coldwater or warmwater because they did not report which species are being raised. The number of warmwater state hatcheries, then, ranges from 53 to 131.

2.1.3 Tribal and Others

Tribal hatcheries support Indian communities' needs and desires for a healthy and abundant fishery for subsistence and cultural heritage. These hatcheries may be funded by the Bureau of Indian

[4]Abernathy, WA; Bozeman, MT; Dexter and Mora, NM; Lamar, PA; San Marcos, TX; and Warm Springs, GA (including the Bear's Bluff, SC field station).

Affairs or the tribal entity (WDNR, 2000). Table 2-1 lists the 17 tribal programs EPA has identified to date. The academic community is very active in aquaculture, with more than 80 institutions that have programs in fisheries, fishing, or fish and game management nationwide (see Table A-3). USDA funds regional aquaculture research centers, while NOAA administers its Sea Grant program to multiple institutions.

2.1.4 Private Aquaculture

Aquaculture's growing economic importance is marked by the 1998 *Census of Aquaculture* (USDA, 2000a). The USDA National Agricultural Statistics Service (NASS) determined that there was a need for a comprehensive snapshot of all aquatic species produced throughout the 50 states and U.S. Territories. The respondent universe for the Census is all farms identified as having sales of $1,000 or more from aquaculture products (USDA, 1998a).[5] As such, the production and revenues from aquatic animals represent a range from some to all of the commercial activities at the facility. The absence of total facility revenues affects the estimates of the number of small businesses in the industry, as discussed in Section 2.7 below.

The 1998 Census forms the basis for the description of commercial activities in this chapter. USDA identified 4,028 facilities that raise aquaculture products, including 20 that raise aquatic vegetables. USDA provided a breakout of facilities by species (e.g., catfish) or groups of related species (e.g., mollusks). Because a facility can raise more than one species, the sum of these individual listings totals about 4,800 operations.

[5]Form OMB 83-1 (Paperwork Reduction Act Submission) box 11 for the 1998 Census identifies the affected public as "farms;" the categories for not-for-profit, federal government, and state, local, or tribal governments are not marked. However, when contacted, USDA mentioned that the survey included commercial and non-commercial facilities but, for the most part, the sales tables do not include noncommercial data (Lang, 2000).

Table 2-1

Tribal Hatcheries

Tribal Program	State(s)	Annual Distributions
Bad River	WI	8,000-10,000 walleye fingerlings 10-14 million walleye fry
Keweenaw Bay	MI	100,000 lake trout yearlings 25,000 brook trout yearlings
Lac Courte Orielles	WI	7 million walleye eggs 140,000 walleye
Lac du Flambeau	WI	~14 million walleye fry 160,000 walleye fingerlings also muskellunge, bass, and trout
Lac Vieux Desert	MI	1.3 million walleye eggs
Leech Lake	MN	8 - 10 million walleye fry 50,000 walleye fingerlings 400,000 lake whitefish fingerlings 20 million white sucker eggs
Menominee	WI	walleye rearing station 400,000 fingerling capacity
Nunns Creek	MI	2-3 million walleye eggs 800,000 walleye fingerlings
Red Cliff	WI	trout and walleye rearing station
Red Lake	MI	capacity for 75 million walleye eggs; walleye and northern pike
Sokaogon	WI	1993 production (under reconstruction) 3 million walleye eggs 2 million walleye fry
St. Croix	WI	walleye
White Earth	MI	200,000 walleye fingerlings
Nez Pierce	ID	
Cherokee	OK	
Navajo Nation	AZ, NM, UT	
Fort Hall Shoshone-Bannock	ID	

Sources: FWS, 2000c; FWS, 2000d.

2.1.5 Aquariums

EPA initially considered aquariums as part of the aquatic animal production industry. Through an Internet search, EPA identified approximately 50 aquariums in the United States (seeTable A-4). Aquariums are part of North American Industry Classification System (NAICS) code 712130. There is no further breakdown of this code. Included in this code are: Animal exhibits, live; Animal safari parks; Aquariums; Arboreta; Aviaries; Botanical gardens; Conservatories, botanical; Gardens, zoological or botanical; Petting zoos; Reptile exhibits, live; Wild animal parks; Zoological gardens; and Zoos. Census data identify 269 non-taxable and 117 taxable establishments in this NAICS code (Census, 2001a and b). The upper bound count for aquariums, then, is 386 establishments.

2.1.6 Observations

Table 2-2 summarizes the estimated facility counts for each of the groups described above. There are between 4,600 to 6,000 facilities within the Agency's definition of the industry.

Table 2-2

Aquatic Animal Production Industry: Estimated Number of Facilities

General Category	Estimated Number of Facilities	
	Lower	Upper
Federal Hatcheries/Centers	90	90
State Hatcheries	422	500
Tribal	17	17
Academic/research	80	80
Private/commercial	4,028	4,800
Aquariums	50	386
Total	4,687	5,873

Source: EPA estimates based on information presented in Section 2.1.

2.2 GEOGRAPHIC DISTRIBUTION

2.2.1 Public

FWS operates 66 hatcheries, nine fish health centers, and six fish technology centers in 37 states[6] while USDA funds five regional aquaculture research centers located in Hawaii, Massachusetts, Michigan, Mississippi, and Washington.

A survey of state coldwater fisheries (Epifanio, 2000) found that all but three states—Florida, Mississippi, and Louisiana—actively manage coldwater species.[7] The survey results report 369 coldwater propagation facilities nationwide, with the state of Washington having the largest number (90).

EPA compiled a partial list of state warmwater hatcheries (see Table A-4). EPA identified a total of 53 warmwater facilities in 15 states. An additional 78 facilities in 12 states could not be classified because they did not report which species are being raised (i.e., they may include trout and salmon facilities).

The information provided in Table A-3 indicates that there is at least one academic institution with some type of fisheries-related program in 46 states, potentially operating an aquaculture facility.[8]

In sum, EPA believes that every state has at least one public aquaculture facility.

---

[6]States without FWS facilities are: Alabama, Alaska, Connecticut, Delaware, Hawaii, Illinois, Iowa, Kansas, Maryland, Minnesota, Nebraska, Ohio, and Rhode Island.

[7]Indiana did not respond to the survey, hence it does not appear in any of these discussions or tables.

[8]Connecticut, Nevada, Oklahoma, and Utah are the exceptions.

2.2.2 Private

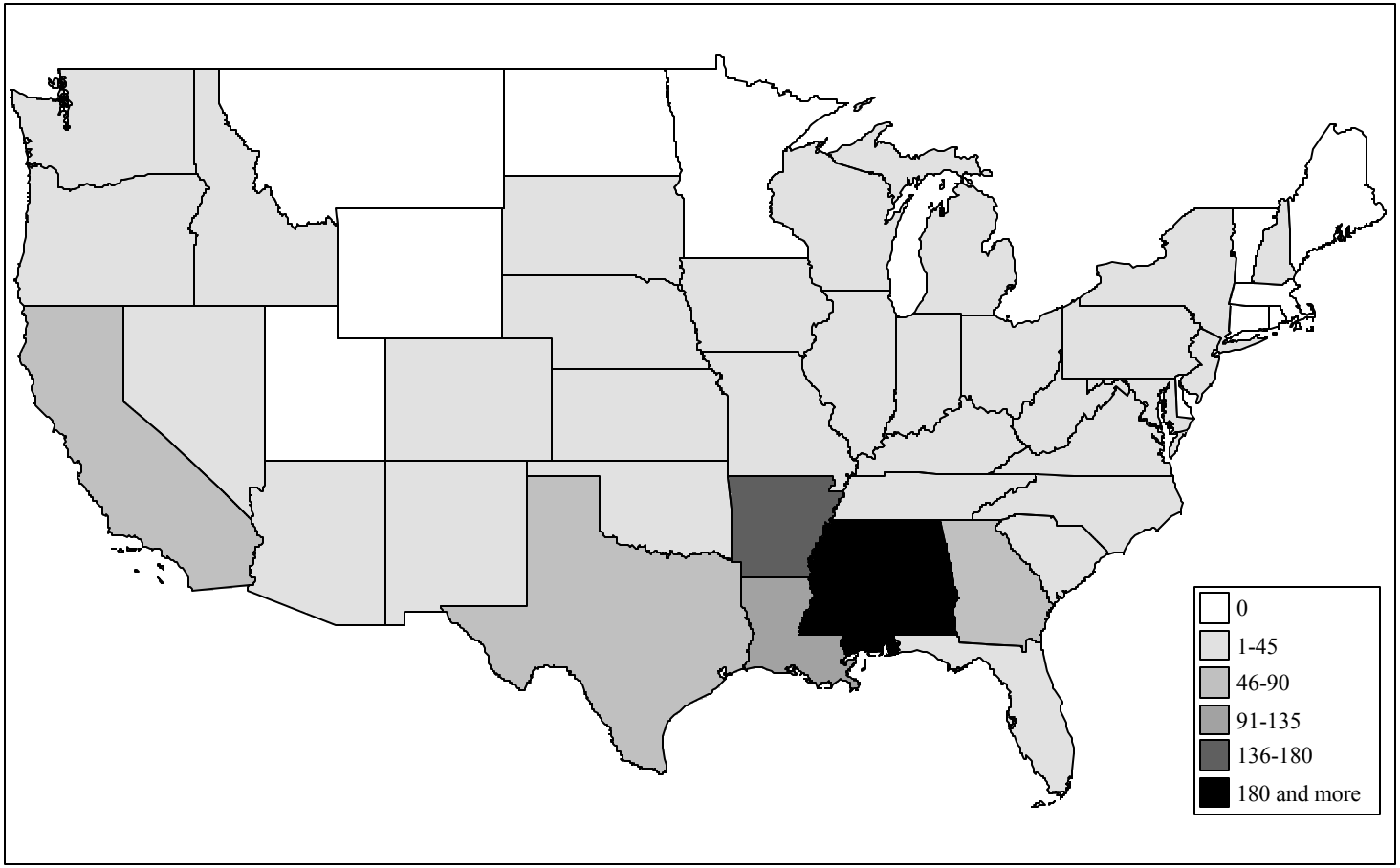
The 1998 *Census of Aquaculture* identified a total of 4,028 private facilities with aquaculture production. Figures 2-1 through 2-5 identify the number of production facilities by state for different species breakdowns. Figure 2-1 illustrates the 1,370 catfish producing facilities (which account for over 30 percent of the total aquaculture facilities) by state. Note that the heaviest concentrations are in Alabama and Mississippi (with a combined total of 654 facilities), with Arkansas and Louisiana having the next heaviest concentration with 156 and 100 facilities respectively. Another 561 facilities raise trout (see Figure 2-2), with North Carolina having the heaviest concentration of facilities (70). Figure 2-3 identifies the 435 facilities that produce food fish (other than catfish or trout); Maryland and Wisconsin have a combined total of 65 facilities. Louisiana dominates crustacean production with nearly 500 crawfish facilities (out of a nationwide total of 837 crustacean facilities), Virginia has 206 of 218 softshell crabs facilities and 33 mollusk facilities, while Florida accounts for 221 of the total 535 mollusk producing facilities (see Figure 2-4). Figure 2-5 illustrates the geographic distribution of other aquatic animal production facilities.[9] A facility that produces more than one type of aquatic animal product is listed under each of the species produced; hence, summing the total facilities by individual species exceeds the 4,028 facility total for the industry. Table 2-3 summarizes the geographic distribution of aquaculture facilities in tabular form. The importance of aquaculture to the southern states is evident; this region is home to two-thirds of the aquaculture facilities in the nation. However, every state has at least one aquatic animal production facility, with several states having marked concentrations, depending on the species.

As shown in Table 2-4, nearly 30 percent of the facilities in the 1998 Census report provide fish and/or eggs for restoration or conservation purposes. Salmon is the largest category with 288 million pounds provided (USDA, 2000a).

[9]Including baitfish, ornamental fish (171 facilities in FL), sport or game fish, turtles (51 of 56 facilities in LA), alligators, and frogs.

Figure 2-1

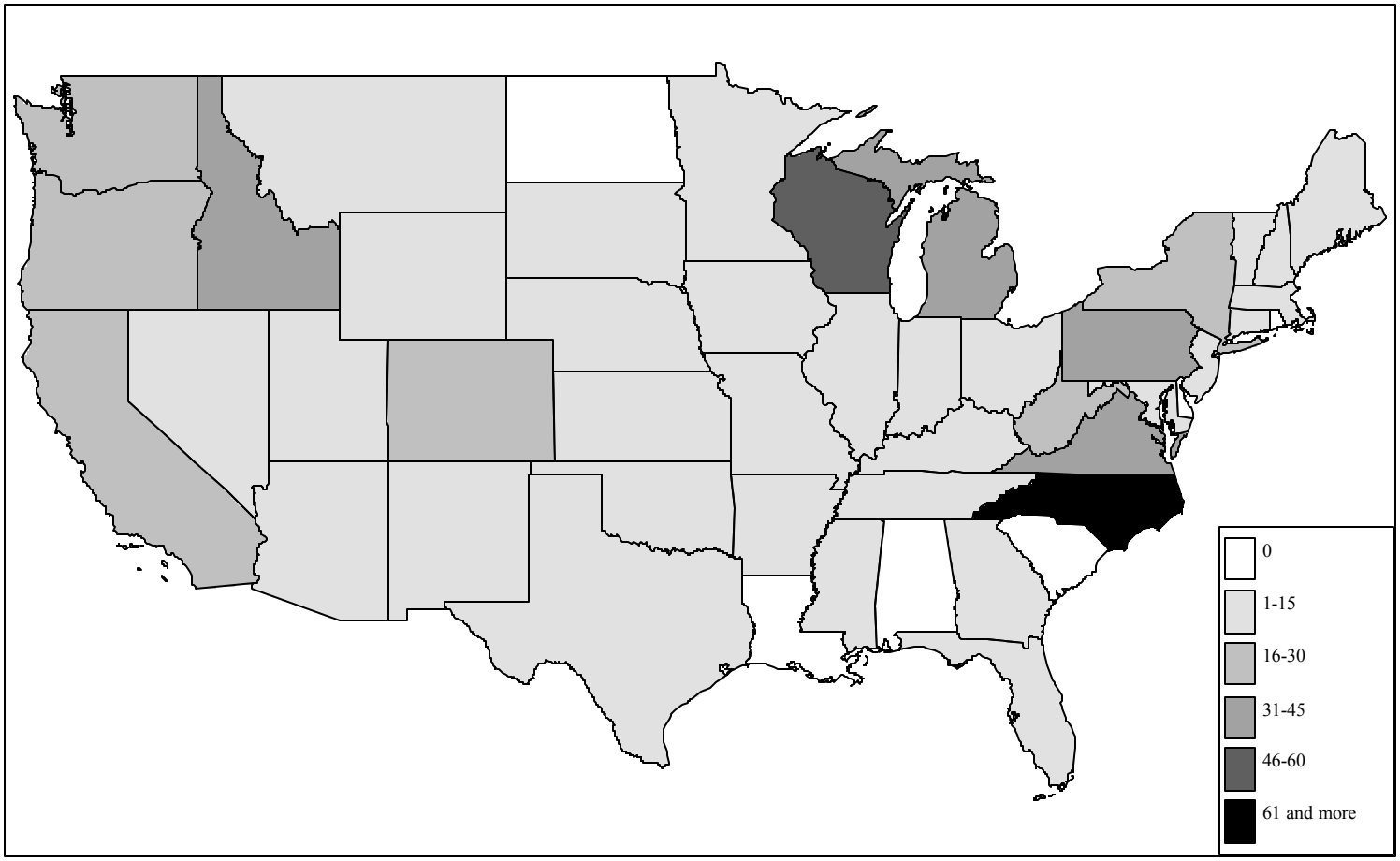
Number of Catfish Producing Facilities By State



Source: USDA, 2000a.

Figure 2-2

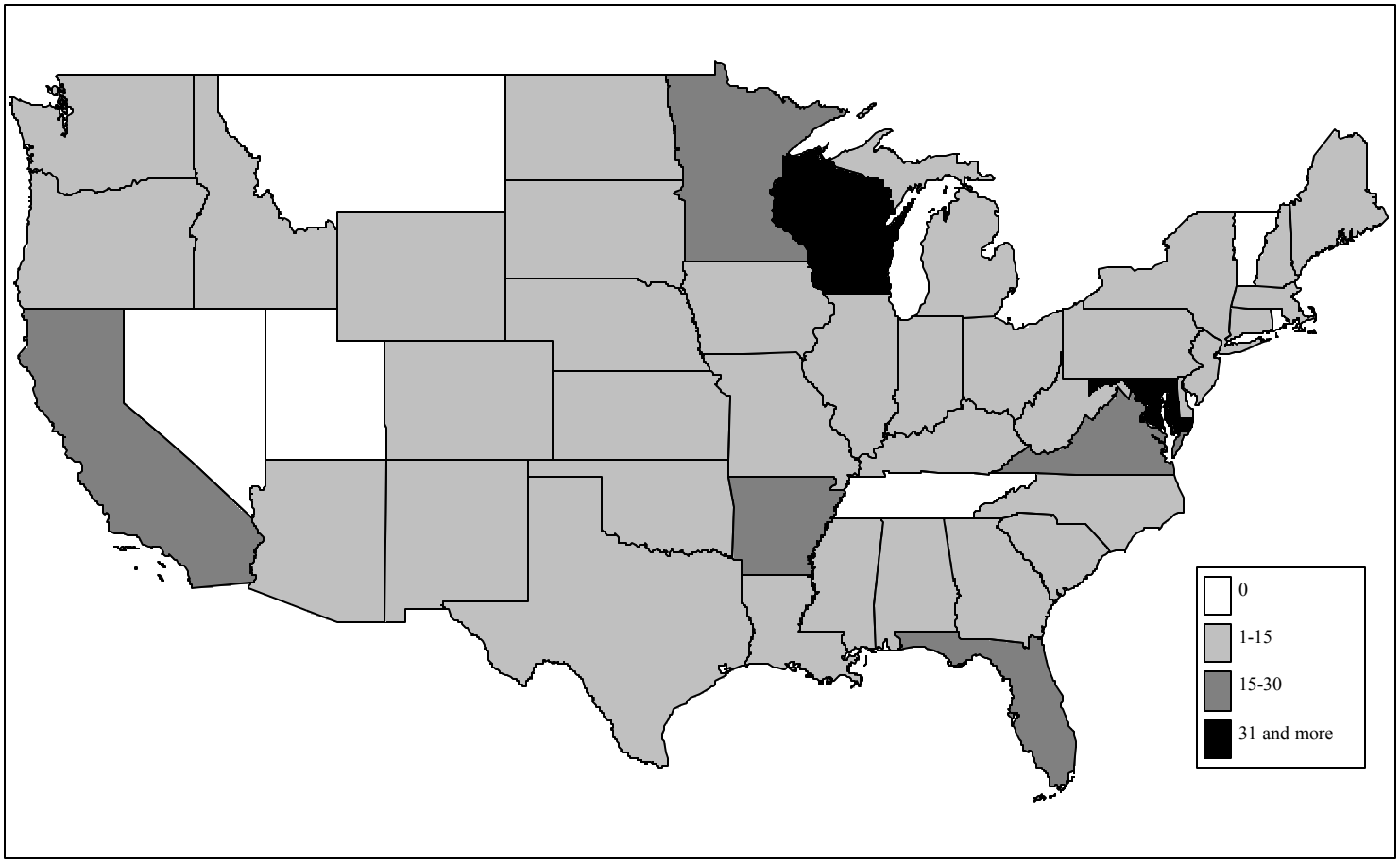
Number of Trout Producing Facilities By State



Source: USDA, 2000a.

Figure 2-3

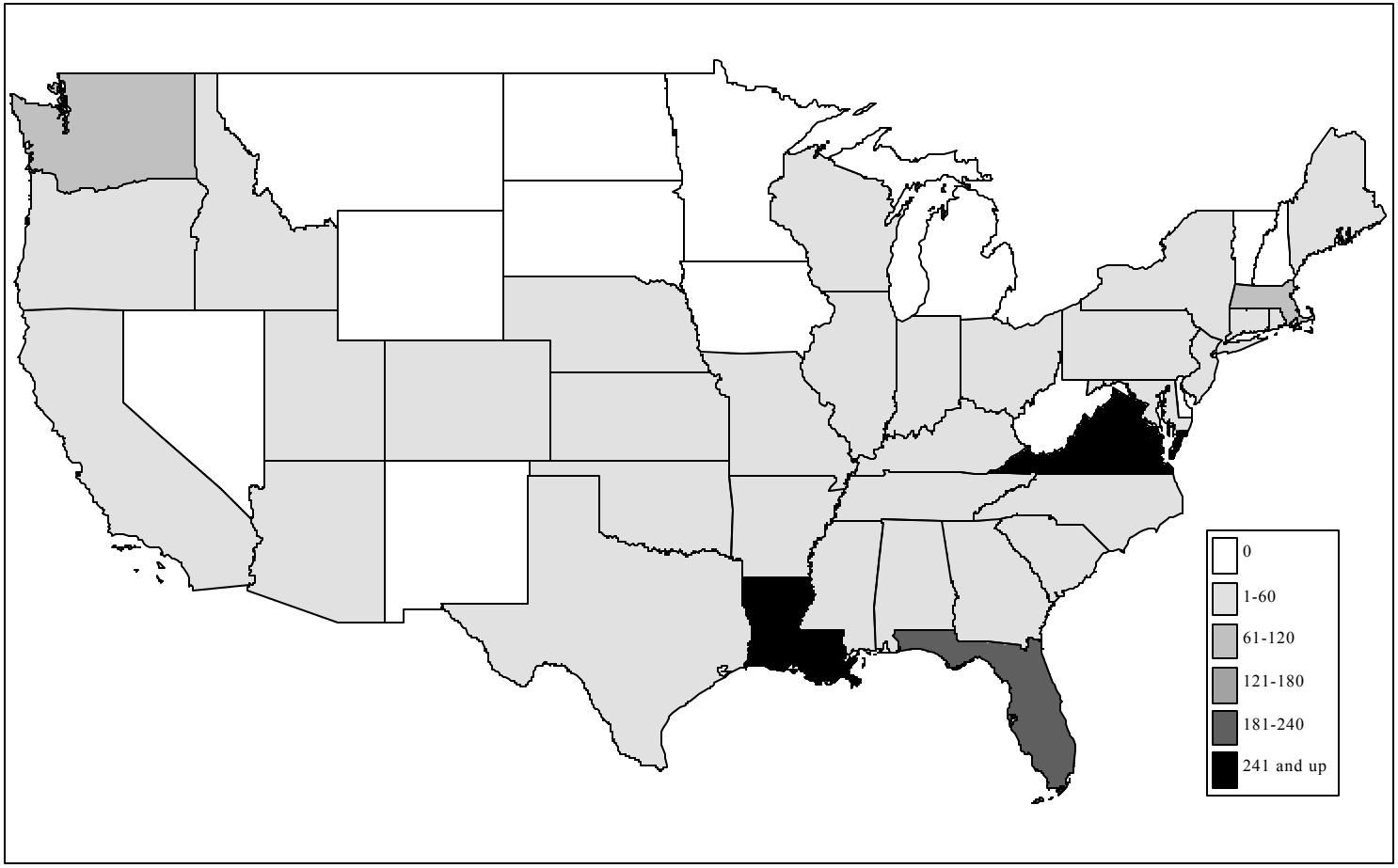
Number of Food Fish Producing Facilities By State



Source: USDA, 2001a.

Figure 2-4

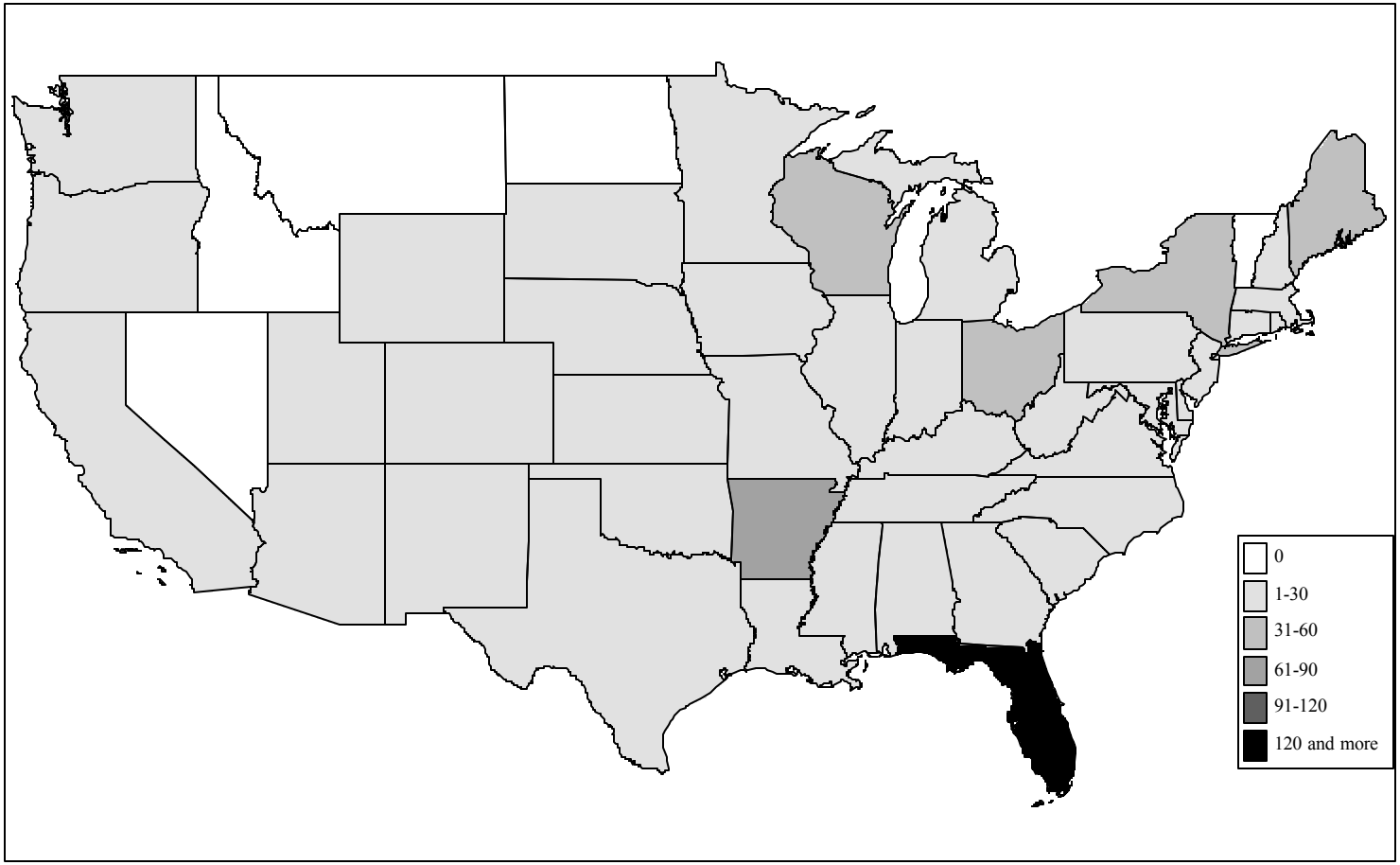
Number of Mollusk and Crustacean Producing Facilities By State



Source: USDA, 2000a.

Figure 2-5

Number of Other Aquatic Animal Producing Facilities By State



Source: USDA, 2001a.

Table 2-3

1998 Aquatic Animal Commercial Facilities

	Total Number of Aquatic Animal Producing Facilities	Number of Trout Producing Facilities	Number of Catfish Producing Facilities	Number of Food Fish Producing Facilities*	Number of Crustacean Mollusk Producing Facilities	Number of All Other Aquatic Animal Producing Facilities
United States	4106	561	1370	435	1372	803
Northeastern Region	465	132	24	81	172	137
Connecticut	24	6	0	1	15	3
Delaware	3	0	0	5	0	3
Maine	56	9	0	12	16	31
Maryland	40	4	7	31	9	20
Massachusetts	115	8	0	2	97	10
New Hampshire	9	5	1	1	0	3
New Jersey	33	2	2	5	18	11
New York	79	30	4	11	12	33
Pennsylvania	65	38	5	6	3	19
Rhode Island	3	0	0	0	2	1
Vermont	7	7	0	0	0	0
West Virginia	31	23	5	7	0	3
Southern Region	2719	136	1152	132	1035	396
Alabama	271	0	250	14	6	15
Arkansas	238	1	156	20	1	80
Florida	429	1	21	19	227	180
Georgia	90	11	55	6	1	23
Kentucky	34	3	20	2	5	6
Louisiana	604	0	100	7	498	6
Mississippi	418	1	404	15	3	10
North Carolina	145	70	36	13	20	19
Oklahoma	27	1	13	2	2	11
South Carolina	25	0	13	5	11	1
Tennessee	45	12	25	0	1	7
Texas	95	1	51	13	17	26
Virginia	298	35	8	16	243	12
North Central Region	488	137	112	116	22	217
Illinois	32	3	15	3	1	13
Indiana	35	3	9	11	5	18

Table 2-3 (cont.)

	Total Number of Aquatic Animal Producing Facilities	Number of Trout Producing Facilities	Number of Catfish Producing Facilities	Number of Food Fish Producing Facilities*	Number of Crustacean Mollusk Producing Facilities	Number of All Other Aquatic Animal Producing Facilities
Iowa	17	2	5	4	0	10
Kansas	36	2	14	8	5	15
Michigan	64	34	12	7	0	18
Minnesota	32	5	0	17	0	27
Missouri	67	10	35	4	3	19
Nebraska	27	10	4	5	2	11
North Dakota	0	0	0	4	0	0
Ohio	60	8	10	15	5	37
South Dakota	8	5	1	4	0	2
Wisconsin	110	55	7	34	1	47
Western Region	371	156	66	54	96	53
Arizona	12	4	5	6	1	2
California	121	22	51	20	18	30
Colorado	37	27	3	6	1	6
Idaho	36	33	2	6	1	0
Montana	10	10	0	0	0	0
Nevada	2	1	1	0	0	0
New Mexico	4	1	1	3	0	2
Oregon	38	21	2	3	10	5
Utah	18	15	0	0	1	2
Washington	84	16	1	9	64	3
Wyoming	9	6	0	1	0	3
Alaska	20	0	0	19	20	0
Hawaii	43	0	16	33	27	0

*Food fish category excludes trout and catfish.
Grand total exceeds 4,028 facilities because a facility may produce in more than one category.
Source: USDA, 2000a.

Table 2-4

1998 Private Aquatic Animal Facilities Providing Stock or Eggs for Restoration or Conservation Purposes

	Total Number of Aquatic Animal Producing Facilities	Number of Trout Producing Facilities	Number of Catfish Producing Facilities	Number of Food Fish Producing Facilities*	Number of Crustacean Mollusk Producing Facilities	Number of All Other Aquatic Animal Producing Facilities
United States	1176	362	113	470	75	156
Northeastern Region	196	70	6	57	44	19
Connecticut	15	4	0	3	8	0
Delaware	1	0	0	1	0	0
Maine	19	10	0	6	2	1
Maryland	15	3	2	3	3	4
Massachusetts	38	6	1	2	28	1
New Hampshire	11	6	0	4	0	1
New Jersey	8	1	1	1	2	3
New York	28	10	0	15	0	3
Pennsylvania	32	14	1	11	1	5
Rhode Island	5	3	0	2	0	0
Vermont	10	4	0	6	0	0
West Virginia	14	9	1	3	0	1
Southern Region	211	32	48	66	23	42
Alabama	9	0	3	3	0	3
Arkansas	23	5	6	7	0	5
Florida	8	0	2	3	0	3
Georgia	25	4	7	8	0	6
Kentucky	9	1	1	3	0	4
Louisiana	23	0	2	3	16	2
Mississippi	3	0	2	0	0	1
North Carolina	9	4	1	3	0	1
Oklahoma	19	1	6	7	0	5
South Carolina	0	0	0	0	0	0
Tennessee	49	11	10	18	0	10
Texas	13	1	5	4	1	2
Virginia	24	5	3	7	6	3
North Central Region	367	81	52	159	2	73
Illinois	5	0	1	1	1	2
Indiana	33	7	7	13	0	6

Table 2-4 (cont.)

	Total Number of Aquatic Animal Producing Facilities	Number of Trout Producing Facilities	Number of Catfish Producing Facilities	Number of Food Fish Producing Facilities*	Number of Crustacean Mollusk Producing Facilities	Number of All Other Aquatic Animal Producing Facilities
Iowa	16	3	1	7	0	5
Kansas	7	0	4	2	0	1
Michigan	10	7	1	0	0	2
Minnesota	170	28	27	85	1	29
Missouri	24	5	5	8	0	6
Nebraska	4	0	1	0	0	3
North Dakota	10	2	0	5	0	3
Ohio	30	7	5	11	0	7
South Dakota	12	4	0	6	0	2
Wisconsin	46	18	0	21	0	7
Western Region	371	179	7	160	6	19
Arizona	0	0	0	0	0	0
California	35	18	0	15	0	2
Colorado	31	18	2	9	0	2
Idaho	56	29	1	24	0	2
Montana	23	11	1	7	0	4
Nevada	11	6	1	3	0	1
New Mexico	11	7	0	3	0	1
Oregon	61	31	0	29	0	1
Utah	15	12	0	1	0	2
Washington	115	36	2	67	6	4
Wyoming	13	11	0	2	0	0
Alaska	28	0	0	28	0	0

*Food fish category excludes trout and catfish.
Source: USDA, 2000a.

2.3 MAJOR SPECIES PRODUCED

2.3.1 Public

The U.S. Fish and Wildlife Service provided their 1999 fish and fish egg distribution data (FWS, 2000d). In 1999, the National Fish Hatchery system made over 5,500 distributions of over 50 species to federal, Tribal, state, and local governments; universities; and private entities. Tables A-5 and A-6 summarize the egg and fish distribution respectively. Egg distributions totaled 146 million, most of which were walleye (36 percent) and rainbow trout (26 percent). These eggs were distributed to the following programs:

- Federal—59.4 million (41 percent)
- State and Local—81.7 million (56 percent)
- Tribal—4.8 million (3 percent)
- Universities—0.5 million (less than one percent)

A minuscule amount (less than 0.02 percent) was distributed to private entities. (Percentages do not sum to 100 because of rounding.)

Fish distributions from National Fish Hatcheries totaled 5.5 million pounds, most of which were rainbow trout (40 percent) and steelhead trout (15 percent). These fish were distributed to the following programs:

- Federal—4.2 million (77 percent)
- State and Local—0.7 million (13 percent)
- Tribal—0.5 million (9 percent)

A small amount (less than 0.2 percent) were distributed to private entities, and universities received about 0.03 percent.

Epifanio (2000) lists the 1996 production of trout and salmon from state hatcheries at 23.7 million pounds (see Table 2-5). Most of the state hatcheries for fish other than trout or salmon report releases in terms of the number of fish, not necessarily by weight. Assuming roughly a sixth of a pound per stocked fish,[10] the information in Table A-2 indicates that approximately another 3.8 to 79 million pounds of warmwater fish may be produced at state hatcheries.

Tribal production is at least 1.3 million fish (see Table 2-1). This may be relatively small in relation to nationwide public or private aquaculture, but extremely important in terms of cultural and religious significance and issues related to fishing rights.

EPA identified no estimates for aquaculture production at academic and research institutions. EPA intends to request this information as part of its detailed questionnaire for the aquatic animal production industry.

2.3.2 Private

Figures 2-6 and 2-7 illustrate the distribution of private aquatic animal production by weight and sales, respectively. Catfish accounts for 68 percent of the total pounds sold and 48 percent of the total value produced. Trout accounts for nearly nine percent of the total pounds sold and eight percent of the total value. The relatively high value per pound for mollusks and crustaceans is evident; they account for only five percent of the total pounds produced but account for 13 percent of the total value. Ornamental fish are included in the "all other aquatic animals" category. The specialized crop is less than one percent of production but accounts for 12 percent of the total value.

Aquaculture production has shown a marked increase over the 1985-1997 time period (JSA, 2002). Figure 2-8 and Table 2-6 track the production increase in terms of weight. Catfish is the primary commodity, with production more than doubling from 207 million pounds in 1985 to 600 million pounds in 1999. Clam production increased from 1.6 million pounds to 10.7 million pounds in 1999. Salmon

[10]Epifanio (2000) reports 136,774,388 trout stocked with an associated biomass of 23,676,004 pounds or, roughly, six trout to a pound.

Table 2-5

Inland Trout Produced and Stocked by Number and Biomass

State	Total Trout Stocked (no.)	Total Trout Biomass (lbs)	Catchables Stocked (no.)	Catchables Biomass (lbs)
Alabama	27,738	11,524	27,738	11,524
Alaska	1,966,646	68,103	245,014	52,952
Arizona	2,970,000	446,220	1,200,000	428,500
Arkansas	2,600,000	788,000	2,100,000	636,000
California	15,357,977	3,895,234	7,041,978	3,722,575
Colorado	13,098,073	1,603,085	3,609,934	1,432,394
Connecticut	857,317	334,000	669,000	321,000
Delaware	30,900	16,200	39,900	16,200
Georgia	1,438,742	472,297	1,278,792	465,810
Hawaii	20,000	NA	10,000	NA
Idaho	11,575,197	1,244,872	2,492,177	908,733
Illinois	342,100	80,000	121,800	60,500
Indiana	55,015	24,394	55,015	24,393
Iowa	438,598	208,853	370,848	207,178
Kansas	94,203	NA	94,203	NA
Kentucky	753,950	251,317	718,800	239,600
Maine	1,203,974	243,107	639,136	186,423
Maryland	600,000	250,000	500,000	200,000
Massachusetts	664,525	505,502	664,525	505,502
Michigan	2,175,192	215,789	7,159	7,779
Minnesota	1,596,689	142,907	408,117	72,999
Missouri	1,754,500	1,209,600	1,754,500	1,209,600
Montana	8,780,317	311,193	145,116	48,179
Nebraska	472,586	115,521	313,607	112,000

Table 2-5 (cont.)

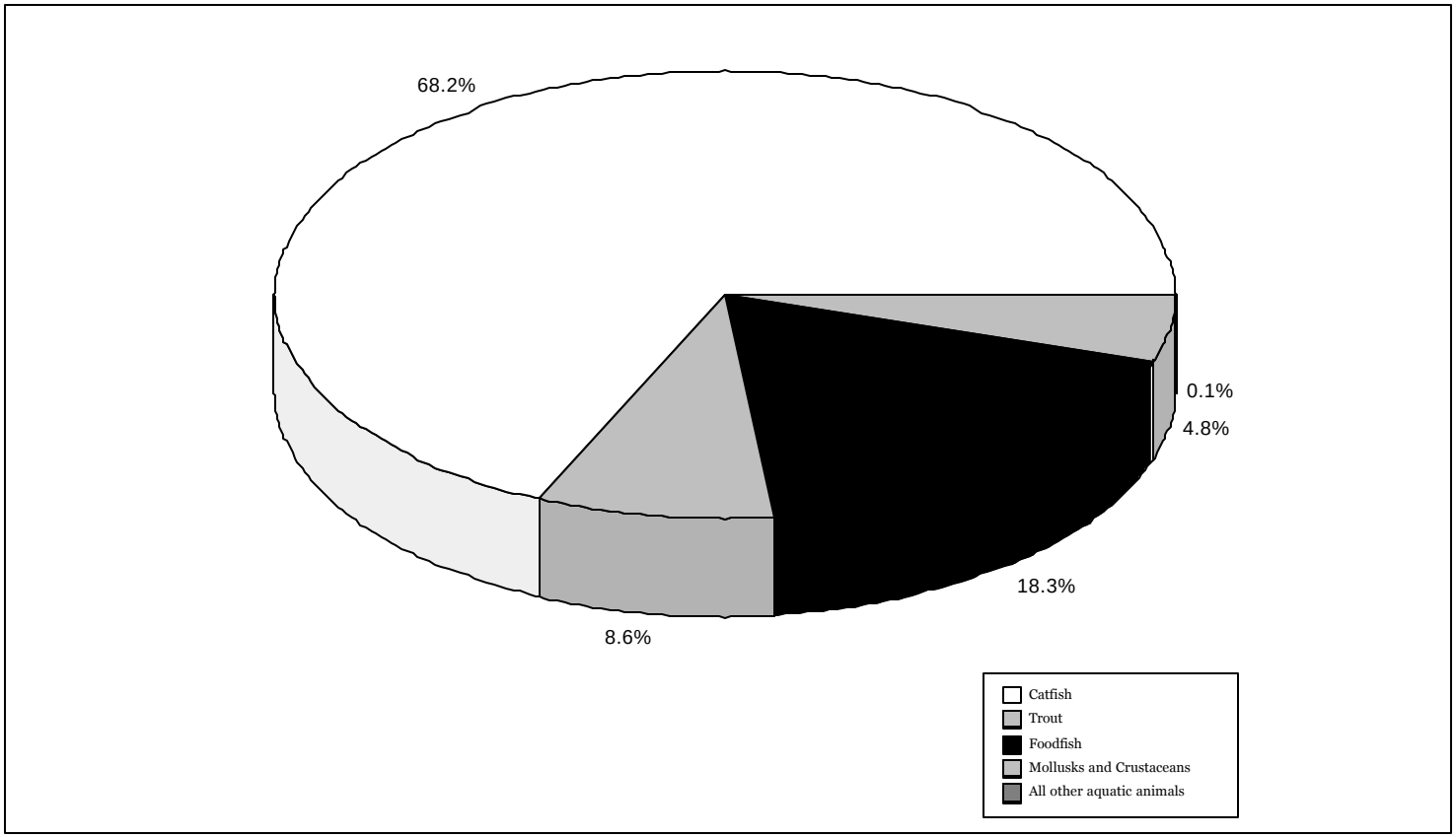
State	Total Trout Stocked (no.)	Total Trout Biomass (lbs)	Catchables Stocked (no.)	Catchables Biomass (lbs)
Nevada	1,971,841	487,784	1,613,000	474,194
New Hampshire	1,671,084	438,382	938,130	426,701
New Jersey	758,310	262,000	687,205	254,000
New York	5,332,865	889,127	3,535,007	?
North Carolina	698,826	286,426	612,747	285,351
North Dakota	372,667	68,202	75,431	41,031
Ohio	363,939	34,991	32,104	18,668
Oklahoma	483,936	NA	408,871	NA
Oregon	7,318,486	887,069	3,428,752	825,478
Pennsylvania	7,929,747	2,701,158	5,216,110	2,543,015
Rhode Island	188,400	155,880	137,400	154,100
South Carolina	418,288	132,518	273,248	91,028
South Dakota	650,000	128,700	174,600	88,440
Tennessee	1,917,498	516,324	1,129,431	486,004
Texas	348,093	70,036	209,862	69,954
Utah	10,137,544	941,788	1,865,721	712,948
Vermont	1,163,938	185,483	612,859	173,448
Virginia	1,541,151	731,766	1,267,054	686,170
Washington	15,770,000	1,169,200	3,517,000	939,900
West Virginia	1,505,667	748,942	1,186,311	743,045
Wisconsin	1,310,675	NA	666,800	NA
Wyoming	6,47,194	402,510	744,246	203,356
Totals	**136,774,388**	**23,676,004**	**52,850,248**	**20,086,672**

Note: Indiana did not reply to the survey. Data for New Mexico not included. Florida, Mississippi and Louisiana do not actively manage cold water species.

Source: Epifanio, 2000.

Figure 2-6

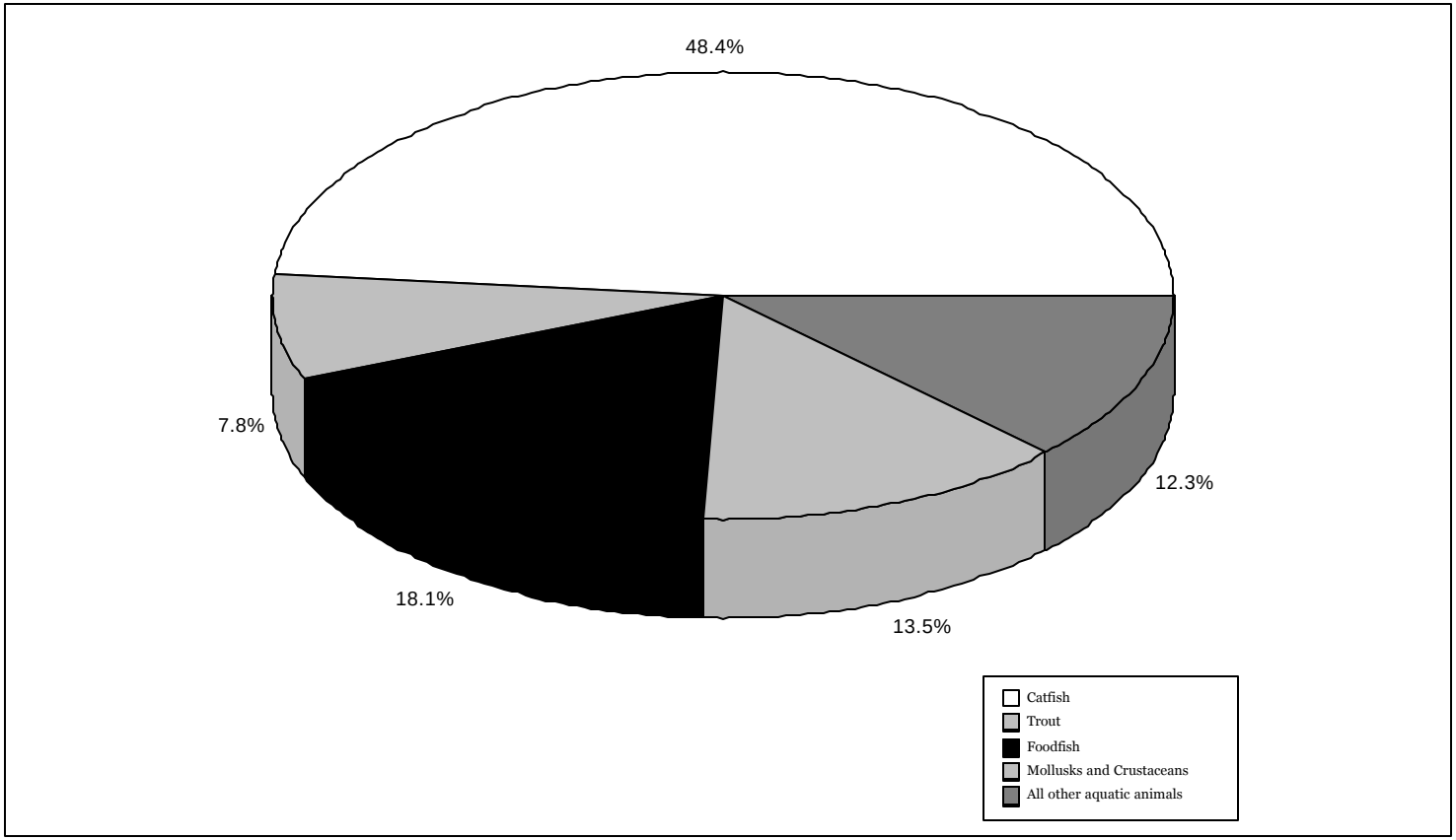
Aquatic Animal Production by Pounds Sold: 1998



Source: USDA, 2000a.

Figure 2-7

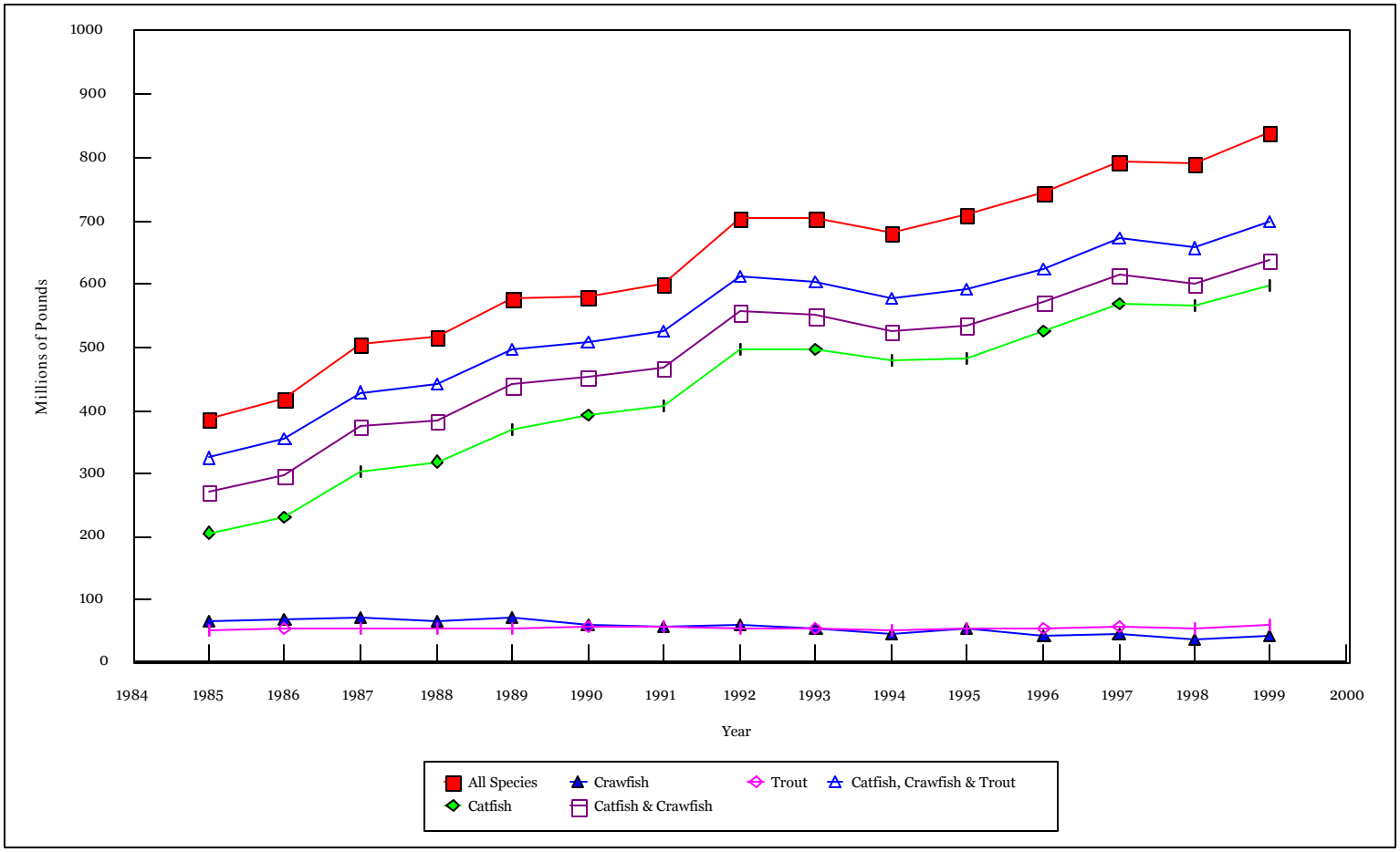
Aquatic Animal Production by Value Sold: 1998



Source: USDA, 2000a.

Figure 2-8

United States Private Aquatic Animal Production By Weight 1985-1999



Source: JSA, 2002.

Table 2-6

U.S. Private Aquaculture Production for 1985-1999
Growth in Time by Weight (1,000 lbs)

Species	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Non-food[1]	24,807	25,247	27,000	28,000	30,000	20,000	20,000	21,000	20,000	20,000	21,000	19,000	19,000	16,369	16,389
Catfish	206,945	230,856	302,936	318,718	369,252	392,429	409,358	497,275	495,758	479,379	481,503	526,276	569,579	564,355	596,628
Clams	1,600	2,500	3,500	4,000	4,200	6,100	6,300	6,600	6,100	7,500	7,800	9,000	8,100	9,735	10,683
Craw fish	65,300	68,400	71,600	67,000	72,400	61,100	57,700	60,000	54,600	46,700	55,400	44,400	46,900	37,945	42,889
Fresh water Prawns	267	178	150	250	250	250	250	250	250	250	250	250	250	----	----
Mussels	800	1,000	950	1,200	1,100	1,000	900	1,100	700	800	1,000	900	600	527	531
Oysters	20,700	21,100	23,100	17,900	18,300	16,500	15,500	17,600	18,600	17,900	19,300	17,700	15,400	18,157	18,662
Salmon[2]	-----	-----	-----	-----	-----	8,000	16,200	24,100	25,600	26,000	32,800	32,600	33,000	32,017	39,114
Shrimp	440	1,354	1,500	2,500	2,500	6,600	4,409	5,200	6,600	4,409	5,200	6,200	5,800	4,409	4,625
Trout	52,000	54,000	55,000	56,000	56,100	56,800	58,900	55,200	54,600	52,000	55,600	53,600	56,900	55,103	60,238
Other Species	14,000	15,500	20,000	22,000	22,000	10,000	12,000	16,000	22,000	27,000	31,000	35,000	37,000	51,071	23,667
Total	386,859	420,135	505,736	517,568	576,102	578,779	601,517	704,325	704,808	681,938	710,853	744,926	792,529	789,708	841,982

Data shown are live weight except for oysters, clams and mussels which are meat weight. Excluded are eggs, fingerlings, etc. which are intermediate products.

1. Baitfish and ornamental fish
2. Salmon estimates are for non-pen production only.

Source: JSA, 2002.

production is tracked only for the time period 1990 to 1999, but increased nearly fivefold from 8 million to 39 million pounds during that time. The only exception to this trend is crawfish production, which shows an overall decline during this period.

Figure 2-9 and Table 2-7 show the increase in production value over the same time period.[11] Catfish is still the primary commodity, with production value ranging from $160 million in 1985 to $439 million in 1999 (nearly 45 percent of the total value tracked in JSA, 2002). Salmon and trout are second and third in terms of production value, with $76.8 million and $65 million, respectively, in 1999. Combined, catfish, trout, and salmon accounted for 60 percent of the total value of aquatic animal production in 1999. The data for total value changes sharply between 1997 and 1998. This is driven primarily by the change in the value of the "Other species" category which jumped from $34 million in 1997 to $209 million in 1998. Although this might be the result of including data in 1998 and 1999 for new species not recorded in earlier years, the web site does not provide any information to this effect.

2.3.3 Observations

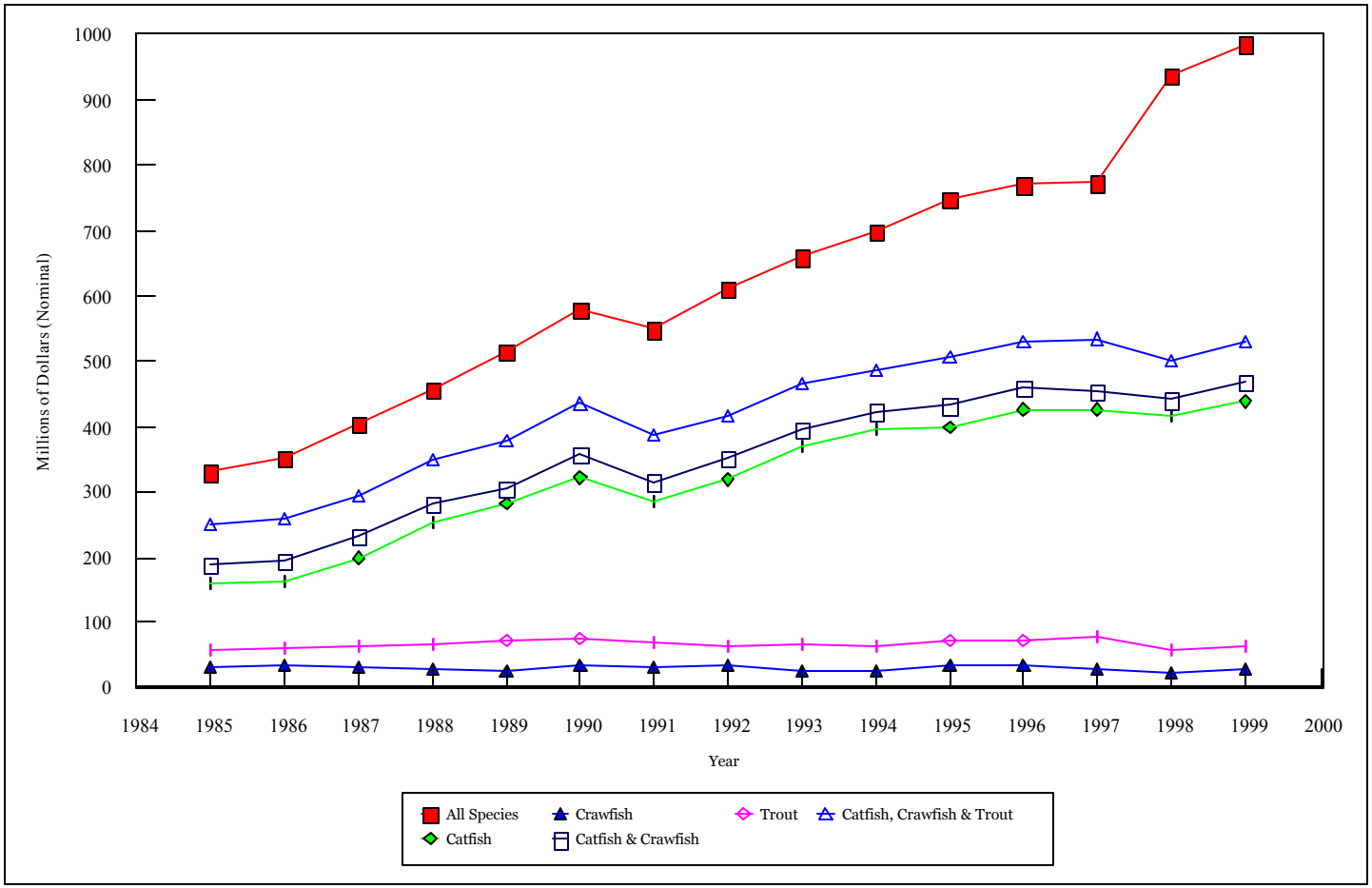
The relative sizes of the public and private aquatic animal production may be coarsely summarized as:

- Public: approximately 35 to 110 million pounds (broken down as follows)
  - Federal: 5.5 million pounds (1999)
  - State: ~28 to 103 million pounds (no date)
  - Tribal: 1.3 million pounds (no date)
  - Academic Institutions: unknown
- Private: approximately 842 million pounds (1999)

[11] Values are presented in nominal dollars.

Figure 2-9

United States Private Aquatic Animal Production by Value 1985-1999



Source: JSA, 2002.

Table 2-7

U.S. Private Aquaculture Production for 1985-1999
Growth in Time by Value ($1,000 Nominal)

Species	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Non-food[1]	25,000	26,000	27,500	32,000	34,500	38,000	40,000	44,000	46,000	52,000	59,000	58,000	56,000	57,392	57,392
Catfish	159,800	164,200	199,300	254,300	281,900	323,200	284,700	319,100	370,500	397,400	399,500	425,400	426,800	419,094	438,936
Clams	4,500	8,100	10,300	11,000	12,500	13,500	11,000	11,500	12,000	14,000	18,500	20,000	18,000	29,612	42,051
Craw fish	31,000	33,100	32,300	27,700	24,000	34,100	31,700	33,100	26,600	25,200	33,100	33,200	27,900	23,649	28,287
Fresh water Prawns	1,500	900	750	1,200	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	----	----
Mussels	400	1,000	1,000	,1200	1,150	1,150	1,100	1,500	1,400	1,950	2,500	3,100	1,200	2,801	799
Oysters	33,300	40,900	48,900	41,200	47,100	51,000	43,000	50,000	41,700	47,400	51,000	48,900	46,700	47,951	55,635
Salmon[2]	5,500	4,500	7,500	2,100	24,000	23,000	43,90	62,100	63,300	64,700	79,100	73,500	75,000	62,694	76,778
Shrimp	1,500	1,800	3,000	4,500	3,800	3,000	3,500	5,300	6,600	4,409	5,200	6,200	6,500	17,637	13,706
Trout	58,000	60,500	63,000	66,400	72,600	77,100	70,000	64,900	68,600	65,100	73,900	72,000	79,800	59,710	64,954
Other Species	9,800	10,000	12,000	14,000	13,500	15,000	19,000	20,000	22,000	25,000	28,000	30,000	34,000	218,103	208,562
Total	330,300	351,000	405,550	455,600	516,050	580,050	548,900	612,500	659,700	698,159	750,800	771,300	772,900	938,643	987,080

Data shown are live weight except for oysters, clams and mussels which are meat weight. Excluded are eggs, fingerlings, etc. which are intermediate products.

1. Baitfish and ornamental fish
2. Salmon estimates are for non-pen production only.

Source: JSA, 2002.

In terms of pounds produced, the data indicate that the private sector is about 8 to 24 times larger than the public sector. Aquariums are not reported here because they do not distribute their animals.

2.4 ECONOMIC VALUE

2.4.1 Public

Public aquatic animal production supports a myriad of goals, including helping to restore depleted fish stocks, establishing sustainable fisheries, and recovering endangered species. Pursuit of these goals may also simultaneously support recreational fishing and Tribal fishing rights.

It is extremely difficult to estimate the total economic value to society associated with public aquatic animal production, particularly accounting for the cultural and religious significance of Tribal fishing and helping to re-establish endangered species. However, we can begin to get an idea of the importance of recreational fishing to national, state, regional and local economies by examining what anglers actually spend to fish. FWS' *1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreation* (FWS, 1997) reports that anglers spent $24 billion in trip-related and equipment expenditures for freshwater fishing in 1996.[12] FWS (1997) does not break down other expenditures, such as magazines, memberships, and licences by fresh- or salt-water fishing. However, in 1996 anglers spent approximately $0.6 billion for licenses, stamps, tags, and permits.

Expenditures are not included when estimating societal benefits. Money that is not spent for fishing at a particular site will be spent fishing at a different site or on an entirely different activity. Any change in expenditures is considered a transfer from one subgroup in society to another subgroup.[13] Net economic value or consumer surplus is the value measured as participants' "willingness to pay" above

[12]Other than salmon, the species listed in Table 5 of FWS (1997) for saltwater fishing are not among those listed in the aquatic animal production lists. Salmon account for only 637,000 of 9,438,000 anglers and 3,976,000 of 103,034,000 fishing days. Hence, the trip-related and equipment expenditures for saltwater fishing are not included in this estimate.

[13]Savings are considered a form of expenditure.

what they actually spend to participate. FWS (1998) examines the economic values for bass, trout, and walleye fishing, and other recreational activities. The goal of the study was to develop net economic value estimates for use in cost-benefit analyses, damage assessments, and project evaluations. The data were analyzed in three different groupings of states, and the decision of which grouping is best for a particular analysis is left to the wildlife manager doing the study. No national estimates are provided. The per-fish marginal values depend on the region and how the states are grouped into regions, but are represented by the following ranges:

- trout - $0.24 to $3.38 per fish caught
- bass - $1.44 to $6.05 per fish caught

Given the 53 million catchable trout stocked by state hatcheries (see Table 2-5), the net economic value for this segment of public aquaculture ranges from $12.7 million to $179 million. Other efforts to restore sustainable fish stocks also contribute to social welfare, so this range represents a lower bound estimate.

2.4.2 Private

In 1998, the value of private aquaculture production was $978 million.[14] The National Marine Fisheries Service presents data for domestic fisheries in its annual *Fisheries of the United States*. In 1997, the value of aquaculture production was nearly one-quarter of the domestic commercial landings (NMFS, 1999). Data for 1998 are available from the *Census of Aquaculture* (USDA, 2000a) and from NMFS, 1999 for domestic commercial landings. Aquaculture is approximately 30 percent of the domestic commercial landings (i.e., $978 million compared to $3.1 billion).

[14]This is within 4 percent of the value presented on the JSA web site (JSA, 2002).

For two states—Maine and Mississippi—aquaculture products were one of the top five agricultural commodities produced in terms of value. Aquaculture ranked fourth in both states, accounting for 10.8 percent of total farm receipts in Maine and 9.0 percent of total farm receipts in Mississippi (USDA, 2000b).

USDA (2000a) categorized facilities by aquaculture revenues. Table 2-8 provides the nationwide data while Table 2-9 disaggregates the information by species. USDA requested information on aquaculture activities only, not on all farm activities. Nearly one-half of the facilities show aquaculture revenues less than $25,000. However, this does not necessarily mean that the total facility income is less than $25,000. Presumably, the 409 facilities with aquaculture revenues in excess of $500,000 represent all-aquaculture entities, while the plethora of smaller facilities represent the range to which an aquaculture enterprise contributes to overall facility revenues. The distinction between aquaculture revenues and total facility revenues is discussed further in Section 2.6.

2.4.3 Aquariums

Revenue data for aquariums represent what people are willing to pay to see and study aquatic animals. Census data are the only source of revenue information for aquariums, however, the information is presented for all of NAICS code 712130 Zoos and Botantical Gardens. Census reports $1.3 billion in revenues for all non-taxable establishments and $0.1 billion for taxable establishments in 1997 form NAICS code 712130 (Census, 2001b).

2.5 ORGANIZATIONAL STRUCTURE

Public entities with aquaculture activities may be separated into four categories:

- Government or Government Agency (Federal, state, or local)
- Not for profit entities, such as Alaskan hatcheries
- Research institutions, such as colleges and universities
- Tribe entities.

Table 2-8

Number of Aquaculture Facilities by Revenue- United States 1998

Revenues		Number of Farms	Percent of Farms
Lower Limit	**Upper Limit**		
$1,000	$24,999	1,977	49.1%
$25,000	$49,999	433	10.8%
$50,000	$99,999	465	11.5%
$100,000	$499,999	743	18.4%
$500,000	$999,999	202	5.0%
$1,000,000	$1,000,000+	208	5.2%
Total		4,028	100.0%

Source: USDA, 2000a.

Table 2-9

Number of Farms by Revenue Category
By Species

Category	Number of Farms by Size (Revenue)							
	Total	$1,000 - $24,999 (No. and Percent)		$25,000 to $49,999	$50,000 to $99,999	$100,000 to $499,999	$500,000 and $999,999	$1,000,000 and above
Catfish	1,370	515	38%	112	165	354	121	103
Trout	561	333	59%	56	64	82	17	9
Other food fish	435	244	56%	36	39	62	14	40
Baitfish	275	161	59%	28	22	45	12	7
Ornamental Fish	345	169	49%	44	44	60	16	12
Sport/game fish	204	158	77%	20	6	19	0	1
Other fish	11	9	82%			2	0	0
Crustaceans	837	637	76%	106	45	40	3	6
Mollusks	535	306	57%	63	60	75	14	17
Other animal aquaculture, algea, and sea vegetables	216	96	44%	30	31	42	8	9
Total	4,789	2,628		495	476	781	205	204
Percentage		55%		10%	10%	16%	4%	8%

Note: Total exceeds 4,028 farms because a farm may raise more than one species.

Source: USDA, 2000a.

2.5.1 Public: Government or Government Agency

Table 2-10 indicates the relationship between Federal and state efforts in fisheries management. Federal funds comprise anywhere from zero to 75 percent of a state's fisheries management budget. For eight states, Federal funds make up 70 percent or more of their operating budget. Only Massachusetts and Washington do not receive Federal funds. Table 2-10 also indicates the relative importance of revenue from fishing licenses and fees to a state budget. For 23 states, this source of revenue forms at least 50 percent of the budget.

2.5.2 Nonprofit Organizations

This section primarily focuses on financial organizations unique to Alaskan hatcheries. The farming of salmon, per se, was outlawed in 1990 (Alaska, 2001a). Instead, Alaska permits nonprofit "ocean ranching" where salmon are reared from egg to smolt stage and then released into public waters to be available for harvest by fishermen upon their return to Alaskan waters as adults. Two types of nonprofit organizations are represented in Alaska operations: regional aquaculture associations and private nonprofit corporations. The state promotes increased salmon production through the Fisheries Enhancement Revolving Loan Fund, e.g., long-term, low-interest loans for hatchery planning, construction, and operation. The corporations are permitted to harvest a certain amount of the fish that return to the hatchery area as adults for cost recovery purposes. Regional corporations vote on a self-imposed state tax (from 1 percent to 3 percent) of the ex-vessel value of the fish in the regions where caught. The tax is collected by the Alaska Department of Revenue and disbursed only to the regional corporations through annual grants (Alaska, 2001b and Alaska, 2002).

Census data identify non-taxable establishments in NAICS code 712130. EPA assumes that this count might include non-profit aquariums (Census, 2001b).

Table 2-10
FY 1999 Revenue Sources

State	Budget ($1,000)	GRF * Revenue (%)	Licenses and Fees (%)	Federal Aid (%)	Other Revenue (%)
Alabama	6,200	0	35	65	0
Alaska	10,974	44	17	12	27
Arizona	6,8008	0	25	75	0
Arkansas	6,698	0	81	19	0
California	44,850	0	41	23	36
Colorado	11,894	0	68	28	4
Connecticut	2,292	17	37	46	0
Delaware	270	19	16	51	14
Florida	19,578	NA	NA	NA	NA
Georgia	7,440	0	59	40	1
Hawaii	20	10	15	75	0
Idaho	5,647	NA	NA	NA	NA
Illinois	9,389	10	69	19	2
Iowa	4,685	0	61	38	1
Kansas	4,558	0	54	46	0
Kentucky	7,767	0	30	70	0
Louisiana	8,304	NA	NA	NA	NA
Maine	6,978	0	25	75	0
Maryland	4,762	0	70	30	0
Massachusetts	4,640	0	100	0	0
Michigan	22,103	1	64	28	7
Minnesota	20,319	0	61	39	0
Mississippi	4,877	2	23	75	0
Missouri	10,628	0	9	5	86
Montana	7,678	0	49	45	6
Nebraska	3,156	0	25	75	0

Table 2-10 (cont.)

State	Budget ($1,000)	GRF * Revenue (%)	Licenses and Fees (%)	Federal Aid (%)	Other Revenue (%)
Nevada	2,975	5	25	70	0
New Hampshire	3,571	0	56	44	0
New Jersey	4,705	0	80	20	0
New Mexico	3,900	0	39	61	0
New York	13,568	5	70	25	0
North Carolina	10,989	0	70	30	0
North Dakota	1,176	0	25	75	0
Ohio	16,604	4	74	18	4
Oklahoma	7,760	0	50	30	20
Oregon	12,369	12	27	4	57
Pennsylvania	19,513	0	54	37	9
Rhode Island	422	6	19	75	0
South Carolina	5,455	32	27	33	8
South Dakota	2,937	0	63	37	0
Tennessee	11,548	0	60	40	0
Texas	32,817	NA	NA	NA	NA
Utah	7,454	7	43	39	11
Vermont	2,080	0	56	44	0
Virginia	9,177	0	55	42	3
Washington	13,083	63	0	0	37
West Virginia	4,696	0	80	20	0
Wisconsin	21,517	3	72	20	5
Wyoming	5,999	0	40	41	19
Total	**486,9877**	**-**	**-**	**-**	**-**

*GRF = State General Revenue (appropriated) Funds

Note: Indiana did not reply to the survey. Florida, Mississippi and Louisiana do not actively manage cold water species.

Source: Epifanio, 2000.

2.5.3 Private

Private entities may be broadly classified as:

- Proprietorship (individual operations)
- Partnership
- Corporations (family and non-family[15])

If facilities with aquacultural activities follow the same pattern as agricultural farms in general, about 90 percent of the facilities are proprietorships. Within the corporation classification, 89 percent are family corporations with more than 50 percent of the stock held by people related by blood or marriage (USDA, 1998b).

2.6 EMPLOYMENT

EPA did not identify a reference or references with industry-wide numbers for employment in aquatic animal production for either the public or private sectors.

[15]EPA searched SEC's *Directory of Companies Required to File Annual Reports with the Securities and Exchange Commission under the Securities Exchange Act of 1934* for industries in Standard Industrial Classification (SIC) codes 0200 (agriculture production, livestock and animal specialties) and 0700 (agriculture services) (SEC, 1999), as well as Internet searches on sites such as Hoovers.com and usinfo.com for publicly held aquatic animal production companies but did not find a sufficient number to develop a representative sample.

2.7 SMALL BUSINESSES

2.7.1 Public

The Regulatory Flexibility Act as Amended by the Small Business Regulatory Enforcement Fairness Act (RFA/SBREFA, Public Law No. 104-121) defines a "small" governmental jurisdiction as the government of a city, county, or town with a population of less than 50,000. For the purposes of the Regulatory Flexibility Act, states and tribal governments are not considered small governments but rather as independent sovereigns (EPA, 1999). Accordingly, EPA has not identified any small governmental jurisdictions for the purpose of a small business analysis.

2.7.2 Private

The Small Business Administration (SBA) sets size standards to define whether a business entity is small and publishes these standards in 13 CFR 121. When making classification determinations, SBA counts receipts or employees of the entity and all of its domestic and foreign affiliates (13 CFR.121.103(a)(4))). As of October, 2000, the size standards are based on NAICS (SBA, 2000). On 21 December 2000, Public Law 106-554 "Small Business Reauthorization Act of 2000" became effective. Section 806(b) of the legislation raised the size standard to $0.75 million for small businesses in the Agriculture Industry. SBA published a direct final rule on 7 June 2001 with this change (SBA, 2001). On 23 January, 2002, SBA adjusted its monetary-based size standards for inflation (SBA, 2002). Table 2-11 summarizes the size standards applicable to the aquatic animal industry.

Table 2-11

Small Business Size Standards

Business Code	Description	Size Standard (Annual Revenues)
NAICS		
112511	Finfish Farming and Fish Hatcheries	$0.75 million
112512	Shellfish Farming	$0.75 million
112519	Other Animal Aquaculture	$0.75 million
712130	Zoos and Botanical Gardens (Aquariums)	$6.0 million

The only readily available source of aquaculture revenue data is USDA *Census of Aquaculture* (2000a). The USDA revenue data are on an individual facility basis while the SBA small business definitions are based on total company revenues. Given that a large percentage of the facilities with aquacultural activities are proprietorships and likely to be single-facility entities (i.e. the facility is the company), this does not necessarily preclude using this data to examine the economic impacts to small businesses. More problematic is the fact that the USDA data reports only revenues from aquaculture, not total facility revenues, while the determination of whether the company (or farm in this case) is a small entity should be done on the basis of total revenues.

Based on these aquaculture revenue data , nearly nine out of every ten facilities would be considered "small" (see Table 2-8). If an individual facility has revenues that exceed the SBA size standard then, by definition, total company revenues must also exceed the size standard. However, if an individual facility has revenues less than the SBA size standard, the total company revenues may or may not exceed the size standard depending on the revenues from the other facilities owned by the company. For example, a company that owns eight facilities, each with $100,000 in annual revenues, would exceed the size standard and hence would not be classified as a small business.

Table 2-9 summarizes the distribution of facilities by revenue category and by species. The individual entries sum to 4,789 facilities while the reported national total is 4,028 facilities, indicating that as many as 761 facilities raise more than one species. Catfish and trout account for approximately 40 percent of the total number of facilities but represent 61 percent of the large facilities. According to this data, about three-quarters of crustacean facilities have revenues below $25,000 (637 out of 837 facilities).

However, this revenue data does not include income from crops that are co-produced with aquaculture. For example, about half the crawfish in Louisiana are raised in rice ponds (Frank, 2000). EPA is aware that classifying operations as "small" solely on the basis of aquaculture revenues at individual facilities will overestimate the number of small entities, but prefers to err by overestimating rather than underestimating that number.

2.8 MARKET STRUCTURE

While the industry profile is organized to present data on the public and private sectors of aquatic animal production, it is in the market structure that the two sectors are inexorably intertwined. In addition, wild catch and imports influence the commercial market and the importance and strength of these influences vary by species. This section summarizes the interplay of these forces and identifies the different markets within the aquatic animal production industry.

2.8.1 Public

Sections 2.1 and 2.3 document the role of public aquatic animal production for ecological restoration, recreation, or fee-fishing. Many of these fish are grown in government fish hatcheries; others are sold to government entities by commercial growers for stocking. Production decisions for these recreationally oriented growers are not governed by the same types of market forces that influence commercial decision-makers. Much of this production is financed by fishing license fees and other taxes. The ultimate consumers are anglers and those who value a natural environment. They do not make consumption decisions based on the price of stocking fish. Hence, there is no market relationship, in the traditional sense for these fish.

Table 2-12 summarizes the uses of aquaculture products and their sources for 1998 combining information from *Census of Aquaculture* and National Marine Fisheries Service (NMFS) documents.[16] Almost half the trout and three-quarters of the salmon raised in U.S. aquaculture are used for ecological restoration, fee-fishing, or recreation. Table 2-13 abstracts information from Table 2-12 to graphically illustrate the variety of market types among the aquaculture products.

2.8.2 Private

The market structure for the private aquaculture industry is characterized by high facility concentration offset by competing sources and substitutes. The Census data indicate a high degree of concentration at the facility level. In the extreme cases, eight facilities in Texas produce 70 percent of the value of shrimp produced by aquaculture in the U.S.; three percent of the ornamental fish facilities (12 facilities) produce 59 percent of the value of the industry. Table 2-14 summarizes the share of production from the top ten percent of facilities. Many of the aquaculture production industries are small and highly concentrated both in terms of the number of firms and geographic area (ornamentals, baitfish, salmon, and shrimp). Commercial production of each aquaculture species also is concentrated geographically (see Figures 2-1 through 2-5).

However, the existence of other sources, namely, wild catch and imports, and close substitutes may limit the exercise of oligopoly power on the part of aquaculture producers. For salmon, shrimp, and most mollusks, the wild catch is greater than domestic aquacultural production. For baitfish, wild catch is not recorded in the fisheries statistics but is an important part of the market and always an option for anglers if farm-raised baitfish prices rise too high. Even when the wild product is only a close substitute for the farm-raised product, prices for the wild product will influence prices for the aquacultural product. If the wild products or imports are setting the price, it is unlikely that changes in costs of aquaculture

[16] Table 2-12 was assembled from three different sources so the data in each column may not be comparable to neighboring columns and adding them together may be incorrect. The purpose of the table, however, is to show rough scales of contributions of aquaculture (for recreation and food use), wild catch and imports to total U.S. supply for various species.

Table 2-12

Sources and Uses of Aquaculture Species in the United States, 1998

Species	Units	Aquaculture		Wild Catch	Net Imports	Total Use
		Total to Recreation, Restoration	Total to Food/ End use			
Catfish	(1,000 lbs)	10,175	563,934	11,590	1,100	586,799
		2%	96%	2%	0%	100%
Trout	(1,000 lbs)	46,341	47,422	789[1]	4,217	98,769
		47%	48%	1%	4%	100%
Salmon	(1,000 lbs)	291,147	107,160	644,434		1,085,072
		27%	10%	59%		100%
Tilapia	(1,000 lbs)	0	11,571	0	60,911	72,482
		0%	16%	0%	84%	100%
Hybrid Striped Bass	(1,000 lbs)	612	8,407	6,715	1,927	17,661
		3%	48%	38%	11%	100%
Ornamentals	($1,000)	414	68,568	0	34,563	103,545
		0%	66%	0%	33%	100%
Baitfish	($1,000)	1,537	35,945	0[1]	0	37,482
		4%	96%	0%	0%	100%
Crawfish	(1,000 lbs)	35	17,426	22,226	4,387	44,074
		0%	39.5%	50.4%	10.0%	100%
Shrimp	(1,000 lbs)	8	4,209	277,757	670,212	952,186
		0%	0%	29%	70%	100%
Crab	($1,000)	21	10,276	473,378	295,518	779,193
		0%	1%	61%	38%	100%
Clam	($1,000)	50	50,026	135,237	31,164	216,477
		0%	23%	62%	14%	100%
Mussel	($1,000)	3	3,177	1,604	29,855	34,639
		0%	9%	5%	86%	100%
Oyster	($1,000)	27	26,985	88,627	29,785	145,424
		0%	19%	61%	20%	100%

[1] Figures shown for wild catch are from NMFS, 1999. Much of the trout and all of the baitfish wild catch is not reported to NMFS. Wild catch will be a substantial factor in both these markets.

Sources: USDA, 2000a; USDA, 2000c; NMFS, 1998; and NMFS 1999.

Table 2-13

Characteristics of Aquaculture Species Markets

Species	Aquaculture is largest source	Recreation is a large use	Imports...		Wild catch...	
			dominate domestic aquaculture	are a major component	dominates domestic aquaculture	is a major component
Catfish	X	-	-	-	-	-
Trout	X	X	-	-	-	(1)
Salmon	-	X	-	-	X	X
Tilapia	-	-	X	X	-	-
Hyb Striped Bass	X	-	-	X	-	X
Ornamentals	X	-	-	X	-	-
Baitfish	X	-	-	-	-	(1)
Crawfish	-	-	-	-	X	X
Shrimp	-	-	X	X	X	X
Crab	-	-	X	X	X	X
Clam	-	-	-	X	X	X
Mussel	-	-	X	X	-	-
Oyster	-	-	X	X	X	X

(1) Much of the trout and all of the baitfish wild catch is not reported. Baitfish wild harvest was reported to be 50 percent of market at JSA Aquaculture Effluents Technical Workshop, 9/20/2000. Wild catch will be a substantial factor in both these markets.

Note: "Recreation is a large use" means ecological restoration, fee-fishing, recreational, and government use is greater than 20 percent of total use. "Dominates domestic aquaculture" means wild catch or net trade provides a greater proportion of total use than aquaculture. "Major component" means more than 10 percent of total use.

Table 2-14

Industry Concentration

Species	Top 10 percent of farms		Total Value ($1,000)
	Number of Farms	Produce (Percentage of value)	
Catfish	137	65%	450,710
Trout	56	72%	72,473
Other Food Fish	44	85%	168,532
Ornamentals	35	75%	68,982
Baitfish	28	67%	37,482
Crustaceans	84	74%	36,318
Mollusks	54	79%	89,128

Source: USDA, 2000a.

Note: Production value categories added together to find top 10 percent.

production will be passed through to consumers and more of the costs of compliance (if not all) will need to be absorbed by the facility.

Like wild catch, a high level of imports reduces the effect of changes in aquacultural production on the market. Imports are discussed in more detail in the next section while the market effects are summarized here. For tilapia, shrimp, and mussels, imports are a much larger share of the market than domestic aquaculture and undoubtedly have more influence on the market price. The situation for salmon is more complex as Tables 2-12 and 2-13 combine Pacific and Atlantic salmon. The U.S. is a large importer of Atlantic salmon and exporter of Pacific salmon so the net trade appears small. Atlantic salmon imports are twice total domestic salmon farm production. There is evidence that Atlantic and

Coho salmon are substitutes in some situations (Clayton and Gordon, 1999). Whatever the precise relationships, trade flows have a large effect on the prices of many aquaculture products.

2.9 INTERNATIONAL TRADE

Import and export codes used by the United States are based on the Harmonized Tariff System (HTS). Import codes (called HTS) are administered by the United States International Trade Commission (ITC) while export codes (called Schedule B) are administered by the U.S. Census (Census 2002a and 2002b; USITC 2002). This means the same product will have different codes depending on whether it is an import or an export. Only three aquatic animal products have export codes that identify them as "farmed"—rainbow trout (0302.11.0010), Atlantic salmon (0302.12.0003), and mussels (0307.31.0010). "Farmed" imports include the rainbow trout (0302.11.00.10), Atlantic salmon (0302.12.00.03), and mussels (0307.31.0010), as well as Chinook salmon (0302.12.00.12), Coho salmon (0302.12.00.53), and oysters (0307.10.00.60). The Census and ITC data, then, provide an incomplete view of trade in aquaculture.

Import and export data for a wider variety of aquaculture products are available from NMFS and USDA. Data on imports and exports of seafood or fishery products include data for both raised (aquaculture) and wild harvested products (confirmed by Harvey, 2000).[17] Hence, data used in this section does not solely reflect aquaculture production. Foreign trade data of certain seafood products and fishery products is provided to portray the overall picture of seafood-related international trade.

In 1999, the world's aquaculture production (inland and marine) equaled 33 million metric tons in live weight (NMFS, 2001). This was 26 percent of the world's total commercial catch. The leading

[17]Harvey (2000) noted that it might be possible to estimate the percentage of aquaculture products traded into and out of the United States. This estimation would depend on the species, the size of the product, the country of origin, among other factors. Mr. Harvey appears to have done this for the USDA website which states that, in 1999 the total value of aquaculture exports was approximately $30-35 million (Harvey, 2002).

aquaculture and commercial catch countries are China, Peru, Japan, Chile, United States, and India. Of these countries, China has the largest share while the U.S. ranks fifth (NMFS, 2001).

Figure 2-10 demonstrates import and export values of fishery products from 1989 to 2000. The solid pair of lines are for all fishery products, both edible and non-edible, while the dashed pair of lines shows only the value for edible products. For all fishery products, U.S. exports increased from 1989 to 1997 and declined in 1998 (perhaps due to the economic difficulties of the U.S.'s largest market—Asia). The trade gap had been increasing slowly until 1998. The U.S. has a growing net trade deficit in fishery products with a pronounced gap in 1998. Exports of edible fishery products peaked in 1992 with $3.5 billion and have been declining ever since.

2.9.1 Imports

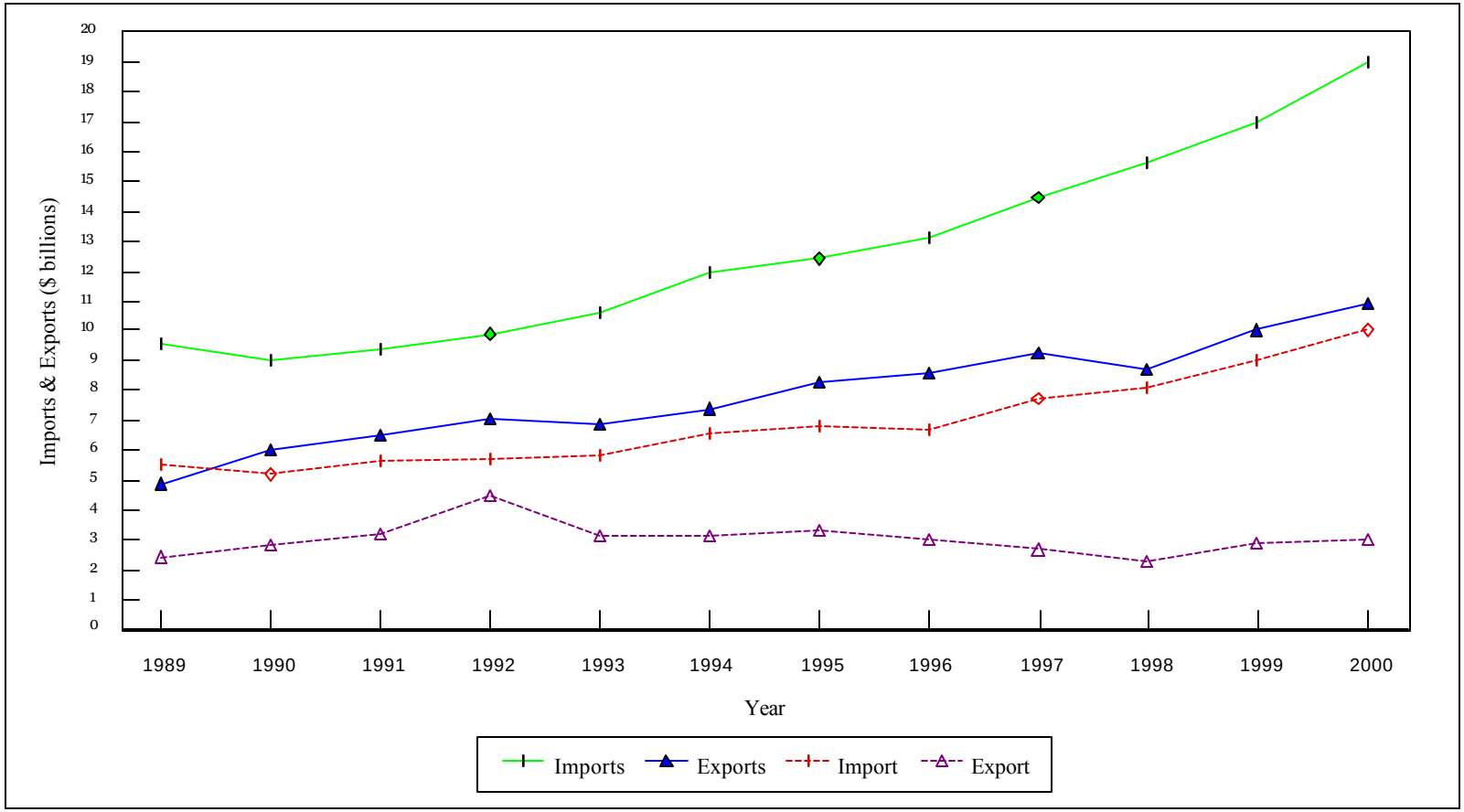
The value of total U.S. imports of edible and nonedible fishery products in 2000 was $19 billion. As a trading region, Asia was the largest source of these imports, accounting for 44 percent of the total tonnage (NMFS, 2001). Canada was the individual country with the largest volume of imports to the U.S. (NMFS, 2001). The value of edible fishery imports has nearly doubled from $5.5 billion in 1989 to $10.1 billion in 2000 (see Figure 2-10).

Switching to USDA data, Tables 2-15 and 2-16 show the value of U.S. imports and exports of selected seafood products for 2000 and 2001, respectively. In both years, the U.S. imported about $4.8 billion worth of these seafood products and exported about $0.6 billion.

Tables 2-15 and 2-16 are rank-ordered from largest net import to largest net export. The largest seafood import for both years was frozen shrimp, accounting for about 62 to 63 percent of the value of all imports. Thailand is the largest exporter of shrimp to the U.S., accounting for 36 percent of shrimp imports in 2000 and 34 percent in 2001 (USDA, 2002a). Mexico, Ecuador, and India are the second through fourth largest shrimp importers to the United States, respectively, in terms of value (USDA, 2002a).

Figure 2-10

Value of U.S. Imports and Exports of Fishery Products 1989-2000 ($1 billion)



Source: NMFS, 1999 and NMFS, 2001.

The value of tilapia imports grew 26 percent from $101.4 million in 2000 to $127.8 million in 2001, while the quantity increase was 39 percent (USDA, 2002a). That is, there was a decrease in the average price of tilapia. Most imports are from Taiwan and China (USDA, 2002a). Although imports of tilapia have been a recent addition to U.S. foreign trade, documented only since 1992, tilapia was the fourth largest seafood product imported in 2001.

The value of Atlantic salmon (both frozen and fresh) imports increased between 2000 and 2001, from $741 million to $773 million. The largest suppliers—Chile and Canada—together account for more than 90 percent of U.S. Atlantic salmon imports (USDA, 2002a).

Table 2-15

2000 Imports and Exports of Selected Seafood Products ($1000)

Product	Imports	Exports	Net
Shrimp, frozen	3,035,173	62,891	2,972,282
Shrimp, fresh & prepared	707,565	52,738	654,827
Atlantic salmon, fresh	654,725	34,471	620,254
Tilipia	101,378	0	101,378
Atlantic salmon, frozen	85,658	583	85,075
Mussels	47,359	1,681	45,678
Oysters	40,763	7,227	33,536
Ornamental Fish	40,761	8,189	32,572
Trout, fresh & frozen	11,291	2,893	8,398
Pacific salmon, fresh	42,633	37,048	5,585
Clams	7,504	5,649	1,855
Trout, live	131	185	(54)
Canned & prepared salmon	32,021	147,127	(115,106)
Pacific salmon, frozen	20,527	273,271	(252,744)
Total	**4,827,489**	**633,953**	**4,193,536**

Table 2-16

2001 Imports and Exports of Selected Seafood Products ($1000)

Product	Imports	Exports	Net
Shrimp, frozen	2,957,944	54,553	2,903,391
Atlantic salmon, fresh	685,289	37,945	647,344
Shrimp, fresh & prepared	678,853	51,481	627,372
Tilipia	127,797	0	127,797
Atlantic salmon, frozen	87,483	139	87,344
Mussels	43,610	1,595	42,015
Ornamental Fish	40,863	6,914	33,949
Oysters	36,914	8,238	28,676
Trout, fresh & frozen	11,507	1,577	9,930
Pacific salmon, fresh	30,462	22,166	8,296
Clams	8,296	6,593	1,703
Trout, live	99	271	(172)
Canned & prepared salmon	36,199	167,825	(131,626)
Pacific salmon, frozen	14,940	236,604	(221,664)
Total	**4,760,256**	**595,901**	**4,164,355**

Source: USDA, 2002a.

2.9.2 Exports

Figure 2-10 portrays the value of U.S. imports and exports of fishery products from 1989 to 2000. The total value of U.S. seafood exports increased slightly, while the export value of edible fish remained relatively constant during the period.

In recent years, however, USDA data show a drop in the value of exports from $634 million to $596 million, see Tables 2-15 and 2-16. Frozen Pacific salmon is the largest U.S. export, comprising between 40 and 43 percent of the total value of U.S. exports.[18] Between 2000 and 2001, the export value of frozen Pacific salmon decreased from $273 million to $237 million. The quantity of exports

[18]Differences between the East and West coasts are obvious for salmon. Fresh Atlantic salmon is the second largest U.S. net import while frozen Pacific salmon is the largest U.S. net export.

increased during this period from 162 million pounds to 168 million pounds. This reflects a decrease in the unit value of Pacific salmon. From 2000 to 2001, only fresh Atlantic salmon, canned and prepared salmon, oysters, and clams showed an increase in the value of exports. All other commodities showed a decline.

2.9.3 Government Intervention

Table 2-17 lists the dramatic rise in reported "catfish" imports from Vietnam from less than 80,000 kilograms in 1995 to 7.8 million kilograms in 2001. In 2001, the value of these imports totaled $21.5 million (NMFS, 2002). Prices paid by catfish processors averaged $0.71/lb in 1997 but dropped to $0.55/lb in December 2001 (USDA, 2002b). The situation was covered in industry news (Fiorillo and McGovern, 2001; McGovern, 2002; Rappaport, 2002; and Rappaport, 2001a and 2001b). In November 2001, President Bush signed a one-year provision declaring that only products from the family *Ictaluridae* could be labeled "catfish." The Vietnamese imports are members of the *Pangasiidae* family. Legislation to make the ban permanent passed the Senate in December (McCain, 2001; Philadelphia, 2002; USDA 2002c).

Table 2-17

"Catfish" Imports 1995-2001

	Imports (kg)			Imports ($)		
Year	All	Vietnam	Percent	All	Vietnam	Percent
1995	1,101,337	79,553	7%	$2,591,161	$263,926	10%
1996	1,119,074	59,096	5%	$3,179,001	$260,847	8%
1997	427,118	54,505	13%	$1,412,010	$233,846	17%
1998	628,354	261,352	42%	$2,135,905	$1,156,550	54%
1999	1,564,631	902,598	58%	$5,674,123	$4,052,524	71%
2000	3,736,242	3,191,068	85%	$12,365,582	$10,695,974	86%
2001	8,201,420	7,765,319	95%	$22,751,433	$21,509,704	95%

Source: NMFS, 2002.

2.10 REFERENCES

Alaska. 2002. Alaska Department of Community & Economic Development. Division of Investments. *Fisheries Enhancement Revolving Loan Fund: Program Overview*. February.

Alaska. 2001a. Alaska Department of Fish and Game. Public Communications Section. *Alaska's Salmon Management: A story of Success*. <www.state.ak.us/adfg/geninfo/special/sustain/management.pdf> downloaded 3 October.

Alaska. 2001b. Alaska Department of Fish and Game. Division of Commercial Fisheries. *Alaska Salmon enhancement Program: 2000 Annual Report*. Regional Information Report 5J01-01. Juneau, AK. January.

Becker, G.S. and E.H. Buck. 1997. Aquaculture and the federal role. CRS Report for Congress. 97-436 ENR. Washington, DC: Congressional Research Service. The Library of Congress. April.

Census. 2002a. United States Department of Commerce. Census Bureau. *FAQ; What's the difference between the Schedule B codes (for exports) and the Harmonized Tariff Schedule (HTS) codes (for imports)?* www.census.gov/foregin-trade/faq/sb0008.html downloaded 16 April.

Census. 2002b. United States Department of Commerce. Census Bureau. *Schedule B codes* www.census.gov/foregin-trade/schedules/b/#download downloaded 16 April.

Census. 2001a. United States Department of Commerce. Census Bureau. http://www.census.gov/epcd/naics/NDEF712.HTM. Downloaded November 9.

Census. 2001b. United States Department of Commerce. Census Bureau. Establishment and Firm Size (including Legal Form of Organization). 1997 Economic Census. Arts, entertainment, and Recreation. Subject Series. EC97S71-SZ. October 2000. http://www.census.gov/prod/ec97/97s71-sz.pdf Downloaded November 9.

Clayton, Patty L. and Daniel V. Gordon. 1999. From Atlantic to Pacific: Price Links in the US Wild and Farmed Salmon Market. *Aquaculture Economics and Management*, 3(2):93-104.

EPA. 1999. U.S. Environmental Protection Agency. *Revised interim guidance for EPA rulewriters: Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act.* Washington, D.C. March.

Epifanio, J. 2000. The status of coldwater fishery management in the United States: an overview of state programs. *Fisheries*. 25(7)13-27. Sponsored by Trout Unlimited.

Fiorillo, John and Dan McGovern. 2001. "Cat Fight: The Vietnam, U.S. catfish war," WorldCatch News Network. 27 September. <www.worldcatch.com/page/WC_Article_View.wc?ID=5609> downloaded 12 April 2002.

Frank, A.D. 2000. Personal communication between A. David Frank, USDA, NASS, LA state office and Maureen F. Kaplan, ERG, dated 24 August.

FWS. 2000a. U.S. Fish and Wildlife Service. Technical publications of the U.S. Fish and Wildlife Service Fish Technology Centers 1996-June 1999. http://fisheries.fws.gov/FTC/FTCPub.htm. Downloaded on 26 July.

FWS. 2000b. U.S. Fish and Wildlife Service. National fish hatchery system. http://fisheries.fws.gov/FWSFH/draftpage/NFHSintro.htm. Downloaded on 26 July.

FWS. 2000c. U.S. Fish and Wildlife Service. Tribal fish hatchery programs of the northern Great Lakes region. Ed. F.G. Stone. <www.fws.gov/r3pao/ashland/tribal/index.html> Downloaded on 16 August.

FWS. 2000d. U.S. Fish and Wildlife Service. Division of National Fish Hatcheries. Spreadsheet entitled USFWS99.txt, e-mailed by Donna Kraus, 17 August.

FWS. 1998. U.S. Fish and Wildlife Service. *1996 Net Economic Values for Bass, Trout and Walleye Fishing, Deer, Elk and Moose Hunting, and Wildlife Watching: Addendum to the 1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreation*. Report 96-2. August.

FWS. 1997. U.S. Fish and Wildlife Service. *1996 National Survey of Fishing, Hunting, and Wildlife Associated Recreation*. FHW/96 NAT. November.

Harvey, David. 2002. U.S. Department of Agriculture. Economic Research Service. Web Site. <www.ers.usda.gov/briefing/aquaculture/Trade.htm> downloaded on 12 April. Mr. Harvey is cited as the contact for further information.

Harvey, David. 2000. Personal communication between David Harvey, USDA and Reetika Motwane, ERG, dated 23 August.

JSA. 2002. United States Joint Subcommittee on Aquaculture. U.S. Private Aquaculture Production for 1985-1999. <ag.ansc.purdue.edu/aquanic/jsa/aquaprod.htm> Downloaded on May 1.

Lang, John. 2000. Personal communication between John Lang, USDA and Andrea Poppiti, ERG, dated 2 August.

McCain. John. 2001. "McCain: Catfish Import Barrier Puts International Trade Agreements at Risk," Press release dated 18 December 2001. <www.senate.gov/~mccain/catfish.html> downloaded 12 April 2002.

McGovern, Dan. 2002. "Catfish prices remain depressed; Imports from Vietnam grow 62%," WorldCatch News Network. 23 January. <www.worldcatch.com/page/WC_Article_View.wc?ID=6715> downloaded 12 April 2002.

NMFS. 2002. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. Web-based trade data base. http://www.st.nmfs.gov/trade/index.html Inquiry dated 12 April

NMFS. 2001. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. *Fisheries of the United States, 2000*. August.

NMFS. 1999. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. *Fisheries of the United States, 1998*. Current Fishery Statistics No. 9800. July.

NMFS. 1998. U.S. Department of Commerce. National Oceanic and Atmospheric Administration. National Marine Fisheries Service. *Imports and Exports of Fishery Products, Annual Summary, 1998*.

Philadelphia, Desa. 2002. "Catfish by Any Other Name." *Time*. February. pp. B14-15.

Rappaport, Stephen. 2002. "US farm-raised catfish industry sees light on horizon." *Fish Farming News*. Volume 10. January/February issue. Pp. 1, 5.

Rappaport, Stephen. 2001a. "Trade Wars! Fish Farmers fight for market equity." *Fish Farming News*. Volume 9. July/August issue. Pp. 1, 10.

Rappaport, Stephen. 2001b. "Catfish: Industry earns Congressional split decision." *Fish Farming News*. Volume 9. November/December issue. Pp. 1, 20A.

SBA. 2002. Small Business Administration. 13 CFR Part 121. Small business size standards; inflation adjustment to size standards. Interim Final Rule. 67 FR 15:3041-3057. 23 January.

SBA. 2001. Small Business Administration. 13 CFR Parts 107 and 121 Size eligibility requirements for SBA financial assistance and size standards for agriculture. Direct Final Rule. 65 FR 100:30646-30649. 7 June.

SBA. 2000. Small Business Administration. 13 CFR Part 121 Small business size regulations: Size standards and the North American Industry Classification System; Final Rule. 65 FR 94:30836-30863. 15 May.

SEC. 1999. Securities and Exchange Commission. *Directory of Companies Required to File Annual Reports with the Securities and Exchange Commission under the Securities Exchange Act of 1934: alphabetically and by industry groups*. Washington, DC. September.

USDA. 2002a. U.S. Department of Agriculture. Economic Research Service. *Aquaculture Outlook*. LDP-AQS-15. 6 March.

USDA. 2002b. U.S. Department of Agriculture. National Agricultural Statistics Service. *Catfish Processing*. Report Aq 1 (3-02). 22 March.

USDA. 2002c. U.S. Department of Agriculture. *Agricultural Outlook.* Commodity spotlight. April.

USDA. 2000a. United States Department of Agriculture. National Agricultural Statistics Service. *1998 Census of Aquaculture*. Also cited as 1997 Census of Agriculture. Volume 3, Special Studies, Part 3. AC97-SP-3. February.

USDA. 2000b. U.S. Department of Agriculture. Economic Research Service. U.S. State Fact Sheets at <www.ers.usda.gov/epubs/other/usfact> for Maine (me.htm) and Mississippi (ms.htm). Downloaded 25 August.

USDA. 2000c. U.S. Department of Agriculture. Economic Research Service. *Aquaculture Outlook*. LDP-AQS-111. 13 March.

USDA. 1999. U.S. Department of Agriculture. National Agricultural Statistics Service. Letter to Mr. Bob Durborow, Cooperative Extension Program, Kentucky State University from Rich Allen, Associate Administrator, dated 2 August 1999, included as Attachment D to supporting statement for Information collection request for revision to the catfish and trout production aquaculture surveys. OMB No. 0535-0150.

USDA. 1998a. U.S. Department of Agriculture. National Agricultural Statistics Service. Supporting statement for Information collection request for 1998 Census of Aquaculture. OMB No. 0535-0237.

USDA. 1998b. U.S. Department of Agriculture. Office of Communications. *Agriculture Fact Book 1998*. Washington, D.C. November.

USITC. 2002. United States International Trade Commission. *Harmonized Tariff Schedule of the United States (2002) (Rev. 2)* Chapter 3. <ftp://ftp.usitc.gov/pub/reports/studies/0202htsa.pdf> downloaded 16 April.

WDNR. 2000. Tribal and Federal Hatcheries. <www.dnr.state.wi.us/org/water/fhp/fish/pubs/2watrib.html> Downloaded 16 August.