Appendix A
Statistical Methodology

THE CENSUS POPULATION

The target population for the census of aquaculture was composed of all farms that reported any amount of aquaculture activity during the 2012 Census of Agriculture. An effort was made to identify additional aquaculture operations of significance from new sources.

DATA COLLECTION

Method of Enumeration

The 2013 Census of Aquaculture was conducted primarily by mail. It was supplemented with Electronic Data reporting (EDR) via the Internet, telephone calls, and personal enumeration. Enumeration methods were similar to those used in the 2005 Census of Aquaculture.

Report Forms

One version of the report form was used in all States. A 16-page 2013 Census of Aquaculture report form was designed to collect data from operations producing or distributing aquaculture. It was designed to collect data that also supported the agricultural surveys conducted for catfish and trout production which are part of the National Agricultural Statistics Service's (NASS) Estimates Program. See Appendix B for changes and a copy of this report form.

Report Form Mailings and Respondent Follow-up

The initial mailout took place in December 2013. Mail packets were mailed to approximately 4,100 farms thought to have produced aquaculture in 2012. The initial mail packets included a labeled report form, an instruction sheet, a letter requesting a prompt response and instructions for completing the form via Internet (an alternate reporting option), and a postage-paid return envelope. Mailout packet preparation, initial mailout, and one follow-up mailing to nonrespondents were handled by the Census Bureau's National Processing Center (NPC) in Jeffersonville, IN. Telephone follow-ups, conducted from a NASS Data Collection Center, began in February 2014 to nonrespondents who were mailed a report form from NPC.

Data were collected for a select group of operations by the NASS field offices. To minimize the number of agency contacts, operations included in this group were flagged for contact by NASS for other agricultural surveys. Report forms were labeled at NPC and sent to field offices in November 2013. Field office staff collected data by personal enumeration or by phone from December 2013 through June 2014. For a description of the adjustment for nonresponse, see Estimation.

REPORT FORM PROCESSING

Data Capture

All report forms returned to NPC were immediately checked in using bar codes printed on the mailing label. This check-in process removed the responding farms from follow-up mailings. All forms were reviewed prior to data keying to identify inconsistencies and ensure that the data could be keyed. Major inconsistencies, respondent remarks, blank report forms, and large aquaculture cases were reviewed by analysts and adjusted prior to data keying, as needed. All forms with any data were scanned and an image was created for each page of a report form.

Data Editing and Analysis

Data from each report form were processed through a computer edit which flagged inconsistent entries.

Each flagged entry was reviewed by staff. Reported data that were obviously incorrect due to misinterpretation of a question were either corrected or deleted prior to the computer edit. In some cases, respondents may have failed to provide all of the information requested, only indicating the presence of an item but not the amount. Some data were estimated by the analyst based on other responses in the geographic area and by similarly sized farms.

Prior to publication, tabulated totals were reviewed to identify and resolve remaining inconsistencies and potential coverage problems. Comparisons were made to 2012 Census of Agriculture data, 2005 Census of Aquaculture data, and other available check data. The data were processed through a disclosure program to prevent data from being published that could be sourced back to an individual operation.

ESTIMATION

Estimates were produced for the Nation and for each of the 50 States. All respondents to the 2012 Census of Agriculture that reported involvement with an aquaculture enterprise, regardless of its economic size, were included on the 2013 Census of Aquaculture mailing list.

The estimation methodology consisted of two weighting components. The first component was the fully adjusted weight pulled in from the 2012 Census of Agriculture. In processing the 2012 Census of Agriculture data, statistical weights were applied to each responding record. These weights were designed to account for 2012 Census of Agriculture mail list non-respondents, farms that existed but were not included on the 2012 Census of Agriculture mail list, and various farm classification errors.

The second weighting component was from a 2013 Census of Aquaculture nonresponse adjustment factor. In spite of a determined effort to obtain aquaculture information from every operation on the 2013 Census of Aquaculture mailing list, not all operations responded. A nonresponse adjustment factor was used to account for active aquaculture operations on the list that did not respond to the 2013 Census of Aquaculture.

Together these two weighting components compensated for aquaculture farm data that were not obtained from either the 2012 Census of Agriculture or the 2013 Census of Aquaculture. Each farm on the 2013 Census of Aquaculture mail list was put into a weight adjustment group. All weight adjustment groups were formed within a given State. These groups were based on the economic size of the farm's aquaculture enterprise as indicated by the data obtained from the 2012 Census of Agriculture. The weights that were carried over from the 2012 Census of Agriculture were summed across every record within each aquaculture weight adjustment group. The resulting weight sum was the best available estimate of the number of aquaculture farms that existed for a given State in 2012. The number of aquaculture farms for the weight adjustment group was divided equally among all aquaculture census respondents within the group. The resulting value became the statistically fully adjusted weight for each respondent in the weight adjustment group. The sum of the adjusted weights across all respondents in the group necessarily equaled the target value.

The fully-adjusted weights applied to respondents on the 2013 Census of Aquaculture mail list were integerized using a random process. This process rounded each raw weight upwards to the smallest integer that exceeded the fully adjusted raw weight using a probability equal to the non-integer portion of the raw weight, otherwise, the weight would have been rounded downwards to the largest integer that was less than the raw weight.

Example: The raw weight for a record is 1.75. It will be rounded up to 2.0 with a probability of 0.75 and rounded down to 1.0 with a probability of 0.25.

The State total for a particular characteristic being estimated was obtained by multiplying each record's value for the characteristic by the record's integerized weight. The weighted values were then summed up over all the responding records in that State to obtain the State-level estimate.

RESPONDENT CONFIDENTIALITY

In keeping with the provisions of Title 7 of the United States Code, no data are published that would disclose information about the operations of an individual farm, unless there is specific written

permission. All tabulated data are subjected to an extensive disclosure review prior to publication. Any tabulated item that identifies data reported by a respondent or allows a respondent's data to be accurately estimated or derived, was suppressed and coded with a 'D'. However, the number of farms reporting an item is not considered confidential information and is provided even though other information is withheld.

DATA COMPARABILITY

Data definitions are comparable between the 2013 and 2005 aquaculture censuses, with the exception that the 2005 Census of Aquaculture did not include the algae categories of microalgae and sea vegetables. For 2013 algae was included in the data for total sales and miscellaneous sales. Specific data changes from 2005 are listed in Appendix B. Dollar figures are expressed in current dollars and have not been adjusted for inflation or deflation.

The census of aquaculture data are not directly comparable to the census of agriculture, due to different priorities and data definitions. A census of agriculture priority is the value of production of all agriculture (including aquaculture) at the county level. A census of aquaculture priority is a more specific look at U.S. and State-level aquaculture sales and aquaculture distributed for conservation.

In the 2012 Census of Agriculture all agriculture production moved off the farm had a value of sales reported or assigned. Aquaculture which was moved for distribution, conservation, recreation, etc. was assigned a value. In the 2013 Census of Aquaculture, farms with aquaculture which was produced and sold are included in tables 1 through 21, and 24. Aquaculture which was not sold, but distributed for conservation is included in tables 22 and 23 only.

The number of farms for each category is also affected between the two censuses. For county level data the census of agriculture attempts to get a response for each location. The census of aquaculture allowed one respondent to report for multiple locations, which reduces farm counts.

Another difference with the census of agriculture is the minimum level of production. The census of agriculture has a minimum of $1,000 of production or potential production of all agriculture items. For example, a farm with $200 of crayfish and $900 of rice is included. The census of aquaculture minimum is $1,000 worth of aquaculture production either sold or distributed for conservation, which could reduce the number of farms.

The last difference is that the census of agriculture food fish category excludes catfish and trout. The census of aquaculture includes catfish and trout in the food fish totals.

MEASURES OF CENSUS QUALITY

There are two main types of estimation error that affect all estimates obtained from almost any survey. These errors make it unlikely that estimates obtained from the 2013 Census of Aquaculture will exactly match the true value in the population for a given farm characteristic.

The first type of error, referred to as non-observation error, occurs in any estimate generated from a survey in which nonresponse occurs or data are not potentially obtainable from every unit in the target population. Statistical weighting as described in the Estimation section is used to reduce the effects of this type of error.

The second type of error is called non-sampling error. There are many sources of nonsampling error. Respondent reporting errors, data collection errors, data keying errors, data editing errors are all examples of errors of this type. Quality controlled data processing is used to keep the effect of non-sampling errors to a minimum.

Census Response Rate

The response rate is one indicator of the quality of a data collection. It is generally assumed that if a response rate is close to a full participation level of 100 percent, the potential for nonresponse bias is small. Because the aquaculture mail list contained both farm and non-farm records, the response rate is an indicator of replying to the data collection effort, but does not reflect whether those responding records qualified for data summarization. The response rate for the 2013 Census of Aquaculture is 90.2 percent.

MEASURES OF PRECISION

Census data obtained from the 2013 Census of Aquaculture are based on the data obtained from a particular set of respondents. If the entire census of aquaculture process was repeated over and over, it is not likely that the same exact mailing list would be constructed nor the exact same set of responding farm operators be obtained. The data obtained from each replication would undoubtedly lead to variation in the estimates being produced by the census. The question of how much these estimates might be expected to differ can be estimated by a statistic called the standard error, and also a closely related statistic called the relative standard error (sometimes referred to as the coefficient of variation).

The relative standard error is used as an indicator of the precision in the estimates and is reported for major items in Table A. The relative standard error expresses the standard error of an estimate as a percent of the estimated value. The standard error of a survey estimate is a measure of the variation among the estimates from all possible samples. It is a measure of the precision with which an estimate from a particular sample approximates the average result of all possible samples.

The relative standard errors given in Table A can be used to construct confidence intervals for the major items. Confidence intervals are another way to express the precision of an estimate by calculating the upper and lower bounds for a level of confidence. This confidence interval is designed to contain the true value being estimated. If all possible samples were selected, each of the samples was surveyed under essentially the same conditions, and an estimate and its standard error were calculated from each sample, then:

1. Approximately 67 percent of the intervals from one standard error below the estimate to one standard error above the estimate would include the average value of all possible samples.

2. Approximately 95 percent of the intervals from 2.0 standard errors below the estimate to 2.0 standard errors above the estimate would include the average value of all possible samples.

The computations necessary to construct the confidence intervals associated with these statements are illustrated in the following example: Assume that the estimated number of goldfish produced in a State is 100,000 and the relative standard error of the estimate is 10.0 percent (.10). Multiplying 100,000 by 0.10 yields 10,000, the standard error. Therefore, a 67-percent confidence interval is defined by the range (90,000 to 110,000) or equivalently 100,000 plus or minus 10,000. If corresponding confidence intervals were constructed for all possible samples of the same size and design, approximately 2 out of 3 (67 percent) of these intervals would contain the true number of goldfish produced in the State. Similarly, an approximate 95-percent confidence interval is (80,000 to 120,000) obtained using 100,000 plus or minus 2.0 x 10,000.

Table A. **Coefficient of variation – United States and States: 2013**

[For meaning of abbreviations and symbols, see introductory text.]

Geographic area	Farms	Coefficient of variation (percent)	Value ($1,000)	Coefficient of variation (percent)
CATFISH				
United States	695	2.0	375,865	1.7
Alabama	140	4.3	107,248	1.4
Arkansas	49	4.6	28,582	4.0
California	42	10.8	10,951	25.1
Colorado	3	11.1	(D)	(D)
Connecticut	-	-	-	-
Florida	14	17.6	(D)	(D)
Georgia	33	11.5	1,531	8.9
Hawaii	6	33.6	24	40.7
Idaho	1	27.6	(D)	(D)
Illinois	7	23.0	262	5.0
Indiana	1	31.0	(D)	(D)
Iowa	7	7.1	76	1.9
Kansas	4	17.2	(D)	(D)
Kentucky	13	9.1	814	6.6
Louisiana	8	21.8	(D)	(D)
Maine	-	-	-	-
Maryland	1	1.0	(D)	(D)
Michigan	5	31.0	(D)	(D)
Minnesota	-	-	-	-
Mississippi	213	2.5	(D)	(D)
Missouri	14	12.1	1,256	3.4
Nebraska	7	16.7	44	5.4
New Hampshire	-	-	-	-
New Jersey	2	65.7	(D)	(D)
New Mexico	-	-	-	-
New York	1	57.1	(D)	(D)
North Carolina	25	14.9	4,378	3.7
Ohio	7	16.6	316	2.4
Oklahoma	2	3.5	(D)	(D)
Oregon	2	45.8	(D)	(D)
Pennsylvania	4	26.4	37	6.8
South Carolina	6	25.0	22	34.6
South Dakota	-	-	-	-
Tennessee	7	15.5	72	8.0
Texas	54	8.7	21,521	20.4
Virginia	5	56.2	4	62.5
Washington	-	-	-	-
West Virginia	6	23.1	60	19.2
Wisconsin	6	23.0	14	46.2
BAITFISH				
United States	166	4.4	29,375	1.4
Alabama	5	40.1	18	41.2
Arkansas	23	6.6	18,360	1.5
California	2	99.1	(D)	(D)
Colorado	2	1.0	(D)	(D)
Florida	12	21.4	41	23.8
Georgia	3	35.5	147	17.4
Hawaii	-	-	-	-
Illinois	2	7.0	(D)	(D)
Indiana	1	31.0	(D)	(D)
Iowa	3	11.4	(D)	(D)
Kansas	3	22.9	47	8.2
Kentucky	-	-	-	-

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Table A. **Coefficient of variation – United States and States: 2013** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Geographic area	Farms	Coefficient of variation (percent)	Value ($1,000)	Coefficient of variation (percent)
BAITFISH - Con.				
Louisiana	6	28.8	(D)	(D)
Maine	1	26.9	(D)	(D)
Maryland	-	-	-	-
Massachusetts	1	34.5	(D)	(D)
Michigan	1	98.1	(D)	(D)
Minnesota	22	5.8	2,398	1.1
Mississippi	6	35.5	172	33.6
Missouri	6	19.9	950	19.7
Nebraska	2	41.2	(D)	(D)
New Hampshire	1	1.0	(D)	(D)
New Jersey	1	(H)	(D)	(D)
New York	7	22.6	83	29.3
North Carolina	2	34.1	(D)	(D)
North Dakota	-	-	-	-
Ohio	16	13.2	1,674	1.4
Oklahoma	1	7.0	(D)	(D)
Pennsylvania	6	15.6	270	1.2
South Carolina	1	87.4	(D)	(D)
South Dakota	2	1.0	(D)	(D)
Tennessee	1	1.0	(D)	(D)
Texas	9	23.2	(D)	(D)
Virginia	1	90.2	(D)	(D)
West Virginia	3	29.6	68	11.8
Wisconsin	11	20.2	1,546	3.0
Wyoming	3	32.5	4	38.7
CRUSTACEANS				
United States	566	2.8	84,880	10.1
Alabama	11	25.2	1,374	21.4
Alaska	1	1.0	(D)	(D)
Arizona	-	-	-	-
Arkansas	3	38.8	(D)	(D)
California	-	-	-	-
Colorado	1	1.0	(D)	(D)
Connecticut	-	-	-	-
Delaware	1	7.0	(D)	(D)
Florida	20	12.1	16,269	25.2
Georgia	3	38.0	135	46.7
Hawaii	12	15.0	15,876	35.7
Illinois	1	(H)	(D)	(D)
Indiana	-	-	-	-
Iowa	2	3.0	(D)	(D)
Kansas	-	-	-	-
Kentucky	11	20.0	(D)	(D)
Louisiana	407	3.4	35,301	4.5
Maine	-	-	-	-
Maryland	2	3.0	(D)	(D)
Massachusetts	2	48.6	(D)	(D)
Michigan	-	-	-	-
Minnesota	1	3.0	(D)	(D)
Mississippi	5	35.8	(D)	(D)
Missouri	3	35.5	9	35.3
Nevada	-	-	-	-
New Hampshire	1	1.0	(D)	(D)
New Jersey	1	72.7	(D)	(D)
New York	-	-	-	-

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Table A. **Coefficient of variation – United States and States: 2013** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Geographic area	Farms	Coefficient of variation (percent)	Value ($1,000)	Coefficient of variation (percent)
CRUSTACEANS - Con.				
North Carolina	19	19.0	334	26.7
Ohio	4	24.1	58	36.4
Pennsylvania	-	-	-	-
South Carolina	10	20.5	431	20.3
Tennessee	1	1.0	(D)	(D)
Texas	23	14.1	9,591	45.9
Vermont	-	-	-	-
Virginia	17	11.6	(D)	(D)
Washington	3	34.3	51	53.8
Wisconsin	1	62.6	(D)	(D)
ORNAMENTAL FISH				
United States	285	3.6	41,485	5.3
Alabama	-	-	-	-
Arizona	3	79.2	6	79.2
Arkansas	6	8.7	1,598	6.5
California	18	21.1	(D)	(D)
Colorado	-	-	-	-
Connecticut	-	-	-	-
Florida	127	4.5	27,128	6.3
Georgia	-	-	-	-
Hawaii	14	19.2	(D)	(D)
Idaho	2	19.9	(D)	(D)
Illinois	2	49.0	(D)	(D)
Indiana	1	1.0	(D)	(D)
Iowa	1	3.0	(D)	(D)
Kansas	-	-	-	-
Kentucky	2	25.9	(D)	(D)
Louisiana	4	49.9	(D)	(D)
Maine	1	1.0	(D)	(D)
Maryland	2	3.5	(D)	(D)
Massachusetts	2	77.9	(D)	(D)
Michigan	6	23.6	(D)	(D)
Minnesota	1	52.1	(D)	(D)
Mississippi	1	41.7	(D)	(D)
Missouri	10	15.8	1,690	9.0
Nebraska	4	29.2	(D)	(D)
New Hampshire	3	40.7	38	59.7
New Jersey	5	30.0	(D)	(D)
New Mexico	1	(H)	(D)	(D)
New York	4	27.6	(D)	(D)
North Carolina	10	24.7	(D)	(D)
Ohio	8	13.6	113	8.7
Oklahoma	3	40.4	(D)	(D)
Oregon	4	23.3	19	23.4
Pennsylvania	16	12.0	615	1.8
Rhode Island	-	-	-	-
South Carolina	2	44.0	(D)	(D)
South Dakota	-	-	-	-
Tennessee	4	23.1	(D)	(D)
Texas	4	45.1	42	54.1
Virginia	3	31.2	(D)	(D)
Washington	4	42.2	25	42.0
West Virginia	3	29.6	8	16.7
Wisconsin	4	39.4	8	42.1