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Veterinary Services

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VS

Catfish 2003

Part I: Reference of Fingerling Catfish Health and Production Practices in the United States, 2003

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The Catfish 2003 study was a cooperative effort among representatives of producer organizations, universities, State and Federal catfish health and production personnel, and others allied with the industry. We want to thank everyone who helped determine the direction and objectives of this study.

Thanks also to the National Agricultural Statistics Service (NASS) enumerators who visited the operations and collected the data. Their hard work and dedication to the National Animal Health Monitoring System (NAHMS) are invaluable. The roles of the producer, Area Veterinarian in Charge (AVIC), NAHMS Coordinator, and NASS enumerators were critical in providing quality data for Catfish 2003 reports. Thanks also to the personnel at the Centers for Epidemiology and Animal Health (CEAH) for their efforts in generating and distributing valuable reports from Catfish 2003 data.

All participants are to be commended, particularly the producers whose voluntary efforts made the Catfish 2003 study possible.

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Introduction

Sponsored by the USDA:APHIS: Veterinary Services (VS), the National Animal Health Monitoring System (NAHMS) undertook its first national study of the catfish industry with the Catfish ’97 study. Catfish 2003 is the second NAHMS catfish study, and like its predecessor was designed to provide both participants and the industry with valuable information on health and management practices on U.S. catfish operations.

This report is the first in a series of reports documenting Catfish 2003 results. Specific objectives of Catfish 2003 are described in Section II: Methodology. The USDA’s National Agricultural Statistics Service (NASS) collaborated with VS to query catfish producers in four participating States: Alabama, Arkansas, Louisiana, and Mississippi. These four States represented the nation’s major catfish producing States, accounting for: 73.4 percent of all U.S. catfish operations on January 1, 2003; 95.5 percent of the total national catfish sales in 2002; and 95.5 percent of the water surface acres to be used for catfish production from January 1 through June 30, 2003. From January 2 through February 14, 2003, NASS enumerators attempted to administer a questionnaire to all known catfish producers, either by phone or through a personal visit. There were 739 respondents to the questionnaire in the four participating States: (Alabama = 223, Arkansas = 157, Louisiana = 67, Mississippi = 292) with an overall response rate of 79.0 percent. All NAHMS Catfish 2003 publications are based upon data collected from these producers via this one collection period. The major publications are:

Part I: Reference of Fingerling Catfish Health and Production Practices in the United States, 2003 focuses on aspects of disease and production of catfish fingerlings.

Part II: Reference of Foodsize Catfish Health and Production Practices in the United States, 2003 focuses on aspects of disease and production of foodsize fish.

The methods used in Catfish 2003 are documented in the last section of the reports.

Further information on NAHMS studies and reports are available online at: www.aphis.usda.gov/vs/ceah/cahm

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Terms Used in This Report

Agitators: A vertical paddle that spins to aerate water in a small area (1/10 horsepower electric motor with a blade attached).

Air stones: Porous stones attached to an air source to create air bubbles.

Algal toxins: Algae-produced chemicals that can kill fish.

Brood stock: Adult catfish (male and female) intended for use in spawning.

Bacterial infection: Sometimes called bacterial egg rot. Occurs when bacteria attack eggs, typically at temperatures above 82 degrees Fahrenheit, and can be recognized as a milky white dead patch on eggs, normally on the underside or center of the egg mass.

Degassing: The process of removing excess gas (particularly nitrogen) from water.

Egg mass: Eggs from a single female catfish, naturally held together by a gelatinous substance.

ESC: Enteric Septicemia of Catfish, an economically important bacterial disease of catfish; also known as hole-in-head disease.

Fingerling: A 1- to 8-inch fish, generally larger than fry but smaller than foodsize fish.

Foodsize fish: Fish of marketable size, generally more than 10-inches long and up to 3 pounds in weight.

Fry: Newly hatched fish less than 1-inch long.

Fungal infection: Fungus growth on infertile or dead eggs that occurs when water temperature is below 78 degrees Fahrenheit. Appears as a white or brown cottonlike growth.

Growout: Raising fingerlings to harvest size (generally 1.3 to 3.0 pounds).

Hatchery: Portion of operation devoted to hatching eggs and the initial rearing of fry.

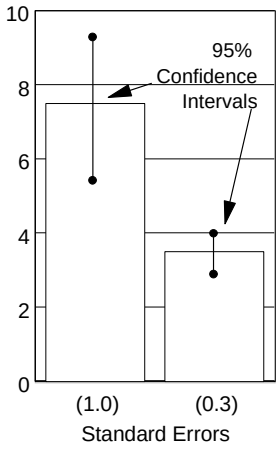
Ich (pronounced “ick”): Also known as white spot disease, *Ichthyophthirius multifiliis* is a parasitic disease of fish noted by white spots on skin.

Krill: Species of small marine shrimp commonly dried and sold as fish feed.

Operation average: The average value for all operations. A single value for each operation is summed over all operations reporting divided by the number of operations reporting. For example, operation average number of years between draining ponds (shown on page 18) is calculated by summing reported average number of years between draining ponds over all operations divided by the number of operations.

Paddles: Attachments to a horizontal rotating bar over hatching troughs that promote water movement over eggs to simulate the natural fanning action of a male catfish’s tail.

Examples of a 95% Confidence Interval



Population estimates: Estimates in this report are provided with a measure of precision called the **standard error.** A 95-percent confidence interval can be created with bounds equal to the estimate, plus or minus two standard errors. If the only error is sampling error, the confidence intervals created in this manner will contain the true population mean 95 out of 100 times. In the example at the left, an estimate of 7.5 with a standard error of 1.0 results in limits of 5.5 to 9.5 (two times the standard error above and below the estimate). The second estimate of 3.4 shows a standard error of 0.3 and results in limits of 2.8 and 4.0. Alternatively, the 90 percent confidence interval would be created by multiplying the standard error by 1.65 instead of 2. In general, when comparing point estimates between categories, estimates with confidence levels that overlap are not considered different. Most estimates in this report are rounded to the nearest tenth. If rounded to zero, the standard error was reported. If there were no reports of the event, no standard error was reported.

Raceway: A structure with a continual flow of water built to hold fish.

Regions
East: Alabama, Eastern Mississippi
West: Arkansas, Louisiana, Western Mississippi (Delta)

Renovation: The draining and drying of ponds, followed by the use of accumulated sediment to rebuild levees.

Sac fry: Newly hatched fry that still have an external yolk sac evident.

Sample profile: Information that describes characteristics of the sites from which Catfish 2003 data were collected.

Size of operation(s): Operation sizes are based on January 1, 2003, inventory. For breeding operations: small operations are those with 2,000 broodstock or less; large operations are those with more than 2,000 broodstock. For hatchery operations: small operations are those with 1,000 spawns or less; large operations are those with more than 1,000 spawns. For fingerling operations: small operations are those with 1 million fry stocked or less; large operations are those with more than 1 million fry stocked.

Spawns: See egg masses.

Swim-up: Movement of fry to the surface looking for food after yolk sac is absorbed, typically 3 to 5 days after hatching.

Trough: Generally a flat-bottom wooden, fiberglass, or metal structure about 8-feet long, 2-feet wide, and 10-inches deep with a water inlet at one end and a drain at the other.

Vaccination: The only vaccine in use in the catfish industry is for ESC. Fry are vaccinated by being immersed in a bath containing the ESC vaccine.

Section I: Population Estimates

A. Broodstock Management

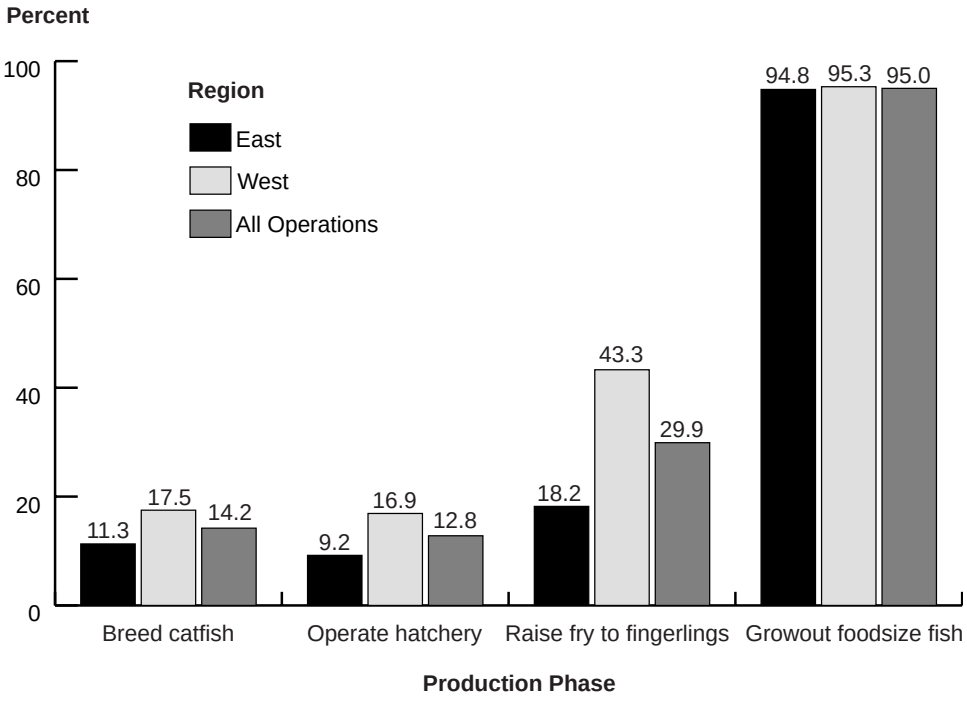
1. Distribution of production phases

Most catfish operations (95.0 percent) raised foodsize fish. A higher percentage of operations in the West region bred catfish, operated a hatchery, and/or raised fry to fingerlings as compared to operations in the East region.

a. Percentage of all catfish operations by phase of production and by region:

	Percent Operations					
	Region					
	East		West		All Operations	
Production Phase	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Breed catfish	11.3	(0.8)	17.5	(1.2)	14.2	(0.7)
Operate hatchery	9.2	(0.7)	16.9	(1.2)	12.8	(0.7)
Raise fry to fingerlings	18.2	(1.0)	43.3	(1.4)	29.9	(0.9)
Growout foodsize fish	94.8	(0.6)	95.3	(0.6)	95.0	(0.4)

Percent of All Catfish Operations by Phase of Production and by Region



2. Broodstock lines

Almost one-fourth of all catfish breeding operations (23.7 percent) had NWAC-103 broodstock, although a higher percentage of large operations (39.1 percent) had that line compared to small operations (3.2 percent). A similar pattern was present for Goldkist broodstock. The use of pond run fish as broodstock was a fairly common practice (34.8 percent of operations).

a. Percentage of breeding operations that had the following broodstock lines on January 1, 2003, by size of operation:

	Percent Operations					
	Size of Operation (Broodstock Inventory)					
	Small (2,000 or Less)		Large (More than 2,000)		All Operations	
Line	Pct.	Standard Error	Pct.	Standard Error	Pct.	Standard Error
NWAC103	3.2	(1.7)	39.1	(4.1)	23.7	(2.6)
Kansas	4.9	(1.2)	6.5	(2.0)	5.8	(1.2)
Goldkist	18.6	(2.8)	34.2	(4.1)	27.5	(2.7)
Norris	0.0	(--)	0.0	(--)	0.0	(--)
Blue catfish	15.1	(2.2)	4.9	(2.0)	9.2	(1.5)
Other channel catfish line	44.0	(3.4)	24.5	(3.6)	32.8	(2.6)
Pond run fish	26.1	(3.0)	41.3	(4.3)	34.8	(2.8)

A higher percentage of catfish breeding operations in the West region (34.7 percent) had NWAC103 broodstock than operations in the East region (8.7 percent). Similarly, a higher percentage of breeding operations in the West region (46.4 percent) used pond run fish than operations in the East region (19.1 percent).

b. Percentage of breeding operations that had any of the following broodstock lines on January 1, 2003, by region:

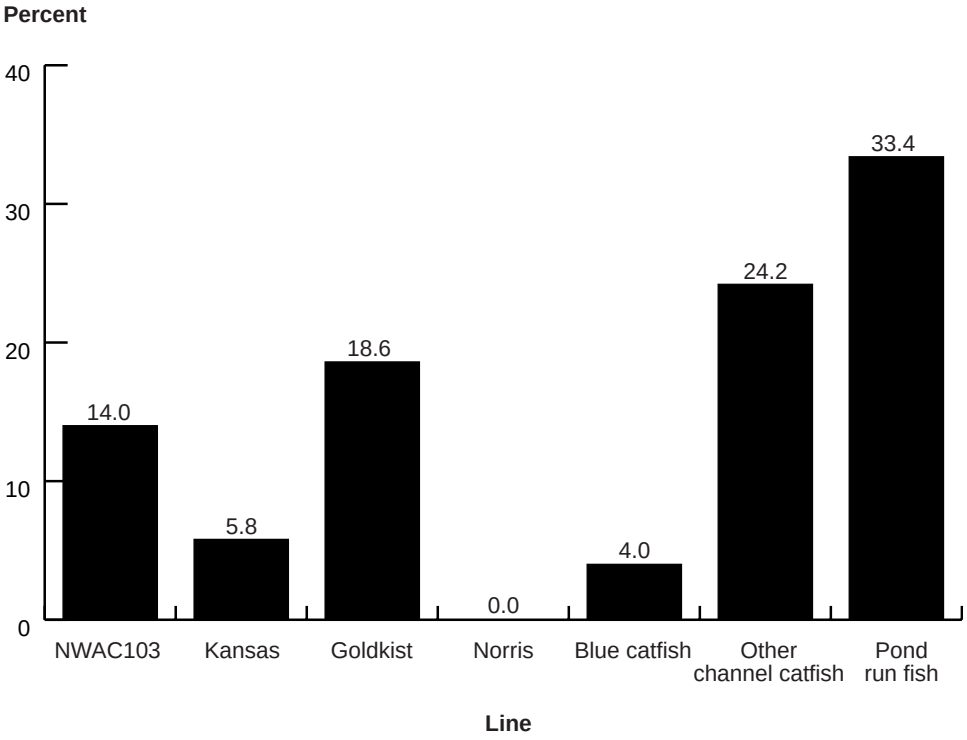
	Percent Operations			
	Region			
	East		West	
Line	Pct.	Std. Error	Pct.	Std. Error
NWAC103	8.7	(2.4)	34.7	(4.0)
Kansas	10.1	(1.8)	2.7	(1.7)
Goldkist	28.3	(3.6)	26.9	(3.8)
Norris	0.0	(--)	0.0	(--)
Blue catfish	12.8	(2.1)	6.6	(2.1)
Other channel catfish	44.5	(3.6)	24.3	(3.6)
Pond run fish	19.1	(2.9)	46.4	(4.2)

Pond run fish and “other” channel catfish lines accounted for the largest percentage of broodstock on catfish breeding operations (57.6 percent combined). Goldkist and NWAC103 broodstock represented the next largest percentage of broodstock (18.6 and 14.0 percent, respectively). Blue catfish comprised a small percentage of all broodstock (4.0 percent).

c. Percentage of broodstock by broodstock line present on January 1, 2003, and by region:

	Percent Broodstock					
	Region					
	East		West		All Operations	
Line	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
NWAC103	6.1	(2.0)	16.0	(2.6)	14.0	(2.3)
Kansas	18.4	(3.0)	2.6	(1.7)	5.8	(1.7)
Goldkist	19.3	(5.9)	18.4	(3.0)	18.6	(2.7)
Norris	0.0	(--)	0.0	(--)	0.0	(--)
Blue catfish	0.5	(0.2)	4.9	(2.2)	4.0	(1.7)
Other channel catfish	49.1	(5.6)	17.9	(4.1)	24.2	(4.1)
Pond run fish	6.6	(2.3)	40.2	(4.7)	33.4	(4.1)
Total	100.0		100.0		100.0	

Percent of Broodstock by Broodstock Line Present on January 1, 2003



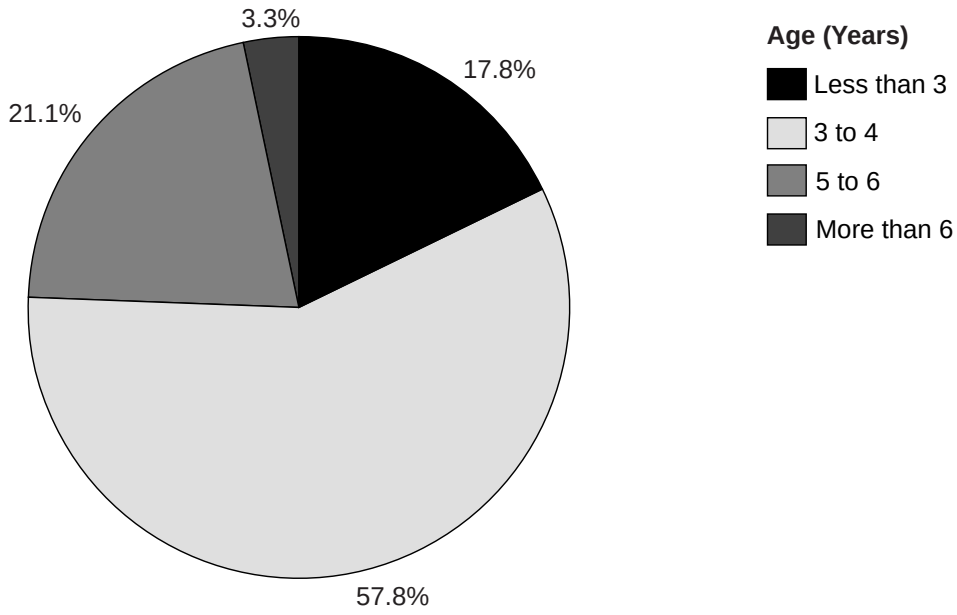
3. Broodstock by age

The majority of broodstock (57.8 percent) was 3 to 4 years of age. However, a substantial percentage (21.1 percent) was 5 to 6 years old.

a. Percentage of broodstock by age:

Age (Years)	**Percent Broodstock**	**Standard Error**
Less than 3	17.8	(3.6)
3 to 4	57.8	(4.9)
5 to 6	21.1	(2.9)
More than 6	3.3	(0.8)
Total	100.0	

Percent of Broodstock by Age



4. Annual cycle rate (cull rate) of broodstock

Approximately one in six catfish broodstock was culled in 2002, relative to the January 1, 2003, inventory. The low percentage of broodstock over 6 years of age present on breeding operations is consistent with this culling rate (table 3.a).

a. Percentage of broodstock culled in 2002 relative to January 1, 2003, broodstock inventories, by operation size:

Percent Broodstock Culled

Size of Operation (Broodstock Inventory)					
Small (2,000 or Less)		**Large** (More than 2,000)		**All Operations**	
Pct.	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
4.4	(1.2)	16.7	(3.5)	16.3	(3.4)

Over one-half of catfish breeding operations (54.5 percent) did not cull any broodstock in 2002, while almost one-fifth of operations (19.1 percent) culled 21 percent or more of their broodstock in 2002, relative to the January 1, 2003, inventory.

b. Percentage of breeding operations by percentage of broodstock culled in 2002 and by size of operation:

Percent Operations

Percent Broodstock Culled	Size of Operation (Broodstock Inventory) Small (2,000 or Less) Percent	Small (2,000 or Less) Standard Error	Large (More than 2,000) Percent	Large (More than 2,000) Standard Error	All Operations Percent	All Operations Standard Error
0	61.2	(3.5)	49.1	(4.6)	54.5	(3.0)
1 to 10.9	21.8	(2.9)	23.8	(3.6)	22.9	(2.3)
11 to 20.9	2.6	(0.9)	4.3	(1.3)	3.5	(0.8)
21.0 or more	14.4	(2.8)	22.8	(4.2)	19.1	(2.6)
Total	100.0		100.0		100.0	

5. Reasons for culling

Half of all broodstock were culled for “other” reasons, which reflects the downsizing of inventory by some producers.

a. Percentage of broodstock culled for the following reasons:

Reason for Culling	Percent Broodstock Culled	Standard Error
Old age	22.6	(6.3)
Weight	7.9	(2.6)
Poor health	4.1	(1.4)
Poor reproductive success	15.1	(7.2)
Other	50.3	(11.7)
Total	100.0	

6. Broodstock losses

Nearly 15 percent of broodstock were lost to disease, predation, or other problems. Broodstock losses were higher in the West region than the East region. In combination with the cull rate (table 4.a), the reduction in the broodstock relative to the January 1, 2003, inventory was approximately 30 percent.

a. Percentage of broodstock lost to disease, predation, or other problems in 2002 by region:

Percent Broodstock					
Region					
East		West		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
4.1	(0.4)	17.1	(3.5)	14.5	(2.8)

Over one-fourth of catfish breeding operations (26.4 percent) lost broodstock due to fighting, although the percentage of all broodstock lost due to fighting was only 1.6 percent. Visceral toxicosis, a newly identified disease, was found on 4.9 percent of operations and accounted for the loss of 5.5 percent of all broodstock.

b. Percentage of breeding operations that lost broodstock (and percentage of broodstock lost) due to the following reasons:

Reason for Loss	Percent Operations	Std. Error	Percent Broodstock	Std. Error	Percent Total Losses	Std. Error
Enteric Septicemia of Catfish	9.1	(1.4)	0.2	(0.0)	1.4	(0.3)
Columnaris	9.0	(1.8)	0.6	(0.2)	4.2	(1.4)
Proliferative gill disease	0.0	(--)	0.0	(--)	0.0	(--)
Anemia	0.0	(--)	0.0	(--)	0.0	(--)
Winter kill	8.6	(1.7)	0.4	(0.1)	2.6	(0.7)
Visceral toxicosis of catfish	4.9	(1.3)	5.5	(2.1)	37.8	(10.1)
Fighting	26.4	(2.5)	1.6	(0.5)	11.1	(3.6)
Predation	14.8	(1.7)	0.1	(0.0)	0.5	(0.1)
Unknown causes	19.6	(2.5)	2.5	(1.1)	17.3	(0.7)
Other	10.5	(2.0)	3.6	(1.2)	25.1	(0.7)
Total	NA		14.5	(2.8)	100.0	

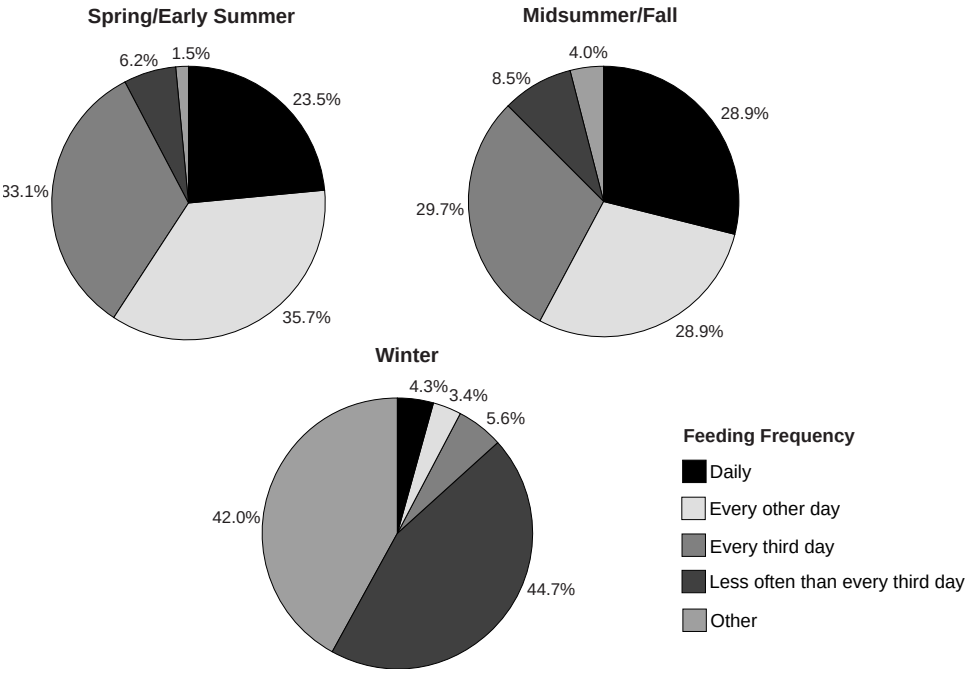
7. Seasonal feeding practices

Broodstock feeding patterns were similar in spring/early summer and midsummer/fall. Feeding frequency decreased substantially in winter. A large percentage of operations stated “other” feeding in winter, which includes “as weather permits.”

a. Percentage of breeding operations by seasonal feeding frequency for broodstock:

	Percent Operations					
	Season					
	Spring/Early Summer		Midsummer/Fall		Winter	
Feeding Frequency	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Daily	23.5	(2.3)	28.9	(2.6)	4.3	(0.8)
Every other day	35.7	(2.8)	28.9	(2.6)	3.4	(0.8)
Every third day	33.1	(2.7)	29.7	(2.7)	5.6	(1.1)
Less often than every third day	6.2	(1.4)	8.5	(1.6)	44.7	(2.9)
Other	1.5	(1.0)	4.0	(1.3)	42.0	(2.9)
Total	100.0		100.0		100.0	

Percent of Breeding Operations by Seasonal Feeding Frequency for Broodstock



8. Protein level fed

a. Percentage of breeding operations by protein level fed to broodstock:

Protein level (Percent)	Percent Operations	Standard Error
28	21.8	(2.5)
32	59.3	(2.9)
35	13.3	(2.2)
Other	5.6	(1.1)
Total	100.0	

9. Stocking of forage fish

While almost one-third of all catfish breeding operations (32.5 percent) stocked forage fish as a supplemental food source, the practice was more common in the East region (44.9 percent of operations) than the West region (23.5 percent of operations).

a. Percentage of breeding operations that stocked forage fish in broodstock ponds as a supplemental food source for broodstock, by region:

Percent Operations					
Region					
East		West		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
44.9	(3.6)	23.5	(3.4)	32.5	(2.5)

B. Spawning Management: Broodstock and Ponds

1. Number of spawning ponds

a. Percentage of breeding operations by number of spawning ponds used in 2002:

Number Spawning Ponds	Percent Operations	Standard Error
1	21.1	(2.0)
2 to 3	33.6	(2.6)
4 to 5	21.3	(2.6)
6 or more	24.0	(2.6)
Total	100.0	

2. Spawning pond draining and renovation

Most breeding operations (79.0 percent) drained ponds used for spawning channel catfish within 3 years, although a lower percentage of small operations (66.6 percent) drained ponds within this time period than large operations (89.1 percent). In contrast, only 9.6 percent of large operations completely renovated spawning ponds within 3 years, compared to 27.9 percent of small operations.

a. Percentage of breeding operations by number of years between draining spawning ponds (and by number of years between complete renovations) by size of operation:

Percent Operations

	Size of Operation (Broodstock Inventory)					
	Small (2,000 or Less)		**Large** (More than 2,000)		**All Operations**	
Years	**Pct.**	**Standard Error**	**Pct.**	**Standard Error**	**Pct.**	**Standard Error**
Drain ponds						
1 to 3	66.6	(3.6)	89.1	(2.2)	79.0	(2.2)
4 to 5	9.8	(1.9)	5.4	(1.6)	7.4	(1.2)
6 or more	23.6	(3.3)	5.5	(1.6)	13.6	(1.8)
Total	100.0		100.0		100.0	
Complete renovation						
1 to 3	27.9	(4.8)	9.6	(3.2)	15.5	(2.7)
4 to 5	15.4	(3.1)	9.1	(2.9)	11.1	(2.2)
6 or more	56.7	(5.2)	81.3	(4.1)	73.4	(3.3)
Total	100.0		100.0		100.0	

For all operations, 3.1 years was the average interval between draining spawning ponds, and 9.4 years was the average interval between renovating spawning ponds. Large breeding operations drained ponds more frequently than small breeding operations, averaging every 2.0 and 4.6 years, respectively. However, small operations renovated ponds sooner than large operations, averaging every 8.3 and 9.9 years, respectively.

b. Average number of years between draining spawning ponds and average number of years between complete renovations of spawning ponds, by size of operation:

Average Years

	Size of Operation (Broodstock Inventory)					
	Small (2,000 or Less)		**Large** (More than 2,000)		**All Operations**	
Procedure	**Years**	**Standard Error**	**Years**	**Standard Error**	**Years**	**Standard Error**
Drain ponds	4.6	(0.4)	2.0	(0.2)	3.1	(0.2)
Complete renovation	8.3	(0.5)	9.9	(0.4)	9.4	(0.3)

3. Broodstock stocking densities

Most catfish breeding operations stocked at least 1,000 pounds of broodstock per acre in spawning ponds (65.8 percent of operations, and 86.0 percent of broodstock). Although a substantial percentage of operations (22.7 percent) stocked less than 800 pounds of broodstock per acre, the percentage of all broodstock stocked at this density was relatively low (7.0 percent).

a. Broodstock stocking densities (pounds per acre):

Stocking Density (lbs/Acre)	Operation Percent	Std. Error	Broodstock Percent	Std. Error
Less than 800	22.7	(2.1)	7.0	(4.1)
800 to 999	11.5	(1.8)	7.0	(3.4)
1,000 to 1,199	38.9	(3.0)	44.4	(9.4)
1,200 or more	26.9	(2.6)	41.6	(10.5)
Total	100.0		100.0	

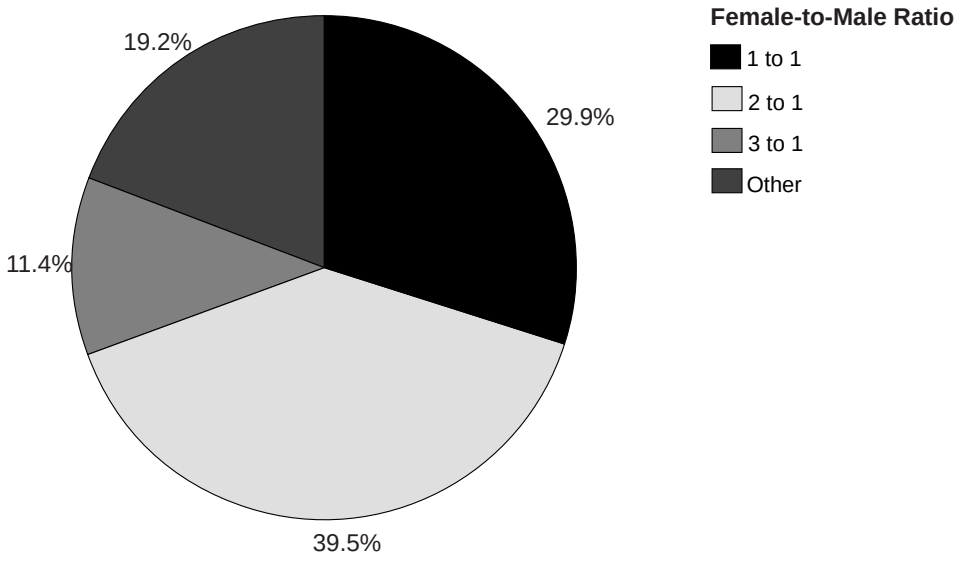
4. Female-to-male ratio in spawning ponds

Most operations stocked broodstock in spawning ponds with a ratio of two females to one male, although a large percentage stocked females and males in equal numbers. The “other” category included operations that stocked three females to two males.

a. Percentage of breeding operations by female-to-male broodstock ratio in spawning ponds and by size of operation:

	Percent Operations					
	Size of Operation (Broodstock Inventory)					
	Small (2,000 or less)		Large (More than 2,000)		All Operations	
Female-to-Male Ratio	Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
1 to 1	37.3	(3.4)	24.4	(3.7)	29.9	(2.6)
2 to 1	35.6	(3.4)	42.4	(4.3)	39.5	(2.9)
3 to 1	15.6	(2.4)	8.3	(1.9)	11.4	(1.5)
Other	11.5	(2.6)	24.9	(4.0)	19.2	(2.6)
Total	100.0		100.0		100.0	

Percent of Breeding Operations by Female-to-Male Broodstock Ratio in Spawning Ponds



C. Spawning Management: Egg Management Prior to Hatchery

1. Egg mass transfer

More than one-half of breeding operations placed less than one egg mass per gallon of water in the container used to transfer eggs from pond to hatchery. Few operations transferred more than 1.5 egg masses per gallon of water in the container.

a. Percentage of breeding operations by average number of egg masses per gallon of water in container used to transfer eggs from pond to hatchery:

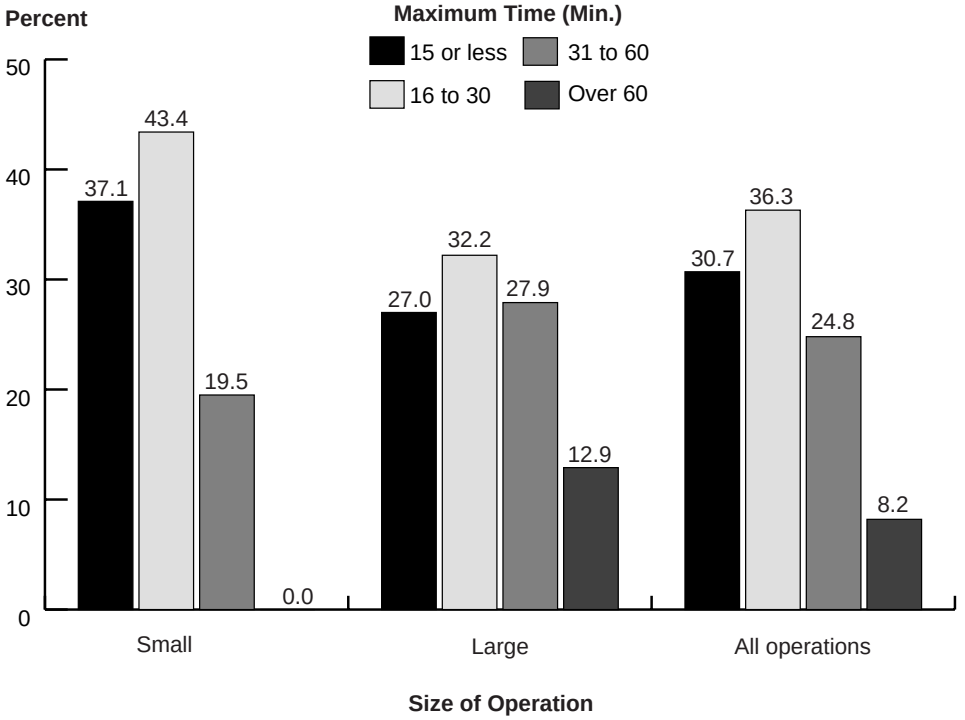
Average Number of Egg Masses Per Gallon	Percent Operations	Standard Error
Less than 1	58.2	(3.4)
1 to 1.5	24.4	(3.0)
More than 1.5	17.4	(2.5)
Total	100.0	

The maximum time between collection of eggs from the pond and placement in the hatchery did not vary much between large and small operations, except that some large operations allowed the maximum time to exceed 1 hour. The maximum holding time did not exceed 15 minutes in 30.7 percent of all breeding operations.

b. Percentage of breeding operations by average maximum time between collection of eggs from pond and placement of eggs in hatchery, and by size of operation:

	Percent Operations					
	Size of Operation (Broodstock Inventory)					
	Small (2,000 or Less)		Large (More than 2,000)		All Operations	
Maximum Time (Min.)	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
15 or less	37.1	(4.1)	27.0	(4.1)	30.7	(3.0)
16 to 30	43.4	(4.1)	32.2	(4.3)	36.3	(3.1)
31 to 60	19.5	(3.7)	27.9	(3.8)	24.8	(2.8)
Over 60	0.0	(--)	12.9	(3.3)	8.2	(2.1)
Total	100.0		100.0		100.0	

Percent of Breeding Operations by Average Maximum Time Between Collection of Eggs From Pond and Placement of Eggs in Hatchery, and by Size of Operation



2. Egg mass aeration

A higher percentage of large breeding operations (70.8 percent) aerated egg transfer containers than small operations (41.0 percent). Operations that did aerate egg transfer containers had an average maximum holding time of 47.1 minutes, compared to 22.4 minutes for nonaerated transfer containers.

a. Percentage of breeding operations that aerated egg transfer containers, by size of operation:

Percent Operations

Size of Operation (Broodstock Inventory)					
Small (2,000 or Less)		**Large** (More than 2,000)		**All Operations**	
Percent	**Standard Error**	**Percent**	**Standard Error**	**Percent**	**Standard Error**
41.0	(3.8)	70.8	(3.8)	59.0	(2.8)

b. Average maximum time (minutes) between collection of eggs and placement of eggs in hatchery, by use of aeration in transfer containers:

Container Aeration	**Average Maximum Time** (Minutes)	**Standard Error**
Aerate transfer containers	47.1	(3.5)
Do not aerate transfer containers	22.4	(1.0)

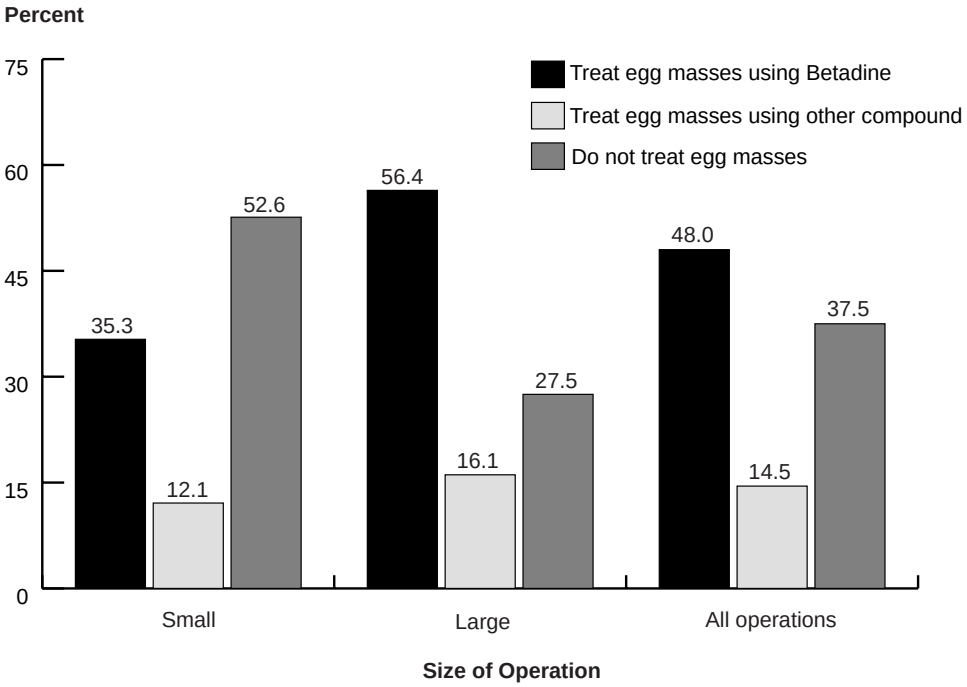
3. Egg mass treatment

Almost one-half of all breeding operations treated egg masses with Betadine® prior to placement in the hatchery. Small breeding operations were less likely to treat egg masses with any compound (100.0 - 52.6 = 47.4 percent) than large operations (100.0 - 27.5 = 72.5 percent).

a. Percentage of breeding operations by egg mass treatment prior to entry into hatchery, and by size of operation:

	Percent Operations					
	Size of Operation (Broodstock Inventory)					
	Small (2,000 or Less)		**Large** (More than 2,000)		**All Operations**	
Treatment	**Pct.**	**Standard Error**	**Pct.**	**Standard Error**	**Pct.**	**Standard Error**
Treat egg masses using Betadine	35.3	(3.8)	56.4	(4.4)	48.0	(3.1)
Treat egg masses using other compound	12.1	(2.3)	16.1	(3.1)	14.5	(2.1)
Do not treat egg masses	52.6	(3.8)	27.5	(4.1)	37.5	(2.9)
Total	100.0		100.0		100.0	

Percent of Breeding Operations by Egg Mass Treatment Prior to Entry into Hatchery, and by Size of Operation



D. Hatchery Management: Hatching Trough /Fry Trough Management

1. Operations with hatchery

a. Percentage of all catfish operations with a hatchery for hatching eggs:

Percent Operations	Standard Error
12.8	(0.7)

Most catfish hatcheries (97.2 percent) had their own broodstock for producing eggs for their hatchery.

b. Percentage of hatchery operations by broodstock inventory status:

Broodstock Inventory Status	Percent Operations	Standard Error
Hatchery with own broodstock	97.2	(1.0)
Hatchery with no broodstock	2.8	(1.0)
Total	100.0	

2. Hatchery water management

Water directly from a well was used to supply over 80 percent of hatchery operations (52.2 percent used water directly from a well and 28.8 percent used well water stored in a holding pond). A small percentage of operations (5.9 percent) used water from a creek or watershed and stored it in a holding pond.

a. Percentage of hatchery operations by primary water source for the hatchery:

Primary Water Source	Percent Operations	Standard Error
Well water stored in a holding pond	28.8	(2.3)
Water from a creek or watershed and stored in a holding pond	5.9	(1.0)
Water directly from a well	52.2	(2.8)
Mixture of water directly from a well and from a holding pond	9.2	(1.7)
Other sources	3.9	(1.1)
Total	100.0	

Over one-half of hatchery operations (51.3 percent) that used water directly from a well degassed it before it was used in the hatchery.

b. Percentage of hatchery operations that degassed well water before it was used in the hatchery:

Percent Operations	Standard Error
51.3	(4.8)

Water was not filtered prior to use in most hatchery operations (69.3 percent). A higher percentage of hatcheries in the West region (35.8 percent) used sand filters, compared to hatcheries in the East region (9.4 percent), although other filter types were used by 10.1 percent of hatcheries in the East region.

c. Percentage of hatchery operations by type of filter used for hatchery water and by region:

	Percent Operations					
	Region					
	East		West		All Operations	
Filter Type	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Sand	9.4	(2.1)	35.8	(4.0)	25.6	(2.7)
Other	10.1	(2.6)	1.9	(0.8)	5.1	(1.1)
None	80.5	(3.2)	62.3	(4.0)	69.3	(2.8)
Total	100.0		100.0		100.0	

d. Percentage of hatchery operations by water flow rate (gallons/minute) in hatching troughs:

Gallons per Minute	Percent Operations	Standard Error
1 to 3	36.5	(4.0)
4 to 5	46.9	(4.1)
More than 5	16.6	(2.6)
Total	100.0	

Paddles were the primary mechanism for water circulation (88.7 percent of operations) in hatching troughs, followed by air stones (38.8 percent of operations). In fry troughs, air stones were the primary water circulation mechanism (63.1 percent of operations) and paddles were less common (29.0 percent of operations).

e. Percentage of hatchery operations by water circulation method in hatching troughs and fry troughs:

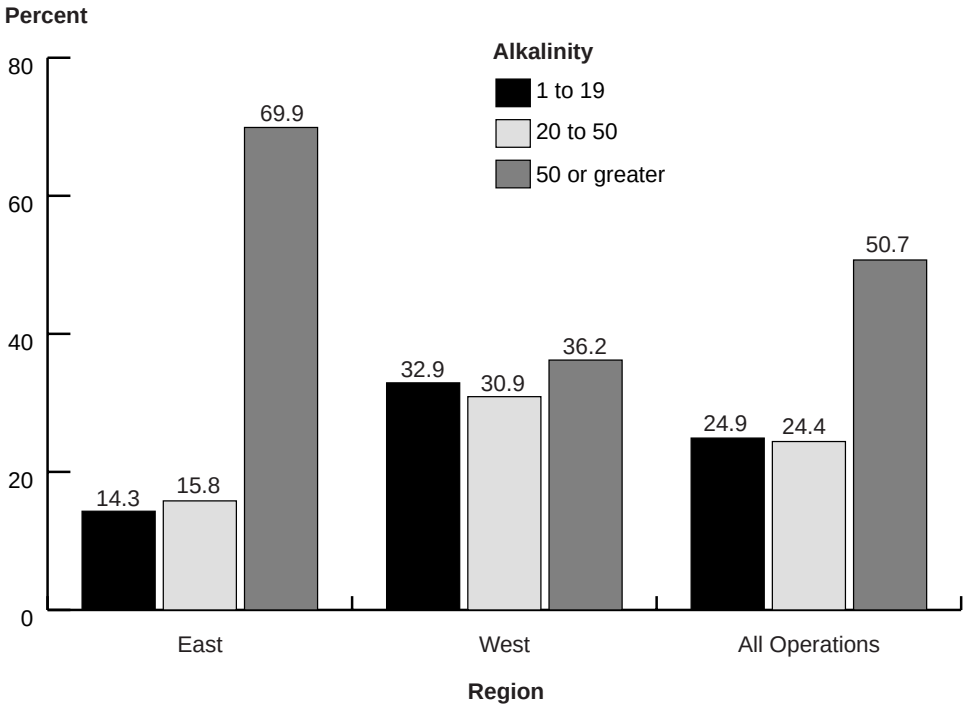
	Percent Operations			
	Hatching Troughs		Fry Troughs	
Method	Percent	Standard Error	Percent	Standard Error
Paddles	88.7	(2.1)	29.0	(2.6)
Air stones	38.8	(3.0)	63.1	(2.9)
Agitators	6.7	(1.5)	16.2	(2.2)
Other	6.2	(1.2)	11.3	(1.6)

A higher percentage of hatcheries in the East region (69.9 percent) had water with alkalinity levels greater than 50 parts per million (ppm) than hatcheries in the West region (36.2 percent). Almost one-third of hatcheries in the West region (32.9 percent) had alkalinity levels below 20 ppm. These differences in alkalinity are reflected in average alkalinity values nearly twice as high in East region hatcheries (108.0 ppm) than in West region hatcheries (56.7 ppm) (Table 2.g), and in the percentage of hatcheries in the West region that added calcium to maintain alkalinity (48.1 percent) (Table 2.h).

f. Percentage of hatchery operations by alkalinity (parts per million) of water used by hatcheries, and by region:

	Percent Operations					
	Region					
	East		West		All Operations	
Alkalinity (ppm)	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
1 to 19	14.3	(5.5)	32.9	(5.8)	24.9	(4.0)
20 to 50	15.8	(3.4)	30.9	(6.1)	24.4	(3.9)
50 or higher	69.9	(5.7)	36.2	(5.8)	50.7	(4.3)
Total	100.0		100.0		100.0	

Percent of Hatchery Operations by Alkalinity (Parts per Million) of Water Used by Hatcheries, and by Region



g. Average alkalinity (parts per million) of water used by hatcheries, by region:

Alkalinity					
Region					
East		West		All Operations	
Average	Standard Error	Average	Standard Error	Average	Standard Error
108.0	(9.1)	56.7	(6.1)	78.8	(5.6)

h. Percentage of hatchery operations that added calcium to water to maintain alkalinity, by region:

Percent Operations					
Region					
East		West		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
21.1	(3.8)	48.1	(4.2)	37.7	(3.1)

3. Density of eggs in hatching trough

a. Percentage of hatchery operations by density of eggs (number of egg masses/100 gallons) in hatching troughs:

Density (Egg Masses per 100 Gallons)	Percent Operations	Standard Error
1 to 15	52.0	(3.2)
16 to 30	38.5	(3.2)
30 or more	9.5	(2.1)
Total	100.0	

Egg mass in hatching trough

b. Average density of eggs (number of egg masses/100 gallons) in hatching troughs:

Average Density (Number of Egg Masses per 100 Gallons)	**Standard Error**
17.7	(0.7)

4. Turning of egg masses

Almost all hatcheries (98.8 percent) turned egg masses in hatching troughs at least once a day.

a. Percentage of hatchery operations by number of times per day that eggs were turned:

Times Per Day	**Percent Operations**	**Standard Error**
Not turned	1.2	(0.4)
1 to 2	30.5	(2.7)
3 or more	68.3	(2.7)
Total	100.0	

E. Egg Health Related Issues

1. Average number of spawns and pounds of eggs

In a typical hatchery production year, an average of 1,712 spawns (egg masses) with an average total weight of 2,144.4 pounds is brought into each hatchery. The estimated average weight of a spawn is 1.36 pounds. Average weight is calculated as a weighted ratio estimate of the total pounds divided by the total number of spawns. Since several hatcheries did not report weight information, the ratio estimate is not equal to the value that would be obtained if the average total weight of pounds is divided by the average number of spawns.

a. Average number of spawns, average pounds of eggs, and average weight of spawns brought to the hatchery for hatching in a typical production year:

Average Number of Spawns	**Standard Error**	**Average Pounds of Eggs**	**Standard Error**	**Average Weight (lbs) of Spawns**	**Standard Error**
1,712	(143)	2,144	(204)	1.4	(0.1)

2. Survival rate of eggs

Most hatcheries (60.7 percent) reported that between 76 to 90 percent of eggs brought into the hatchery survived to hatching. A higher percentage of small hatcheries (20.6 percent) reported that typically more than 90 percent of eggs survived to hatching, as compared to large hatcheries (7.2 percent).

a. Percentage of hatchery operations by percentage of eggs brought to the hatchery that typically survived to hatching, and by size of operation:

Percent Operations

Size of Operation (Number of Spawns)

	Small (1,000 or Less)		**Large** (More than 1,000)		**All Operations**	
Percent of Eggs Surviving to Hatching	**Percent Operations**	**Std. Error**	**Percent Operations**	**Std. Error**	**Percent Operations**	**Std. Error**
50 to 75	19.6	(2.7)	30.7	(5.3)	24.0	(2.7)
76 to 90	59.8	(3.5)	62.1	(5.4)	60.7	(3.0)
90 or more	20.6	(3.1)	7.2	(2.5)	15.3	(2.2)
Total	100.0		100.0		100.0	

Overall, almost 80 percent of eggs brought into the hatchery survived to hatching. The percentage of all eggs typically surviving to hatching did not differ significantly between small and large hatcheries.

b. Percentage of eggs brought into the hatchery operation (weighted by number of spawns) that typically survived to hatching, by size of operation:

Percent Eggs

Size of Operation (Number of Spawns)

Small (1,000 or less)		**Large** (More than 1,000)		**All Operations**	
Percent	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
82.5	(2.7)	78.9	(2.3)	79.3	(2.1)

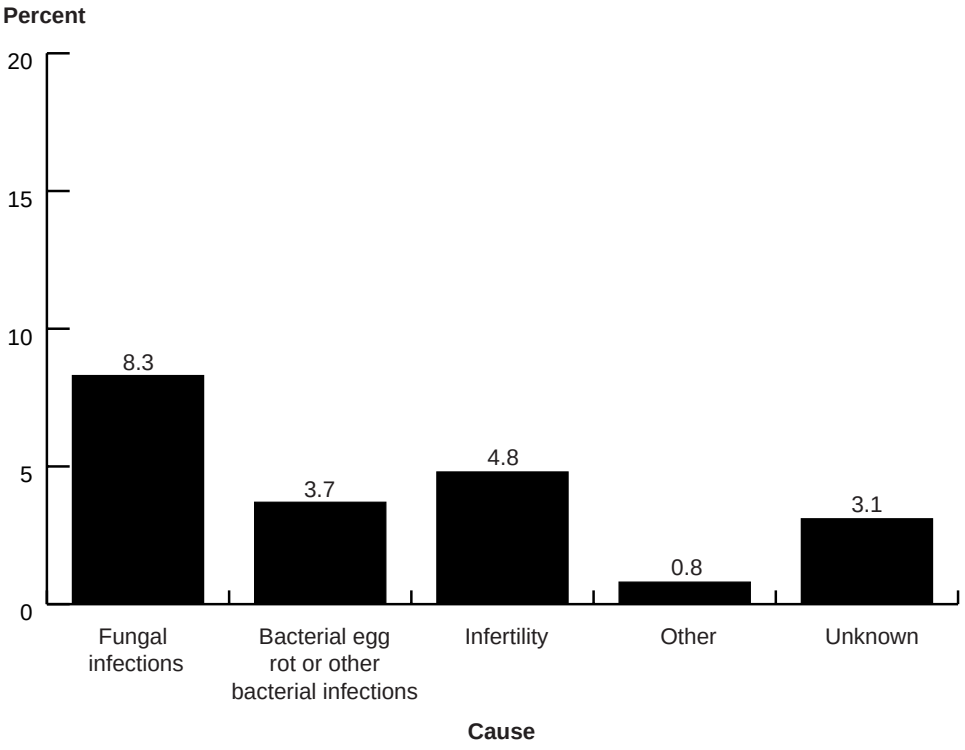
3. Eggs lost

Fungal infections accounted for the loss of 8.3 percent of all eggs brought into the hatchery. Infertility, bacterial infections, and unknown causes also represented a substantial percentage of losses (4.8, 3.7, and 3.1 percent of eggs, respectively).

a. Percentage of all eggs (weighted by number of spawns) that typically did not hatch, by cause:

Cause	Percent Eggs	Standard Error
Fungal infections	8.3	(1.7)
Bacterial egg rot (or other bacterial infections)	3.7	(0.7)
Infertility	4.8	(1.6)
Other	0.8	(0.7)
Unknown	3.1	(0.9)
Total	20.7	(2.1)

Percent of All Eggs (Weighted by Number of Spawns) that Typically Did Not Hatch, by Cause



More than three out of five hatcheries (65.1 percent) reported having any eggs that failed to survive to hatching because of fungal infections. Slightly over one-half of hatcheries (52.5 percent) reported some egg losses due to infertility, while less than one-half reported losses due to bacterial infections (44.8 percent) or unknown causes (44.4 percent).

b. Percentage of hatchery operations with any eggs that typically did not hatch, by cause:

Cause	Percent Operations	Standard Error
Fungal infections	65.1	(2.9)
Bacterial egg rot (or other bacterial infections)	44.8	(3.0)
Infertility	52.5	(3.0)
Other	9.6	(1.4)
Unknown	44.4	(3.0)

4. Fungal/bacterial prevention and treatment

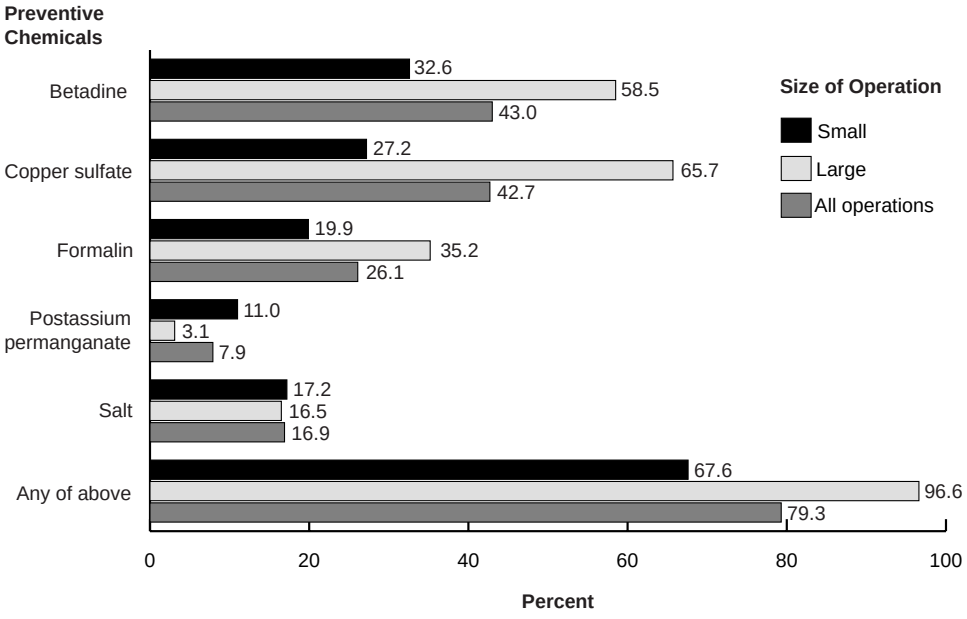
The majority of hatcheries (79.3 percent) used chemicals to prevent fungal or bacterial infections in hatching troughs. A higher percentage of large hatcheries than small hatcheries (96.6 and 67.6 percent, respectively) used at least one chemical to prevent fungal or bacterial infection. Betadine and copper sulfate were the most commonly used preventive chemicals (43.0 and 42.7 percent, respectively).

a. Percentage of hatchery operations that used chemicals to ***prevent*** fungal or bacterial infections in hatching troughs, by size of operation:

Percent Operations

	Size of Operation (Number of Spawns) **Small** (1,000 or Less)		**Large** (More than 1,000)		**All Operations**	
Preventive Chemicals	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Betadine	32.6	(3.4)	58.5	(5.5)	43.0	(3.0)
Copper sulfate	27.2	(3.4)	65.7	(5.4)	42.7	(3.1)
Formalin	19.9	(2.9)	35.2	(5.2)	26.1	(2.8)
Potassium permanganate	11.0	(2.2)	3.1	(1.3)	7.9	(1.5)
Salt	17.2	(2.6)	16.5	(3.6)	16.9	(2.1)
Any of above	67.6	(3.2)	96.6	(1.7)	79.3	(2.1)

Percent of Hatchery Operations that Used Chemicals to *Prevent* Fungal or Bacterial Infections in Hatching Troughs, by Size of Operation



Large hatcheries that used formalin, salt, copper sulfate, or Betadine to prevent fungal or bacterial infections applied them, on average, more than 1.5 times per day, while small hatcheries averaged less than 1.5 applications per day. Potassium permanganate was used an average of one time a day on both small and large hatcheries.

b. Average number of times per day hatchery operations used chemicals to ***prevent*** fungal or bacterial infections in hatchery troughs, by size of operation:

	Average Number of Times Per Day					
	Size of Operation (Number of Spawns)					
	Small (1,000 or Less)		**Large** (More than 1,000)		**All Operations**	
Preventive Chemicals	**Average**	**Std. Error**	**Average**	**Std. Error**	**Average**	**Std. Error**
Betadine	1.1	(0.0)	1.6	(0.1)	1.4	(0.1)
Copper sulfate	1.2	(0.1)	2.0	(0.2)	1.7	(0.1)
Formalin	1.4	(0.2)	2.5	(0.3)	2.0	(0.2)
Potassium permanganate	1.0	(0.0)	1.0	(0.0)	1.0	(0.0)
Salt	1.1	(0.0)	2.2	(0.6)	1.5	(0.2)

The use of chemicals to treat fungal infections paralleled the use of chemicals to prevent fungal or bacterial infections. Most large hatcheries (96.6 percent) used at least one chemical to treat fungal infections, while a lower percentage of small operations (61.7 percent) used at least one chemical to treat fungal infections. The two most common treatments for all operations were Betadine and copper sulfate.

c. Percentage of hatchery operations that used chemicals to ***treat*** fungal infections in hatching troughs, by size of operation:

	Percent Operations					
	Size of Operation (Number of Spawns) **Small** (1,000 or Less)		**Large** (More than 1,000)		**All Operations**	
Treatment Chemical	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Betadine	31.1	(3.4)	57.8	(5.4)	41.9	(3.1)
Copper sulfate	19.8	(2.9)	57.6	(5.5)	35.0	(2.9)
Formalin	19.6	(2.9)	27.7	(4.8)	22.9	(2.6)
Potassium permanganate	11.4	(2.4)	6.0	(1.8)	9.2	(1.6)
Salt	15.2	(2.5)	11.9	(2.4)	13.9	(1.8)
Any of above	61.7	(3.3)	96.6	(1.7)	75.7	(2.3)

A lower percentage of hatcheries (57.2 percent) used any chemicals to treat bacterial infections, compared to the percentage of hatcheries (75.7 percent) that used any chemicals to treat fungal infections (table 4.c). Similar percentages of large hatcheries used Betadine, copper sulfate, and formalin, while similar percentages of small hatcheries used those three chemicals and salt.

d. Percentage of hatchery operations that used chemicals to ***treat*** bacterial infections in hatching troughs, by size of operation:

	Percent Operations					
	Size of Operation (Number of Spawns) **Small** (1,000 or Less)		**Large** (More than 1,000)		**All Operations**	
Treatment Chemical	**Pct. Ops.**	**Std. Error**	**Pct. Ops.**	**Std. Error**	**Pct. Ops.**	**Std. Error**
Betadine	18.7	(3.1)	43.1	(5.4)	28.5	(2.9)
Copper sulfate	13.0	(2.3)	33.3	(4.8)	21.1	(2.4)
Formalin	13.7	(2.7)	35.2	(5.2)	22.4	(2.7)
Potassium permanganate	6.7	(1.9)	6.0	(1.8)	6.5	(1.4)
Salt	13.2	(2.4)	12.5	(2.7)	12.9	(1.8)
Any of above	40.5	(3.6)	81.9	(4.3)	57.2	(2.9)

F. Hatchery Management: Fry Management

1. Fry hatched annually

In a typical year, the average number of fry produced in a catfish hatchery is 17.2 million.

a. Operation average number of fry hatched annually, by size of operation:

Number of Fry Hatched (x 1,000)					
Size of Operation (Number of Spawns)					
Small (1,000 or Less)		**Large** (More than 1,000)		**All Operations**	
Number	**Standard Error**	**Number**	**Standard Error**	**Number**	**Standard Error**
6,162	(914)	33,575	(2,234)	17,216	(1,346)

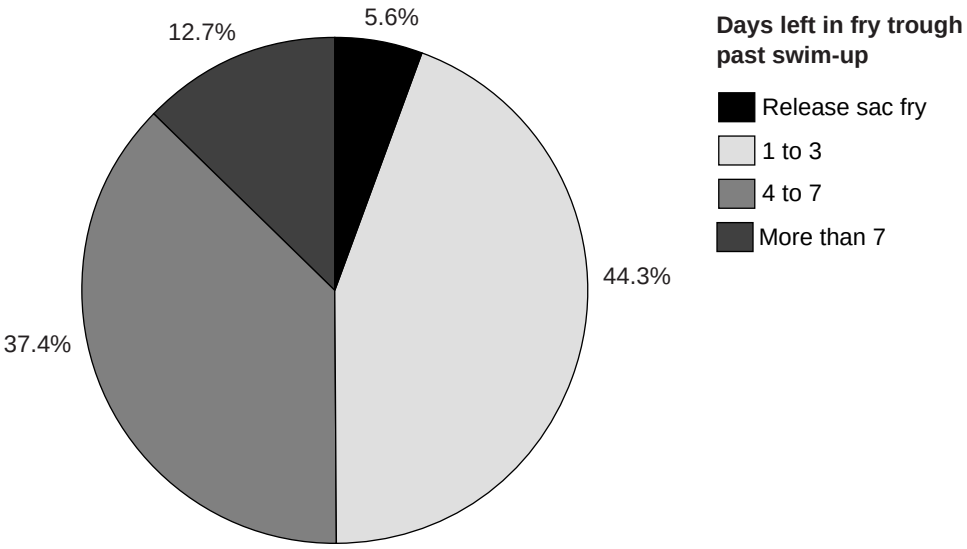
2. Fry left in fry troughs

Fry were left in fry troughs for 1 to 3 days past swim-up by 44.3 percent of all hatchery operations. A similar percentage of operations (37.4 percent) left fry in hatching troughs for 4 to 7 days past swim-up. The number of days fry stayed in fry troughs did not differ substantially between the East and West regions.

a. Percentage of hatchery operations by how many days fry were normally left in fry troughs past swim-up, and by region:

	Percent Operations					
	Region					
	East		**West**		**All Operations**	
Days Left in Fry Trough Past Swim-Up	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Release sac fry	7.1	(2.4)	4.7	(1.9)	5.6	(1.5)
1 to 3	41.9	(4.3)	45.9	(4.2)	44.3	(3.1)
4 to 7	35.0	(3.7)	38.9	(4.2)	37.4	(2.9)
More than 7	16.0	(2.8)	10.5	(2.1)	12.7	(1.7)
Total	100.0		100.0		100.0	

Percent of Hatchery Operations by How Many Days Fry Were Normally Left in Fry Trough Past Swim-Up



3. Primary feed in fry troughs

Catfish starter was the primary feed used by the highest percentage of hatcheries (68.3 percent). Almost 10 percent of hatcheries did not feed fry in fry troughs. The primary feed used was similar regardless of hatchery size.

a. Percentage of hatchery operations by primary feed fed in fry troughs and by size of operation:

	Percent Operations					
	Size of Operation (Number of Spawns)					
	Small (1,000 or Less)		**Large** (More than 1,000)		**All Operations**	
Primary Feed	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Catfish starter	67.0	(3.4)	70.2	(5.2)	68.3	(2.9)
Salmon/trout starter	11.5	(2.6)	10.4	(3.2)	11.1	(2.0)
Krill	2.3	(1.2)	11.9	(4.0)	6.2	(1.8)
Other	6.1	(1.4)	3.2	(1.5)	4.9	(1.0)
Nothing fed to fry in fry troughs	13.1	(2.3)	4.3	(2.7)	9.5	(1.8)
Total	100.0		100.0		100.0	

4. Times per day fry fed

a. For hatchery operations that fed fry, percentage of operations by number of times fry in fry troughs were fed in a 24-hour period:

Times Fed Per Day	Percent Operations	Standard Error
1 to 2	12.5	(1.8)
3 to 4	19.2	(2.1)
5 to 6	20.7	(2.6)
7 or more	47.6	(3.1)
Total	100.0	

5. Fry trough disinfection

Disinfecting between batches of fry was the most common fry trough disinfection procedure (85.8 percent of all operations). A higher percentage of small operations did not disinfect fry troughs (13.1 percent) compared to large operations (2.8 percent).

a. Percentage of hatchery operations by frequency of fry trough disinfection and by size of operation:

	Percent Operations					
	Size of Operation (Number of Spawns)					
	Small (1,000 or Less)		**Large** (More than 1,000)		**All Operations**	
Frequency	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Between batches of fry	78.0	(3.0)	97.2	(0.9)	85.8	(1.9)
Annually	4.3	(1.3)	0.0	(--)	2.5	(0.8)
Other	4.6	(1.6)	0.0	(--)	2.7	(0.9)
Do not disinfect	13.1	(2.5)	2.8	(0.9)	9.0	(1.6)
Total	100.0		100.0		100.0	

G. Fingerling Pond Management: Prior to Stocking

1. Raising fry to fingerlings

Almost one out of three catfish operations (29.9 percent) raised fry to fingerlings; these operations will hereafter be described as fingerling operations.

a. Percentage of all catfish operations that raised fry to fingerlings, by region:

Percent Operations					
Region					
East		West		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
18.2	(1.0)	43.3	(1.4)	29.9	(0.9)

2. Fry placed in raceways or tanks prior to stocking

The practice of placing fry in raceways or tanks (other than hatching or fry troughs) prior to stocking into fry/fingerling ponds was more common in the East region (15.9 percent of operations) than the West region (2.3 percent of operations).

a. Percentage of fingerling operations that placed fry in raceways or tanks (other than hatching or fry troughs) prior to stocking into fry/fingerling ponds, by region:

Percent Operations					
Region					
East		West		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
15.9	(2.3)	2.3	(0.6)	6.7	(0.9)

For operations that stocked fry in raceways or tanks, most (59.3 percent) kept fry for at least 8 days after hatching before placing them in fry/fingerling ponds.

b. For fingerling operations that used raceways or tanks, percentage of operations by average age of fry (in days) when moved from the raceway or tank to fry/fingerling ponds:

	All Operations	
Average Fry Age (in Days)	**Percent**	**Standard Error**
4 to 7	40.7	(6.7)
8 to 14	33.9	(6.5)
Over 14	25.4	(6.2)
Total	100.0	

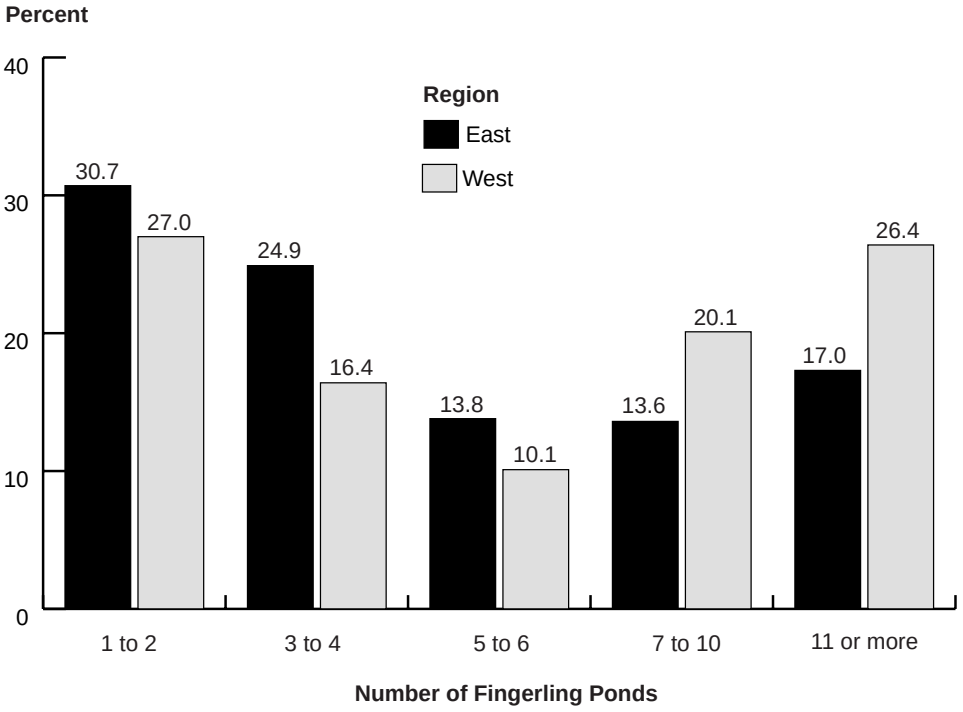
3. Fingerling pond numbers and size

Almost a fourth (23.3 percent) of all operations that raised fingerlings had 11 or more fingerling ponds.

a. Percentage of fingerling operations by number of fingerling ponds and by region:

	Percent Operations					
	Region					
	East		West		All Operations	
Number of Fingerling Ponds	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1 to 2	30.7	(2.8)	27.0	(1.8)	28.2	(1.5)
3 to 4	24.9	(2.5)	16.4	(1.8)	19.2	(1.5)
5 to 6	13.8	(2.1)	10.1	(1.4)	11.3	(1.2)
7 to 10	13.6	(2.1)	20.1	(2.1)	18.0	(1.6)
11 or more	17.0	(2.3)	26.4	(2.3)	23.3	(1.7)
Total	100.0		100.0		100.0	

Percent of Fingerling Operations by Number of Fingerling Ponds, and by Region



Overall, fingerling operations had an average of 10.3 fingerling ponds and an average of 77.0 total surface acres. Total water surface area was higher, on average, in the West region (94.9 acres) than the East region (40.2 acres). Overall, the average size of fingerling ponds was 7.6 surface acres (table 3.c).

b. Average number of fingerling ponds on fingerling operations, by region:

Number of Ponds

	Region					
	East		West		All Operations	
	Average	Std. Error	Average	Std. Error	Average	Std. Error
Number of ponds	8.1	(1.4)	11.4	(1.0)	10.3	(0.8)
Total surface acres	40.2	(11.5)	94.9	(6.3)	77.0	(5.5)

c. Average size (surface acres) of fry/fingerling ponds:

Average Pond Size	Standard Error
7.6	(0.2)

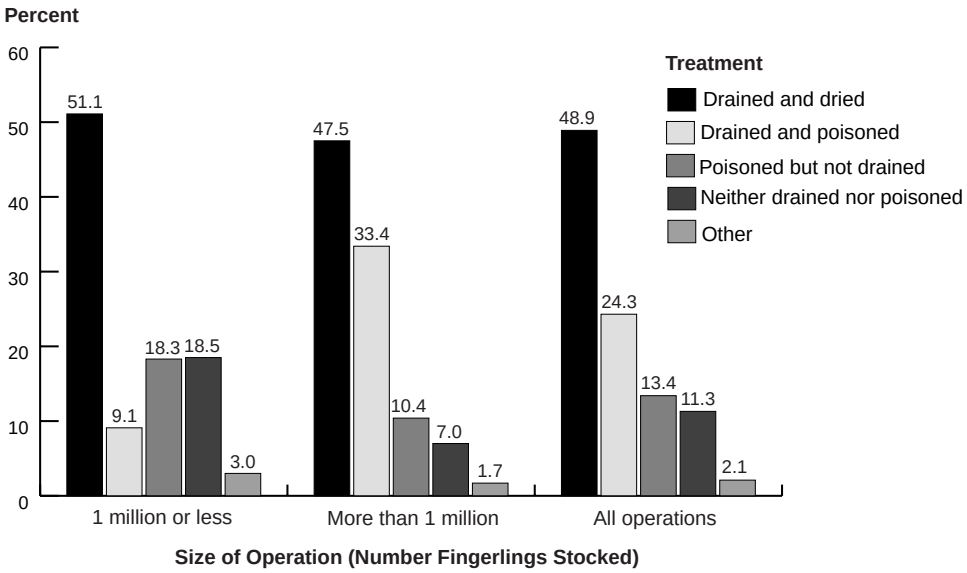
4. Treatment of fry/fingerling ponds prior to stocking

Regardless of operation size, almost one-half of all fingerling operations drained and dried fry/fingerling ponds prior to stocking fry. A higher percentage of small operations (18.5 percent) neither drained nor poisoned their ponds, compared to large operations (7.0 percent).

a. Percentage of fingerling operations by procedure that best describes the treatment of fry/fingerling ponds prior to stocking, and by size of operation:

	Percent Operations					
	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Treatment	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Drained and dried	51.1	(2.6)	47.5	(2.5)	48.9	(1.9)
Drained and poisoned	9.1	(1.7)	33.4	(2.6)	24.3	(1.8)
Poisoned but not drained	18.3	(2.3)	10.4	(1.8)	13.4	(1.4)
Neither drained nor poisoned	18.5	(2.0)	7.0	(1.1)	11.3	(1.0)
Other	3.0	(1.0)	1.7	(0.5)	2.1	(0.5)
Total	100.0		100.0		100.0	

Percent of Fingerling Operations by Procedure that Best Describes the Treatment of Fry/Fingerling Ponds Prior to Stocking, and by Size of Operation



5. Average days between filling ponds and stocking

Most fingerling operations (53.1 percent) filled their ponds 7 to 14 days prior to stocking fry.

a. For operations that drained fingerling ponds prior to stocking, percentage of fingerling operations by number of days between filling fingerling ponds and stocking with fry, and by size of operation:

Percent Operations

	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Days Before Stocking	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Less than 7	23.0	(3.1)	19.5	(2.3)	20.6	(1.9)
7 to 14	49.6	(3.4)	54.6	(2.9)	53.1	(2.3)
More than 14	27.4	(3.2)	25.9	(2.7)	26.3	(2.1)
Total	100.0		100.0		100.0	

On average, fingerling operations that drained their ponds refilled them 14 days prior to stocking fry.

b. For operations that drained fingerling ponds prior to stocking, average number of days between filling fry/fingerling ponds and stocking fry:

Average Days					
Size of Operation (Fry Stocked)					
Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Days	**Standard Error**	**Days**	**Standard Error**	**Days**	**Standard Error**
16.9	(1.2)	12.7	(0.5)	14.0	(0.5)

6. Average years to renovate ponds

Typically, fingerling ponds are completely renovated after 6 or more years. However, a substantial percentage of fingerling operations (32.0 percent) reported that they renovate fingerling ponds every 1 to 5 years.

a. Percentage of fingerling operations by number of years between completely renovating fry/fingerling ponds:

Years	Percent Operations	Standard Error
1 to 5	32.0	(2.0)
6 to 10	48.3	(2.3)
More than 10	19.7	(2.0)
Total	100.0	

7. Fertilize fry/fingerling ponds

a. Percentage of fingerling operations that usually fertilize fry/fingerling ponds, by region:

Percent Operations					
Region					
East		West		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
40.9	(3.0)	65.6	(2.4)	57.5	(1.9)

Most operations that fertilized fry/fingerling ponds usually fertilized ponds no sooner than 7 days prior to stocking. A higher percentage of operations in the East region (28.9 percent) fertilized 15 or more days prior to stocking fry than operations in the West region (8.9 percent).

b. For operations that usually fertilize fry/fingerling ponds, percentage of operations by number of days prior to stocking that pond fertilization begins, and by region:

	Percent Operations					
	Region					
	East		West		All Operations	
Days Before Stocking	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Less than 7	12.6	(3.2)	25.4	(2.2)	22.4	(1.9)
7 to 14	58.5	(4.7)	65.7	(2.7)	64.1	(2.3)
15 or more	28.9	(4.2)	8.9	(2.0)	13.5	(1.8)
Total	100.0		100.0		100.0	

8. Chloride level

Chloride levels in fry/fingerling ponds averaged 135.0 ppm. However, ponds in the East region had higher (mean = 253.8 ppm) and more variable (standard error = 68.6) levels than ponds in the West region (mean = 77.3 ppm and standard error = 2.4).

a. Operation average chloride level in fry/fingerling ponds in parts per million, by region:

Average Chloride Level (ppm)					
Region					
East		**West**		**All Operations**	
Average	**Standard Error**	**Average**	**Standard Error**	**Average**	**Standard Error**
253.8	(68.6)	77.3	(2.4)	135.0	(23.0)

9. Salt usage

A higher percentage of operations in the West region (50.7 percent) routinely added salt to fry/fingerling ponds to maintain chloride levels than did operations in the East region (34.8 percent). Similarly, a higher percentage of operations in the East region (30.4 percent) “add salt only in response to health problems” than operations in the West region (18.2 percent).

a. Percentage of fingerling operations by use of salt in fry/fingerling ponds and by region:

	Percent Operations					
	Region					
	East		West		All Operations	
Salt Usage	Pct.	Std. Error	Pct.	Std. Error	Pct.	Std. Error
Routinely add salt to maintain a desired chloride level	34.8	(2.9)	50.7	(2.3)	45.5	(1.8)
Add salt only in response to health problems	30.4	(2.8)	18.2	(1.9)	22.2	(1.6)
Do not add salt to ponds	34.8	(2.8)	31.1	(1.8)	32.3	(1.5)
Total	100.0		100.0		100.0	

H. Fingerling Pond Management: After Stocking

1. Fry stocked in 2001 and 2002

In 2001 and 2002, the number of fry stocked into fry/fingerling ponds on individual operations averaged 6.96 million and 6.04 million, respectively. However, because of the relatively large standard errors, there is no detectable difference between stocking rates in 2001 and 2002.

a. Operation average number of fry stocked into fry/fingerling ponds, by year:

Year Stocked	**Operation Average Number of Fry** (x1,000)	**Standard Error** (x1,000)
2001	6,963.5	(487.6)
2002	6,039.7	(478.8)

2. Fry stocking rates

Stocking density of fry in fry/fingerling ponds is a management tool used for producing fingerlings of desired size. On 41.9 percent of ponds fry were stocked at a rate of 100,000 to 149,000 per pond surface acre. Almost one-third of all ponds (29.7 percent) were lightly stocked (less than 100,000 per acre). In 2002, close to 12 percent of fry/fingerling ponds were not stocked with any fry.

a. Percentage of fry/fingerling ponds by stocking rate in 2002 and by region:

	Percent Ponds					
	Region					
	East		**West**		**All Ponds**	
Stocking Rate (Fry/Acre)	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Fry/fingerling ponds not stocked in 2002	6.8	(1.6)	13.6	(2.8)	11.9	(2.2)
Less than 100,000	48.8	(5.4)	23.1	(3.0)	29.7	(3.4)
100,000 to 149,000	24.9	(2.5)	47.8	(3.4)	41.9	(2.9)
150,000 to 199,000	3.6	(1.1)	5.9	(1.1)	5.3	(0.9)
200,000 or more	15.9	(3.3)	9.6	(1.8)	11.2	(1.5)
Total	100.0		100.0		100.0	

3. Fry feed type

Almost all operations (97.0 percent) fed fry some sort of feed prior to the acceptance of pelleted floating feeds. The three most widely used feeds were: fines or meals (53.9 percent of operations); fry starter (21.8 percent of operations); and crumbles (14.8 percent of operations).

a. Percentage of fingerling operations by type of feed provided to fry prior to the acceptance of floating feeds:

Feed Type	Percent Operations	Standard Error
Fines or meals	53.9	(1.9)
Pellets	5.5	(0.8)
Fry starter	21.8	(1.6)
Crumbles	14.8	(1.2)
Other	1.0	(0.2)
None	3.0	(0.7)
Total	100.0	

4. Fry feeding frequency

The majority of operations fed fish in fry/fingerling ponds at least once a day in spring and summer (78.1 and 94.3 percent, respectively). In fall, 59.0 percent of all operations fed at least once a day. Feeding in winter was much less routine, with most operations feeding “other,” which includes when weather and pond levee conditions permit.

a. Percentage of fingerling operations by how often fry/fingerlings are fed during each season:

	Percent Operations							
	Season							
	Spring		Summer		Fall		Winter	
Feeding Frequency	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
At least twice daily	37.3	(1.9)	33.6	(1.9)	9.9	(1.3)	2.3	(0.5)
Once a day	40.8	(1.9)	60.7	(1.9)	49.1	(1.9)	4.3	(0.7)
Every other day	12.5	(1.3)	3.3	(0.6)	20.4	(1.5)	5.8	(0.7)
Every third day	4.0	(0.8)	1.3	(0.5)	16.7	(1.5)	13.6	(1.3)
Other	5.4	(0.8)	1.1	(0.4)	3.9	(0.7)	74.0	(1.6)
Total	100.0		100.0		100.0		100.0	

5. Percent protein

a. Percentage of fingerling operations by percentage protein of the floating feed fed to fry/fingerlings:

Protein Level (percent)	**Percent Operations**	**Standard Error**
28	8.0	(1.0)
32	33.3	(1.8)
35	41.3	(1.9)
Other protein	17.4	(1.3)
Total	100.0	

6. Monitoring dissolved oxygen

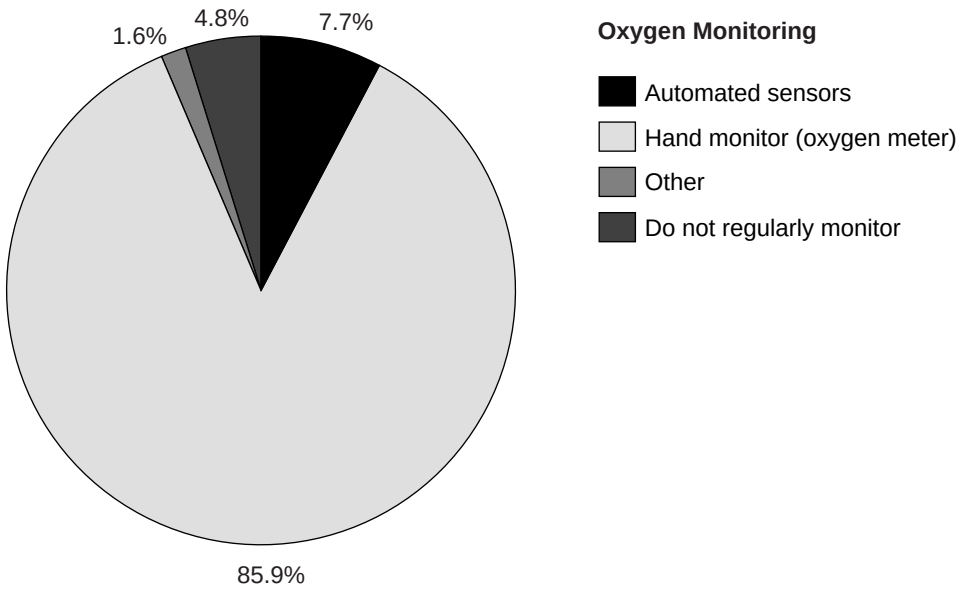
The majority of operations (85.9 percent) used hand monitors to monitor dissolved oxygen in fry/fingerling ponds, while fewer operations used automated sensors (7.7 percent). A small percentage of operations (4.8 percent) did not regularly monitor oxygen levels in ponds.

a. Percentage of fingerling operations by primary method used for monitoring dissolved oxygen in fry/fingerling ponds, and by size of operation:

Percent Operations

	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Dissolved Oxygen Monitoring	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Automated sensors	11.8	(1.8)	5.2	(0.9)	7.7	(0.9)
Hand monitor (oxygen meter)	78.4	(2.1)	90.5	(1.2)	85.9	(1.1)
Other	2.8	(0.7)	0.8	(0.4)	1.6	(0.3)
Do not regularly monitor dissolved oxygen levels	7.0	(1.2)	3.5	(0.8)	4.8	(0.7)
Total	100.0		100.0		100.0	

Percent of Fingerling Operations by Primary Method Used for Monitoring Dissolved Oxygen in Fry/Fingerling Ponds



7. Horsepower of fixed aeration

a. Average horsepower of fixed aeration per surface acre of fry/fingerling ponds, by size of operation:

Average Horsepower

Size of Operation (Fry Stocked)					
Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Horsepower	**Standard Error**	**Horsepower**	**Standard Error**	**Horsepower**	**Standard Error**
1.9	(0.1)	1.8	(0.0)	1.8	(0.0)

8. Emergency aerators

a. Average number of emergency aerators (power takeoffs) on fingerling operations, by size of operation:

Average Number of Aerators

Size of Operation (Fry Stocked)					
Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Average	**Standard Error**	**Average**	**Standard Error**	**Average**	**Standard Error**
7.4	(0.8)	19.8	(2.4)	15.1	(1.5)

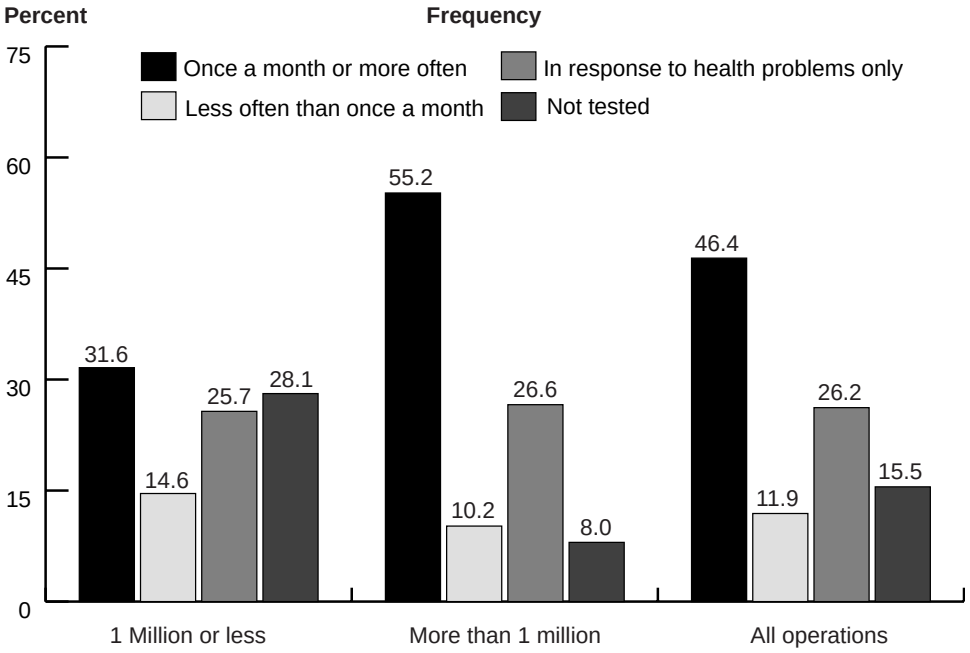
9. Water quality testing

Almost one-half of all fingerling operations (46.4 percent) tested water quality once a month or more often. A higher percentage of large operations (55.2 percent) tested at least once a month, as compared to small operations (31.6 percent). A higher percentage of small operations did not test water quality (28.1 percent), as compared to large operations (8.0 percent).

a. Percentage of fingerling operations by frequency of water quality testing in fry/fingerling ponds and by size of operation:

	Percent Operations					
	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 million)		**All Operations**	
Water Quality Testing	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Once a month or more often	31.6	(2.6)	55.2	(2.5)	46.4	(1.9)
Less often than once a month	14.6	(1.9)	10.2	(1.5)	11.9	(1.2)
In response to health problems only	25.7	(2.3)	26.6	(2.2)	26.2	(1.6)
Not tested	28.1	(2.3)	8.0	(1.3)	15.5	(1.2)
Total	100.0		100.0		100.0	

Percent of Fingerling Operations by Frequency of Water Quality Testing in Fry/Fingerling Ponds, and by Size of Operation



For operations that tested water quality at least once a month, over 90 percent tested for ammonia, chloride, and nitrite. Most operations that tested water quality at least once a month tested the water quality parameters four or fewer times a month.

b. For operations that performed some water quality testing in fry/fingerling ponds at least once a month, percentage of operations by number of times per month fry/fingerling ponds were tested for specific chemicals:

	Percent Operations					
	Water Quality Characteristics					
	Ammonia		Chloride		Nitrite	
Times Tested Per Month	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
0	9.3	(2.2)	6.7	(1.1)	6.9	(1.2)
1 to 2	44.5	(3.0)	59.4	(3.0)	42.1	(3.1)
3 to 4	40.8	(3.0)	31.2	(2.9)	45.6	(3.1)
5 to 7	0.0	(--)	0.0	(--)	1.1	(0.4)
8 or more	5.4	(1.5)	2.7	(1.1)	4.3	(1.5)
Total	100.0		100.0		100.0	

I. Fingerling Health Related Issues

1. Operations that vaccinated against Enteric Septicemia of Catfish
Overall, 11.4 percent of fingerling operations vaccinated fry against Enteric Septicemia of Catfish (ESC) in the past 2 years. The percentage of operations that vaccinated for ESC was comparable on small and large operations (table 1.a) and in the East and West regions (table 1.b).

a. Percentage of fingerling operations that vaccinated fry against ESC in the past 2 years, by size of operation:

Percent Operations					
Size of Operation (Fry Stocked)					
Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
7.5	(1.5)	13.8	(1.9)	11.4	(1.3)

b. Percentage of fingerling operations that vaccinated fry against ESC in the past 2 years, by region:

Percent Operations			
Region			
East		West	
Percent	Standard Error	Percent	Standard Error
8.9	(1.9)	12.4	(1.7)

2. Fry vaccinated for ESC

On operations that vaccinated for ESC, 22.7 and 18.1 percent of fry were vaccinated in 2001 and 2002, respectively. Small operations that vaccinated for ESC vaccinated over 70 percent of fry in both years, while a much smaller percentage of fry were vaccinated on large operations in 2001 and 2002 (22.1 and 17.1 percent, respectively).

a. Of those operations that vaccinated for ESC in the past 2 years, percentage of fry, weighted by number of fry stocked, that were vaccinated for ESC in last 2 years, by size of operation:

	Percent Fry					
	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		Large (More than 1 Million)		All Operations	
Year	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
2001	71.3	(21.3)	22.1	(8.0)	22.7	(7.9)
2002	87.1	(10.0)	17.1	(4.8)	18.1	(4.9)

3. Average number of days after hatching before vaccination

a. For fingerling operations that vaccinated for ESC, operation average number of days after hatching fry were typically vaccinated against ESC:

Average Days	Standard Error
8.8	(0.4)

4. Fry intended for on-farm growout vaccinated for ESC

For operations that vaccinated for ESC, 29.4 percent vaccinated all fry intended for growout on their operation. A much higher percentage of small operations (78.9 percent) vaccinated all fry intended for their own use, compared to large operations (13.1 percent). While all small operations vaccinated at least some fry intended for use on their own operation, 22.5 percent of large operations did not vaccinate any fry intended for their own use. A substantial percentage of large operations (19.5 percent) did not intend to growout any of their own fry.

a. Percentage of fingerling operations by ESC vaccination practice for fry intended for growout on the operation, and by size of operation:

Percent Operations

	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Vaccination Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
All fry vaccinated	78.9	(9.4)	13.1	(4.3)	29.4	(5.1)
A portion of the fry vaccinated	21.1	(9.4)	44.9	(7.5)	39.0	(6.3)
None of the fry vaccinated	0.0	(--)	22.5	(6.6)	16.9	(5.1)
No fry growout on this operation	0.0	(--)	19.5	(5.0)	14.7	(3.8)
Total	100.0		100.0		100.0	

5. Fry intended for sale vaccinated against ESC

In contrast to fry intended for growout on fingerling operations, the percentage of operations that vaccinated all fry intended for sale was low (5.2 percent of operations). Only large operations vaccinated any fry intended for sale. Over 40 percent of large operations vaccinated a portion of their fry based on customer request, while 22.1 percent of large operations vaccinated a portion of their fry for sale regardless of customer request.

a. Percentage of fingerling operations by ESC vaccination practice for fry intended for sale, and by size of operation:

	Percent Operations					
	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Vaccination Practice	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
All fry intended for sale	0.0	(--)	6.9	(3.5)	5.2	(2.6)
A portion of the fry for sale based on customer request	0.0	(--)	40.6	(7.2)	30.6	(5.6)
A portion of the fry for sale regardless of customer request	0.0	(--)	22.1	(6.4)	16.6	(5.0)
None of the fry intended for sale	21.1	(9.4)	14.8	(5.7)	16.3	(4.9)
No fry for sale	78.9	(9.4)	15.6	(6.0)	31.3	(5.7)
Total	100.0		100.0		100.0	

6. Stocked fry survival

The operation average percentage survival of fry from stocking to harvest during the past 2 years was 69.0 percent. The percentage survival of fry weighted by the number of fry stocked in 2001 was similar (66.2 percent) to the operation average percentage survival. Percentage survival was similar between small and large operations.

a. Operation average and average percentage of stocked fry that survived until harvest as fingerlings during the past 2 years, by size of operation:

	Average Percent Stocked Fry					
	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Survival	**Average**	**Std. Error**	**Average**	**Std. Error**	**Average**	**Std. Error**
Operation average survival	70.7	(1.1)	68.0	(0.8)	69.0	(0.7)
Fry average survival	69.9	(2.6)	66.1	(1.6)	66.2	(1.6)

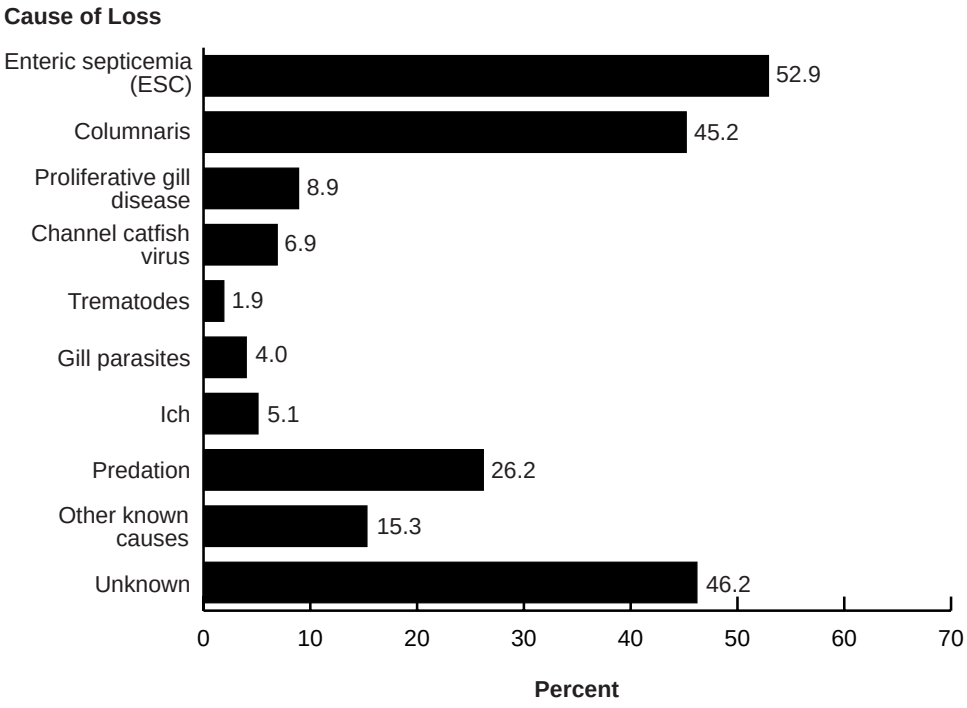
7. Causes of fry/fingerling losses

Losses can occur for many reasons on any fingerling operation. The highest percentages of operations reported some losses due to ESC (52.9 percent), unknown causes (46.2 percent), and Columnaris (45.2 percent). Predation losses were reported by 26.2 percent of fingerling operations. Proliferative gill disease was not reported by any small fingerling operations.

a. Percentage of fingerling operations that lost any fry/fingerlings during the last 2 years, by cause and by size of operation:

	Percent Operations					
	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Causes of Loss	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Enteric septicemia (ESC)	45.6	(2.7)	57.2	(2.6)	52.9	(1.9)
Columnaris	36.1	(2.7)	50.5	(2.6)	45.2	(1.9)
Proliferative gill disease	0.0	(--)	14.2	(2.0)	8.9	(1.3)
Channel catfish virus	1.7	(0.8)	9.9	(1.9)	6.9	(1.2)
Trematodes	1.4	(0.6)	2.2	(0.9)	1.9	(0.6)
Gill parasites	1.7	(0.8)	5.3	(1.0)	4.0	(0.7)
Ich	1.4	(0.6)	7.2	(1.1)	5.1	(0.7)
Predation	32.8	(2.5)	22.3	(2.2)	26.2	(1.7)
Other	9.3	(1.7)	18.9	(2.2)	15.3	(1.5)
Unknown	48.7	(2.7)	44.8	(2.6)	46.2	(1.9)

Percent of Fingerling Operations that Lost Any Fry/Fingerlings During the Last 2 Years, by Cause



Marked regional differences were not apparent in the percentage of operations reporting specific causes of loss. The West region had a slightly higher percentage of operations reporting losses due to ESC and Columnaris than the East region. Proliferative gill disease was reported by a higher percentage of operations in the West region, compared to the East region. Notably, trematode problems were reported on an equal percentage of operations (1.9 percent) in both the East and West regions.

b. Percentage of fingerling operations that lost any fry/fingerlings during the past 2 years, by cause and by region:

	Percent Operations			
	Region			
	East		West	
Cause of Loss	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Enteric Septicemia (ESC)	42.1	(3.0)	57.8	(2.3)
Columnaris	39.8	(3.0)	47.4	(2.4)
Proliferative gill disease	1.9	(0.9)	12.3	(1.8)
Channel catfish virus	1.9	(0.9)	9.3	(1.8)
Trematodes	1.9	(0.9)	1.9	(0.8)
Gill parasites	0.0	(--)	5.9	(1.0)
Ich	1.6	(0.7)	6.7	(1.1)
Predation	33.5	(2.7)	22.4	(2.1)
Other known causes	12.7	(2.2)	16.5	(1.9)
Unknown	50.8	(3.0)	44.4	(2.4)

Fingerlings with ESC

Approximately 30 percent of stocked fry did not survive until harvest as fingerlings (see table I.6.a ~70 percent survive to harvest). Of these, 27.3 percent were lost due to ESC and 24.8 percent due to Columnaris. A substantial percentage of losses (18.4 percent) were due to unknown causes. Other known causes accounted for 9.8 percent of fry/fingerling losses and channel catfish virus accounted for 8.2 percent. Although predation loss was reported on over one-fourth of operations (table 7.a), only 6.0 percent of all reported fry/fingerling losses were due to predation.

c. Percentage of fry/fingerlings lost, weighted by the number of fingerlings stocked in 2001, from the following causes, by size of operation:

Percent Fry/Fingerlings Lost

	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Causes of Loss	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Enteric Septicemia (ESC)	22.3	(5.5)	27.5	(2.6)	27.3	(2.6)
Columnaris	21.2	(6.7)	24.8	(2.9)	24.8	(2.9)
Proliferative gill disease	0.0	(--)	3.1	(0.8)	3.0	(0.8)
Channel catfish virus	0.4	(0.4)	8.4	(3.1)	8.2	(3.1)
Trematodes	0.1	(0.1)	0.9	(0.6)	0.9	(0.6)
Gill parasites	2.0	(1.8)	0.7	(0.3)	0.7	(0.3)
Ich	0.0	(--)	0.9	(0.3)	0.9	(0.3)
Predation	9.6	(3.0)	5.9	(1.1)	6.0	(1.1)
Other known causes	2.5	(1.3)	9.9	(4.0)	9.8	(4.0)
Unknown	41.9	(7.4)	17.9	(3.6)	18.4	(3.5)
Total	100.0		100.0		100.0	

The percentages of fry/fingerling losses due to specific causes did not have strong patterns by region. Channel catfish virus accounted for a higher percentage of lost fry/fingerlings in the West region (9.3 percent) than in the East region (0.1 percent).

d. Percentage of fry/fingerlings lost, weighted by the number of fingerlings stocked in 2001, from the following causes, by region:

	Percent Fry/Fingerlings Lost			
	Region			
	East		West	
Cause of Loss	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Enteric Septicemia (ESC)	18.8	(3.9)	28.5	(2.9)
Columnaris	23.4	(5.2)	25.0	(3.2)
Proliferative gill disease	2.1	(1.7)	3.2	(0.9)
Channel catfish virus	0.1	(0.1)	9.3	(3.4)
Trematodes	4.2	(4.0)	0.5	(0.4)
Gill parasites	0.0	(--)	0.8	(0.3)
Ich	1.0	(1.0)	0.9	(0.3)
Predation	9.2	(3.4)	5.5	(1.1)
Other known causes	11.7	(3.6)	9.5	(4.5)
Unknown	29.5	(11.0)	16.8	(3.7)
Total	100.0		100.0	

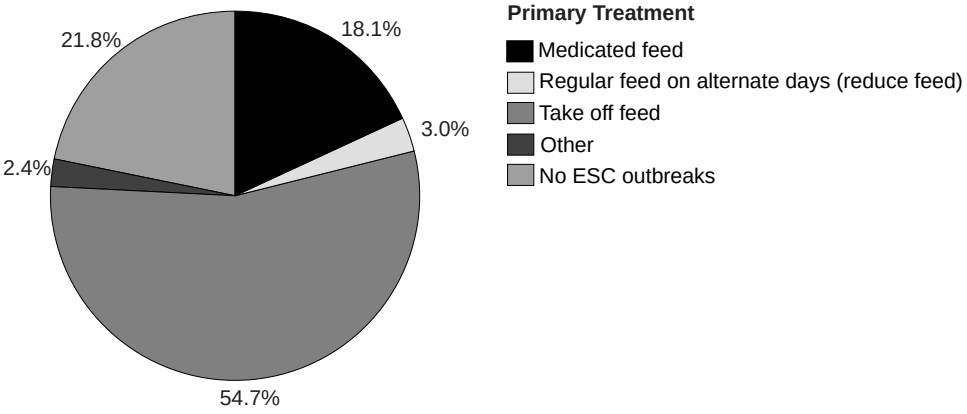
8. Primary treatment for ESC outbreaks

More than one-half of fingerling operations (54.7 percent) reported that their primary treatment for ESC was to take fish off feed. Medicated feed was the primary ESC treatment on 18.1 percent of operations. No ESC outbreaks were reported by 21.8 percent of fingerling operations. This contrasts with 52.9 percent of operations that reported problems with ESC in the past 2 years (table I.7.a).

a. Percentage of fingerling operations by primary treatment for ESC outbreaks:

Primary Treatment	Percent Operations	Standard Error
Medicated feed	18.1	(1.4)
Regular feed on alternate days (reduce feed)	3.0	(0.7)
Take off feed	54.7	(1.8)
Other	2.4	(0.7)
No ESC outbreaks	21.8	(1.4)
Total	100.0	

Percent of Fingerling Operations by Primary Treatment for ESC Outbreaks



9. Laboratory diagnoses

A lower percentage of fingerling operations in the East region (24.7 percent) submitted any fingerling samples to a diagnostic laboratory, compared to the West region (47.8 percent). A higher percentage of operations in the West region submitted samples to confirm the cause of an outbreak and to identify an unknown disease (32.9 and 33.1 percent, respectively) than in the East region (16.2 and 12.4 percent, respectively). Similarly, a higher percentage of fingerling operations in the West region (24.1 percent) submitted samples for early problem detection than operations in the East region (5.2 percent).

a. Percentage of fingerling operations that submitted any fingerling samples to a diagnostic laboratory, by submission reason and by region:

Percent Operations

	Region					
	East		West		All Operations	
Submission Reason	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
Early problem detection	5.2	(1.4)	24.1	(2.2)	18.0	(1.6)
Confirming cause of outbreak	16.2	(2.4)	32.9	(2.3)	27.5	(1.8)
Identifying unknown disease	12.4	(2.1)	33.1	(2.3)	26.4	(1.8)
Other reasons	5.6	(1.6)	1.9	(0.8)	3.1	(0.8)
Any reason	24.7	(2.7)	47.8	(2.4)	40.3	(1.9)

10. Snail control

Snail problems were reported by 11.6 percent of fingerling operations. The percentage of operations with snail problems was not substantially different between the East and West regions.

a. Percentage of fingerling operations that had a problem with snails in any fry/fingerling ponds in 2002, by region:

Percent Operations					
Region					
East		West		All Operations	
Percent	Standard Error	Percent	Standard Error	Percent	Standard Error
8.3	(1.6)	13.1	(1.9)	11.6	(1.4)

Over one-fourth of fingerling operations used at least one measure to control snails. Copper, lime, and weed control were used by the highest percentage of operations (14.5, 8.6, and 7.7 percent, respectively).

b. Percentage of fingerling operations that used the following measures to control snails in fry/fingerling ponds, by region:

	Percent Operations					
	Region					
	East		West		All Operations	
Snail Control	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error
Lime	11.6	(1.8)	7.1	(1.6)	8.6	(1.2)
Copper	13.8	(2.1)	14.9	(2.0)	14.5	(1.5)
Weed control	10.4	(1.9)	6.4	(1.3)	7.7	(1.1)
Biological control	3.4	(1.1)	4.0	(1.2)	3.8	(0.9)
Other measures	0.0	(--)	3.4	(0.9)	2.3	(0.6)
Any measures	20.5	(2.5)	29.8	(2.3)	26.8	(1.7)

11. Use of medicated feed

Medicated feed was fed to fry by 27.0 percent of operations in 2002. A higher percentage of large operations (32.4 percent) reported feeding medicated feed than did small operations (18.0 percent).

a. Percentage of fingerling operations that fed medicated feed to fry in 2002, by size of operation:

Percent Operations					
Size of Operation (Fry Stocked)					
Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Percent	**Standard Error**	**Percent**	**Standard Error**	**Percent**	**Standard Error**
18.0	(2.2)	32.4	(2.6)	27.0	(1.8)

b. Percentage of fingerling operations that fed terramycin or Romet®, by size of operation:

	Percent Operations					
	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Medicated Feed	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**	**Pct.**	**Std. Error**
Terramycin	15.0	(2.0)	27.4	(2.5)	22.7	(1.8)
Romet	7.4	(1.5)	14.1	(2.0)	11.6	(1.3)

For fingerling operations that fed medicated feed in 2002, an average of 8.4 and 4.7 tons of feed with terramycin and Romet were fed, respectively. As expected, the average tons of medicated feed fed was much higher on large operations than on small operations.

c. For fingerling operations that fed medicated feed to fry in 2002, average tons of medicated feed fed, by size of operation:

	Average Tons					
	Size of Operation (Fry Stocked)					
	Small (1 Million or Less)		**Large** (More than 1 Million)		**All Operations**	
Medicated Feed	**Tons**	**Std. Error**	**Tons**	**Std. Error**	**Tons**	**Std. Error**
Terramycin	1.3	(0.2)	10.8	(1.2)	8.4	(0.9)
Romet	0.7	(0.1)	5.3	(1.1)	4.7	(0.8)

12. Record keeping

Written or computerized records of some kind were kept by 82.5 percent of fingerling operations. A larger percentage of operations kept harvesting, stocking, and feeding records (74.1, 73.8, and 72.1 percent, respectively) than other types of records.

a. Percentage of fingerling operations that kept the following types of written or computerized records:

Types of Records	**Percent Operations**	**Standard Error**
Stocking	73.8	(1.6)
Harvesting	74.1	(1.6)
Disease	25.9	(1.8)
Feeding	72.1	(1.6)
Water quality	42.3	(1.9)
Breeding	25.3	(1.7)
Other	5.9	(1.0)
Any	82.5	(1.3)

J. Wild Bird Issues

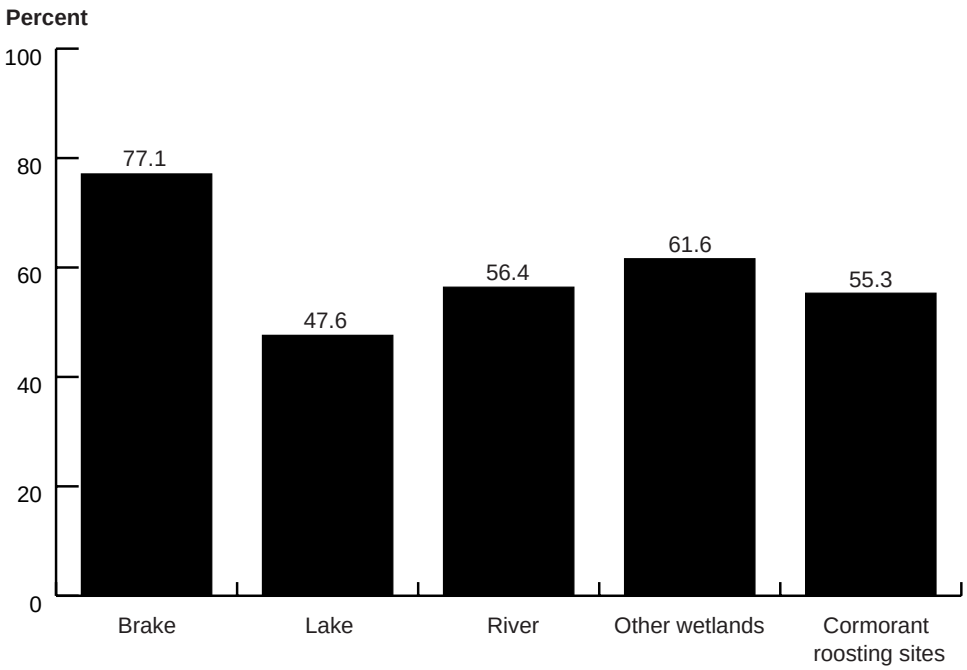
1. Distance to bodies of water, other operations, and cormorant roosting sites

Over three-fourths of fingerling operations were located within 5 miles of a brake or fish production ponds on another operation. Cormorant roosting sites were within 5 miles of 55.3 percent of fingerling operations. These distances may be related to potential bird predation problems.

a. Percentage of fingerling operations by distance of operations from the following:

	Percent Operations						
	Distance						
	Within 5 Miles		Greater than 5 Miles		Don't Know		All Operations
Items	Percent	Std. Error	Percent	Std. Error	Percent	Std. Error	Percent
Brake	77.1	(1.4)	13.6	(1.2)	9.3	(1.0)	100.0
Lake	47.6	(1.9)	43.0	(1.9)	9.4	(1.2)	100.0
River	56.4	(1.8)	38.6	(1.8)	5.0	(0.8)	100.0
Other wetlands	61.6	(1.8)	22.6	(1.5)	15.8	(1.4)	100.0
Cormorant roosting sites	55.3	(1.9)	28.3	(1.7)	16.4	(1.3)	100.0
Fish production ponds on another operation	78.1	(1.3)	13.3	(1.1)	8.6	(0.9)	100.0

Percent of Fingerling Operations Within 5 Miles of the Following . . .



2. Bird dispersal

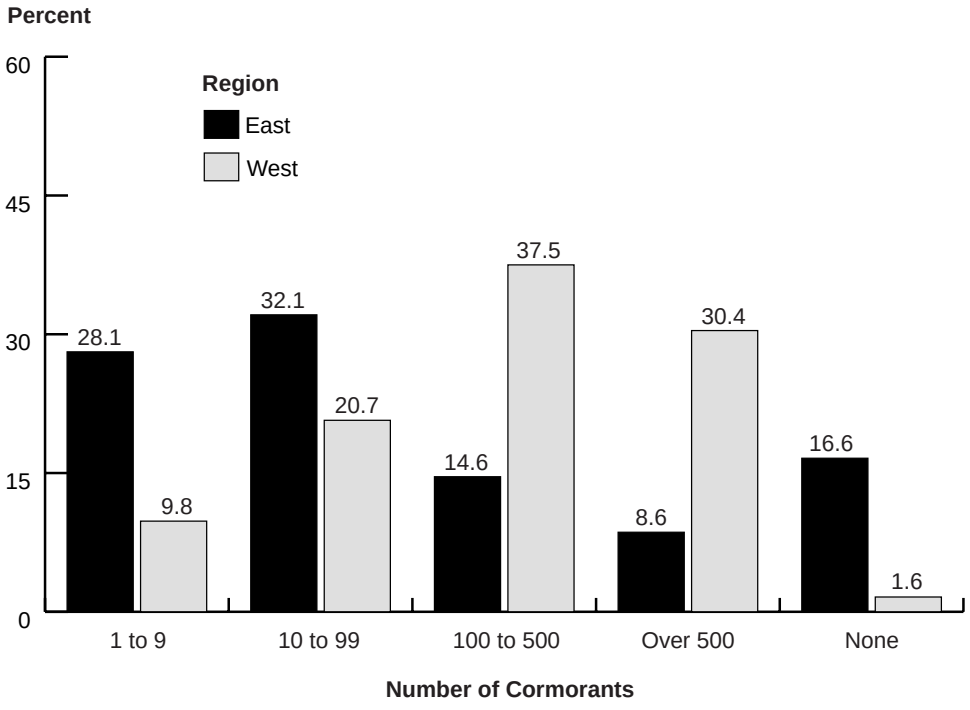
More than one-half of fingerling operations reported having over 100 cormorants visit their operation daily during winter. This percentage was much higher in the West region (67.9 percent of operations) than in the East region (23.2 percent of operations). Only a small percentage of operations in the West region (1.6 percent) reported that no cormorants visited their fingerling operation.

a. Percentage of fingerling operations by average number of cormorants that visit the operations each day during winter, and by region:

Percent Operations

	Region					
	East		West		All Operations	
Number of Cormorants	**Percent**	**Std. Error**	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1 to 9	28.1	(2.5)	9.8	(1.3)	15.6	(1.2)
10 to 99	32.1	(2.9)	20.7	(1.8)	24.3	(1.6)
100 to 500	14.6	(2.4)	37.5	(2.4)	30.2	(1.8)
Over 500	8.6	(1.7)	30.4	(2.3)	23.5	(1.7)
None	16.6	(2.0)	1.6	(0.5)	6.4	(0.8)
Total	100.0		100.0		100.0	

Percent of Fingerling Operations by Average Number of Cormorants that Visit the Operations Each Day During Winter, and by Region



A higher percentage of large operations (63.2 percent) reported 100 or more daily cormorant visits compared to small operations (38.0 percent).

b. Percentage of fingerling operations by average number of cormorants that visit the operation each day during winter, and by size of operation:

	Percent Operations			
	Size of Operation (Fry Stocked)			
	Small (1 Million or Less)		**Large** (More than 1 Million)	
Number of Cormorants	**Percent**	**Std. Error**	**Percent**	**Std. Error**
1 to 9	21.2	(2.1)	11.6	(1.5)
10 to 99	26.6	(2.4)	23.4	(2.1)
100 to 500	20.6	(2.2)	36.6	(2.6)
Over 500	17.4	(2.1)	26.6	(2.5)
None	14.2	(1.8)	1.8	(0.6)
Total	100.0		100.0	

More than 8 out of 10 fingerling operations (82.0 percent) practiced active bird dispersal. A higher percentage of operations in the West region (88.2 percent) actively dispersed birds than operations in the East region (68.8 percent).

c. Percentage of fingerling operations that actively dispersed birds, by region:

Percent Operations					
Region					
East		**West**		**All Operations**	
Percent	**Standard Error**	**Percent**	**Standard Error**	**Percent**	**Standard Error**
68.8	(2.6)	88.2	(1.5)	82.0	(1.3)

d. Percentage of fingerling operations that actively dispersed birds, by size of operation:

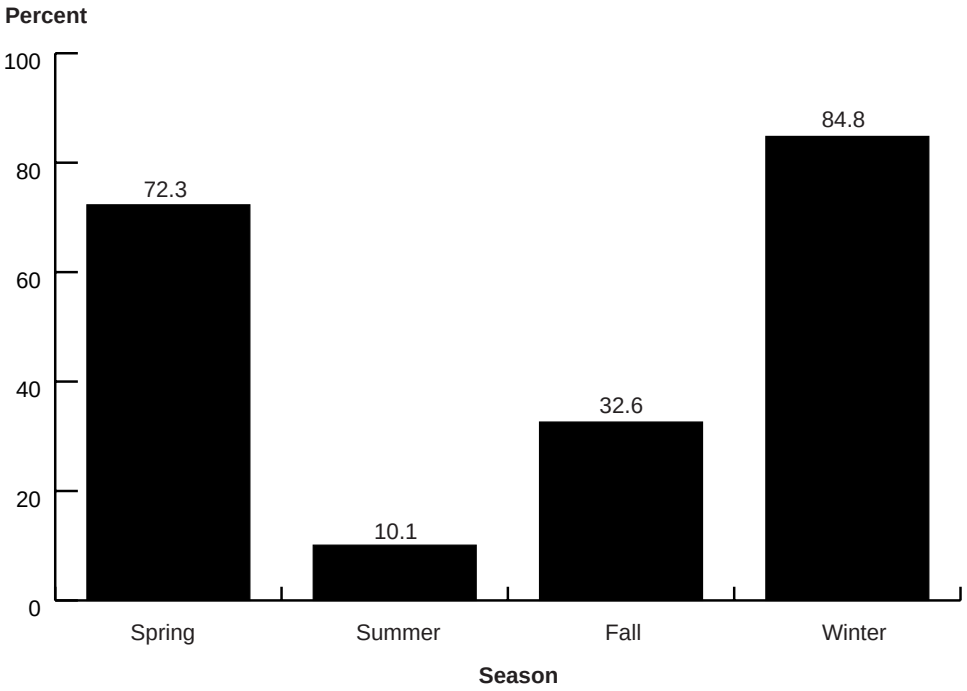
Percent Operations			
Size of Operation (Fry Stocked)			
Small (1 Million or Less)		**Large** (More than 1 Million)	
Percent	**Standard Error**	**Percent**	**Standard Error**
70.3	(2.3)	89.6	(1.6)

The highest amount of bird-dispersal activity (person-hours per week) occurred in winter (84.8 person-hours per week) followed by spring (72.3 person-hours per week). Operations in the West region expended more person-hours per week than operations in the East region, especially in winter and spring.

e. For fingerling operations that actively dispersed birds, average person-hours per week devoted to bird dispersal activities, by season and by region:

	Region					
	East		**West**		**All Operations**	
Season	**Avg. Hours**	**Std. Error**	**Avg. Hours**	**Std. Error**	**Avg. Hours**	**Std. Error**
Spring	21.6	(5.9)	90.5	(23.6)	72.3	(17.4)
Summer	7.3	(2.1)	11.1	(1.0)	10.1	(0.9)
Fall	18.8	(5.9)	37.6	(3.5)	32.6	(3.0)
Winter	23.5	(5.9)	106.7	(23.5)	84.8	(17.4)

For Fingerling Operations that Actively Dispersed Birds, Average Person-Hours Per Week Devoted to Bird Dispersal Activities, by Season



As expected, large operations expended more person-hours per week in all seasons, compared to small operations.

f. For fingerling operations that actively dispersed birds, operation average person-hours per week devoted to bird dispersal activities, by season and by size of operation:

	Operations Average Hours			
	Size of Operations (Fry Stocked)			
	Small (1 Million or less)		**Large** (More than 1 Million)	
Season	**Average**	**Std. Error**	**Average**	**Std. Error**
Spring	15.9	(1.0)	99.3	(25.7)
Summer	4.8	(0.6)	12.7	(1.3)
Fall	15.0	(1.1)	41.0	(4.3)
Winter	23.2	(1.4)	114.0	(25.6)

Section II. Methodology

A. Needs Assessment

NAHMS develops study objectives by exploring existing literature and contacting industry members about their informational needs and priorities during a needs assessment phase. The planning for the Catfish 2003 study involved an extensive effort to obtain input from representatives of producer organizations, universities, State and Federal catfish health and production personnel, and others allied with the industry. In addition to contacting individuals for their input, a formal focus group was convened at the Thad Cochran National Warmwater Aquaculture Center to identify broad study objectives and to begin a prioritization of topics. Also, after a presentation describing the national study at the 2002 Catfish Farming Trade Show, a short survey was distributed to attendees. The results from the survey were summarized for inclusion as input into the study planning.

Specific objectives for the NAHMS Catfish 2003 study:

1. Investigate foodsize fish production practices. Management practices for foodsize fish are continually evolving, as producers refine their methods and adjust to changes in market demands. Areas of investigation to meet this objective include: stocking practices (use of stocker ponds, stocking size, strain of fish, and timing of stocking); feeding practices (protein level, seasonal feeding, especially in the fall); pond management (draining, pond size, and maintenance schedule); and general practices (aeration, oxygen and water quality monitoring, harvesting).

2. Describe fingerling production practices, specifically brood stock management, hatchery management, vaccination practices, fingerling pond management, fingerling stocking and feeding practices.

3. Address a broad range of fish health related issues including: estimation of operation/pond level prevalence of reported foodsize fish disease problems (Columnaris, Enteric Septicemia, Proliferative Gill disease, Winter Kill, Ich, Anemia, Visceral Toxicosis of Catfish, and Trematodes); fingerling disease problems (Columnaris, Enteric Septicemia, Channel Catfish virus, Ich); control practices; treatment practices; and risk factors. Assess the effects of predation by birds in terms of the direct loss to producers and for potential association with disease problems.

4. Quantify the magnitude of the problem of off-flavor in terms of the percentage of ponds annually affected by off-flavor and the duration of off-flavor episodes. Assess the use of diuron and copper sulfate as pond treatments.

B. Sampling and Estimation

1. State selection

National Agricultural Statistics Service (NASS), USDA publishes catfish production estimates annually (published in February) for 13 States. NAHMS contracts with NASS to provide a statistically reliable sample from their sample frames. A goal for NAHMS national studies is to include States that account for at least 70 percent of the animal and producer populations in the United States. The initial review of States identified four major States (AL, AR, LA, and MS) with 95.5 percent of the inventory (as measured by sales) and 73.4 percent of all U.S. catfish operations on January 1, 2003.

2. Operation selection

Operations were selected in the four participating States (Alabama, Arkansas, Louisiana, and Mississippi) via NASS. Essentially all catfish producers on the list sampling frame were selected. This list frame provided complete coverage of catfish producers in the four States on January 1, 2003. There were 936 operations selected for the study.

3. Population inferences

Inferences from data collection cover the population of producers with any catfish in the four States. These States accounted for 73.4 percent of all catfish operations in the United States as of January 1, 2003, and 95.5 percent of all catfish sales in the United States (see Appendix II). Census data were adjusted for response and nonresponse within each State and size group to allow for inferences back to the original population from which the sample was selected.

C. Data Collection

1. Phase I

NASS enumerators in each of the four States administered the General Catfish Management Report from January 2 to February 14, 2003. The interview took just under 1 hour to complete.

D. Data Analysis

1. Validation and estimation

Initial data entry and validation for the General Catfish Management Report were performed in the individual NASS State offices. Data were entered into a SAS data set. NAHMS national staff in Fort Collins, Colorado performed additional validation on the entire data set after data from all States were combined.

2. Response rates

Of the 936 operations screened (NASS January 1, 2003, catfish annual survey), 36 had no catfish on January 1, 2003, and were therefore ineligible for the NAHMS Catfish 2003 study. This left a total of 900 operations to be contacted. Of these, 600 operations participated in the Catfish 2003 study, and only 152 operations (16.2 percent of the total sample) refused to participate in the study.

Response Category	Number Operations	Percent Operations
No catfish on January 1, 2003	36	3.8
Out of business[1]	89	9.5
Refusal	152	16.2
Survey complete	600	64.2
Out of scope (research farm, etc.)	14	1.5
Inaccessible	45	4.8
Total	936	100.0

[1]Operations that sold land and/or catfish and had no intention of returning to catfish business

Appendix I: Sample Profile

A. Responding Operations

1. Responding operations by pond size

Size of Foodsize Fish Pond (Acres)	Number of Responding Operations*
1 to 19	83
20 to 49	115
50 to 149	196
150 or more	175
Size not known	1
Total	570

* 30 responding producers did not raise foodsize fish

2. Responding operations by region

Region	Number of Responding Operations
East	322
West	278
Total	600

3. Responding operations by State

State	Number of Responding Operations
Alabama	172
Arkansas	123
Louisiana	46
Mississippi	259
Total	600

4. Responding operations by operation type

Operation Type	Number of Responding Operations[1]
Breed catfish	82
Operate hatchery	74
Raise fry to fingerlings	176
Growout foodsize fish	570

[1] Sum is greater than 600 because a number of operations are of multiple types.

Appendix II: U.S. Catfish Acreage Inventory and Operations

A. Regional Summary

State	Number (Acres Intended for Utilization) During January 1 to June 30, 2003			2002 Total Sales (x $1,000)	January 1, 2003, Number of Operations
	Foodsize	Fingerlings	Broodfish		
Alabama*	22,900	1,500	630	76,045	231
Arkansas*	28,500	4,200	650	56,380	155
California	1,810	360	90	7,875	38
Florida	590	45	15	756	34
Georgia	700	115	60	1,411	43
Illinois	65	45	10	226	12
Kentucky	460	95	15	1,180	60
Louisiana*	8,600	1,050	170	15,812	57
Mississippi*	86,000	16,800	3,000	243,226	405
Missouri	690	590	55	1,070	31
North Carolina	1,480	140	60	3,143	46
South Carolina	70	25	20	617	13
Texas	175	105	55	2,087	30
Total (4 study States*) Percent of U.S.	146,000 (96.0%)	23,550 (93.9 %)	4,450 (92.1%)	391,463 (95.5%)	848 (73.4 %)
Total U.S. (13 States)	152,040	25,070	4,830	409,828	1,155

Appendix III: Study Objectives and Related Outputs

1. Examine fingerling production practices including broodstock management, hatchery management, vaccination practices, fingerling pond management, and stocking and feeding practices. Investigate foodsize fish production practices including stocking, feeding, pond management, and general management.

- **Part I: Reference of Fingerling Catfish Health and Production Practices in the United States, 2003, November 2003**
- Part II: Reference of Foodsize Catfish Health and Production Practices in the United States, November 2003

2. Describe the prevalence of disease problems in fingerling and foodsize fish, disease control and treatment practices, and risk factors associated with disease.

- Trematodes on U.S. Catfish Operations, information sheet, November 2003
- ESC and Vaccination Practices on U.S. Catfish Operations, November 2003
- Off-flavor on U.S. Catfish Operations, information sheet, November 2003