Miscellaneous Paper EL-97-5
September 1997

US Army Corps of Engineers
Waterways Experiment Station

Standard Operating Procedures for Collection and Handling of Phase III Testing and Monitoring Data, Richard B. Russell Dam

by Dennis L. Brandon, John M. Nestler, Compilers

Prepared for U.S. Army Engineer District, Savannah

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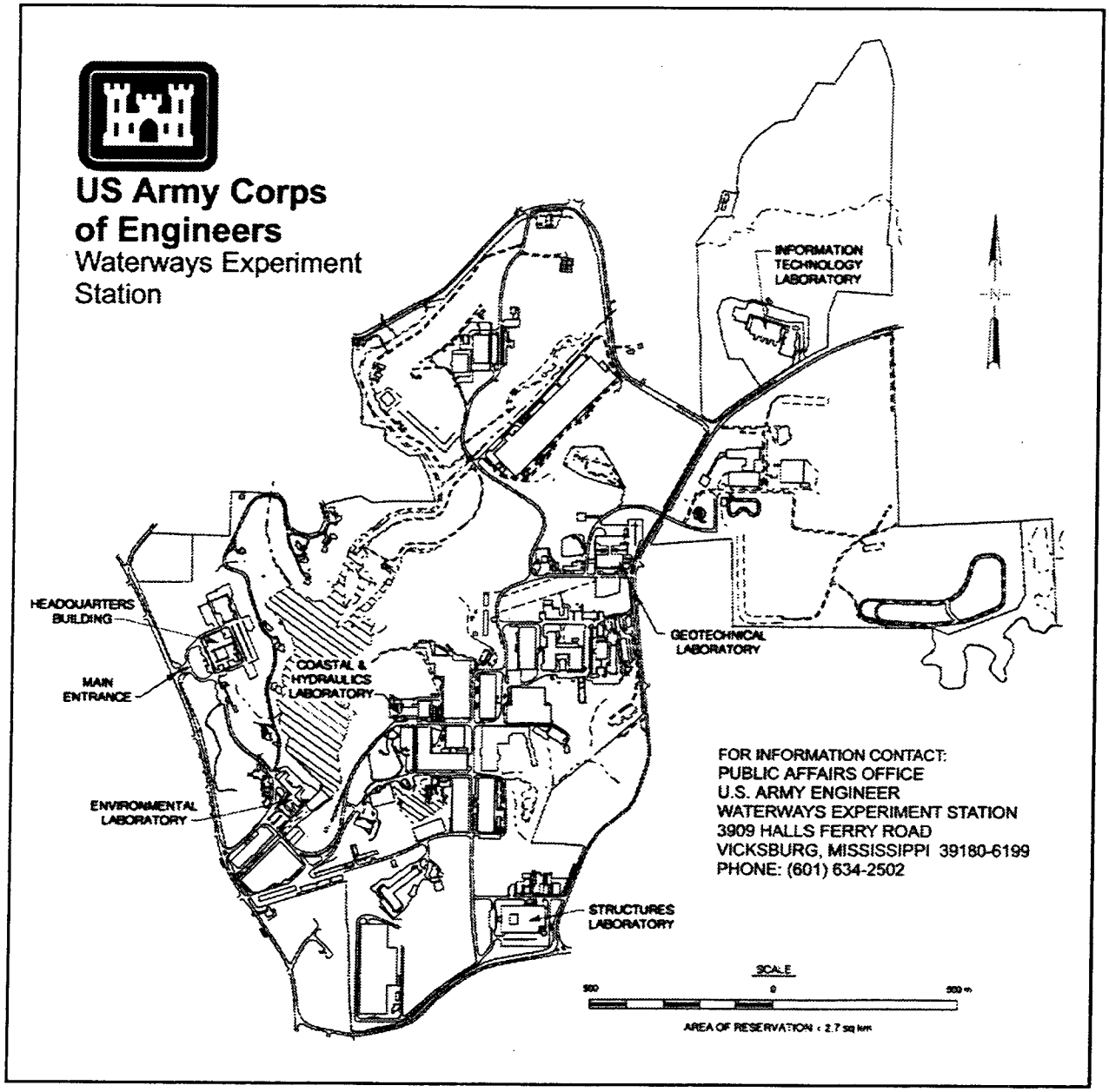
U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Final report

Prepared for U.S. Army Engineer District, Savannah
Savannah, GA 31402-0889



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Preface

The report herein lists the standard operating procedures used during Phase III of the Richard B. Russell (RBR) project. This phase of testing evaluated fish entrainment and fish mortality during capacity operation of the project. The report was prepared for the U.S. Army Engineer District, Savannah. The RBR Project Manager was Mr. Bill Lynch.

These procedures were compiled by Mr. Dennis L. Brandon, Fate and Effects Branch (FEB), Environmental Processes and Effects Division (EPED), Environmental Laboratory (EL), U.S. Army Engineer Waterways Experiment Station (WES), and Dr. John M. Nestler, Water Quality and Contaminant Modeling Branch (WQCMB), EPED. Technical reviews by Mr. Steve Ashby, Ecosystem Processes and Effects Branch (EPEB), EPED; Dr. John Hains, EPEB; and Ms. Toni Schneider, WQCMB, are gratefully acknowledged. Additional reviews were performed by technical representatives from the Savannah District, U.S. Fish and Wildlife Service, South Carolina Department of Natural Resources, and Game and Fish Division of the Georgian Department of Natural Resources.

The work was conducted under the general supervision of Dr. Bobby L. Folsom, Jr., Chief, FEB; Dr. Mark S. Dortch, Chief, WQCMB; Dr. Richard E. Price, Chief, EPED; and Dr. John Harrison, Director, EL.

At the time of publication of this report, Dr. Robert W. Whalin was Director of WES.

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Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
feet	0.3048	meters
gallons (U.S. liquid)	3.785412	liters
inches	2.54	centimeters

1 Introduction[1]

The U.S. Army Engineer District, Savannah, manages and develops water resources on the Savannah River. Richard B. Russell (RBR) Dam and Lake is the most recent Savannah River impoundment. The RBR dam has four conventional turbines and four reversible turbines (Figure 1). The reversible turbines can be used to replenish upstream storage for peak generation needs. Fish entrainment during pump storage is the primary environmental concern with this operation. Detailed fisheries studies have been conducted at RBR. During coordination of the RBR studies, the Savannah District made four commitments regarding the operation of the reversible turbines to protect the J. Strom Thurmond (JST) Lake fishery: (a) initial testing of the reversible turbines would not be conducted until a period of minimum fish activity in the tailrace; (b) the reversible turbines would not be made available for dependable commercial power production until the District is satisfied that the turbines could be operated in an environmentally acceptable manner; (c) any fish protection procedures needed to minimize fish entrainment associated with pump storage operations would be implemented before the turbines were made available for commercial power production; (d) post pump storage monitoring would be conducted to determine the impacts of entrainment on the JST Lake fishery.[2]

The Savannah District evaluated an array of alternative action plans. The preferred plan included (a) the installation of a high-frequency sound and light fish protection system at RBR prior to operation of the reversible turbines, (b) phased operation of the four reversible turbines to be brought into operation in an environmentally acceptable manner, (c) monitoring to evaluate the effective-ness of the light fish protection and the impact of entrainment on the JST Lake fishery.[2] A Testing and Monitoring Plan was developed that addressed fish entrainment as well as other environmental concerns. This plan was jointly developed by the Savannah District and the U.S. Army Engineer Waterways Experiment Station (WES) in consultation with various Federal and State agencies (e.g., U.S. Fish and Wildlife, South Carolina Wildlife and Marine

[1] Dennis L. Brandon and John M. Nestler, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

[2] U.S. Army Corps of Engineers. (1991). "Final supplement to final Environmental Impact Statement pump storage Richard B. Russell Dam and Lake Georgia and South Carolina," U.S. Army Engineer District, Savannah, Savannah, GA.

Figure 1. Richard B. Russell Dam

Resources Department, South Carolina Department of Health and Environmental Control, Game and Fish Division of the Georgia Department of Natural Resources). This plan includes detailed fishery and water quality studies. The fish entrainment studies were implemented in three phases. Phase I was the time period required to mechanically and electrically certify each reversible turbine for commercial operation. The major objective of Phase II was to evaluate fish passage and mortality while running one or more of the reversible turbines in pumpback mode. Another major objective was to obtain acceptable correlations between recovery net catches and the data obtained with fixed aspect hydroacoustic fish monitoring equipment. Ploskey et al. summarized the results of Phase II sampling.[1] Phase III testing evaluated fish entrainment and fish mortality during capacity operation of the RBR project.[2] This document is a compilation of the Standard Operating Procedures used in Phase III Testing.

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[1] Ploskey, G. R., Weeks, G., Scherck, S., Schilt, C., Johnson, P. and Nestler, J. M. (1995). "Richard B. Russell Phase II completion report: Impacts of two-unit pumpback operation," Draft Report, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

[2] U.S. Army Corps of Engineers. (1992). "Testing and monitoring plan pumped storage operations Richard B. Russell Dam and Lake," U.S. Army Engineer District, Savannah, Savannah, GA.

2 Protocol and Procedures for Conventional Generation Netting: Part 1[1]

Introduction

The following protocols represent the most current procedures followed by AScI/WES personnel in preparation for and during a Unit 5 netted generation test. Netted generation tests are performed using two sock nets that together cover both draft tube openings on Unit 5. These tests are designed to use netted recovery and hydroacoustic monitoring to estimate entrainment during operation of pump turbines in the conventional generating mode. The focus of this chapter will be on the netting operations and test coordination. Specifics related to hydroacoustic sampling, induction procedures, data recording, and data analyses are covered in appropriate chapters elsewhere in this report. It should be noted that these procedures represent the current state of the art and are subject to and likely to be modified and improved during the course of testing.

Procedures

Pretest arrangements

A testing schedule will be provided by the area engineer. The area engineer will contact the net-handling contractor and make arrangements to attach the downstream generation nets. The nets are typically removed from the dam between test series; however, they can be hung in a storage position on the dam if a number of test series are to be conducted in a short time period.

If the nets are not in the hanging storage position on the dam, the net-handling contractor will attach the nets to the Unit 5 trash racks before the test. Ideally, the nets will be attached to the trash rack at least 1 day prior to the test, but

[1] Patrick C. Pierce, AScI Corporation, Trotter Shoals Research Facility, Calhoun Falls, SC.

attachment of the nets immediately prior to a test is possible if scheduling does not permit earlier attachment. AScI/WES personnel will be onsite in an appropriate vessel to support the net-handling contractor during net attachment. The nets are attached directly to the Unit 5 trash racks by tying with nylon web straps at the terminus of the side riblines of the net and with heavy duty cotton rope at numerous locations across the top and bottom of the nets. AScI/WES personnel will inspect the net for tears and make arrangements for any repairs that may be necessary. Also, AScI/WES personnel will verify that the cod ends of the nets are properly secured prior to the beginning of testing.

The University of Georgia-Athens (UGA) Cooperative Fisheries and Wildlife Research Unit (Co-op Unit) inducts fish during netted generation tests for net calibration purposes. AScI/WES personnel will set up the induction system prior to a test. The weighted induction hose is lowered into position at the mouth of the Unit 5 penstock from the water level platform at Unit 5 in the forebay. AScI/WES and the UGA Co-op Unit will coordinate to ensure that a supply of fish is available and ready for induction.

Net deployment

General configuration. The nets are deployed with trash racks in the up position. The Georgia side is deployed first, followed by the South Carolina side net. The line from the Georgia side net runs to the buoyed cable line, and the line from the South Carolina side net attaches to the Georgia line at a shackle beyond the terminus of the Georgia side net to form a "Y" configuration.

Procedure. AScI/WES personnel, using an appropriate vessel, will shackle the Georgia side line to the Georgia side net and begin pulling the net away from the dam. The net-handling contractor will release the hanging net from the dam in sections. While the AScI/WES vessel maintains tension on the net, the net-handling contractor will straighten the net. Once the net is fully deployed from the dam, the AScI/WES boat will deploy the remainder of the Georgia line and attach the end of the line to the buoyed cable line using a G-hook and flat link attachment. Slack in the Georgia line is removed by hand.

The South Carolina side net is deployed and straightened in the same manner as was the Georgia side net. Once the South Carolina side net is straightened, the South Carolina side line is deployed from the AScI/WES vessel and attached to the Georgia side line at a point between the buoyed cable line and the Georgia side net where a shackled link occurs in the Georgia side line. All shackles at attachment points are tightened using pliers. Flotation buoys attached to the sides of the nets are inflated if necessary using a specially designed pump or can be removed and inflated using the air compressor located in the maintenance shop at the dam. The net-handling contractor then lowers the trash racks to begin the test.

Hydroacoustics

Hydroacoustic monitoring of entrainment is conducted during netted generation tests as described in Chapter 14 of this report. All eight transducer mounts are completely lowered before starting the hydroacoustic system. A data handling check sheet is described in Chapters 14 and 16.

Generation

Once the generation has begun, AScI/WES personnel will monitor the performance of both the hydroacoustic system and the nets. The UGA Co-op Unit will perform inductions for net calibrations as described in Chapter 12. AScI/WES personnel will be available to assist the UGA Co-op Unit with inductions if necessary.

Fishing the nets

Once generation has ended and on-the-water clearance has been granted by the dam operator, the net-handling contractor will raise the trash racks. AScI/WES personnel will unshackle the South Carolina side net line from the Georgia side line and pull the net into a position where the net-handling contractor can begin lifting the net in sections back into the storage position on the face of the dam. As the net contractor lifts the net, workers stationed on the net contractor's barge will shake fish toward the cod end of the net and remove any gilled fish from the net. Once the net is completely retrieved, AScI/WES personnel will open the cod end of the net and remove the captured fish. The fish will then be transferred to the UGA Co-op Unit for enumeration. AScI/WES personnel will secure the cod end of the net and inspect the condition of the net at this time. This procedure is then repeated for the Georgia side net.

Post test

AScI/WES personnel will secure hydroacoustic data and distribute as described in Chapter 16 of this report. All vessels will be removed from the tailrace or secured to the floating platform. AScI/WES personnel will coordinate with the area engineer's office to make any necessary repairs.

3 Protocol and Procedures for Conventional Generation Netting: Part 2[1]

Introduction

Conventional generation netting is used to estimate fish entrainment during generation operation. Each draft tube is separated into two bays by a wall. A sock net is connected to the trash rack in each bay, completely covering the two bays. Each net is 200 ft^2 long and tapers to a close at the cod end, where it is cinched. Fish can be collected only after the unit has been shut down and the nets have been pulled in.

Objective

The objective is to determine the species composition, length distribution, and numbers of fish passing through a turbine.

Methods

Pretest inventory and setup

Prior to the test it is necessary to make sure the following list of equipment is available and in working order at the dam for the test.

- Large fish tubs.
- Gallon buckets.

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[1] Mark A. Weiland, Georgia Cooperative Fisheries and Wildlife Reserach Unit, D. B. Warnell School of Forest Resources, University of Georgia, Athens, GA.

[2] A table of factors for converting non-SI units to SI units is presented on page vi.

- Life jackets.
- Hard hats.
- Data sheets.
- Calibration data sheets.
- Log book.
- Measuring board (at dam).
- Hanging scale (at dam).
- Balance scale (at dam).
- Dyes and scissors (at dam).
- Frozen fish (at dam).

The UGA Co-op Unit workers will arrive at the dam at least 30 min before the scheduled beginning of the generation test to set up the induction system, ensure that it is operational, and ensure that the hoses have been installed properly. The induction hose will be placed by WES employees prior to the test. Fish will be thawed and marked with a clip and dyed for net calibration (see Chapter 12, Protocol for Induction Systems and Net Calibration). Species, fish length, marking, and number of fish to be inducted will be recorded on the calibration data sheet (Appendix 3-1, this chapter). Fish species are determined using a fish guide.[1]

"Conventional" will be marked for the net calibration at the top of the calibration data sheet (Appendix 3-1, this chapter). The start and end date for the test, who collected the data, units operating during the test, and unit fished (unit with nets attached) are entered. After the test the exact start and end time for the test will be received from the dam operator and written on the sheet. If more than one page is needed for a test, a second data sheet will be used and page numbers added to the sheets. "Test number" will be recorded on the data sheet after it has been returned to UGA. Each test will receive a code and will be recorded on all data for the test (Chapter 12, Protocol for Induction Systems and Net Calibration).

During conventional generation test

Marked fish of at least one species will be inducted about 30 min into each test for net calibration. Inducted fish will be divided by species and size group

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[1] Page, L. M., and Brooks, M. B. (1991). *A field guide to freshwater fishes: North America north of Mexico.* Houghton Mifflin, Boston.

due to differences in net efficiency for different species and size groups. Between 20 and 40 fish of at least one species will be inducted (if large fish >6 in., 20-25 fish). Fish will be inducted in standard length groups for all species (Chapter 12, Protocol for Induction Systems and Net Calibration).

A second set of fish will be inducted with about 30 min left in the test. A third set of fish will be inducted if the test is longer than 2 hr.

After unit shutdown

After the unit being fished (unit with nets attached) has been shut down, a tub will be lowered to the barge where the net has been retrieved. Fish from the two nets will be collected in separate tubs and data compiled from each net separately.

Data will be recorded on separate data sheets for each net. The date, unit number, side of unit sampled (GA or SC), test number, start time, and end time will be recorded on each data sheet for the test. Species code, sample code, and fish length will be recorded (Appendix 3-2, this chapter) for individual fish. If high entrainment occurs, a subsample of the abundant species will be measured for lengths, a weight taken of the subsample, and a bulk weight will be recorded for the rest of the sample for that species (see Chapter 11, Protocol for Entrainment Monitoring Procedures, for subsampling fish and an explanation of the data sheet). The number of marked fish captured is recorded on the calibration data sheet for each net. See Appendix 3-3, 3-4, and 3-5 (this chapter) for completed calibration and entrainment data sheets.

Most species of entrained fish will be saved and frozen for use as marked fish in later tests. Large fish (i.e., carp, striped bass, and hybrid bass) will not be saved since they will not pass through the induction system. Blueback herring and threadfin shad will not be saved because they do not preserve well. Unless fish are saved for calibration purposes, fish will be disposed of at a designated site specified by the RBR area engineer.

Post conventional generation net testing

After the fish have been counted and the work area is cleaned up, the trash rack will be raised and the induction hose removed.

The number of fish entrained, by species, is recorded on a data sheet provided by the Corps of Engineers (COE) supervisor for their use; total numbers are provided by species but are not divided by size group. If bulk weight of the fish was determined, an estimate of fish entrainment will be provided. The bulk weighing process is described in Chapter 11. The exact start and end times will be received from the dam operator. These times are included in Appendix 16-2 (Chapter 16).

Data sheets will be returned to the Co-op Unit at the University of Georgia following testing or will be faxed from Trotter Shoals Research Laboratory to UGA within 12 hr of the test and a cover sheet attached and filled out (Appendix 3-6, this chapter). (Original data sheets will be returned to UGA as soon as possible). See Chapter 13, Protocol of Data Management for Netted Fish (Includes Expansion), for use of collected data.

Net Calibration:__Fyke Net__Conventional__Full Recovery Page__of__

Date: Start_____End_____
Time: Start_____End_____

Collected by:_____
Units Tested_____Unit Fished___

Species	Size	Mark	# Inducted	Time Inducted	# Recovered			
					USC	LSC	UGA	LGA

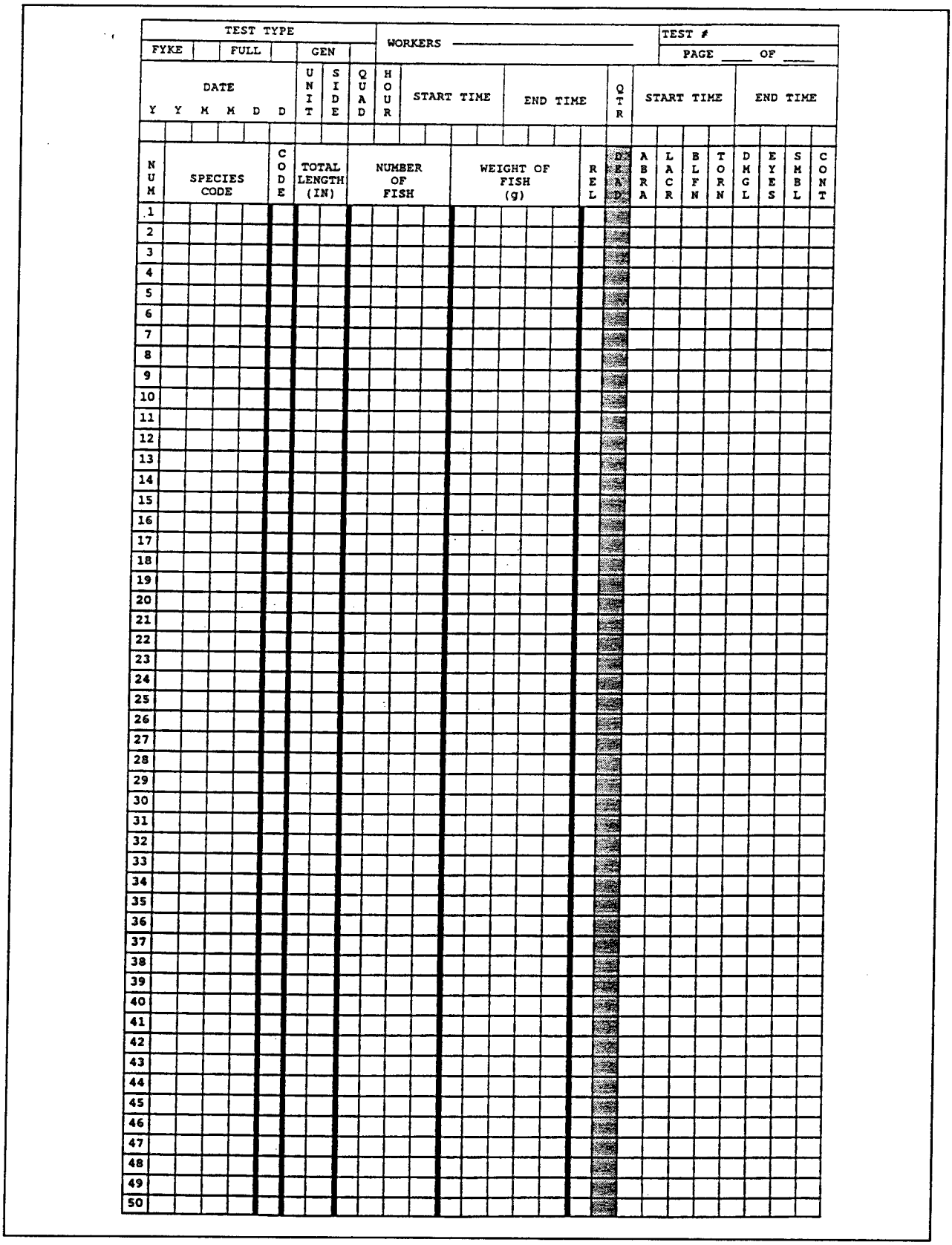
Bagged Fish:
Species:_____

Floaters:_____
Impinged fish:_____
_____
Net Blowback__Yes__No Panel____ Severity:

	GA	SC
Upper	Mark____ # ____ Rec ____	Mark____ # ____ Rec ____
Lower	Mark____ # ____ Rec ____	Mark____ # ____ Rec ____

Comments:

Appendix 3-1. Calibration Data Sheet



TEST TYPE: FYKE ☐ FULL ☐ GEN ☐ | WORKERS _____ | TEST # | PAGE ____ OF ____

DATE (Y Y M M D D)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	DEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
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42															
43															
44															
45															
46															
47															
48															
49															
50															

Appendix 3-2. Data Sheet

Net Calibration: __Fyke Net X Conventional __Full Recovery Page 1 of 2

Date: Start 8-28-95 End 8-28-95
Time: Start 0725 End 1100

Collected by: Mark Weiland, Kyle Spendlife
Units Tested 5,6 Unit Fished 5
Test Number 95237684.

Species	Size	Mark	# Inducted	Time Inducted	# Recovered			
					USC	LSC	UGA	LGA
GS	2-3	dorsal red	30	0939	2		6	
GS	3-5	caudal red	30	0939	8		14	
Phony	1.5	Green	30	0806	13		11	
fish	3.0	↓	↓	↓	6		12	
↓	4+	↓	↓	↓	10		15	
↓	4f	↓	↓	↓	8		16	
↓	7.5	↓	↓	↓	14		15	
Phony	1.5	natural	30	0940	8		14	
fish	3.0	↓	↓	↓	9		14	
↓	4+	↓	↓	↓	8		17	
↓	4f	↓	↓	↓	9		19	
↓	7.5	↓	↓	↓	11		19	
GS	caudal 2-3	brown	30	1040	3		4	
GS	dorsal 3-5	brown	30	1040	13		15	

Bagged Fish:
Species:_____

Floaters:_____
Impinged fish:_____

Net Blowback __Yes __No Panel___ Severity:

	GA	SC
Upper	Mark___ # ___ Rec ___	Mark___ # ___ Rec ___
Lower	Mark___ # ___ Rec ___	Mark___ # ___ Rec ___

Comments:

Appendix 3-3. Completed Calibration Data Sheet

Net Calibration: __Fyke Net X Conventional __Full Recovery Page 2 of 2

Date: Start 8-28-95 End 8-28-95
Time: Start 0725 End 1100

Collected by: Mark Weiland Kyle Spaniol CF
Units Tested 5,6 Unit Fished 5
Test Number 952.37684

Species	Size	Mark	# Inducted	Time Inducted	# Recovered			
					USC	LSC	UGA	LGA
Phony	1.5	Orange	30	1040	9		9	
Fish	3.0	/	/	/	7		13	
	4+	/	/	/	8		13	
	4C	/	/	/	12		11	
	7.5	V	V	V	10		17	

Bagged Fish:
Species:_____

Floaters:_____
Impinged fish:_____

Net Blowback __Yes __No Panel___ Severity:

Comments:

	GA	SC
Upper	Mark___ # ___ Rec ___	Mark___ # ___ Rec ___
Lower	Mark___ # ___ Rec ___	Mark___ # ___ Rec ___

Appendix 3-4. Calibration Data Sheet

TEST TYPE: FYKE [ ] FULL [ ] GEN [X]

WORKERS: Mark Weiland / Kyle Spendiff

TEST # 95237GA

PAGE 1 OF 2

DATE (YYMMDD)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
950828	5	GA	–	1	0725	1100			

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	DEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	191 2	C	7												
2	"	"	3												
3	"	"	3												
4	"	"	3												
5	192 1	C	2												
6	"	"	3												
7	"	"	4												
8	"	"	4												
9	382 2	C	4												
10	"	"	4												
11	"	"	4												
12	"	"	4												
13	"	"	5												
14	"	"	4												
15	"	"	4												
16	"	"	4												
17	"	"	4												
18	"	"	4												
19	"	"	5												
20	"	"	4												
21	381 2	C	4												
22	"	"	5												
23	378 6	C	3												
24	"	"	4												
25	"	"	2												
26	"	"	3												
27	"	"	4												
28	"	"	3												
29	"	"	2												
30	"	"	3												
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33	"	"	4												
34	"	"	3												
35	"	"	4												
36	"	"	3												
37	381 4	C	2												
38	"	"	2												
39	563 1	C	4												
40	"	"	4												
41	"	"	5												
42	"	"	5												
43	"	"	4												
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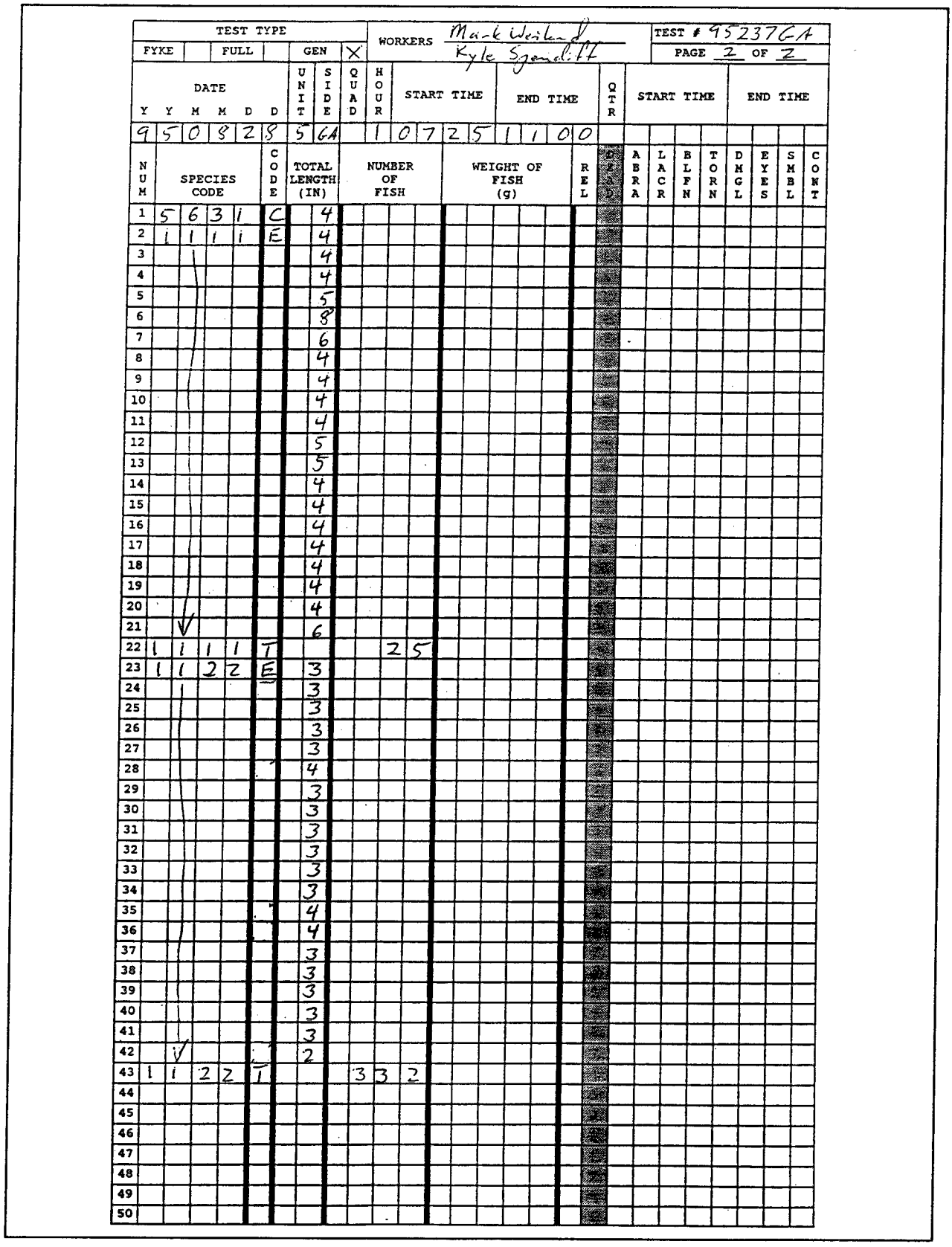
Appendix 3-5. Completed Data Sheets (Sheet 1 of 4)



TEST TYPE: FYKE [ ] FULL [ ] GEN [X]

WORKERS: Mark Weiland, Kyle Sgamelotti

TEST # 95237GA

PAGE 2 OF 2

DATE (YY MM DD)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
950828	5	GA		1	0725	1100			

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	RECAP	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	563 1	C	4												
2	111 1	E	4												
3			4												
4			4												
5			5												
6			8												
7			6												
8			4												
9			4												
10			4												
11			4												
12			5												
13			5												
14			4												
15			4												
16			4												
17			4												
18			4												
19			4												
20			4												
21			6												
22	1111	T		25											
23	1122	E	3												
24			3												
25			3												
26			3												
27			3												
28			4												
29			3												
30			3												
31			3												
32			3												
33			3												
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37			3												
38			3												
39			3												
40			3												
41			3												
42			2												
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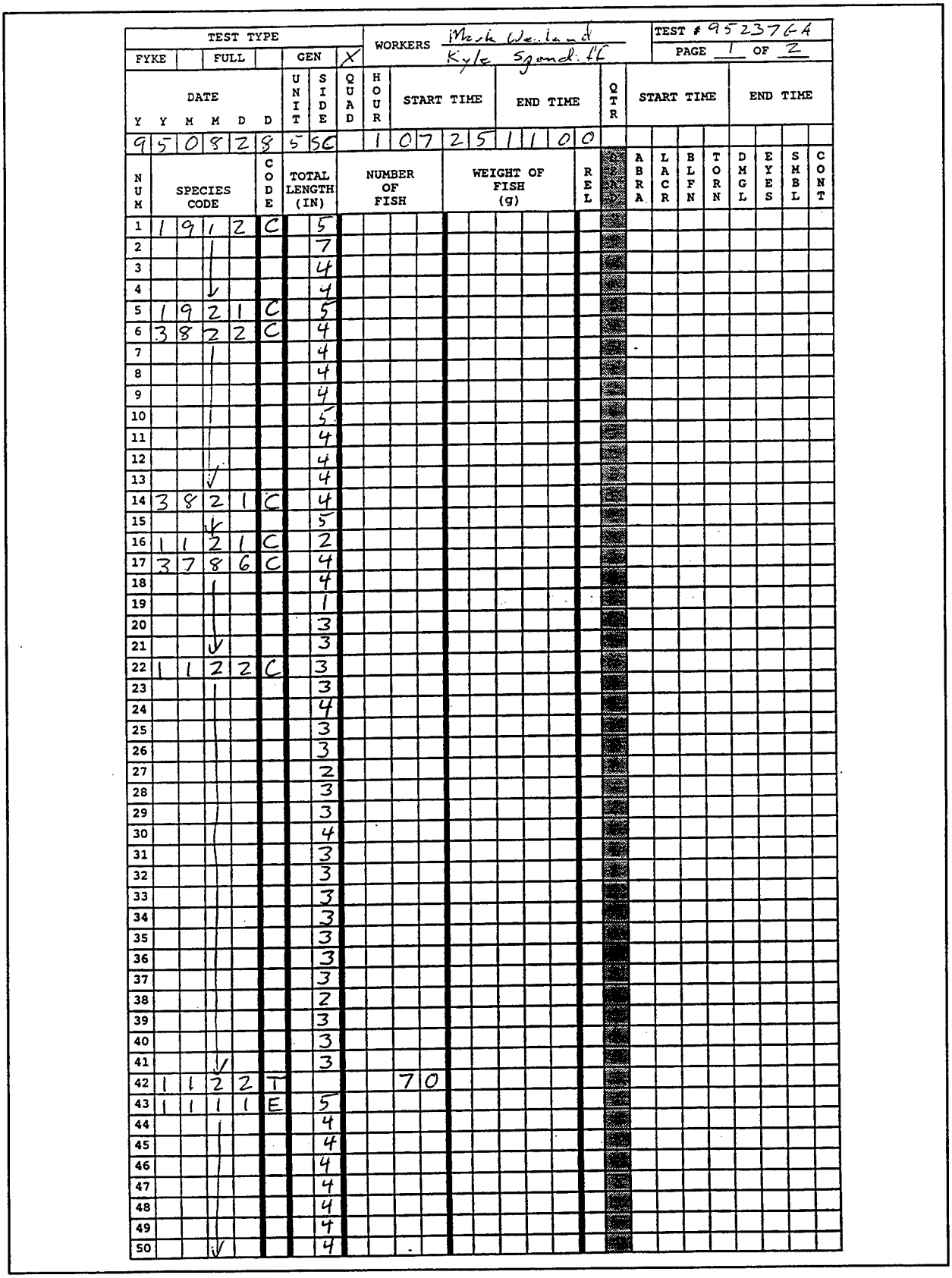
50															

Appendix 3-5. (Sheet 2 of 4)



TEST TYPE: FYKE | FULL | GEN X

WORKERS: Mark Weiland, Kyle Sgondilis

TEST # 9523764

PAGE 1 OF 2

DATE (Y Y M M D D)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
9 5 0 8 2 8	5	SC		1	0 7 2 5	1 1 0 0			

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	1 9 1 2	C	5											
2			7											
3			4											
4			4											
5	1 9 2 1	C	5											
6	3 8 2 2	C	4											
7			4											
8			4											
9			4											
10			5											
11			4											
12			4											
13			4											
14	3 8 2 1	C	4											
15			5											
16	1 1 2 1	C	2											
17	3 7 8 6	C	4											
18			4											
19			1											
20			3											
21			3											
22	1 1 2 2	C	3											
23			3											
24			4											
25			3											
26			3											
27			2											
28			3											
29			3											
30			4											
31			3											
32			3											
33			3											
34			3											
35			3											
36			3											
37			3											
38			2											
39			3											
40			3											
41			3											
42	1 1 2 2	T		7 0										
43	1 1 1 1	E	5											
44			4											
45			4											
46			4											
47			4											
48			4											
49			4											
50			4											

Appendix 3-5. (Sheet 3 of 4)

TEST TYPE: FYKE [ ] FULL [ ] GEN [X]

WORKERS: Mark Weiland, Kyle Spendiff

TEST # 95237C-A

PAGE 2 OF 2

DATE (Y Y M M D D)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
9 5 0 8 2 8	5	SC		1	0 7 2 5	1 1 0 0			

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	DEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	1111	E	4												
2			4												
3			5												
4			4												
5			4												
6			4												
7			4												
8			4												
9			5												
10			5												
11			4												
12			4												
13	1111	T		11											
14															
15															
16															
17															
18															
19															
20															
21															
22															
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49															
50															

Appendix 3-5. (Sheet 4 of 4)

Data Cover Sheet

TEST NUMBER 95237G5A

Date of test: 8-28-95
Hours of test: 1) Start 0725 End 1100
Test type: Fyke ___ Full ___ Gen X Unit 5 Side GA & SC
Number of data pages: 6

	Date	Worker Initials	File Name
Field data received	8-28-95	By MAW From MAW	
Field data scanned for errors	8-30	MAW	
Data entered	8-30	MAW	95237G5A.WQ1
Entered data verified	8-30	MAW	
Converted to ASCII	8-30	MAW	95237G5A.DAT
Verification	8-31	MAW	
Data expansion program run	8-31	MAW	Prog 95237G5A.PRG Out 95237G5A.EXP
Expanded data verified	8-31	MAW	
Expanded data uploaded to server	8-31	MAW	
Data mailed to WES for repository	9-15	MAW	

Appendix 3-6. Data Cover Sheet

4 Protocol and Procedures for Slot Net Pump Test (Fyke Net): Part 1[1]

Introduction

The following represents the procedures followed by AScI/WES personnel during slot or "fyke" net tests. Slot net tests are used in conjunction with hydroacoustic monitoring to estimate entrainment during pump mode operations. The slot net is inserted into one draft tube of a pump unit by lowering with the draft tube deck crane. The slot net consists of a large rectangular steel frame from which four nearly identical, lined, sock nets are hung (Figure 2). The focus of this chapter will be on the netting operations and test coordination. Protocols for data handling (Chapter 15) and hydroacoustic system operation (Chapter 14) are also covered.

Procedures

Pretest arrangements

The area engineer will provide a schedule of expected testing times and make arrangements with the net-handling contractor to place the net frame at the appropriate unit. AScI/WES personnel will notify the area engineer as to which draft tube of the unit should be sampled. Sampling effort is split 50 percent on Georgia side draft tubes and 50 percent on South Carolina side draft tubes. AScI/WES personnel will inspect the nets for tears and ensure that the cod ends are properly tied before testing begins.

The UGA Co-op Unit will induct fish for net calibration monitoring during the slot net tests. AScI/WES personnel will set up the induction system, and

[1] Patrick C. Pierce, AScI Corporation, Trotter Shoals Research Facility, Calhoun Falls, SC.

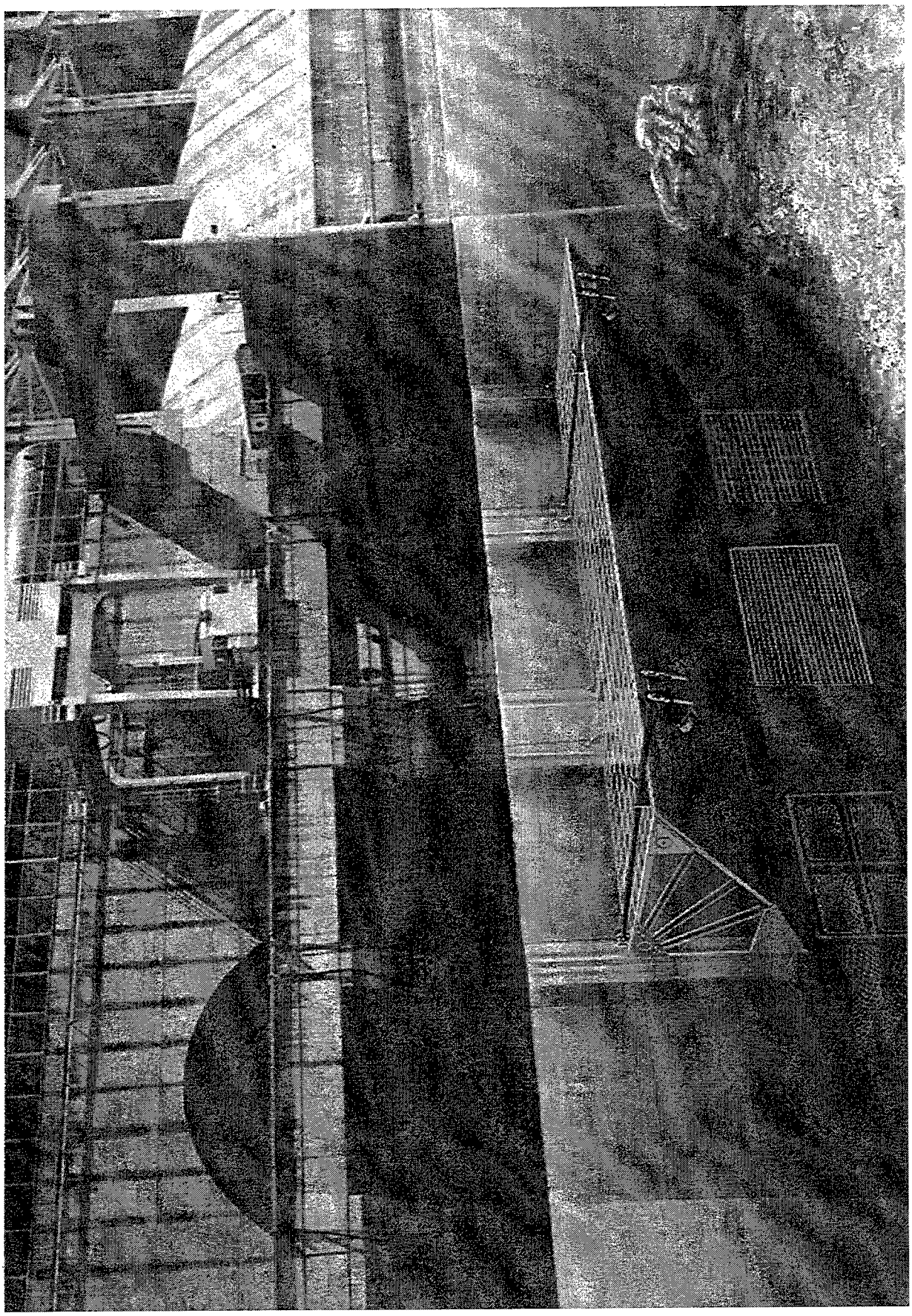

Figure 2. Slot net pump test

with the assistance of the net-handling contractor, attach the induction hose to the center of the trash rack prior to testing. Also, the UGA Co-op Unit will test for losses caused by unit blow back at shut down.

AscI/WES personnel will activate the ultrasonic fish deterrent system at least 1 hr before pumping begins and verify that fish-attracting lights have been turned on at least 1 hr before pumping.

The net-handling contractor will lower the net into testing position just prior to pump start and after the dam operator has pressurized the unit for start-up.

Hydroacoustics

Hydroacoustic monitoring of entrainment is conducted during slot net tests as described in Chapter 14. The four downstream transducer mounts are lowered into the water before activating the hydroacoustic system. A data handling check sheet (see Appendix 14-1, Chapter 14) is completed as described in Chapters 14 and 16.

Pumping

Once pumping has begun, AScI/WES personnel will monitor the performance of the hydroacoustic system. If a high entrainment event is observed with hydroacoustics, an unscheduled shutdown of the pump unit may be used to prevent overloading and tearing the slot nets. AScI/WES personnel will also be available to assist the UGA Co-op Unit with fish inductions if necessary.

Fishing the nets

Once pumping has ceased and the unit has been valved down, the net-handling contractor will raise the slot net frame to the draft tube deck. The net-handling contractor will then lift the individual nets and shake the captured fish either to the cod end or to the mouth of the net. Care is taken to not lose fish through the larger web at the mouth of the net. AScI/WES personnel will collect the fish from the mouth of the net and the cod end and place them into a bucket. A unique bucket is used for each of the four nets to allow data to be analyzed by quadrant. Once all fish have been removed from an individual net, the fish are transferred to the UGA Co-op Unit for enumeration. AScI/WES personnel secure the cod ends of the nets for future tests and inspect the nets for damage. At their discretion, AScI/WES personnel may attempt minor or temporary repairs between sampling runs. Large tears often require the postponement of additional tests until repairs can be made.

Post test

AscI/WES personnel will secure hydroacoustic data and distribute as described in Chapter 16 of this report. All vessels will be removed from the tailrace or secured to the floating platform. AScI/WES personnel will coordinate with the area engineer's office to make any necessary repairs.

5 Protocol and Procedures for Slot Net Pump Test (Fyke Net): Part 2[1]

Introduction

The draft tube fyke net is one of two methods used to estimate fish entrainment during a pumpback operation (see Chapter 7, Protocol for Unit 5 Full Recovery Net Pump Test: Part 2, for the other type of pumpback netting). The fyke net spans half of a pumpback unit, sampling one of the two draft tube bays and collects fish before they pass through the turbine. The net system consists of a frame that can be raised and lowered in a gate slot on the draft tube deck of the dam. The frame supports four nets each measuring approximately 15 ft wide by 10 ft high and extends into the draft tube about 20 ft from the frame (Figure 2). The cod end of each net is cinched with rope and is untied after a net test to remove fish. The fyke net can be fished in either side of any of the four pumpback units. Fish can be collected only after the unit has been shut down and the net has been raised.

Objective

The objective is to determine species composition, length distribution, and numbers of fishes passing through a turbine unit.

---

[1] Mark A. Weiland, Georgia Cooperative Fisheries and Wildlife Research Unit, D. B. Warnell School of Forest Resources, Univeristy of Georgia, Athens, GA.

Methods

Pretest inventory and setup

Prior to the test it is necessary to make sure the following list of equipment is available and in working order at the dam for the test.

- Large fish tubs.
- Gallon buckets.
- Life jackets.
- Hard hats.
- Data sheets.
- Calibration data sheets.
- Log book.
- Paper bags, string (at dam).
- Measuring board (at dam).
- Hanging scale (at dam).
- Balance scale (at dam).
- Dyes and scissors (at dam).
- Frozen fish (at dam).

Note: A sufficient supply of data sheets, paper bags, dye, etc., will be kept on hand at all times. Enough supplies will be available at any one time for at least six tests.

UGA Co-op Unit workers will arrive at the dam at least 1 hr prior to the scheduled beginning of the fyke net test to set up the induction system, help Valley Construction workers install induction hoses properly, and ensure that the pump is operational and primed (see Protocol for Induction Systems and Net Calibration).

Phony fish will be used for the bag test. Color, length, marking, and which quadrant where the phony fish are attached will be recorded on the calibration data sheet (Appendix 3-1, Chapter 3). At least 10 phony fish of the same color and clip mark will be placed inside a paper bag and tied inside of each of the four panels of the fyke net to monitor the occurrence of net blowback during unit shutdown, and to estimate fish loss due to blowback if it occurs.

During fyke net test

Fish will be fin clipped and dyed for net calibration. On the calibration data sheet (Appendix 3-1, Chapter 3), the number of fish inducted, species, length range, mark, and time inducted will be recorded. "Fyke Net" will be checked for the net calibration at the top of the calibration data sheet. The start and end date for the test, who collected the data, units operating during the test, and unit and side fished (unit and side the fyke net is in) are entered. After the test the exact start and end time for the test will be received from the dam operator and written on the sheet. If more than one page is needed for a test, a second data sheet will be used and page numbers added to the sheets. "Test number" will be recorded on the data sheet after it has been returned to UGA. Each test will receive a code and will be recorded on all data for the test. Marked fish of at least one species will be inducted during each test for net calibration. Fish species are determined using a fish guide.[1] Inducted fish will be divided by species and size group due to differences in net efficiency of different species and size groups. Between 20 and 40 fish of at least one species will be inducted (if large fish >6 in., 20-25 fish will suffice). Fish will be inducted in standard length groups (see Chapter 12, Protocol for Induction Systems and Net Calibration).

A second set of fish will be inducted later in the test if a single test is longer than 2 hr.

After unit shutdown

After the netted unit has been shut down, tubs will be provided to transport entrained fish. Fish will be kept separate for each of the four quadrants and data compiled for each quadrant separately.

Data will be recorded on a separate data sheet for each quadrant. The date, unit number, test number, start time, end time, side of unit sampled (GA or SC), and quadrant sampled (upper GA, lower GA, upper SC, or lower SC) will be recorded on each data sheet for the test. For individual fish, species code, sample code, and fish length will be recorded (Appendix 3-2, Chapter 3). If high entrainment occurs, a subsample of the abundant species will be measured for lengths, a weight taken of the subsample, and a bulk weight will be recorded for the rest of the sample for that species (see Chapter 11, Protocol for Entrainment Monitoring Procedures). The number of marked fish captured is recorded on the calibration data sheet for each net. See Appendixes 5-1 and 5-2 (this chapter) for examples of completed calibration and entrainment data sheets.

Most species of entrained fish will be saved and frozen for use as marked fish in later tests. Large fish (i.e., carp, striped bass, and hybrid bass) will not be saved since they will not pass through the induction system. Blueback herring

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[1] Page, L. M., and Brooks, M., B. (1991). *A field guide to freshwater fishes: North America north of Mexico.* Houghton Mifflin, Boston.

and threadfin shad will not be saved because they do not thaw well after being frozen.

Numbers of fish floating in the slot from which the nets were pulled will be counted or estimated by UGA Co-op workers and recorded on the calibration data sheet. These fish occur normally from blowback or fall from the net during removal.

If there is another test, attach bagged fish to the net before the net is lowered into the slot, and UGA will repeat the above procedure.

Post fyke net testing

After the fish have been counted, the work area will be cleaned up and help given to Valley Construction to pull and store induction hoses. Impinged fish removed from the trash rack by WES employees will be speciated and measured by UGA Co-op workers. These data are included in the proper space on the calibration data sheet. Unless fish are saved for calibration purposes, fish will be disposed of at a designated site specified by the RBR area engineer.

The number of fish entrained, by species, will be recorded on a data sheet provided by the COE supervisor. If bulk weighing of the fish was done, an estimate of entrainment will be provided. The exact start and end time for the tests will be received from the dam operator.

Data sheets will be returned to the Co-op Unit at the University of Georgia following testing or faxed from Trotter Shoals Research Laboratory to UGA within 12 hr of the test (original data sheets will be returned to UGA at the soonest possible time and a cover sheet added (Appendix 5-3, this chapter). Data will then be entered and analyzed following procedures in Chapter 13, Protocol of Data Management for Netted Fish (Includes Expansion).

Net Calibration: X Fyke Net __ Conventional __ Full Recovery Page 1 of 1

Date: Start 8-9-95 End 8-10-95
Time: Start 2300 End 2500

Collected by: Mark Weiland, Kyle Spendliff
Units Tested 6 7 8 Unit Fished 8-GA
Test Number 95221FSA

Species	Size	Mark	# Inducted	Time Inducted	# Recovered			
					USC	LSC	UGA	LGA
Crappie	3-5"	caudal	40	2339	0	0	36	2
Phoney	1.5	Green	30	2337	0	0	24	2
"	3.0	"	30	"	0	0	23	7
"	4f	"	30	"	0	0	20	5
"	4+	"	30	"	0	0	27	2
"	7.5	"	30	"	0	0	23	2

Bagged Fish:
Species: crappie

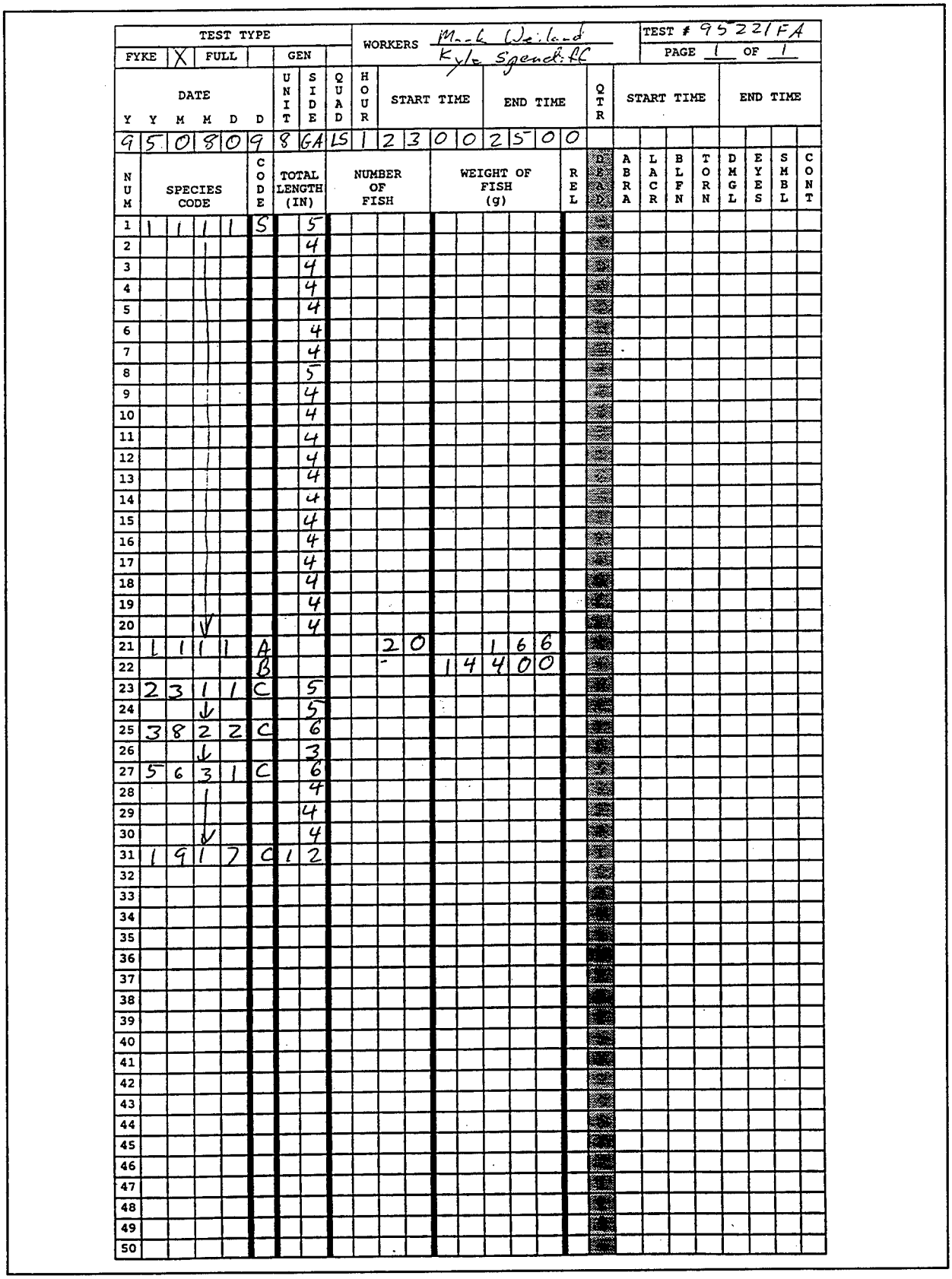
Floaters: 80 BBH
Impinged fish: 0

Net Blowback __ Yes X No Panel ___ Severity:

	GA	SC
Upper	Mark dorsal # 10 Rec 10	Mark caudal lower # 10 Rec 10
Lower	Mark caudal # 10 Rec 10	Mark pelvic # 10 Rec 10

Comments:

Appendix 5-1. Calibration data sheet



TEST TYPE: FYKE [ ] FULL [X] GEN [ ]

WORKERS: M. L. Weiland / K. L. Sgendi, AC

TEST # 95221FA

PAGE 1 OF 1

DATE (YY MM DD)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
95 08 09	8	GA	LS	1	2300	2500			

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	QRAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	1111	S	5												
2			4												
3			4												
4			4												
5			4												
6			4												
7			4												
8			5												
9			4												
10			4												
11			4												
12			4												
13			4												
14			4												
15			4												
16			4												
17			4												
18			4												
19			4												
20			4												
21	1111	A		20	1664										
22		B		-	14400										
23	2311	C	5												
24			5												
25	3822	C	6												
26			3												
27	5631	C	6												
28			4												
29			4												
30			4												
31	1917	C	12												
32															
33															
34															
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49															
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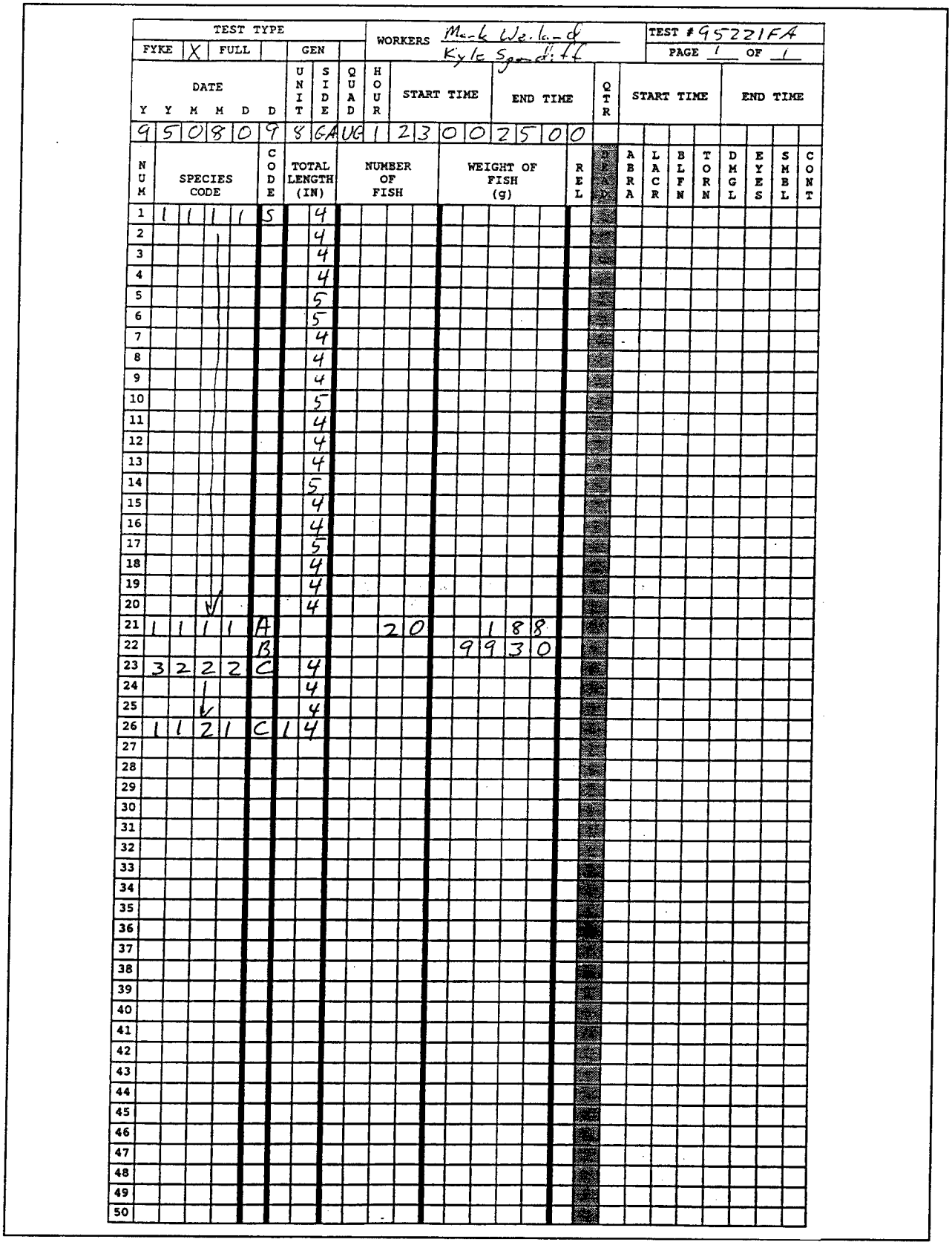
Appendix 5-2. Entrainment data sheet (Sheet 1 of 4)



TEST TYPE				WORKERS	TEST #	
FYKE	X	FULL	GEN	Mark Weiland, Kyle Spindler	95221FA	
					PAGE 1	OF 1

DATE						UNIT	SIDE	QUAD	HOUR	START TIME				END TIME				QTR	START TIME				END TIME			
Y	Y	M	M	D	D																					
9	5	0	8	0	9	8	GA	UG	1	2	3	0	0	2	5	0	0									

NUM	SPECIES CODE					CODE	TOTAL LENGTH (IN)	NUMBER OF FISH		WEIGHT OF FISH (g)				REL	DEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	1	1	1	1		5	4																
2							4																
3							4																
4							4																
5							5																
6							5																
7							4																
8							4																
9							4																
10							5																
11							4																
12							4																
13							4																
14							5																
15							4																
16							4																
17							5																
18							4																
19							4																
20				↓			4																
21	1	1	1	1		A			2	0			1	8	8								
22						B					9	9	3	0									
23	3	2	2	2		C	4																
24				↓			4																
25							4																
26	1	1	2	1		C	1	4															
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Appendix 5-2. (Sheet 2 of 4)

TEST TYPE				WORKERS	Mark Weiland Kyle Sgandiff	TEST #	95221FA
FYKE	X	FULL		GEN		PAGE 1 OF 1	

DATE (YYMMDD)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
950809	8	GA	US	1	2300	2500	0		

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	DEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	1111	S	4												
2	↓		4												
3			4												
4			4												
5			4												
6			4												
7			4												
8			4												
9			4												
10			4												
11			4												
12			4												
13			4												
14			4												
15			5												
16			4												
17			4												
18			4												
19			4												
20	↓		4												
21	1111	A		20	167										
22	1111	B			8950										
23	5631	C	5												
24	↓		5												
25	↓		4												
26	3822	C	5												
27	↓		4												
28			4												
29			4												
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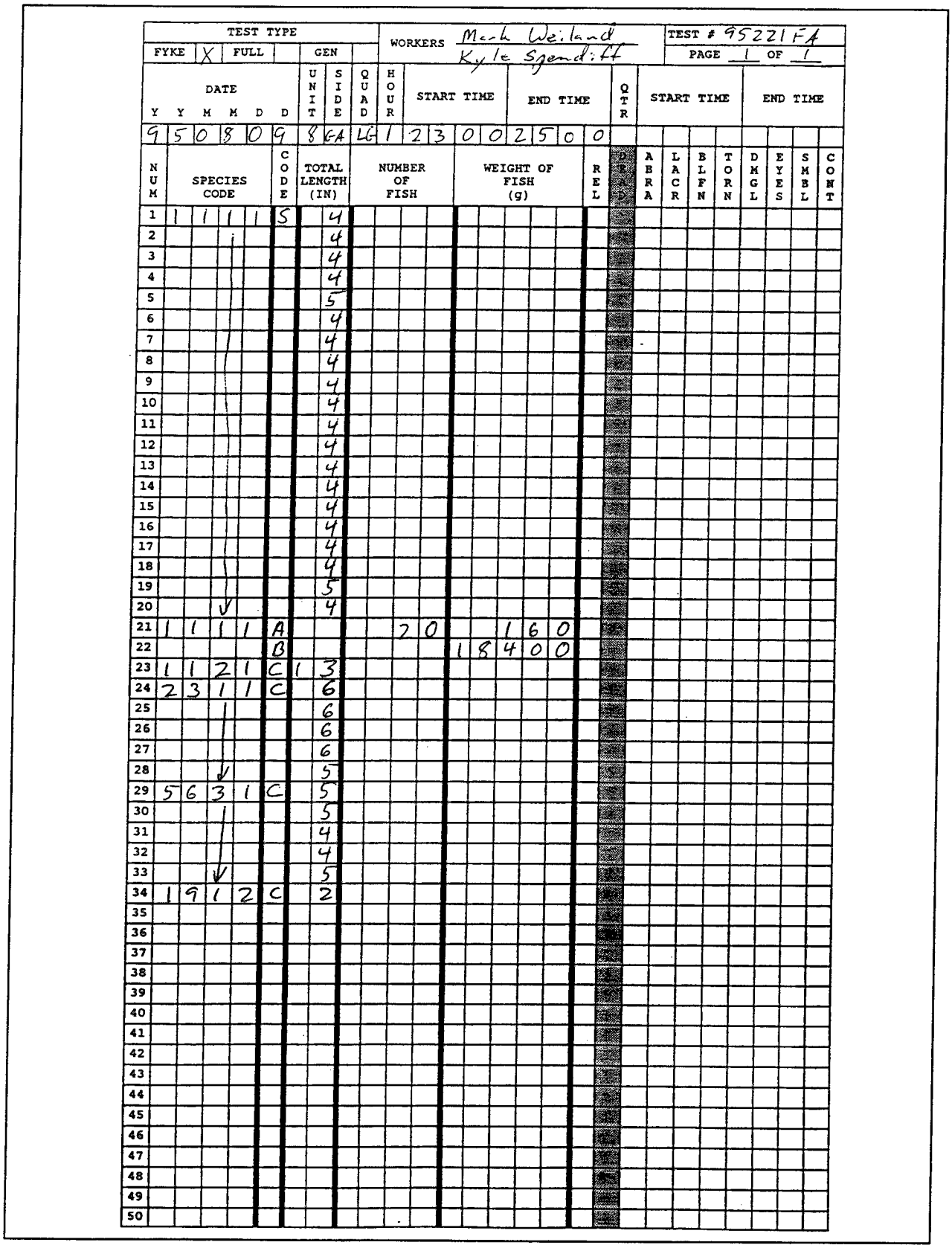
Appendix 5-2. (Sheet 3 of 4)



TEST TYPE							WORKERS	TEST #
FYKE	X	FULL		GEN			Mark Weiland Kyle Sgendiff	95221FA
								PAGE 1 OF 1

DATE						UNIT	SIDE	QUAD	HOUR	START TIME				END TIME				QTR	START TIME				END TIME			
Y	Y	M	M	D	D																					
9	5	0	8	1	0	8	FA	LG	1	2	3	0	0	2	5	0	0									

NUM	SPECIES CODE					CODE	TOTAL LENGTH (IN)		NUMBER OF FISH			WEIGHT OF FISH (g)					REL	DEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	1	1	1	1		S		4																		
2								4																		
3								4																		
4								4																		
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17								4																		
18								4																		
19								5																		
20				↓				4																		
21	1	1	1	1		A				2	0				1	6	0									
22						B						1	8	4	0	0										
23	1	1	2	1		C	1	3																		
24	2	3	1	1		C		6																		
25				↓				6																		
26								6																		
27								6																		
28				↓				5																		
29	5	6	3	1		C		5																		
30				↓				5																		
31								4																		
32								4																		
33				↓				5																		
34	1	9	1	2		C		2																		
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Appendix 5-2. (Sheet 4 of 4)

Data Cover Sheet

TEST NUMBER 95221F8A

Date of test: 8-9-95
Hours of test: 1) Start 2300 End 2500
Test type: Fyke X Full ___ Gen ___ Unit 8 Side GA
Number of data pages: 5

	Date	Worker Initials	File Name
Field data received	8-9-95	By MAW From MBG	
Field data scanned for errors	8-10	MAW	
Data entered	8-10	MBG	95221F8A.WQ1
Entered data verified	8-11	MBG	
Converted to ASCII	8-11	MAW	95221F8A.DAT
Verification	8-11	MAW	
Data expansion program run	8-12	MAW	Prog 95221F8A.PRG Out 95221F8A.EXP
Expanded data verified	8-12	MAW	
Expanded data uploaded to server	8-12	MAW	
Data mailed to WES for repository	8-15	MAW	

Appendix 5-3. Data cover sheet

6 Protocol for Unit 5 Full Recovery Net Pump Tests: Part 1[1]

Introduction

The following represents the procedures followed by AScI/WES personnel during Unit 5 full recovery net pump tests. The upstream full recovery net samples penstock outflow on Unit 5 and allows for real-time data analysis since fish are continually collected at a barge at the cod end of the net (Figure 3). These tests are in support of the UGA Co-op Unit mortality studies. The focus of this chapter will be on netting and test coordination. Hydroacoustic operation (Chapter 15), data handling (Chapter 14), and mortality testing protocols (Chapter 9) are also covered.

Procedures

Pretest arrangements

Test coordination and induction systems. The area engineer will provide a schedule of expected testing times and make arrangements with the net-handling contractor to be available to assist with barge connection and net deployment. The UGA Co-op Unit will induct fish for net calibrations and mortality testing during Unit 5 full recovery net tests. AScI/WES personnel will set up the induction system and verify that it is operational. Two induction systems are typically used during Unit 5 generation tests. The penstock induction hose is tied to the full recovery net frame during net deployment. The draft tube induction hose is positioned in the draft tube slot by AScI/WES personnel prior to pump start-up.

---

[1] Patrick C. Pierce and R. Scot Yarbrough, AScI Corporation, Trotter Shoals Research Facility, Calhoun Falls, SC.

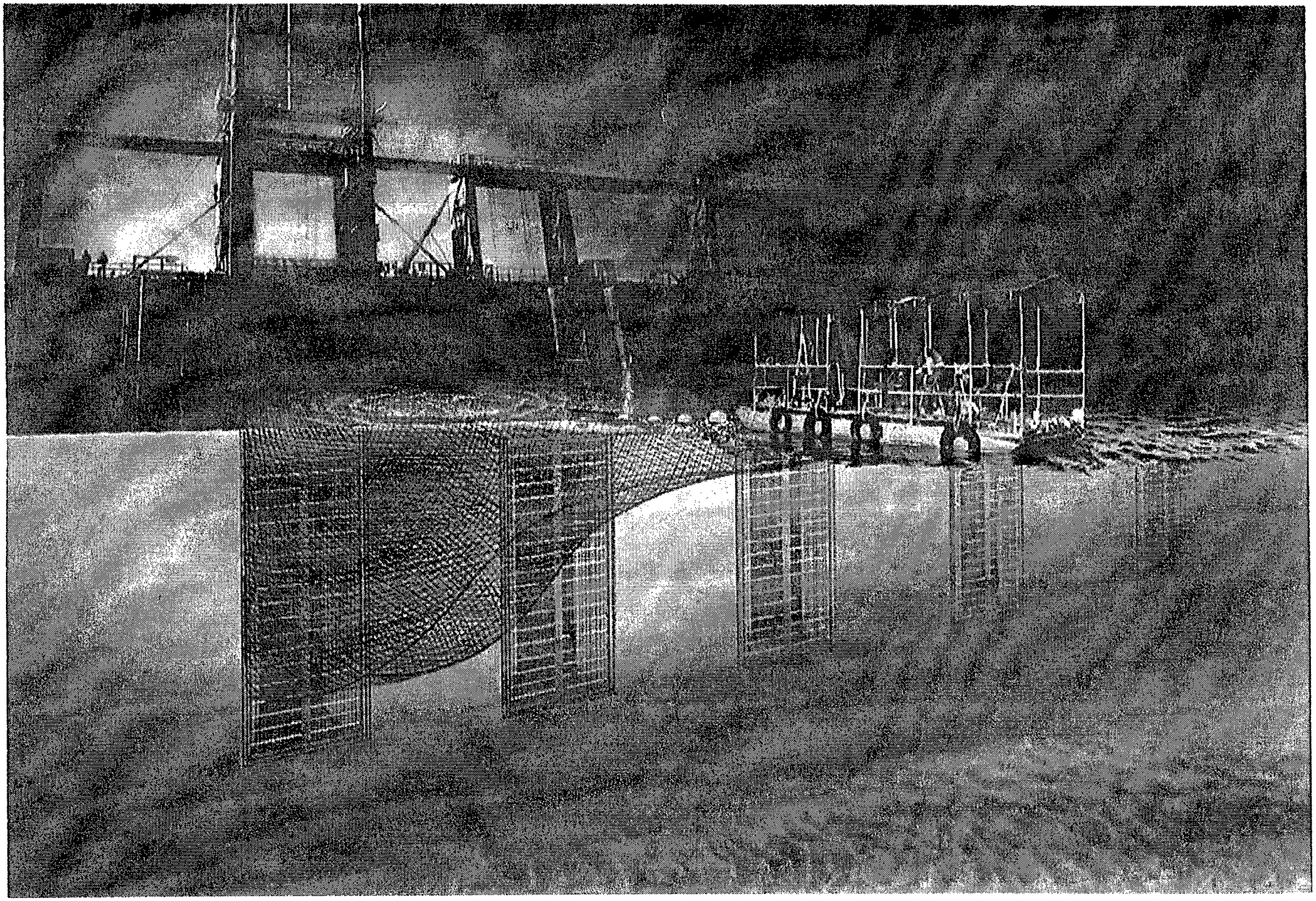

Figure 3. Full recovery Unit 5 net pump test

Barge hookup. AScI/WES personnel will coordinate with the area engineer to arrange a moratorium for barge hookup. Ideally, the barge is hooked up at least 1 day before testing. Barge hookup requires 2 to 3 hr on the water and is an important scheduling consideration.

During the barge hookup moratorium, AScI/WES personnel will tow the barge into position below the net. The upstream hydroacoustic system will be shut down, and the beam-mounted transducer at Unit 5 will be swung out of position to allow barge access to the hanging net. The net contractor will slightly lower the net so that AScI/WES personnel are able to access the net. AScI/WES personnel will attach the outer large web net to the collection trough and secure the barge to the net by means of the four large corner ropes on the net. The inner liner is then pulled into the trough and secured. The barge is connected to three anchor lines from the rear that hold the barge in position during deployment. Two additional lines are run from the front corners of the barge to the water level platforms on either side of the Unit 5 penstock. These lines secure the barge in a storage position directly below the net, above the center of the Unit 5 penstock.

Net deployment. The net is deployed approximately 45 min before the scheduled start-up time. AScI/WES personnel will coordinate via radio with the net-handling contractor during start-up. The net-handling contractor will begin lowering the net while AScI/WES personnel on the barge slowly maneuver the barge away from the dam using the three rear anchor lines attached to the electric windlasses on the rear of the barge. When the slide at the mouth of the net is being lowered, the net-handling contractor and the UGA Co-op Unit will attach the penstock induction hose to the frame inside the mouth of the net. Once the net is completely deployed and the barge is correctly positioned, AScI/WES personnel will secure the barge, inspect the barge for safety, correct attachment, and finally notify the test coordinator that they are in position for a pump start.

Fish deterrent systems and lights. At least 1 hr before pumping begins, AScI/WES personnel will activate the ultrasonic fish deterrent system and verify that the appropriate fish-attracting lights have been activated in the tailrace.

Pumping

Hydroacoustics. AScI/WES personnel will collect hydroacoustic data during Unit 5 full recovery net tests following the procedures outlined in Chapter 14 of this report. A pump data handling check sheet (see Appendix 14-1, Chapter 14) is completed as described in Chapters 14 and 16 of this report.

Pump start. During pump start, AScI/WES personnel on the barge will use the rear anchor lines to adjust the barge into the proper position and verify that the net appears to be fishing properly. Once AScI/WES personnel have secured the barge, they will notify the test coordinator that the UGA Co-op Unit is cleared to attach their vessel to the rear of the barge. AScI/WES personnel will assist the UGA Co-op Unit during attachment.

Pumping. During pumping, AScI/WES personnel will monitor the performance of the hydroacoustic system and the net. AScI/WES personnel will be available to assist the UGA Co-op Unit with inductions or collection of fishes at the barge as necessary. AScI/WES personnel will monitor conditions on the barge and notify the test coordinator if unsafe or otherwise unfavorable conditions develop. At their discretion, AScI/WES personnel may call for a shutdown and/or barge evacuation if conditions become unsafe.

Fishing the net

Once all pumping units have been shut down, AScI/WES personnel will coordinate with the net-handling contractor to retrieve the barge and net. While the net-handling contractor raises the net back into the storage position, AScI/WES personnel on the barge will allow the barge to slowly move toward the dam on the anchor lines. The front securing lines will be retrieved from the dam and tied to the front of the barge to provide stabilization in the cross currents, which typically develop shortly after pump shutdown. Once the net is fully retrieved, all fish remaining in the collection trough will be transferred to the UGA Co-op Unit for enumeration.

Post test

Hydroacoustic data. AScI/WES personnel will secure hydroacoustic data and distribute as described in Chapter 16 of this report.

Barge and net. AScI/WES personnel will either secure the barge in a storage position above the Unit 5 penstock or remove the barge and tow it out of the forebay if no other testing is scheduled in the near future. AScI/WES personnel will secure the beam-mounted Unit 5 upstream transducer, inspect the net for damage, and coordinate with the area engineer's office to make any necessary repairs. All boats will be removed from the forebay and tailrace areas.

7 Protocol for Unit 5 Full Recovery Net Pump Tests: Part 2[1]

Introduction

The full recovery net is one of two methods used to estimate fish entrainment during a pumpback operation (see Chapter 5, Protocol and Procedures for Slot Net Pump Test (Fyke Net): Part 2, for the other type of pumpback netting). The full recovery net covers the entire intake of Unit 5 in the forebay of RBR dam. Although the net covers the entire unit, net efficiency is lower than for fyke net, and the test is more labor intensive. The full recovery net filters fish from the discharge plume and concentrates the fish at the recovery barge. Full recovery netting provides real-time data since fish are collected continuously during the test and can be visually examined to determine any injuries caused by turbine passage. Mortality testing is also done in conjunction with full recovery tests (see Chapter 9, Protocol for Fish Mortality Testing).

The net assembly comprises a frame, the net, and a collection barge. The frame is attached to the dam on the forebay side and rides on a vertical track that allows the net to be raised out of the water or be completely submerged. Additional winches connected to jib booms allow the cod end of the net to be raised sufficiently high so the net can be purged of fish at the conclusion of a pumpback test. The net is approximately 36 ft wide by 94 ft deep at the dam and 4 ft wide by 4 ft deep at the barge. The total length of the net is approximately 185 ft from the dam to the barge. The cod end of the full recovery net connects to the recovery barge, which contains a slotted recovery box to sieve the fish from the water as they pass through the box.

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[1] Mark A. Weiland, Georgia Cooperative Fisheries and Wildlife Research Unit, D. B. Warnell School of Forest Resources, University of Georgia, Athens, GA.

Objective

The objective is to determine species composition, length distribution, and numbers of fishes passing through a turbine/pump unit (see also Chapter 9, Protocol for Fish Mortality Testing).

Methods

Pretest inventory and setup

Prior to the test it is necessary to make sure the following list of equipment is available and at the dam for the test.

- Large fish tubs.
- Gallon buckets.
- Life jackets.
- Hard hats.
- Data sheets.
- Calibration data sheets.
- Log book.
- Measuring board.
- Hanging scale.
- Balance scale.
- Dyes and scissors (at the dam).
- Frozen fish (at the dam).
- Oranges.
- Pontoon boat.
- Generators (2).
- Deep cycle batteries (2).
- Gas cans (2).
- Tool box.

- Hand-held radios.
- Dip nets (2).
- Hanging nets (2).

UGA Co-op Unit workers will arrive at the dam at least 2 hr prior to the scheduled beginning of the full recovery pumpback test for the safety meeting and to set up the boats. Workers will also check to ensure that the induction hoses on the draft tube deck are in place and that the induction hose on the penstock deck is ready for lowering with the net if mortality testing is to be done also. Fish will be thawed and marked with a clip and dyed for net calibration. "Full Recovery" will be marked for the net calibration at the top of the calibration data sheet. The start and end date for the test, who collected the data, units operating during the test, and that Unit 5 was fished are entered. Species, fish length, and marking will be recorded on the calibration data sheet (Appendix 7-1, this chapter). After the test the exact start and end time for the test will be received from the dam operator and written on the sheet. If more than one page is needed for a test, a second data sheet will be used and page numbers added to the sheets. "Test number" will be recorded on the data sheet after it has been returned to UGA. Each test will receive a code and will be recorded on all data for the test.

The induction hose on the penstock deck will be attached by a rope to the net frame and lowered into the water with the net about one-half hour before the test begins (see Chapter 12, Protocol for Induction Systems and Net Calibration).

During full recovery test

Upon clearance from the COE test coordinator, the pontoon boat will be called into the forebay for attachment to the collection barge. The fish will be collected from the watering trough, speciated, and length recorded on the data sheet (Appendix 3-2, Chapter 3). Fish species and lengths will be recorded at 15-min intervals. If high entrainment occurs, fish will be subsampled and the rest bulk weighed or counted. Date, unit number, hour, start time, end of hour, quarter, quarter start, and quarter end time will also be recorded on the data sheet (See Chapter 11, Protocol for Entrainment Monitoring Procedures, for a complete description of recording at different entrainment levels). See Appendix 7-2 (this chapter) for an example of completed entrainment data sheets.

Within 30 min of start-up, 20 oranges will be inducted to determine if the net is fishing properly and has opened up. The net is fishing properly if at least 15 oranges are recovered within 10 min of induction. These data are recorded on the calibration data sheet. If 15 oranges are not recovered, the net is adjusted and oranges are inducted again. Marked fish of at least one species will be inducted during the test for net calibration. Inducted fish will be divided by species and size group due to differences in net efficiency. Between 25 and 40 fish of at least one species will be inducted (if large fish >6 in., 20-25). Fish will be inducted in

standard length groups for all species (see Chapter 12, Protocol for Induction Systems and Net Calibration). On the calibration data sheet (Appendix 7-1, this chapter), the number of fish inducted, species, length range, mark and time inducted will be recorded. See Appendix 7-1 (this chapter) for an example of completed calibration data sheets.

Fish may also be inducted during the full recovery pumpback test as part of mortality testing (see Chapter 9, Protocol for Fish Mortality Testing).

After unit shutdown

As the net is being pulled in, after unit shutdown, fish are collected from the dewatering trough and the net. The data sheet is labeled "Purge," and a default number 9 is put in the hour column and 5 in the quarter column. Fish in the purge are speciated, and lengths are recorded. Counts or bulk weights are recorded if large numbers of species are entrained. Visual estimates of the number of fish floating around the net in the forebay and the number of fish hung in the net are recorded after the net has been raised.

Most species of entrained fish will be saved and frozen for use as marked fish in later tests. Large fish (i.e., carp, striped bass, and hybrid bass) will not be saved since they will not pass through the induction system. Blueback herring and threadfin shad will not be saved because they do not thaw well after being frozen. Unless fish are saved for calibration purposes, fish will be placed at a designated site specified by the RBR area engineer.

Post full recovery net testing

The pontoon boat will be detached from the collection barge so that it may return to the Resource Management Office (RMO) ramp to be cleaned and unloaded.

One draft tube trash rack will be raised to check for impinged fish. Impinged fish will be removed from the trash rack by WES employees. The fish will be speciated and measured by a UGA Co-op employee. These data are included in the proper space on the calibration data sheet.

The number of fish entrained, by species, will be recorded on a data sheet provided by the COE supervisor. Total entrainment numbers are provided by species but are not divided by size group. If bulk weighing of the fish was done, an estimate of entrainment will be provided. Exact start and end times are received from the dam operator (Appendix 7-2, this chapter).

Data sheets will be returned to the Co-op Unit at the University of Georgia following testing or will be faxed from Trotter Shoals Research Laboratory to UGA within 12 hr of the test (original data sheets will be returned to UGA at the soonest possible time and a cover sheet attached (Appendix 7-3, this chapter)).

See Chapter 13, Protocol of Data Management for Netted Fish (Includes Expansion), for analysis and distribution of collected data.

Net Calibration: __Fyke Net__Conventional X Full Recovery Page 1 of 1

Date: Start 8-16-95 End 8-17-95
Time: Start 2300 End 0415

Collected by: Mark Weiland, Peter Dimmick etc.
Units Tested 5 Unit Fished 5
Test Number 95228R8A.

Species	Size	Mark	# Inducted	Time Inducted	# Recovered			
					USC	LSC	UGA	LGA
BB H	3-4"	Red candle	50	2436	20			
Phony	1.5	Yellow	30	2436	17			
↓	3.0	↓	30	↓	25			
↓	4.0	↓	60	↓	47			
↓	7.5	↓	30	↓	26			
Phony	1.5	Green	30	2559	19			
↓	3.0	↓	30	↓	26			
↓	4.0	↓	60	↓	27			
↓	7.5	↓	30	↓	19			

Bagged Fish:
Species: _____

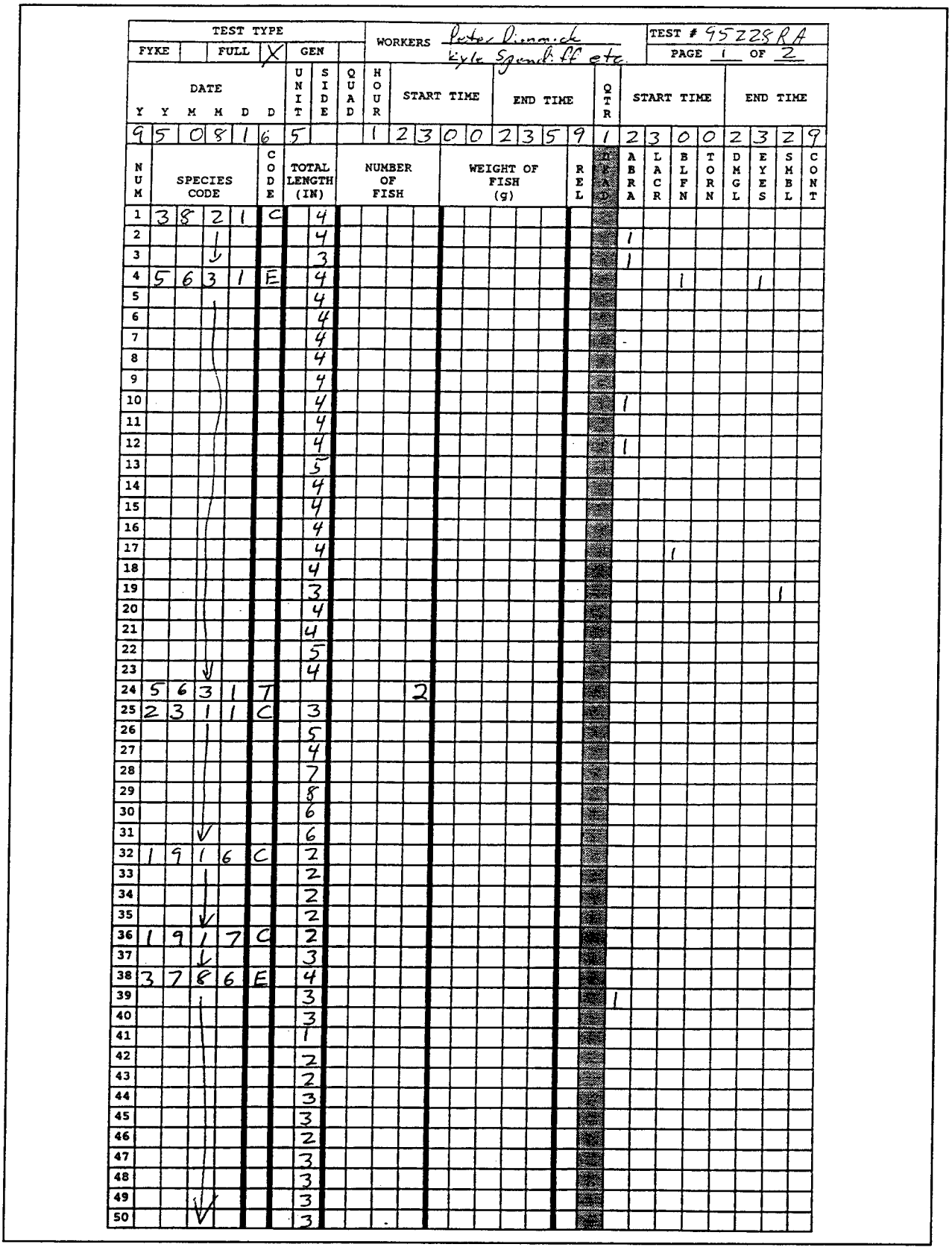
Floaters: _____
Impinged fish: none

Net Blowback __Yes __No Panel ___ Severity:

	GA	SC
Upper	Mark ___ # ___ Rec ___	Mark ___ # ___ Rec ___
Lower	Mark ___ # ___ Rec ___	Mark ___ # ___ Rec ___

Comments:

Appendix 7-1. Calibration data sheet



TEST TYPE: FYKE [ ] FULL [X] GEN [ ]

WORKERS: Peter Dimmick, Kyle Spindler etc.

TEST # 95228RA

PAGE 1 OF 2

DATE (YYMMDD)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
950816	5			1	1200	2359	1	2300	2329

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	HEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	382 1	C	4												
2	"	"	4					1							
3	"	"	3					1							
4	5631	E	4							1			1		
5	"	"	4												
6	"	"	4												
7	"	"	4					-							
8	"	"	4												
9	"	"	4												
10	"	"	4					1							
11	"	"	4												
12	"	"	4					1							
13	"	"	5												
14	"	"	4												
15	"	"	4												
16	"	"	4												
17	"	"	4							1					
18	"	"	4												
19	"	"	3											1	
20	"	"	4												
21	"	"	4												
22	"	"	5												
23	"	"	4												
24	5631	T		2											
25	2311	C	3												
26	"	"	5												
27	"	"	4												
28	"	"	7												
29	"	"	8												
30	"	"	6												
31	"	"	6												
32	1916	C	2												
33	"	"	2												
34	"	"	2												
35	"	"	2												
36	1917	C	2												
37	"	"	3												
38	3786	E	4												
39	"	"	3					1							
40	"	"	3												
41	"	"	1												
42	"	"	2												
43	"	"	2												
44	"	"	3												
45	"	"	3												
46	"	"	2												
47	"	"	3												
48	"	"	3												
49	"	"	3												
50	"	"	3												

Appendix 7-2. Entrainment data sheet (Sheet 1 of 4)

TEST TYPE: FYKE [ ] FULL [X] GEN [ ] | WORKERS ____ | TEST # 95228RA | PAGE 2 OF 2

DATE (YY MM DD)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
95 08 16	5			1	2300	2359	1	2300	2329

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	DEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	37866	E	3												
2	"	"	3												
3	"	"	3					1							
4	"	"	4												1
5	"	"	3												1
6	"	"	3												
7	"	"	3												
8	37866	T		2											
9	11116	C	4												
10	"	"	4												
11	"	"	4												
12	"	"	4												
13	"	"	4												
14	"	"	4												
15	"	"	4												
16	"	"	4												
17	"	"	4												
18	"	"	4												
19	"	"	4												
20	"	"	4												
21	"	"	4												
22	"	"	4												
23	"	"	4												
24	11226	E	3												
25	"	"	2												
26	"	"	2												
27	"	"	2												
28	"	"	2												
29	"	"	2												
30	"	"	2												
31	"	"	3												
32	"	"	2												
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35	"	"	2												
36	"	"	2												
37	"	"	2												
38	"	"	3												
39	"	"	3												
40	"	"	2												
41	"	"	2												
42	"	"	2												
43	"	"	2												
44	11226	T		93											
45															
46															
47															
48															
49															
50															

Appendix 7-2. (Sheet 2 of 4)

TEST TYPE: FYKE [ ] FULL [X] GEN [ ]

WORKERS ——————

TEST # 95228RA

PAGE 1 OF 1

DATE (YYMMDD)	UNIT	SIDE	QUAD	HOUR	START TIME	END TIME	QTR	START TIME	END TIME
950816	5			1	1300	2359	2	2330	2344

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	3781	C	4											
2	"	"	5											
3	"	"	3											
4	"	"	3											
5	"	"	2											
6	1111	C	4											
7	"	"	4											
8	1122	C	2											
9	"	"	2											
10	"	"	2											
11	"	"	2											
12	"	"	2											
13	"	"	2											
14	5631	C	4											
15	"	"	5											
16	"	"	3											
17	"	"	6											
18	"	"	4											
19	5631	G												
20														
21														
22	3822	C	4											
23	"	"	6											
24	"	"	3											
25	"	"	4											
26	3822	G												
27														
28														
29														
30														
31														
32														
33														
34														
35														
36														
37														
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42														
43														
44														
45														
46														
47														
48														
49														
50														

Appendix 7-2. (Sheet 3 of 4)

TEST TYPE: FYKE [ ] FULL [X] GEN [ ] WORKERS _____ TEST # 95228RA PAGE 1 OF 1

DATE (Y Y M M D D)	UNIT	SIDE	QUAD	HOUR	START TIME (Purge)	END TIME	QTR	START TIME	END TIME
950816	5			9	0415	0445	5	0415	0445

NUM	SPECIES CODE	CODE	TOTAL LENGTH (IN)	NUMBER OF FISH	WEIGHT OF FISH (g)	REL	DEAD	ABRA	LACR	BLFN	TORN	DMGL	EYES	SMBL	CONT
1	1111	C	4												
2	1122	C	3												
3			2												
4			2												
5			1												
6			1												
7			1												
8			1												
9			2												
10			1												
11	1111	V		60											
12–50															

Appendix 7-2. (Sheet 4 of 4)

Data Cover Sheet

TEST NUMBER 95228R5A

Date of test: 8-16-95

Hours of test: 1) Start 2300 End 2815

Test type: Fyke ___ Full X Gen ___ Unit 5 Side ___

Number of data pages: ___

	Date	Worker Initials	File Name
Field data received	8-17-95	By MAW From MAW	
Field data scanned for errors	8-18	MAW	
Data entered	8-18	MAW	95228R5A.W21
Entered data verified	8-18	MAW	
Converted to ASCII	8-19	MAW	95228R5A.OAT
Verification	8-19	MAW	
Data expansion program run	8-19	MAW	Prog 95228R5A.PRG Out 95228R5A.EXP
Expanded data verified	8-19	MAW	
Expanded data uploaded to server	8-20	MAW	
Data mailed to WES for repository	8-21	MAW	

Appendix 7-3. Data cover sheet

8 Protocol for Ichthyoplankton Sampling[1]

Introduction

Entrainment of ichthyoplankton may adversely affect certain fish populations by adding an additional source of mortality to the early life stages of populations when class strength is determined. Ichthyoplankton, or fish eggs and young fish that have a discernable yolk sac, will be sampled in the RBR tailwater immediately preceding a pumpback event and in water passing through draft tubes during pumpback operation to estimate the number of ichthyoplanktons entrained.

Objective

The purpose of this study is to estimate the number of ichthyoplanktons entrained by sampling draft tubes during netted pumpback events or system pumps.

Methods

To obtain a direct estimate of ichthyoplankton passing through turbines during pumpback operation, ichthyoplankton will be sampled from piezometer header pipes inside the dam (Figure 4). A known volume of water will be sampled (approximately 25 gal/min) as it passes through the draft tube. Each header pipe will be equipped with a shutoff valve, and flow from the two header pipes will be combined and directed into a 243-µm net suspended on a movable frame. The sampled portion of the draft tube water will be routed from the header pipe into the ichthyoplankton net via a 2-in. flexible hose fitted with an in-line

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[1] Mark A. Weiland, Brian Gregory, and Keith Taulbee, Georgia Cooperative Fisheries and Wildlife Research Unit, D. B. Warnell School of Forest Resources, University of Georgia, Athens, GA.

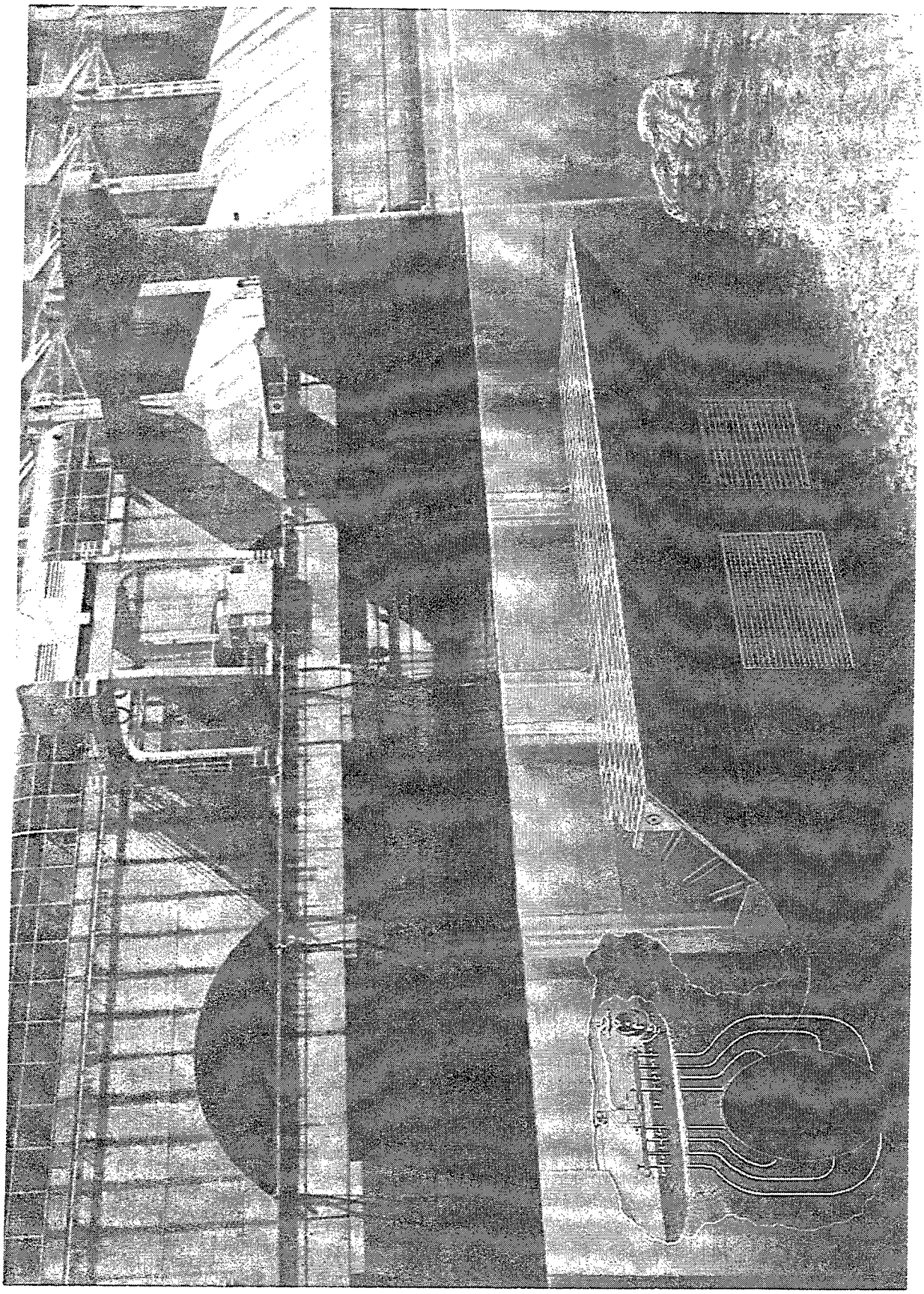

Figure 4. Ichthyoplankton sampling

flowmeter. Samples will be collected from each unit operating during pumpback testing and, if sampled, during system pumps. One sample will be collected from each operating unit, except for the unit being netted (pumpback), or a randomly determined unit (system pump). For this unit, three subsamples of equivalent time intervals will be taken over the course of the pump event.

Prior to each sampling event, UGA personnel will set up the sampling apparatus and begin sampling immediately after pumping begins by opening valves on header pipes. Sampling will continue for the duration of the pumping event or until an adequate volume of water has been sampled. Pertinent test information will be recorded on data sheets (Appendix 8-1, this chapter), and samples will be preserved and returned to UGA for enumeration (Appendix 8-2, this chapter). Ichthyoplankton densities for each sample will be calculated by dividing numbers collected by the water volume that passed through the net. Ichthyoplankton estimates for the total pump event will be obtained by multiplying the total number of ichthyoplankton collected by the ratio of water volume sampled to the total water volume passing through the turbines (approximately 0.007 percent per turbine).

APPENDIX 8-1

ICHTHYOPLANKTON COLLECTION DATA PIEZOMETER TUBE SAMPLING

DATE:_____ WORKERS:_____

_____

TURBINES IN OPERATION (CHECK ALL THAT APPLY):
_____5 _____6 _____7 _____8

REPLICATE STATION:_____ NUMBER OF TESTS:_____

TEST #	UNIT #	REPL #	START TIME	END TIME	TOTAL MIN.	FLOW MET. START	FLOW MET. END	TOTAL FLOW (GAL.)	RATE (GAL/ MIN)

ADDITIONAL COMMENTS:_____

Appendix 8-1. Ichthyoplankton collection data piezometer tube sampling

APPENDIX 8-2

ICHTHYOPLANKTON LAB ANALYSIS

DATE OF TEST:_____ **LAB WORKER:**_____

TEST NUMBER:_____ **DATE ANALYZED:**_____

PERCENT OF SAMPLE ANALYZED:_____

UNIT# _____ REPL. # _____	TYPE OF TEST: _____ PIEZOMETER TUBE _____ TAILWATER TRAWL		VOLUME FILTERED _____	
SPECIES	SIZE (mm)	TALLY	NUMBER	ESTIMATE OF TOTAL SAMPLE

ADDITIONAL COMMENTS: _____

Figure 8-2. Ichthyoplankton lab analysis

9 Protocol for Fish Mortality Testing[1]

Introduction

Fish entrained during pumpback activity experience many conditions going through the dam, ranging from pressure changes to actual contact with the turbines. Mortality studies are employed to determine the effects of entrainment on fish survival. Marked fish will be inducted into Unit 5 and recovered on the upstream side of the unit; entrained fish will also be captured after unit passage. The percentage of fish injured or killed will be adjusted by controls to compensate for handling and induction effects. Fish mortality will be evaluated during full recovery pumpback events (see Chapter 7, Protocol for Unit 5 Full Recovery Net Pump Test: Part 2).

Objective

The objective is to estimate mortality of fish passing through the turbines during pumpback operations at Richard B. Russell Dam.

Methods

Species and sizes tested

Mortality studies will be conducted during three periods from April-September (April and May, June and July, August and September). Each species and size group will be tested during the three periods if fish of the species and size group are available. The species and size group to be tested are as follows:

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[1] Mark A. Weiland, Georgia Cooperative Fisheries and Wildlife Research Unit, D. B. Warnell School of Forest Resources, University of Georgia, Athens, GA.

Blueback herring	entrained all sizes
Bluegill	3-5 in. and ≥6 in.
Ictalurid sp.	3-5 in. and ≥6 in.
Morone sp.	3-6 in. and ≥7 in.
Yellow perch	3-5 in. and ≥6 in. (if possible to obtain)

Study fish, except blueback herring, will be obtained and held onsite in advance of mortality testing to allow for acclimation to holding conditions and reduce hauling stress.

Tank setup and fish acclimation

Fish will be held in a partial recirculation system in an enclosed building near the dam. Tanks will receive aeration from Sweetwater blower air pumps attached to air stones in each tank, and water will be replaced with well water. A biofilter system will remove waste and ammonia from the water.

Yellow perch will be collected by electroshocking from Richard B. Russell and J. Strom Thurmond reservoirs. Bluegill, *Ictalurid* sp., and *Morone* sp. will be obtained from a commercial dealer 2 to 4 days prior to testing. The fish will be anesthetized, marked, and separated by experimental group 1 to 2 days prior to the test.

Blueback herring will not be held prior to mortality testing. Only entrained blueback herring will be used for mortality tests. Changes were made in light of prior mortality tests. Blueback herring could not be held in tanks and kept in good health. Also, a suitable marking technique was not found to mark these fish. Mr. Ned Taft of Alden Research Laboratory, Inc., suggested this alternative and confirmed the acceptance of the method.

Fish marking

Fin-clip marking will be used for all species of fish tested, excluding blueback herring. Fish will be anesthetized prior to clipping, and each test group will receive a distinct mark.

Experimental groups

Penstock inducted (**PS**) -- Marked fish will be inducted into the penstock discharge plume inside the full recovery net and retrieved at the recovery barge. At the recovery barge, the number of dead fish will be recorded (Appendix 9-1, this chapter), and the remaining live fish will be transferred to holding tanks to monitor delayed mortality. Possible causes of mortality in this group include marking and handling (prior to induction), induction, contact with the recovery net, handling at the recovery barge to the holding tanks, and confinement stress in the holding tanks.

Draft tube inducted (**DT**) -- Marked fish will be inducted into the draft tubes during full recovery pumpback, pass through the turbines, and will be retrieved at the collection barge. At the collection barge, the number of dead fish will be recorded (Appendix 9-1, this chapter), and the remaining live fish will be transferred into holding tanks to monitor delayed mortality. Possible causes of mortality in this group include marking and handling (prior to induction), induction, turbine entrainment, contact with the recovery net, handling at the recovery barge to the holding tanks, and confinement stress in the holding tanks.

Control group 1 (**C1**) -- Unmarked fish will be held in tanks at the building. Mortality from this group is assumed to result from confinement stress in the holding tanks.

Control group 2 (**C2**) -- Marked fish will be put in the holding tanks with the inducted fish. Mortality from this group is assumed to result from marking and handling or confinement stress in the holding tanks.

Entrained fish (**ENT**) -- Entrained fish collected at the recovery barge will be recorded, and a subsample of the live fish will be transferred into holding tanks to monitor delayed mortality. Possible causes of mortality in this group include turbine entrainment, contact with the recovery net, handling at the recovery barge, and confinement stress in the holding tanks.

Fish induction

Fish will be moved in transport tanks from the holding building to the dam and inducted immediately. Fish will be inducted using a pressurized induction system or through a trash pump.

Replication and sample size

For each night of mortality testing, three replicates of each treatment group will be used for a given test species and size group. Survivors from each treatment group will be held for a 48-hr observation period in holding tanks. Groups of 60 fish will be inducted into the draft tube and 60 fish inducted into the penstock plume. Thirty control fish will also be held with the recovered fish from the induction treatments. The total number of fish used for a given species/size group in a mortality test will be approximately:

3(60) **DT** + 3(60) **PS** +3(30) **C1** +3(30) **C2** = 540

Entrained (**ENT**) fish will also be retrieved at the barge and held to estimate mortality for each species. For blueback herring, entrained fish will be the only group of fish sampled.

Fish transport

Fish will be transported from the pretest holding facilities to the dam in fish transport tanks in the bed of a pickup truck. Fish will be scooped from tanks at the pretest holding facility only after the pumpback operation has started and inducted oranges have shown the net is fishing properly. The fish will then be transported to the designated induction site (see Chapter 12, Protocol for Induction Systems and Net Calibration).

Holding tanks for test

Fiberglass fish transport tanks will be used for holding tanks during the tests. Large tanks consist of two compartments (74 in. long by 18 in. wide by 24 in. deep). Each side will hold one test replicate. Small tanks (24 in. long by 24 in. wide by 19 in. deep) will each hold one test replicate. The tanks will be in boats for easy transport between the collection barge and the RMO ramp. Each tank section will be aerated. After replicates have been inducted and collected at the barge, the tanks will be transported to the RMO ramp. The boat will be pulled out of the water and trailered to the tank building, and fish will be transferred to holding tanks for observation.

Testing sequence

C1 and C2 fish will be placed in holding tanks at the tank building on the evening of the test. The first replicate of DT and PS fish will be inducted after the pontoon boat is secured to the barge and the net is open and fishing properly. The second replicate of DT and PS fish will be inducted at least one-half hour after the first set of fish and so forth. The species being inducted and/or entrained fish collected for testing will be recorded on a data sheet at the collection barge (Appendix 9-1, this chapter). The species name, replicate number, if entrained or inducted, collection start and end time, and number of dead fish recovered will be recorded on this sheet. After the first hour of testing, entrained fish will also be kept to monitor survival.

Observation period (48 hr)

For each replicate, all test fish of a given species/size group will be held in one tank. Tanks will be monitored at 4- to 8-hr intervals for mortalities. Dead fish will be removed, checked for marks, measured, and checked for damage. The time at which the dead fish were removed will also be recorded on the data sheet (Appendix 9-2, this chapter).

Entrained fish will be used to estimate percent mortality for mitigation purposes. If a problem with entrained fish occurs, or enough fish are not collected, estimates from inducted fish will be used. At least 10 fish and 30 blueback herring or threadfin shad must be collected to represent a replicate.

Calculation of mortality effects

Each of the sources of mortality is assumed to be additive; therefore, the following formulas will be used to calculate mortality effects:

a) EFFECT OF TURBINE PASSAGE = DT-PS

b) EFFECT OF HANDLING PRIOR TO TURBINE ENTRAINMENT = DT-ENT

c) EFFECT OF OVERALL HANDLING = PS - C1

d) EFFECT OF HANDLING AFTER TURBINE PASSAGE = (PS -C1) - (DT - ENT)

Proposed schedule

This is a tentative schedule for mortality testing during Phase III. Changes are possible due to problems getting the fish or health of the fish.

April
- Blueback herring (entrained)
- *Morone* sp. 3-6 in.
- *Morone* sp. ≥7 in.
- Yellow perch 3-5 in.
- Yellow perch ≥6 in.

May
- Blueback herring (entrained)
- Bluegill 3-5 in.
- Bluegill ≥6 in.
- Catfish 3-5 in.
- Catfish ≥6 in.

June
- Blueback herring (entrained)
- *Morone* sp. 3-6 in.
- *Morone* sp. ≥7 in.
- Yellow perch 3-5 in.
- Yellow perch ≥6 in.

July
- Blueback herring (entrained)
- Bluegill 3-5 in.
- Bluegill ≥6 in.
- Catfish 3-5 in.
- Catfish ≥6 in.

August
- Blueback herring (entrained)
- *Morone* sp. 3-6 in.
- *Morone* sp. ≥7 in.
- Yellow perch 3-5 in.
- Yellow perch ≥6 in.

September
- Blueback herring (entrained)
- Bluegill 3-5 in.
- Bluegill ≥6 in.
- Catfish 3-5 in.
- Catfish ≥6 in.

Mortality will be tested once a month; this schedule is subject to change. Each species listed will be tested in its respective month. Test and control groups will be tested for each species and entrained fish tested, also, except for blueback herring where only entrained fish will be tested.

Grouping for applying mortality rates

Mortality estimates for species tested will be applied to groups of species to approximate mortality for other species entrained. As designated by the South Carolina Department of Natural Resources, grouping of species will be as follows:

Blueback herring (4-6 in.) will be applied to all size classes of blueback herring, threadfin shad, and gizzard shad.

Bluegill (3-5 in.) will be applied to bluegill, warmouth, redbreast sunfish, green sunfish, pumpkinseed, redear, white crappie, flier, and black crappie ≤5.4 in.

Bluegill (≥6 in.) will be applied to bluegill, warmouth, redbreast sunfish, green sunfish, pumpkinseed, redear, white crappie, flier, and black crappie ≥5.5 in.

***Ictalurid* sp. (3-5 in.)** will be applied to blue catfish, white catfish, yellow bullhead, brown bullhead, flat bullhead, black bullhead, channel catfish, tadpole madtom, margined madtom, madtoms, spotted gar, shortnose gar, flathead catfish, snail bullhead, longnose gar, and American eel ≤5.4 in.

***Ictalurid* sp. (≥6 in.)** will be applied to blue catfish, white catfish, yellow bullhead, brown bullhead, flat bullhead, black bullhead, channel catfish, tadpole madtom, margined madtom, madtoms, spotted gar, shortnose gar, flathead catfish, snail bullhead, longnose gar, and American eel ≥5.5 in.

***Morone* sp. (3-6 in.)** will be applied to all size groups of white perch, common carp, quillback, silver redhorse, river carpsucker, spotted sucker, white bass, striped bass, white sucker, smallmouth bass, yellow bass, rock bass, hybrid striped bass, largemouth bass, spotted bass, and coosa bass ≤6.4 in.

***Morone* sp. (≥7 in.)** will be applied to all size groups of white perch, common carp, quillback, silver redhorse, river carpsucker, spotted sucker, white bass, striped bass, white sucker, smallmouth bass, yellow bass, rock bass, hybrid striped bass, largemouth bass, spotted bass, and coosa bass ≥6.5 in.

Yellow perch (3-5 in.) will be applied to yellow perch, tesselated darter, golden shiner, spottail shiner, whitefin shiner, coastal shiner, bluehead chub, northern hog sucker, river redhorse, smallfin redhorse, blackbanded darter, river chub, banded killifish, sauger, creek chub, chain pickerel, rainbow trout, brown trout, and walleye ≤5.4 in.

Yellow perch (≥6 in.) will be applied to yellow perch, tesselated darter, golden shiner, spottail shiner, whitefin shiner, coastal shiner, bluehead chub, northern hog sucker, river redhorse, smallfin redhorse, blackbanded darter, river chub, banded killifish, sauger, creek chub, chain pickerel, rainbow trout, brown trout, and walleye ≥5.5 in.

Hierarchy of importance and use of data

An order has been set up by the Coordination Group as to importance of species and entrained fish or inducted fish usage for mortality estimates. Blueback herring are the most important fish, followed by *Morone* sp. and yellow perch. Bluegill and *Ictalurid* sp. are of lesser importance. Entrained fish will be used to estimate mortality of the fish. If a good estimate or enough fish per replicate are not available, the inducted fish will be used to estimate mortality.

Mortality Tank Sheets

Tank #____ Date fish received_____

Species____ Clip used_____

Date	Temp	O_2	Beginning saln. (ppt)	End saln. (ppt)	# Fish Dead	Est. # Alive	Comments

Appendix 9-1. Mortality tank sheet (1)

Mortality Tank Sheet

Date_____		Rep ____		Ind / Ent			
Time	Species	Clip/Length	Damage	Time	Species	Clip/Length	Damage

Appendix 9-2. Mortality tank sheet (2)

10 Fish Mortality Data Handling Protocol[1]

This chapter is a draft plan that attempts to establish goals by which fish mortality estimates associated with the operation of pump turbines at Richard B. Russell Dam will be evaluated. This is only a guideline for the use of the Coordination Group (CG). Before any mortality rates are applied to any data, a majority of the CG must agree upon the method used to obtain the estimates. Please refer to U.S. Army Corps of Engineers (1992)[2] and to the Protocol for Fish Mortality Testing (Chapter 9) for definition of terms, etc.

The CG developed an order of importance for obtaining mortality rate data. Blueback herring were defined as the most important species to collect information followed by *Morone* sp. and yellow perch. Bluegill and *Ictalurid* sp. were assigned a lower priority than previously mentioned species groups. The CG also agreed upon the size and species of test groups and the fish groupings to which to apply mortality rates.

Ultimate Goal

Mortality rates from both entrained and inducted fish for all species and size classes will be available at the end of Phase III testing except for blueback herring. Mortality rates for blueback herring will only be obtained from the entrained mortality study.

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[1] Tripp Boltin, South Carolina Department of Natural Resources, Wildlife and Freshwater Fisheries Division.

[2] U.S. Army Corps of Engineers. (1992). "Testing and monitoring plan pumped storage operations Richard B. Russell Dam and Lake," U.S. Army Engineer District, Savannah, Savannah, GA.

Guidelines

Guidelines are as follows:

a. If both types of mortality studies (entrained or inducted) provide results for a size-specific species group, results from the entrainment study will be used pending the rate is agreed upon by the CG.

b. The sample size for the entrained mortality study will be at least 30 blueback herring and 10 of any other size-specific species group. If the sample size criteria are met for the entrainment study, results from the test in question cannot be excluded based on the sample size criteria. If the sample size criteria are not met for the entrainment study, results from the test in question should be disregarded for the size-specific species group.

c. If control mortality (C1 and C2) and/or penstock mortalities (PS) are <50 percent for the inducted study, results from the test in question will be used in estimating mortality rates for a size-specific species group. Control mortality (C1 and C2) should be ≤10 percent for inducted fish mortality estimates.

d. If control mortality (C1 and C2) and/or penstock mortality (PS) are ≥50 percent for the inducted study, results from the test in question should be disregarded for the size-specific species group.

e. If penstock mortality rates (immediate or delayed) are higher than draft tube mortality rates (immediate or delayed) for the inducted study, results from the test in question should be disregarded for the size-specific species group unless determined otherwise by the CG.

Contingencies

Contingencies are as follows:

Scenario 1: If no size-specific mortality estimates are available for a particular species group, 100-percent mortality is assumed for that test group and associated mortality application group. The CG may recommend using applicable data (i.e., another size class, literature values, etc.) to the "missing" size class.

Scenario 2: If mortality estimates for a size-specific species group are only collected in 1 month, if agreed upon, the mortality rate will apply to other months in the fiscal year.

Scenario 3: If only one type of mortality study (entrained or inducted) provides results for a size-specific species group, results from that study will be

used to estimate a mortality rate for the applicable species grouping for that size interval.

Scenario 4: If monthly (ENT) and/or seasonal (inducted) mortality rates cannot be determined for a size-specific species group for a particular period, the average mortality rate determined from the monthly and/or seasonal data available will be used to calculate the mortality rate for the missing period.

11 Protocol for Entrainment Monitoring Procedures[1]

Introduction

This chapter explains the procedures used for handling and recording data for fish at different entrainment levels. The terms and scenarios explained in this section are for use with the entrainment data sheet (Appendix 3-2, Chapter 3).

Terms defined

Abundant taxa. A taxa of entrained fish that exceed 20 fish but can be easily counted in a 15-min time period.

Aggregate weight. Aggregate weight is the total weight of a known number of fish from a superabundant taxon.

Bulk weight. Bulk weight is the weight of unknown numbers of a super-abundant taxon or taxa and is taken during high rates of entrainment and used to estimate total numbers.

Entrainment monitoring. Determination of the species composition, length distribution, mortality, degree of external injuries, and number of fishes passing through a turbine/pump or generation unit.

Hour. The unit of time in which data are collected during a monitoring event. The term hour for fyke net and conventional generation tests does not refer to hour as a period of time.

For a full recovery pumpback test, the first hour begins when pumps are activated and ends 1 hr later. The last hour ends when pumps are deactivated.

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[1] Mark A. Weiland, Georgia Cooperative Fisheries and Wildlife Research Unit, D. B. Warnell School of Forest Resources, University of Georgia, Athens, GA.

For conventional generation and fyke net tests, hour means the test number. The first test in a series is considered Hour 1 and a second test is Hour 2, regardless of the length of the test.

Processing. The act of collecting length, weight, vital disposition, and external injury data for individual fish during a quarter or a test.

Quadrant. One of four net sections of the fyke net. Each quadrant is a separate net and has a specific name: Upper Georgia (UG), Lower Georgia (LG), Upper South Carolina (US), and Lower South Carolina (LS). Fish sampled from each quadrant are recorded separately.

Quarter. A discrete subunit of an hour for pumpback testing. In most cases a quarter will be 15 min long; but under high rates of entrainment, it can be extended to 30 min. Separate data sheets will be used to record entrainment information collected during different quarters.

Sample. A portion of a quarter's entrainment, or a test quadrant or net that is processed and used to describe the total entrainment for that quarter, quadrant, or net. Samples are taken when entrainment rates are high enough to prohibit complete processing of all fish observed. A sample of 20 fish will be taken for abundant and superabundant taxa.

Superabundant taxa. A taxa of entrained fish that exceed the number that can be easily enumerated in a 15-min time period (usually more than 500 fish of a given taxa).

Unit. A turbine or pump/turbine used to generate power or pump water upstream. RBR dam consists of four turbines and four pump turbines and are numbered from one to eight, starting with one on the Georgia side of the dam.

Unit side. Each unit consists of two outflow openings on the draft tube deck of the dam. The two sides are the South Carolina (SC) and the Georgia (GA) side, respective to the closest State. Nets are attached to the trash racks on both the GA and SC sides of a unit for conventional generation. The fyke net can be lowered into either the GA or SC side of a unit for fyke net tests.

Entrainment scenarios

The following three scenarios will be used to determine how entrainment data will be collected.

Scenario 1--Low entrainment rates (every fish can be processed).

Very few fish are encountered. Entrainment consists of several taxa in nearly equal abundance, allowing complete processing of every fish. Under this scenario no samples or weights are taken, all lengths are recorded for the quarter,

quadrant, or net. To indicate that all fish were processed, each record will be accompanied by a "C" (census) code.

General procedure: All fish are processed individually.

Scenario 2--Moderate entrainment rates (only a portion of the fish is measured/examined).

Entrainment consists of one or a few abundant taxa and several nonabundant taxa. All fish are enumerated.

General procedure:

a. Nonabundant taxa (less than 20 individuals) collected in a given quarter, quadrant, or net will be separated, processed completely, and given a "C" (census) code.

b. For an abundant taxa each fish is given an "E" (enumerated) code. Sample size will be 20 fish for all species.

c. The remaining (nonsampled) portion of the abundant taxa will be counted by species. A "T" (total) code will accompany the number of fish in each species less the "E" (enumerated). Thus, the total number of fish entrained in the quarter, quadrant, or net can be calculated by adding the number census (code "C"), number sampled (coded "E"), and the remaining number counted (coded "T").

Scenario 3-- High entrainment rates (only a portion of the fish can be measured/examined).

Entrainment consists of abundant taxa, nonabundant taxa, and at least one superabundant taxa; there are too many fish to completely process, but all fish are enumerated or weighed.

General procedure:

a. Nonabundant taxa (less than 20 individuals) collected in a given quarter, quadrant, or net will be separated, processed completely, and given a "C" (census) code.

b. A species will be categorized as abundant taxa if there are more than 20 fish of a species collected, but all fish can be counted in a reasonable amount of time (about 5 min). A sample of 20 of each abundant species will be processed (code "E"). A "T" (total) code will accompany the number of fish in each species less the "E" (enumerated).

c. A sample of at least 20 fish is taken of the superabundant taxa. Length is recorded for each fish in the sample "S" (sampled) code, and an aggregate weight is taken of the sample. An "A" (aggregate) code is entered with

the number and aggregate weight for the superabundant species. The remaining (nonsampled) superabundant fish are weighed in bulk. Bulk weights are denoted by a "B" (bulk) code. In this case, the total number entrained for a given superabundant species will be estimated by dividing the bulk weight by the average individual weight from the sampled portion of the superabundant species.

If there are two or more superabundant taxa, the superabundant taxa are not separated. A grab sample is taken from the fish, assuming the taxa are randomly mixed. The sample is sorted by taxon, and length is recorded for each fish in the sample "S" (sample). If at least 20 of each superabundant species is not sampled, a second grab sample is taken and lengths are recorded. Samples are taken until at least 20 fish of the least abundant superabundant taxon are processed. The number processed may be much higher for the more abundant superabundant taxon. This sample provides the percentage of the superabundant taxa that comprises each superabundant taxon and length frequency distribution. An "A" (aggregate) code is entered with the number and aggregate weight for each superabundant species. The remaining (nonsampled) superabundant fish are weighed in bulk (not separated by species). Bulk weights are denoted by a "B" (bulk) code. No species code is entered for the bulk weight. Species composition of the bulk weighed fish is estimated by a computer program. The total number entrained for a given superabundant species will be estimated by dividing the bulk weight by the average individual weight from the sampled portion of the superabundant species.

Methods

The following is an explanation of the data fields on the field sheets and how they will be completed. A sample data sheet can be found in Appendix 3-2, Chapter 3.

Date/time card

Full Recovery Pumpback

DATE: Enter the date when the pumpback event begins.

UNIT: Pump/generator being monitored.

HOUR: Enter single sequential digits that correspond to the hour-long subunits of the entrainment event. For example: Hour 1 begins when pumps are activated and ends an hour later. The last hour of the event ends when pumps are deactivated. During the purging procedure, the hour will be recorded as 9.

START
TIME: The time the hour begins. Recorded in military time. After 2400, time will continue to increase until the end of the test (i.e., 2500, 2600 ...).

END
TIME: The time the hour ends (start time plus 59 min).

QTR
(Quarter): Enter single sequential digits, 1-4, that correspond to the subunits of the hour monitoring period. The first quarter begins at the beginning of the hour, and the last quarter ends at the end of the hour. During the purge procedure, the quarter will be recorded as 5.

START
TIME: The time when the quarter begins. Recorded in military time.

END
TIME: The time when the quarter ends (start time plus 14 min).

Fyke Net/Conventional Generation

DATE: Enter the date when the pumpback event begins.

UNIT: Pump/generator being monitored.

SIDE: Side of the unit sampled during the test enter SC for South Carolina or GA for Georgia.

QUAD: Quadrant that the fish being entered on a data sheet were collected from: Upper Georgia (UG), Upper South Carolina (US), Lower Georgia (LG), or Lower South Carolina (LS).

HOUR: Enter the test number. If it is the first test of the day, then hour is 1. If it is the second test of the day, hour is 2. Hour in this case does not refer to the length of the test.

START
TIME: The time the test begins. Recorded in military time. After 2400, time will continue to increase until the end of the test (i.e., 2500, 2600 ...).

END
TIME: The time the test ends.

Biological data

Scenario 1 - Low entrainment rates

Under this scenario all fish are processed.

SPECIES CODE: The 4-digit COE codes are entered in this field. See Species Codes.

CODE: Since all fish are processed (census), a "C" is entered in this field for fish collected during the test.

A "G" is entered on the line on which a partial fish is recorded. A 2 is recorded in the dead column if the head is missing, or a 3 is recorded if the tail is missing.

TOTAL LENGTH: The total length in 1-in. intervals is entered in this field. If a fish is between 4.5 and 5.4 in., it falls in the 5-in. interval.

NUMBER OF FISH: If a "C" or "G" is entered in the CODE column, this field is left blank.

TOTAL WEIGHT: If a "C" or "G" is entered in the CODE column, this field is left blank.

See Appendix 7-2, Chapter 7, for an example of low entrainment.

Scenario 2 - Moderate entrainment

SPECIES CODE: The 4-digit COE codes are entered in this field. See Species Codes.

CODE: A "C" is entered for each fish from the nonabundant taxa.

An "E" is entered for each sampled fish from the abundant taxa.

A "T" is entered on the line on which the number of the remaining nonsampled fish of the abundant taxa is entered.

A "G" is entered on the line on which a partial fish is recorded. A 2 is recorded in the dead column if the head is missing, or a 3 is recorded if the tail is missing.

A "V" is entered if a visual estimate determines the number fish of a given taxon that remain in the net or floating in the forebay after the purge. This code will only be used in the purge--Hour 9 Quarter 5 full recovery pumpback. A visual estimate will be recorded on the calibration sheet for fish counted in the slot after a fyke net test.

TOTAL LENGTH: The total length of processed fish, in inch intervals, is recorded in this column. If a fish is between 4.5 and 5.4 in. long, it falls in the 5-in. interval. Total lengths will only be recorded on a line that carries a "C" or an "E" in the CODE field.

NUMBER OF FISH: If a "C" is entered in the CODE column, this field is left blank.

If an "E" is entered in the CODE column, this field is left blank.

If a "T" is entered in the CODE column, the total number per taxon of the nonsampled abundant fish will be recorded in this field.

If a "G" is entered in the CODE column, this field is left blank.

If a "V" is entered in the CODE column, the estimated number per taxon of the fish remaining in the net or floating in the forebay at the end of a full recovery pumpback test or number of fish floating in the slot at the end of a fyke net test is entered.

TOTAL WEIGHT: If a "C" is entered in the CODE column, this field is left blank.

If an "E" is entered in the CODE column, this field is left blank.

If a "T" is entered in the CODE column, this field is left blank.

If a "G" is entered in the CODE column, this field is left blank.

If a "V" is entered in the CODE column, this field is left blank.

See Appendixes 3-5, Chapter 3, and 7-2, Chapter 7, for an example of moderate entrainment.

Scenario 3 - High Entrainment

SPECIES CODE: The 4-digit COE codes are entered in this field. See Species Codes.

CODE: A "C' is entered for each fish sampled from the nonabundant taxa.

An "E" is entered for each sampled fish from the abundant taxa.

A "T" is entered on the line on which the number of the remaining nonsampled fish of the abundant taxa is entered.

An "S" is entered for each sampled fish from the superabundant taxa.

An "A" is entered on the line that carries the number and aggregate weight per superabundant taxon of the sampled fish.

A "B" is entered on the line that carries the bulk weight(s) of the remaining nonsampled fish of the superabundant taxa.

A "G" is entered on the line on which a partial fish is recorded. A 2 is recorded in the dead column if the head is missing, or a 3 is recorded if the tail is missing.

If a "V" is entered in the CODE column, the estimated number per taxon of the fish remaining in the net or floating in the forebay at the end of a full recovery pumpback test or number of fish floating in the slot at the end of a fyke net test is entered.

TOTAL LENGTH: The total length of processed fish, in inch intervals, is recorded in this column. If a fish is between 4.5 and 5.4 in. long, it falls in the 5-in. interval. Total lengths will only be recorded on a record that carries a "C," "E," or an "S" in the CODE field.

NUMBER OF FISH: If a "C" is entered in the CODE column, this field is left blank.

If an "E" is entered in the CODE column, this field is left blank.

If a "T" is entered in the CODE column, the total number per taxon of the nonsampled abundant fish will be recorded in this field.

If an "S" is entered in the CODE column, this field is left blank.

If an "A" is entered in the CODE column, the total number per taxon of the sampled superabundant fish will be recorded in this field.

If a "B" is entered in the CODE column, this field is left blank.

If a "G" is entered in the CODE column, this field is left blank.

If a "V" is entered in the CODE column, the estimated number per taxon of the fish remaining in the net or floating in the forebay at the end of a full recovery pumpback test or number of fish floating in the slot at the end of a fyke net test is entered.

TOTAL
WEIGHT: If a "C" is entered in the CODE column, this field is left blank.

If an "E" is entered in the CODE column, this field is left blank.

If a "T" is entered in the CODE column, this field is left blank.

If an "S" is entered in the CODE column, this field is left blank.

If an "A" is entered in the CODE column, the weight of the sampled superabundant fish will be recorded in this field.

If a "B" is entered in the CODE column, the bulk weight(s) of the remaining nonsampled fish will be recorded in this field.

If a "G" is entered in the CODE column, this field is left blank.

If a "V" is entered in the CODE column, this field is left blank.

See Appendix 5-2, Chapter 5, for an example of high entrainment.

External damage/released data (for full recovery pumpback)

NOTE: The External Damage/ Released cards are used to record whether processed fish are uninjured, injured, or dead. For dead fish, one of three dead codes will be placed in the DEAD column, and a "1" will be placed in the appropriate field for each clinical sign observed (assuming one is observed). For alive and injured fish, the DEAD column will be left blank and at least one clinical sign field will contain a "1." For live and uninjured fish, the DEAD column and all clinical sign fields will be left blank.

REL - If a fish is released, a "1" is entered in this field.

DEAD - Fish is dead or not able to swim upright.

Dead codes: 1- Dead, body intact.
2- Dead, head missing.
3- Dead, tail missing.

NOTE: Fish with rigor or fish that appear to have been in the net for some time will be ignored.

Enter a "1" for each clinical sign observed for each fish. The headings are:

ABRA - Evidence of abrasion.

LACA - Evidence of laceration: a rip, cut, or a tear.

BLFN - Fins or base of fins bloody: not broken or torn.

TORN - Evidence of body parts (fins, opercles, etc.) being torn from body.

DMGL - Gill arch torn, twisted, or broken.

EYES - "Popped" or bloody eyes.

SMBL - Inverted swim bladder protruding into mouth cavity.

CONT - Evidence of contusion: bruising, subcutaneous bleeding from collision.

Species Codes

LEPISOSTEIDAE - GAR

Spotted gar - *Lepisosteus oculatus* -- **2011**

Longnose gar - *Lepisosteus osseus* -- **2012**

Shortnose gar - *Lepisosteus platostomus* -- **2013**

CLUPIEDAE - HERRINGS

Blueback herring - *Alosa aestivalis* -- **1111**

Gizzard shad - *Dorosoma cepedianum* -- **1121**

Threadfin shad - *Dorosoma petenense* -- **1122**

SALMONIDAE - TROUT

Rainbow trout - *Oncorhynchus mykiss* -- **6043**

Brown trout - *Salmo trutta* -- **6046**

ESOCIDAE - PIKE

Chain pickerel - *Esox niger* -- **1411**

CYPRINIDAE - MINNOWS

Golden shiner - *Notemigonus crysoleucas* -- **4311**

Spottail shiner - *Notropis hudsonius* -- **4368**

Coastal shiner - *Notropis petersoni* -- **4388**

Whitefin shiner - *Cyprinella nivea* -- **4382**

Common carp - *Cyprinus carpio* -- **4071**

CATASTOMIDAE - SUCKERS

River carpsucker - *Carpoides carpio* -- **3511**

Quillback - *Carpoides cyprinus* -- **3512**

White sucker - *Catostomus commersoni* -- **3525**

Northern hog sucker - *Hypentilium nigricans* -- **3582**

Spotted sucker - *Minytrema melanops* -- **3621**

Silver redhorse - *Moxostoma anisurum* -- **3632**

River redhorse - *Moxostoma carinatum* -- **3636**

Smallfin redhorse - *Moxostoma robustum* -- **3653**

ICTALURIDAE - CATFISHES

Blue catfish - *Ictalurus furcatus* -- **1903**

Snail (or Green) bullhead - *Ictalurus brunneus* -- **1911**

White catfish - *Ameiurus catus* -- **1912**

Yellow bullhead - *Ictalurus natalis* -- **1916**

Brown bullhead - *Ictalurus nebulosus* -- **1917**

Flat bullhead - *Ictalurus platycephalus* -- **1918**

Black bullhead - *Ictalurus melas* -- **1919**

Channel catfish - *Ictalurus punctatus* -- **1921**

Margined madtom - *Noturus insignis* -- **1939**

Flathead catfish - *Polydictis olivaris* -- **1951**

POECILIIDAE - LIVEBEARERS

Mosquitofish - *Gambusia affinis* -- **2411**

PERCICHTHYIDAE - TEMPERATE BASS

White perch - *Morone americana* -- **2311**

White bass - *Morone chrysops* -- **2312**

Yellow bass - *Morone mississippiensis* -- **2313**

Striped bass - *Morone saxatilis* -- **2314**

Hybrid striped bass - *Morone saxatilis X Morone chrysops* -- **2315**

CENTRARCHIDAE - SUNFISHES

Rock bass - *Ambloplites rupestris* -- **3722**

Warmouth - *Lepomis gulosus* -- **3751**

Redbreast sunfish - *Lepomis auritus* -- **3781**

Green sunfish - *Lepomis cyanellus* -- **3782**

Pumpkinseed - *Lepomis gibbosus* -- **3783**

Bluegill - *Lepomis macrochirus* -- **3786**

Longear sunfish - *Lepomis megalotis* -- **3788**

Redear - *Lepomis microlophus* -- **3789**

Coosa bass - *Micropterus coosae* -- **3811**

Smallmouth bass - *Micropterus dolomieui* -- **3812**

Spotted bass - *Micropterus punctulatus* -- **3814**

Largemouth bass - *Micropterus salmoides* -- **3815**

White crappie - *Pomoxis annularis* -- **3821**

Black crappie - *Pomoxis nigromaculatus* -- **3822**

PERCIDAE - PERCHES

Tesselated darter - *Etheostoma olmstedi* -- **5567**

Yellow perch - *Perca flavescens* -- **5631**

Sauger - *Stizostedion canadense* -- **5681**

Walleye - *Stizostedion vitreum* -- **5682**

SCIAENIDAE - DRUMS

Freshwater drum - *Aplodinotus grunniens* -- **2911**

12 Protocol for Induction Systems and Net Calibration[1]

Introduction

Fish are inducted during pumpback and conventional generation tests to determine net efficiency and during full recovery pumpback for mortality estimates.

Objective

The objective is to estimate the percentage of fish entrained during conventional generation or pumpback operation that is actually collected in the nets.

See Chapter 9, Protocol for Fish Mortality Testing, for mortality test objectives.

Methods

Induction system

The induction system used to introduce fish into the units is composed of three parts: pump, induction tub, and 4-in. hoses. The pump is a 650-gal-per-minute trash pump used to pump water from the lake to the induction tub to wash the fish into the unit.

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[1] Mark A. Weiland, Georgia Cooperative Fisheries and Wildlife Research Unit, D. B. Warnell School of Forest Resources, University of Georgia, Athens, GA.

The induction tub is mounted on a table. The tub has a hole in the center with a vertical tube coming up through the table and is flush with the bottom of the tub. Another tube is used as a standpipe and fits tightly into the tube in the bottom of the tub. A hose from the outlet on the trash pump passes under the tub and is attached to the vertical tube. The hose continues down into the water to the unit intake (Figure 5).

When the pump is running and primed, the tub is filled with water and calibration or mortality fish are put in the tub. The standpipe is pulled out, and the fish are sucked into the lower hose going to the unit. The system is similar to the venturi on a carburetor. All hoses must be placed before the test begins.

The induction system is set up the same way for every test; however, the hose positioning for intake and outflow varies between tests. During mortality testing, induction systems will be set up on the draft tube (DT) and penstock (PS) decks at Unit 5. The intake and weighted outflow hoses for the DT system will both be in the bulkhead slot of Unit 5 (Figure 6). The outflow hose needs to be low enough in the unit to be directly in the water flow. The intake hose for the PS system will be in the trash rack slot of Unit 5, and the outflow hose will be tied to the frame of the full recovery net at the 32-ft mark. The hose will be tied on the GA side of the frame with about 10 ft of hose sticking out beyond where it is tied to the frame, to ensure the end of the hose is beyond the boil flowing toward the dam (Figure 7).

The induction system used for net calibration during full recovery pumpback is placed the same as the draft tube deck system for mortality tests (Figure 6). For the fyke net test, the hoses are placed in the trash rack slot and the side of the unit being fished on the draft tube deck. The induction hose hangs down the side of the slot, and the outflow hose is tied to the trash rack by WES employees (Figure 8). For the conventional generation test, the intake hose is in the same trash rack slot on the penstock deck as for the mortality test. A weighted outflow hose is lowered over the face of the dam and rests on the outside of the trash rack (Figure 9).

Net calibration

Calibration tests will include the induction of known numbers and sizes of marked fish of a given species into the unit being tested during conventional generation and pumpback tests. The fish will be given a distinct fin clip and/or dyed prior to induction. The species, size group, mark, and number inducted will be recorded on the net calibration data sheet (Appendix 3-1, Chapter 3). The fish will then be inducted into the unit tested and the time inducted recorded on the net calibration data sheet.

Number of marked fish recovered will be recorded for each quarter for a given group of fish retrieved at the collection barge during full recovery pumpback testing. The total number of fish recovered from each net will be

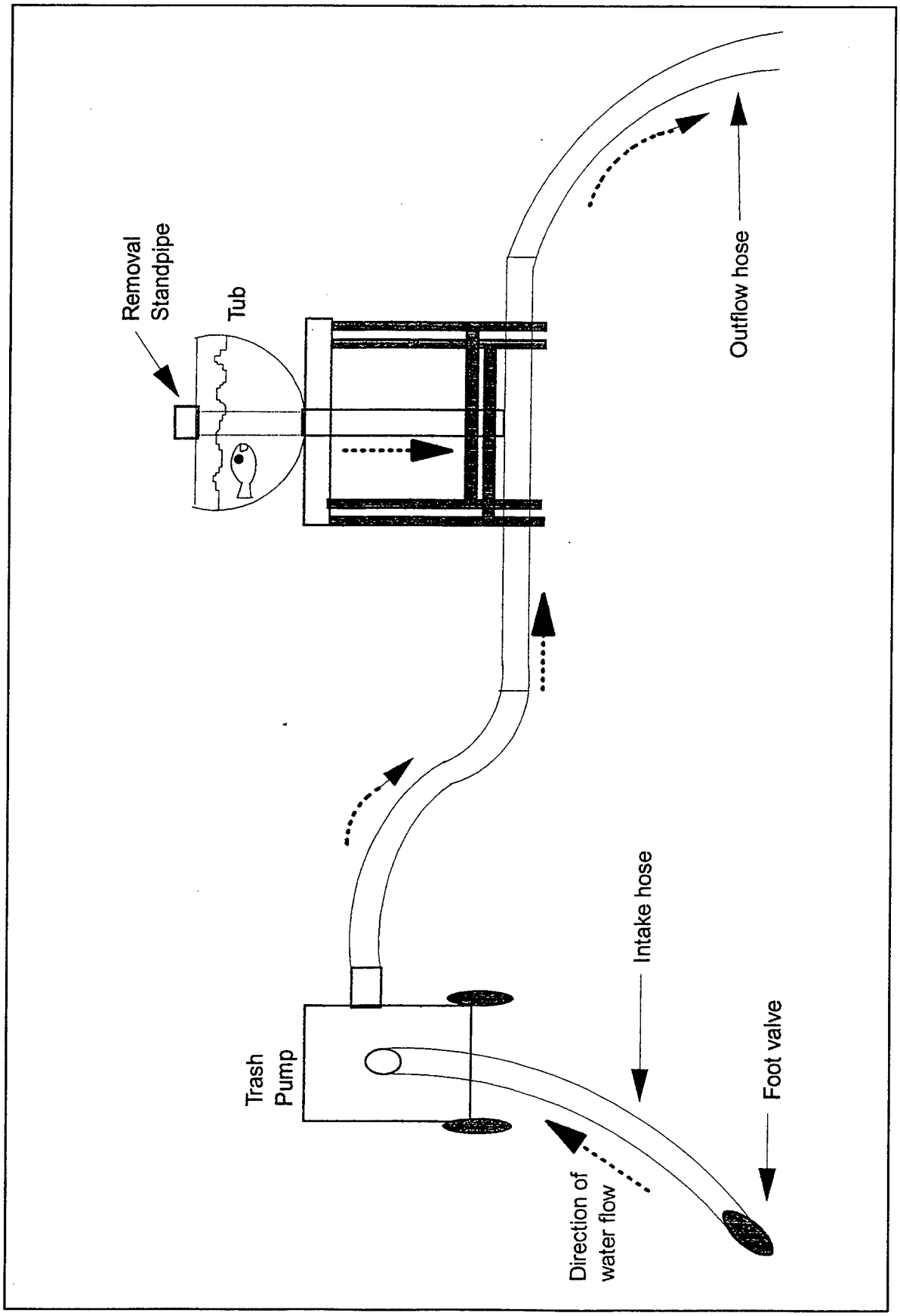

Figure 5. Induction system used for induction of fish for net calibration and mortality estimates

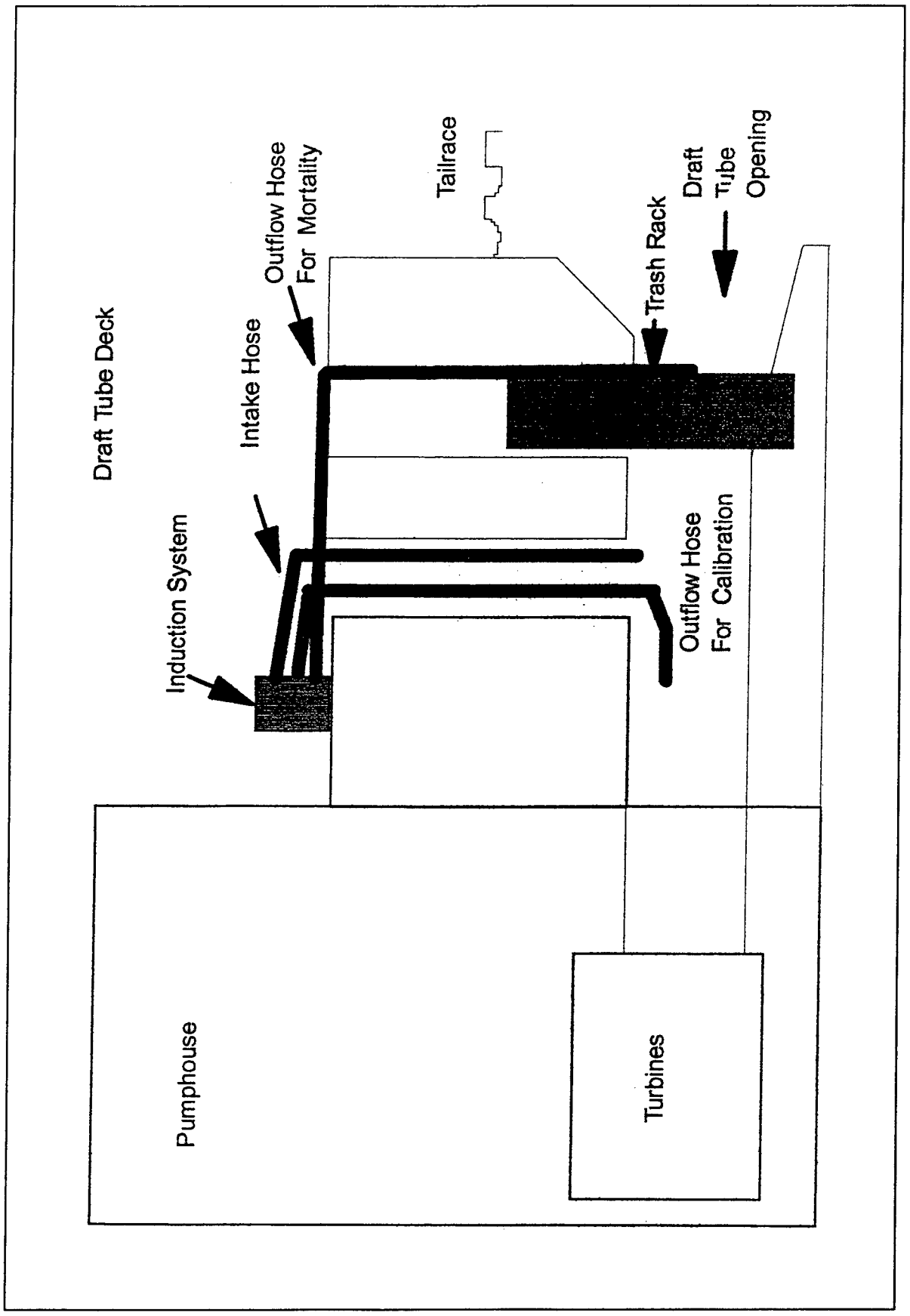

Figure 6. Induction system on draft tube desk for full recovery pumpback and mortality test induction

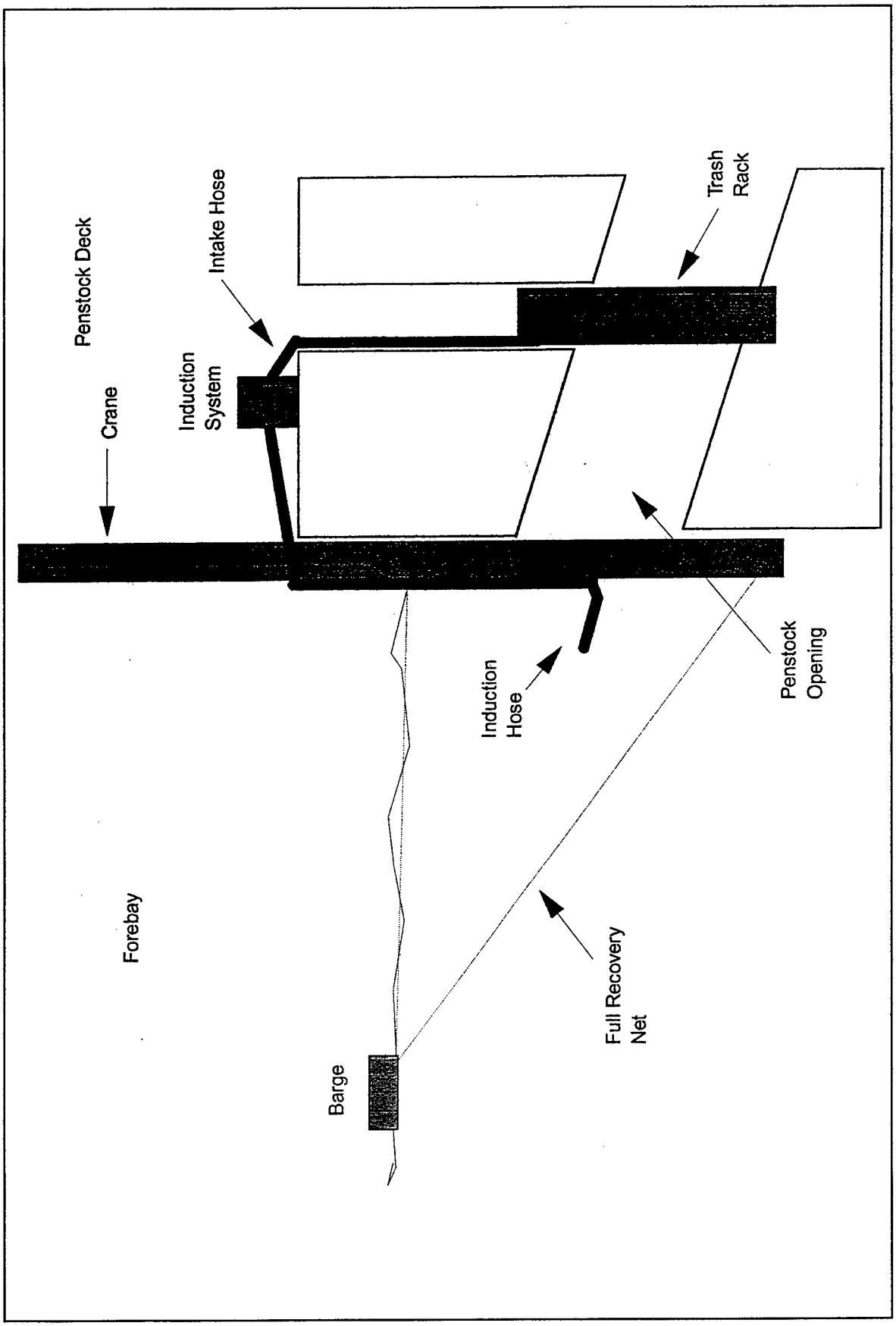

Figure 7. Induction system on penstock deck for mortality test

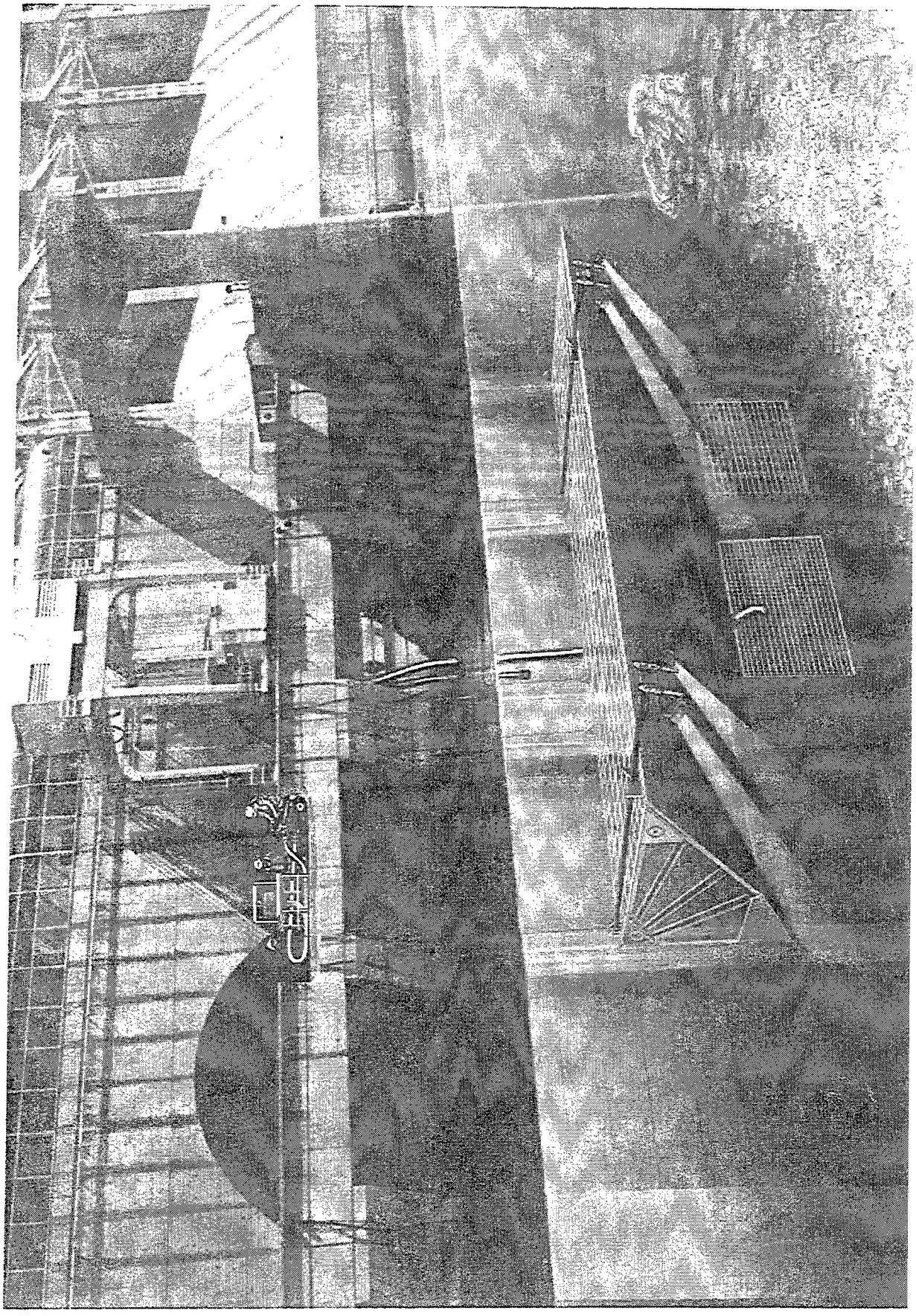

Figure 8. Induction system on draft tube desk for fyke net test

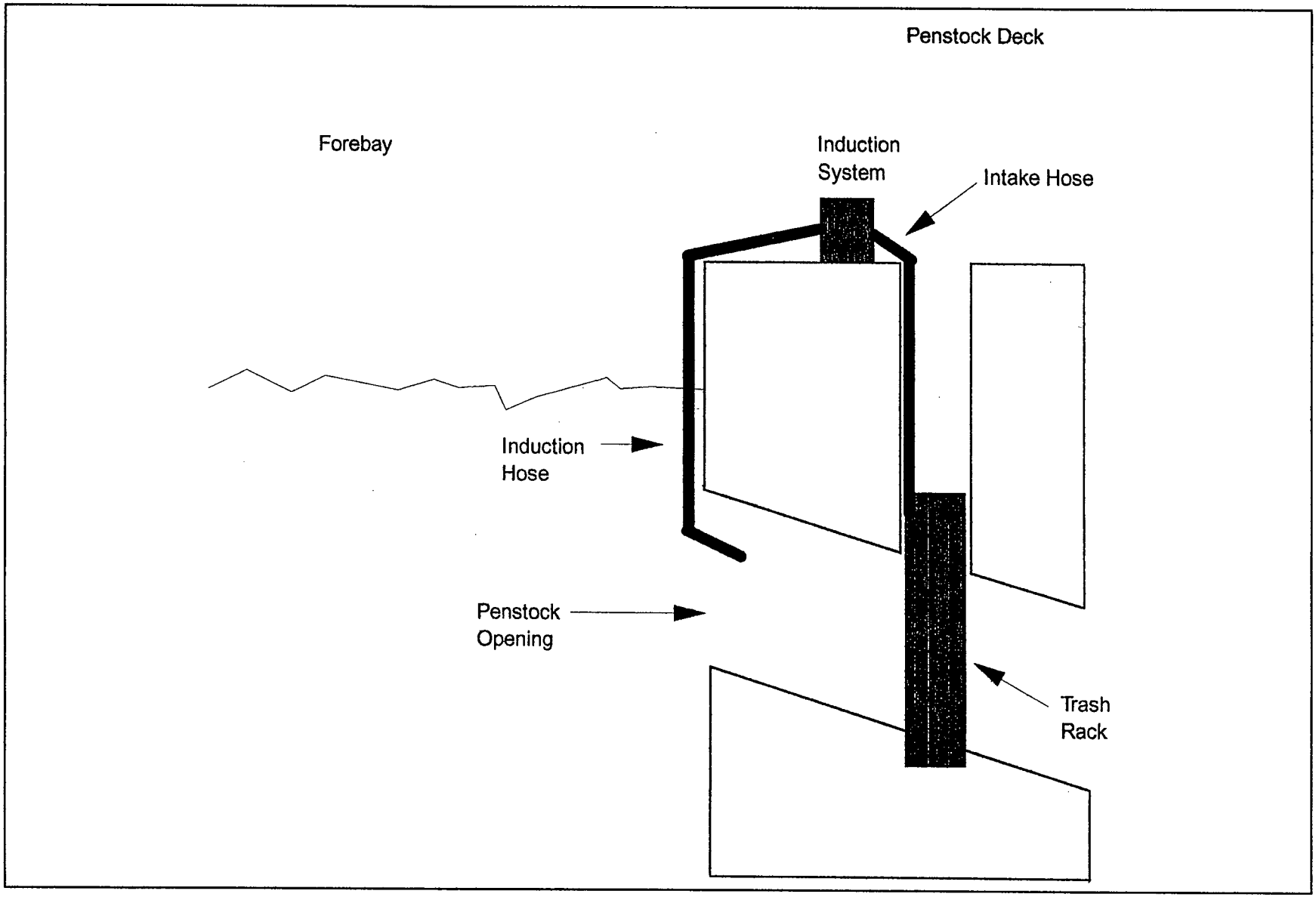

Figure 9. Induction system on penstock deck for conventional generation test

recorded for conventional generation tests. The total number of fish recovered from each quadrant will be recorded for fyke net tests.

At the beginning of each full recovery net test, 20 oranges will be inducted on the draft tube deck to determine if the induction tube is properly located and that the net is fishing properly. Oranges will also be inducted at the penstock induction pump during mortality tests.

Calibration data sheet

The following is an explanation of the data fields on the calibration data sheet and how they will be completed. A sample data sheet can be found in Appendix 3-2, Chapter 3).

Event data

Net Calib.:	Mark if the test is fyke net, conventional generation, or full recovery.
Date:	Enter the date when the event begins and the date when the event ends.
Time:	Enter the time the event begins and the time the event ends.
Collected By:	Names of the UGA Co-op workers who collected the data.
Units Tested:	Number of the units operating during the event.
Unit Fished:	The unit being netted.
Test Number:	The code number given to the event. This is recorded back at UGA (See Appendix 13-1, Chapter 13).

Fish data

Species:	Species of fish inducted for calibration test.
Size:	Length group to which the inducted group of fish is assigned (see Table 1, this chapter).
Mark:	Marking, either fin clip or dye, used to distinguish marked fish from entrained fish.

# Inducted:	Number of calibration fish inducted in a replicate.
Time Inducted:	Time the fish were inducted into the nets.
# Recovered:	Number of fish recovered. For fyke net, the recovery is divided by quadrant (USC, LSC, UGA, LGA). For conventional generation, the recovery is divided by net as GA side and SC side. Results will be entered in UGA and USC, respectively. For full recovery, the results will be entered in USC, representing the entire net catch.

The "Bagged Fish" section is used during the fyke net test for bagged fish, used to measure net blowback. "Species" is the fish used in the test. "Floaters" is the number of fish floating in the headgate slot after a test. "Impinged fish" is the species, size, and number of fish trapped in the trash rack or bar screens. "Net blowback," if it occurs is checked "yes." The panel of the net blowback is entered, and the degree of blowback is entered on the sheet.

The box on the lower left represents the fyke net. The mark received by the fish in the bag is entered in "Mark" for the respective quadrant. The number of fish recovered is entered in the "#"space, and the number recovered after the test is entered in the "Rec" space.

Determination of net efficiency

Net efficiency for each replicate will be determined by dividing the number of marked fish recovered by the number of marked fish inducted for the replicate. Mean efficiency for a given species/size group will be determined from the average of all net efficiencies for a given species and size group for that net.

Calibration efficiencies will be estimated for the percent return from all previous calibration tests, and additional calibration data will be added to the data set each month. If a problem occurs with a net, such as a tear or the net is not fishing properly, the calibration efficiencies for the fish inducted during that test will be used to expand the data for the respective groups of fish.

Species and size groups for inducted fish

Fish inducted for net efficiency will be species and size groups that constitute the majority of the entrainment, since most fish inducted are ones collected from previous net events. Golden shiners, however, will be purchased from a bait dealer and inducted to determine the percentage of small fish captured in the nets. Fish of abundant species (whatever is in the freezer at the time) will also be inducted by size group and species. At least 25-40 fish of a species should be inducted as a replicate. For fish larger than 6 in., 20 fish are enough for a replicate. Replicates will be composed of fish of standard size groups (Table 1).

If large enough numbers of a smaller or larger size group of a species are entrained, another size group may be generated for that species.

Fish should be inducted at least every 2 hr during full recovery pumpback tests. Fish will be inducted about 30 min into fyke net and conventional generation tests and again about 30-45 min prior to shutdown.

Juvenile fish calibration

As requested by the CG, numbers of juvenile fish entrained will be estimated using 1- to 2-in. calibration fish to estimate retention in the net. Shiners and bluegill of 1- to 2-in. size groups will be inducted during most tests.

Expansion of data using calibration estimates

Calibration estimates will be produced from the average percentage of a species and size group recovered from all tests. The numbers from each test will be added to the test numbers from all previous tests. If there is a problem with the net and the percent fish recovered decreases significantly, the percent of inducted fish recovered in the problem test will be used as the calibration estimate.

Table 1
Species and Size Groups Used for Induction

Species	Size Group, in.	Species	Size Group, in.
Blueback Herring	3-4	Bluegill	1-2
Blueback Herring	5-10	Bluegill	3-5
Threadfin Shad	1-2	Bluegill	≥6
Threadfin Shad	3-4	White Perch	3-4
Yellow Perch	3-4	White Perch	5-10
Yellow Perch	5-10	Spottail Shiner	3-5
Crappie	3-5	Catfish sp.	2-5
Crappie	6-8	Catfish sp.	≥6
Golden Shiner	1-2	Golden Shiner	3-4

Grouping applied to net efficiencies

Net efficiency estimates for species tested will be applied to groups of species to approximate net efficiencies for other species entrained. Estimated efficiencies will be collected for each of the three net types. Calibration groups are divided as follows:

Threadfin Shad, Golden Shiner (1-2 in.) will be applied to blueback herring, gizzard shad, threadfin shad, river carpsucker, northern hog sucker, spotted sucker, silver redhorse, bluehead chub, golden shiner, spottail shiner, whitefin shiner, coastal shiner, rainbow trout, brown trout, quillback, and common carp <2.5 in.

Golden Shiner, Blueback Herring, Threadfin Shad (3-4 in.) will be applied to blueback herring, gizzard shad, threadfin shad, river carpsucker, northern hog sucker, spotted sucker, silver redhorse, bluehead chub, golden shiner, spottail shiner, whitefin shiner, coastal shiner, rainbow trout, brown trout, quillback, and common carp 2.5-4.4 in.

Blueback Herring (5-10 in.) will be applied to blueback herring, gizzard shad, threadfin shad, river carpsucker, northern hog sucker, spotted sucker, silver redhorse, bluehead chub, golden shiner, spottail shiner, whitefin shiner, coastal shiner, rainbow trout, brown trout, quillback, and common carp 4.5-10.4 in.

Yellow Perch (3-4 in.) will be applied to chain pickerel, coosa bass, spotted bass, largemouth bass, longnose gar, tesselated darter, yellow perch, sauger, and walleye <4.5 in.

Yellow Perch (5-10 in.) will be applied to chain pickerel, coosa bass, spotted bass, largemouth bass, longnose gar, tesselated darter, yellow perch, sauger, and walleye 4.5-10.4 in.

White Perch (3-4 in.) will be applied to white perch, white bass, striped bass, and hybrid bass 2.5-4.5 in.

White Perch (5-10 in.) will be applied to white perch, white bass, striped bass, and hybrid bass 4.5-10.4 in.

Bluegill (1-2 in.) will be applied to bluegill, warmouth, green sunfish, redbreast sunfish, redear, pumpkinseed, chain pickerel, striped bass, hybrid bass, coosa bass, spotted bass, largemouth bass, longnose gar, tesselated darter, white crappie, white perch, yellow perch, walleye, sauger, and black crappie <2.5 in.

Bluegill, Crappie (3-5 in.) will be applied to bluegill, warmouth, green sunfish, redbreast sunfish, redear, pumpkinseed, white crappie, and black crappie 2.5-5.4 in.

Bluegill, Crappie (≥6 in.) will be applied to bluegill, warmouth, green sunfish, redbreast sunfish, redear, pumpkinseed, white crappie, and black crappie ≥5.5 in.

Catfish (2-5 in.) will be applied to blue catfish, white catfish, yellow bullhead, brown bullhead, flat bullhead, black bullhead, channel catfish, tadpole madtom, margined madtom, flathead catfish, and snail bullhead <5.5 in.

Catfish (≥6 in.) will be applied to blue catfish, white catfish, yellow bullhead, brown bullhead, flat bullhead, black bullhead, channel catfish, tadpole madtom, margined madtom, flathead catfish, and snail bullhead ≥5.5 in.

American eel will be applied to the grand mean of all fish calibration groups.

13 Protocol of Data Management for Netted Fish (Includes Expansion)[1]

Introduction

The processing of data and the proper distribution of the data are important in providing for smooth, efficient, and rapid turnaround time for the netting data. Included in this section are the steps and procedures used to verify, enter, and expand the field-collected data from fyke net, full recovery, and conventional generation tests. File-naming convention and distribution of raw and processed data are also covered.

Objective

The objective of this protocol is to provide a reference for data entry and expansion of the data to ensure accurate and efficient entry and usage while maintaining a specific format. The format should also ensure a fast turnaround time for the data (3 to 4 days as requested by WES).

Methods

Data sheet handling

Data collected in the field will be returned to the UGA Co-op Unit within 12 hr of a full recovery, fyke net, or conventional generation test completion. If no one is able to return to the UGA Co-op Unit within this time, the data will be faxed from Trotter Shoals Research Laboratory to the UGA Co-op Unit. Upon being received, a cover sheet (Appendix 13-1, this chapter) will be attached to

[1] Mark A. Weiland, Georgia Cooperative Fisheries and Wildlife Research Unit, D. B. Warnell School of Forest Resources, University of Georgia, Athens, GA.

the data and, the time received will be recorded on the cover sheet along with the names of who received and delivered the data. If faxed, the original raw data will be delivered as soon as possible. The test type, date of the test, and number of pages of data will also be recorded on the cover sheet.

The data sheets will be given a test code original to that test, and all data collected during the test will use the same test code. The same codes will also be used during the analysis of the data. The test code will be eight characters long beginning with a two-digit year code followed by the three-digit Julian date of the test, a one-digit code for the unit tested, a one-digit code for the test type, and a one-digit code for test replicate. For example, 96025F8A is data collected on 25 January 1996 (96025), Fishing Unit 8 using the fyke net, and is the first test replicate (F8A). The three test types will be coded "F" for fyke net test, "R" for full recovery test, and "G" for conventional generation test. Test replicates will be labeled "A" for the first test and "B" for the second test in a replicate.

Data sheets will be visually scanned for errors during entry of the field data. Full recovery data sheets will be scanned for correct date, unit, hour, start time and end time, quarter, and quarter start time and end time. Species code, sampling code, length, number, and bulk weight of fish will also be scanned for errors during entry to see if the numbers are logical or realistic (i.e., 1122 c 33, 33 in. is not a realistic size for a threadfin shad).

Conventional generation data sheets will be scanned for correct date, unit, hour (test number), start time and end time, and unit side (SC or GA). Fyke net data sheets will be scanned for correct date, unit, hour (test number), start and end time, side of unit sampled (SC or GA), and quadrant sampled (UG, US, LG, or LS).

If any of the data have been incorrectly recorded, the person scanning the data will correct the error if certain of the change (i.e., incorrect date). If uncertain of the correct entry, the person who collected the data will be contacted to help with the correction. After the data sheets have been scanned and any errors corrected, the person who scanned the data will initial and date the cover sheet.

Data entry

Data from the field sheets will be entered into a spreadsheet program, Quattro Pro for Windows (QPW). File format will be identical to that used for the field data sheets (Appendixes 13-2, 13-3, 13-4, this chapter). The test code, workers, calibration data set used, tears in net, and any other pertinent information will be recorded on the first lines of the data set. Species code, code, fish length, bulk weights, and number of fish will be entered after the comments. The person who entered the data will initial the cover sheet and date it. The entered data will then be printed out and compared with the field data sheets, and corrections made if necessary. The person who verified these data will initial and date the cover sheet. The field data will then be saved using the format described in the File-naming convention section below and file name entered on the cover sheet.

Conversion of data to ASCII text

The data will be converted to an ASCII text file so the data can be used in SAS (Statistical Analysis Systems) for data verification and manipulation. The data will be converted to ASCII using Quattro Pro Dos version. From experience it was found that conversion using the windows version causes problems with column alignment.

To convert the file to ASCII text:

a. Open the Quattro Pro Windows (QPW) file in Quattro Pro for Dos.

b. Choose the "print" field and pick the "block" command.

c. Move the cursor to the top left corner of the data and enter a ".".

d. Page down and over to the end of the data set and press <enter>. This is the block of data that will be converted to an ASCII text file.

e. Next, choose the "destination" command and pick the "file" command.

f. Enter the name, using the format described in the file-naming convention section, for the output data set. This will be the file containing the data in ASCII text format.

g. Choose the "layout" command and then "page break," set "page break" to "off." While still in "layout" choose "left margin" and set it to "0."

h. Next, choose "printer" and pick "align."

i. Lastly, choose "spreadsheet print." This saves the file under the name entered in Step *f* as an ASCII file.

j. Exit the program, but do not save changes made. This would save changes to the QPW file.

The person converting the data to an ASCII text file will initial, date, and record the name of the file created on the cover sheet.

Data verification

As a final check of the data for any errors that may have been overlooked, an SAS program will be used to check the data for any errors. The program will not show if a 4-in. fish was really a 5-in. fish, but will identify any abnormalities in the date line or unrealistic fish lengths.

After the program has been run, the output will be scanned for errors. If an error is found, the data will be corrected in both the QPW file and the ASCII text file. The worker will then initial and date the cover sheet.

Data manipulation and expansion

An SAS program will be used to compute estimated expanded fish entrainment for each of the three test types using the data in the ASCII text file. Netted fish data will be expanded for net efficiency using calibration estimates for the fish (see Chapter 12, Protocol for Induction Systems and Net Calibration).

Impinged fish will be added to the entrainment estimate but are not expanded for net efficiencies. Fish floating in the water are added to the estimate and are expanded for net efficiency. When blowback of a net occurs during a fyke net test, the number of fish in that quadrant will be adjusted using the bag test estimates (see Chapter 5, Protocol and Procedures for Slot Net Pump Test (Fyke Net): Part 2). For example, if 5 of the 10 objects were collected from the bag test, the estimate will be doubled for that quadrant and expanded for net efficiency.

The results of this program will include a single expanded estimate for the number of fish entrained during a test event, independent of species or length, for correlation with the hydroacoustic estimate. A second estimate of numbers of fish entrained during testing will also be calculated by species and length. The person running the program will initial and date the cover sheet verifying that the program has been run, the estimate is reasonable for the number of fish collected in the net, and that the single expanded estimate equals the sum of the estimate from the second estimate by species and length. The file name of the program and output data set will be recorded on the cover sheet.

A second SAS program will be used to compute numbers of netted fish per event for the three test types. These results will be computed on a monthly basis. The objective of this program is to provide numbers for netted fish to the State and Federal agencies involved with the project.

File-naming conventions

Files for the netted data will be saved in a standard format for all files. The eight character prefix will begin with a two-digit year code followed by the three-digit Julian date of the test, a one-digit code for the unit tested, and a two-digit code for the test type. The suffix will show what part of the analysis step the file represents. Each test and step in the analysis will have its own distinctive file name (Table 2). For example, 96025F8A.DAT is the data (.dat) collected on January 25 (025) 1996 (96) for the first replicate of a fyke net test on Unit 8 (F8A). Separate files will also be kept for calibration data and comments from each test.

Data distribution

Data will be uploaded to the server at Trotter Shoals Research Laboratory within 5 working days of the test using File Transfer Protocol (FTP). Data will be entered in the directory "NET." This directory will be divided into two subdirectories: "GEN" and "PUMP" (Figure 10, Chapter 16). Each of these subdirectories will further be divided into two more subdirectories: "RAW" and "FINAL." Unexpanded netting data from conventional generation tests will be loaded into the "RAW" subdirectory, and subsequent data expanded for calibration efficiency will be loaded into the "EXPANDED" subdirectory. Fyke net and full recovery net data will be loaded into the "PUMP" subdirectory and under the respective subdirectories as explained for generation data. Data will be loaded under file names as explained in the File-naming convention section and as illustrated in Table 2. Raw data for a conventional generation test would be loaded as follows:

C:\NET\GEN\RAW\96025G8A.DAT

Table 2
Example of File Formats

Step in Data Process	Fyke Net (F)	Full Recovery Pumpback (R)	Conventional Generation (G)
Date File	96025F8A.DAT	96025R8A.DAT	96025G8A.DAT
Expansion Program	96025F8A.PRG	96025R8A.PRG	96025G8A.PRG
Output from Expansion Program	96025F8A.EXP	96025R8A.EXP	96025G8A.EXP
Program for CG Report	96025F8A.PCG	96025R8A.PCG	96025G8A.PCG
Output from CG Program	96025F8A.OUT	96025R8A.OUT	96025G8A.OUT
Calibration Test Results	9601CAL.DAT	9601CAL.DAT	9601CAL.DAT

Note: This example is for 25 January 1996, Unit 8, first replicate "A".

A photocopy of the field data sheets, calibration data sheets, and the cover sheet will be mailed to WES to be archived in its repository. A disk copy of the raw data, expansion programs, and output data will also be mailed. The data will be mailed on a monthly basis.

Data outputs for the three tests will be passed out at the CG meeting every month. A hard copy of the program outputs and five disk copies of the data, programs, and output will be given to the COE Environmental Coordinator before the meeting for distribution to the proper people.

Data Cover Sheet

TEST NUMBER_____

Date of test:_____
Hours of test: 1) Start_____ End_____ 2) Start_____ End_____
Test type: Fyke___ Full___ Gen___ Unit____ Side____
Number of data pages:____

	Date	Worker Initials	File Name
Field data received	/time	By From	
Field data sheets scanned for errors			
Data entered in			
Entered data			
Converted to ASCII			
Verification			
Data expansion program run			Prog _____ Out
Expanded data verified			
Expanded number sent to Gary Weeks			
Expanded data and data sheets sent to Dennis Brandon			

Gary Weeks office 803/447-8561
fax 803/447-8563

Dennis Brandon office 601/634-2807
fax 601/634-4298

Appendix 13-1. Data Cover Sheet

Column heading and line spacing for Fyke net Quattro Pro speadsheet.

Date	Sampling code	Unit netted	Side netted	Quadrant	Test number	Start time	End time	Bagged fish recovered	# fish bagged
yymmdd	C	U	SD	QD	h	strt	end	rc	bg
column alignment: 3-8	10	13	15-16	19-20	25	28-31	34-37	44-45	50-51

Species code	Sampling code	Fish length	Number of fish	Fish weight	Dead
sp code	S	TL	N	W	D
column alignment: 5-8	10	12-13	15-17	19-23	31

Appendix 13-2. Column heading and line spacing for fyke net Quattro Pro spreadsheet

Column heading and line spacing for Full Recovery net Quattro Pro speadsheet.

	Date	Sampling code	Unit netted		Hourr	Start time	End time	Quarter	Quarter start	Quarter end
	yymmdd	C	U		h	strt	end	qrt	qstr	qend
column alignment:	3-8	10	13		25	28-31	34-37	39	42-45	48-51

	Species code	Sampling code	Fish length	Number of fish	Fish weight	Released	Dead	Abrasions	Lacerations	Bloody fins	Torn body	Damaged gills	Damaged eyes	P. swimbladder	Contusions
	sp code	S	TL	N	W	R	D	A	L	B	T	D	E	S	C
column alignment:	5-8	10	12-13	15-17	19-23	25	31	37	39	45	51	56	61	66	68

Appendix 13-3. Column heading and line spacing for full recovery net Quattro Pro spreadsheet

Column heading and line spacing for Conventional Generation net Quattro Pro speadsheet.

	Date	Sampling code	Unit netted	Side netted	Test number	Start time	End time
	yymmdd	C	U	SD	h	strt	end
column alignment:	3-8	10	13	15-16	25	28-31	34-37

	Species code	Sampling code	Fish length	Number of fish	Fish weight	Dead
	sp code	S	TL	N	W	D
column alignment:	5-8	10	12-13 15-17		19-23	31

Appendix 13-4. Column heading and line spacing for conventional generation net Quattro Pro spreadsheet

14 Protocol for Hydroacoustic Data Collection (Includes Protocol for Nonnetted Pumping)[1]

Introduction

This chapter describes the general procedures used by AScI/WES personnel in operating the hydroacoustic system during both netted and nonnetted pumping. These procedures are designed to be used in conjunction with hydroacoustic check-off sheets (Appendix 14-1).

Data to Be Collected

Hydroacoustic data will be collected for each pumping event. During post processing the data can be analyzed using either tracking and/or integration techniques. Tracking identifies individual fish based on a pattern of reflected sound pulses created as the fish passes through the area sampled by the hydroacoustic system. Integration provides estimates of fish passage by summing the reflected voltages in the sampled area and then scaling those voltages based on an expected voltage return for one fish. See Chapter 16 for a discussion on when each type of data is to be used.

Hardware and Software

Data will be collected using Biosonics ES2000 sounder to generate and receive the sound pulses. The analog sound pulses will be converted to digital data with a Biosonics ESP processing board. Biosonics ESP_DBM and

[1] Gary N. Weeks and Patrick C. Pierce, AScI Corporation, Trotter Shoals Research Facility, Calhoun Falls, SC.

ESP_EIM software will be used to process the tracking and integration data respectively.

Pretest Setup

Deterrent systems (pump test only)

The ultrasonic fish deterrent system is to be activated and fish-attracting lights turned on at least 1 hr before any pumping. The number of lights working and time the ultrasonic fish deterrent system was activated will be recorded on the hydroacoustic check-off sheet.

Hydroacoustic system quality assurance and control checks

With the transducers in the lowered position, the hydroacoustic system is activated and ESP_DBM and ESP_EIM are opened with the appropriate control files for data collection. With the control files running, bottom settings are checked and any noise or apparent structures on the echograms are noted on the hydroacoustic check-off sheet. Bottom voltage and the time required for a pulse to travel to the bottom and return to the transducer are read from an oscilloscope and written on the check-off sheet for each individual transducer. These values are to be compared with previous values for deviations that may signal system malfunction.

All system settings are compared with the system settings check sheets. A complete set of system settings check sheets is stored in each hydroacoustic equipment building at the dam and updated when any changes are made to the control files. Changes to the control files are noted in the equipment log and the check-off sheet (see Appendix 14-1).

Once all of the hydroacoustic system tests have been completed and appear normal, data collection is begun. At this time, the control room check-off sheet is to be completed and presented to the powerhouse operator.

Hydroacoustics Operation

Continuous data collection will begin on all units prior to pumping. Immediately after starting the programs, each transducer is again oscilloscoped to ensure that it appears to be running properly. The netted unit and side will be recorded in the appropriate location on the hydroacoustic check-off sheet if appropriate. Hydroacoustic data collection is verified (i.e., the Target Strength Distribution window in ESP_DBM and the Density window in ESP_EIM are checked for output, and the *.dat and *.dei file size should be checked to ensure data are being written to disk).

Post Operation

Once all units have been stopped, the runs on both the ESP_DBM and ESP_EIM programs are ended. The data files are downloaded and transferred as described in the data handling protocol elsewhere in this report. Once all the data have been secured, the hydroacoustic system can be shut down and the transducers raised.

Quality Assurance

All transducers are field calibrated before being put into service for data collection, prior to being used after modification or replacement of cables, or on a monthly basis, whichever is the shortest time span. Results of the field calibrations are forwarded for review by an expert in hydroacoustics. The reviewer will provide a written quality assurance report to AScI/WES staff at Trotter Shoals Research Facility (TSRF) noting the need for repair, recalibration, and/or changes in software settings. If changes are required, the AScI/WES staff at TSRF will make the appropriate adjustments and write an amendment to the quality assurance report documenting the changes. All changes in and anomalies of the hydroacoustic system will be documented in the hydroacoustic equipment logs, which are kept with the system.

Appendix 14-1. A sample hydroacoustic check-off sheet for pumpback data collection.

Pumpback Date: ----/----/----
Time: Sounder Computer _____ Control Room _____

Fish Protection Systems

Lights	# on	Floating Barges	_____
GA Bank	_____	High Freq. Sound	on/off
Face of Dam	_____	Tailrace	_____
Spillway	_____	Spillway	_____
SC Bank	_____		

Hydroacoustics

☐ Raise Generation Xducers
☐ Lower Pump Xducers
☐ System Start
☐ Turn sounder on

☐ Check Transducers
☐ Check all system settings and compare to attached sheet

Xducer	Ch1 BottomV (dc)	Ch1 Range (ms)	Ch2 BottomV (dc)	Ch2 Range (ms)
☐ X1				
☐ X2				
☐ X3				
☐ X4				
☐ X5				
☐ X6				
☐ X7				
☐ X8				

Netted Unit-Side 5 G S 6 G S 7 G S 8 G S
☐ Go to control room and sign off
☐ Update daily log

This sheet competed by:_____ Date: _____/_____/_____

Comments:

Appendix 14-1. Sample hydroacoustic check-off sheet for pumpback data collection

15 Data Handling Protocol for Hydroacoustics[1]

Introduction

This chapter describes the procedures followed by AScI/WES onsite personnel in the collection and distribution of hydroacoustic data. Many of the procedures described here are also discussed in other chapters of this report, and this chapter will reference other chapters and appendixes. For a description of net data handling and expansion, refer to Chapter 13, Protocol of Data Management for Netted Fish (Includes Expansion).

Hydroacoustic Data Protocol

Data management

Two analysis files will be maintained on the computerized database for each hour of raw data collected using the fish-tracking software. The first file will be a database file named with the Julian date, hour, and fm2.dbf extension (ex: 10604fm2.dbf). These files are unedited files containing tracked fish data generated by the real-time tracking software as part of the Biosonics ESP-DBM software. Parameters for real-time tracking were developed and approved by AScI, WES, and Aquacoustics personnel. The fm2.dbf files will be maintained in the C:\96DATA\ACOUSTIC\PUMP\DBF directory.

Final data files, edited for structure, debris, and other nonfish echos that may have been recognized as fish by the real-time software will be maintained in the C:\96DATA\ACOUSTIC\PUMP\FINAL directory. These files will be identified using an x96 prefix followed by the Julian date, hour, and the .xls extension (ex: x9610604.xls). These files will be in the Microsoft Excel Workbook format and are viewable in Microsoft Excel. These files represent the final data that will be used in further analysis of pump-related entrainment.

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[1] Gary N. Weeks and Patrick C. Pierce, AScI Corporation, Trotter Shoals Research Facility, Calhoun Falls, SC.

Raw data files (.dat extension) will continue to be maintained in the C:\96DATA\ACOUSTIC\PUMP\RAW\DAT directory. No changes to the management of integration (.dei extension) files are proposed at this time. See Figure 10, Chapter 16.

Quality assurance/quality control (QA/QC)

In order to maintain the integrity of the hydroacoustic database and to ensure that no significant variance between hydroacoustic data editors occurs, 1 hr for one transducer for each pump event will be independently edited by a second editor. The hour and transducer to be independently edited will be randomly selected from the pool of operational pump hours for that event and from the pool of transducers monitoring operational units during that hour. A difference in the total number of fish tracked between editors greater than 20 percent of the higher of the two totals will result in the immediate retracking of the entire pump event by the original editor. If, upon retracking, the difference remains greater than 20 percent, both editors will view the files together to reach a consensus. If no consensus can be reached, a third editor will track all the data files for that event, and the set of files representing the median number of fish tracked will be maintained as final data. Additionally, long-term trends between editors will be monitored. If any trends are identified between editors that consistently exceed the normal variance between all editors, corrective measures will be taken as necessary.

A QA/QC log will be electronically maintained at the Trotter Shoals Limnological Research Facility. For each event, the original editor will randomly select an hour and transducer to be entered into this log. The second editor will then retrack the file and enter the results of their editing onto the log. The log is maintained in a limited access directory and is available for public viewing upon request to the Principal Investigator for WES.

16 Electronic Distribution of Preliminary and Processed Data for Public Review[1]

Introduction

In order to facilitate the rapid posting of both netting and hydroacoustic data, a permanent file transfer protocol site (FTP) will be established on the Internet. This site is called "Alosa" and its Internet protocol (IP) address is 206.74.110.28. To access this site, users should use the login name "anonymous". The password for this address is the e-mail address of the person attempting to gain access.

Structure and File Naming

Directory structure for hydroacoustic data

The data will be in a root directory named "data\" that will have two subdirectories, one for hydroacoustic data, "acoustic", and one for netting data, "net". These directories are further subdivided to separate pumping and generation data. The acoustic directory also contains unit start and stop times in a subdirectory called "log" that itself is subdivided for pump and generation. The data in the data directories will also be separated into processed (final) and unprocessed (raw) data (Figure 10).

File types and naming

A standard eight-character name plus three-character extension convention will be used to name hydroacoustic data files. File naming will be in the format of "%T%Y%J%H.%E". Characters will be assigned as follows:

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[1] Gary N. Weeks and Patrick C. Pierce, AScI Corporation, Trotter Shoals Research Facility, Calhoun Falls, SC.

a. %T- one alphabetic character to indicate type of file. A "P" indicates raw pump data. A "G" indicates raw generation data. An "X" indicates final pump data, and "Y" indicates final generation data.

b. %Y - Two numeric characters denoting the year.

c. %J - Three numeric characters denoting the numeric day of the year (1 to 366 for 1996 since it is a leap year).

d. %H - Two numeric characters representing the time (military, Eastern Standard Time or Eastern Daylight Time) that the data file began collecting. Data files are 1 hr long with a new file beginning at the top of each hour.

e. %E - A three alphabetic character file extension denoting the file type. Final data files will have a ".csv" extension. Raw data files are of two types: ".dat" files contain raw echo tracking data, and ".dei" files contain raw echo-integration data. The raw data files are binary files that require Biosonics software for processing.

Netting data will also use an eight-character name plus the three-character extension method. The format for netting data will be %Y%J%N%U%T %E where:

a. %Y - Two numeric characters denoting the year.

b. %J - Three numeric characters denoting the numeric day of the year (1 to 366 for 1996 since it is a leap year).

c. %N - One alphabetic character representing the type of net. Fyke nets are "f", full recovery net is "r", and generation nets are "g".

d. %U - One numeric character denoting the netted unit.

e. %T - One alphabetic character representing the net haul for the test period with the first net haul being "a" and subsequent hauls following alphabetic order. If there is only one net haul, only one data set will be generated and %T = a; but if there are two net hauls, then there are two data sets with %T = a in the first and %T = b in the second.

f. %E - Three alphabetic characters denoting data processing level. Raw data will have a "dat" extension, and expanded data will have an "exp" extension.

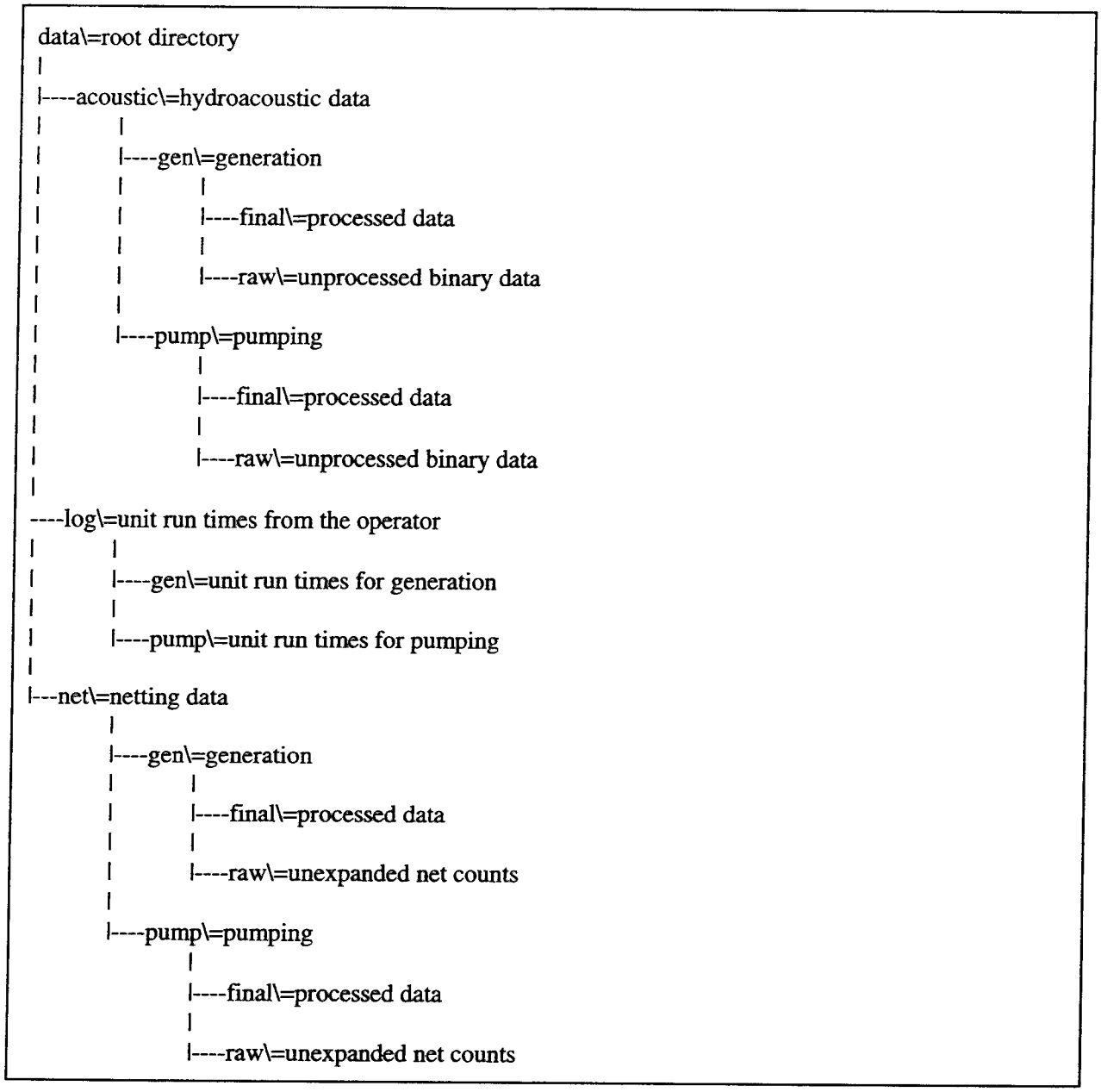

Figure 10. Directory structure of Alosa, the data posting site for Richard B. Russell Phase III monitoring data

Appendix 16-1. Data Transfer Record

File name(s)

Location	Date	Transferred by	Received by

Appendix 16-1. Data transfer record

Appendix 16-2. Example page from a pump log, generation logs will use the same format.

Pump	Date	Unit	S_time	E_time	Net	S_file	E_file	Comments
55	9/12/95	7	0:00	2:30	8SC	P9525500	P9525502	problems w/unit
55	9/12/95	6	0:45	2:45	8SC	P9525500	P9525502	
56	9/12/95	5	23:00	0:00	7GA	P9525523	P9525523	
56	9/12/95	6	23:15	0:00	7GA	P9525523	P9525523	
56	9/12/95	7	23:30	0:00	7GA	P9525523	P9525523	
56	9/13/95	7	0:00	3:30	7GA	P9525600	P9525603	One 4hr. sample
56	9/13/95	6	0:00	3:45	7GA	P9525600	P9525603	
56	9/13/95	5	0:00	4:00	7GA	P9525600	P9525603	
57	9/13/95	5	23:00	0:00	none	P9525623	P9525623	Unit 7 never
57	9/14/95	5	0:00	1:00	none	P9525700	P9525700	started
57	9/14/95	6	0:00	1:00	none	P9525700	P9525700	
58	9/20/95	8	23:00	0:00	8GA	P9526323	P9526323	
58	9/21/95	8	0:00	1:00	8GA	P9526400	P9526400	
58	9/21/95	8	2:00	4:00	8GA	P9526402	P9526403	
59	9/21/95	8	23:00	0:00	8GA	P9526423	P9526423	
59	9/22/95	8	0:00	1:00	8GA	P9526500	P9526500	
59	9/22/95	8	2:00	4:00	8GA	P9526502	P9526503	
60	9/26/95	8	23:05	0:00	8SC	P9526923	P9526923	
60	9/27/95	8	0:00	1:00	8SC	P9527000	P9527000	Lower GA net
60	9/27/95	8	2:00	4:00	8SC	P9527002	P9527003	torn

Appendix 16-2. Example page from a pump log (generation logs use same format)

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The Richard B. Russell (RBR) Dam has four conventional turbines and four reversible turbines. The reversible turbines can be used to replenish upstream storage for peak generation needs. Fish entrainment during pump storage is the primary environmental concern with this operation. The U.S. Army Engineer District, Savannah, evaluated an array of alternative action plans. The preferred plan included high-frequency sound and a light fish-protection system at RBR prior to operation of the reversible turbines. A Testing and Monitoring Plan was developed that addresses fish entrainment as well as other environmental concerns. The fish entrainment studies were implemented in three phases. Phase I was the time period required to mechanically and electrically certify each reversible turbine for commercial operation. Phase II evaluated fish passage and mortality during pump storage operations. Phase III testing evaluated fish entrainment and fish mortality during capacity operation of the RBR project. This report is a compilation of the Standard Operating Procedures used in Phase III Testing. The tasks include netting during conventional power generation, netting during a pump storage operation, full recovery netting, and estimating fish entrainment with hydroacoustic equipment.

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