Appendix A

Quality Control Report for the 2005 Hudson River Ichthyoplankton Laboratory Program and 2005 Fall Juvenile Survey

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QUALITY CONTROL REPORT FOR THE 2005 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM AND 2005 FALL JUVENILE SURVEY

1.0 INTRODUCTION

This quality control report for the laboratory tasks of the 2005 Hudson River Ichthyoplankton Survey and the 2005 Fall Juvenile Survey was prepared for Entergy Nuclear Operations, Inc. by Normandeau Associates Inc. (NAI).

To comply with Entergy's requirements for valid and reliable data on the Hudson River Ichthyoplankton Laboratory Program and the Fall Juvenile Survey, NAI implemented a Quality Assurance Plan that provides a 10% Average Outgoing Quality Limit (AOQL) for all measurement parameters collected. The Quality Assurance Plan consists of two systems: a quality control (QC) system and a quality assurance (QA) system. The QC system is managed by the program manager and conducted by operational personnel. The system monitors and documents the reliability and validity (accuracy, precision, completeness) of daily operations. The specific features of the QC system are determined by the Quality Assurance Department to insure that all procedures conform to Entergy's data requirements. The QA system is managed by NAI's Quality Assurance Director and utilizes project independent personnel familiar with the work or activities under evaluation to conduct performance and systems audits. These audits are designed to provide objective evidence that the quality control program and technical requirements, methods, and procedures as outlined in the program Standard Operating Procedures are being implemented. The outcomes of the QA system activities are

- verification of the effectiveness of the QC system,
- assignment of corrective actions to resolve nonconforming procedures or data deficiencies,
- communication of audit results to project and staff managers for follow-up, and
- objective validation or improvement of project operations.

This report provides a compilation of QC system data verifying the results of the 2005 Hudson River Ichthyoplankton Laboratory Program and 2005 Fall Juvenile Survey activities. Determinations of the fraction inspected, percent nonconforming, and average outgoing quality are presented for both programs. In addition, for the 2005 Hudson River Ichthyoplankton Laboratory Program the results include percent measurement error, a summary of the number of each taxon-life stage found during sorting QC, and cumulative error rates for each taxon-life stage.

2.0 METHODS

2.1 LABORATORY QUALITY CONTROL PROCEDURES

2.1.1 Ichthyoplankton Survey

For sorting and identification of samples from the 2005 Hudson River Ichthyoplankton Laboratory Program, NAI used a continuous sampling plan designed to provide a 10% Average Outgoing Quality Limit (U.S. Department of Defense 1981). A flow diagram of how the sampling plan was applied is presented in Figure 1. A summary of the sampling plan, tolerances and QC sample definitions used for each measurement parameter is presented in Table 1. Quality control inspection was applied on a laboratory-wide basis for the sorting task and to each individual processor for the identification task. Quality control samples were selected in a random manner utilizing random number tables. As determined from the sampling plan outlined in Table 1, a given number of quality control samples were reprocessed by QC inspectors with expertise in the task being inspected. In cases where a sample was subdivided and counted, counts for all subdivisions were combined before calculating percent error for that sample. If the difference between the quality control value and the original value exceeded acceptable tolerances (Table 1), a third measurement could be obtained to verify one of the measurements. If a sample was found to have exceeded acceptable tolerances, all subsequent samples processed by the same technician were subjected to 100% quality control until an appropriate number of consecutive samples (i) were found within tolerance as determined by the continuous sampling plan (Table 1 and Figure 1). The standard operating procedures manual (NAI 2003) documents specific QA/QC methods utilized for this program.

Table 1. Task Specific Applications of Continuous Sampling Plans for the 2005 Hudson River Ichthyoplankton Laboratory Program

Laboratory Task	CSP-1 AOQL 10%		Sample Tolerance	QC Sample Definition
	i	f		
Sorting	8	1/7	± 2 if ≤20 organisms ± 10% if >20 organisms	one sample
Identification	8	1/7	± 2 if ≤20 ± 10% if >20 for every taxon in the sample (in identifying, assigning a life stage, or counting any species, errors are cumulative by life stage within each taxon)	one sample

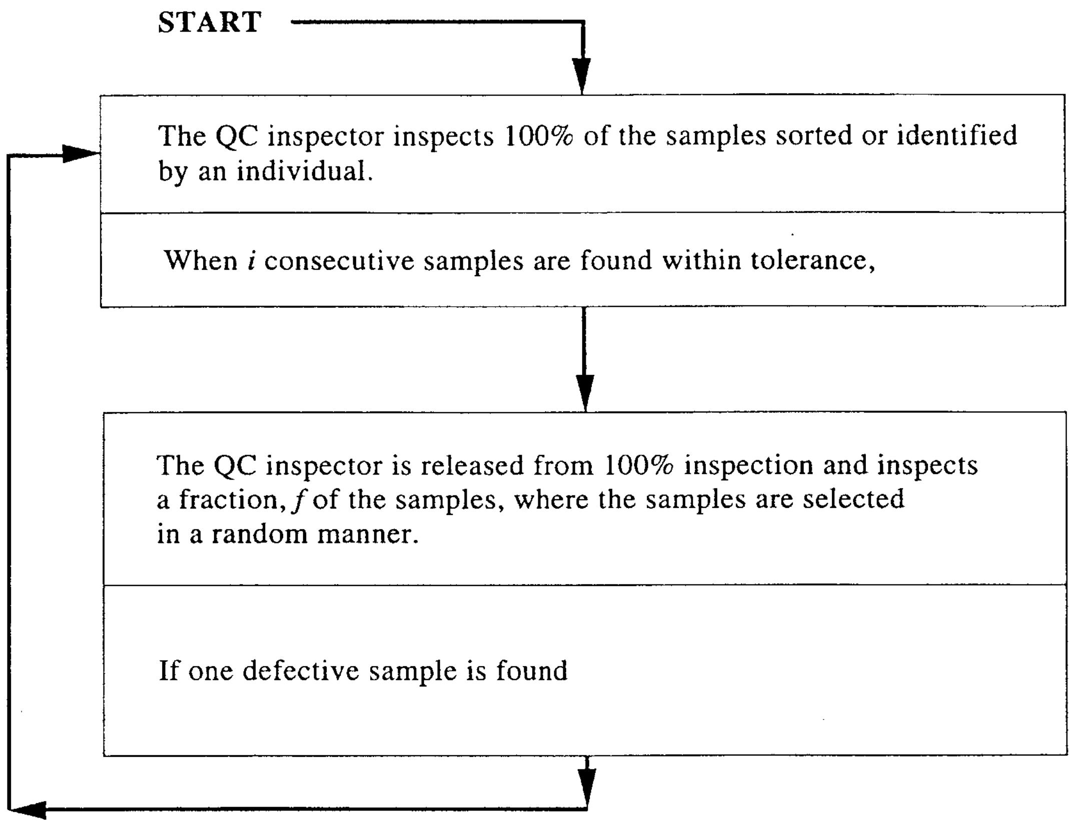

Figure 1. Quality control inspection plan for ichthyoplankton sorting and identification tasks.

In some cases one of the taxonomists (either the original identifier or the QC inspector) was able to determine the taxon or life stage of damaged specimens when the other taxonomist recorded them as unknown life stage, unidentified taxon, or a higher level taxon (genus or family). If a more general taxon or life stage used by one taxonomist *included* the more specific category used by the other taxonomist, and that was the only reason for a count discrepancy, then that sample was not considered as failing the QC inspection. For example, damaged specimens recorded as *Morone* sp. by the original identifier and as striped bass by the QC inspector were considered to be in agreement because the category *Morone* sp. includes striped bass. In contrast, an original determination of unidentified gobiid would not be acceptable if the QC determination was striped bass, because striped bass is not included in the family Gobiidae.

2.1.2 Fall Juvenile Survey

The Fall Juvenile Survey consisted of two types of collections, referred to as the Fall Shoals Survey (which used Tucker trawls) and the Beach Seine Survey. For laboratory identification and length measurements of young-of-the-year fishes in the 2005 Fall Juvenile Survey, NAI used a continuous sampling plan designed to provide a 10% Average Outgoing Quality Limit (U.S. Department of

Defense, 1981). A flow diagram of how the plan was applied is presented in Figure 2. A summary of the sampling plan, tolerances, and QC sample definitions used for each task is shown in Table 2. QC samples were selected as specified by the appropriate plan in Table 2, using random numbers, and reprocessed by QC inspectors. If the difference between original and QC values exceeded the acceptable tolerance, a third value was obtained as a resolution. The standard operating procedures manual (NAI 2005) documents specific QA/QC methods used for the 2005 Fall Juvenile Survey. Young-of-the-year fishes were identified in the laboratory for the first two Fall Shoals "river runs" (sampling weeks) and the first three Beach Seine Survey river runs. Young-of-the-year fishes were identified in the field starting with Fall Shoals river run 3 and Beach Seine Survey river run 4. The same quality control procedures applied to both field and laboratory identifications. All length measurements of young-of-the-year fishes occurred in the laboratory.

Table 2. Task Specific Applications of Continuous Sampling Plans for the 2005 Fall Juvenile Survey.

Task	QC Plan	AOQL	i	f	x	Tolerance	QC Sample Definition
Identification	CSP-V	7%	21	1/15	7	±10% of total count or ±2 individuals when <25 fish	One taxon
Length	CSP-V	7%	30	1/50	10	±1 mm when <34 mm TL ±3% when >34 mm TL	One fish

2.2 REPORTING PROCEDURES

The 2005 Hudson River Ichthyoplankton Laboratory Program Sort and Identification Quality Control Logs were keyed, verified, and error-checked to produce SAS data sets. From these data, fraction inspected, percent nonconforming, and percent measurement error (precision) were determined for each river run and for the entire study. For the 2005 Fall Juvenile Survey, QC data were used to determine fraction inspected and percent nonconforming for the entire study (combining all river runs processed in the laboratory for both the Fall Shoals Survey and the Beach Seine Survey).

2.2.1 Fraction Inspected

Fraction Inspected

$$= \frac{\text{Number of Samples Inspected}}{\text{Total Number of Samples}} \times 100 \qquad \text{(Equation 1)}$$

River Run: Fraction inspected for a river run (Equation 1) was one hundred times the number of samples inspected divided by the total number of samples analyzed for that river run. For ichthyoplankton tasks, the number of samples inspected excludes "training QC samples," which do not represent the independent performance of the technician. For the ichthyoplankton identification task, the total number of samples identified excludes empty ("no catch") samples, which did not require processing by an identifier.

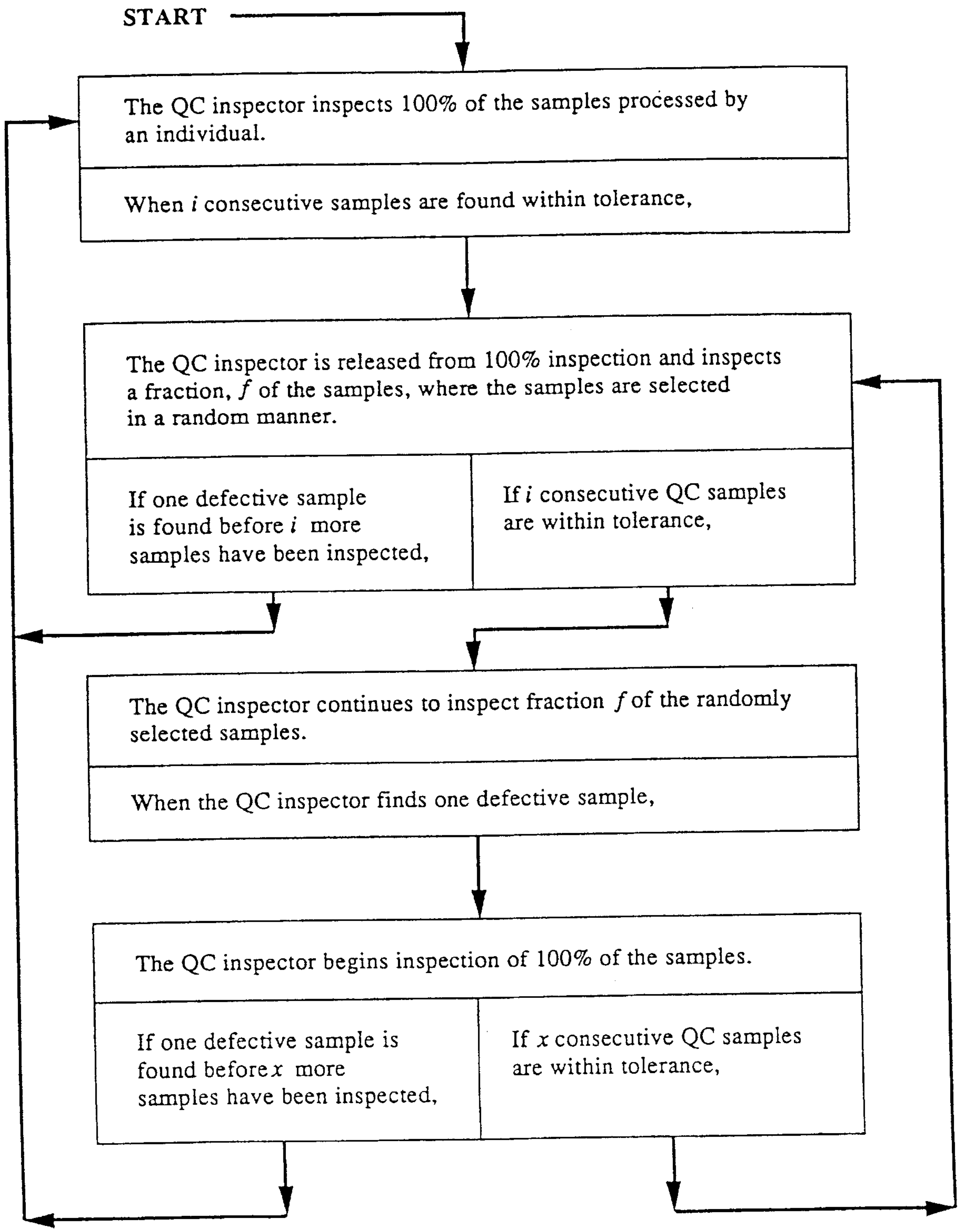

Figure 2. Quality control inspection plan for identification and length measurement of young-of-the-year fishes.

Entire Study: Fraction inspected for the entire study was one hundred times the number of samples inspected divided by the total number of samples analyzed during the study.

2.2.2 Percent Nonconforming

Percent Nonconforming

$$= \frac{\text{Number of Nonconforming Samples Inspected}}{\text{Number of Samples Inspected}} \times 100 \qquad \text{(Equation 2)}$$

River Run: Percent nonconforming for a river run (Equation 2) was one hundred times the number of nonconforming quality control samples found for that river run divided by the total number of quality control samples inspected for that river run.

Entire Study: Percent nonconforming for the entire study was one hundred times the total number of nonconforming quality control samples for the study divided by the total number of quality control samples inspected for the study. The results of this analysis was a determination of the actual incoming quality level of each measurement parameter. (Note that because samples checked by QC found to be defective were rectified during QC, the average outgoing quality of the final data set was better than that indicated by the percent nonconforming.)

2.2.3 Percent Measurement Error

Sorting Task

Sorting Percent Measurement Error

$$= \frac{\text{Quality Control Value}}{(\text{Original Value} + \text{Quality Control Value})} \times 100 \qquad \text{(Equation 3)}$$

Sample: Percent measurement error for a sorted sample (Equation 3) was one hundred times the quality control value divided by the sum of the original value and the quality control value. If the total count (original value plus quality control value) was less than or equal to 20, and the quality control value (i.e., the number of organisms missed by the sorter and found during sort QC inspection) was one or two, the percent measurement error for the sorted sample was defined as zero.

River Run: Mean percent measurement error for sorted samples for a river run was the sum of the percent measurement errors for each sample inspected during the river run divided by the total number of samples inspected for the river run.

Entire Study: Mean percent measurement error for sorted samples for the entire study was the sum of the percent measurement errors for each sample inspected during the study divided by the total number of samples inspected for the study. (Note that this method of averaging gives equal weight to each sample, regardless of the number of organisms present).

Identification Task

Life Stage Percent Measurement Error

$$= \frac{(\text{Original Value} - \text{Quality Control Value})}{\text{Quality Control Value}} \times 100 \qquad \text{(Equation 4)}$$

Life Stage: Percent measurement error for a life stage (Equation 4) was one hundred times the difference between the original value and the quality control value divided by the quality control value. For life stages where the quality control value was 20 or less, if the original and quality control values differed by less than or equal to two organisms the percent measurement error was defined as zero. For life stages where the quality control value was 20 or less and the original and quality control values differed by more than two organisms, the percent measurement error was calculated utilizing Equation 4. If the quality control value was zero, the percent measurement error was calculated by multiplying the difference between the original and quality control values by 100. This results in percent measurement error values which are at times extremely large (e.g. possibly several hundred percent for a life stage of a taxon in a sample) and not truly indicative of the actual proportion of specimens misidentified, mis-staged, or miscounted in a sample. If the original count for a life stage was acceptably close to a resolution value but not to the quality control value, the percent measurement error was calculated as described above except that the resolution value was substituted for the quality control value.

Taxon: Percent measurement error for an identified taxon was the sum of the absolute values of percent measurement error for each life stage within the taxon. Refer to Figure 3 for an example of taxon percent measurement error calculations.

		Eggs	Post Yolk-Sac Larvae	Young-of-the-Year	Total
Taxon 1					
	Original Value	103	176	25	
	Quality Control Value	100	194	26	
	% Measurement Error Life Stage	3.0	-9.3	-3.8	16.1
Taxon 2					
	Original Value		2		
	Quality Control Value		1		
	% Measurement Error Life Stage		0		0
Taxon 3					
	Original Value		8		
	Quality Control Value		2		
	% Measurement Error Life Stage		300		300

Figure 3. Example of percent measurement error calculations for individual taxa during the identification task.

River Run: Mean percent measurement error for the identification task for a river run was the sum of the percent measurement errors for all taxa inspected during the river run divided by the total number of taxa inspected for the river run. This statistic was computed by averaging taxa rather than samples because even though complete samples were inspected and reworked for identification quality control, the pass/fail criterion was whether any taxon in the sample individually exceeded the 10% tolerance.

Entire Study: Mean percent measurement error for identified taxa for the entire study was the sum of the percent measurement errors for all taxa inspected during the study divided by the total number of taxa inspected for the study.

2.2.4 Average Outgoing Quality

At the completion of these studies, the Average Outgoing Quality (AOQ) was calculated for each measurement parameter inspected. Continuous sampling plans were used for all tasks. Continuous sampling plans are devised for processes involving a continuous or nearly continuous flow of products or other entities. For these types of processes, it is extremely difficult to organize units into discrete groups commonly referred to as lots. As a result, inspection must be performed on individual units drawn from a continuous flow of products and a decision made concerning the quality of units produced based on the inspection results. Rectification is performed on any nonconforming unit found during inspection, followed by 100% screening of a number of subsequent units depending on the sampling plan. Average Outgoing Quality for each laboratory task was calculated as a function of the percent nonconforming and the fraction of total units inspected (Stephens 1979). This calculation applies to continuous sampling plans when nonconforming units found are rectified:

$$\text{AOQ} = \frac{p'(1-f)q^{i}}{f+(1-f)q^{i}} \times 100 \qquad \text{(Equation 5)}$$

where

p' = Percent nonconforming as a decimal fraction
f = Fraction of units inspected. This is a parameter of the sampling plan.
q = 1-p' = Percent conforming as a decimal fraction
i = Clearing interval. This is a parameter of the sampling plan.

Example:

$p' = 0.0689$
$f = 1/7 = 0.1429$
$q = 1-0.0689 = 0.9311$
$i = 8$

$$\text{AOQ} = \frac{0.0689(1-0.1429)(0.9311)^{8}}{0.1429+(1-0.1429)(0.9311)^{8}} \times 100 = 5.32\%$$

The above equation for calculating AOQ was formulated specifically for CSP-1 sampling plans such as those used for the ichthyoplankton sorting and identification (Table 1). The same equation was used to calculate AOQ for young-of-the-year identifications and measurements, which used CSP-V plans (Table 2). When Equation 5 is used for CSP-V plans, the calculated AOQ is conservatively high, because the equation does not take into account the times when the number of consecutive reinspections following a failure is x (which is smaller than i).

2.2.5 Cumulative Error Rates

Due to the non-independence of identification errors across taxa and life stages, and to the cumulation of errors within taxa, a relatively high fraction of samples may fail QC inspection even though only a small fraction of organisms are incorrectly identified or counted. In order to present the error frequencies more realistically for particular taxa-life stages, two additional statistics were calculated for each taxon-life stage for the identification/counting process.

Absolute Error Rate =

$$\sum_{i=1}^{n} | I_i - Q_i | / \sum_{i=1}^{n} Q_i \qquad \text{Equation 6}$$

Net Error Rate =

$$\sum_{i=1}^{n} (I_i - Q_i) / \sum_{i=1}^{n} Q_i \qquad \text{Equation 7}$$

where

I_i = initial count for taxon-life stage in sample i
Q_i = QC count for taxon-life stage in sample i (or the resolution count, if I_i was acceptably close to it but not to the QC count)
n = number of samples in the entire study

If the sum of Q_i for the entire study was zero for the taxon-life stage, then the sum of Q_i was set equal to one for the purpose of calculating absolute and net error rate.

The absolute error rate is the approximate fraction of the taxon-life stage that was originally identified or counted incorrectly. This is an estimate of the fraction of erroneous countable items in the uninspected samples.

Net error rate is the approximate relative error in the total counts for the taxon-life stage. For this index, positive (original count too high) and negative (original count too low) errors cancel each other so that the index reflects the relative net bias to the taxon-life stage abundance.

3.0 RESULTS

3.1 ICHTHYOPLANKTON LABORATORY PROGRAM

The Average Outgoing Quality (AOQ) of the 2005 Hudson River Ichthyoplankton Laboratory Program was 2.05% for the sorting task 0.73% for the identification task. These AOQ levels represent the actual or achieved quality for measurement parameters and were well within the 10% AOQL requirement of the study. The Average Fraction Inspected (AFI) was 16.13% for sorting and 15.67% for identification (Table 3).

Table 3. Fraction Inspected, Percent Nonconforming, Mean Percent Measurement Error, and Average Outgoing Quality of Tasks Performed By NAI for the 2005 Hudson River Ichthyoplankton Laboratory Program.

Task	Fraction Inspected (%)	Percent Noncon-Forming (%)	Mean Percent Measurement Error (%)	AOQ (%)
Sorting	16.13	2.46	1.98	2.05
Identification	15.67	0.86	3.37	0.73

The AFI for the sorting task as calculated here is conservatively low, because samples used as "training QCs" were not entered into the formal QC inspection plan. Each training QC sample was reprocessed by the Sorting Supervisor during the training process, so these do not represent the independent performance of the sorter. Only after a new sorter demonstrated proficiency in the training program were subsequent samples processed by that sorter entered into the laboratory-wide QC plan.

Sorting and identification tasks were also evaluated on the basis of river runs (sampling weeks). Sorted samples were inspected at a rate of 11.85% to 23.61% for individual river runs (Table 4). Nonconformance for the sorting task among the inspected samples ranged from 0% to 13.79% among the river runs and was 2.46% overall (Table 5). Sorting measurement error was between 0% and 7.90% and averaged 1.98% for the study (Table 6). For the task of sample identification, 11.54% to 22.50% of samples were inspected from individual river runs (Table 7). Percent nonconforming for the identification task ranged from 0% to 5.56% for each of the 25 river runs and averaged 0.86% (Table 8). Measurement error ranged from 0% to 32.99% and overall measurement error was 3.37% for the identification task of this study (Table 9).

Measurement error results are skewed towards high values as a result of the method of computation at the life stage level. In addition, measurement errors are summed over life stages within each taxon, which then amplifies the already skewed life stage values. These data are not indicative of actual measurement error and should only be compared to other measurement error results that are calculated using exactly the same methods. In all cases of failed QC samples, the data were corrected and the QC sample inspection frequency was maintained at 100% for that individual until acceptable results were demonstrated as determined by the QC sampling plan.

Additional organisms found during the sort QC were identified independently to determine the frequency of species and life stages missed during the initial sort. Six taxa accounted for 90% of the

Table 4. Sample Sorting Fraction Inspected Results, 2005 Hudson River Ichthyoplankton Laboratory Program.

Sampling Week (Beginning Monday)	Total # of Samples Inspected	Total # of Samples Sorted	Fraction Inspected
14Mar05	17	72	23.61
21Mar05	10	73	13.70
28Mar05	13	74	17.57
4Apr05	22	122	18.03
11Apr05	23	126	18.25
18Apr05	19	126	15.08
25Apr05	16	133	12.03
2May05	25	135	18.52
9May05	16	135	11.85
16May05	24	126	19.05
23May05	29	126	23.02
30May05	26	126	20.63
6Jun05	15	123	12.20
13Jun05	16	123	13.01
20Jun05	22	123	17.89
27Jun05	17	123	13.82
11Jul05	13	81	16.05
25Jul05	12	81	14.81
8Aug05	12	81	14.81
22Aug05	11	81	13.58
5Sep05	12	81	14.81
19Sep05	11	81	13.58
3Oct05	12	81	14.81
14Nov05	7	42	16.67
5Dec05	6	42	14.29
Study	**406**	**2517**	**16.13**

Table 5. Sample Sorting Percent Nonconformance Results, 2005 Hudson River Ichthyoplankton Laboratory Program.

Sampling Week (Beginning Monday)	# of Non-conformities	Total # of Samples Inspected	% Non-conformance (Week)	% Non-conformance (Study)
14Mar05	1	17	5.88	5.88
21Mar05	0	10	0.00	3.70
28Mar05	0	13	0.00	2.50
4Apr05	0	22	0.00	1.61
11Apr05	0	23	0.00	1.18
18Apr05	0	19	0.00	0.96
25Apr05	0	16	0.00	0.83
2May05	1	25	4.00	1.38
9May05	1	16	6.25	1.86
16May05	2	24	8.33	2.70
23May05	4	29	13.79	4.21
30May05	1	26	3.85	4.17
6Jun05	0	15	0.00	3.92
13Jun05	0	16	0.00	3.69
20Jun05	0	22	0.00	3.41
27Jun05	0	17	0.00	3.23
11Jul05	0	13	0.00	3.10
25Jul05	0	12	0.00	2.99
8Aug05	0	12	0.00	2.88
22Aug05	0	11	0.00	2.79
5Sep05	0	12	0.00	2.70
19Sep05	0	11	0.00	2.62
3Oct05	0	12	0.00	2.54
14Nov05	0	7	0.00	2.50
5Dec05	0	6	0.00	2.46
Study	**10**	**406**		

Table 6. Sample Sorting Mean Percent Measurement Error Results, 2005 Hudson River Ichthyoplankton Laboratory Program.

Sampling Week (Beginning Monday)	Total # of Samples Inspected	Mean Percent Measurement Error
14Mar05	17	1.09
21Mar05	10	3.28
28Mar05	13	0.76
4Apr05	22	0.25
11Apr05	23	0.30
18Apr05	19	0.21
25Apr05	16	0.57
2May05	25	1.57
9May05	16	7.90
16May05	24	3.69
23May05	29	6.05
30May05	26	3.50
6Jun05	15	2.39
13Jun05	16	1.40
20Jun05	22	2.56
27Jun05	17	1.59
11Jul05	13	1.71
25Jul05	12	1.45
8Aug05	12	0.99
22Aug05	11	0.00
5Sep05	12	0.00
19Sep05	11	0.00
3Oct05	12	0.00
14Nov05	7	0.28
5Dec05	6	0.00
Study	**406**	**1.98**

Table 7. Sample Identification Fraction Inspected Results, 2005 Hudson River Ichthyoplankton Laboratory Program.

Sampling Week (Beginning Monday)	Total # of Samples Inspected	Total # of Samples Identified	Fraction Inspected
14Mar05	10	68	14.71
21Mar05	10	72	13.89
28Mar05	9	65	13.85
4Apr05	3	26	11.54
11Apr05	9	46	19.57
18Apr05	10	77	12.99
25Apr05	17	120	14.17
2May05	20	133	15.04
9May05	19	134	14.18
16May05	24	118	20.34
23May05	19	126	15.08
30May05	18	126	14.29
6Jun05	17	123	13.82
13Jun05	17	123	13.82
20Jun05	25	123	20.33
27Jun05	18	123	14.63
11Jul05	11	81	13.58
25Jul05	11	81	13.58
8Aug05	17	81	20.99
22Aug05	11	79	13.92
5Sep05	13	81	16.05
19Sep05	18	80	22.50
3Oct05	11	81	13.58
14Nov05	6	36	16.67
5Dec05	4	25	16.00
Study	**347**	**2228**	**15.67**

Table 8. Sample Identification Percent Nonconformance Results, 2005 Hudson River Ichthyoplankton Laboratory Program.

Sampling Week (Beginning Monday)	# of Noncon-formities	Total # of Samples Inspected	% Non-conformance (Week)	% Non-conformance (Study)
14Mar05	0	10	0.00	0.00
21Mar05	0	10	0.00	0.00
28Mar05	0	9	0.00	0.00
04Apr05	0	3	0.00	0.00
11Apr05	0	9	0.00	0.00
18Apr05	0	10	0.00	0.00
25Apr05	0	17	0.00	0.00
02May05	0	20	0.00	0.00
09May05	0	19	0.00	0.00
16May05	1	24	4.17	0.76
23May05	0	19	0.00	0.67
30May05	0	18	0.00	0.60
06Jun05	0	17	0.00	0.54
13Jun05	0	17	0.00	0.50
20Jun05	1	25	4.00	0.88
27Jun05	0	18	0.00	0.82
11Jul05	0	11	0.00	0.78
25Jul05	0	11	0.00	0.75
08Aug05	0	17	0.00	0.70
22Aug05	0	11	0.00	0.68
05Sep05	0	13	0.00	0.65
19Sep05	1	18	5.56	0.92
03Oct05	0	11	0.00	0.89
14Nov05	0	6	0.00	0.87
05Dec05	0	4	0.00	0.86
Study	**3**	**347**		

Table 9. Sample Identification Mean Percent Measurement Error Results, 2005 Hudson River Ichthyoplankton Laboratory Program.

Sampling Week (Beginning Monday)	Total # of Samples Inspected	Mean Percent Measurement Error	Number of Taxa Inspected
14Mar05	10	0.08	18
21Mar05	10	0.18	24
28Mar05	9	0.25	12
04Apr05	3	0.00	8
11Apr05	9	0.06	14
18Apr05	10	0.11	18
25Apr05	17	0.20	41
02May05	20	0.27	44
09May05	19	0.58	61
16May05	24	32.99	87
23May05	19	0.80	109
30May05	18	1.35	97
06Jun05	17	1.70	80
13Jun05	17	1.28	103
20Jun05	25	3.04	162
27Jun05	18	1.37	97
11Jul05	11	0.56	47
25Jul05	11	0.73	49
08Aug05	17	0.72	44
22Aug05	11	0.58	33
05Sep05	13	0.88	24
19Sep05	18	0.61	30
03Oct05	11	0.84	24
14Nov05	6	0.18	22
05Dec05	4	0.00	7
Study	**347**	**3.37**	**1255**

additional organisms found during sort QC: white perch, striped bass, clupeids, bay anchovy, *Morone* sp., and winter flounder (Table 10). For these six taxa, the additional number found in the sort QC was less than 1% of the total found during sample processing except for winter flounder (1.65%).

For the six taxa most commonly encountered during sort QC the total number of each life stage found in the sort QC was low compared to the total number sorted (Table 11). For most taxa-life stages the percentage missed by the original sorter was well under 2%.

The life stage most commonly missed by sorters was eggs for bay anchovy and striped bass, unidentified life stage for *Morone* sp., and it was post yolk-sac larvae for white perch, clupeids, and winter flounder (Table 11). Generally the life stage most frequently missed by sorters was the most abundant one.

Absolute error rates of the identification process for individual life stages of commonly encountered taxa ranged from 0 to 2, but most taxa-life stages had rates less than 0.05. Generally, only those taxa-life stages with low total counts had absolute error rates above 0.05 (Table 12).

Net error rates were substantially lower than the absolute error rates in most cases, demonstrating that errors often tended to cancel each other out. This was noticeable for many of the more abundant taxa-life stages, such as yolk-sac larvae and post yolk-sac larvae of striped bass, white perch, clupeids, and bay anchovy, and young-of-the-year of bay anchovy and Atlantic tomcod.

3.2 FALL JUVENILE SURVEY

Results of the laboratory quality control program for the 2005 Fall Juvenile Survey (consisting of the Beach Seine Survey and the Fall Shoals Survey) were summarized by the same methods as the QC results for the 2005 Hudson River Ichthyoplankton Laboratory Program (Section 2.1.2) and are presented in Table 13.

A total of 1,374 and 911 young-of-the-year fish identification records were made in the laboratory for the Fall Shoals and Beach Seine surveys respectively and 6,567 and 6,032 young-of-the-year fish length measurement records were made for the Fall Shoals and Beach Seine surveys respectively.

Table 10. Ranking of Taxa Missed During Initial Sort and Found During Sort QC.

Taxon	Number of Organisms Found in Sort QC	Percent
White perch	510	31.88
Striped bass	351	21.94
Herring family	285	17.81
Bay anchovy	195	12.19
Morone species	65	4.06
Winter flounder	27	1.69
Goby family	23	1.44
Atlantic menhaden	19	1.19
Cunner	19	1.19
Atlantic tomcod	18	1.13
Weakfish	12	0.75
Windowpane	12	0.75
Grubby	11	0.69
Unidentified	11	0.69
Fourbeard rockling	8	0.50
Hogchoker	8	0.50
Atlantic croaker	7	0.44
Carp and minnow family	5	0.31
Rock gunnel	3	0.19
Yellow perch	3	0.19
Tessellated darter	2	0.13
American sand lance	1	0.06
American shad	1	0.06
Drum family	1	0.06
Freshwater drum	1	0.06
Sunfish family	1	0.06
Tautog	1	0.06
Total	**1600**	**100.00**

Table 11. Summary By Life Stage of the Six Highest Ranked Taxa Missed During Original Sort and Found During Sort QC Compared to Total Count.

Taxon	Life Stage	Number	Percent in Each Stage	Percent of Total Found	Total Organisms Found
Bay anchovy	Eggs	138	70.77	0.27	50404
	Yolk-sac larvae	2	1.03	1.56	128
	Post yolk-sac larvae	55	28.21	0.21	25675
	Young-of-the-year	0	0.00	0.00	11015
	Unidentified	0	0.00	0.00	6
Herring family	Eggs	8	2.81	0.16	4967
	Yolk-sac larvae	25	8.77	0.92	2729
	Post yolk-sac larvae	249	87.37	0.97	25690
	Young-of-the-year	0	0.00	0.00	2
	Unidentified	3	1.05	3.53	85
Morone species	Yolk-sac larvae	0	0.00	0.00	10
	Post yolk-sac larvae	5	7.69	0.39	1267
	Unidentified	60	92.31	0.63	9535
Striped bass	Eggs	149	42.45	0.73	20475
	Yolk-sac larvae	107	30.48	0.32	33472
	Post yolk-sac larvae	95	27.07	0.09	107179
	Young-of-the-year	0	0.00	0.00	475
	Unidentified	0	0.00	0.00	406
White perch	Eggs	47	9.22	0.58	8114
	Yolk-sac larvae	204	40.00	1.39	14675
	Post yolk-sac larvae	259	50.78	0.52	49668
	Young-of-the-year	0	0.00	0.00	190
	Unidentified	0	0.00	0.00	9
Winter flounder	Eggs	0	0.00	0.00	181
	Yolk-sac larvae	10	37.04	3.91	256
	Post yolk-sac larvae	16	59.26	1.34	1191
	Young-of-the-year	0	0.00	0.00	107
	Unidentified	1	3.70	1.11	90

[a] Includes both original count and additional organisms found during sort QC.

Table 12. Cumulative Net and Absolute Error Rates for Commonly Encountered Taxa in Samples Selected for QC Inspection of Identification and Counting Process.

Taxon	Stage	Total Count	Net Error	Absolute Error	N
Alewife	Young-of-the-year	305	0.00656	0.03934	18
American shad	Eggs	576	0.00174	0.00868	14
	Yolk-sac larvae	17	0.05882	0.05882	7
	Post yolk-sac larvae	36	0.02778	0.19444	15
	Young-of-the-year	9	-0.55556	0.55556	7
Atlantic croaker	Post yolk-sac larvae	122	0.00820	0.02459	17
	Young-of-the-year	132	0.00000	0.01515	9
Atlantic menhaden	Eggs	688	0.00872	0.04070	14
	Post yolk-sac larvae	47	-0.17021	0.17021	23
	Young-of-the-year	24	0.08333	0.16667	19
Atlantic tomcod	Unidentified	222	0.01351	0.02252	9
	Yolk-sac larvae	33	0.00000	0.00000	9
	Post yolk-sac larvae	1864	0.00322	0.00966	57
	Young-of-the-year	1328	0.00452	0.00753	82
Bay anchovy	Eggs	6625	-0.00045	0.01434	47
	Yolk-sac larvae	20	0.05000	0.05000	5
	Post yolk-sac larvae	4484	-0.01004	0.03011	126
	Young-of-the-year	1624	-0.00800	0.03017	74
Blueback herring	Young-of-the-year	438	0.00228	0.01142	23
Cunner	Eggs	357	0.06162	0.08403	17
	Yolk-sac larvae	2	0.00000	0.00000	2
	Post yolk-sac larvae	3	0.33333	0.33333	4
Fourbeard rockling	Eggs	318	-0.00314	0.00314	6
	Post yolk-sac larvae	1	0.00000	0.00000	1
Goby family	Post yolk-sac larvae	564	0.00355	0.01773	55
Herring family	Unidentified	0	2.00000	2.00000	1
	Eggs	754	0.00133	0.01194	20
	Yolk-sac larvae	479	0.00209	0.03132	44
	Post yolk-sac larvae	3691	0.01030	0.02926	122
	Young-of-the-year	1	0.00000	0.00000	1
Hogchoker	Eggs	573	-0.01396	0.04188	18
	Post yolk-sac larvae	1	0.00000	0.00000	1
	Young-of-the-year	5	0.00000	0.00000	3
Morone species	Unidentified	1150	0.02435	0.06435	41
	Yolk-sac larvae	0	1.00000	1.00000	1
	Post yolk-sac larvae	108	0.03704	0.11111	12
Striped bass	Unidentified	83	0.02410	0.02410	1
	Eggs	3625	0.00966	0.01076	44
	Yolk-sac larvae	4784	0.00125	0.02759	67
	Post yolk-sac larvae	15536	0.00290	0.02182	102
	Young-of-the-year	101	-0.01980	0.01980	12

(continued)

Table 12. (Continued)

Taxon	Stage	Total Count	Net Error	Absolute Error	N
Tautog	Eggs	359	-0.01950	0.04178	15
	Post yolk sac larvae	2	0.00000	0.00000	2
Weakfish	Eggs	996	-0.00803	0.05020	24
	Yolk-sac larvae	1	0.00000	0.00000	1
	Post yolk sac larvae	204	-0.00980	0.02941	27
	Young of the year	18	0.00000	0.00000	11
White perch	Unidentified	0	1.00000	1.00000	1
	Eggs	764	0.00262	0.00785	33
	Yolk-sac larvae	3001	0.01400	0.03466	71
	Post yolk sac larvae	8315	-0.01347	0.03608	95
	Young of the year	31	0.00000	0.00000	10

Table 13. Fraction Inspected, Percent Nonconforming, and Average Outgoing Quality of Laboratory Tasks Performed by Normandeau for the 2005 Fall Juvenile Survey.

Task	Average Fraction Inspected (%)	Percent Nonconforming (%)	Average Outgoing Quality (%)
Identification	5.38	0.00	0.00
Measurement	2.29	0.00	0.00

4.0 LITERATURE CITED

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