Appendix A

Quality Control Report for the 1999 Hudson River Ichthyoplankton Laboratory Program and 1999 Fall Juvenile Survey

QUALITY CONTROL REPORT FOR THE 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM AND 1999 FALL JUVENILE SURVEY

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QUALITY CONTROL REPORT FOR THE 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM AND 1999 FALL JUVENILE SURVEY

1.0 INTRODUCTION

This quality control report for the laboratory tasks of the 1999 Hudson River Ichthyoplankton Survey and the 1999 Fall Juvenile Survey was prepared for Con Edison by Normandeau Associates Inc. (NAI).

To comply with Consolidated Edison'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 Consolidated Edison'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 1999 Hudson River Ichthyoplankton Laboratory Program and 1999 Fall Juvenile Survey activities. Determinations of the fraction inspected, percent nonconforming, and average outgoing quality are presented for both programs. In addition, for the 1999 Hudson River Ichthyoplankton Laboratory Program the results include percent measurement error, a summary of the number of each taxon-life stage found during sorting QA, 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 1999 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 1998) documents specific QA/QC methods utilized for this program (there were no changes between the 1998 and 1999 programs, so the manual was not changed for 1999).

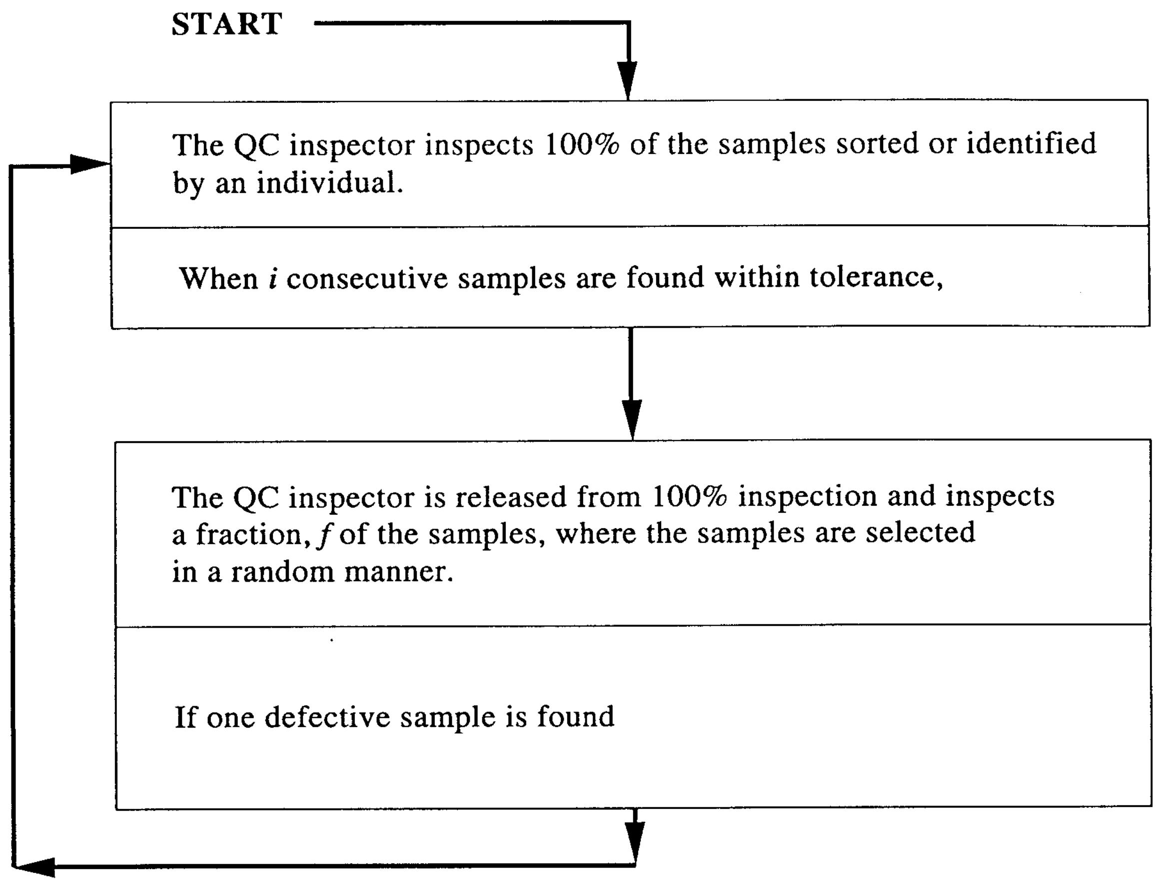

Figure 1. Quality control inspection plan for ichthyoplankton sorting and identification tasks.

TABLE 1. TASK SPECIFIC APPLICATIONS OF CONTINUOUS SAMPLING PLANS FOR THE 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM.

LABORATORY TASK	CSP-1 AOQL-10% i	f	SAMPLE TOLERANCE	QC SAMPLE DEFINITION
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

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 1999 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 QC methods are documented in the Standard Operating Procedures (NAI 2000). 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.

2.2 REPORTING PROCEDURES

The 1999 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 1999 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

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

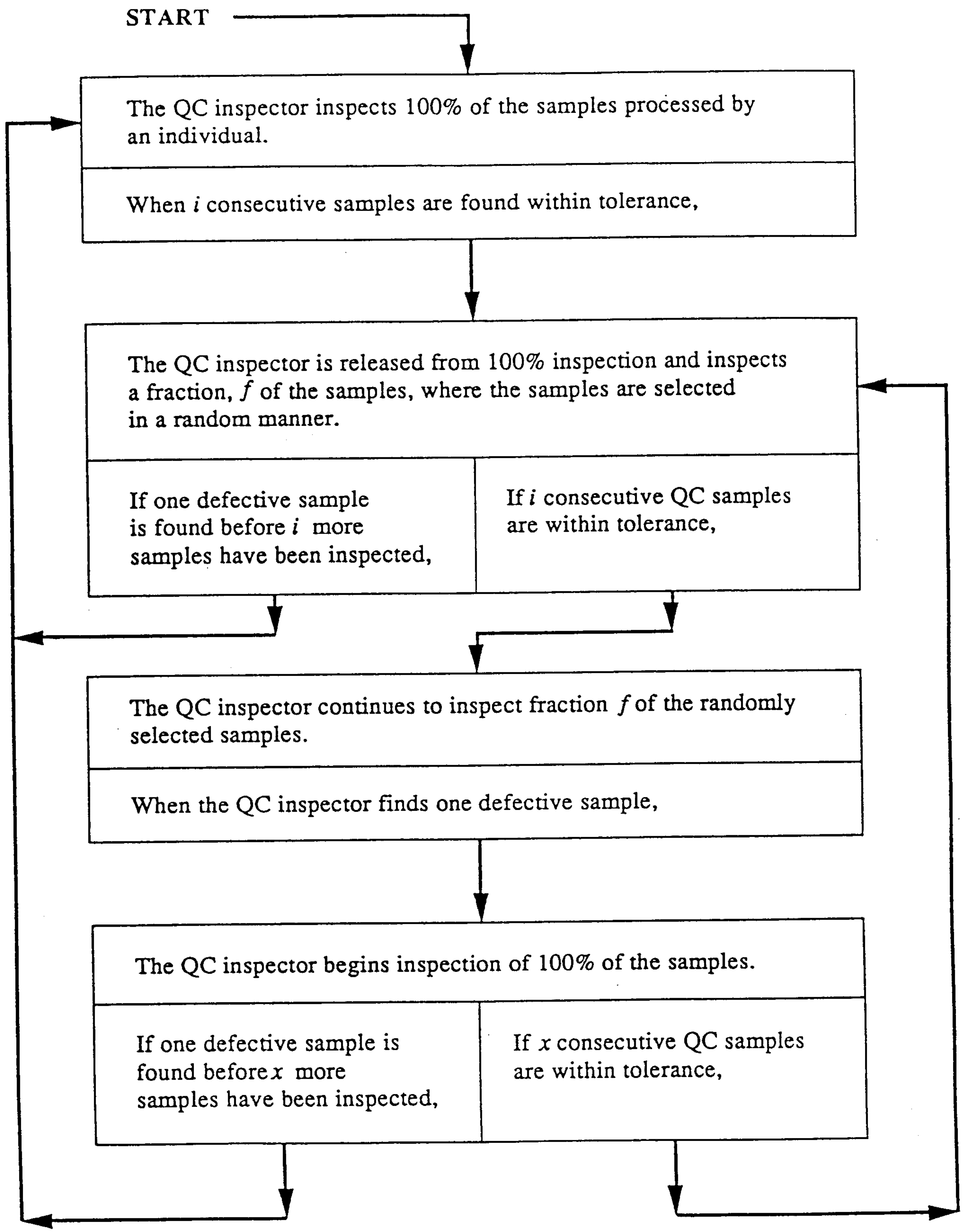

Figure 2. Quality control inspection plan for identification and length measurement of young-of-the-year fishes.

TABLE 2. TASK SPECIFIC APPLICATIONS OF CONTINUOUS SAMPLING PLANS FOR THE 1999 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

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.

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

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

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 differed from the percent nonconforming.)

2.2.3 Percent Measurement Error

Sorting Task

Sorting Percent Measurement Error

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

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

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

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.

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.

		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.

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:

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

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:

$p' = 0.0689$

$f = 1/7 = 0.1429$

$q = 1-0.0689 = 0.9311$

$i = 8$

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

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 reinspection 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 1999 Hudson River Ichthyoplankton Laboratory Program was 2.17% for the sorting task and 2.02% 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 Con Edison. The Average Fraction Inspected (AFI) was 13.08% for sorting and 18.24% 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 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM.

TASK	FRACTION INSPECTED(%)	PERCENT NONCON-FORMING(%)	MEAN PERCENT MEASUREMENT ERROR(%)	AOQ(%)
Sorting	13.08	2.62	1.80	2.17
Identification	18.24	2.43	2.13	2.02

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 a sampling week basis representing river runs (sampling weeks) 2 through 23 (river run 1 was canceled in 1999). Sorted samples were inspected at a rate of 8.64% to 16.28% for individual river runs (Table 4). Nonconformance for task among the inspected samples ranged from 0% to 11.76% among the river runs and was 2.62% overall (Table 5). Sorting measurement error was between 0% and 4.59% and averaged 1.80% for the study (Table 6). For the task of sample identification, 10.32% to 40.74% of samples were inspected from individual river runs (Table 7). Percent nonconforming for the identification task ranged from 0% to 21.05% for each of river runs 2-23 and averaged 2.43 (Table 8). Measurement error ranged from 0% to 10.36% and overall measurement error was 2.13% 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 80% of the additional organisms found during sort QC: striped bass, *Morone* sp., bay anchovy, white perch, clupeids, and cyprinids (Table 10). The additional number found in the sort QC was less than 1% of the total found during sample processing.

TABLE 4. SAMPLE SORTING FRACTION INSPECTED RESULTS, 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM.

	FRACTION INSPECTED SORTING QC		
SAMPLING WEEK (BEGINNING MONDAY)	TOTAL # OF SAMPLES INSPECTED	TOTAL # OF SAMPLES SORTED	FRACTION INSPECTED
22MAR99	7	43	16.28
29MAR99	10	74	13.51
05APR99	17	126	13.49
12APR99	15	126	11.90
19APR99	15	126	11.90
26APR99	16	134	11.94
03MAY99	18	135	13.33
10MAY99	17	135	12.59
17MAY99	20	126	15.87
24MAY99	14	125	11.20
31MAY99	17	126	13.49
07JUN99	16	122	13.11
14JUN99	17	122	13.93
21JUN99	16	123	13.01
28JUN99	18	122	14.75
12JUL99	7	81	8.64
26JUL99	11	81	13.58
09AUG99	12	81	14.81
23AUG99	8	81	9.88
06SEP99	11	81	13.58
20SEP99	12	80	15.00
04OCT99	11	81	13.58
STUDY	305	2331	13.08

TABLE 5. SAMPLE SORTING PERCENT NONCONFORMANCE RESULTS, 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM.

	% NONCONFORMANCE SORTING QC			
SAMPLING WEEK (BEGINNING MONDAY)	# OF NONCON-FORMITIES	TOTAL # OF SAMPLES INSPECTED	% NON-CONFORMANCE (WEEK)	% NON-CONFORMANCE (STUDY)
22MAR99	0	7	0.00	0.00
29MAR99	0	10	0.00	0.00
05APR99	0	17	0.00	0.00
12APR99	1	15	6.67	2.04
19APR99	0	15	0.00	1.56
26APR99	0	16	0.00	1.25
03MAY99	0	18	0.00	1.02
10MAY99	2	17	11.76	2.61
17MAY99	0	20	0.00	2.22
24MAY99	0	14	0.00	2.01
31MAY99	2	17	11.76	3.01
07JUN99	0	16	0.00	2.75
14JUN99	1	17	5.88	3.02
21JUN99	1	16	6.25	3.26
28JUN99	1	18	5.56	3.43
12JUL99	0	7	0.00	3.33
26JUL99	0	11	0.00	3.19
09AUG99	0	12	0.00	3.04
23AUG99	0	8	0.00	2.95
06SEP99	0	11	0.00	2.84
20SEP99	0	12	0.00	2.72
04OCT99	0	11	0.00	2.62
STUDY	8	305		

TABLE 6. SAMPLE SORTING MEAN PERCENT MEASUREMENT ERROR RESULTS, 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM.

	MEAN PERCENT MEASUREMENT ERROR SORTING QC	
SAMPLING WEEK (BEGINNING MONDAY)	TOTAL # OF SAMPLES INSPECTED	MEAN PERCENT MEASUREMENT ERROR
22MAR99	7	0.22
29MAR99	10	1.57
05APR99	17	0.14
12APR99	15	1.23
19APR99	15	0.00
26APR99	16	0.22
03MAY99	18	0.43
10MAY99	17	2.96
17MAY99	20	2.00
24MAY99	14	2.24
31MAY99	17	4.14
07JUN99	16	3.35
14JUN99	17	4.59
21JUN99	16	4.04
28JUN99	18	2.37
12JUL99	7	3.39
26JUL99	11	3.86
09AUG99	12	0.34
23AUG99	8	0.00
06SEP99	11	0.00
20SEP99	12	0.00
04OCT99	11	0.00
STUDY	305	1.80

TABLE 7. SAMPLE IDENTIFICATION FRACTION INSPECTED RESULTS, 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM.

	FRACTION INSPECTED IDENTIFICATION QC		
SAMPLING WEEK (BEGINNING MONDAY)	TOTAL # OF SAMPLES INSPECTED	TOTAL # OF SAMPLES IDENTIFIED	FRACTION INSPECTED
22MAR99	5	37	13.51
29MAR99	5	37	13.51
05APR99	5	37	13.51
12APR99	10	71	14.08
19APR99	12	80	15.00
26APR99	16	98	16.33
03MAY99	15	114	13.16
10MAY99	16	131	12.21
17MAY99	20	126	15.87
24MAY99	18	125	14.40
31MAY99	13	126	10.32
07JUN99	15	122	12.30
14JUN99	32	122	26.23
21JUN99	31	122	25.41
28JUN99	19	120	15.83
12JUL99	33	81	40.74
26JUL99	19	81	23.46
09AUG99	11	81	13.58
23AUG99	19	80	23.75
06SEP99	16	81	19.75
20SEP99	20	75	26.67
04OCT99	20	81	24.69
STUDY	370	2028	18.24

TABLE 8. SAMPLE IDENTIFICATION PERCENT NONCONFORMANCE RESULTS, 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM.

	% NONCONFORMANCE IDENTIFICATION QC			
SAMPLING WEEK (BEGINNING MONDAY)	# OF NONCON-FORMITIES	TOTAL # OF SAMPLES INSPECTED	% NON-CONFORMANCE (WEEK)	% NON-CONFORMANCE (STUDY)
22MAR99	0	5	0.00	0.00
29MAR99	0	5	0.00	0.00
05APR99	0	5	0.00	0.00
12APR99	0	10	0.00	0.00
19APR99	0	12	0.00	0.00
26APR99	0	16	0.00	0.00
03MAY99	0	15	0.00	0.00
10MAY99	0	16	0.00	0.00
17MAY99	0	20	0.00	0.00
24MAY99	0	18	0.00	0.00
31MAY99	0	13	0.00	0.00
07JUN99	0	15	0.00	0.00
14JUN99	3	32	9.38	1.65
21JUN99	0	31	0.00	1.41
28JUN99	4	19	21.05	3.02
12JUL99	2	33	6.06	3.40
26JUL99	0	19	0.00	3.17
09AUG99	0	11	0.00	3.05
23AUG99	0	19	0.00	2.87
06SEP99	0	16	0.00	2.73
20SEP99	0	20	0.00	2.57
04OCT99	0	20	0.00	2.43
STUDY	9	370		

TABLE 9. SAMPLE IDENTIFICATION MEAN PERCENT MEASUREMENT ERROR RESULTS, 1999 HUDSON RIVER ICHTHYOPLANKTON LABORATORY PROGRAM.

	MEAN PERCENT MEASUREMENT ERROR IDENTIFICATION QC		
SAMPLING WEEK (BEGINNING MONDAY)	TOTAL # OF SAMPLES INSPECTED	MEAN PERCENT MEASUREMENT ERROR	NUMBER OF TAXA INSPECTED
22MAR99	5	0.00	12
29MAR99	5	0.08	15
05APR99	5	0.23	10
12APR99	10	0.15	29
19APR99	12	0.35	29
26APR99	16	0.11	35
03MAY99	15	0.06	42
10MAY99	16	0.60	54
17MAY99	20	0.89	84
24MAY99	18	1.27	92
31MAY99	13	2.06	71
07JUN99	15	0.99	111
14JUN99	32	6.27	193
21JUN99	31	0.47	186
28JUN99	19	10.36	104
12JUL99	33	1.54	227
26JUL99	19	0.90	68
09AUG99	11	0.67	34
23AUG99	19	0.74	36
06SEP99	16	0.33	39
20SEP99	20	0.17	46
04OCT99	20	0.25	70
STUDY	370	2.13	1587

TABLE 10. RANKING OF TAXA MISSED DURING INITIAL SORT AND FOUND DURING SORT QC.

TAXON	NUMBER OF ORGANISMS FOUND IN SORT QC	PERCENT
STRIPED BASS	476	17.15
MORONE SPECIES	458	16.50
BAY ANCHOVY	426	15.35
WHITE PERCH	406	14.63
HERRING FAMILY	293	10.56
CARP AND MINNOW FAMILY	168	6.05
WEAKFISH	158	5.69
HOGCHOKER	134	4.83
GOBY FAMILY	84	3.03
ATLANTIC MENHADEN	67	2.41
WINDOWPANE	46	1.66
WINTER FLOUNDER	15	0.54
ATLANTIC TOMCOD	11	0.40
UNIDENTIFIED	9	0.32
TESSELLATED DARTER	6	0.22
FOURBEARD ROCKLING	4	0.14
FEATHER BLENNY	3	0.11
GIZZARD SHAD	3	0.11
GRUBBY	3	0.11
TAUTOG	2	0.07
AMERICAN SHAD	1	0.04
CUNNER	1	0.04
ORDER PLEURONECTIFORMES	1	0.04
TOTAL	2775	100.00

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 except for cyprinid eggs (Table 11). For most taxa-life stages the percentage missed by the original sorter was well under 2%. The high number of cyprinid eggs missed during sorting were almost entirely due to a single sample, in which 160 of 290 eggs were missed during the original sort and subsequently found during the sort QC.

The life stage most commonly missed by sorters for white perch, striped bass, *Morone* sp., and clupeids was post yolk-sac larvae (Table 11). The most commonly missed life stage was eggs for bay anchovy and cyprinids. Generally the life stage most frequently missed by sorters was the most abundant one, except that the larger of the post yolk-sac larvae and the young-of-the-year fish were very rarely overlooked by the sorters.

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 post yolk-sac larvae of striped bass, white perch, and bay anchovy; and young-of-the-year of bay anchovy.

3.2 FALL JUVENILE SURVEY

Results of the laboratory quality control program for the 1999 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 1999 Hudson River Ichthyoplankton Laboratory Program (Section 2.1.2) and are presented in Table 13.

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[a]
BAY ANCHOVY	EGGS	277	65.02	0.68	40596
	YOLK-SAC LARVAE	0	0.00	0.00	22
	POST YOLK-SAC LARVAE	143	33.57	0.46	31060
	YOUNG-OF-THE-YEAR	5	1.17	0.02	20169
	UNIDENTIFIED	1	0.23	3.45	29
CARP AND MINNOW FAMILY	EGGS	161	95.83	31.08	518
	YOLK-SAC LARVAE	3	1.79	0.59	505
	POST YOLK-SAC LARVAE	3	1.79	0.78	385
	UNIDENTIFIED	1	0.60	9.09	11
HERRING FAMILY	EGGS	5	1.71	0.21	2421
	YOLK-SAC LARVAE	2	0.68	0.25	816
	POST YOLK-SAC LARVAE	286	97.61	0.93	30593
	YOUNG-OF-THE-YEAR	0	0.00	0.00	10
	UNIDENTIFIED	0	0.00	0.00	28
MORONE SPECIES	YOLK-SAC LARVAE	4	0.87	1.22	329
	POST YOLK-SAC LARVAE	446	97.38	2.83	15773
	UNIDENTIFIED	8	1.75	0.54	1495
STRIPED BASS	EGGS	69	14.50	0.38	18396
	YOLK-SAC LARVAE	120	25.21	0.36	33532
	POST YOLK-SAC LARVAE	287	60.29	0.20	142638
	YOUNG-OF-THE-YEAR	0	0.00	0.00	1301
WHITE PERCH	EGGS	19	4.68	0.27	7060
	YOLK-SAC LARVAE	31	7.64	0.49	6301
	POST YOLK-SAC LARVAE	356	87.68	0.52	67830
	YOUNG-OF-THE-YEAR	0	0.00	0.00	132
	UNIDENTIFIED	0	0.00	0.00	3

[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 RATE	ABSOLUTE ERROR RATE	N
ALEWIFE	YOUNG OF THE YEAR	589	-0.00170	0.01188	56
AMERICAN SHAD	EGGS	207	0.01449	0.01449	16
	YOLK-SAC LARVAE	9	0.00000	0.00000	6
	POST YOLK SAC LARVAE	256	0.00391	0.06641	21
	YOUNG OF THE YEAR	140	0.01429	0.05714	42
ATLANTIC CROAKER	POST YOLK SAC LARVAE	1327	0.00829	0.00829	23
	YOUNG OF THE YEAR	8	0.12500	0.12500	5
ATLANTIC HERRING	POST YOLK SAC LARVAE	528	-0.01136	0.01136	28
	YOUNG OF THE YEAR	68	0.02941	0.02941	16
ATLANTIC MENHADEN	EGGS	552	0.03623	0.03623	10
	POST YOLK SAC LARVAE	691	-0.16932	0.20984	68
	YOUNG OF THE YEAR	233	0.04292	0.09442	39
ATLANTIC TOMCOD	UNIDENTIFIED	0	1.00000	1.00000	1
	YOLK-SAC LARVAE	1	0.00000	0.00000	1
	POST YOLK SAC LARVAE	758	0.02507	0.02770	35
	YOUNG OF THE YEAR	507	-0.02170	0.02170	58
BAY ANCHOVY	UNIDENTIFIED	3	0.00000	1.33333	4
	EGGS	10581	0.00680	0.01550	71
	YOLK-SAC LARVAE	1	-1.00000	1.00000	1
	POST YOLK SAC LARVAE	7088	-0.00522	0.01933	169
	YOUNG OF THE YEAR	4946	-0.00162	0.01456	116
BLUEBACK HERRING	YOUNG OF THE YEAR	806	0.00124	0.00620	27
GOBY FAMILY	UNIDENTIFIED	2	-0.50000	1.50000	3
	POST YOLK SAC LARVAE	2526	0.00713	0.02296	93
	YOUNG OF THE YEAR	1	-1.00000	1.00000	1
HERRING FAMILY	UNIDENTIFIED	3	0.00000	0.00000	2
	EGGS	252	-0.01190	0.01984	20
	YOLK-SAC LARVAE	67	0.02985	0.08955	14
	POST YOLK SAC LARVAE	4668	0.03620	0.05463	132
	YOUNG OF THE YEAR	3	0.66667	0.66667	3
HOGCHOKER	EGGS	4214	0.00071	0.01115	37
MORONE SPECIES	UNIDENTIFIED	72	-0.05556	0.11111	10
	POST YOLK SAC LARVAE	1638	0.05006	0.05250	39
STRIPED BASS	EGGS	609	-0.00164	0.02791	30
	YOLK-SAC LARVAE	3378	0.00326	0.02457	47
	POST YOLK SAC LARVAE	16728	0.00209	0.02278	122
	YOUNG OF THE YEAR	145	0.01379	0.04138	37
TESSELLATED DARTER	YOLK-SAC LARVAE	237	0.01266	0.03797	26
	POST YOLK SAC LARVAE	52	-0.05769	0.21154	18
	YOUNG OF THE YEAR	11	-0.09091	0.09091	3

(continued)

TABLE 12. (Continued)

TAXON	STAGE	TOTAL COUNT	NET ERROR RATE	ABSOLUTE ERROR RATE	N
WEAKFISH	EGGS	1659	0.00663	0.01989	10
	YOLK-SAC LARVAE	0	2.00000	2.00000	1
	POST YOLK SAC LARVAE	410	0.00244	0.03171	53
	YOUNG OF THE YEAR	258	-0.02713	0.02713	40
WHITE PERCH	EGGS	827	0.00484	0.01209	27
	YOLK-SAC LARVAE	803	-0.00125	0.03861	34
	POST YOLK SAC LARVAE	10440	-0.02184	0.03889	106
	YOUNG OF THE YEAR	31	-0.09677	0.09677	14
WINDOWPANE	EGGS	378	0.01058	0.01587	9
	POST YOLK SAC LARVAE	21	0.04762	0.04762	10
	YOUNG OF THE YEAR	15	-0.06667	0.06667	8

TABLE 13. FRACTION INSPECTED, PERCENT NONCONFORMING, AND AVERAGE OUTGOING QUALITY OF LABORATORY TASKS PERFORMED BY NAI FOR THE 1999 ALL JUVENILE SURVEY.

TASK	AVERAGE FRACTION INSPECTED(%)	PERCENT NONCON-FORMING(%)	AVERAGE OUTGOING QUALITY(%)
Identification	5.28	0.89	0.82
Measurement	1.73	0.00	0.00

A total of 2,217 and 2,025 young-of-the-year fish identification records were made in the laboratory for the Fall Shoals and Beach Seine surveys respectively and 7,927 and 6,940 young-of-the-year fish length measurement records were made for the Fall Shoals and Beach Seine surveys respectively.

4.0 LITERATURE CITED

Normandeau Associates Inc. (NAI). 1998. Quality assurance plan for the 1998 Hudson River ichthyoplankton laboratory program. Rev. 0, Change 0, Jul 98. Prepared for Consolidated Edison Company of New York, Inc.

__________. 2000. 1999 Hudson River fall juvenile and beach seine surveys standard operating procedures. Rev. 10, Change 10, 15 Feb 00. Prepared for Consolidated Edison Company of New York, Inc.

Stephens, K.S. 1979. Volume 2: How to perform continuous sampling (CSP). American Society for Quality Control. 70 pp.

U.S. Department of Defense. 1981. Military standard. Single- and multi-level continuous sampling procedures and table for inspection by attributes. MIL-STD-1235B.