Summary of Analysis Results
Based on Corrected Format 2 Data Files
Dated March 2015

Update of Aquatic Impact Analyses
Presented in NRC's FSEIS (December 2010)
Regarding Potential Impacts of
Operation of Indian Point Units 2 and 3

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April 2015

Table 3. Competing Models Used To Characterize the Standardized River Segment 4 FSS Population Trends of YOY Fish Density Using a 3-Year Moving Average (updated FSEIS Table I-9).

Species	Linear Regression				Segmented Regression					
	MSE	Slope	Std Err of Slope Estimate	p-value	MSE	Slope 1		Join Point	Slope 2	
						Lower 95% CL	Upper 95% CL		Lower 95% CL	Upper 95% CL
Alewife	0.875	-0.055	0.026	0.047	0.863	-2.189	3.276	1989	-0.132	-0.010
American Shad	0.271	-0.117	0.014	0.000	0.249	-2.156	0.780	1988	-0.143	-0.078
Atlantic Tomcod	0.666	-0.082	0.023	0.001	0.410	-1.081	-0.239	1991	-0.080	0.023
Bay Anchovy	0.601	-0.088	0.021	0.000	0.527	-1.456	2.814	1989	-0.158	-0.063
Blueback Herring	0.877	-0.054	0.026	0.048	0.083	-5.262	-3.565	1988	-0.027	0.010
Bluefish	0.925	-0.046	0.027	0.099	0.587	0.080	1.506	1990	-0.160	-0.045
Hogchoker	0.434	-0.104	0.018	0.000	0.275	-0.271	-0.127	2001	-0.070	0.138
Rainbow Smelt	0.623	-0.086	0.022	0.001	0.535	-0.193	0.534	1992	-0.188	-0.060
Striped Bass	0.745	-0.073	0.024	0.006	Failed to Converge					
Weakfish	0.810	-0.064	0.025	0.017	Failed to Converge					
White Catfish	0.941	-0.042	0.027	0.128	0.892	-0.144	0.363	1995	-0.206	0.007
White Perch	0.838	-0.060	0.025	0.026	0.656	-0.543	-0.023	1995	-0.062	0.104

Table 4. River Segment 4 Assessment of the Level of Potential Negative Impact Based on the Standardized FSS Density Using a 3-Year Moving Average (updated FSEIS Table I-10).

Species	Best Fit	Slope from Linear Regression	Slope 1 from Segmented Regression	Slope 2 from Segmented Regression	Final Decision
Alewife	SR		S1=0	S2<0	4
American Shad	SR		S1=0	S2<0	4
Atlantic Tomcod	SR		S1<0	S2=0	4
Bay Anchovy	SR		S1=0	S2<0	4
Blueback Herring	SR		S1<0	S2=0	4
Bluefish	SR		S1>0	S2<0	4
Hogchoker	SR		S1<0	S2=0	4
Rainbow Smelt	SR		S1=0	S2<0	4
Striped Bass	LR	S<0			4
Weakfish	LR	S<0			4
White Catfish	SR		S1=0	S2=0	1
White Perch	SR		S1<0	S2=0	4

Table 5. Competing Models Used To Characterize the Standardized River Segment 4 BSS Population Trends of YOY Fish Density Using a 3-Year Moving Average (updated FSEIS Table I-12).

Species	Linear Regression				Segmented Regression					
	MSE	Slope	Std Err of Slope Estimate	p-value	MSE	Slope 1		Join Point	Slope 2	
						Lower 95% CL	Upper 95% CL		Lower 95% CL	Upper 95% CL
Alewife	0.725	0.075	0.024	0.004	0.698	-0.088	0.120	2002	-0.007	0.376
American Shad	0.215	-0.121	0.013	0.000	0.234	-0.151	-0.066	2005	-0.404	0.077
Bay Anchovy	0.844	0.059	0.025	0.029	Failed to Converge					
Blueback Herring	0.726	-0.075	0.024	0.004	0.665	-0.154	0.369	1994	-0.211	-0.043
Bluefish	1.034	0.013	0.028	0.646	0.915	-0.355	0.083	1997	-0.014	0.224
Hogchoker	0.776	0.069	0.024	0.010	0.331	-0.251	-0.023	1998	0.152	0.310
Spottail Shiner	0.993	-0.030	0.028	0.290	0.930	-0.530	2.306	1989	-0.123	0.012
Striped Bass	1.023	0.019	0.028	0.502	0.447	0.110	0.343	1999	-0.292	-0.085
White Perch	1.039	-0.009	0.028	0.753	0.906	-1.099	0.153	1991	-0.042	0.111

Table 6. River Segment 4 Assessment of the Level of Potential Negative Impact Based on the Standardized BSS Density Using a 3-Year Moving Average (updated FSEIS Table I-13).

Species	Best Fit	Slope from Linear Regression	Slope 1 from Segmented Regression	Slope 2 from Segmented Regression	Final Decision
Alewife	SR		S1=0	S2=0	1
American Shad	LR	S<0			4
Bay Anchovy	LR	S>0			1
Blueback Herring	SR		S1=0	S2<0	4
Bluefish	SR		S1=0	S2=0	1
Hogchoker	SR		S1<0	S2>0	4
Spottail Shiner	SR		S1=0	S2=0	1
Striped Bass	SR		S1>0	S2<0	4
White Perch	SR		S1=0	S2=0	1

Table 7. Competing Models Used To Characterize the Standardized River Segment 4 LRS Population Trends of YOY Atlantic Tomcod Density Using a 3-Year Moving Average (updated FSEIS Table I-15).

Species	**Linear Regression**				**Segmented Regression**					
	MSE	**Slope**	**Std Err of Slope Estimate**	**p-value**	**MSE**	**Slope 1**		**Join Point**	**Slope 2**	
						Lower 95% CL	**Upper 95% CL**		**Lower 95% CL**	**Upper 95% CL**
Atlantic Tomcod	1.031	-0.015	0.028	0.604	0.480	-2.709	-0.671	1989	-0.007	0.090

Table 8. River Segment 4 Assessment of the Level of Potential Negative Impact Based on the Standardized LRS Atlantic Tomcod YOY Density Using a 3-Year Moving Average (updated FSEIS Table I-16).

Species	**Best Fit**	**Slope from Linear Regression**	**Slope 1 from Segmented Regression**	**Slope 2 from Segmented Regression**	**Final Decision**
Atlantic Tomcod	SR		S1<0	S2=0	4

Table 9. Competing Models Used To Characterize the Standardized River Segment 4, FSS Population Trends of YOY Fish CPUE (updated FSEIS Table I-19).

Species	Linear Regression				Segmented Regression					
	MSE	Slope	Std Err of Slope Estimate	p-value	MSE	Slope 1		Join Point	Slope 2	
						Lower 95% CL	Upper 95% CL		Lower 95% CL	Upper 95% CL
Alewife	0.953	-0.036	0.024	0.144	0.987	-0.115	0.130	2000	-0.272	0.071
American Shad	0.776	-0.063	0.022	0.007	0.688	-0.123	0.204	1996	-0.224	-0.038
Atlantic Tomcod	0.791	-0.062	0.022	0.010	0.746	-0.492	0.060	1993	-0.090	0.059
Bay Anchovy	1.039	0.003	0.025	0.903	0.882	-0.027	0.231	1999	-0.267	0.021
Blueback Herring	0.938	-0.039	0.024	0.112	0.633	-2.448	-0.120	1987	-0.048	0.049
Bluefish	0.861	-0.052	0.023	0.031	0.847	-0.098	0.090	2002	-0.371	0.049
Hogchoker	0.832	-0.056	0.023	0.019	0.805	-1.988	3.262	1987	-0.125	-0.022
Rainbow Smelt	0.839	-0.055	0.023	0.022	0.837	-0.265	0.451	1992	-0.163	-0.016
Striped Bass	0.952	-0.037	0.024	0.140	0.893	-1.943	3.587	1987	-0.111	-0.003
Weakfish	1.014	-0.020	0.025	0.430	0.967	-0.091	0.130	2000	-0.296	0.092
White Perch	0.948	-0.038	0.024	0.131	0.944	-0.318	0.065	1996	-0.091	0.127

Table10. River Segment 4 Assessment of the Level of Potential Negative Impact Based on the Standardized FSS CPUE (updated FSEIS Table I-20).

Species	Best Fit	Slope from Linear Regression	Slope 1 from Segmented Regression	Slope 2 from Segmented Regression	Final Decision
Alewife	LR	S=0			1
American Shad	SR		S1=0	S2<0	4
Atlantic Tomcod	SR		S1=0	S2=0	1
Bay Anchovy	SR		S1=0	S2=0	1
Blueback Herring	SR		S1<0	S2=0	4
Bluefish	SR		S1=0	S2=0	1
Hogchoker	SR		S1=0	S2<0	4
Rainbow Smelt	SR		S1=0	S2<0	4
Striped Bass[a]	SR		S1=0	S2=0	1
Weakfish	SR		S1=0	S2=0	1
White Perch	SR		S1=0	S2=0	1

[a] Please see the discussion of the regression analyses for striped bass following Table 26 below.

Table 11. Competing Models Used To Characterize the Standardized River Segment 4 LRS Population Trends of YOY Atlantic Tomcod CPUE Using a 3-Year Moving Average (updated FSEIS Table I-22).

Species	**Linear Regression**				**Segmented Regression**					
	MSE	**Slope**	**Std Err of Slope Estimate**	**p-value**	**MSE**	**Slope 1**		**Join Point**	**Slope 2**	
						Lower 95% CL	**Upper 95% CL**		**Lower 95% CL**	**Upper 95% CL**
Atlantic Tomcod	1.012	-0.021	0.025	0.410	0.842	-1.609	0.089	1988	-0.044	0.076

Table 12. River Segment 4 Assessment of the Level of Potential Negative Impact Based 7 on the Standardized LRS Atlantic Tomcod YOY CPUE Using a 3-Year Moving Average (updated FSEIS Table I-23).

Species	**Best Fit**	**Slope from Linear Regression**	**Slope 1 from Segmented Regression**	**Slope 2 from Segmented Regression**	**Final Decision**
Atlantic Tomcod	SR		S1=0	S2=0	1

Table 13. Assessment of Population Impacts for IP2 and IP3 River Segment 4 (updated FSEIS Table I-24).

Species	Density			CPUE		River Segment Assessment
	FSS	BSS	LRS	FSS	LRS	
Alewife	4	1	N/A	1	N/A	2.0
American Shad	4	4	N/A	4	N/A	4.0
Atlantic Menhaden	N/A	N/A	N/A	N/A	N/A	Unknown
Atlantic Sturgeon	N/A	N/A	N/A	N/A	N/A	Unknown
Atlantic Tomcod	4	N/A	4	1	1	2.5
Bay Anchovy	4	1	N/A	1	N/A	2.0
Blueback Herring	4	4	N/A	4	N/A	4.0
Bluefish	4	1	N/A	1	N/A	2.0
Gizzard Shad	N/A	N/A	N/A	N/A	N/A	Unknown
Hogchoker	4	4	N/A	4	N/A	4.0
Rainbow Smelt	4	N/A	N/A	4	N/A	4.0
Shortnose Sturgeon	N/A	N/A	N/A	N/A	N/A	Unknown
Spottail Shiner	N/A	1	N/A	N/A	N/A	1.0
Striped Bass	4	4	N/A	1	N/A	3.0
Weakfish	4	N/A	N/A	1	N/A	2.5
White Catfish	1	N/A	N/A	N/A	N/A	1.0
White Perch	4	1	N/A	1	N/A	2.0
Blue Crab	N/A	N/A	N/A	N/A	N/A	Unknown

Table 14. Competing Models Used To Characterize the Standardized Riverwide FSS Population Trends of YOY Fish CPUE (updated FSEIS Table I-27).

Species	Linear Regression				Segmented Regression					
	MSE	Slope	Std Err of Slope Estimate	p-value	MSE	Slope 1		Join Point	Slope 2	
						Lower 95% CL	Upper 95% CL		Lower 95% CL	Upper 95% CL
Alewife	1.005	0.023	0.025	0.361	Failed to Converge					
American Shad	0.563	-0.085	0.019	0.000	0.537	-0.362	0.597	1989	-0.152	-0.050
Atlantic Tomcod	0.623	-0.080	0.020	0.000	0.628	.	.	1986	-0.128	-0.043
Bay Anchovy	1.030	0.012	0.025	0.633	0.929	-0.012	0.114	2007	-1.362	0.421
Blueback Herring	0.750	-0.066	0.021	0.005	0.795	-0.161	-0.006	2004	-0.279	0.291
Bluefish	0.750	-0.067	0.021	0.005	0.784	-0.125	0.094	1999	-0.268	0.038
Hogchoker	0.941	-0.039	0.024	0.118	0.923	-0.224	0.014	1999	-0.120	0.213
Spottail Shiner	0.838	-0.055	0.023	0.022	0.891	-0.186	0.026	2000	-0.201	0.172
Striped Bass	0.833	-0.056	0.023	0.020	0.590	0.164	2.411	1987	-0.135	-0.042
White Perch	1.022	-0.017	0.025	0.514	1.008	-0.425	0.112	1993	-0.068	0.121

Table 15. Riverwide Assessment of the Level of Potential Negative Impact Based on the Standardized FSS CPUE (updated FSEIS Table I-28).

Species	Best Fit	Slope from Linear Regression	Slope 1 from Segmented Regression	Slope 2 from Segmented Regression	Final Decision
Alewife	LR	S=0			1
American Shad	SR		S1=0	S2<0	4
Atlantic Tomcod	LR	S<0			4
Bay Anchovy	SR		S1=0	S2=0	1
Blueback Herring	LR	S<0			4
Bluefish	LR	S<0			4
Hogchoker	SR		S1=0	S2=0	1
Spottail Shiner	LR	S<0			4
Striped Bass	SR		S1>0	S2<0	4
White Perch	SR		S1=0	S2=0	1

Table 16. Competing Models Used To Characterize the Standardized Riverwide BSS Population Trends of YOY Fish CPUE (updated FSEIS Table I-30).

Species	Linear Regression				Segmented Regression					
	MSE	Slope	Std Err of Slope Estimate	p-value	MSE	Slope 1		Join Point	Slope 2	
						Lower 95% CL	Upper 95% CL		Lower 95% CL	Upper 95% CL
Alewife	0.701	0.072	0.021	0.002	0.687	-0.054	0.116	2002	-0.012	0.366
American Shad	0.584	-0.083	0.019	0.000	0.562	-0.358	0.623	1990	-0.161	-0.057
Atlantic Tomcod	0.507	-0.090	0.018	0.000	0.390	-0.388	-0.103	1994	-0.092	0.036
Bay Anchovy	0.800	0.061	0.022	0.011	0.593	-0.044	0.063	2006	-0.018	0.989
Blueback Herring	1.040	0.002	0.025	0.946	1.058	-1.084	1.925	1988	-0.080	0.046
Bluefish	1.036	0.008	0.025	0.754	1.048	-0.065	0.188	1999	-0.239	0.115
Hogchoker	1.025	0.015	0.025	0.546	1.054	-0.183	0.098	1998	-0.084	0.231
Rainbow Smelt	0.975	-0.031	0.024	0.210	1.005	-0.270	0.370	1993	-0.138	0.036
Spottail Shiner	0.751	0.066	0.021	0.005	0.811	-0.014	0.155	2003	-0.190	0.291
Striped Bass	1.031	0.012	0.025	0.641	0.930	-0.019	0.125	2005	-0.722	0.232
Weakfish	0.915	-0.044	0.024	0.076	0.480	.	.	1986	-0.052	0.023
White Catfish	1.034	-0.010	0.025	0.703	1.008	-1.315	0.543	1989	-0.047	0.084
White Perch	1.030	-0.012	0.025	0.624	1.000	-0.371	0.084	1994	-0.060	0.144

Table 17. Riverwide Assessment of the Level of Potential Negative Impact Based on the BSS CPUE (updated FSEIS Table I-31).

Species	Best Fit	Slope from Linear Regression	Slope 1 from Segmented Regression	Slope 2 from Segmented Regression	Final Decision
Alewife	SR		S1=0	S2=0	1
American Shad	SR		S1=0	S2<0	4
Atlantic Tomcod	SR		S1<0	S2=0	4
Bay Anchovy	SR		S1=0	S2=0	1
Blueback Herring	LR	S=0			1
Bluefish	LR	S=0			1
Hogchoker	LR	S=0			1
Rainbow Smelt	LR	S=0			1
Spottail Shiner	LR	S>0			1
Striped Bass	SR		S1=0	S2=0	1
Weakfish	LR	S=0			1
White Catfish	SR		S1=0	S2=0	1
White Perch	SR		S1=0	S2=0	1

Table 18. Competing Models Used To Characterize the Standardized Riverwide LRS Population Trend of YOY Atlantic Tomcod CPUE (updated FSEIS Table I-33).

Species	Linear Regression				Segmented Regression					
	MSE	Slope	Std Err of Slope Estimate	p-value	MSE	Slope 1		Join Point	Slope 2	
						Lower 95% CL	Upper 95% CL		Lower 95% CL	Upper 95% CL
Atlantic Tomcod	0.831	-0.057	0.023	0.019	0.880	-0.360	0.141	1994	-0.123	0.053

Table 19. Riverwide Assessment of the Level of Potential Negative Impact Based on the Standardized LRS CPUE of Atlantic Tomcod (updated FSEIS Table I-34).

Species	Best Fit	Slope from Linear Regression	Slope 1 from Segmented Regression	Slope 2 from Segmented Regression	Final Decision
Atlantic Tomcod	LR	S<0			4

Table 20. Competing Models Used To Characterize the Standardized Riverwide YOY Abundance Index Trends (updated FSEIS Table I-36).

Species	Linear Regression				Segmented Regression					
	MSE	Slope	Std Err of Slope Estimate	p-value	MSE	Slope 1		Join Point	Slope 2	
						Lower 95% CL	Upper 95% CL		Lower 95% CL	Upper 95% CL
Alewife	1.017	0.019	0.025	0.458	0.992	-0.727	0.258	1990	-0.021	0.127
American Shad	0.596	-0.082	0.019	0.000	0.594	-0.379	0.630	1989	-0.153	-0.046
Atlantic Tomcod	0.588	-0.083	0.019	0.000	0.561	-1.665	2.716	1987	-0.141	-0.055
Bay Anchovy	0.744	-0.067	0.021	0.004	0.786	-0.194	0.005	2000	-0.198	0.152
Blueback Herring	0.792	-0.062	0.022	0.010	0.794	-0.154	-0.021	2006	-0.300	0.581
Bluefish	1.035	0.009	0.025	0.731	0.967	-0.038	0.205	1999	-0.259	0.081
Hogchoker	0.902	-0.046	0.023	0.062	0.942	-0.165	0.017	2003	-0.219	0.299
Rainbow Smelt	0.971	-0.033	0.024	0.193	0.960	-0.286	0.480	1992	-0.142	0.015
Spottail Shiner	0.844	0.055	0.023	0.024	0.879	-0.008	0.168	2003	-0.273	0.227
Striped Bass	1.039	0.004	0.025	0.864	0.928	-0.018	0.149	2003	-0.505	0.110
Weakfish	0.647	-0.077	0.020	0.001	0.576	-0.561	0.032	1992	-0.095	0.027
White Catfish	0.833	-0.056	0.023	0.020	0.863	-0.198	0.011	2001	-0.173	0.193
White Perch	1.039	-0.003	0.025	0.906	1.093	-0.079	0.103	2003	-0.424	0.243

Table 21. Riverwide Assessment of the Level of Potential Negative Impact Based in the Abundance Index (updated FSEIS Table I-37).

Species	Best Fit	Slope from Linear Regression	Slope 1 from Segmented Regression	Slope 2 from Segmented Regression	Final Decision
Alewife	SR		S1=0	S2=0	1
American Shad	SR		S1=0	S2<0	4
Atlantic Tomcod	SR		S1=0	S2<0	4
Bay Anchovy	LR	S<0			4
Blueback Herring	LR	S<0			4
Bluefish	SR		S1=0	S2=0	1
Hogchoker	LR	S=0			1
Rainbow Smelt	SR		S1=0	S2=0	1
Spottail Shiner	LR	S>0			1
Striped Bass	SR		S1=0	S2=0	1
Weakfish	SR		S1=0	S2=0	1
White Catfish	LR	S<0			4
White Perch	LR	S=0			1

Table 22. Assessment of Riverwide Population Impacts (updated FSEIS Table I-38).

Species	**CPUE**			**Abundance Index**	**Riverwide Assessment**
	FSS	**BSS**	**LRS**		
Alewife	1	1	N/A	1	1.0
American Shad	4	4	N/A	4	4.0
Atlantic Menhaden	N/A	N/A	N/A	N/A	Unknown
Atlantic Sturgeon	N/A	N/A	N/A	N/A	Unknown
Atlantic Tomcod	4	4	4	4	4.0
Bay Anchovy	1	1	N/A	4	2.0
Blueback Herring	4	1	N/A	4	3.0
Bluefish	4	1	N/A	1	2.0
Gizzard Shad	N/A	N/A	N/A	N/A	Unknown
Hogchoker	1	1	N/A	1	1.0
Rainbow Smelt	N/A	1	N/A	1	1.0
Shortnose Sturgeon	N/A	N/A	N/A	N/A	Unknown
Spottail Shiner	4	1	N/A	1	2.0
Striped Bass	4	1	N/A	1	2.0
Weakfish	N/A	1	N/A	1	1.0
White Catfish	N/A	1	N/A	4	2.5
White Perch	1	1	N/A	1	1.0
Blue Crab	N/A	N/A	N/A	N/A	Unknown

Table 23. Weight of Evidence Results for the Population Trend Line of Evidence (updated FSEIS Table H-15).

Species	River Segment Assessment Score	Riverwide Assessment Score	WOE Score	Impact Conclusion
Alewife	2.0	1.0	1.6	Undetected Decline
American Shad	4.0	4.0	4.0	Detected Decline
Atlantic Menhaden	Unknown	Unknown	Unknown	Unresolved
Atlantic Sturgeon	Unknown	Unknown	Unknown	Unresolved
Atlantic Tomcod	2.5	4.0	3.1	Detected Decline
Bay Anchovy	2.0	2.0	2.0	Undetected Decline
Blueback Herring	4.0	3.0	3.6	Detected Decline
Bluefish	2.0	2.0	2.0	Undetected Decline
Gizzard Shad	Unknown	Unknown	Unknown	Unresolved
Hogchoker	4.0	1.0	2.8	Variable
Rainbow Smelt	4.0	1.0	2.8	Variable
Shortnose Sturgeon	Unknown	Unknown	Unknown	Unresolved
Spottail Shiner	1.0	2.0	1.4	Undetected Decline
Striped Bass	3.0	2.0	2.6	Variable
Weakfish	2.5	1.0	1.9	Undetected Decline
White Catfish	1.0	2.5	1.6	Undetected Decline
White Perch	2.0	1.0	1.6	Undetected Decline
Blue Crab	Unknown	Unknown	Unknown	Unresolved

Table 24. Parameter Values Used in the Monte Carlo Simulation (updated FSEIS Table I-46).

RIS	Survey Used	Linear Slope (r)	Slope plus Standard Error of the Slope Estimate	Error Mean Square from Regression	CV of Density Data (1985-1996)	EMR	IMR
Alewife	BSS	0.075	0.099	0.725	1.294	0.095	0.0020
American Shad	BSS	-0.121	-0.108	0.215	0.494	0.042	0.0005
Atlantic Tomcod	FSS	-0.082	-0.059	0.666	0.812	0.036	0.0300
Bay Anchovy	FSS	-0.088	-0.067	0.601	0.510	0.213	0.0040
Blueback Herring	BSS	-0.075	-0.051	0.726	1.034	0.095	0.0040
Bluefish	BSS	0.013	0.041	1.034	0.754	0.003	0.0005
Hogchoker	FSS	-0.104	-0.086	0.434	1.224	0.386	0.0005
Rainbow Smelt	FSS	-0.086	-0.064	0.623	1.211	0.258	0.0005
Spottail Shiner	BSS	-0.030	-0.002	0.993	1.196	0.031	0.0070
Striped Bass	BSS	0.019	0.047	1.023	0.515	0.106	0.0080
Weakfish	FSS	-0.064	-0.039	0.810	0.637	0.544	0.0005
White Catfish	FSS	-0.042	-0.016	0.941	2.161	0.114	0.0005
White Perch	BSS	-0.009	0.019	1.039	1.002	0.076	0.0320

Table 25. Quartiles of the Relative Difference in Cumulative Abundance and Conclusions for the Strength-of-Connection From the Monte Carlo Simulation (updated FSEIS Table I-47).

Taxa	Number of Years	$N_0 = 1000$			$N_0 = 1 \times 10^8$			Strength of Connection Conclusion
		Median	Q1	Q3	Median	Q1	Q3	
Alewife	20	-0.07	-1.19	1.03	-0.07	-1.17	1.01	Low
	27	-0.32	-1.63	1.02	-0.32	-1.69	1.04	
American Shad	20	0.06	0.00	0.13	0.06	-0.01	0.13	Low
	27	0.05	0.00	0.11	0.06	0.00	0.11	
Atlantic Tomcod	20	0.15	-0.03	0.34	0.16	-0.03	0.35	Low
	27	0.15	0.01	0.30	0.15	0.01	0.29	
Bay Anchovy	20	0.29	0.13	0.44	0.29	0.13	0.44	High
	27	0.27	0.15	0.39	0.27	0.15	0.39	
Blueback Herring	20	0.21	-0.03	0.46	0.22	-0.02	0.46	Low
	27	0.22	0.04	0.41	0.23	0.04	0.42	
Bluefish	20	0.45	-0.09	0.99	0.45	-0.09	0.98	Low
	27	0.67	0.11	1.21	0.69	0.15	1.23	
Hogchoker	20	0.58	0.31	0.85	0.57	0.30	0.86	High
	27	0.56	0.35	0.78	0.56	0.35	0.78	
Rainbow Smelt	20	0.45	0.16	0.74	0.46	0.16	0.76	High
	27	0.45	0.23	0.68	0.45	0.23	0.68	
Spottail Shiner	20	0.27	-0.14	0.69	0.28	-0.14	0.70	Low
	27	0.34	-0.01	0.70	0.35	0.00	0.69	
Striped Bass	20	0.80	0.23	1.36	0.79	0.22	1.36	High
	27	1.19	0.60	1.81	1.20	0.60	1.80	
Weakfish	20	0.74	0.44	1.06	0.75	0.43	1.06	High
	27	0.76	0.50	1.01	0.76	0.51	1.01	
White Catfish	20	0.41	-0.18	1.01	0.43	-0.19	1.04	Low
	27	0.49	0.00	0.98	0.46	-0.03	0.98	
White Perch	20	0.42	-0.09	0.93	0.42	-0.07	0.91	Low
	27	0.53	0.10	0.98	0.53	0.08	0.98	

Table 26. Impingement and Entrainment Impact Summary for Hudson River YOY RIS (updated FSEIS Table H-17).

Species	Population Trend Line of Evidence	Strength of Connection Line of Evidence	Impacts of IP2 and IP3 Cooling Systems on YOY RIS
Alewife	Undetected Decline	Low	Small
American Shad	Detected Decline	Low	Small
Atlantic Menhaden	Unresolved	Low(b)	Small
Atlantic Sturgeon	Unresolved	Low(b)	Small
Atlantic Tomcod	Detected Decline	Low	Small
Bay Anchovy	Undetected Decline	High	Small
Blueback Herring	Detected Decline	Low	Small
Bluefish	Undetected Decline	Low	Small
Gizzard Shad	Unresolved	Low(b)	Small
Hogchoker	Variable	High	Moderate
Rainbow Smelt	Variable	High	Moderate
Shortnose Sturgeon	Unresolved	Low(b)	Small
Spottail Shiner	Undetected Decline	Low	Small
Striped Bass	Variable	High	Moderate
Weakfish	Undetected Decline	High	Small
White Catfish	Undetected Decline	Low	Small
White Perch	Undetected Decline	Low	Small
Blue Crab	Unresolved	Low(b)	Small

(b) Strength of connection could not be established using Monte Carlo Simulation; therefore, strength of connection was based on the rate of entrainment and impingement.

Discussion

The conclusions presented in the February 2014 report, as well as the preceding tables, were based upon our attempt to recreate and apply the methods used by NRC in developing the conclusions presented in the FSEIS. Applying those methods to the segmented regression analysis of the River Segment 4, FSS CPUE index of abundance for striped bass, the slope 2 estimate from the February 2014 report was considered not statistically significant, but the slope 2 estimate from the current analysis is considered significant. The segmented regression analysis conducted for the February 2014 report produced a 95% confidence interval for slope 2 from -0.1149 to 0.0005, which was considered not significant because it included zero. Whereas the current segmented regression analysis produced a 95% confidence interval from -0.1113 to -0.0028, which was considered significant because it did not include zero.

Given the sensitivity that the overall impact conclusions can have to such small changes in statistical results, the statistical methods on which the results were based warranted a careful review. Statistical properties of the FSEIS method for determining which trend slopes are significant are discussed below along with a discussion of the use of the results of the linear regression for the striped bass data.

On page I-9 of Appendix I of the FSEIS, NRC describes its method for determining which trend slopes it considered to be significant, and how it selected a regression model on which to base trend scores:

> "The statistics displayed in the second table included the mean squared error (MSE) for each model; the estimate of the linear slope and associated 95 percent confidence interval; the p-value associated with the significance test of the null hypothesis that the slope (S) associated with the simple linear model equals zero; the estimated 95 percent confidence interval (CI) of the two slopes from the segmented regression (Slope 1=S1 and Slope 2=S2); and the estimated join point. For the segmented regression, slopes were defined as significant if the CI did not include zero.
>
> The best-fit model (defined as the model with the smaller MSE) was then characterized in a third table, based on the general trend depicted by the direction of the estimated slopes. If the slope was significantly different from 0, the trend was represented by either the statement S > 0 for a positive slope or S < 0 for a negative slope. If the slope was not significant, the statement depicting the lack of a trend was S = 0."

For the segmented regressions, the FSEIS test of the null hypothesis that a slope is equal to zero (based on the confidence interval including zero) is based on the standard error of the slope estimate and is equivalent to a t-test of the significance of the slope estimate. That test is a conditional test addressing the question: "after all other parameters in the model are estimated, does the inclusion of the slope estimate in the model significantly improve the fit of the model to the data?" The result of the test depends on the estimates of all of the other parameters as well as the estimate of the slope being tested. Accordingly, the reliability of the other parameter estimates may affect the result of the significance test for the slope. For the striped bass, Region 4, FSS, CPUE example, NRC's method could lead to the conclusion that slope 2 was significant, although none of the other parameter estimates would have been considered statistically significant:

Parameter	Lower 95% Confidence Limit	Upper 95% Confidence Limit
Join Point	1982	1992
Slope 1	-1.9426	3.5866
Slope 2	-0.1113	-0.0028

In addition, the FSEIS test of significant slopes does not necessarily provide an error rate of 5%, as suggested by a test based on 95% confidence intervals. As noted above, the test is equivalent to a t-test of the significance of the slope estimate. For each test based on the 95% confidence interval, the probability of falsely rejecting the null hypothesis when it is true is 5%. That is the case if one test is performed. However, if two tests are performed (e.g. the test for slope 1 and the test for slope 2) then the probability of falsely rejecting the null hypothesis in at least one test, when both slopes in fact are zero, is greater than 0.05. For example, the probability of correctly failing to reject the null hypothesis in two independent tests when the null hypothesis is true (e.g., when both slopes are zero) is 0.95 x 0.95. In this case the probability of falsely rejecting the null hypothesis is 1 – (0.95 x 0.95) = 0.0975, almost twice the intended error probability of 0.05.

For regressions with multiple parameters being estimated simultaneously, the two issues discussed above can be avoided by testing the significance of all parameter estimates simultaneously. By doing so, the reliability of every parameter estimate is taken into account. In addition, the probability of falsely rejecting the null hypothesis is controlled and not affected by the number of parameters in the model. The standard F-test for the overall significance of a regression model can be used for this purpose. For this test, the null hypothesis is that all slopes in the model are equal to zero. The alternative hypothesis is that at least one parameter is not equal to zero (Draper, N.R. and H. Smith, 1966. Applied Regression Analysis.). If the regression is not statistically significant based on the standard F-test, then the null hypothesis that all parameters are zero cannot be rejected.

For these reasons, the standard F-test for a regression model is the appropriate test for the null hypothesis that both slopes in the segmented regression are equal to zero. The segmented regression has three parameters in addition to the intercept: two slopes and the join point. By labeling the first year in the time series as year zero, the join point parameter is equal to zero when there is no change in slope over the years being analyzed. Therefore the null hypothesis of all parameters being equal to zero would be: slope 1 = 0, slope 2 = 0 and join point = 0 (i.e., no change in slope). If the null hypothesis is rejected by the F-test, then the FSEIS conditional method could be applied to identify which particular slope estimates are significantly non-zero.

For the striped bass, River Segment 4, FSS, CPUE example, the F-statistic for the segmented regression is 2.04 (with 3 and 23 degrees of freedom). The probability of observing an F-statistic that large under the null hypothesis is 0.14. Because 0.14 exceeds the acceptable error rate for the test of 0.05, the null hypothesis that both slopes are equal to zero cannot be rejected. Because the null hypothesis that all slopes are equal to zero cannot be rejected, it is not necessary or appropriate to apply the FSEIS conditional test for the significance of individual slopes in this case. This more robust statistical result that neither slope 1 nor slope 2 is significantly different from zero is consistent with the results presented in the February 2014 report.