IPRenewal NPEmails

From: Louie, Richard <rlouie@entergy.com>
Sent: Monday, April 25, 2016 4:11 PM
To: Wentzel, Michael
Cc: Gray, Dara F; Walpole, Robert W
Subject: [External_Sender] NL-16-044 Signed
Attachments: NL-16-044 Final Signed.pdf

Mike,

As you requested, attached is an advance copy of Entergy's responses to the 3rd party comments regarding the Draft FSEIS.

Richard Louie
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Regulatory Assurance
Indian Point Energy Center
(914) 254-6618

Hearing Identifier: IndianPointUnits2and3NonPublic_EX
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From: Louie, Richard

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Recipients:
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Tracking Status: None
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Fred Dacimo
Vice President
Operations License Renewal

NL-16-044

April 25, 2016 **Rulemaking Docket ID NRC-2008-0672**

Cindy Bladey
Chief, Rules, Announcements, and Directives Branch
Office of Administration
U.S. Nuclear Regulatory Commission
Mail Stop: OWFN-12-H08
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SUBJECT: **Entergy's Corrections and Clarifications in Response to Third-Party Comments on the NRC Staff's Draft Second Supplement to the Final Supplemental Environmental Impact Statement for Indian Point Nuclear Generating Units 2 and 3 License Renewal**
Indian Point Nuclear Generating Unit Nos. 2 and 3
Docket Nos. 50-247 and 50-286, License Nos. DPR-26 and DPR-64

REFERENCES:

1. NUREG–1437, Supplement 38, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Indian Point Nuclear Generating Unit Nos. 2 and 3

   a. Volumes 1-3, Final Report (Dec. 2010)
   b. Volume 4, Final Report (Supp. 1) (June 2013)
   c. Volume 5, Draft Report (Supp. 2) for Comment (Dec. 2016)

2. Entergy Nuclear Operations, Inc.; Indian Point Nuclear Generating Unit Nos. 2 and 3; Draft supplemental environmental impact statement; request for comment; 80 FR 81377 (Dec. 29. 2015)

3. Entergy Letter (NL-16-021) to NRC re: "Comments on the Second Draft Supplement to Final Supplemental Environmental Impact Statement for Indian Point License Renewal" (Mar. 4, 2016)

Dear Ms. Bladey:

On December 22, 2015, the Nuclear Regulatory Commission (NRC) published in draft a second supplement (Draft Supplement) to the December 2010 Final Supplemental Environmental Impact Statement (FSEIS) prepared by the NRC Staff and its consultants for the Indian Point Nuclear Generating Unit Nos. 2 and 3 (Indian Point) License Renewal Application (LRA). See References 1.a-c. By notice published in the *Federal Register* on December 29, 2015 (80 FR 81377) (Reference 2), the NRC requested comments on the Draft Supplement.

On March 4, 2016, Entergy submitted detailed comments on the Draft Supplement. See Reference 3. Various stakeholders, including individual members of the public, public interest groups, and government agencies, also submitted comments on the Draft Supplement. Entergy has reviewed those comments and found that, in numerous instances, they contain information and assertions that are factually incorrect or unsupported. Accordingly, in Attachment 1, Entergy is providing its corrections and clarifications to ensure a complete and accurate record relative to the issues discussed in the Draft Supplement. In brief, the comments Entergy is responding to raise issues related to the NRC Staff's assessment of aquatic resource impacts, the no-action alternative (as it relates to consideration of other potential sources of baseload power generation), and the impacts of radionuclides released to groundwater beneath the Indian Point site. Attachments 2 through 6 are technical papers prepared by Entergy consultants that support Entergy's corrections on issues related to aquatic resource impacts.

Entergy appreciates the NRC Staff's efforts and respectfully requests that it consider the attached information in preparing the final version of its second supplement to the FSEIS.

There are no new commitments identified in this submittal.

If you have any questions regarding these comments, please contact Dara Gray at (914) 254-8414.

Sincerely,

FRD/rl

Attachments:

1. Entergy's Corrections and Clarifications in Response to Third-Party Comments on the NRC Staff's Draft Second Supplement to the FSEIS
2. Fish Community Persistence in the Hudson River 1985 through 2013 Compared to Hinkley Station 1981 through 2012 (August 10, 2015)
3. NYSDEC's misrepresentation of Dr. Barnthouse's papers and memoranda (April 20, 2016)
4. Comparison of Estimates of Historical Entrainment Losses of Striped Bass at IPEC to Corresponding Estimates of Historical Abundance of Striped Bass in the Hudson River (April 20, 2016)
5. Critique of Community Analyses in 2008 and 2015 Versions of "The Status of Fish Populations and Ecology of Hudson River" (August 2015)
6. Review of Estimates of Entrainment Reported in NYSDEC Staff's Comments on the NRC Draft Supplement

cc: Mr. Daniel H. Dorman, Regional Administrator, NRC Region I
Mr. Sherwin E. Turk, Special Counsel, NRC OGC
Mr. Michael Wentzel, Project Manager, NRC NRR DLR
Mr. Douglas Pickett, Senior Project Manager, NRC NRR DORL
Ms. Bridget Frymire, New York State Department of Public Service
Mr. John B. Rhodes, President and CEO NYSERDA
NRC Resident Inspector's Office

ATTACHMENT 1 TO NL-16-044

<u>ENTERGY'S CORRECTIONS AND CLARIFICATIONS IN RESPONSE TO THIRD-PARTY COMMENTS ON THE NRC STAFF'S DRAFT SECOND SUPPLEMENT TO THE FSEIS</u>

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 & 3
DOCKET NOS. 50-247 AND 50-286

Entergy's Corrections and Clarifications in Response to Third-Party Comments on the NRC Staff's Draft Second Supplement to the FSEIS

I. Introduction

On March 4, 2016, Entergy submitted detailed comments on NUREG-1437, Supplement 38, Vol. 5, Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Indian Point Nuclear Generating Unit Nos. 2 and 3, Draft Report (Dec. 2015) ("Draft Supplement").[1] Various stakeholders, including individual members of the public, public interest groups, and government agencies, also submitted comments on the Draft Supplement. Entergy has reviewed those comments and found that, in numerous instances, they contain information and assertions that are factually incorrect or unsupported. Accordingly, Entergy is providing these supplemental, responsive comments to correct those errors and to ensure a complete and accurate record relative to the issues discussed in the Draft Supplement.

These comments and corrections respond specifically to statements made by: (1) the U.S. Environmental Protection Agency ("EPA"); (2) Riverkeeper, Inc. ("Riverkeeper"); (3) the New York State Department of Environmental Conservation staff ("NYSDEC Staff"); (4) the U.S. Department of the Interior ("DOI"), and (5) Public Health and Sustainable Energy ("PHASE").[2] In particular, Section II of this submission, which incorporates the views of the members of Entergy's Biological Team,[3] responds to (and, where necessary, identifies and corrects errors contained in) EPA, Riverkeeper, and NYSDEC Staff's respective comments on the NRC Staff's assessment of the potential aquatic resource impacts of license renewal, as set forth in Sections 4.0 ("New Information on Entrainment and Impingement Impacts") and Section 5.14.6 ("Cumulative Impacts – Aquatic Resources") of the Draft Supplement. Section III responds to Riverkeeper's claim that the NRC Staff has not adequately considered purported new and significant information regarding the "no-action alternative," a topic that is addressed in Sections 8.0 and 9.0 of the NRC Staff's December 2010 final supplemental environmental impact statement ("FSEIS") for Indian Point Units 2 and 3 ("IP2" and "IP3") license renewal and Section

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1 *See* Letter from Fred Dacimo, Entergy, to Cindy Bladey, NRC, NL-16-021: Comments on Second Draft Supplement to Final Supplemental Environmental Impact Statement for Indian Point License Renewal (Mar. 4, 2016) ("Entergy Comments") (ADAMS Accession Nos. ML16070A053 and ML16070A054).

2 *See* Letter from Susan S. Shapiro, PHASE, to NRC (Mar. 4, 2016) ("PHASE Comments") (ADAMS Accession NO. ML16069A335); Letter from James Bacon, Riverkeeper, to NRC, Comments of Riverkeeper on [the Draft Supplement] at 6 (Mar. 4, 2016) ("Riverkeeper Comments") (ADAMS Accession No. ML16069A366); Letter from Judy-Ann Mitchell, EPA, to Cindy Bladey, NRC, at 1-2 (Mar. 4, 2016) ("EPA Comments") (ADAMS Accession No. ML16082A272); Letter from Kathleen Moser, New York State Department of Environmental Conservation, to Cindy Bladey, NRC, at 1 (Mar. 4, 2016) ("NYSDEC Staff Comments") (ADAMS Accession No. ML16069A379); Letter from Andrew Raddant, U.S. Department of Interior, to James Danna, NRC, at 1 (Mar. 2, 2016) ("DOI Staff's Comments") (ADAMS Accession No. ML16069A375).

3 Entergy's Biological Team consists of the following leading national biologists: Dr. Lawrence W. Barnthouse of LWB Environmental Services, Inc.; Dr. Douglas G. Heimbuch of AKRF; Dr. John R. Young of ASA Analysis and Communications, Inc.; and Dr. Mark M. Mattson of Normandeau Associates, Inc.

8.3 of the Draft Supplement.[4] Finally, Section IV responds to comments submitted by PHASE, Riverkeeper, and the EPA concerning the impacts of radionuclide releases to Indian Point site groundwater, as discussed in Section 5.4 of the Draft Supplement.

Submission of corrections to the comments of other parties is routine and appropriate as a matter of applicable law and NRC practice.[5] First, these supplemental, responsive comments foster the development of an accurate and complete final Supplement; one based on the "best available evidence"—a goal that Entergy and NRC Staff share.[6] Second, the NRC Staff is obligated to consider and appropriately respond to any material comments received, to the extent that they are accurate.[7] Finally, the NRC Staff has not participated with Entergy, NYSDEC Staff, and Riverkeeper in the ongoing State Pollutant Discharge Elimination System ("SPDES") permit renewal and Water Quality Certification ("WQC") proceedings (collectively, the "NYSDEC Proceedings") for IP2 and IP3, and thus may not have access to those Proceedings' voluminous records relevant to the other parties' comments. Entergy submits these Corrections to enhance the NRC Staff's ability to expeditiously fulfill its National Environmental Policy Act ("NEPA") obligations.

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4 NUREG-1437, Supplement 38, Vols. 1-3, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants, Regarding Indian Point Nuclear Generating Unit Nos. 2 and 3, Final Report" (Dec. 2010) ("FSEIS").

5 *See, e.g.,* 10 C.F.R. pt. 51, subpt. A, app. A, § 2(f) (reflecting NRC practice that late-filed comments on a draft EIS should "be considered if it is practical to do so"); *Vermont Yankee Nuclear Power Corp. v. Natural Resources*, 435 U.S. 519, 553 (1978) (applying APA standard to NEPA case); *Kootenai Tribe of Idaho v. Veneman*, 142 F. Supp. 2d 1231 (D. Idaho 2001) (applying APA notice and comment standard to NEPA case); *Ad Hoc Metals Coal. v. Whitman*, 227 F. Supp. 2d 134, (D.D.C. 2002) (applying the APA standard of review to federal action (in this case, a rulemaking), and in the process rejecting the position that late-filed comments "can be ignored," instead finding that "where highly relevant information comes to light … with a sufficient amount of time remaining that the ultimate decision can be influenced … such information should be included in the record"); *see also* Federal Register Notice, Denial of Petition for Rulemaking, PRM-50-105, NRC-2012-0056 (June 12, 2013) at 16 (ADAMS Accession No. ML13042A368) (addressing late-filed comments submitted in response to another party's comments); Federal Register Notice, AP100 Design Certification Amendment Final Rule, RIN 3150-AI81, NRC-2010-0131, at 8-9 (ADAMS Accession No. ML112380825) (noting that NRC addressed late-filed comments on proposed rule submitted on June 30, 2011, after public comment period closed on May 10, 2011).

6 *See*, *e.g., Luminant Generation Co. LLC (Comanche Peak Nuclear Power Plant, Units 2 and 3), CLI-12-7, 75 NRC 379, 391-92 (2012) (citations omitted)* ("NEPA requires that we conduct our environmental review with the best information available today."); *see also Ctr. for Biological Diversity v. U.S. Forest Serv.*, 349 F.3d 1157, 1167 (9th Cir. 2003) (CEQ regulations "obligate[] the agency to make available to the public high quality information, *including accurate scientific analysis*, expert agency comments and public scrutiny, before decisions are made and actions are taken") (emphasis added); *see also Natural Res. Def. Council, Inc. v. Callaway*, 524 F.2d 79 (2d Cir. 1975) (approving "the use of supplemental data and statements . . . to bolster an otherwise deficient EIS").

7 *See, e.g.,* 40 C.F.R. § 1503.4(a); *Pub. Citizen, Inc. v. FAA*, 988 F.2d 186, 197 (D.C. Cir. 1993) ("The requirement that agency action not be arbitrary or capricious includes a requirement that the agency adequately explain its result, and respond to 'relevant' and 'significant' public comments." (citations omitted)).

II. Entergy's Corrections and Clarifications in Response to Comments Concerning Aquatic Resource Impacts

A. EPA Comments Confirm that Indian Point's Ristroph Screens, Fish Handling and Return Systems Represent the Best Technology Available

In its comments on Section 4.0 of the Draft Supplement, U.S. Environmental Protection Agency ("EPA") states that Indian Point's optimized Ristroph screen and fish return system "was independently reviewed by federal and state agencies and determined to be a compliant intake structure pursuant to 316[b]" of the federal Clean Water Act and its implementing regulations.[8] Section 316(b) of the federal Clean Water Act, 33 U.S.C. Section 1326(b) requires that the "location, design, construction, and capacity of cooling water intake structures reflect the best technology available [("BTA")] for minimizing adverse environmental impact."[9] EPA's comment therefore facially acknowledges that the Indian Point optimized Ristroph screen and fish return system is the best technology available. EPA's perspective is important in the context of these Corrections, because it underscores the need for response to Riverkeeper's comments, as set forth below.

B. Riverkeeper's Criticisms of the NRC's Assessment of Impacts on Sturgeon Lack Technical and Legal Support

Riverkeeper, in both the body of its comments and in the memorandum from Dr. Richard Seaby of Pisces Conservation, Ltd (the "Pisces Memo") attached thereto,[10] suggests that vessel strikes associated with Tappan Zee Bridge construction have "increased Sturgeon mortality 20-fold."[11] Riverkeeper's comments focus on "significant new circumstances or information"[12]effectively suggesting reconsideration of the 2013 Biological Opinion ("BiOP") issued by the National Marine Fisheries Service ("NMFS")[13] and that portion of the Draft Supplement dependent on the BiOp. Riverkeeper further posits that, because NEPA "specifically requires examination of cumulative impacts," the Draft Supplement "must examine whether NRC's prior assumptions of ultimate Sturgeon mortality impacts and baseline data remain valid in light of the unexpected increases in mortality resulting from the [Tappan Zee Bridge] construction."[14]

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8 EPA Comments at 2.

9 EPA Comments at 2; *see also* 40 CFR Parts 122 and 125, National Pollutant Discharge Elimination System—Final Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities; Final Rule, 79 Fed. Reg. 48300, 48337 (Aug. 15, 2014).

10 *See* Seaby (2016).

11 *See* Riverkeeper Comments at 5; *see also* Pisces Memo at 4.

12 *See* Riverkeeper Comments at 2.

13 NMFS (2013).

14 *Id.* Riverkeeper further asserts that Section 5.14.6 of the Draft Supplement, while discussing cumulative impacts to aquatic resources, "falls short by limiting examination to oyster habitat and ignoring impacts to Sturgeon, a federally-listed endangered species" purportedly caused by Tappan Zee Bridge construction activities. Entergy disagrees with Riverkeeper's characterization of Draft Supplement Section 5.14.6. Although it specifically discusses Tappan Zee Bridge construction-related impacts on oyster habitat, it further states that "[t]he final EIS for the Tappan Zee Hudson

As detailed below, Riverkeeper's criticisms of the Draft Supplement's discussion of sturgeon-related impacts—including both direct and cumulative impacts resulting from Tappan Zee Bridge construction—lack technical and legal merit.

Entergy acknowledges that Riverkeeper's catalogue of vessel strikes, *if* demonstrated to NMFS' and NYSDEC's satisfaction (which Entergy does not concede), might warrant additional NMFS and NYSDEC review of the Tappan Zee Bridge project or vessel-related mortality generally, because that mortality can impact population dynamics. However, because Indian Point causes no sturgeon mortality, it, therefore, *cannot reasonably be considered to impact sturgeon population dynamics, including in a manner relevant for NRC's NEPA analysis or the NMFS BiOp*. More specifically, even if Riverkeeper has correctly documented vessel strikes to NMFS's and NYSDEC's satisfaction (again, which Entergy does not concede), such strikes have no bearing on NRC's Indian Point site-specific sturgeon assessment in the Draft Supplement, whether on a direct or cumulative basis, because NRC's assessment of Indian Point is premised on its non-lethal impacts.[15]

In this regard, Riverkeeper's comments provide no credible basis for reopening the NMFS BiOp, which concluded that continued operation of Indian Point is "not likely to jeopardize the continued existence" of either sturgeon species – a final determination that Riverkeeper has not challenged.[16] Indeed, Riverkeeper advances no actual link between Indian Point's collection and return to the Hudson of certain juvenile sturgeon and the recent sturgeon mortality that Riverkeeper claims resulted from vessel strikes, because there is none.[17] It is well established that vessel strikes cause readily discernible injuries and sturgeon mortality of the very sort Riverkeeper's own comments catalogue – lacerations, gashes, slashes and losses of portions of sturgeon bodies.[18] Such injuries *are not* and *cannot* be caused by Indian Point, which only intercepts and returns to the River certain juvenile sturgeon of a particular size through its specially designed, peer-reviewed, state-of-the-art fish handling system – the very system that EPA views as BTA, as noted above. Because Indian Point does not cause or contribute to sturgeon mortality, the BiOp and NRC's Draft Supplement remain valid.

River Crossing Project (NYSDOT and NYSTA 2015, Chapter 16) finds that the project would not have the potential to result in adverse impacts on *aquatic biota*," and that the updated information does not substantially alter the NRC staff's previous analysis (and, in fact, is bounded by that analysis), as documented in the 2010 FSEIS. Draft Supplement at 107 (emphasis added).

15 For its part, NYSDEC Staff claims that "between 1975 and 1990" over "1,100 Atlantic and shortnose sturgeon have been impinged and killed on the Indian Point [cooling water intake structures]." Even if this tally were correct, which it is not, it ignores the plain fact that – as of 1991 – Indian Point had installed and was operating its specially designed, peer-reviewed, state-of-the-art Ristroph screen and fish return system with its multi-speed pumps that reduced cooling water flow, a system EPA concludes is BTA. *See, e.g.,* NRC (2013) at 14. In other words, what occurred in the 1970s and 1980s is irrelevant to NRC's NEPA-based assessment of Indian Point's future potential license renewal-related, non-lethal sturgeon impacts pursuant to a BiOp and SPDES permit that mandate use of BTA-compliant technology.

16 NMFS (2013) at 1.

17 *See* Pace (2015), Exhibit 2.

18 *See*, *e.g.*, Brown and Murphy (2010) at Table 1 (identifying injuries in dead sturgeon consistent with vessel strikes); *see also* Gutreuter and Wahl (2003) at 649 (describing injuries identified in forensic examination consistent with propeller strikes).

More specifically, Indian Point causes no entrainment mortality, and therefore cannot alter population dynamics.[19] NMFS articulates the lack of entrainment in its BiOp:

> Given what is known about these life stages (*i.e.*, no eggs expected to be present in the action area; larvae only expected to be found in the deep channel area away from the intakes) and the intensity of the past monitoring, it is reasonable to assume that this past monitoring provides an accurate assessment of past entrainment of sturgeon early life stages. Based on this, it is unlikely that any entrainment of sturgeon eggs and larvae occurred historically.[20]

Furthermore, Indian Point does not impinge live, healthy sturgeon on its trash racks (or bars). Again, as the NMFS's BiOP makes clear, healthy yearling or older sturgeon are strong swimmers and can easily swim away from the maximum one foot per second ("fps") cooling water intake structure velocity found at Indian Point.[21] As such, healthy sturgeon "are expected to be able to *readily avoid*" impingement on Indian Point's trash racks.[22] Because healthy yearling or older sturgeon can readily avoid impingement, NMFS found that "*all* [sturgeon] impinged at the trash bars *are expected to be dead or stressed*"[23], and the "capture or collection" of such dead or moribund fish "*would not affect the numbers, reproduction or distribution of [sturgeon] in the Hudson River or throughout their range*."[24] In other words, Entergy's non-lethal collection of dead sturgeon does not and cannot alter sturgeon population dynamics.[25]

Importantly, younger-than-yearling sturgeon small enough to pass through the trash racks or bars are collected by Indian Point's state-of-the-art Ristroph screen and fish return systems and returned to the Hudson River. There is no evidence that any sturgeon managed

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19 *See* NMFS (2013) at 49.

20 *Id*.

21 *See, e.g.*, NMFS (2013) at 61-62 (describing extensive tests performed by Kynard *et al.* (2005) in which no healthy yearling-or-older sturgeon were impinged on vertical trash racks at an intake velocity of 1 fps or lower); *see also* Kynard and Pugh (2012) at slide 18 (presentation of additional studies demonstrating that no yearling shortnose sturgeon were impinged on vertical trash racks at flow velocities up to 2 fps, and no juveniles or adults were impinged at flow velocities up to 3 fps).

22 *See* NMFS (2013) at 116 (shortnose sturgeon) and 120 (Atlantic sturgeon) (emphasis added).

23 *Id*. (Emphasis added).

24 *See id*. at 116 (shortnose sturgeon) and 123 (Atlantic sturgeon) (emphasis added).

25 Indian Point's identification and report of a dead, moderately decomposed, 1.2 m long Atlantic sturgeon found in front of the Unit 2 trash rack among debris on the river bottom in 2015 exemplifies NMFS's findings, and confirms Indian Point's lack of impact on yearling-or-older sturgeon. *See* Incident Report Sturgeon Take - Indian Point and Sturgeon Salvage Form dated February 26, 2015. This dynamic is similar to other incidents of power plants collecting dead sturgeon on trash racks. *See*, *e.g.*, PSEG (2013) (November 20, 2013 report by PSEG Nuclear LLC of two deceased and decomposed Atlantic sturgeon found on Salem Generating Station trash racks) and PSEG (2015) (December 11, 2015 report of shortnose sturgeon with large dorsal laceration found on Salem Generating Station trash racks).

through this fish-handling system experience any injury, let alone the mortality that would be necessary to alter population dynamics. Rather, there is much evidence to the contrary.[26] For example, it is well established that sturgeon can withstand highly stressful environmental conditions due, in part, to the several rows of boney plates or shields (called scutes) that cover their leathery skin.[27] Notably, for instance, the National Oceanographic and Atmospheric Administration's ("NOAA") protocol for safe sturgeon handling, prepared by a consortium of leading fisheries scientists, states: "*Both shortnose and Atlantic sturgeons are very hardy species*" and their "*ability ... to survive* under extremely stressful conditions" is "*well established*."[28] Moreover, peer-reviewed, published impingement survival studies performed in 1986 at the full-scale Ristroph screen installed and operated at Indian Point Unit 2 demonstrate survival rates for white perch and striped bass, two relatively "hardy" species, of 86% and 91% respectively.[29] Given that the "well-established" hardiness of Atlantic and shortnose sturgeon exceeds that of both white perch and striped bass[30], and the general consistency of the Ristroph screens and fish return system with NOAA's 2010 protocols for safe sturgeon handling,[31] concluding that sturgeon that encounter the Indian Point Ristroph screens are likely to survive is consistent with the best available Indian Point-specific evidence on impingement.

In addition, impingement studies of Ristroph screens comparable to those operating at Indian Point reflect similarly high survival rates across a range of fish species, including sturgeon. Thus, for instance, a recent investigation of lake sturgeon (*Acipenser fulvescens*) found no mortality, despite prolonged impingement on traveling screens and 12 hours in a collection box—conditions far more severe than would occur at Indian Point.[32] Likewise, leading scientists Black and Perry (2014) tested more than 13,000 fish from twelve different species, finding nominal impingement mortality rates of less than 5% for all species tested, and less than 3.2% for half of those species tested.[33] As these studies underscore, survival of sturgeon that

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[26] Indeed, NMFS merely makes a "worst case" mortality assumption on an interim basis, pending confirmatory monitoring that NMFS is expected to authorize in the relatively near term. *See, e.g.,* BiOp at 79 ("because we do not know the condition of the fish prior to impingement, and we have no site-specific studies to base an estimate . . . we will assume the worst case, that mortality is 100%."); *see also* NMFS (2016) at 1, 4 ("we agree in principal to the proposed monitoring plan. We are prepared to approve the monitoring plan with the revisions noted in this letter . . . [and] plan to issue the amendment to the January 2013 Opinion within 45 days of receiving your updated implementation schedule.")

[27] *See, e.g.,* NYSDEC website at: http://www.dec.ny.gov/animals/7025.html.

[28] *See* Moser *et al.* (1990) at 1, 2. (Emphasis added).

[29] Fletcher (1990).

[30] Since the most recent Permit to Take Protected Species for Scientific Purposes No. 20795, which authorizes HRBMP-related sturgeon incidental takes, took effect on August 29, 2012, a total of 415 juvenile, sub-adult and adult sturgeon have been captured and released by Entergy's Biological Team with zero mortality. All were released alive after substantial processing required by NMFS, which included length and weight measurements, meristic measurements for identification, photographs of observed injuries, tagging and scanning for previous tags, and collection of a tissue sample from each fish. This processing, likewise, underscores the hardiness of sturgeon.

[31] Moser *et al*. (2000).

[32] *See* Georgia Power Company (2006) at 15.

[33] *See* Black and Perry (2014) at 367. The authors also recorded descaling (or scale loss), an injury that compromises the integrity of the fishes' protective body covering and can lead to mortality of

encounter the Indian Point fish-handling system is the only technical conclusion that is consistent with the best available national evidence on impingement.

For all of these reasons, Riverkeeper's suggestion that purported increases in sturgeon mortality due to vessel strikes somehow warrant reconsideration of NRC Staff's sturgeon assessment in the Draft Supplement or the NMFS BiOp, both of which are premised on Indian Point's non-lethal impacts, lacks technical and legal merit. Thus, Riverkeeper's comments provide no basis for revisiting either the NRC Staff's sturgeon assessment in the Draft Supplement or the NMFS BiOP.

C. The NRC Staff Should Reject NYSDEC's Proposed Surrogate Definition of "Significant Adverse Impact to the Environment" As It Pertains to the Evaluation of Population-Level Effects

Under NEPA and the NRC's General Environmental Impact Statement ("GEIS") for license renewal, the NRC Staff's aquatic assessment in the Draft Supplement must evaluate the potential impacts of license renewal on fish populations.[34] The precedent is clear, well-established, and typified by the Court of Appeals decision in *Envtl. Prot. Info. Ctr. v. U.S. Forest Serv.,* 451 F.3d 1005, 1010-11 (9th Cir. 2006), in which the Ninth Circuit stated: "NEPA regulations direct the agency to consider the degree of adverse effect *on a species, not the impact on individuals of that species.*" (Emphasis added). The reasoning behind population-level scrutiny is familiar and obvious: if impacts on individuals were sufficient to equate to a significant adverse impact to the environment, virtually every project would be deemed to have significant adverse impacts on the environment.

Without even acknowledging this controlling NEPA law, NYSDEC Staff advocates that NRC Staff replace the settled NEPA standard for significant adverse impact to the environment, including adverse aquatic impact, with NYSDEC's idiosyncratic interpretation of a legally distinct phrase arising from New York State Pollution Discharge Elimination System ("SPDES") law. Specifically, NYSDEC Staff suggests that NRC define the phrase "significant adverse impact to the environment" under NEPA in the same way that NYSDEC Staff defines the phrase "adverse environmental impact" in its own non-binding, internal SPDES permit guidance document to

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many impinged fish, but one that does not impact sturgeon due to their characteristic armoring. *See id*. at 360; *see also* Hanson et al (1977) at 9.

34 *See*, *e.g.*, NUREG-1437, Rev. 1, "Generic Environmental Impact Statement for License Renewal of Nuclear Plants—Final Report," Vol. 1, at 4-117 (June 2013) ("GEIS") (reflecting focus on "species populations" and "fish populations, especially in the context of listed species)*; Envtl. Prot. Info. Ctr. v. U.S. Forest Serv., 451 F.3d 1005, 1010-11 (9th Cir. 2006)* ("NEPA regulations direct the agency to consider the degree of adverse effect on a species, not the impact on individuals of that species."); *National Audubon Soc., Inc., v. U.S. Fish and Wildlife Service*, 55 F. Supp. 3d 316, 364 (E.D.N.Y 2014) (same); *see also W. Watersheds Project v. Salazar*, 993 F. Supp. 2d 1126, 1135-36 (C.D. Cal. 2012) *aff'd sub nom. W. Watersheds Project v. Jewell,* 601 F. App'x 586 (9th Cir. 2015) ("Yet, NEPA requires only discussion of *significant* impacts. As the 2010 biological opinion makes clear, the destruction of eggs and juvenile tortoises at the ISEGS project site does not have a *significant impact on the stability of the desert tortoise population*. Thus, a discussion of this impact in the FEIS was unnecessary") (emphasis added); *Native Ecosystems Council v. U.S. Forest Ser.,* 428 F.3d 1233,1240 (9th Cir. 2005) ("[I]t does not follow that the presence of some negative effects necessarily rises to the level of demonstrating a significant effect on the environment.").

mean "the number of [individual] fish and shellfish impinged and entrained," even where those early life stages survive or their mortality has no population impact.[35]

Even if the Atomic Safety Licensing Board had not already determined that the NRC Staff is barred from addressing SPDES permit standards applicable to Indian Point[36], there is no credible legal reason that NRC should abandon NEPA precedent and NRC guidance in favor of a NYSDEC guidance document without force of law.[37] Likewise, there is no credible technical or scientific reason to deviate from the well-established NEPA definition that requires NRC to consider populations as the correct measure of impact owing to high natural mortality among early life stages of aquatic species, particularly when the best available evidence is that Indian Point's continued operations have, as Entergy's prior Draft Supplement comments demonstrate, a "SMALL" impact on the overwhelming majority of Hudson River species (or populations). Thus, the NRC Staff should reject NYSDEC's invitation to use a surrogate definition.[38]

D. NYSDEC's and Riverkeeper's Claims Regarding the Alleged Difficulty of Identifying Long-Term Population Trends for Key Hudson River Species Based on Hudson River Biological Monitoring Program Data Are Both Unsupported and Demonstrably False

NYSDEC Staff claim—without any citation to or analysis of data—that "attempting to determine if the impingement and entrainment of a single power plant has caused impacts on fish populations is an *impossible* endeavor."[39] Riverkeeper, also without any supporting data or analysis, echoes that claim, stating that that "attempting to assign cause from a single source of impact on to a population is difficult."[40] As discussed below, in making these assertions, NYSDEC and Riverkeeper challenge Entergy's and the NRC Staff's reliance on fish population trend data collected as part of the Hudson River Biological Monitoring Program ("HRBMP").

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35 NYSDEC Staff cite to three sources in support of its definition, none of which relates to NEPA: (1) NYSDEC Department Policy CP-52, a non-binding guidance document, the stated purpose of which is "to clarify the Department's Best Technology Available (BTA) review process and to provide certainty to Department staff's ongoing implementation of 6 NYCRR Part 704.5 regarding requirements applicable to CWIS.; (2) USEPA's 2014 Section 316(b) Phase II Final Rule, which "establishes requirements under section 316(b) of the Clean Water Act (CWA) for existing power generating facilities"; and (3) a 2007 opinion of the Second Circuit Court of Appeals, *Riverkeeper Inc. v. U.S. EPA* (a case that interprets Section 316(b), 33 U.S.C. § 1326(b), which again requires that the "location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact."). *See* NYSDEC Staff Comments at 2.

36 *See In the Matter of Entergy Nuclear Operations, Inc. (Indian Point Nuclear Generating Units 2 and 3)*, U.S. Nuclear Regulatory Commission, Atomic Safety and Licensing Board, Docket Nos. 50-247-LR and 50-286-LR ASLBP No. 07-858-03-LR-BD01 (July 31, 2008) at 139 ("the NRC is barred from altering any discharge limitation imposed by the EPA-approved governing body.").

37 *See* New York State Administrative Procedure Act § 102(2)(b)(iv) (excluding from the definition of "Rule" "interpretive statements and statements of general policy which in themselves have no legal effect but are merely explanatory."

38 *See* Entergy Comments, Attach. 2 at 12.

39 NYSDEC Staff Comments at 2 (emphasis added).

40 Pisces Memo at 3.

Riverkeeper, for example, claims that the HRBMP data used "most in [the NRC's] analysis (table 4-1, page 34) are from 1985 – 2011"; *i.e.*, from the period after Indian Point started operation.[41] In doing so, Riverkeeper again relies, in part, on the Pisces Memo.

1. <u>NYSDEC Staff and Riverkeeper's Claims of the "Impossibility" of Detecting Trends in Fish Populations are False</u>

By way of background, the HRBMP was specifically designed by leading fisheries scientists—and approved and overseen initially by EPA and now by NYSDEC—to monitor the abundance of key, representative Hudson River fish populations over time.[42] It is widely lauded as among the most (if not the most) extensive, complete and robust data sets in existence for the abundance of young of the year estuarine fish[43], and has been characterized by former NYSDEC Staff (to EPA) as "probably, the best dataset on the planet."[44]

The robustness of the HRBMP is apparent even in the briefest description of the program: The HRBMP dataset is a collection of thousands of stratified-random samples of Hudson River aquatic species, taken from various locations over the 153-mile stretch from the Battery to the federal dam at Troy, New York, over a period of 36 continuous years, in a consistent manner, according to statistically rigorous sampling designs and an unparalleled quality-assurance, quality-control system adapted from the U.S. military's weapons program.[45] Multiple types of sampling gear are used to collect ichthyoplankton, as well as juvenile and adult fish, in bottom, water column, and shore zone habitats.[46] By sampling multiple habitats over such a large geographic expanse with multiple gear types, the HRBMP minimizes the risk that a fish species of interest is inadvertently unsampled.[47] Due to its rigorous design, the HRBMP sampling regime also minimizes within-year variability associated with sampling error, which results in precise estimates of annual Hudson River fish abundances that are sufficient to allow the detection of long-term population trends.[48]

Given its widely acknowledged robustness, the HRBMP dataset has for decades not only been used as the basis for regulatory decision-making and fisheries management, but has also been employed as the operative dataset for multiple peer-reviewed publications, including those authored by NYSDEC Staff members, on the status of Hudson River fish populations. For example, the 2015 SPDES permit for Danskammer Generating Station, located approximately 30 miles north of Indian Point on the Hudson River, requires as part of its BTA approval that entrainment estimates be verified against HRBMP Longitudinal River Survey ("LRS") data.[49]

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41 *Id*.

42 *See, e.g.,* HRSA (1980).

43 *See*, *e.g.*, Waldman *et al.* (2016) at 2.

44 *See id*.; *see also* Sarbello (2000) at 17.

45 *See* Mattson (2011b) at 15:14-18:3.

46 *Id*.

47 *Id.*

48 *Id*.

49 *See* March 1, 2015 State Pollutant Discharge Elimination Permit for Danskammer Generating Station, SPDES Number 0006262, Additional Requirement 10 at p. 14 ("the permittee must submit an approvable plan to modify [the Danskammer Alternative Technology Evaluation Model] using the

Likewise, Waldman *et al.* (2006) describe the Hudson River as "one of the most scientifically-studied rivers in the world" in part as a function of the HRBMP dataset, which Dr. Waldman and his colleagues Drs. Limburg and Strayer characterize as being "among the most comprehensive anywhere" and a major contributor to "a golden age of Hudson River research."[50] Similarly, Strayer *et al.* (2004), with his co-authors NYSDEC Staff members Hattala and Kahnle, have for more than a decade analyzed and published their conclusions regarding fish population trends in the Hudson River, including the Indian Point representative important species, based in part on the HRBMP dataset.[51]

In short, insofar as NYSDEC's and Riverkeeper's comments challenge the NRC Staff's reliance on HRBMP data, they are unsupported and contrary to the actual practices of NYSDEC and the scientific community. Therefore, on this basis alone, they merit little to no consideration under NEPA, and fail to identify any errors or flaws in the NRC Staff's analysis in the Draft Supplement.[52]

NYSDEC's and Riverkeeper's overarching claim that population impacts are "impossible" to discern also is demonstrably incorrect as a technical matter. For example, in annual year class reports required by and submitted to NYSDEC since 1974, Entergy's Biological Team has reported long-term population trends for key Hudson River species – trends that NYSDEC Staff have received without ever stating that these required data-collection efforts have no value to its assessment of Indian Point.[53] Further, in connection with the ongoing NYSDEC Proceedings, members of the Biological Team performed an exhaustive analysis of all HRBMP data sets available for the years 1974-2005 (later supplemented by an extended trends analysis that considered data collected through 2009), *the scientific validity of which was never challenged by NYSDEC or Riverkeeper*.[54] In that analysis, they successfully investigated causes of change in these populations using the HRBMP's then nearly four decades worth of data on trends in abundance, early life stage mortality rates, power plant-related mortality, and other factors potentially affecting fish population abundance. Although changes in the abundance of some fish populations were observed, these changes were found to be unrelated to cooling water withdrawals at Indian Point, but clearly related to other activities, most notably overfishing.[55]

Other authors, including NYSDEC Staff, also have been able to detect changes in abundance of Hudson River fish populations, and, like the Biological Team, have attributed

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most recently available Long River Survey and entrainment data so the output of the model more accurately predicts the actual entrainment at Danskammer").

50 *See* Waldman *et al.* (2006) at 1, 2.

51 *See, e.g.,* Strayer *et al.* (2004).

52 Courts have found agencies under no obligation to consider or respond to comments that "are not the product of formal scientific study" or "speculative and divorced from the scientific method" (*Habitat Educ. Ctr., Inc. v. U.S. Forest Serv.*, 593 F. Supp. 2d 1019, 1038 (E.D. Wis. 2009), or are "purely speculative and do not disclose the factual or policy basis on which they rest" *Pub. Citizen, Inc. v. F.A.A.*, 988 F.2d 186, 197 (D.C. Cir. 1993) (citation omitted).

53 NRC Staff are in possession of the annual year class reports.

54 *See* Barnthouse *et al.* (2008); *see also* Barnthouse (2011).

55 Barnthouse *et al.* (2008) at 79.

them to causes other than entrainment and impingement at Indian Point. For example, in their American shad recovery plan, NYSDEC Staff persons Kahnle and Hattala identify "overharvest by directed ocean commercial fisheries and in-river commercial and recreational fisheries" as "the *principal known cause* of the decline in Hudson River American shad."[56] Likewise, Limburg and Waldman (2009) explicitly identify dams, overfishing, water pollution, and climate change as the primary threats to diadromous species, including American Shad and river herring.[57] Even the authors cited in the Pisces Memo (O'Connor *et al.*, 2012) have found that changes in the Hudson River fish community "correlate with local hydrology (freshwater flow and water temperature) and regional climate," but did not attribute any of these changes to cooling water withdrawals, let alone Indian Point's withdrawals.[58]

Moreover, the author of the Pisces Memo, Dr. Richard Seaby, along with his Pisces colleague and Riverkeeper expert witness Dr. Peter Henderson, has published a number of reports and peer-reviewed articles identifying and assessing the potential causes of fish population trends based on a long-term dataset of *monthly* impingement monitoring data from the Hinkley Point 'B' nuclear power station located on the Bristol Channel in Sommerset England.[59] This dataset, though a fraction of the size and breadth of the HRBMP dataset,[60] was in 2001 characterized by Drs. Seaby and Henderson as a relatively robust and continuous dataset.[61] As described below, while Drs. Seaby and Henderson initially hypothesized that the data would show impacts of power plants on fish populations, in publications spanning more than a decade, they repeatedly reported no impacts from power plants, instead concluding that population changes were due to climate change.

In a 2001 report, Drs. Seaby and Henderson analyzed what was then 20 years of data from the Hinkley Point 'B' dataset, stating that some of the principal uses of this dataset are: 1) "it provides for the detection and analysis of ecological change caused by industrial water users such as power stations"; 2) "it provides a robust indicator of recent trends in animal abundance"; 3) it "benefits fisheries management interests"; and 4) "it helps the Hinkley Point power stations to address the concerns of regulatory organizations."[62] Drs. Seaby and Henderson concluded in 2001 that changes in fish abundance were potentially related to changes in temperature, but not to changes in salinity, and although evaluating potential impacts of power plants was a primary goal of their investigation, they concluded at the time that two additional years of data would be useful to focus on potential power plant impacts.[63] Nonetheless, Drs. Seaby and

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56 Kahnle and Hattala (2010) at 1 (emphasis added).

57 *See* Limburg and Waldman (2009) at 960-62.

58 *See* O'Connor *et al.* (2012).

59 Henderson and Seaby (2001) at 1-2.

60 The HRBMP dataset: (1) is substantially larger with far more diverse sampling of different species and life stages (totaling more than 67 million individuals for the HRBMP as compared to 146,000 for Hinckley Point 'B'); (2) is not fixed to a particular location as Hinckley Station is and therefore more representative of diverse population of the entire length of estuary; and (3) reflects a longer continuous period of years than the Hinckley Point 'B' dataset. *See* Normandeau (2015), which is Attachment 1 to these Corrections.

61 Henderson and Seaby (2001) at 11.

62 *Id*. at 2.

63 *Id*. at 1, 4.

Henderson discussed the potential impacts of power plant mortality in terms of whether the number of fish killed would have an impact on the populations as a whole.[64] Thus, in contrast to his comments questioning use of the much more robust HRBMP dataset to identify population trends and assess their possible causes, Dr. Seaby did precisely that in his 2001 Report.

As planned by Drs. Seaby and Henderson (in 2001), and after 25 years of data had been collected (in 2007), Dr. Henderson published a peer-reviewed article on the findings of his investigations into *the cause* of the "increased abundance of common fish and crustaceans at Hinkley Point." He concluded that climate change was the cause.[65]

Subsequently, Drs. Seaby and Henderson reiterated and expanded on their views, publishing a peer reviewed article analyzing the then-30-year-long Hinkley Point 'B' dataset.[66] This paper made no mention of power plant impacts, again linking long-term fish population trends to climate change.[67] Then, in 2015, Dr. Henderson and another colleague published yet another article based on the same Hinkley Point 'B' dataset, then 31-years long.[68] In this article, Dr. Henderson not only made no mention of impacts of power plants on fish populations, but also found high "stability" in the Bristol Channel community based on the long-term persistence of core species, despite the long-term operation of several large-scale, once-through-cooled power plants.[69]

In connection with the ongoing NYSDEC Proceedings, Entergy's Biological Team performed *the same analysis* undertaken by Drs. Seaby and Henderson on the much larger, more comprehensive HRBMP dataset and found similar persistence among the Hudson River species (or populations).[70] Thus, as shown by his own research and publications, and those of his Pisces colleague Dr. Henderson, Dr. Seaby's criticisms in the Pisces Memo regarding the usefulness of the HRBMP dataset for detecting fish population trends, and the possible linkage of such trends to power plants, are unfounded.[71]

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64 *Id*. at 10.

65 Henderson (2007).

66 *See* Henderson *et al.* (2011).

67 *Id*. at 88.

68 *See* Henderson and Magurran (2015).

69 *Id*. at 3-4.

70 *See* Normandeau (2015).

71 To support its position that NRC Staff should focus only on numbers of organisms entrained or impinged because assessing impacts on populations is an "impossibility," NYSDEC Staff cite several documents authored by a member of Entergy's Biological Team, Dr. Lawrence Barnthouse, between 1979 and 2013. As explained in Attachment 2 to these comments, in each instance, NYSDEC Staff's assertions are based on selective quotations and misrepresentations that distort the actual content of those documents. NYSDEC's Staff's misrepresentation of Dr. Barnthouse's previous work is particularly troubling and warrant correction, because they previously have been corrected by Dr. Barnthouse (during the NYSDEC Proceedings). Attachment 2 also presents information that refutes the incorrect statement made by NYSDEC Staff that the 2010 American Shad recovery plan concluded that "impingement and entrainment caused by cooling water withdrawals on the Hudson River must be reduced or eliminated." NYSDEC Staff Comments at 3.

2. Riverkeeper's Claim that Potential Impacts of Indian Point Would be "Invisible" in the HRBMP Dataset is False

As noted above, with respect to its "impossibility" argument, Riverkeeper and Dr. Seaby also cite the fact that most of the HRBMP data used the NRC's analysis are from 1985 – 2011 time frame and thus from the post-startup period.[72] Based on this premise, Dr. Seaby opines in the Pisces Memo that, "if the power plant were impacting the fish populations, much of the impact would be *invisible* using these data, as the station had already been running for more than a decade before the analysis started."[73] Citing the Draft Supplement, Dr. Seaby also hypothesizes that "populations may have responded soon after operation began and subsequently restabilized at lower levels before 1985," which, if true, would not be detected using data starting in 1985.[74]

Riverkeeper's "invisib[ility]" argument is as flawed as NYSDEC Staff and Riverkeeper's "impossibility" claim. First, a portion of the data analyzed by NRC Staff is "the utilities' River wide index, which dominates the HRBMP dataset and reflects data from 1974-2011."[75] Indian Point Unit 2 began operation in 1974 and Unit 3 in 1976. Thus, the predominant portion of the data used by NRC antedates the time at which both units were operational. Indeed, these data are presented by Pisces in Section 4 of its 2015 Report and cited in the Pisces Memo, which contains a series of graphs depicting annual juvenile abundance indices for 13 species of fish, 11 of which extend back to 1974.[76] Further, these Pisces graphs show no such initial decline in populations after 1976 and no subsequent restabilization at lower levels.[77]

As described in the Draft Supplement, the first step in NRC's two-step analysis is to apply a simple linear regression to HRBMP data to determine whether there are long-term trends (declines) in the Hudson River fish populations.[78] If Indian Point were having an effect, then the NRC's model would predict a continuing decline in abundance over the plant's *operational* history, which would manifest as a statistically significant downward trend in abundance following the plant's startup. Therefore, the NRC's analysis would detect such a population trend, regardless of whether data are available from before the plant was operational. This, too, is presumptively known to Riverkeeper and Dr. Seaby, as the Hinkley "B" dataset analyzed by Drs. Seaby and Henderson ostensibly for the purpose of evaluating power plant impacts also includes no pre-operation data.[79]

Striped Bass provide a clear example of how specific population trends, and the causes of those trends, are both readily knowable and known (*i.e.*, possible and visible) to NYSDEC

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72 Pisces Memo at 3.

73 *Id*.

74 *Id*. (Emphasis added).

75 *Id*.

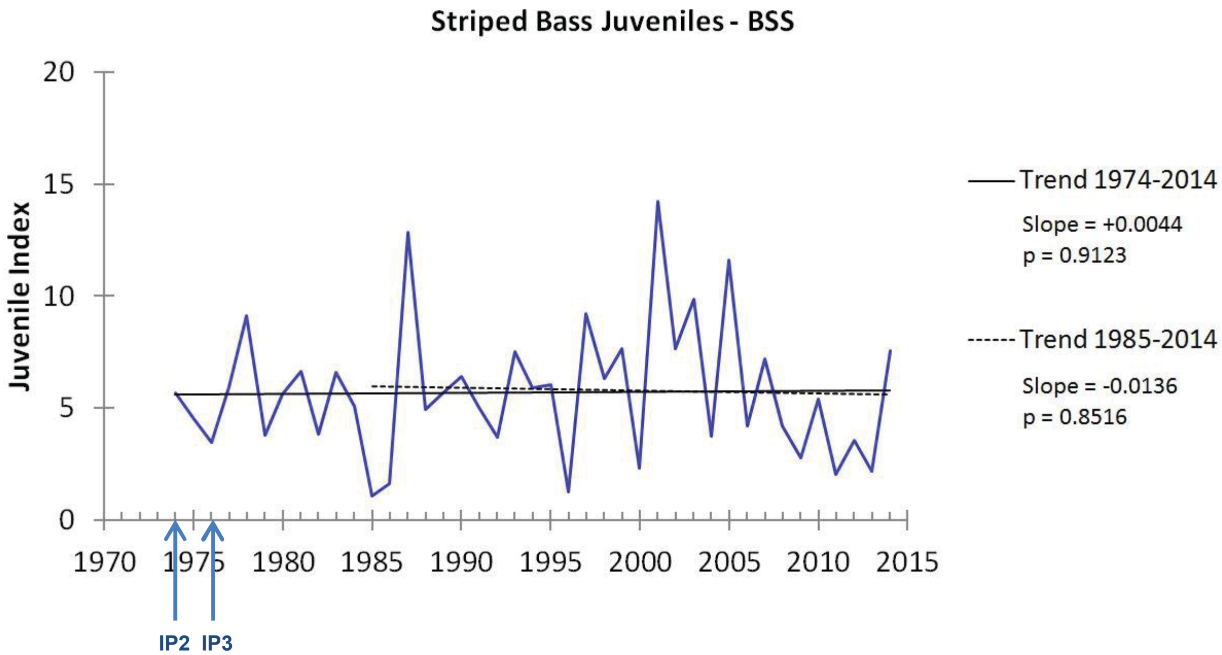
76 *See* Henderson and Seaby (2015) (the "2015 Pisces Report") at 16-35. Data for all species except Bay Anchovy and Weakfish extend to 1974.

77 *Id.*

78 *See* Draft Supplement, Appendix A at A-20.

79 *See*, *e.g.*, Henderson and Seaby (2001); Henderson *et al.* (2011).

Staff, to federal fisheries managers, and to the scientific community. Striped Bass are the species entrained in greatest numbers at Indian Point, accounting for approximately 60.5% of all individuals entrained between 2001 and 2007.[80] Because of its susceptibility to entrainment and its importance to commercial and recreational fisheries, the Striped Bass species has historically been a focus of the HRBMP. The plot below shows the abundance of juvenile striped bass collected by the HRBMP Beach Seine Survey ("BSS") in the Hudson River from 1974 through 2014 as reported in Figure 4-8 of the 2014 HRBMP Year Class Report.[81] The beginning of Unit 2 and Unit 3 operations, in 1974 and 1976, respectively, are indicated by two arrows.



The absence of a response in the Hudson River Striped Bass population to Indian Point commencing operations is not unexpected, as Barnthouse *et al.* (2008) found no impact of more than 30 years of Indian Point operations on the abundance of Striped Bass or any other examined species.[82] As a straight-forward means of putting into perspective the relative magnitude of Indian Point's entrainment of Striped Bass, Entergy's Biological Team compared available data on the number of early ("age-0") life stages of Striped Bass entrained at Indian Point (*i.e.*, the years 1981 and 1983 - 1987) to estimates of Hudson River Striped Bass abundance for the same life stages and years. The results of this analysis, which is set forth in Attachment 3 to these supplemental comments, are summarized in the table below.

Summary of Average (1981, 1983-1987) Indian Point Entrainment Losses Compared to Estimates of Number of Hudson River Striped Bass Entering Lifestages

Age-0 Lifestage	Average Number of Striped Bass	Average Estimated Entrainment Losses	Average Percentage of Lifestage Lost

80 *See* Mattson (2011) at 1825:13-1926:7.

81 ASA Analysis and Communications (2014) at Figure 4-8.

82 *See* Barnthouse *et al.* (2008).

	Entering Lifestage	**of Lifestage**	
Eggs	754,230,877,570	253,083	< 0.001%
Yolk-sac Larvae	189,748,312,852	4,640,833	0.004%
Post Yolk-sac Larvae	20,608,395,160	41,383,333	0.233%
Young-of-Year Juveniles	130,771,798	266,717	0.316%

As the above summary shows, for all age-0 life stages, Indian Point's average entrainment losses of Striped Bass over the years 1981 and 1983-1987 was well below 1% of the estimated Hudson River population of those lifestages. The small number of relevant lifestages entrained annually relative to the very large numbers of individuals entering those lifestages provides some perspective on the ability of Indian Point to impact the Hudson River population of Striped Bass. It also highlights the inappropriateness of NYSDEC Staff's continued focus on the number of individuals entrained with no consideration of whether those numbers are of ecological significance.

In contrast to the absence of evidence that Indian Point impacts, or could impact, the Hudson River Striped Bass population, this population has been shown to respond strongly to fisheries management policies. As Barnthouse *et al.* (2008) explained:

> Fishing indirectly affects the abundance of early life stages of fish by reducing the abundance of spawning adults (Goodyear 1993). If a population is being overfished, then reducing the rate of fishing should cause the spawning population, and therefore the number of eggs spawned, to increase. As discussed by Young-Dubovsky *et al.* (1994), a coastwide ban on harvesting of striped bass was imposed in 1986. Estimates of fishing mortality and adult population abundance developed by the ASMFC (2005) show that the coastwide adult population has increased greatly since 1986. [T]he abundance of striped bass PYSL began increasing in 1988 and increased steadily throughout the 1990s. This is the same period during which the adult striped bass population was expanding.[83]

The ability to greatly influence fish populations through regulation of fishing is well known to NYSDEC Staff. In a 2006 book chapter titled "Fisheries of the Hudson River," which was co-authored by NYSDEC Staff persons Hattala and Kahnle, along with respected academic fish biologists Limburg and Waldman, the authors describe the regulations enacted in the 1980s to restrict both commercial and recreational fishing of Striped Bass.[84] As recounted by the authors, "[t]he effect of these regulations was startling, not only for the Chesapeake stock, but for other striped bass stocks along the coast. *The coastal protective measures immediately protected immature fish of the Hudson spawning stock of striped bass*."[85] Thus, there is no

83 Barnthouse *et al.* (2008) at 33.

84 *See* Limburg *et al.* (2006).

85 *Id.* at 193 (emphasis added).

question that controlling fishing can change populations from year to year, while regulating power plant cooling water intakes achieves nothing.[86]

As explained by Barnthouse (2013), one of the key reasons why fishing has such a powerful influence on fish populations relative to entrainment is because:

> Hudson River striped bass are susceptible to entrainment for only a few months, and to impingement primarily during their first year of life. In contrast, striped bass first become susceptible to fishing at an age of 2 years and become fully recruited to the fishery at age 5 (ASMFC, 1998). They continue to be susceptible to fishermen for the remainder of their lifespan of up to 30 years.[87]

The rapid recovery of the Striped Bass population following the 1980s fisheries regulations stands in stark contrast to the lack of response of the American Shad population to the virtual elimination of 85% of power plant-related mortality discussed in Attachment 2 to these Corrections. Thus, it further highlights the peer-reviewed scientific literature and unavoidable fact that properly managing commercial and recreational fishing, and not entrainment mortality, is the key to maintaining Hudson River fish populations.

3. Riverkeeper's Aquatic Ecosystem Instability Argument is Unsupported

In addition to its "impossibility" and "invisibility" arguments, Riverkeeper offers a third (and also specious) argument. Specifically, Riverkeeper claims that Hudson River warming has "contributed to changes in the fish community," and quotes from the 2015 Pisces Report for the proposition that "[a]ll the evidence points to the Hudson ecosystem presently being in a state of change, with declining stability. Neither the ecosystem as a whole nor many of the individual species' population are in a healthy state." [88]

Riverkeeper's position regarding aquatic stability previously has been shown to be erroneous and even contrary to the findings of NYSDEC.[89] In 2014, Riverkeeper submitted similar comments objecting to NYSDEC's draft SPDES permit for the continued operation of Danskammer Generating Station ("Danskammer"), claiming that Danskammer operations have "directly or indirectly destabilized the Hudson River ecosystem."[90] In its January 21, 2015 response, NYSDEC Staff adopted the conclusions of two peer-reviewed publications by long-time Hudson River researchers:

> Finally, after thoroughly reviewing the changes (both positive and negative) in several stocks of Hudson River fish species, Daniels

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86 By comparison, as explained in Attachment 2 to these Corrections, the decommissioning of the once-through-cooled Albany Steam Station and repowering as the closed-cycle-cooled Bethlehem Energy Center in 2005 virtually eliminated 85% of all power plant-related American Shad mortality in the Hudson River, with no recovery in the Shad population.

87 Barnthouse (2013) at 154.

88 Pisces Memo at 3.

89 *See*, *e.g.*, ASA Analysis and Communications, Inc. (2015).

90 NYSDEC (2015c) at 7.

> *et al*. (2005) concluded that ***the Hudson River fish assemblage was remarkably resilient, rich, and dynamic***. The causes the authors attribute to the observed changes in some of the populations include: increased number of alien fishes in the drainage, the establishment of zebra mussels in the estuary, and abiotic factors associates with land use, urbanization, nonpoint source pollution, and climate change (at p. 484). Strayer *et al*. (2014) attributed changes in the Hudson River ecosystem to biological invasions, climate change, extreme weather events, and changes in the harvests of fishes. None of the authors of these two peer reviewed journal articles concluded, as Riverkeeper commented, that "[a]ll the evidence points to the Hudson estuary ecosystem presently in a state of change with declining stability." ***The fact that there has been change in the Hudson River ecosystem does not imply the ecosystem is declining in stability or is unhealthy***. Riverkeeper's comments on the causes of fish population change, and the "health" of the Hudson River do not accurately reflect the current scientific understanding presented in recent peer reviewed publications.[91]

Thus, as recently as January 2015, NYSDEC Staff expressed the view that the Hudson River fish community is "remarkably resilient, rich, and dynamic," and neither "declining in stability" nor "unhealthy." Moreover, NYSDEC Staff adopted the conclusions of both articles regarding the cause of observed changes to the Hudson River fish community, none of which was related to Indian Point operations.

Riverkeeper and its consultants also have praised the quality of the Hudson River estuary. In 2002, Riverkeeper's Vice Chair and Chief Prosecuting Attorney Robert F. Kennedy, Jr. stated: "[t]he Hudson River has seen dramatic recovery since the 1960s. Back then, the River was considered an open sewer. Today, it is the only large river in the North Atlantic that retains strong spawning stocks of its entire collection of historical migratory species."[92] Moreover, in 2010, Riverkeeper's expert biological consultant in the NYSDEC Proceedings, Dr. Peter Henderson, wrote: "the Hudson River is one of the healthiest estuaries on the Atlantic Coast. Its rich history and striking environmental recovery have made it one of the nation's 14 American Heritage Rivers. As the Historical Timeline . . . shows, the cycles of fish population strength have continued from the late 1960s to the present day."[93]

4. <u>NYSDEC Staff's Claim that NRC Staff's Entrainment Estimates are Not Conservative is Unsupported</u>

Finally, DEC Staff questions whether the NRC's estimates of entrainment are in fact "highly conservative."[94] NYSDEC Staff's own calculations reflect that the NRC Staff's estimates for three of six species (Striped Bass, White Perch and Atlantic Tomcod) exceed reported

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91 *Id*. (Emphasis added). *Citing* Daniels et al. (2005); Strayer et al. (2014).

92 Kennedy (2002). (Emphasis supplied).

93 Speight and Henderson (2010), at 167.

94 *See* NYSDEC Staff Comments at 5.

entrainment by at least 252% and another two species (Bay Anchovy and American Shad) are essentially the same.[95] As explained in Attachment 5 to these Corrections, the one species for which NRC's estimate is lower than NYSDEC Staff's (River Herring) is a function of the use of different datasets.

E. DOI's Comments on the NRC Staff's Aquatic Impacts Assessment Lack a Technical Basis and Clearly Exceed Its Jurisdiction and Expertise

In its March 2, 2016 Comments ("DOI Staff's Comments"), DOI Staff state that "[t]he most effective" of the three entrainment-reduction measures being considered by NYSDEC Staff—cylindrical wedgewire screens, permanent mandatory summertime outages and cooling towers—"would be cooling towers."[96] According to DOI Staff, with cooling towers "fishery resources would no longer be susceptible to continuous entrainment impacts as under the current situation."[97] DOI Staff also reasons that it is possible to retrofit Indian Point with cooling towers because "[c]ooling towers … have been used elsewhere for many years." DOI Staff thus concludes that cooling towers "represent the Best Available Technology [*sic*, Best Technology Available ("BTA")] to minimize fish entrainment at Indian Point," and recommends "that cooling towers be installed to minimize fish entrainment."[98] DOI Staff also comments on the purported impacts of Indian Point on the populations of certain fish species.

DOI Staff's Comments are inconsistent with the evidence developed during years of litigation in the NYSDEC Proceedings, as reflected in thousands of pages of prefiled and live testimony, expert reports and exhibits.[99] DOI's error may be attributed to its non-party status in the SPDES Proceedings. The *only* factual basis that DOI Staff cited in support of their Comments is a "personal communication" with William Little.[100] Mr. Little is trial counsel to NYSDEC Staff, and therefore adverse to Entergy in the NYSDEC Proceeding. DOI Staff's Comments do not reveal what the substance of the communication from Mr. Little was, including what, if any, factual basis Mr. Little supplied to DOI Staff and whether he supplied DOI Staff any of the voluminous evidence from the NYSDEC Proceedings. Thus, DOI Staff's Comments lack sufficient factual support and credibility to warrant substantive consideration by the NRC.

DOI Staff's Comments also are deficient as a matter of NEPA law. "[C]omments must be significant enough to step over a threshold requirement of materiality before any lack of agency response or consideration becomes of concern."[101] A comment "cannot," for instance, "merely state that a particular mistake was made; it must show why the mistake was of possible

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95 *See id.* at 7.

96 DOI Staff's Comments at 2.

97 *Id.*

98 *Id.*

99 *See Matter of Entergy Nuclear Indian Point 2, LLC*, NYSDEC Dkt. No. 3-5522-00011/00004; *see also*, *e.g.*, *Luminant Generation Co. LLC* (Comanche Peak Nuclear Power Plant, Units 2 and 3), CLI-12-7, 75 NRC 379, 391-92 (2012) (citations omitted) ("NEPA requires that we conduct our environmental review with the best information available today.").

100 DOI Staff's Comments at 1.

101 *Vt. Yankee Nuclear Power Corp. v. Natural Res. Def. Council, Inc.*, 435 U.S. 519, 553 (1978) (citation omitted).

significance in the results."[102] Courts have accordingly found agencies under no obligation to consider or respond to comments that, *e.g.*, "consist[] of three sentences without any citation to scientific authority,"[103] are "not the product of a formal scientific study" or "speculative and divorced from the scientific method,"[104] or are "purely speculative and do not disclose the factual or policy basis on which they rest."[105] Under that standard, DOI Staff's Comments are insufficient to require consideration by or a response from NRC Staff. Finally, DOI Staff are not responsible for, and do not possess the technical expertise necessary for making, BTA determinations under Section 316(b) of the CWA. Rather, those decisions are made by EPA or delegated state decisionmakers. Therefore, the DOI Staff's position on BTA issues is not entitled to any deference, particularly when it contradicts EPA's conclusion.[106]

DOI Staff also asserts that cooling towers can be *retrofitted* and operated at Indian Point, because they "have been used elsewhere for many years."[107] As an initial matter, in assessing the environmental impacts of alternatives to license renewal, the NRC Staff considered the impacts that may result if the Indian Point facility converts from once-through cooling to a closed-cycle cooling system in 2010 FSEIS. Section 8.1.1 ("Closed-Cycle Cooling Alternative") describes the Staff's analysis and the resulting environmental impact findings. Nonetheless, the FSEIS states that, "[r]egardless of the NRC staff's findings, the NRC does not have the regulatory authority to implement the requirements of the Clean Water Act (CWA), and it is not up to the NRC staff to judge the validity of Entergy's or others' claims in the ongoing NYSDEC SPDES permit process."[108]

As reflected in the FSEIS, retrofitting a space-constrained, operating, two-unit nuclear generation facility with cooling towers would be an extraordinarily complex undertaking, and in fact it never has been done at any operating nuclear facility in the United States.[109] That a new facility located on a spacious site can be designed and built to incorporate closed-cycle cooling does not mean that any given existing facility can be retrofitted to use closed-cycle cooling. In part for this reason, EPA's Section 316(b) regulations recognize that BTA selection for existing generation facilities is inherently site-specific, and further that "there is no single technology basis that is BTA for entrainment at existing facilities, but instead a number of factors that are best accounted for on a site-specific basis" which could result in rejection of closed-cycle cooling:

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102 *Id*.

103 *Conservation Law Found. of New England, Inc. v. Andrus*, 623 F.2d 712, 718 (1st Cir. 1979)

104 *Habitat Educ. Ctr., Inc. v. U.S. Forest Serv.*, 593 F. Supp. 2d 1019, 1038 (E.D. Wis. 2009).

105 *Pub. Citizen, Inc. v. F.A.A.*, 988 F.2d 186, 197 (D.C. Cir. 1993) (citation omitted).

106 *See Scheduled Airlines Traffic Offices, Inc. v. Dep't of Def.*, 87 F.3d 1356, 1361 (D.C. Cir. 1996) (holding that agency is not entitled to deference in its application of a statute that it is not charged with administering, or as to matters otherwise beyond its technical expertise).

107 DOI Staff's Comments at 2.

108 FSEIS, Vol. 1 at 8-4.

109 *See* FSEIS, Vol. 1 at 8-4 ("In addition, Entergy asserts that retrofitting facilities the size and configuration of IP2 and IP3 with a closed-cycle cooling system is neither tried nor proven."); *see also* Beaver (2014b) at 13:1-13.

> Site-specific decision making may lead to a determination by the NPDES permitting authority that entrainment requirements should be based on variable screen pumps, water reuse, fine mesh screens, a closed-cycle recirculating system, or some combination of technologies that constitutes BTA for the individual site. The site-specific decision-making may also lead to no additional technologies being required.[110]

EPA's regulations also set forth a highly sophisticated process for site-specific BTA determinations for particular facilities.[111] These site-specific determinations require extensive analysis of site-specific feasibility, as well as the weighing of costs and benefits of the retrofit.[112]

Further, DOI Staff's conclusion that closed-cycle cooling is BTA for Indian Point is contrary to the undisputed evidence in the ongoing NYSDEC Proceedings. In months of hearings spread over several years, the parties in the NYSDEC Proceedings have submitted evidence addressing both the engineering feasibility of installing cooling towers at Indian Point (including in light of acknowledged siting conflicts)[113], and whether the installation of cooling towers at Indian Point would comply with federal, state, and local environmental regulations.[114] No witness in the NYSDEC Proceedings offered qualified testimony that closed-cycle cooling is available at Indian Point on a site-specific basis. NYSDEC Staff's only two witnesses were a piping engineer and an environmental manager for mining projects, neither of whom had any nuclear experience and neither of whom actually opined that closed-cycle cooling is feasible at Indian Point.[115] Entergy's nuclear engineering witnesses, on the other hand, identified a variety of major, unresolved barriers to the retrofitting of Indian Point with closed-cycle cooling, including a number of nuclear safety concerns and detrimental impacts to operations.[116] Echoing NRC Staff's conclusions, the evidence at the NYSDEC Proceedings also demonstrates that a closed-cycle cooling retrofit of Indian Point will have numerous, significant, unresolved adverse environmental impacts,[117] and is also unlikely to receive necessary state and local

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110 EPA Final Rule, National Pollutant Discharge Elimination System—Final Regulations To Establish Requirements for Cooling Water Intake Structures at Existing Facilities and Amend Requirements at Phase I Facilities, 79 Fed. Reg. 48,300, 48,303 (Aug. 14, 2014).

111 *Id*. at 48,369-73.

112 *See, e.g.*, EPA – New England, Clean Water Act NPDES Permitting Determinations for the Thermal Discharge and Cooling Water Intake Structures at Merrimack Station in Bow, NH (NPDES Permit No. NH 0001465), Chapters 10-11, *available at* https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/MerrimackStationAttachD.pdf; EPA – New England, Clean Water Act NPDES Permitting Determinations for Brayton Point Station's Thermal Discharge and Cooling Water Intake in Somerset, MA (NPDES Permit No. MA 0003654) (2002), Chapters 7-8, *available at* https://www3.epa.gov/region1/npdes/braytonpoint/pdfs/BRAYTONchapters7-8.PDF.

113 *See, e.g.*, Beaver (2014a) at 6:13-23; Beaver (2014b) at 13:1-16.

114 *See, e.g.*, Young (2014) at 5:2-7:17; NYSDEC (2014e) at 11359-60 (testimony of Kevin Young); Main (2014) at 26:11-17.

115 *See, e.g.*, NYSDEC (2014a) at 7414-15, 7429, 7438, 7442-43 (testimony of Tim Havey), 7417-18 (testimony of Eduardo Ortiz); Ortiz (2014) at 4:19-5:2.

116 *See, e.g.*, Beaver (2014a) at 6:13-23, 8:15-10:8; Beaver (2014b) at 32:8-22, 43:16-44:2; Enercon (2013b) at 42-45; NYSDEC (2014f) at 11904-06 (testimony of Richard Clubb and Yan Kishinevsky).

117 TRC (2013).

environmental and zoning permits and authorizations.[118] None of these circumstances are addressed by DOI Staff.

Similarly contrary to record evidence in the NYSDEC Proceedings is DOI Staff's comment that closed-cycle cooling would be the "most effective" technology for reducing entrainment at Indian Point. First, a claim that closed-cycle cooling is more effective on an annual basis at reducing entrainment requires an assumption that the cooling towers are allowed to operate continuously year-round.[119] That assumption is contrary to the record evidence; neither of the proposed cooling tower configurations presently under consideration by NYSDEC Staff is likely to receive the necessary air permits required for year-round operation (due to significant particular matter emissions), with the result that cooling towers would be able to operate as little as 43% of the calendar year, dramatically reducing their entrainment-reduction efficacy to below that of cylindrical wedgewire screens.[120]

Second, the record evidence in the NYSDEC Proceedings is that the construction and installation of closed-cycle cooling at Indian Point would take more than a decade to complete after final resolution, in judicial proceedings, of any SPDES permit; by contrast, the competing cylindrical wedgewire screen proposal can be installed and begin to operate much earlier, in just six years.[121] The consequence of the substantial delay in the implementation of closed-cycle cooling at Indian Point is that, in the aggregate over the remaining Indian Point license renewal term, cylindrical wedgewire screens will be more effective at reducing entrainment than closed-cycle cooling, even in the unlikely event that closed-cycle cooling is allowed to operate year-round.[122]

Third, the credible scientific evidence in the NYSDEC proceeding demonstrates that the differences in annual efficacy between closed-cycle cooling (operating year round) and cylindrical wedgewire screens are at most minor. Accounting for the fact that more than 40% of organisms entrained survive passage through Indian Point's cooling water system[123], and converting entrainment mortality to age-1 equivalents as EPA does,[124] cylindrical wedgewire screens would achieve annual entrainment reductions of up to 93%, as compared to the 96% expected for cooling towers.[125]

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118 *See supra* notes 113-114, 116.

119 *See* NYSDEC (2014b) at 9231:18-22; Nieder (2014) at 13:14-14:2; *see also* Sedefian (2014) at 3:29-5:3; Valis (2014) at 2:23-3:8.

120 *See* TRC (2013), § 4.3.2.2, at p. 4-7; TRC (2009) at p. 1-4; Enercon (2010) at 14 & tbl. 5.1, App. B, and App. C at 43 tbl. 1, 44 tbl. 2, 45 tbl. 3.

121 *See* Tetra Tech (2013), Appendix B, at 3; Tetra Tech (2014); NYSDEC (2014a) at 7662:22-7663:9; NERA (2013) at 8; Enercon (2013).

122 *See* NYSDEC (2014d) at 10074:14-10075:16, 10311:4-10312:18.

123 *See* ASA Analysis and Communications (2011) at 3, tbl. 1, case 4.1.

124 Expressing entrainment mortality as age-1 equivalents accounts for the very high natural mortality rate of early life stages by converting mortality of eggs and larvae to the number of one-year-old fish those eggs and larvae would have grown into, had they survived.

125 *See* Barnthouse (2011) at 33:12-13; 48:8-12, Mattson *et al*. (2011) at 10:1-5 (Testimony of Dr. Young).

Finally, DOI Staff's comment that Indian Point entrainment "impacts a variety of freshwater and estuarine fishery resources, in particular blueback herring . . . and rainbow smelt"[126] cites no supporting information. It also is belied by the uncontroverted evidence from the NYSDEC proceeding, which demonstrates that Indian Point entrainment has had no discernible impact on Hudson River fish populations, including both blueback herring and rainbow smelt.[127] In addition, as Entergy explained in its comments on the Draft Supplement, blueback herring are susceptible to entrainment at Indian Point only in infrequent years with unusually high flow events in the May 1 to June 15 timeframe.[128] Rainbow smelt suffered a rapid population collapse the mid-1990s for reasons wholly unrelated to Indian Point's operation and have been virtually absent from the Hudson River since then.[129] As such, DOI Staff's claims regarding Indian Point's impacts on Hudson River fisheries resources are contrary to the available evidence.

III. Entergy's Corrections to Comments Concerning the No-Action Alternative and Other Potential Sources of Baseload Power Generation Capability

In its March 4, 2016 Comments, Riverkeeper contends that the Draft Supplement does not address new and significant information regarding the benefits of the no-action alternative. Specifically, it asserts that "[r]ecent developments, not evaluated in the [Draft Supplement], demonstrate that closing IPEC is a viable option that would avoid or mitigate potential impacts because New Yorkers' energy needs can be met today, with full reliability, without IPEC, even in peak demand Summer months."[130] More specifically, Riverkeeper cites the following "[r]ecent developments" as supporting its position that Indian Point is not needed for the New York State electric system to operate reliably:

1. Increases in downstate generation totaling 1047 MW, including the return of the Danskammer, Astoria, and Bowline power plants;[131]

2. Increases in downstate transmission capability totaling 400 MW, represented by the so-called "Transmission Owner Transmission Solutions" ("TOTS") projects mandated by order of the New York State Public Service Commission ("NYSPSC");[132]

3. Increases in energy efficiency achieved through Consolidated Edison's so-called "DR/EE/CHP" program;[133] and

4. Reductions in forecasted load (*i.e.*, demand for electricity), including reductions that are due to increases in distributed renewable energy (*e.g.*, residential solar panels).[134]

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[126] DOI Staff's Comments at 1.

[127] *See* generally Barnthouse *et al*. (2008).

[128] *See* Entergy Comments, Attach. 2 at 10-13.

[129] *See id*. at 7-10.

[130] *See* Riverkeeper Comments at 8-12.

[131] *See id.* at 9.

[132] *See id.* at 9-10.

[133] *See id.* at 10.

The evidence Riverkeeper cites does not support its conclusion. To the contrary, New York State regulators have looked at the very same evidence and concluded that Indian Point remains necessary to the New York electric system. In particular, the New York Independent System Operator ("NYISO"), the regulatory body responsible for ensuring the present and future reliability of the New York electric system, recently studied the reliability implications of Indian Point's hypothetical retirement in its 2014 Comprehensive Reliability Plan ("CRP"). NYISO found that, "[i]f the Indian Point Plant becomes unavailable in 2016, even with the additional resources modeled in the 2014 CRP, reliability violations would still occur immediately in 2016 … requiring approximately 500 MW in compensatory MW in SENY [southeast New York, comprising the Lower Hudson Valley, New York City and Long Island] to satisfy resource adequacy criteria."[135]

In pointing to potential resources to bridge the 500 MW gap for 2016, Riverkeeper does not acknowledge NYISO already took into account most the very same "[r]ecent developments" that Riverkeeper points to, yet still found a resource gap. NYISO's 2014 CRP reliability study already assumed, for example, that the Danksammer, Bowline and Astoria plants would return to service by the summer of 2016.[136] NYISO likewise factored in for 2016 the transmission improvements represented by the TOTS projects, as well as full achievement of the energy efficiency goals established as part of the DR/EE/CHP program.[137] Even with those additional resources, however, NYISO's study still concludes that Indian Point's unavailability in 2016 would cause "immediate[]" violations of system-reliability criteria.[138] Riverkeeper therefore cannot rely on these "[r]ecent developments" to establish that the electric system no longer needs Indian Point's generating capacity; NYISO's analysis demonstrates that to be untrue.

Riverkeeper's focus on 2016 is also entirely myopic, as NYISO projects that reliability violations in the absence of Indian Point would increase in severity over time. The 2014 CRP predicts an increasing loss of load expectation ("LOLE"), indicative of a worsening resource adequacy and system reliability picture over time, through the year 2024 for both for southeastern New York ("SENY," represented by zones G-K) and on a statewide basis, as shown in Table 6 of the CRP below, where a result over 0.10 equals a violation of mandated system reliability criteria.[139]

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[134] *See id.* at 9, 10-12.

[135] NYISO (2015a) at 23.

[136] *See id.* at 6 (Table).

[137] *Id.*

[138] *Id.* at 23.

[139] *See id.* at 23 (Table 6).

Table 6: LOLE Results IP Scenario

Year	A	B	C	D	E	F	G	H	I	J	K	NYCA	NYBA
Y2015	-	-	-	-	-	-	-	-	-	-	-	-	0.01
Y2016	0	0.04	0	0	0.04	0	0.02	0.17	0.17	0.15	0.07	0.17	0.17
Y2017	0	0.03	0.00	0	0.03	0	0.02	0.20	0.20	0.19	0.09	0.21	0.21
Y2018	0	0.03	0.00	0	0.03	0	0.03	0.25	0.25	0.23	0.13	0.25	0.25
Y2019	0	0.03	0.00	0	0.04	0.00	0.03	0.30	0.30	0.27	0.17	0.30	0.30
Y2020	0	0.03	0.00	0	0.04	0.00	0.04	0.33	0.33	0.30	0.20	0.33	0.33
Y2021	0	0.04	0.00	0	0.04	0.00	0.04	0.39	0.39	0.36	0.26	0.39	0.39
Y2022	0	0.04	0.00	0	0.04	0.00	0.05	0.46	0.46	0.42	0.33	0.46	0.46
Y2023	0	0.04	0.00	0	0.05	0.00	0.06	0.54	0.54	0.49	0.41	0.54	0.54
Y2024	0.00	0.04	0.00	0	0.05	0.00	0.07	0.62	0.62	0.56	0.49	0.62	0.62

The 2014 CRP's modeling analysis likewise predicts that capacity margins, *i.e.*, the number of MW of generation that can be removed from service without an LOLE violation, in SENY and statewide will decrease every year until 2024, as reflected in Table 5 of the CRP below.[140] "Zonal capacity at risk" represents the amount of capacity that is needed in order to avoid a violation of NYISO's reliability criteria. Put differently, the -1500 MW figure reported in SENY for the year 2016 means that NYISO expects there to be a 1500 MW surplus of excess capacity beyond what is needed to assure system reliability in that year. Removing Indian Point's approximately 2,000 MW of capacity in SENY, however, turns that 1,500 MW surplus into the 500 MW shortfall in 2016 that the CRP reported.[141] In 2020, when the expected surplus in SENY is projected to be only 800 MW, removing Indian Point produces a shortfall in SENY of 1,200 MW. By the year 2024, the expected surplus in SENY would be only 10 MW, it would be necessary to bring in 1,990 MW of replacement capacity to keep the electric system functioning reliably in the absence of Indian Point.

Table 5: Zonal Capacity at Risk of 2014 CRP

Year	Zone J	Zone K	Zones A-F	Zones G-J	Zones G-K	Zones A-K	Zones A-E
Y2015	-1300	-800	-3500	-1300	-1300	-2300	-3400
Y2016	-1500	-800	-3200	-1500	-1500	-2400	-3200
Y2017	-1300	-700	-3100	-1300	-1300	-2000	-3200
Y2018	-1100	-600	-3000	-1100	-1000	-1700	-3000
Y2019	-900	-550	-2600	-1000	-900	-1500	-2700
Y2020	-800	-500	-2400	-800	-800	-1300	-2400
Y2021	-600	-400	-2100	-600	-600	-1000	-2100
Y2022	-400	-300	-1500	-400	-400	-700	-1600
Y2023	-200	-100	-900	-200	-200	-300	-900
Y2024	-15	-10	-45	-10	-10	-15	-35

Riverkeeper's reliance on reduced load forecasts to protect electric system reliability in the absence of Indian Point is equally inconsistent with the available evidence.[142] The best evidence, including testimony provided by members of the New York State Department of

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140 *See id.* at 21-22 & Table 5.

141 *Id.* at 23.

142 *See* Riverkeeper Comments at 10-11.

Public Service ("NYSDPS") Staff in the NYSDEC SPDES/WQC proceeding, refutes Riverkeeper's reliance on reduced load forecasts. While the 2015 NYISO "Gold Book" forecast that Riverkeeper cites may ameliorate the future outlook somewhat, it contains no finding that the New York electric system will satisfy electric system reliability criteria in Indian Point's absence over any time horizon. In fact, the 2015 Gold Book predicts that peak loads in SENY and statewide will continue to increase, even if by less than NYISO previously anticipated.[143] Moreover, Riverkeeper does not acknowledge the possibility that projected load forecasts may increase in the future, as has happened previously.[144]

Recent testimony in the NYSDEC proceeding from NYSDPS Staff witnesses who have extensive experience in electric-system reliability matters confirms that, despite the reduced load forecast in the 2015 Gold Book, one still can expect "a worsening reliability picture over time."[145] As a NYSDPS Staff witness explained, "as you march through time, load is growing," meaning that less capacity can be lost in future years without violating system-reliability criteria.[146] That witness further testified that, "[c]apacity coming on the system is necessary" in order "to address the reliability issues" that would be created by Indian Point's retirement.[147]

Riverkeeper's comments also incorrectly assume a perfectly linear relationship between forecasted load reductions and the need for compensatory MW—in other words, that a 500 MW reduction in projected peak load allows a 500 MW reduction in generation capacity while maintaining electric system reliability. The NYSDPS Staff witness explained in the NYSDEC proceeding that the relationship between load and generation needs is "not necessarily linear, [or] one for one."[148] He further testified that, while the reductions in the load forecast likely have reduced the need for compensatory MW if Indian Point were to retire, the amount of compensatory MW needed still "would probably be something above zero."[149]

Riverkeeper's Comments completely fail to address other, important aspects of electric-system reliability that might be adversely affected in the event that Indian Point retires.[150] These include voltage support and transmission security. The undisputed evidence in the NYSDEC proceeding demonstrates that Indian Point supplies voltage support at a critical location within the New York State electric system, in "very close" proximity to the transmission interface

143 *See* NYISO (2015b) at 12 (Table I-2a).

144 *See* Harrison & Meehan (2015) at 31 (Table).

145 NYSDEC (2015a) at 13488:8-13489:1.

146 *Id.* at 13547:11-20.

147 NYSDEC (2015a) at 13472:3-8; *see also id.* at 13549:16-13550:6 (agreeing that immediate reliability violations would ensue if Indian Point were to be unavailable during the summertime in the years 2016-2024, and that replacement capacity is necessary to address these concerns).

148 NYSDEC (2015a) at 13433:20-13534:5. *See also* NYSDEC (2015b) (Dr. Marczewski, testifying for New York City that "500 megawatts of compensatory megawatts, as found in the 2014 CRP, does not necessarily get reduced one for one just because the load forecasts happen to change").

149 NYSDEC (2015a) at 13490:10-13491:6.

150 *See* NYSDEC (2015a) at 13532:13533:16 (Gjonaj) (testifying that determining whether there is a need for compensatory MW or additional capacity is only a "first cut" and "one facet of reliability planning," which addresses other issues as well).

between upstate and southeast New York.[151] That voltage support helps other generating units operate "in a coherent manner" and reduces the risk of problems that could lead to system failures or even blackouts.[152] Importantly, voltage support is location-dependent, meaning that voltage support currently provided by Indian Point cannot be entirely replaced by generation units in different locations.[153] With respect to the related issue of transmission security, NYISO's most recent study found that "[s]ignificant violations of transmission security … criteria would occur in 2016 if the Indian Point Plant were to be retired as of that time."[154]

Finally, Riverkeeper's Comments fail to address the adverse air quality and climate change impacts that Indian Point's retirement would cause, as its generation is replaced by generation from other, largely fossil-fuel powered units including those identified by Riverkeeper in its Comments. As Entergy explained in its own Comments, these adverse impacts would likely include large, ongoing increases in greenhouse gas emissions, as well as significant, ongoing increases in the emissions of criteria air pollutants such as NOx and SOx, with concomitant, persistent adverse consequences for the human health and mortality of those affected.[155]

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151 *See* NYSDEC (2015b) at 15801:22-15802:7.

152 *See id.* at 15803:7-15804:6.

153 *See id.* at 15763:16-15764:20.

154 NYISO (2014) at 39.

155 *See* Entergy Comments, Attach. 3 at 4-8.

IV. Entergy's Corrections and Clarifications in Response to Comments Concerning Radionuclides Released to Indian Point Site Groundwater

A. Entergy's Corrections to PHASE's Comments

PHASE's overarching comment is that the Draft Supplement "was written prior to significant 'new information'" concerning "dramatically increased levels of tritium found in the groundwater [at Indian Point] in February 2016."[156] According to PHASE, the Draft Supplement cannot be accepted as complete and accurate without "significant corrections" to remove "any references to decreasing concentration of radionuclides of tritium.[157] For the reasons discussed below, PHASE's claims reflect a misunderstanding of current groundwater conditions at the Indian Point site. As a result, the requests in its comments are not supported.

Specifically, based on the available data, Entergy disagrees with PHASE's characterization of tritium concentrations in Indian Point site groundwater as "progressively increas[ing]."[158] Entergy also disagrees with the claim that the Draft Supplement requires "significant corrections" in light of purportedly new and significant information concerning radionuclide releases to groundwater at Indian Point.[159] In making the foregoing claims, PHASE misleadingly conflates two disparate sources of plant-related radionuclides in site groundwater: (1) historical releases of radionuclides (including tritium) that resulted from since-repaired leaks in the IP1 and IP2 spent fuel pools, and (2) more recent inadvertent releases that resulted from short-lived operational occurrences in April 2014 and January 2016, and which were promptly detected by the Indian Point Radiological Groundwater Monitoring Program.[160]

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[156] PHASE Comments at 1. Ms. Susan Shapiro, counsel for PHASE, submitted the comments on that organization's behalf. PHASE's comments contain multiple references to "the Board." Presumably, PHASE is referring to the Atomic Safety and Licensing Board overseeing the ongoing contested adjudication on the Indian Point license renewal application. Entergy notes that PHASE and Ms. Shapiro are not parties to the contested proceeding, and that the issue of radionuclides in site groundwater is not the subject of a pending contention. Additionally, early in the proceeding, Ms. Shapiro represented PHASE and several other petitioners. In a July 2008 Order, the Board struck those petitioners' hearing requests and expelled them from the adjudicatory proceeding due to counsel's "appalling lack of candor" and "repeated[] misrepresent[ations of the] facts." Licensing Board Order (Striking WestCAN's Request for Hearing) at 1 (July 31, 2008) (unpublished) (July 31 Order). The Commission affirmed the Board's Order on appeal, and also sanctioned Ms. Shapiro, directing the Secretary of the Commission to screen all future filings by Ms. Shapiro for compliance with the Commission's procedural requirements. *See Entergy Nuclear Operations, Inc.* (Indian Point, Units 2 and 3), CLI-08-29, 68 NRC 899 (2008).

[157] PHASE Comments at 1, 5.

[158] *See id.* at 1 ("[T]he radioactivity has progressively increased from when leaks at Indian Point were first reported in the 1990s [and] have never been fully identified or stopped.").

[159] *Id.* at 1.

[160] In addition to long-term quarterly sampling of groundwater installations conducted under the Indian Point Radiological Groundwater Monitoring Program, Entergy proactively increased the frequency of groundwater monitoring prior to and during the outages associated with both the 2014 and 2016 operational events. This more frequent monitoring expedited the detection of the resulting leaks to the subsurface.

The Draft Supplement clearly and correctly distinguishes between these two different sources of radionuclides in Indian Point site groundwater. The Draft Supplement correctly states that Entergy's removal of the fuel assemblies and draining of the water from the IP1 spent fuel pools *permanently prevented* further releases of radionuclides (chiefly characterized by strontium-90, not tritium) to groundwater.[161] It also correctly states that Entergy's repair of the weld imperfection in the IP2 transfer canal liner, among other repairs, eliminated that historical source of tritium releases to site groundwater.[162] Consequently, as discussed further below, the Draft Supplement appropriately indicates that groundwater chemistry data collected from 2007 through the 4th Quarter of 2014 show that, when viewed in the aggregate, radioisotope concentrations attributable to these past releases to site groundwater decreased substantially over that eight-year period.[163] By way of example, from the Second Quarter of 2007 through the 1st Quarter of 2014, the radioisotope activity levels measured at monitoring installations within the plume that were attributable to historic IP2 spent fuel pool leaks decreased by 80 percent.[164] This information on historic leaks is properly reflected in the Draft Supplement, because it underscores for the public the appropriateness of the remediation strategy, including the repairs to the IP2 weld imperfection and monitored natural attenuation, which has been employed at the site over the last decade, as well as the increasingly diminishing exposure considerations associated with these historic conditions.

By contrast, the more recent (2014) and current (2016) events, discussed below, should be considered separately for multiple reasons: (1) they resulted from discrete, now-completed activities that therefore do not pose any ongoing risk of further subsurface contamination; (2) they are being separately investigated, with differing remediation considerations (an extraction system, discussed below); and (3) they should be independently followed in order to continue to ensure, in a direct and clear manner, that those events have posed no risk to the health of the public or plant workers or to the environment. The importance of differentiating between historic and near-term incidents is evidenced by Entergy's decision to facilitate remediation of the 2016 event by installing an extraction system. The extraction system, which Entergy plans to begin operating by August 2016, will serve to reduce the tritium concentrations in the area of the site nearest to the source, thereby limiting the movement of tritium from this area to other areas farther downgradient of the site.[165] A focused review of the recent and current events is thus warranted.

To that end, and as discussed in the Draft Supplement, the elevated tritium levels observed in April 2014 occurred at certain elevations in three monitoring installations located near the Unit 2 Fuel Storage Building.[166] The elevated levels of tritium were traced to a floor

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[161] *See* Draft Supplement at 68-69.

[162] *See id.*at 68-69.

[163] *See id.* at 69-71.

[164] *See id.*

[165] *See* Indian Point Nuclear Generating Units 2 and 3 – Integrated Inspection Report 05000247/2015003 and 05000286/2015003 at 35 (Nov. 5, 2015) (ADAMS Accession No. ML15316A083).

[166] *See* Draft Supplement at 57, 70.

drain that backed up during refueling activities in the First Quarter of 2014.[167] The backed-up water then came into contact with floor/wall joints, which provided a pathway for that water to reach the groundwater.[168] Importantly, Entergy's groundwater monitoring program promptly detected the leaks of tritium into the groundwater in April 2014.[169] Further, while the April 2014 release increased tritium concentrations in the plume, tritium plume concentrations in total, as measured during the Fourth Quarter of 2014, were still 46 percent less than the quantity measured in 2007.[170]

The Draft Supplement was issued on December 22, 2015, and therefore considers the information and data available to the NRC Staff at the time it prepared Section 5.4. As such, it could not discuss the January 2016 tritium release. Entergy does not disagree with PHASE that this event should be discussed in the final version of the NRC Staff's supplement, in part because it would serve to inform the public's understanding of the event. However, as detailed below, Entergy disagrees with PHASE's characterization of the nature and significance of the event, which Entergy discussed in its March 4, 2016 comments on the Draft Supplement, and thus whether it is required to be addressed under NEPA.

Specifically, during January 2016 preparations for the March 2016 refueling outage at Unit 2, elevated levels of tritium were first identified at certain elevations in certain monitoring installations (including MW-32-59 and MW-31-49) near the Unit 2 Fuel Storage Building by Entergy's ongoing groundwater monitoring activities. Entergy promptly notified the NRC and Stakeholders and entered the event into the Indian Point corrective action program. In early-February 2016, Entergy commenced its investigation of potential causes of these elevated tritium levels. Based on the best available evidence, at this time, Entergy has determined that the tritium levels in question were associated with a temporary reverse osmosis system ("ROS"), employed from January 16, 2016 to January 31, 2016, to filter water from the Unit 2 Refueling Water Storage Tank in preparation for the March 2016 refueling outage. Specifically at issue is the tritium-containing ROS reject flow fluid, which is known to have spilled, likely on the 35' elevation of the Primary Auxiliary Building ("PAB"), and by way of another leak path (the investigation of which is continuing), migrated to the monitoring wells, where it was detected.[171]

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[167] *See id.* at 57; Letter from F. Dacimo, Entergy, to NRC Document Control Desk, NL-15-028: Reply to Request for Additional Information Regarding the License Renewal Application Environmental Review (TAC 43 Nos. MD5411 and MD5412), Attach. 1 at 31 (Mar. 10, 2015) (ADAMS Accession No. ML15089A338).

[168] *See id.*

[169] *See id.* Contrary to PHASE's suggestion, Entergy does not represent that it can "predict" or prevent all leaks, but simply that its robust monitoring system is sufficient to promptly identify leaks, as occurred in 2016. *See* PHASE Comments at 2, 5. Indeed, NRC regulations do not foreclose the possibility of releases to site groundwater, but instead require that licensees account for such releases, evaluate them relative to NRC regulatory requirements, and report the quantity of radioactivity released and the dose to the hypothetical maximally exposed member of the public. Furthermore, as discussed later in these comments, one of the purposes of the Indian Point Radiological Groundwater Monitoring Program is to detect potential inadvertent releases of radionuclides to the groundwater at the site.

[170] *See* Draft Supplement at 70.

[171] The reject flow, which includes borated water with concentrated silica, also contains boron and Antimony-125, both of which were detected in elevated levels in site monitoring installations. Tritium is a product of boron use (*i.e.*, it is produced from neutron reaction with borated water, or "neutron

Because use of the ROS skid was terminated, Entergy believes that the release source also has been terminated.

Several additional points bear emphasis, particularly in light of PHASE's claims that overall tritium levels in onsite groundwater at Indian Point are "progressively increas[ing]."[172] First, the elevated tritium levels that were measured in samples taken from the abovementioned monitoring installations (including the approximately 8 million picocuries per liter ("pCi/L") value cited by PHASE on pages 2-3 of its comments) resulted from a transient release, and were reflected only in a certain subset of the existing array of on-site monitoring installations for a short duration. Such measurements also occurred for groundwater samples that were collected from monitoring installations located proximate to the source and shortly after the January 2016 release. Furthermore, to date, no trend of increasing tritium concentrations has been detected in most of the on-site monitoring installations, including those located in the riverfront area. These data trends support the conclusion that the 2016 tritium release resulted from a discrete, now-ceased spill event. The effects of that short-term release on subsurface tritium levels are therefore expected to continually abate with time, with some fluctuations in individual monitoring installations occurring, and likely to continue occurring, as the tritium released during the January 2016 event migrates underground. Moreover, based on the current data, Entergy expects those transient effects to be eclipsed by the overall site trend of declining tritium levels evident since all of the identified spent fuel pool leaks were previously terminated (multiple termination dates, all prior to 2008). Thus, it is misleading for PHASE to assert that there has been a "1000 fold increase in levels of radiation *being* leaked into the ground water and Hudson River," when in fact the evidence shows only elevated tritium levels in a fraction of on-site groundwater and no releases to the Hudson River at this time.[173]

Second, PHASE's statement that the February 2016 reading of approximately 8 million pCi/L is "400 times above the safe drinking water limit of 20,000 pCi/l" is both incorrect and likely to mislead a public unfamiliar with the federal Safe Drinking Water Act ("SDWA") standards.[174] As Entergy explained in its March 4, 2016 comments, it is inappropriate to compare radionuclide concentrations in Indian Point site groundwater to standards promulgated under the federal Safe Drinking Water Act ("SDWA")—*i.e.*, maximum contaminant levels ("MCLs") for drinking water—for purposes of assessing the radiological impacts of radionuclides released to site groundwater under NEPA.[175] The SDWA does not apply to Indian Point site groundwater, which is neither being used for drinking water purposes nor is suitable for such purposes.[176] The primary and secondary drinking water regulations developed pursuant to the SDWA apply to "public water systems," defined by statute to be "a system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if

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capture," during power operation). Antimony-125, also a byproduct of nuclear power plant operations, has a relatively short half-life (2.7 years), and thus can be useful as a "tracer" in conjunction with ongoing monitoring activities.

172 PHASE Comments at 1.

173 *Id.* at 5. Future subsurface "releases" to the Hudson River are expected as the tritium naturally migrates downgradient, but there is no evidence that would support a 1,000-fold increase.

174 *Id.* at 1.

175 *See* Entergy Comments, Attach. 4 at 1-6.

176 *See* Entergy Comments, Attach. 4 at 4-6.

such system has at least fifteen service connections or regularly serves at least twenty-five individuals."[177] Furthermore, the term "maximum contaminant level" is defined by statute to be "the maximum permissible level of a contaminant in water which is delivered to any user of a public water system."[178] In other words, the SDWA sets MCLs for water "at the tap," rather than at the source. The single monitoring well value is not representative of groundwater beneath Indian Point. Indian Point groundwater is not collected or delivered for drinking. The groundwater at Indian Point does not communicate with any other groundwater-based drinking water source. For these reasons, the comparison that PHASE offers is not appropriate and should not inform NRC Staff's NEPA assessment.

Third, contrary to PHASE's suggestion, the more recent 2014 and 2016 releases of tritiated water to groundwater have not posed any threat to public health and safety or to the environment. As noted above, those releases were inadvertent, short-term operational occurrences that are fully anticipated by the NRC's regulatory framework. Importantly, Entergy continues to meet all NRC 10 C.F.R. Part 20 and Part 50, Appendix I requirements at Indian Point by a very wide margin.[179] This is evidenced, in part, by calculated doses reported in Indian Point's Annual Radioactive Effluent Release Reports for the years 2005 to 2014, which include the April 2014 release near IP2 that is discussed above and in the Draft Supplement.[180] The combined groundwater and storm water dose remains less than 0.1 percent of the guidelines in Appendix I of 10 C.F.R. Part 50.[181] In this regard, the dose from groundwater and storm water is so small as to be inconsequential to human health or the environment.[182] And, with regard to the January 2016 release near IP2, Entergy has confirmed that there are no adverse radiological consequences as a result of this event, since the quantity of radioactivity in the leak is a small fraction of the plant's authorized effluent limit and, similarly, the estimated doses are still a small fraction of the annual dose limit for a member of the public.[183]

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177 42 U.S.C. §§ 300f(1)-(4), 300g. Entergy is unaware of any law or regulation that supports PHASE's conclusory statement that "New York State law requires that all groundwater in the State is potable." PHASE Comments at 3. PHASE cites no such law or regulation in support of its claim.

178 42 U.S.C. §300f(3) (emphasis added).

179 The 10 C.F.R. Part 50, Appendix I design objectives are 3 mrem to the total body and 10 mrem to any organ.

180 Draft Supplement at 57, 75.

181 Entergy's radiological environmental monitoring program ("REMP") for IP2 and IP3 supplements the radioactive effluent release program by verifying that any measurable concentrations of radioactive materials and levels of radiation in the environment are not higher than those calculated using the radioactive effluent release measurements and transport models. In this way, the REMP confirms that the plants are operating in accordance with applicable NRC requirements.

182 There is no factual or technical basis for PHASE's claims that "increasing radioactive pollution into the Hudson by Indian Point" is precluding or interfering with use of the Hudson River as a drinking water supply, or that Indian Point operations will "adversely affect operations of the proposed Haverstraw Water Supply Project." PHASE Comments at 2. Regarding the latter issue, as Entergy noted in its March 4, 2016 comments, SUEZ Water New York Inc. (formerly United Water) has abandoned the Haverstraw Water Supply Project at the direction of the State of New York Public Service Commission, because there is no longer an immediate need for a new water supply source. *See* Entergy Comments, Attach. 4 at 12.

183 *See* Event Notification Report, Event Number 51274, "Offsite Notification Via New Release Concerning Tritium Levels in Groundwater Monitoring Wells" (Feb. 10, 2016), *available at* http://www.nrc.gov/reading-rm/doc-collections/event-status/event/2016/20160211en.html#en51724;

Fourth, PHASE's claim that "government regulators have failed in their job of protecting public health and safety" is entirely unfounded.[184] The NRC has been inspecting Entergy's response to the January 2016 release to groundwater through the resident inspectors and a specialist health physics inspector from the NRC's Region I office. In fact, NRC Chairman Stephen Burns noted in a recent letter to New York Senator Kirsten Gillibrand that "there is no health risk to the public or plant workers due to the increased tritium levels detected and that the quantity of radioactivity in the leak is a small fraction of the plant's authorized effluent limit."[185]

Finally, although Entergy discussed the January 2016 release in its comments on the Draft Supplement, it does not view the release as constituting "new and significant information" within the meaning of NEPA. The Commission has stated that new information would be considered significant under NEPA if it presents "a seriously different picture of the environmental impact of the proposed project from what was previously envisioned."[186] As Entergy explained in its comments on the Draft Supplement, the NRC's NEPA-implementing regulations state that "[f]or the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small" as the term is used in 10 C.F.R. Part 51.[187] Neither the 2014 nor the 2016 isolated, short-lived releases of tritiated water to site groundwater resulted in any exceedances of the NRC permissible dose limits or liquid effluent release limits.

B. Entergy's Corrections to Riverkeeper's Comments

In its March 4, 2016 comments, Riverkeeper also makes statements related to tritium in Indian Point site groundwater. First, it states that the January 2016 release "has caused groundwater radioactivity levels to rise more than 65,000 percent," and that "[t]he tritium leak is just the latest of an increasing number of safety incidents at [Indian Point] in the past year."[188] Second, it states that "[e]xamination must be made now of precisely why the tritium levels suddenly increase by many orders of magnitude and whether the fuel pools are the source."[189]

Letter from Stephen G. Burns, Chairman, NRC, to Congresswoman Nita M/ Lowey at 1 (Mar. 10, 2016) (ADAMS Accession No. ML16055A474).

184 PHASE Comments at 3.

185 Letter from Stephen G. Burns, Chairman, NRC, to Senator Kirsten Gillibrand at 1 (Mar. 29, 2016) (ADAMS Accession No. ML16068A232).

186 *DTE Elec. Co.* (Fermi Nuclear Power Plant, Unit 3), CLI-15-10, 81 NRC 535 (2015). *See also Luminant Generation Co. LLC* (Comanche Peak Nuclear Power Plant, Units 3 and 4), CLI-12-7, 75 NRC 379, 388-89 (2012); *Union Elec. Co.* (Callaway Plant, Unit 2), CLI-11-5, 74 NRC 141, 167-68 (2011); *Hydro Res., Inc.* (2929 Coors Road, Suite 101, Albuquerque, NM 87120), CLI-99-22, 50 NRC 3, 14 (1999) (citing *Marsh v. Or. Natural Res. Council*, 490 U.S. 360, 373 (1989)).

187 10 C.F.R. Part 51, Appendix B, Table B-1. *See also* NUREG-1437, "Final Generic Environmental Impact Statement for License Renewal of Nuclear Plants," Rev. 1, Vol. 1 at 4-136 (June 2013).

188 *See* Riverkeeper Comments at 6.

189 *Id.* at 7.

Each of the foregoing statements by Riverkeeper is factually incorrect.[190] First, it is incorrect and misleading to state that "groundwater radioactivity levels" have increased by 65,000 percent. As explained above, although the 2016 isolated, short-term release resulted in elevated tritium levels at certain elevations in certain monitoring installations located proximate to the source, those levels cannot reasonably be considered representative of groundwater conditions generally at Indian Point. As explained above, current data trends support the conclusion that the effects of 2016 release on subsurface tritium levels are transient, and thus will continually abate with time, with some fluctuations in individual monitoring installations occurring as the tritium released during the January 2016 event migrates underground. Further, based on the current data, Entergy expects those transient effects to be eclipsed by the overall site trend of declining tritium levels evident since all of the identified SFP leaks were previously terminated (multiple termination dates, all prior to 2008)

[190] Riverkeeper also states that Federal Energy Regulatory Commission ("FERC") "must reconsider whether the proximity to Indian Point and the construction methods required to install the [Algonquin Incremental Market ("AIM") Project] would have an impact on the recent increasing leaks of tritium into ground water or otherwise increase the potential for serious operational problems at Indian Point." Riverkeeper Comments at 7-8. There is no technical basis (and Riverkeeper cites none) for Riverkeeper's concern about the AIM natural gas pipeline expansion project potentially affecting tritium levels in site groundwater. Moreover, any nuclear safety concerns related to the AIM Project (which have been fully evaluated by Entergy, FERC, and the NRC Staff) are not within the scope of the NRC's NEPA review for IP2 and IP3 license renewal.

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<u>ATTACHMENT 2 TO NL-16-044</u>

Fish Community Persistence in the Hudson River 1985 through 2013
Compared to Hinkley Station 1981 through 2012

Prepared by Normandeau Environmental Consultants

August 10, 2015

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 & 3
DOCKET NOS. 50-247 AND 50-286

10 AUGUST 2015

Fish Community Persistence in the Hudson River 1985 through 2013 Compared to Hinkley Station 1981 through 2012

The Bristol Channel Estuary sampled by Hinkley Point Station (Bristol Channel Estuary, UK) impingement is described by Henderson and others as having a high temporal stability of core species (Henderson and Magurran 2014). Core species were defined by Henderson and Magurran (2014) as those present in at least 22 out of 31 full years analyzed, however no basis was provided for selection of 22 years as the relevant duration defining core species or their persistence. Reference in Henderson and Magurran (2014) to a previous publication (Magurran and Henderson 2003) supporting the selection of core species based on 22 years of persistence was not found in that previous publication. Instead, Magurran and Henderson (2003) defined core species as persistent in ten out of the 21 years of data available for analysis from Hinkley Point Station at the time of that publication.

To better understand the relationship between species persistence and temporal stability in estuarine ecosystems, we reviewed the quantitative data set of 31 years (1981-2012) of monthly fish impingement abundance from Hinkley Power Station in the Bristol Channel Estuary, Somerset, UK (Henderson and Magurran 2014; obtained by discovery in this proceeding) and compared it with the comparable fish abundance data obtained from the three Hudson River Biological Monitoring Programs (HRBMPs) . The Hinkley Station data set was considered robust for community analysis (Henderson and Magurran 2014), with nearly 150,000 individuals recorded among 81 total species of fish and with 27 core species. The data that we examined from the three HRBMP data sets (derived from the data presented in the 2013 Year Class Report Tables C-1, C-2 and C-3 (ASA 2015)) are summarized below in Table 1 with the Hinkley data presented for comparison.

Table 1. Summary of Fish Taxa found in three Hudson River Biological Monitoring Program surveys (Beach Seine, Fall Shoals, Ichthyoplankton) from 1985-2013 compared to Hinkley Point Station impingement data from 1981-2012.

				Count of the Number of Taxa (%)			
Survey	**Years**	**# Years**	**# Individuals**	**Total**	**All Years**	**22 Years**	**< 4 Years**
Beach Seine	1985-2013	29	3,342,116	129	32 (25%)	47 (36%)	40 (31%)
Fall Shoals	1985-2013	29	3,784,703	115	23 (18%)	35 (30%)	37 (32%)
Ichthyoplankton	1988-2013	26	60,087,494	129	28 (22%)	42 (33%)	38 (29%)
Hinkley	1981-2012	31	146,042	81	14 (17%)	30 (37%)	22 (27%)

As indicated in Table 1, each of the three HRBMPs is substantially more extensive and robust compared to the Hinkley dataset, with the Hinkley data comprising just 4% of the number of individuals collected in the comparable two juvenile fish sampling surveys of the HRBMP (Beach Seine and Fall Shoals Surveys; ichthyoplankton were not sampled at Hinkley) . The source water body (Bristol Channel Estuary, UK) sampled by Hinkley Power Station had an overall species richness (total fish species = 81) and the number of core (persistent) taxa of 14 found in all years sampled (Table 1). , The Hudson River, as sampled by the three HRBMP programs, had either 129 or 115 fish taxa present, exhibiting higher species richness compared to Bristol Channel over a comparable time period (Table 1).

To provide a direct comparison between the Hudson River and Bristol Channel, while adjusting for the lower taxa richness in Bristol Channel, Table 1 also presents the percent of all fish taxa that are present in all years, 22 years (consistent with Henderson and Magurran 2014), or fewer than four years, in each long-term data set. Comparing the percent of taxa present in all years, or in 22 years out of each time series, reveals remarkable similarity among the three Hudson River surveys and between these Hudson River surveys and Bristol Channel. Between 18% and 25% of the fish taxa were present in the HRBMP surveys in all years, compared to 17% present in the Hinkley Station impingement samples. Similarly, between 30% and 36% of the fish taxa were present in the HRBMP surveys in 22 or more years (*i.e.*, core taxa), compared to 37% present in the Hinkley Station impingement samples for 22 or more years. The relatively frequency of occurrence of rare fish taxa (*i.e.*, those found in fewer than four years) in each data set were again quite similar among all four surveys, with between 29% and 32% of the fish taxa were present in the HRBMP surveys in less than four years, compared to 27% present in the Hinkley Station impingement samples.

The selection of 22 years (or any other period other than all years) may influence the perception of persistence when defining "core species", as was done in the Hinkley analysis (Magurran and Henderson 2003; Henderson and Magurran 2014; Shimadzu et al. 2013). The following figures (Figures 1, 2 and 3) compare the actual relationship describing the frequency of occurrence of fish taxa in each of the three HRBMP surveys to the Hinkley Station impingement time series. These figures reveal there are a relatively high number of taxa present in two conditions, all years and few years, and that an arbitrary selection of 22 years to define core or persistent taxa has no distinguishing characteristic compared to 24 years, or 20 years, or any other arbitrary period selected to define core taxa persistence.

Given the higher species richness and similar persistence of core fish species observed in the Hudson River HRBMP data sets, compared to the Hinkley Station impingement data set, it is difficult to understand how the Pisces (June 2015, page 37) report describing the status of fish populations and the ecology of the Hudson concludes that "all the evidence points to the Hudson ecosystem presently being in a state of change, with declining stability." Again, the Bristol Channel Estuary sampled by Hinkley Point Station impingement is described by Henderson and others as having a high temporal stability of core species (Henderson and Magurran 2014). It is likely that the same density dependence that provides temporal stability among the core species in the Bristol Channel Estuary also functions to stabilize the more diverse set of core species found in the Hudson River Estuary over the past three decades.

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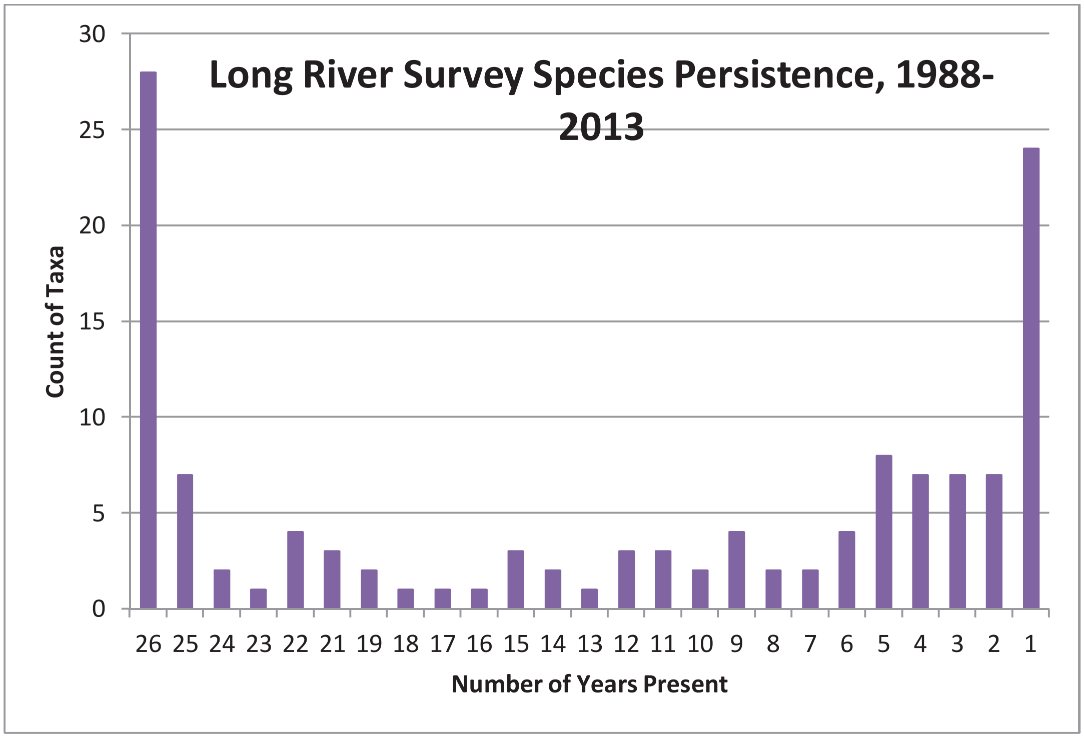


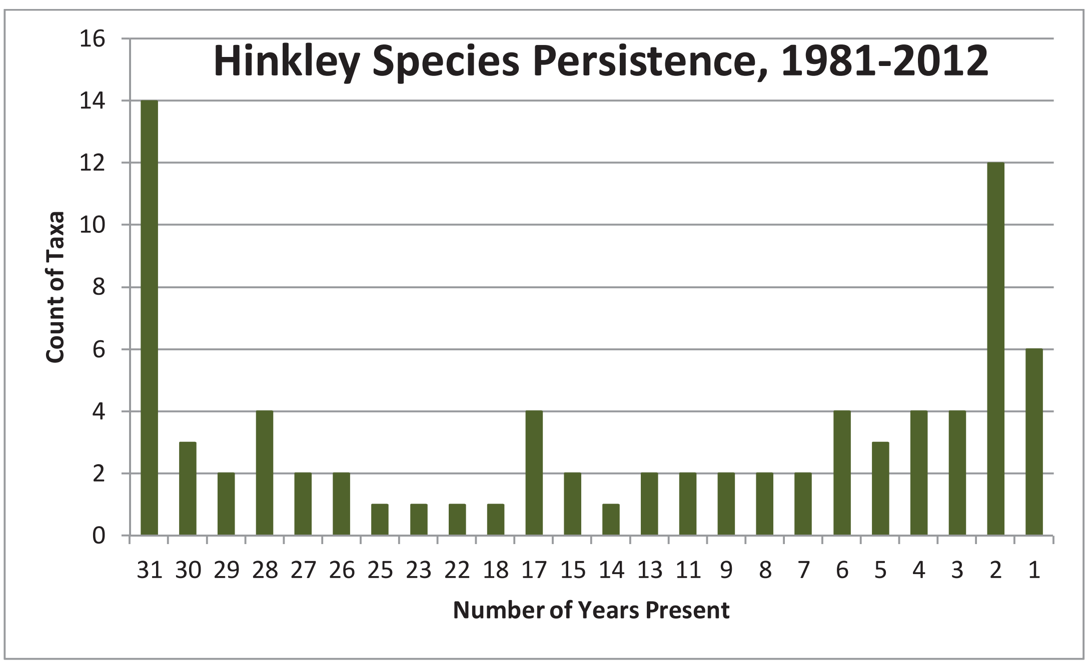
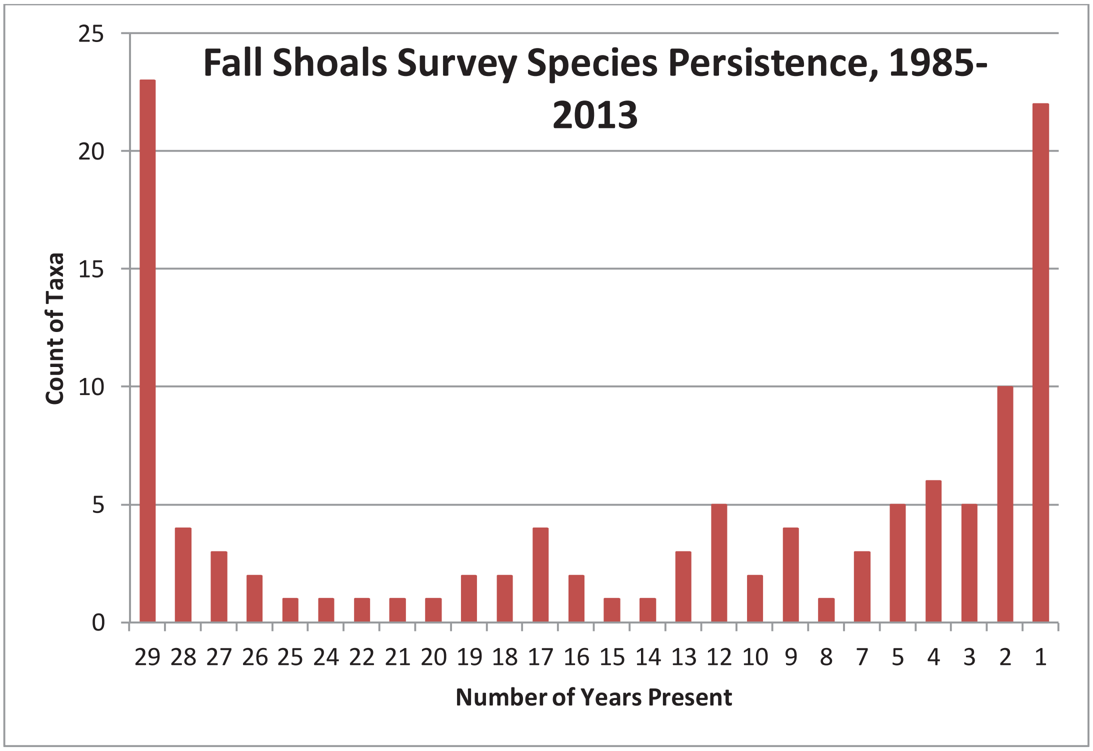


Figure 1. Fish community persistence (number of taxa present) among 26 consecutive years of Hudson River (NY) Long River Ichthyoplankton Surveys from 1988 through 2013 compared to 31 consecutive years of impingement data from Hinkley Point B Power Station (Bristol Channel, UK) from 1981 through 2012.



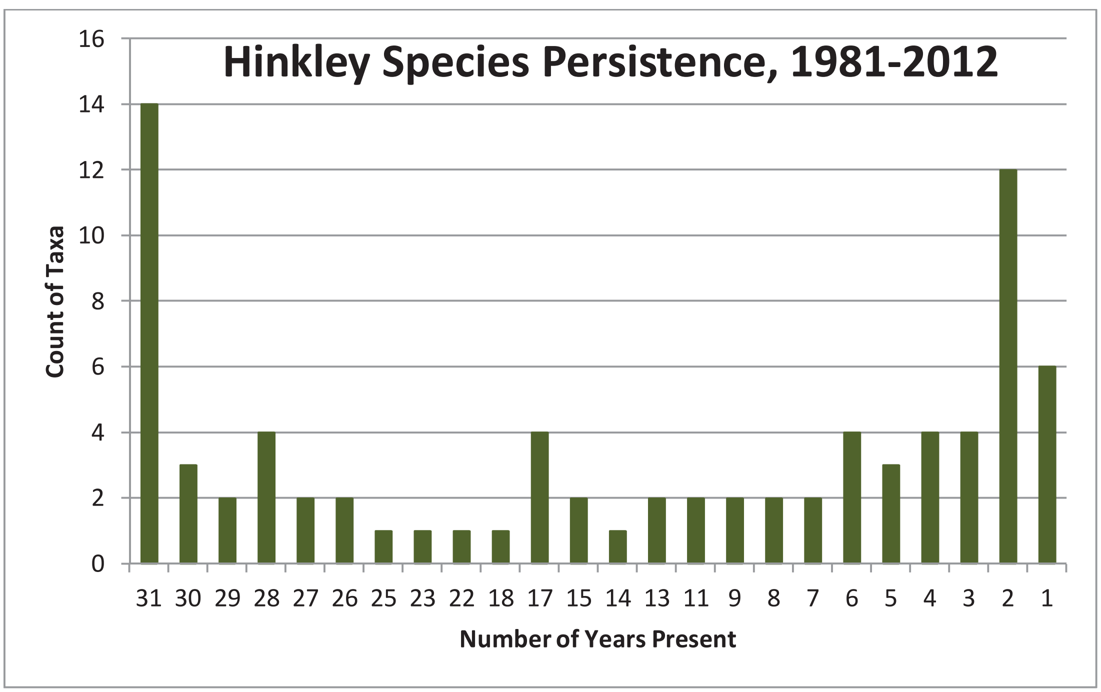
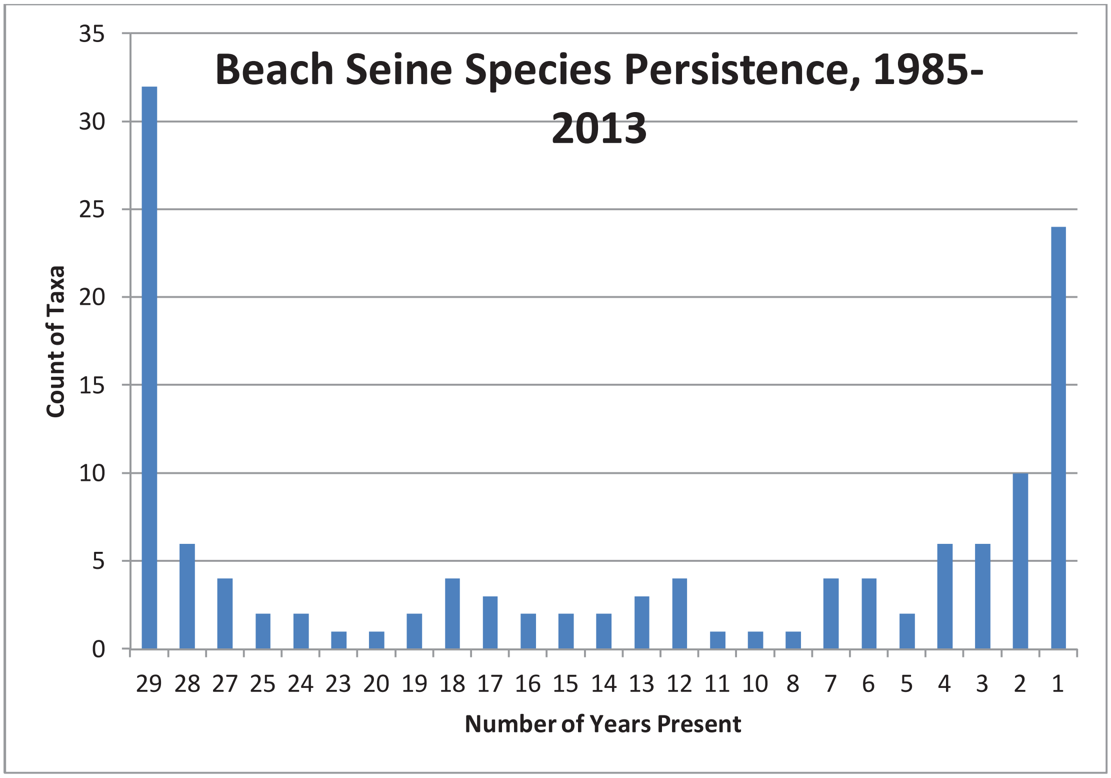


Figure 2. Fish community persistence (number of taxa present) among 29 consecutive years of Hudson River (NY) Fall Juvenile Surveys from 1985 through 2013 compared to 31 consecutive years of impingement data from Hinkley Point B Power Station (Bristol Channel, UK) from 1981 through 2012.



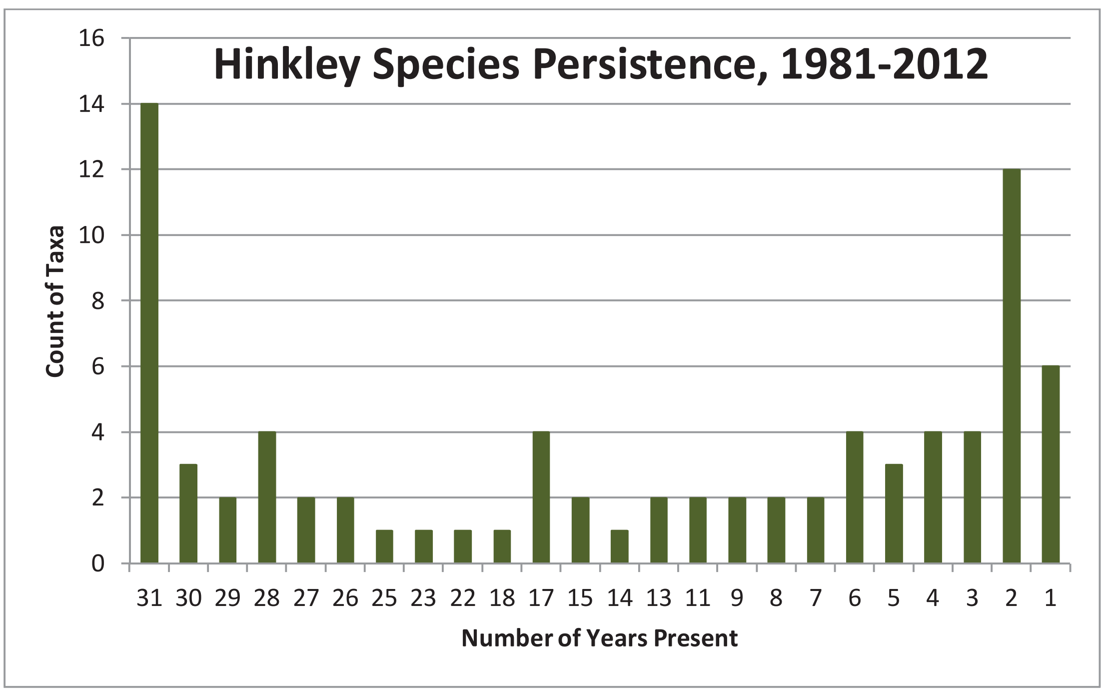


Figure 3. Fish community persistence (number of taxa present) among 29 consecutive years of Hudson River (NY) Long River Beach Seine Surveys from 1985 through 2013 compared to 31 consecutive years of impingement data from Hinkley Point B Power Station (Bristol Channel, UK) from 1981 through 2012.

ATTACHMENT 3 TO NL-16-044

NYSDEC's Misrepresentation of Dr. Barnthouse's Papers and Memoranda

Prepared by L. W. Barnthouse
LWB Environmental Services, Inc.

April 20, 2016

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 & 3
DOCKET NOS. 50-247 AND 50-286

NYSDEC's misrepresentation of Dr. Barnthouse's papers and memoranda

L. W. Barnthouse
LWB Environmental Services, Inc.

April 20, 2016

To support its position that NRC Staff should base its assessment only on numbers of organisms entrained or impinged because assessing impacts on populations is an "impossibility," NYSDEC Staff cites several documents I wrote between 1979 and 2013. In all cases, NYSDEC's citations are based on selective quotations and misrepresentations that greatly distort the actual content of the documents. NYSDEC's Staff's misrepresentation of my previous work is particularly troubling because it made the same misrepresentations during the NYSDEC proceedings and was corrected by my testimony at trial. In addition, NYSDEC Staff's statements regarding the conclusions of the American Shad recovery plan authored by Kahnle and Hattala also are misleading.

Citation to Barnthouse and Van Winkle (1988)

According to NYSDEC, Barnthouse and Van Winkle (1988) concluded that "determining the long-term impacts to fish populations caused by the operation of a CWIS was unattainable."[1] This paper was published in 1988, and reflected the state-of-the-science at the time of the 1981 Hudson River Settlement Agreement, when only three years of HRBMP data (1974-1976) were available for analysis and prior to the development of many modern analytical methodologies. Consequently, the conclusions of that paper are not relevant to the issue of detecting impacts today through analysis of almost 40 years of high-quality data collected by HRBMP.

Citations to Barnthouse 2013 paper and 1979 letter to EPA

With respect to the 2013 paper, NYSDEC states:

> "Barnthouse (2013) could not find any example in the published literature where such an impact had been conclusively demonstrated. However, Barnthouse (2013) did not conclude that failing to demonstrate a direct impact proved that one does not truly exist now nor does it prove that no adverse impact may exist in the future (*See*, Barnthouse (2013) *at* p. 154-155)."[2]

This statement is an out-of-context interpretation of a paragraph that actually comes to a very different conclusion:

> "It is often said that it is impossible to prove a negative. Although adverse impacts due to entrainment and impingement have not

[1] NYSDEC Staff, Nuclear Plants, 5 Supplement 38, Volume 5, Regarding Indian Point Nuclear Generating Unit Nos. 2 and 3, Draft 6 Report for Comment (NUREG-143 7) ("NYSDEC Staff Comments") at 2.

[2] *Id*.

> been conclusively documented in published studies, this absence does not prove that adverse impacts are not occurring or could never occur. It can always be argued that the statistical power of tests used in environmental impact studies is simply too low to detect reductions in abundance, even reductions that are large enough to warrant regulatory action. However, the rarity of documentation of such impacts, after 40 years of operation of large power plants, some of which have been conducting extensive monitoring programs for several decades, provides substantial evidence that impacts related to entrainment and impingement are generally small compared to impacts identified by the Pew Oceans Commission (2003) and other sources as being major threats to aquatic ecosystem integrity. *Most importantly, there is no scientific evidence to support a conclusion that reducing entrainment and impingement via aggressive regulation of cooling water intakes will result in measurable improvements in recreational or commercial fish populations* (emphasis added)."

The full text of Barnthouse (2013) is provided as an attachment to NYSDEC's comments; the paper clearly contradicts rather than supports NYSDEC's position.

NYSDEC also cited my 1979 letter to EPA in support of its assertion that:

> "Before the Hudson River monitoring program was started, federal agency scientists cast serious doubts as to whether any population impact resulting from once-through cooling could be detected."

This letter was the subject of cross-examination and redirect testimony during the NYSDEC Proceeding on January 17-18, 2012, where I provided the actual context of the letter and explained why it is irrelevant to the current permitting and licensing proceedings for Indian Point:

> [Barnthouse] At the time that I wrote that letter, settlement negotiations were going on between EPA, the State of New York, and Consolidated Edison. And one of the proposals on the table was to base the settlement on a trends monitoring test, whereby the striped bass population in the Hudson would be monitored for a few years, presumably using the beach seine data, which was the main monitoring data we had at that point. A statistical test would be performed after some reasonable period, like five or ten years; and if a significant decline were detected, cooling towers would be built, and otherwise the operation of the plant with once-through cooling would be allowed on a permanent basis.
>
> We had done research on the influence of variability in population sizes on the ability to detect differences in trends data, published in papers that have been cited and are I believe on the record here.

> And we concluded that within a period of only five or ten years it would not be possible to perform a meaningful test.
>
> We recommended to EPA that that proposal not be accepted and instead the agencies and Consolidated Edison should simply use what we had already to evaluate alternative mitigating measures and, you know, pick something that seemed reasonable to both sides and then come to a settlement without any kinds of a test. Ultimately that's what they did.
>
> Q. And so how is that different from now?
>
> [Dr. Barnthouse]: Well, the situation is very different now. We have multiple long-term monitoring data sets that interlink and are redundant with each other. We have annual estimates of entrainment mortality through the CMR. We did not imagine in 1979 that any data set like that would ever become possible. So we are able to do things now with those data that no one could have envisioned in 1979.[3]

As this exchange makes clear, more than four years ago NYSDEC was made aware that my letter to EPA did not support the Agency's conclusion concerning the impossibility of detecting impacts of entrainment or impingement on fish populations, and yet NYSDEC is still citing this letter as supporting its position.

Citation to Kahnle and Hattala (2010)

NYSDEC's statements concerning the conclusions made in the 2010 American shad recovery plan authored by Kahnle and Hattala (2010) are also misleading. According to NYSDEC:

> Department fisheries scientists have identified cooling water withdrawals as a threat to the recovery of Hudson River American shad (<u>*see*</u>, Kahnle and Hattala 2010 *at* p. 1) and have determined that the impingement and entrainment caused by cooling water withdrawals on the Hudson River must be reduced or eliminated (<u>*See*</u> Kahnle and Hattala 2010 *at* p. 5).[4]

In contrast to NYSDEC's emphasis on cooling water withdrawals, on page one of Kahnle and Hattala (2010), the authors identify "overharvest by directed ocean commercial fisheries and in-river commercial and recreational fisheries" as "the *principal known cause* of the decline in

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3 Hearing Transcript, *In the Matter of Entergy Nuclear Indian Point 2, LLC, and Entergy Nuclear Indian Point 3, LLC*, DEC Nos. 3-5522-00011/00004, 3-5522-00011/00030, & 3-5522-00105/00031. January 18, 2012, at 3746-48.

4 NYSDEC Staff Comments at 3.

Hudson River American shad." (emphasis added).[5] The authors further state that young American shad in the river are also lost to various cooling water intakes, but they do not characterize these losses as being a threat to the recovery of American shad.[6]

As noted by NYSDEC, on page five of Kahnle and Hattala (2010), the authors identify "reduce or eliminate losses of all shad life stages to power generating plants" as a short-term management action for promoting population recovery.[7] The authors failed to note, however, and NYSDEC has not acknowledged, that the *largest possible reduction* in American shad losses at power plants has already occurred, with no effect on the population. Prior to 2005, the Albany Steam Station, located on the Hudson River just south of Albany, withdrew approximately 500 million gallons per day ("mgd") from the region that constitutes the primary spawning grounds for American Shad.[8] As documented in the Hudson River DEIS, prior to 2005, the Albany Steam Station historically accounted for 85% of all power plant-related mortality.[9] The Albany station was decommissioned in 2005 and replaced by the Bethlehem Energy Center, which has a closed-cycle cooling system that withdraws only about 8 mgd, or about a 98% reduction relative to the Albany Steam Station.[10] If entrainment mortality were adversely affecting the Hudson River American shad population, one would reasonably expect that upon removing by far the largest source of entrainment mortality on the Hudson River, this species' abundance in the Hudson River would show a noticeable, if not substantial, increase. Yet the near elimination of entrainment and impingement losses at Albany Steam Station did not lead to any recovery of the American shad population, which instead has continued to decline.[11] The failure of this population to respond positively to elimination of the single greatest source of entrainment and impingement mortality provides further evidence supporting my (2013) conclusion that aggressively regulating cooling water intake technology to reduce entrainment mortality has no impact on fish population abundances, and supports Entergy's position that fish population abundances in the Hudson River are determined by fishery management decisions, not by entrainment.

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5 Kahnle, A. and Hattala, K. (2010). *Hudson River American Shad: An Ecosystem-Based Plan For Recovery*, at 1.

6 *Id*.

7 *Id*. at 5.

8 *See* Javetski, J. (2006). *Bethlehem Energy Center, Glenmont, New York*, Power Magazine, at 2.

9 *See* Draft Environmental Impact Statement for State Pollutant Discharge Elimination System Permits for Bowline Point 1 & 2, Indian Point 2 & 3 and Roseton 1 & 2 Steam Electric Generating Stations, December 14, 1999.

10 Javetski (2006) at 2.

11 *See, e.g.,* ASA Analysis and Communications (2014). *2014 Year Class Report for the Hudson River Estuary Monitoring Program*. December 2015, Figure 4-41.

ATTACHMENT 4 TO NL-16-044

Comparison of Estimates of Historical Entrainment Losses of Striped Bass at IPEC to Corresponding Estimates of Historical Abundance of Striped Bass in the Hudson River

Prepared by AKRF, Inc.

April 20, 2016

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 & 3
DOCKET NOS. 50-247 AND 50-286

Comparison of Estimates of Historical Entrainment Losses of Striped Bass at IPEC to Corresponding Estimates of Historical Abundance of Striped Bass in the Hudson River

4/20/16

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The Final Environmental Impact Statement ("FEIS") for several steam electric stations operating on the Hudson River (NYSDEC 2003) listed the average of annual entrainment loss estimates of striped bass at IPEC. That average (Table 2, page 3 of the FEIS) was based directly on year- and lifestage-specific estimates listed in Appendix V-I-D-1 of the Draft Environmental Impact Statement ("DEIS") (CHE&G, et.al. 1999). Annual entrainment loss estimates were listed for 1981, and 1983-1987. Riverwide abundance estimates for the affected lifestages (i.e., eggs, yolk-sac larvae, post yolk-sac larvae and young-of-year juveniles) from the same years as the entrainment loss estimates can provide a context for interpreting the magnitude of the entrainment loss estimates.

The recent stock assessment for striped bass that was prepared by the NMFS Northeast Fisheries Science Center in 2013 (referred to as the 57th SAW Assessment Report) lists estimates of the abundance of age-1 striped bass for the years of entrainment loss estimates listed in the DEIS. These independent estimates of striped bass abundance can be coupled with published estimates of age-0 natural mortality rates for striped bass (EPRI 2012) to estimate riverwide abundances of the lifestages of striped bass affected by entrainment at IPEC.

Table 1, below, lists estimates of coastwide abundance of age-1 striped bass for the 1981 and 1983-1987 cohorts from Table B7-10 of the 57th SAW Assessment Report. The 57th SAW Assessment Report also notes (page 554) that 13% of the coastwide stock of striped bass is thought to be of Hudson River origin. Accordingly, abundance of age-1 striped bass of Hudson River origin was estimated as 13% of the listed coastwide abundance of age-1 striped bass (Table 1, below).

Estimates of natural mortality rates for striped bass young of year juvenile, post yolk-sac larvae, yolk-sac larvae and eggs from EPRI (2012) are listed in Table 2, below. For each of these lifestages, an estimate of the number of striped bass entering the lifestage was estimated as the age-1 abundance divided by the survival fraction from the beginning of the lifestage to age 1:

$$\hat{N}_j = \frac{\hat{N}_{age1}}{\hat{S}_{j,age1}}$$

where $\hat{N}_j$ is the estimate of the number of striped bass entering lifestage *j* (1=eggs, 2=yolk-sac larvae, 3= post yolk-sac larvae, 4=young of year juveniles). The survival fraction was calculated based on the natural mortality rate estimates from the literature (see Table 2, below):

$$\hat{S}_{j,age1} = \prod_{i=j}^{4} e^{-\hat{M}_i}$$

where $\hat{M}_i$ is the natural mortality rate estimate for lifestage *i* (1=eggs, 2=yolk-sac larvae, 3= post yolk-sac larvae, 4=young of year juveniles).

Estimates of numbers of striped bass entering each lifestage, $\hat{N}_j$ computed as described above, for the 1981 and 1983-1987 cohorts are listed in Table 3, below. The corresponding estimates of entrainment losses from the DEIS are listed in Table 4. The corresponding ratios of estimated entrainment loss divided by estimated number entering the lifestage are listed in Table 5.

For the years 1981 and 1983-1987, the average number of striped bass entering the egg stage was 754,230,877,570 in comparison to the average annual entrainment loss of 253,083. The average number entering the yolk-sac larval stage was 189,748,312,852 per year in comparison to the average annual entrainment loss of 4,640,833. The average number entering the post yolk-sac larval stage was 20,608,395,160 per year in comparison to the average annual entrainment loss of 41,383,333; and the average number entering the young of year juvenile stage was 130,771,798 per year in comparison to the average annual entrainment loss of 266,717.

Table 1. Estimates of coastwide and Hudson River abundance of age-1 striped bass (from 57th SAW Assessment Report, NMFS 2013).

Cohort	Year	Estimated Abundance	
		Coastwide	Hudson River
1981	1982	18,308,700	2,380,131
1983	1984	39,684,200	5,158,946
1984	1985	39,279,900	5,106,387
1985	1986	32,458,500	4,219,605
1986	1987	43,188,300	5,614,479
1987	1988	56,506,300	7,345,819

Table 2. Estimates of age-0 natural mortality rates for striped bass by lifestage from EPRI (2012).

Lifestage	Lifestage Index (i)	Lifestage Duration (days)	Daily Natural Mortality Rate	Natural Mortality Rate for Lifestage (M_i)
Egg	1	2	0.69000	1.38000
Yolk-sac Larvae	2	6	0.37000	2.22000
Post Yolk-sac Larvae	3	46	0.11000	5.06000
Young of Year Juveniles	4	311	0.01051	3.26985

Table 3. Cohort-specific estimates of number of Hudson River striped bass entering age-0 lifestages.

Cohort	Number of Striped Bass Entering Lifestage			
	Young of Year Juveniles	Post yolk-sac larvae	Yolk-sac larvae	Eggs
1981	62,615,292	9,867,576,184	90,854,038,768	361,135,866,565
1983	135,718,962	21,388,021,367	196,926,589,288	782,763,820,258
1984	134,336,267	21,170,121,622	194,920,314,245	774,789,074,325
1985	111,007,251	17,493,689,970	161,070,191,623	640,238,166,823
1986	147,702,896	23,276,575,644	214,315,133,382	851,881,572,475
1987	193,250,120	30,454,386,172	280,403,609,806	1,114,576,764,975
Average	130,771,798	20,608,395,160	189,748,312,852	754,230,877,570

Table 4. Cohort- and lifestage-specific estimates of striped bass entrainment losses at IPEC (from DEIS Appendix V-I-D-1).

Cohort	Estimated Entrainment Loss			
	Young of Year Juveniles	Post yolk-sac larvae	Yolk-sac larvae	Eggs
1981	909,000	51,100,000	13,200,000	208,000
1983	160,000	26,300,000	3,940,000	69,200
1984	124,000	54,600,000	4,480,000	1,110,000
1985	28,000	19,300,000	1,280,000	75,500
1986	62,300	71,800,000	4,900,000	42,100
1987	317,000	25,200,000	45,000	13,700
Average	266,717	41,383,333	4,640,833	253,083

Table 5. Cohort- and lifestage-specific ratios of estimated number entrained divided by estimated number entering lifestage.

Cohort	Ratio			
	Eggs	Yolk-sac larvae	Post yolk-sac larvae	Young of Year Juveniles
1981	<0.001%	0.015%	0.518%	1.452%
1983	<0.001%	0.002%	0.123%	0.118%
1984	<0.001%	0.002%	0.258%	0.092%
1985	<0.001%	0.001%	0.110%	0.025%
1986	<0.001%	0.002%	0.308%	0.042%
1987	<0.001%	<0.001%	0.083%	0.164%
Average	<0.001%	0.004%	0.233%	0.316%

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ATTACHMENT 5 TO NL-16-044

Critique of Community Analyses in 2008 and 2015 Versions of "The Status of Fish Populations and Ecology of Hudson River"

Prepared by ASA Analysis & Communication, Inc.

August 2015

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 & 3
DOCKET NOS. 50-247 AND 50-286

CRITIQUE OF COMMUNITY ANALYSES IN 2008 AND 2015 VERSIONS OF "THE STATUS OF FISH POPULATIONS AND ECOLOGY OF HUDSON RIVER"

Prepared for:
Entergy Indian Point Unit 2
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August 2015

REPORT SUMMARY

An independent Principal Component Analysis (PCA) was performed in an attempt to replicate the PCA results in the 2008 and 2015 reports on fish populations and Hudson River ecology. The replication was successful in producing PCA results, in terms of plots on 1st and 2nd principal component axes and percent of variation explained by these components, which were reasonably close to the results in both reports. However, for the 2015 report, it was necessary to switch from the covariance matrix that was apparently used in the 2008 Report to the correlation matrix. This switch, similar to many other decisions necessary to conduct the analyses, was not explained in the 2015 report.

The PCA results were incompletely and inaccurately reported in both the 2008 and 2015 reports. Neither the pattern of eigenvalues (measures of the amount of variance explained) for the principal components, nor the coefficients for the species were provided. Given the low amount of variation explained by the 2015 analysis, and lack of additional results, any biological interpretation of the meaning of the PCA is suspect. The statements about decreasing stability are contradicted by the pattern of the PCA results that were presented.

The term "stability" was used in both reports without any definition of what it means in the present context. Without an operational definition that could be used to construct testable hypotheses about stability, the statements about stability of the populations or communities are not meaningful.

Note: Subsequent to completion of this report, a "revised" version of the 2015 Report was received. The revision was the inclusion of the following statement on Figure 12:

> "The analysis was performed using the statistical software Community Analysis Package. The raw data set was reduced in size by removing all fish species which had not been observed in at least 5 years. The data were square root transformed to remove the dominance of the most abundant species. Analysis was performed using the correlation matrix."

After removing the species that had occurred in less than 5 years, and not standardizing the counts, the results in the 2015 Report for BSS and LRS data were able to be replicated. The results for FSS data closely approximated those in the 2015 Report, but did not match exactly.

Despite the ability to replicate some of the 2015 results, the conclusions stated above about the analyses in the 2008 and 2015 Reports still hold.

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1 INTRODUCTION

In 2008 and 2015, Drs. Seaby and Henderson of Pisces Conservation Ltd. prepared reports on the status of Hudson River fish populations which were used to support Dr. Henderson's testimony in the ongoing SPDES permit renewal proceedings for Indian Point Units 2 and 3. These reports, the "2008 Report", "2015 Report", and collectively "Pisces Reports", used data from Appendix C of the 2005 and 2013 Year Class Reports prepared by ASA Analysis and Communication.

Among other analyses the 2008 and 2015 reports contained multivariate analyses of the Hudson River fish community, the group of fish species that resides permanently or temporarily in the Hudson River estuary. This community is composed of resident species that live their entire life cycle within the estuary, freshwater species that reside primarily in tributaries or freshwater portions of the estuary, anadromous species that live in marine waters as adults but return to the Hudson to reproduce, a single catadromous species that spawns in marine waters but the immature life stages spend most of their life in the estuary and/or watershed of the Hudson, marine migrant species that migrate along the coast and spend part of their time within the estuary, and vagrant marine species that are far from their normal range. The species consist of both native and introduced components. Smith and Lake (1990) used 11 different categories to describe the Hudson River fish community; however, several of these categories denoted the zoogeographic origins of the species, a consideration not relevant to the present analysis.

The 2008 and 2015 reports described changes in physical factors (temperature and dissolved oxygen, which are addressed elsewhere), trends in many individual species (which are also addressed elsewhere), a multivariate analysis of the fish community, and raised concerns about the stability of the community. This report addresses the multivariate analyses, and the stability concerns.

2 METHODS

In this report, we attempt to duplicate the multivariate analysis (principal components analysis or PCA) in the 2008 and 2015 reports. However, the methods were described only briefly in those reports:

> "To compare the structure of the communities through time, the annual abundance data from all three surveys were analysed, using a number of multivariate statistical methods. As all the methods investigated lead to the same conclusion, we use here Principal Components Analysis (PCA), which is a standard technique familiar to most scientists. PCA is a method used to summarise the relationship between objects. Here we use it to summarise the relationship between the fish communities living in the Hudson in different years."
> 2008 Report, page 13.

These annual abundance data, which are the total number caught of each species in each of the three long-term surveys in each year since the mid-1980s, are presented in Appendix C of the 2005 and 2013 Year Class Reports.

The total counts in Appendix C for any species vary from year to year because of actual abundance differences, but also because of sampling variation, and also some differences in the temporal and geographic extent of sampling which has changed some over the years. For instance, in 2012, sampling effort was reduced as a result of delays in endangered species permitting. In both Pisces reports, the importance of accounting for these spatial and temporal sampling differences is discussed, but there is no indication whether or how any adjustments were made for these differences.

2.1 PRINCIPAL COMPONENTS ANALYSIS

PCA reduces the dimensions of a group of data by creating a smaller number of abstract variables (linear combinations of the original variables) called "principal components". The method maximizes the variance of the linear combinations, and ensures that each subsequent component is uncorrelated with previous components (James and McCulloch 1990). When presenting the results of PCA, "it is important to give the list of objects and attributes, the eigenvalues, and any coefficients that are interpreted and to state whether the analysis was performed on the variance-covariance or the correlation matrix" (James and McCulloch 1990). None of these are provided in either of the reports.

2.2 REPLICATING THE PCA

For the attempt to replicate the Pisces PCA, it was necessary to make educated guesses about how the analysis was conducted at several decision points. These are summarized below.

2.2.1 Level of taxonomic specificity

In conducting analyses of communities, it is important to recognize that not all individuals may be identified to the species level. Thus individuals of a particular species could be represented at the species level, while other individuals of the same species may only be identified to the genus or family level. This overlap of classifications might be eliminated by special handling of those groups which could not be unambiguously classified, such as by eliminating or combining of groups. Since neither Pisces report indicated any special handling, each taxon (at whatever level of identification) was retained for the analysis.

2.2.2 Data censoring

When conducting multivariate analyses on communities it can be useful to remove taxa that are rarely present (Clarke and Green 1988; Clarke and Warwick 2001). For example the BSS data from 1985-2013 contain 18 taxa that occurred only as a single individual in a single year, and 22 additional taxa that had fewer than 10 individuals captured over the 29 years of data. The Pisces reports did not indicate whether rare species were censored from the analysis; therefore, all were retained.

2.2.3 Effort standardization

The next decision was whether and how to standardize the catch data for differences in effort across years. Appendix C of the Year Class Reports provides the number of samples collected each year for all three surveys (Beach Seine Survey or BSS, Fall Shoals Survey or FSS, and Long River Survey or LRS). In addition for the FSS and LRS, the total volume sampled each year is also provided.

Given that Pisces explicitly discussed the need for standardization, we assumed that they had standardized. One logical way to do that would be to adjust the beach seine catches to number of fish per 1000 seine hauls, and to adjust FSS and LRS catches to number of fish per a standard amount of volume sampled. However, since the standard operating procedures for FSS and LRS keep the volume per sample relatively uniform, those surveys were also standardized as number per 1000 tows.

$$\text{Adjusted annual Catch} = \text{Annual Catch} \times 1000 / \text{Number of samples}$$

2.2.4 Data transformation

The need for data transformation is discussed in standard references for multivariate analyses, e.g. Poole (1974), Digby and Kempton (1987), Tabachnick and Fidell (1989). Fishery count data typically is skewed with a long upper tail, and thus often transformed by either logarithmic or square root transformation. The Pisces reports did not mention data transformation. In this report a square root transformation was applied to the adjusted annual count.

2.2.5 Choice of Correlation or Covariance Matrix

The relationships among the different variables, in this case abundance of each of the species, can be summarized by various methods, but for the current analysis the choices are either a correlation matrix, or a variance-covariance matrix (simply “covariance matrix” hereafter). If the covariance matrix is used, species with large variances, i.e. those that are more abundant, will be more strongly associated with components with large eigenvalues (first and second principal components), and those with small variances (lower abundance) to be more strongly associated with components with small eigenvalues. If the correlation matrix is used, the variation is essentially standardized so that lesser and more abundant species may both be associated with the components with larger eigenvalues. Neither Pisces report explicitly stated whether the covariance or correlation matrix was used. Both methods were used in the attempt to replicate the Pisces analysis.

2.2.6 Analytical Software

Neither Pisces report stated what analytical software was used. In the attempt to replicate the analysis, the Princomp procedure from SAS was employed[1].

2.2.7 Data source

The data matrices provided by Riverkeeper as comma-separated value files were imported into the SAS System using the Import procedure, then transposed to a data matrix in which each year was a row of the matrix and the columns represented the species. These matrices appeared to match the data in Appendix C of the 2013 Year Class Report.

[1] http://support.sas.com/documentation/cdl/en/statug/63033/HTML/default/viewer.htm#princomp_toc.htm

3 RESULTS

3.1 REPLICATION OF 2008 RESULTS

The choices employed for the analysis (no combining or censoring of taxa, standardization to 1000 samples, square root transformation, and use of the covariance matrix) produced results close to those in the 2008 Report. The patterns plotted on the principal component 1 and 2 axes were similar to those Pisces obtained for all three surveys, and the magnitudes of the axes were also similar (**Figure 1**). In addition, the amount of variation explained by the 1st and 2nd principal components was similar, with the combined percentage for the first two components ranging from approximately 52% for BSS, to over 70% for FSS and LRS (**Table 1**).

The close agreement of the plots with those of the 2008 Report, and the similar amounts of variation explained, suggests that the methods imputed for the 2008 analysis must be close to those used in the original report. No other results were provided in the 2008 Report so actual descriptions of the principal components (mix of species comprising each component) cannot be compared.

3.2 REPLICATION OF 2015 ANALYSIS

3.2.1 Use of 2008 methods

Since the 2015 Report did not indicate any change in methodology, the same methods that nearly replicated the 2008 analysis were applied to the entire dataset (1985 [BSS and FSS] or 1988 [LRS] through 2013). However, the plots on the first two principal component axes using these methods did not appear to match those in the 2015 Report (**Figure 2**), and the amount of variation explained by the two components was much higher than reported (**Table 2**). The plots in Figure 12 of the 2015 Report actually contain the word “Correlation” in the title, which strongly suggests that the 2015 analysis used the correlation matrix rather than the covariance matrix as was done in the 2008 Report.

3.2.2 Alternate methods for 2015 analyses

By making the single change in methodology to use the correlation matrix rather than covariance matrix, the results from the 2015 Report can be approached much more closely both in terms of the percent of variation explained (**Table 2**), and for the pattern when years are plotted on the first two principal components (**Figure 3**, **Figure 4**, **Figure 5**).

The change to the correlation matrix had several profound effects on the analyses. First, the percent of the variation explained in the analyses declined substantially from approximately 50% to 75% explained by the first two principal components using the covariance matrix, to only 22% to 26% being explained by these components. This low concentration of variance in the first two components would typically be viewed as a sign of poor success, in that successful PCA typically obtains results in the 50% to 70% range. Clarke and Warwick (2001) presented a similar biological use of PCA with similarly low percentage of variation explained, stating: “However, closer study shows that the % of variance explained by the first two PC axes is very low: 22% for PC1 and 15% for PC2. The picture is likely to be very unreliable therefore…” They go on to warn that one should be “very wary of interpreting any PCA plot which explains so little of the total variability in the original data.”

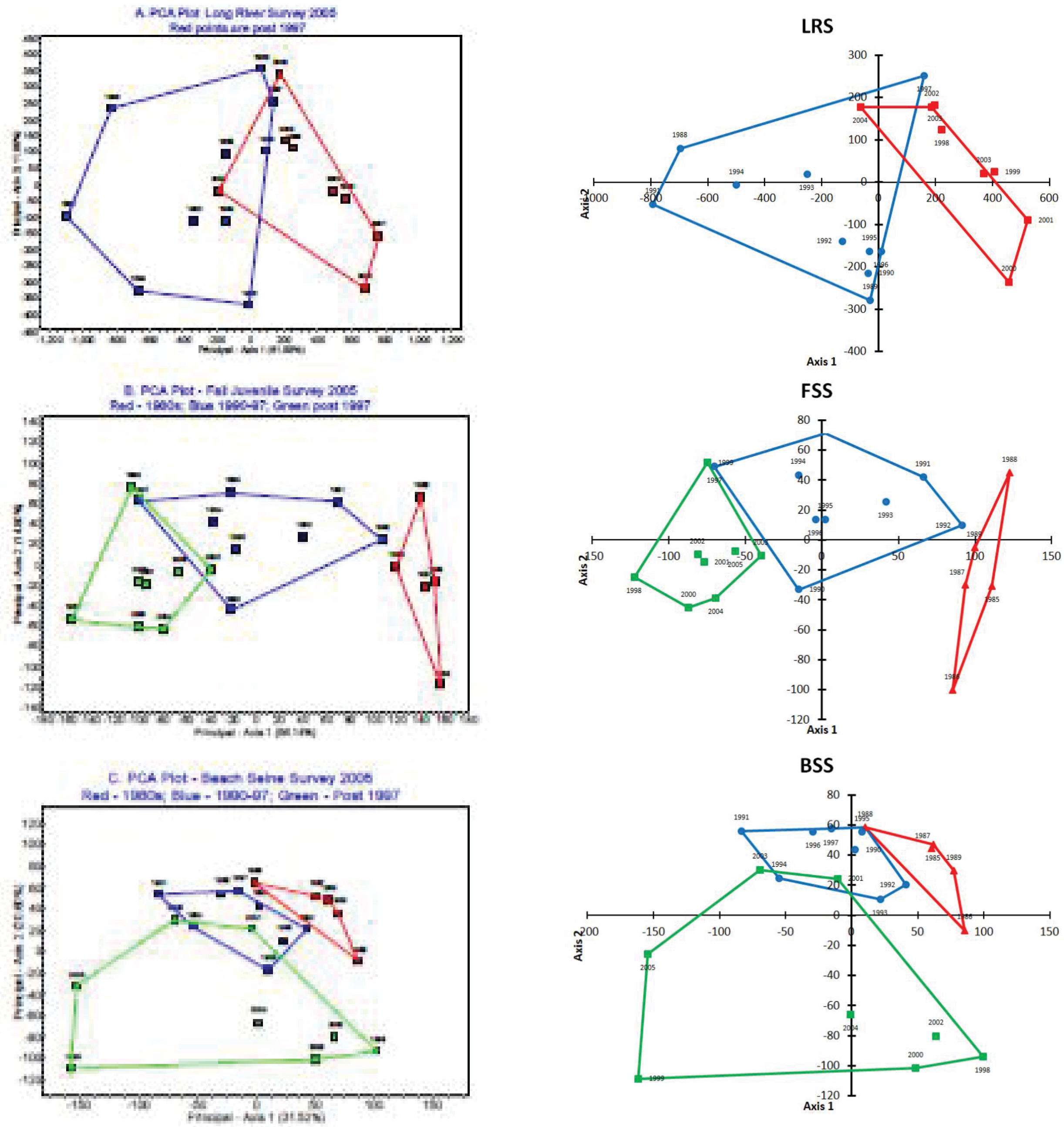

Figure 1 Results of PCA analysis from the 2008 Report (left column), and attempted replication (right column), for LRS (top), FSS (middle) and BSS (bottom). Data through 2005.

Table 1 Comparison of percent of total variance explained by 1st and 2nd principal component from Pisces 2008 report and current analysis.

Survey	Principal Component	Pisces 2008	Replication
LRS	1st	61.9	64.3
	2nd	11.9	11.7
	Combined	73.8	76.0
FSS	1st	56.1	58.1
	2nd	14.8	16.2
	Combined	70.9	74.3
BSS	1st	31.5	32.3
	2nd	20.6	20.1
	Combined	52.1	52.4

Table 2 Comparison of percent of total variance explained by 1st and 2nd principal component from applying 2008 methods to entire data set, from Pisces 2015 report, and from current analysis using correlation matrix.

Survey	Principal Component	Replication (2008 methods)	Pisces 2015 (correlation)	Replication (correlation)
LRS	1st	60.1	16.7	14.3
	2nd	14.7	9.6	8.5
	Combined	74.8	26.3	22.8
FSS	1st	46.8	16.6	15.0
	2nd	22.7	10.1	7.3
	Combined	69.4	26.7	22.2
BSS	1st	32.8	15.8	12.3
	2nd	17.3	13.6	10.7
	Combined	50.1	29.4	23.0

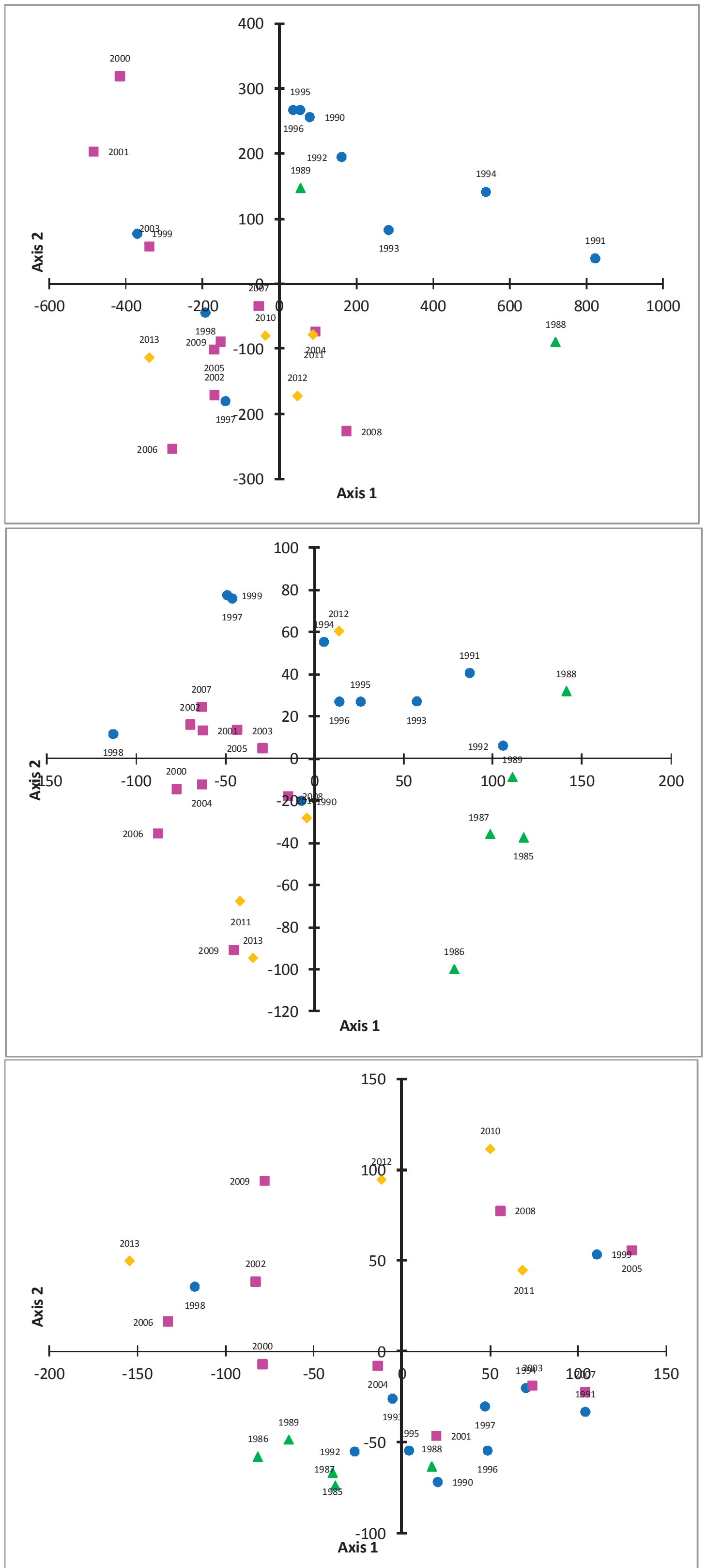

Figure 2 Plot of 1st and 2nd principal component scores for years LRS, FSS, and BSS data through 2013 using imputed methods from the 2008 Report.

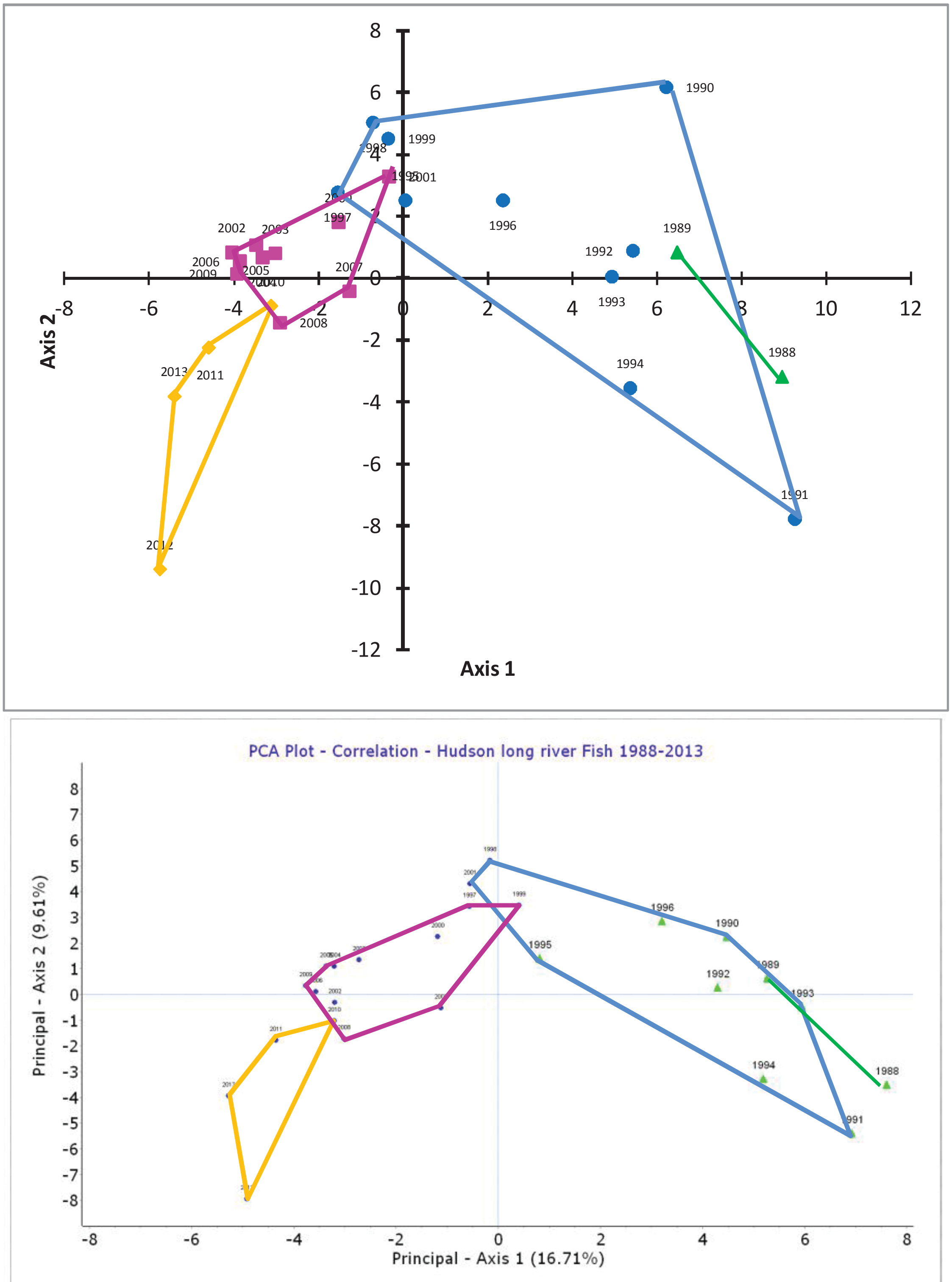

Figure 3 Plot of 1st and 2nd principal component scores for years 1988-2013 LRS data using correlation matrix for replication analysis (top) and the 2015 Pisces report (bottom).

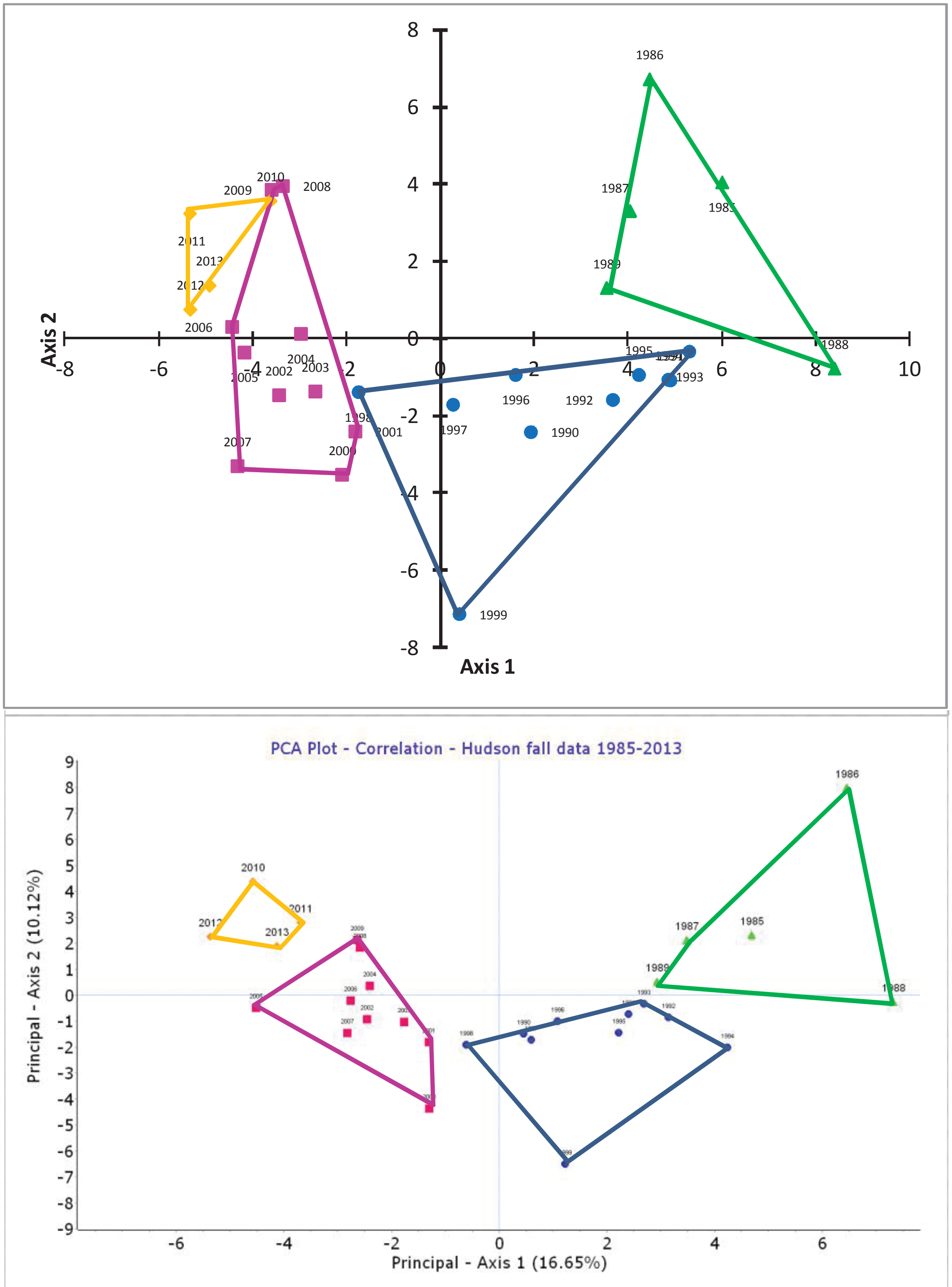

Figure 4 Plot of 1st and 2nd principal component scores for years 1985-2013 FSS data using correlation matrix for replication analysis (top) and the 2015 Pisces report (bottom).

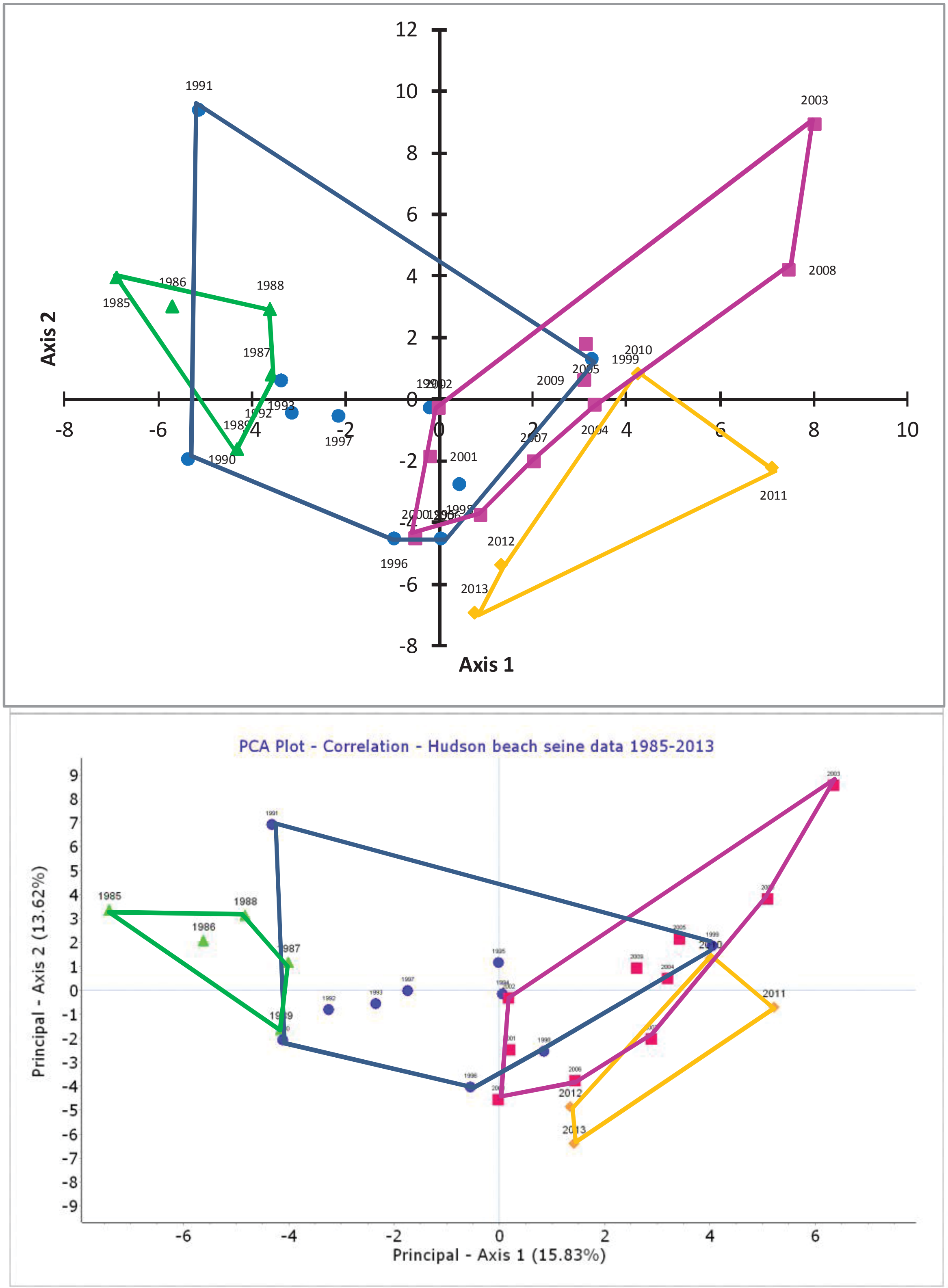

Figure 5 Plot of 1st and 2nd principal component scores for years 1985-2013 BSS data using correlation matrix for replication analysis (top) and the 2015 Pisces report (bottom).

3.3 PISCES REPORT CONCLUSIONS BASED ON PCA

Without disclosing what appears to be a change from a covariance-based analysis in 2008, to the correlation-based analysis in 2015 or the fact that the change degrades the results in 2015 to a point of unreliability, Pisces reached the same conclusion that the fish community of the Hudson Estuary had undergone "progressive change". Specifically, the 2015 Report states that "It can be concluded that the fish community has been changing rapidly since 1985 and is showing clear signs of increased between-year instability, in that between-year differences are generally larger than observed in earlier periods."

These statements about change and instability appear to arise from the authors' understanding of PCA providing plots where "the most similar years, in terms of their fish community, are plotted closest together, and the years which are most different in terms of their fish community, are furthest apart." (2015 Report, page 14).

There are several additional and serious problems with these conclusions. First, PCA does a poor job of maintaining the Euclidian distances on the principal component axes, especially when so little of the variation is explained by the axes of the plot. Clarke and Warwick (2001) stated about PCA:

> "2) *Its distance-preserving properties are poor*. Having defined dissimilarity as distance in the p-dimensional species space, PCA converts these distances by *projection* of the samples onto the 2-dimensional ordination plane. This may distort some distances rather badly…."

Second, neither Pisces report contained any quantification of the statements about increasing inter-annual variation in the community. The conclusion that variation is increasing is not obvious from the plots in Figure 12 of either report. In fact, if the inter-annual distances, to the extent they actually may reflect community change, are plotted through time, there is no significant pattern of increasing variation (**Figure 6**).

Finally, even if the analyses presented truly indicated changes in the fish community, neither Pisces report presents any information about what these changes have been. There is no presentation of the principal component coefficients for the species that would aid in understanding how the community has changed. This omission is significant, particularly in light of the change from a covariance-based analysis to a correlation based analysis. The covariance analysis performed for this report on data through 2013 has 1st principal components dominated by the more abundant species, which generally are members of the designated Representative Important Species (RIS) for IPEC (**Table 3**). However, the 1st components of the correlation-based analyses have many species with coefficient magnitudes that are nearly equal (only the largest 15 shown in the table), which provide little if any insight to biological changes in the community. Many of the species with largest coefficients are actually quite rare in the sampling.

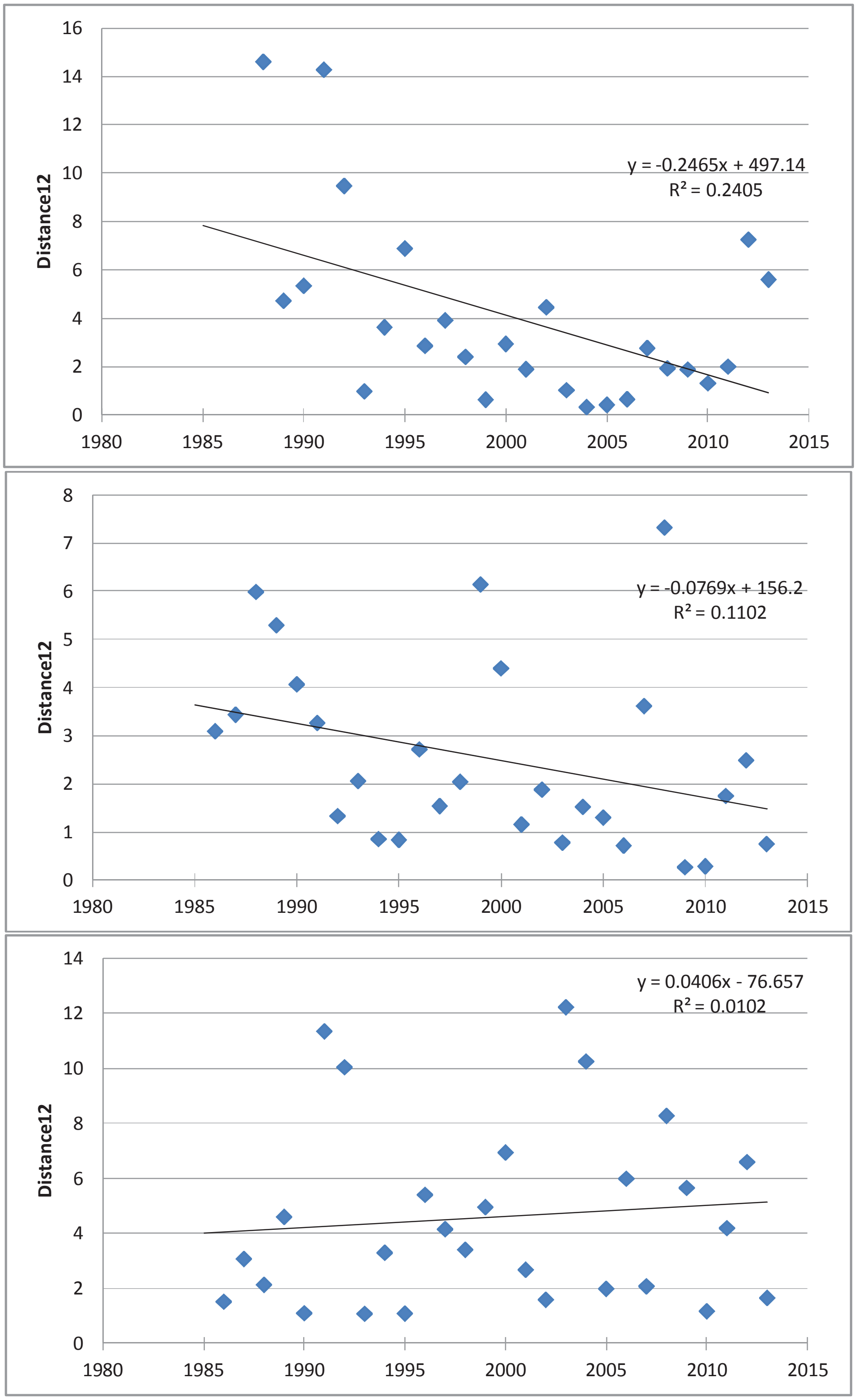

Figure 6 Euclidean distance on Principal Component 1 and Principal Component 2 axes from prior year for LRS (top), FSS (middle), and BSS (bottom) surveys from the replication of the PCA in the 2015 Report.

Table 3. Species with largest absolute coefficients (a) with absolute value > 0.1 for 1st Principal Component, for PCA of LRS, FSS, and BSS surveys using covariance or correlation matrix. Shaded cells indicate members of the designated Representative Important Species (RIS). Only the 15 largest coefficients are included.

	LRS				FSS				BSS			
	Covariance		Correlation		Covariance		Correlation		Covariance		Correlation	
	Species	a	Species	a	Species	a	Species	a	Species	a	Species	a
1	Bay anchovy	0.894	Bluefish	0.194	Hogchoker	0.706	Channel catfish	-0.212	Blueback herring	0.633	Smallmouth bass	0.205
2	Hogchoker	0.342	American shad	0.190	Blueback herring	0.475	American eel	0.211	Alosa sp.	0.529	Logperch	0.186
3	Striped bass	-0.137	American Eel	0.183	White perch	0.302	American shad	0.190	Spottail shiner	0.384	Freshwter drum	0.184
4	Weakfish	-0.128	Goldfish	0.166	Atlantic croaker	-0.203	Blueback herring	0.188	Atl silverside	0.274	Gizzard shad	0.179
5	Alosa sp.	0.124	Rainbow smelt	0.159	Atlantic tomcod	0.179	White catfish	0.185	Striped bass	0.202	Yellow perch	0.176
6			Channel catfish	-0.157	Striped bass	0.157	Winter flounder	0.182	Alewife	0.141	Brown Bullhead	0.168
7			White perch	0.156	Bay anchovy	0.145	Tess. darter	0.182			Spotfin shiner	0.167
8			4spine sticklback	0.156	American shad	0.111	Rainbow smelt	0.177			Brook silverside	0.164
9			Conger eel	0.152	Channel catfish	-0.107	Bluefish	0.176			White sucker	0.164
10			Alosa sp.	0.151			White perch	0.175			Tess. darter	0.153
11			Seaboard goby	-0.145			Oyster toadfish	-0.170			Channel catfish	0.150
12			Tess. darter	0.143			Atlantic tomcod	0.168			American shad	-0.150
13			Blueback herring	0.143			Striped bass	0.162			Atlantic tomcod	-0.149
14			Bay anchovy	0.140			Brown bullhead	-0.161			Trout perch	0.146
15			Spottail shiner	0.140			Atlantic croaker	-0.158			Largemouth bass	0.140

Even if the Pisces reports had presented information on the sizes of the component coefficients, the analysis still would have had, at best, limited utility in understanding the fish communities and how they had changed. This has long been recognized as a problem for PCA. Poole (1974) stated:

> "Although principal components ordination is far more elegant and formalized than either polar ordination or direct ordination, it is not necessarily the preferred method of ordination. One of the primary purposes of ordination is to create an ordination understandable in terms of the environment….. In principal components ordination, however, the axes correspond to the purely mathematical criteria of maximum variability and orthogonality. Although mathematically succinct, the axes often have little or no interpretation in terms of biological factors."

Clarke and Warwick (2001) also recommend against PCA for applications such as this one:

> "PCA is the longest-established method, though the relative inflexibility of its definition limits its practical usefulness more to multivariate analysis of environmental data rather than species abundances or biomass…"

Rather than resorting to PCA, more biological understanding of the community changes might have been obtained by simple plots of the data for some of the other species that were used for the PCA. The Pisces reports claimed that the species trends presented were for the 13 species studied most intensively. This statement reflects a significant misunderstanding of the Hudson River Biological Monitoring Program in that the sampling is designed to be most effective for a few of the target species, such as striped bass and Atlantic tomcod. The 13 species for which abundance indices are presented are those seven species that are designated Representative Important Species (RIS) for IPEC, plus additional species that the NYSDEC directed that indices be calculated for in the DEIS. These additional species were of interest to NYSDEC either because they are harvested and/or managed by the agency, or otherwise felt to be of importance. The analysis presented by the Pisces reports fails to recognize the many species whose numbers collected in the sampling programs has been increasing through time, for example freshwater drum, channel catfish, gizzard shad, spotfin shiner, white sucker, and tesselated darter, among others (**Figure 7**).

Clearly there have been changes in the fish community of the Hudson Estuary since the mid-1980s. However the Pisces Reports PCA analyses have provided no valid insight to the magnitude of change, nor any understanding of what the biological changes have been. It also provides no link to Indian Point's operations.

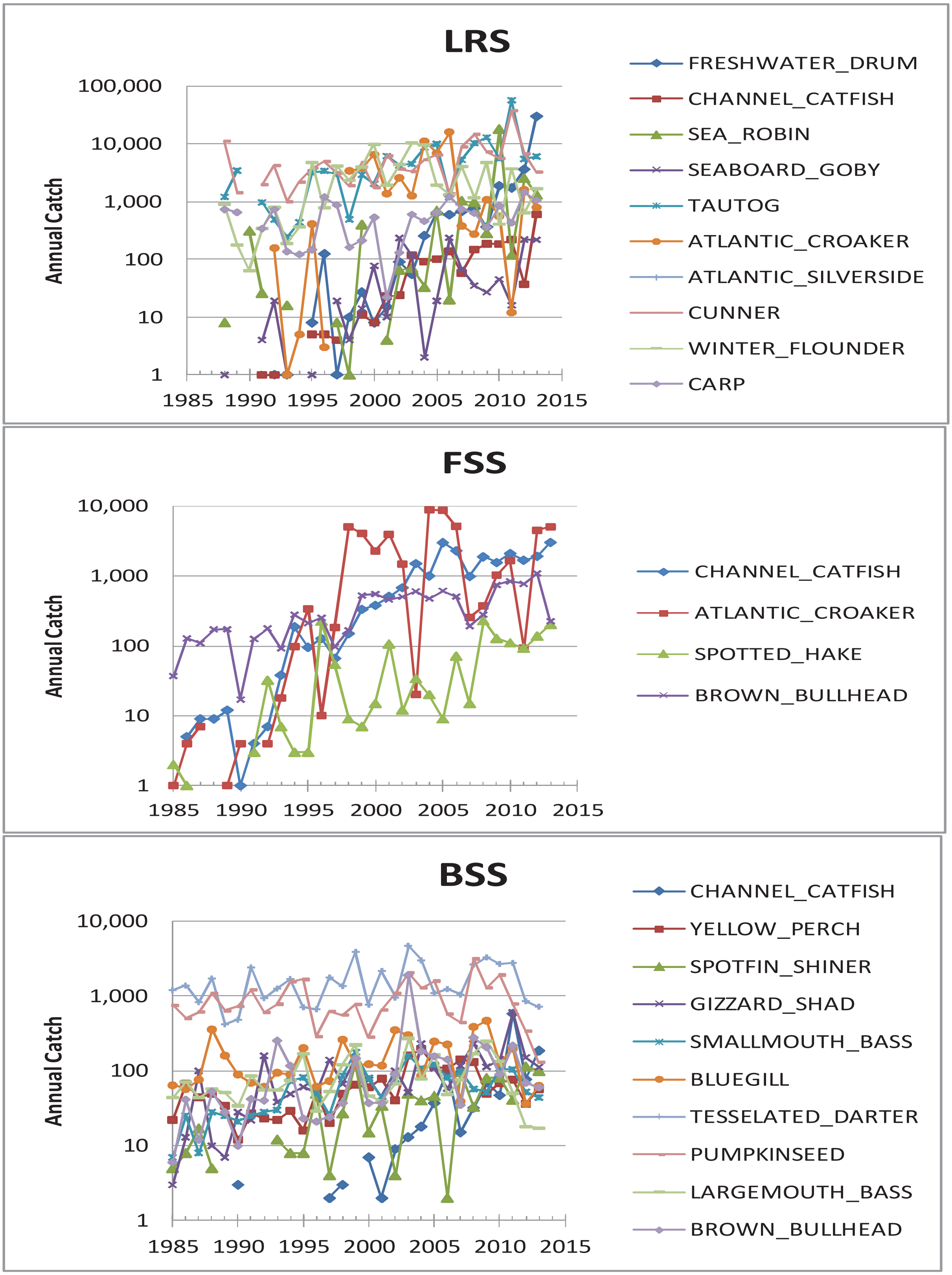

Figure 7 Annual catch of species with >1000 collected and increasing catches in LRS, FSS, and BSS sampling from 1985-2013.

4 MISUSE OF STABILITY

Stability is a nebulous concept in ecology. Although stability has long been of interest to ecologists, it does not have a single universally accepted definition. Orians (1975) attempted to break 'stability' into subconcepts which would have a clearer definition, such as constancy (absence of change), persistence (length of survival), inertia (resistance to perturbation), elasticity (speed of return after perturbation), amplitude (displacement from which return is possible), cyclic stability (degree of oscillation), and trajectory stability (tendency to move toward a similar endpoint). Whittaker (1975) found 13 different meanings for 'stability' without exhausting the possibilities. Concepts such as elasticity and amplitude, although measurable for models of ecological systems and possibly some experimental populations, are often impossible to apply to natural populations and communities due to the changes in the environmental setting. R.H. Peters (1991, pp. 95-96) provides a good summary of the problems in addressing stability in real-world settings:

> "Stability illustrates several common characteristics of troublesome concepts in ecology (Whittaker 1957). Like all the concepts mentioned in this section, it is a 'concept cluster' (Peet 1974) because it 'conflates' (Lewontin 1979) 'multiple meanings' (Hawkins & MacMahon 1989). In addition, it is a 'pseudo-cognate' (Salt 1979) because a meaning for the term is grasped intuitively, without the onerous necessity of operational definition. Regrettably, different scientists intuit different meanings and failure to define this term has ended in a terminological and conceptual morass. Ecologists have had to use subjective judgments to abstract some partial aspect of the concept. Worse, repetition and familiarity have made us so uncritical of the term that it has become accepted as a concrete property of nature. The vagueness of this and related terms has allowed the elaboration of a grand and complex conceptual system that obscures serious scientific shortcomings."

The vagueness of 'stability' has not prevented Pisces from attempting to apply it to the Hudson River estuary. The Pisces reports, without providing any definition of stability, claimed that the fish community, individual fish populations, and the ecosystem are becoming less stable on the basis of increasing inter-annual spread on two unspecified principal axes from principal components analysis (see section 3 above for quantification), and inter-annual variation in fish population indices. Notwithstanding that their description of the data patterns is debatable, their failure to provide any definition of stability makes it difficult to evaluate their claims of declining stability.

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ATTACHMENT 6 TO NL-16-044

Review of Estimates of Entrainment Reported in NYSDEC Staff's Comments on the NRC Draft Supplement

Prepared by AKRF, Inc.

April 20, 2016

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NOS. 2 & 3
DOCKET NOS. 50-247 AND 50-286

Review of Estimates of Entrainment Reported in NYSDEC Staff's Comments on the NRC Draft Supplement

4/20/16

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In its comments on the NRC Draft Supplement published in December 2015, NYSDEC Staff present three tables with estimates of number of organisms entrained at Indian Point. The accuracy of these estimates is not discernable from the comments because NYSDEC Staff did not provide clear explanations of what the numbers in the tables represented, or what the sources of the numbers were. After reviewing several reports and data files with entrainment estimates, AKRF was able to match all of the numbers in the three tables and determine what each estimate represented. As explained below, NYSDEC Staff were not always correct in their claims.

On page 8 of its comments, NYSDEC staff presented the following table (referred to here as "Table A").

	Year					
Species	1983	1984	1985	1986	1987	*TOTAL*
Bay anchovy	632,540,000	947,885,000	659,570,000	294,431,000	460,342,822	2,994,768,822
American shad	450,000	26,239,000	0	332,000	18,000	27,039,000
Striped bass	13,017,000	24,490,000	24,286,000	25,935,000	16,499,000	104,227,000
Atlantic tomcod	10,000	432,000	12,978,000	385,000	453,000	14,258,000
White perch	7,551,000	11,531,000	13,281,000	4,368,000	2,247,000	38,978,000
River herring	308,779,000	407,074,000	1,793,000	116,576,000	2,002,000	836,224,000
TOTAL	962,347,000	1,417,651,000	711,908,000	442,027,000	481,561,822	*4,015,494,822*

According to NYSDEC, Table A "presents the baseline entrainment for seven representative important species using the most recent and complete information on species specific entrainment densities (1983-1987)". Based on its review, AKRF determined that the sources of the estimates of annual entrainment presented in Table A are from the following annual entrainment reports:

Year	Report	Table	Type of Estimate
1983	EA. 1984. Indian Point Generating Station Entrainment Abundance and Outage Evaluation – 1983 Annual Report	4-6	Numbers Cropped
1984	EA. 1985. Indian Point Generating Station Entrainment Abundance and Outage Evaluation – 1984 Annual Report	4-8	Numbers Cropped
1985	NAI. 1986. Indian Point Generating Station Entrainment Abundance Program – 1985 Annual Report	4.5-3	Numbers Entrained
1986	NAI. 1986. Indian Point Generating Station Entrainment Abundance Program – 1986 Annual Report	4.4-4	Numbers Killed
1987	NAI. 1988. Indian Point Generating Station Entrainment Abundance Program – 1987 Annual Report	4.3-5	Numbers Killed

In all cases, the estimates reported by NYSDEC Staff are from the column labeled "Without Mitigation" from the tables in the Annual Reports, which represent baseline (i.e., 24-hours per day, 365 days per year) operation. Except for the year 1985, these estimates include entrainment survival, and therefore represent "losses" (i.e., numbers killed or "cropped"), not

numbers entrained. Although the 1985 Annual Report did include a table of "Numbers Killed," which would be consistent with the other years, NYSDEC selected the table for "Numbers Entrained" for 1985. Therefore, Table A does not report the same data for 1985 as the other years.

With respect to the following table on page 8 of NYSDEC Staff's comments (referred to here as "Table B"), NYSDEC Staff claimed: "[u]sing the known entrainment numbers from the 1980's and adjusting them for current river densities and Indian Point operating levels, the estimated 'current' annual entrainment presented in the 2003 FEIS for Indian Point is as follows:"

Species	Number Entrained
Bay anchovy	326,666,667
American shad	13,380,000
Striped bass	158,000,000
Atlantic tomcod	No Data
White perch	243,333,333
River herring	466,666,667
TOTAL	***1,208,046,667***

NYSDEC went on to conclude that in comparison to Table A, Table B demonstrates that: "[t]he [current] estimated annual entrainment of 1.2 billion fish is nearly a 50% increase over the average annual baseline entrainment that was measured from 1983 to 1987 (803,098,964) for these seven representative important species of fish."

Actually, the estimates in Table B, taken from Table 1 of the 2003 Hudson River Power Plants FEIS, are the averages of annual estimates for actual operating conditions for the years 1981 and 1983-1987, not baseline (which assumes 24/7/365 operation). The annual estimates from which these averages were computed were taken directly from Table 2 in Appendix VI-I-D-2 of the 1999 Hudson River Power Plants DEIS. Those estimates were not "adjusted" to reflect current operating conditions, but they did include an adjustment for probability of capture by entrainment sampling, which caused those estimates to be higher than estimates that do not include such an adjustment, such as those presented in Table A. Furthermore, except for 1985, Table A lists estimates of numbers lost, i.e., numbers entrained adjusted for entrainment survival. Table B lists estimates of numbers entrained. Therefore, it does not account for entrainment survival. Therefore, Table B cannot be directly compared to Table A.

On page 7 of its comments, NYSDEC Staff present another table of entrainment estimates (referred to here as Table C). Table C lists entrainment estimates from the NRC Draft Supplement (labeled "NRC Estimate") and estimates from the Entrainment Abundance Annual Reports (labeled "Reported"). A copy of Table C is shown below.

Entrainment Years 1983 to 1987			
Species	*Reported*	*NRC Estimate*	*Percent Difference*
Striped bass	61,907,000	225,209,000	263.8
White Perch	22,956,000	189,087,000	723.7
Bay anchovy	1,536,144,000	1,583,424,000	3.1
American shad	19,173,000	18,811,270	-1.9
River herring	679,882,000	301,991,600	-55.6
Atlantic tomcod	9,332,000	32,884,000	252.4
Total	2,329,394,000	2,351,406,870	0.9

Interpreting Table C, NYSDEC Staff concluded that "for four of the species, the NRC's methods do indeed overstate the entrainment that was reported in the 1980s Hudson River Entrainment Abundance Reports (i. e., striped bass, white perch, bay anchovy, and Atlantic tomcod)." NYSDEC Staff continued "[h]owever, for three species of greatest management concern for NYSDEC, American shad and river herring . . . , the NRC methods actually underestimated what the utility consultants reported to the Department back in the 1980s." The reasons for the differences are explained below.

The estimates in Table C are totals over the years 1983-1987. The "Reported" estimates are from the same Entrainment Abundance Annual Report tables that NYSDEC Staff used for Table A above, i.e., losses rather than numbers entrained (except for 1985, which is numbers entrained). However, for Table C, NYSDEC Staff selected the estimates listed under the column from the Entrainment Abundance Annual Reports labeled "With Mitigation," which are estimates for actual operations accounting for flow reductions, rather than baseline as in Table A.

The estimates listed under the column labeled "NRC Estimate" are totals of annual estimates (1983-1987) from Table A-7 of the NRC Draft Supplement. Each annual estimate was calculated by multiplying each the week-specific entrainment density estimate times the corresponding water withdrawal volume for the week (listed in the data file provided to NRC by Entergy in 2007). Then the week-specific entrainment estimates were summed the over weeks within each year. Accordingly, the "NRC Estimate" column represents numbers entrained, not entrainment losses.

The entrainment density data file provided to NRC listed four taxa codes for clupeids: 4000 (herring family); 4001 (blueback herring); 4005 (Alewife); and 4007 (Alosa sp.). NRC Staff apparently combined three of these taxa—Blueback Herring, Alewife and Alosa sp.—into the single taxon labeled "river herring," omitting taxon 4000 (herring family). The NRC Staff's apparent omission of taxon 4000 is the reason for the difference in the estimates for river herring in Table C. Had taxon 4000 been included, the total of the NRC estimates would have matched the total from the Annual Reports (because entrainment survival was set to zero for river herring).

For bay anchovy, NRC Staff apparently combined taxa codes 4109 (bay anchovy) and 4100 (anchovy family). For striped bass and white perch, NRC apparently allocated the unidentified Morone, taxa code (10508), to striped bass (10504) and white perch (10501) in proportion to the numbers entrained (and identified to species) of those two species.

The differences between the "Reported" estimate and the "NRC Estimate" for Striped Bass, White Perch and Tomcod, all of which had higher NRC estimates, are likely due to "Reported" estimates being losses and the "NRC Estimate" being numbers entrained. If the Annual Reports used a different method than NRC for allocating unidentified Morone to Striped Bass and White Perch, that also may have contributed to the differences for those species. The difference for River Herring, as explained above, likely is due to NRC Staff apparently omitting taxon code 4000 (herring family) from its river herring total. The differences for Bay Anchovy (3.1%) and American Shad (-1.9%) are too small to be of concern.