UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

IN THE MATTER OF	)	
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	)	
CONSOLIDATED EDISON COMPANY OF NEW YORK, INC.	)	Docket No. 50-286
	)	
	)	
(Indian Point Nuclear Generating Unit 3)	)	

TESTIMONY

OF

JOHN R. CLARK

March 25, 1975

I testified at length for the Hudson River Fishermen's Association in the Indian Point 2 proceeding before the Atomic Energy Commission's Atomic Safety and Licensing Board. That testimony covered the major impacts of once-through cooling at Indian Point on the aquatic biota of the Hudson, particularly the entrainment and impingement of fish with special emphasis on the striped bass. This testimony builds on my earlier testimony and is addressed to the knowledge which has been gained in the two years since I last testified.

"F" FACTORS

In the Indian Point 2 proceeding, Con Edison introduced three "f" factors into its entrainment analysis which compared the concentration of striped bass organisms in the plant intakes to the concentration in the cross-section of the River in front of the plant. The company generally contended that the concentration in the intakes was less than that in the River cross-section. On the basis of the data, I took the position that there was no reliable showing that the concentrations differed significantly between the intakes and the River.

NYU has done studies for Con Edison on this problem over the last two years and has now submitted "A Preliminary Analysis of the Abundance of Four Life History Stages of Striped Bass (Morone saxatilis) Collected in the Intakes

of Indian Point Unit 1 and in the Hudson River in Front of Indian Point" (December 1974). The data on which the analysis is based are not included in the report, copies of these data were requested from Con Edison on February 5, 1975. As of March 20, 1975, those data have not been supplied by the company so that it has been impossible to conduct an independent analysis or review of the data or of NYU's conclusions.

Nevertheless, the NYU conclusions do not support the contention that there is a consistently lower concentration of striped bass in the intakes than there is in the River cross-section. Tables 4 and 5 of the NYU analysis are reproduced here and indicate that in numerous cases the concentration is higher in the intakes than in the River cross-section.

During the hearings on the Storm King project before the Federal Power Commission in the fall of 1974, Con Edison's consultants maintained that there is a "patchiness" to the distribution of striped bass organisms in the River. If this is so and if the underlying NYU data show the same to be true in front of Indian Point, then the significance of the differences in concentrations observed by NYU may not be great. In that case, the best assumption must still be that over the long run there is no difference in concentrations between intakes and the River cross-section in front of the plant.

Until the NYU data are in hand and have been analyzed, it is unwise to take a firm position on their significance.

Table 4

Abundances for river and intakes in no/1000 m^3 with 95% confidence interval for striped bass by life stage, and day/night.

		RIVER	INTAKES
Eggs 5/29-6/26	Day	13 ± 6	92 ± 22
	Night	7 ± 5	42 ± 9
Yolk-sac larvae 5/29-6/26	Day	21 ± 6	16 ± 2
	Night	6 ± 2	15 ± 4
Larvae 5/29-8/21	Day	141 ± 24	38 ± 3
	Night	182 ± 36	126 ± 31
Juveniles 6/12-8/21	Day	2 ± 1	2 ± 1
	Night	1 ± 1	57 ± 20

"A Preliminary Analysis of the Abundance of Four Life History Stages of Striped Bass (Morone saxatilis) Collected in the Intakes of Indian Point Unit 1 and in the Hudson River in Front of Indian Point" (December 1974).

Table 5

Results of ANOVA comparing abundances collected in the river and in the intakes, by life history stage, and day/night.

Eggs 5/29-6/26	Day	INTAKE > RIVER
	Night	INTAKE > RIVER
Yolk-sac larvae 5/29-6/26	Day	no difference
	Night	INTAKE > RIVER
Larvae 5/29-8/21	Day	RIVER > INTAKE
	Night	RIVER > INTAKE
Juveniles 6/12-8/21	Day	no difference
	Night	INTAKE > RIVER

"A Preliminary Analysis of the Abundance of Four Life History Stages of Striped Bass (Morone saxatilis) Collected in the Intakes of Indian Point Unit 1 and in the Hudson River in Front of Indian Point" (December 1974).

At the same time, the conclusions of that analysis show that there is not a consistently higher concentration of organisms in the River cross-section than there is in the intakes and they do not present any conclusive evidence to lead me to believe that the assumption that there is no significant difference in concentrations over the long run is incorrect.

The very short time since Quirk, Lawler & Matusky's analysis of the "f" factors at Bowline, Lovett, Roseton and Danskammer were forwarded to HRFA on February 26, 1975 has not allowed me to do an analysis of the calculations of "f" factors at those plants. This must obviously be done with care since there is very major disagreement between Con Edison and the Staff on what the data show "f" factors at those plants to be. Con Edison's consultants consistently arrive at composite "f" factors of less than 1. This is so even when 100% mortality on passage through the condensors is assumed. Letter from Quirk, Lawler & Matusky Engineers to Mr. H. G. Woodbury re f-Factor calculations for Lovett, Bowline, Roseton and Danskammer Plants (undated). The Staff analysis of the QLM data* produces very different results. The composite intake

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* The Staff does not clearly identify the QLM data which it analyzed. 1 IP3 FES at V-90. But since both the QLM and Staff analysis are addressed to 1973 sampling data, it is assumed that the same body of information is being analyzed by both parties.

factor ($\hat{f}^*_{1,1}$ or $\hat{f}^*_{1,2}$) is frequently greater than 1. In the most extreme case the intake factor for Lovett on the June 19-20 sampling reaches 54.8 by Method 1 calculation and 60.0 by Method 2 calculation. 1 IP3 FES at V-98. Clearly differences of this magnitude will need careful consideration which the brief time prior to this hearing has not allowed.

ENTRAINMENT

The percentage of striped bass organisms surviving passage through Indian Point was a matter of controversy in the Indian Point 2 proceeding and it was evident in that proceeding that close attention to data was necessary in order to segregate samples when the plant was operating at full power conditions from other samples. NYU has presented the results of its 1973 entrainment study, Institute of Environmental Medicine, NYU Medical Center, "Hudson River Ecosystem Studies" Progress Report for 1973 (September 1974). A request was made to Con Edison for the data on which this report was based, in so far as it relates to the entrainment and mortality of fish organisms, on February 5, 1975. As of March 20, 1975, Con Edison has not supplied that data. Therefore, the analysis and discussion of this latest entrainment study must be tentative and limited. Nevertheless, a few salient items should be underscored.

There was a $\triangle T$ at the Indian Point plant on only three sampling dates in 1973. Progress Report at 229. On no sampling data in 1973 did the $\triangle T$ reach the level which is to be expected with normal, full-power operation of Indian Point 2. Thus more than two years after its presentation of testimony on this issue in the Indian Point 2 proceeding, Con Edison is unable to provide further data on the effects of entrainment at full power operation at Indian Point 1 or 2. In fact, during the 1973 sampling there was apparently only one day with a $\triangle T$ on which NYU believed there to be a sufficient number of organisms to allow a comparison between the intake and discharge canal stations. Progress Report at 236-37. The $\triangle T$ that day was 5.7°F, significantly lower than the $\triangle T$ of 14-15°F which would be attained at full power operation. Thus there is clearly a limited utility to the data developed in the 1973 Con Edison program.

Two further aspects of the 1973 sampling program relating to reliability of the sampling program deserve attention. First, are the low recapture rates of the egg marking and recapture experiments. Progress Report at 252 and following. In the two experiments, striped bass eggs were dyed and released in the intake and an attempt to recapture the eggs was made in the discharge canal. In one case, 17% of the expected number of eggs and in the other 26.8% of the expected number of eggs were recaptured.

Various possible explanations for these results were presented:

1. Some of the eggs were not retained in the net.

2. All eggs collected from the discharge canal have experienced not only collection effects, but also plant effects. A portion of the eggs may have been destroyed during passage through the plant and therefore should not be considered as part of the total number available for collection.

3. There may have been some loss of eggs in the intake, in that all those introduced into the intakes did not enter the plant.

4. The number of eggs entering the net approached the expected numbers; however due to the velocities encountered during collection a large number of eggs were destroyed and therefore were never counted.

There is some evidence to support the fourth of the above possibilities. Immediately after the 50-minute collection period, as the nets were being washed, it was noted that the nets had taken on a red speckled appearance. Observations revealed that large numbers of collected eggs had become imbedded in the mesh of the nets, such that they were not dislodged by the normal washing procedure. There was no way to make a reasonable quantitative estimate of the number of eggs involved in the loss from the sample. NYU 1973 Progress Report at 255-256.

The second and fourth possibilities are likely explanations in my opinion. Striped bass eggs are fragile organisms and their destruction in the plant's cooling system and in the nets is highly likely. The "red speckled appearance" of the net is likely to be egg remains. These results indicate that the sampling program is likely to underestimate

seriously the damage and destruction of eggs caused by passage through the plant. The same is likely to be true of other fragile striped bass organisms. These results must be considered in analysing the results of the sampling program.

Second, while the 1973 NYU Progress Report contains no information on sampling results on fishes other than striped bass, the NYU Progress Report for 1971 and 1972 contains useful information on other species. Institute of Environmental Medicine, NYU Medical Center, "Hudson River Ecosystem Studies" Progress Report for 1971 and 1972 (September 1973). Since this document appears not to have been submitted to the ASLB by Con Edison, it is necessary to quote its results on species other than striped bass and white perch at some length:

> Well over 1,000 samples were collected in 1972 to determine effects of pumped entrainment of fish eggs and larvae through Indian Point Unit 1.
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> The seasonal occurrence of planktonic species of fish eggs and larvae in the plant intake and discharge-canal samples corresponded very closely to their presence in the river at Indian Point (Figure 7-1 and 7-2).
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> Six species, including the anchovy, alewife and blueback herring (clupeids), striped bass, white perch and tomcod accounted for most of the fish eggs and larvae entrained through the Indian Point plant.
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> Anchovy eggs and yolk-sac larvae were not observed in intake-bay or discharge-canal samples in 1971 and 1972. These stages are produced in more brackish water than occurred at Indian Point. However, during late summer and fall, anchovy larvae were by far the most

> abundant species in samples from the plant cooling water system. Very few of the small anchovy survived capture at either the intake or discharge-canal station locations. Thus it has not been possible to determine effects of entrainment on anchovy larvae by available techniques.
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> Alewife eggs were sparse in cooling system entrainment samples, probably because this species spawns several miles upstream from Indian Point and the demersal eggs of the alewife are not transported to the vicinity of the plant by water currents. Too few eggs were observed to determine effects of pumped entrainment.
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> Cluepeids (alewife and blueback herring) were not the most abundant larvae in entrainment samples at Indian Point. Most of the clupeid larvae could not be taken alive by available collection methods, so it was not possible to determine effects of pumped entrainment by the Indian Point plant.
> NYU Progress Report 1971 and 1972 at 214-215.

Few results were obtained with tomcod. No eggs were observed in the sampling at Indian Point and larvae were observed only on a few days in 1971 and 1972. Though survival of the larvae through the condensors appeared high, the Progress Report concluded, "Too few tomcod larvae were collected in intake and discharge canal samples to permit reliable conclusions as to how they are affected by pumped entrainment" NYU Progress Report 1971 and 1972 at 227.

The results with anchovy and the clupeids indicates the fragility of the early life stages of those species and the high probability that all or nearly all of those organisms passing through the Indian Point cooling system will be killed. This conlcusion is supported and confirmed by the research conducted by Marcy at the Connecticut Yankee

plant on the Connecticut River. Marcy, "Survival of Young Fish in the Discharge Canal of a Nuclear Power Plant" Journal Fisheries Research Board of Canada, Vol. 28, pp. 1057-1060 (1971); Marcy, "Vulnerability and Survival of Young Connecticut River Fish Entrained at a Nuclear Power Plant," Journal Fisheries Research Board of Canada, Vol. 30, pp. 1195-1203 (1973).

The results of Con Edison's entrainment studies to date have not led me to change the opinion that I presented at the Indian Point 2 proceeding that all or nearly all of the striped bass organisms which are entrained by the plant at normal full power operation will be killed and that the same is likely to be true of other fish species including white perch, anchovies, alewifes and blueback herring, all of which are present under certain environmental conditions at the Indian Point site.

COMPENSATION

On the question of whether or not there is a compensatory mechanism operating within the Hudson-spawned striped bass population, Con Edison has submitted a "Report of Quirk, Lawler & Matusky Engineers to H.G. Woodbury, Executive Vice President, Con Edison - March 15, 1974." This is essentially nothing more than a general discussion of compensation in animal populations. When the author focusses on the Hudson River, he begins by stating:

> To date, the clear demonstration of a particular type of compensation in the Hudson River has not occurred. Report at 12.

There follows a discussion of possible compensatory mechanisms which might operate in the Hudson striped bass population, but no data is presented and no claim is made that it can be shown that compensation is, in fact, operating.

This leaves the analysis of compensation by Con Edison essentially where it was two years ago. No one has argued that compensation does not take place in animal populations, nor that under some conditions it may take place in the Hudson River-spawned striped bass population. The question is whether at present population and spawning levels any compensatory mechanism will be effective in reducing the impact of power plant-induced mortalities on the Hudson-spawned striped bass population. The company has come forward with no new evidence to indicate that a compensatory mechanism is operating through the first year of life of Hudson-spawned striped bass. I see no basis on which to alter my opinion, put forward on the basis of the evidence in the Indian Point 2 proceeding, that no effective compensatory mechanism is operating during the first year of life.

In the Final Environmental Statement, the Staff puts forward the position that compensation may exist later in life through the operation of the fishery. Two points must be emphasized in response. First, the Staff's

formulation of this mechanism does not rest on a factual analysis but on hypothesis. Second, and most importantly, this compensatory mechanism is nothing more than a statement that fishermen will reduce their pursuit of striped bass as the population declines. Essentially, the resource base would be maintained by giving up the use of the resource. Obviously, this not untypical response of fishermen to a declining fish population is utterly unlike a natural compensatory mechanism. Decline in the fishery will result in loss of recreation, income, food and the other enjoyments which the Hudson stripers provide. There are real costs associated with the operation of this mechanism unlike any natural compensatory mechanism.

In sum, neither Con Edison nor the Staff presents evidence showing compensation in the first year of life of Hudson-spawned striped bass. The evidence presented in the Indian Point 2 proceeding still stands, indicating that a compensatory mechanism is not operative in that period. The introduction of compensation through a decline of the fishery is an extension of views presented in Indian Point 2, but it must be recognized for what it is, a loss of the use of the resource with all the adverse consequences that entails.

IMPINGEMENT

Con Edison has submitted an impingement study for

Indian Point which covers the period from June 15, 1972 to December 31, 1973. Texas Instruments, Indian Point Impingement Study Report for the Period 15 June 1972 through 31 December 1973 (December 1974). This report is of very little value because of the operational history of the Indian Point plants during that period. Indian Point 2 did not have a license for operation other than testing up to 50% of full power until late in the summer of 1973. There were other difficulties in operation which T.I. states bluntly:

> Plant operational problems such as circulator downtime reduced the opportunity to collect impingement data during the following approximate periods:
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> - Unit 1: mid-January 1973 through early May 1973 and mid-June 1973 through early November 1973
> - Unit 2: July through August 1972 and mid-October 1972 through January 1973.
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> Texas Instruments Impingement Study at II-4.

The net result of this circumstance is that there is not any significant body of new and organized data which would lead to a reanalysis of the impingement impact of the Indian Point plants. Con Edison does submit monthly reports of the impingement at Indian Point, but these reports do not indicate pumping rate, level of power output, or thermal discharge and until that information is presented little further fruitful analysis of impingement is possible.

Essentially, the additional information presented by Con Edison's impingement studies at Indian Point provides little useful data which would indicate the need for revision of the opinions on the impingement impact of the plants which was presented in the Indian Point 2 proceeding.

CONTRIBUTION OF HUDSON-SPAWNED STRIPED BASS TO THE ATLANTIC COASTAL STOCK

Few results are available from the state-federal tagging program or from Con Edison's research program which would add to the facts which were available for analysis in 1972 and early 1973. The information which has been developed tends to confirm that the Hudson-spawned striped bass make a major and significant contribution to the coastal stock of striped bass in New Jersey, New York and New England waters.

Con Edison reports that the New York Department of Environmental Conservation's federally-funding tagging program has failed to meet its planned goals and that virtually no results are in hand from it. Applicant's Memorandum in Response to Inquiries by the Atomic Safety and Licensing Board at 12. During the first two years of the study approximately 10,000 fish were to be tagged, in fact only about 3500 were tagged. This tends to confirm the opinion which I expressed two years ago that one cannot rely with confidence on state efforts to

determine the constituent parts of the Atlantic coastal stock of striped bass. Apparently only one fish tagged in this program has been returned from outside the Hudson, a fact that is not surprising since the fish were tagged as young of the year, but which also means that so far the program has added little to our knowledge of the range of Hudson-spawned striped bass or their contribution to the coastal stock.

Texas Instruments has also conducted a small tagging program for Con Edison. The results of this program confirm that mature fish which spawn in the Hudson contribute to the coastal stock well beyond the western end of Long Island Sound and the New York Bays. Five striped bass of Age VI and older were tagged by Texas Instruments in the Hudson and have been recovered. One was recovered approximately six weeks later a mile from the place where it was tagged, a second was taken in Lower New York Bay. The remaining three were taken in Nantucket Sound, Massachusetts, at Montauk Point in Long Island Sound and in Buzzards Bay, New Bedford, Massachusetts. Texas Instruments Hudson River Ecology Study Annual Report (July 1974) at III-38. This clearly confirms that mature Hudson-spawning striped bass contribute to the coastal stock along the south shore of Long Island, in Long Island Sound and in the coastal waters of New England.

These tagging results do not directly provide

information on the percentage contribution which the Hudson-spawned striped bass make to the coastal stock. I know of no further information developed during the past two years which would lead me to change the opinion I expressed in the Indian Point 2 proceeding as to what the percentage contribution from the Hudson is. Certainly the electrophoretic studies which Con Edison's consultant claimed could provide further data on this question within a year have not yielded new information over the course of the last two years. Applicant's Memorandum in Response to Inquiries by the Atomic Safety and Licensing Board at 12 and following.

Texas Instruments concludes that further tagging research will "add little" to estimating the Hudson contribution to the coastal fishery (p. III-46).

In sum, the studies of the last two years have confirmed the range of Hudson-spawning striped bass which I presented in the Indian Point 2 proceeding and there is no new information which would lead me to change my opinion as to the percentage contribution from the Hudson to the coastal stock.

MITIGATING MEASURES: HATCHERIES

Consolidated Edison's fish stocking research program of 1973 proved that hatchery-reared fish are not able to survive in significant numbers in the Hudson estuary thus

eliminating stocking as a potential method to replace the fish killed by power plants. Feasibility of Culturing Stocking Hudson River Striped Bass, T.I. 1973 Annual Report (July 1974), Tables VI-5, and App. D. No fish reared at Verplank were stocked apparently. None of the Oklahoma reared fish are known to have survived in the estuary. Very few of the Florida hatched fish survived.

Of 28,674 hatchery fish tagged and stocked in 1973, only 0.16% were recaptured from the estuary. This compares to 1.53% recapture of native Hudson fish tagged in comparative tests. Thus only 1/10 as many hatchery fish survived as wild fish during the brief autumn tests of 1973. No adjustment for gear selectivity can explain this difference. I would not expect any hatchery fish to have lasted through the winter (but no data are yet available to confirm this expected mortality).

Thus, it is clear that the stocking alternative is proved to be a failure, confirming my previous testimony that striped bass could be hatched but would not have significant survival in the Hudson.

RESEARCH

In the Indian Point proceeding, I testified on behalf of the Hudson River Fishermen's Association on the issues of the entrainment and impingement of Hudson River fish, particularly striped bass, at the Indian Point plant, on

compensation in the Hudson-spawned striped bass population and on the contribution of the Hudson-spawned striped bass to the coastal stock. It was my position and that of the Fishermen that there was sufficient data in hand in 1972 to estimate the impact of the Indian Point plants on the Hudson striped bass fishery and that further research on that issue was unnecessary before deciding that a closed-cycle cooling system should be required at the Indian Point 2 plant. The Staff and the Licensing Board essentially agreed with that position:

> HRFA asserts that data on hand give sufficient evidence of the serious impact that once-through cooling of Unit No. 2 could have on the Hudson River and related fisheries. HRFA does not oppose the imposition of a condition on the license requiring the Applicant to conduct research, but this requirement should in no way be accepted as an alternative for installation of an alternative cooling system at a date no later than that suggested by the Staff and preferably much earlier. The State of New York fully supports this position.
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> The Staff is in general concurrence with the position of HRFA. The Staff has decided that the research effort proposed by the Applicant is unlikely to conclusively demonstrate that operation of Unit Nos. 1 and 2 with once-through cooling will not have an unacceptable adverse impact on the fisheries supported by the Hudson River. The Staff would require that the research be continued at least as long as Unit Nos. 1 and 2 operate with once-through cooling to show compliance with the Technical Specifications and with applicable federal, state, and local regulations.
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> After careful consideration of the voluminous testimony on the research program, the Board reaches essentially the same conclusion as the Staff and the Intervenors. Consolidated Edison Company of New York, Inc. (Indian Point 2) RAI-73-9 751, 780.

Virtually two years have passed since the final testimony was taken in the Indian Point 2 proceeding and eighteen months since the Licensing Board decision was issued. My opinion on the need for research remains what it was two years ago. Where later results are available from the research program on the issues on which I testified, they tend to confirm the positions taken by HRFA and the Staff in the Indian Point 2 proceeding. This is so, for instance, on the question of the range of Hudson-spawning striped bass along the coast and on the relative concentrations of striped bass organisms in the Indian Point intake and in the River cross-section in front of the plant. Thus the results of the research program over the last two years have not led me to alter my opinion that a sufficient data base is presently available for requiring a closed-cycle cooling system at the plant.

In its decision at Indian Point 2, the Licensing Board also summarized its opinion of the results which the research program is likely to produce: "The Applicant has not . . . provided reliable, probative and substantial evidence to constitute a convincing case that its research program will resolve the question of the impact of entrainment at Unit Nos. 1 and 2 on the fisheries." RAI-73-9 751, 783. The results of the research program to date tend to confirm the soundness of this judgment. The Staff has included in the Final Environmental Statement an analysis

of the failings of the research program which need not be repeated here. The paucity of important results to date from the program underscores the Staff analysis. It seems likely that the research program will do little more than fill in the details surrounding the major facts which are already known. This may have the advantage of adding a further degree of certainty to the judgments of the Staff and the regulatory bodies. There is no showing so far that this research program will add major new knowledge to our data on the Hudson striped bass fishery or that it will demonstrate that the data presently relied on are inaccurate or inadequate in any major or significant respect.