BEFORE THE UNITED STATES

ATOMIC ENERGY COMMISSION

In the Matter of Consolidated Edison Company of New York, Inc. (Indian Point Station, Unit No. 2)	)	Docket No. 50-247

Affidavit of John R. Clark

REVISED CALCULATION OF EFFECTS OF INDIAN POINT UNITS 1 & 2 ON HUDSON RIVER AQUATIC LIFE BASED UPON PRIOR OPERATION OF ROSETON AND BOWLINE PLANTS.

JOHN R. CLARK, being duly sworn deposes and says,

1. The AEC's draft environmental statement on Indian Point 2 (1, p. V-54) states: "The level of recruitment loss will be determined by the proportion of the 0+ age class that is killed by density-independent factors, such as other power plant operations." This statement points out that the effects of power plants on the fish populations are cumulative, although not directly additive. The Staff report continues:

> "It is expected that the population will be able to maintain stable density until density-independent losses from this and subsequent power plants exceed the buffering capacity of the population." (1, p. V-55).

2. It is thus clear that any analysis of the effects of Indian Point No. 2 must consider the concurrent effects of the other new power plants. Therefore, I have undertaken a revision of the calculations of the effect of removal of 0+ age class striped bass by Indian Point No. 1 and 2 (3), taking into

account the removals by Roseton and Bowline Point.

3. The Roseton plant is situated in an area of heavy spawning of striped bass and an area of moderate abundance of larvae (3, fig. 1). The plant will remove a significant number of the larvae. The Bowline Point plant is located in an area of moderate abundance of larvae and a heavy abundance of juveniles. (3, fig. 1). This plant will remove a significant number of these stages. As with the Indian Point analysis, the destruction of eggs is not included in these calculations.

4. Stage II Early Larvae. The average density of early larvae (average of 1966 and 1967) from the Carlson and McCann data (2) is 0.34 per 1000 cu. ft. for Bowline Point (Croton sector) and 1.06 per 1000 cu.ft. for Roseton (Marlboro sector) for the 28-day early larvae period, June 1 - 28, (see 3). With Bowline Point (both units) and Roseton (both units) at full power they will pump respectively 1,730 and 1,460 cfs (4, 5) or 4.2×10^9 and 3.5×10^9 cu. ft. in the 28-day period. Thus they will remove respectively 1.43×10^6 and 3.71×10^6 early larvae, or a total of 5.14×10^6 early larvae. This is a removal of 4.6 percent of the Hudson population of early larvae (see table 1). All population quantities are relative,not absolute(3,p9)

5. Stage III Later larvae and prejuveniles. The density of this 45-day stage is estimated at 8.5% of the peak density of early larvae (see 3, p. 26) corresponding to 7 3/4 weeks after hatching, the median of the period. Peak density

was respectively 0.62 and 2.18 per 1000 cu. ft. at Bowline Point and Roseton (for 1966 - 1967: 2, App. tables 2-7, 10; 3-7, 10) and the densities at the median are 0.053 and 0.185 per 1000 cu. ft. In the 45 days, Bowline Point and Roseton would pump, respectively, 6.8×10^9 cu. ft. and 5.6×10^9 cu. ft. and the plants would have removed 0.36×10^6 and 1.03×10^6 or a total of 1.39×10^6 later larvae and early pre-juveniles in the 45-day period, if 4.6% of the population had not been removed in the early larvae stage. Adjusting for this previous loss, the removal would be 1.33×10^6 fish. This is 14.8 percent of the population of this stage of striped bass (see table 1).

6. Stage IV - Early juveniles. The density of juveniles is based upon the ratio of their abundance to Cornwall where the only good samples are reported: Bowline Point, 77%, and Roseton, 8.7%, (3, table 4). The Cornwall density was 0.11 per 1000 cu. ft. for 1966-1967 (3, p. 28). Therefore the estimated abundance at Bowline is 0.085 per 1000 cu. ft. and at Roseton is 0.01 per 1000 cu. ft. In the 28 days, the Bowline Point and Roseton plants would pump, respectively, 4.2×10^9 cu. ft. and 3.5×10^9 cu. ft. and would have removed 0.36×10^6 and 0.035×10^6 early juveniles or a total of 0.395×10^6 early juveniles, if the population had not already been reduced at Stage II and III. Adjusting for these previous losses, the removal of early juveniles would be about 0.32×10^6. However,

this stage is becoming progressively less pelagic and vulnerable to entrainment and more screenable (3, p. 29). Corrections (50% non-vulnerable, and 22.5% non-screenable) reduce the estimated amount actually removed by entrainment to 0.036 x 10^6.

7. The number of early juveniles which will be killed on the screens in this 28-day period is calculated from the historical rate of kills at Indian Point No. 1 (3, table 6) because there is no information available on fish kills for plants any closer to Bowline Point and Roseton. Using the abundance ratios of 77% and 8.7% to express the relative unit abundance of juveniles at Bowline Point and Roseton and pumping ratios of 73% and 62% on the Indian Point No. 1 and 2 kill of 0.020 x 10^6 predicted for this period (3, p. 29), I calculate 0.011 x 10^6 and 0.001 x 10^6, or a total of 0.012 x 10^6 early juveniles that would be killed by the screens if they had not already been reduced at stages II and III. Adjusting for this previous loss, we have 0.01 x 10^6 killed on the screens.

8. Adding the entrainment and the screen kill losses for the 28-day period we estimate a total removal of .046 x 10^6 early juveniles. This is 1.6 percent of the population of this stage of striped bass.

9. Stage V - Later Juveniles. The only basis for estimating this loss is the Indian Point experience where an estimated reduction of 18.6% of the population would take place

in the 261 days of this period (3). Using the ratios of juvenile fish abundance and pumping rate developed for early juveniles, and using a cooling water flow reduction (15 percent) in order to compare to Indian Point Nos. 1 and 2 impingement kills based on reduced flow (3), Bowline Point would kill 56% and Roseton 5.4% of the amount of Indian Point Nos. 1 and 2, or about 60% altogether, of 0.28×10^6 (0.35×10^6, reduced 79% for previous reductions in Stages II-IV). This amount, 0.167×10^6, is 11.1 percent of the population of early juveniles in the Hudson. (see table 1).

10. The removals at each stage are listed in table 1 along with calculations to show their effect on the population of striped bass. The calculations are based upon the assumption of total mortality of all removals (3, p. 38). Quantities are relative.

11. The Bowline Point and Roseton plants would remove 30 percent of each year class of striped bass during the first year of life. The proportion removed by the plants is highest during the later larval stage (from entrainment) and the later juvenile stage (from impingement).

12. Table 2 is a revision of my previous calculations for Indian Point No. 1 and 2 (3, table 7) assuming that Bowline Point (both units) and Roseton (both units) are in operation, with removals by those plants already accounted for. Whereas in the original calculation, without Roseton or Bowline Point, Indian Point No. 1 and 2 removed 40 percent of the 0+ age class, in this calculation they remove 26.5 percent.

13. With Indian Point 1 and 2 and Roseton and Bowline Point all operating at full power, the total removal would come

to 56.5 percent of the 0+ year class. That is, at the end of one year, there would be only 43.5 percent as many 0+ striped bass in the Hudson with all four plants on line as there would be if none operated. This is based upon the assumptions that all striped bass removed are killed and that there is no mitigation by compensating mechanisms (see 3 for discussion of these assumptions).

14. Reduction of breeding success to 43.5 percent of normal would have a disastrous effect on the striped bass population. In a theoretical study of brook trout populations, Jensen (6) showed that the population went to extinction when only 50 percent of the 0+ group were exterminated. Jensen further showed that if even 5 percent were exterminated, the yield of the trout population was reduced.

15. In my opinion anything over a 10% reduction in the 0+ year class will have a demonstrable and seriously adverse effect on the striped bass population and the fisheries. This amount of damage, and more, will in all probability be caused by the Bowline Point and Roseton plants. Indian Point No. 2, if operated with a once-through cooling system, will raise the damage to a possibly disastrous level.

16. Similarly serious effects can be expected for the white perch and other valuable species of the Hudson.

TABLE 1. Bowline and Roseton. Effect of removals on relative population of Hudson striped bass.

LIFE HISTORY STAGE AND LENGTH OF STAGE	ORIGINAL RELATIVE POPULATION MEDIAN (millions)	ADJUSTED[1] POPULATION (millions)	ADJUSTED[1] REMOVAL (millions)	PERCENT OF POPULATION REMOVED	REMAINING RELATIVE POPULATION (millions)
II. Early Larvae 28 days	112.	112.	5.14	4.6	106.86
III. Later Larvae 45 days	9.5	9.0	1.33	14.8	7.67
IV. Early Juveniles 28 days	3.5	2.8	.046	1.6	2.754
V. Later Juveniles 261 days	1.9	1.5	.167	11.1	1.333

Percentage of original population remaining at end of year = 70%

[1]Adjusted for removals at previous stage

TABLE 2 Indian Point No. 1 and 2. Revised calculation (Bowline Point and Roseton operating) of effect of removals on relative population of Hudson striped bass

LIFE HISTORY STAGE AND LENGTH OF STAGE	ORIGINAL REL. POPULATION, MEDIAN (millions)	POPULATION REMAINING AFTER BOWLINE POINT AND ROSETON REMOVALS DEDUCTED	ADJUSTED BASE POPULATION[1] (millions)	ADJUSTED REMOVAL [1] (millions)	PERCENT OF ADJUSTED BASE POPULATION REMOVED	REMAINING RELATIVE POPULATION (millions)
II. Early Larvae 28 days	112	107	107	5.5	5.1	101.5
III. Later Larvae 45 days	9.5	7.7	7.3	1.2	16.4	6.1
IV. Early Juveniles 28 days	3.5	2.75	2.16	0.06	2.8	2.1
V. Later Juveniles 261 days	1.9	1.33	1.01	0.18	17.9	0.83

Percentage of original population remaining at end of year = 43.5%

[1]Adjusted for removals at each previous stage

REFERENCES

1. "Draft Detailed Statement on Environmental Considerations Related to the Proposed Issuance of an Operating License to the Consolidated Edison Company of New York for the Indian Point Unit No. 2 Nuclear Generating Plant, Docket No. 50-247" by the U. S. A.E.C. Division of Radiological and Environmental Protection (April 13, 1972).

2. Carlson, Frank T. & James A. McCann, Hudson River Fishery Investigations 1965-1968: 50 pp & App.

3. Testimony of John R. Clark on Effects of Indian Point Units 1 & 2 on Hudson River Aquatic Life, submitted in this proceeding on April 5, 1972.

4. Quirk, Lawler & Matusky, "Effect of Roseton Plant Cooling Water Discharge on Hudson River Temperature Distribution and Ecology" (December 1969).

5. Quirk, Lawler & Matusky, "Environmental Effects of Bowline Generating Station on Hudson River" (March 1971).

6. Jensen, A. L., "The Effect of Increased Mortality on the Young in a Population of Brook Trout, A Theoretical Analysis," Trans. Amer. Fish. Soc. 100 (3), (July 1971).

Sworn to before me this

8th day of May, 1972

Richard E. Ayres

RICHARD E. AYRES
Notary Public, State of New York
No. 31-0121155
Qualified in New York County
Commission Expires March 30, 1973

John R. Clark

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