U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Atlantic Estuarine Fisheries Center
Beaufort, North Carolina 28516

February 2, 1973

Mr. J. P. Stohr, Sr.
Environmental Protection and
Special Programs Section
U.S. Atomic Energy Commission
Directorate of Regulatory Operations
Region I
970 Broad Street
Newark, NJ 07102

Dear Mr. Stohr:

In response to your telephone call of January 31, attached are "Additional Comments Relative to the Oyster Creek Menhaden Kill, January 1973." I have included more information on the estimates of menhaden killed with some statistical confidence limits as to what these estimates might mean. Because relatively unscientific methods were used in sampling, it is questionable that a statistical treatment is appropriate. I hope these additional remarks are helpful.

If I do not see you and discuss these reports at the Johns Hopkins University Workshop in Baltimore, I would appreciate some further discussion on the type and content of reports you would like regarding any future consulting.

Also enclosed are copies of Dr. Wurtz' reports of January 11 and 17.

Sincerely,

John W. Reintjes

John W. Reintjes
Fishery Biologist

Attachments

Additional Comments Relative to Oyster Creek

Menhaden Kill, January 1973.

In my report of January 19, I summarized information received from three sources: 1. Charles B. Wurtz, Biological Consultant
2. Paul E. Hamer, Director, N.J. Nacote Creek Research Station,
3. John Mahoney, Fishery Biologist, Middle Atlantic Coastal Fisheries Center, Sandy Hook

From the information received, I compiled 3 estimates of the number of dead menhaden in the surface ice of Oyster Creek and 1 estimate of the total kill including those out of sight on the bottom.

1. Dr. Wurtz estimated 900 dead in 20,000 ft^2 of surface ice in the 4 finger lagoons. This number was arrived at by counting the dead fish in the terminal 50 feet of each lagoon. He mentioned that the dead seemed concentrated in the closed end of each lagoon. However, if the number were extrapolated to the total area of the 4 lagoons (I estimated each lagoon was 1,000 by 100 feet), it would give an estimate of 18,000 dead menhaden. For comparison, if the dimensions used by NCRS were used the extrapolated figure would be 24,468 dead in the surface ice of the 4 lagoons.

2. Paul E. Hamer and staff biologists estimated 23,000 dead menhaden in the surface ice of the 4 finger lagoons. This was done by counting the number of dead while walking on the ice. The area covered was approximately 1/4 of the lagoon starting from the closed end. They cut holes in the ice and used an Ekman grab dredge (36 in^2) to sample the fish on the bottom. They made 9 grabs towards the closed ends of the lagoons and obtained 5 menhaden, 4-5 in. long. From these samples they calculated the number of dead menhaden in the bottom of the lagoons. The lagoon dimensions used were 1,050 by 125 ft. for the 3 western and 1,200 by 125 feet for the easternmost.

3. I called John Mahoney because I heard that Sandy Hook Laboratory had investigated the kill. He had not been involved but would inquire and call me back. He reported that someone from the Laboratory had called Mr. Mallie, a yacht basin operator at Forked River. Mr. Mallie estimated 6 dead menhaden per yd^2 frozen in the ice along the bulkheads and 1 per yd^2 in the central areas of the lagoons. By interpreting and extrapolating this observation, an estimated total of 58,000 fish was obtained for the 4 lagoons, 1000 X 100 ft. For comparison, if the

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dimensions used by NCRS were used the extrapolated figure would be 74,718 dead in the surface ice of the 4 lagoons.

The estimates of 23,000, 24,468, and 74,718 when treated statistically give confidence limits of 7,409 and 74,048, unless a 1/20 error occurred in the sampling counts. I extrapolated the estimates without any information on the uniformity of the actual values for the total lagoon area. Dr. Wurtz reported the dead were concentrated near the closed ends of the lagoons and Mr. Mallie's estimate of 6 per yd^2 may have been the maximum in one lagoon or in a small area. Extrapolated estimates from counts made in restricted areas tend to be larger than total area counts.

The estimate of 1,208,321 dead menhaden on 543,750 ft^2 of bottom in the 4 lagoons would have wide confidence limits. The results of the 9 grabs resemble a negative binomial distribution and were so treated with a Poisson generation to obtain 95% confidence limits*. The number of dead fish on the bottom of the 4 lagoons calculated from the sample of 5 fish obtained in 9 grabs is between 386,665 and 2,827,492 unless a 1/20 chance of error occurred in sampling.

The Ekman grab dredge used was too small to adequately sample the dead menhaden on the bottom. It is unlikely that the grab would take fish larger than 6 inches long. Wurtz' gillnet catch of 205 menhaden with a mean length of 8.6 inches on December 29 and the reported size to 14 inches among those in the ice means that menhaden over 6 inches were present that would not be taken by the grab. Also, the gillnet Wurtz used will not catch menhaden 3 inches or less, fork length.

Wurtz' estimates in the following table showed that lagoons 1 and 3 (numbered from the west) had fewer dead fish in the ice than did lagoons 2 and 4 and this is also indicated in the Ekman grab samples:

Lagoon	Estimated size ft^2	Wurtz'[1] estimate in 5,000 ft^2	NCRS grab samples
1. Venice	131,250	50	0,0,0
2. Sanabel	131,250	400	1,1
3. Buccaneer	131,250	50	0,0
4. Privateer	150,000	400	1,2

[1] in surface ice at closed end of lagoon.

*95% confidence limits: Poisson

$$m = X + 1.92 \mp 1.960\sqrt{X + 1}$$

It is reasonable to assume that more dead menhaden would be on the bottom than in the surface ice. Menhaden have a relatively small swim bladder so that recently dead menhaden usually sink. Decomposition and bloating will bring them to the surface but with ambient temperatures near freezing this process would occur very slowly or not at all.

In conclusion, the methods used to estimate the number of dead fish lacked the precision required to evaluate the situation adequately. Undoubtedly, the number frozen in the ice represented some fraction of the total dead. Any assumption that the number counted in part of a lagoon or in part of each lagoon could be used to calculate the number in the total area leaves room for doubt. The number of bottom samples and the type and size of grab dredge raises many questions about the reliability of the estimated number of dead on the bottom.

Suggestions to ameliorate or prevent a cold-shock kill in a heated effluent area when the generating station is closed down:

1. If dilution pumps are available, operate for a period proceding the shutdown to decrease the effluent temperature.

2. Shut down gradually so that a shallow declining gradient is developed towards ambient.

3. Select or adjust the date for a planned shutdown to coincide with a warm meterological forecast.

4. If feasible avoid planned shut downs during the colder months of the year.

At present, the best way to avoid cold-shock kills is to utilize discharge areas that distribute and circulate the heated effluent so that a very small area has a high Δ t and a large area has a small Δ t. Basins, embayments, and other relatively closed bodies of water, such as Oyster Creek, are profoundly influenced by the effluent creating an environment that is maintained 15° or more above winter embient. If this habitat is large, proportionally large cold-shock kills may occur.

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