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INTERIM REPORT

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Contract Program or Project Title: Threadfin Shad Impingement: Population Response

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NRC Research and Technical Assistance Report

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INTERIM REPORT

Quarterly Progress Report for
Nuclear Regulatory Commission
Reporting Period April-June 1980

Project (189 No.) B0406 - Threadfin shad Impingement: Population Response

Person In Charge: W. Van Winkle

Principal Investigator: R. B. McLean

Major Accomplishments:

The purpose of the research is to determine the feasibility of using sonar to quantify larval and adult fish populations. Larval populations were surveyed in the reservoir June 23-27, 1980. The purpose of the surveys was to determine the influence of fish larvae, zoo- and phytoplankton, and detritus on the return sonar signal. Application of these results will include use of sonar in systems which are eutrophic, or which have suspended allocthonous organic matter.

The experimental design for the trawls also included testing mesh sizes of nets to determine which would yield the maximum amount of needed information for interpretation of the recorded sonar signal. Mesh sizes included 153μm, 505μm, and 1800μm. Paired tows with 1/4 meter 153μm and 505μm and with 1 meter 505μm and 1800μm nets were done at each of three stations. (Table 1, Figure 1) One station was located in a cove, and two in the main channel of the reservoir. Stations were picked to insure an abundance of at least one of the three parameters listed (fish larvae, plankton, detritus). Enumeration of the fish larvae in the samples have been subcontracted.

Results from the survey of adult fish in November, 1979, shows that sonar has promise as an impact assessment tool. The estimates resulting from the six surveys done in November are given in Table 2. The results were calculated using theoretical fish target strengths (TTS) and back-calculated (BCTS). Patchy distribution of the fish is apparent by comparing echograms (Figures 2

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and 3). Figure 2 is a photocopy of the sonar paper tape for the calibration run done at station 5b, and Figure 3 is for station 2, run 4.

The lack of agreement between the TTS and BCTS estimates, based respectively on fish length and numbers from the trawl, is an example of the ground truth accuracy problem. TS estimates are no better than the trawl catches. Echos from insonified fish not captured by the net, or echos from boat wakes or other turbulence, and reverberation of fish echos inside schools can cause errors in estimating the TS, or the MSV from the magnetic tape record of the sonar pings. The above were all likely operating during this work.

Two papers which will summarize the results of the research funded by the NRC over the past four years are being prepared. The main subject matters addressed are 1) evaluation of impingment counts, gill nets and fish predator stomach content analysis, as tools in assessing the effects of energy facilities on farage fish and 2) the key parameters of a "healthy" reservoir system that maintains both predator and prey populations. Results from this continuum of research has resulted in two research proposals being written, one to EPRI and one for Laboratory Funds (seed money).

Table 1. Experimental design of trawl samples taken concurrently with sonar runs in Watts Bar Reservoir, Tenn., June 23-27, 1980.

	1/4 meter nets		1 meter nets	
	153 µm	505 µm	505 µm	1800 µm
Station 4				
Station 5				
Station 8				

Table 2. Numbers and kilograms of shad per hectare from the calibration runs November, 1979, Watts Bar Reservoir, TN. Values are based on theoretical and back-calculated target strengths.

Station-Run	No.·ha^{-1}		Kg·ha^{-1}	
	Theory	Back-calculated	Theory	Back-calculated
1-1	959.64	939.95	17.15	31.86
1-2	24.28	23.78	0.43	0.81
1-3	181.62	177.89	3.25	6.03
1-4	55.19	54.05	0.99	1.83
$\bar{1}$	305.18	298.92	5.45	10.13
2-1	9554.38	15535.01	175.14	374.13
2-2	2590.62	4212.22	378.54	101.45
2-3	8790.57	14293.06	128.74	344.23
2-4	17016.6	27668.23	240.87	666.35
$\bar{2}$	9488.04	15427.13	145.65	371.54
4-1	1458.43	203.67	29.22	4.78
4-2* gain 7	28256.58	3946.11	566.11	92.69
4-2* gain 6	28705.01	4008.72	575.09	94.16
4-3	7833.80	1094.01	156.95	25.70
$\bar{4}$	12635.85	2027.70	253.15	41.45
5b-1	2.33	2.01	0.35	0.48
7-1	3194.21	6112.28	62.69	155.18
7-2	125.40	239.96	2.46	6.09
7-3	260.00	497.53	5.10	12.63
7-4	216.54	414.36	4.25	10.52
$\bar{7}$	949.04	1816.03	18.63	46.08
9-1	114.21	98.54	1.73	2.35

*Station 4, run 2 was done at a sonar gain of 7 for 2 minutes and at a gain of 6 for 8 minutes.

Figure 1. Watts Bar Reservoir, TN showing the sampling stations

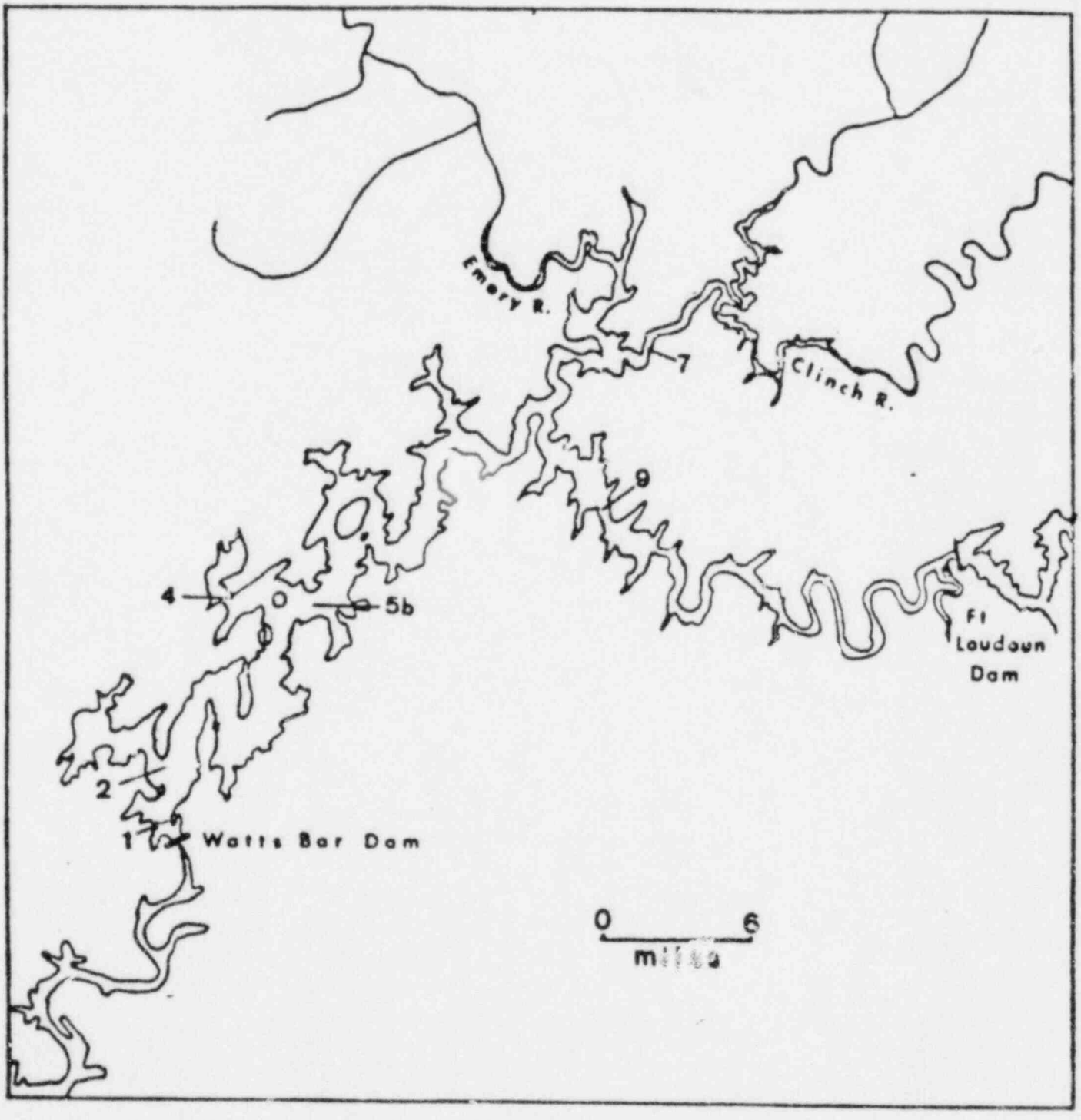

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Figure 2

Photocopy of the paper tape from the Simrad EY-M from station 2, run 4, Watts Bar Reservoir, TN, November 1979. Fish density over the top 10 m estimated as 27,668 fish·ha^{-1}.

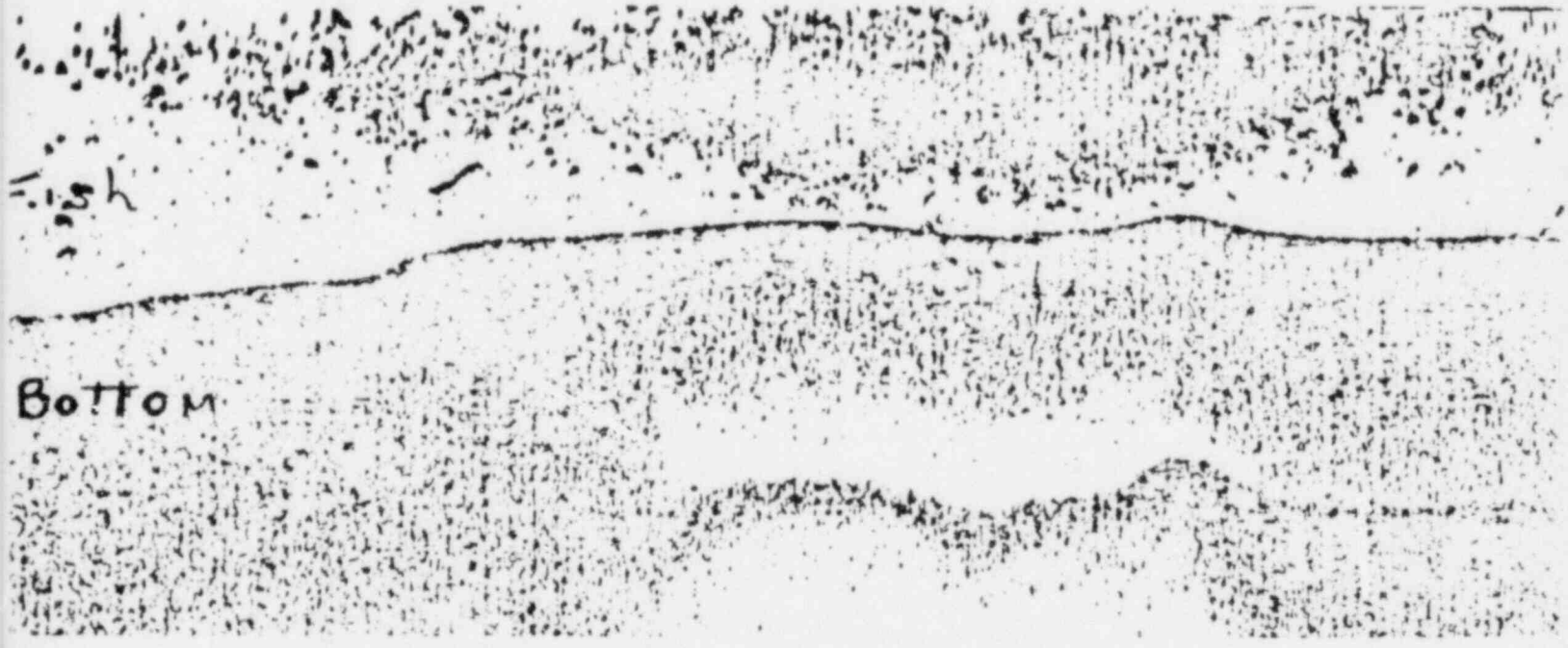

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Figure 3

Photocopy of the paper tape from the Simrad EY-M from station 5b, Watts Bar Reservoir, TN, November 1979. Fish density over the top 4 m estimated as 2 fish·ha^{-1}.

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