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TABLE 1

WATER TEMPERATURES (°F)

DATE	WATER BOX	ILLINOIS BAYOU		POWER LEVEL
		Point 16[1]	Point 20[1]	C&J.
October 25-26, 1974	63 (8 a.m.)	63.4[2]	63.4[2]	46%[4]
November 15-16, 1974	55 (8 a.m.)	54.2[2]	53.4[2]	0%
December 17-18, 1974	44-43 (24 hr. avg)	43.4[2]	43.3[2]	82%[5]
	Min. Max. Avg.	Min.	Max.	
January 21, 1975	42 44 43	41.4[3]	43.6[3]	Full Power

1. See Environmental Technical Specifications Figure 4-3.
2. Average over all depths.
3. From thermal mapping; minimum and maximum for entire Bayou at any depth.
4. For October 25 only; shutdown October 26.
5. Average of December 17 and December 18.

ABSOLUTE POPULATION DENSITY ESTIMATE

SCOPE OF WORK

1. SPECIES

According to the literature it is very difficult to differentiate between gizzard and threadfin larvae ≤ 18 mm; therefore, early in the program a decision will be made as to the effort required to differentiate between the two species. If differentiation is cost-prohibitive, then they will be combined until they can be differentiated at later stages. Consequently, population-density estimates may include both gizzard and threadfin shad during the early portion of the program and only threadfin after the larvae become >18mm.

The primary target population is the threadfin shad; however, since the field effort will have been expended to collect the sample, we recommend that the ichthyoplankton other than the Clupeiadae be preserved for future entrainment questions relative to other species of fish.

2. GEAR

All gear are selective for or against a particular species and/or size group. Of the numerous biases that affect the accuracy of population estimates, the gear used is probably the most significant, and this bias needs to be reduced. In light of this situation, and since it appears that the midwater trawl is not obtaining a representative sample of threadfin shad in Lake Dardanelle, we propose that various gear and tow speeds be tested to determine which (mouth opening, mesh size, length, etc.) is most efficient in capturing threadfin shad. The following gear have been used for capturing ichthyoplankton of various size groups.

A 54 in.^{2}, 20-ft-long, 1/32-in. mesh net has been used to capture shad larvae ≤ 25 mm.

A 8 ft^2, 48-ft-long net with various mesh sizes has been used to capture shad ≥ 25 mm, even up to adults.

A 2.44 m^2, 13.7-m-long net with mesh sizes of 76 to 38 mm in the body, with 19 mm at cod end has been used to capture shad.

A 2.44 m^2, 13.7-m-long net with mesh sizes of 32, 25, 19, and 13 mm in the body and 6 mm at cod end has been used to capture shad.

Epibenthic sleds and tucker trawls with various mouth openings, lengths, and mesh sizes have been used to capture ichthyoplankton.

We propose that early in the program (April or May) certain of the above gear be tested in Lake Dardanelle to determine their efficiency in capturing young shad. The selected gear will be used until the shad begin avoiding the net, requiring a second gear type to be used. We propose to test again in June to determine the most efficient gear in capturing the larger shad.

3. CATCH PER VOLUME

The two basic methods used to estimate fish densities (numbers) are mark-recapture and catch per unit area or volume. Since the objective is to estimate the density of larvae and young-of-the-year, the mark-recapture method is virtually impossible. Therefore, we propose to base an estimate on catch per volume.

4. VOLUME/TOW SPEED

Once the most efficient gear have been selected, measuring two speed and the volume of water "filtered" becomes important, since the population density will be based on volume. The standard digital flowmeter in the mouth of most nets is designed to record velocity from which volume will be calculated. We propose such a flowmeter for this study, but also propose placing an electrical readout meter outside the net. Its readings are not influenced by back pressure that occurs when the net begins to clog. Such a meter facilitates making all tows at the same speed. This repeatability is important because tow speed influences catch independent of the volume of water filtered. The correct tow speed will be determined during the April and June test periods, and the electrical readout meter will help insure that tows are taken at the same speed.

5. TOW DEPTH

Certain icthyoplankton species are captured in greater numbers with bottom tows and others with subsurface tows, and, for certain species, quantity depends on whether tows are taken during the day or night. This variation depends on spatial distribution (vertical, horizontal) of the target population, which may change greatly during a 24-hour period. Oblique and horizontal tows both have been used to collect young shad. But due to the shallowness of Lake Dardanelle, we propose horizontal tows. Also, it appears that bottom tows cannot be made in Lake Dardanelle due to the debris; therefore, midwater tows are proposed. However, oblique and horizontal tows, along with bottom, midwater, and subsurface tows, may be tried during the test periods. To reduce net avoidance, we propose that all tows be taken at night.

6. SAMPLING PERIOD

To insure that the spawning season is not missed, we propose to test the gear during mid-April to early May. The first shad larvae in 1974 were collected on April 23. The first selected gear will be used until the fish begin avoiding the net, and then the second gear will be used. Based on the 1974 shad data, it appears that by July 1, 1974, the shad are large enough to avoid the smaller-mesh gear. Therefore, we propose to test the second gear during the latter part of June. Both gear will be used for a time during the transition period to make sure all size groups are being sampled.

This overlap of gear is presently scheduled for July, but the actual time when only the second gear will be used will depend on catch rate of the smaller-mesh gear. The second gear will be used through October. We propose to sample through October because impingement numbers increased during the first week in November 1974. Therefore, by sampling through October, we should have a reasonable population-density estimate of threadfin shad immediately before the anticipated high-impingement season.

7. SAMPLING FREQUENCY

We find that biweekly sampling is not frequent enough to document the maximum peaks in spawning activity. Therefore, we propose weekly sampling from April (after gear selection) through July and biweekly from August through October. It is possible that some threadfin shad that did not spawn in the spring will do so in late summer. In fact, one Oklahoma State biologist (personal communication) hypothesized that even some of the spring spawn may become sexually mature and spawn in late summer or early fall during the same year. If either occurs in Lake Dardanelle, the biweekly sampling proposed in August through October may not depict this second spawn, but weekly sampling can be reinstated as an addition to the proposed scope of work.

8. SAMPLING LOCATION

The sampling frequency and number of sampling locations greatly affect the validity of any program. If the shad were randomly distributed horizontally, as it appears they may be vertically, few sampling stations would be needed to obtain a representative sample. But the literature suggest that this is not the case. Therefore, the complete reservoir needs to be sampled or the reservoir stratified into different regions and only certain strata sampled. If there were little mixing among strata, this would be an acceptable technique. Also, if one stratum contained a greater density of shad than the other strata, greater effort in collection could be allocated to that stratum. But based on our present knowledge of shad in Lake Dardanelle, we cannot stratify the reservoir based on density. Thus, we propose to mark off the reservoir into a grid system and randomly select 25 grids to be sampled on a weekly or biweekly basis, depending on month.

9. REPLICATIONS

To evaluate the variance among samples taken at the same station during the same time, we recommend taking two (2) replicated samples. The effort required to take the second sample will be minimal, since both tows can be taken at the same time.

SUMMARY

Density estimates be based on catch per volume.

Density estimates be made on threadfin shad.

Before the gear are selected, their efficiency in Lake Dardanelle should be determined during April-May and again in late June.

Make sure the correct volume and tow speed are measured correctly during all tows.

Horizontal midwater tows be taken during the night.

Sampling weekly from April through July and biweekly from August through October.

Use both gear during July or until the catch rate for the first gear is basically zero.

Preserve samples of other ichthyoplankton for future analysis.

Random sample in 25 grids once per week or biweekly, depending on month.

Replicate (two) samples be taken at all grid stations.

THERMAL EFFECTS ON SWIM-SPEED

SCOPE OF WORK

1. Variables

The experimental design includes the variables of size groups, ambient water temperature, rate of temperature drop, and intake velocities. Each is briefly discussed.

a. Size Groups

From 95% to 100% of the threadfin shad impinged during the fall of 1974 were in the 3.1- to 12.0-cm size group, and most of these were in the 6.1- to 9.0-cm group. Therefore, we propose to determine the swim speed of the 3.1- to 9.0-cm and the 9.1- to 12.0-cm groups.

b. Ambient Water Temperature

Since fish are poikilothermic, water temperature greatly affects their metabolic rate, feeding rate, and swimming ability. The water may become cold enough that some species become very lethargic and may even die. Temperature-induced lethargy may be occurring at ANO-Unit 1; i.e., as the temperature dropped in the fall of 1974, threadfin shad were unable to avoid the intake velocity and were impinged. The impingement rate increased as the temperature dropped below 65^{o}F.

We therefore propose to determine the swim speed of threadfin shad at ambient temperatures of 70^{o}, 65^{o}, 55^{o}, and 45^{o}F. The swim-speed studies should be performed when these temperatures exist in Lake Dardanelle, since the thermal history of the test organisms may affect their swimming ability. For example, the swim speed of a fish taken from Lake Dardanelle at 80^{o}F (summer) and acclimated at 55^{o}F (fall) in a shorter time than would occur in nature may differ from the swimming ability of that fish had it been taken from the lake at 55^{o}F and tested. Therefore, we propose to perform the swim-speed studies during late summer-early fall when the ambient water temperature is decreasing, to simulate what is occurring in nature as close as possible.

c. Rate of Temperature Drop

Perhaps more significant to some poikilothermic organisms than the ambient temperature is the rate of temperature change. As already noted, the number of impinged threadfin shad increased as water temperature dropped below 65^{o}F. It is possible that the rate of temperature drop was more important (causal relationship) than the absolute temperature itself. Therefore, we also propose to determine swim speed of threadfin shad after various rates of temperature drop from various acclimated temperatures. We propose to acclimate fish to 65^{o} and 55^{o}F, hold them at this temperature for 48 hr. and then subject them to temperature drops of 3^{o}, 5^{o}, and 7^{o}F during a 12-hr period.

d. Intake Velocity

The approach velocity at the confluence of the intake canal with the reservoir is $\leq$ 0.3 ft/sec. At one point in the canal where bedrock has not been removed, water velocity increases to 3.0 ft/sec because of reduced depth and width. Beyond this point, toward the traveling screens, the velocity is approximately 1.5 ft/sec along most of the canal. Therefore, we propose to test the swim speed of threadfin shad at 0.3, 1.0, 1.5, 2.0, and 3.0 ft/sec.

2. Methodology

a. Units

Various units have been used to measure swimming speed or swimming ability of fish. MacLeod (1967) defined a maximum swimming speed as that at which fish swim for 3 min in a current slightly greater than their swimming ability. Fry and Hardt (1948) defined a cruising speed as that at which a fish can stem a current for a considerable period of time. Brett, et al (1958), described final swimming speed as a water velocity which forces a fish against a screen, and Hande (1969) defined larvae swimming speeds as the current velocity at which 50% of the larvae can sustain for 1 hr. King (1970) defined critical swimming speed (CSS) as that at which fish can swim for 30 min.

We propose to use the term "final swimming speed" as used by Brett, et al, since the major objective is to determine at what water velocity the fish will be impinged on the screens. Also, since we propose to run each test for 20 min or until all fish are impinged, King's "critical swimming speed" can also be determined.

b. Apparatus

The two basic apparatuses, or variations thereof, generally used to determine swim speed of fish are the MacLeod and Beamish apparatuses. The MacLeod apparatus is basically an open circular sluiceway (trough) in which currents are generated by paddlewheels driven by an electric motor. The Beamish apparatus is similar to the MacLeod except that closed tubes rather than open troughs are used. We propose to use the Beamish apparatus; the closed system produces less water turbulence, which could be a problem with the MacLeod apparatus, especially at the high velocities (3.0 ft/sec) proposed.

c. Field Sampling

Threadfin shad will be collected from Lake Dardanelle by various gear. Trawls are efficient in capturing this species but mortality may be too high. Therefore, floating fyke nets, shoreline seining, and electrofishing are other gear that may be required to collect viable fish for testing.

Captured threadfin shad will be placed in live boxes and returned to the laboratory at ANO-Unit 1. They will be separated by size group and placed in holding tanks containing Lake Dardanelle water at lake temperature. Holding tanks will be aerated and NaCl, Acriflavin, or other appropriate prophylactic added if needed to reduce bacteria and fungus.

d. Tests

The tests will be divided in two groups: acclimation group and shock group. The acclimation group will comprise tests in which fish are acclimated to a certain temperature and their swimming ability tested against the five (5) water velocities at that temperature. The shock group will comprise tests in which fish are subjected to a drop in temperature from their acclimated temperature and their swimming ability tested against the five velocities in water at the lower temperature.

Fish will be acclimated to temperatures of 70°, 65°, 55°, and 45°F at a rate of approximately 4°F (increase) or 2°F (decrease) during a 24-hr period. Once the appropriate acclimation temperature is reached, fish used for testing in the acclimation group will be held at this temperature at least 24 hr prior to testing. Fish in the shock group will be held at the appropriate acclimation temperature (65° or 55°F) at least 48 hr before thermal shock is applied. The temperature will be decreased 3°, 5°, or 7°F over a 12-hr period, and swim-speed testing will begin immediately at the end of the period. All viable fish will be returned to Lake Dardanelle upon completion of testing. Individual fish will be used for one test only. Tests will last for 20 min or until all fish become impinged, whichever occurs first.

1) Acclimation Group

We propose to perform the swim-speed test on two size groups (Group I - 3.1 to 9.0 cm; Group II - 9.1 to 12.0 cm) of threadfin shad at temperatures of 70°, 65°, 55°, and 45°F at velocities of 0.3, 1.0, 1.5, 2.0, and 3.0 ft/sec (Table 1). Each test will be replicated three times, with five fish per replication. If none of the 15 fish tested resist impingement for the full 20 min, that size group will not undergo tests at higher water velocities at that temperature or at lower temperatures. If as few as one fish resists impingement, the more rigorous tests will proceed for that size group.

If all tests are performed as proposed, 600 fish will be required to perform the tests of the acclimation group, not including those used as a control.

Table 1

Proposed Sampling Scheme for Swim-Speed Tests of Temperature-acclimated Threadfin Shad

Acclimation Temperatures (^{o}F)	Size Groups	Water Velocities (ft/sec)	Replicates per Velocity	Fish per Replicate	Total Fish
70, 65, 55, 45	I, II	0.3, 1.0, 1.5, 2.0, 3.0	3	5	600

2) Shock Group

We propose to perform the swim-speed test on two size groups (I and II) of threadfin shad subjected to a temperature drop of 3^{o}, 5^{o}, and $7^{o}F$/12 hr from acclimation temperatures of 65^{o} and $55^{o}F$. Tests will be performed at 0.3, 1.0, 1.5, 2.0, and 3.0 ft/sec, with three replications per test and five fish per replication (Table 2).

Table 2

Proposed Sampling Scheme for Swim-Speed Tests of Temperature-shocked Threadfin Shad

Acclimation Temperatures (^{o}F)	Temperature Drop (^{o}F)	Size Groups	Water Velocities (ft/sec)	Replicates per Velocity	Fish per Replicate	Total Fish
65, 55	3, 5, 7	I, II	0.3, 1.0, 1.5, 2.0, 3.0	3	5	900

As with the acclimation group tests, if no fish in a size group can withstand a certain velocity after a particular shock treatment, tests at higher velocities after the same or more severe shock treatments at that acclimation temperature or lower will be omitted.

If all tests are performed as proposed, 900 fish will be required to perform the tests covered in the shock group, not including those used as a control.

e. Measurements

The flow patterns produced in the Beamish apparatus will be determined at all five test velocities. Flow straighteners will be used if needed to reduce eddies. Water temperature and current velocity will be measured at the beginning and end of each test. If these parameters change significantly during a test, that test will be rerun after the correct test temperature and velocity have been established. Dissolved oxygen, pH and alkalinity will be recorded frequently to document that they do not have a direct or indirect effect on test results.

The number of fish, size group, and time will be recorded at the beginning of each test. During each 20-min test, behavioral observations will be recorded, along with the time each fish withstood the velocity, with 20 min being the maximum.

SUMMARY STATEMENT

More than 1500 viable threadfin shad of the correct size group must be collected. It may prove impossible to collect that many viable threadfin shad. If this is the case, replications, number per replication, or even certain variables (e.g., 1.0 ft/sec velocity) may need to be reduced or omitted. However, as noted, failures to pass less rigorous tests may eliminate the need to perform the more rigorous tests.

Based on the results of the tests, the need for testing at lower temperatures should be examined.

THERMAL EFFECTS ON MORTALITY

INTRODUCTION

The objective of the thermal shock project is to determine whether threadfin shad can withstand water temperature decreases occurring naturally in the vicinity of ANO-Unit 1, primarily when water temperatures are in the 70 to 45°F range. Two basic methods may be used to measure mortality. One is to observe mortality/survival only during the shock period; this yields acute mortality. The second is to observe mortality for 24, 48, or 96 hr after the shock period; this yields chronic mortality. If acute mortality is all that needs to be observed, many of the viable fish at the end of the shock treatment could be used in the swim-speed test, since the temperature treatments prior to the swim-speed tests are the same. If an evaluation of chronic mortality is needed, the fish are held for longer periods of observation and cannot be used in the swim-speed test.

We propose that the fish be observed during the 12-hr shock treatment to determine acute mortality and periodically for 96 hr to determine chronic mortality.

SCOPE OF WORK

1. VARIABLES

The experimental design includ s the variables of size groups, ambient water temperature, and rate of temperature decrease.

a. Size Groups

From 95% to 100% of the threadfin shad impinged during the fall of 1974 were in the 3.1- to 12.0-cm size group, and most of these were in the 6.1- to 9.0-cm group. Therefore, we propose to determine the thermal tolerance of the 3.1- to 9.0-cm and the 9.1- to 12.0-cm groups.

b. Ambient Water Temperature

Since fish are poikilothermic, water temperature greatly affects their metabolic rate, feeding rate, swimming ability, and resistance to thermal sock. Temperature-induced lethargy may be occurring at ANO-Unit 1; i.e., as the temperature dropped in the fall of 1974, large numbers of threadfin shad were impinged on the screens of ANO-Unit 1. The impingement rate increased as the temperature dropped below 65 F.

We therefore propose to determine thermal-shock tolerance of threadfin shad at ambient temperatures of 70°, 65°, 55°, and 45°F. These tests should be performed when these temperatures exist in Lake Dardanelle, since the thermal history of the test organisms may affect their tolerance. Therefore, we propose to perform the thermal-schock studies during late summer-early fall when the ambient water temperature is decreasing, to simulate what is occurring in nature as close as possible.

c. Rate of Temperature Drop

Perhaps more significant to some poikilothermic organisms than the ambient temperature is the rate of temperature change. As already noted, the number of impinged threadfin shad increased as water temperature dropped below 65°F. It is possible that the rate of temperature drop was more important (causal relationship) than the absolute temperature itself. We propose to acclimate threadfin to 70°, 65°, 55°, and 45°F, hold them at this temperature for 48 hr and then subject them to temperature drops of 3°, 5°, and 7°F during a 12-hr period, measuring the death rate and estimating thermal-shock tolerance (cold) at each acclimation temperature.

2. METHODOLOGY

a. Units

Various units have been used to measure thermal death in fishes and other organisms. Common terms used include EC_{50}, TC_{50}, LD_{50}, or LC_{50}, which express effective, toxic, or lethal dosages (or concentrations) which have been observed to kill 50% of the organisms, and TL_m, which expresses the mean (or median in some cases) tolerance limits for particular parameters. All of these terms have a time figure associated with them - minutes, hours, days, or weeks.

We propose to use the term TL_m and observe the acute mortality during the 12-hr shock treatment and chronic mortality during 96 hr after the shock treatment.

b. Apparatus

The basic apparatus generally used in thermal-tolerance studies and proposed here is a series of temperature controlled holding tanks with incorporated stirring device and aerator to maintain temperatures within 1°F and oxygen content within an acceptable range.

c. Field Sampling

Threadfin shad will be collected as specified for the swim-speed project.

d. Tests

Fish in both size groups will be acclimated to temperatures of 70°, 65°, 55°, and 45°F at a rate of approximately 4°F (increase) or 2°F (decrease) during a 24-hr period. Fish for testing will be held at acclimation temperature for 48 hr prior to testing. The temperatures will be decreased 3°, 5°, or 7°F over a 12-hr period, and thermal mortality will be calculated for each acclimation temperature-temperature stress combination. All tests will be run in duplicate with a minimum of six fish per test. All viable fish will be returned to Lake Dardanelle upon completion of all tests. Individual fish will be used for one set of tests only.

In all tests are performed as proposed, a minimum of 288 fish (not including controls) will be required to perform the thermal-shock tolerance testing (Table 3).

TABLE 3

Proposed Sampling Scheme for Temperature-Shocked Threadfin Shad

Acclimation Temperatures (°F)	Size Groups	Thermal Drops (°F)	Replicates per Thermal Drop	Fish per Replicate	Total Fish
70, 65, 55, 45	I,II	3, 5, 7	2	6 (Minimum)	288

e. Measurements

Water temperature will be recorded during each test and if it significantly changes from proposed test temperature, that test will be rerun after the correct test temperature is established.

Dissolved oxygen, pH and alkalinity will be monitored to document that they do not have a direct or indirect effect on test results.

The number of fish, size group, and time will be recorded at the beginning of each test. During each test, behavioral observations will be recorded for use in interpreting the TL_m data.

SUMMARY

More than 288 viable threadfin shad of the correct size groups must be collected. It may prove impossible to collect that many threadfin shad. If this is the case, replications, number per replication, or even certain variables (e.g., 70° acclimation temperature) may need to be reduced or omitted. However, as previously stated, failures to pass less rigorous tests may eliminate the need to perform the more rigorous tests.

Bases:

Under normal conditions, no sodium nitrite based corrosion inhibitor will be discharged to the Reservoir. Any abnormal leakage should be detected either in the discharge canal or by inhibitor analysis in the cooling system. Any leakage of sodium nitrite from the closed cooling water system will most probably find its way to the discharge canal. By sampling the intake canal and Point 20, a determination can be made of any nitrite present in the lake water from sources other than plant operation. Specification 2.3.2 requires that no sodium nitrite be discharged. 0.005 mg/l is the detection limit for the nitrite nitrogen test.

(3) Dissolved Oxygen:

Objective

To determine levels of dissolved oxygen concentration in the Reservoir water and the effects of station effluents theron.

Specification

(a) Dissolved oxygen analysis shall be made at all sample points shown in Figure 4-3 on a monthly basis.

(b) Analyses shall be made at the one and two foot depths and at five foot intervals thereafter to the bottom.

(c) Dissolved oxygen analysis shall be made 5 days per week at a depth of 3.5 feet at the end of the barge slip. (point 1A on Figure 4-3) If the most recent impingement sample from Specification 4.1 2.a(2) is 2,000 lbs. in 24 hours or more and the most recent dissolved oxygen measurement is below 6.0 mg/l, dissolved oxygen analysis shall be made daily until the impingement level is measured at less than 2,000 lbs. in 24 hours. At that time the 5 days per week schedule will resume.

(d) Analysis shall be made using a polarographic membrane electrode with Yellow Springs Instruments Model 54 or equivalent. The instrument shall be calibrated just prior to and immediately following analyses made, according to Table 2-1.

Reporting Requirements:

If dissolved oxygen is found to be less than 5 mg/l a report shall be made according to Specification 5.6.2.

Bases:

Monthly analyses of dissolved oxygen will provide information on changes in concentration caused by naturally occurring seasonal changes as well as any changes brought about by station operation.

The specified sampling at the barge slip will provide indications of any impact of fish grinding operations on dissolved oxygen values. The specified depth corresponds to applicable state water quality standards cirteria. The frequency specified requires weekend sampling only during high impingements and low dissolved oxygen in order to reduce weekend manpower requirements.

Frequencies of sampling were chosen to obtain a trend of aquatic life in the area. Most fish surveys are set up to be conducted in the summer because the fish are more plentiful at this time of year. It is felt that more frequent sampling of the organisms would produce repetitive data. However, less frequent sampling might yield erratic data from which no trend could be detected.

The data will be evaluated in relation to preoperational data obtained by AP&L, UALR, Ark. Tech., and various governmental agencies. By comparing preoperational data with postoperational data, changes in the environment can be detected. It is felt that in this way effects on the aquatic life by ANO can be monitored and controlled.

(2) Impingement of Organisms

Objective:

The objective is to monitor those fish impinged on the intake screens to permit a quantitative assessment of impingement impacts. Potential impacts of concern are effects on the fishery resource and dissolved oxygen resource of Lake Dardanelle. If these impacts are significant, appropriate state and federal agencies responsible for fisheries shall be consulted, and the necessary modifications to the intake system shall be implemented to satisfactorily reduce these impacts.

Specification

Fish trapped on all of the intake screens will be sluiced to a collection basket where they will be identified, counted and weighed following a twenty four (24) hour sampling period twice each week. If the weight of fish impinged on any given sampling day exceeds 150 pounds, two 50 pound subsamples will be taken and their average used for extrapolation to determine species data for the total weight impinged. Length and weight of each fish in a subsample will be determined for up to 25 fish in each specie. If the total number of fish in a subsample in a particular specie is >25 but ≤100, 25% of the number in that specie will have their length and weight measured. If the number of fish in a subsample in a particular specie is greater than 100, 25 fish plus 1% of N-100 (where N is the number of fish in that specie) will have their length and weight measured. Total biomass of all fish impinged will be determined regardless of the number impinged. Tabulations of this data will be made.

Fish may be disposed of through the trash grinder and discharged into the outfall as long as the dissolved oxygen, as measured per Specification 4.1.1. (3) (c), is 5.5 mg/l or greater. When grinding operations are discontinued as a result of the dissolved oxygen measurements taken per Specification 4.1.1.a.(3) (c), grinding will not be resumed until those measurements read 6.0 mg/l or higher.

Reporting Requirements:

Monthly tabulations of quantity and weight by species for each 24 hour sample will be reported to the Nuclear Regulatory Commission, Office of Inspection & Enforcement, regional office. A summary of impingements will be reported on a semiannual basis.

Bases

The purpose of this program is to permit accomplishment of the specification objective. Surveillance frequency is based on previous surveillance data at Arkansas Nuclear One indicating that twice per week sampling provides essentially the same numbers as 3 or 5 times per week sampling. Subsampling is done to reduce the sampling effort and replicates are taken to reduce subsampling error. Length and weight determinations are made to determine impingement selectivity. The numbers methodology for length and weight determinations is a fairly standard practice in aquatic biology. The limits on fish grinding operations are based on state water quality regulations of a minimum dissolved oxygen level of 5.0 mg/l at 5 ft. or 1/2 the total depth, whichever is less, except as a result of natural causes.

(3) Entrainment of Plankton, Eggs and Larval Forms

Objective:

The purpose of the entrainment survey is to determine the thermal and mechanical effects of the cooling water system on the various kinds and quantities of larvae, eggs, and plankton taken into the plant water system.

Specification

Biological samples (organisms) of bottom samples and water samples were taken at 6-month intervals prior to plant operation and shall be taken at one-month intervals after operaton at the intake and discharge locations. Pelagic larval fishes shall be sampled by trawling with a fish larval net also in the intake and discharge areas.

Reporting Requirements

If the samples taken indicate a significant detrimental effect on these organisms such as radically increased radioactivity or drastically reduced population and these factors can be traced to ANO, whether due to pressure changes, thermal shock, mechanical stress or biocide exposure, appropriate action shall be taken to assure that these effects will not ultimately affect survival of the organism or its population. For additional information on the monitoring of these organisms, see Specification 4.1.2, General Ecological Survey.

6.3 Bubble Curtain Testing

Objective

To determine the effectiveness of the bubble curtain in deterring viable fish from entering the intake canal.

Program Specification:

Each season for a one year period a six week test will be conducted. The test will consist of monitoring impingement six days per week, three of those days with the bubble curtain on and three with it off, except for equipment failure, an occasional intervening holiday or day of illness of personnel doing the sampling. Impingement sampling will be done on a 24-hour basis. Test data will be reported to a consultant, competent in both statistics and aquatic biology. The consultant will analyze the data and report their conclusions to the licensee.

Reporting Requirements

The results of this test will be reported to the NRC upon its completion.

Bases

This program will provide data to supplement Specification 4.1.2.a(2) in addition to evaluating the effect of the bubble curtain on fish impingement. Monthly reports specified in Specification 4.1.2.a(2) will include the data from this test that was obtained during that month. Completion of this program is scheduled for September, 1975.

6.4 Absolute Population Density Estimate of Threadfin Shad

Objective:

To determine an estimate of the absolute population density of young-of-the-year threadfin shad in Dardanelle Reservoir in order to quantitatively assess the impact of impinging this species in large numbers.

Program Specification:

During 1975 an estimate of the absolute population density of young-of-the-year threadfin shad will be made in Dardanelle Reservoir. The estimates will be based on a catch per volume sampling method. Before the sampling gear is selected, their efficiency in Dardanelle Reservoir will be determined in April-May and again in late June. An effort will be made to ensure that the correct volume and tow speed are measured during all tows. All horizontal midwater tows will be taken during the night. Sampling will be done weekly from April through July and Bi-weekly from August through October. During April through July one set of gear will be used to sample the smaller younger fish and during July through October another set of gear will be used to catch the fish that have grown during the preceding months to a larger size. Both sets will be used during July or until the catch rate for the first gear is basically zero. Samples of other ichthyoplankton will be preserved for future analysis. Random sampling will be done in 25 grids on lower Dardanelle Reservoir (downstream of Piney Bay) once per week or bi-weekly, depending on the time of year. Replicate (two) samples will be taken at all grid stations.

This work will be done by a consultant capable of quality field work and capable of analyzing the data to the point of making the population density estimate.

Reporting Requirements:

The results of this program will be reported to the NRC upon its completion.

Bases

This program constitutes a "state-of-the-art" effort to quantify the population density of threadfin shad in Dardanelle Reservoir. The program will attempt to determine the validity of concerns that have been raised over the large threadfin shad impingements that have been experienced by the licensee.

6.5 Laboratory Study of Effects of Temperature and Temperature Change On the Swim-Speed and Mortality of Threadfin Shad.

Objective:

To determine the effects of reduced temperature and rates of temperature reduction on the swim-speed and mortality of threadfin shad and in turn develop possible methods to reduce threadfin shad impingements.

Program Specification:

A laboratory study will be conducted to document the effects of reduced temperature and rate of temperature reduction on the swim-speed capabilities and mortality of threadfin shad in Dardanelle Reservoir. One group of fish will be used for the swim-speed determinations and another for the mortality determinations. Within the swim-speed group other groups will be delineated, one for reduced temperature and another for rate of temperature reduction. The reduced temperature group will be acclimated to various temperatures and tested for swim-speed with different fish being used for each acclimation temperature. The temperature reduction rate groups will be acclimated to various temperatures and subjected to various rates of temperature drops, then tested for swim-speed or observed for mortality. No single fish will be subjected to more than one set of conditions; i.e., used for more than one test. A control group will be maintained and handled in the same manner as the other fish to differentiate natural mortality, the effects of handling, etc.

Before the test is begun an effort will be made to catch and maintain enough fish for the test. If this effort fails the study will be discontinued. If possible, all fish for the sutdy will be obtained from Dardanelle Reservoir.

This study will be done by a consultant competent in the field of aquatic biology laboratory work and capable of analyzing all data generated by the study.

Reporting Requirements:

The results of this study will be reported to the NRC upon its completion.

Bases

This study constitutes a "state-of-the-art" determination of temperature effects on threadfin shad in Dardanelle Reservoir. The results will contribute to the documentation of the fact that the large threadfin shad impingements experienced by the licensee are a result of natural causes.

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TO: Mr. A. Giambusso	ORIG 1-signed	CC 39	OTHER	SENT AEC PDR xxx SENT LOCAL PDR xxx		
CLASS	UNCLASS xxxx	PROP INFO	INPUT	NO CYS REC'D 40	DOCKET NO: 50-313	

DESCRIPTION:

Ltr notarized 4-11-75 re our 1-9-75 ltr and subsequent meetings .... concerning proposed changes to Environmental Tech- Specs .... trans the following:

ENCLOSURES:

Proposed changes to Envirnmental Tech- Specs concerning fish impingement at the Arkansas Nuclear Facility Unit 1 ....

PLANT NAME: Arkansas #1

4-18-75 JGB

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