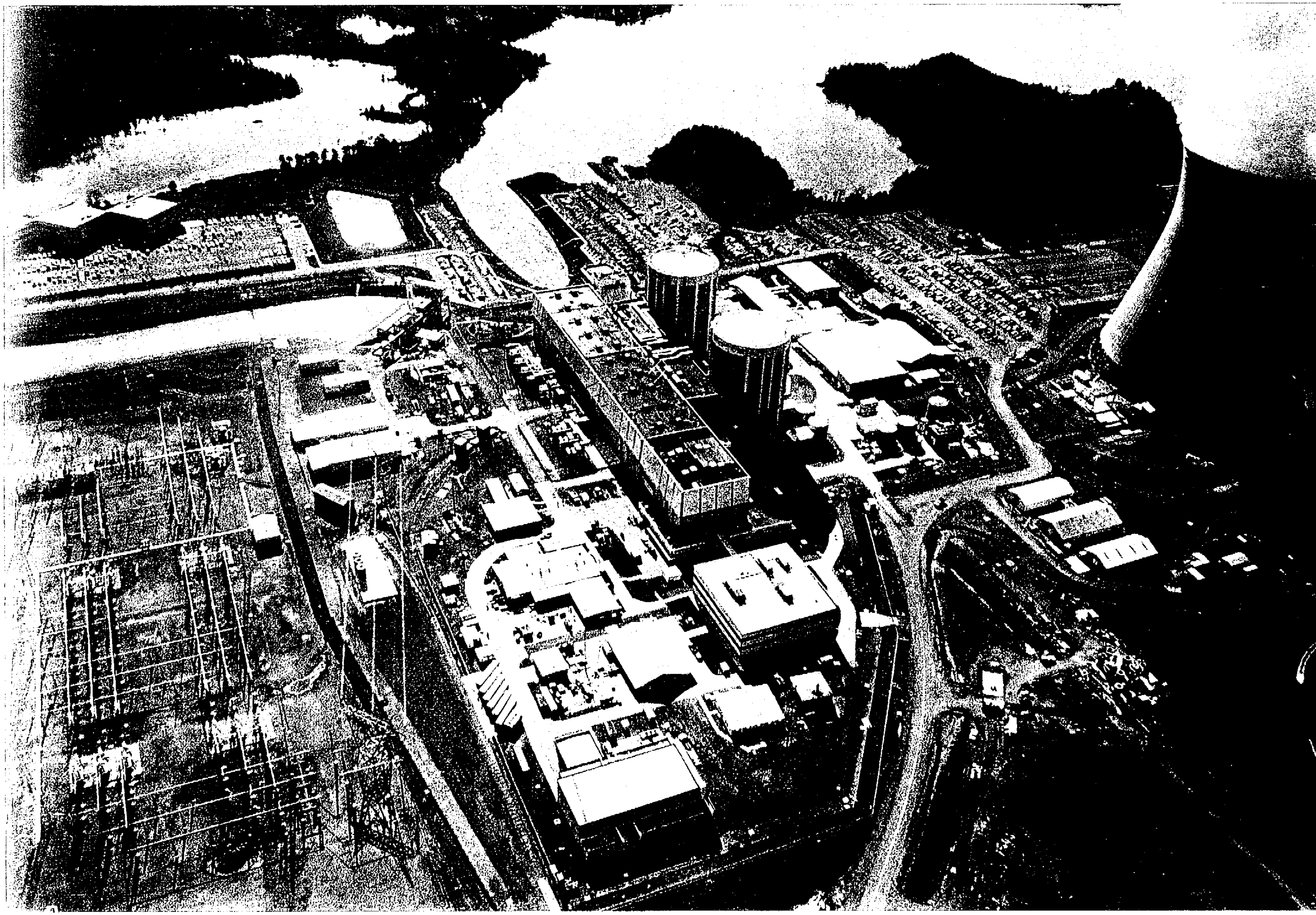
Attachment 2

Information Provided to NRC During

April 3-6, 2000

Environmental Site Audit



Facility Facts

- Points of site interests (cooling tower, cooling pond, intake and discharge canals, sanitary sewage ponds)
- Three archaeological sites of interest identified
- No threatened or endangered species identified
- Discharge canal provides suitable habitat for fish and wildlife during winter months
- Lake Dardanelle recreational activities (fishing, skiing, swimming, boating and nature trails)
- Weather patterns typical for this area
- No minority populations exist based on environmental justice criteria

Onsite Maintenance Activities

- Onsite herbicide applications performed by ANO Plant Services personnel during summer months (Roundup)
- Onsite pesticide applications performed by offsite contractor (Terminix)
- Fish and clam control inside Protected Area
  - Continuous feed of sodium hypochlorite
  - Quarterly injections of microbiocide (Calgon H-130M)
- Fish and clam control outside Protected Area
  - Intake bay traveling screens transfer fish/debris to baskets
  - Intake bays coated with special paint
  - Intake bays manually cleaned (dependent on ATU study)
  - Currently testing shad barrier net (November – March)

Major Modifications or Component Replacement

- None identified during evaluation of structures and components pursuant to 10 CFR 54.21

New and Significant Information Process

- Qualified investigative team from corporate headquarters, ANO and contractor personnel assembled for preparation of ANO-1 ER
- Type of documents reviewed included site permits, documents and reports, and documents and reports prepared by regulatory agencies/academic institutions
- Documented review of Category 1 Issues
- Reviews identified no new and significant information

Identification and Resolution of Environmental Issues

- Nuclear Management Manual Procedures and Site Directives:
  - Describe environmental policies, practices and standards
  - Ensure plant managers are aware of changes in regulations
  - Describes interface between various groups
- Environmental issues identified by corporate headquarters and further evaluated by Environmental Peer Group

Identification and Resolution of Environmental Issues

- Assessment of Environmental Issues at Peer Group Level
  - Peer Group consists of representatives from corporate group, nuclear stations and executive management team
  - Evaluates new requirements respective to their site and develops strategies to implement
  - Action items are assigned when new requirements apply
  - Action items documented in quarterly meeting minutes and reviewed by Peer Group until closure

Identification and Resolution of Environmental Issues

- ANO Site Chemistry
  - ANO Site Chemistry has primary responsibility for ensuring compliance
  - Provides support and direction to site groups/individuals for implementing and maintaining compliance/enhancements
  - Makes supervision aware of appropriate environmental training
  - Provides regulatory interpretations to site groups
  - Actively seeks ways to minimize environmental impacts
  - Reviews changes to plant system processes, procedures, or plant equipment

Identification and Resolution of Environmental Issues

- EOI Environmental Peer Group Meetings
  - Provides consistent work practices and improves environmental performance
  - Activities controlled by EOI's Nuclear Management Manual
  - Meets quarterly, maintains meeting minutes/action item list
  - Reviews cover environmental and associated services, systems, processes, products and personnel
  - Ensures items affecting individual plants are brought to attention of plant managers
  - Responsible for ensuring regulatory compliance
  - Assessing impact of new regulatory requirements and developing strategies for implementation
  - Periodically evaluates existing site programs

Identification and Resolution of Environmental Issues

- Environmental Practices at ANO
  - Peer Group and ANO Site Chemistry provides assurance that:
    - Issues are addressed in appropriate time frame/priority
    - Resources assigned to issues that add greatest value to sustaining environment and achieving compliance
- EOI Companywide and Site Environmental Procedures
  - Companywide and site procedures provide guidance on implementation of federal, state and local environmental processes
  - Peer Group and ANO Site Chemistry develop procedures, with input from affected work groups

Identification and Resolution of Environmental Issues

- Problem Investigation Process
  - Condition Reporting (CR) process identifies and documents problems at ANO
  - CR process tracks resolution of events and is used as a predictive tool to help prevent future problems
- EOI Nuclear Management Manual and Site Directives
  - NMM and Site Directives provide direction and requirements on various EOI policy matters
  - Provide minimum requirements to promote consistency
  - Address company's position on environmental issues
  - Provide instructions and requirements for implementation of work activities

ENTERGY OPERATIONS INCORPORATED PROCESS

FOR EVALUATING NEW AND SIGNIFICANT INFORMATION

A. Description of Process

Entergy Operations, Incorporated (EOI) in-house process ensured that new and significant information regarding environmental issues, as it relates to Arkansas Nuclear One – Unit 1 (ANO-1), was properly reviewed prior to submittal of the Environmental Report (ER). This process ensured that new and significant environmental information related to renewal of the ANO-1 license was identified, reviewed and addressed.

1. Review of Environmental Issues Prior to ER Submittal

EOI assembled a qualified investigative team from ANO and corporate headquarters to provide support in preparing the ANO-1 license renewal environmental report. These individuals formed a group knowledgeable about plant systems, the site environment, and plant environmental issues. In addition, ANO contracted with an environmental consulting firm with expertise in the National Environmental Policy Act and the scientific disciplines involved in preparing a license renewal environmental report. The strong combination of ANO and non-ANO multidisciplinary personnel ensured that the team was well qualified to identify new and significant information.

A review was performed of environmental issues applicable to license renewal at ANO-1. This review was performed on the Category 1 issues appearing in 10CFR51, Subpart A, Appendix B, Table B-1 to verify that the conclusions of the Generic Environmental Impact Statement (GEIS) remained valid with respect to ANO-1. During this phase, the following type documents were reviewed:

- Site environmental permits.
- Site environmental documents and reports (including routine monitoring), prepared by EOI.
- Environmental documents and reports prepared by regulatory agencies and academic institutions.

The level of review conducted on the Category 1 Issues was as follows:

- Corporate headquarters identified the Category 1 Issues applicable to ANO-1 and performed an initial documented review.

- Corporate headquarters and ANO station personnel performed a secondary review of the Category 1 Issues.
- Environmental consulting firm performed an independent review of the Category 1 Issues.
- Corporate headquarters and ANO personnel, and environmental consulting firm evaluated reviews of Category 1 Issues for new and significant information.

As a result of this review, EOI is not aware of any new and significant environmental information associated with the renewal of the ANO-1 operating license.

B. Identification and resolution of Environmental Issues

This section describes the process by which environmental issues are identified at EOI's nuclear plants. This section also describes the processes used to track the resolution of environmental issues affecting ANO.

1. Identification of Environmental Issues at the Corporate Level

EOI's Nuclear Management Manual (NMM) Procedures and Site Directives describe environmental policies, practices and standards. The purpose of this manual and directives is to ensure compliance with environmental regulations by promoting consistency of interpretation, implementation, and communications. Specifically, the NMM describes the interface between the Environmental Peer Group, EOI nuclear stations, EOI's Corporate Nuclear Support Group, and other organizations (see EOI Nuclear Management Manual Policy PL-101, Entergy Operations Organization). Both the NMM and Site Directives ensure that EOI station managers are made aware of changes in regulations by requiring all revisions to be reviewed by affected managers.

Environmental issues at the nuclear facilities are identified by the EOI Corporate Nuclear Support Group and are evaluated further by the Environmental Peer Group. This group consists of technical personnel involved in environmental compliance, environmental monitoring, environmental planning, natural resource management, and health and safety issues. This group is also involved in the development and review of regulations. In addition, the Nuclear Support Group serves as the interface between the regulatory agencies and the EOI site environmental organizations, when requested.

2. **Assessment of Environmental Issues at the Peer Group Level**

EOI's Environmental Peer Group consists of environmental representatives from the Corporate Nuclear Support Group, Arkansas Nuclear One, Grand Gulf Nuclear Station, River Bend Station and Waterford 3, and a member from the EOI executive management team. When new regulatory requirements are identified at the Corporate Nuclear Support Group level, these requirements are summarized and presented to the Environmental Peer Group for evaluation. The Peer Group evaluates new requirements as it applies to their respective site and develops strategies to implement, as appropriate. If a new requirement applies to a site, then an action item is assigned to the site. Action items are documented in the quarterly meeting minutes and are reviewed by the Peer Group each meeting until the item is closed.

3. **ANO Site Chemistry**

ANO Site Chemistry has primary responsibility for ensuring compliance with environmental regulations and for enhancement of the systems related to environmental issues. In addition, this group is responsible for:

- Providing environmental support and direction to site groups/individuals for implementing and maintaining compliance/ enhancements within their areas.

- Making first line supervision aware of the appropriate environmental training needed for site personnel.

- Providing regulatory interpretations to site groups to enable them to effectively carry out environmental processes.

- Actively seeking ways to minimize environmental impacts through minimization of wastes generated at ANO.

Finally, they review changes to plant system processes, procedures, or plant equipment prior to being implemented, to determine if there are environmental related impacts from these proposed changes (see EOI Nuclear Management Manual Policy LI-101, 10CFR50.59 Review Program).

4. **EOI Environmental Peer Group Meetings**

The EOI Environmental Peer Group participates as a team to provide consistent work practices, to improve environmental performance, and to reduce costs. This group meets quarterly and maintains meeting minutes and an action item list. Peer group activities are controlled through EOI's Nuclear Management Manual (see EOI Nuclear Management Manual Policy PL-109, Peer Group Concept). The scope of review by this group covers all environmental and associated services, systems, processes, products and personnel at nuclear sites and within support organizations. This process also helps ensure that items affecting individual plants are brought to the attention of the environmental managers at other EOI plants.

In summary, the Environmental Peer Group is responsible for:

- Sharing environmental information on emerging issues or problems.

- Ensuring that the EOI sites are complying with existing regulatory requirements.

- Assessing impact of new regulatory requirements and developing compliance strategies at the site level.

- Ensuring that each site has measures in place to assure compliance with regulatory requirements.

- Periodic review and evaluation of existing site environmental programs.

5. Environmental Practices at ANO

Several years ago, an Environmental Peer Group was established within EOI to focus on environmental regulatory compliance issues, broad environmental policy direction, and initiatives to minimize plant impact on the environment. The Environmental Peer Group, along with ANO Site Chemistry, provides assurance that:

- Environmental issues at ANO are addressed in the appropriate time frame.

- Emerging environmental issues are identified in a timely manner and given the appropriate priority.

- Resources are assigned to the environmental issues that add the greatest value to sustaining the environment and achieving compliance, and are the most cost-effective, consistent with ANO operational goals.

6. **EOI Companywide and Site Environmental Procedures**

EOI companywide and site environmental procedures provide guidance to the site on how environmental processes are to be implemented. These procedures provide the guidance and direction that enable the site to comply with federal, state, and local regulations. The EOI Environmental Peer Group and ANO Site Chemistry develop procedures, with input from the work groups responsible for implementation of the work practice.

7. **Problem Investigation Process**

The operation, maintenance, and modification of a nuclear station may result in problems where equipment, process and/or personnel do not perform as expected, unexpected changes occur, or conditions are identified that are inconsistent with requirements or regulations. ANO Procedure 1000.104, Condition Reporting and Corrective Actions is a process by which problems are identified, documented, and responded to with a level of effort and timeliness commensurate with their significance. In addition to tracking the resolution of events, the process is used as a predictive tool to help prevent future problems that may lead to environmental incidents.

8. **EOI Nuclear Management Manual and Site Directives**

The EOI Nuclear Management Manual and specific Site Directives provide direction and requirements on various policy matters concerning operation and maintenance of EOI's nuclear plants. The NMM and Site Directives:

- Provide minimum requirements to promote consistency among the nuclear sites and the corporate office in fulfilling licensing and administrative requirements.

- Address the company's position on issues as they arise in the nuclear industry or as EOI experience indicates the need for a more definitive policy statement.

- Provide instructions and minimum requirements for the implementation of various work activities.

ANO Management Manual Procedure A4.701, Environmental Permits and Plans and Entergy's Environmental Policy outlines ANO's commitment and philosophy to comply with environmental regulatory requirements. In addition, they emphasize EOI's responsibility to support and comply with activities involving the environmental permits and plans at ANO.

Category 1 Issues for Refurbishment Evaluation

10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*
SURFACE-WATER QUALITY, HYDROLOGY AND USE (FOR ALL PLANTS)	
Impacts of refurbishment on surface-water quality	3.4.1
Impacts of refurbishment on surface-water use	3.4.1
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Refurbishment	3.5
GROUNDWATER USE AND QUALITY	
Impacts of refurbishment on groundwater use and quality	3.4.2
LAND USE	
Onsite land use	3.2
HUMAN HEALTH	
Radiation exposures to the public during refurbishment	3.8.1
Occupational radiation exposures during refurbishment	3.8.2
SOCIOECONOMICS	
Public services, public safety, social services, and tourism and recreation	3.7.4, 3.7.4.3, 3.7.4.4 & 3.7.4.6
Aesthetic impacts (refurbishment)	3.7.8

Entergy Operations performed an evaluation of structures and components pursuant to 10 CFR 54.21 to identify activities that are necessary to continue operation of ANO-1 during the license renewal term. It was determined that replacement of these components and additional inspection activities would be within the bounds of normal plant component replacement and inspections. Therefore, they are not expected to affect the environment outside the bounds of plant operations as evaluated in the Final Environmental Statement (February 1973). In addition, an evaluation of structures and components as required by 10 CFR 54.21, did not identify any major plant refurbishment activities or modifications necessary to support the continued operation of ANO-1 during the license renewal term. Therefore, evaluation of refurbishment issues was not considered.

Category 1 Issues Applicable to ANO-1 Cooling System (Renewal Term)

10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*
SURFACE-WATER QUALITY, HYDROLOGY AND USE (FOR ALL PLANTS)	
Altered current patterns at intake and discharge structures	4.2.1.2.1, 4.3.2.2 & 4.4.2
Altered thermal stratification of lakes	4.2.1.2.3 & 4.4.2.2
Temperature effects on sediment transport capacity	4.2.1.2.3 & 4.4.2.2
Scouring caused by discharged cooling water	4.2.1.2.3 & 4.4.2.2
Eutrophication	4.2.1.2.3 & 4.4.2.2
Discharge of chlorine or other biocides	4.2.1.2.4 & 4.4.2.2
Discharge of sanitary wastes and minor chemical spills	4.2.1.2.4 & 4.4.2.2
Discharge of other metals in waste water	4.2.1.2.4, 4.3.2.2 & 4.4.2.2
Water-use conflicts (plants with once-through cooling systems)	4.2.1.3
AQUATIC ECOLOGY (FOR ALL PLANTS)	
Accumulation of contaminants in sediments or biota	4.2.1.2.4, 4.3.3, 4.4.3 & 4.4.2.2
Entrainment of phytoplankton and zooplankton	4.2.2.1.1, 4.3.3 & 4.4.3
Cold shock	4.2.2.1.5, 4.3.3 & 4.4.3
Thermal plume barrier to migrating fish	4.2.2.1.6 & 4.4.3
Distribution of aquatic organisms	4.2.2.1.6 & 4.4.3
Premature emergence of aquatic insects	4.2.2.1.7 & 4.4.3
Gas supersaturation (gas bubble disease)	4.2.2.1.8 & 4.4.3
Low dissolved oxygen in the discharge	4.2.2.1.9, 4.3.3 & 4.4.3
Losses from predation, parasitism, and disease among Organisms exposed to sublethal stresses	4.2.2.1.10 & 4.4.3
Stimulation of nuisance organisms	4.2.2.1.11 & 4.4.3
HUMAN HEALTH	
Microbial organisms	4.3.6
Noise	4.3.7

Entergy Operations identified no new and significant information associated with the renewal of the ANO-1 operating license during the review process of these issues. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted. A brief discussion for each of these issues is provided below.

<u>Altered current patterns at intake and discharge structures</u>: Based on information in the GEIS, the Commission found that "Altered current patterns have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other

available information. Based on Section 3.f(6) (Biological Impact) of the ANO-1 FER, the reservoir through flow is considerably greater than the intake and circulating water flows, and therefore impacts, if any, would be non-detectable.

In addition, the hydraulic influence of ANO on Lake Dardanelle is limited to the immediate areas of the intake canal and discharge embayment. Therefore, due to large volume of the lake and the high average daily through flow (measured at Dardanelle Lock and Dam) no significant impact on the overall hydraulic flow of the lake is anticipated. Therefore, Entergy Operations concludes that there are no impacts of altered current patterns during the renewal term beyond those discussed in the GEIS.

Altered thermal stratification of lakes: Based on information in the GEIS, the Commission found that "Generally, lake stratification has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Section 5.4.1 (Conclusion) of the ANO-1 FES states, "Therefore, the ecological impact of this heated discharge is expected to be restricted to the upper strata of the lake and, generally, to be limited to the area of the lake near and downstream of the discharge embayment (less than 10% of the lake's surface area even under once-in-ten-years minimum flow conditions). Thus, the ecological effect on the entire lake is expected to be negligible." In addition, Section 2.5 (Hydrology) of the ANO-1 FES states, "The storage capacity of the lake is 486,000 acre-feet; at the average inflow of 35,620 cfs (0.82 acre-feet), the average residence time of water in the lake will be about 7 days. This factor, together with the relative shallowness of the lake (maximum depth, about 63 ft near the dam), gives Lake Dardanelle the characteristics of a main stream, or "run-of-the-river", impoundment as compared with a storage reservoir, which is ordinarily much deeper and in which the entering water may be retained for several months."

In addition, based on the results of previous studies conducted by the University of Arkansas at Little Rock (Rickett and Watson, 1992, 1993, 1994), Lake Dardanelle does not experience strongly defined seasonal stratification typical of most deep-water lakes and reservoirs in the region. The lack of stratification is the result of a shallow depth and the high through-flow. The thermal influence of the cooling water discharge from ANO-1 is limited to the discharge embayment and the adjacent area in the main channel of the lake. Previous studies have concluded that the discharge has no significant impact on the thermal conditions in Lake Dardanelle outside of the discharge embayment area. FTN agrees with the conclusion that the impact on thermal stratification of the lake outside this area is insignificant. Therefore, Entergy Operations concludes that there are no impacts of altered thermal stratification of Lake Dardanelle during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to ANO-1 Cooling System (Renewal Term)

Temperature effects on sediment transport capacity: Based on information in the GEIS, the Commission found that "These effects have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on Section 3.f(6) (Biological Impact) of the ANO-1 FER, the reservoir through flow is considerably greater than the circulating water flow, and affects, if any, would be non-detectable. In addition, due to the limited thermal influence of ANO-1 on Lake Dardanelle, FTN concurs with the conclusions in the GEIS that temperature effects from ANO-1 would have an insignificant impact on sediment transport capacity. Therefore, Entergy Operations concludes that there are no impacts of temperature effects on sediment transport capacity during the renewal term beyond those discussed in the GEIS.

Scouring caused by discharged cooling water: Based on information in the GEIS, the Commission found that "Scouring has not been found to be a problem at most operating nuclear power plants and has caused only localized effects at a few plants. It is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Section 3.f(6) (Biological Impact) of the ANO-1 FER states, "There has been considerable scouring in the Dardanelle Reservoir due to the through flow. Since the reservoir through flow is considerably greater than the circulating water flow, it is expected that any scouring effect by the circulating water flow will be non-detectable."

In addition, according to the results of a twenty-four year study of benthic taxa in Lake Dardanelle in the vicinity of ANO (Rickett and Watson, unpublished report), high cooling water flow in the immediate vicinity of the ANO intake canal and discharge canal has removed unconsolidated bottom sediments. The scouring effect was noted to be insignificant short distances in the intake canal and discharge embayment area. FTN concludes that scouring effects from the ANO-1 cooling water system are insignificant outside the immediate vicinity of the intake and discharge canals. Therefore, Entergy Operations concludes that there are no impacts of scouring during the renewal term beyond those discussed in the GEIS.

Eutrophication: Based on information in the GEIS, the Commission found that "Eutrophication has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Eutrophication is most likely to be seen in smaller lakes (Lake Dardanelle is considered a large lake). In addition, results of previous Lake Dardanelle water quality studies performed by the University of Arkansas at Little Rock, identified no increase in biological productivity as result of the ANO-1 thermal discharge.

In addition, Rickett and Watson (1983) concluded that no significant change in the phytoplankton populations occurred as a result of the operation of ANO-1. Based on a review of ANO compliance with NPDES permit AR0001392, the potential for ANO to cause eutrophication in Lake Dardanelle is considered to be insignificant. Therefore, Entergy Operations concludes that there are no impacts of eutrophication during the renewal term beyond those discussed in the GEIS.

Discharge of chlorine or other biocides: Based on information in the GEIS, the Commission found that "Effects are not a concern among regulatory and resource agencies, and are not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. ANO's NPDES Permit AR0001392 controls discharges of chlorine or other biocides. In addition, during evaluation of estimating the average and maximum chemical concentrations that could be released during plant operation, it was concluded in Section 3.d (Chemical Discharges) of the ANO-1 FER that, "It is not expected that these low concentrations will have any adverse effect on the biota in the Dardanelle Reservoir."

In addition, based on a review of ANO compliance with conditions of NPDES Permit AR0001392, FTN concludes that no significant impact from biocides on the biota of Lake Dardanelle has occurred. Therefore, Entergy Operations concludes that there are no impacts of discharge of chlorine or other biocides during the renewal term beyond those discussed in the GEIS.

Discharge of sanitary wastes and minor chemical spills: Based on information in the GEIS, the Commission found that "Effects are readily controlled through the NPDES permit and periodic modifications, if needed, and are not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Discharge of sanitary wastewater at ANO is controlled under the NPDES Permit AR0001392 as Outfall 005. In addition, Part III, Item 15 of the NPDES Permit AR0001392 requires that ANO implement best management practices to minimize and control onsite chemical spills.

In addition, based on a review of ANO compliance with conditions of NPDES Permit AR0001392, FTN concludes that no significant impact from sanitary wastes and minor chemical spills on the biota of Lake Dardanelle have occurred. Therefore, Entergy Operations concludes that there are no impacts of discharges of sanitary wastes and minor chemical spills during the renewal term beyond those discussed in the GEIS.

Discharge of other metals in waste water: Based on information in the GEIS, the Commission found that "These discharges have not been found to be a problem at operating nuclear power plants with cooling-tower-based heat dissipation systems and have been satisfactorily mitigated at other plants. They are not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Discharges of wastewaters containing metals at ANO are controlled under the NPDES Permit AR0001392 as Outfall 007.

In addition, based on a review of ANO compliance with conditions of NPDES Permit AR0001392, FTN concludes that no significant impact from the discharge of metals on the biota of Lake Dardanelle has occurred. Therefore, Entergy Operations concludes that there are no impacts of discharges of other metals in wastewater during the renewal term beyond those discussed in the GEIS.

Water-use conflicts (plants with once-through cooling systems): Based on information in the GEIS, the Commission found that "These conflicts have not been found to be a problem at operating nuclear power plants with once-through heat dissipating systems." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on the 1999 Steam-Electric Plant Operation and Design Report for ANO, the consumptive loss of 11.3 cfs for Unit 1's once-through cooling system was less than that of Unit 2's cooling tower consumptive loss of 21.5 cfs. In addition, Section 3.b(2) (Water Use Compatibility) of the ANO-1 FER, states "There are no industrial sites or irrigation divisions which use the Dardanelle Reservoir as a water source."

In addition, FTN did not identify any water-use conflicts on the Arkansas River and Lake Dardanelle related to the operations of ANO-1. It was concluded that the consumptive loss of 11.3 cfs has an insignificant impact on the lake's intended uses of navigation and hydropower generation. Therefore, Entergy Operations concludes that there are no water-use conflicts during the renewal term beyond those discussed in the GEIS.

Accumulation of contaminants in sediments or biota: Based on information in the GEIS, the Commission found that "Accumulation of contaminants has been a concern at a few nuclear power plants but has been satisfactorily mitigated by replacing copper alloy condenser tubes with those of another metal. It is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. The ANO Unit's 1 and 2 copper condensers have been replaced with titanium. Also, ANO does not utilize water treatment chemicals containing chromium, nor does it utilize water treatment chemicals containing zinc for the Unit 1 circulating water system.

In addition, based on the review of ANO compliance with the conditions of NPDES permit AR0001392, it is unlikely ANO-1 discharges any contaminants that would accumulate in sediments or biota. The Permit contains water-quality based limits that are designed to prevent the accumulation of toxic constituents in sediments and biota. FTN concludes that the potential for this problem to occur at ANO-1 is very low and any impact would be small and insignificant. Therefore, Entergy Operations concludes that there are no impacts of accumulation of contaminants in sediments or biota during the renewal term beyond those discussed in the GEIS.

Entrainment of phytoplankton and zooplankton: Based on information in the GEIS, the Commission found that "Entrainment of phytoplankton and zooplankton has not been found to be a problem at operating nuclear power plants and is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on previous studies conducted in Lake Dardanelle by the University of Arkansas at Little Rock, impacts were small since phytoplankton and zooplankton densities were quickly re-established within the lake.

In addition, Rickett and Watson (1983a and 1983b) concluded that ANO-1 has no significant impact on phytoplankton or zooplankton populations in Lake Dardanelle. FTN concurs that any impact (resulting from entrainment or thermal influence) would be small. Therefore, Entergy Operations concludes that there are no impacts of entrainment of phytoplankton and zooplankton during the renewal term beyond those discussed in the GEIS.

Cold shock: Based on information in the GEIS, the Commission found that "Cold shock has been satisfactorily mitigated at operating nuclear plants with once-through cooling systems, has not endangered fish populations or been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds, and is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. During initial operations and as part of the operating license requirements, ANO biologists would monitor the discharge embayment area for signs of dead or stressed fish during periods when the plant tripped. This practice was later discontinued (and approved by the NRC) since observations identified no impacts to the fish population in the discharge embayment area.

Category 1 Issues Applicable to ANO-1 Cooling System (Renewal Term)

FTN discussed the issue with ANO biologists who performed the evaluation of potential cold shock mortality of fish in the discharge embayment. FTN concurs that the potential impact on fish populations in the embayment would be small. Therefore, Entergy Operations concludes that there are no impacts of cold shock during the renewal term beyond those discussed in the GEIS.

Thermal plume barrier to migrating fish: Based on information in the GEIS, the Commission found that "Thermal plumes have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Section 3.f(4) (Biological Impacts) of the ANO-1 FER states, "These studies show that no thermal blockage occurs on the Reservoir due to the discharged effluent and that the warmer temperatures, although prevalent at the surface, quickly dissipate a few feet below the surface." In addition, Section 5.4.1 (Conclusion) of the ANO-1 FES states, "Thermal barriers to fish movement are not expected to occur in the lake."

In addition, based on review by Rickett and Watson (1992, 1993, and 1994), the ANO-1 cooling water discharge does not create a thermal barrier to migrating fish. FTN concludes the potential impact of this issue is insignificant. Therefore, Entergy Operations concludes that there are no impacts of thermal plumes during the renewal term beyond those discussed in the GEIS.

Distribution of aquatic organisms: Based on information in the GEIS, the Commission found that "Thermal discharge may have localized effects but is not expected to affect the larger geographical distribution of aquatic organisms." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Section 5.4.1 (Conclusion) of the ANO-1 FES states, "Therefore, the ecological impact of this heated discharge is expected to be restricted to the upper strata of the lake and, generally, to be limited to the area of the lake near and downstream of the discharge embayment (less than 10% of the lake's surface area even under once-in-ten-years minimum flow conditions). Thus, the ecological effect on the entire lake is expected to be negligible."

In addition, resource agencies (Limbird, 1999) have concluded that the ANO discharge embayment has a small localized impact on aquatic organisms in the discharge embayment. FTN concurs that the impact is localized and does not cause a significant impact on the distribution of aquatic organisms outside the immediate discharge embayment area. Therefore, Entergy Operations concludes that there are no impacts on the distribution of aquatic organisms during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to ANO-1 Cooling System (Renewal Term)

Premature emergence of aquatic insects: Based on information in the GEIS, the Commission found that "Premature emergence has been found to be a localized effect at some operating nuclear power plants but has not been a problem and is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Section 5.4.1 (Conclusion) of the ANO-1 FES states, "The thermal plume that enters the lake from the discharge embayment is expected to be confined to the upper 6 ft of the lake. Therefore, the ecological impact of this heated discharge is expected to be restricted to the upper strata of the lake and, generally, to be limited to the area of the lake near and downstream of the discharge embayment (less than 10% of the lake's surface area even under once-in-ten-years minimum flow conditions). Thus, the ecological effect on the entire lake is expected to be negligible." In addition, studies conducted by the University of Arkansas at Little Rock have supported this conclusion.

In addition, Rickett and Watson's twenty-four year study (unpublished report) of benthic invertebrates in Lake Dardanelle, identified no significant shift in population structure or dynamics of insect populations. FTN concludes, that outside of immediate discharge embayment area, no significant impact on insect emergence should occur as a result of the cooling water discharge from ANO-1. Therefore since bottom areas will be uninfluenced by the thermal discharge, Entergy Operations concludes that there are no impacts of premature emergence of aquatic insects during the renewal term beyond those discussed in the GEIS.

Gas supersaturation (gas bubble disease): Based on information in the GEIS, the Commission found that "Gas supersaturation was a concern at a small number of operating nuclear power plants with once-through cooling systems but has been satisfactorily mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on previous operational years, ANO personnel have not observed any fish kills as a result of gas supersaturation.

In addition, FTN concludes that potential for gas supersaturation to occur in Lake Dardanelle from the discharge of ANO-1 cooling water is low. Due to the lack of any history of this problem occurring in the past, the potential for the problem to occur during the period of license renewal is considered to be low and any impacts from gas bubble disease in fish to be insignificant. Therefore, Entergy Operations concludes that there are no impacts of gas supersaturation during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to ANO-1 Cooling System (Renewal Term)

Low dissolved oxygen (DO) in the discharge: Based on information in the GEIS, the Commission found that "Low dissolved oxygen has been a concern at one nuclear power plant with a once-through cooling system but has been effectively mitigated. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term." Section 12.3.3 (Effect of Thermal Plume on Aquatic Biota) of the ANO-1 FES states, "However, under once-in-ten years minimum-flow conditions, the thermal plume (with a $\Delta T > 5.0°$ F) is expected to cover about 7.5% of the lake surface in January (at 4300 cfs) and less than 4% in July (at 3500 cfs). Therefore, if reduction in oxygen concentration should occur, it would involve a very small percentage of the lake. ....the staff does not expect lowered oxygen levels (<5.0 mg/liter) to occur in the lower waters of the lake." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information.

In addition, according to the Arkansas Department of Environmental Quality (1998 Water Quality Inventory Report-305b), Lake Dardanelle meets current water quality standards for dissolved oxygen (DO). Personal communication with the Arkansas Department of Environmental Quality (ADEQ) has revealed a recent trend of lower than average DO values in the Arkansas River system. This problem has been detected in Oklahoma and Arkansas and is considered to be the result of the recent introduction of zebra mussels. FTN concurs with the ADEQ that a high biological oxygen demand in the river does occur after the mid-summer die-off of zebra mussels throughout the Arkansas River. This phenomenon is unrelated to the operation of ANO-1. A review of the results of Rickett and Watson (1992, 1993, and 1994) shows no significant impact of ANO-1 on DO concentrations in Lake Dardanelle. FTN also concludes that any such impact would be small and limited to the discharge embayment area. Therefore, Entergy Operations concludes that there are no impacts of low dissolved oxygen during the renewal term beyond those discussed in the GEIS.

Losses from predation, parasitism, and disease among organisms exposed to sublethal stresses: Based on information in the GEIS, the Commission found that "These types of losses have not been found to be a problem at operating nuclear power plants and are not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on information received from the Arkansas Game and Fish Commission (Letters from A. Carter dated March 8, 1995 and Bob Limbird dated March 14, 2000), the operation of ANO has not affected the maintenance of quality recreational fishery in Lake Dardanelle.

Therefore since fish populations in Lake Dardanelle continue to thrive, Entergy Operations concludes that there are no impacts of losses from predation, parasitism, and disease among organisms exposed to sub-lethal stresses during the renewal term beyond those discussed in the GEIS.

Stimulation of nuisance organisms: Based on information in the GEIS, the Commission found that "Stimulation of nuisance organisms has been satisfactorily mitigated at the single nuclear power plant with a once-through cooling system where previously it was a problem. It has not been found to be a problem at operating nuclear power plants with cooling towers or cooling ponds and is not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Zebra mussels and Asiatic clams are present in Lake Dardanelle due to the lake's ecological dynamics, not due to the presence of the ANO plant. Although the plant's intake and discharge areas may enhance the presence of these organisms, the effects would be localized and not global. Finally, since Lake Dardanelle is a freshwater lake, shipworms are not applicable to ANO. Therefore, Entergy Operations concludes that there are no impacts of stimulation of nuisance organisms during the renewal term beyond those discussed in the GEIS.

Microbiological organisms (occupational health): Based on information in the GEIS, the Commission found that "Occupational health impacts are expected to be controlled by continued application of accepted industrial hygiene practices to minimize worker exposures." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on an EPRI study (EPRI Report EA-4300) and consultation with the Arkansas Department of Health (Charles McGrew on August 31, 1997), no increased presence of microorganisms was identified. Therefore, Entergy Operations concludes that there are no impacts of microbiological organisms during the renewal term beyond those discussed in the GEIS.

Noise: Based on information in the GEIS, the Commission found that "Noise has not been found to be a problem at operating plants and is not expected to be a problem at any plant during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on Section 12.7 (Noise Levels Associated With Arkansas Nuclear One) of the ANO-1 FES, noise from the site could not be heard at the nearest residence or town during construction of ANO-1. ANO-1 plant operational noise levels are considerably less than that of construction and have not presented a problem at ANO-1 since operation began. Therefore, Entergy Operations concludes that there are no impacts of noise during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to ANO-1 Transmission Lines (Renewal Term)

10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*
TERRESTRIAL RESOURCES	
Power line right-of-way management (cutting and herbicide application)	4.5.6.1
Bird collision with power lines	4.5.6.2
Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock)	4.5.6.3
Floodplains and wetland on power line right-of-way	4.5.7
AIR QUALITY	
Air quality effects of transmission lines	4.5.2
LAND USE	
Onsite land use	3.2
Power line right-of-way	4.5.3

Entergy Operations identified no new and significant information associated with the renewal of the ANO-1 operating license during the review process of these issues. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted. A brief discussion for each of these issues is provided below.

<u>Power line right-of-way management (cutting and herbicide application)</u>: Based on information in the GEIS, the Commission found that "The impacts of right-of-way maintenance on wildlife are expected to be of small significance at all sites." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on Entergy's right-of-way management practices, mechanical clearing occurs approximately every four years, with minimal herbicide usage. Any significant impacts to wildlife would have occurred during initial construction of the lines. The frequency of mechanical clearing and minimal herbicide usage occurring after construction is not expected to have a significant impact on wildlife. Therefore, Entergy Operations concludes that there are no impacts of power line right-of-way management during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to ANO-1 Transmission Lines (Renewal Term)

Bird collisions with power lines: Based on information in the GEIS, the Commission found that "Impacts [of bird collisions with power lines] are expected to be of small significance at all sites." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on Section 12.19 (Effects on Terrestrial Environs) of the ANO-1 FES, it was indicated that the transmission lines have been routed away from wildlife refuges and waterfowl flyways. In addition based on past experience, no adverse effects on birds have been observed. Section 5.1.4.2 (Effect of Natural Draft Cooling Tower on Migratory Birds) of the ANO-2 FES concludes that studies show that most bird losses coincide with overcast weather conditions, wind shifts due to cold weather fronts, and precipitation and/or /fog. Such losses are not a frequent occurrence, rather they are a sporadic phenomena. Therefore, Entergy Operations concludes that there are no impacts of bird collisions with power lines during the renewal term beyond those discussed in the GEIS.

Impacts of electromagnetic fields on flora and fauna (plants, agricultural crops, honeybees, wildlife, livestock): Based on information in the GEIS, the Commission found that "No significant impacts of electromagnetic fields on terrestrial flora and fauna have been identified. Such effects are not expected to be a problem during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Entergy monitors current research on the effects of electromagnetic fields on flora and fauna. Based on consultation with Entergy personnel involved with the study of electromagnetic fields, research has shown no conclusive evidence that these type fields affect flora and fauna. Therefore, Entergy Operations concludes that there are no impacts of electromagnetic fields on flora and fauna during the renewal term beyond those discussed in the GEIS.

Floodplains and wetland on power line right-of-way: Based on information in the GEIS, the Commission found that "Periodic vegetation control is necessary in forested wetlands underneath power lines and can be achieved with minimal damage to the wetland. No significant impact is expected at any nuclear power plant during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Prior to conducting maintenance activities occurring in floodplain or wetland areas, appropriate permits must be obtained (contracts established by Entergy for right-of-way maintenance specifies this). These permits control and minimize the effects of maintenance activities on these type areas. Therefore, Entergy Operations concludes that there are no impacts on floodplains and wetland on the power line right-of-way during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to ANO-1 Transmission Lines (Renewal Term)

Air quality effects of transmission lines: Based on information in the GEIS, the Commission found that "Production of ozone and oxides of nitrogen is insignificant and does not contribute measurably to ambient levels of these gases." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Section 5.9.1 (Ozone Formation) of the ANO-1 FES states, "Recent studies have shown that no measurable amounts of ozone (less than 2 ppb) are formed due to the presence and operation of transmission lines that carry up to 765 kv. No adverse effect on vegetation or animals occurs even during foul weather when the heaviest corona loss occurs. High-voltage lines for the Station will carry a maximum of 500 kV; therefore, no significant adverse effects are expected as a result of ozone formation." Therefore, Entergy Operations concludes that there are no air quality impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Onsite land use: Based on information in the GEIS, the Commission found that "Projected onsite land use changes required during ... the renewal period would be a small fraction of any nuclear power plant site and would involve land that is controlled by the applicant." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on previous years of operational experience, uses of land at ANO beyond that of normal day-to-day operational use has been temporary in nature and has been confined to previously disturbed areas. There are no current plans to use land for plant operational support purposes, beyond that currently used (i.e., dry cask spent fuel storage). Entergy Operations concludes that there are no onsite land-use impacts during the renewal term beyond those discussed in the GEIS.

Power line right-of-way (land use): Based on information in the GEIS, the Commission found that "Ongoing use of power line rights-of-way would continue with no change in restrictions. The effects of these restrictions are of small significance." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Transmission lines built for supporting the operation of ANO-1 would remain in service due to area growth loads should ANO-1 cease operation. Also, Entergy Arkansas holds the easement to the land beneath the transmission lines, therefore controls the land-use. In addition, there are no plans to alter the transmission line right-of-way corridor. Finally, Section 4.1.2 (Transmission Line Construction) of the ANO-1 FES states, "The presence of lines across land used for agriculture will not alter present land use or productivity." Therefore, Entergy Operations concludes that there are no impacts of restriction on use of power line rights-of-way during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to ANO-1 Radiological Impacts (Renewal Term)

HUMAN HEALTH	
10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*
Radiation exposures to public (license renewal term)	4.6.2
Occupational radiation exposures (license renewal term)	4.6.3

Entergy Operations identified no new and significant information associated with the renewal of the ANO-1 operating license during the review process of these issues. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted. A brief discussion for each of these issues is provided below.

Radiation exposures to public (license renewal term): Based on information in the GEIS, the Commission found that "Radiation doses to the public will continue at current levels associated with normal operations." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. There are no major operational changes planned during the license renewal period that would alter the conclusions already reached in the GEIS. Doses reported in the ANO Annual Radioactive Effluent Release Report are below the dose design objectives of Appendix I to 10 CFR Part 50, and is expected to continue to remain below these levels during the license renewal period. Therefore, Entergy Operations concludes that there are no impacts of radiation exposures to the public during the renewal term beyond those discussed in the GEIS.

Occupational radiation exposures (license renewal term): Based on information in the GEIS, the Commission found that "Projected maximum occupational doses during the license renewal term are within the range of doses experienced during normal operations and normal maintenance outages, and would be well below regulatory limits." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. There are no major operational changes planned during the license renewal period that would alter the conclusions already reached in the GEIS. Based on ANO Annual Radioactive Effluent Release Reports, occupational doses have shown no elevated trends and are expected to continue to be of small significance during the license renewal period. Therefore, Entergy Operations concludes that there are no impacts of occupational radiation exposures during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to Socioeconomics (ANO-1 Renewal Term)

SOCIOECONOMICS	
10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*
Public services: public safety, social services, and tourism and recreation	4.7.3, 4.7.3.3, 4.7.3.4 & 4.7.3.6
Public services: education (license renewal term)	4.7.3.1
Aesthetic impacts (license renewal term)	4.7.6
Aesthetic impacts of transmission lines (license renewal term)	4.5.8

Entergy Operations identified no new and significant information associated with the renewal of the ANO-1 operating license during the review process of these issues. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted. A brief discussion for each of these issues is provided below.

Public services: public safety, social services, and tourism and recreation: Based on information in the GEIS, the Commission found that "Impacts to public safety, social services, and tourism and recreation are expected to be of small significance at all sites." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. No additional staff has been identified as needed during the license renewal term. Therefore, impacts during the renewal term will be essentially the same as those that have occurred during plant operations and would be of small significance. In addition, GEIS, Volume 2, Appendix C supports the conclusion that impacts would be small. Therefore, Entergy Operations concludes that there are no impacts on public safety, social services, and tourism and recreation during the renewal term beyond those discussed in the GEIS.

Public services: education (license renewal term): Based on information in the GEIS, the Commission found that "Only impacts of small significance are expected." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. No additional staff has been identified as needed during the license renewal term. Therefore, impacts during the renewal term will be essentially the same as those that have occurred during plant operations and would be of small significance. In addition, GEIS, Volume 2, Appendix C supports the conclusion that impacts would be small. Therefore, Entergy Operations concludes that there are no impacts on education during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to Socioeconomics (ANO-1 Renewal Term)

Aesthetic impacts (license renewal term): Based on information in the GEIS, the Commission found that "No significant impacts are expected during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Table 4.16 of the GEIS concludes that aesthetic impacts due to ANO plant structures are insignificant. Although some site-specific activities such as timber management may occur on the ANO property, any aesthetic impacts would be short-term rather than long-term. Therefore, Entergy Operations concludes that there are no aesthetic impacts during the renewal term beyond those discussed in the GEIS.

Aesthetic impacts of transmission lines (license renewal term): Based on information in the GEIS, the Commission found that "No significant impacts are expected during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Based on past experience, there have been no complaints from the affected public regarding the presence of these lines, and no measurable impact on socioeconomic institutions and processes. In addition based on Section 4.1.2 (Transmission-Line Construction) of the ANO-1 FES, "Environmental Criteria for Electric Transmission Lines," published by the Department of Interior and Agriculture in 1970, was used for guidance in selecting design and routes of the transmission lines. Maximum use of natural screens to hide transmission facilities was utilized to minimize aesthetic impacts. Therefore, Entergy Operations concludes that there are no aesthetic impacts of transmission lines during the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to Postulated Accidents (ANO-1 Renewal Term)

POSTULATED ACCIDENTS	
10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*
Design-Basis Accidents (DBAs)	5.3.2 & 5.5.1

Entergy Operations identified no new and significant information associated with the renewal of the ANO-1 operating license during the review process of these issues. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted. A brief discussion for each of these issues is provided below.

Design-Basis Accidents (DBAs): Based on information in the GEIS, the Commission found "The NRC staff has concluded that the environmental impacts of design basis accidents are of small significance for all plants." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Design-based accidents were evaluated during the initial ANO-1 license process. The results of these evaluations are found in the ANO-1 FES and ANO-1 Safety Analysis Reports. For design-basis accidents, ANO is required to maintain these acceptable design and performance criteria throughout the life of the plant, including the license renewal period. For severe accidents, the probability-weighted consequence from atmospheric releases associated with severe accidents is considered to be of small significance at ANO-1. Therefore, Entergy Operations concludes that there are no impacts of Design Basis Accidents beyond those discussed in the GEIS.

Category 1 Issues Applicable to Uranium Fuel Cycle and Solid Waste Management (ANO-1 Renewal Term)

URANIUM FUL CYCLE AND WASTE MANAGEMENT	
10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*
Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste)	6.1, 6.2.1, 6.2.2.1, 6.2.2.3, 6.2.3, 6.2.4 & 6.6
Offsite radiological impacts (collective effects)	6.1, 6.2.2.1, 6.2.3 & 6.2.4
Offsite radiological impacts (spent fuel and high level waste disposal)	6.1, 6.2.2.1, 6.2.3 & 6.2.4
Nonradiological impacts of the uranium fuel cycle	6.1, 6.2.2.6, 6.2.2.7, 6.2.2.8, 6.2.2.9, 6.2.3, 6.2.4 & 6.6
Low-level waste storage and disposal	6.1, 6.2.2.2, 6.4.2, 6.4.3, 6.4.3.1, 6.4.3.2, 6.4.3.3, 6.4.4, 6.4.4.1, 6.4.4.2, 6.4.4.3, 6.4.4.4, 6.4.4.5, 6.4.4.5.1, 6.4.4.5.2, 6.4.4.5.3, 6.4.4.5.4 & 6.4.4.6
Mixed waste storage and disposal	6.4.5.1, 6.4.5.2, 6.4.5.3, 6.4.5.4, 6.4.5.5, 6.4.5.6, 6.4.5.6.1, 6.4.5.6.2, 6.4.5.6.3 & 6.4.5.6.4
On-site spent fuel	6.1, 6.4.6, 6.4.6.1, 6.4.6.2, 6.4.6.3, 6.4.6.4, 6.4.6.5, 6.4.6.6, 6.4.6.7 & 6.6
Nonradiological waste	6.1, 6.5, 6.5.1, 6.5.2, 6.5.3 & 6.6
Transportation	6.1, 6.3.1, 6.3.2.3, 6.3.3, 6.3.4 & 6.6

Entergy Operations identified no new and significant information associated with the renewal of the ANO-1 operating license during the review process of these issues. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted. A brief discussion for each of these issues is provided below.

Category 1 Issues Applicable to Uranium Fuel Cycle and Solid Waste Management (ANO-1 Renewal Term)

Offsite radiological impacts (individual effects from other than the disposal of spent fuel and high level waste): Based on information in the GEIS, the Commission found that

> Offsite impacts of the uranium fuel cycle have been considered by the Commission in Table S-3 of this part [10 CFR 51.51(b)]. Based on information in the GEIS, impacts on individuals from radioactive gaseous and liquid releases, including radon-222 and technetium-99 are small.

No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. There are no operational changes planned during the license renewal period that would alter the conclusions already reached in the GEIS. Offsite radiological impacts would continue to remain at the levels they were during pre-license renewal years. Any impacts are theoretical due to the extremely low doses and do not pose a measurable impact. Therefore, Entergy Operations concludes that there are no offsite radiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

Offsite radiological impacts (collective effects): Based on information in the GEIS, the Commission found that

> The 100-year environmental dose commitment to the U.S. population from the fuel cycle, HLW, and spent fuel disposal is calculated to be about 14,800 person rem [148 person Sv], or 12 cancer fatalities, for each additional 20-year power reactor operating term. Much of this, especially the contribution of radon releases from mines and tailing piles, consists of tiny doses summed over large populations. This same dose calculation can theoretically be extended to include many tiny doses over additional thousands of years as well as doses outside the United States. The result of such a calculation would be thousands of cancer fatalities from the fuel cycle, but this result assumes that even tiny doses have some statistical adverse health effect which will not ever be mitigated (for example no cancer cure in the next thousand years), and that these doses projected over thousands of years are meaningful. However, these assumptions are questionable. In particular, science cannot rule out the possibility that there will be no cancer fatalities from these tiny doses. For perspective, the doses are very small fractions of regulatory limits and even smaller fractions of natural background exposure to the same populations.
>
> Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made, and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into

> account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the collective effects of the fuel cycle, this issue is considered Category 1.

No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. NRC proposes 25mrem/year individual dose from all pathways. The EPA, however, has proposed a dose of 15rem/year be applied to all pathways with a separate dose of 4rem/year from the groundwater pathway. The NCR's standard should have little impact on license extension. Therefore, Entergy Operations concludes that there are no collective impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

<u>Offsite radiological impacts (spent fuel and HLW disposal)</u>: Based on information in the GEIS, the Commission found that

> For the high-level waste and spent fuel disposal component of the fuel cycle, there are no current regulatory limits for offsite releases of radioactive nuclides for the current candidate repository site. However, if we assume that limits are developed along the lines of the 1995 National Academy of Sciences (NAS) report, "Technical Bases for Yucca Mountain Standards," and that in accordance with the Commission's Waste Confidence Decision, 10 CFR 51.23, a repository can and likely will be developed at some site that will comply with such limits, peak doses to virtually all individuals will be 100 millirem (1 mSv) per year or less. However, while the Commission has reasonable confidence that these assumptions will prove correct, there is considerable uncertainty since the limits are yet to be developed, no repository application has been completed or reviewed, and uncertainty is inherent in the models used to evaluate possible pathways to the human environment. The NAS report indicated that 100 millirem (1 mSv) per year should be considered as a starting point for limits for individual doses, but notes that some measure of consensus exists among national and international bodies that the limits should be a fraction of the 100 millirem (1 mSv) per year. The lifetime individual risk from 100 millirem (1 mSv) annual dose limit is about is about 3×10-3.
>
> Estimating cumulative doses to populations over thousands of years is more problematic. The likelihood and consequences of events that could seriously compromise the integrity of a deep geologic repository were evaluated by DOE in

the "Final Environmental Impact Statement: Management of Commercially Generated Radioactive Waste," October 1980 [DOE 1980]. The evaluation estimated the 70-year whole-body dose commitment to the maximum individual and to the regional population resulting from several modes of breaching a reference repository in the year of closure, after 1,000 years, after 100,000 years, and after 100,000,000 years. Subsequently, the NRC and other federal agencies have expended considerable effort to develop models for the design and for the licensing of a HLW repository, especially for the candidate repository at Yucca Mountain. More meaningful estimates of doses to population may be possible in the future as more is understood about the performance of the proposed Yucca Mountain repository. Such estimates would involve very great uncertainty, especially with respect to cumulative population doses over thousands of years. The standard proposed by the NAS is a limit on maximum individual dose. The relationship of the potential new regulatory requirements, based on the NAS report, and cumulative population impacts has not been determined, although the report articulates the view that protection of individuals will adequately protect the population for a repository at Yucca Mountain. However, EPA's generic repository standards in 40 CFR Part 191 generally provide an indication of the order of magnitude of cumulative risk to population that could result from the licensing of a Yucca Mountain repository, assuming the ultimate standards will be within the range of standards now under consideration. The standards in 40 CFR Part 191 protect the population by imposing "containment requirements" that limit the cumulative amount of radioactive material released over 10,000 years. Reporting performance standards that will be required by EPA are expected to result in releases and associated health consequences in the range between 10 and 100 premature cancer deaths with an upper limit of 1,000 premature cancer deaths worldwide for a 100,000 metric tonne (MTHM) repository.

Nevertheless, despite all the uncertainty, some judgement as to the regulatory NEPA implications of these matters should be made, and it makes no sense to repeat the same judgement in every case. Even taking the uncertainties into account, the Commission concludes that these impacts are acceptable in that these impacts would not be sufficiently large to require the NEPA conclusion, for any plant, that the option of extended operation under 10 CFR Part 54 should be eliminated. Accordingly, while the Commission has not assigned a single level of significance for the impacts of spent fuel and high-level waste disposal, this issue is considered Category 1.

Category 1 Issues Applicable to Uranium Fuel Cycle and Solid Waste Management (ANO-1 Renewal Term)

No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. NRC proposes 25mrem/year individual dose from all pathways. The EPA, however, has proposed a dose of 15rem/year be applied to all pathways with a separate dose of 4rem/year from the groundwater pathway. The NCR's standard should have little impact on license extension. Therefore, Entergy Operations concludes that there are no offsite radiological impacts from disposal of spent fuel and high-level waste.

Nonradiological impacts of the uranium fuel cycle: Based on information in the GEIS, the Commission found that " The nonradiological impacts of the uranium fuel cycle resulting from the renewal of an operating license for any plant are found to be small."
No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Therefore, Entergy Operations concludes that there are no nonradiological impacts of the uranium fuel cycle during the renewal term beyond those discussed in the GEIS.

Low-level waste storage and disposal: Based on information in the GEIS, the Commission found that

> The comprehensive regulatory controls that are in place and the low public doses being achieved at reactors ensure that the radiological impacts to the environment will remain small during the term of a renewed license. The maximum additional onsite land that may be required for low-level waste storage during the term of a renewed license and associated impacts will be small. Nonradiological impacts on air and water will be negligible. The radiological and nonradiological environmental impacts of long-term disposal of low-level waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient low-level waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Disposal capacity for Class "A" waste will continue with the availability of the Envirocare Facility in Utah. Although disposal capacity for Class "B & C" waste is questionable with the potential close of the Barnwell Facility, the Envirocare Facility is proposing to expand its capabilities by submitting a Class "B & C" license application to the state of Utah. Therefore, Entergy Operations concludes that there are no impacts of low-level waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

Category 1 Issues Applicable to Uranium Fuel Cycle and Solid Waste Management (ANO-1 Renewal Term)

Mixed waste storage and disposal: Based on information in the GEIS, the Commission found that

> The comprehensive regulatory controls and the facilities and procedures that are in place ensure proper handling and storage, as well as negligible doses and exposure to toxic materials for the public and the environment at all plants. License renewal will not increase the small, continuing risk to human health and the environment posed by mixed waste at all plants. The radiological and nonradiological environmental impacts of long-term disposal of mixed waste from any individual plant at licensed sites are small. In addition, the Commission concludes that there is reasonable assurance that sufficient mixed waste disposal capacity will be made available when needed for facilities to be decommissioned consistent with NRC decommissioning requirements.

No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. There are no plans to change operational practices during the license renewal period that would alter the conclusions reached in the GEIS. Due to tight controls placed on chemical usage at the ANO, quantities of generated mixed waste have been almost non-existent, and if generated, would be shipped off-site within the allowed 90-days to avoid permitted storage requirements. ANO minimizes and properly manages mixed wastes in accordance with company and site procedures that will continue to exist during the license renewal term. Therefore, Entergy Operations concludes that there are no impacts of mixed waste storage and disposal associated with the renewal term beyond those discussed in the GEIS.

On-site spent fuel: Based on information in the GEIS, the Commission found that " The expected increase in volume of spent fuel from an additional 20 years of operation can be safely accommodated on site with small environmental effects through dry or pool storage at all plants if a permanent repository or monitored retrievable storage is not available." The onsite spent fuel impacts were determined to be SMALL. No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. ANO is already utilizing dry cask fuel storage. Environmental affects from this activity are confined onsite and have shown have no identifiable impacts. Although it is anticipated that an offsite disposal facility would become available in the future, ANO has sufficient on-site capacity to accommodate dry cask fuel storage during the license renewal period. Therefore, Entergy Operations concludes that there are no impacts of onsite spent fuel associated with license renewal beyond those discussed in the GEIS.

Category 1 Issues Applicable to Uranium Fuel Cycle and Solid Waste Management (ANO-1 Renewal Term)

Nonradiological waste: Based on information in the GEIS, the Commission found that " No changes to generating systems are anticipated for license renewal. Facilities and procedures are in place to ensure continued proper handling and disposal at all plants." The nonradiological waste impacts were determined to be SMALL. No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. There are no plans to change operational practices during the license renewal period that would alter the conclusions reached in the GEIS. ANO minimizes and properly manages nonradiological wastes in accordance with company and site procedures that will continue to exist during the license renewal term. Therefore, Entergy Operations concludes that there are no nonradiological waste impacts during the renewal term beyond those discussed in the GEIS.

Transportation: Based on information contained in the GEIS, the Commission found that

> The impacts of transporting spent fuel enriched up to 5 percent uranium-235 with average burnup for the peak rod to current levels approved by NRC up to 62,000 MWd/MTU and the cumulative impacts of transporting high-level waste to a single repository, such as Yucca Mountain, Nevada are found to be consistent with the impact values contained in 10 CFR 51.52(c), Summary Table S-4--Environmental Impact of Transportation of Fuel and Waste to and from One Light-Water-Cooled Nuclear Power Reactor. If fuel enrichment or burnup conditions are not met, the applicant must submit an assessment of the implications for the environmental impact values reported in §51.52.

The transportation impacts were determined to be SMALL if fuel enrichment and burnup conditions set forth in the Addendum 1 to the GEIS are met. ANO-1 meets the fuel enrichment and burnup conditions. No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Therefore, Entergy Operations concludes that there are no impacts of transportation associated with license renewal beyond those discussed in the GEIS.

Category 1 Issues Applicable to Decommissioning of ANO-1
(Following Renewal Term)

DECOMMISSIONING	
10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*
Radiation Doses	7.3.1 & 7.4
Waste Management	7.3.2 & 7.4
Air Quality	7.3.3 & 7.4
Water Quality	7.3.4 & 7.4
Ecological Resources	7.3.5 & 7.4
Socioeconomic Impacts	7.3 & 7.4

Entergy Operations identified no new and significant information associated with the renewal of the ANO-1 operating license during the review process of these issues. For all of the issues, the GEIS concluded that the impacts are SMALL, and plant-specific mitigation measures are not likely to be sufficiently beneficial to be warranted. A brief discussion for each of these issues is provided below.

Radiation doses: Based on information in the GEIS, the Commission found that "Doses to the public will be well below applicable regulatory standards regardless of which decommissioning method is used. Occupational doses would increase no more than 1 man-rem (0.01 person-SV) caused by buildup of long-lived radionuclides during the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Radiation doses would continue to be regulated by the NRC during the decommissioning period. In regard to public health protection, permissible exposure levels established by the NRC provide an ample margin of safety. ANO would be required to continue to meet these same levels established by the NRC during the decommissioning period. Therefore, Entergy Operations concludes that there are no radiation doses associated with decommissioning following license renewal beyond those discussed in the GEIS.

Category 1 Issues Applicable to Decommissioning of ANO-1
(Following Renewal Term)

Waste management: Based on information in the GEIS, the Commission found that "Decommissioning at the end of a 20-year license renewal period would generate no more solid wastes than at the end of the current license term. No increase in the quantities of Class C or greater than Class C wastes would be expected." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Extending ANO-1 operations by an additional twenty years would not increase decommissioning waste volumes, so the ratio of decommissioning waste volume to operating waste volume would be even lower. Although it is anticipated that the volume of Class "C" waste would not increase to any appreciable extent, the Envirocare facility in Utah is proposing to expand its capabilities by submitting a Class "B & C" license application to the state of Utah. Therefore, Entergy Operations concludes that there are no impacts of solid waste associated with decommissioning following the license renewal term beyond those discussed in the GEIS.

Air quality: Based on information in the GEIS, the Commission found that "Air quality impacts of decommissioning are expected to be negligible either at the end of the current operating term or at the end of the license renewal term." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Emission equipment currently in place for supporting ANO-1 operation (Air Permit 0090-AR-2) would be discontinued, thereby, decreasing overall site emissions. Air quality impacts from operation of motor vehicles during this period is expected to be small due to adequate pavement of roads on and near the ANO-1 site. Finally, decommissioning activities and associated potential of radioactive airborne release will continue to be regulated under NRC requirements. Therefore, Entergy Operations concludes that there are no impacts of license renewal on air quality during decommissioning beyond those discussed in the GEIS.

Water quality: Based on information in the GEIS, the Commission found that "The potential for significant water quality impacts from erosion or spills is no greater whether decommissioning occurs after a 20-year license renewal period or after the original 40-year operation period, and measures are readily available to avoid such impacts." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Since the ANO workforce during the decommissioning period is expected to be considerably less than that of the operational period, there will be no increased demand on the ANO sanitary sewer operations. In addition, ANO will continue to be subject to State imposed erosion and spill prevention management practices during this period. Therefore, Entergy Operations concludes that there are no impacts of the license renewal term on water quality during decommissioning beyond those discussed in the GEIS.

Category 1 Issues Applicable to Decommissioning of ANO-1
(Following Renewal Term)

Ecological resources: Based on information in the GEIS, the Commission found that "Decommissioning after either the initial operating period or after a 20-year license renewal period is not expected to have any direct ecological impacts." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. With the exception of the sanitary sewer operations, wastewater discharges associated with ANO-1 would cease. In addition, it is anticipated that the establishment of any temporary storage areas would occur on property already disturbed. Therefore, Entergy Operations concludes that there are no impacts of the license renewal term on ecological resources during decommissioning beyond those discussed in the GEIS.

Category 1 Issues Applicable to Decommissioning of ANO-1
(Following Renewal Term)

Socioeconomic Impacts: Based on information in the GEIS, the Commission found that "Decommissioning would have some short-term socioeconomic impacts. The impacts would not be increased by delaying decommissioning until the end of a 20-year relicense period, but they might be decreased by population and economic growth." No new and significant information was identified during site and independent reviews of the ANO-1 Environmental Report, or evaluation of other available information. Since the ANO workforce during the decommissioning period is expected to be considerably less than that of the operational period, no increased socioeconomic demands should occur. Although a lesser workforce could potentially impact the local economy, these impacts would be essentially similar whether that action was taken in year 60 or in year 40. Therefore, Entergy Operations concludes that there are no impacts from license renewal on the socioeconomic impacts of decommissioning beyond those discussed in the GEIS.

Category 1 Issues Not Applicable to ANO-1

10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*	*Comment*
SURFACE-WATER QUALITY, HYDROLOGY AND USE (FOR ALL PLANTS)		
Altered salinity gradients	4.2.1.2.2 & 4.4.2.2	ANO-1 cooling system does not discharge to an estuary. Lake Dardanelle is fresh-water.
AQUATIC ECOLOGY (FOR PLANTS WITH COOLING-TOWER-BASED HEAT DISSIPATION SYSTEMS)		
Entrainment of fish and shellfish in early life stages	4.3.3	This issue is related to heat-dissipation systems that are not installed at ANO-1.
Impingement of fish and shellfish	4.3.3	This issue is related to heat-dissipation systems that are not installed at ANO-1.
Heat shock	4.3.3	This issue is related to heat-dissipation systems that are not installed at ANO-1.
GROUNDWATER USE AND QUALITY		
Groundwater use conflicts (potable and service water; plants that use <100 gpm)	4.8.1.1	ANO has no operable onsite groundwater wells. Potable water supplied by City of Russellville and service water withdrawn from Lake Dardanelle.
Groundwater quality degradation (Ranney wells)	4.8.2.2	ANO does not have or use Ranney wells.
Groundwater quality degradation (saltwater intrusion)	4.8.2.1	ANO is located on Lake Dardanelle, a freshwater lake.
Groundwater quality degradation (cooling ponds in salt marshes)	4.8.3	This issue is related to a heat-dissipation system that is not installed at ANO-1.

Category 1 Issues Not Applicable to ANO-1

10CFR51, Subpart A, Appendix B, Table B-1 Issue	*GEIS Sections*	*Comment*
TERRESTRIAL RESOURCES		
Cooling tower impacts on crops & ornamental vegetation	4.3.4	This issue is related to a heat-dissipation system that is not installed at ANO-1.
Cooling tower impacts on native plants	4.3.5.1	This issue is related to a heat-dissipation system that is not installed at ANO-1.
Bird collisions with cooling towers	4.3.5.2	This issue is related to a heat-dissipation system that is not installed at ANO-1.
Cooling pond impacts on terrestrial resources	4.4.4	This issue is related to a heat-dissipation system that is not installed at ANO-1.

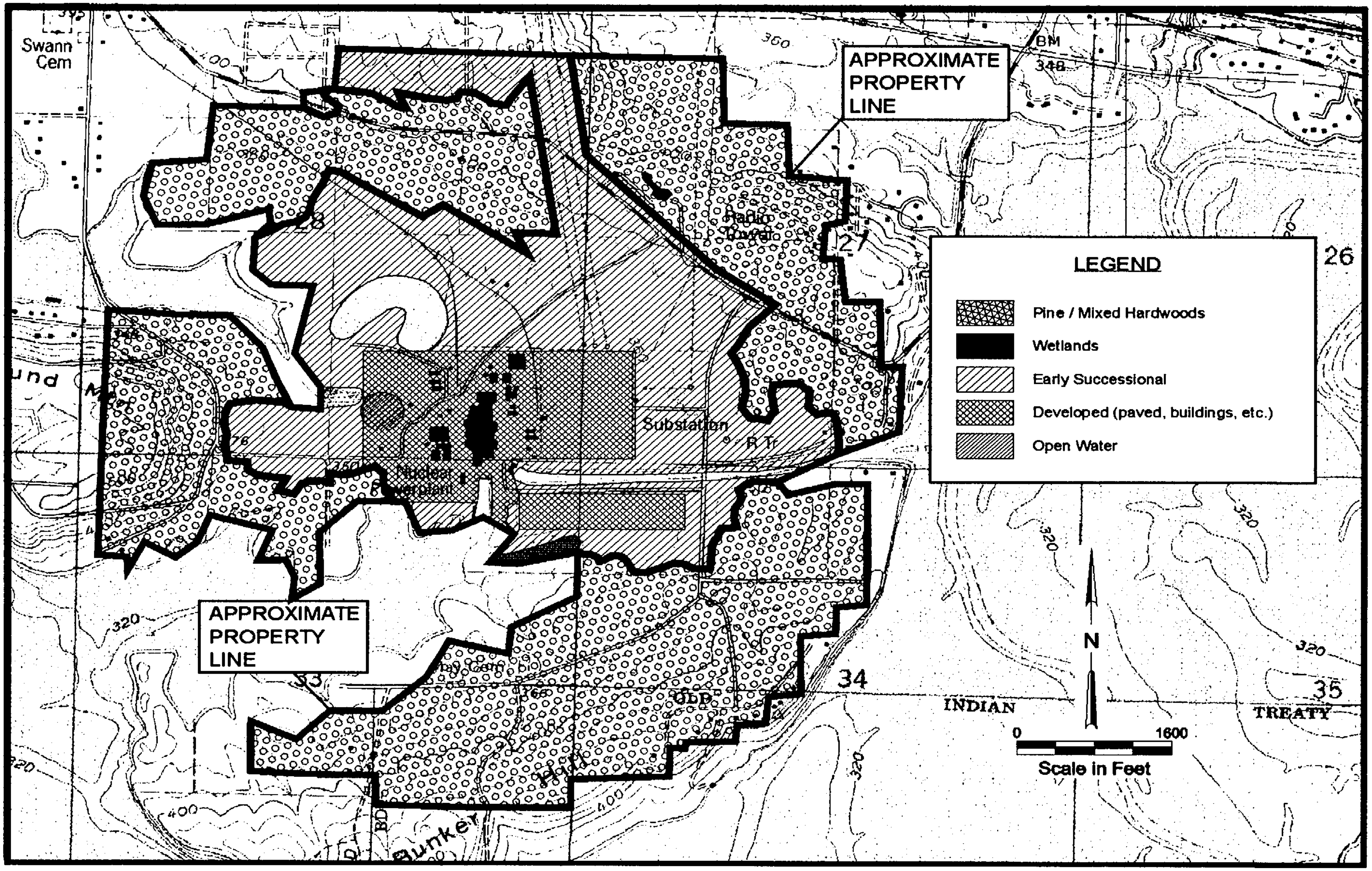
Terrestrial and Aquatic Ecology

1. Reference Table 2.1-1 and Figure 2.1-2. Discuss apparent discrepancy between the table and figure. The figure shows "water" as both black (in the legend) and gray (the reservoir in the map itself), and does not show wetlands. According to the footnote in the table, buildings, graveled areas, and parking lots would all be classed as "early successional" habitat in the figure. They cannot be so classified.

   Response: The discrepancy was the result of using different methods for characterizing major land cover types. The ANO site map (Figure 2.1-2) was revised to illustrate these land cover types at a level of detail similar to information shown in the revised Table 2.1-1. Revisions to this table and figure are attached.

Table 2.1-1. ANO Land Cover Classification Areas

Land Cover Classes	Land Cover Class Acres	Land Cover Class Percentage
Pine/Mixed Hardwoods	461	39.6%
Early Successional Communities	485	41.6%
Developed (paved, buildings, etc.)	180	15.4%
Open Water	30	3.0%
Wetlands	5	0.4%
TOTAL LAND AREA	1,164	100.%



APPROXIMATE PROPERTY LINE
APPROXIMATE PROPERTY LINE
LEGEND
Pine / Mixed Hardwoods
Wetlands
Early Successional
Developed (paved, buildings, etc.)
Open Water
Substation
Radio Tower
Nuclear Powerplant
Swann Cem
N
0
1600
Scale in Feet
INDIAN
TREATY
OLD
Bunker
Hill
26
27
28
33
34
35

Terrestrial and Aquatic Ecology

2. Reference Sections 2.1 and 2.3. Provide a map delineating the transmission line corridors associated with license renewal. Habitats and topography within the rights-of-way should be identified on the map. Discuss management practices for vegetation and erosion control.

   Response: A color index map that shows the general location of the two 500 kV and two 161 kV transmission lines associated with ANO-1 is attached. Also attached are 7.5-minute topographic quadrangle maps for each of the three transmission line routes.

   Vegetation control on Entergy transmission line right-of-ways is maintained by mechanical and chemical methods. Grass covered areas are not re-cleared. Woody vegetation, however, is removed from the right-of-ways on a four-year cycle using mechanical means. Some hand-clearing and herbicide applications are used for spot treatments on areas where mechanically clearing is not feasible. Entergy's use of herbicides is restricted according to the purposes and methods outlined in the manufacturer's product label.

Terrestrial and Aquatic Ecology

3. Reference Section 2.2, Page 2-6. Provide reference for the comment that Lake Dardanelle is "....suitable for propagation of fish/wildlife".

   Response: According to the Arkansas Department of Environmental Quality (ADEQ) 1998 Water Quality Inventory Report (page A-143), the designated uses for Lake Dardanelle include primary and secondary contact recreation, domestic, industrial, and agricultural water supply; and propogation of fish/wildlife. According to this report and the ADEQ 1998 Water Quality Limited Waterbodies - 303(d) List, Lake Dardanelle is currently supporting all designated uses.

Terrestrial and Aquatic Ecology

4. Reference Section 2.3, Page 2-8. Provide a reference that compares the screen mesh and approach velocities at the screens to current U.S. Fish and Wildlife and State of Arkansas criteria for fish protection facilities.

   Response: The screen mesh size of the traveling screens installed at ANO-1 is 3/8-inch mesh. The maximum water velocity measured at the traveling screens is 2.2 fps. The U.S. Fish and Wildlife Service (USFWS) regional office in Atlanta, Georgia and the USFWS district offices in Conway, Arkansas and Little Rock, Arkansas were contacted for information regarding specific fish protection criteria. State of Arkansas environmental resource agencies were also contacted. No specific standards or criteria regarding screen mesh size or approach velocities were identified. A summary of efforts to locate this information is provided in the attached Client Contact Reports.

Project/Client:	ANO Entergy	**Date/Time:**	03/15/00, 1100
Topic:	ANO Environmental Impact/Water	**Phone:**	501-223-6371
Contact:	April Layher, Fisheries Biologist	**By:**	Phoned by LCL
Firm:	Arkansas Game and Fish Commission	**Date:**	03/30/00, 1047
Address:		**Referral:**	
City State Zip:	Little Rock		

Remarks:

Contacted and responded by phone. Indicated that there were no known AGFC criteria or regulations pertaining to intake structure screen mesh size or approach velocity.

	Routing	**Reviewed**	**Comments/Action**
1	BMW	DW	
2			
3			
4			
5			

Disposition: ☐ **Discard** ☐ **File** 6045-061/6045-070 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

Project/Client:	ANO Entergy	**Date/Time:**	03/15/00, 900
Topic:	ANO Environmental Impact/Water	**Phone:**	501-682-0656
Contact:	Chuck Bennett, Chief Water Division	**By:**	Phoned by LCL
Firm:	Arkansas Dept. of Env. Quality	**Date:**	03/30/00, 1043
Address:		**Referral:**	
City State Zip:	Little Rock		

Remarks:

Contacted and responded by phone. Indicated that there were no known DEQ criteria pertaining to impingement by ANO. He only knew of NPDES permits, reports, and requirements on discharge of water and storm water. He was unaware of any regulations or standards for intake structure screen mesh size of approach velocities. The NPDES permit only regulates and monitors the discharge quantity and water quality.

	Routing	**Reviewed**	**Comments/Action**
1	BMW	JTS	
2			
3			
4			
5			

Disposition: ☐ **Discard** ☐ **File** 6045-061/6045-070 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

Project/Client:	ANO Entergy	Date/Time:	03/15/00, 930
Topic:	ANO Environmental Impact/Water	Phone:	501-682-3966
Contact:	Mike Guess, Water Use Specialist	By:	Phoned by LCL
Firm:	AR State Soil and Water Consv.	Date:	03/30/00, 1046
Address:		Referral:	
City State Zip:	Little Rock		

Remarks:

Contacted and responded by phone. Indicated that there were no known ASSWCC criteria or regulations pertaining to water intake structures, screen mesh, or approach velocities.

	Routing	Reviewed	Comments/Action
1	BMW	DWS	
2			
3			
4			
5			

Disposition: ☐ **Discard** ☐ **File** 6045-061/6045-070 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

Project/Client:	ANO Entergy	**Date/Time:**	03/15/00, 100
Topic:	ANO Environmental Impact/Water	**Phone:**	501-513-4470
Contact:	Marge Harney, Biologist	**By:**	Phoned by LCL
Firm:	US Fish and Wildlife Service	**Date:**	03/30/00, 1048
Address:		**Referral:**	
City State Zip:	Conway		

Remarks:

Contacted and responded by phone. Indicated that there were no known USFWS reports, criteria, or regulations pertaining to impacts on fisheries and wildlife by ANO. Mr. Lyons indicated that there were no known regulations or standards on intake screen mesh or approach velocities. Mrs. Harney added that she would research the matter further and contact me if she descovered any information on this matter.

	Routing	Reviewed	Comments/Action
1	BMW	SJS	
2			
3			
4			
5			

Disposition: ☐ **Discard** ☐ **File** 6045-061/6045-070 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

Project/Client:	ANO Entergy	**Date/Time:**	03/23/00, 200
Topic:	ANO Environmental Impact/Water	**Phone:**	501-513-4470
Contact:	Alan Robinson, Regional Env.	**By:**	Phoned by LCL
Firm:	US Fish and Wildlife Service	**Date:**	03/30/00, 1040
Address:		**Referral:**	
City State Zip:	Atlanta		

Remarks:

Contacted and responded by phone. Indicated that there were no known standards for water intakes, impingement, screen mesh size, approach velocities, or screen velocities set by USFWS. He further indicated that there were no known USFWS reports, criteria, or regulations pertaining to impacts on fisheries, wildlife, commercial fisheries, or recreational fisheries and wildlife by ANO, unless there had been some from when the project was being considered and constructed. He indicated that the Conway office should know if there are any current criteria or actions at this time. I informed him of my having contacted the Conway office and he believed that their answer was correct in saying that there were no and are no USFWS standards, criteria, regulations, permits, or reports concerning fish impingement, flow velocities, or screen mesh size at ANO.

	Routing	**Reviewed**	**Comments/Action**
1	BMW	SW	
2			
3			
4			
5			

Disposition: ☐ **Discard** ☐ **File** 6045-061 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**__________

CLIENT CONTACT REPORT

Project/Client:	Entergy Operations/ANO-1 Relicensing	**Date/Time:**	04/03/00, 1147
Topic:	Intake screen mesh size and approach	**Phone:**	
Contact:	Mr. Ben Rizzo	**By:**	bmw
Firm:	US Fish & Wildlife Serivice	**Date:**	04/03/00, 1147
Address:		**Referral:**	
City State Zip:			

Remarks:

Called Ms. Cindy Bohn (USFWS Regional Office in Atlanta, 404-679-7122) regarding any criteria related to intake structure screen mesh size and approach velocities. Ms. Bohn indicated that her office was not aware of any specific criteria. It was her understanding that if any such criteria were used by USFWS, they would apply to new facilities. If no significant impingment problem was occuring at an existing facility, specific criteria would not likely be applicable.Ms. Bohn called back and suggested that we call Mr. Ben Rizzo, a Fishway Engineer, with the USFWS Enginnering Field Office in Newton, MA (617-244-1368).

Mr. Rizzo indicated that he had worked extensively with power plant and hydro intake issues in the Northeast. Best Available Technology (at the time of construction) is generally evaluated by his office.His office tended to use (for internal purposes) an approach velocity of 2.0 fps as an indicator. Velocities above this value would receive close attention from his office. He said the USFWS has not published or promulgated any specific criteria, rules, or guidance on the issue. All power plants and the local environments tend to be unique and each is addressed on a case-by-case basis. Also, intake screens at plants he was familiar with had sizes from 1/8-inch (wedge wire) to 3/8-inch (woven wire). Mr. Rizzo noted that for existing facilities, particularly those with no significant impingment problems, his office wouldn't be concerned if the facility used BAT at the time it was constructed and, regardless of the approach velocity, if no significant impingment or entrainment problems were occuring with recreational, commercial, or ecologically sensitive species.

	Routing	Reviewed	Comments/Action
1	LCL		
2			
3			
4			
5			

Disposition: ☐ **Discard** ☐ **File** 6045-061 Entergy Operations/ANO-1

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

Terrestrial and Aquatic Ecology

5. Reference Section 4.6.5.1. Discuss threatened or endangered (T&E) species potentially in the vicinity of the transmission line corridors. Provide additional discussions on T&E species that may occur in the northwest portion of Arkansas, especially the American Burying Beetle, the least tern and the gray myotis.

   Response: A discussion of T&E species potentially in the vicinity of the transmission line corridors and additional information on the three species that may occur in northwest Arkansas is shown below.

   The September 29, 2000 letter from Ms. Cindy Osborne, Arkansas Natural Heritage Commission, to Dr. Gary Tucker addresses potential element occurrence issues regarding transmission line corridors. Ms. Osborne's letter indicates a potential for occurrence of three sensitive species: a mock orange (*Philadelphus hirsutus*), Ozark chinquapin (*Castanea pumila* var. *ozarkensis*), and Bachman's sparrow (*Aimophila aestivalis*). These species are not listed at either state or federal levels, and if they were to occur within the transmission line corridors, there is absolutely no indication that their continued viability would be affected in any way. The facts are that known localities of Arkansas populations for each of these three species are relatively numerous and none of the species represents anything approaching "threatened" or "endangered" status in the State. The mock orange is found on blufflines and rocky woods, and blufflines in uplands of north-central Arkansas, where it is known from an area of at least 10 counties. Ozark chinquapin occurs throughout most of the Ozark and Ouachita regions, where it occurs primarily in the dominant oak-hickory forest type. Ozark chinquapin has been heavily impacted in Arkansas by chestnut blight since the 1940s, which accounts for biologists' interest in the species. Bachman's sparrow occurs primarily in southern Arkansas, but local populations extend north into the Arkansas River Valley and lower foothills of the Ozark region. None of these species is regulated under the Endangered Species Act or State regulation.

   Ms. Osborne's letter also makes reference to an interest in three areas having aquatic features: Illinois Bayou, Cadron Creek, and Goose Pond Natural Area. Illinois Bayou and Cadron Creek are each classified as "Extraordinary Resource Waters" by Arkansas Department of Environmental

Quality. This status provides severe limitations on new impacts to these waters, but the presence of existing transmission line corridors across the streams does not appear to represent an issue of concern. Any required maintenance associated with these corridors should not impact streams that would be of water quality concern. Goose Pond Natural Area is a State-owned property, where Entergy's ANO-2 500 kv transmission line corridor passes through one corner of it. Again, there probably should be no potential problems with maintenance of the existing line (although requests for additional corridors or a wider corridor would probably have a high likelihood for denial).

American burying beetle

American burying beetle (ABB) (*Nicrophorus americanus*) once occurred throughout much of Arkansas. At the present time, however, populations are known to persist in a five-county area in west-central Arkansas. Since September 4, 1992, the U.S. Forest Service has conducted surveys for the species on an annual basis throughout its massive land holdings of approximately 2.5 million acres, both north and south of the Arkansas River in western Arkansas. In addition, the U.S. Army has sponsored extensive survey activities at the approximately 71,000-acre land holdings of its Fort Chaffee in west-central Arkansas since ABB was first trapped there in 1992. These various surveys have indicated the occurrence of remnant populations in several counties in the vicinity of Fort Smith, Arkansas. To date, surveys have not revealed the presence of ABB at any location north of the Arkansas River, although it has been found in abundance at Fort Chaffee, and in a few localities on the Ouachita National Forest (ONF).

ANO facilities and transmission lines are not located within a five-county area (i.e., Crawford, Sebastian, Scott, Franklin, and Logan) for which U.S. Fish and Wildlife Service (FWS) has required ABB trapping surveys for projects
involving ground disturbing activities in past years. Moreover, within the past two years, FWS has taken a much more lenient attitude regarding ABB. FTN Associates, Ltd. has conducted numerous projects in the Fort Smith area within the past three years, and FWS did not require field surveys for any of the projects, despite the fact that all were located in areas where the ABB previously had been considered a species of concern. Coordination with Ms.

Marge Harney, Coordinator of Arkansas projects involving T&E species issues, has told FTN on more than one occasion in recent years that FWS wants to back off requiring field surveys wherever possible. She indicated that all linear projects, i.e., roads, underground utility lines, aboveground transmission lines, etc., had been taken out of consideration for field surveys. She said that the FWS may rarely suggest that a project proponent apply bait outside the area proposed for ground disturbing activities, but has no interest in trapping and relocation of ABB. FWS personnel have indicated in off the record conversations that ABB populations appear to be stable in western Arkansas and eastern Oklahoma, and that the species does not merit heroic efforts under the Endangered Species Act. There is a Recovery Plan for the species, however, and until its requirements have been met, the species probably will not be delisted. FWS will probably continue its relaxed attitude toward ABB in the interest of directing agency resources toward species that appear to be exhibit population levels of a more critical nature.

Ms. Susan Hooks, T&E Species Coordinator on ONF, provided information on the ABB in a phone conversation with Dr. Gary E. Tucker on March 16, 2000. Ms. Hooks confirmed that the closest location for a population of ABB with respect to ANO and its transmission lines is located in Logan County on the ONF's Cold Springs District, which is well outside the 10-mile radius.

Gray Bat

The gray bat (*Myotis grisescens*) is a bat that inhabits caves throughout the year. Most gray bats migrate seasonally between caves used for winter hibernation and caves used for rearing of young in summer. In Arkansas, the gray bat has been reported primarily in the Ozark Mountain region of northwestern and north-central Arkansas, where solution caves are numerous. It is estimated that 95% of the US population of gray bat hibernates in only eight caves: two in Tennessee, three in Missouri, and one each in Kentucky, Alabama, and Arkansas. The Arkansas hibernation cave typically houses approximately 15% of the total gray bat population. Because of the species' exacting microhabitat requirements, it is said that fewer than 5% of available caves are suitable for gray bat habitation (Harvey, 1986).

Nelson et al. (1991) reported the occurrence of gray bat in a sandstone fracture cave located on Norristown Mountain, *i.e.*, on the east bank of Arkansas River at a point just upstream from Dardanelle Lock and Dam. This report apparently represents a first record for a locality that is substantially outside the geographic area recognized as range for the species in Arkansas by Harvey (1986). The cave on Norristown Mountain is relatively small and difficult to access. While the locality is within a 10-mile radius of ANO facilities and transmission lines, there would be no proposed activities under relicensing that would impact the gray bat.

Interior least tern

The Interior Least Tern represents a species that is for the most part an uncommon but irregular transient in all regions of Arkansas (James and Neal 1986). Local summer breeding also occurs, however, on a few sandbars on the Arkansas and Mississippi Rivers. Habitat preferences for nesting on sandbars are exacting, *i.e.*, the sandbar must have very limited vegetation cover and well protected from both predator access and high water levels during the nest season. The U.S. Army Corps of Engineers (Corps) coordinates an annual survey for Interior Least Tern nesting colonies on the Arkansas River that involves cooperation with the Arkansas Game and Fish Commission and Arkansas Natural Heritage Commission (ANHC). Ms. Cindy Osborne, ANHC Database Manager, examined the ANHC database element occurrence records on March 16, 2000. She determined that the closest nest sites are located on USGS topographic quadrangle maps at Atkins, Arkansas and Clarksville, Arkansas (7.5 minute series). Neither location falls within the 10-mile radius of ANO.

Relicensing conditions would involve neither a change in water levels on the Arkansas River nor sandbar habitat disturbance. Consequently, there would be no affect on Interior Least Tern.

Terrestrial and Aquatic Ecology

6. Reference Section 4.6.5.2, Page 4-30. Discuss the Client Contact Report and justification for not conducting an on-the-ground survey for Arkansas State-listed species at the plant and transmission corridors.

   Response: The justification for not conducting an on-the-ground survey for Arkansas State-listed species relates to the fact that State-listed species (1) consist only of plant species, (2) the list of plant species was compiled by the Arkansas Natural Heritage Commission years ago for the stated purpose of qualifying for federal grant dollars, (3) the list of "State-Listed Plant Species" has never been updated in light of new field data, and according to ANHC personnel, there are no plans for its revision, (4) the list includes a number of species that could not be considered to be "threatened" or "endangered" in light of current knowledge, and (4) the list has absolutely no regulatory relationship. The Arkansas Game and Fish Commission has legal authority to compile a list of "State-Listed Animal Species" but has not compiled such a list and for that reason, there is no state list for animal species.

   ANHC presently tracks occurrences of a total of 443 plant species [see attached "State Inventory List – Plants"]. These 443 species represent a mixed lot and are tracked for a number of reasons: some are endemic to a local area, some are restricted to localized habitats, some represent organisms that are rare because of the effects of disease, some are federally-listed as either threatened or endangered, but most are tracked because they occur in Arkansas as peripherals, i.e., they are at the margin of their geographic range, and collections have been too few to accurately assess their degree of rarity in Arkansas. For these reasons, one must consider these 443 species on an individual basis in assessing their individual significance at any particular location. In most cases, the State rank, i.e., S1, S2, etc., is of much greater importance for individual species than the State status, i.e., "State Threatened" or "State Endangered".

   In the case of ANO and its surrounding area, the potential for occurrence of plant species that are truly "rare" is extremely limited. Moreover, the potential for occurrence of unusual habitat or community types is equally limited. Prior to construction of ANO, the entire facility site and surrounding tracts largely represented an area of small farms that consisted of farm land or otherwise cleared areas, in addition to forested areas that had been repeatedly impacted by timber harvest, fire, or other factors of disturbance.

Terrestrial and Aquatic Ecology

7. Section 4.19. Discuss the process for identifying and tracking data for new and significant information, especially for Category 1 issues.

   Response: See attached "White Paper" for ANO's in-house process used for identifying new and significant information.

ENTERGY OPERATIONS INCORPORATED PROCESS

FOR EVALUATING NEW AND SIGNIFICANT INFORMATION

A. Description of Process

Entergy Operations, Incorporated (EOI) in-house process ensured that new and significant information regarding environmental issues, as it relates to Arkansas Nuclear One – Unit 1 (ANO-1), was properly reviewed prior to submittal of the Environmental Report (ER). This process ensured that new and significant environmental information related to renewal of the ANO-1 license was identified, reviewed and addressed.

1. Review of Environmental Issues Prior to ER Submittal

EOI assembled a qualified investigative team from ANO and corporate headquarters to provide support in preparing the ANO-1 license renewal environmental report. These individuals formed a group knowledgeable about plant systems, the site environment, and plant environmental issues. In addition, ANO contracted with an environmental consulting firm with expertise in the National Environmental Policy Act and the scientific disciplines involved in preparing a license renewal environmental report. The strong combination of ANO and non-ANO multidisciplinary personnel ensured that the team was well qualified to identify new and significant information.

A review was performed of environmental issues applicable to license renewal at ANO-1. This review was performed on the Category 1 issues appearing in 10CFR51, Subpart A, Appendix B, Table B-1 to verify that the conclusions of the Generic Environmental Impact Statement (GEIS) remained valid with respect to ANO-1. During this phase, the following type documents were reviewed:

- Site environmental permits.
- Site environmental documents and reports (including routine monitoring), prepared by EOI.
- Environmental documents and reports prepared by regulatory agencies and academic institutions.

The level of review conducted on the Category 1 Issues was as follows:

- Corporate headquarters identified the Category 1 Issues applicable to ANO-1 and performed an initial documented review.

- Corporate headquarters and ANO station personnel performed a secondary review of the Category 1 Issues.
- Environmental consulting firm performed an independent review of the Category 1 Issues.
- Corporate headquarters and ANO personnel, and environmental consulting firm evaluated reviews of Category 1 Issues for new and significant information.

As a result of this review, EOI is not aware of any new and significant environmental information associated with the renewal of the ANO-1 operating license.

B. Identification and resolution of Environmental Issues

This section describes the process by which environmental issues are identified at EOI's nuclear plants. This section also describes the processes used to track the resolution of environmental issues affecting ANO.

1. Identification of Environmental Issues at the Corporate Level

EOI's Nuclear Management Manual (NMM) Procedures and Site Directives describe environmental policies, practices and standards. The purpose of this manual and directives is to ensure compliance with environmental regulations by promoting consistency of interpretation, implementation, and communications. Specifically, the NMM describes the interface between the Environmental Peer Group, EOI nuclear stations, EOI's Corporate Nuclear Support Group, and other organizations (see EOI Nuclear Management Manual Policy PL-101, Entergy Operations Organization). Both the NMM and Site Directives ensure that EOI station managers are made aware of changes in regulations by requiring all revisions to be reviewed by affected managers.

Environmental issues at the nuclear facilities are identified by the EOI Corporate Nuclear Support Group and are evaluated further by the Environmental Peer Group. This group consists of technical personnel involved in environmental compliance, environmental monitoring, environmental planning, natural resource management, and health and safety issues. This group is also involved in the development and review of regulations. In addition, the Nuclear Support Group serves as the interface between the regulatory agencies and the EOI site environmental organizations, when requested.

2. **Assessment of Environmental Issues at the Peer Group Level**

EOI's Environmental Peer Group consists of environmental representatives from the Corporate Nuclear Support Group, Arkansas Nuclear One, Grand Gulf Nuclear Station, River Bend Station and Waterford 3, and a member from the EOI executive management team. When new regulatory requirements are identified at the Corporate Nuclear Support Group level, these requirements are summarized and presented to the Environmental Peer Group for evaluation. The Peer Group evaluates new requirements as it applies to their respective site and develops strategies to implement, as appropriate. If a new requirement applies to a site, then an action item is assigned to the site. Action items are documented in the quarterly meeting minutes and are reviewed by the Peer Group each meeting until the item is closed.

3. **ANO Site Chemistry**

ANO Site Chemistry has primary responsibility for ensuring compliance with environmental regulations and for enhancement of the systems related to environmental issues. In addition, this group is responsible for:

- Providing environmental support and direction to site groups/individuals for implementing and maintaining compliance/ enhancements within their areas.

- Making first line supervision aware of the appropriate environmental training needed for site personnel.

- Providing regulatory interpretations to site groups to enable them to effectively carry out environmental processes.

- Actively seeking ways to minimize environmental impacts through minimization of wastes generated at ANO.

Finally, they review changes to plant system processes, procedures, or plant equipment prior to being implemented, to determine if there are environmental related impacts from these proposed changes (see EOI Nuclear Management Manual Policy LI-101, 10CFR50.59 Review Program).

4. **EOI Environmental Peer Group Meetings**

The EOI Environmental Peer Group participates as a team to provide consistent work practices, to improve environmental performance, and to reduce costs. This group meets quarterly and maintains meeting minutes and an action item list. Peer group activities are controlled through EOI's Nuclear Management Manual (see EOI Nuclear Management Manual Policy PL-109, Peer Group Concept). The scope of review by this group covers all environmental and associated services, systems, processes, products and personnel at nuclear sites and within support organizations. This process also helps ensure that items affecting individual plants are brought to the attention of the environmental managers at other EOI plants.

In summary, the Environmental Peer Group is responsible for:

- Sharing environmental information on emerging issues or problems.

- Ensuring that the EOI sites are complying with existing regulatory requirements.

- Assessing impact of new regulatory requirements and developing compliance strategies at the site level.

- Ensuring that each site has measures in place to assure compliance with regulatory requirements.

- Periodic review and evaluation of existing site environmental programs.

5. Environmental Practices at ANO

Several years ago, an Environmental Peer Group was established within EOI to focus on environmental regulatory compliance issues, broad environmental policy direction, and initiatives to minimize plant impact on the environment. The Environmental Peer Group, along with ANO Site Chemistry, provides assurance that:

- Environmental issues at ANO are addressed in the appropriate time frame.

- Emerging environmental issues are identified in a timely manner and given the appropriate priority.

- Resources are assigned to the environmental issues that add the greatest value to sustaining the environment and achieving compliance, and are the most cost-effective, consistent with ANO operational goals.

6. **EOI Companywide and Site Environmental Procedures**

EOI companywide and site environmental procedures provide guidance to the site on how environmental processes are to be implemented. These procedures provide the guidance and direction that enable the site to comply with federal, state, and local regulations. The EOI Environmental Peer Group and ANO Site Chemistry develop procedures, with input from the work groups responsible for implementation of the work practice.

7. **Problem Investigation Process**

The operation, maintenance, and modification of a nuclear station may result in problems where equipment, process and/or personnel do not perform as expected, unexpected changes occur, or conditions are identified that are inconsistent with requirements or regulations. ANO Procedure 1000.104, Condition Reporting and Corrective Actions is a process by which problems are identified, documented, and responded to with a level of effort and timeliness commensurate with their significance. In addition to tracking the resolution of events, the process is used as a predictive tool to help prevent future problems that may lead to environmental incidents.

8. **EOI Nuclear Management Manual and Site Directives**

The EOI Nuclear Management Manual and specific Site Directives provide direction and requirements on various policy matters concerning operation and maintenance of EOI's nuclear plants. The NMM and Site Directives:

- Provide minimum requirements to promote consistency among the nuclear sites and the corporate office in fulfilling licensing and administrative requirements.

- Address the company's position on issues as they arise in the nuclear industry or as EOI experience indicates the need for a more definitive policy statement.

- Provide instructions and minimum requirements for the implementation of various work activities.

ANO Management Manual Procedure A4.701, Environmental Permits and Plans and Entergy's Environmental Policy outlines ANO's commitment and philosophy to comply with environmental regulatory requirements. In addition, they emphasize EOI's responsibility to support and comply with activities involving the environmental permits and plans at ANO.

Terrestrial and Aquatic Ecology

8. Section 4.10. Discuss the recreational fishery near ANO. Provide appropriate references for recreational activities related to fish and wildlife.

Response: In many ways the plant may be considered beneficial to fisheries and wildlife, as well as to the recreational pursuits of game species. ANO policy and regulations prevent weapons, and therefore hunting on the facility property. Thus, many wildlife species may benefit by using this area as a sanctuary (Pers. com. Charlie Adams). The site provides a number of diverse habitats such as fields, hardwood stands, conifer stands, and wetlands. As a result, there is numerous transitional areas or edge that results in a high quality of habitat for species diversity.

The cooling water intake canal provides habitat for numerous species of fish at critical times of the year. During warm months, the intake flow mixes warm less oxygenated surface water with cool more highly oxygenated Illinois Bayou channel water to provide a potentially more suitable and more highly productive habitat within the canal. This could lead to increased sizes and densities of aquatic species such as mussels, benthic invertebrates, striped bass, white bass, largemouth, channel catfish, and blue catfish within the reservoir and increased recreational opportunities within the vicinity of the canal, as well as throughout the reservoir (Limbird, Adams).

The heated effluent has an almost inverse effect by providing a potentially more suitable habitat for numerous species of aquatic life during cooler months. Numerous species of fish and waterfowl utilize the warm water effluent to survive cold water conditions and as an excellent habitat for increased productivity and reproduction (Pers. Comm. Adams, Limbird). As a result, many predator species such as pelicans, gulls, cormorants, eagles, otter, and turtles take full advantage of the high densities of shad, coots, and ducks. Most of the effluent canal is off limits to boating, thereby creating a bank fishing only condition. Anglers may fish this section of the canal without competition and disturbance by boat anglers. Boating anglers may access the remainder of the effluent canal by using either the gravel boat ramp on the south side of the effluent bay or, can motor into the canal from the reservoir.

Terrestrial and Aquatic Ecology

A small inundated wetland south of the effluent bay provides excellent habitat for numerous mammals, fish, reptiles, amphibians, and waterfowl (Pers. Comm. Adams, Limbird). Additionally, it serves as a wildlife sanctuary from hunting for numerous species of waterfowl such as ducks and geese, and from trapping for mammals such as beaver and raccoon. ANO policies and regulations prohibit vehicle access, hunting, and overall disturbance of this area.

Anglers travel from all over the nation to fish Lake Dardanelle, many of which will fish in the vicinity of ANO (Brown, Limbird). Bird watchers have been observed on site and around the site taking pictures and enjoying the many avian visitors. Hunters, trappers, and commercial fisherman frequent the perimeter of the facility to take advantage of the high densities and diversity of wildlife and fish moving in and out of the facility's sanctuary. For these reasons, many people visit the ANO area on a regular basis.

For a list of parks operated by the Corps of Engineers and the State of Arkansas near the ANO site, see attached brochure.

Project/Client:	ANO Entergy	**Date/Time:**	03/14/00, 200
Topic:	ANO Environmental Impact/Water	**Phone:**	(501) 858-5485
Contact:	Charlie Adams, ANO Biologist	**By:**	Phoned by LCL
Firm:	ANO/Entergy	**Date:**	03/30/00, 1601
Address:		**Referral:**	
City State Zip:	Russellville		

Remarks:

Contacted and responded by phone. I discussed with Mr. Adams the recreational and commercial hunting and fishing in relation to the plant. We also discussed the potential fisheries and wildlife benefits and impacts in relation to the plant. He indicated that there was no hunting or trapping allowed on the premises, however numerous hunters and trappers had been observed around the perimeter. We discussed the possibility that the ANO property served as a sanctuary for numerous fowl, waterfowl, deer, and furbearers. We discussed our both having seen numerous species of wildlife in the terrestrial environment and in the small wetland south of the plant such as deer, turkey, ducks, geese, beaver, raccoon, and numerous birds. He further indicated that many waterfowl were present during migratory periods and especially during extreme cold weather. Many of the birds and fish within the lake appear to utilize the warm effluent bay water when icing or cold-stressing conditions are occurring. As a result many hunters and fishermen, both recreational and commercial, fish or hunt in the vicinity of the plant as fish and wildlife move on and off of the property. Fishing is allowed up to a certain point. Many fishermen are observed in the inlet and outlet. Stiper, shad, white bass, catfish, crappie, and numerous other species are commonly pursued in the intake flows during the summer and in the effluent during winter. Many fishermen line the banks around the discharge in winter. The actual canal part of the discharge is off-limits to boating, thus providing a place for bank anglers to fish without competition or disturbance from boats and boat anglers. Below the canal, however, is open to boating and many boat anglers fish this part of the bay throughout the year and especially in winter. Mr. Adams commented as well that approximately .3-.4 miles of the .7 mile intake canal was restricted to access and thus fishing. Above this point fishing is common throughout most of the year. Many predatory fish are observed in the restricted stretch, therefore, this area may serve as a sanctuary for many species to feed without having to search for food as the flow brings plankton, invertebrates, and thus other prey fish to them. In this area fish can avoid commercial nets and anglers hooks, but eventually due to climactic or diurnal

	Routing	Reviewed	Comments/Action
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Disposition: ☐ **Discard** ☐ **File** 6045-061/6045-070 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

Project/Client:	ANO Entergy	**Date/Time:**	03/14/00, 200
Topic:	ANO Environmental Impact/Water	**Phone:**	(501) 858-5485
Contact:	Charlie Adams, ANO Biologist	**By:**	Phoned by LCL
Firm:	ANO/Entergy	**Date:**	03/30/00, 1601
Address:		**Referral:**	
City State Zip:	Russellville		

Remarks:

conditions the fish will leave this area and may then be pursued by anglers and commercial fishermen. Wildlife as well will eventually move on or increasing densities will lead to wildlife migrating off the property. Bird watchers and wildlife viewers have also been observed in the area. Many have been observed watching the pelicans, raptors, or shorebirds that are feeding on the high densities of shad in the flowing waters of the intake or the discharge. Others appear to want to see the geese or waterfowl in the fields or wetlands around the plant.

	Routing	Reviewed	Comments/Action
1	BMW	DAS	
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Disposition: ☐ **Discard** ☐ **File** 6045-061/6045-070 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

Project/Client:	ANO Entergy	**Date/Time:**	03/18/00, 400
Topic:	ANO Environmental Impact/Water	**Phone:**	501-967-5516
Contact:	Jon Brown, Superintendant III	**By:**	Phoned by LCL
Firm:	Lake Dardanelle State Park	**Date:**	03/30/00, 1042
Address:		**Referral:**	
City State Zip:	Russellville		

Remarks:

Contacted in person responded in person and by letter. Lake Dardanelle State Park is located across the Illinois Bayou from the ANO intake. He indicated that anglers often utilize the intake and outflow of ANO for fishing. He noted that fishing on the reservoir appeared consistent and that recreational fishing was increasing, due to increased tourism advertising and information. Furthermore he indicated that ANO/Entergy had provided the park with used pallets for construction of fish habitat structures in the past. In his letter he indicated that he is in the beginning stage of talking with the Environmental
Educational section of Entergy, Anita Hymel, Natural Education
Coordinator from the New Orleans Entergy Office about potential involvement in the creation of an educational/informational exhibit as part of the soon to be constructed Lake Dardanelle State Park visitor center. He expressed his gratitude for ANO's past involvement and a desire to work with ANO on future projects.

	Routing	**Reviewed**	**Comments/Action**
1	BMW	DMS	
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Disposition: ☐ **Discard** ☐ **File** 6045-061/6045-070 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

Project/Client:	ANO Entergy	**Date/Time:**	03/12/00, 1000
Topic:	ANO Environmental Impact/Water	**Phone:**	501-967-7577
Contact:	Bob Limbird, District Fisheries	**By:**	Phone and Letter, LCL
Firm:	Arkansas Game and Fish Commission	**Date:**	03/25/00, 0839
Address:	District Office	**Referral:**	
City State Zip:	Russellville		

Remarks:

I contacted Bob Limbird by phone concerning environmental impacts and effects of ANO operations as they relate to recreational and commercial fishing, fisheries and wildlife impacts, and water quality on Lake Dardanelle. He responded over the phone and by letter (Dated 3/14/00) as detailed by the following. I asked Mr. Limbird if there was any data on such issues. He indicated that the only known data was that which had been collected by the plant during initial licensing and subsequent studies by Arkansas Tech University, the University of Arkansas at Little Rock, and by ANO/Entergy. To his knowledge, the only adverse impacts were related to impingement/entrainment of aquatic organisms at the intake as well as the thermal discharge increase in temperature below the effluent bay. He recalled that previous findings had shown some impact, but that those impacts were negligible and not significant. He went on to add that the intake provides habitat and water quality that is desirable to many species during the summer months and that the effluent bay heated discharge provides increased productivity and preferred habitat for many species throughout the year and especially during winter. In turn this provides excellent recreational and commercial fishing opportunities that otherwise would not exist in the vicinity of the plant. He noted that an average of 5 people are fishing every day of the year in the vicinity of ANO. Fishing in this area increases during spring spawn, fall and winter shad die-offs, and vacation periods when people recognize these recreational opportunities. He remarked over the phone that there has been no indication that ANO operations on the reservoir has had any negative impacts on recreational or commercial fishing. He attributed recent declines in commercial fisheries catches to be a result of decreased commercial fishing due to market demands shifting towards aquaculture. Furthermore, he

	Routing	**Reviewed**	**Comments/Action**
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Disposition: ☐ **Discard** ☒ **File** 6045-061 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other** ________

Project/Client:	ANO Entergy	**Date/Time:**	03/12/00, 1000
Topic:	ANO Environmental Impact/Water	**Phone:**	501-967-7577
Contact:	Bob Limbird, District Fisheries	**By:**	Phone and Letter, LCL
Firm:	Arkansas Game and Fish Commission	**Date:**	03/25/00, 0855
Address:	District Office	**Referral:**	
City State Zip:	Russellville		

Remarks:

added that the fisheries on the reservoir if declining at all, is most likely a result of increased fishing pressure. He noted in his letter that the recent addition of the block net during winter to repel cold-stressed shad was a concern and somewhat of a problem for some fishermen and that he hoped that the amount of time the net was left out could be limited. Overall he said that ANO has provided increased recreation opportunities and restricted some. Additionally, he noted the desire to reach some agreement with ANO operations over construction of a boat launching area in the vicinity of the effluent cove to provide additional fishing access to the effluent bay.

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Disposition: ☐ **Discard** ☑ **File** 6045-061 ANO Entergy

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**__________

Socioeconomics and Alternatives

9. Reference Pages 4-42 to 43. Regarding housing, discuss the entities that receive direct tax benefits, specifically, which local governments are receiving tax benefits from the plant and to what degree.

   Response: Pope County has received a total of $25,053,791 from Entergy in property taxes over the following years:

   a. 1997 - $8,491,712
   b. 1998 - $8,328,322
   c. 1999 - $8,233,757

   The millage rate of 39 for the County is broken down as follows:

   a. 33.9 mills - Schools
   b. 1 mill - County General
   c. 2.5 mills - Roads
   d. 0.6 mills - Bond Issues
   e. 1 mill - Library

   Taxes paid by ANO contributed approximately 6% to the total Pope County budget of $17,000,000 during 1999, based on the millage rate.

   Of the 33.9 mills given to the Russellville School District, 8.9 mills is retained within the district and 25 mills is sent to the State general fund, where it is then returned back to the district. Therefore, taxes paid by ANO contributed approximately 6% directly and 21% indirectly to the total Russellville school district budget of $30,000,000 during 1999.

Socioeconomics and Alternatives

10. Reference pages 4-43 to 44. Discuss the expected indirect impacts on public utilities resulting from the tax benefits of the plant.

    Response: Potable water systems within a 10-mile radius of ANO are from subsurface and surface sources and are used for domestic and industrial purposes. The area has seven public water systems and four wastewater systems that serve the incorporated towns and rural areas. Table 1 (see attached) shows source and capacity information on selected water supply systems in areas near ANO.

Socioeconomics and Alternatives

Table 1. Major Public Water Supply Systems Within 10-Mile Radius of ANO in 2000

Water System	Water Source	Minimum Daily Capacity (Gallons)	Average Daily Capacity (Gallons)	Area Served
City Corporation	Illinois Bayou	4,536,000	5,566,000	City of Russellville
Dardanelle Water Department	Wells	No data	1,200,000	City of Dardanelle
Dover Water Department	City Corporation (Illinois Bayou)	62,400	118,100	City of Dover and surrounding rural areas
London Water Department	City Corporation (Illinois Bayou)	72,000	79,000	City of London and surrounding rural areas
Northeast Yell County Water Association, Inc.	Danville Water Department (Cedar Piney Reservoir)	No data	52,000	Rural Yell, Conway, and Perry Counties
Tri-County Regional Water Distribution District	City Corporation (Illinois Bayou); also some from Atkins Water Department (Galla Lake)	No data	436,000	Rural Pope County from above London east to Conway County line
West Crow Mountain Water Association	City Corporation (Illinois Bayou)	No data	203,000	Rural area east of Russellville

Socioeconomics and Alternatives

11. Reference page 4-45. Discuss any potential traffic issues and expected trends in the future.

    Response: Information is provided in the attached Client Contact Reports.

CLIENT CONTACT REPORT

Project/Client:	ANO Relicensing	**Date/Time:**	March 29, 2000
Topic:		**Phone:**	
Contact:		**By:**	Gary E. Tucker
Firm:	Arkansas Hwy & Transp. Dept.	**Date:**	
Address:		**Referral:**	
City State Zip:	Russellville and Little Rock, AR		

Remarks:

I first talked w/ B.J. McCallister, at the Russellville District office, who referred me to Mr. Kinslow. I asked Mr. Kinslow if he could (1) identify any traffic issues of concern pertaining to the area surrounding Arkansas Nuclear One, and (2) if any potential remedies had been identified to alleviate those issues. He indicated that the intersection between Hwy 333 (Nuclear Plant Rd.) and Hwy 64 has been considered a problem area by some area residents, primarily those who are employed at the ANO facility. He said he is not aware that Arkansas Highway and Transportation Department (AHTD) has made any decisions that result in placement of a traffic light or a turning lane at the site. Also, he indicated that he has heard that AHTD has conducted some preliminary investigations related to possibly adding an east-bound on-ramp to I-40 at the west end of Russellville, which would serve to alleviate some of the east-bound traffic from ANO that is presently directed through Russellville. He had no further information regarding those studies, however, and suggested that I contact someone else (possibly Frank Russenberger) for additional information. He was not aware of any other potential traffic issues related to ANO operations or to future road projects that would relate to ANO operations.

I called Mike Webb of Environmental Section, Little Rock offices of AHTD, to request additional information regarding the potential for future construction of an east-bound on-ramp for I-40. Mr. Webb suggested that I call either Frank Vozell (501-569-2262) or Vozell's assistant, Scott Bennett ((501-569-2542). Mr. Bennett indicated that AHTD programs projects on three year intervals. The current list will be approved and distributed in summer 2000. He confirmed that AHTD has examined the potential for an additional east-bound on-ramp on I-40 for the area west of Russellville, and also a new interchange in east Russellville at the intersection with Hwy 326. Neither project, however, is included in the list of programmed projects to be distributed this year for the period of 2001-2003.

	Routing	Reviewed	Comments/Action
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Disposition: **Discard** **File** 6045-061 Entergy ANO Relicensing

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

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CLIENT CONTACT REPORT

Project/Client:	ANO	**Date/Time:**	3/24/2000
Topic:		**Phone:**	
Contact:	Maj. Dillard Bradley	**By:**	Gary E. Tucker
Firm:	Pope County Sheriff's Office	**Date:**	
Address:		**Referral:**	
City State Zip:	Russellville, AR 72801		

Remarks:

I talked with Maj. Bradley, who serves as one of two Deputy Sheriffs in Pope County. I queried him as to his knowledge of any present or future potential traffic issues of concern related to operations at the ANO facility. He indicated that he thinks the major issue would be the absence of a traffic light at the intersection of Highway 333 and Highway 64, which serves as a major ingress/egress point for ANO traffic. This intersection carries a particularly heavy traffic load at peak periods. He is not aware of any movement at the present time to install a light at the intersection.

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Disposition: **Discard** **File** 6045-061 ANO Relicensing

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other**

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Socioeconomics and Alternatives

12. Reference pages 2-13 to 2-16. Discuss estimates of current temporary daily, weekly, or seasonal population in the surrounding region.

    Response: Information is attached.

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1. INTRODUCTION

In October of 1980, the NRC published a revised version of its NUREG-0654. This document includes a requirement of nuclear power plants to provide time estimates for various emergency evacuation scenarios. Appendix 4 of the regulation provides an outline of the information requested by the NRC in relation to evacuation time estimates.

In response to the revised NUREG-0654, the Arkansas Power & Light Company asked HMM Associates of Waltham, Massachusetts to calculate evacuation time estimates using available population data and NETVAC2, a computer-based evacuation simulation model. This report described the Emergency Planning Zone (EPZ), examines the assumption used, described the study methodology and summarized the results of the evacuation time study performed by HMM Associates in February and March of 1981.

1.1 Site Location and EPZ

Arkansas Nuclear One (A.N.O) is located in Pope County, Arkansas. It is on the northern shore of Lake Dardanelle. Figure 1-1 shows the general location of the plant in Arkansas and Figure 1-2 shows where the plant is located in relation to Lake Dardanelle and nearby towns, together with the EPZ boundaries. The EPZ boundaries encompass portions of four counties in Arkansas. These are Johnson, Pope, Yell and Logan counties. Each of these counties has an emergency plan and participates in a joint planning effort with the state through the Arkansas Nuclear Planning Response Program (ANP&RP) office located in Russellville, Arkansas, seven miles WSW of the plant.

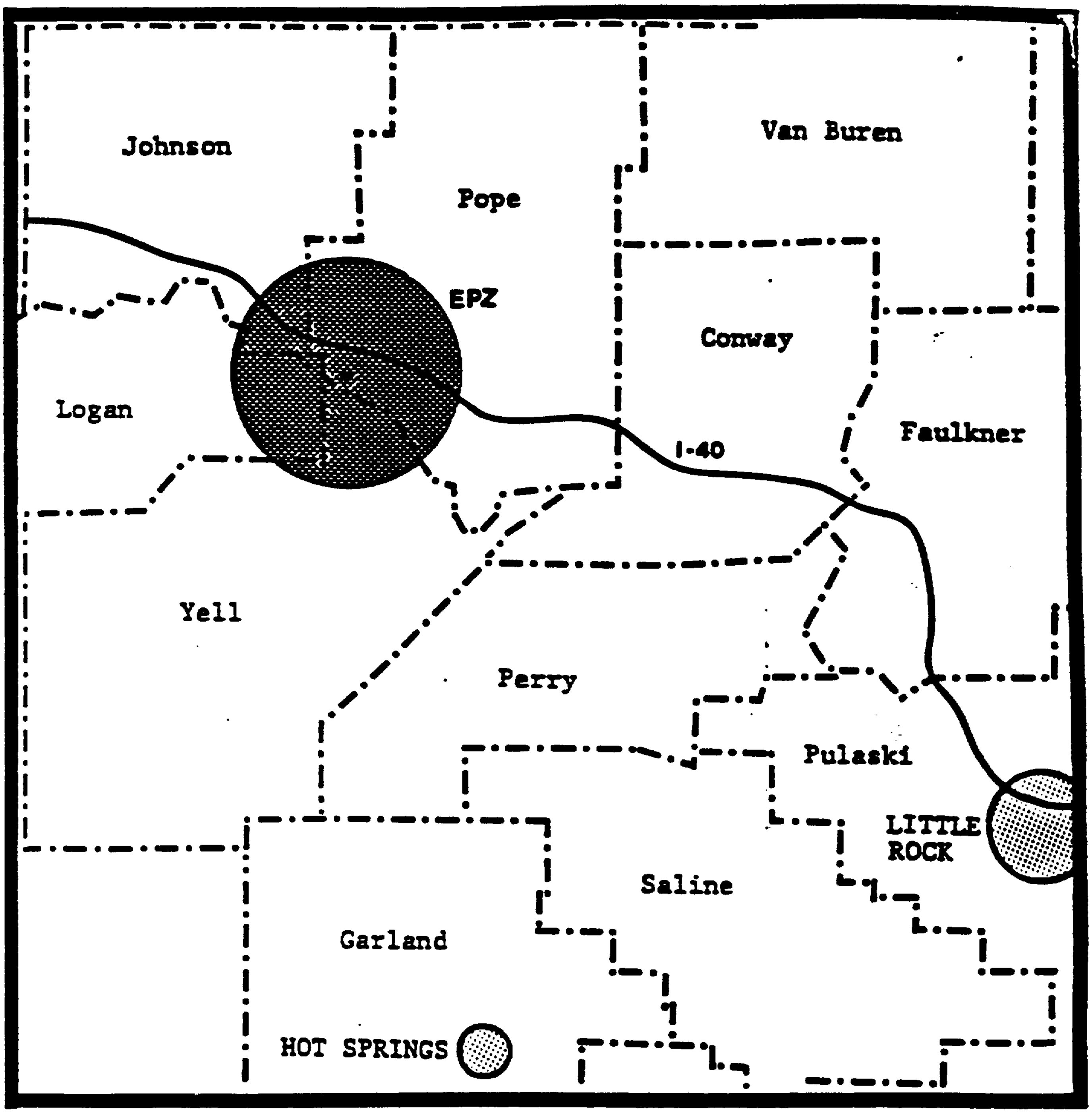

FIGURE 1-1 GENERAL LOCATION MAP

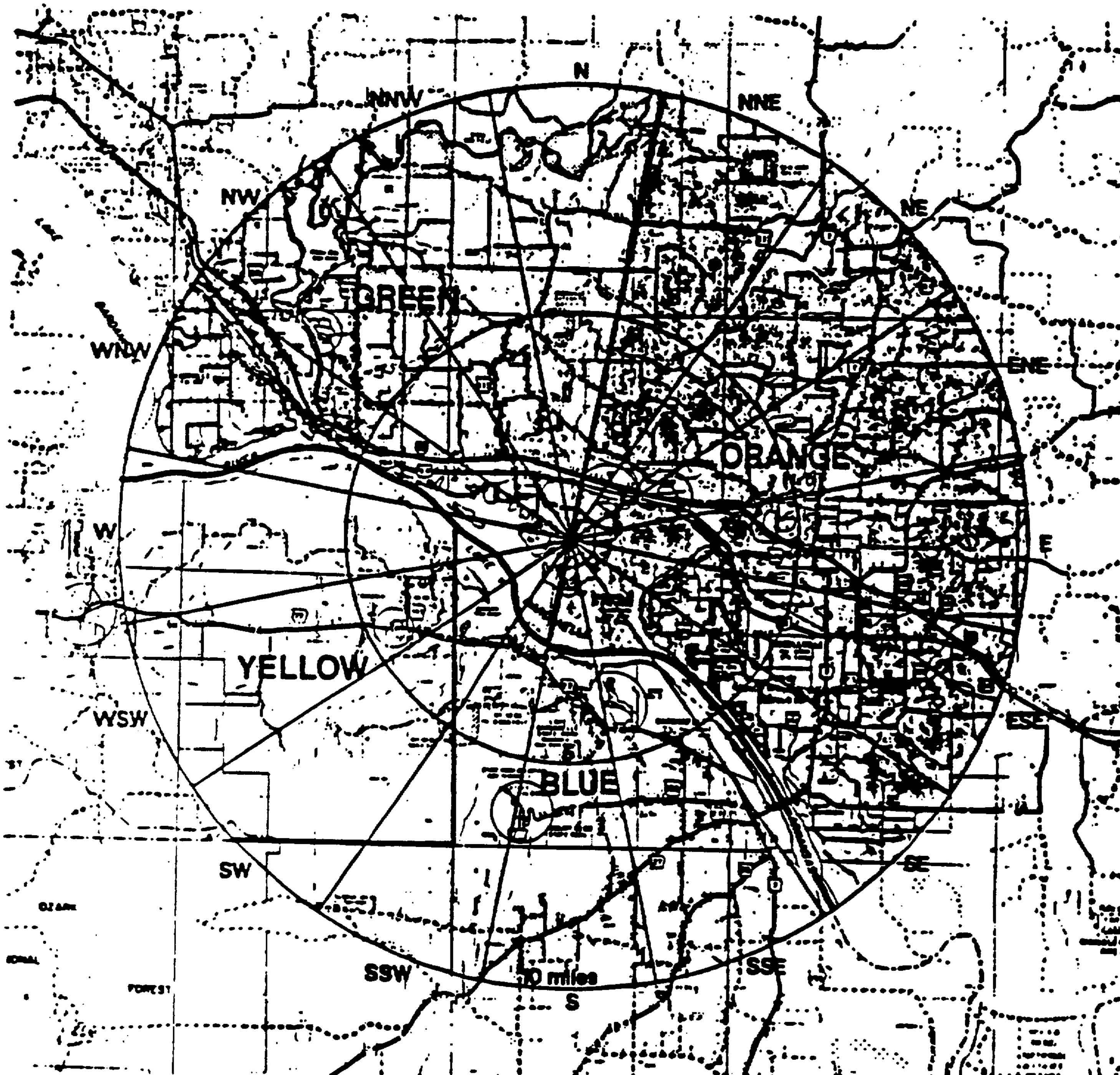

FIGURE 1-2

MAP OF EPZ AND PLANNING SECTORS

The EPZ surrounding A.N.O is sparsely populated. The permanent population in the EPZ is approximately 26.800 persons. The majority of the population is located in Russellville. Other smaller towns in the EPZ include Dardanelle, Dover, London, an Knoxville. The, remaining land area is rural, unincorporated land with generally sparse population. Lake Dardanelle is a dominant feature of the EPZ. There are a number of parks and recreation areas on the shores of the lake. A significant number of tourists enter the EPZ to use these facilities, especially during the warmer months.

1.2 General Assumption and Methodology

The evacuation time estimates compiled by HMM are based on computer modeling of several evacuation scenarios. The model used by HMM is the NETVAC model which simulates the movement of evacuating vehicles over a predetermined highways evacuation network. the model is a dynamic network model which accounts for traffic congestion on the network, and route choices by the evacuating vehicle operators. Capacities of the evacuation network are calculated based on algorithms take from the Highway Capacity manual. A more detailed description of tht NETVAC model is incuded in Appendix A.

To apply its evacuation model, HMM requires a considerable amount of population and highway network data. Best available data was sought from the Arkansas Nuclear Planning and Response Program (ANP&RP) personnel who have detailed knowledge of the EPZ. The best available data was supplemented by field survey work undertaken by HMM staff. Where key assumptions were required to model evacuation scenarios, HMM collaborated with the local officials.

The following are the sources of key data elements and assumptions.

- Permanent Population Data were provided by Arkansas Power & Light Company. These population data were extracted from the FSAR.

- Transient Population and Employment Levels at Major Facilities were provided by the ANP&RP officials. These numbers reflect both estimates and phone survey data.

- Descriptions of Special Facilities and Their Population were provided by the local officials.

- Definition of the Evacuation Network was compiled based on the county emergency plans and individual interviews with the ANP&RP.

- Network Capacities were determined by the NETVAC model. The calculations are based on physical descriptions of the network compiled by HMM through field survey of each roadway and intersection in the network.

- Auto Occupancy factors used were 2.5 for permanent population. 2.0 for the transient population and 1.0 for employees at the major industries. The ANP&RP officials concurred with the use of these numbers.

- Evacuation Mobilization and Preparation Times were assumed based on discussions with local officials. It was assumed that the first departures would take place 30 minutes after the order to evacuate is given. It was assumed that employee departures from the work places would take place over the next 30 minutes. Permanent and transient population departures were distributed over a 90- to 120-minute period beginning 30 minutes after the order to evacuate. These departures were staggered to approximate a statistical distribution of departure times.

These assumptions and data are presented in greater detail in the following sections of this report.

2. POPULATION AND AUTOMOBILE DEMAND ESTIMATION

The demand estimation phase is made up of two steps. The first step is the determination of the number and distribution of the population to be evacuated. The second step is the determination of the appropriate number of vehicles required to evacuate each of the population groups. Federal guidance indicates that three potential population segments should be considered in a study of this type. These include permanent residents, transients, and persons in special facilities.

2.1 Permanent Residents

Permanent residents were defined as those persons having residences within the Arkansas Nuclear One (A.N.O.) EPZ. The base data for determining the permanent population distribution were taken from the FSAR. the base data provided totals of permanent population in each sector shown on the population rose, Figure 2-1, form 0-6 miles, and a single total for each sector from 5-10 miles. The data from 5-10 miles was divided into one mile sectors during meeting between HMM and ANP&RP personnel.

2.2 Transient Population

In the course of these evacuation time estimate studies, two components of transients population were considered. First, estimates of the size and location of the population engaged in recreational activities within the EPZ were compiled. The location and estimated attendance at each campground or park were provided by ANP&RP and supplemented by telephone calls by HMM to some State Parks. Figure 2-2 shows the locations of the recreation areas within the EPZ and Table 2-1 summarized the peak attendance estimates for these facilities.

Similarly, the ANP&RP officials described the locations of the major employment centers within the EPZ compiled. The location and estimated attendance at each campground or park were provided by ANP&RP and supplemented by telephone calls by HMM to some State Parks. Figure 2-2 shows the locations of the recreation areas within the EPZ and Table 2-1 summarized the peak attendance estimated for these facilities.

Similarly, the ANP&RP officials described the locations of the major employment centers within the EPZ. Corresponding employment estimates were provided for peak daytime period, for night shift and for weekend shift. Figure 2-3 shows the locations of the major employers and Table 2-2 summarizes employment levels.

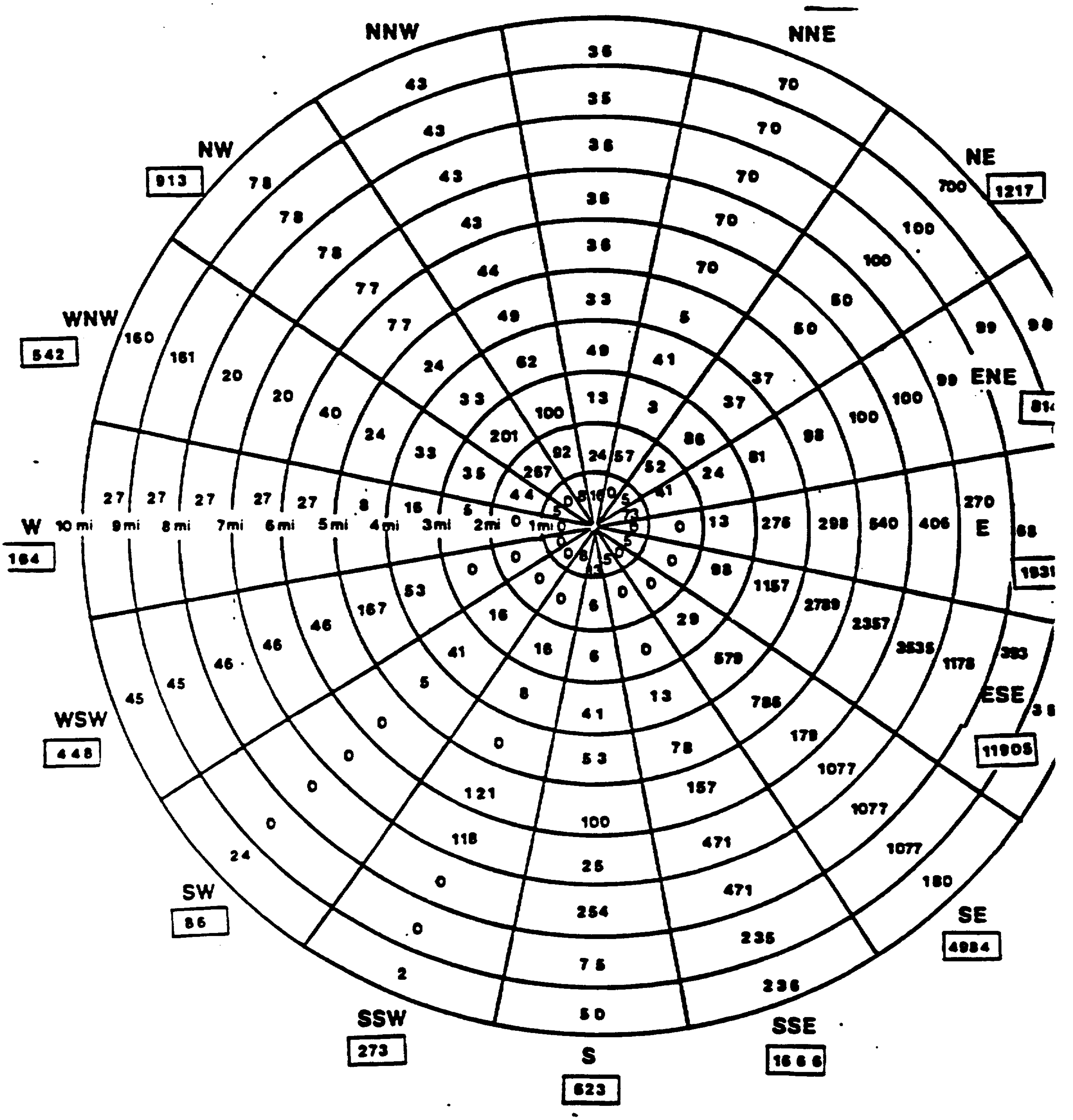

FIGURE 2-1 - POPULATION ROSE

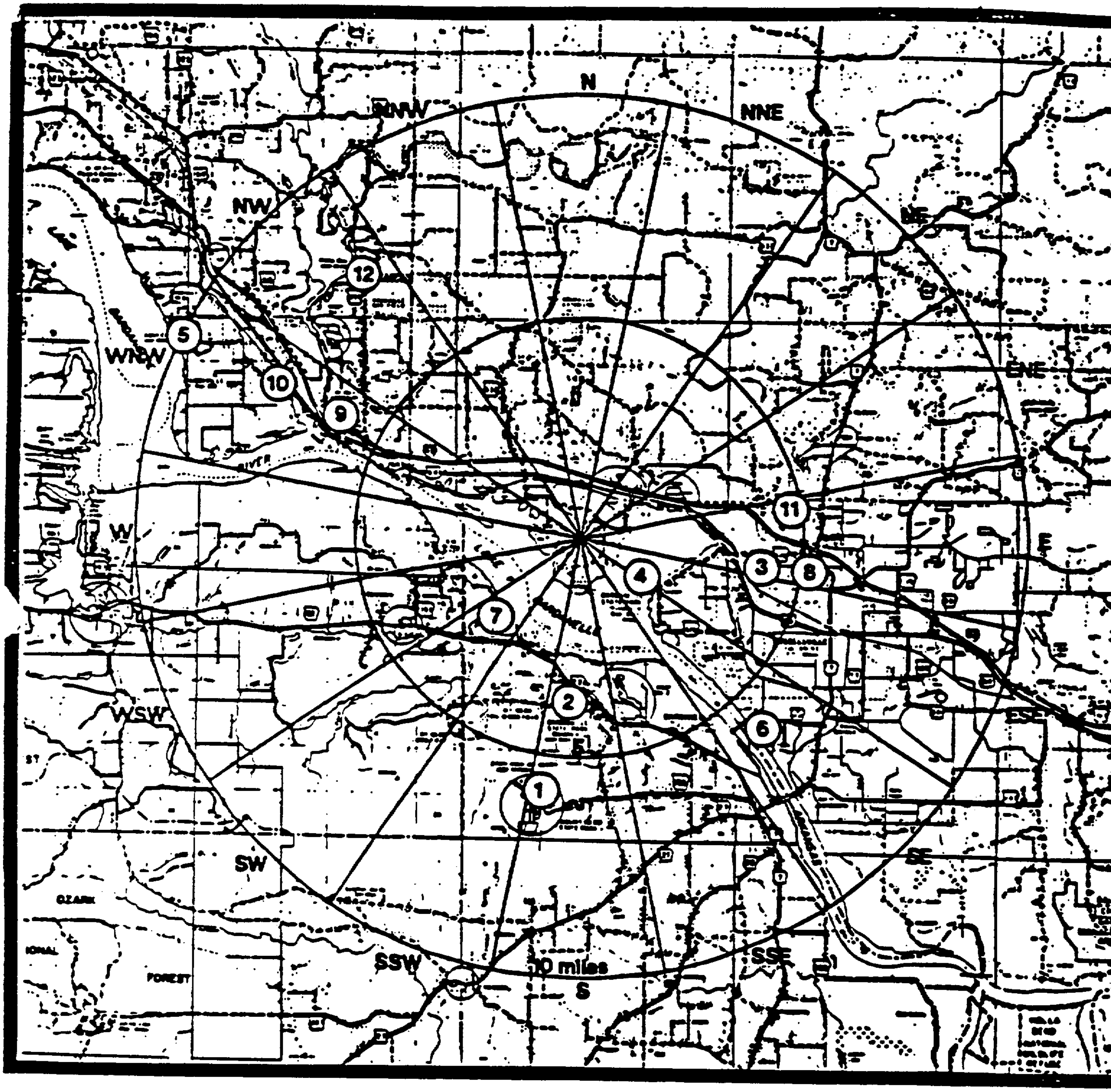

FIGURE 2-2 - LOCATIONS OF RECREATION AREAS

TABLE 2-1

LIST OF RECREATION AREAS

Number	Name	Node	Peak Autos	Average Day Autos	Night Autos
1	Mt. Nebo**+	991	2,000	500	250
2	Lake Dardanelle**	998	2,500	100	25
3	Ouita**	963	500	300	100
4	Russellville State Park**++	968	4,000	1,000	300
5	Cabin Creek*	911		133	57
6	Dam Site East*	981		1,323	0
7	Delaware Use Area*	995		129	64
8	Dike View	963		0	0
9	Flat Rock*	907		142	71
10	Highway 64 Cove	900		10***	0
11	Illinois Bayou	967		0	0
12	Piney Bay*	907		313	157

* Source: FSAR: Assume .99% of yearly attendance occurs on peak days. Night attendance is one-half daytime.

** Source: HMM telephone conversation with park officials.

*** Source: HMM field inspection of parking facility

\+ These numbers apply to peak attendance for annual "Chicken Fry Day".
++ These numbers apply to peak attendance during Independence day weekend.

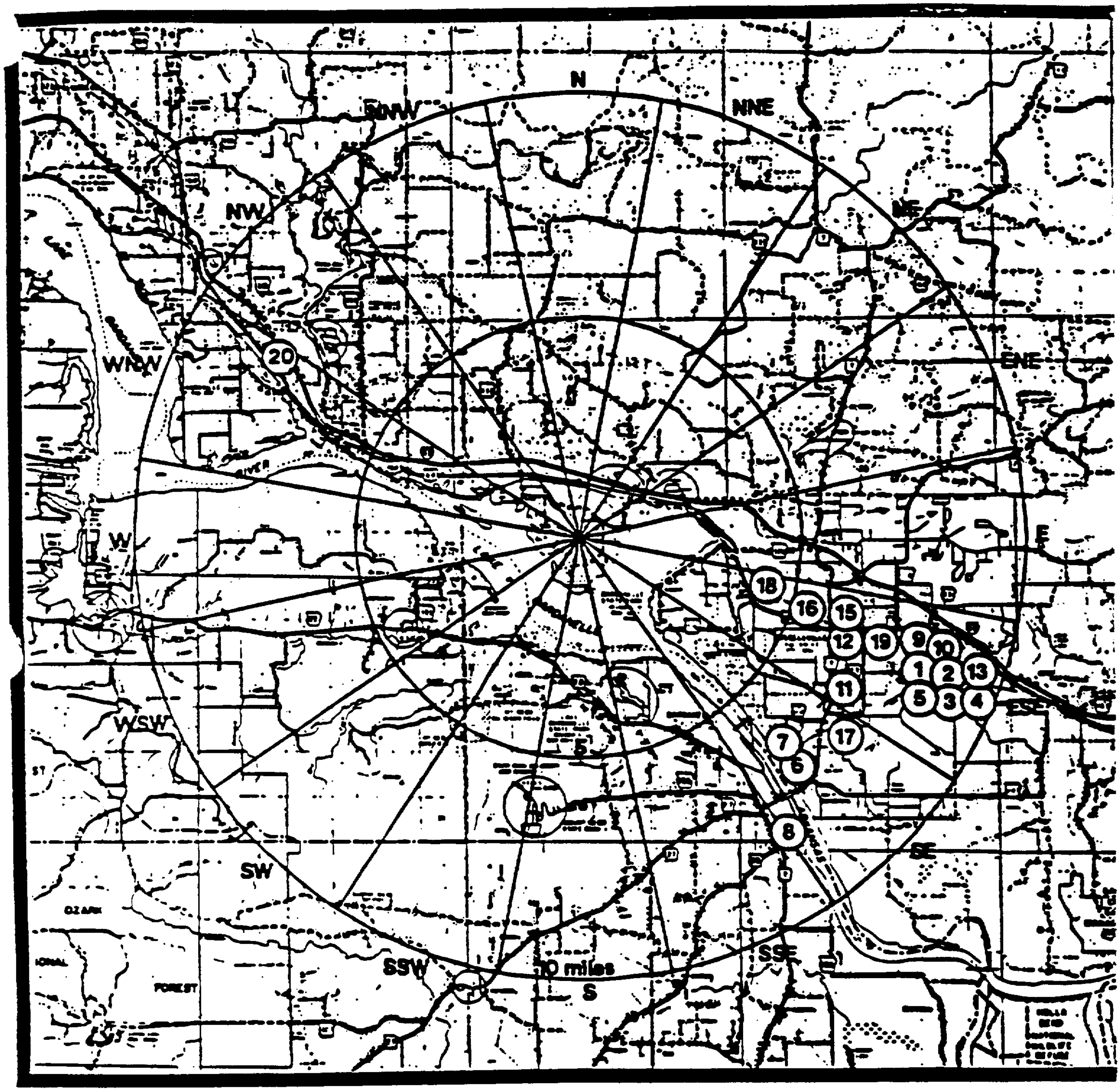

FIGURE 2-3 - LOCATIONS OF MAJOR EMPLOYERS WITHIN THE EPZ

TABLE 2-2

EMPLOYMENT LEVELS WITHIN THE EPZ

			Person/Cars			
Number	Name	Node	Day	Night	Wk/End	Total
1.	Firestone Tire & Rubber	958	150	50	50	350
2.	Morton Frozen Foods	958	300	100	100	860
3.	Tabor Metals	958	50	10	10	90
4.	Arkansas Billet Corp.	958	30	5	5	41
5.	Laddish Company	958	140	30	30	240
6.	Dow chemical	981	180	60	60	383
7.	International Paper Co.	981	70	10	10	108
8.	Valmac Industries	988	526	472	0	998
9.	Ridgeview Hatcheries	958	22	1	1	25
10.	Poultry Food Industries	958	45	0	0	45
11.	Bibler Bros.	962	170	5	5	180
12.	Frolic Footwear	652	275	0	0	275
13	P.O.M. Inc.	958	70	0	0	70
14.	Russellville Steel		34	0	0	34
15.	Valmac Russellville	952	135	0	0	135
16.	Sugar Creek Foods	952	60	0	0	60
17.	Standard Rendering	981	50	5	5	60
18.	Riverside Furniture	963	35	0	0	35
19.	Ralston Purina	962	33	0	0	33
20	Formall	911	100	0	0	100

2.3 Special Facility Populations

The special facility population within the A.N.O. EPZ is comprised of schools, hospitals and nursing homes. the locations of the schools. hospitals and the nursing homes are shown in Figures 2-4 and 2-5, and listed on tables 2-3 and 2-4.

2.4 Vehicle Demands

The permanent and transient populations are assumed to evacuate using private automobiles.* An auto occupancy factor of 2.5 has been used to calculate the number of automobiles used to evacuate the permanent population. This is a conservative value derived from 1980 census data for the four counties.

An auto occupancy factor of 2.0 was assumed for the transient population to be evacuated. This factor was chosen in consultation with the ANP&RP officials. It was agreed that this assumption is conservative (i.e., it tends to over-estimate the number of automobiles) for three reasons. First, the people visiting the recreational facilities will seldom travel in units of less than two, in fact many times large groups of friends or family will travel in a single vehicle. Second, there is very likely some double-counting involved with the transient population. Many of the visitors to the parks and recreational facilities will be permanent residents of the EPZ, as well, Third, the transient population numbers were based on peak and seasonal usage of the facilities. for these reasons, it is very unlikely that transient auto traffic will be as high as assumed in the study.

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* It is assumed that all permanent and transient residents of the EPZ have access to private automobiles. Most persons will leave using their own vehicles, while others may rely on friends, neighbors, or relatives for transportation.

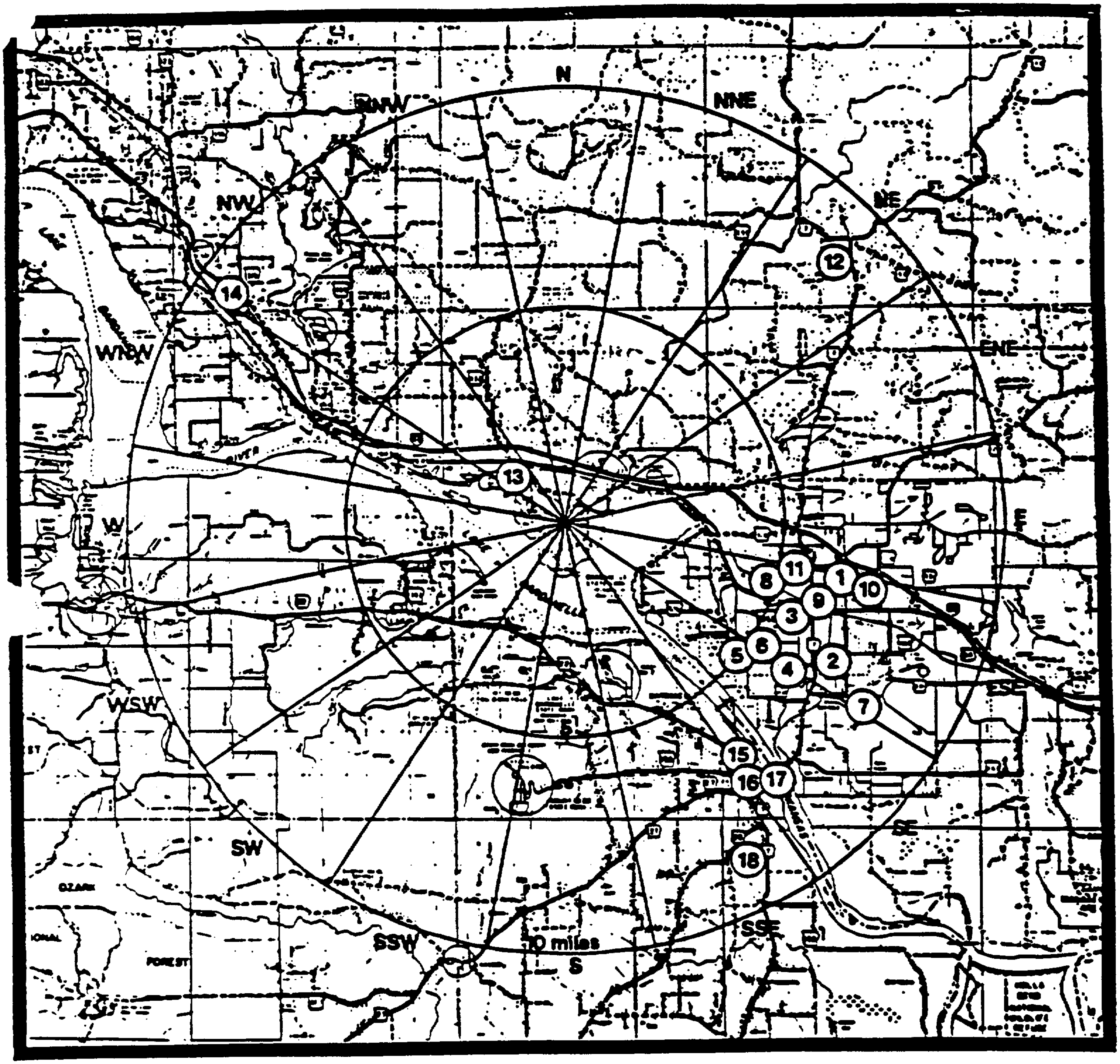


FIGURE 2-4 - LOCATIONS OF SCHOOLS WITHIN THE EPZ

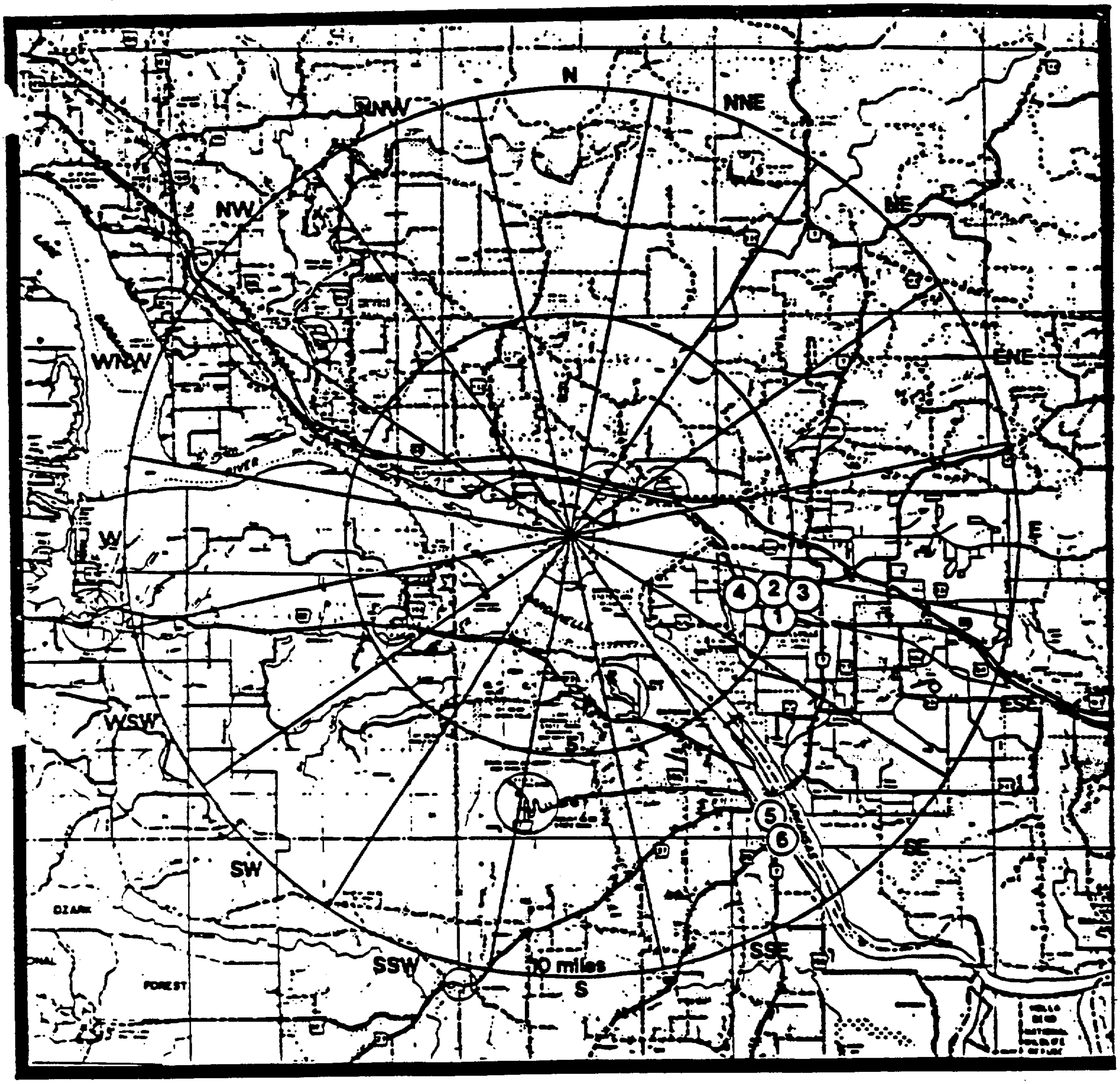


FIGURE 2-5 - LOCATIONS OF HOSPITAL AND NURSING HOMES WITHIN THE EPZ

TABLE 2-3

LIST OF SCHOOLS

Number	Name	Node	Autos
1.	Crawford (E)	959	
2.	Oakland Heights (E)	962	
3.	Dwight School (E)	973	
4.	Sequoyah (E)	973	
5.	Russellville Middle/Jr. H.S.	962	
6.	" " "	962	
7.	Russellville H.S.	962	400
8.	St. John's (E)	963	
9.	Ding Dong Campus (Day Care)	952	
10.	Friendship School (Handicapped)	959	
11.	Arkansas Tech.	952	2,500
12.	Dover (K-12)	923	
13.	London Elementary	935	
14.	Knoxville (K-12)	911	
15.	Dardanelle (E)	983	
16.	Dardanelle Middle/Jr. H.S.	983	
17.	" " "	983	
18.	Dardanelle H.S.	988	100

TABLE 2-4

LIST OF MEDICAL FACILITIES

Number	Name	Node	Autos
1.	St. Mary's Hospital **	973	65
2.	Russellville Nursing Home*	973	
3.	Stella Manor Nursing*	973	
4.	Legacy Lodge Nursing*	973	
5.	Dardanelle Hospital**	988	13
6.	Dardanelle Nursing Center*	988	

* Would probably be sheltered rather than evacuated.

** Not all patients will be evacuated. Some will be sheltered rather than evacuated.

An auto occupancy of 1.0 was assumed for vehicles departing from the employment centers. This value was used, since the local officials feel that the large majority of the work force in the area commutes alone. The 1.0 value may well be 1.1 or 1.2 in reality, but the lower value was assumed to ensure that vehicle volumes were not underestimated. The use of 1.0 vehicle per worker involves some double counting, since many, if not most, of the workers at the major employers are also permanent resident of the EPZ. It appears that the double counting is warranted, however, because the local plans assume these workers will not return to their homes before departing the EPZ. The workers will go directly out of the EPZ. The families of these workers will leave in separate vehicles.3.

EMERGENCY PLANNING ZONE AND SUB-AREAS

The Arkansas Nuclear One EPZ covers the 10-mile radius surrounding the plant, as shown on Figure 1-2. The EPZ is divided into four sectors which approximate the 90° sector divisions suggested in NUREG-0654. Major geographical and political boundaries are used to define the sector boundaries to the extent possible. For example, the Arkansas River and County lines serve as sector boundaries in certain cases. Care was taken to avoid dividing heavily populated areas. A brief description of the boundaries, population and features of special interest in each sector follows. Each 10-mile sector has been color-coded for easy reference, as shown on Figure 1-2. Each case was run of the weekday, night and weekend-day populations. the 2-mile case was not defined separately. Since the population within 2 miles is so small, it was included in the cases north of Lake Dardanelle (cases 1, 2, 5, 6, 9). This causes some double counting , but it is believed that it is warranted since this group will probably evacuate in any of the above cases. The largest number of cars in the 2-mile area come form the plant itself: 1,600 during days and 800 at night (during refueling outages only). It should be noted that many of the plant staff would not be evacuated during a public evacuation.

Case 1: 5-Mile Green Case

This case is bounded on the south by Lake Dardanelle and the Arkansas river. The eastern boundary is defined by the North 22½° sector's east boundary. The remaining boundary is defined by the 5-mile radius from the plant. Figure 3-1 shows the boundaries for Case 1 which includes portions of Johnson and Pope Counties. Case 1 includes the employee population at Arkansas Nuclear One, as well as the permanent population residing within the case boundaries.

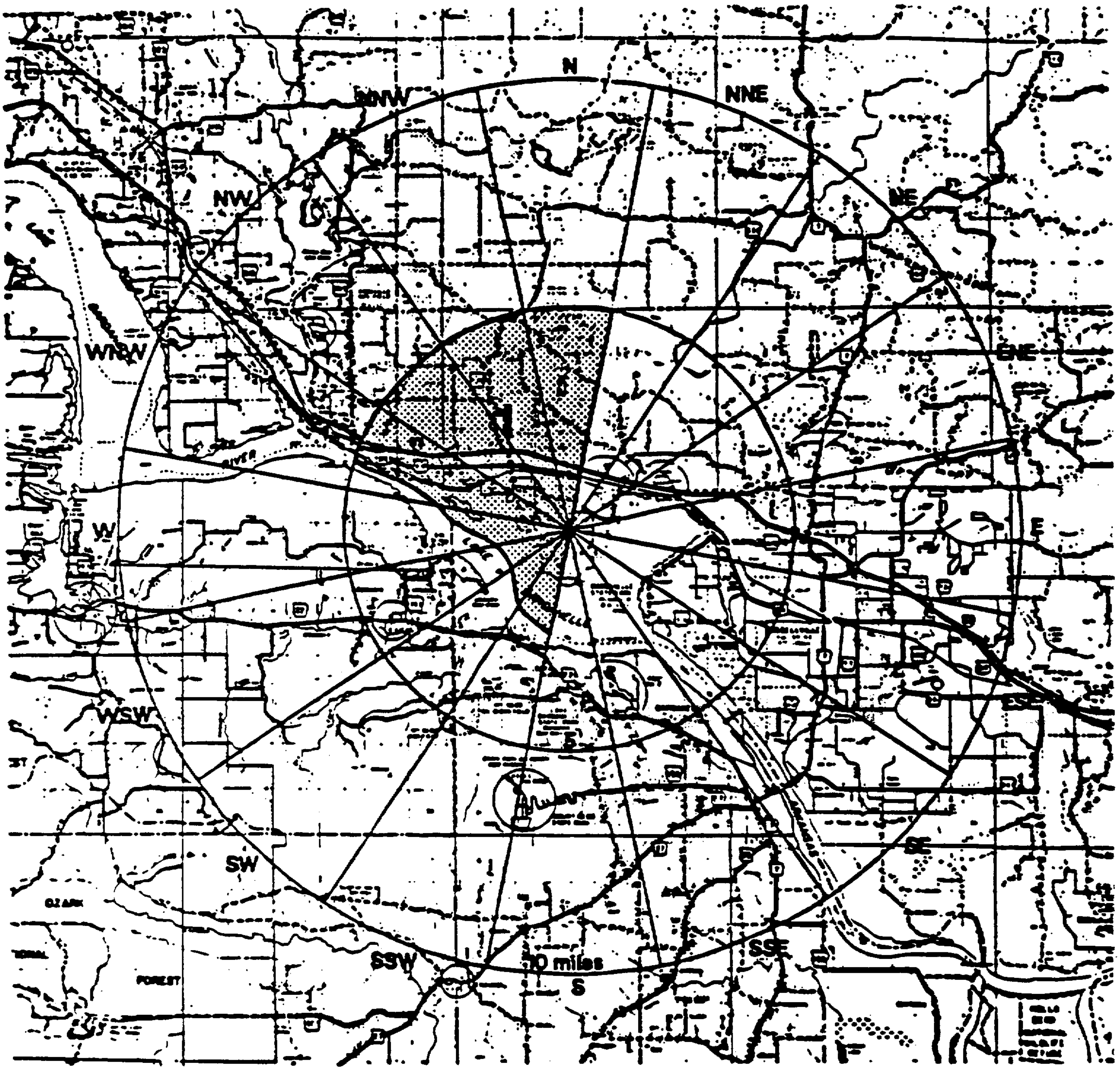


FIGURE 3-1 - CASE 1: 5-MILE GREEN CASE

The town of London is in this case. There are no recreation facilities, and therefore no transients within this case. The total resident population is approximately 1,575 people, or about 630 cars. Some double counting of people living on the peninsula where A.N.O. is located occurs since these people are also included in Case 2, as mentioned above. The number of employees at the plant, on a peak day, during a refueling outage, equals 1,600 cars. During the peak night-time situation, 800 cars will be involved. It must be noted that these figures for workers at the plant reflect a refueling outage situation in which it is assumed that all cars evacuate. During the more common, on-line periods, only 600 day and 150 night cars would be involved. The outage employee numbers were used in order to provide conservative estimates.

Case 2: 5-Mile Orange Case

Case 2 is bordered on the east by the North 22-½° sector boundary and by the Arkansas River to the south. It is entirely within Pope County. The 5-mile radius is the east and north boundary. This is the largest 5-mile case both in terms in size and population. Figure 3-2 shows the boundary of this case.

There are approximately 7,773 permanent residents in this sector. This translates to about 3,109 cars. the majority of these are located near the 5-mile boundary in Russellville. In addition, there are two large recreational areas in this sector; Ouita State Park and Russellville state Park at Lake Dardanelle. Together these two parks may have up to 4,500 automobiles during the peak weekend of the year. During summer weekdays, there are about 1,350 transient autos associated with these two parks and about 450 during the night

The power plant, with peaks of 1,600 and 800 cars on days and nights respectively, is incuded in this case. During a peak case, on a weekend day, a total of about 9,244 autos will leave this sector. During a peak night, this Number would drop to about 4,359.

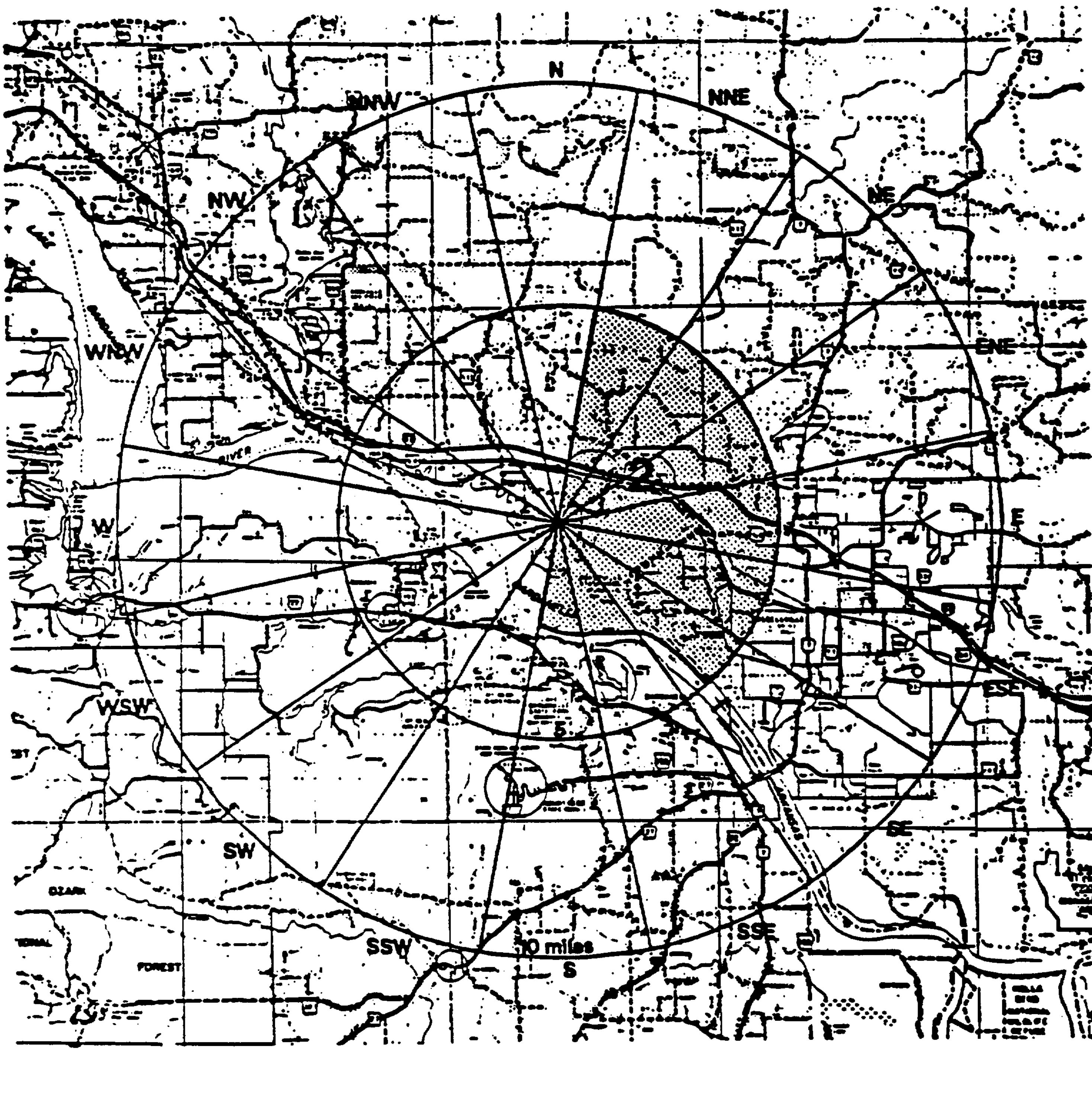


FIGURE 3-2 - CASE 2: 5-MILE ORANGE CASE

Case 3: 5-Mile Blue Case

This case includes the part of Yell County within the 5-mile radius of the plant (see Figure 3-3). It covers a sparsely populated area containing approximately 263 permanent residents, or about 105 cars. It also includes the Lake Dardanelle State Park. During a peak summer weekend as many as 2,500 automobiles may be located at the Park. This number falls to 100 during a weekday in the summer and to 25 for the nighttime case. There are no major industrial employers in this sector.

Case 4: 5-Mile Yellow Case

This case includes the portion of Logan County within the 5-mile radius of the site, as shown on Figure 3-4. It is sparsely populated with a total of about 285 permanent residents. The Delaware Use Area is the only transient facility in this sector. This is a relatively small park which has about 129 cars during the day and 64 at night. Thus a maximum of 243 will evacuate this sector.

Case 5: 10-Mile Green Case

This case, shown on Figure 3-5, is similar to Case 1, but it extends to the 10-mile boundary. It follows the same boundaries as, and includes, Case 1. The area encompassed by this case is mainly rural, with a resident population of 2,350 people. Knoxville and London are the only towns, with populations of 202 and 539 respectively (as of 1975). The Piney Bay and Flat Rock use areas are in this sector. These two parks together generate about 598 cars during the day, and about 285 during the night. Industrial employment includes Formall, on Rt. 64 near Knoxville, with about 100 autos during weekdays, and A.N.O.. In the peak case, about 3.238 cars will evacuate from this sector.

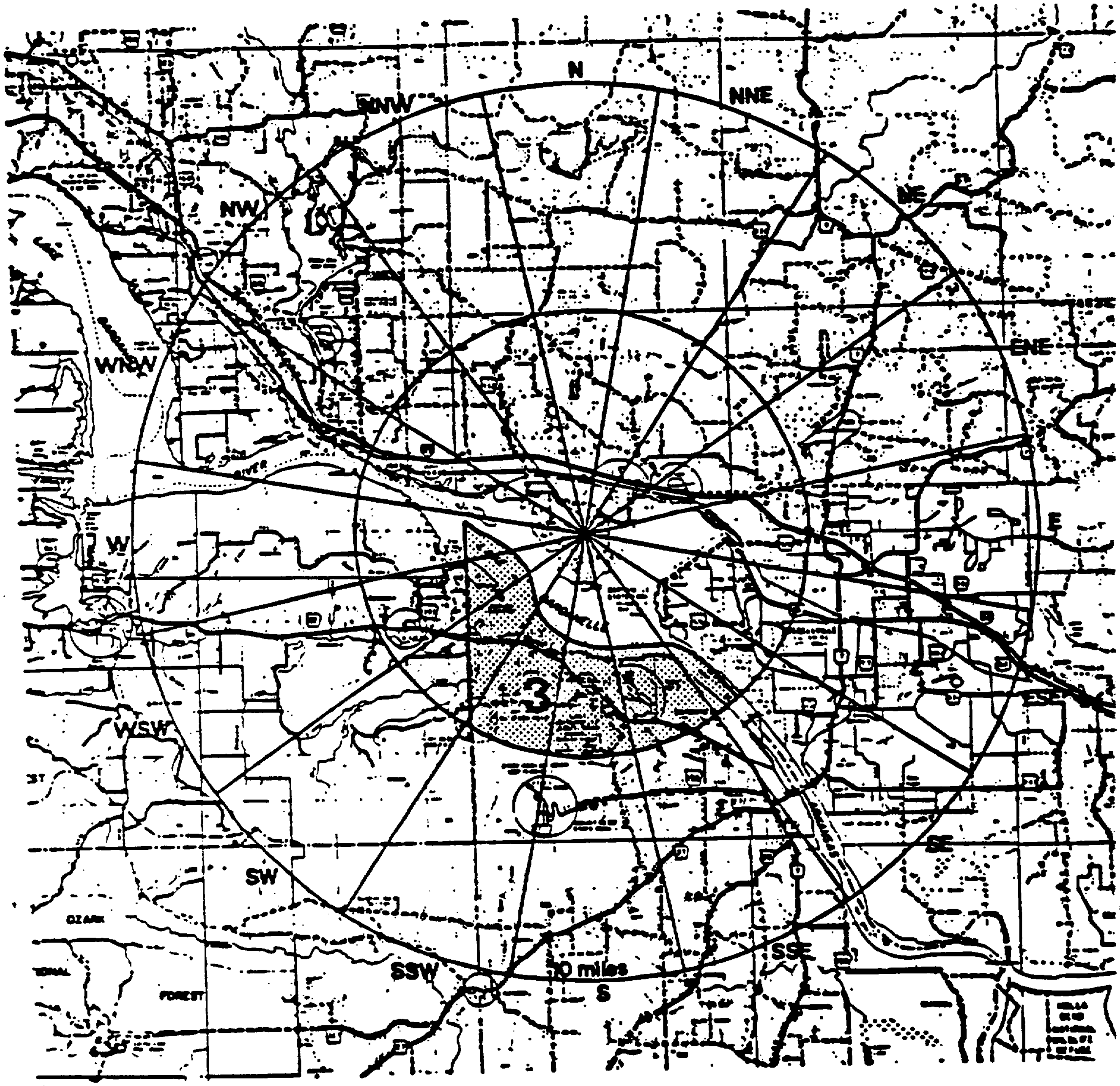


FIGURE 3-3 - CASE 3: 5- MILE BLUE CASE

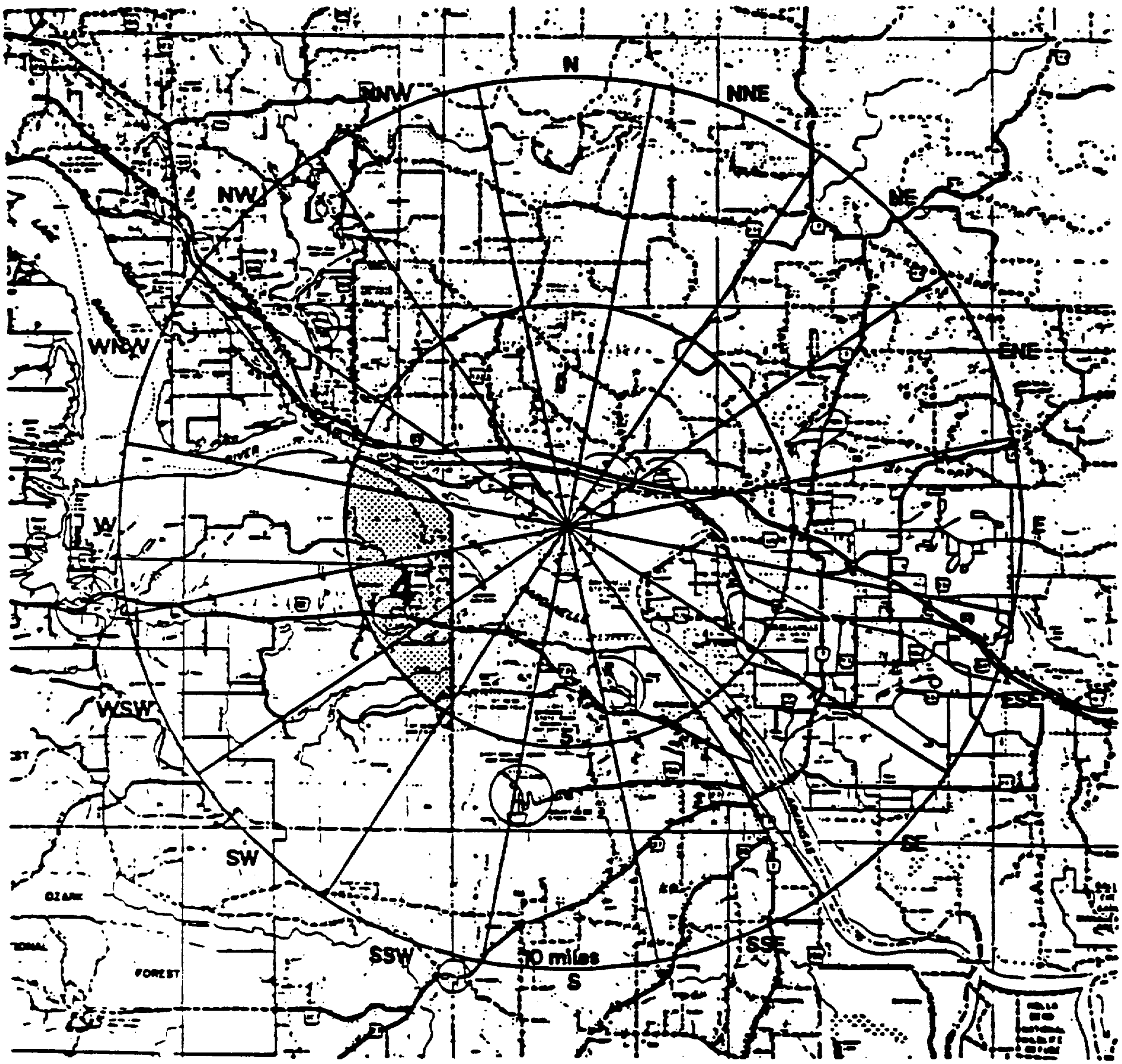


FIGURE 3-4 - CASE 4: 5-MILE YELLOW CASE

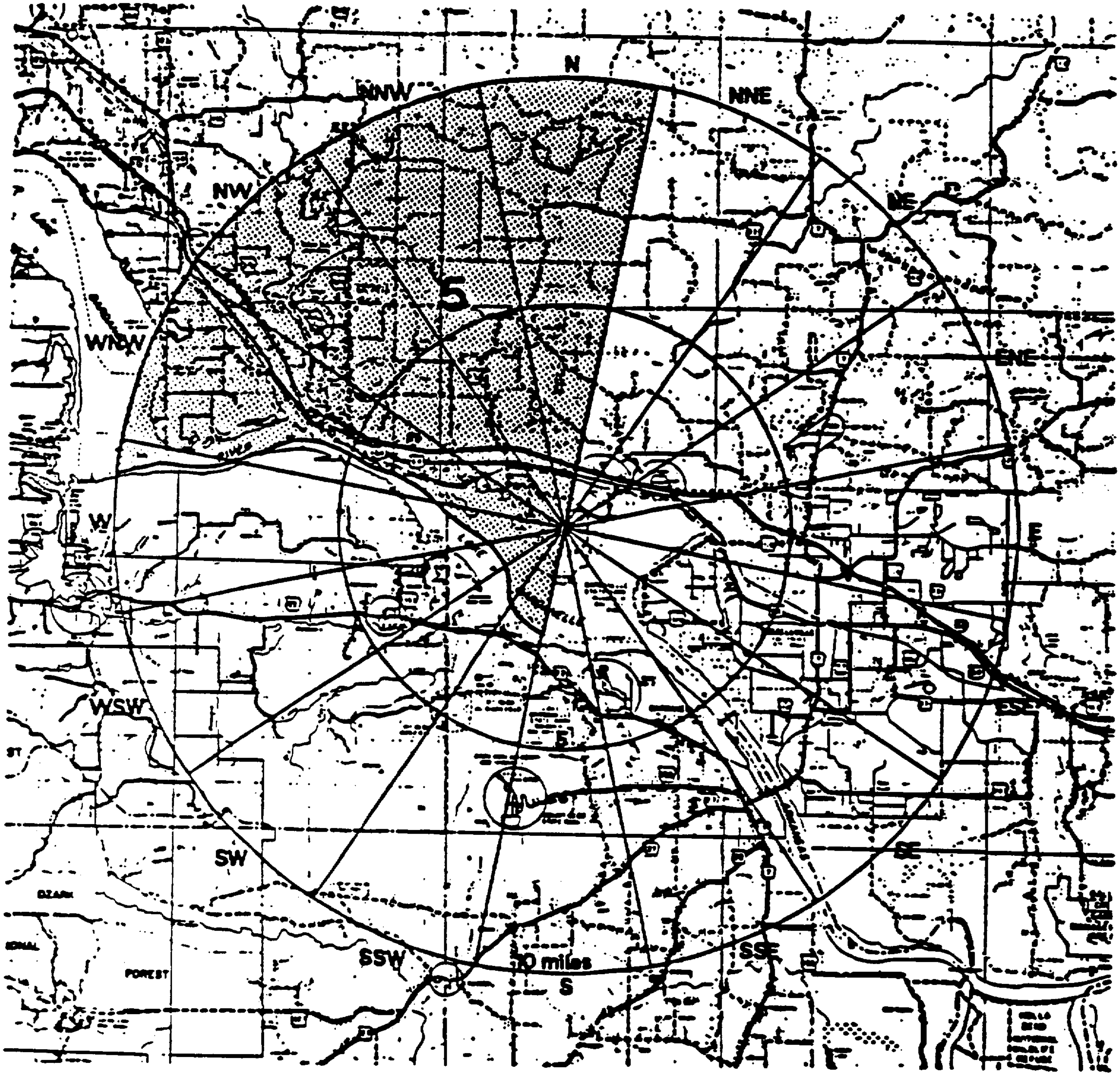


FIGURE 3-5 CASE 5: 10-MILE GREEN CASE

Case 6: 10-Mile Orange Case

Case 6 is similar to Case 2, but extends to 10 miles. It is the largest and most populous of the four 10-mile sectors. Figure 3-6 shows the boundaries and certain features in this sector. A total of about 20,845 people reside in this sector. This translates to about 8,338 cars. The large majority, 14,314 (1975 population of Russellville, 7 miles WSW of A.N.O., is the largest population center in the EPZ. The small town of Dover is also located in this sector. There are several recreational facilities in this sector, as well. Two of these were mentioned in regard to Case 1. In addition, the Dam Site East Park, with a peak of about 1,323 cars, is located in this sector. There are also a number of motels in Russellville, adding to the transient population. In addition, the majority of the large employers in the EPZ are located in this case, including A.N.O., resulting in about 3,405 cars in a peak, weekday situation. The maximum number of cars expected to evacuate this sector would be about 16,453 on the peak summer weekend.

Case 7: 10-Mile Blue Case

This case, shown on Figure 3-7, includes the portion of Yell County within the 10-mile radius of A.N.O.. There are about 4,638 permanent residents in this case, with 3,684 (as of 1975) of these in the town of Dardanelle. There is one major employer located in Dardanelle. In addition to the park mentioned in the 5-mile case, Mt. Nebo State Park is included in this case. On a peak day, up to 2,00 cars may be expected to evacuate from Mt. Nebo. The maximum number of cars included in this case would be about 6,405 on a peak weekend day.

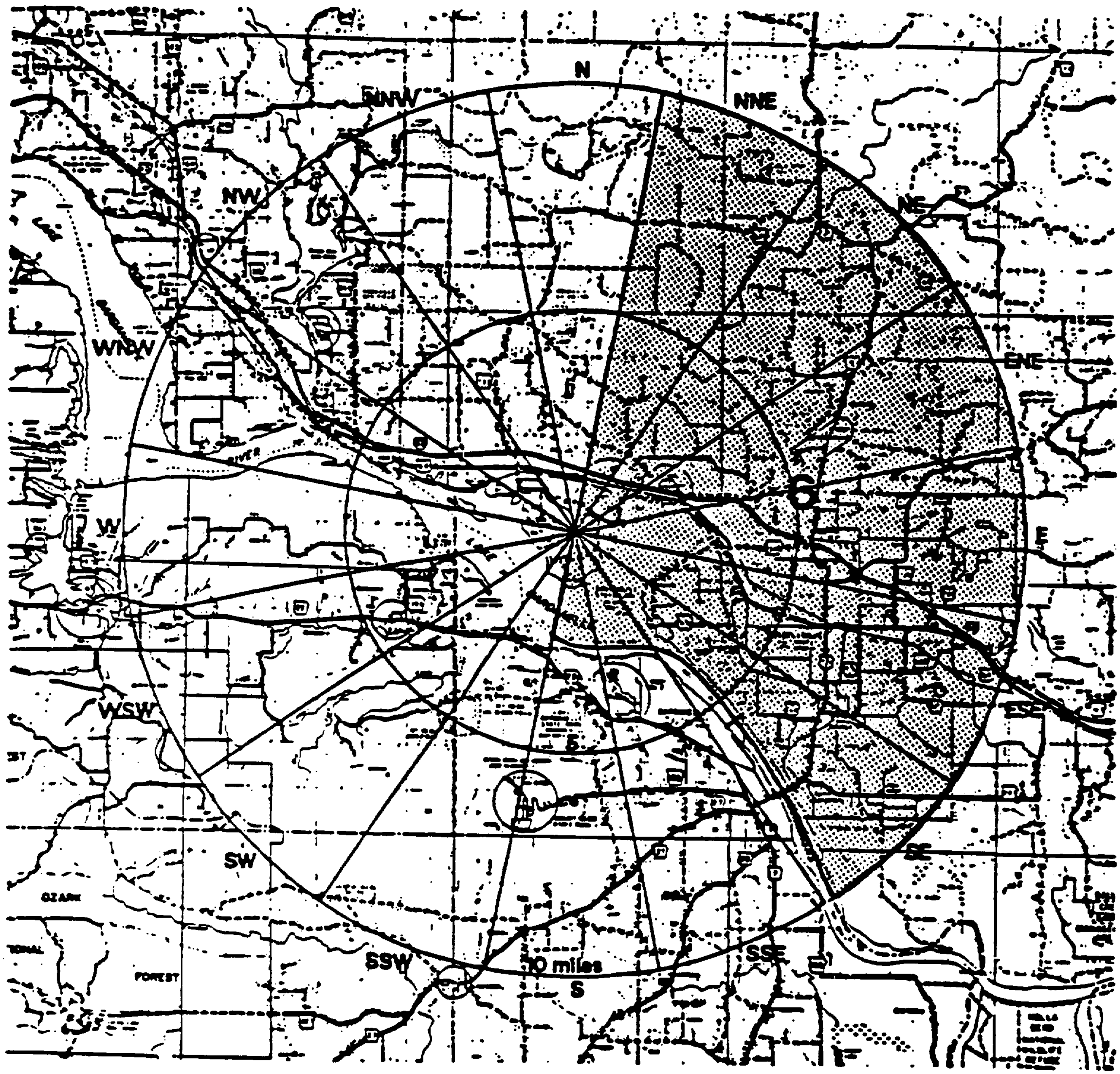


FIGURE 3-6 - CASE 6: 10-MILE ORANGE CASE

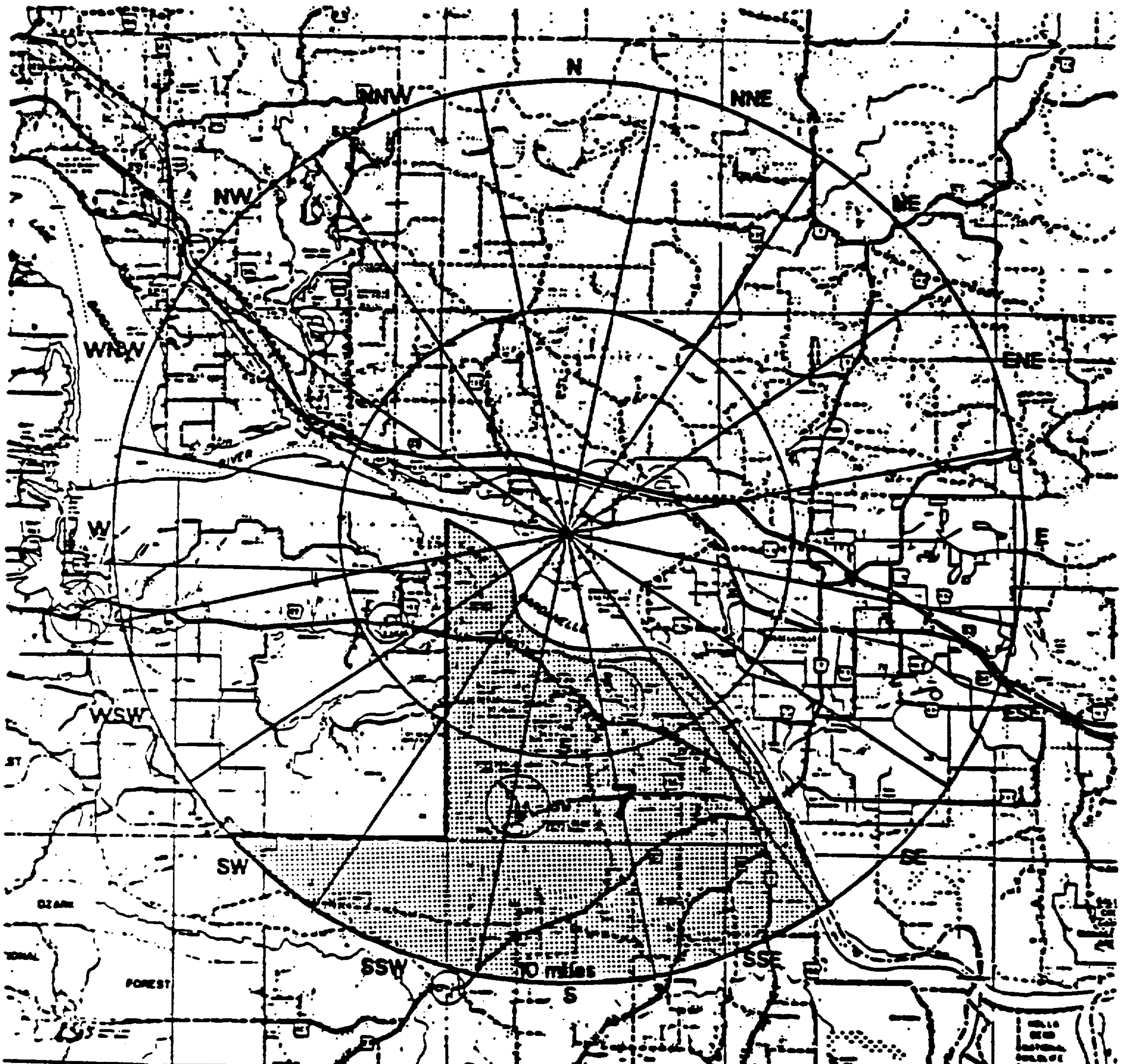


FIGURE 3-7 - CASE 7: 10-MILE BLUE CASE

Case 8: 10-Mile Yellow Case

Case 8 includes the part of Logan County within 10 miles of the site (See Figure 3-8). A total of about 690 people reside in this area. This would mean about 276 autos evacuate in this case. A peak number of 129 transient autos are also in this sector. Thus, under peak weekend conditions, about 405 cars may evacuate from this sector.

Case 9: Full EPZ

This case includes the entire 10-mile radius surrounding the power plant. This case includes about 26,800 permanent residents, a maximum of 11,516 transient autos and up to 4,031 employees' autos. A maximum of about 24,800 cars would evacuate the EPZ on a peak summer weekend. During a summer day when transient facilities are in use, but not at peak capacity, about 20,000 cars would evacuate. The boundaries for the case are shown on Figure 1-2.

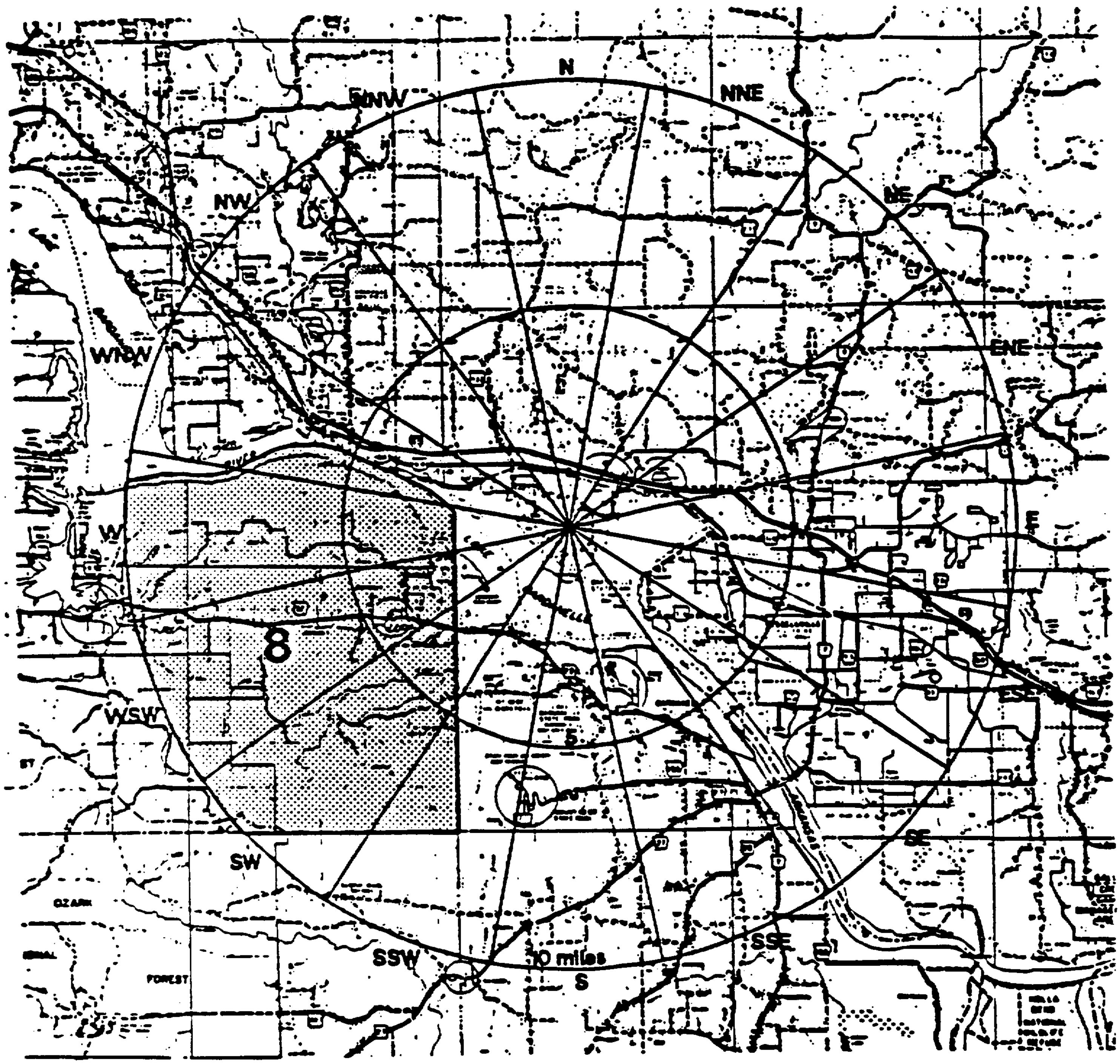


FIGURE 3-8 - CASE 8: 10-MILE YELLOW CASE

4. THE EVACUATION ROADWAY NETWORK

4.1 Network Definition

In order to estimate evacuation clear-times, an evaluation of the traffic network likely to be used by departing vehicles was undertaken. In defining the evacuation roadway network, HMM relied heavily on three sources of information.

1) The evacuation routes described in the existing county emergency response plans.
2) County, state, local and USGS maps of the EPZ area, and
3) Interviews with the ANP&RP officials.

Based on these data, HMM selected a comprehensive evacuation network to be used for evacuation simulation modeling. The traffic network elements considered in the evacuation modeling consist of the major streets and intersections within the EPZ. The major streets include roadways of the following classifications.

1) Expressways as characterized by high design standards, limited access, grade separation, and primarily through-traffic. Interstate 40 is the only expressway in the study area.

2) State Highways as characterized by continuity of travel; connecting business, population, or major recreation areas, and traffic controls and geometric designs which enhance traffic flow and safety.

3) Connector Streets as characterized by links between residential areas (served by local roads) and arterial streets.

The smaller local residential roadways are not specifically evaluated as part of the model simulation. In addition to the roadways, the evacuation network includes the intersections of major streets. The intersections are particularly important, since the ability of intersections to handle traffic is the major capacity constraint during an evacuation.

The total traffic network considered in the evacuation estimates is shown on Figure 4-1.

4.2 Links and Nodes

For the purpose of identification and for subsequently calculating evacuation times, the network a has been coded into a system of numbered "links" and "nodes".

A total of 88 nodes, representing the intersections, have been included in the network. These nodes have been given numerical identifier codes. The numbers from 0- to 200 were used to identify the internal nodes.

A total of 128 links, representing the actual evacuation segments, are included in the network. The links are identified by the number of the upstream and downstream nodes. Therefore, link 32-33 is the link upon which evacuees travel from node #32 to node #33.

"Entry" links and nodes are the mechanisms used to load the evacuation network with the departing automobiles. For modeling purposes, all automobiles are assumed to "enter" the real network at entry nodes (i.e., entry nodes are used as surrogates for all the parking lots, driveways, etc., from which the evacuating automobiles originate). The entry link is the link between the entry node and the internal node where the vehicles enter the real network, on a stochastic basis. For the A.N.O. network, 33 entry nodes were selected. The entry nodes are coded with 900 series numbers.

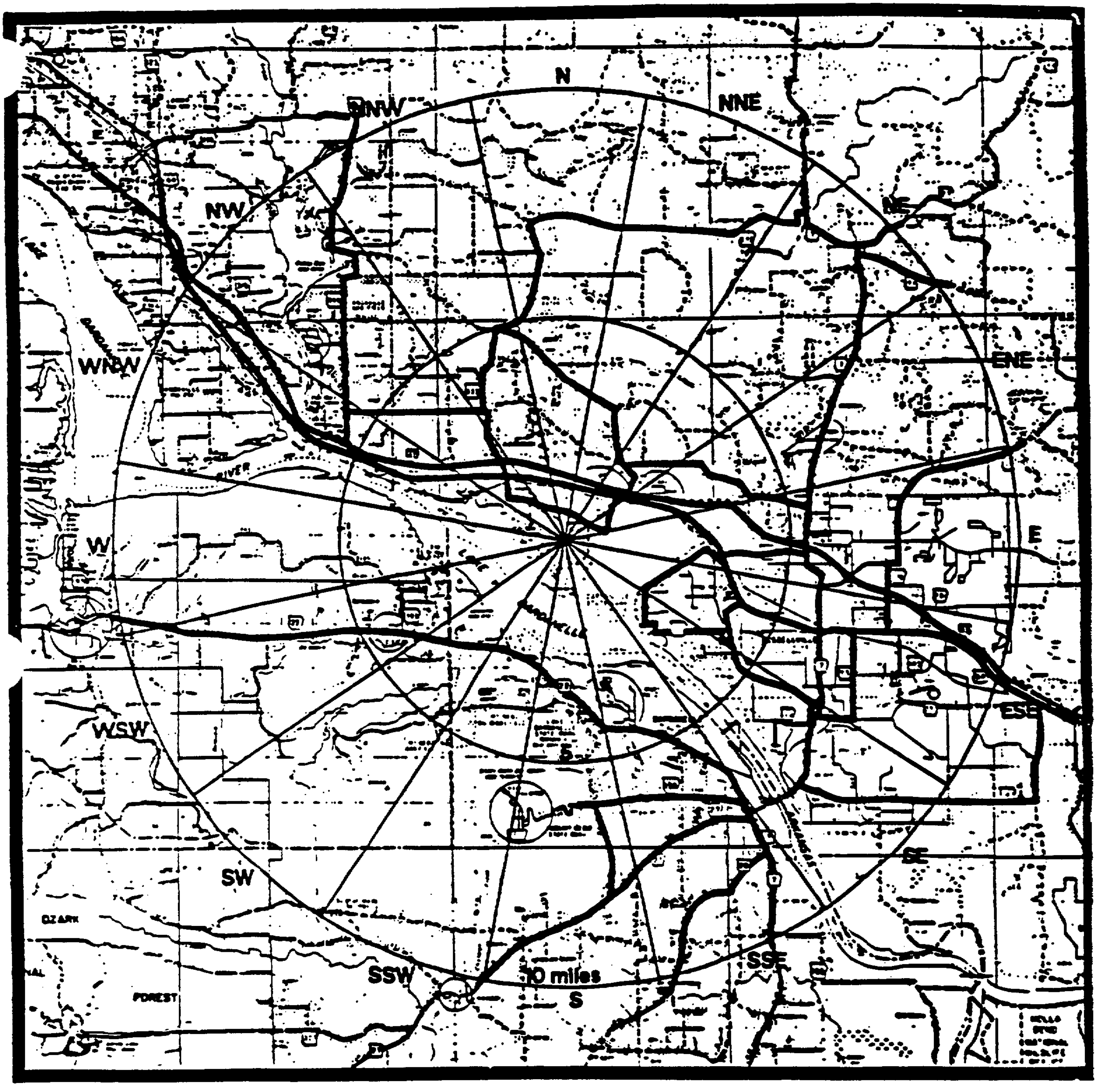


FIGURE 4-1 - EVACUATION ROADWAY NETWORK

Once carried through the internal evacuation network by the simulation process, the vehicles are simulated to leave the internal network at "exit nodes". Exit nodes are placed on the evacuation routes that depart the EPZ. They are generally located along the perimeter of the EPZ. For A.N.O. there are a total of 12 exit nodes. The exit nodes are identified by 800 series numbers (800-813).

The coded network for the Network is shown in figure 4-2. The figure shows the locations and number codes for each link and node in the network.

4.3 Characterizing the Evacuation Network

After defining and mapping the links and nodes included in evacuation roadway network, the traffic carrying characteristics for the system were inventoried. Using both field studies and available maps, the geometric descriptions for each component of the network were compiled. Figure 4-3 is an example of the field sheet used to compile the descriptive data for each link and node in the network. This field data incuded the number of lanes, the lane widths, shoulder widths, distances to obstructions, grade, cruise speeds and other data necessary to calculate the traffic capacity of each link in the system. Link lengths were measured from available maps. Traffic capacity information for each intersection (or node) in the network was also collected. The data sheet in Figure 4-3 was used to record numbers of lanes, lane width, approach widths, the presence of on-street parking on or near intersections, signalization, intersection shape, stop signs, yield signs, and other kinds of traffic control that would be significant in an evacuation network analysis.

The data from these efforts were coded and keypunched for input to the NETVAC model. The model, in turn, provided a listing of the evacuation roadway network and its characteristics.

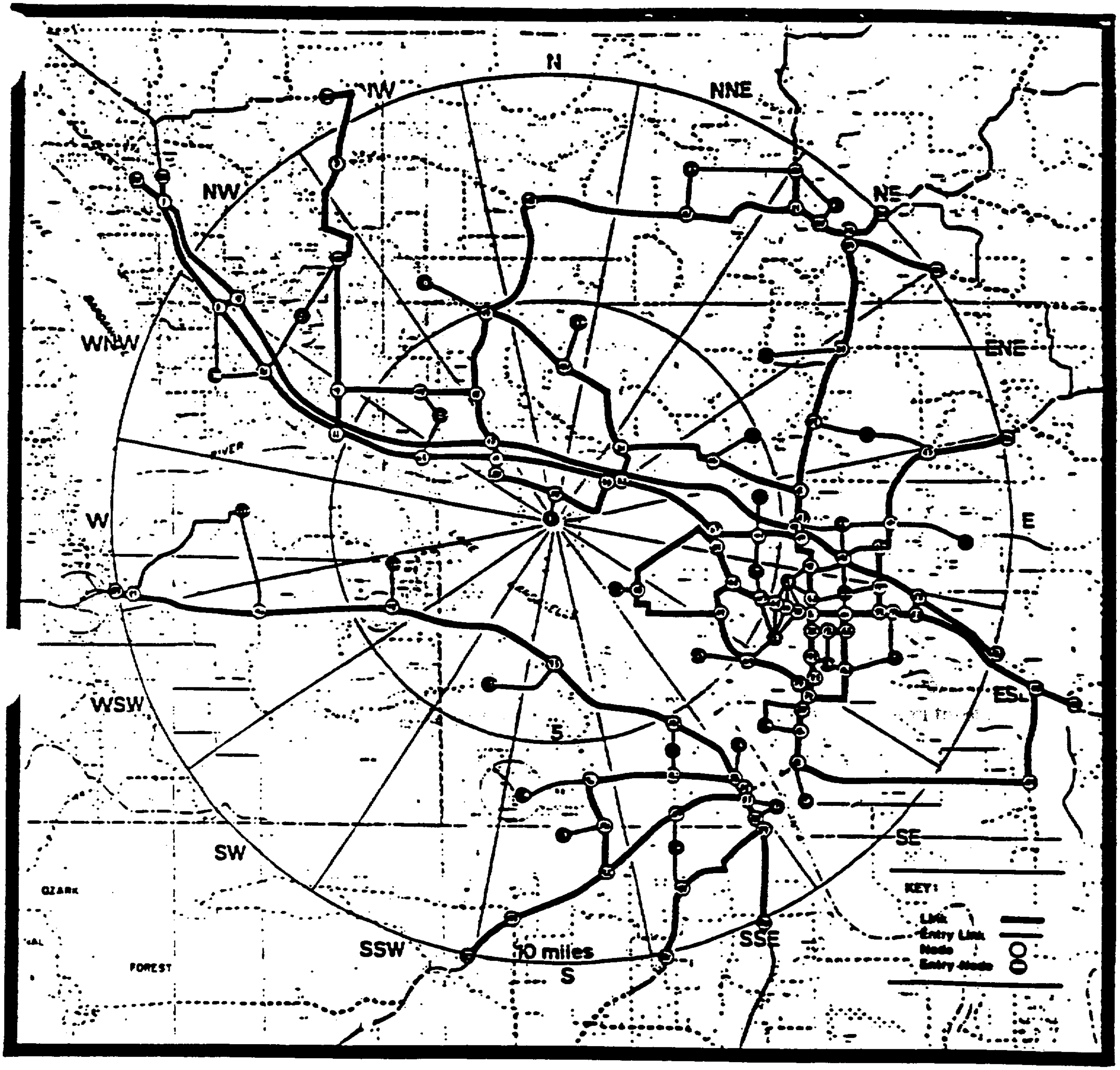


FIGURE 4-2 - LOCATIONS AND NUMBER CODES FOR EACH LINK AND NODE IN THE NETWORK

NODE #__________ A-TYPE__________ PLANT____________

Link from No.___	Link from No.___	Link from No.___	Link from No.___
Shldr. w.___	Shldr. w.___	Shldr. w.___	Shldr. w.___
Lane w. ___	Lane w. ___	Lane w. ___	Lane w. ___
# Lanes ___	# Lanes ___	# Lanes ___	# Lanes ___
L-type ___	L-type ___	L-type ___	L-type ___
Posted ___	Posted ___	Posted ___	Posted ___
Cruise ___	Cruise ___	Cruise ___	Cruise ___

The network listing descibes the geometric characteristics of each link in the network. The listing also describes the possible turning movements from each node and the traffic capacity of each link in the network (vehicles per hour that can be accommodated on each link during an evacuation). The listing of geometric characteristics and capacities is provided by the preprocessor for the NETVAC computer model prior to the actual evacuation simulation calculations. The network listing is attached as Appendix C to the report.

5. EVACUATION TIME ESTIMATE METHODOLOGY

5.1 Initial Alert and Notification

The EPZ surrounding A.N.O. has an early warning system consistent with NRC guidelines. This system will be used to alert the population to turn on their radios and television sets. It is assumed that evacuation notification messages will commence on the designated television and radio stations virtually immediately. Within 15 minutes the population within the EPZ will have received an informational or instructional message. The message will describe the need to evacuate, the evacuation routes, and the reception center locations.

All schools in the 10-mile EPZ will receive an advance alert to evacuate. It is planned that kindergarten through eighth grade will then be evacuated by bus, while grades 10 through 12 leave by private automobiles. This evacuation is expected to be complete prior to commencement of the general evacuation.

The timing of the order to evacuate and notification measures will be controlled by the state and local emergency planning officials. They may choose to alert and mobilize an emergency response work force to control and expedite evacuation prior to sounding the initial siren alert.

5.2 Evacuation Preparation Times and Departure Distribution

It is assumed that all population groups require at least some minimal preparation time. Therefore a base preparation time of fifteen minutes was assigned to all population groups. This means that no vehicles commence evacuation until 30 minutes after the initial order to evacuate. At this point the various population groups begin to enter the network. Network loading distributions for permanent population transient population, work force and special facilities were considered separately.

Permanent Population Departures

The local officials felt that permanent residents could take varying amounts of time to begin evacuating. They felt that some persons would leave as quickly as they could; most would take some time to form family units, pack valuable and clothes and then depart; and that some would take added time to secure farms and property before departing. It was therefore assumed that there would be a two hour period over which the permanent residents would begin departing. Within the two hour period, beginning 30 minutes after the initial order to evacuate, HMM suggested, and the ANP&RP officials approved, the use of three loading rates. During the first half hour it was assumed that only 15% of the permanent population would depart. This fraction was chosen to represent those persons that will leave as quickly as possible, with minimum preparation. It was assumed that 80%, or the bulk of the population would leave over the course of the following hour. The remaining 5% of the permanent residents were assumed to evacuate the small portion of the last half hour. This 5% represents the small portion of the population that requires additional time to secure property and to mobilize for departure. In some very low population cases, it was assumed that the population would all leave within 120 minutes.

Transient Population Departures

The departure distribution curve developed for permanent population was determined by ANP&RP, in discussions with HMM, to be equally applicable to the transient population. The 15%-80%-5% provides for rapid departure by some day-trip recreational visitors; it provides for longer preparation times for boaters, hikers and persons in remote locations; and it provides for some stragglers that do not receive prompt notification messages or that have a considerable amount of gear to pack before leaving.

Work Force Departures

It was assumed that the work force would receive initial alerts and notification promptly. It was also assumed that the large majority of the work force could, and would be released from the major employment centers expeditiously. Therefore, all work force departures were uniformly distributed over the first half hour (from time 30 to time 60 after initial order to evacuate) of the departure period.

Special Facility Departure Distribution

There are four nursing homes and two hospitals in the 10-mile EPZ. It is expected that nursing home residents and non-ambulatory hospital patients will remain in these facilities and be sheltered there. It is believed that there is greater risk involved in transporting these people than leaving them in place. Approximately 65 ambulatory patients are expected to evacuate St. Mary's hospital in private automobiles, and about 13 from Dardanelle hospital, with one person per automobile. These people will leave in the first 30 minutes of the evacuation.

The Arkansas Nuclear Planning and Response Program maintains an updated list of all the residents in the EPZ who are without means of private transportation. As of February, 1981, these were approximately 165 such residents listed. Arrangements have been made to transport these people in the automobiles of friends and relatives. No specific modeling procedures were used for this element of the population.

5.3 Evacuation Simulation

Actual evacuations were simulated by HMM using the population distribution data, evacuation network data, and evacuation preparation and departure time distribution assumptions discussed in previous sections. Evacuation was simulated using the NETVAC computer model. NETVAC is a flexible, fixed step, macro traffic simulation model which used traffic flow relationships to calculate and record traffic densities, speeds, flows, queues at bottlenecks, spill back where the network cannot handle the desired traffic loading demand, and other relevant information through the evacuation simulation process. At every simulation interval the model assigns traffic from links entering an intersection to the links emanating from it, thus advancing the traffic along the evacuation routes in the network.

NETVAC includes a dynamic route selection feature whereby drivers' choice of outbound links, at every intersection, is based on two criteria:

1) The directionality of the outbound link (i.e., the degree to which it leads away for the plant).

2) The traffic conditions on the outbound links (i.e., speeds and queuing). The traffic flow leaving a link at any intersection is subject to various approach capacity constraints, and all the traffic assigned onto an outbound link is constrained by the capacity of that link.

The roadway and intersection approach capacities calculated by NETVAC are based upon the Highway Capacity Manual (Highway Research Board, Special Report 87, 1965). Due to the dynamic route assignment mechanism, intersection approach capacities are updated at each simulation interval to account for the changing turning movements. The intersection control options which can be specified for NETVAC include fully signalized approaches, uncontrolled approaches, and secondary priority approaches (accounting for stop signs and yields signs in instances where they can be assumed to be obeyed).

The input to the model includes link information, node information, and traffic loading information. Link information includes:

1) Lane width,
2) Distance to obstructions,
3) Number of lanes,
4) Roadway type,
5) Directionality, and
6) Free-flow travel speed.

Node information includes:

1) Intersection approach width,
2) Intersection priorities and controls coordinates,
3) Intersection location within the metropolitan area, and
4) Traffic control.

Traffic loading information includes a stepwise time variable loading rate which may be specified at any node.

Prior to any execution, the NETVAC model computes all the traffic flow equations needed for each link and, on request, performs an elaborate series of checks to insure the integrity of the input data. The model output includes several types of information. These include pre-execution reports and simulation reports. Pre-execution reports include items such as:

1) Echo listings,
2) Network listings,
3) Heading labels,
4) List of signalized intersections,
5) List of entry nodes and entry rates, and
6) Network diagnostics,

Simulation reports may include items such as:

1) Total vehicles on the network,
2) Summary of departures through exit nodes on the EPZ perimeter,
3) Spill-backs at entry nodes,
4) Simulation completion report,
5) User-specified reporting interval, and
6) Link conditions for each network which list flow, queues, entry rates, departure rate, cumulative departures, and speed.

5.4 Conditions Modeled

Evacuation time analyses were made for three time periods for each case described in Section 3. Each case was analyzed for weekdays, nighttime, and weekend day. The following assumptions were made for each time period:

Weekday
- One or more family member in each residence,
- School children in school,
- Work places fully staffed,
- Recreational facilities normally in used, but not at peak. Note, this is a conservative assumption since this condition is not likely during most of the year and probably does not coincide with full school attendance.

Nighttime
- All permanent residents in homes,
- Schools empty,
- Work places on night shift, if any,
- Recreational facilities at nighttime attendance level.

Weekend
- At least one family member in each residence,
- Schools empty,
- Recreational facilities at peak capacity,
- Work places with weekend shift employment levels.

It should be repeated that each these time periods represents a conservative case. There is a certain amount of double counting since there are undoubtedly permanent residents also counted as transients at recreation facilities and as employees.

In addition, adverse-weather cases were run for the day cases since this is the limiting case in bad weather. An adverse-weather situation is assumed to be heavy rainfall or snow. The weekend case was not modeled for adverse weather since recreational facilities would not be at peak capacity under such weather conditions. To model adverse weather, it was assumed that all roads would operate at 70% of their normal capacity.

5.5 Evacuation Movement Consideration

The modeling of evacuation movements was designed to be consistent with the county emergency plans. It was assumed that the evacuation instructions in the emergency plans and the traffic control measures suggested in the plans would be implemented. Johnson County instructs all its residents to take the most expeditious routes to Route 40 and proceed west to a reception center in Clarksville, well to the west. Pope County directs its evacuees either west to Clarksville or east to Morrilton, depending upon where they originate. Yell County directs its residents south to Danville. Residents of Logan County are directed west to Paris. It should be noted that the model does not account for traffic control officers expediting flow. Existing traffic signals are the only traffic control facilities included in the model.

6. ANALYSIS OF EVACUATION TIMES

Clear time estimates for each case are presented on Table 6-1. These are estimates for the maximum time needed to clear each sector. During the winter, many of these times should be lower since the recreational facilities will not be occupied.

No provision is made for persons to travel home and form family units. It is assumed that the evacuating population departs directly from the school, work-place, recreation area or residence at which they are located when the alert sounds. Rendezvous will occur at the reception centers.

Case 1

For Case 1, the 5-mile green case, the maximum predicted evacuation time is 160 minutes. This occurs during both the weekday and weekend cases. These two cases are the same since there is no transient population in this sector. The nighttime case is slightly shorter than the day cases, clearing in 155 minutes. The limiting factor in this case is the employee populations at A.N.O.. During the day, 1,600 cars are loaded over a period of 120 minutes after a 30 minute preparation period. during the nighttime, 800 cars leave the plant site. These cars disperse over the roadway so that the capacity is not a limiting factor, rather the loading time is.

During adverse weather, weekday evacuation will take longer, 200 minutes. In this case the roadway capacity constraints the evacuation time.

TABLE 6-1

EVACUATION CLEAR-TIME ESTIMATES

Case	Weekday	Night	Weekend	Adverse Weekday
1	160	155	160	200
2	225	180	325	305
3	125	125	155	125
4	125	125	125	125
5	170	160	177	215
6	285	220	275	390
7	160	160	190	160
8	130	130	130	130
9	285	220	375	390

Case 2

Case 2 is the most heavily populated 5-mile case. It takes longer to clear on weekends, a predicted 325 minutes. This is due to two large state parks within this sector; Russellville State Park with a peak of 4,000 autos, and Ouita State Park with a maximum of 500 autos. Russellville State Park is the limiting factor in this case, with long queues to exit the park. Related queues also appear as this traffic goes through Russellville.

During the weekday and night cases, evacuation times are estimated to be 225 and 180 minutes respectively. During adverse weather on a weekday it will take a predicted 305 minutes to evacuate this sector. These three cases are constrained by the roadway network going through downtown Russellville, rather than a large number of cars entering at one point, since the park population is significantly lower.

Case 3

Case 3 includes Dardanelle State Park. On a peak weekend, 2,500 cars may be at this park. The weekend would, therefore, present the worst case for evacuating this sector, taking 155 minutes. On weekends and nights, and during adverse weather, an estimated 135 minutes will be needed for evacuation. In all four of these scenarios, the limiting factor is the loading time of cars onto the network. Loading for the weekend case ends at the 150 minutes, and 120 minutes for the remaining cases. The clear time indicates about 5 minutes for the last car to leave the 5-mile network once loaded.

Case 4

Case 4 has the smallest number of cars, and although the number of autos in the day cases is twice the night case due to recreational facilities, all four time and weather scenarios clear in 125 minutes. In each case, the loading rate is the constraint, not the capacity of the roadways. Roads operate below capacity, and congestion is not a problem.

Case 5

The maximum evacuation time predicted for Case 5, in fair weather, is 170 minutes. This time estimate is for weekday and weekend cases. These two are the same because there is no weekend increase in transient population over that found on a summer weekday. The limiting factor in this case, like Case 1, is the worker population evacuating A.N.O. No significant roadway constraints or particular problem areas occur beyond the plant area. During adverse whether, the evacuation time is 45 minutes longer, 215 minutes. In this case, roadway capacity constraints come into play, slowing down traffic on the roadway network. The nighttime case is less, taking about 160 minutes to clear.

Case 6

The weekend is the time with the longest evacuation time in this case, 375 minutes. This is the longest evacuation time for any of the 10-mile cases, which is to be expected since it includes Russellville and has by far the largest population. The main constraint in this case is the 4,000 autos leaving Russellville State Park. This traffic causes long queues and take nearly the full evacuation time to reach Route 7 on the way out of the EPZ. In addition, queues form where cars try to gain access to roads used heavily by cars evacuating the park. Another problem area in this case is Route 326 where it intersects Route 64. Route 64 is a major carrier of evacuating autos and the dense traffic on this road causes traffic from Route 326 to come to a virtual standstill for 30 to 40 minutes while trying to gain access to it. However, this traffic clears before park related traffic, and is therefore not the limiting factor.

The weekday case clears in an estimated 285 minutes in fair weather and 390 minutes in adverse weather. In these cases, the park traffic is not as significant. However, the bottleneck on Route 326 remains a problem. This also holds true for the nighttime case, which clears in an estimated 220 minutes. The large number of industrial facilities in this sector, as well as transient facilities which operate with many fewer people at night, cause the nighttime evacuation time to be considerably lower than the daytime cases.

Case 7

The peak for Case 7 occurs on the weekend. During this time period, evacuation takes an estimated 190 minutes. The largest contributors to weekend population are the transients at Dardanelle and Mt. Nebo State Parks. Together. these two parks account for about 4,500 of the approximately 6,400 cars in this case, and cause most of the congestion noticed in this evacuation. The Mt. Nebo access road becomes very congested and slow moving as does Route 27 beyond the Mt. Nebo cut-off. Traffic associated with the Dardanelle State Park does not create as much of a problem as it clears out steadily.

Both the weekday and night cases clear in about 160 minutes. This is also true for the weekday adverse weather case. All three of these cases evacuate smoothly with no major congestion. The limiting factor in these cases is the loading rate, not roadway constraints. Autos are clearing the EPZ as fast as they can get from the entry point to the EPZ boundary.

Case 8

All four scenarios modeled for Case 8 clear the EPZ in about 130 minutes. The peak case, the weekend, has a total of about 400 cars to evacuate. The constraint in this case is the loading rate. There is no congestion on the roadways; they all operate well below their capacity throughout the evacuation.

Case 9

This case involves a complete evacuation of the entire 10-mile EPZ. As can be seen from Table 6-1, all the clear-time estimates for this case are the same as those for Case 6. this indicates that Case 6, with Russellville, is the limiting case. Evacuating the other three 10-mile cases at the same time does not interfere with the evacuation time of Case 6. Each case proceeds more or less independently. This is due, in large part, to roadblocks set up north and south of the plant preventing most traffic from going into one sector from another. In addition, the Arkansas River separates the two northern sectors from the two southern sectors. The model runs of this evacuation case show that the problem areas for each individual case still exist: near Mt. Nebo, Route 326, and the center of Russellville. The main carriers for exiting traffic, as expected are Route 40 east and westbound, Route 64 eastbound. In addition, large traffic volumes south of the Arkansas River exit via Route 7, Route 28, and Route 27 south.

Confirmation of Evacuation

ANP&RP staff, and county officials estimate that is will take one hour to verify evacuation.

APPENDIX 5A

ARKANSAS NUCLEAR ONE

EVACUATION TIME STUDY FOR PUBLIC

PROTECTIVE ACTION ZONES

JUNE, 1989

APPENDIX 5A
TABLE OF CONTENTS

PROTECTIVE ACTION ZONES

The Protective Action Zone (PAZs) for the general public in the 10-Mile Emergency Planning Zone (EPZ) surrounding Arkansas Nuclear One (ANO) were redefined during 1989. The information in the Evacuation Time Study was utilized to develop evacuation time estimates, by PAZ. These zones are described in the State and County Emergency Plans and the Emergency Instruction Booklet which is distributed to the general public. Figure 1 is a black and white reproduction of the 10-Mile EPZ map describing these zones.

The University of Arkansas, Little Rock (UALR) State Data Center performed an analysis of the population in the 10-Mile EPZ around ANO. This analysis, along with data from the Evacuation Time Study itself, was utilized to develop population distribution data and evacuation times, by zone. Table 1 lists the population and the number of households in each zone. Table 2 lists the evacuation time estimate for each zone. This information was extrapolated from the data in the Evacuation Time Study.

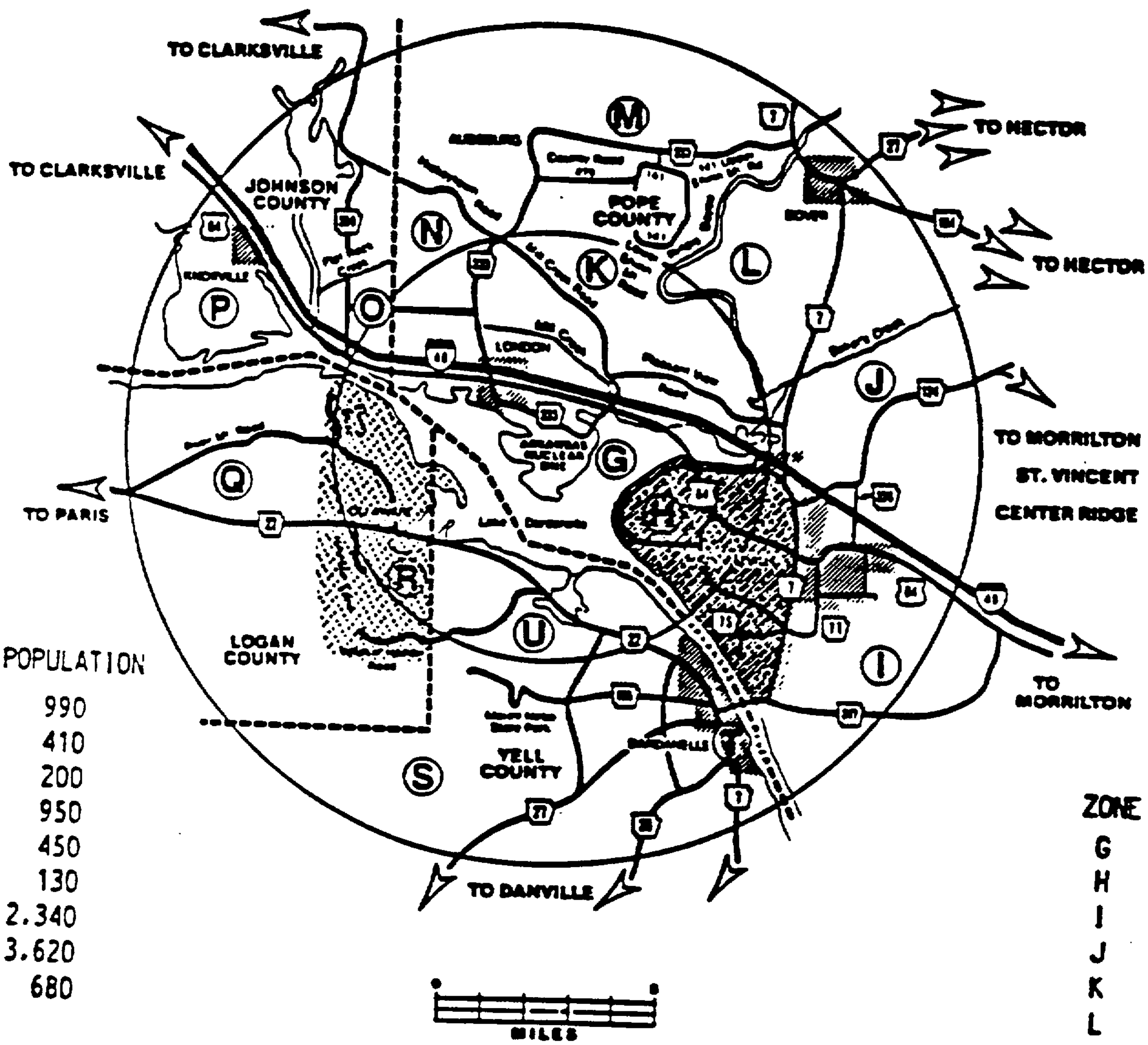
FIGURE 1

TEN-MILE EPZ MAP

OF

PROTECTIVE

ACTION ZONES



ZONE	POPULATION
M	990
N	410
O	200
P	950
Q	450
R	130
S	2.340
T	3.620
U	680

ZONE	POPULATION
G	1.070
H	9.930
I	7.720
J	1.980
K	1.030
L	2.210

TABLE 1

TABLE 1

POPULATION AND HOUSEHOLD TOTALS FOR
PROTECTIVE ACTION ZONES

ZONE	POPULATION	HOUSEHOLDS
G	1,064	439
H	9,928	3,489
I	7,721	3,299
J	1,980	811
K	1,032	400
L	2,266	891
M	989	357
N	410	163
O	199	80
P	946	394
Q	449	199
R	134	59
S	2,340	928
T	3,621	1,481
U	675	269
10-MILE RADIUS TOTAL	33,754	13,259

Source: 1980 Census of Population, Master Area Reference File (MARF)

TABLE 2

EVAUCATION TIMES FOR PROTECTIVE
ACTION ZONES
(IN MINUTES)

ZONE	WEEKDAY	NIGHT	WEEKEND	ADVERSE WEATHER
G	160	160	160	200
L	160	160	160	215
U	120	120	150	120
T	160	160	190	160
S	120	120	150	120
R	120	120	120	120
Q	130	130	130	130
H	220	180	320	300
I	180	220	370	390
J	150	150	150	180
K	190	160	170	210
M	170	160	170	210
N	170	160	170	210
P	90	90	90	90
O	90	90	90	90

Socioeconomics and Alternatives

13. Reference Section 6. Discuss alternative uses at the site as well as away from the site. Discuss the statement on page 6-1 that purchased power is not a "reasonable alternative because there is no assurance that the capacity or energy would be available."

    Response: Information is attached.

Answers to Additional Questions from NRC for ANO-1 relicensing
3/28/00

1. Purchased Power option (Section 6.0)

"Imported" or "purchased" power means power purchased and transmitted from electric generation plants that the applicant does not own and that are located elsewhere within the region or nation. Entergy Arkansas purchases substantial amounts of capacity on the wholesale market (3.6 million MWh in 1998). The majority of this power is currently purchased from the Tennessee Valley Authority (TVA). For the purposes of this analysis, it is assumed that replacement of generation by ANO-1 with purchased power would come from the TVA. As approximately 45% of electricity from the TVA is generated using fossil fuels, air emissions would be higher from purchased power than from generation by ANO-1. Other large generators in the region would have as high, if not higher, emissions rates, as energy production in the region is generally from older coal plants that have the highest emissions per kWh of all generation sources.

2. Include land use impacts from transportation of fuel in Section 6.2

Section 6.2, Comparison of Environmental Impacts for Reasonable Alternatives, includes information on the environmental effects of displacing the ANO-1 plant with gas, coal or oil fired generation. However, the effects of transporting these fuels to either a site at ANO-1 or elsewhere are not included.

Section 6.2.1 – Conventional Coal Fired Units: There are rail lines at the ANO-1 site. A new coal plant on that location would not have additional environmental impacts due to transportation. However, a new coal plant elsewhere in the service territory may have an increased environmental impact due to the need to build additional rail lines to the facility.

There is not enough land at the ANO-1 site to build both a coal fired unit and have space for a coal yard. The additional land use would increase the environmental impact of coal fired generation.

Section 6.2.2 – Oil and Gas (Combined Cycle): Oil to other Entergy plants is shipped via barge up the Mississippi. If that is a possibility for ANO-1 (up the Arkansas), that would be the preferred method of transport. Otherwise, Oil can be trucked or shipped by train. Little environmental impact from both these options.

Section 6.2.3 – Natural Gas (Combined Cycle): Currently Reliant and Ozark are two natural gas pipelines approximately five miles from the ANO-1 site. The Reliant pipeline is a 24" diameter interstate natural gas pipeline and is capable of providing 550 lbs. of inlet pressure to the ANO-1 site. The second pipeline, Ozark, is a 20" intrastate natural gas pipeline would not provide the necessary pressure for a natural gas-fired electric generation facility on the ANO-1 site. Firm Transport, required to develop a combined cycle 500 MW electric generation plant, is currently not available due the pipeline being fully subscribed. In order to increase the amount of firm transport capacity a parallel line or looping would be required on the 24" diameter line. Natural gas supplies to the ANO site could be provided from the Gulf of Mexico, South Texas or the Permian Basin reserves. You will definitely get Oklahoma Arkoma Basin gas and some Oklahoma Anadarko Basin gas as well.

3. Update Conservation statement in Section 6.1

The output of ANO-1 could be displaced by reducing energy use through a substantial amount of energy conservation. Entergy currently is reducing emissions, and increasing efficiency at it's plants, in order to decrease greenhouse gas emissions as part of the Clinton Administration's Climate Challenge for utilities. Carbon Dioxide (CO_2) emissions reductions in 1998 totaled to approximately 5.3 million tons, corresponding to a reduction in fossil generation of approximately 7 million MWh, using the average emissions rate for Entergy's fossil plants. This reduction, however, and future reductions of CO_2 emissions, are already accounted for in Entergy's generation needs.

From a review of conservation plans at other companies, it is assumed that it would potentially be possible to displace approximately 5% of the generation from ANO-1 from a targeted program. The environmental impacts of an energy conservation program would be SMALL, but the potential to displace the entire generation at ANO-1 solely with conservation is not realistic. Conservation is instead used in assessing combinations of alternatives in Section 6.1.

4. Combinations of Alternatives in Section 6.1

By combining conservation, purchased power and new generation, the output of ANO-1 could be displaced at lower environmental effect than one option alone. For this assessment, 500 MW of combined cycle gas turbines (CCGT), a conservation rate displacing 5% of ANO-1's output, and purchased power, are assessed. The MW contributions from these sources would be as follows:

Existing ANO-1 generation:	836 MW (e)
CCGT:	500 MW
Conservation (5% of 836 MW):	42 MW
Purchased power:	294 MW

While conservation measures would have very little, or no, negative environmental effects, the CCGT and purchased power components of this option would increase air emissions and environmental impacts.

Entergy

Entergy Services, Inc.
7701 Frazier Pike
Little Rock, AR 72206

Materials. Purchasing
& Contracts - T&DS

February 9, 1999

Mike Bewley Construction
6071 SR 333
London, AR 72847

Subject: CAS00481
1999 TRANSMISSION LINE RIGHT OF WAY RECLEARING

Gentlemen:

Enclosed find two (2) copies of the above subject contract. Please sign both copies of this contract, keep one copy for your records and return the other copy to me at the following address:

Entergy Arkansas, Inc.
7701 Frazier Pike
Little Rock, AR 72206
ATTN: Donald R Horton

The Contractor should invoice Entergy Arkansas, Inc., Attn. Donald Lee Woods, Mail Unit: A-TDS-TCM. **Please contact Donald Lee Woods at (501) 490-4743, to obtain the mailing address for submitting invoices for payment.** The Contractor must reference the contract manager and contract number on the invoice.

If you have any questions, please give me a call at (501) 490-3732.

Sincerely,

Donald R Horton
Sr. Procurement Specialist
T&D Support - MP&C

CMIS/mb
Enclosure
c: Donald Lee Woods, A-TDS-TCM

Final

FORM A-2

Contract No.: **CAS00481**
Effective Date: **01/04/1999**

ENTERGY MULTIPURPOSE MAINTENANCE, MODIFICATION AND CONSTRUCTION SERVICES STAND-ALONE CONTRACT
SHORT FORM

THIS CONTRACT is between **Entergy Arkansas, Inc.** ("Owner") and **Mike Bewley Construction** ("Contractor").

1. Terms. Contractor agrees to perform and complete the work as described below for the amount of money and in accordance with Owner's schedule described below.

2. Description and Schedule of Work. The Contractor shall perform and complete the work or jobs in accordance with Owner's specifications or standards, and Contractor shall furnish all labor, supervision, materials, tools and equipment necessary to reclear the following transmission line rights of way.

a) Mabelvale – Pinnacle/OG&E 500kV	$31,800
b) Keo – ISES 500kV	$19,500

Reclearing shall be done in accordance with attached - Specification #4 "Transmission Line Corridors – Mechanical Re-Clearing – Mowing"

In addition Contractor may be requested to provide support to Owner for storm restoration and other emergency work.

Time is an essential element in this Contract. Work will start on or about **01/04/1999** and shall be entirely completed on or before **02/12/2000**.

3. Compensation.

Lump sum amount for Items a and b - $51,300.00

Time & Material rates for storm restoration and other emergency work –

Two (2) tractors, two (2) operators and one (1) pickup	$75.00/hour
Chain saw operators	$15.00/hour

4. Representatives and Claims Notifications. The following representatives are designated by Owner and Contractor respectively, for communications and liaison relative to this Contract:

Owner's Contract Manager:

Name:	Donald Lee Woods
Address:	A-TDS-TCM
Phone #:	(501) 490-4743
Contractor:	
Name:	__________________
Address:	__________________
Phone #:	__________________

For commercial questions regarding this Contract, contact Donald R Horton at (501) 490-3732.

Contractor shall immediately notify the Owner's Contract Manager in writing of any claims or accidents or injuries to persons or property in connection with work hereunder and shall provide to Owner with access to accident reports or claim investigations as requested by Owner. A copy of the notice required in the preceding sentence shall be sent by Contractor to Claims Management, Entergy Services, Inc., P.O. Box 8082 Little Rock, Arkansas 72203, and to Legal Services Department, P.O. Box 61000, New Orleans, Louisiana 70161.

5. Invoicing and Payment. Owner agrees to pay Contractor the compensation due for the work specified above upon the later of (i) acceptance of the work by Owner or (ii) forty-five (45) days from Owner's receipt of Contractor's properly prepared invoice for the completed work. All invoices submitted by Contractor shall be in the form and supported by such documentation as Owner may reasonably require. Any money due Contractor under this or other contracts between the parties shall be adjusted for amounts inappropriately invoiced, whether discovered prior or subsequent to payment by Owner. For all work performed on time and material, unit price, or cost reimbursable basis, Contractor shall keep complete books or records and receipts of expenses to support charges billed. Contractor shall make these records available for audit by Owner and shall provide full assistance to Owner's audit. Invoicing and payment of taxes shall be in accordance with Exhibit A attached hereto. Unless expressly provided otherwise in Exhibit A, no taxes are to be invoiced or charged to Owner. The Contractor should invoice Entergy Arkansas, Inc., Attn. Donald Lee Woods, A-TDS-TCM. Please contact Donald Lee Woods at (501) 490-4743, to obtain the mailing address for submitting invoices for payment. **Owner's Contract Manager, Donald Lee Woods and Contract Number, CAS00481 must be referenced on all invoices.**

6. Termination. Owner reserves the right to terminate this Contract for breach or convenience upon prior written notice to Contractor. In such event, work in process and information developed for Owner by Contractor prior to termination shall be delivered to Owner, and Owner shall pay Contractor for acceptable performance of work up to the date of termination, but Contractor is not entitled to anticipated profits on work not performed. Termination shall not relieve either party of obligations arising out of this Contract in connection with the work performed prior to termination.

7. Suspension. Owner may suspend all or any of the work upon prior written notice to Contractor. Within ten (10) days from a subsequent written notice from Owner to Contractor to resume the suspended work, Contractor shall submit a written invoice to Owner setting forth any actual and reasonable increases in Contractor's costs resulting solely from the Owner's suspension, and Owner shall reimburse Contractor for such costs, subject to Owner's right to contest in good faith the accuracy of the costs.

8. Risk of Loss and Use. In the event Owner provides Contractor with materials or equipment, Contractor will make a full and complete accounting to Owner of the disposition of all such items issued and delivered to Contractor by Owner. Contractor will be responsible (at full replacement cost) for the loss or destruction of any materials or equipment in its possession during the period of contract performance and for work in process until the work is accepted in its entirety by Owner, except to the extent any such loss is covered by the proceeds of an All Risk/Builder's Risk Policy paid to Owner. Upon completion of the work, Contractor shall return any such property to Owner in the condition in which it was received, except as repaired or modified in the performance of the work. Contractor shall be solely responsible for assuring itself of the safety and suitability of such equipment prior to use and shall indemnify and defend Owner, its employees, and agents against any claims or damages arising from such use by Contractor.

9. Warranty.

(a) Unless otherwise specified, Contractor warrants that the services and goods supplied shall be of high quality, shall be new, fit for intended purposes, free of defects, and that goods supplied shall perform as specified. In addition to other remedies, Contractor agrees promptly and at its own expense to remedy, replace, or re-perform (including removal or reinstallation) any part of the work which proves defective or otherwise unsuitable for the purposes of this Contract. If Contractor does not remedy or replace any such work, Owner may undertake such remedial work at Contractor's expense. This warranty shall also apply to any replacement work. Contractor shall assign qualified and competent personnel to the performance of the work, and Contractor and such personnel shall use their best efforts to perform the work, in the most expeditious, professional and economical manner consistent with the interests of Owner.

(b) Contractor represents and warrants: (1) that all hardware, software and firmware delivered under this contract including all subsequent updates and/or upgrades thereto, (the "Delivered Systems") shall correctly and accurately recognize, support and process date data (including by way of example and without limitation solely to such examples, calculating, comparing, sorting or sequencing) from, into, among and between the twentieth and twenty first centuries (including, by way of example and without limitation solely to such examples, correct and accurate recognition of leap years and correct and accurate distinction among each and every date in the year 2000 A.D.); (2) that any serializing, logging, indexing, sequencing, docketing, dating or other numbering, sequencing or data management systems or methods employed in or by the Delivered Systems that use all or any part of any date data to form all or any part of such numbering, sequencing or data management systems or methods will operate correctly and accurately with all dates in the range of January 1, 1900 to December 31, 2050; and, (3) that the year portion of all date data fields in the Delivered systems accommodate and store four digit year dates.

10. Independent Contractor. , Owner has the right to review qualifications of Contractor's employees before assignment to perform Work hereunder. Contractor will have complete control of, and supervision over, its employees, tools and equipment, and the methods and procedures used in the performance of this Contract or operations incidental thereto. It is expressly understood and agreed between the parties hereto that Contractor shall be, and operate as, an independent Contractor in the performance of this Contract and shall be solely responsible for wages, benefits and safety of Contractor's employees. Nothing herein shall preclude Owner from raising a "Statutory Employer" defense, if applicable. Further the parties mutually agree that it is their intention to recognize Owner as the statutory employer of the Contractor's employees, whether direct employees or statutory employees of the Contractor in accordance with Louisiana Revised Statute 23:1061 while Contractor's employees are providing Work hereunder.

11. Compliance with Laws and Rules.

(a) Unless otherwise provided in paragraph 2 above, Contractor shall procure, at its own expense, all necessary governmental permits and inspections required in connection with the work under this Contract and shall be licensed as required by law. Contractor shall observe and abide by all applicable federal, state, and local laws, and the rules and regulations of any lawful regulatory body acting thereunder in connection with the services to be rendered pursuant to this Contract. Contractor shall, prior to commencement of work, request from Owner's representative listed in paragraph 4 any applicable site health, safety, quality and security rules, procedures or programs, and Contractor shall comply with such applicable rules, procedures or programs. In addition, Contractor shall maintain a written safety program for the work performed hereunder. Contractor shall comply with the provisions of Owner's safety program in effect at the work site or Contractor's own safety program, whichever is most stringent. Contractor shall designate a competent on-site representative with responsibility for the safety program implemented by Contractor and recordkeeping. Failure to comply with applicable laws, site rules, or safety programs may result in removal of the Contractor or applicable employees or subcontractors from the work site. The Contractor further agrees that to the extent applicable, including but not limited to, the purpose of promoting small and small disadvantaged businesses, the Contractor will fully comply with the requirements of the Small Business Act, 15 U.S.C. Section 631, et seq., and the Office of Procurement Policy Act, 41 U.S.C. Section 423, et seq., as implemented in the Federal Acquisition Regulations found at 48 C.F.R. Part 1, et seq., all of which are hereby incorporated by reference and made part of this Contract.

(b) Unless this Contract is exempt from Executive Order 11246, under the rules and regulations of the Secretary of Labor (41 C.F.R. Ch. 60), the Contractor agrees that during the performance of this Contract it will fully comply with the provisions of the equal opportunity clause as set forth in Section 202 of Executive Order 11246 and 41 C.F.R., Section 60-1.4(a) (1-7), which provisions are hereby incorporated by reference and made a part of this Contract. During the performance of this Contract, Contractor also agrees that it will fully comply with the applicable equal opportunity provisions of the Rehabilitation Act of 1973, as amended and applicable regulations, 41 C.F.R. Section 60-741, et seq., and the Vietnam Era Veterans Readjustment Act of 1974, as amended and applicable regulations, 41 C.F.R. Section 60-250, et seq., which are hereby incorporated by reference and made a part of this Contract. The Contractor certifies that it does not and will not maintain or provide for its employees any facilities which are segregated by race, color, religion or national origin or permit its employees to perform any services at any location, under its control, where segregated facilities are maintained and Contractor will obtain a similar certification for all non-exempt subcontractors, as required by 41 C.F. R. Section 60-1.8.

12. Use of Information. Contractor warrants that it has full and unrestricted right to disclose all data and documents presented to Owner in the performance of this Contract, and that Owner has full and unrestricted rights to use, copy and distribute such documents and data as Owner may deem appropriate, and that such data and documents shall be the sole and exclusive property of Owner. Contractor shall not disclose confidential or proprietary information provided to Contractor by Owner in connection with this Contract without Owner's prior written consent, except where such information was already publicly available or except where disclosure is required by judicial or regulatory bodies.

13. Indemnity. To the fullest extent allowed by law, Contractor shall indemnify and hold harmless Owner, its affiliated and associated companies, and their agents, officers, directors, shareholders and employees for any liability, loss, cost, claims, expenses, including attorneys' fees, arising from the performance of or failure to perform this Contract by Contractor, REGARDLESS OF ANY NEGLIGENCE ATTRIBUTABLE TO OWNER, ITS AGENTS OR EMPLOYEES. Owner may require Contractor to defend any suits concerning the foregoing. In case the use of anything protected by patent, trademark, copyright, trade secret or other proprietary right is enjoined, Contractor shall, in addition to the foregoing indemnity and defense, at its own expense, either procure for Owner the right of continued use of or replace the same with noninfringing articles or processes of equal functionality and efficiency.

14. Subcontracts or Assignments. For work to be performed in Louisiana, Contractor agrees to give preference to sources of supply within the State of Louisiana in subcontracting opportunities. Contractor shall not employ outside subcontractors to perform any of the services covered by this Contract or assign its rights and obligations hereunder without first procuring the written consent of Owner and requiring the subcontractor or assignee to produce evidence of insurance coverage required in paragraph 15. Contractor shall remain liable for all acts or omissions of an authorized subcontractor. Contractor further hereby agrees to provide maximum practicable opportunity to small and small disadvantaged businesses (as such businesses are defined by the Small Business Administration or by the Federal Acquisition Regulations) for participation in any subcontracts that are to be let by Contractor in the performance of its obligations under this Contract. Lists of all subcontractors that qualify as such small or small disadvantaged businesses shall be supplied to Owner by Contractor.

15. Insurance. Without limiting any obligations or liabilities of Contractor under this Contract, Contractor shall provide and maintain during the course of the Contract, at its own expense, without direct reimbursement, insurance coverage in forms and amounts which Contractor believes will adequately protect it, but in no case less than:

(a) Workers' Compensation Insurance, and such insurance shall be in accordance with all applicable state, federal, and maritime laws, including Employer's Liability Insurance in the amount of $500,000 per accident. Policy shall be endorsed to include a waiver of subrogation in favor of the Owner and its affiliated and associated companies. This coverage shall be maintained regardless of the number of employees employed by Contractor.

(b) Commercial General Liability Insurance including Contractual Liability Coverage covering liability assumed under this Contract, Products/Completed Operations Coverage, Broad Form Property Liability Coverage, and Personal injury Coverage in the amount of $1,000,000 per occurrence for Bodily Injury and Property Damage and Underground Collapse and Explosion Hazards.

(c) Commercial Automobile Liability Insurance including all owned, hired, leased, assigned and non-owned vehicles, with a combined single limit of $1,000,000 per accident.

Contractor's insurance policies required by paragraphs (b) and (c) above, shall name the Owner and its affiliated and associated companies as Additional Insureds with respect to Contractor's liability arising from this Contract. Contractor hereby waives all rights of recourse, including any right to which another may be subrogated. against the Owner and its affiliated and associated companies for personal injury, including death, and property damage.

All of Contractor's policies of insurance shall be primary and non-contributing with any insurance maintained by Owner and its affiliated and associated companies. Policies are to provide Owner with thirty(30) days' prior written notice of cancellation or any material adverse change in conditions.

Contractor shall provide Owner with Certificates of Insurance issued to the Owner, as defined in this Contract, as the Certificate Holder, evidencing coverage currently in effect upon execution and for the duration of this Contract.

Contractor shall require any subcontractor providing on-site services under this Contract to carry insurance coverage in a form and amount consistent with the requirements of this Insurance Article. Contractor shall obtain Certificates of Insurance evidencing such coverages prior to the commencement of services by the subcontractor and shall present such Certificates to the Owner upon request and, in any case, no later than completion of Work hereunder.

16. Severability. It is agreed that if any clause or provision of this Contract is held by the courts to be illegal or void. the validity of the remaining provisions of the Contract shall not be affected, and the rights and obligations of the parties shall be enforced as if the Contract did not contain illegal or void clauses or provisions.

17. Liens. Contractor agrees to indemnify and defend Owner against any liens or encumbrances upon Owner's property as a result of work hereunder, and Contractor will provide evidence that no such encumbrances exist upon Owner's request.

18. Site Conditions. Contractor is solely responsible for satisfying itself concerning the nature and location of the work prior to signing this Contract and shall not make claims for unknown site conditions discovered during performance of the work if such conditions could have been discovered in a reasonable site investigation prior to commencement of the work.

19. Use of Site. Any roadways, landscaping, or other property damaged as a result of Contractor's work shall be repaired or replaced at Contractor's expense. Title to rock, soil, gravel, sand, timber or other materials obtained in the performance of the work shall remain in the Owner. Contractor shall confine its work areas to those assigned by the Owner's representative and shall maintain such areas in a neat and safe condition. Prior to final payment, Contractor will remove its unused materials, equipment and rubbish, and shall return to Owner salvageable materials supplied by or paid for by Owner.

20. Hazardous Materials. If Contractor should discover asbestos or other hazardous materials while performing the work that were not known to exist, Contractor shall notify the Owner's representative immediately. Contractor shall not remove or further disturb such hazardous materials until Owner has provided Contractor with written instructions related thereto.

21. Entire Contract. This Contract and any documents referenced herein constitute the entire contract with respect to the subject matter hereof. Referenced documents are intended to be complementary; however, any conflict between the body of this Contract and the provisions of documents referenced herein shall be resolved in favor of the terms and conditions contained in the body of this Contract.

22. Amendments. This Contract may only be altered, amended, or modified in a written document executed by both parties. Contractor hereby waives all claims for schedule extensions or additional compensation because of any alleged changes to the work scope, unless Contractor provides Owner's Contract Manager and Owner's Contract Administrator with a written request for an amendment within ten(10) working days of the event Contractor claims has added to or changed the schedule or scope of work and prior to commencement of performance of such changed work.

23. Governing Law. This Contract shall be governed and construed in accordance with the laws of the state in which the work is to be performed hereunder. However, if the work is to be performed in Mississippi, the parties agree that this Contract shall be governed and construed in accordance with the laws of the state of Arkansas.

24. Nonwaiver. The failure of Owner to insist upon, in any instance, strict performance by the Contractor of any of the terms of this Contract shall not be construed as a waiver of Owner's right to enforce such terms on any future occasion

ACCEPTED AND AGREED:

Owner: Entergy Arkansas, Inc.

By: Donald R Horton

Signature: Donald R. Horton

Title: Sr. Procurement Specialist

Date: 2/9/99

Contractor: Mike Bewley Construction

By: ____________________

Signature: ____________________

Title: ____________________

Date: ____________________

CONTRACT NO.: CAS00481

EXHIBIT A
TO
ENTERGY MULTIPURPOSE MAINTENANCE, MODIFICATION AND CONSTRUCTION SERVICES STAND-ALONE CONTRACT
SHORT FORM

A. GENERAL.

1. Except with respect to taxes paid directly by the Owner as may be described in Part B below, Contractor will bill and collect applicable state and local taxes in a timely manner. Prompt pay discounts or refunds obtained from taxing authorities will be passed on to the Owner.

2. Invoices shall separately itemize material costs, service costs, the portion of the price representing manufacturing or processing machinery or other items that are exempt from taxes or subject to a lower rate and itemize tax rates applicable to each.

B. COMPANY SPECIFIC SALES AND CONTRACTOR'S TAX PROVISIONS [Add as applicable.]

1. Entergy New Orleans, Inc., Entergy Services, Inc., System Fuels, Inc., and Entergy Arkansas, Inc. - Contractor is solely responsible for billing and remittance of state and local taxes in a timely manner, except in cases where the Contractor is not registered or authorized to, and is not otherwise required to, collect and remit such taxes. In cases where contracts for repair or construction of permanent fixtures or structures are not subject to tax, the Contractor may be required to pay gross receipts or sales tax on sales to it of materials used in construction or repair. Thus, on cost reimbursable Contract Orders, Contractor's invoices must itemize taxes paid by Contractor to its suppliers for materials used or consumed in the Work.

Entergy

Last Update:
AR Grid 10-99

SPECIFICATION #4

TRANSMISSION LINE CORRIDORS
"*MECHANICAL RE-CLEARING - MOWING*"

OBJECTIVE:

Use mechanical mowing equipment designed to cut trees and other woody vegetation at or near ground level to prepare for follow-up chemical herbicide treatments and to provide Long-term safety and reliability at minimum cost.

WORK TO BE PERFORMED:

Contractor shall have all required State and Federal licenses and permits prior to submitting bids.

This work may be accomplished by use of manual crews and/or mechanized re-clearing - mowing equipment. **The Contractor shall act as an independent Contractor furnishing all supervision, labor, tools, equipment, chemical herbicide materials, licenses, permits and conveyances necessary for re-clearing the transmission line right-of- way, disposal of limbs and brush, and disposal of tree trunks and merchantable timber as specified herein or as directed by the Company Contract Manager.**

AREAS TO BE MAINTAINED:

Contractor shall provide notification to the proper State and Federal authorities for work on Public lands prior to commencing re-clearing services and upon completion of work (i.e, - U.S. Forest Service, State Forestry Commissions, U.S. Parks Service, Federal and State Wildlife Agencies). When possible, Contractor shall notify other property owners prior to commencing re-clearing services. Contractor shall perform right of way services in designated work areas only.

1.) The distance to be controlled will be specified in the **Schedule of Work**. Generally, it will be the entire length from:

A.) GPS location to GPS location along a line
B.) Structure number to Structure number
C.) Line junction to Line junction
D.) Substation to another Line junction
E.) Substation to Substation

2.) The width to be controlled shall be from the right of way's edge to the right of way's edge or within the following:

A.) To the line of timber that exists from initial line construction.

B.) To the edge of a pipeline, railroad or other right of way that is being maintained by mowing, spraying or other treatment that has already eliminated tall-growing trees.

C.) The width of the corridor as listed in the **Schedule of Work**.

Contractor shall locate and attach brightly colored plastic flagging at a minimum of one (1) location on each side of the right of ways' edge near the center of each span and/or approximately every 300-linear feet where re-clearing activities are being performed.

Flagging may be attached to stakes, limbs, trees, fences etc. This flagging is to remain intact after the re-clearing operations have been concluded. There is a mutual benefit for both parties, - It will aid the Contractor in assuring the full specified width of right of way is being obtained, and give inspector a visual confirmation that a reasonable attempt is being made to secure the specified widths of cleared right of way. In turn, if the inspector determines that narrow or out of specification clearing has been accomplished, he will provide the contractor with a written list indicating structure numbers of the area(s) requiring additional work. In no way is this provision intended to relieve the contractor of his obligation to perform under this agreement.

Corridors or portions of corridors found to be more narrow than the specified width shall be brought to the attention of the Company Contract Manager. The Company Contract Manager shall provide Contractor with instructions as to what to do about less than full width corridors.
If additional work is determined, all removed trees and brush shall be cut to within 4" of the ground line unless other wise specified by Company Contract Manager. If additional payment is due to the Contractor for this work, Company and Contractor will establish a price for this work prior to work beginning and the Contractor will be paid at that price.

Company has the option, if additional work is determined, to perform this work using the Contractor at the Contractor's regularly hourly price which is established for rates or choose another Contractor to perform this specific work task.

3.) Mechanical re-clearing - Mowing will include all acreage within Entergy's transmission right of ways unless specifically excluded in writing by Company Contract Manager.

4.) Hazard trees (trees that are posing an immediate threat to line reliability because they are, leaning toward the line, subject to falling on the line because of advanced soil erosion) outside the corridor are to be cut down or topped depending on what is most appropriate. **Any observed dead trees which are not cut shall be reported to the Company Contract Manager on a weekly basis.**

In some situations hazard trees may be live, green trees, where the landowners are due fair compensation for their removal. Such cases are to be handled **on a case by case basis,** contractor shall coordinate through the Company Contract Manager.

5.) All road crossings, fence lines, water crossings, swamps, marshes or other variations of occurrences with vegetation within the corridor must be re-cleared or controlled to the Company's satisfaction.

6.) See the attached Special Provisions (if any) for each line.

7.) Solid grass areas are not targeted for re-clearing.

8.) All areas around poles, down guys, anchor rods, and structure legs/foundation will require hand or manual type re-clearing or chemical herbicide applications. No mechanical cutting shall be performed within a five foot (6') radius of the above mentioned electrical facilities. Vines climbing on poles and guys shall be cut leaving a 48" (4 foot) space or gap and the vine left to die. Herbicides shall be used to control the vine's root systems after cutting. **Extreme care shall be taken by Contractor not to cut nor damage any ground wire or other devices that may be located on any pole or structure. For safety reasons, do not remove any vines from structures and/or other facilities.**

TREATMENTS:

Undesirable trees and other woody vegetation are to be controlled by using mechanical mowing equipment that can be pulled or pushed by a motorized vehicle.

1.) Undesirable trees and other woody vegetation that are not accessible and/or restricted from use by motor vehicle are to be controlled by either Hand Cutting equipment or by the use of Chemical Herbicides. Chemical herbicides applied such as Foliar, basal bark, or soil banding shall be performed as recommended in the herbicide manufactures product label.
. These areas would include locations such as all down guys, anchor rod locations, **fence rows, gates and ditches. Any tree and /or brush eighteen feet (6') tall or taller shall be cut down then the stump treated with herbicides.**

The intent of this specification is for the bidder to perform herbicide applications for all areas not re-cleared mechanically to control re-sprouting. The cost for labor, application equipment, permits, licenses, herbicide mixtures and mixing agents etc. will be included in the Bidders unit price per Brush Acre or in the Lump sum price for re-clearing the line or line segments. **All herbicides proposed for use must be approved by the Company Contract Manager, prior to use. All Herbicide products used must be listed on the Entergy Transmission "Approved Herbicide List".**

2.) All treatments through cutting shall leave tree stumps no higher than four inches (4") above ground level. In some cases, a stem or stump may impose a safety hazard to the worker, in these cases stumps may be higher than the four inches (4"). **This should be the exception not a regular occurrence.**

3.) Woody debris resulting from re-clearing activities shall be processed in a manner that leaves the right of way with a pleasing appearance (mowing, re-mowing debris, chipping debris onto the right of way). Exception to normal work practices, if limbs/debris have to be removed from the right of way, Contractor will select an environmentally approved location for that waste. Contractor shall obtain approval from the Company Contract Manager regarding any cost associated with the **removal of debris prior to cleanup.**

4.) The contractor will be responsible and in compliance with all Federal, State and Local regulations related to the use of mechanical woody plant cutting devices and any or all aspects associated with the use of chemical herbicides (shipping, storing, mixing, container disposals; product application etc.)

REPORTS / DOCUMENTATION:

Contractor shall call the Company Contractor Manager each day informing him of whether the crew(s) are working or not, and their exact work location(s) and any other specific information as requested by Company Contract Manager. Contractor shall also provide a written weekly progress report for all work that occurred in the previous week. This report shall detail the re-clearing progress made for each line(s) and structure numbers re-cleared with an attached **list for all dead trees observed that week which were not cut and their locations.**

Access, customer relations and line outages have historical value to the Company. Refusals, Damages/ Complaints and Contractor Caused Outages shall be documented on the proper Company form and provided to the Company Contract Manager within three (3) days of the occurrence. **Resolutions regarding any and all claims shall be the Contractors' responsibility.**

Upon completion of work the Company Contract Manager shall complete the Company Contractor Evaluation Form and forward copies to Contract Administration and to the Transmission Vegetation Group.

SAFETY:

Contractor may be required to call Company DOC / TOC each day, informing the Operations Control Group of crew(s) work location(s) before starting work and ending work and upon crew(s) moving to another line segment or to another line branch.

CLEAN-UP, ACCESS & PUBLIC RELATIONS, MISCELLANEOUS:

1.) Refuse, brush and debris are the contractors' responsibility. It should be noted that landowners property is to be guarded with the highest degree of respect and consideration.

2.) Detailed maps can be available by request. Access and landowner problems have historical value to the company and shall be recorded and given to the Company Contract Manager.

3.) Contractor shall take all necessary measures to promote good public relations for the company's present and future maintenance operations. All gates and fences shall be left in as good or better condition. **Gates found closed shall remain closed at all times.**

4.) No trees or branches are to be cut and left in creeks, rivers, ponds, lakes, in roads, in ditches or on fences. Brush and Debris should be removed from pastures and managed fields.

5.) Public land tracts such as National and State Forest, etc. and other lands under the control of Federal and/or State authorities shall be cleared under the guidelines from that agency If issues/concerns involving work specification arise Contractor shall contact the Company Contract Manager for instructions.

ADDITIONAL ARKANSAS REQUIREMENTS

1.) Installation of plastic down-guy markers may be required by the successful contractor. This will include labor to properly cut the necessary woody-brush and install plastic markers at each wood and/or steel structures with down-guy construction. Down-guy marker materials (8-feet in length) will be provided by the Company Contract Manager.

FTN Associates Ltd.
water resources / environmental consultants

April 6, 2000

Mr. Mike Hendricks
Chief, Reservoir Control Branch
Little Rock District
US Army Corps of Engineers
PO Box 867
Little Rock, AR 72203

RE: Request for Lake Dardanelle Operations Information
FTN No. 6045-061

Dear Mr. Hendricks:

Entergy Operations, Inc. (EOI) has submitted a license renewal application to the Nuclear Regulatory Commission (NRC) for Arkansas Nuclear One Unit-1 (ANO-1) located on Lake Dardanelle near Russellville, Arkansas. This application, if approved, will extend the operating license for the facility from 2014 to 2034. EOI is currently assisting the NRC in the development of an Environmental Impact Statement (EIS) for ANO-1 that will address environmental issues related to the continued operation of this facility.

As part of the hydrology and water quality issues associated with the EIS, we are requesting information regarding any plans the Corps of Engineers may have for changing the operation of Lake Dardanelle. We are particularly interested in information related to any anticipated changes in flow, pool elevations, and water quality.

Your assistance in this matter is appreciated. Please call Rick Buckley (Entergy) at (601) 368-5372 or me at (501) 225-7779 with any questions you may have.

Kindest regards,
FTN ASSOCIATES, LTD.

W. Johnson
for Bob West
Project Manager

cc: Mr. Rick Buckley (Entergy)
Ms. Natalie Mosher (EOI/ANO)

P:\WP_FILES\6045-061\L-HNDRKS.DOC\MCJ

3 Innwood Circle • Suite 220 • Little Rock, AR 72211
(501) 225-7779 • Fax (501) 225-6738
Web Site: www.ftn-assoc.com
E-mail: ftn@ftn-assoc.com

RESULTS FROM ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM ON FISH IMPINGEMENT

RESULTS FROM ARKANSAS NUCLEAR ONE - UNIT ONE
INTAKE SCREEN MONITORING PROGRAM
ON FISH IMPINGEMENT

Attached are the results of the Impingement Monitoring Program at Arkansas Nuclear One - Unit One for the period January through June, 1975.

The impingement was high during the first three months of this reporting period with actual or estimated weights above a thousand pounds in twenty-four hour periods. Impingement started on a downward trend during the latter part of March along with rising water temperatures, to a low point in this report of nine pounds of fish in a twenty-four hour period.

Astericks in this report are used in the following manner:

*	Indicates a twenty-four hour weight extrapolated from an eight hour sample.
***	Indicates a twenty-four hour weight extrapolates from a sixteen hour sample.
	All other weights are from actual twenty-four hour samples.
**	Indicates an abnormal or unique occurrence.

CODE FOR FISH

SPECIE	CODE NAME
Threadfin Shad	T. Shad
Gizzard Shad	G. Shad
Freshwater Drum	F. Drum
Blue Catfish	B. Catfish
Channel Catfish	C. Catfish
Mississippi Silverside	M. Silverside
Black Crappie	B. Crappie
White Crappie	W. Crappie
White Bass	W. Bass
Bluegill Sunfish	B. Sunfish
Flathead Catfish	F. Catfish
Largemouth Bass	L. Bass
River Carpsucker	R. Carpsucker
Green Sunfish	G. Sunfish
Redear Sunfish	R. Sunfish
Golden Shiner	G. Shiner
Silverband Shiner	S. Shiner
European Carp	E. Carp
Skipjack Herring	S. Herring
Orangespotted Sunfish	O. Sunfish
Longear Sunfish	L. Sunfish
Smallmouth Buffalo	S. Buffalo
Black Bullhead	B. Bullhead
Paddle Fish	Paddle Fish
Common Carp	C. Carp
Chestnut Lamprey	C. Lamprey
Sauger	Sauger
Warmouth Bass	Wa. Bass
Gold Eye	Gold Eye
River Shiner	R. Shiner
Longnose Gar	L. Gar
Stripped Bass	Str. Bass

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
1-3-75	2						*206
G. Shad		50	4329	91 - 120	210	5.1 - 10	
T. Shad		150	9636	61 - 90	136	0 - 5.0	
B. Catfish		.87	120	61 - 90	87	0 - 5.0	
M. Silverside		.62	60	91 - 120	104	0 - 5.0	
W. Bass		.87	20	132	132	21	
W. Crappie		3.2	120	61 - 90	186	0 - 5.0	
1-7-75	4						*710
T. Shad		672	36,703	91 - 120	158	5.1 - 10	
G. Shad		37	1531	91 - 120	1250	5.1 - 10	
M. Silverside		.45	50	61 - 90	99	0 - 5.0	
B. Catfish		.15	12	87	87	6	
C. Catfish		.15	12	80	80	5	
B. Crappie		3.0	12	205	205	108	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
1-10-75	4						
T. Shad		2203	134,003	91 - 120	124	5.1 - 10	
G. Shad		45	2741	91 - 120	120	5.1 - 10	
B. Catfish		.6	63	91 - 120	9.5	0 - 5.0	2252*
W. Bass		1.4	32	135	135	19	
M. Silversides		.4	32	108	108	5	
1-13-75	4						
B. Catfish		.14	15	61 - 90	92	0 - 5.0	
T. Shad		706	49,437	61 - 90	118	0 - 5.0	732
G. Shad		22	1533	91 - 120	229	5.1 - 10	
M. Silverside		.38	45	91 - 120	105	0 - 5.0	
W. Crappie		1.18	8	187	187	72	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
<u>1-14-75</u>	4						
G. Shad		213	9421	91 - 120	129	5.1 - 10	
W. Crappie		.16	26	70	70	3.0	
C. Catfish		.32	51	61-90	82	0 - 5.0	3048
M. Silverside		.96	102	91 - 120	100	0 - 5.0	
T. Shad		2830	179,251	91 - 120	127	0 - 5.0	
<u>1-15-75</u>	4						
T. Shad		1585	115,735	91 - 120	127	0 - 5.0	
G. Shad		422	30,747	91 - 120	130	5.1 - 10	
W. Crappie		4.8	34	184	184	64	2034*
M. Silverside		.53	68	61 - 90	97	0 - 5.0	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
1-16-75	4						5610
T. Shad		5566	289,411	91 - 120	126	5.1 - 10	** Only one found to date
G. Shad		70	2621	120 - 150	200	15.1 - 20	
M. Silverside		.29	23	113	113	6	
Polyodon ** Spathula		2.0	1	610	610	965	
1-17-75	4						
M. Silversides		.70	57	107	107	5	
G. Shad		272	13,867	91 - 120	138	15.1 - 20	6790
T. Shad		6502	332,525	91 - 120	145	5.1 - 10	
C. Catfish		1.77	57	140	140	13	
1-18-75	4						
W. Crappie		16	78	202	202	95	9300
T. Shad		9,014	471,820	91 - 120	148	5.1 - 10	
G. Shad		155	4728	91 - 120	220	15.1 - 20	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
1-19-75	4						
G. Shad		139	9031	91 - 120	205	10.1 - 15	10,230 *
T. Shad		9915	440,825	91 - 120	195	5.1 - 10	
1-21-75	4						
F. Drum		.14	18	75	75	4.0	
M. Silverside		.11	18	97	97	3.0	2123
C. Catfish		1.5	71	61 - 90	146	0 - 5.0	
B. Catfish		.19	18	98	98	5.0	
G. Shad		74	4531	91 - 120	202	5.1 - 10	
T. Shad		2048	85,987	91 - 120	135	5.1 - 10	
1-24-75							
M. Silverside		.52	47	91 - 120	105	0 - 5.0	
G. Shad		33	2228	91 - 120	184	5.1 - 10	1898
T. Shad		1817	10,751	91 - 120	113	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
1-25-75	4						
M. Silverside		.17	28	84	113	2.0	3331
F. Drum		1.73	28	152	152	30	
Skip Jack Herring		12.14	28	270	270	200	
C. Catfish		.87	28	134	134	14	
G. Shad		125	7271	91 - 120	235	5.1 - 10	
T. Shad		3150	171,967	91 - 120	144	5.1 - 10	
W. Bass		2.43	28	154	154	40	
1-25-75	4						
M. Silverside		.67	89	61 - 90	100	0 - 5.0	*2685
G. Shad		419	15,510	91 - 120	222	5.1 - 10	
T. Shad		2218	94,943	91 - 120	147	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
<u>1-28-75</u>	4						
F. Drum		4.26	32	61 - 90	147	0 - 5.0	609
B. Catfish		.40	41	91 - 120	107	0 - 5.0	
M. Silverside		.15	16	91 - 120	102	0 - 5.0	
C. Carp		8.27	8.0	400	400	463	
G. Shad		34.0	2907	91 - 120	132	5.1 - 10	
C. Catfish		1.14	40	61 - 90	187	0 - 5.0	
T. Shad		533	29,435	91 - 120	135	5.1 - 10	
<u>1-31-75</u>	4						
Chestnut Lamprey		1.29	11	275	275	55	
F. Drum		2.71	22	151 - 180	262	31 - 35	1057
M. Silverside		.07	11	95	95	3.0	
C. Catfish		.24	33	61 - 90	88	0 - 5.0	
B. Catfish		4.41	347	91 - 120	172	0 - 5.1	
L. Sunfish		.41	44	96	96	17	
T. Shad	1	575	26,680	91 - 120	135	5.1 - 10	
G. Shad		469	24,727	91 - 120	232	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-4-75	4						
M. Silverside		.21	22	100	100	4.0	
F. Drum		1.46	45	61 - 90	179	0 - 5.0	557
W. Crappie		.07	22	61 - 90	65	2.0	
G. Sunfish		.35	22	31 - 60	91	0 - 5.0	
C. Catfish		3.27	290	61 - 90	155	0 - 5.0	
B. Catfish		1.18	100	91 - 120	107	0 - 5.0	
G. Shad		89	5826	91 - 120	240	5.1 - 10	
T. Shad		442	23,193	91 - 120	126	5.1 - 10	
2-7-75	4						
S. Herring		4.6	11	273	273	208	
B. Catfish		2.0	63	61 - 90	218	0 - 5.0	
C. Catfish		1.3	137	61 - 90	133	0 - 5.0	1261
B. Bullhead		.20	11	95	95	9.0	
G. Shiner		.37	11	68	68	1.0	
M. Silverside		.33	42	91 - 120	97	0 - 5.0	
F. Drum		.06	21	31 - 60	64	0 - 5.0	
G. Shad		393	25,735	91 - 120	238	5.1 - 10	
T. Shad		841	[illegible]	91 - 120	111	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-8-75	4						
F. Drum		5.0	34	190	190	67	
C. Catfish		.22	34	80	80	2.0	
B. Catfish		.42	34	100	100	6.0	
G. Shad		477	19,811	91 - 120	250	5.1 - 10	4050
T. Shad		3573	225,383	91 - 120	124	5.1 - 10	
2-18-75	4						
M. Silverside		.67	76	100	100	4.0	
C. Catfish		2.86	76	100	100	16	*27480
G. Shad		210	8779	91 - 120	210	5.1 - 10	
T. Shad		8931	520,059	91 - 120	125	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-10-75	4						
M. Silverside		.78	126	92	92	3.0	
F. Drum		.78	126	66	66	2.0	*** 15,128
G. Shad		452	42,104	91 - 120	214	5.1 - 10	
T. Shad		14,623	787, 134	91 - 120	123	5.1 - 10	
2-11-75							
B. Catfish		1.37	105	95	95	4.0	18,825
C. Catfish		.98	105	75	75	2.0	
G. Shad		167	1098	181 - 210	224	65 - 70	
T. Shad		18,168	931, 053	91 - 120	125	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-12-75	4						
C. Catfish		3.45	184	61 - 90	137	0 - 5.0	
G. Shad		587	43,851	91 - 120	225	5.1 - 10	*** 11,055
T. Shad		10,462	441,094	91 - 120	130	0 - 5.0	
2-13-75							
B. Catfish		.80	64	112	112	7.0	*** 7,665
G. Shad		1078	52,569	91 - 120	210	5.1 - 10	
T. Shad		6583	322,505	91 - 120	132	5.1 - 10	
2-14-75							
M. Silverside		.33	52	95	95	4.0	*** 6,255
B. Catfish		.98	104	61 - 90	95	0 - 5.0	
C. Catfish		.33	104	61 - 90	80	0 - 5.0	
F. Drum		.33	104	76	76	4.0	
G. Shad		251	18,765	91 - 120	127	5.1 - 10	
T. Shad		6,000	293,829	91 - 120	127	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-15-75	4						
C. Catfish		.66	107	61 - 90	83	0 - 5.0	3205
F. Drum		8.35	53	181 - 210	210	51 - 55	
B. Catfish		2.67	80	61 - 90	179	0 - 5.0	
G. Shad		147	6089	91 - 120	216	5.1 - 10	
T. Shad		3045	143,103	91 - 120	129	5.1 - 10	
2-15-75	4						
W. Crappie		11.6	50	208	208	106	* 6015
F. Drum		39	50	333	333	353	
B. Catfish		1.25	150	61 - 90	93	0 - 5.0	
G. Shad		105	5614	91 - 120	203	5.1 - 10	
T. Shad		5852	267,768	91 - 120	124	10.1 - 15	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-17-75	4						
M. Silverside		.24	28	93	93	4.0	
G. Shiner		.24	28	80	80	4.0	
B. Catfish		.30	28	103	103	5.0	3350
C. Catfish		.17	28	78	78	3.0	
G. Shad		70	3378	91 - 120	194	5.1 - 10	
T. Shad		3280	163,899	91 - 120	123	5.1 - 10	
2-18-75	4						
C. Catfish		.52	124	61 - 90	79	0 - 5.0	4945
B. Catfish		.77	83	61 - 90	94	0 - 5.0	
G. Shad		64	4739	91 - 120	132	5.1 - 10	
T. Shad		4878	232,497	91 - 120	125	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-19-75	4						
F. Drum		1.48	47	124	124	15	
W. Crappie		.59	47	80	80	5.0	** Only Individual in sample
C. Catfish		1.77	284	61 - 90	90	0 - 5.0	
G. Shad		57	2364	91 - 120	217	5.1 - 10	
T. Shad		5613	229,885	91 - 120	125	5.1 - 10	
L. Gar **		2.5	1.0		820		
2-20-75	4						
F. Drum		1.28	205	61 - 90	95	0 - 5.0	
C. Catfish		1.28	68	61 - 90	127	0 - 5.0	4100
T. Shad		4057	188,634	91 - 120	127	5.1 - 10	
G. Shad		41	1913	91 - 120	127	0 - 5.0	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-21-75	4						
W. Crappie		.35	28	92	92	5.0	
M. Silverside		.52	55	91 - 120	103	0 - 5.0	3320
C. Catfish		.61	166	61 - 120	80	0 - 5.0	
B. Catfish		.17	28	95	95	3.0	
F. Drum		.17	55	31 - 60	65	0 - 5.0	
G. Shad		81	3016	91 - 120	220	5.1 - 10	
T. Shad		3237	142,400	91 - 120	128	5.1 - 10	
2-22-75	4						
W. Crappie		.46	37	89	89	6.0	4425
M. Silverside		.23	37	87	87	2.0	
C. Catfish		1.6	258	61 - 90	90	0 - 5.0	
B. Catfish		1.7	184	91 - 120	102	0 - 5.0	
G. Shad		63	5052	91 - 120	223	5.1 - 10	
T. Shad		4351	162,508	91 - 120	133	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-22-75	4						
M. Silverside		.59	68	96	96	4.0	
C. Catfish		.84	68	95	95	5.0	*8130
B. Catfish		1.69	136	91 - 120	99	0 - 5.0	
G. Shad		165	7114	91 - 120	136	5.1 - 10	
T. Shad		7961	350,403	91 - 120	143	5.1 - 10	
2-23-75	4						
W. Bass		1.28	34	119	119	17.0	
C. Catfish		1.28	171	61 - 90	94	0 - 5.0	*1710
M. Silverside		.64	68	91 - 120	97	0 - 5.0	
G. Shad		72.9	4925	91 - 120	205	0 - 5.0	
T. Shad		1635	64,946	91 - 120	128	10.1 - 15	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
<u>2-25-75</u>	4						
C. Catfish		.32	73	61 - 90	73	0 - 5.0	
F. Drum		.46	37	85	85	6.0	*3660
G. Shad		791	34,371	91 - 120	208	5.1 - 10	
T. Shad		3591	153,683	91 - 120	151	5.1 - 10	
<u>2-26-75</u>	4						
F. Drum		.049	26	61	61	1.0	
M. Silverside		.23	26	101	101	4.0	*3165
G. Shad		387	22,287	91 - 120	237	5.1 - 10	
C. Catfish		1.15	53	61 - 90	132	0 - 5.0	
T. Shad		2776	125,967	91 - 120	130	5.1 - 10	
<u>2-27-75</u>	4						
B. Catfish		.27	25	96	96	5.0	
C. Catfish		.15	25	80	80	3.0	*2955
M. Silverside		1.39	148	91 - 120	107	0 - 5.0	
G. Shad		66	2856	91 - 120	218	0 - 5.0	
T. Shad		2886	132,162	91 - 120	143	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
3-3-75	4						
W. Bass		.95	22	139	139	20.0	
F. Drum		5.27	87	91 - 120	230	5.0 - 10	
B. Catfish		.34	22	99	99	7.0	*2595
C. Catfish		.81	130	61 - 90	100	0 - 5.0	
G. Shad		55	5709	91 - 120	214	0 - 5.0	
T. Shad		2532	108,017	91 - 120	133	5.1 - 10	
3-7-75	4						
F. Drum		9.1	77	61 - 90	308	0 - 5.0	* 768
C. Catfish		1.68	154	61 - 90	185	0 - 5.0	
B. Crappie		2.88	13	123	123	102	
M. Silverside		.14	26	61 - 90	98	0 - 5.0	
W. Bass		.72	13	146	146	26.0	
G. Shad		59	4326	91 - 120	250	0 - 5.0	
T. Shad		662	31,437	91 - 120	140	10.1 - 15	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
3-11-75	4						
G. Shad		142	8533	91 - 120	222	5.1 - 10	
F. Drum		14	454	61 - 90	203	0 - 5.0	*2835
W. Crappie		3.5	57	61 - 90	185	0 - 5.0	
W. Bass		.88	28	115	115	14.0	
M. Silverside		1.0	113	91 - 120	112	0 - 5.0	
C. Catfish		1.77	198	61 - 90	128	0 - 5.0	
B. Catfish		.88	113	61 - 90	94	0 - 5.0	
T. Shad		2670	116,859	91 - 120	124	0 - 5.0	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
3-14-75	4						
River Shiner		.46	39	61 - 90	90	0 - 5.0	*2445
M. Silverside		1.22	171	91 - 120	105	0 - 5.0	
W. Crappie		.15	24	70	70	2.0	
T. Shad		2100	113,863	91 - 120	124	0 - 5.0	
G. Shad		210	14,866	91 - 120	239	0 - 5.0	
B. Catfish		4.97	562	61 - 90	148	0 - 5.0	
W. Bass		1.22	49	91 - 120	124	5.1 - 10	
F. Drum		56.5	4230	61 - 90	172	0 - 5.0	
C. Catfish		13	1174	61 - 90	135	0 - 5.0	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
3-18-75	4						
C. Catfish		.90	110	61 - 90	130	0 - 5.0	
B. Catfish		.50	25	61 - 90	145	0 - 5.0	
W. Crappie		.05	8	87	87	4.0	*848
M. Silverside		.16	25	91 - 120	97	0 - 5.0	
F. Drum		4.9	237	61 - 90	193	0 - 5.0	
B. Sunfish		.63	8	130	130	33	
W. Bass		.64	17	91 - 120	131	10.1 - 15	
G. Shad		35	1415	91 - 120	256	0 - 5.0	
T. Shad		759	46,223	91 - 120	126	0 - 5.0	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
4-22-75	4						
B. Catfish		5.1	219	91 - 120	380	0 - 5.0	257
C. Catfish		8.0	437	61 - 90	325	0 - 5.0	
G. Shiner		.006	3.0	64	64	1.0	
B. Sunfish		.05	3.0	92	92	9.0	
W. Bass		.36	5.0	121 - 150	150	15.1 - 20	
F. Catfish		.04	5.0	61 - 90	80	4.0	
W. Crappie		.40	28	61 - 90	183	0 - 5.0	
F. Drum		77	1362	121 - 150	157	5.1 - 10	
G. Shad		32	750	91 - 120	234	10.1 - 15	
T. Shad		30	1593	91 - 120	135	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
4-25-75	4						
T. Shad		8.2	475	91 - 120	125	5.1 - 10	
G. Shad		41	901	91 - 120	235	10.1 - 15	196.5
F. Drum		28	426	121 - 150	315	30.1 - 35	
B. Catfish		3.2	185	91 - 120	190	0 - 5.0	
C. Catfish		9.6	411	61 - 90	415	0 - 5.0	
B. Sunfish		.004	2.0	44	44	1.0	
S. Buffalo		1.8	2.0	370	370	506	
W. Bass		1.1	8.0	91 - 120	290	10.1 - 15	
W. Crappie		.07	8.0	61 - 90	83	0 - 5.0	
G. Shiner		.12	5.0	121 - 150	135	5.1 - 10	
B. Bullhead		.06	3.0	61 - 90	97	5.1 - 10	
F. Catfish		.06	3.0	91 - 120	117	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
4-29-75	4						
W. Crappie		12.0	28	61 - 90	305	0 - 5.0	
E. Carp		2.0	2.0	275	275	408	
G. Shiner		.21	9.0	61 - 90	145	5.1 - 10	91.5
W. Bass		.09	2.0	122	122	18.0	
B. Sunfish		.43	7.0	121 - 150	140	5.1 - 10	
C. Catfish		10.3	227	121 - 150	406	0 - 5.0	
B. Catfish		3.4	117	61 - 90	295	0 - 5.0	
T. Shad		2.9	170	91 - 120	120	5.1 - 10	
G. Shad		32	743	91 - 120	235	5.1 - 10	
F. Drum		28	382	121 - 150	300	25.1 - 30	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
5-2-75	4						
R. Shiner		.04	3.0	85	85	6.0	
G. Shad		31	660	121 - 150	227	10.1 - 15	84.0
T. Shad		.26	16	91 - 120	112	5.1 - 10	
B. Catfish		1.4	63	91 - 120	195	0 - 5.0	
C. Catfish		2.2	95	61 - 90	152	0 - 5.0	
B. Sunfish		1.1	9.0	61 - 90	172	10.1 - 15	
W. Crappie		28	95	61 - 90	275	0 - 5.0	
B. Crappie		.19	3.0	140	140	28.0	
F. Drum		7.9	88	121 - 150	190	10.1 - 15	
W. Bass		3.1	3.0	330	330	444	
S. Buffalo		4.9	3.0	380	380	709	
E. Carp		3.8	3.0	380	380	539	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
5-6-75	4						
R. Carpsucker		2.0	1.0	415	415	907	
F. Drum		1.5	17	121 - 150	280	5.1 - 10	
W. Crappie		14.6	67	61 - 90	272	0 - 5.0	37
E. Carp		2.2	2.0	301 - 330	367	499	
S. Buffalo		3.8	2.0	360 - 390	395	851	
W. Bass		.25	6.0	91 - 120	150	10.1 - 15	
L. Sunfish		.25	4.0	91 - 120	138	20.1 - 25	
L. Bass		.13	1.0	160	160	46	
B. Bullhead		.04	1.0	122	122	13	
B. Sunfish		.54	9.0	121 - 150	146	0 - 5.0	
G. Shiner		.006	1.0	65	65	2.0	
C. Catfish		2.56	32	61 - 90	433	0 - 5.0	
B. Catfish		.19	18	91 - 120	142	0 - 5.0	
T. Shad		.09	3.0	121 - 150	127	0 = 5.0	
G. Shad		9.3	250	121 - 150	242	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
5-9-75	4						
F. Drum		2.4	30	151 - 180	230	25.1 - 30	
W. Crappie		6.2	41	61 - 90	290	0 - 5.0	
B. Sunfish		1.0	8.0	121 - 150	190	50.1 - 55	
W. Bass		.03	1.0	100	100	11.0	
L. Sunfish		.06	1.0	105	105	38	25
O. Sunfish		.04	3.0	31 - 60	85	0 - 5.0	
G. Sunfish		.04	1.0	100	100	13	
M. Silverside		.02	1.0	116	116	9.0	
C. Lamprey		.88	8.0	241 - 270	320	55.1 - 60	
R. Carpsucker		1.5	1.0	375	375	680	
E. Carp		3.0	2.0	391 - 420	415	.660	
C. Catfish		1.1	39	121 - 150	290	5.1 - 10	
B. Catfish		1.06	14	91 - 120	325	5.1 - 10	
B. Bullhead		.06	2.0	61 - 90	137	0 - 5.0	
T. Shad		.13	4.0	91 - 120	120	10.1 - 15	
G. Shad		7.6	137	121 - 150	273	10.1 - 15	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
2-13-75	4						
F. Drum		3.69	64	91 - 120	270	5.1 - 10	
W. Crappie		9.5	495	61 - 90	250	5.1 - 10	
B. Crappie		.19	2.0	61 - 90	190	5.1 - 10	
E. Carp		2.5	2.0	331 - 360	430	581	
W. Bass		1.1	2.0	211 - 240	330	20.1 - 25	32
B. Sunfish		.50	6.0	91 - 120	175	20.1 - 25	
G. Shiner		.05	5.0	61 - 90	90	0 - 5.0	
L. Sunfish		.07	1.0	112	112	39	
W. Bass		.01	1.0	70	70	7.0	
G. Sunfish		.006	2.0	50	50	2.0	
C. Lamprey		.77	7.0	241 - 270	290	50.1 - 55	
R. Carpsucker		1.4	1.0	413	413	624	
S. Buffalo		2.9	2.0	331 - 360	375	624	
C. Catfish		.80	25	61 - 90	245	0 - 5.0	
B. Catfish		.94	33	61 - 90	215	0 - 5.0	
T. Shad		.06	2.0	91 - 120	120	5.1 - 10	
G. Shad		8.1	132	121 - 150	227	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
5-16-75	4						
F. Drum		4.5	103	91 - 120	255	5.1 - 10	
B. Crappie		.13	4.0	91 - 120	180	10.1 - 15	
W. Crappie		6.8	279	61 - 90	265	5.1 - 10	
B. Sunfish		.19	11	31 - 60	142	0 - 5.0	
R. Carpsucker		.25	1.0	222	222	112	23
W. Bass		.04	1.0	140	140	20	
G. Shiner		.02	2.0	76	76	5.0	
W. Bass		.05	1.0	105	105	22	
G. Sunfish		.04	3.0	31 - 60	60	0 - 5.0	
L. Sunfish		.006	1.0	51	51	3.0	
O. Sunfish		.006	1.0	48	48	2.0	
C. Lamprey		.44	4.0	211 - 240	265	30.1 - 35	
E. Carp		4.75	2.0	391 - 420	490	1078	
C. Catfish		.44	25	61 - 90	197	0 - 5.0	
B. Catfish		.10	8.0	61 - 90	145	5.1 - 10	
B. Bullhead		.006	1.0	70	70	4.0	
T. Shad		.09	4.0	91 - 120	115	5.1 - 10	
G. Shad		5.5	125	121 - 150	[illegible]	[illegible]	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
5-20-75	4						
F. Drum		3.25	62	91 - 120	260	15.1 - 20	
B. Crappie		.38	3.0	61 - 90	320	5.1 - 10	
W. Crappie		9.6	334	61 - 90	320	0 - 5.0	
B. Sunfish		.30	7.0	61 - 90	152	10.1 - 15	
G. Shiner		.04	4.0	61 - 90	97	0 - 5.0	24
B. Bullhead		.02	1.0	92	92	9.0	
R. Shiner		.01	1.0	87	87	5.0	
O. Sunfish		.006	1.0	54	54	2.0	
C. Lamprey		.11	1.0	240	240	47	
R. Carpsucker		1.19	1.0	355	355	539	
E. Carp		3.0	2.0	361 - 390	440	680	
B. Catfish		.46	10	91 - 120	225	5.1 - 10	
C. Catfish		1.6	35	61 - 90	182	0 - 5	
T. Shad		.14	5.0	91 - 120	147	5.1 - 10	
G. Shad		4.25	51	121 - 150	280	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
5-23-75	4						
F. Drum		3.5	46	91 - 120	250	5.1 - 10	
T. Shad		.09	4.0	91 - 120	122	5.1 - 10	
G. Shad		3.5	49	121 - 150	255	5.1 - 10	
B. Crappie		.12	1.0	150	150	49	19
W. Crappie		7.4	289	91 - 120	320	5.1 - 10	
W. Bass		.63	2.0	181 - 210	232	110.1 - 115	
C. Lamprey		.18	1.0	270	270	78	
B. Sunfish		.12	4.0	61 - 90	112	5.1 - 10	
G. Shiner		.03	3.0	61 - 90	80	0 - 5.0	
O. Sunfish		.01	1.0	67	67	5.0	
B. Catfish		.04	4.0	91 - 120	110	0 - 5.0	
C. Catfish		.25	23	61 - 90	190	0 - 5.0	
E. Carp		2.0	2.0	301 - 330	420	454	
S. Buffalo		.34	1.0	242	242	153	
Gold Eye		1.1	1.0	370	370	485	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
5-27-75	4						
W. Crappie		3.6	105	91 - 120	265	5.1 - 10	
F. Drum		4.0	62	91 - 120	380	5.1 - 10	
W. Bass		1.1	4.0	151 - 180	300	15.1 - 20	
B. Sunfish		.10	3.0	91 - 120	110	5.1 - 10	
R. Sunfish		.04	1.0	102	102	16	17
F. Catfish		.006	1.0	77	77	4.0	
G. Shiner		.01	1.0	86	86	6.0	
F. Carp		1.8	1.0	420	420	822	
S. Herring		.65	1.0	390	390	295	
B. Catfish		.31	5.0	91 - 120	230	5.1 - 10	
C. Catfish		.48	15	61 - 90	285	0 - 5.0	
T. Shad		.19	8.0	91 - 120	122	5.1 - 10	
G. Shad		4.75	74	121 - 150	225	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
5-30-75	4						16
F. Drum		1.8	54	91 - 120	205	10.1 - 15	
W. Crappie		5.25	74	61 - 90	290	5.1 - 10	
W. Bass		.50	3.0	181 - 210	195	45.1 - 50	
G. Shiner		.04	4.0	61 - 90	100	0 - 5.0	
B. Sunfish		.08	2.0	91 - 120	107	10.1 - 15	
B. Catfish		.10	5.0	61 - 90	135	0 -5.0	
C. Catfish		.15	4.0	61 - 90	165	0 - 5.0	
Sauger		1.0	1.0	360	360	454	
E. Carp		1.2	1.0	390	390	539	
T. Shad		.09	4	91 - 120	125	5.1 - 10	
G. Shad		5.19	52	181 - 210	249	10.1 - 15	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
6-3-75	4						
Paddle Fish		.006	1.0	90	90	2.0	
G. Shad		6.0	59	181 - 210	235	10.1 - 15	
T. Shad		.27	9.0	91 - 120	150	5.1 - 10	
C. Catfish		.10	14	61 - 90	105	0 - 5.0	
B. Catfish		.05	3.0	61 - 90	122	0 - 5.0	19
G. Shiner		.03	4.0	61 - 90	85	0 - 5.0	
B. Sunfish		.05	1.0	102	102	24	
S. Herring		.17	1.0	237	237	78	
W. Bass		.41	2.0	120 - 150	230	92	
E. Carp		2.8	1.0	480	480	822	
W. Crappie		4.6	142	91 - 120	266	5.1 - 10	
F. Drum		4.75	145	91 - 120	177	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
6-6-75	4						
T. Shad		.39	17	91 - 120	127	5.1 - 10	
G. Shad		6.4	68	181 - 210	227	40.1 - 45	
C. Catfish		.19	9.0	61 - 90	147	0 - 5.0	
B. Catfish		.19	2.0	61 - 90	220	0 - 5.0	
G. Shiner		.09	2.0	61 - 90	17	0 - 5.0	
B. Sunfish		.14	1.0	152	152	66	20
E. Carp		1.1	2.0	331 - 360	365	0 - 5.0	
W. Bass		1.5	2.0	271 - 300	334	343	
W. Crappie		7.25	217	61 - 90	220	5.1 - 10	
F. Drum		3.19	59	91 - 120	310	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
6-10-75	4						
G. Shad		5.1	48	211 - 240	262	35.1 - 40	
T. Shad		.40	11	91 - 120	133	10.1 - 15	
C. Catfish		.07	4.0	90	140	0 - 5.0	
B. Catfish		.08	2.0	61 - 90	162	0 - 5.0	10
W. Bass		.006	1.0	47	47	1.0	
B. Sunfish		.18	2.0	91 - 120	143	35.1 - 40	
W. Crappie		1.4	21	91 - 120	240	10.1 - 15	
F. Drum		1.5	46	91 - 120	170	15.1 - 20	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
6-13-75	4						
Paddle Fish		.025	2.0	91 - 120	132	6.0	
T. Shad		2.4	68	91 - 120	132	10.1 - 15	
G. Shad		9.5	94	181 - 210	253	20.1 - 25	
W. Crappie		2.6	37	61 - 90	202	5.1 - 10	22
F. Drum		6.5	185	91 - 120	137	15.1 - 20	
B. Crappie		.06	3.0	91 - 120	102	5.1 - 10	
B. Sunfish		.01	2.0	31 - 60	62	0 - 5.0	
O. Sunfish		.006	1.0	62	62	3.0	
B. Catfish		.38	3.0	61 - 90	240	0 - 5.0	
C. Catfish		.05	5.0	61 - 90	125	0 - 5.0	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
6-17-75	4						
F. Drum		3.8	68	91 - 120	37	5.1 - 10	
G. Shad		16	162	181 - 210	226	35.1 - 40	
T. Shad		2.5	77	91 - 120	140	10.1 - 15	
C. Catfish		.19	15	61 - 90	145	0 - 5.0	25
B. Catfish		.18	5.0	91 - 120	170	10.1 - 15	
Sauger		.01	2.0	31 - 60	80	0 - 5.0	
B. Sunfish		.31	3.0	121 - 150	145	65.1 - 70	
W. Bass		.94	8.0	31 - 60	215	0 - 5.0	
W. Crappie		2.0	74	91 - 120	190	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
6-20-75	4						
Str. Bass		.34	1.0	235	235	152	
T. Shad		.63	27	91 - 120	126	10.1 - 15	
G. Shad		11.6	119	181 - 210	250	35.1 - 40	
C. Catfish		.22	11	61 - 90	150	0 - 5.0	
B. Catfish		.27	5.0	121 - 150	210	15.1 - 20	20
G. Shiner		.006	1.0	72	72	3.0	
L. Sunfish		.05	1.0	100	100	23	
B. Sunfish		.22	3.0	91 - 120	163	20.1 - 25	
W. Bass		2.0	12	31 - 60	300	0- 5.0	
B. Crappie		.04	1.0	117	117	19	
W. Crappie		2.8	31	61 - 90	345	0 - 5.0	
F. Drum		1.5	36	91 - 120	192	15.1 - 20	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
6-24-75	4						
G. Shad		4.5	39	211 - 240	236	25.1 - 30	
W. Crappie		.06	4.0	61 - 90	91	5.1 - 10	
W. Bass		.27	4.0	61 - 90	208	0 - 5.0	
F. Drum		1.75	21	31 - 60	312	0 - 5.0	9.0
B. Catfish		.19	2.0	121 - 150	180	10.1 - 15	
C. Catfish		1.5	9.0	91 - 120	490	0 - 5.0	
T. Shad		.28	12	91 - 120	134	5.1 - 10	

RESULTS OF FISH IMPINGEMENT

ARKANSAS NUCLEAR ONE - UNIT ONE INTAKE SCREEN MONITORING PROGRAM

DATE/SPECIES	NUMBER OF CIRCULATING WATER PUMPS OPERATING	SPECIES TOTAL WEIGHT FOR 24 HOURS (POUNDS)	SPECIES TOTAL NUMBER FOR 24 HOURS	MODAL LENGTH (MM)	MAXIMUM LENGTH (MM)	MODAL WEIGHT (GRAMS)	TOTAL SAMPLE WEIGHT (POUNDS)
6-27-75	4						
Sauger		.01	1.0	85	85	6.0	
F. Drum		2.0	122	31 - 60	153	0 - 5.0	
W. Crappie		1.88	26	91 - 120	320	5.1 - 10	
Wa. Bass		.08	2.0	61 - 90	117	0 - 5.0	11.0
Log Perch		.002	1.0	42	42	1.0	
C. Catfish		.12	6.0	61 - 90	170	0 - 5.0	
B. Catfish		.05	2.0	61 - 90	105	5.1 - 10	
T. Shad		.16	5.0	121 - 150	128	10.1 - 15	
G. Shad		.71	65	181 - 210	232	35.1 - 40	

A SUMMARY OF FISH IMPINGMENT MONITORING
AT ARKANSAS NUCLEAR ONE
FROM JANUARY 1 - DECEMBER 31, 1981

In reviewing the Impingement data for 1981, it does not appear that the operation of Arkansas Nuclear One is having a significant impact on the fishery of Dardanelle Reservoir.

There were 110 samples collected in the twelve month period. Sampling was conducted two to three times a week as required in the technical specifications. Weekly sampling was without interruption because Unit Two was operating when Unit One was off-line for refueling. This would, in essence, give 365 Reactor Power days for the year and a sampling frequency factor of 3.32 was used to extrapolate total numbers and weights for the year.

Dardanelle Reservoir covers approximately 36,600 acres. Using Rotenone survey estimates for 1981 supplied by the Arkansas Game and Fish Commission and Arkansas Tech University, it is estimated that there were 6,029 fish per acre and 605 pounds per acre. The estimated total impingement for 1981 was calculated to be approximately 8.1 million fish with a weight of approximately 97,000 pounds. This impingement represented approximately 3.7% of the calculated total fish in the Reservoir and .44% of the calculated weight in pounds. Of the fish impinged, there were 34 species representing 13 families.

Tables 1 and 2 present the number, weights and percentage of each species impinged in the monthly samples and the total for the year. The most impinged species of fish were the Gizzard Shad, Dorosoma cepedianum (LeSueur) and Threadfin Shad, Dorosoma petenense (Gunther) representing the Herring (Clupeidae) Family at 99.25% of the total number and 95.34% of the total weight (Tables 3 and 4). Freshwater Drum, Aplodinotus grunniens (Rafinesque) representing the Drum (Sciaenidae) Family contributed 2.17% of the total weight of fish impinged. All other species were less than 1.0% in total number or weight.

Highest impingement occurs during late fall, winter and early spring, October through March. As stated before, the Shad species are the most prevalent in the impingment samples. They become thermally stressed at temperatures below 60°F. Strawn (1963) demonstrated that Threadfin Shad in Arkansas will most likely not survive the winter in lakes in which temperatures drop below 41°F (5.0°C) for any extended length of time. Recorded water temperatures at the intake structure (Table 5) indicate that the temperature had dropped below this threshold in January and February of 1977, 1978 and 1979. It is during this period of time that the Threadfin Shad began to experience a sharp decline in numbers as evidenced by both impingement data and Reservoir data (Table 6).

Texas Instruments, Inc. (1976) concluded that the loss and possible subsequent reduction in Threadfin Shad standing crop due to natural mortality and impingement will effect little change in the numbers and/or biomass of the sport and/or commercial fish populations in Dardanelle Reservoir. Further, they concluded that any shift in predator-prey relationships brought on by a reduction in standing crop of Threadfin Shad may be buffered by compensatory changes in Gizzard Shad population levels.

Reservoir data over the last nine years seems to support these conclusions. In fact, there appears to be an enhancement of the predator:forage ratio when Threadfin Shad numbers decline (Figures 1 and 2). Generally, when the Threadfin Shad numbers decrease, the Gizzard Shad numbers increase (Figure 3). This provides evidence of the buffering capacity alluded to in Texas Instruments' conclusions.

A comparison of the number and weight of the more important forage and commercial/sport fish is presented in Table 7. The calculated percent of number and weight of these species impinged compared to the estimated reservoir total is small and represents a minimal impact. The forage fish species, Gizzard and Threadfin Shad make up the greatest percentage impinged. Gizzard Shad represents 2.50% of the number and .64% of the weight and Threadfin Shad represents 12.71% of the number and 12.67% of the weight removed from the reservoir. Again, this is primarily due to their inability to withstand thermal stress in the winter months. The impingement of sport and commercial fish species does not present a significant impact on the reservoir fishery due to the low numbers and biomass removed.

As a general rule, there is a close relationship between the average weight per species impinged and the average weight in the reservoir (Table 8). With the exception of a few species, the average weight impinged is slightly less than the average weight in the reservoir. The most notable exception was the Largemouth Bass, *Micropterus salmoides* (Lacépède), which was over twice the average weight in the reservoir. A possible explanation for the phenomenon would be the greater feeding opportunities near the intake screens.

Due to the demonstrated affect of thermal stress on the Shad species in the winter months and the low number and biomass of the other species of fish removed from the reservoir by impingement, the operation of Arkansas Nuclear One does not appear to significantly impact the fishery of Dardanelle Reservoir.

References

Strawn, K. 1963. Resistance of threadfin shad to low temperatures. Proc. Ann. Conf. SE Assn. Game and Fish Comm. 17:290-293.

Texas Instruments, Inc. 1976. Evaluation of potential impact of impingement on fishing resources and dissolved oxygen Dardanelle Reservoir. Annual Report prepared for AP&L Co. xxii.

TABLE 1

SPECIES NUMBERS IMPINGED BY MONTH AT AND FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH FREQUENCY PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
CHANNEL CATFISH	17 0.00	24 0.00	7 0.00	36 0.00	24 0.00	51 0.00	56 0.00	69 0.00	121 0.00	150 0.01	40 0.00	11 0.00	605 0.02
CHESTNUT LAMPREY	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00
EMERALD SHINER	0 0.00	0 0.00	0 0.00	9 0.00	7 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	16 0.00
EUROPEAN CARP	0 0.00	0 0.00	0 0.00	2 0.00	1 0.00	2 0.00	1 0.00	0 0.00	0 0.00	2 0.00	2 0.00	1 0.00	11 0.00
FLATHEAD CATFISH	1 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	13 0.00	16 0.00
FRESHWATER DRUM	101 0.00	107 0.00	283 0.01	1320 0.05	3580 0.15	2816 0.12	507 0.02	184 0.01	257 0.01	560 0.02	281 0.01	272 0.01	10263 0.42
GIZZARD SHAD	63722 2.61	41629 1.71	225126 9.23	13233 0.54	4344 0.18	457 0.02	62 0.00	589 0.02	3421 0.14	18301 0.75	6821 0.28	10523 0.43	388223 15.91
GOLDEN SHINER	13 0.00	11 0.00	59 0.00	17 0.00	15 0.00	2 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	118 0.00
BLACK BULLHEAD	0 0.00	0 0.00	0 0.00	2 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	3 0.00	0 0.00	0 0.00	6 0.00
GREEN SUNFISH	7 0.00	0 0.00	6 0.00	2 0.00	2 0.00	0 0.00	0 0.00	2 0.00	1 0.00	2 0.00	2 0.00	5 0.00	29 0.00
LARGEMOUTH BASS	1 0.00	0 0.00	0 0.00	4 0.00	1 0.00	1 0.00	0 0.00	2 0.00	2 0.00	1 0.00	0 0.00	3 0.00	15 0.00
LONGEAR SUNFISH	11 0.00	0 0.00	26 0.00	9 0.00	5 0.00	12 0.00	9 0.00	10 0.00	8 0.00	16 0.00	10 0.00	11 0.00	127 0.01
TOTAL	101967 4.18	445320 18.25	257622 10.56	16272 0.67	8392 0.34	3607 0.15	906 0.04	1902 0.08	16119 0.66	532500 21.82	360265 14.76	695183 28.49	244005[illegible] 100.00

(CONTINUED)

TABLE 1 (Cont)

SPECIES NUMBERS IMPINGED BY MONTH AT ANO FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES MONTH

FREQUENCY PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
LONGNOSE GAR	0	0	0	0	0	0	0	0	0	0	1	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSISSIPPI SILVERSIDE	1003	1601	207	46	69	47	8	2	2	4	2	98	3089
	0.04	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
BLACK CRAPPIE	0	0	4	0	2	0	0	0	0	0	0	0	6
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GOLDEYE	0	0	0	0	0	0	0	0	0	4	0	0	4
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ORANGESPOTTED SUNFISH	5	4	0	2	1	0	0	1	0	0	0	2	15
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RED SHINER	0	0	0	0	0	1	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REDEAR SUNFISH	0	0	4	0	0	0	0	0	0	0	0	0	4
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER CARPSUCKER	1	0	4	4	0	1	0	0	0	0	0	2	12
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER SHINER	1	0	0	0	2	1	1	0	0	0	0	0	5
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAUGER	0	0	0	0	0	1	1	0	0	0	0	0	2
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SHORTNOSE GAR	1	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BLUE CATFISH	27	25	15	39	35	20	45	126	263	565	178	47	1385
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.06
TOTAL	101957	445320	257622	16272	8392	3607	906	1902	16119	532500	360265	695163	2440055
	4.18	18.25	10.56	0.67	0.34	0.15	0.04	0.08	0.66	21.82	14.76	28.49	100.00

(CONTINUED)

TABLE 1 (Cont)

SPECIES NUMBERS IMPINGED BY MONTH AT AND FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES MONTH

FREQUENCY / PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
SKIPJACK HERRING	50	33	16	1	1	0	0	0	2	17	11	83	214
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
SMALLMOUTH BUFFALO	1	3	0	0	0	0	0	0	0	0	2	0	6
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STRIPED BASS	435	45	32	16	5	9	11	6	8	140	5	9	721
	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.03
THREADFIN SHAD	36505	401778	31730	1379	192	76	43	775	11932	512234	352514	684058	2033217
	1.50	16.47	1.30	0.06	0.01	0.00	0.00	0.03	0.49	20.99	14.45	28.03	83.33
WHITE BASS	24	11	14	15	11	22	27	17	52	321	370	1	885
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.04
BLUEGILL SUNFISH	25	36	74	50	38	45	116	105	31	137	20	39	716
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.03
WHITE CRAPPIE	7	5	13	74	55	42	19	13	18	43	6	5	299
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
WARMOUTH	0	0	2	11	0	1	1	0	0	0	0	0	15
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AMERICAN EEL	1	3	0	0	0	0	0	0	0	0	0	0	4
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BROOK SILVERSIDE	7	5	0	0	0	0	0	0	0	0	0	0	12
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	101967	445320	257622	16272	8392	3607	906	1902	16119	532500	360265	695163	2440055
	4.18	18.25	10.56	0.67	0.34	0.15	0.04	0.08	0.66	21.82	14.76	28.49	100.00

TABLE 2

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT AND FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH (FREQUENCY / PERCENT)	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
CHANNEL CATFISH	2	13	1	3	2	4	6	7	11	15	4	1	67
	0.01	0.05	0.00	0.01	0.01	0.01	0.02	0.02	0.04	0.05	0.01	0.00	0.23
CHESTNUT LAMPREY	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EMERALD SHINER	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EUROPEAN CARP	0	0	0	3	3	6	4	0	0	2	2	4	25
	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.09
FLATHEAD CATFISH	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRESHWATER DRUM	10	24	42	58	97	78	18	20	53	122	59	55	635
	0.03	0.08	0.14	0.20	0.33	0.27	0.06	0.07	0.18	0.42	0.20	0.19	2.17
GIZZARD SHAD	1450	1314	4227	265	123	25	3	4	27	200	129	590	8357
	4.95	4.48	14.42	0.90	0.42	0.08	0.01	0.01	0.09	0.68	0.44	2.01	28.51
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BLACK BULLHEAD	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GREEN SUNFISH	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LARGEMOUTH BASS	1	0	0	3	2	0	0	1	1	0	0	6	15
	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05
LONGEAR SUNFISH	1	0	2	1	1	1	1	1	1	1	0	1	9
	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
TOTAL	1962	9151	4766	415	261	139	61	70	193	3323	2364	6606	29311
	6.69	31.22	16.26	1.41	0.89	0.47	0.21	0.24	0.66	11.34	8.06	22.54	100.00

(CONTINUED)

TABLE 2 (Cont)

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT AND FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH — FREQUENCY / PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
LONGNOSE GAR	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
MISSISSIPPI SILVERSIDE	11 0.04	17 0.06	2 0.01	1 0.00	1 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.01	34 0.12
BLACK CRAPPIE	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00
MOONEYE	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	1 0.00
ORANGESPOTTED SUNFISH	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
RED SHINER	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
REDEAR SUNFISH	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
RIVER CARPSUCKER	4 0.01	0 0.00	4 0.02	10 0.04	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	5 0.02	25 0.08
RIVER SHINER	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
SAUGER	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	2 0.01
SHORTNOSE GAR	2 0.01	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	2 0.01
BLUE CATFISH	1 0.00	14 0.05	1 0.00	4 0.01	3 0.01	5 0.02	4 0.01	8 0.03	11 0.04	23 0.08	8 0.03	4 0.01	85 0.29
TOTAL	1962 6.69	9151 31.22	4766 16.26	415 1.41	261 0.89	139 0.47	61 0.21	70 0.24	193 0.66	3323 11.34	2364 8.06	6606 22.54	29311 100.00

(CONTINUED)

TABLE 2 (Cont)

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT ANO FUR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH — FREQUENCY / PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
SKIPJACK HERRING	2	1	9	0	0	0	0	0	1	8	7	4	32
	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.01	0.11
SMALLMOUTH BUFFALO	2	10	0	0	0	0	0	0	0	0	6	0	19
	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.06
STRIPED BASS	12	1	1	1	1	1	2	3	4	66	6	3	101
	0.04	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.22	0.02	0.01	0.34
THREADFIN SHAD	455	7744	454	21	6	2	0	3	65	2792	2085	5929	19555
	1.55	26.42	1.55	0.07	0.02	0.01	0.00	0.01	0.22	9.52	7.11	20.23	66.72
WHITE BASS	3	0	6	9	5	4	5	5	9	65	55	0	167
	0.01	0.00	0.02	0.03	0.02	0.01	0.02	0.02	0.03	0.22	0.19	0.00	0.57
BLUEGILL SUNFISH	3	4	9	6	5	5	17	15	4	15	1	1	84
	0.01	0.01	0.03	0.02	0.02	0.02	0.06	0.05	0.01	0.05	0.00	0.00	0.29
WHITE CRAPPIE	1	0	7	28	12	7	2	3	5	13	1	1	79
	0.00	0.00	0.02	0.09	0.04	0.02	0.01	0.01	0.02	0.04	0.00	0.00	0.27
WARMOUTH	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AMERICAN EEL	1	8	0	0	0	0	0	0	0	0	0	0	9
	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
BROOK SILVERSIDE	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	1962	9151	4766	415	261	139	61	70	193	3323	2364	6606	29311
	6.69	31.22	16.26	1.41	0.89	0.47	0.21	0.24	0.66	11.34	8.06	22.54	100.00

TABLE 1

SPECIES NUMBERS IMPINGED BY MONTH AT AND FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH FREQUENCY PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
CHANNEL CATFISH	17 0.00	24 0.00	7 0.00	36 0.00	24 0.00	51 0.00	55 0.00	69 0.00	121 0.00	150 0.01	40 0.00	11 0.00	605 0.02
CHESTNUT LAMPREY	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00
EMERALD SHINER	0 0.00	0 0.00	0 0.00	9 0.00	7 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	16 0.00
EUROPEAN CARP	0 0.00	0 0.00	0 0.00	2 0.00	1 0.00	2 0.00	1 0.00	0 0.00	0 0.00	2 0.00	2 0.00	1 0.00	11 0.00
FLATHEAD CATFISH	1 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	13 0.00	16 0.00
FRESHWATER DRUM	101 0.00	107 0.00	283 0.01	1320 0.05	3580 0.15	2816 0.12	507 0.02	184 0.01	257 0.01	560 0.02	281 0.01	272 0.01	10268 0.42
GIZZARD SHAD	63722 2.61	41629 1.71	225126 9.23	13233 0.54	4344 0.18	457 0.02	62 0.00	589 0.02	3421 0.14	18301 0.75	6821 0.28	10523 0.43	388228 15.91
GOLDEN SHINER	13 0.00	11 0.00	59 0.00	17 0.00	15 0.00	2 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	118 0.00
BLACK BULLHEAD	0 0.00	0 0.00	0 0.00	2 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	3 0.00	0 0.00	0 0.00	6 0.00
GREEN SUNFISH	7 0.00	0 0.00	6 0.00	2 0.00	2 0.00	0 0.00	0 0.00	2 0.00	1 0.00	2 0.00	2 0.00	5 0.00	29 0.00
LARGEMOUTH BASS	1 0.00	0 0.00	0 0.00	4 0.00	1 0.00	1 0.00	0 0.00	2 0.00	2 0.00	1 0.00	0 0.00	3 0.00	15 0.00
LONGEAR SUNFISH	11 0.00	0 0.00	26 0.00	9 0.00	5 0.00	12 0.00	9 0.00	10 0.00	8 0.00	16 0.00	10 0.00	11 0.00	127 0.01
TOTAL	101967 4.18	445320 18.25	257622 10.56	16272 0.67	8392 0.34	3607 0.15	906 0.04	1902 0.08	16119 0.66	532500 21.82	360265 14.76	695183 28.49	2440055 100.00

(CONTINUED)

TABLE 1 (Cont) SPECIES NUMBERS IMPINGED BY MONTH AT AND FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH — FREQUENCY / PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
LONGNOSE GAR	0	0	0	0	0	0	0	0	0	0	1	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSISSIPPI SILVERSIDE	1003	1601	207	46	69	47	8	2	2	4	2	98	3089
	0.04	0.07	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13
BLACK CRAPPIE	0	0	4	0	2	0	0	0	0	0	0	0	6
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MOONEYE	0	0	0	0	0	0	0	0	0	4	0	0	4
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ORANGESPOTTED SUNFISH	5	4	0	2	1	0	0	1	0	0	0	2	15
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RED SHINER	0	0	0	0	0	1	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REDEAR SUNFISH	0	0	4	0	0	0	0	0	0	0	0	0	4
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER CARPSUCKER	1	0	4	4	0	1	0	0	0	0	0	2	12
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER SHINER	1	0	0	0	2	1	1	0	0	0	0	0	5
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAUGER	0	0	0	0	0	1	1	0	0	0	0	0	2
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SHORTNOSE GAR	1	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BLUE CATFISH	27	25	15	39	35	20	45	126	263	565	178	47	1385
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.06
TOTAL	101967	445320	257622	16272	8392	3607	906	1902	16119	532500	360265	695163	2440055
	4.18	18.25	10.56	0.67	0.34	0.15	0.04	0.08	0.66	21.82	14.76	28.49	100.00

(CONTINUED)

TABLE 1 (Cont)

SPECIES NUMBERS IMPINGED BY MONTH AT ANO FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES / FREQUENCY / PERCENT (MONTH)	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
SKIPJACK HERRING	50	33	16	1	1	0	0	0	2	17	11	83	214
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
SMALLMOUTH BUFFALO	1	3	0	0	0	0	0	0	0	0	2	0	6
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STRIPED BASS	435	45	32	16	5	9	11	6	8	140	5	9	721
	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.03
THREADFIN SHAD	36505	401778	31730	1379	192	76	43	775	11932	512234	352514	684058	2033217
	1.50	16.47	1.30	0.06	0.01	0.00	0.00	0.03	0.49	20.99	14.45	28.03	83.33
WHITE BASS	24	11	14	15	11	22	27	17	52	321	370	1	885
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.04
BLUEGILL SUNFISH	25	36	74	50	38	45	116	105	31	137	20	39	716
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.03
WHITE CRAPPIE	7	5	13	74	55	42	19	13	18	43	6	5	299
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
WARMOUTH	0	0	2	11	0	1	1	0	0	0	0	0	15
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AMERICAN EEL	1	3	0	0	0	0	0	0	0	0	0	0	4
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BROOK SILVERSIDE	7	5	0	0	0	0	0	0	0	0	0	0	12
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	101967	445320	257622	16272	8392	3607	906	1902	16119	532500	360265	695163	2440055
	4.18	18.25	10.56	0.67	0.34	0.15	0.04	0.08	0.66	21.82	14.76	28.49	100.00

TABLE 2

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT AND FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH (FREQUENCY / PERCENT)	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
CHANNEL CATFISH	2	13	1	3	2	4	6	7	11	15	4	1	67
	0.01	0.05	0.00	0.01	0.01	0.01	0.02	0.02	0.04	0.05	0.01	0.00	0.23
CHESTNUT LAMPREY	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EMERALD SHINER	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EUROPEAN CARP	0	0	0	3	3	6	4	0	0	2	2	4	25
	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.01	0.01	0.09
FLATHEAD CATFISH	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRESHWATER DRUM	10	24	42	58	97	78	19	20	53	122	59	55	635
	0.03	0.08	0.14	0.20	0.33	0.27	0.06	0.07	0.18	0.42	0.20	0.19	2.17
GIZZARD SHAD	1450	1314	4227	265	123	25	3	4	27	200	129	590	8357
	4.95	4.48	14.42	0.90	0.42	0.08	0.01	0.01	0.09	0.68	0.44	2.01	28.51
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BLACK BULLHEAD	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GREEN SUNFISH	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LARGEMOUTH BASS	1	0	0	3	2	0	0	1	1	0	0	6	15
	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05
LONGEAR SUNFISH	1	0	2	1	1	1	1	1	1	1	0	1	9
	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
TOTAL	1962	9151	4766	415	261	139	61	70	193	3323	2364	6606	29311
	6.69	31.22	16.26	1.41	0.89	0.47	0.21	0.24	0.66	11.34	8.06	22.54	100.00

(CONTINUED)

TABLE 2 (Cont)

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT AND FOR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH FREQUENCY PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
LONGNOSE GAR	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
MISSISSIPPI SILVERSIDE	11 0.04	17 0.06	2 0.01	1 0.00	1 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.01	34 0.12
BLACK CRAPPIE	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00
MOONEYE	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00	0 0.00	0 0.00	1 0.00
ORANGESPOTTED SUNFISH	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
RED SHINER	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
REDEAR SUNFISH	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
RIVER CARPSUCKER	4 0.01	0 0.00	4 0.02	10 0.04	0 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	5 0.02	25 0.08
RIVER SHINER	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
SAUGER	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00	1 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	2 0.01
SHORTNOSE GAR	2 0.01	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	2 0.01
BLUE CATFISH	1 0.00	14 0.05	1 0.00	4 0.01	3 0.01	5 0.02	4 0.01	8 0.03	11 0.04	23 0.08	8 0.03	4 0.01	86 0.29
TOTAL	1962 6.69	9151 31.22	4766 16.26	415 1.41	261 0.89	139 0.47	61 0.21	70 0.24	193 0.66	3323 11.34	2364 8.06	6606 22.54	29311 100.00

(CONTINUED)

TABLE 2 (Cont)

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT ANO FUR 1981

TABLE OF SPECIES BY MONTH

SPECIES / MONTH FREQUENCY PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
SKIPJACK HERRING	2 0.01	1 0.00	9 0.03	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00	8 0.03	7 0.02	4 0.01	32 0.11
SMALLMOUTH BUFFALO	2 0.01	10 0.03	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	6 0.02	0 0.00	19 0.06
STRIPED BASS	12 0.04	1 0.00	1 0.00	1 0.00	1 0.00	1 0.00	2 0.01	3 0.01	4 0.02	66 0.22	6 0.02	3 0.01	101 0.34
THREADFIN SHAD	455 1.55	7744 26.42	454 1.55	21 0.07	6 0.02	2 0.01	0 0.00	3 0.01	65 0.22	2792 9.52	2085 7.11	5929 20.23	19555 66.72
WHITE BASS	3 0.01	0 0.00	6 0.02	9 0.03	5 0.02	4 0.01	5 0.02	5 0.02	9 0.03	65 0.22	55 0.19	0 0.00	167 0.57
BLUEGILL SUNFISH	3 0.01	4 0.01	9 0.03	6 0.02	5 0.02	5 0.02	17 0.06	15 0.05	4 0.01	15 0.05	1 0.00	1 0.00	84 0.29
WHITE CRAPPIE	1 0.00	0 0.00	7 0.02	28 0.09	12 0.04	7 0.02	2 0.01	3 0.01	5 0.02	13 0.04	1 0.00	1 0.00	79 0.27
WARMOUTH	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.00
AMERICAN EEL	1 0.00	8 0.03	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	9 0.03
BROOK SILVERSIDE	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00
TOTAL	1962 6.69	9151 31.22	4766 16.26	415 1.41	261 0.89	139 0.47	61 0.21	70 0.24	193 0.66	3323 11.34	2364 8.06	6606 22.54	29311 100.00

TABLE 3.

PERCENTAGE OF FISH NUMBERS BY FAMILY
IMPINGED AT AND IN 1981

TABLE OF SPECIES BY YEAR

SPECIES / PERCENT	YEAR 1981	TOTAL
LAMPREY	0,00	0.00
DRUM	0,42	0,42
MOONEYE	0,00	0.00
MINNOW	0,01	0.01
PERCH	0,00	0.00
GAR	0,00	0.00
CATFISH	0,08	0.08
SUCKER	0,00	0.00
HERRING	99,25	99.25
BASS	0,07	0.07
SUNFISH	0,05	0.05
EEL	0,00	0.00
SILVERSIDE	0,13	0.13
TOTAL	2440055 100,00	2440055 100.00

TABLE 4. PERCENTAGE OF FISH WEIGHTS (POUNDS) BY FAMILY IMPINGED AT ANJ IN 1981

TABLE OF SPECIES BY YEAR

SPECIES / PERCENT	YEAR 1981	TOTAL
LAMPREY	0.00	0.00
DRUM	2.17	2.17
MOONEYE	0.00	0.00
MINNOW	0.09	0.09
PERCH	0.01	0.01
GAR	0.01	0.01
CATFISH	0.53	0.53
SUCKER	0.15	0.15
HERRING	95.34	95.34
BASS	0.91	0.91
SUNFISH	0.65	0.65
EEL	0.03	0.03
SILVERSIDE	0.12	0.12
TOTAL	29311 100.00	29311 100.00

TABLE 5. AVERAGE MONTHLY WATER TEMPERATURES (F) FOR THE WINTER MONTHS

OCTOBER THROUGH MARCH AT THE AVO INTAKE STRUCTURE

TABLE OF YEAR BY MONTH

YEAR / MONTH FREQUENCY	01_JAN	02_FEB	03_MAR	10_OCT	11_NOV	12_DEC
1974	.	.	.	65	57	45
1975	43	44	45	69	59	46
1976	40	47	56	66	52	43
1977	36	40	.	68	61	43
1978	36	35	.	68	59	46
1979	34	37	50	70	53	46
1980	44	41	48	67	56	47
1981	41	42	53	68	57	46

TABLE 6. COMPARISON OF PERCENT THREADFIN SHAD IMPINGED
TO
PERCENT THREADFIN SHAD IN THE RESERVOIR
1967 THROUGH 1981

YEAR		% THREADFIN SHAD IN DAILY IMPINGEMENT	% THREADFIN SHAD IN THE RESERVOIR
1967		.	0.02
1968		.	6.40
1969	DATA MISSING	.	.
1970		.	2.00
1971		.	36.90
1972		.	26.60
1973		.	1.60
1974	CAME ONLINE IN OCTOBER	95.60	47.30
1975		94.00	6.00
1976		94.70	52.20
1977		80.40	36.20
1978		8.70	0.02
1979		0.02	0.02
1980		28.40	0.40
1981		83.30	27.60

FIGURE 1.

PERCENT OF THREADFIN SHAD IN RESERVOIR

AS CALCULATED FROM ROTENONE DATA FOR DARDANELLE RESERVOIR FOR 1973 THROUGH 1981

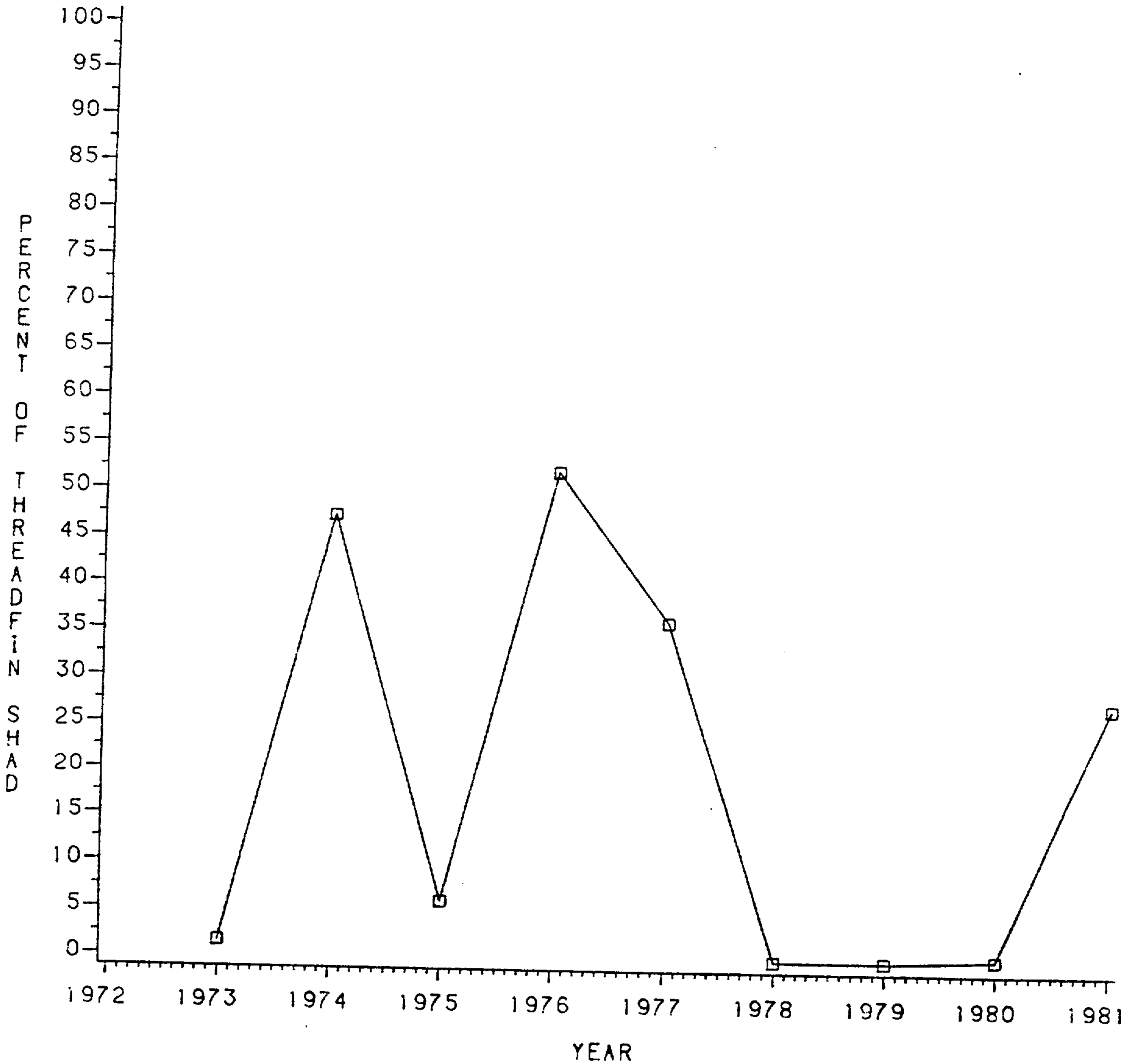


FIGURE 2.

PREDATOR TO NON-PREDATOR RATIO BY WEIGH

AS CALCULATED FROM ROTENONE DATA FOR DARDANELLE RESERVOIR FOR 1973 THROUGH 1981

PLOTTED VALUES REPRESENT THE NUMBER OF FORAGE FISH TO ONE PREDATOR FISH

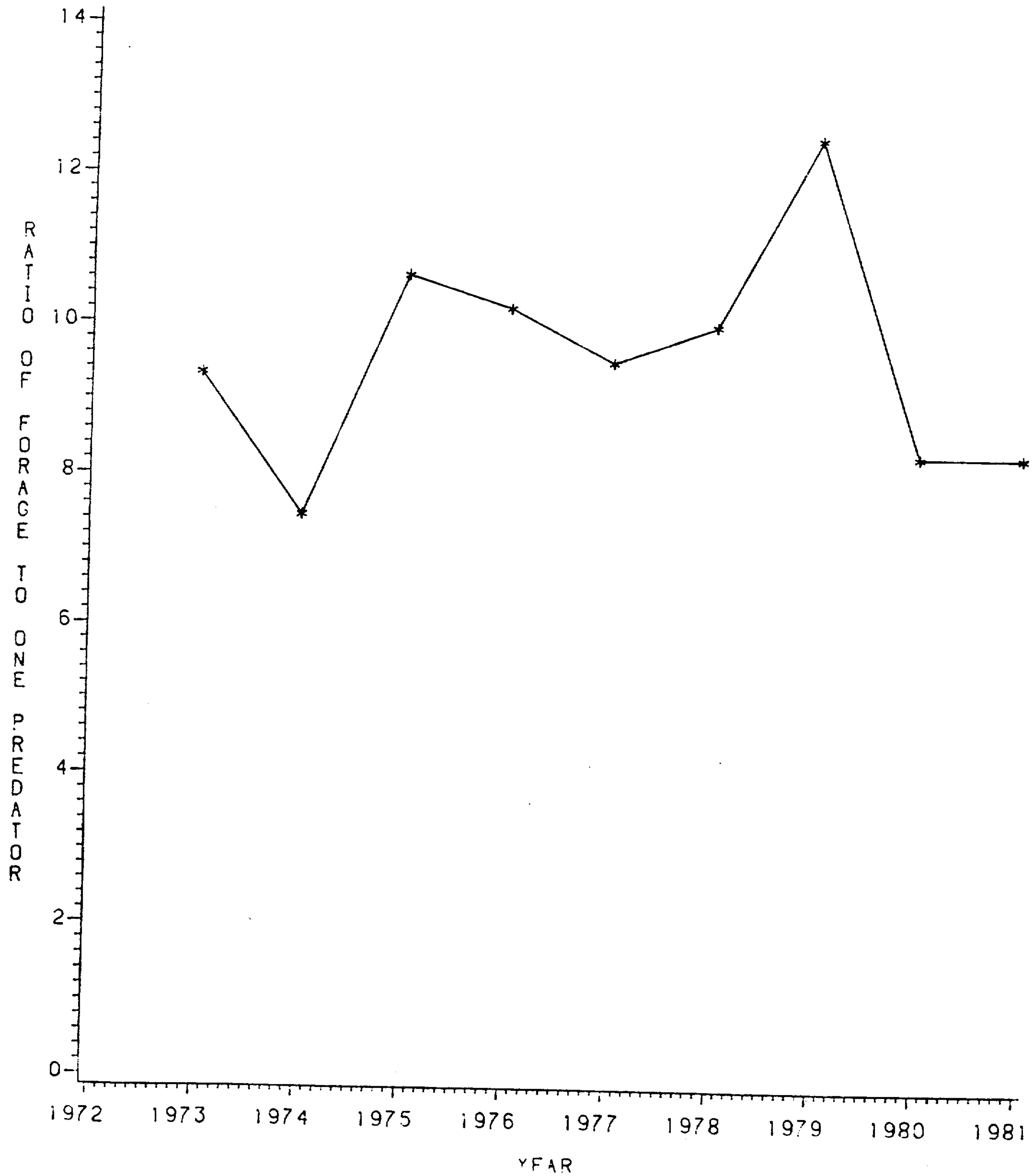


FIGURE 3.

PERCENT GIZZARD SHAD COMPARED TO PERCENT THREADFIN SHAD IN DARDANELLE RESERVOIR FOR 1973 THROUGH 1981

SQUARE SYMBOL=GIZZARD SHAD
STAR SYMBOL=THREADFIN SHAD

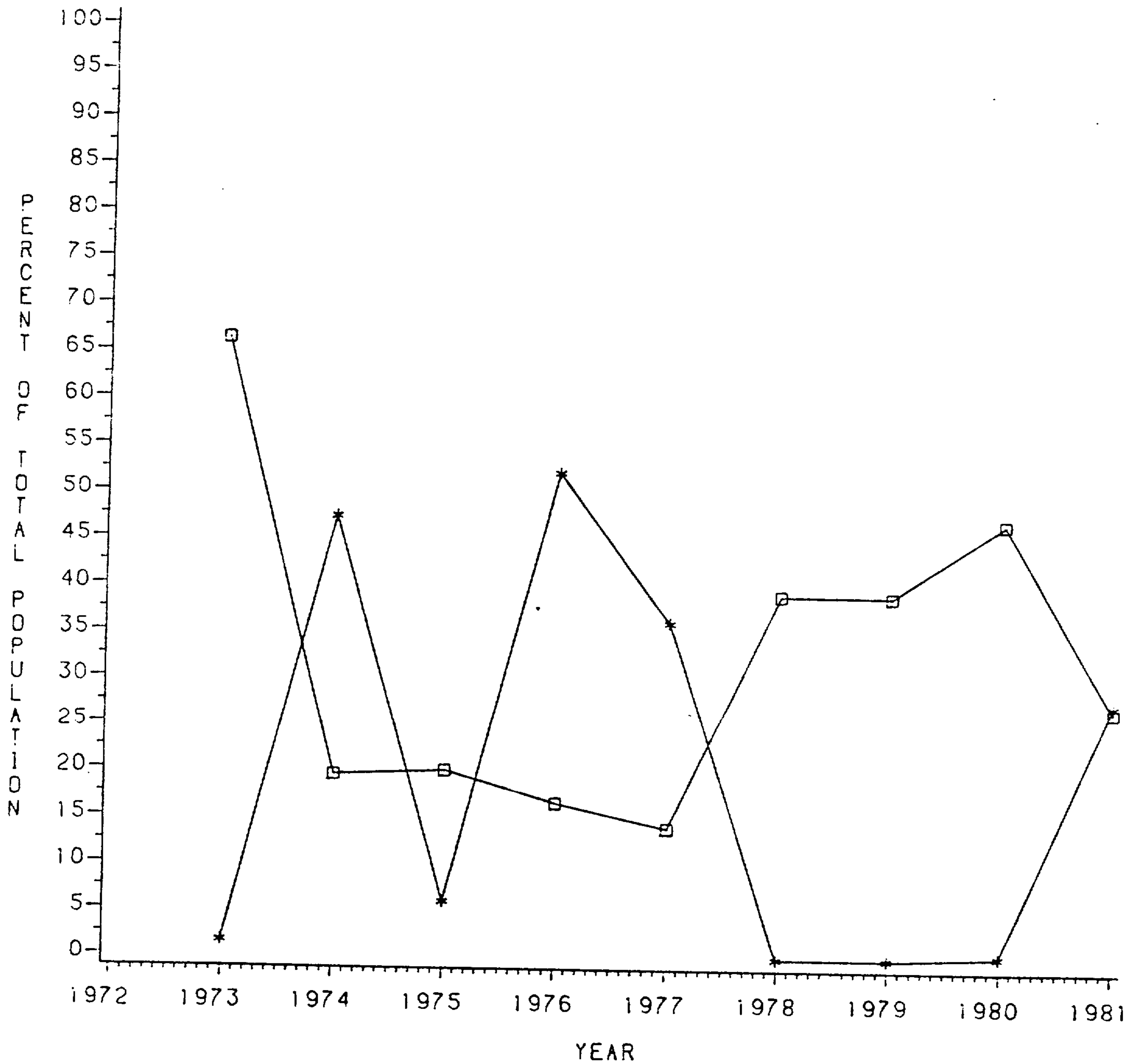


TABLE 7. COMPARISON OF NUMBER AND WEIGHT IMPINGED TO ESTIMATED RESERVOIR TOTAL OF SOME OF THE MORE IMPORTANT COMMERCIAL AND SPORT FISH AND FORAGE FISH FOR 1981

SPECIES	CALCULATED NUMBER IMPINGED FOR 1981	CALCULATED NUMBER IN RESERVOIR FOR 1981	PERCENT IMPINGED FROM RESERVOIR	CALCULATED WEIGHT (LB) IMPINGED FOR 1981	CALCULATED WEIGHT (LB) IN RESERVOIR FOR 1981	PERCENT WEIGHT IMPINGED FROM RESERVOIR
CHANNEL CATFISH	2,012	8,710,800	0.02	222	1,554,200	0.01
FLATHEAD CATFISH	53	65,880	0.08	0	109,800	0.00
BLUE CATFISH	4,598	695,400	0.66	286	146,400	0.19
LARGEMOUTH BASS	50	988,200	0.00	50	292,800	0.02
STRIPED BASS	2,394	606,828	0.39	335	402,600	0.08
WHITE BASS	2,938	292,800	1.00	554	109,800	0.50
BLACK CRAPPIE	20	50,509	0.04	3	10,797	0.03
WHITE CRAPPIE	993	622,200	0.16	262	67,710	0.39
LONGEAR SUNFISH	422	13,249,200	0.00	30	366,000	0.01
BLUEGILL SUNFISH	2,377	22,069,800	0.01	279	805,200	0.03
FRESHWATER DRUM	34,090	24,176,130	0.14	2,108	2,013,000	0.10
GIZZARD SHAD	1,288,917	51,506,000	2.50	27,745	4,318,800	0.64
THREADFIN SHAD	6,750,280	53,106,600	12.71	64,926	512,400	12.67

TABLE 8. AVERAGE WEIGHT (LB) PER SPECIES IMPINGED
COMPARED TO
AVERAGE WEIGHT (LB) IN RESERVOIR
OF SOME OF THE MORE IMPORTANT COMMERCIAL, SPORT AND FORAGE FISH
FOR 1981

SPECIES	AVERAGE WEIGHT (LB) IMPINGED FOR 1981	AVERAGE WEIGHT (LB) IN RESERVOIR FOR 1981
CHANNEL CATFISH	0.11	0.16
FLATHEAD CATFISH	0.00	1.67
BLUE CATFISH	0.06	0.21
LARGEMOUTH BASS	1.00	0.30
STRIPED BASS	0.14	0.66
WHITE BASS	0.19	0.38
BLACK CRAPPIE	0.15	0.21
WHITE CRAPPIE	0.26	0.11
LONGEAR SUNFISH	0.07	0.03
BLUEGILL SUNFISH	0.12	0.04
FRESHWATER DRUM	0.06	0.08
GIZZARD SHAD	0.02	0.08
THREADFIN SHAD	0.01	0.01

A SUMMARY OF FISH IMPINGEMENT MONITORING
AT
ARKANSAS NUCLEAR ONE
FROM
JANUARY 1 - DECEMBER 31, 1982

Arkansas Nuclear One, Unit 1, draws water from the Illinois Bayou arm of Dardanelle Reservoir for once-through cooling water. The water is withdrawn from the reservoir by means of a 4400-foot-long canal. Four pumps supply the circulating water system needs for the unit, with a trash rack and eight traveling screens in front of the pumps to prevent trash and fish above fingerling size from passing through the station. The fish collected or impinged on the traveling screens are the subject of this report. The environmental impact of impingement on the Dardanelle Reservoir fishery is of concern to AP&L and regulating agencies.

Sampling Methods

Impingement samples are taken twice a week for a 24-hour period every week ANO Unit 1 is operating. Fish are sorted from the trash and separated into species, counted, weighed and measured. Subsamples are taken when the quantity of fish is too large to reasonably process.

A monthly impingement report is submitted to the Nuclear Regulatory Commission. The report includes sample dates, time period of sample, water temperature (F°) in the area of the intake structure, number of screens washed, number of pumps in operation, and calculated fish total count and weight (lbs.). Each species is then listed with a total weight and count, maximum and modal length (mm), modal weight, and weight of trash, if any.

Data and Discussion

There were 101 samples taken in the twelve-month period January 1 through December 31, 1982. Sampling was interrupted for a week in April when ANO Unit 1 was not operating. This gives 358 Reactor Power days for the year and a sampling frequency factor of 3.54 to extrapolate total number and weight of fish impinged for the year.

The estimated number of fish impinged was 4.4 million with a weight of 169,000 pounds. Of the fish impinged, there were 32 species representing 11 families.

In an attempt to quantify the impact of impingement on the reservoir's fish population, rotenone data was used. This data was supplied by the Arkansas Game and Fish Commission and Arkansas Tech University. Two areas were sampled, the discharge embayment of ANO and a sample station eight miles upstream away from possible plant impact. Fish numbers and weights in 1982 were estimated to be 207.4 million and 21 million, respectively. Impingement removed from the reservoir 2.1% of the number of fish and 0.79% of the weight of fish.

Tables 1 and 2 list the number, weight and percentage of each species of fish impinged by month, and a total for the year. Highest impingement occurs during late fall, winter and early spring, October through March. The most impinged species of fish were Dorosoma cepedianum (Gizzard Shad) and Dorosoma petenense (Threadfin Shad) representing the Clupeidae (Herring) Family at 96.9% of the total number and 94.7% of the total weight (Tables 3 and 4). Aplodinotus grunniens (Freshwater Drum) representing the Sciaenidae

(Drum) Family contributed 1.6% of the total number and 2.5% of the total weight; all other species contributed less than 1.0% of the total number or total weight impinged.

Gizzard and Threadfin Shad are very susceptible to thermal stress or cold shock. Water temperatures from October through March ranged from 75°F to 34°F. Any sudden temperature drops or prolonged temperatures below 60°F severely impacts these species.

Estimating the percentage number and weight of the total reservoir and impingement species densities gives the following results:

Gizzard Shad	(Reservoir)	21.5% number	23.4% weight
	(Impingement)	44.8%	77.4%
Threadfin Shad	(Reservoir)	3.5% number	0.3% weight
	(Impingement)	52.2%	17.3%

It can readily be observed that impingement appears to significantly impact a relatively small, select portion of the reservoir's fish population. Historically, the shad have successfully recovered from such high losses.

Five of the more notable species of fish impinged, whether by reason of numerical importance or commercial/sport fishery importance, are Gizzard and Threadfin Shad, Freshwater Drum, *Roccus chrysops* and *Roccus saxatilis* (White and Striped Bass, respectively). The proportion of the total number of impinged fish for Threadfin Shad was 52.2% with an average length of 77 mm, ranging in size (total length) from less than 30 mm to 175 mm; Gizzard Shad was 44.8% with an average length of 124 mm, ranging in size from less than 30 mm to 353 mm; Freshwater Drum was 1.6% with an average length of 106 mm, ranging in size from less than 30 mm to 410 mm; White Bass was 0.13% with an average length of 176 mm, ranging in size from less than 30 mm to 450 mm; and Striped Bass was 0.04% with an average length of 276 mm, ranging in size from less than 30 mm to 574 mm.

Using historical impingement data, 1974 through 1982, the estimated average yearly weight of fish was 132,600 pounds. The minimum yearly fish weight was 14,116 pounds in 1978, and the maximum yearly fish weight was 271,000 in 1979. The weight of trash contributes an additional 16,000 pounds a year.

However, the number of fish impinged in any one year varies considerably and cannot be reliably predicted. Factors other than the operation of ANO Unit 1 that influence impingement include such parameters as temperature, turbidity, spawning success and the general condition of the fish.

Over the nine-year period, 56 species of fish have been collected; however, in any one year, there are less than 40 species. Some species of fish, such as Scaphirhynchus platorynchus (Shovelnose Sturgeon) and Esox vermiculatus (Grass Pickerel) are very rarely seen in impingement samples (Table 5).

The mean weight (lbs.) of each species of fish impinged in any one year (Table 5) and the mean weight over the nine-year period (Table 6) for each species indicates variability with some species exhibiting more variation than others. Using a nonparametric Runs Up and Down Distribution test to determine randomness, the mean weights, for the most part, appear to be randomly distributed over time (P>.05). Figures 1 through 56 plot the mean weight of each species of fish impinged over the nine-year period of plant operation. One species, *Alosa chrysochloris* (Skipjack Herring) Figure 34, is the only species which exhibits a tendency toward nonrandom mixing (P=.044). Three species exhibit a tendency toward nonrandom clustering (P=.025). They are Gizzard Shad (Figure 9), Striped Bass (Figure 37) and *Lepomis cyanellus* (Green Sunfish) Figure 14. It should be noted that all three are similar in direction of variation and period of time. By all appearances, some unknown factor(s) brought about an adverse impact on weight, however slight, on several species of fish from 1978 through 1979. In addition to Gizzard Shad, Striped Bass and Green Sunfish, other species indicating a downward mean weight during this period of time were *Ictalurus punctatus* (Channel Catfish) Figure 3, *Ictalurus furcatus* (Blue Catfish) Figure 32, *Pylodictis olivaris* (Flathead Catfish) Figure 7, *Ictiobus bubalus* (Smallmouth Buffalo) Figure 35, *Lepomis macrochirus* (Bluegill Sunfish) Figure 41, and *Chaenobryttus coronarius* (Warmouth) Figure 43. Most of the fish were predators.

Conclusions

In reviewing 1982 impingement data and historical data, it does not appear that the operation of Arkansas Nuclear One, Unit 1, is having a significant impact on the fishery of Dardanelle Reservoir.

TABLE 1

SPECIES NUMBERS IMPINGED BY MONTH AT AND FOR 1982

TABLE OF SPECIES BY MONTH

SPECIES / MONTH (FREQUENCY / PERCENT)	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
CHANNEL CATFISH	0	28	185	68	37	473	101	43	288	203	85	643	2154
	0.00	0.00	0.02	0.01	0.00	0.04	0.01	0.00	0.02	0.02	0.01	0.05	0.17
CHESTNUT LAMPREY	0	0	0	4	4	0	0	0	0	0	0	0	8
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EMERALD SHINER	0	0	1	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EUROPEAN CARP	0	0	0	2	0	1	12	1	0	0	0	2	18
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FLATHEAD CATFISH	0	0	21	0	0	0	3	2	1	0	1	0	28
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRESHWATER DRUM	276	1011	2642	282	672	8003	1815	574	1446	786	308	1617	19432
	0.02	0.08	0.21	0.02	0.05	0.65	0.15	0.05	0.12	0.06	0.03	0.13	1.58
GIZZARD SHAD	236299	242549	58106	377	146	2705	453	94	148	1176	683	8448	551184
	19.19	19.70	4.72	0.03	0.01	0.22	0.04	0.01	0.01	0.10	0.06	0.69	44.77
GOLDEN SHINER	0	0	7	8	8	8	1	0	0	2	0	20	54
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BLACK BULLHEAD	0	30	5	1	1	3	0	0	1	0	0	128	169
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
GREEN SUNFISH	10	129	27	7	7	9	2	0	0	1	4	207	403
	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03
LARGEMOUTH BASS	0	0	5	0	1	4	0	3	3	0	0	26	40
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	858107	244933	62266	952	989	11559	2702	1101	4490	8159	5220	30606	1231084
	69.70	19.90	5.06	0.08	0.08	0.94	0.22	0.09	0.36	0.66	0.42	2.49	100.00

(CONTINUED)

TABLE 1 (CONTINUED)

SPECIES NUMBERS IMPINGED BY MONTH AT AND FOR 1982

TABLE OF SPECIES BY MONTH

SPECIES / MONTH FREQUENCY PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
LARGEMOUTH BUFFALO	0	0	0	1	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LONGEAR SUNFISH	0	10	89	18	8	19	17	5	9	2	9	66	252
	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
LONGNOSE GAR	0	0	0	0	0	4	15	1	0	0	0	0	20
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSISSIPPI SILV-ERSIDE	332	232	14	1	1	0	0	0	7	25	63	485	1160
	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.09
BLACK CRAPPIE	0	0	4	0	0	0	0	0	0	0	0	7	11
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ORANGESPOTTED SUN-FISH	10	0	2	4	2	2	2	0	1	0	1	4	28
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PADDLEFISH	0	0	0	0	0	0	1	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REDEAR SUNFISH	0	0	0	0	0	0	0	0	0	0	0	1	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER CARPSUCKER	0	0	9	6	1	0	0	0	0	1	0	5	22
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER SHINER	0	0	1	0	0	0	0	0	0	0	0	14	15
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAUGER	0	0	0	1	0	1	0	0	0	0	0	0	2
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	858107	244933	62266	952	989	11559	2702	1101	4490	8159	5220	30606	1231084
	69.70	19.90	5.06	0.08	0.08	0.94	0.22	0.09	0.36	0.66	0.42	2.49	100.00

(CONTINUED)

SPECIES NUMBERS IMPINGED BY MONTH AT AND FOR 1982

TABLE 1 (CONTINUED)

TABLE OF SPECIES BY MONTH

SPECIES / FREQUENCY / PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
BLUE CATFISH	88	91	598	78	17	70	30	189	253	475	116	97	2102
	0.01	0.01	0.05	0.01	0.00	0.01	0.00	0.02	0.02	0.04	0.01	0.01	0.17
SKIPJACK HERRING	2226	299	61	5	6	3	0	0	7	13	28	54	2702
	0.18	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22
SMALLMOUTH BUFFALO	0	0	1	10	0	0	0	0	0	2	0	2	15
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STRIPED BASS	11	18	35	3	6	8	5	36	54	27	15	300	518
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04
THREADFIN SHAD	618827	216	165	0	0	1	62	17	2007	5066	3509	12699	642569
	50.27	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.16	0.41	0.29	1.03	52.20
WHITE BASS	0	44	9	3	21	125	113	67	183	329	352	368	1614
	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.13
BLUEGILL SUNFISH	11	266	259	63	23	68	42	59	44	22	30	5274	6161
	0.00	0.02	0.02	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.43	0.50
WHITE CRAPPIE	17	5	7	7	25	29	48	28	37	29	16	81	329
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03
WARMOUTH	0	5	11	3	3	3	0	2	1	0	0	54	82
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
RIVER DARTER	0	0	3	0	0	0	0	0	0	0	0	4	7
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STONEROLLER	0	0	1	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	858107	244933	62266	952	989	11559	2702	1101	4490	8159	5220	30606	1231084
	69.70	19.90	5.06	0.08	0.08	0.94	0.22	0.09	0.36	0.66	0.42	2.49	100.00

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT AND FOR 1982

TABLE 2

TABLE OF SPECIES BY MONTH

SPECIES / MONTH — FREQUENCY / PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
CHANNEL CATFISH	0	1	15	12	5	24	7	7	14	11	3	23	120
	0.00	0.00	0.03	0.03	0.01	0.05	0.02	0.01	0.03	0.02	0.01	0.05	0.25
CHESTNUT LAMPREY	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EMERALD SHINER	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EUROPEAN CARP	0	0	0	5	0	0	3	0	0	0	0	0	8
	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02
FLATHEAD CATFISH	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRESHWATER DRUM	59	188	418	43	24	277	36	12	20	23	14	81	1196
	0.12	0.39	0.88	0.09	0.05	0.58	0.08	0.03	0.04	0.05	0.03	0.17	2.51
GIZZARD SHAD	15715	16743	3669	19	10	148	20	2	7	51	32	538	36955
	32.92	35.07	7.69	0.04	0.02	0.31	0.04	0.01	0.02	0.11	0.07	1.13	77.40
GOLDEN SHINER	0	0	0	0	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BLACK BULLHEAD	0	1	0	0	0	0	0	0	0	0	0	12	13
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03
GREEN SUNFISH	0	1	1	0	0	1	0	0	0	0	0	3	7
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
LARGEMOUTH BASS	0	0	0	0	0	1	0	1	1	0	0	1	5
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
TOTAL	23864	16998	4209	143	75	505	104	77	188	304	204	1070	47743
	49.98	35.60	8.82	0.30	0.16	1.06	0.22	0.16	0.39	0.64	0.43	2.24	100.00

(CONTINUED)

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT AND FOR 1982

TABLE 2 (CONTINUED)

TABLE OF SPECIES BY MONTH

SPECIES MONTH

FREQUENCY PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
LARGEMOUTH BUFFALO	0	0	0	5	0	0	0	0	0	0	0	0	5
	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
LONGEAR SUNFISH	0	0	4	1	1	2	1	0	1	0	1	3	15
	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03
LONGNOSE GAR	0	0	0	0	0	0	1	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MISSISSIPPI SILV-ERSIDE	5	2	0	0	0	0	0	0	0	0	1	6	14
	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03
BLACK CRAPPIE	0	0	2	0	0	0	0	0	0	0	0	1	3
	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
ORANGESPOTTED SUN-FISH	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PADDLEFISH	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REDEAR SUNFISH	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER CARPSUCKER	0	0	12	9	2	0	0	0	0	1	0	6	31
	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06
RIVER SHINER	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAUGER	0	0	0	1	0	0	0	0	0	0	0	0	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	23864	16998	4209	143	75	505	104	77	188	304	204	1070	47743
	49.98	35.60	8.82	0.30	0.16	1.06	0.22	0.16	0.39	0.64	0.43	2.24	100.00

(CONTINUED)

SPECIES WEIGHTS (IN POUNDS) IMPINGED BY MONTH AT AND FOR 1982

TABLE 2 (CONTINUED)

TABLE OF SPECIES BY MONTH

SPECIES / MONTH FREQUENCY PERCENT	01_JAN	02_FEB	03_MAR	04_APR	05_MAY	06_JUNE	07_JULY	08_AUG	09_SEPT	10_OCT	11_NOV	12_DEC	TOTAL
BLUE CATFISH	9	4	45	7	5	9	5	4	12	16	5	17	135
	0.02	0.01	0.09	0.01	0.01	0.02	0.01	0.01	0.03	0.03	0.01	0.03	0.28
SKIPJACK HERRING	77	11	6	3	3	1	0	0	2	2	2	3	110
	0.16	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.23
SMALLMOUTH BUFFALO	0	0	3	27	0	0	0	0	0	3	0	6	39
	0.00	0.00	0.01	0.06	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.08
STRIPED BASS	2	4	9	2	3	5	4	24	42	25	19	26	165
	0.00	0.01	0.02	0.00	0.01	0.01	0.01	0.05	0.09	0.05	0.04	0.05	0.34
THREADFIN SHAD	7990	10	7	0	0	0	0	0	13	57	42	146	8264
	16.74	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.12	0.09	0.30	17.31
WHITE BASS	0	17	4	1	8	26	18	19	70	108	82	64	417
	0.00	0.04	0.01	0.00	0.02	0.05	0.04	0.04	0.15	0.23	0.17	0.13	0.87
BLUEGILL SUNFISH	0	15	14	3	2	9	5	3	4	2	2	133	193
	0.00	0.03	0.03	0.01	0.00	0.02	0.01	0.01	0.01	0.00	0.00	0.28	0.40
WHITE CRAPPIE	7	1	0	3	12	4	4	5	3	4	1	2	44
	0.01	0.00	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.09
WARMOUTH	0	0	0	0	0	0	0	0	0	0	0	1	1
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RIVER DARTER	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STONEROLLER	0	0	0	0	0	0	0	0	0	0	0	0	0
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	23864	16998	4209	143	75	505	104	77	188	304	204	1070	47743
	49.98	35.60	8.82	0.30	0.16	1.06	0.22	0.16	0.39	0.64	0.43	2.24	100.00

TABLE 3

PERCENTAGE OF FISH NUMBERS BY FAMILY
IMPINGED AT AND IN 1982

TABLE OF SPECIES BY YEAR

SPECIES YEAR

PERCENT	1982	TOTAL
LAMPREY	0.00	0.00
DRUM	1.58	1.58
GAR	0.00	0.00
SILVERSIDE	0.09	0.09
PADDLEFISH	0.00	0.00
CATFISH	0.36	0.36
SUCKER	0.00	0.00
HERRING	97.19	97.19
BASS	0.17	0.17
SUNFISH	0.59	0.59
PERCH	0.00	0.00
MINNOW	0.01	0.01
TOTAL	1231084 100.00	1231084 100.00

TABLE 4

PERCENTAGE OF FISH WEIGHTS (POUNDS) BY FAMILY
IMPINGED AT ANO IN 1982

TABLE OF SPECIES BY YEAR

SPECIES / PERCENT	YEAR 1982	TOTAL
LAMPREY	0.00	0.00
DRUM	2.51	2.51
GAR	0.00	0.00
SILVERSIDE	0.03	0.03
PADDLEFISH	0.00	0.00
CATFISH	0.56	0.56
SUCKER	0.16	0.16
HERRING	94.95	94.95
BASS	1.22	1.22
SUNFISH	0.56	0.56
PERCH	0.00	0.00
MINNOW	0.02	0.02
TOTAL	47743 100.00	47743 100.00

TABLE 5

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT AND BY YEAR FROM 1974 THROUGH 1982

OBS	YR	SPECIES	MEAN_WT	MIN_WT	MAX_WT
1	1976	ARKANSAS RIVER SHINER	0.01603	0.01412	0.01857
2	1975	BULLHEAD MINNOW	0.01000	0.01000	0.01000
3	1976	BULLHEAD MINNOW	0.01000	0.01000	0.01000
4	1977	BULLHEAD MINNOW	0.01000	0.01000	0.01000
5	1980	BULLHEAD MINNOW	0.01000	0.01000	0.01000
6	1974	CHANNEL CATFISH	0.03259	0.00421	0.09367
7	1975	CHANNEL CATFISH	0.04366	0.00314	0.72000
8	1976	CHANNEL CATFISH	0.06738	0.00375	0.63286
9	1977	CHANNEL CATFISH	0.10902	0.00333	1.08000
10	1978	CHANNEL CATFISH	0.09000	0.00077	1.27333
11	1979	CHANNEL CATFISH	0.08011	0.00187	1.07333
12	1980	CHANNEL CATFISH	0.08431	0.00333	1.38000
13	1981	CHANNEL CATFISH	0.11014	0.00800	0.90857
14	1982	CHANNEL CATFISH	0.09699	0.00818	0.79500
15	1975	CHESTNUT LAMPREY	0.12123	0.11000	0.17000
16	1976	CHESTNUT LAMPREY	0.12175	0.09500	0.14500
17	1977	CHESTNUT LAMPREY	0.09875	0.05000	0.16000
18	1978	CHESTNUT LAMPREY	0.09312	0.03000	0.13500
19	1980	CHESTNUT LAMPREY	0.10712	0.07000	0.18000
20	1981	CHESTNUT LAMPREY	0.09000	0.09000	0.09000
21	1982	CHESTNUT LAMPREY	0.09500	0.08000	0.10500
22	1976	EMERALD SHINER	0.01000	0.01000	0.01000
23	1977	EMERALD SHINER	0.01000	0.01000	0.01000
24	1978	EMERALD SHINER	0.00833	0.00333	0.01000
25	1979	EMERALD SHINER	0.00809	0.00500	0.01000
26	1980	EMERALD SHINER	0.00822	0.00333	0.01000
27	1981	EMERALD SHINER	0.00885	0.00667	0.01000
28	1982	EMERALD SHINER	0.01000	0.01000	0.01000
29	1974	EUROPEAN CARP	1.06333	1.06333	1.06333
30	1975	EUROPEAN CARP	1.35312	0.53000	2.81000
31	1976	EUROPEAN CARP	2.00817	1.13000	3.89000
32	1977	EUROPEAN CARP	0.92333	0.01000	2.31000
33	1978	EUROPEAN CARP	1.40690	0.65000	2.50000
34	1979	EUROPEAN CARP	1.20754	0.02789	2.88000
35	1980	EUROPEAN CARP	1.58646	0.31000	2.81500
36	1981	EUROPEAN CARP	2.51611	1.08500	4.38000
37	1982	EUROPEAN CARP	0.78969	0.01000	3.06000
38	1975	FLATHEAD CATFISH	0.03900	0.00333	0.17667
39	1976	FLATHEAD CATFISH	0.07272	0.00500	0.85000
40	1977	FLATHEAD CATFISH	0.02255	0.00333	0.08000
41	1978	FLATHEAD CATFISH	0.04356	0.00667	0.27667
42	1979	FLATHEAD CATFISH	0.02575	0.00909	0.10000
43	1980	FLATHEAD CATFISH	0.02137	0.00636	0.05000
44	1981	FLATHEAD CATFISH	0.07167	0.00833	0.18000
45	1982	FLATHEAD CATFISH	0.07339	0.00714	0.25000
46	1974	FRESHWATER DRUM	0.04338	0.00667	0.34580
47	1975	FRESHWATER DRUM	0.07689	0.00192	1.38000
48	1976	FRESHWATER DRUM	0.05628	0.00575	0.41200
49	1977	FRESHWATER DRUM	0.04318	0.00823	0.29955
50	1978	FRESHWATER DRUM	0.07936	0.00680	0.47062
51	1979	FRESHWATER DRUM	0.09568	0.00633	1.51300
52	1980	FRESHWATER DRUM	0.06831	0.00444	0.56800
53	1981	FRESHWATER DRUM	0.14259	0.01714	0.60385
54	1982	FRESHWATER DRUM	0.10002	0.00960	1.17500
55	1974	GIZZARD SHAD	0.01596	0.00022	0.03579
56	1975	GIZZARD SHAD	0.05903	0.00903	0.27000

TABLE 5 (CONTINUED)

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT ANO BY YEAR FROM 1974 THROUGH 1982

OBS	YR	SPECIES	MEAN_WT	MIN_WT	MAX_WT
57	1976	GIZZARD SHAD	0.06265	0.00300	0.16640
58	1977	GIZZARD SHAD	0.03759	0.00432	0.13152
59	1978	GIZZARD SHAD	0.03172	0.00419	0.07963
60	1979	GIZZARD SHAD	0.03225	0.00621	0.62500
61	1980	GIZZARD SHAD	0.02759	0.00432	0.06273
62	1981	GIZZARD SHAD	0.02989	0.00478	0.10000
63	1982	GIZZARD SHAD	0.05482	0.00526	0.06929
64	1974	GOLDEN SHINER	0.00333	0.00333	0.00333
65	1975	GOLDEN SHINER	0.01082	0.00273	0.04500
66	1976	GOLDEN SHINER	0.00842	0.00250	0.01000
67	1977	GOLDEN SHINER	0.01072	0.00154	0.09429
68	1978	GOLDEN SHINER	0.01069	0.00500	0.02000
69	1979	GOLDEN SHINER	0.01123	0.00455	0.04000
70	1980	GOLDEN SHINER	0.00895	0.00222	0.02000
71	1981	GOLDEN SHINER	0.00970	0.00250	0.03000
72	1982	GOLDEN SHINER	0.01308	0.00500	0.03000
73	1974	BLACK BULLHEAD	0.01333	0.01333	0.01333
74	1975	BLACK BULLHEAD	0.09227	0.01000	0.60000
75	1976	BLACK BULLHEAD	0.10125	0.01000	0.14000
76	1977	BLACK BULLHEAD	0.11660	0.00667	0.83000
77	1978	BLACK BULLHEAD	0.04025	0.00200	0.14000
78	1979	BLACK BULLHEAD	0.07432	0.00324	0.32750
79	1980	BLACK BULLHEAD	0.01919	0.01000	0.06000
80	1981	BLACK BULLHEAD	0.07800	0.02000	0.24000
81	1982	BLACK BULLHEAD	0.24404	0.01500	3.56000
82	1977	GOLDFISH	0.01000	0.01000	0.01000
83	1975	GOLDEYE	1.15500	1.06000	1.25000
84	1976	GOLDEYE	0.10000	0.10000	0.10000
85	1978	GOLDEYE	0.09333	0.09333	0.09333
86	1979	GOLDEYE	0.23625	0.23625	0.23625
87	1974	GREEN SUNFISH	0.00872	0.00333	0.03000
88	1975	GREEN SUNFISH	0.03781	0.00500	0.14000
89	1976	GREEN SUNFISH	0.04060	0.00500	0.20000
90	1977	GREEN SUNFISH	0.04427	0.00500	0.28000
91	1978	GREEN SUNFISH	0.03373	0.00333	0.13000
92	1979	GREEN SUNFISH	0.01979	0.00250	0.13200
93	1980	GREEN SUNFISH	0.02937	0.00333	0.12000
94	1981	GREEN SUNFISH	0.04279	0.00250	0.13500
95	1982	GREEN SUNFISH	0.04407	0.00417	0.34000
96	1974	LARGEMOUTH BASS	0.24333	0.09333	0.39333
97	1975	LARGEMOUTH BASS	0.60143	0.01000	2.88000
98	1976	LARGEMOUTH BASS	0.35311	0.01000	4.44000
99	1977	LARGEMOUTH BASS	0.35567	0.01000	2.13000
100	1978	LARGEMOUTH BASS	0.91214	0.01000	1.88000
101	1979	LARGEMOUTH BASS	0.89997	0.01222	4.13000
102	1980	LARGEMOUTH BASS	1.08867	0.00667	3.31000
103	1981	LARGEMOUTH BASS	0.81992	0.01000	2.31000
104	1982	LARGEMOUTH BASS	0.14611	0.01000	0.45000
105	1976	LARGEMOUTH BUFFALO	2.69000	2.69000	2.69000
106	1977	LARGEMOUTH BUFFALO	3.84000	3.84000	3.84000
107	1980	LARGEMOUTH BUFFALO	3.06000	3.06000	3.06000
108	1982	LARGEMOUTH BUFFALO	5.25000	5.25000	5.25000
109	1975	LOGPERCH	0.01000	0.01000	0.01000
110	1977	LOGPERCH	0.01667	0.01000	0.03000
111	1974	LONGEAR SUNFISH	0.03333	0.00333	0.06333
112	1975	LONGEAR SUNFISH	0.08438	0.01000	0.19000

TABLE 5 (CONTINUED)

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT AND BY YEAR FROM 1974 THROUGH 1982

OBS	YR	SPECIES	MEAN_WT	MIN_WT	MAX_WT
113	1976	LONGEAR SUNFISH	0.06026	0.003333	0.19000
114	1977	LONGEAR SUNFISH	0.06119	0.005000	0.18000
115	1978	LONGEAR SUNFISH	0.06543	0.010000	0.18000
116	1979	LONGEAR SUNFISH	0.06233	0.003333	0.14000
117	1980	LONGEAR SUNFISH	0.06536	0.010000	0.13000
118	1981	LONGEAR SUNFISH	0.07654	0.003750	0.14000
119	1982	LONGEAR SUNFISH	0.07157	0.005000	0.23000
120	1975	LONGNOSE GAR	1.25500	0.010000	2.50000
121	1976	LONGNOSE GAR	0.16450	0.020000	0.26750
122	1978	LONGNOSE GAR	0.76000	0.210000	1.41000
123	1980	LONGNOSE GAR	0.28500	0.015000	0.81000
124	1981	LONGNOSE GAR	0.12000	0.120000	0.12000
125	1982	LONGNOSE GAR	0.03485	0.025000	0.05500
126	1976	MADTOM	0.01000	0.010000	0.01000
127	1977	MADTOM	0.01000	0.010000	0.01000
128	1978	MADTOM	0.01000	0.010000	0.01000
129	1974	MISSISSIPPI SILVERSIDE	0.01108	0.000732	0.06333
130	1975	MISSISSIPPI SILVERSIDE	0.00957	0.003333	0.06000
131	1976	MISSISSIPPI SILVERSIDE	0.00824	0.003333	0.02000
132	1977	MISSISSIPPI SILVERSIDE	0.00883	0.003333	0.02000
133	1978	MISSISSIPPI SILVERSIDE	0.01175	0.005000	0.06600
134	1979	MISSISSIPPI SILVERSIDE	0.01108	0.005000	0.02000
135	1980	MISSISSIPPI SILVERSIDE	0.01156	0.000909	0.02000
136	1981	MISSISSIPPI SILVERSIDE	0.01205	0.005000	0.02667
137	1982	MISSISSIPPI SILVERSIDE	0.01111	0.002308	0.02000
138	1974	BLACK CRAPPIE	0.13507	0.012500	0.22000
139	1975	BLACK CRAPPIE	0.10957	0.020000	0.27000
140	1976	BLACK CRAPPIE	0.33000	0.150000	0.55000
141	1977	BLACK CRAPPIE	0.16563	0.010000	0.64600
142	1978	BLACK CRAPPIE	0.13067	0.050000	0.25000
143	1979	BLACK CRAPPIE	0.23628	0.080000	0.42750
144	1980	BLACK CRAPPIE	0.13074	0.046667	0.30000
145	1981	BLACK CRAPPIE	0.18125	0.090000	0.27000
146	1982	BLACK CRAPPIE	0.43917	0.093333	0.72000
147	1978	MOONEYE	0.28000	0.280000	0.28000
148	1979	MOONEYE	0.44000	0.440000	0.44000
149	1981	MOONEYE	0.33250	0.332500	0.33250
150	1974	ORANGESPOTTED SUNFISH	0.00333	0.003333	0.00333
151	1975	ORANGESPOTTED SUNFISH	0.01138	0.002727	0.05000
152	1976	ORANGESPOTTED SUNFISH	0.00981	0.005000	0.02000
153	1977	ORANGESPOTTED SUNFISH	0.01191	0.003333	0.02000
154	1978	ORANGESPOTTED SUNFISH	0.01583	0.005000	0.05000
155	1979	ORANGESPOTTED SUNFISH	0.00830	0.002353	0.02000
156	1980	ORANGESPOTTED SUNFISH	0.01681	0.002500	0.07000
157	1981	ORANGESPOTTED SUNFISH	0.01925	0.002500	0.05000
158	1982	ORANGESPOTTED SUNFISH	0.01874	0.005000	0.07000
159	1975	PADDLEFISH	0.71667	0.010000	2.15000
160	1976	PADDLEFISH	0.01000	0.010000	0.01000
161	1977	PADDLEFISH	0.02000	0.020000	0.02000
162	1982	PADDLEFISH	0.02000	0.020000	0.02000
163	1975	RED SHINER	0.01000	0.010000	0.01000
164	1980	RED SHINER	0.01000	0.010000	0.01000
165	1981	RED SHINER	0.01000	0.010000	0.01000
166	1975	REDEAR SUNFISH	0.04000	0.040000	0.04000
167	1976	REDEAR SUNFISH	0.01000	0.010000	0.01000
168	1979	REDEAR SUNFISH	0.05269	0.015385	0.05000

TABLE 5 (CONTINUED)

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT AND BY YEAR FROM 1974 THROUGH 1982

OBS	YR	SPECIES	MEAN_WT	MIN_WT	MAX_WT
169	1980	REDEAR SUNFISH	0.04000	0.04000	0.04000
170	1981	REDEAR SUNFISH	0.02500	0.02500	0.02500
171	1982	REDEAR SUNFISH	0.14000	0.14000	0.14000
172	1974	RIVER CARPSUCKER	0.00829	0.00829	0.00829
173	1975	RIVER CARPSUCKER	1.34889	0.25000	2.00000
174	1976	RIVER CARPSUCKER	1.33600	0.46000	2.19000
175	1977	RIVER CARPSUCKER	1.15934	0.04000	2.24000
176	1978	RIVER CARPSUCKER	0.92111	0.10000	1.44000
177	1979	RIVER CARPSUCKER	1.08961	0.60333	2.18000
178	1980	RIVER CARPSUCKER	1.24000	0.10000	2.77000
179	1981	RIVER CARPSUCKER	2.27500	1.10000	3.51000
180	1982	RIVER CARPSUCKER	1.38458	0.59500	2.19000
181	1975	RIVER SHINER	0.01159	0.00500	0.02000
182	1976	RIVER SHINER	0.01650	0.01000	0.04000
183	1977	RIVER SHINER	0.01917	0.01000	0.03000
184	1978	RIVER SHINER	0.01125	0.01000	0.02000
185	1979	RIVER SHINER	0.01378	0.01200	0.01556
186	1980	RIVER SHINER	0.00937	0.00500	0.01000
187	1981	RIVER SHINER	0.01000	0.01000	0.01000
188	1982	RIVER SHINER	0.01292	0.00167	0.02000
189	1975	SAUGER	0.28000	0.00500	1.00000
190	1976	SAUGER	0.60000	0.50000	0.70000
191	1977	SAUGER	0.22784	0.01000	2.00000
192	1978	SAUGER	0.10714	0.02000	0.35000
193	1979	SAUGER	0.70111	0.01000	1.56000
194	1980	SAUGER	1.21000	1.21000	1.21000
195	1981	SAUGER	0.77000	0.75000	0.79000
196	1982	SAUGER	0.66000	0.01000	1.31000
197	1975	SHORTNOSE GAR	1.13000	1.13000	1.13000
198	1976	SHORTNOSE GAR	1.96375	1.46000	2.46750
199	1977	SHORTNOSE GAR	1.19000	1.19000	1.19000
200	1979	SHORTNOSE GAR	1.06000	1.06000	1.06000
201	1980	SHORTNOSE GAR	1.25000	1.25000	1.25000
202	1981	SHORTNOSE GAR	2.38000	2.38000	2.38000
203	1974	BLUE CATFISH	0.01703	0.00568	0.04333
204	1975	BLUE CATFISH	0.04789	0.00607	0.19000
205	1976	BLUE CATFISH	0.14327	0.00750	1.73500
206	1977	BLUE CATFISH	0.19160	0.00200	1.17500
207	1978	BLUE CATFISH	0.10966	0.00333	0.74000
208	1979	BLUE CATFISH	0.10748	0.00750	0.79167
209	1980	BLUE CATFISH	0.10451	0.00500	1.56500
210	1981	BLUE CATFISH	0.12813	0.00600	2.37250
211	1982	BLUE CATFISH	0.10110	0.00425	0.39500
212	1975	SHOVELNOSE STURGEON	0.01000	0.01000	0.01000
213	1974	SKIPJACK HERRING	0.05000	0.05000	0.05000
214	1975	SKIPJACK HERRING	0.10415	0.01000	0.65000
215	1976	SKIPJACK HERRING	0.06098	0.01000	0.33500
216	1977	SKIPJACK HERRING	0.11948	0.01000	1.00250
217	1978	SKIPJACK HERRING	0.06444	0.01963	0.45000
218	1979	SKIPJACK HERRING	0.13660	0.05294	0.45750
219	1980	SKIPJACK HERRING	0.04915	0.01667	0.29000
220	1981	SKIPJACK HERRING	0.24973	0.00250	1.03000
221	1982	SKIPJACK HERRING	0.17779	0.02083	0.83000
222	1974	SMALLMOUTH BUFFALO	0.01351	0.00421	0.03132
223	1975	SMALLMOUTH BUFFALO	1.38700	0.34000	2.83000
224	1976	SMALLMOUTH BUFFALO	2.29389	1.88000	2.63000

TABLE 5 (CONTINUED)

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT AND BY YEAR FROM 1974 THROUGH 1982

OBS	YR	SPECIES	MEAN_WT	MIN_WT	MAX_WT
225	1977	SMALLMOUTH BUFFALO	2.03300	1.63000	2.44000
226	1978	SMALLMOUTH BUFFALO	1.86846	0.01000	2.58000
227	1979	SMALLMOUTH BUFFALO	1.44000	1.44000	1.44000
228	1980	SMALLMOUTH BUFFALO	2.61889	1.48000	3.78000
229	1981	SMALLMOUTH BUFFALO	2.89167	2.13000	3.36000
230	1982	SMALLMOUTH BUFFALO	2.55667	1.19000	3.94000
231	1977	SPOTTED GAR	0.16000	0.16000	0.16000
232	1975	STRIPED BASS	0.04516	0.01000	0.34000
233	1976	STRIPED BASS	0.09405	0.01000	1.34000
234	1977	STRIPED BASS	0.45218	0.00500	2.06000
235	1978	STRIPED BASS	0.15811	0.00400	2.25000
236	1979	STRIPED BASS	0.08496	0.01000	0.32500
237	1980	STRIPED BASS	0.10052	0.00250	0.66000
238	1981	STRIPED BASS	0.24394	0.01667	1.64667
239	1982	STRIPED BASS	0.68862	0.00500	3.56000
240	1974	THREADFIN SHAD	0.01250	0.00158	0.01933
241	1975	THREADFIN SHAD	0.01766	0.00333	0.03636
242	1976	THREADFIN SHAD	0.01436	0.00201	0.02955
243	1977	THREADFIN SHAD	0.01469	0.00231	0.08000
244	1978	THREADFIN SHAD	0.00743	0.00200	0.03875
245	1979	THREADFIN SHAD	0.01158	0.00333	0.02430
246	1980	THREADFIN SHAD	0.01478	0.00200	0.04000
247	1981	THREADFIN SHAD	0.01279	0.00333	0.05000
248	1982	THREADFIN SHAD	0.01612	0.00360	0.07000
249	1974	TILAPIA	0.29387	0.25108	0.33667
250	1974	WHITE BASS	0.03791	0.01538	0.15667
251	1975	WHITE BASS	0.11943	0.00250	0.75000
252	1976	WHITE BASS	0.07692	0.00333	0.55500
253	1977	WHITE BASS	0.14188	0.00516	1.02000
254	1978	WHITE BASS	0.20904	0.00071	1.15667
255	1979	WHITE BASS	0.16013	0.01000	1.26545
256	1980	WHITE BASS	0.27635	0.00379	1.44000
257	1981	WHITE BASS	0.26363	0.01333	1.27000
258	1982	WHITE BASS	0.30962	0.09437	1.05000
259	1974	BLUEGILL SUNFISH	0.02411	0.00185	0.11167
260	1975	BLUEGILL SUNFISH	0.05526	0.00286	0.19000
261	1976	BLUEGILL SUNFISH	0.07073	0.00333	0.30333
262	1977	BLUEGILL SUNFISH	0.08676	0.00333	0.24667
263	1978	BLUEGILL SUNFISH	0.08298	0.00286	0.32000
264	1979	BLUEGILL SUNFISH	0.07013	0.00284	0.42625
265	1980	BLUEGILL SUNFISH	0.06329	0.00250	0.20000
266	1981	BLUEGILL SUNFISH	0.10884	0.00333	0.21167
267	1982	BLUEGILL SUNFISH	0.08363	0.00444	0.46000
268	1974	WHITE CRAPPIE	0.05670	0.00372	0.29222
269	1975	WHITE CRAPPIE	0.16043	0.00318	2.00000
270	1976	WHITE CRAPPIE	0.15617	0.00500	0.80400
271	1977	WHITE CRAPPIE	0.15097	0.00368	1.85600
272	1978	WHITE CRAPPIE	0.17312	0.01000	1.89000
273	1979	WHITE CRAPPIE	0.12512	0.00333	1.00013
274	1980	WHITE CRAPPIE	0.28188	0.00200	2.59833
275	1981	WHITE CRAPPIE	0.23717	0.00667	0.92000
276	1982	WHITE CRAPPIE	0.16268	0.00375	0.79000
277	1975	WARMOUTH	0.06143	0.01000	0.16000
278	1976	WARMOUTH	0.06667	0.01000	0.14000
279	1977	WARMOUTH	0.04655	0.01000	0.19000
280	1978	WARMOUTH	0.03500	0.02750	0.04000

TABLE 5 (CONTINUED)

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT AND BY YEAR FROM 1974 THROUGH 1982

OBS	YR	SPECIES	MEAN_WT	MIN_WT	MAX_WT
281	1979	WARMOUTH	0.00976	0.00235	0.02667
282	1980	WARMOUTH	0.03260	0.01000	0.16750
283	1981	WARMOUTH	0.05156	0.02000	0.20000
284	1982	WARMOUTH	0.03925	0.00600	0.20000
285	1975	YELLOW BULLHEAD	0.04000	0.04000	0.04000
286	1976	YELLOW BULLHEAD	0.01000	0.01000	0.01000
287	1978	YELLOW BULLHEAD	0.06500	0.01000	0.16000
288	1980	YELLOW BULLHEAD	0.02000	0.02000	0.02000
289	1976	FATHEAD MINNOW	0.01000	0.01000	0.01000
290	1977	FATHEAD MINNOW	0.01000	0.01000	0.01000
291	1974	BLUNTNOSE MINNOW	0.00631	0.00630	0.00632
292	1976	DARTER	0.01000	0.01000	0.01000
293	1976	JOHNNY DARTER	0.01000	0.01000	0.01000
294	1975	SPOTTED SUNFISH	0.01000	0.01000	0.01000
295	1977	SLIM MINNOW	0.01000	0.01000	0.01000
296	1978	SLIM MINNOW	0.00750	0.00500	0.01000
297	1979	SLIM MINNOW	0.00458	0.00417	0.00500
298	1980	SLIM MINNOW	0.01000	0.01000	0.01000
299	1978	BLACK BUFFALO	1.58000	0.97000	2.19000
300	1979	BLACK BUFFALO	2.31000	2.31000	2.31000
301	1977	AMERICAN EEL	0.38357	0.10000	0.67000
302	1979	AMERICAN EEL	0.60375	0.02000	2.25000
303	1980	AMERICAN EEL	0.01000	0.01000	0.01000
304	1981	AMERICAN EEL	1.94333	1.38000	2.50667
305	1979	GRASS PICKEREL	0.07176	0.07176	0.07176
306	1980	RIVER DARTER	0.01000	0.01000	0.01000
307	1982	RIVER DARTER	0.01292	0.01250	0.01333
308	1982	STONEROLLER	0.10000	0.10000	0.10000
309	1974	BROOK SILVERSIDE	0.00530	0.00431	0.00630
310	1975	BROOK SILVERSIDE	0.00916	0.00500	0.01077
311	1976	BROOK SILVERSIDE	0.00750	0.00500	0.01000
312	1977	BROOK SILVERSIDE	0.00500	0.00333	0.00667
313	1978	BROOK SILVERSIDE	0.01000	0.00400	0.06000
314	1979	BROOK SILVERSIDE	0.00568	0.00333	0.00725
315	1980	BROOK SILVERSIDE	0.00911	0.00333	0.02000
316	1981	BROOK SILVERSIDE	0.00794	0.00667	0.01000

TABLE 6

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED OVER THE NINE YEAR PERIOD, 1974 THROUGH 1982

OBS	SPECIES	MEAN_WT	MIN_WT	MAX_WT
1	ARKANSAS RIVER SHINER	0.01603	0.01412	0.01857
2	BULLHEAD MINNOW	0.01000	0.01000	0.01000
3	CHANNEL CATFISH	0.08263	0.00077	1.38000
4	CHESTNUT LAMPREY	0.10644	0.03000	0.18000
5	EMERALD SHINER	0.00863	0.00333	0.01000
6	EUROPEAN CARP	1.45945	0.01000	4.38000
7	FLATHEAD CATFISH	0.04076	0.00333	0.85000
8	FRESHWATER DRUM	0.08220	0.00192	1.51300
9	GIZZARD SHAD	0.04102	0.00022	0.62500
10	GOLDEN SHINER	0.01023	0.00154	0.09429
11	BLACK BULLHEAD	0.11215	0.00200	3.56000
12	GOLDFISH	0.01000	0.01000	0.01000
13	GOLDEYE	0.54792	0.09333	1.25000
14	GREEN SUNFISH	0.03617	0.00250	0.34000
15	LARGEMOUTH BASS	0.55746	0.00667	4.44000
16	LARGEMOUTH BUFFALO	3.58000	2.69000	5.25000
17	LOGPERCH	0.01500	0.01000	0.03000
18	LONGEAR SUNFISH	0.06810	0.00333	0.23000
19	LONGNOSE GAR	0.28878	0.01000	2.50000
20	MADTOM	0.01000	0.01000	0.01000
21	MISSISSIPPI SILVERSIDE	0.01053	0.00073	0.06600
22	BLACK CRAPPIE	0.19275	0.01000	0.72000
23	MOONEYE	0.35083	0.28000	0.44000
24	ORANGESPOTTED SUNFISH	0.01410	0.00235	0.07000
25	PADDLEFISH	0.31714	0.01000	2.13000
26	RED SHINER	0.01000	0.01000	0.01000
27	REDEAR SUNFISH	0.04577	0.01000	0.14000
28	RIVER CARPSUCKER	1.28004	0.00829	3.51000
29	RIVER SHINER	0.01317	0.00167	0.04000
30	SAUGER	0.31806	0.00500	2.00000
31	SHORTNOSE GAR	1.52344	1.06000	2.46750
32	BLUE CATFISH	0.11052	0.00200	2.37250
33	SHOVELNOSE STURGEON	0.01000	0.01000	0.01000
34	SKIPJACK HERRING	0.11911	0.00250	1.03000
35	SMALLMOUTH BUFFALO	2.02301	0.00421	3.94000
36	SPOTTED GAR	0.16000	0.16000	0.16000
37	STRIPED BASS	0.25002	0.00250	3.56000
38	THREADFIN SHAD	0.01416	0.00158	0.08000
39	TILAPIA	0.29387	0.25108	0.33667
40	WHITE BASS	0.19370	0.00071	1.44000
41	BLUEGILL SUNFISH	0.07809	0.00185	0.46000
42	WHITE CRAPPIE	0.17890	0.00200	2.59833
43	WARMOUTH	0.04166	0.00235	0.20000
44	YELLOW BULLHEAD	0.04800	0.01000	0.16000
45	FATHEAD MINNOW	0.01000	0.01000	0.01000
46	BLUNTNOSE MINNOW	0.00631	0.00630	0.00632
47	DARTER	0.01000	0.01000	0.01000
48	JOHNNY DARTER	0.01000	0.01000	0.01000
49	SPOTTED SUNFISH	0.01000	0.01000	0.01000
50	SLIM MINNOW	0.00842	0.00417	0.01000
51	BLACK BUFFALO	1.82333	0.97000	2.51000
52	AMERICAN EEL	0.67931	0.01000	2.50667
53	GRASS PICKEREL	0.07176	0.07176	0.07176
54	RIVER DARTER	0.01146	0.01000	0.01333
55	STONEROLLER	0.10000	0.10000	0.10000
56	BROOK SILVERSIDE	0.00657	0.00333	0.06000

FIGURE 1

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-ARKANSAS RIVER SHINER

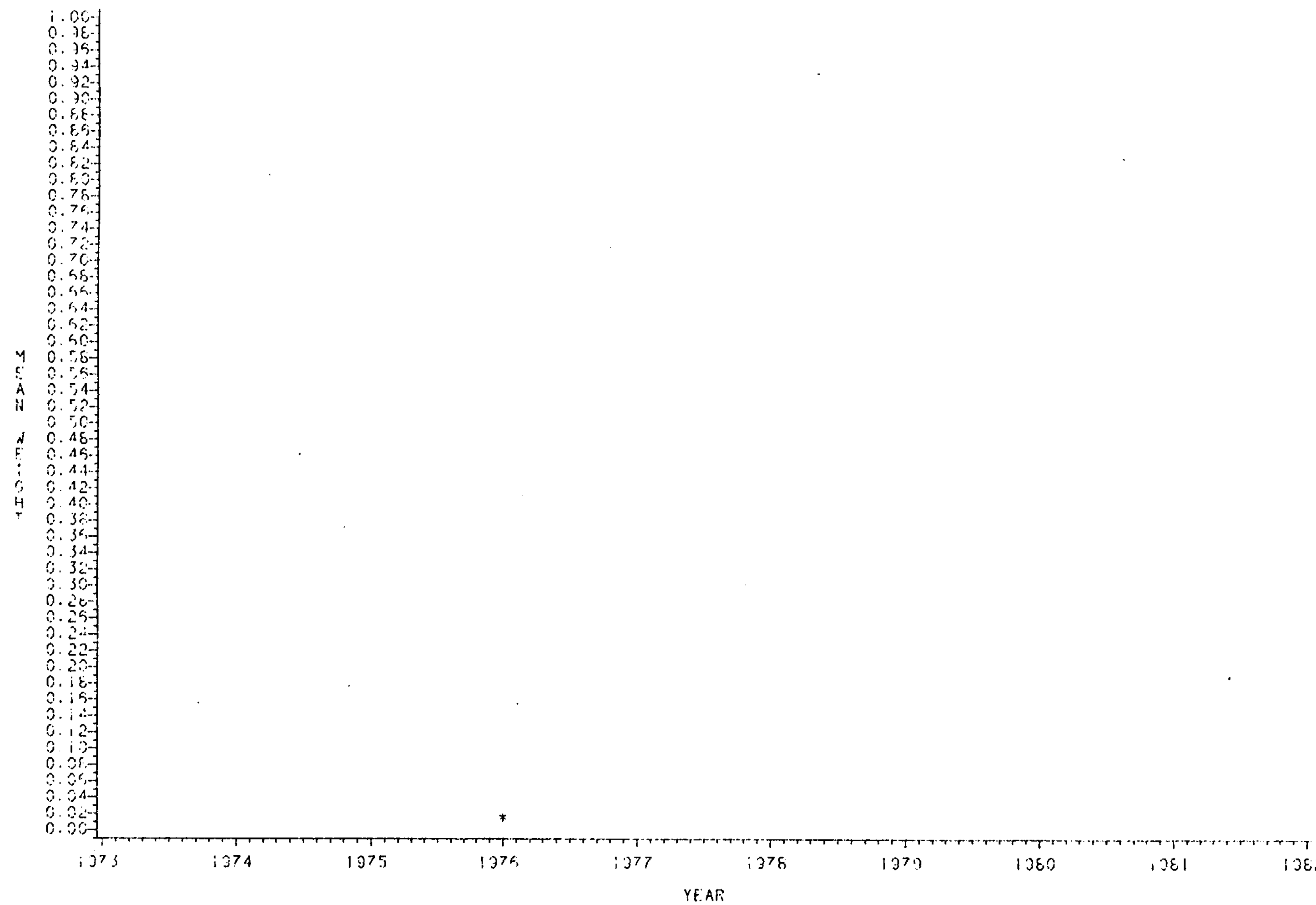


FIGURE 2

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-BULLHEAD MINNOW

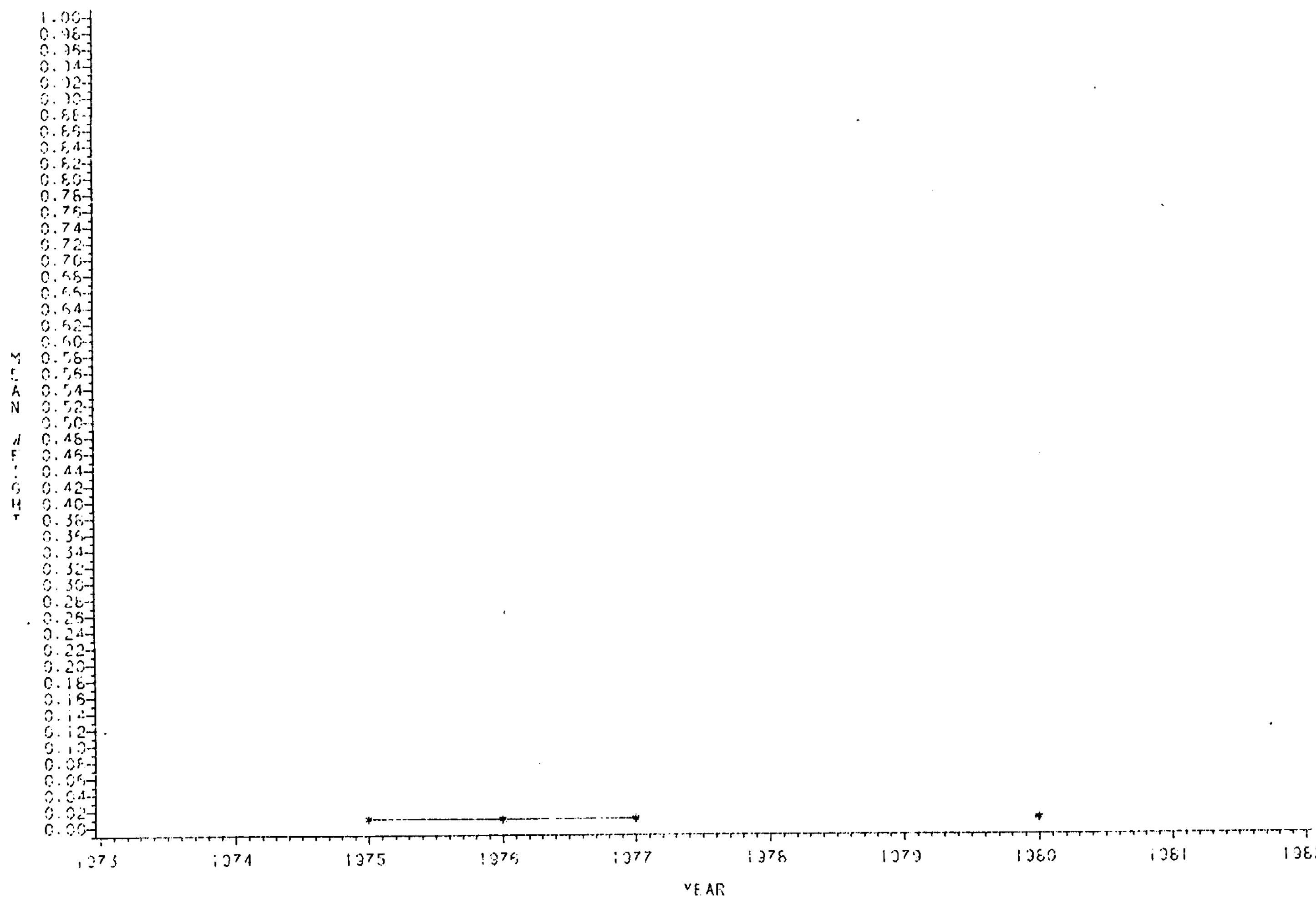


FIGURE 3

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-CHANNEL CATFISH

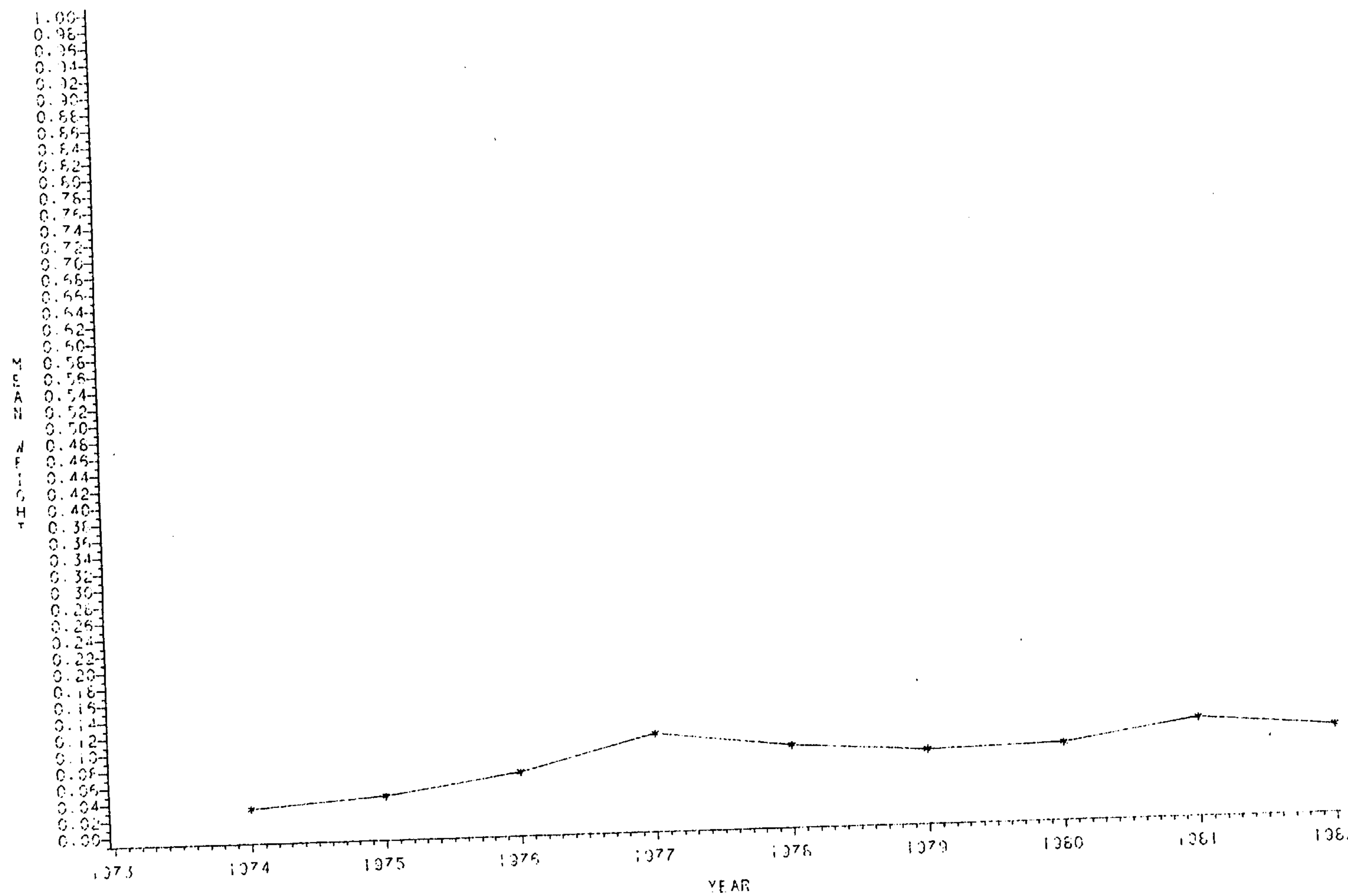


FIGURE 4

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-CHESTNUT LAMPREY

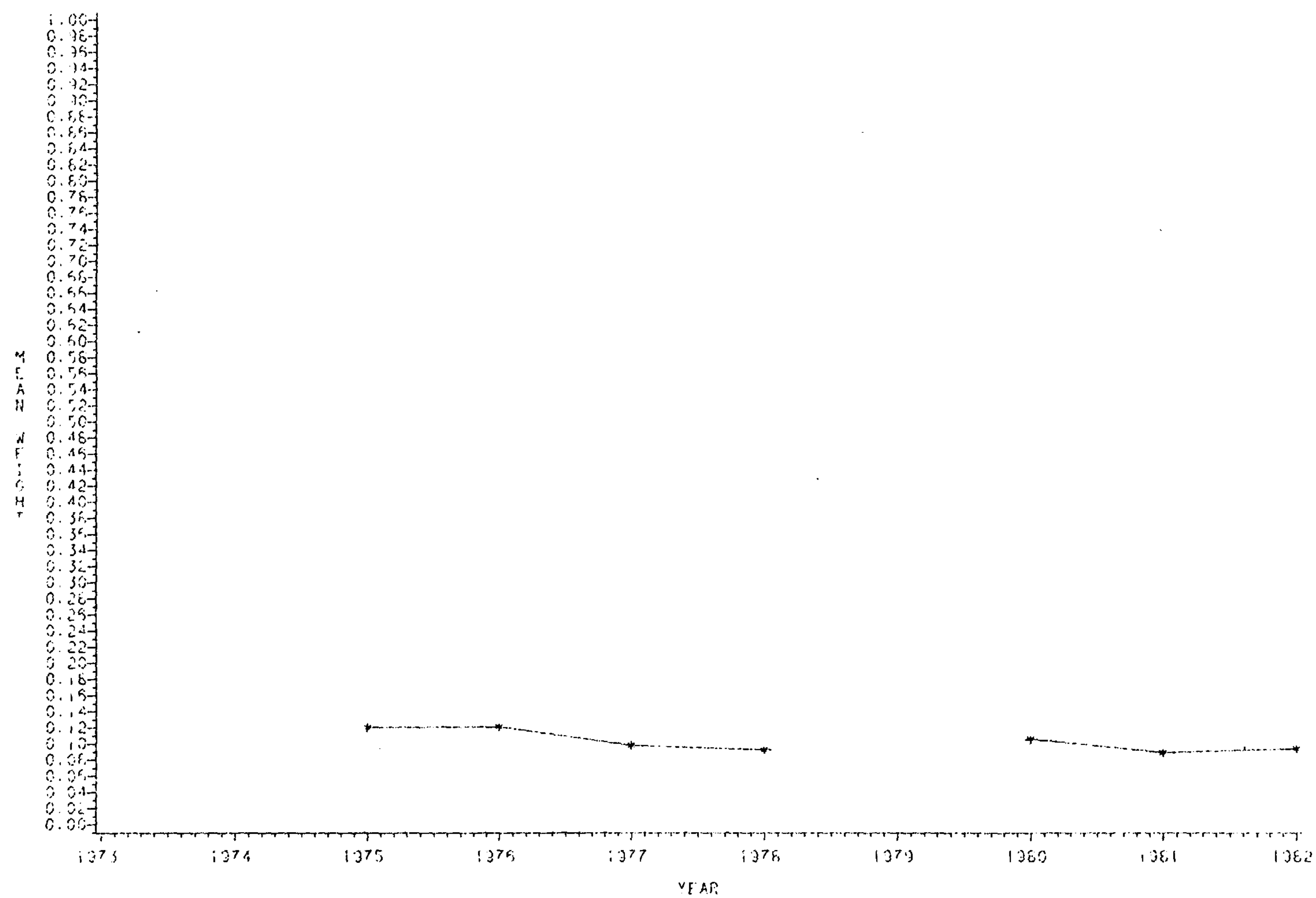


FIGURE 5

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-EMERALD SHINER

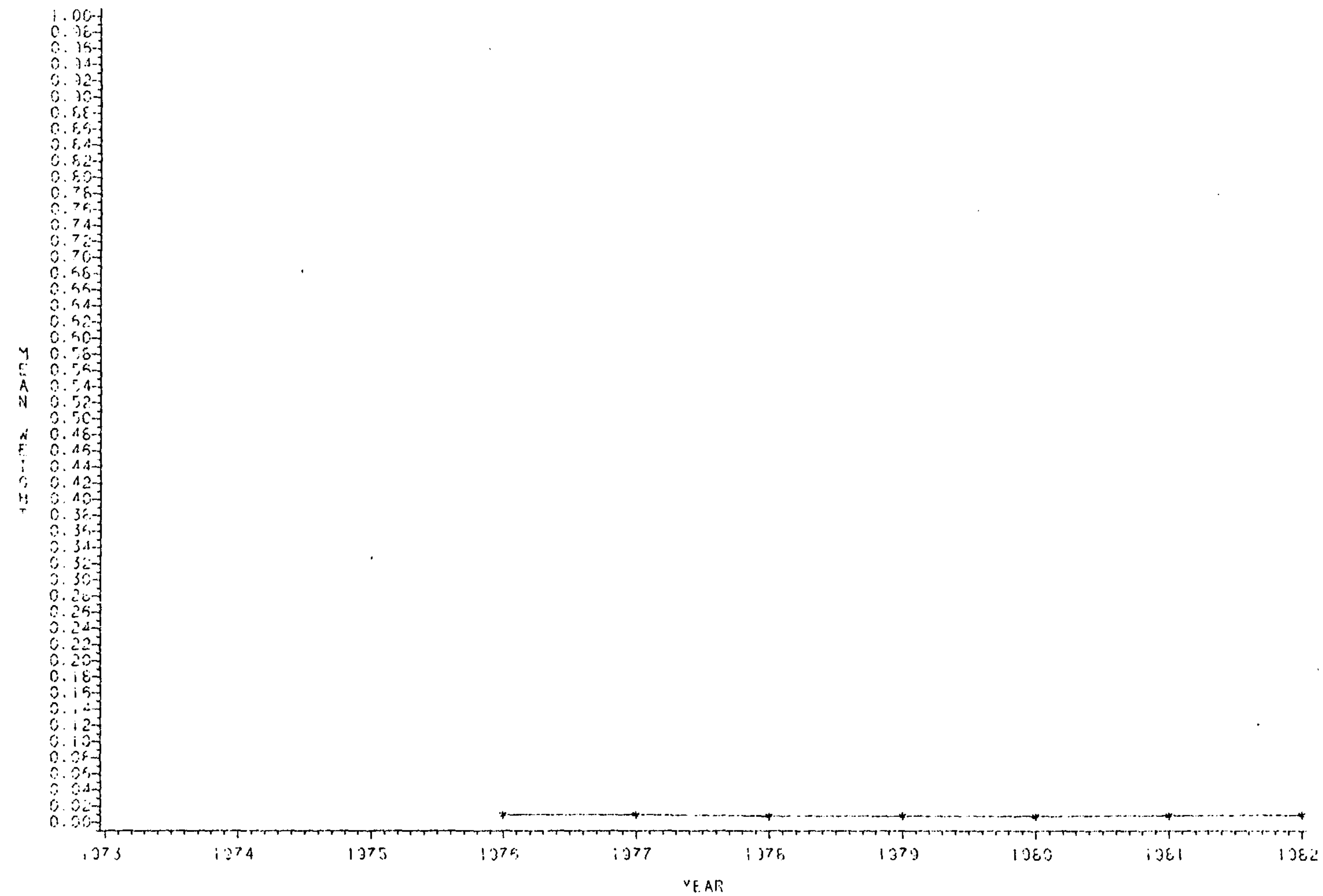
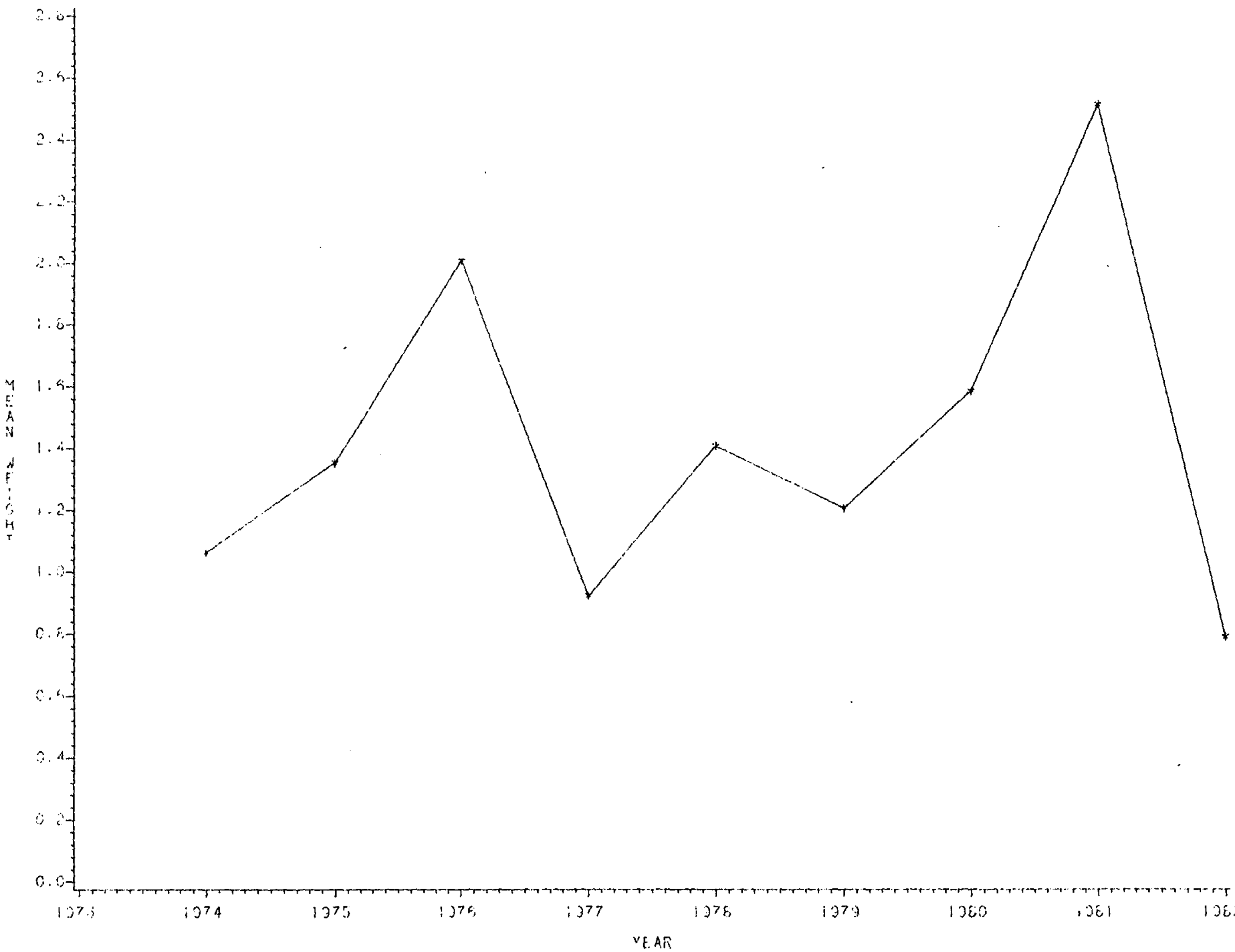


FIGURE 6

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES=EUROPEAN CARP



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 7

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-FLATHEAD CATFISH

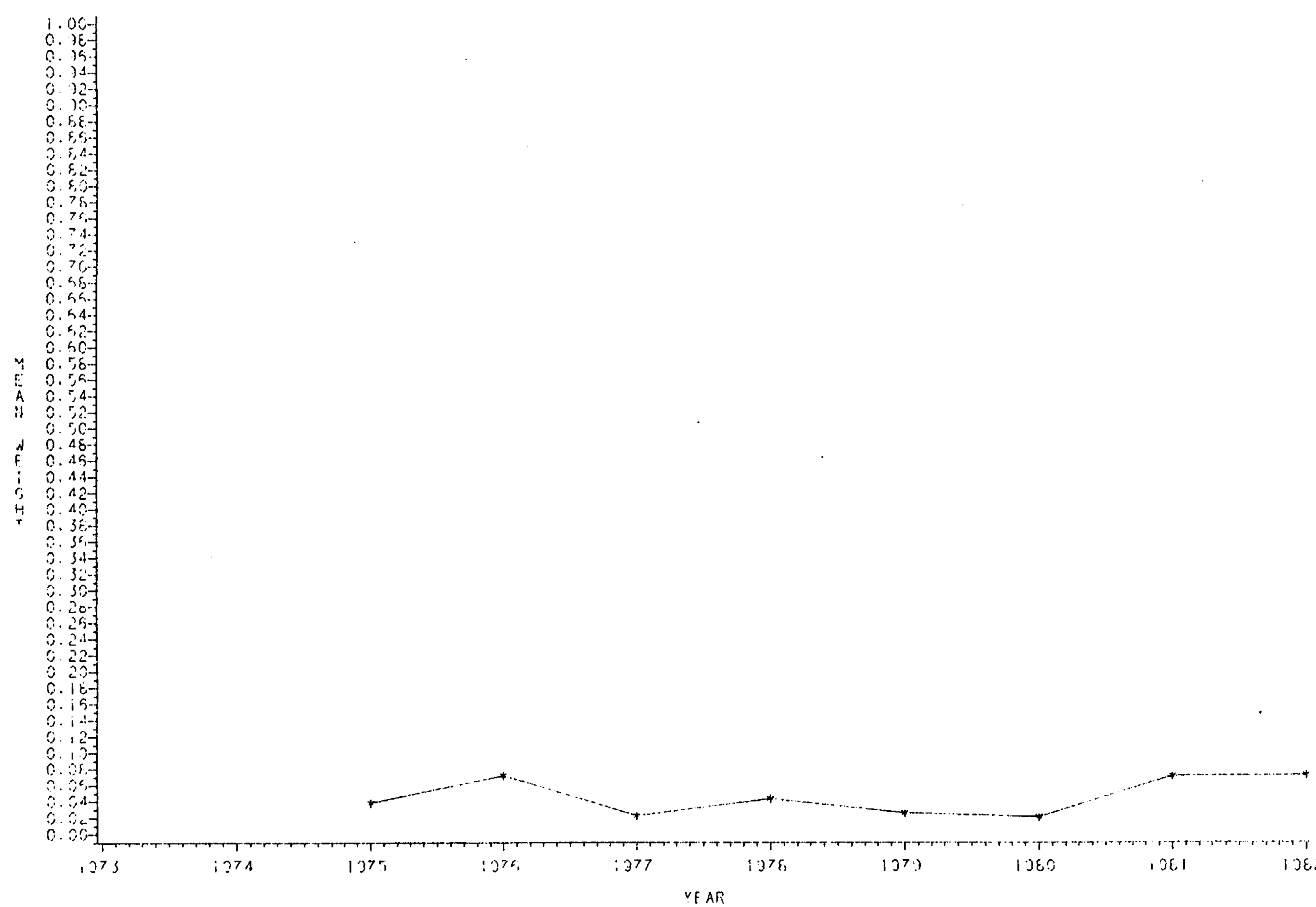


FIGURE 8

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-FRESHWATER DRUM

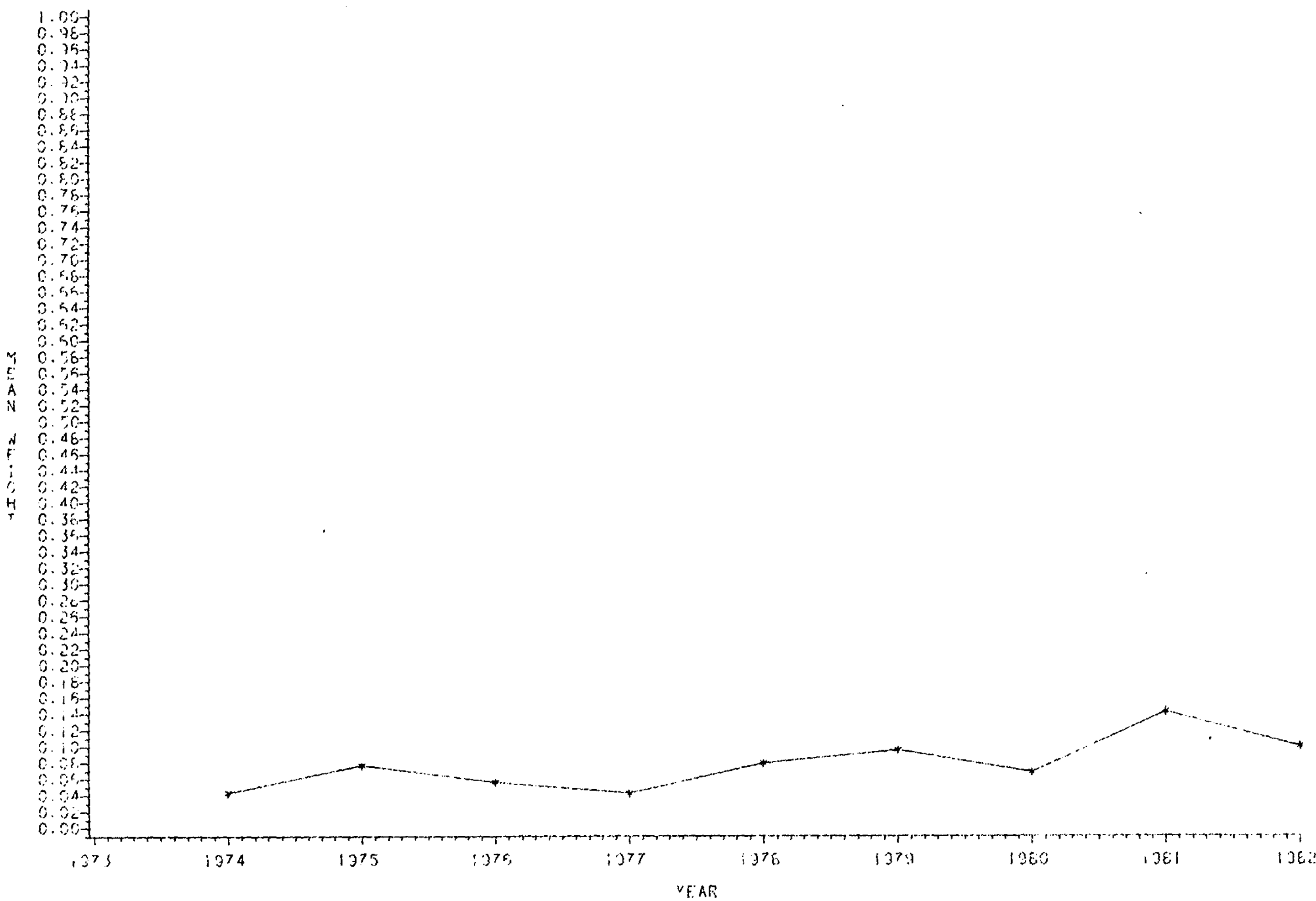


FIGURE 9

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-GIZZARD SHAD

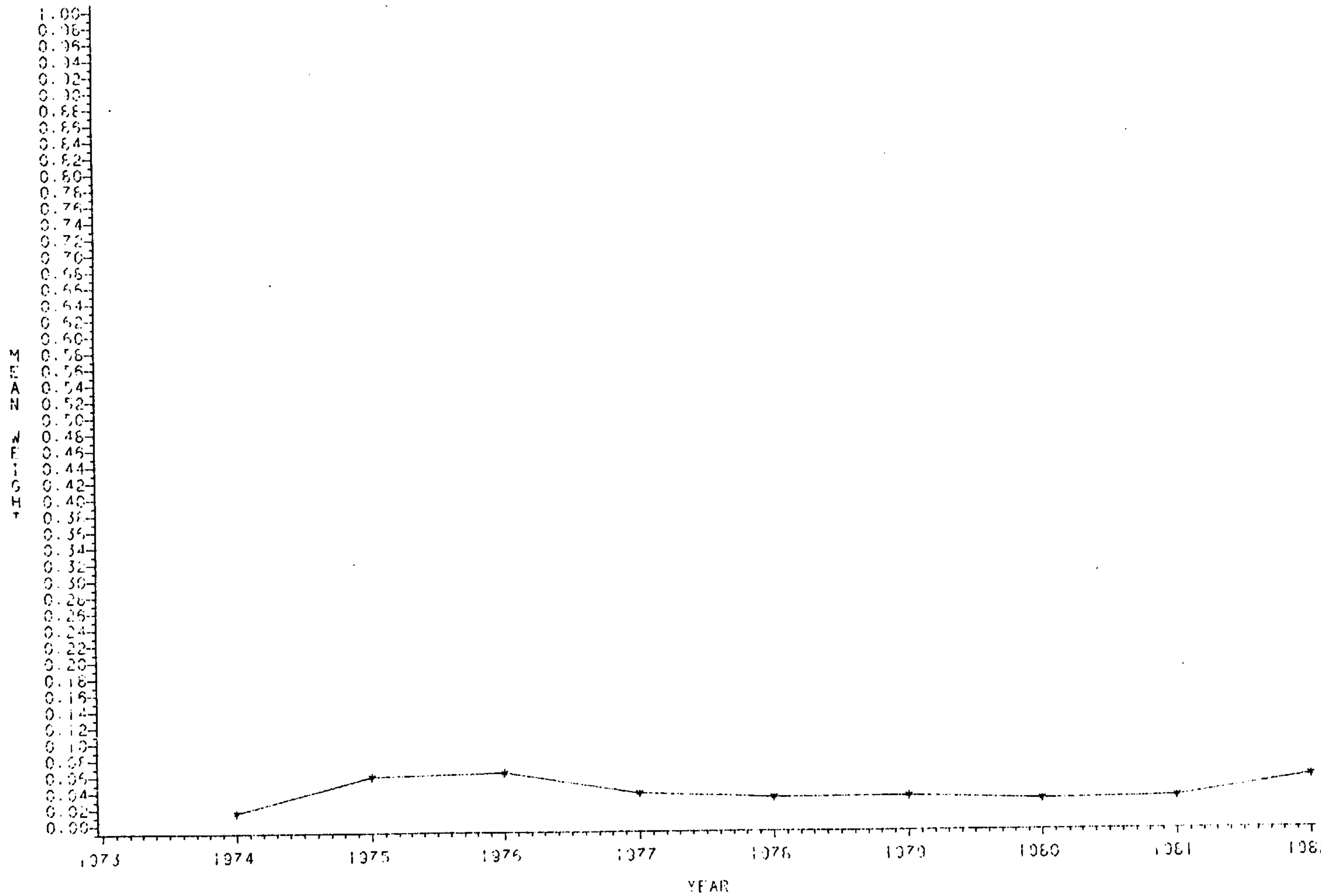


FIGURE 10

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-GOLDEN SHINER

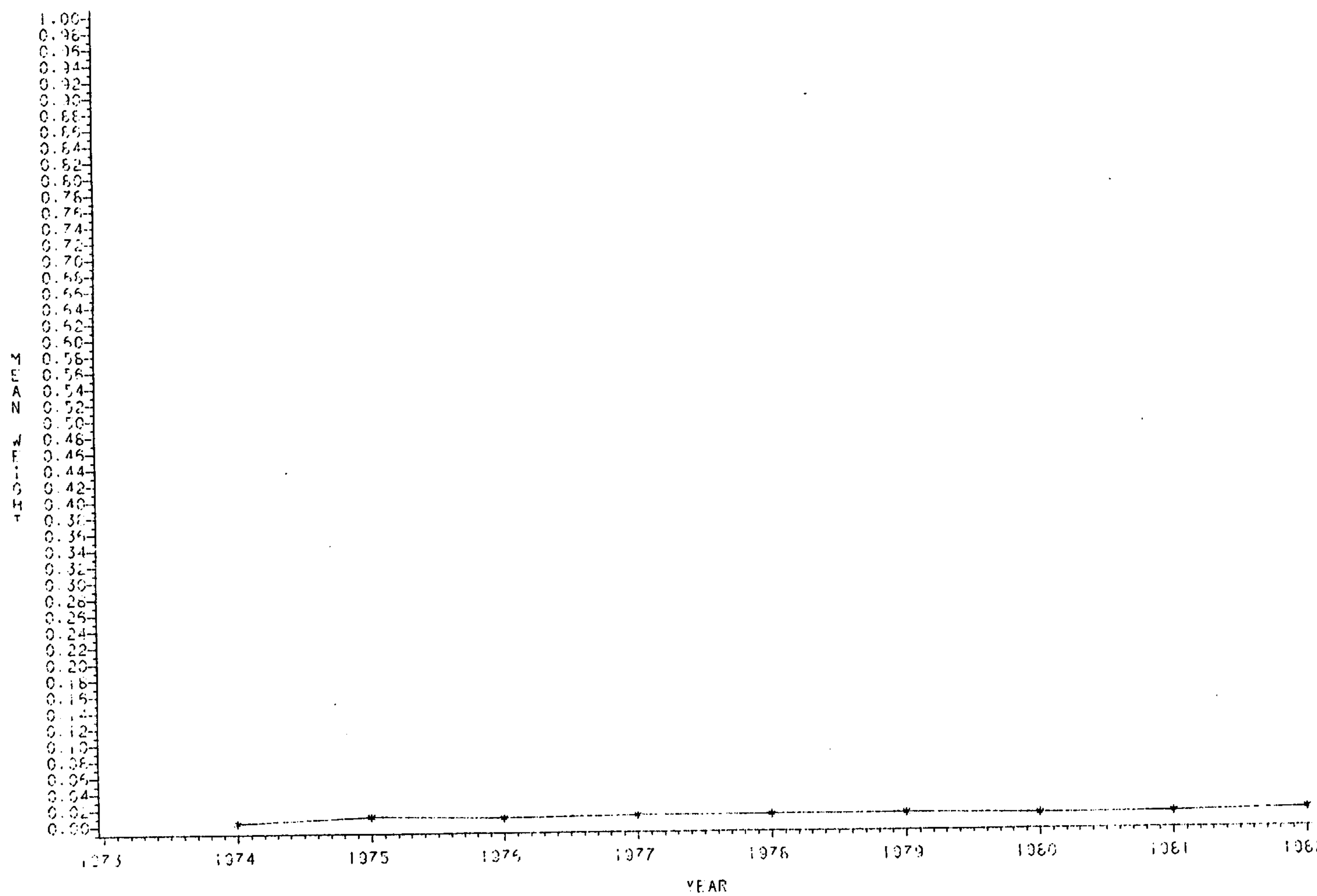


FIGURE 11

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-BLACK BULLHEAD

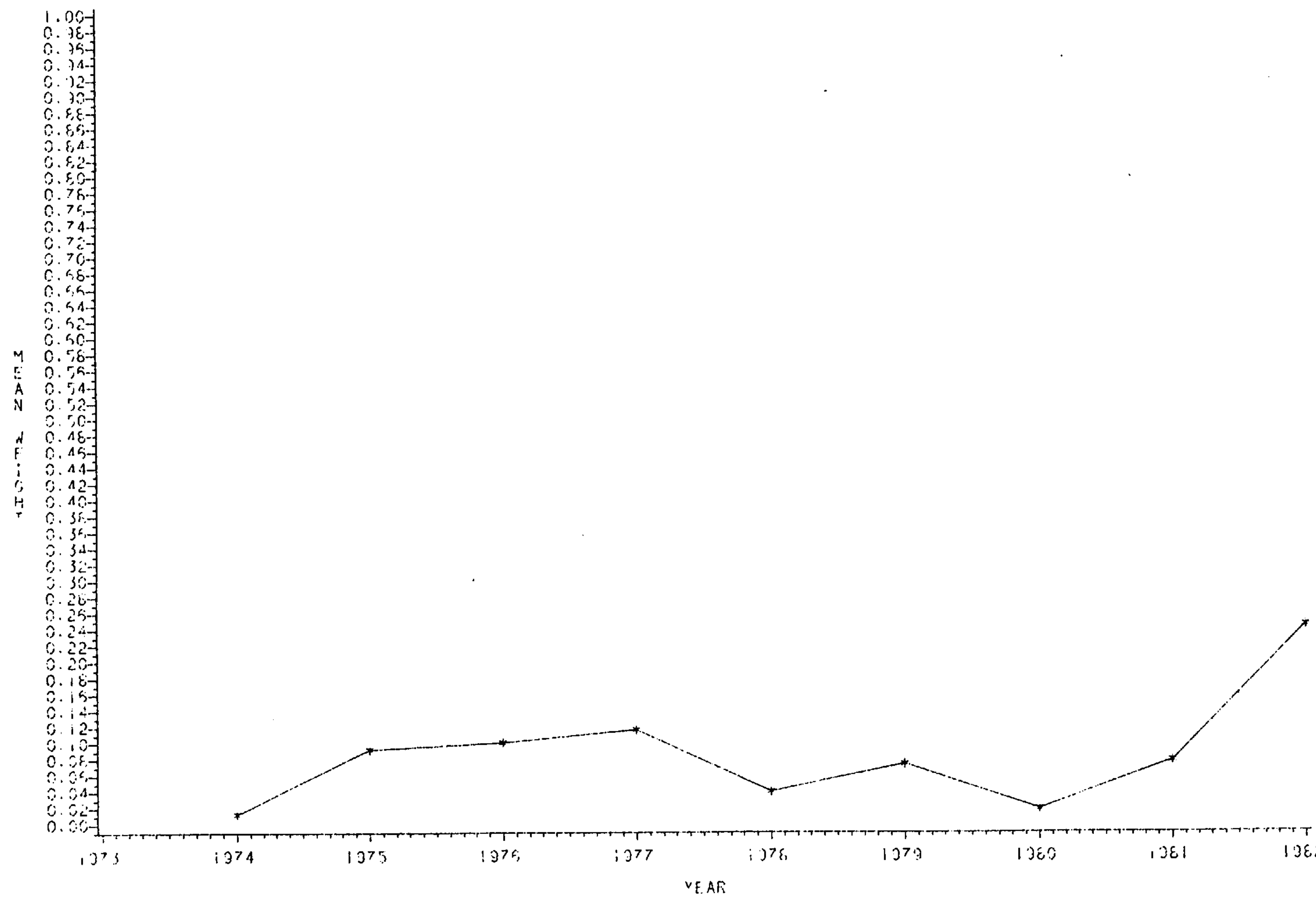


FIGURE 12

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-GOLDFISH

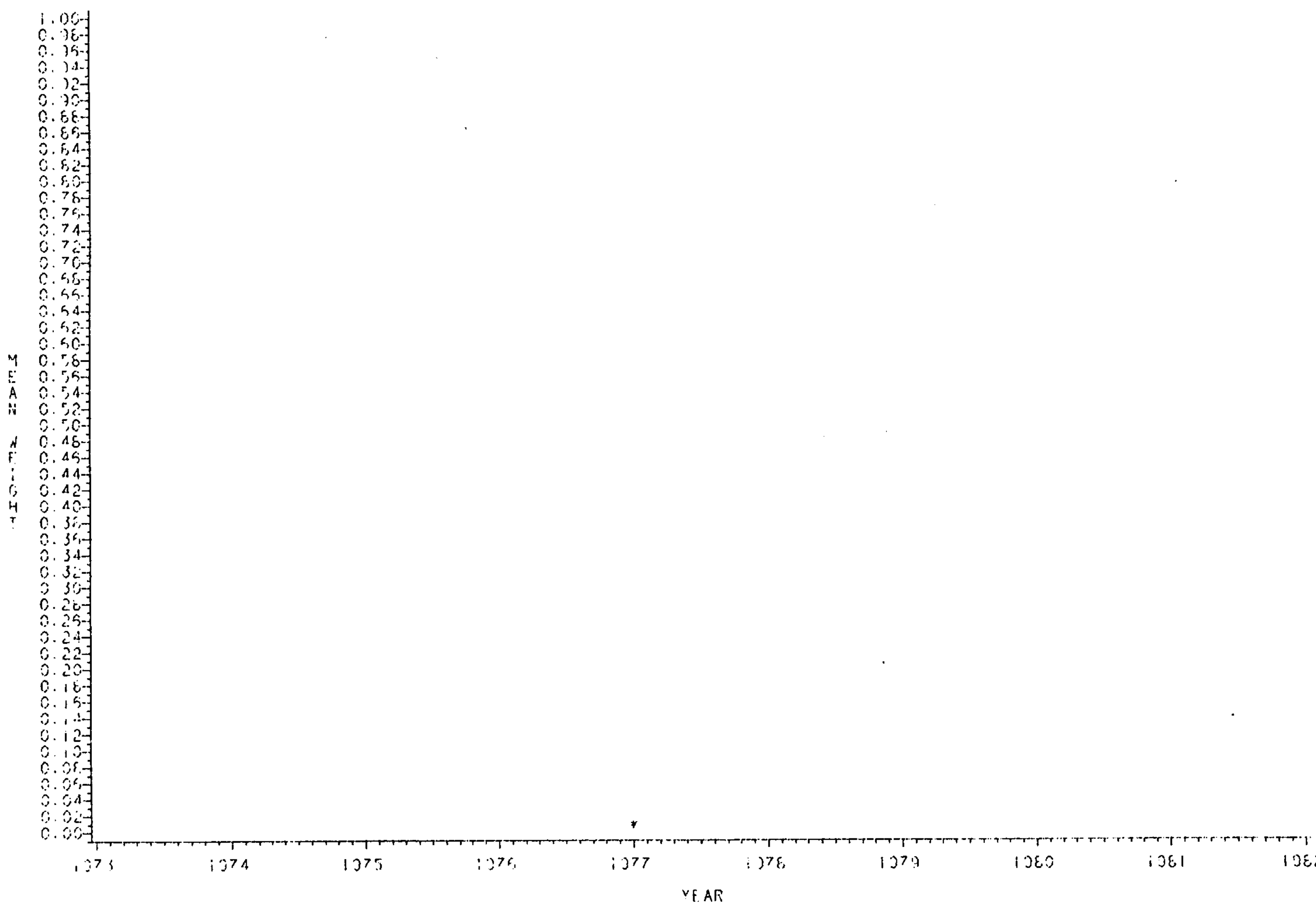
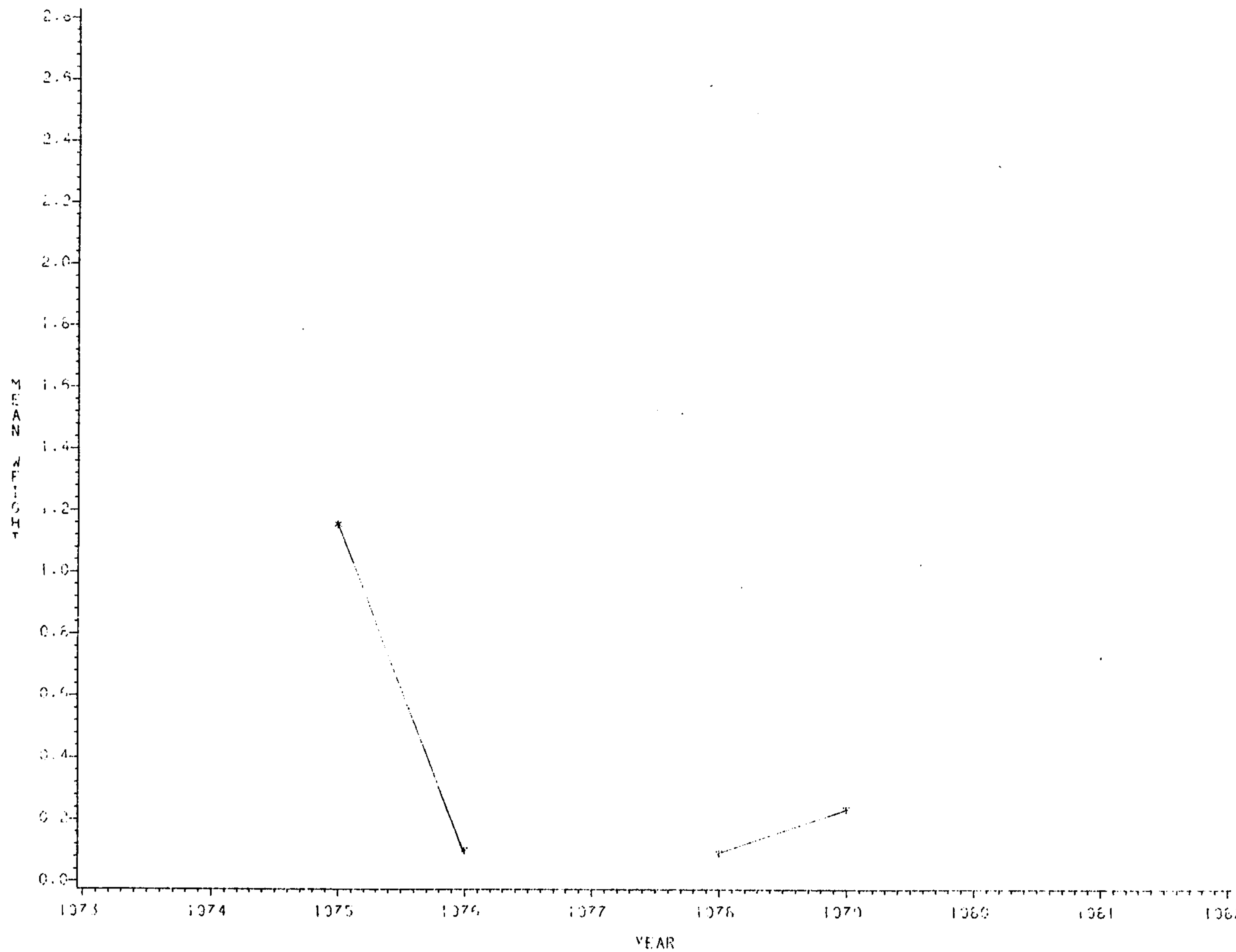


FIGURE 13

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-GOLDEYE



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 14

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-GREEN SUNFISH

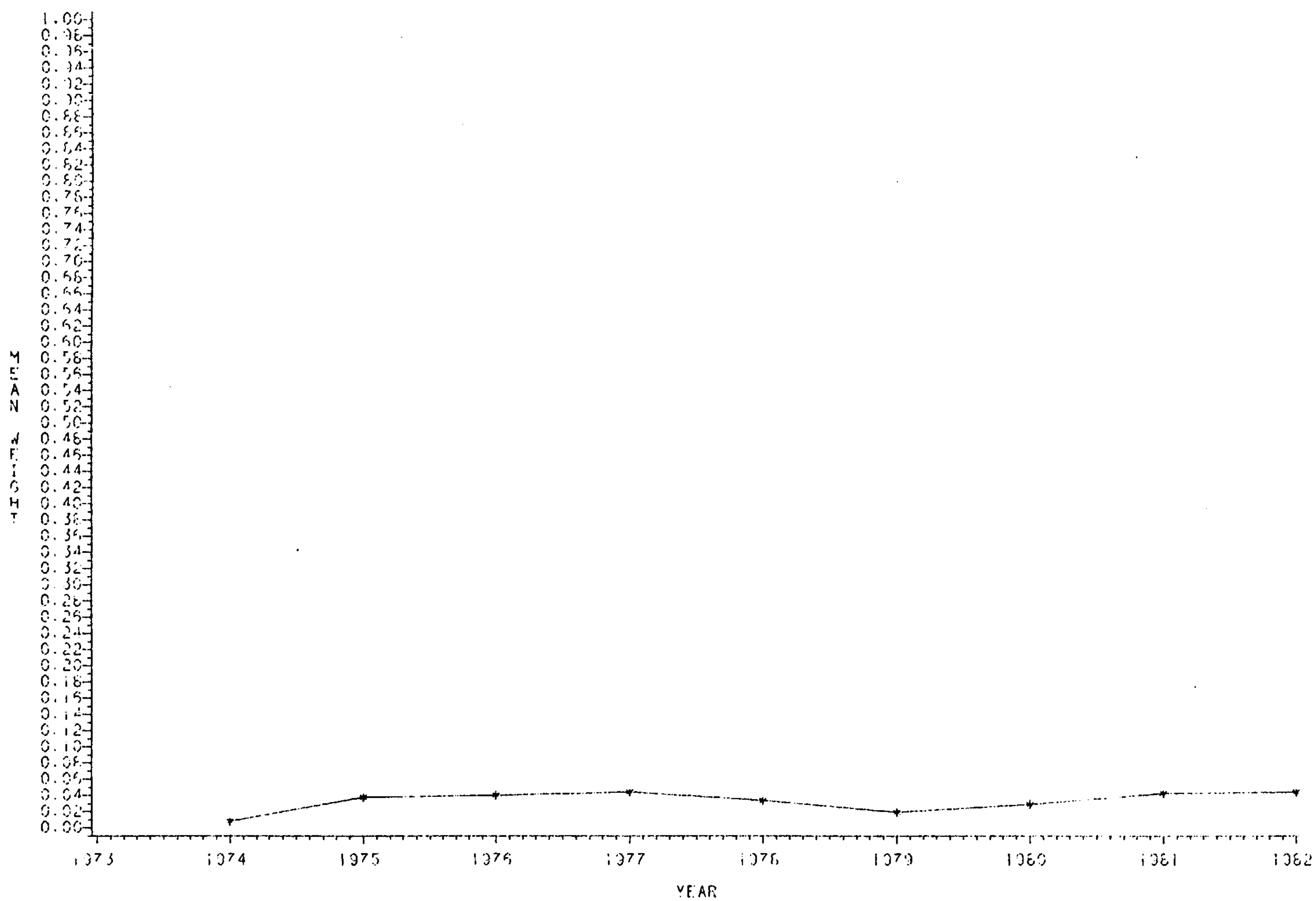
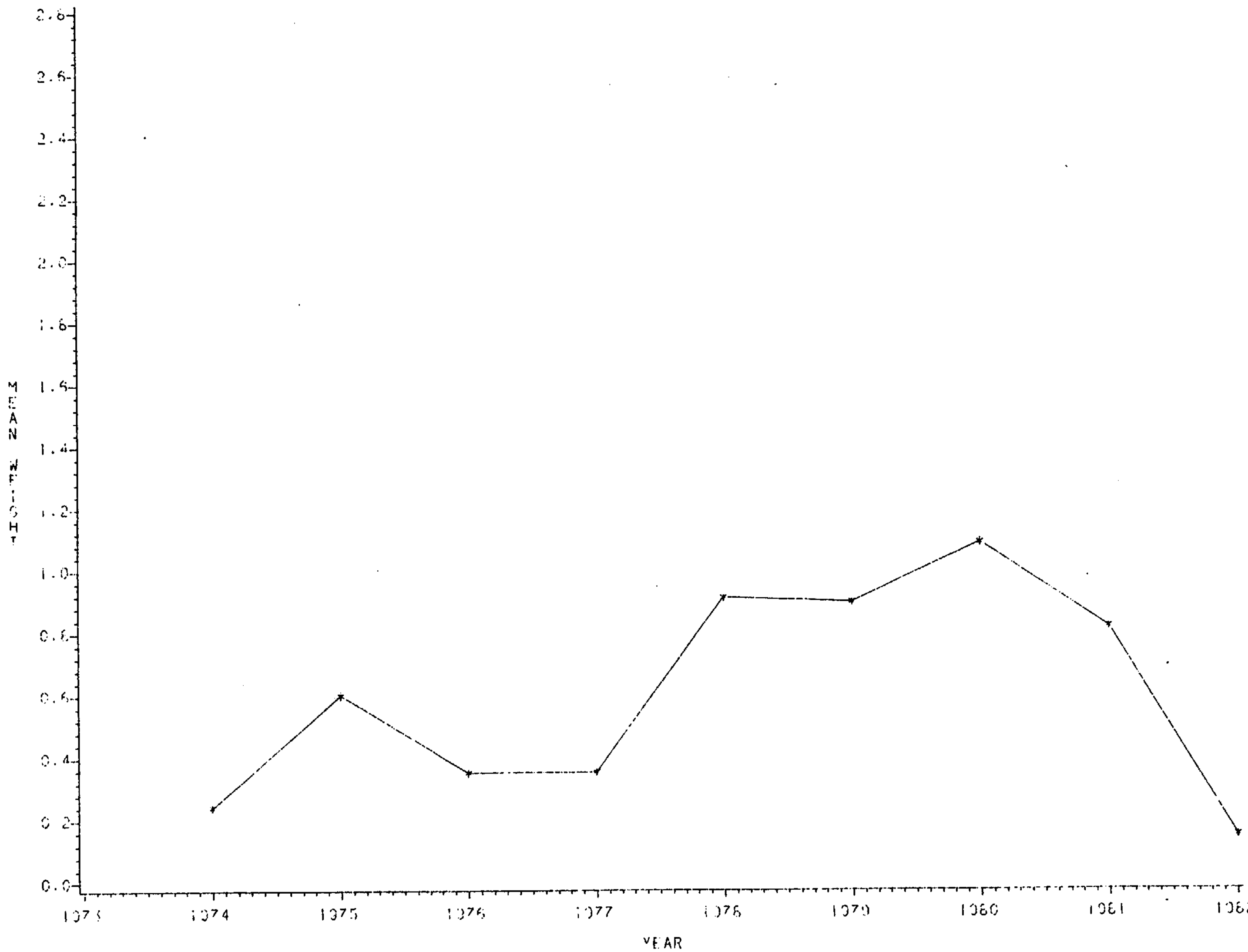


FIGURE 15

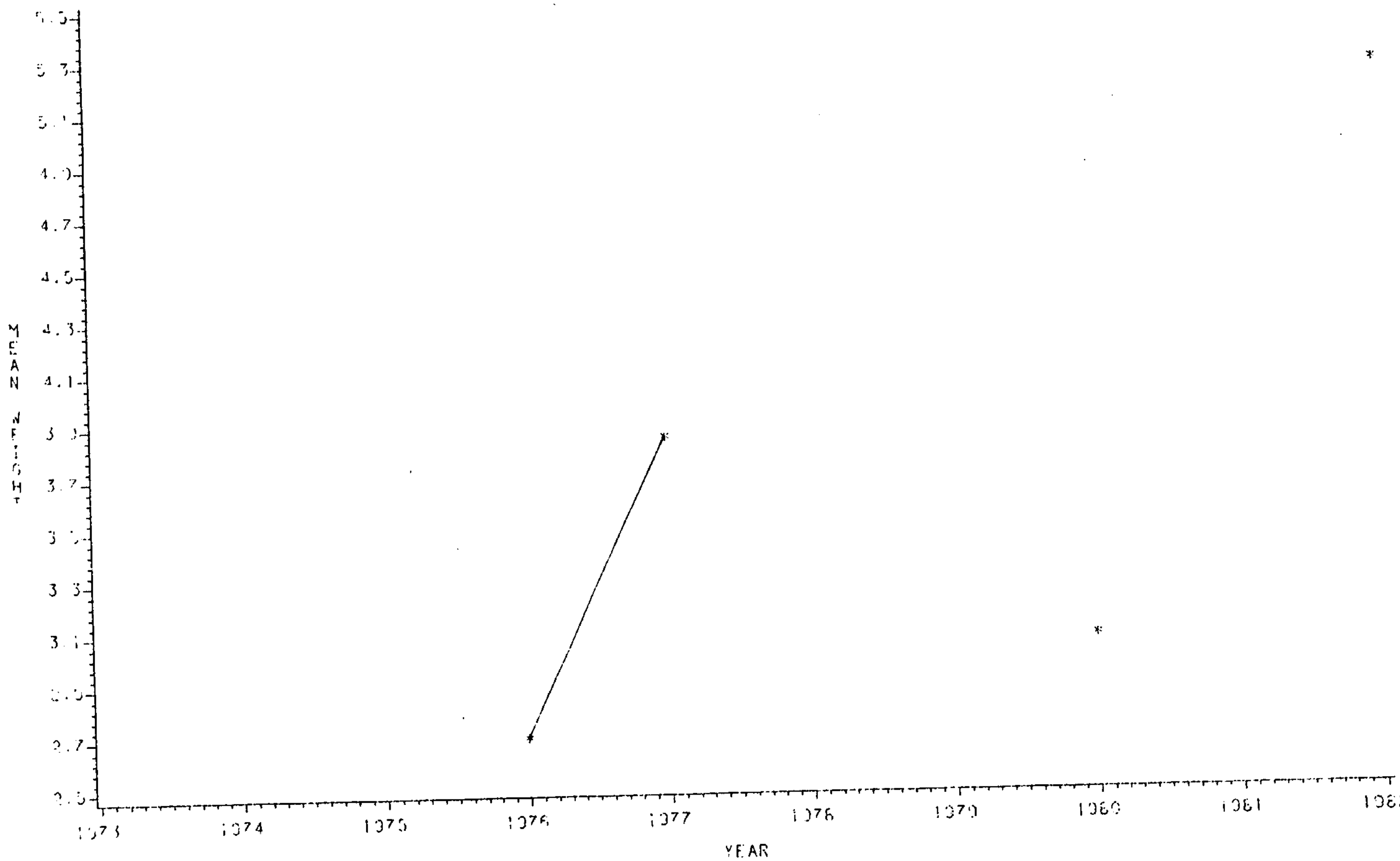
MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES=LARGEMOUTH BASS



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES=LARGEMOUTH BUFFALO

FIGURE 16



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 17

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES=LOGPERCH

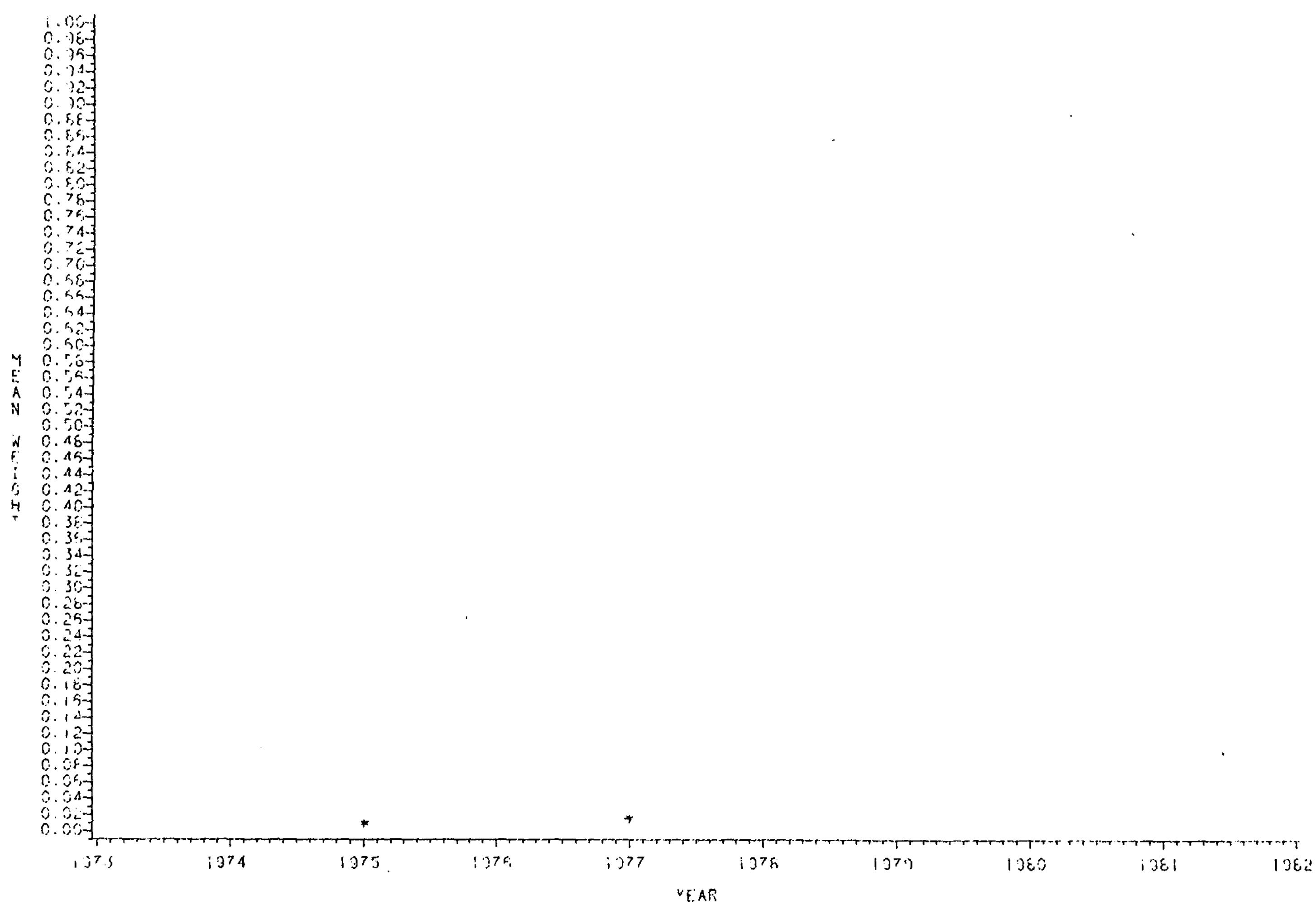


FIGURE 18

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-LONGEAR SUNFISH

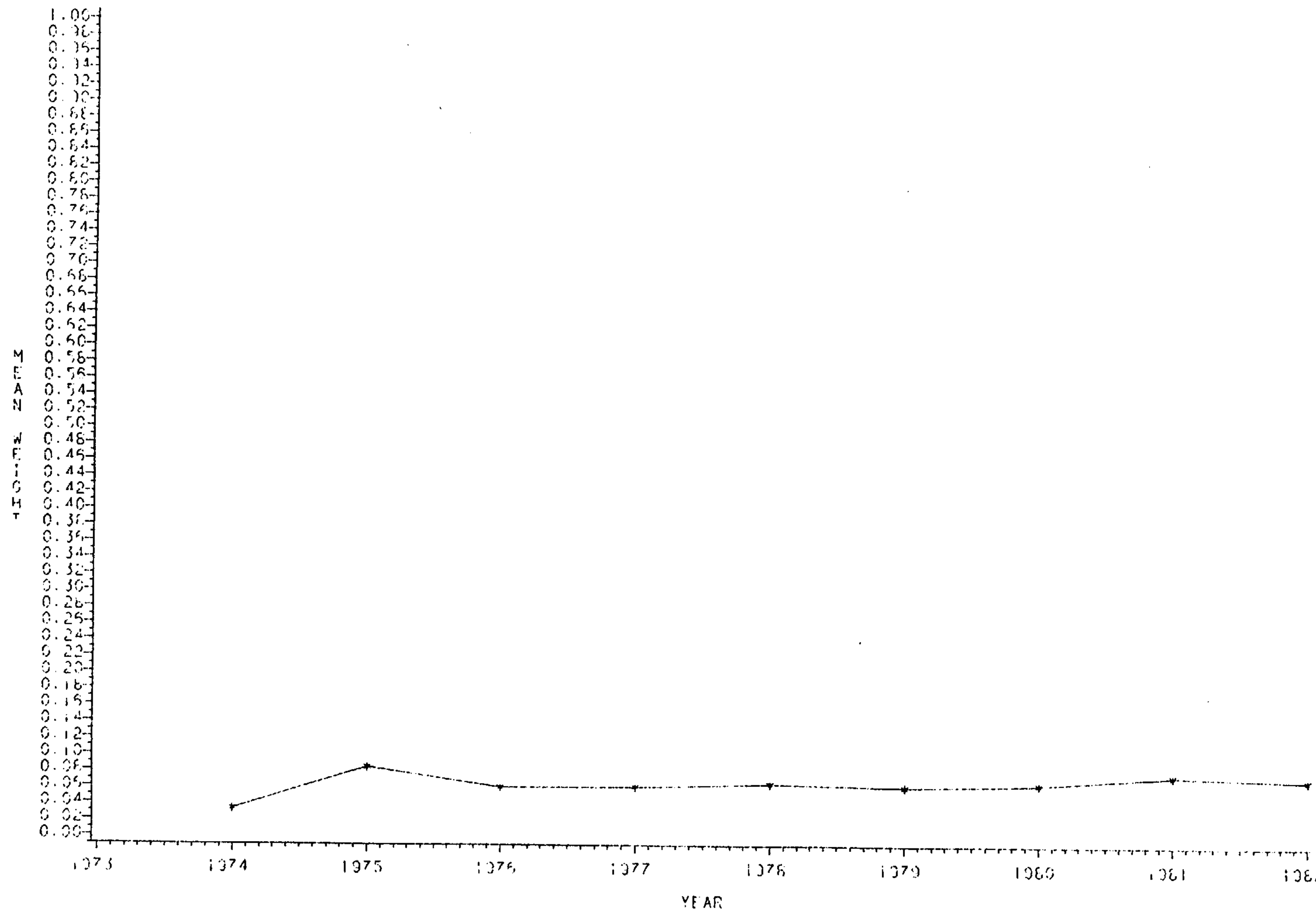
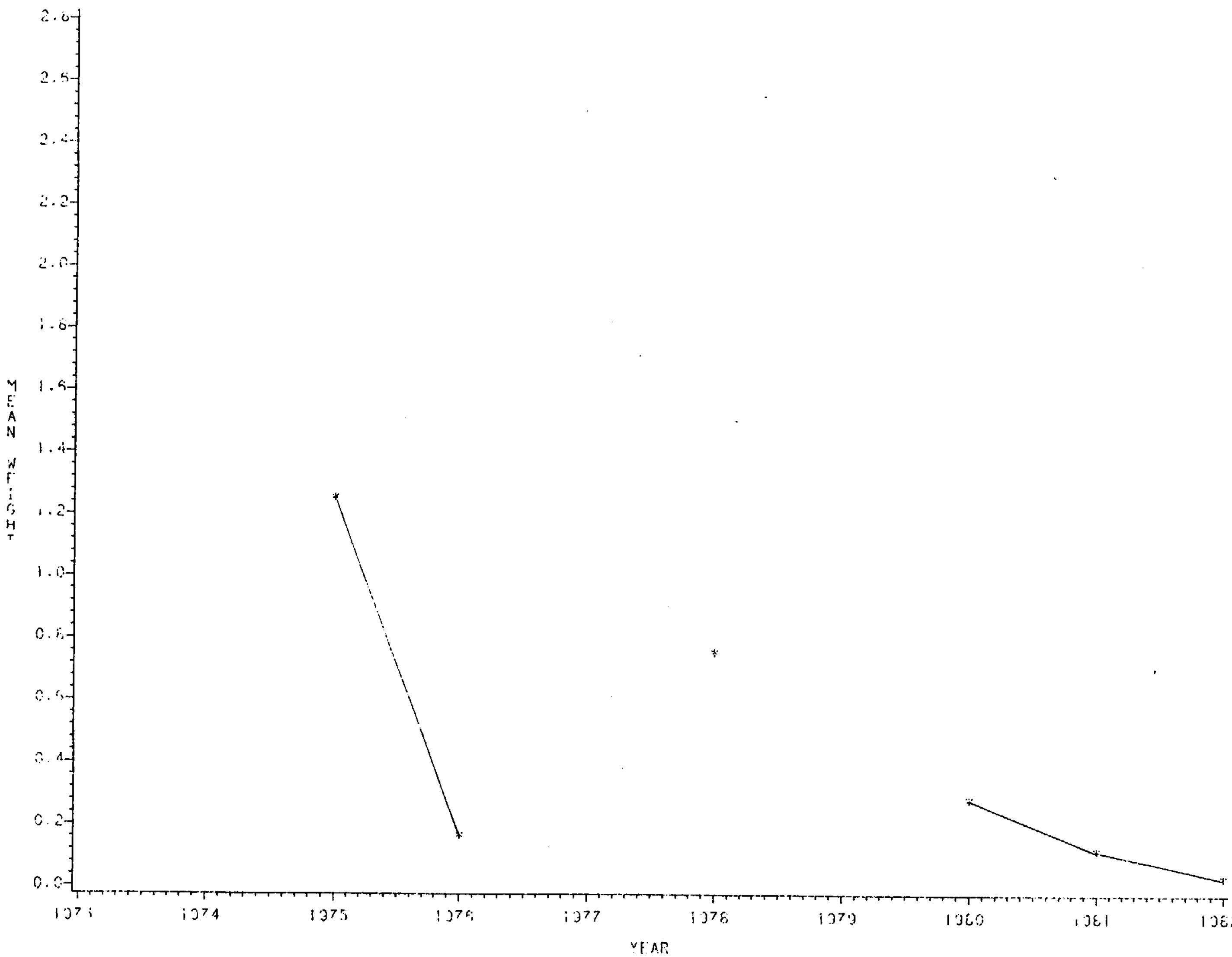


FIGURE 19

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-LONGNOSE GAR



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 20

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-MADTOM

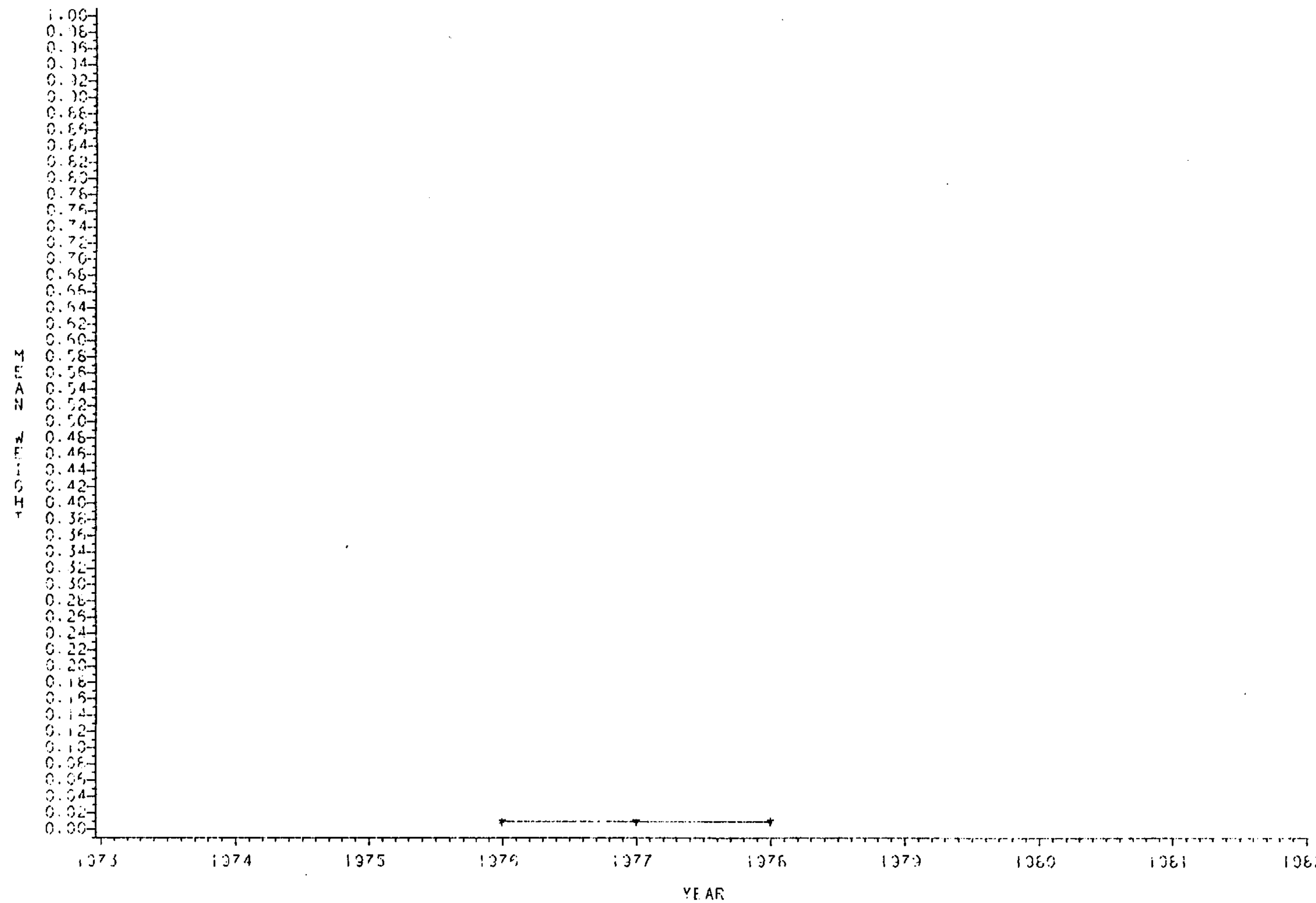


FIGURE 21

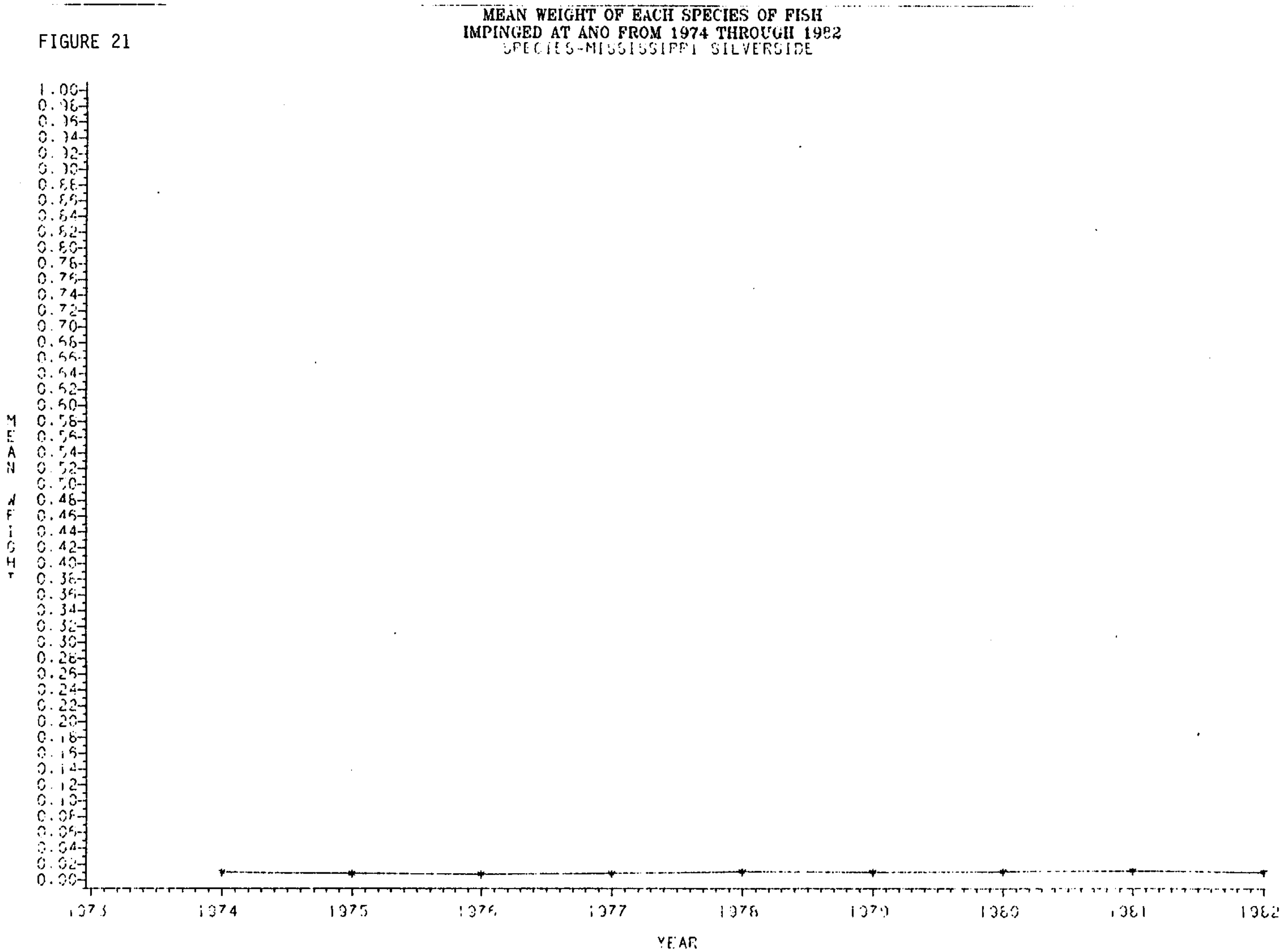

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-MISSISSIPPI SILVERSIDE
MEAN WEIGHT
YEAR
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982

FIGURE 22

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-BLACK CRAPPIE

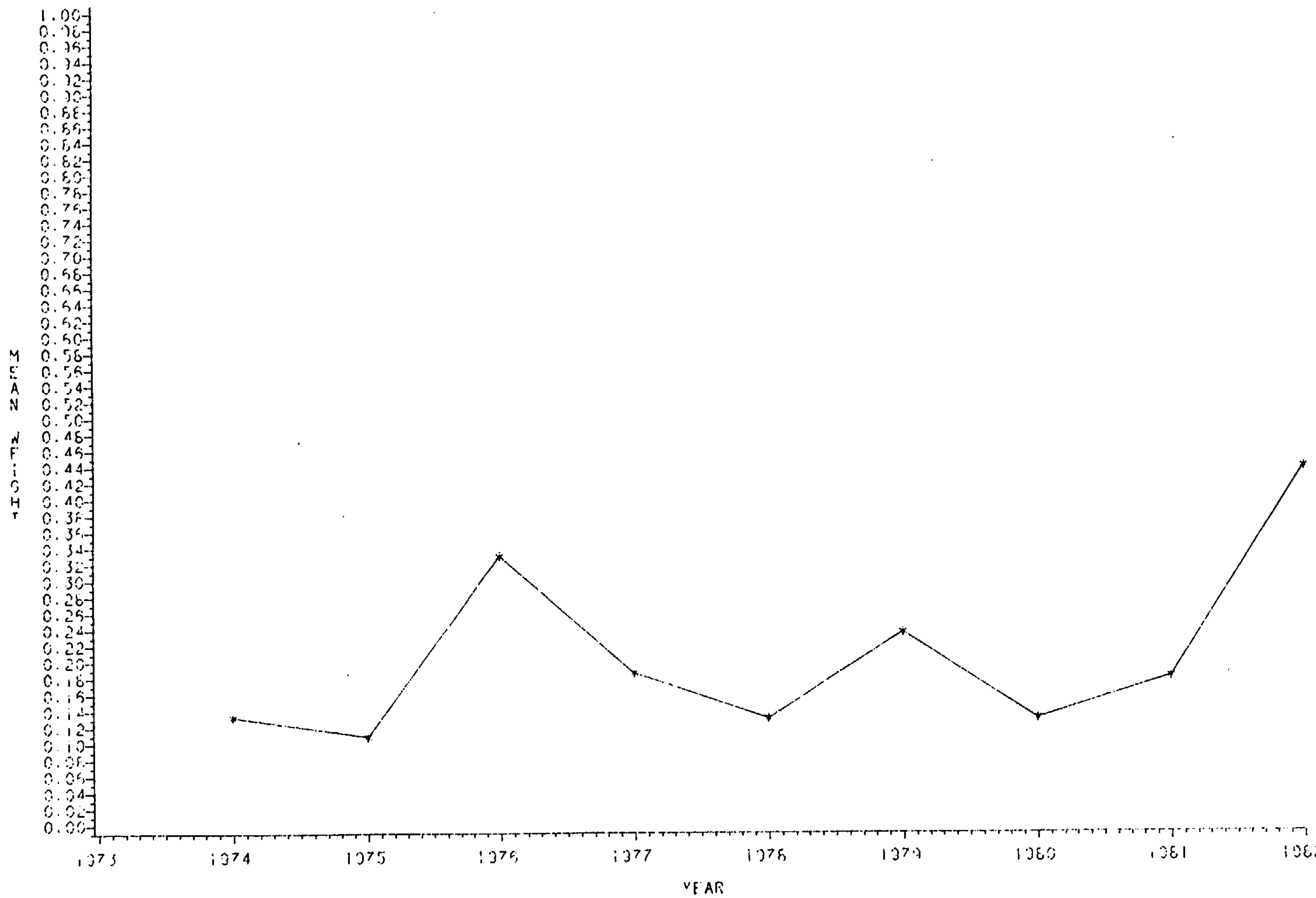


FIGURE 23

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT ANO FROM 1974 THROUGH 1982

SPECIES-MOONEYE

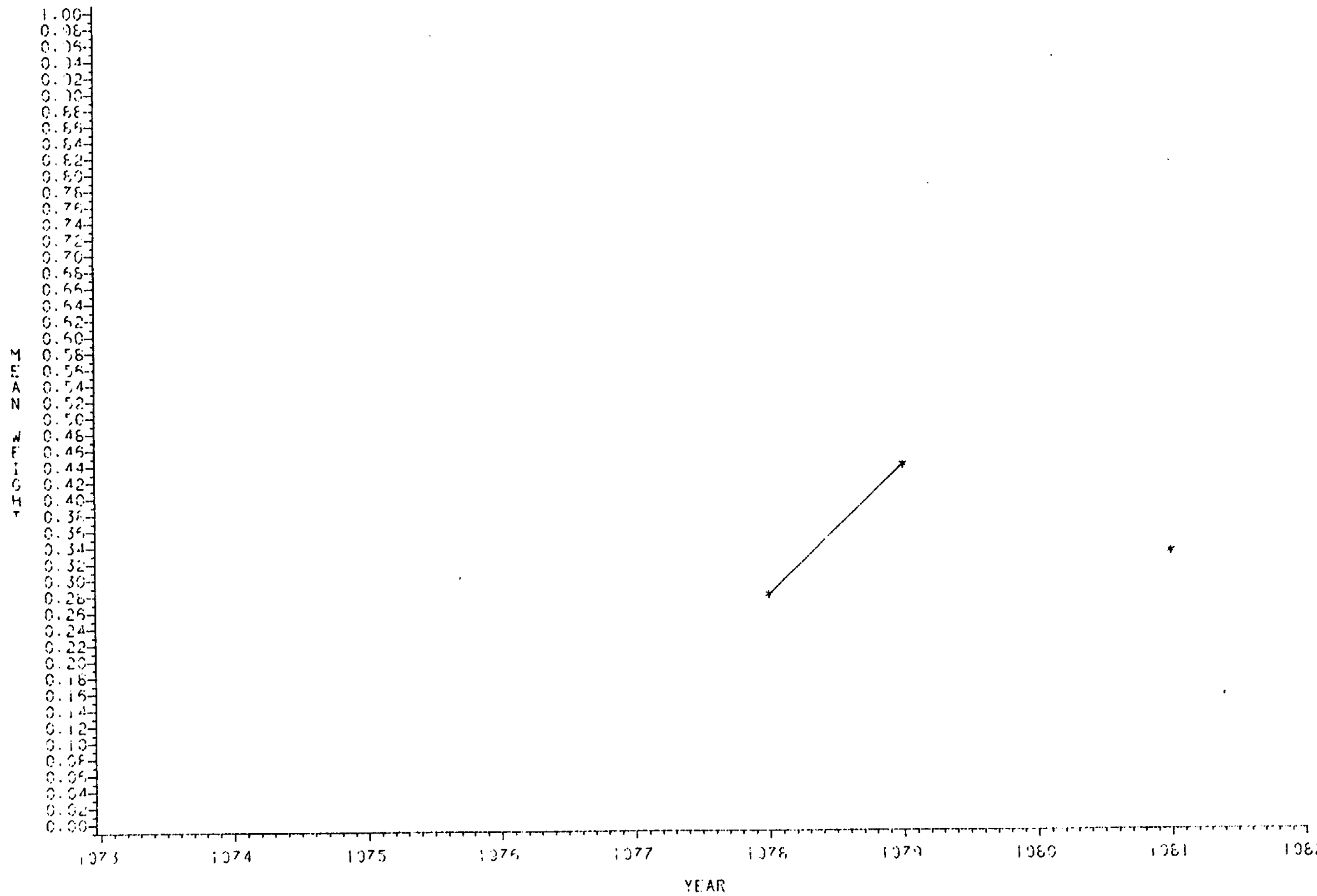


FIGURE 24

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-ORANGESPOTTED SUNFISH

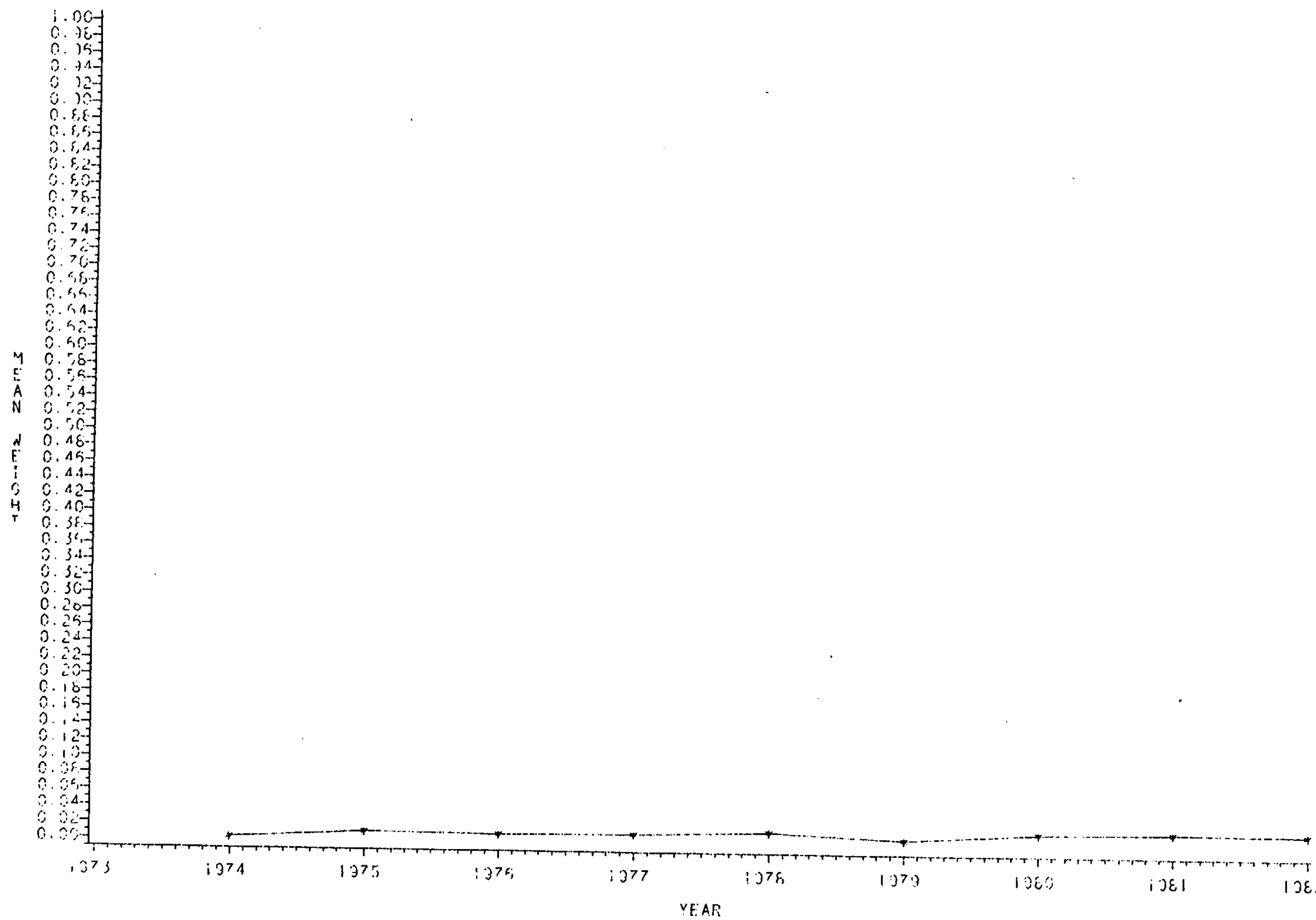


FIGURE 25

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-PADDLEFISH

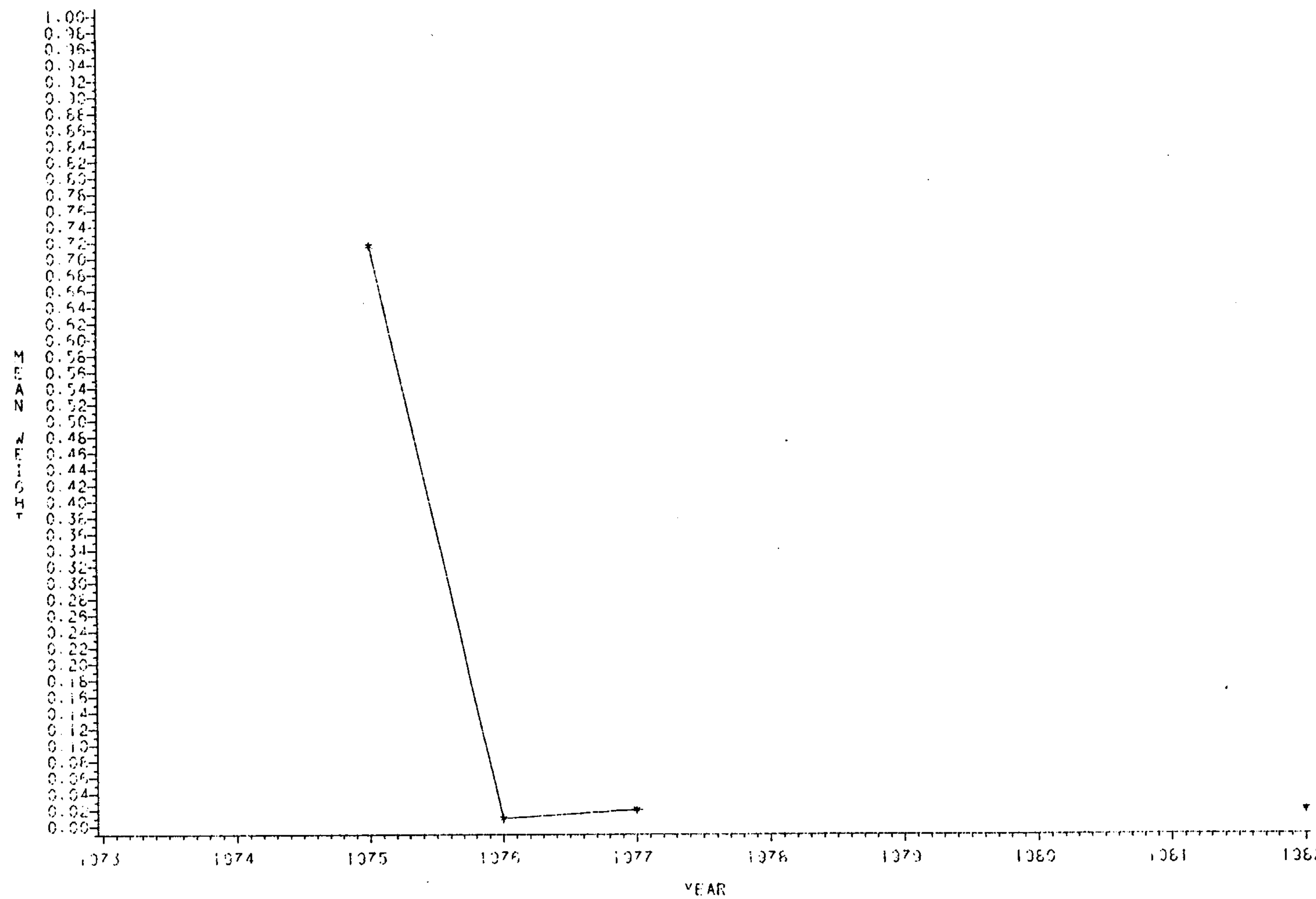


FIGURE 26

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-RED SHINER

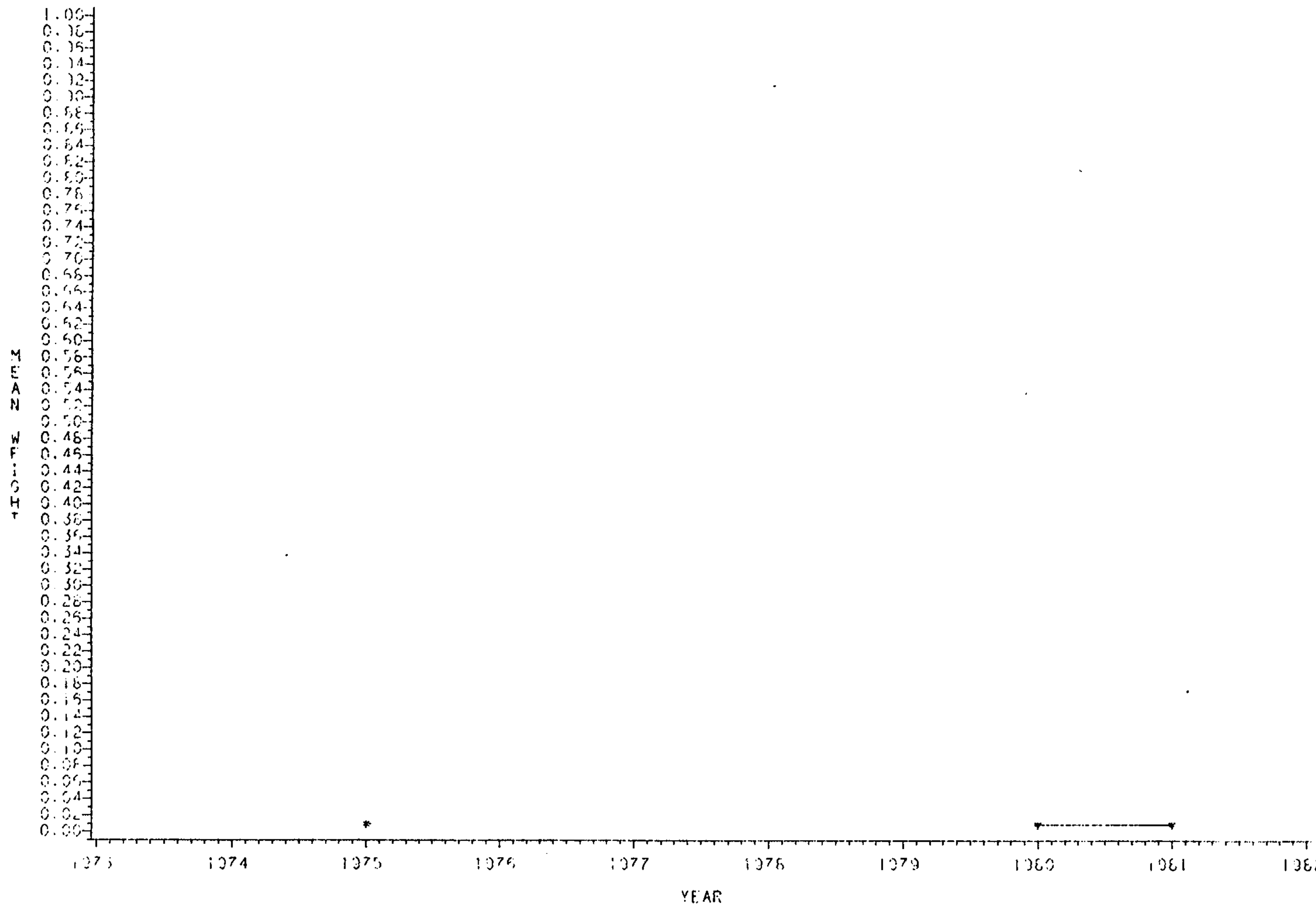


FIGURE 27

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT ANO FROM 1974 THROUGH 1982

SPECIES-REDEAR SUNFISH

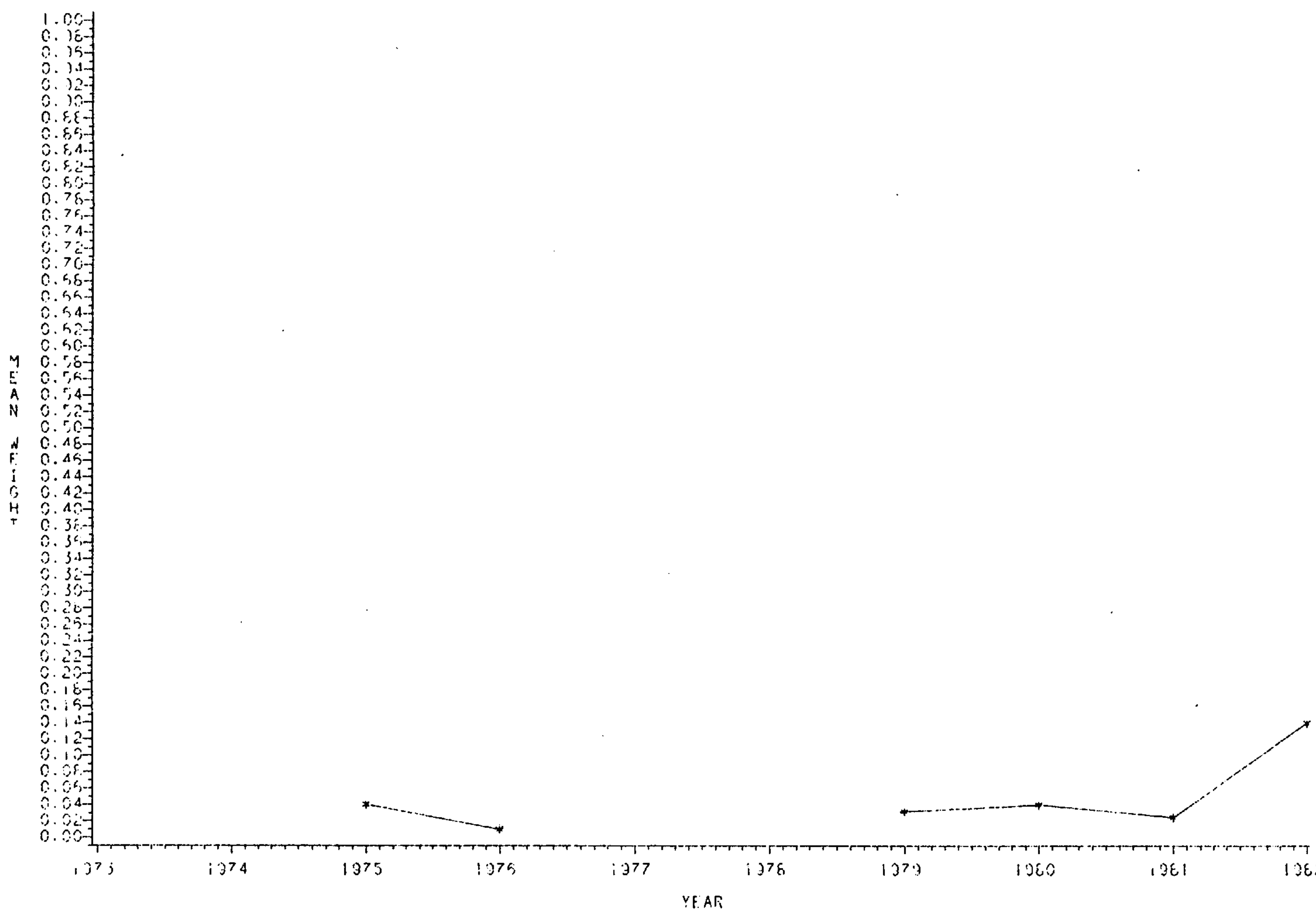
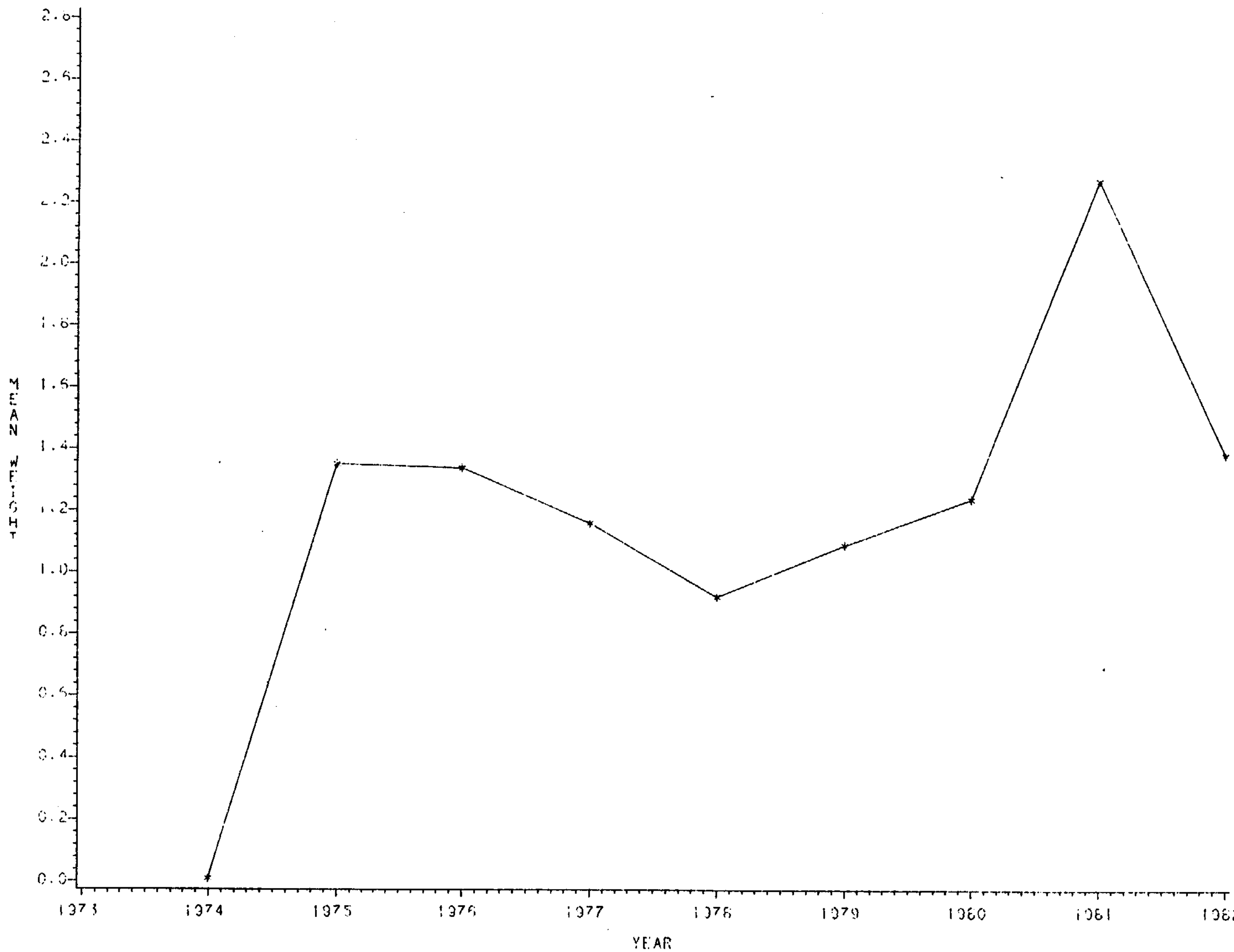


FIGURE 28

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-RIVER CARPSUCKER



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 29

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-RIVER SHINER

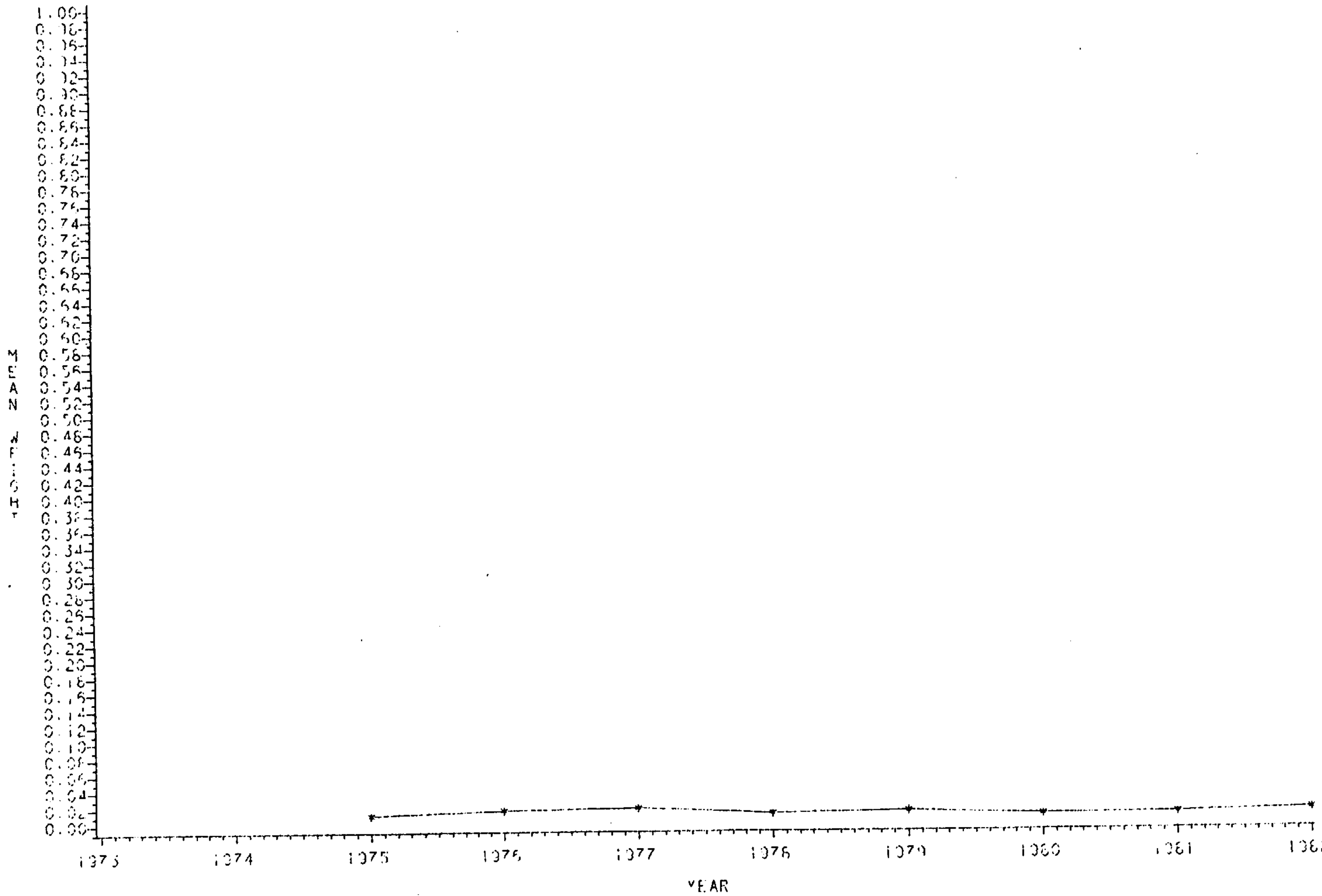
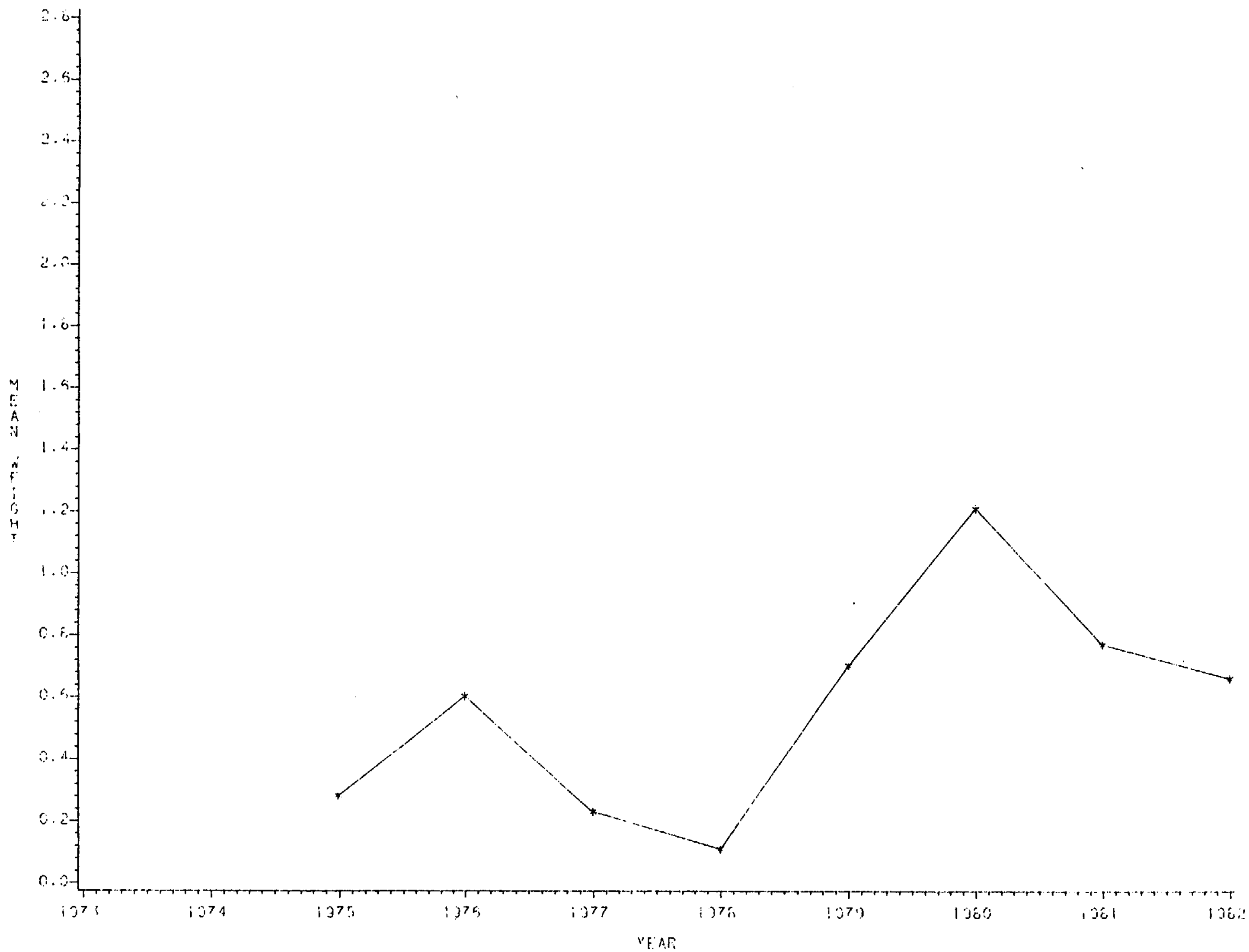


FIGURE 30

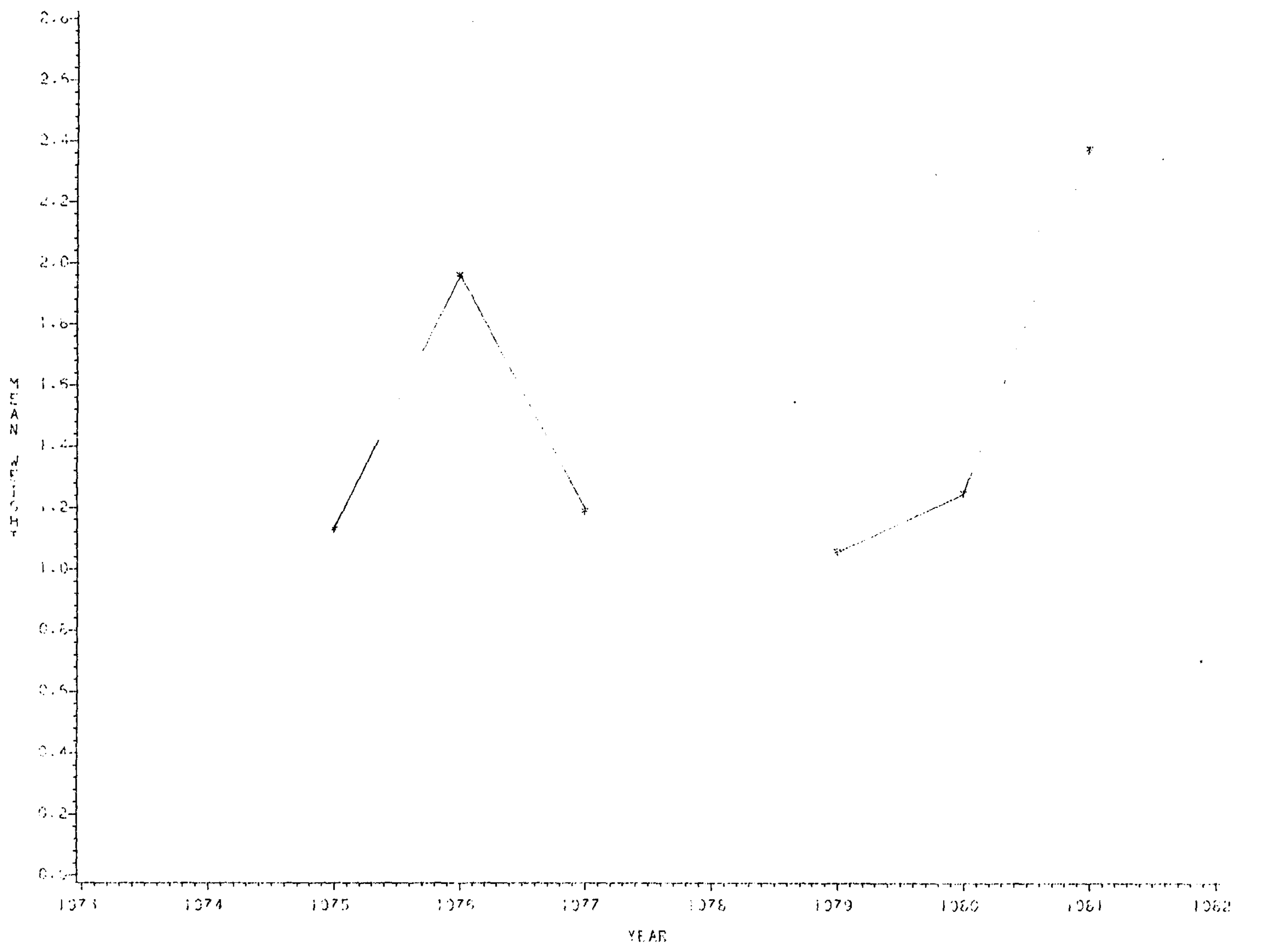
MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-SAUGER



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 31

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-SHORTNOSE GAR



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 32

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-BLUE CATFISH

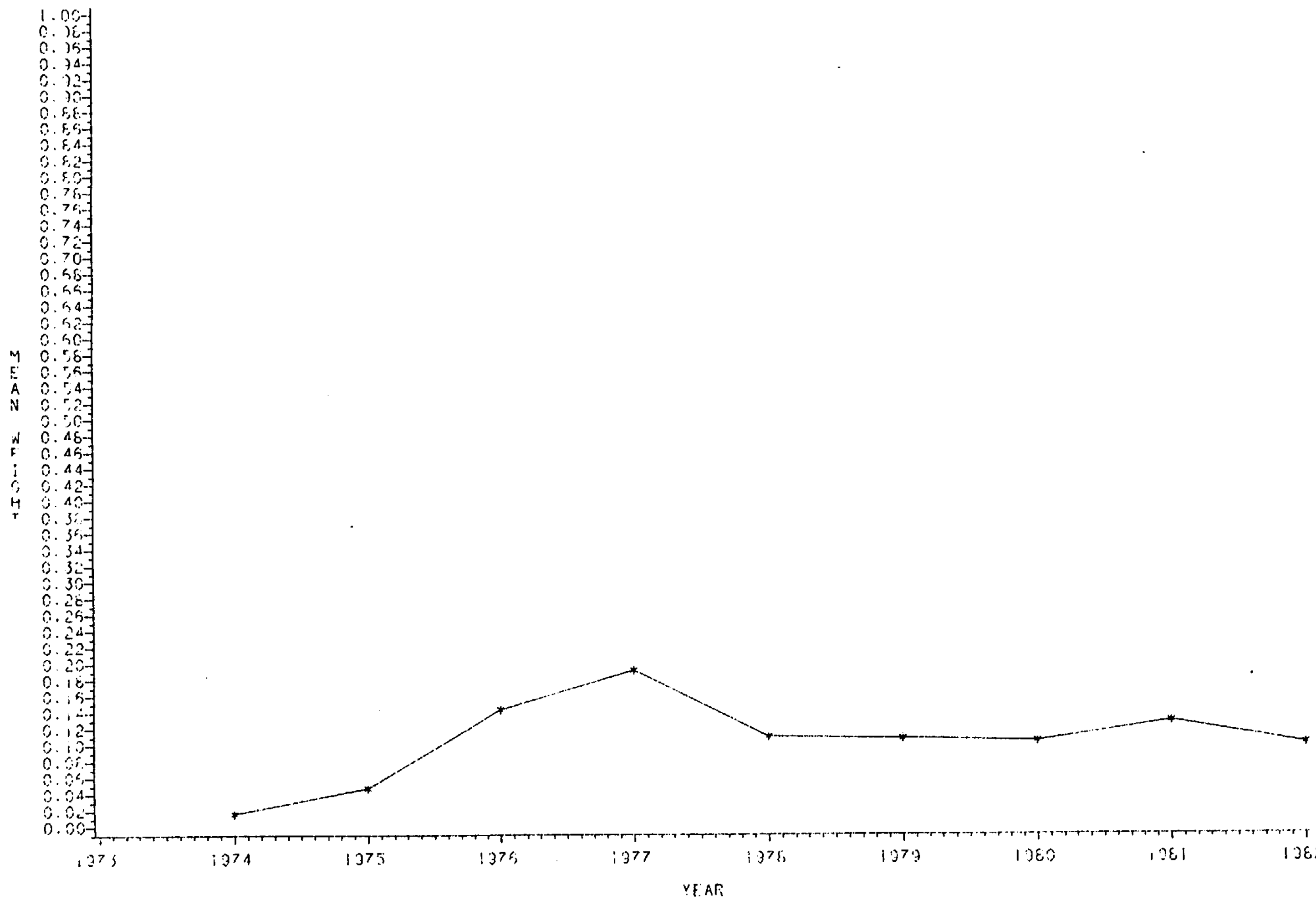


FIGURE 33

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-SHOVELNOSE STURGEON

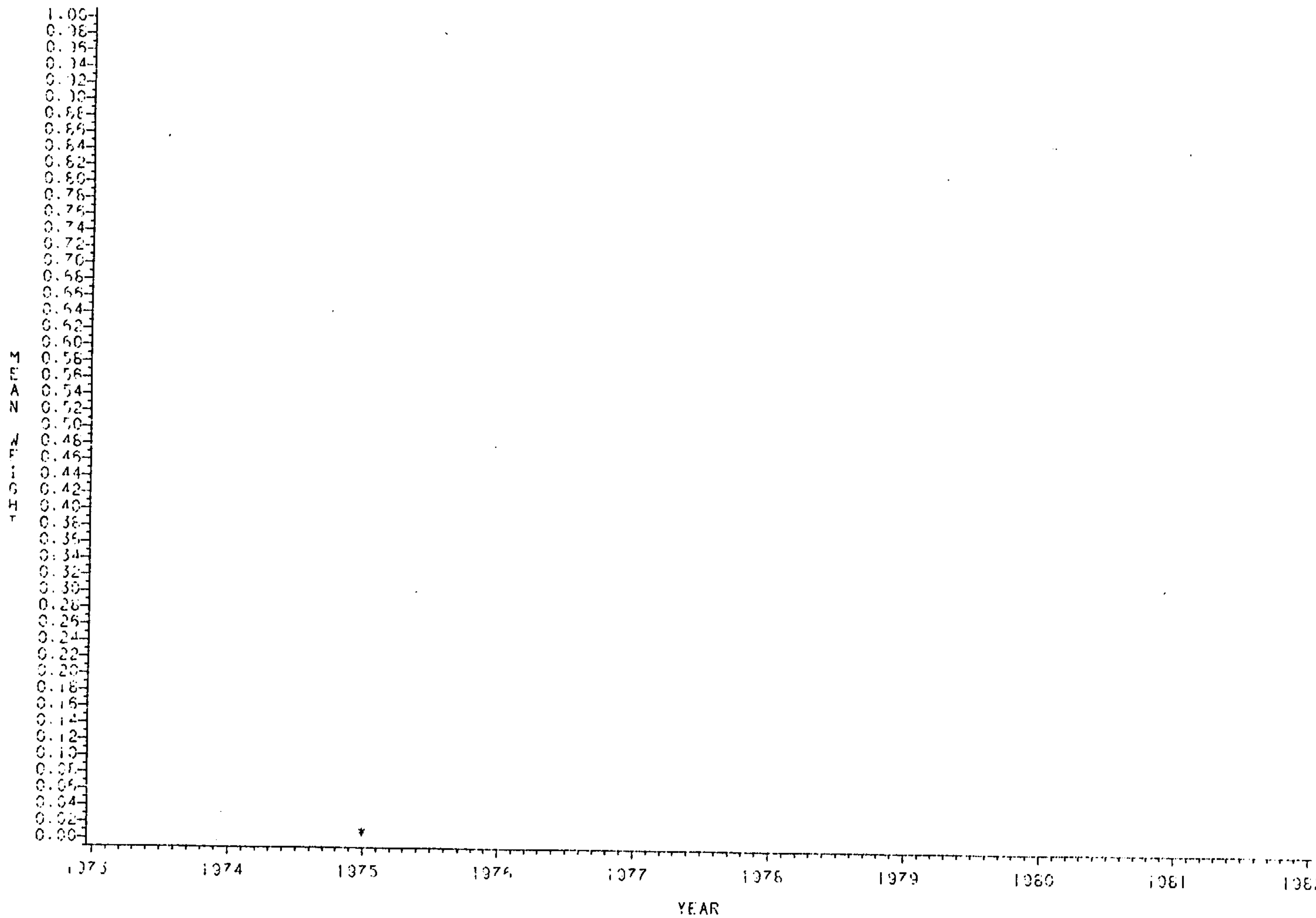


FIGURE 34

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-SKIPJACK HERRING

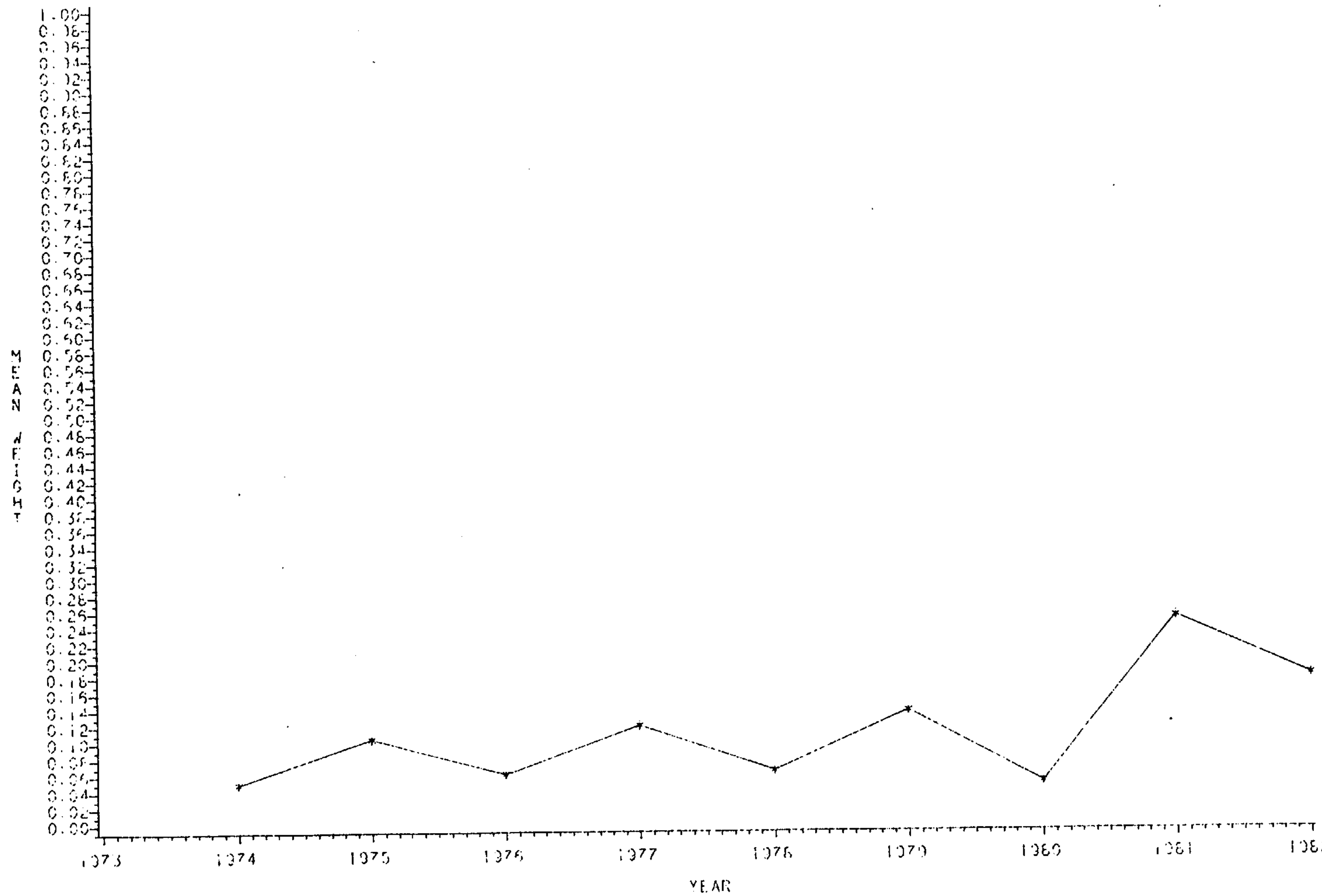
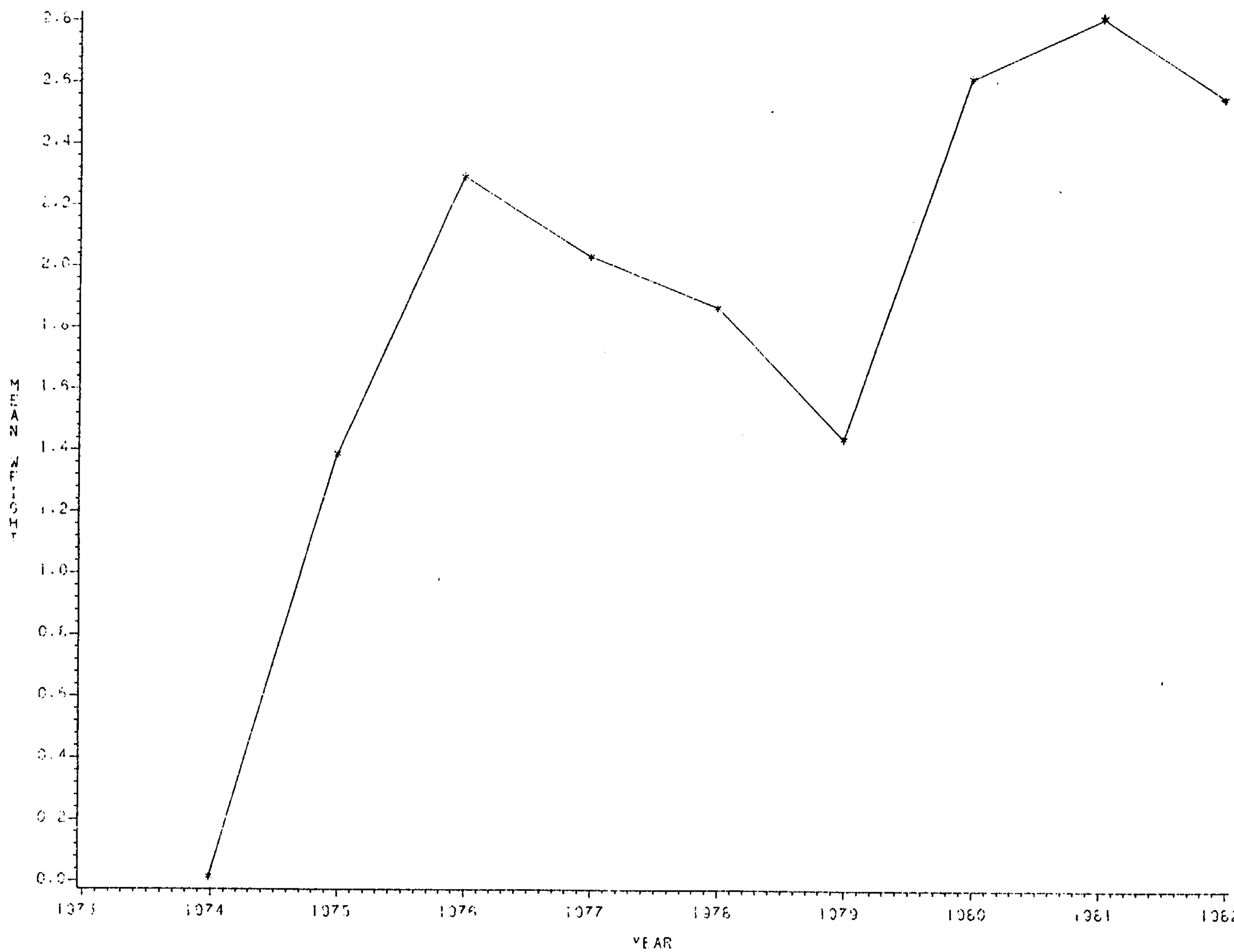


FIGURE 35

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-SMALLMOUTH BUFFALO



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-SPOTTED GAR

FIGURE 36

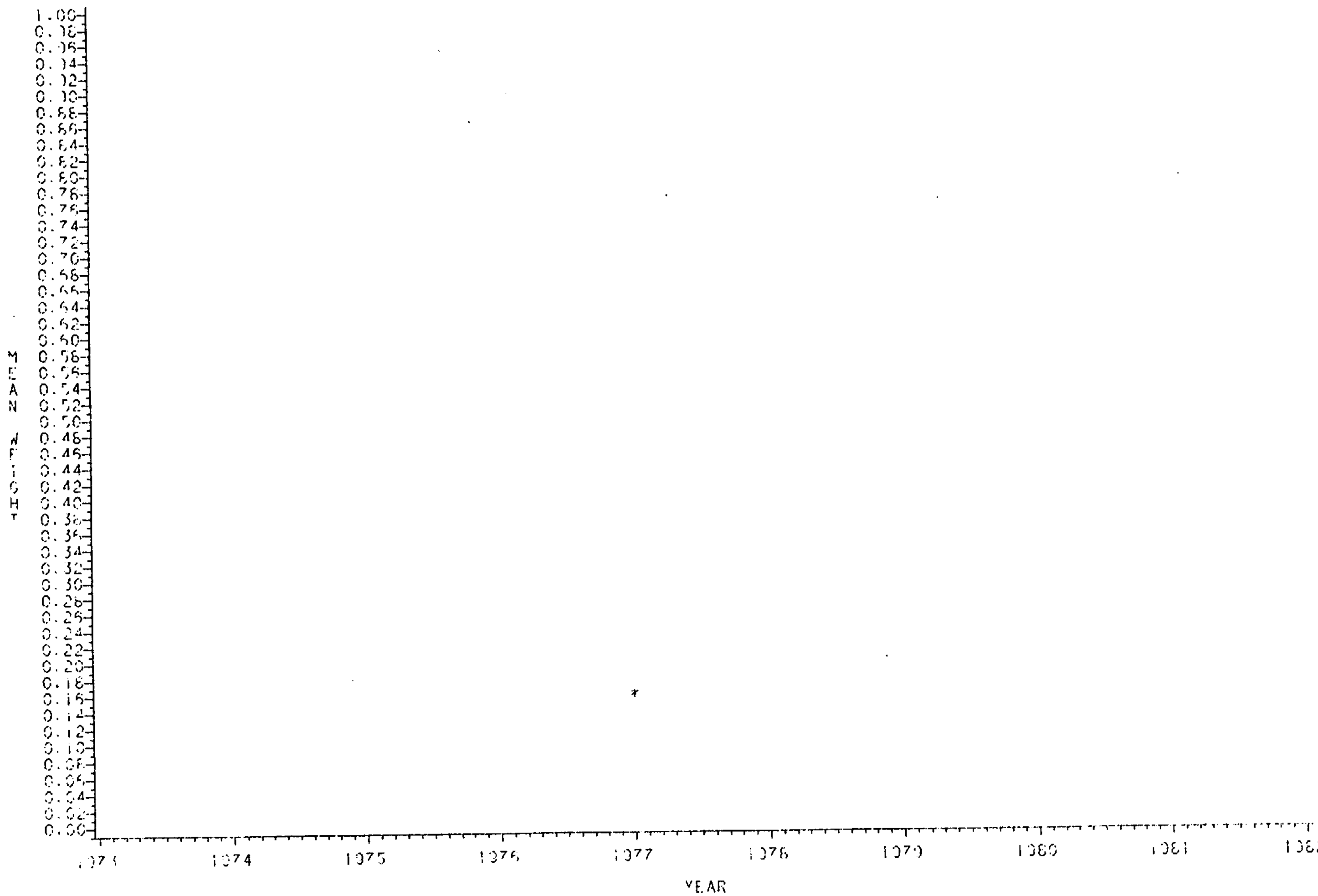


FIGURE 37

MEAN WEIGHT OF EACH SPECIES OF FISH IMPINGED AT ANO FROM 1974 THROUGH 1982

SPECIES-STRIPED BASS

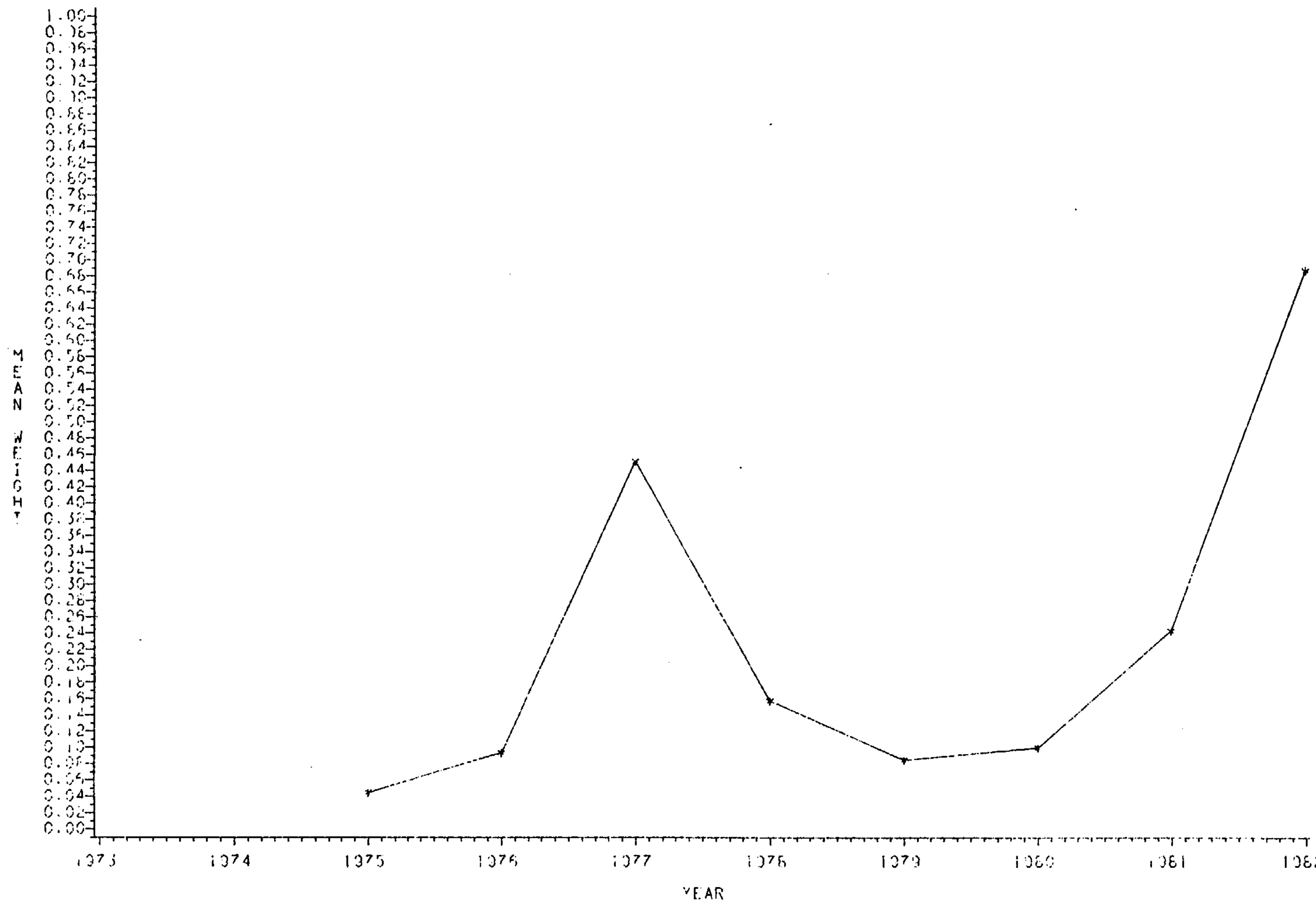


FIGURE 38

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-THREADFIN SHAD

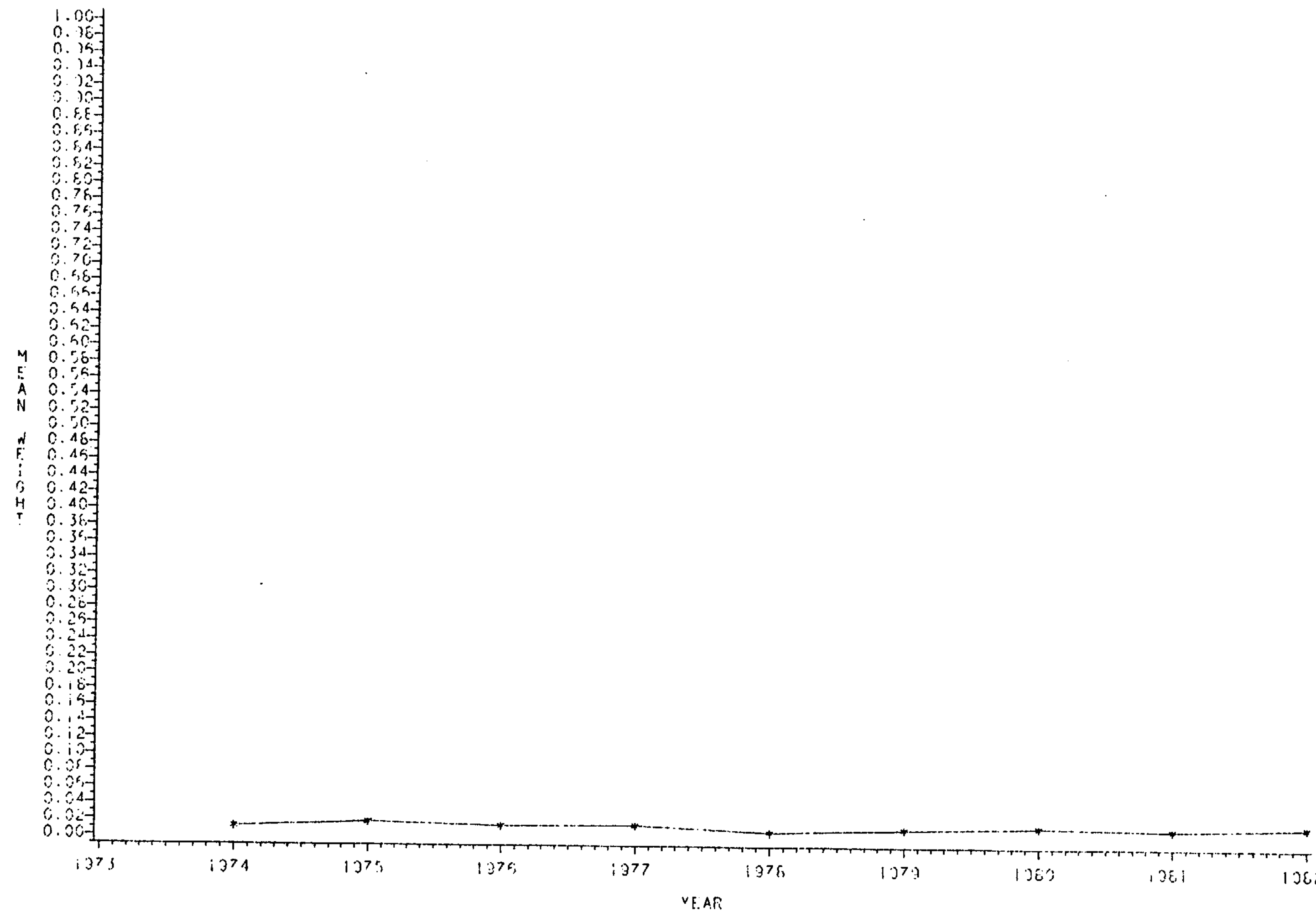


FIGURE 39

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES=TILAPIA

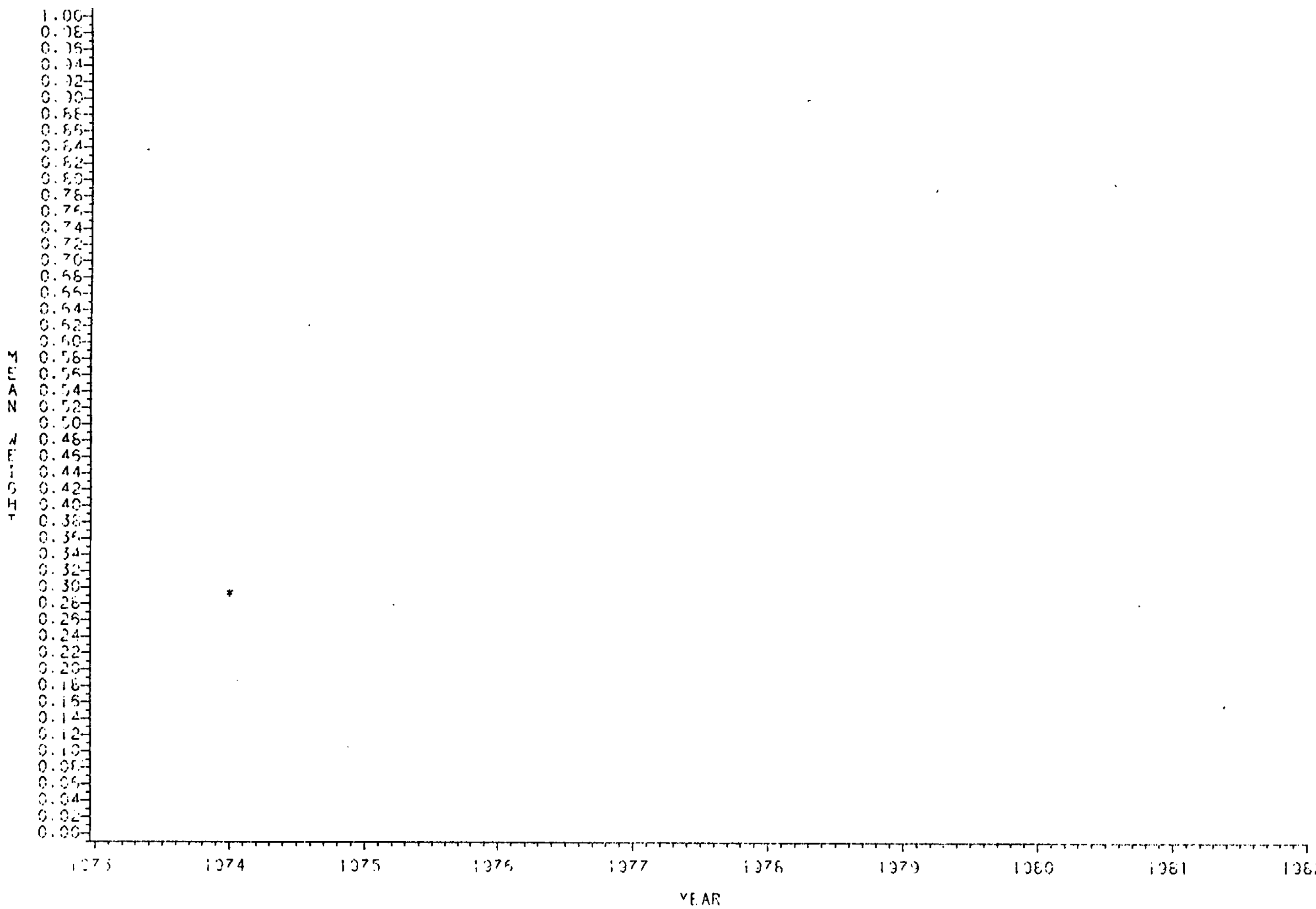


FIGURE 40

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-WHITE BASS

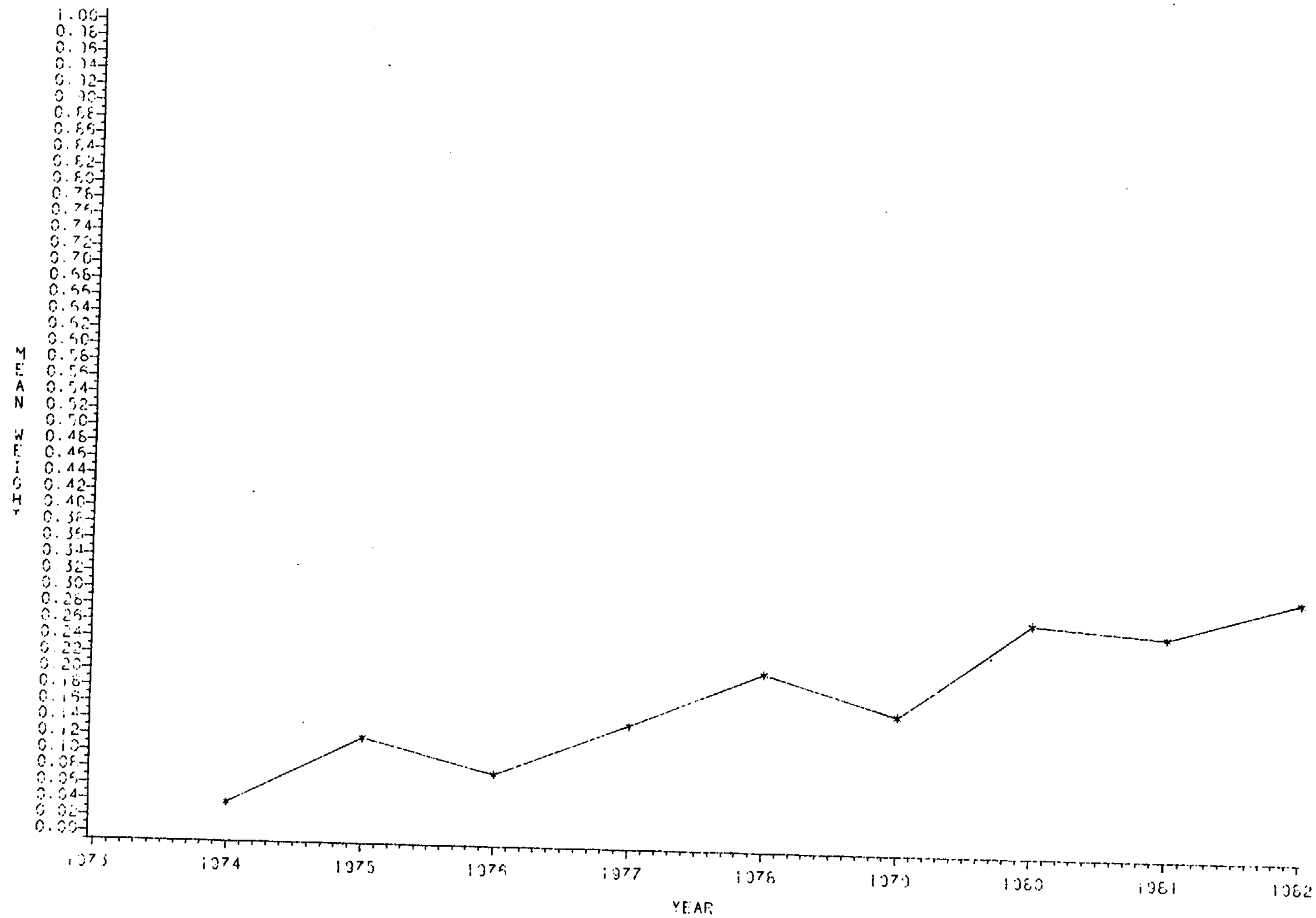


FIGURE 41

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-BLUEGILL SUNFISH

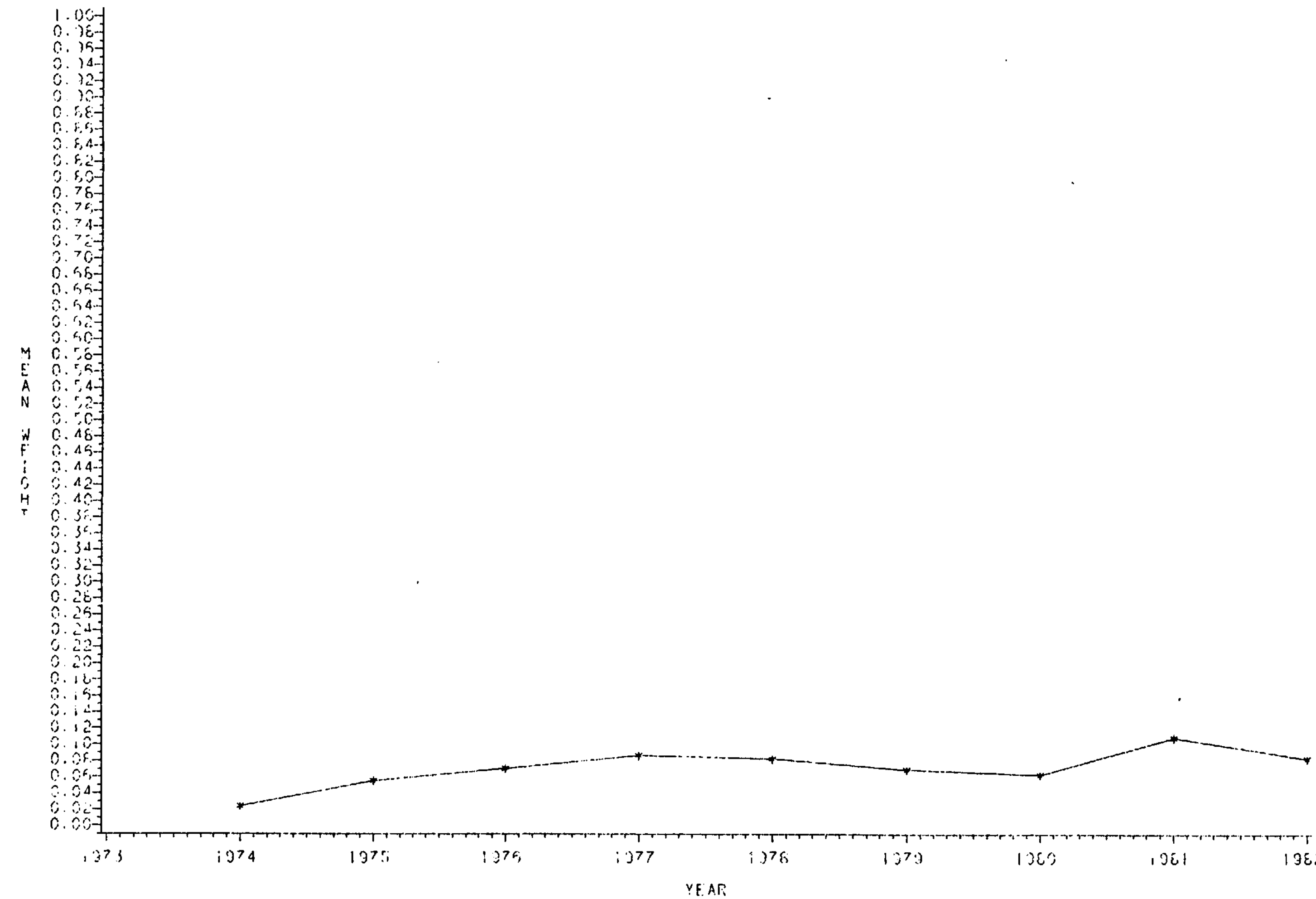


FIGURE 42

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-WHITE CRAPPIE

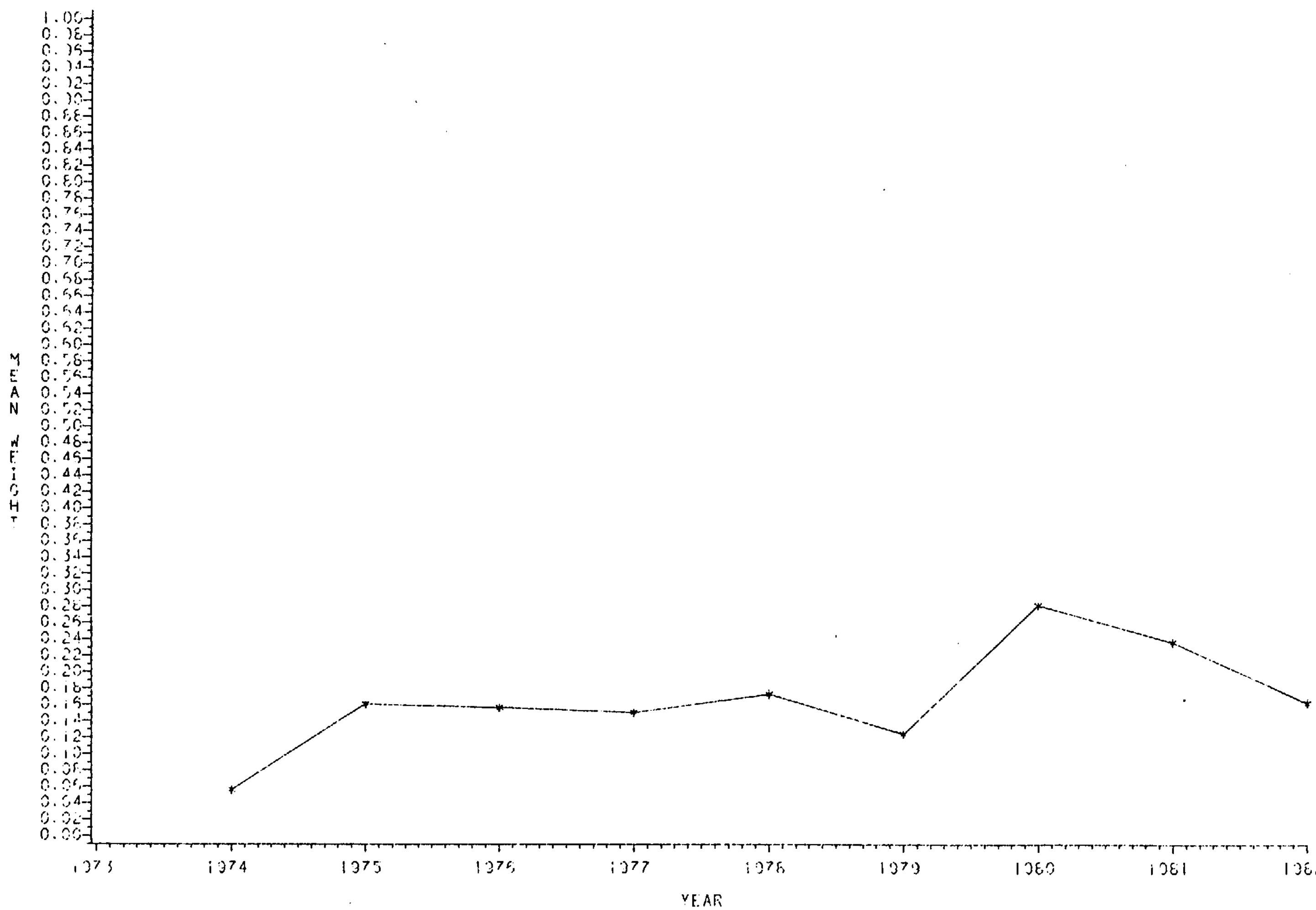


FIGURE 43

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-WARMOUTH

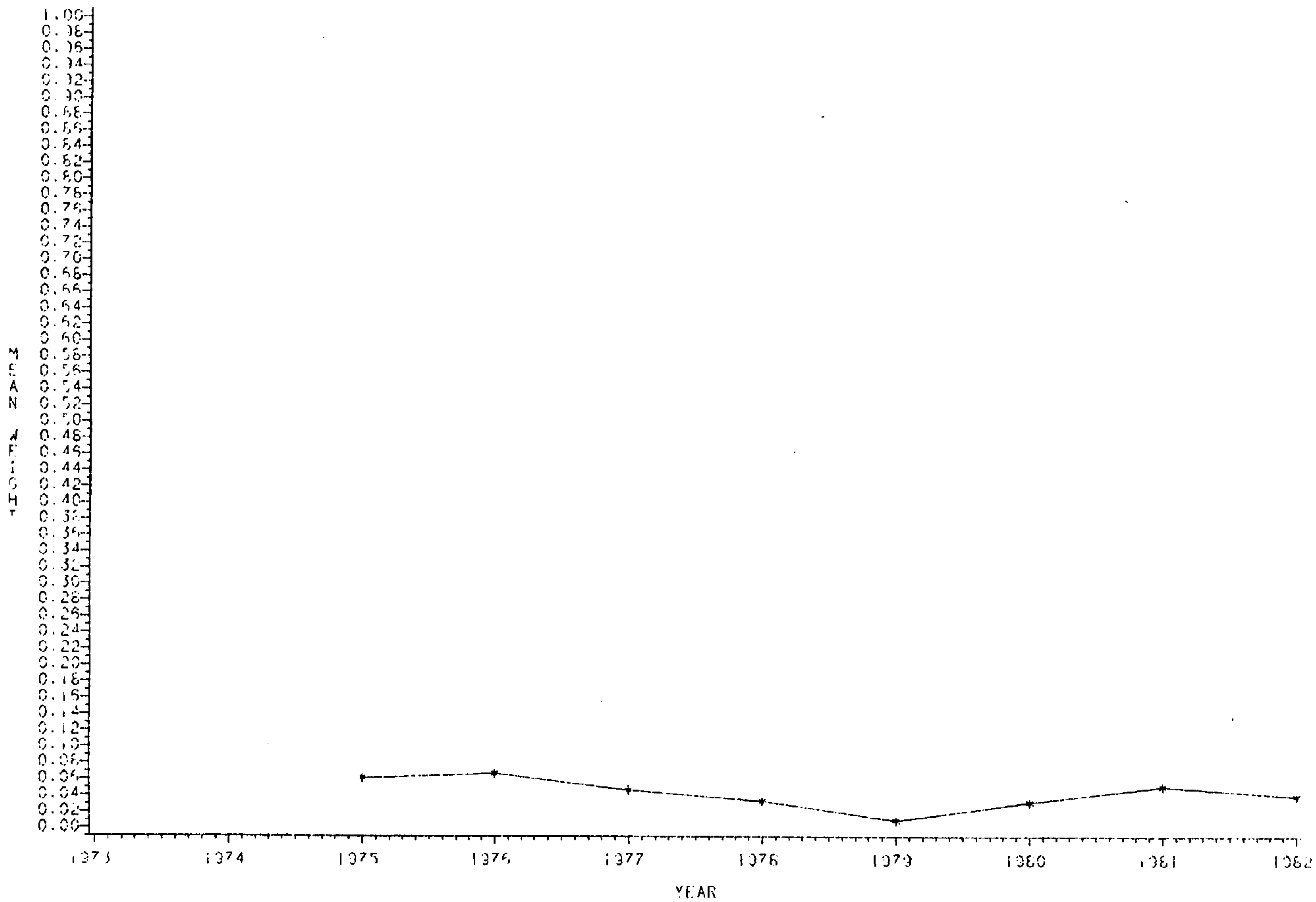


FIGURE 44

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES=YELLOW BULLHEAD

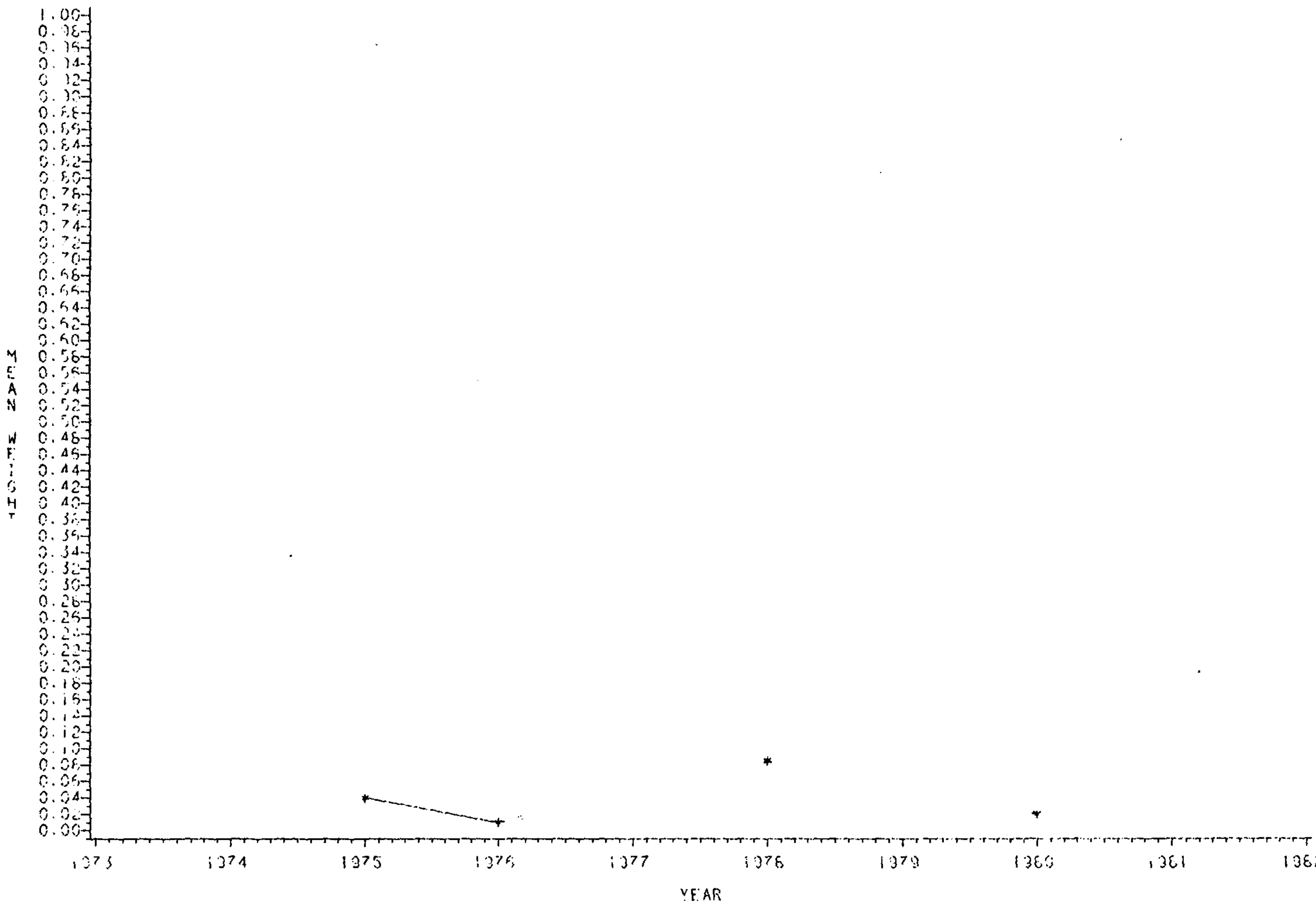


FIGURE 45

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-FATHEAD MINNOW

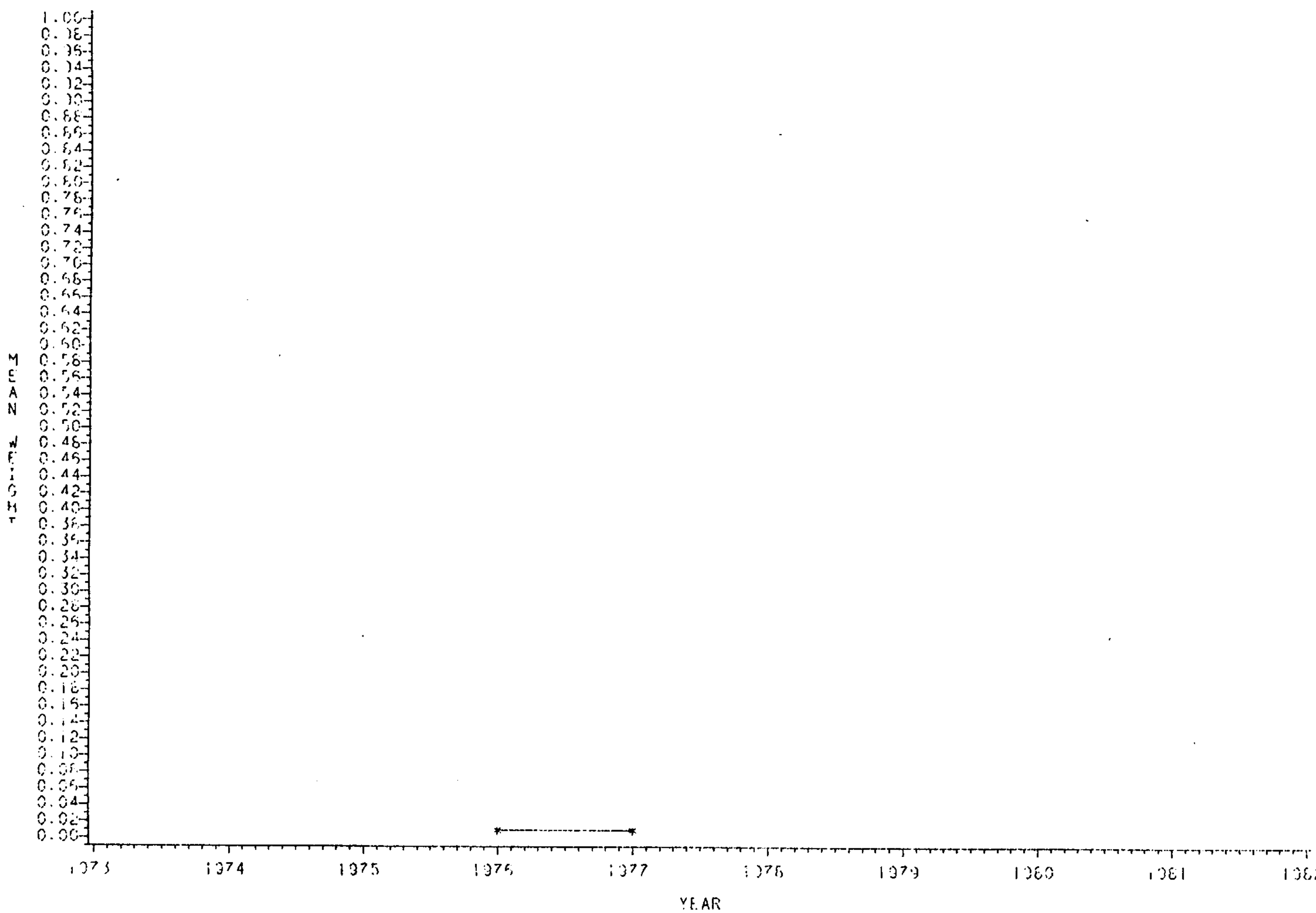


FIGURE 46

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-BLUNTNOSE MINNOW

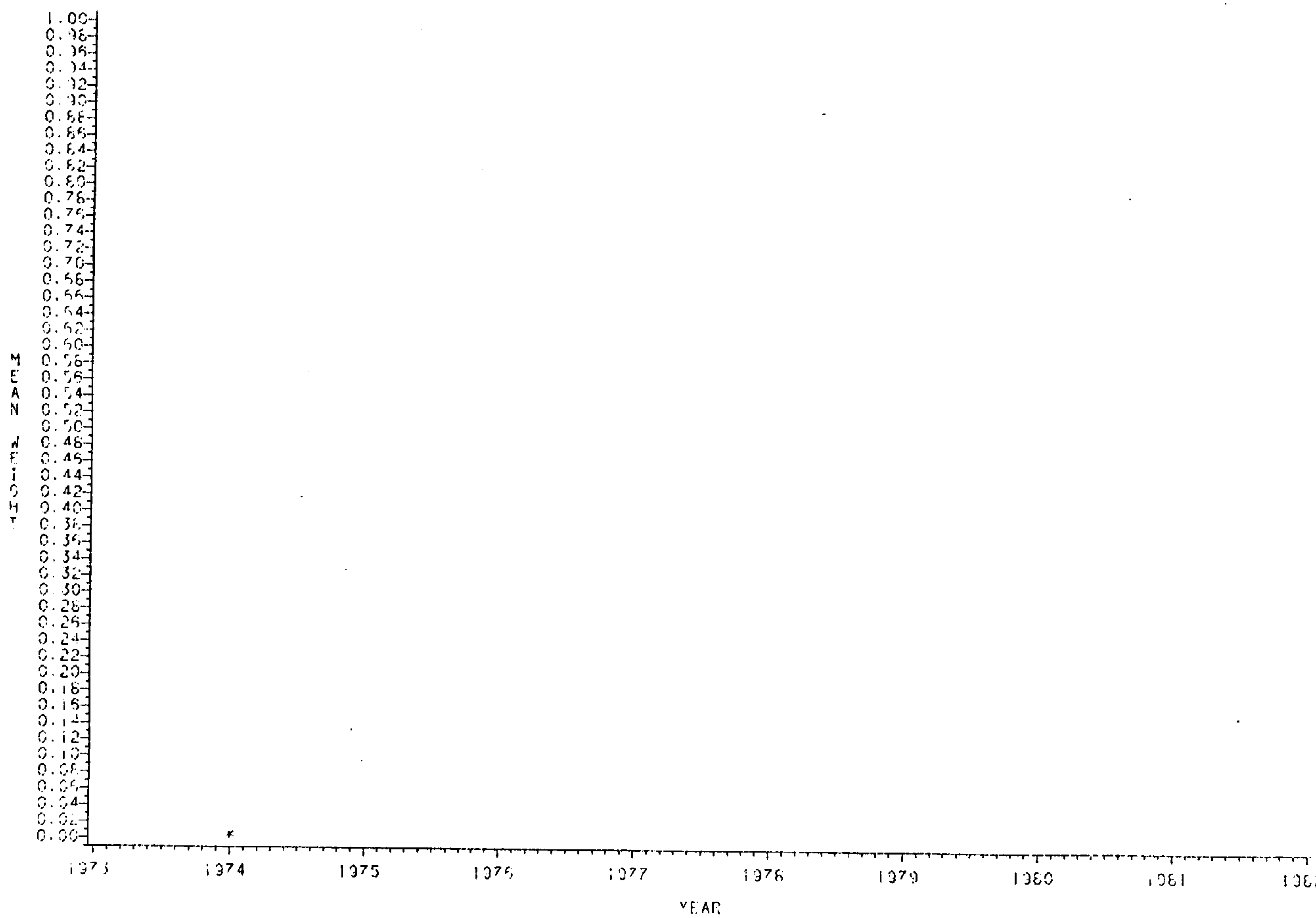


FIGURE 47

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-DARTER

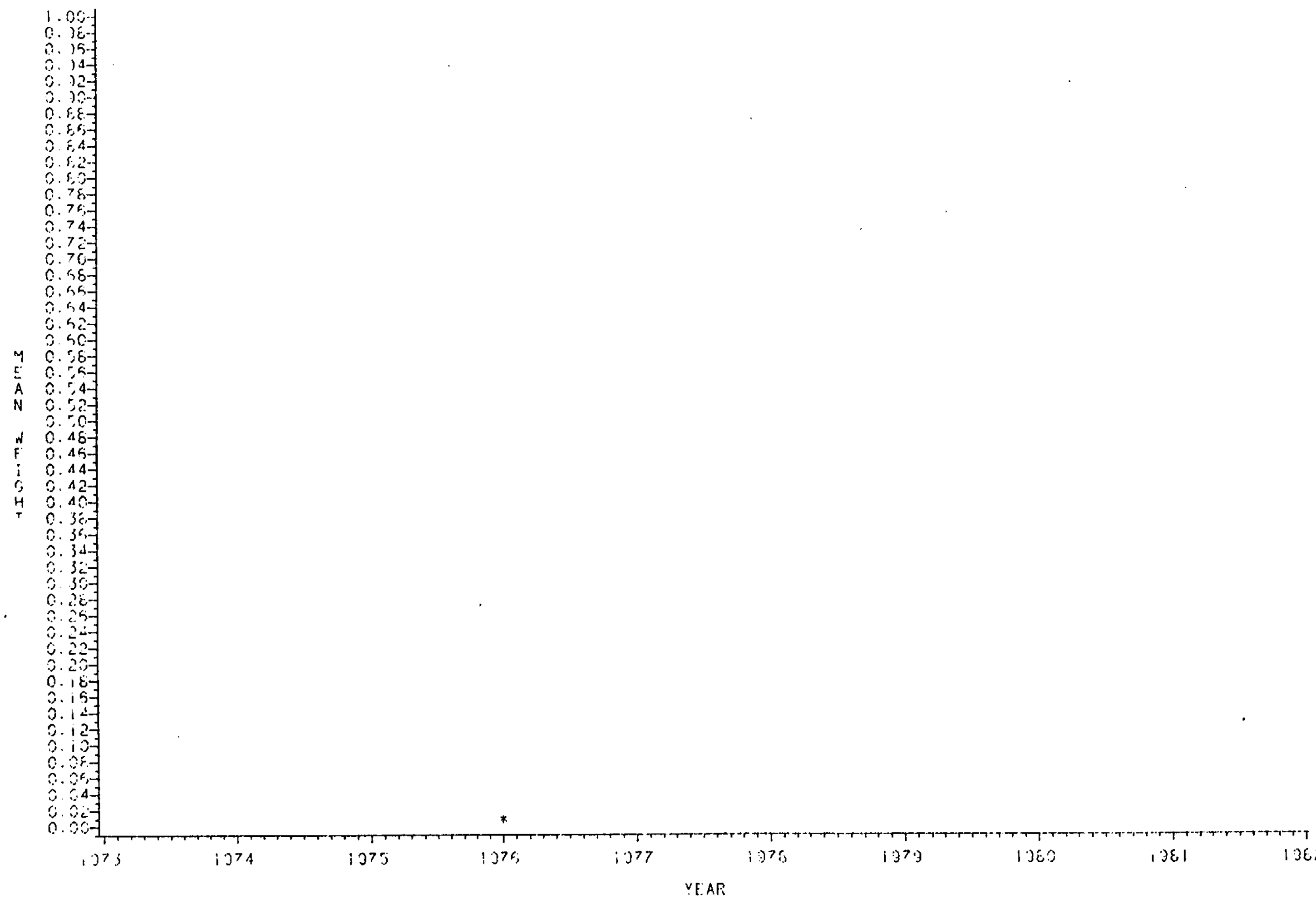


FIGURE 48

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-JOHNNY DARTER

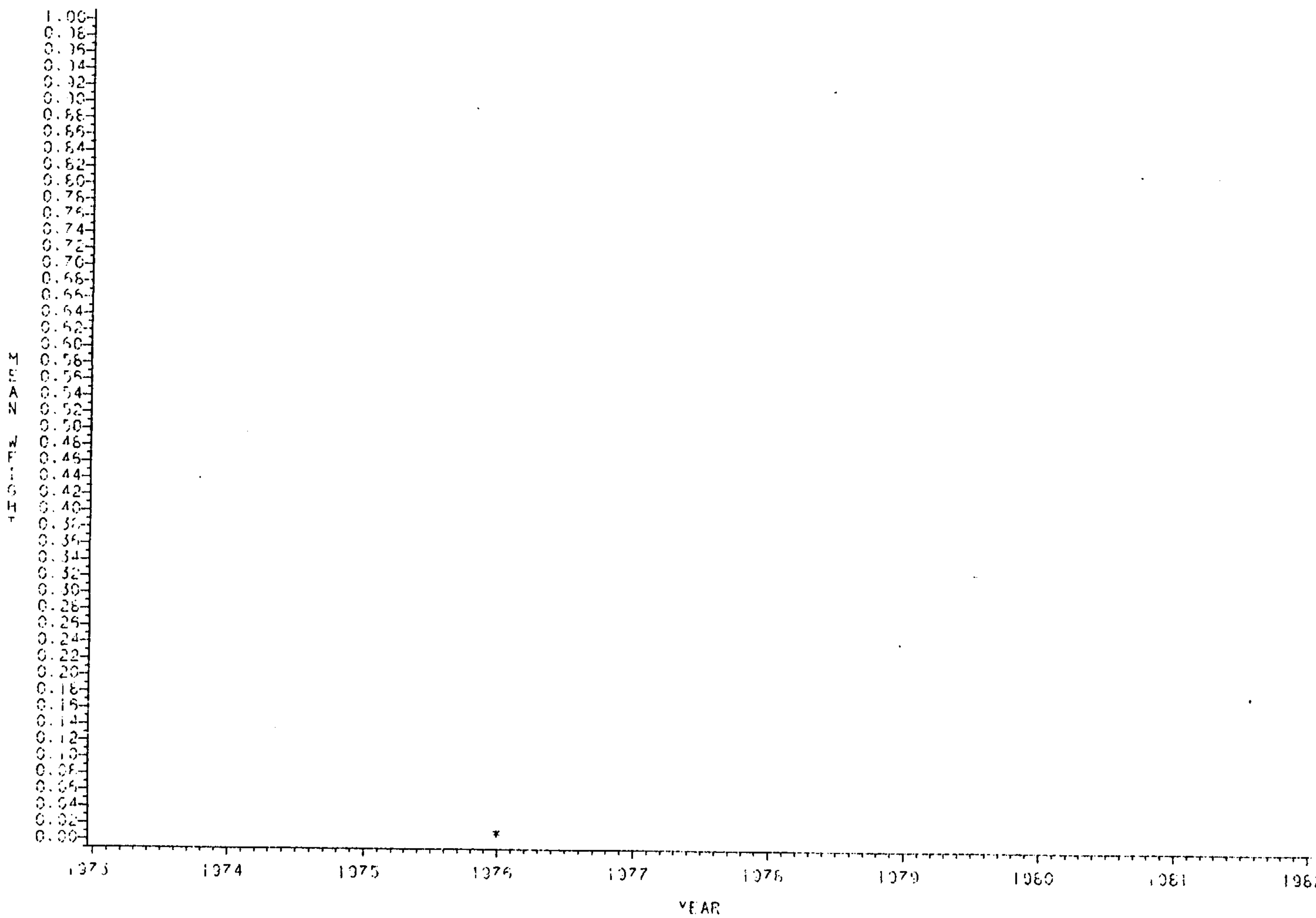


FIGURE 49

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-SPOTTED SUNFISH

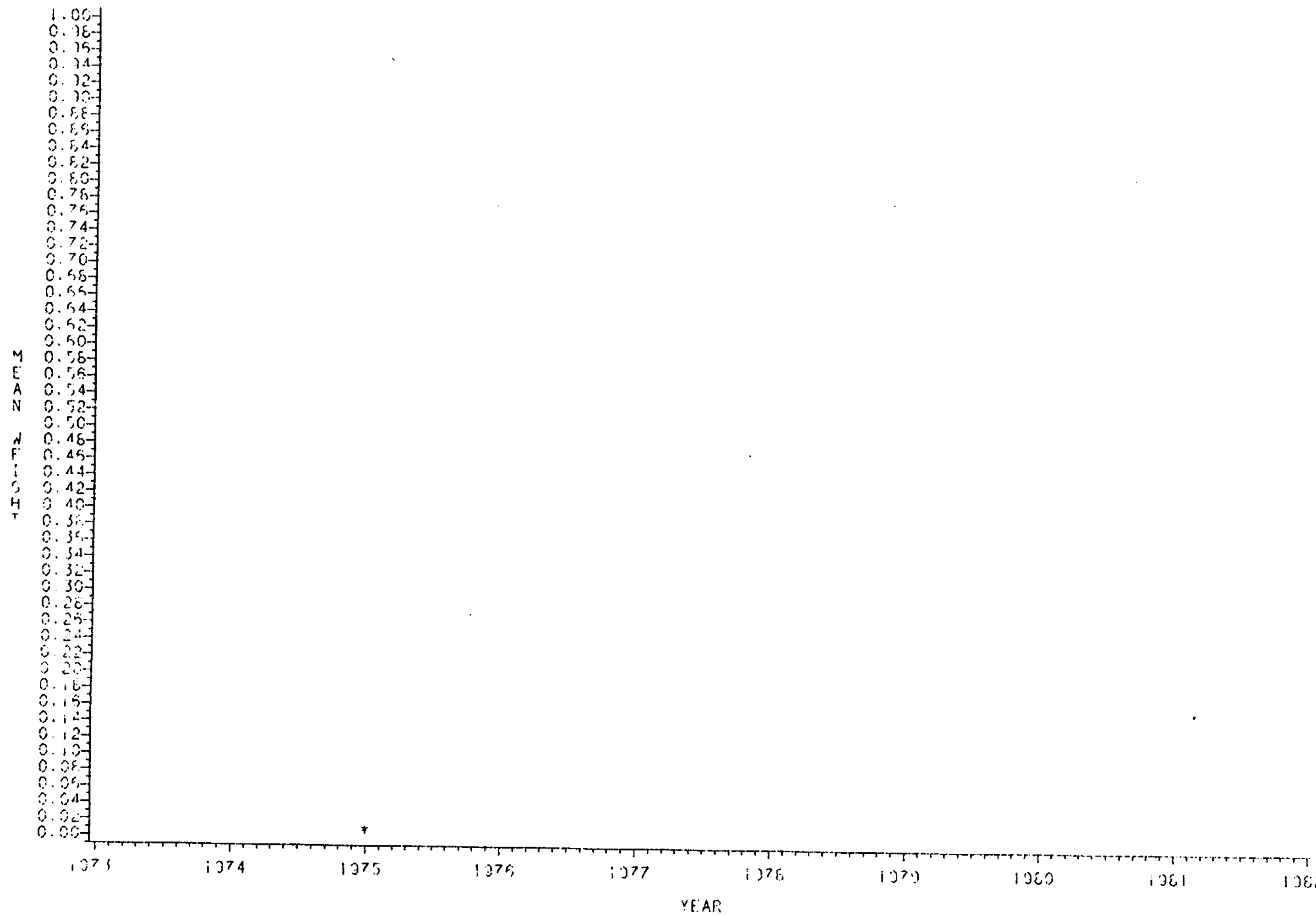


FIGURE 50

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-SLIM MINNOW

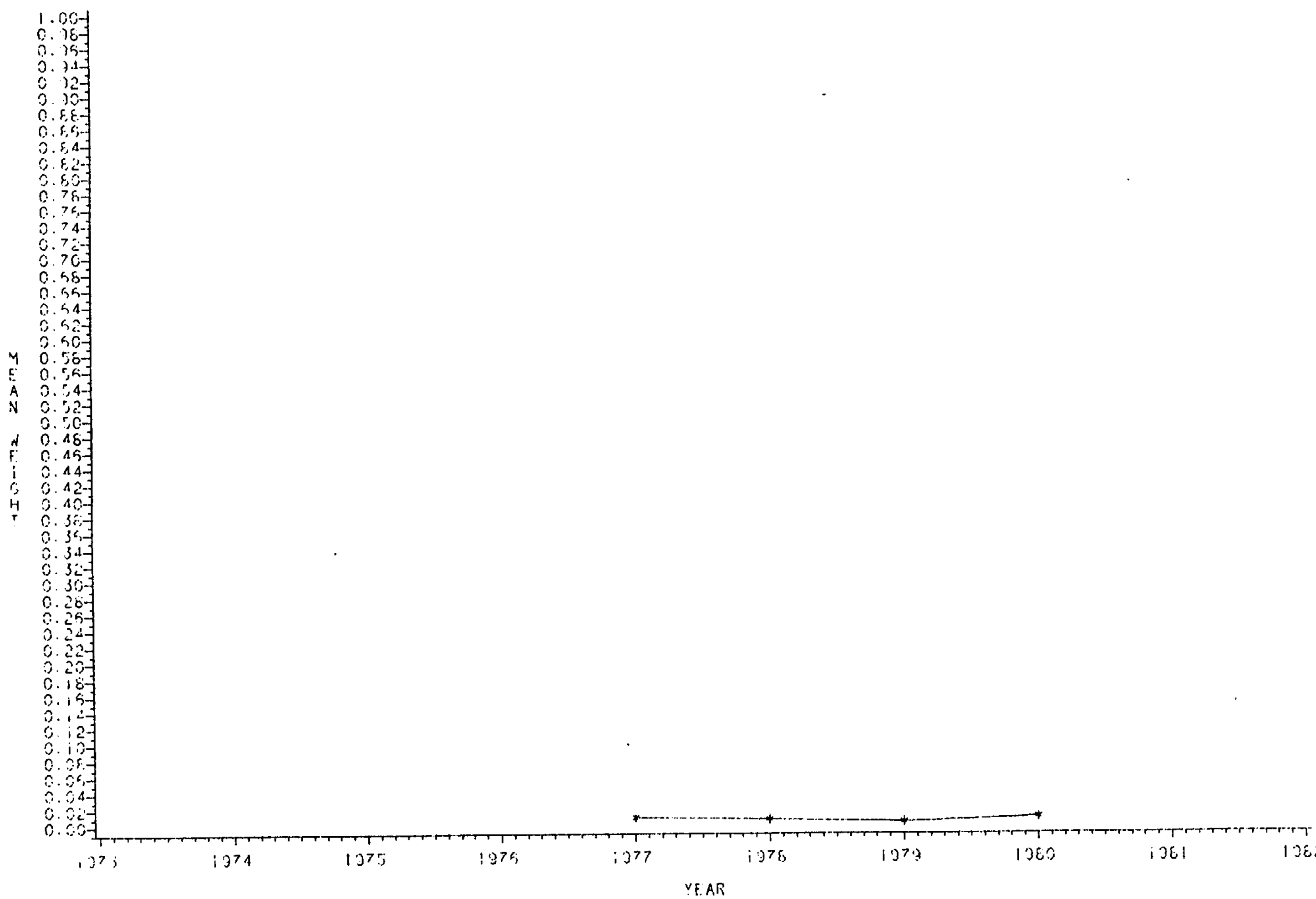
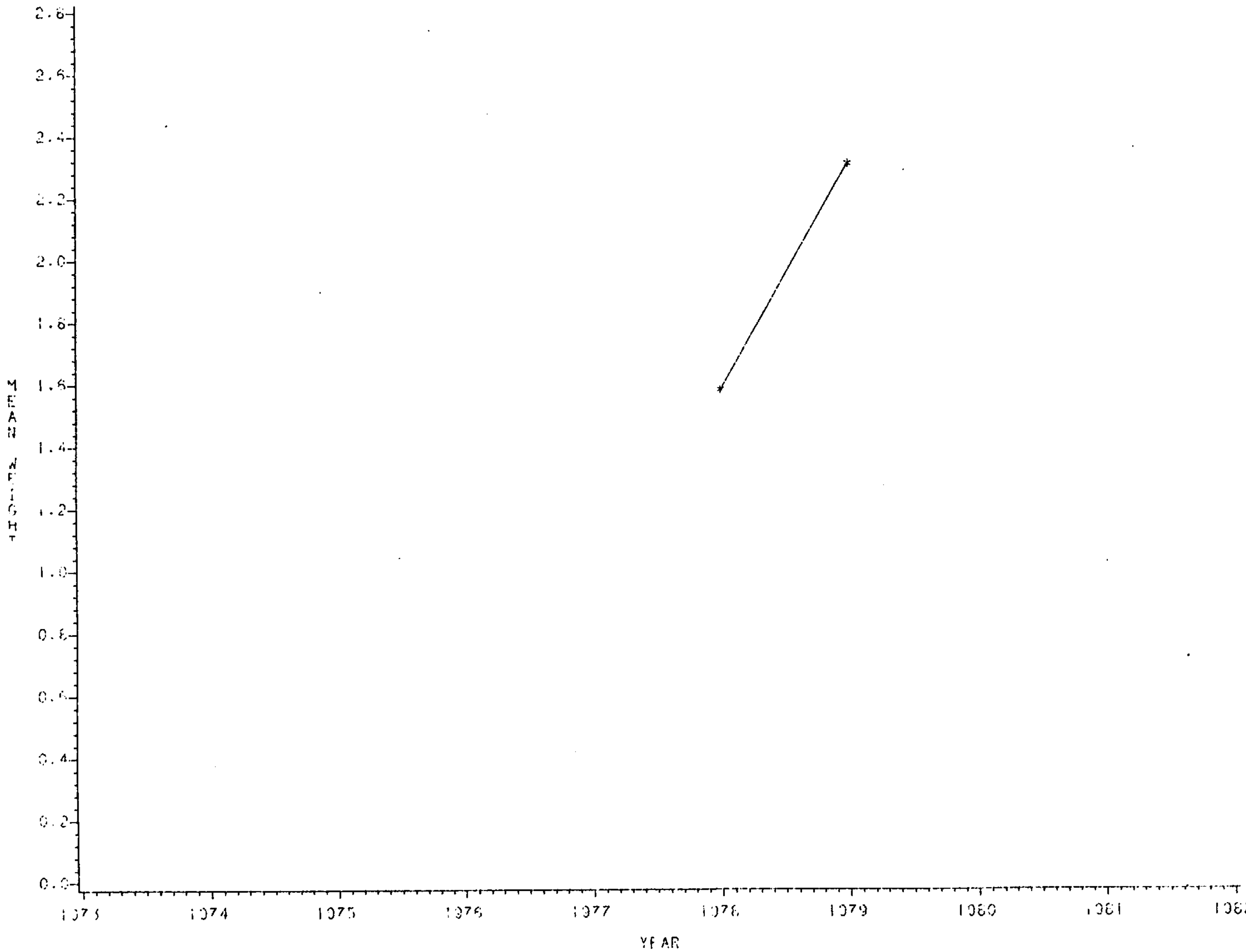


FIGURE 51

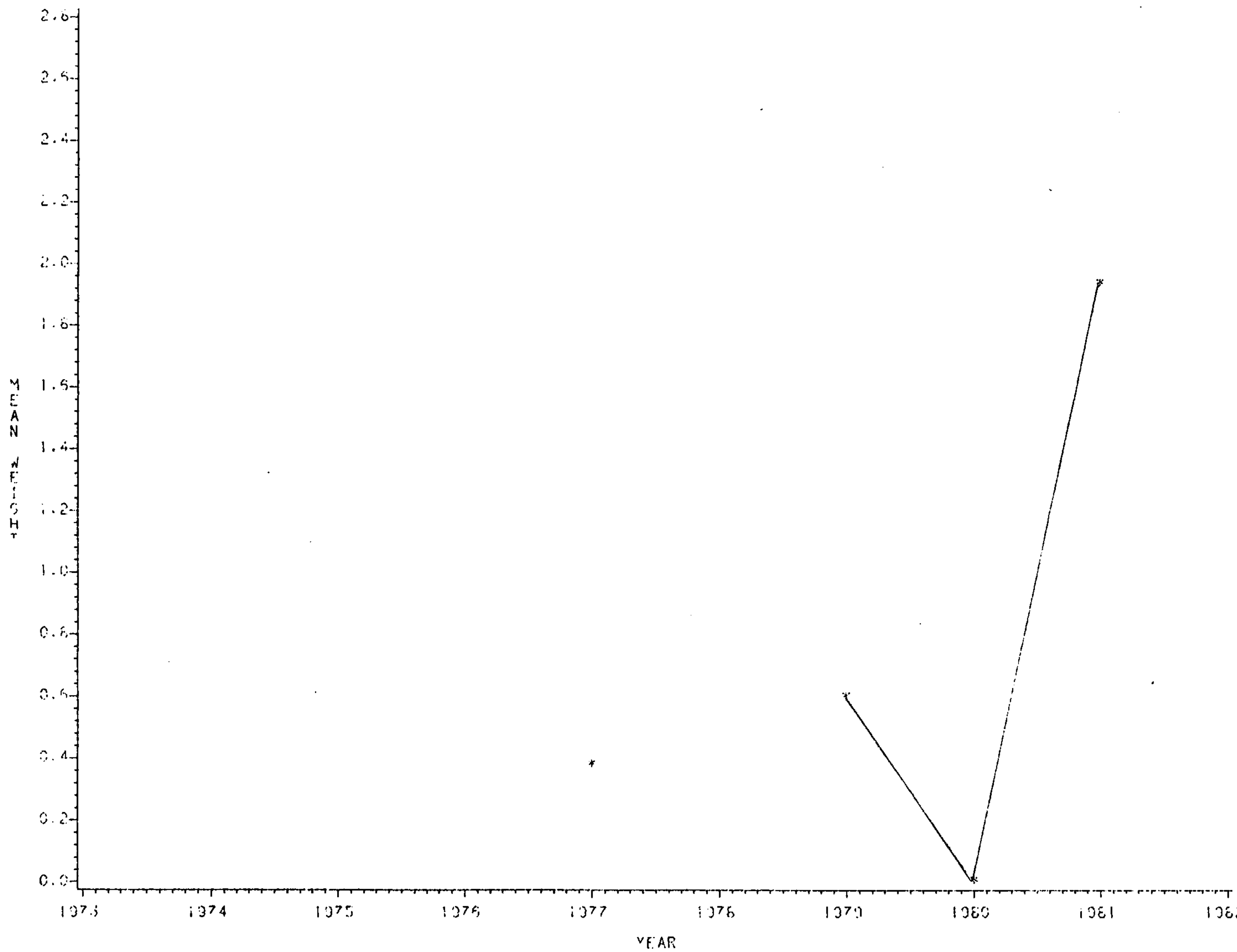
MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-BLACK BUFFALO



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 52

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-AMERICAN EEL



SCALE ADJUSTED TO ACCOMODATE MEAN WEIGHTS OVER ONE POUND

FIGURE 53

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-GRASS PICKEREL

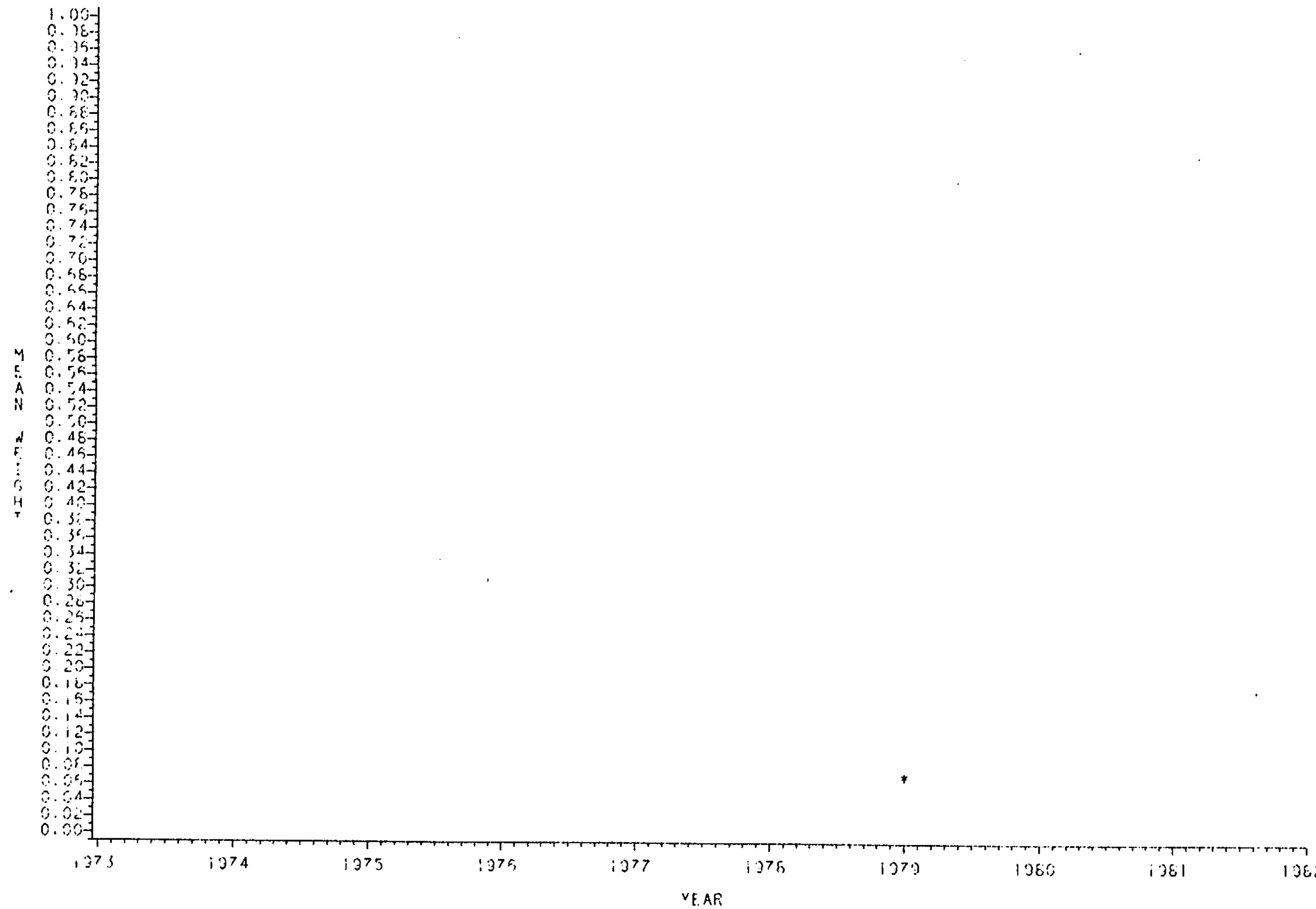


FIGURE 54

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-RIVER DARTER

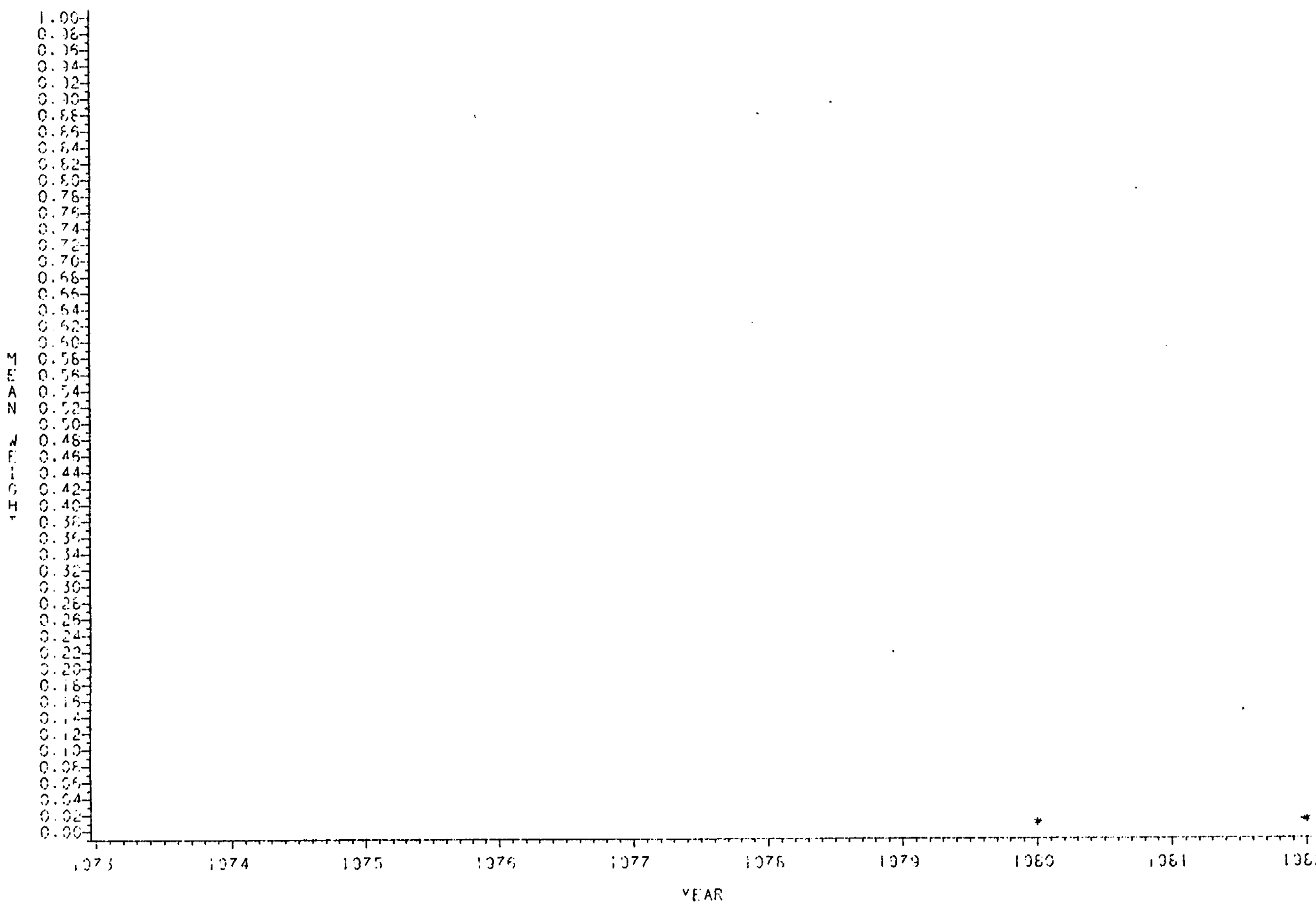


FIGURE 55

MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-STONEROLLER

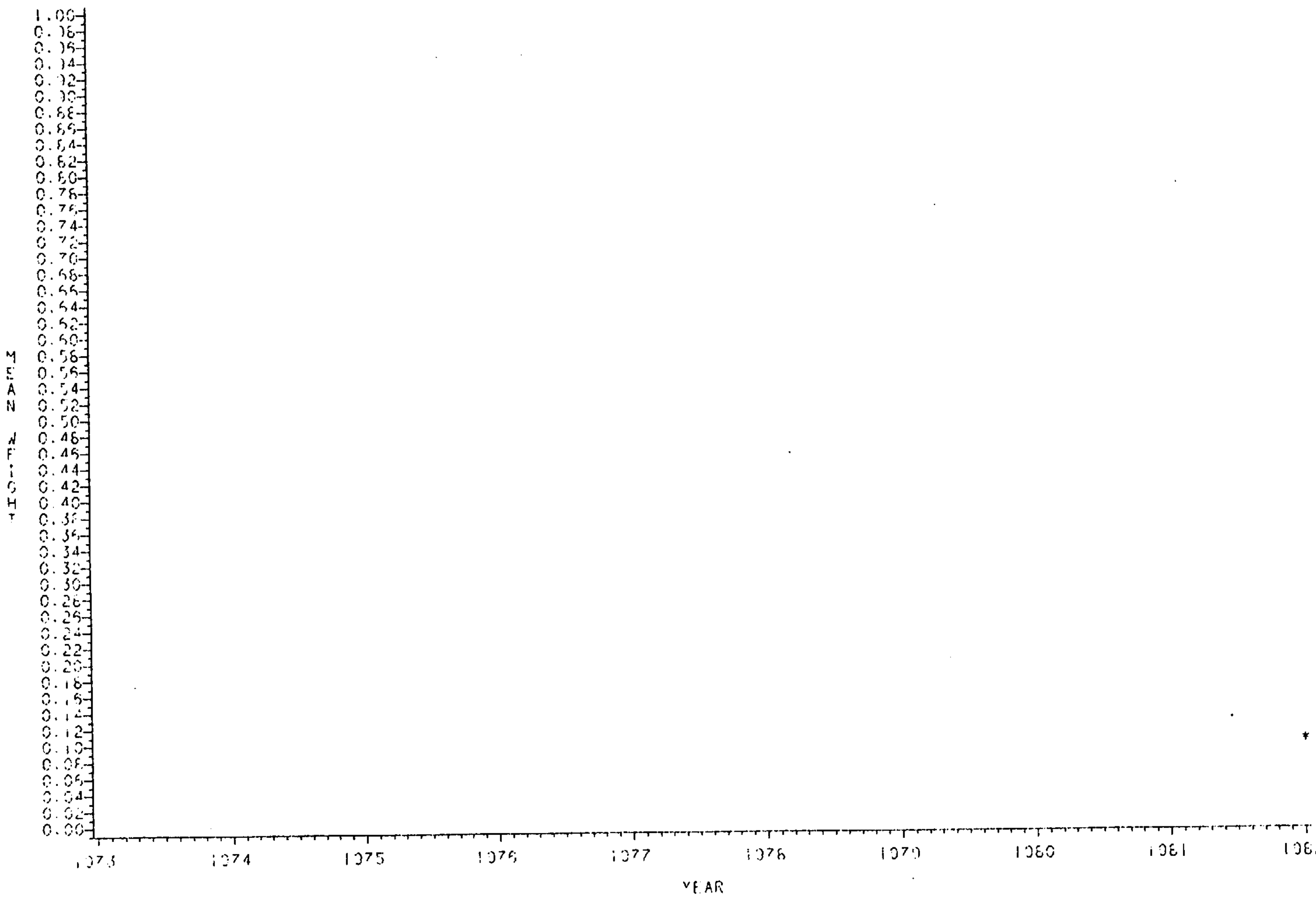
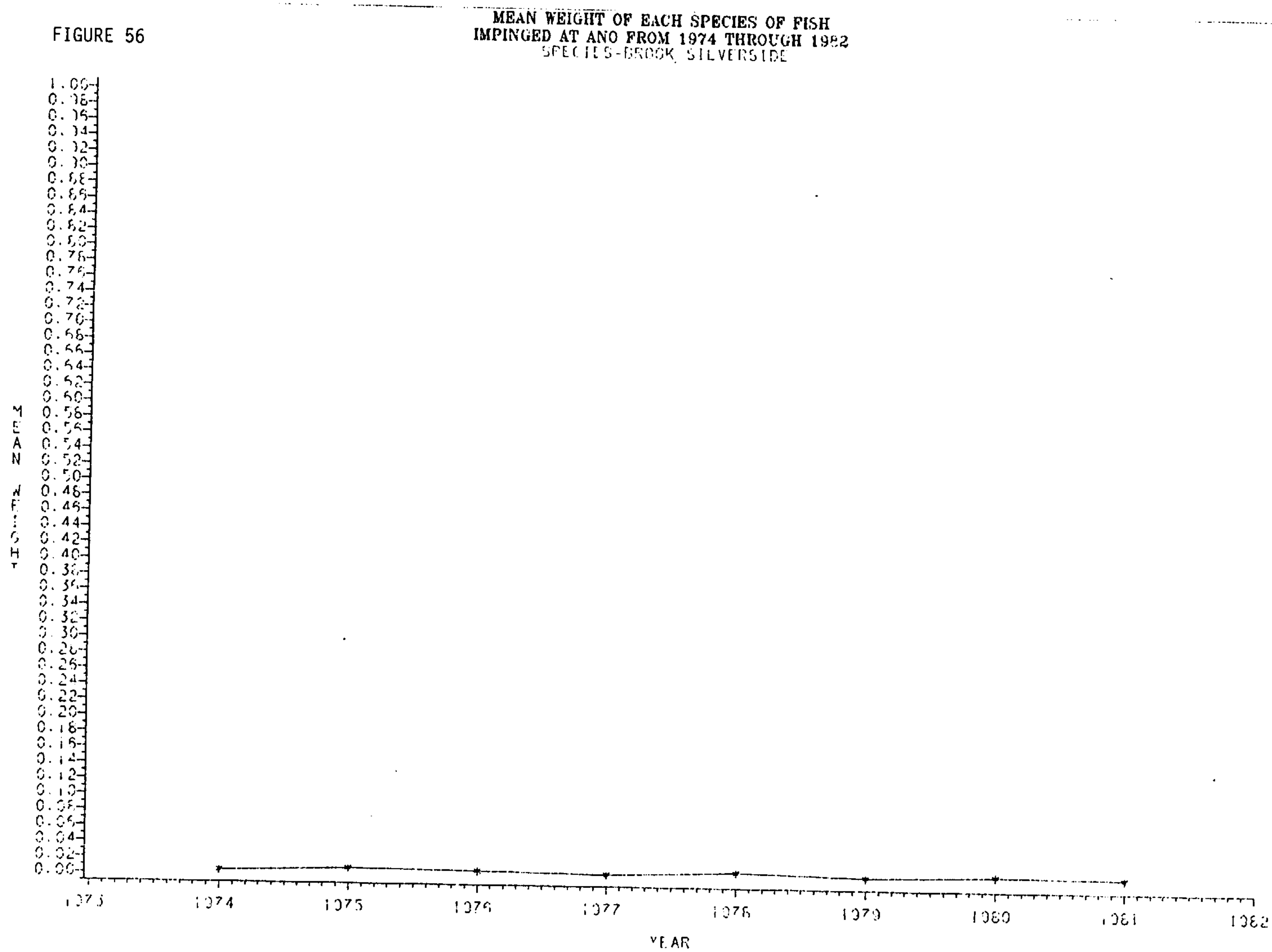


FIGURE 56


MEAN WEIGHT OF EACH SPECIES OF FISH
IMPINGED AT ANO FROM 1974 THROUGH 1982
SPECIES-BROOK SILVERSIDE
MEAN WEIGHT
YEAR

ARKANSAS NUCLEAR ONE
NON RADIOLOGICAL
ENVIRONMENTAL SURVEY
1994

Subject: Eradication of Fish From ECP
Procedure 1608.007

Rotenone was added to the Emergency Cooling Pond on September 27. Due to the size of the fish no pickup and disposal was attempted. the fish were allowed to decay in the pond leaving no residue. The block off net was removed on October 10 and the pond was returned to normal operation.

The Rotenone was supplied at cost by the Arkansas Game And Fish Commission and the application was assisted by the Fisheries Biologist from the Russellville District.

The fish population was determined by bank count method and results are as follows:

Number:	Size:	Species:
Green Sunfish 97%	Less Than 3 Inches 97%	Green Sunfish
Bluegill Sunfish 2%	3 To 5 Inches 4%	Bluegill Sunfish
All Others 1%	Over 5 Inches 1%	Freshwater Drum
		Yellow Bullhead
Total: 15,000 Fish		Mosquito Fish
		Gizzard Shad

DARDANELLE RESERVOIR-
ILLINOIS BAYOU
EMBAYMENT SURVEY
PROGRESS REPORT NO. 34

submitted to
ENTERGY CORPORATION
ARKANSAS NUCLEAR ONE
RUSSELLVILLE, ARKANSAS

John Rickett, Ph.D.
30 December 1994

LIST OF ILLUSTRATIONS

TABLES

FIGURES

DARDANELLE RESERVOIR-ILLINOIS BAYOU EMBAYMENT SURVEY

PROGRESS REPORT NO. 34

DECEMBER 30, 1994

John D. Rickett

Biology Department

University of Arkansas at Little Rock

Little Rock, AR 72204

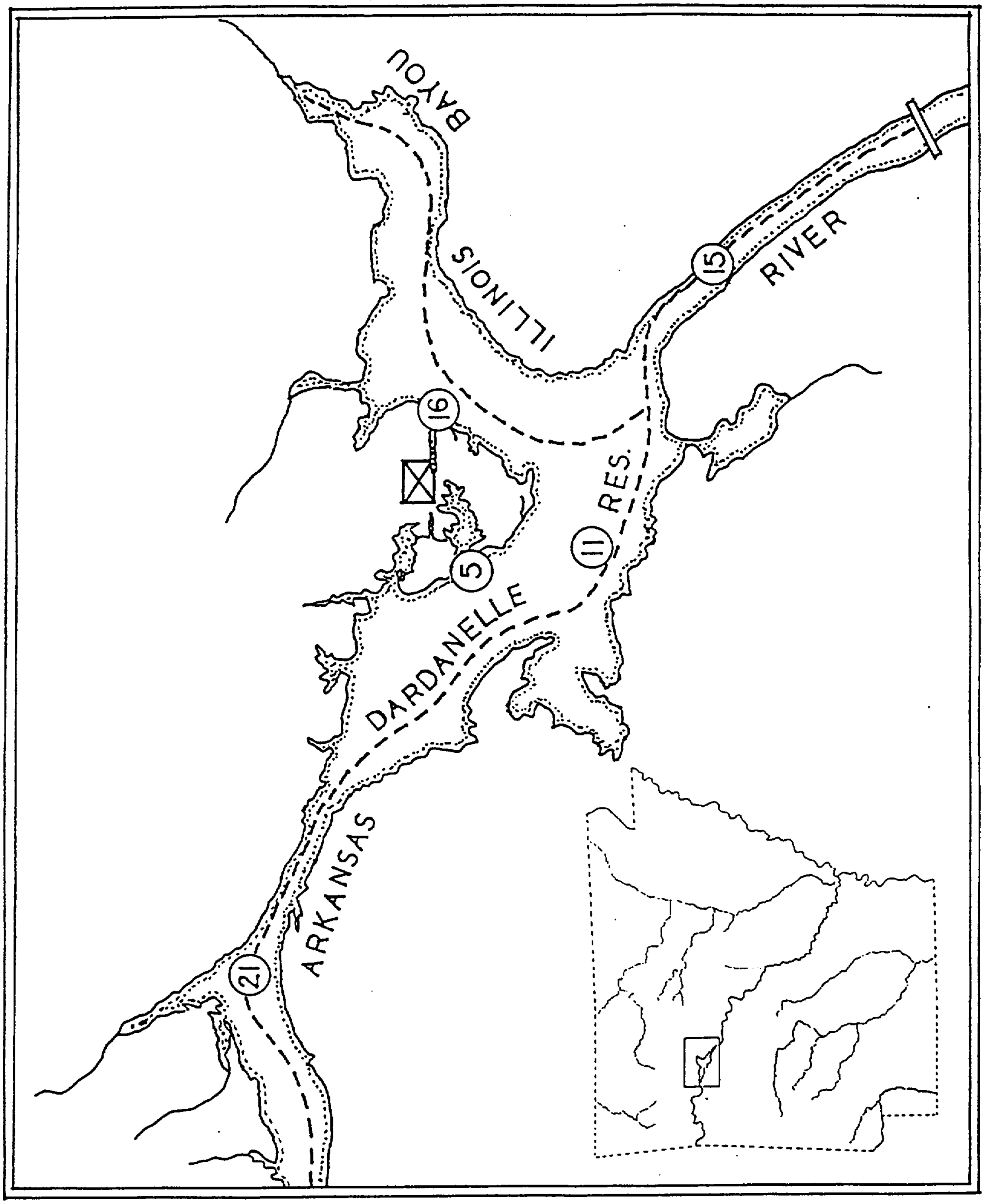
Introduction

According to specifications of contract between the University of Arkansas at Little Rock and Entergy Corporation (formerly Arkansas Power & Light Co.), this report is respectfully submitted.

This report contains only the data and a limited summary and interpretation, and the reader is referred to Progress Report No. 33 (filed with Entergy Corporation, 28 December 1993, Mr. Charles Adams, Project Liaison), which contained the most recent copy of our Standard Operations Procedures. No procedural changes were made during the 1994 project year.

Figure 1 shows the locations of the 1993 sampling stations. Sta. 5 is the mouth of the discharge bay, Sta. 11 is the mid-reservoir flat (positioned to evaluate the extent of the discharge mixing zone), Sta. 15 is the downstream "control"

Figure 1. Sampling stations on Dardanelle Reservoir, 1994 project year.


BAYOU
ILLINOIS
RIVER
15
16
5
11
RES.
DARDANELLE
ARKANSAS
21

(positioned to evaluate any residual or total-reservoir impact of plant operation), Sta. 16 is the intake channel (pre-treatment control), and Sta. 21 is the upstream control.

Data and Summary

Weather and Physicochemical Data. Meteorological data are reported in Table 1. No unusual variations or trends were observed except, perhaps, that the summer of 1994 was noticeably warmer than 1993 in central Arkansas. There was the usual haziness-cloudiness during the June and December collecting periods, but otherwise, randomness of collecting trip dates resulted in considerable variation of air temperature, wind, and solar radiation.

Physicochemical data are reported in Table 2, and median ranges are tabulated in Table 3. The median ranges were calculated using all data points. Seasonal differences were the strongest source of variation. Water temperatures, compared to 1993, were 7-10° warmer in March, 4-7° warmer in June and 10-12° warmer in September (compared to early October in 1993). Actual temperatures ranged from the mid 40s in December to the mid 80s in September.

Dissolved oxygen fluctuated inversely with temperature, but always contained adequate concentrations to support the aquatic community. D.O. concentrations in 1994 were slightly lower, than in 1993, except in December. The lowest readings occurred near the bottom at Sta. 5, but were not low enough to qualify as "hypolimnetic stagnation" (readings around 2 mg/l). Such hypoxia was documented regularly at the deeper stations prior to 1992.

pH readings were quite consistent during the year; slightly higher in September, rather than in March when phytoplankton was most

Table 1. Weather data in vicinity of ANO, Dardanelle Reservoir, Arkansas, 1994.

Variable	Station Number 05	11	15	16	21
	22 March 1994				
Time	1500	1140	1220	1340	1030
Air temperature (F)	68.0	63.0	65.0	67.0	60.8
Solar radiation (BTU)	210	280	285	260	250
Wind direction	S	ENE	ENE	NE	E
Wind velocity (mph)	5-7	5-7	3-5	0-3	6-8
Cloud cover	0%	0%	0%	0%	0%
	4 June 1994				
Time	1400	1110	1150	1310	1010
Air temperature (F)	77.0	81.5	80.6	77.0	78.8
Solar radiation (BTU)	90	155	25	15	40
Wind direction	--	NE	W	--	--
Wind velocity (mph)	calm	0-3	3-5	calm	calm
Cloud cover	100%	100%	100%	100%	100%
	10 September 1994				
Time	1500	1130	1215	1340	1015
Air temperature (F)	84.2	80.6	81.5	84.2	78.8
Solar radiation (BTU)	240	240	260	260	160
Wind direction	E	W	W	W	SE
Wind velocity (mph)	3-5	0-3	10-12	6-8	9
Cloud cover	hzy0%	hzy0%	hzy0%	hzy10%	hzy0%
	20 December 1994				
Time	1505	1215	1330	1420	1055
Air temperature (F)	44.0	48.5	44.2	43.8	49.1
Solar radiation (BTU)	30	10	20	40	10
Wind direction	ESE	ESE	ESE	ESE	ESE
Wind velocity (mph)	0-3	3-5	5-8	0-3	8-10
Cloud cover	(all stations: overcast, raining)				

Table 2. Physicochemical data in vicinity of ANO, Dardanelle Reservoir, Arkansas, 1994.

Variable	Depth ft	Depth (m)	Station No.- 22 Mar 94 05	11	15	16	21	Station No.- 4 Jun 94 05	11	15	16	21
Water temp (F)	1	0.3	72.0	58.6	60.4	65.3	59.0	87.8	84.4	81.3	80.2	80.6
	2	0.6	71.8	58.3	59.9	64.4	58.5	89.1	84.9	81.9	80.2	80.8
	5	1.5	66.7	57.7	59.4	60.6	57.9	89.2	82.9	81.1	80.4	80.6
	8	2.4	59.0	57.4	58.6	59.0	57.6	82.9	80.4	80.6	80.6	80.6
	12	3.7	58.6	57.2	57.6	58.6	57.4	78.6	78.6	78.8	78.8	80.4
	22	6.7			57.2		57.2			77.7		79.3
	32	9.8			56.8		57.2			77.0		78.4
	37	11.3			56.7					75.4		
Dissolved oxygen (mg/l)	1	0.3	10.3	10.3	9.9	10.4	10.4	6.6	7.1	7.2	7.5	7.1
	2	0.6	10.0	10.2	9.8	10.3	10.4	6.2	7.1	7.0	7.4	6.6
	5	1.5	9.5	10.1	9.8	10.2	10.2	6.1	6.0	6.5	7.3	6.5
	8	2.4	9.0	10.0	9.6	10.2	10.2	5.1	5.6	6.4	6.7	6.5
	12	3.7	9.1	10.0	9.5	10.2	10.2	3.2	5.3	5.3	5.3	6.5
	22	6.7			9.6		10.2			4.9		6.1
	32	9.8			9.5		10.1			4.2		5.4
	37	11.3			9.5					2.6		
pH	2	0.6	8.57	8.05	8.22	8.60	8.15	8.02	7.98	8.16	7.78	7.82
	12	3.7	8.40	8.00		8.18		7.60	7.76		7.53	
	32	9.8					7.86			7.36		7.80
	37	11.3			7.98							
Turbidity (FTU)	2	0.6	21	35	30	17	36	55	53	54	47	56
	12	3.7	56	37		21		92	70		48	
	32	9.8					40			96		85
	37	11.3			42							
Total hardness (mg/l)	2	0.6	90	98	96	56	98	98	102	103	97	118
	12	3.7	76	96		56		110	113		99	
	32	9.8					100			108		114
	37	11.3			104							
Nitrate nitrogen (mg/l)	2	0.6	0.50	0.10	0.25	0.23	0.40	0.10	0.20	0.85	0.35	0.45
	12	3.7	0.27	0.22		0.42		0.40	0.15		0.40	
	32	9.8					0.40			0.80		0.60
	37	11.3			0.42							

			22 March 1994					4 June 1994				
			05	11	15	16	21	05	11	15	16	21
Nitrite	2	0.6	.005	.003	.004	.003	.004	.000	.001	.002	.003	.004
nitrogen	12	3.7	.002	.004		.003		.003	.001		.002	
(mg/l)	32	9.8					.002			.000		.000
	37	11.3			.001							
Ortho-	2	0.6	0.36	0.16	0.28	0.18	0.45	0.42	0.32	0.40	0.48	0.37
phos-	12	3.7	0.12	0.14		0.05		0.39	0.30		1.80	
phate	32	9.8					0.14			0.42		0.40
(mg/l)	37	11.3			0.11							
Iron	2	0.6	0.23	0.29	0.32	0.19	0.28	0.57	0.54	0.49	0.46	0.57
(mg/l)	12	3.7	0.41	0.31		0.17		0.91	0.57		0.49	
	32	9.8					0.27			0.80		0.74
	37	11.3			0.35							
Copper	2	0.6	0.01	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
(mg/l)	12	3.7	0.00	0.02		0.00		0.00	0.00		0.01	
	32	9.8					0.01			0.00		0.02
	37	11.3			0.00							
Sulfate	2	0.6	24	29	30	22	31	28	30	32	29	32
(mg/l)	12	3.7	28	27		17		28	32		30	
	32	9.8					28			27		30
	37	11.3			29							
Chloride	2	0.6	23	30	28	25	26	38	40.5	40.5	37.5	42
(mg/l)	12	3.7	30	28		20		40	43.5		38	
	32	9.8								40.5		42
	37	11.3			29		26					
Total	2	0.6	23	28	24	16	28	17	16	5	16	17
susp.	12	3.7	29	18		17		38	13		13	
solids	32	9.8					12			35		40
(mg/l)	37	11.3			21							
C.O.D.	2	0.6	6	35	24	3	20	5	25	35	18	58
(mg/l)	12	3.7	50	40		8		5	29		6	
	32	9.8					42			26		31
	37	11.3			15							
Spec.	2	0.6	181	283	268	208	288	334	352	354	332	366
cond.	12	3.7	265	276		184		357	372		334	
(umhos)	32	9.8					275			359		378
	37	11.3			279							

Table 2. Continued.

Variable	Depth ft	(m)	Station No.- 10 Sep 94 05	11	15	16	21	Station No.- 20 Dec 94 05	11	15	16	21
Water temp (F)	1	0.3	93.2	82.2	82.2	85.3	80.6	57.6	46.2	45.0	46.8	47.8
	2	0.6	93.2	82.2	82.2	84.6	80.6	58.8	46.2	45.3	46.8	47.7
	5	1.5	87.8	81.7	82.0	84.2	80.8	56.8	46.4	46.4	46.8	47.7
	8	2.4	84.0	81.5	82.0	84.0	80.8	49.6	46.4	47.8	46.8	47.5
	12	3.7	82.8	81.5	81.3	82.6	80.8	48.2	46.4	47.8	46.8	47.5
	22	6.7			81.0		80.6			46.8		47.5
	32	9.8			80.8		80.6			46.8		47.5
	37	11.3			80.8					46.6		46.4
Dissolved oxygen (mg/l)	1	0.3	7.1	8.4	8.1	8.4	7.4	9.2	10.2	9.5	9.4	10.6
	2	0.6	7.0	8.2	7.8	8.3	7.3	8.9	10.1	9.4	9.3	10.4
	5	1.5	7.6	6.8	7.6	8.2	7.1	8.7	10.0	9.3	9.2	10.3
	8	2.4	5.5	6.4	7.5	8.2	6.9	8.9	9.9	9.3	9.2	10.2
	12	3.7	4.1	6.3	6.4	6.7	6.7	8.9	9.9	9.3	9.2	10.0
	22	6.7			5.8		6.7			9.4		10.0
	32	9.8			5.1		6.4			9.4		10.0
	37	11.3			3.3					9.4		9.8
pH	2	0.6	8.82	8.90	8.87	8.96	8.15	7.52	8.15	7.89	7.88	8.22
	12	3.7	8.70	8.68		8.82		8.22	8.20		7.42	
	32	9.8					8.12					
	37	11.3			8.40					8.04		8.03
Turbidity (FTU)	2	0.6	20	18	17	12	10	25	38	25	24	28
	12	3.7	23	32		15		38	32		26	
	32	9.8					36					
	37	11.3			60					38		36
Total hardness (mg/l)	2	0.6	130	134	134	128	144	56	92	80	44	98
	12	3.7	136	134		128		88	89		35	
	32	9.8					146					
	37	11.3			142					90		94
Nitrate-nitrogen (mg/l)	2	0.6	0.55	0.36	0.75	0.85	0.40	0.30	0.50	0.20	0.70	0.70
	12	3.7	0.65	0.15		0.25		0.60	0.50		0.60	
	32	9.8					0.10					
	37	11.3			0.10					0.60		0.70

			10 Sep 94					20 Dec 94				
			05	11	15	16	21	05	11	15	16	21
Nitrite-nitrogen (mg/l)	2	0.6	.004	.006	.007	.009	.006	.006	.006	.007	.006	.005
	12	3.7	.022	.009		.013		.009	.008		.008	
	32	9.8					.024					
	37	11.3			.073					.008		.007
Ortho-phosph. (mg/l)	2	0.6	0.25	0.30	0.21	0.21	0.60	0.78	0.58	0.28	0.14	0.28
	12	3.7	0.34	0.27		0.26		0.20	0.29		0.13	
	32	9.8					0.28					
	37	11.3			0.44					0.23		0.19
Iron (mg/l)	2	0.6	0.11	0.12	0.08	0.11	0.12	0.29	0.27	0.27	0.19	0.33
	12	3.7	0.18	0.22		0.17		0.26	0.26		0.19	
	32	9.8					0.29					
	37	11.3			0.49					0.26		0.28
Copper (mg/l)	2	0.6	0.01	0.02	0.01	0.03	0.00	0.00	0.01	0.01	0.00	0.04
	12	3.7	0.00	0.01		0.06		0.00	0.00		0.00	
	32	9.8					0.01					
	37	11.3			0.00					0.01		0.03
Sulfate (mg/l)	2	0.6	42	41	46	39	45	17	29	28	13	27
	12	3.7	52	42		38		25	32		14	
	32	9.8					40					
	37	11.3			43					30		29
Chloride (mg/l)	2	0.6	79	84	87	77	93	21	44	41	16	45
	12	3.7	91	83		74		41	44		17	
	32	9.8					97					
	37	11.3			91					43		46
Total sus. solids (mg/l)	2	0.6	16	17	3	6	3	5	6	2	8	8
	12	3.7	10	18		6		4	18		3	
	32	9.8					58					
	37	11.3			18					12		10
C.O.D. (mg/l)	2	0.6	30	57	32	20	30	15	20	65	10	130
	12	3.7	10	10		15		20	45		5	
	32	9.8					38					
	37	11.3			80					20		50
Specific cond. (umhos)	2	0.6	540	510	560	520	610	182	369	333	152	376
	12	3.7	610	520		510		335	367		147	
	32	9.8					630					
	37	11.3			600					361		378

Table 3. Ranges of physicochemical variables, all stations combined, Dardanelle Reservoir, 1994.

	Mar	Jun	Sep	Dec
Temp.*	high 50s	hi70s-lo80s	low 80s	mid 40s
Diss. Ox.	9.0-10.4	2.6- 7.5	4.1- 8.4	8.7-10.6
means	9.96	6.19	6.91	9.59
pH	7.86-8.60	7.36-8.16	8.12-8.96	7.42-8.22
means	8.201	7.781	8.642	7.957
Turbidity	17-56	47-96	10-60	24-38
means	33.5	65.6	24.3	31.0
T. Hardness	56-104	97-118	128-146	35-98
means	87.0	106.2	135.6	76.6
NO_3-N	0.10-0.50	0.10-0.85	0.10-0.85	0.20-0.70
means	0.321	0.430	0.416	0.540
NO_2-N	.001-.005	.000-.004	.004-.073	.005-.009
means	.0031	.0016	.0173	.0070
o-PO_4	0.05-0.45	0.30-1.80	0.21-0.60	0.13-0.78
means	0.199	0.530	0.432	0.310
Iron	0.17-0.41	0.46-0.91	0.08-0.49	0.19-0.33
means	0.282	0.614	0.189	0.260
Copper	0.00-0.02	0.00-0.02	0.00-0.06	0.00-0.04
means	0.006	0.005	0.015	0.010
Sulfate	17-31	27-32	38-52	13-32
means	26.5	29.8	42.8	24.4
Chloride	20-30	37.5-43.5	74-97	16-46
	26.5	40.25	85.6	35.8
T.S.S.	12-29	5-40	3-58	2-18
means	21.6	21.0	15.5	7.6
C.O.D.	3-50	5-58	10-80	5-130
means	24.3	23.8	32.2	38.0
Sp. Cond.	181-288	332-378	510-630	147-378
means	251	354	561	300

*Ranges for temperature are not given because samples at Sta. 5 was expected to be unnaturally warm.

abundant (Table 3). Variations in turbidity, total suspended solids, total hardness, chloride, sulfate, and specific conductance were related primarily to seasonal rainfall and its area of primary impact. In previous years, a pattern of dilution of sulfate, chloride, specific conductance, and total hardness by a general rainfall has been apparent, but rainfall in specific areas has contributed to greater localized leachings of these ions. In 1994, these variables exhibited their greatest concentrations during the September sampling and second highest in June. Turbidity and suspended solids were increased by rainfall and exhibited highest concentrations during June.

Measurements of the other physicochemical characteristics varied independently of seasonal changes and sampling stations. Table 4 compares physicochemical measurements between Sta. 16 (intake) and 5 (discharge). Water temperature was expected to be higher at Sta. 5, but only minor differences were observed between the intake and discharge regarding other variables. In terms of lower turbidity, hardness, iron, suspended solids, and specific conductance, the discharge water differed noticeably from that at Sta. 11, 15, and 21, because of innate differences between Illinois Bayou water and Arkansas River water.

Phytoplankton. Table 5 contains data from phytoplankton sampling. Green algae (Chlorophyta) were the dominant group throughout the year with secondary abundances represented by the diatoms (Chrysophyta) and consistent minor representation of the bluegreens (Cyanophyta) and dinoflagellates (Pyrrhophyta). Blue-green algae (Cyanophyta) were more abundant during the September

Table 4. Physicochemical variables at Stations 16 (intake) and 05 (discharge) compared, Dardanelle Reservoir, 1994. Means of both surface and bottom samples at each station used.

	Mar		Jun		Sep		Dec	
	16	05	16	05	16	05	16	05
Temp.	62.0	65.3	79.5	83.2	84.0	88.0	46.8	52.9
Diss. Ox.	10.3	9.70	6.40	4.90	7.55	5.60	9.30	9.05
pH	8.39	8.48	7.66	7.81	8.89	8.76	7.65	7.87
Turbidity	19.0	38.5	47.5	73.5	13.5	21.5	25.0	31.5
T. Hardness	56.0	83.0	98.0	104	128	133	39.5	72.0
NO_3-N	.325	.385	.375	.250	0.550	.600	.650	.450
NO_2-N	.003	.0035	.0025	.0015	.011	.013	.007	.0075
o-PO_4	.115	.240	1.14	.405	.235	.295	.135	.490
Iron	.180	.270	.475	.740	.140	.145	.190	.275
Copper	.0000	.0005	.0005	.0000	.0045	.0005	.0000	.0000
Sulfate	19.5	26.0	29.5	28.0	38.5	47.0	13.5	21.0
Chloride	22.5	26.5	37.7	39.0	75.5	85.0	16.5	31.0
T.S.S.	16.5	26.0	14.5	27.5	6.0	13.0	5.5	4.5
C.O.D.	5.5	28.0	12.0	5.0	17.5	20.0	7.5	17.5
Sp. Cond.	196	223	333	346	515	575	150	258

Table 5. Phytoplankton collected in Dardanelle Reservoir during

Taxa	Station No.- 22 Mar 94					Station No.- 6 Jun 94				
	05	11	15	16	21	05	11	15	16	21
CHLOROPHYTA										
Actinastrum										
Ankistrodesmus										
Chlorella	3.6	5.2	9.3	3.6	2.3	0.2	0.7			0.4
Closteriopsis	8.8	4.4	5.9	6.5	6.4					
Closterium				0.4						
Coelastrum										
Microspora	52	19	20	13	49	0.4	0.7		0.3	0.4
Pediastrum		0.8		0.4		1.0	1.5	3.2	0.9	1.1
Sphaerocystis	12	1.6	1.3	24	1.3	12	12	2.8	32	2.1
Spirogyra										
Staurastrum										
Schroederia										
Tribonema	347	341	483	306	402	1.0	2.7	0.8	0.6	7.2
Volvox									0.3	
Unid. green algae	0.8			0.4						
CHRYSOPHYTA										
Asterionella	79	108	158	49	104	0.2				0.4
Bacillaria										
Diatomella										
Fragillaria	15	40	29	8.3	41					
Navicula		0.8								
Stauroneis			0.9							
Synedra										
Synura	1.6			1.1	0.3					
Unid. diatoms										
CYANOPHYTA										
Anabaena		1.2	0.9	0.4	1.0					
Aphanizomenon						0.2				
Borzia					0.3					
Lyngbya	0.4	0.4			0.3					
Microcystis	1.2		0.4			0.8		0.8	0.3	0.4
PYRRHOPHYTA										
Ceratium						1.0		2.4	1.6	0.4
Gonyaulax										
Totals	521	522	709	413	608	17	18	10	36	12

1994. Numbers are organisms per liter.

Taxa	Station No.- 10 Sep 94					Station No.- 20 Dec 94				
	05	11	15	16	21	05	11	15	16	21
CHLOROPHYTA										
Actinastrum	0.2		0.6		0.2			0.2		
Ankistrodesmus	0.7	0.2		1.9	0.4					
Chlorella	1.5	1.6	2.1	2.5	1.0		0.2	0.2	0.4	0.6
Closteriopsis	3.7	2.8	2.3	4.4	0.8	1.0	0.5	0.9	1.0	0.4
Closterium	0.2					0.4				
Coelastrum			0.2	0.2						
Microspora					0.2	3.7	1.2	0.9	0.6	2.4
Pediastrum	5.7	3.2	2.3	3.2	3.0	2.1	1.2	1.9	1.2	2.2
Schroederia										0.8
Sphaerocystis	2.4	4.4	3.1	0.9	2.0	1.0	0.2	0.2	1.2	0.2
Spirogyra								0.2		
Staurastrum					0.2					
Tribonema	11	14	16	11	15	51	178	123	49	129
Volvox										
Unid. green algae	0.2	0.2	0.2	0.2	0.2			0.2	0.2	0.2
CHRYSOPHYTA										
Asterionella							0.5	0.2		0.4
Bacillaria								0.2		
Diatomella	2.4	2.2	1.5	2.3	0.2					
Fragillaria							1.5	0.5		0.8
Navicula						0.4			0.6	
Synedra		0.4				0.4		0.7	2.0	0.2
Synura						0.2				
Unid. diatoms			0.2		0.2					
CYANOPHYTA										
Anabaena	9.5	3.4	1.7	8.3	1.0			0.2		0.2
Aphanizomenon							0.5	0.7		1.6
Borzia	0.4		0.4							
Lyngbya										
Microcystis		0.4	0.9		0.2	0.4	0.2	0.2		0.4
PYRRHOPHYTA										
Ceratium	0.2			0.5						
Gonyaulax	0.4	0.2	0.6	1.4						0.2
Totals	38	33	32	37	25	61	184	130	56	140

samples than the rest of the year. Diatoms were most abundant in March with a minor secondary abundance in September. With the exception of a single *Gonyaulax* in December, dinoflagellates (Pyrrhophyta) were present only in the June and September samples. Compared to 1993, slight declines in taxon diversity and total abundance were observed.

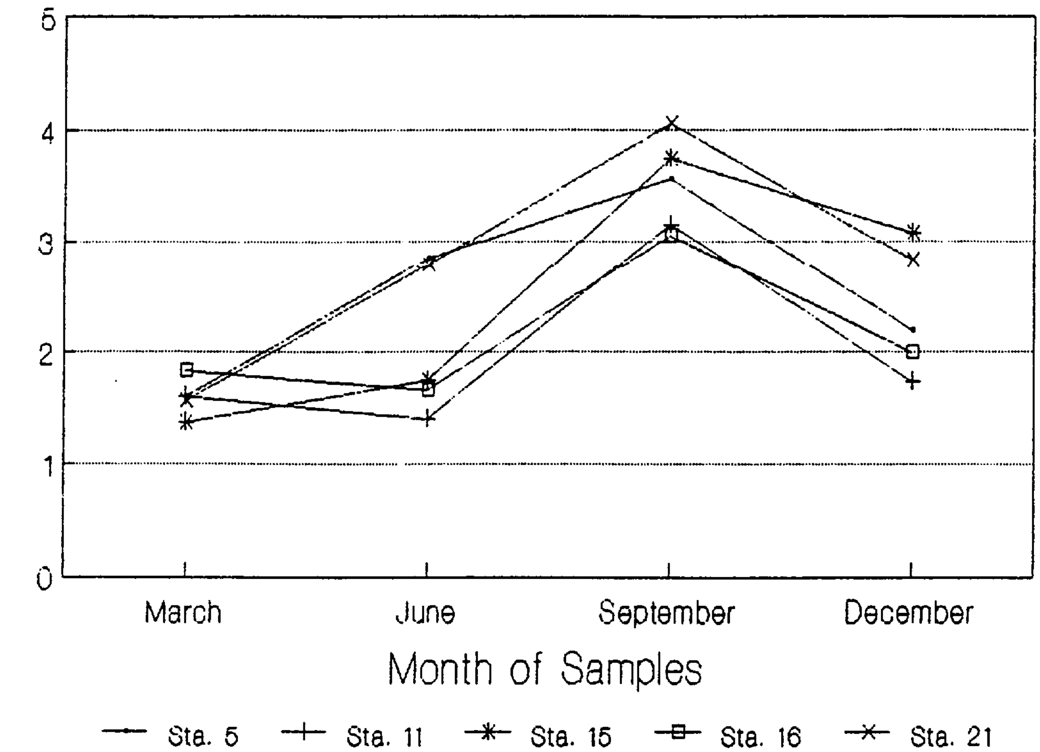
Margalef's (species) Richness Index quantifies the ratio that exists between the number of individuals and the number of taxa in a given sample. Shannon's Heterogeneity Index considers both the number of individuals and taxa, is sensitive to differing numbers of individuals and taxa (although the ratio of the numbers may be the same), and reflects the way individuals are distributed among the taxa.

Phytoplankton community diversity, as illustrated by both indices, increased sharply between June and September and began to decline toward the end of the year (Figures 2 and 3). The March samples exhibited the lowest and most tightly clustered richness and heterogeneity indices.

Zooplankton. Zooplankton sample data are given in Table 6. Again there was the usual but minor (compared to phytoplankton) variations for the different seasons. By both numbers or taxa and organisms, rotifers dominated all samples, except in June, but the specific taxa which were dominant changed during the year. Generally the abundance of each taxon varied with the seasons. *Kellicottia bostoniensis* was more numerous in 1994 than in 1993, appearing only in the March and December samples. *Platyias patulus* was present at only one station in March and all stations in September. *Brachionus*

Dardanelle Phytoplankton

Margalef's Richness Index



Shannon Heterogeneity Index

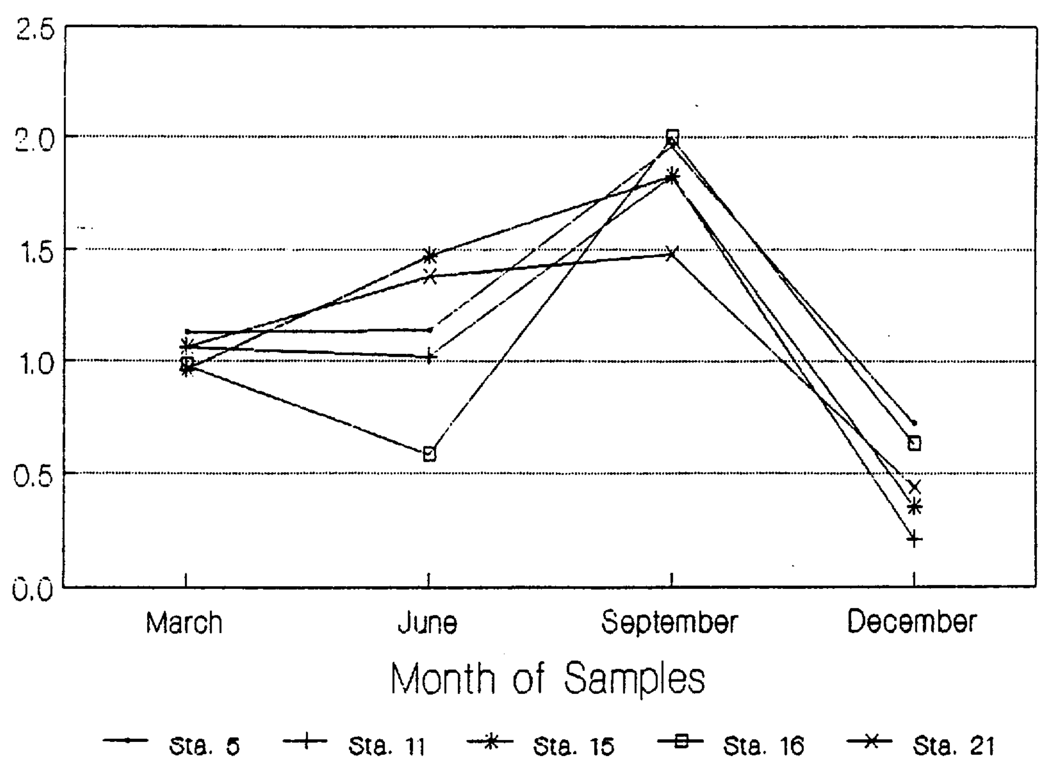


Table 6. Zooplankton collected in Dardanelle Reservoir during

Taxa	Station No.- 22 Mar 94					Station No.- 4 Jun 94				
	05	11	15	16	21	05	11	15	16	21
Asplanchna sp.	2.4	1.6	2.1	1.1	2.2	0.2				
Bosmina longirostris	17	36	28	20	25	4.8	12	13	5.8	6.2
Brachionus angularis	1.6	9.2	7.2	9.4	6.4					
B. bidentata										
B. calyciflorus	20	36	8.0	46	18	2.2	3.1	1.6	1.0	1.5
Ceriodaphnia lacustris								0.4		0.7
C. quadrangula							0.4	1.2	1.0	
Chaoborus								0.4		
Chironomidae				0.3		0.2				
Conchilus colony						0.2	1.5	0.4		2.5
Cyclops sp.	7.2	15	9.7	9.7	8.6	3.8	22	26	6.2	72
Daphnia sp.		2.4	1.7	1.1	0.3	5.4	17	20	8.8	19
Diaphanosoma sp.						1.8	22	8.4	6.2	2.5
Diaptomus sp.		1.2	2.1	0.7	1.9	0.8	1.2	1.2		0.7
Difflugia sp.	0.4	1.2	1.7	0.4	1.6	1.0	3.4	5.6	1.4	2.8
eggs	17	24	17	19	15	6.2	22	29	8.8	13
Filinia sp.	2.0	3.2	2.5	1.5	1.9	3.2	1.2	0.4	1.7	0.7
Hexarthra sp.	2.0	2.0	2.1	1.5	2.2	3.8	11	5.6	5.5	3.2
Kellicottia bostoniensis	0.8	1.2			1.3					
Keratella cochlearis	9.6	20	9.2	12	11	3.6	13	12	4.8	16
Leptodora kindti						0.6			1.7	
Moina									0.7	
nauplii	38	42	28	68	29	55	152	141	116	273
Notholca sp.		0.4	0.4	0.4						
Ostracoda			0.8	0.4		0.4			0.3	
Platyias patulus				0.4						
Polyarthra sp.	10	8.8	8.8	11	5.5	6.8	11	9.2	10	10
Tardigrada				0.3						
Testudinella sp.	6.0			9.0		4.8	10	5.2	6.8	7.2
Trichocera sp.				0.4						0.4
Trochosphaera					1.6					
Turbellaria stalked eggcase										
Vorticella		0.4			0.3					
Unid. insects		0.4								
Unid. protozoa										
Unid. rotifers						3.4	8.0	7.2	3.4	6.8
Totals	134	205	129	213	132	108	311	288	190	438

1994. Numbers are organisms per liter.

Taxa	Station No.- 10 Sep 94					Station No.- 20 Dec 94				
	05	11	15	16	21	05	11	15	16	21
Asplanchna sp.	6.8	2.3	6.9	7.6	15	0.2			0.4	
Bosmina longirostris	0.4	1.8	0.4			0.8		0.2	0.2	0.4
Brachionus angularis		1.0			1.6					
B. bidentata	0.2									
B. calyciflorus	91	109	52	87	73	6.4	2.2	4.5	3.0	2.0
Ceriodaphnia lacustris										
C. quadrangula		0.4	0.8		1.8		0.2			
Chaoborus										
Chironomidae										
Conchilus colony					0.2		0.2			
Cyclops sp.	1.5	1.2	4.2	0.2	1.4					0.2
Daphnia sp.			0.2		0.4					
Diaphanosoma sp.	0.2		1.7	0.5	0.4					
Diaptomus sp.		0.2	0.2						0.2	
Difflugia sp.	5.7	1.4	0.4	4.3	1.2	0.4	0.2	0.2	0.6	0.4
eggs	19	31	16	26	27	1.0	1.7	1.7	1.0	4.0
Filinia sp.			0.2	0.2	0.6					
Hexarthra sp.	1.1	0.6	0.2	0.9	0.4			0.5		0.4
Kellicottia bostoniensis						0.6	1.5	0.9	0.2	1.2
Keratella cochlearis	1.8	7.0	2.1	5.3	4.8	1.2	3.2	6.0	1.6	6.0
Leptodora kindti										
Moina										
nauplii	9.0	16	38	9.5	13	0.8	0.5	0.5	1.4	1.0
Notholca										
Ostracoda										
Platyias patulus	0.8	1.2	2.1	0.9	1.2					
Polyarthra sp.	13	18	12	15	33	0.4	3.2	1.7	0.6	2.4
Tardigrada										
Testudinella sp.	9.5	8.2	16	11	18	0.6	0.5	0.7	0.8	0.6
Trichocera sp.	1.3	1.2	1.2	0.9	1.0			0.2		0.2
Trochosphaera sp.	6.4	1.7	8.8			3.7	5.8	11	9.6	3.9
Turbellaria stalked eggcase									0.2	
Vorticella							0.2			
Unid. insects										
Unid. protozoa	0.2	0.4	1.2	0.5						
Unid. rotifers	5.9	9.4	9.0	6.9	8.8	0.8	0.5	2.6	1.2	2.2
Totals	174	212	174	177	203	17	20	31	21	25

spp., *Keratella cochlearis*, and *Polyarthra* sp. were most abundant overall. Micro-crustaceans have rarely exhibited numerical dominance over rotifers, but this year, in June, they did. The giant cladoceran, *Leptodora kindti*, was collected in Dardanelle Reservoir for the first time at one station in 1993 (Rickett and Watson 1994a), but this year was taken at two stations and in greater abundance than last year.

The greater numerical stability of zooplankton (compared to phytoplankton) caused the P/Z ratios to dip below 1.0 for several samples during summer and autumn, meaning phytoplankton was considerably less abundant than zooplankton during this time (Table 7). P/Z ratios were calculated after removing the numbers of eggs from the total counts of zooplankton per sample. Overall, P/Z ratios in 1994 were considerably smaller than in 1993.

For all stations, species richness increased throughout the year (Figure 4). Heterogeneity remained fairly constant (Figure 5). Overall, the zooplankton community exhibited greater diversity but less temporal variation than the phytoplankton.

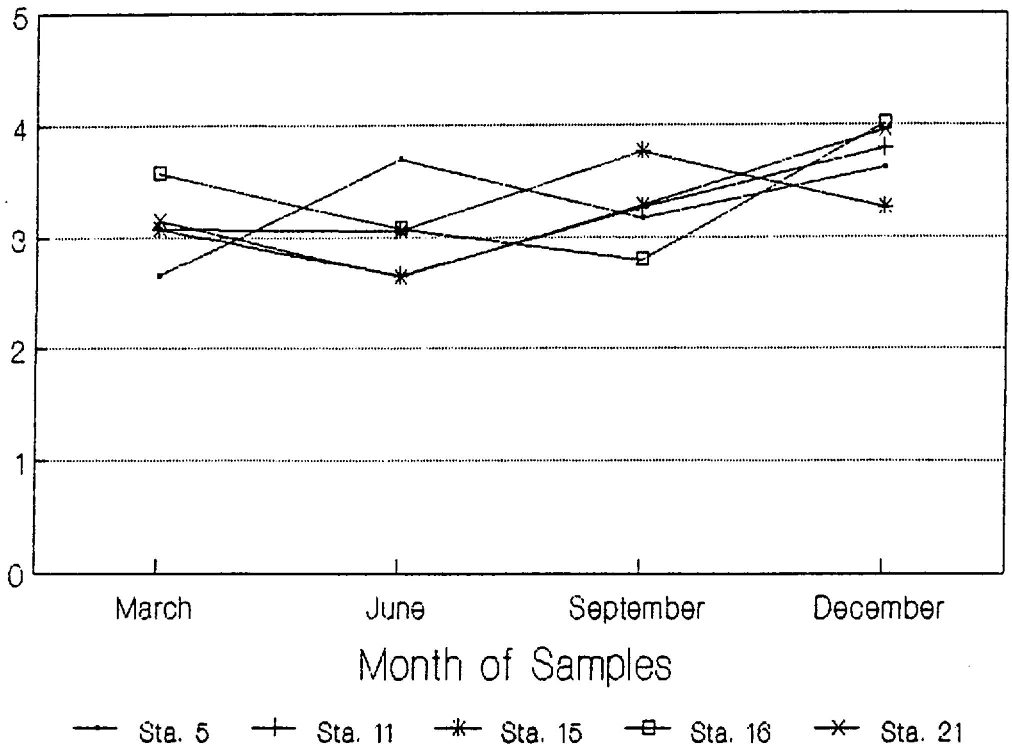
Table 7. Numerical phytoplankton/zooplankton (P/Z) ratios in Dardanelle Reservoir, 1994.

Sta. No.	Mar	Jun	Sep	Dec	Means
05	4.45	0.17	0.24	3.81	2.168
11	2.88	0.06	0.18	10.05	3.292
15	6.33	0.04	0.20	9.29	3.965
16	2.13	0.20	0.24	2.80	1.342
21	5.20	0.03	0.14	6.67	3.010
Means	4.20	0.10	0.20	6.52	

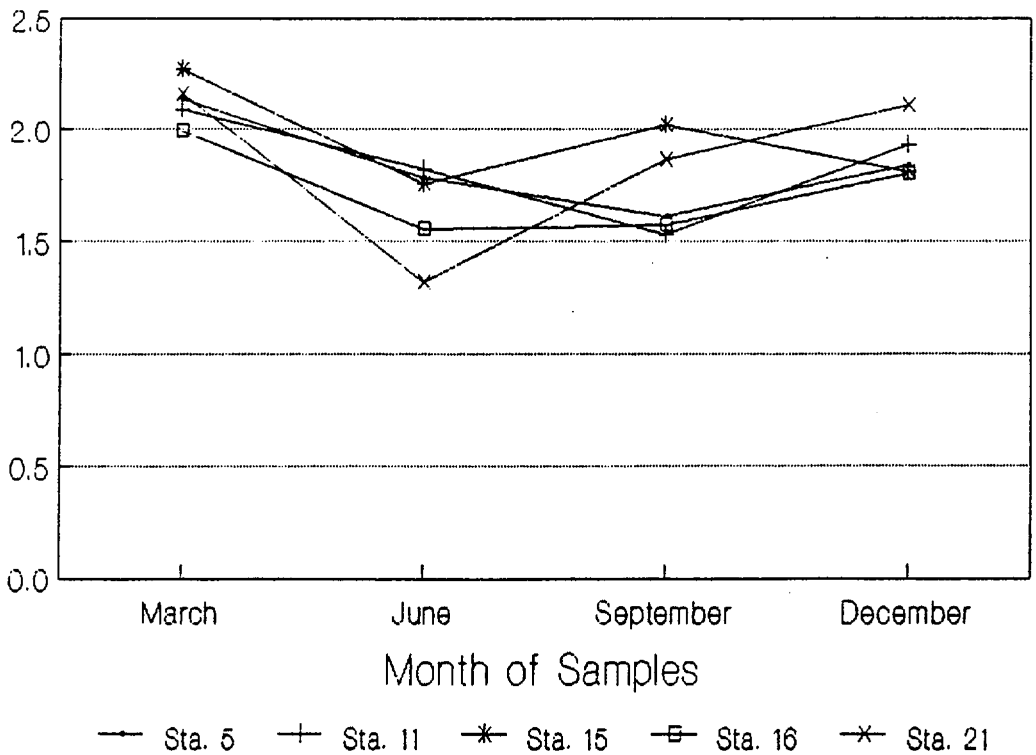
Benthos. Data from benthic macroinvertebrate collections are

Dardanelle Zooplankton

Margalef's Richness Index



Shannon Heterogeneity Index



given in Table 8. The number of taxa was larger by two than in 1993, whereas the total numbers of organisms was approximately equal. The December samples contained the largest total number of organisms, while the June samples contained the smallest total number. Most sample groups were co-dominated by Chironomidae and Oligochaeta, but dense clusters of *Hexagenia* and *Chaoborus* were also sampled. Fingernail clams (Spheriidae) were slightly less numerous than in 1993 but are still showing evidence of a fairly strong comeback from several years ago. We collected *Corophium*, an estuarine amphipod recently added to the Dardanelle fauna (Rickett and Watson 1994b), at all stations but Sta. 5 and all sampling periods except September. Abundances of specific taxa varied considerably among the sampling stations and during the year. Station 16 generally exhibited the lowest numbers because of low substrate quality, and there was a slight decrease in abundance over 1993. *Urnatella*, was collected only at Sta. 16 during all sampling periods except June in 1994. In recent years it has been collect usually during spring and summer sampling.

Benthic species richness and heterogeneity of individual samples varied widely among the stations and sampling times, but overall remained quite stable (Figures 6 and 7).

Thermal Dispersal. Surface temperatures at Sta. 05 (discharge bay) were approximately 7 to 11°F warmer than at Sta. 16 (intake). Differences were greater during December as they have been in years previous to 1992. Temperatures at Sta. 16 (Illinois Bayou section) showed greater than usual differences compared to Sta. 11, 15, and 21 (Arkansas River section). At the 12-foot depth there was little

Table 8. Benthic organisms collected in Dardanelle Reservoir in

Taxa	Station Number -- 22 Mar 94: 05		11		15		16		21	
Sample--	1	2	1	2	1	2	1	2	1	2
Chaoborus sp.	172	172	43		43	172			129	86
Chironomidae	301	301	172		688	517			215	172
Corbicula fluminea		43		86	43	129				
Corophium					43	43	43	43	86	
Gastropoda			129	344	43		43			86
Hexagenia sp.	517	172	517	172	689	646	86		646	1033
Oligochaeta	43	43	603	1076	258	258	129	86		86
Sialis	43									
Sphaeriidae	215	387		43	387	172			301	344
Trichoptera							43			
Turbellaria cocoon								43		
Urnatella								43		
Totals	**1291**	**1118**	**1464**	**1721**	**2194**	**1937**	**344**	**215**	**1377**	**1807**
depth (ft)	13		14		38		13		34	
bottom temp. (F)	58.6		57.2		56.7		58.6		57.2	
sediment chara.	soft,org. silt		sandy silt		soft,org. silt		hard gray clay		soft,org. silt	

Taxa	Station Number -- 4 Jun 94: 05		11		15		16		21	
Sample--	1	2	1	2	1	2	1	2	1	2
Chaoborus sp.	474	474	43							
Chironomidae	129	258	43	86	301	517	43	86	86	
Corbicula	43			172				43	86	43
Corophuim			258	172						
Dragonfly naiad			86	43	43					
Gastropoda			646	430			86	258		43
Heleidae										43
Hexagenia sp.	43	258	129	86	129	43				
Hydracarina								43		
Oligochaeta			560	517			86			43
Sphaeriidae				86	258	474	86			86
Trichoptera				43			43			
Totals	**689**	**990**	**1765**	**1635**	**731**	**1034**	**344**	**430**	**172**	**258**
depth (ft)	12		12		38		14		35	
bottom temp. (F)	78.6		78.6		75.4		78.8		78.4	
sediment chara.	soft,org. silt		sandy silt		soft,org. silt		hard gray clay		sandy,som silt	

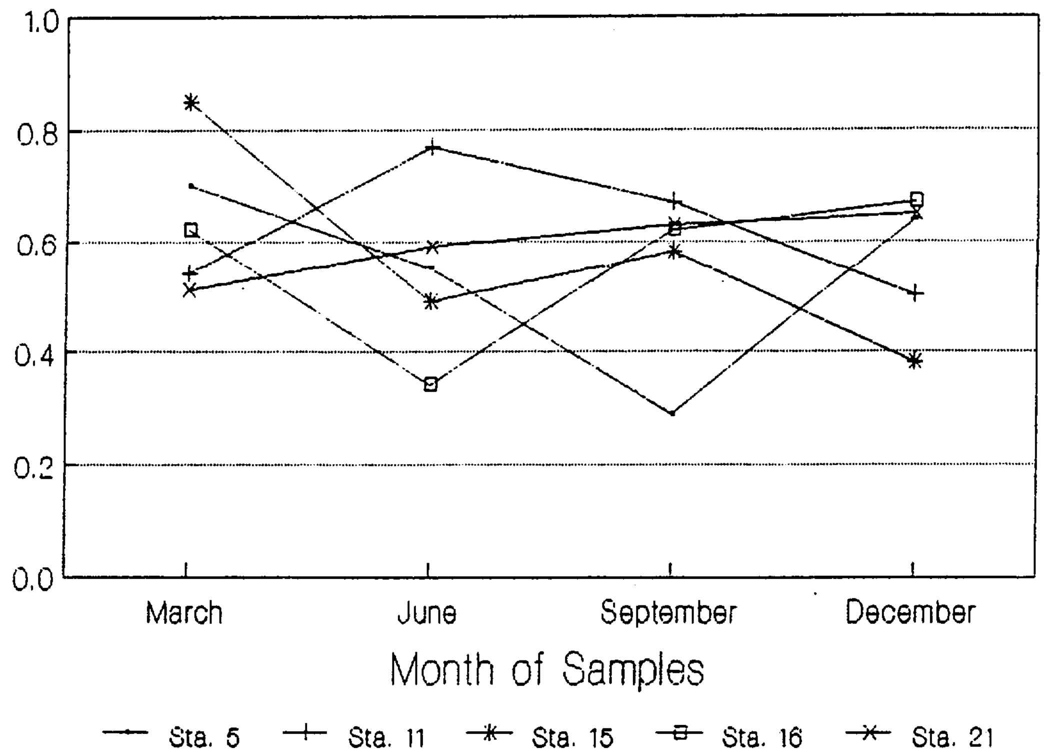
1994. Numbers are organisms per square meter.

Taxa / Sample--	05 1	05 2	11 1	11 2	15 1	15 2	16 1	16 2	21 1	21 2
	Station Number -- 10 Sep 94									
Chaoborus sp.	215	215	430	258	301	603	215	129	86	129
Chironomidae	689	775	301	646	86	517	172	172	215	388
Corbicula fluminea						43				
Gastropoda			43	86				43		
Hexagenia sp.			129	301		43			86	43
Nematoda				43					43	
Oligochaeta		43	904	344		301	172	129		86
Pectinatella statoblast					43					
Sialis		43								
Sphaeriidae				86	43	86			43	43
Trichoptera								129		
Urnatella							43	43		
Totals	904	1076	1807	1764	473	1593	602	645	473	689
depth (ft)	12		13		37		12		36	
bottom temp. (F)	82.8		81.5		80.8		82.6		80.6	
sediment chara.	soft,org. silt		sandy silt		soft,org. silt		hard gray clay		firmish org. silt	

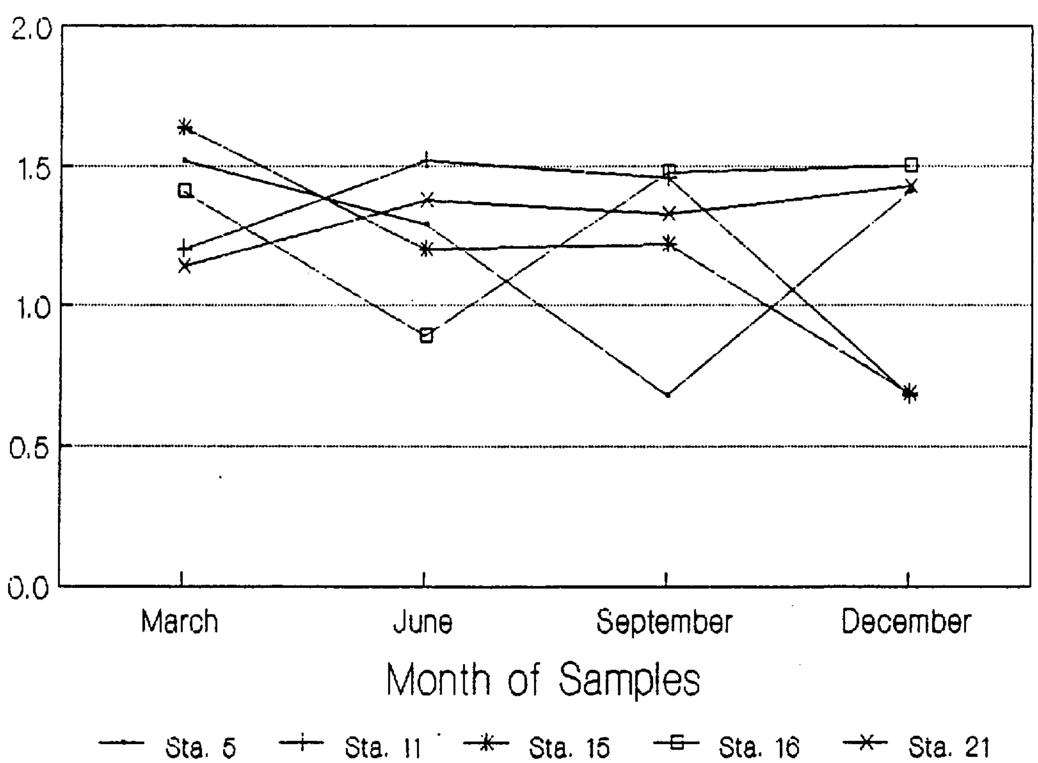
Taxa / Sample--	05 1	05 2	11 1	11 2	15 1	15 2	16 1	16 2	21 1	21 2
	Station Number -- 20 Dec 94									
Chaoborus sp.	904	861			1550	2239	301		172	215
Chironomidae	990	904	86	43	387	560	172	172	387	689
Corbicula			43	43				86		
Corophium			86	43						
Gastropoda		43								
Hexagenia sp.	86	215				43			129	129
Hydracarina		129	43					43	43	129
Oligochaeta	344	43	1550	474		129	430	258	129	86
Sphaeriidae	344	172			43	43		86	86	
Trichoptera							43			
Urnatella							86	86		
Totals	2668	2367	1808	603	1980	3014	1032	731	946	1248
depth (ft)	12		12		37		15		42	
bottom temp. (F)	48.2		46.4		46.6		46.8		46.4	
sediment chara.	soft,org. silt		sandy soft silt		soft,org. silt		hard gray clay		soft,org. silt	

Dardanelle Benthos

Margalef's Richness Index



Shannon Heterogeneity Index



temperature difference between Station 5 and elsewhere. Sta. 21 (upstream control) was most often the coolest by a small margin, probably because it was usually the first station sampled on our travel routine. When the wind blows from the southeast, warm surface water travels from Sta. 5 upstream toward (but not reaching) Sta. 21. If the wind comes from the northwest, warm water moves out into the reservoir and downstream toward Sta. 11. Our data indicated all significant thermal loading was dispersed before the discharge water reached Sta. 11. The highest temperature we recorded was 93.2°F in September while most of the rest of the reservoir was in the low 80s. We conclude thermal dispersal was adequate, and no area we sampled was hot enough to create a hazard to the biological community. We also conclude normal seasonal variations and innate differences between the Illinois Bayou and Arkansas River sections of the reservoir exceeded those caused by the operation of ANO.

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1994 ANNUAL REPORT: ENTERGY
LAKE DARDANELLE FISH AND ZEBRA MUSSEL STUDY

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Introduction

The Lake Dardanelle Fish Study is a cooperative effort by Entergy and Arkansas Tech University (ATU). Data for identification and enumeration of larval fish, identification and enumeration of fish impinged on the intake screens of Arkansas Nuclear One (ANO), determination of age and growth for adult sport fishes, and evaluation of population trends of the zebra mussel were collected by student assistants from ATU. Rotenone sampling involved ATU students and staff from Entergy, and was supervised by fisheries biologists from the Arkansas Game and Fish Commission (AGFC). Samples of fish collected during the rotenone sampling, by netting, by electrofishing, and by hook-and-line sampling were submitted for radiological analysis. The data were collected, compiled, and processed by student assistants under the supervision of Joe Stoeckel and Charlie Gagen at ATU. This report consists of the following sections: larval fish samples, impingement samples, age and growth determinations, zebra mussel samples, rotenone samples (AGFC report), and radiological samples. A brief explanation precedes a summary of data for each section. Arkansas Nuclear One is located on the peninsula between sampling area B (near water intake) and area C which receives heated water effluent (Figure 1).

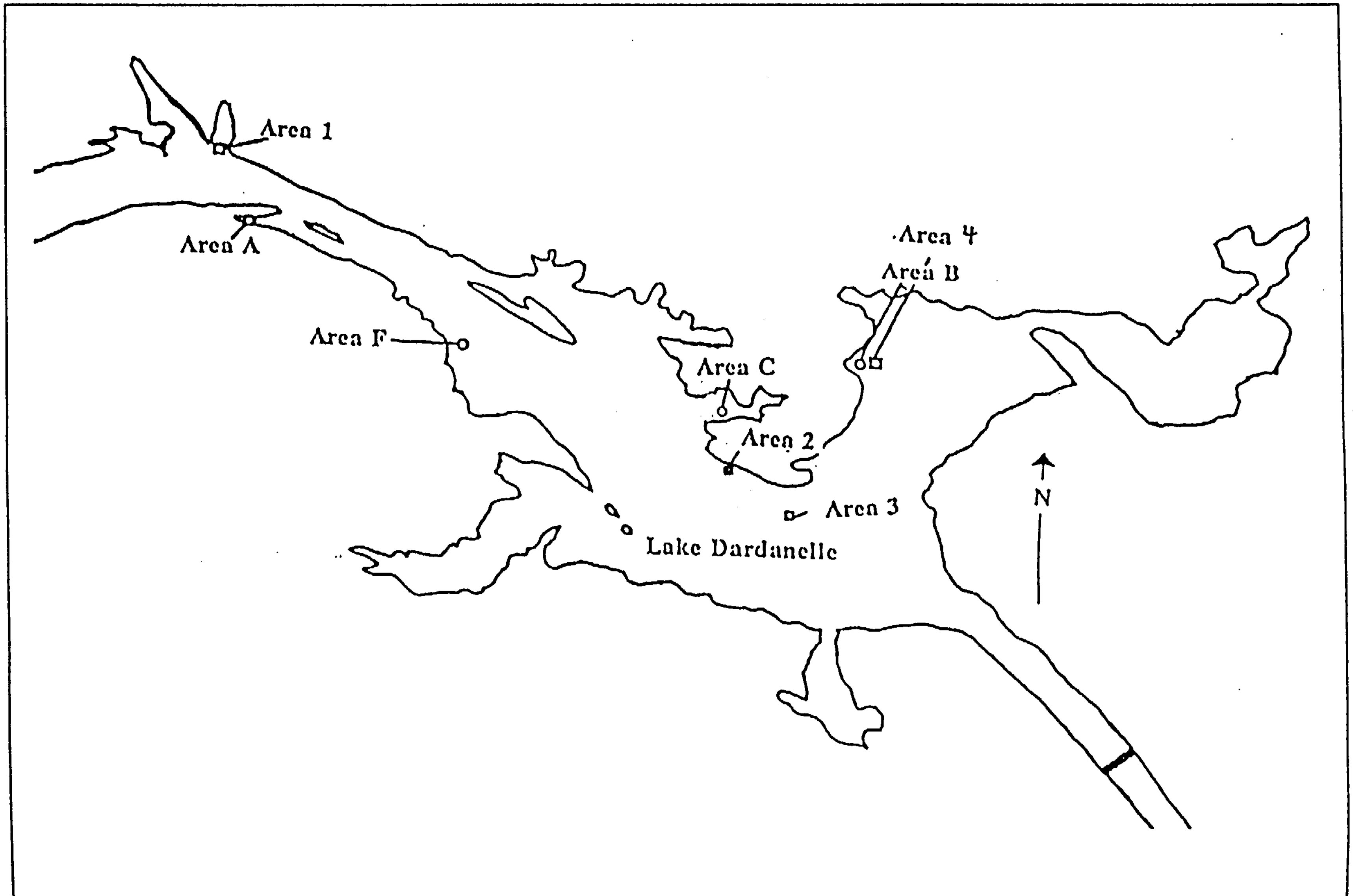


Figure 1. Sample locations on Lake Dardanelle. Larval fish sampling areas are designated by letters, and zebra mussel sampling areas are designated by numbers.

Larval fish samples

Larval fish collected with a meter net were used to determine trends in larval fish diversity and abundance at the following sites: Area A, Area B, Area C, and Area F (Figure 1). Samples were collected in two, five-minute meter-net trawls at each site from 22 March to 21 September, 1994. The larvae from each trawl were placed into a plastic container, labeled according to tow number, site, and date, and then preserved in five-percent formaldehyde. Dissolved oxygen and water temperature readings were also recorded at 20 and 80 percent of the water column depth at each site. Preserved larval fish samples were then taken to the ATU lab for identification and enumeration. The results of analyses of these data follow immediately, and begin with a description of abbreviations and units used in a series of tables which summarize meter-net data. The tables, which constitute the largest section of this report, include numbers and taxa of fish collected, and physical water quality data for each date and location sampled. The section ends with figures that show relationships among densities of larvae collected at each sample area and sample dates.

Summary of Meter Net Data

The following is a description of variables used in Table 1 to summarize data collected on each sample date at each site.

Date = mm/dd/yy

Areas: **A** = Panther Cove

B = Inlet Cove

C = Outlet Cove

F = South River Channel

Time of sample = **hh:mm**

Air temp. (C) = air temperature in degrees centigrade

Volume (m3) = cubic meters of water sampled (both tows combined)

Depth (feet) = depth of water column in feet at time of sample

H2O temp. (C): **20% D** = water temperature in degrees centigrade at 20% of water column depth

80% D = water temperature in degrees centigrade at 80% of water column depth

D.O. (mg/l): **20% D** = dissolved oxygen in milligrams per liter at 20% of water column depth

80% D = dissolved oxygen in milligrams per liter at 80% of water column depth

Taxon = taxonomic grouping of larval fish

Size Groups (mm) = number of larvae (both tows combined) in each taxon in four -millimeter size groups that range from 3 to 6 mm up to 30 to 33 mm

Total Number = total number of larvae (both tows combined) of all size groups in each taxon that ranged in total length from 3 to 33 mm

Tables 2 through 13 contain the number of larvae collected in each size group (all sample areas combined) on each sample date, by taxon. Tables 14 through 17 contain the number of larvae collected in each taxa (all size groups combined) on each sample date, by sample area. Table 18 contains the number of larvae collected in each taxa (all size groups and sample areas combined) on each sample data. Figure 2 compares the total catches of all taxa (including clupeids) and clupeids only among sample dates for all sample areas combined. Figures 3 through 6 compare the total catches of all taxa (including clupeids), clupeids only, and temperature among dates, by sample area.

Table 1. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
03/22/94	A	1810	24.4	528	15.0	16.5	16.0	11.4	9.0

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
03/22/94	B	1930	24.4	473	15.0	16.0	15.5	8.3	6.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
03/22/94	C	2020	24.4	369	11.0	23.0	21.0	10.4	8.1

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
03/22/94	F	1855	24.4	473	9.0	16.1	15.7	9.0	4.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
03/29/94	A	1830	12.8	492	16.0	13.9	13.3	10.5	10.3

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	1	0	0	0	0	0	0	0	0	1
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
03/29/94	B	2005	12.8	512	16.0	13.2	12.9	10.1	9.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
03/29/94	C	2040	12.8	485	10.0	21.1	16.3	10.7	8.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	1	0	0	0	0	0	0	0	0	0	1
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
03/29/94	F	1920	12.8	518	12.0	13.9	13.5	10.6	10.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/06/94	A	1900	7.8	526	16.0	14.2	14.2	11.0	10.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	5	0	0	0	0	0	0	0	0	5
Clupeidae	0	6	0	0	0	0	0	0	0	0	6
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/06/94	B	2000	7.8	590	9.0	13.6	13.8	11.4	10.2

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	1	0	0	0	0	0	0	0	0	1
Catostomidae	0	6	0	0	0	0	0	0	0	0	6
Clupeidae	0	0	2	0	0	0	0	0	0	0	2
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/06/94	C	2100	7.8	493	16.0	13.9	14.1	10.1	10.6

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	3	0	0	0	0	0	0	0	0	3
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/06/94	F	2200	7.8	550	12.0	21.9	21.9	11.6	10.9

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/12/94	A	1904	27.7	516	15.0	16.4	16.2	10.0	10.8

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	8	13	0	0	0	0	0	0	0	21
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/12/94	B	2007	27.7	535	11.0	16.9	16.1	10.9	10.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/12/94	C	2035	27.7	472	10.0	18.7	17.1	9.9	9.6

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	2	1	0	0	0	0	0	0	0	0	3
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/12/94	F	2007	27.7	535	11.0	16.9	16.1	10.9	10.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	6	1	0	0	0	0	0	0	0	7
Clupeidae	0	12	7	0	0	0	0	0	0	0	19
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	1	0	0	0	0	0	0	0	0	1
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D		
04/19/94	A	1945	29.4	550	15.0	17.9	17.5	10.0	10.5		
	Size Groups (mm)										Total
Taxon	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	1	1	0	0	0	0	0	0	0	2
Clupeidae	0	0	3	0	0	0	0	0	0	0	3
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D		
04/19/94	B	2120	29.4	528	15.0	19.6	16.6	13.6	9.5		
	Size Groups (mm)										Total
Taxon	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	1	0	0	0	0	0	0	0	0	1
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D		
04/19/94	C	2205	29.4	518	10.0	26.2	17.6	10.9	10.2		
	Size Groups (mm)										Total
Taxon	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	1	0	1	0	0	0	0	0	0	0	2
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	1	0	0	0	0	0	0	1
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D		
04/19/94	F	2040	29.4	542	10.0	18.5	17.5	10.8	10.7		
	Size Groups (mm)										Total
Taxon	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/27/94	A	2048	29.4	543	15.0	20.8	20.1	10.6	10.6

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	4	0	0	0	0	0	0	0	4
Clupeidae	0	2	6	0	0	0	0	0	0	0	8
Cyprinidae	0	0	1	0	0	0	0	0	0	0	1
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	1	0	0	0	0	0	0	1
Moronidae	0	0	5	6	0	0	0	0	0	0	11
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/27/94	B	2230	29.4	486	14.0	21.6	20.3	11.7	10.2

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	1	0	0	0	0	0	0	0	1
Clupeidae	0	3	6	0	0	0	0	0	0	0	9
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	1	0	0	0	0	0	0	0	1
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/27/94	C	2000	29.4	545	8.0	27.8	20.8	10.5	9.1

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	12	5	0	0	0	0	0	0	0	17
Clupeidae	0	0	2	0	0	0	0	0	0	0	2
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	1	0	0	0	0	0	0	1
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
04/27/94	F	2135	29.4	517	10.0	21.0	19.7	11.2	10.2

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	7	2	0	0	0	0	0	0	0	9
Clupeidae	0	5	0	0	0	0	0	0	0	0	5
Cyprinidae	0	2	2	0	0	0	0	0	0	0	4
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	1	2	0	0	0	0	0	0	3
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/03/94	A	2000	20.6	491	11.0	15.8	15.8	9.3	9.0

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	11	8	1	0	0	0	0	0	0	20
Clupeidae	0	9	11	4	0	0	0	0	0	0	24
Cyprinidae	0	1	0	0	0	0	0	0	0	0	1
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	10	13	8	0	0	0	0	0	0	31
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/03/94	B	2120	20.6	513	14.0	15.6	15.5	9.8	9.6

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	5	7	0	0	0	0	0	0	0	12
Clupeidae	0	2	10	0	0	0	0	0	0	0	12
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	4	7	5	0	0	0	0	0	0	16
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/03/94	C	2200	20.6	513	11.0	23.6	17.8	9.1	8.9

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	4	0	0	0	0	0	0	0	0	4
Clupeidae	0	1	2	0	0	0	0	0	0	0	3
Cyprinidae	0	0	1	0	0	0	0	0	0	0	1
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	7	0	0	0	0	0	0	0	0	7
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/03/94	F	2040	20.6	489	12.0	15.7	15.7	9.7	9.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	5	3	0	0	0	0	0	0	0	8
Clupeidae	0	2	3	0	0	0	0	0	0	0	5
Cyprinidae	0	0	0	3	0	0	0	0	0	0	3
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	3	0	0	0	0	0	0	0	3
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/10/94	A	2025	25.6	333	11.0	18.8	18.8	9.1	9.3

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	1	3	0	0	0	0	0	0	0	4
Clupeidae	0	1	10	7	0	0	0	0	0	0	18
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	4	4	5	2	0	0	0	0	0	15
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/10/94	B	2210	25.6	479	16.0	21.7	17.6	12.3	8.9

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	1	1	0	0	0	0	0	0	0	2
Clupeidae	1	8	15	3	0	0	0	0	0	0	27
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	1	0	0	0	0	0	0	0	1
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/10/94	C	2249	25.6	495	12.0	25.7	18.7	10.0	8.8

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	4	4	1	0	0	0	0	0	0	9
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	1	0	0	0	0	1
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	1	0	0	1
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/10/94	F	2105	25.6	487	12.0	18.7	18.5	9.0	9.0

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	1	0	0	0	0	0	0	0	1
Clupeidae	0	1	3	0	0	0	0	0	0	0	4
Cyprinidae	0	0	0	0	1	0	0	0	0	0	1
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	1	0	0	0	0	0	1
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/17/94	A	2210	27.8	481	15.0	21.4	21.4	8.8	8.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	2	0	0	0	0	0	0	0	0	2
Catostomidae	2	23	8	0	0	0	0	0	0	0	33
Clupeidae	2	4	5	0	0	0	0	0	0	0	11
Cyprinidae	2	13	1	0	0	0	0	0	0	0	16
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	3	1	0	0	0	0	0	4
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	2	1	0	0	0	0	0	0	3
Percidae	0	0	0	1	0	0	0	0	0	0	1
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/17/94	B	2055	27.8	521	16.0	23.3	32.1	9.0	9.1

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	1	4	0	0	0	0	0	0	0	0	5
Clupeidae	13	31	6	4	1	0	0	0	0	0	55
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	2	1	0	0	0	0	0	3
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/17/94	C	2345	27.8	535	11.0	28.4	21.2	9.4	8.0

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	1	0	0	0	0	0	0	0	1
Catostomidae	0	4	1	0	0	0	0	0	0	0	5
Clupeidae	5	14	7	1	0	0	0	0	0	0	27
Cyprinidae	0	2	0	0	0	0	0	0	0	0	2
Ictaluridae	0	0	0	1	1	0	0	0	0	0	2
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	5	3	0	0	0	0	0	8
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	2	0	0	0	0	0	0	0	2

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/17/94	F	2130	27.8	477	9.0	21.2	21.1	8.7	8.8

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	2	0	0	0	0	0	0	0	0	2
Clupeidae	1	3	2	1	0	0	0	0	0	0	7
Cyprinidae	0	2	0	0	0	0	0	0	0	0	2
Ictaluridae	0	1	0	0	0	0	0	0	0	0	1
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	1	3	1	0	0	0	0	0	5
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	1	0	0	0	0	0	0	0	0	1

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/26/94	A	2031	24.4	500	16.0	23.9	23.5	6.6	6.0

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	2	45	38	5	0	0	0	0	0	0	90
Clupeidae	12	124	959	274	32	4	0	0	0	0	1405
Cyprinidae	1	6	12	0	0	0	1	0	0	0	20
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	3	0	0	0	0	0	0	3
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	2	2	5	7	2	2	1	0	0	21
Percidae	0	0	0	1	0	0	0	0	0	0	1
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	1	4	1	0	0	0	0	0	0	0	6

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/26/94	B	2220	24.4	758	16.0	24.9	25.1	7.4	7.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	1	0	0	0	0	0	0	0	0	0	1
Catostomidae	0	5	1	0	0	0	0	0	0	0	6
Clupeidae	8	217	601	218	32	3	0	0	0	0	1079
Cyprinidae	0	0	1	0	0	0	0	0	0	0	1
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	1	13	1	0	0	0	0	0	0	15
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	3	5	0	0	0	0	0	0	8
Sciaenidae	10	8	1	0	0	0	0	0	0	0	19

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/26/94	C	2300	24.4	494	12.0	30.4	28.6	6.3	6.2

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	3	0	1	1	0	1	1	7
Catostomidae	0	1	1	0	0	0	0	0	0	0	2
Clupeidae	0	31	74	60	8	2	2	1	1	0	179
Cyprinidae	0	0	0	1	0	0	0	0	0	0	1
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	1	0	0	0	0	1
Micropterus	0	0	0	0	1	0	0	0	0	0	1
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	4	0	0	0	0	0	0	0	0	0	4

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
05/26/94	F	2135	24.4	457	9.0	24.9	24.9	7.6	7.8

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	2	12	0	0	0	0	0	0	0	14
Clupeidae	0	1	0	3	2	0	0	0	0	0	6
Cyprinidae	0	1	0	0	0	0	0	0	0	0	1
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	2	1	0	0	1	0	0	0	4
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/01/94	A	2325	30.0	495	10.0	28.2	25.6	9.5	7.9

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	1	0	0	0	0	0	0	0	1
Catostomidae	0	66	114	11	2	0	0	0	0	0	193
Clupeidae	0	35	161	85	30	4	1	0	0	0	316
Cyprinidae	0	0	1	2	0	0	0	0	0	0	3
Ictaluridae	0	0	1	1	0	0	0	0	0	0	2
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	3	1	0	4	3	3	0	0	14
Moronidae	0	1	2	5	3	1	0	0	0	0	12
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	4	5	0	0	0	0	0	1	10
Sciaenidae	0	51	130	27	8	0	0	0	0	0	216

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/01/94	B	2145	30.0	486	17.0	27.5	24.2	10.5	8.1

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	1	0	0	0	0	0	0	1
Catostomidae	0	42	20	0	0	0	0	0	0	0	62
Clupeidae	0	6	116	46	24	1	1	0	0	0	194
Cyprinidae	0	3	1	0	0	0	0	0	0	0	4
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	1	1	1	2	0	0	0	0	5
Micropterus	0	0	0	0	2	0	0	0	0	0	2
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	2	57	50	3	0	0	0	0	0	0	112

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/01/94	C	2115	30.0	499	11.0	32.1	26.5	9.5	7.2

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	12	1	0	0	0	0	0	0	0	13
Clupeidae	0	4	55	37	27	7	2	3	1	1	137
Cyprinidae	0	0	0	1	0	0	1	0	0	0	2
Ictaluridae	0	0	0	0	0	0	1	0	0	0	1
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	1	1
Moronidae	0	0	4	1	0	0	0	0	0	0	5
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	3	115	237	26	0	0	0	0	0	0	381

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/01/94	F	2255	30.0	470	11.0	26.8	26.2	9.8	9.4

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	16	9	1	0	0	0	0	0	0	26
Clupeidae	0	9	75	46	25	16	0	0	0	0	171
Cyprinidae	0	0	0	0	0	0	1	0	0	0	1
Ictaluridae	0	0	1	0	0	0	0	0	0	0	1
Lepomis	0	0	5	4	6	0	0	0	0	0	15
Micropterus	0	0	6	56	6	2	3	0	1	0	74
Moronidae	0	0	5	11	0	0	0	0	0	0	16
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	1	21	56	3	0	0	0	0	0	81
Sciaenidae	5	68	49	2	3	0	0	0	0	0	127

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/08/94	A	2100	30.0	464	12.0	28.5	27.8	8.3	6.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	1	0	1	0	0	0	0	0	2
Catostomidae	0	1	22	16	5	0	0	0	0	0	44
Clupeidae	0	9	110	133	102	12	5	3	1	0	375
Cyprinidae	0	0	8	7	1	0	0	0	0	0	16
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	7	1	0	0	0	0	0	0	8
Micropterus	0	0	3	0	1	1	0	2	0	0	7
Moronidae	0	0	7	2	0	0	0	0	0	0	9
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	5	0	0	0	0	0	0	0	5
Sciaenidae	4	13	17	11	7	0	0	0	0	0	52

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/08/94	B	2220	30.0	442	13.0	28.5	28.5	7.9	7.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	2	7	0	0	0	0	0	0	0	9
Clupeidae	0	21	87	162	44	11	3	0	0	0	328
Cyprinidae	0	0	2	0	0	0	0	0	0	0	2
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	1	1	1	0	1	0	4
Moronidae	0	0	1	3	2	0	0	0	0	0	6
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	1	0	0	0	0	0	0	1
Sciaenidae	1	35	155	128	46	22	0	0	0	0	387

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/08/94	C	2250	30.0	585	9.0	34.2	28.1	7.8	6.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	2	0	0	0	0	0	2
Catostomidae	0	0	3	2	0	0	0	0	0	0	5
Clupeidae	12	26	108	91	37	10	17	7	11	6	325
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	1	1	4	0	0	0	0	0	6
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	1	2	0	0	0	0	0	3
Sciaenidae	20	67	165	104	40	1	0	0	0	0	397

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/08/94	F	2145	30.0	419	10.0	28.3	28.3	7.3	7.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	1	2	0	1	0	4
Catostomidae	0	0	2	11	0	0	0	0	0	0	13
Clupeidae	4	29	186	183	62	36	12	1	0	0	513
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	1	4	3	1	0	0	0	9
Moronidae	0	0	0	4	1	1	0	0	0	0	6
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	3	1	0	0	0	0	4
Sciaenidae	3	41	97	63	6	1	1	0	0	0	212

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/14/94	A	2100	32.0	490	15.0	29.0	27.1	10.4	5.9

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	1	0	0	1	0	2	0	0	4
Catostomidae	0	2	2	0	0	0	0	0	0	0	4
Clupeidae	8	7	43	13	20	33	18	4	5	0	151
Cyprinidae	0	0	1	2	7	4	0	0	0	0	14
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	3	1	0	1	0	0	0	0	5
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	1	0	2	3
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	2	0	0	0	0	1	0	1	4
Sciaenidae	0	0	18	9	6	12	1	0	0	0	46

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/14/94	B	2210	32.0	495	15.0	28.2	28.2	9.1	9.0

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	1	0	0	0	0	0	0	0	0	1
Catostomidae	0	1	0	0	0	0	0	0	0	0	1
Clupeidae	0	2	19	21	36	25	12	4	1	0	120
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	1	0	0	0	0	0	0	1
Lepomis	0	0	1	1	0	0	0	0	0	0	2
Micropterus	0	0	0	0	0	0	2	0	0	0	2
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	7	44	85	18	11	1	0	0	1	0	167

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/14/94	C	2240	32.0	492	9.0	34.4	32.0	8.7	8.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	1	0	1	0	0	0	0	2
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	3	10	33	27	24	19	48	43	207
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	1	0	0	0	0	0	0	1
Moronidae	0	0	0	0	0	1	1	0	0	0	2
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	2	0	0	0	0	0	0	0	2
Sciaenidae	2	6	14	16	11	2	1	3	2	1	58

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/14/94	F	2137	32.0	488	10.0	28.6	28.3	7.8	6.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	1	0	0	1	0	0	0	0	2
Clupeidae	0	0	20	40	100	42	5	0	1	0	208
Cyprinidae	0	0	0	3	0	0	8	0	1	0	12
Ictaluridae	0	0	0	2	6	0	0	0	0	0	8
Lepomis	0	0	0	0	1	1	0	0	0	0	2
Micropterus	0	0	0	0	3	4	6	1	2	0	16
Moronidae	0	0	0	0	1	0	0	0	0	0	1
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	1	0	0	0	0	0	1
Sciaenidae	0	20	114	87	26	19	11	5	0	0	282

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/22/94	A	2105	26.0	469	11.0	32.3	30.1	9.1	5.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	4	3	0	0	0	0	7
Catostomidae	0	1	9	2	0	2	0	0	0	0	14
Clupeidae	0	0	137	357	98	15	14	5	6	1	633
Cyprinidae	0	0	2	8	18	6	2	0	0	0	36
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	1	0	0	0	0	0	0	0	1
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	3	0	0	0	0	0	0	0	3
Sciaenidae	0	3	6	1	0	0	0	0	0	0	10

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/22/94	B	2245	26.0	460	13.0	30.6	29.0	11.6	5.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	7	29	41	23	4	3	0	0	1	108
Cyprinidae	0	1	0	0	0	0	0	0	0	0	1
Ictaluridae	0	0	0	0	1	0	0	0	0	0	1
Lepomis	0	0	1	2	1	0	0	0	0	0	4
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	5	2	1	0	0	0	0	0	0	8

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/22/94	C	2335	26.0	478	11.0	35.6	29.5	6.7	3.6

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	4	15	14	10	29	27	11	5	115
Cyprinidae	0	0	1	0	0	1	0	2	0	0	4
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	1	0	0	0	0	0	1
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	2	0	0	2
Sciaenidae	0	0	0	1	2	0	0	0	0	0	3

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/22/94	F	2150	26.0	437	10.0	31.0	29.9	9.1	7.0

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	2	0	0	0	0	1	0	1	0	4
Catostomidae	0	0	1	0	0	0	0	0	0	0	1
Clupeidae	0	2	44	44	4	0	1	0	0	0	95
Cyprinidae	0	0	0	0	1	3	3	2	0	0	9
Ictaluridae	0	0	0	2	9	0	0	0	0	0	11
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	1	0	1
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	1	0	0	0	0	0	0	1
Sciaenidae	0	0	0	1	0	0	0	0	0	0	1

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/28/94	A	2045	36.7	509	12.0	33.9	33.0	14.0	5.4

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	3	0	0	0	1	0	1	0	0	5
Catostomidae	0	12	2	3	0	0	0	0	0	0	17
Clupeidae	0	16	40	42	42	23	23	12	13	10	221
Cyprinidae	0	0	3	2	0	0	0	0	0	0	5
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	66	38	3	0	0	0	0	0	0	107
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	1	1	8	0	0	0	0	0	0	0	10
Sciaenidae	0	0	1	0	0	0	0	0	0	0	1

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/28/94	B	2230	36.7	429	14.0	32.3	30.2	13.9	5.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	1	0	0	1
Clupeidae	0	0	36	107	68	24	8	8	9	8	268
Cyprinidae	0	0	0	0	0	0	0	0	0	1	1
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	1	1
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	1	2	1	0	0	0	0	0	0	4

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/28/94	C	2305	36.7	445	11.0	37.1	30.9	7.4	5.8

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	2	1	0	0	0	0	0	0	0	3
Clupeidae	0	0	2	3	5	9	0	1	0	2	22
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	1	0	0	0	0	0	0	1
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	1	0	0	0	0	0	1
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
06/28/94	F	2125	36.7	453	11.0	32.7	30.7	10.3	6.3

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	1	0	0	0	0	0	0	0	1
Clupeidae	0	2	20	22	20	1	3	0	4	2	74
Cyprinidae	0	0	0	0	0	2	0	1	0	0	3
Ictaluridae	0	0	0	11	4	0	0	0	0	0	15
Lepomis	0	0	0	0	1	0	0	0	0	0	1
Micropterus	0	0	0	0	0	1	0	0	0	0	1
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	2	5	0	0	0	0	0	0	7

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
07/06/94	A	2023	32.7	323	14.0	32.5	32.4	9.6	8.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	2	0	0	0	0	0	0	0	0	2
Catostomidae	0	4	4	2	0	0	0	0	0	0	10
Clupeidae	0	0	0	18	4	15	17	12	4	0	70
Cyprinidae	0	0	0	1	0	2	1	0	0	0	4
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	13	14	0	0	0	0	0	0	0	27
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	18	44	5	0	0	0	0	0	0	67
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
07/06/94	B	2217	32.7	333	14.0	31.1	31.1	9.2	9.1

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	3	10	5	4	4	3	5	1	35
Cyprinidae	0	0	0	1	0	0	1	2	0	0	4
Ictaluridae	0	0	0	1	1	0	0	0	0	0	2
Lepomis	0	0	0	0	0	0	1	0	0	0	1
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	1	0	0	0	0	1
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
07/06/94	C	2300	32.7	311	10.0	37.2	33.7	8.3	6.8

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	1	0	0	0	0	0	0	0	0	1
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	1	2	1	3	3	2	0	0	0	12
Cyprinidae	0	0	0	0	0	1	2	1	0	0	4
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	1	0	0	0	0	0	0	1

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
07/06/94	F	2138	32.7	303	10.0	32.0	32.0	8.5	8.3

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	1	1	1	3
Catostomidae	0	2	1	0	0	0	1	1	0	0	5
Clupeidae	0	7	2	5	10	4	8	6	4	0	46
Cyprinidae	0	0	0	0	1	1	1	1	2	0	6
Ictaluridae	0	0	0	0	1	0	0	0	0	0	1
Lepomis	0	0	1	0	0	0	0	0	0	0	1
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	1	2	1	0	0	0	0	0	0	4
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
07/19/94	A	2110	33.3	338	12.0	32.1	29.0	10.2	3.3

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	2	1	0	0	0	0	3
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	3	98	369	98	105	25	38	9	2	747
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	1	0	0	0	0	0	0	1
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	2	3	0	0	0	0	0	0	0	5
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
07/19/94	B	2210	33.3	300	14.0	30.8	29.2	9.6	7.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	1	0	0	0	0	0	0	1
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	3	18	16	1	0	0	0	0	0	38
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
07/19/94	C	2240	33.3	319	9.0	35.7	33.6	7.9	7.3

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	2	3	1	4	0	1	2	2	15
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
07/19/94	F	2140	33.3	344	10.0	29.9	29.6	9.0	9.2

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	1	0	0	0	0	0	0	1
Catostomidae	0	0	0	0	0	1	0	0	1	0	2
Clupeidae	0	1	26	29	18	11	9	3	1	0	98
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	5	4	0	0	0	0	0	9
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	80% D	D.O. (mg/l) 20% D	80% D		
08/02/94	A	2040	30.0	324	15.0	30.0	28.9	14.6	11.8		
		Size Groups (mm)									Total
Taxon		3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Number
Atherinidae		0	0	0	0	0	0	0	0	0	0	0
Catostomidae		0	0	0	0	0	0	0	0	0	0	0
Clupeidae		0	1	34	27	11	3	1	0	0	0	77
Cyprinidae		0	0	0	0	0	0	0	0	0	0	0
Ictaluridae		0	0	0	0	0	0	0	0	0	0	0
Lepomis		0	0	0	0	0	0	0	0	0	0	0
Micropterus		0	0	0	0	0	0	0	0	0	0	0
Moronidae		0	0	0	0	0	0	0	0	0	0	0
Percidae		0	0	0	0	0	0	0	0	0	0	0
Pomoxis		0	0	0	0	0	0	0	0	0	0	0
Sciaenidae		0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	80% D	D.O. (mg/l) 20% D	80% D		
08/02/94	B	2145	30.0	355	14.0	30.5	30.4	16.1	16.1		
		Size Groups (mm)									Total
Taxon		3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Number
Atherinidae		0	0	0	0	0	1	0	0	0	0	1
Catostomidae		0	0	0	0	0	0	0	0	0	0	0
Clupeidae		0	0	13	15	5	1	0	0	0	0	34
Cyprinidae		0	0	0	0	0	0	0	0	0	0	0
Ictaluridae		0	0	0	0	0	0	0	0	0	0	0
Lepomis		0	0	0	0	0	0	0	0	0	0	0
Micropterus		0	0	0	0	0	0	0	0	0	0	0
Moronidae		0	0	0	0	0	0	0	0	0	0	0
Percidae		0	0	0	0	0	0	0	0	0	0	0
Pomoxis		0	0	0	0	0	0	0	0	0	0	0
Sciaenidae		0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	80% D	D.O. (mg/l) 20% D	80% D		
08/02/94	C	2220	30.0	310	10.0	35.5	29.7	13.8	5.4		
		Size Groups (mm)									Total
Taxon		3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Number
Atherinidae		0	0	0	0	0	0	0	0	0	1	1
Catostomidae		0	0	0	0	0	0	0	0	0	0	0
Clupeidae		0	0	2	6	3	1	0	0	1	0	13
Cyprinidae		0	0	0	0	0	0	0	0	0	0	0
Ictaluridae		0	0	0	0	0	0	0	0	0	0	0
Lepomis		0	0	0	0	0	0	0	0	0	0	0
Micropterus		0	0	0	0	0	0	0	0	0	0	0
Moronidae		0	0	0	0	0	0	0	0	0	0	0
Percidae		0	0	0	0	0	0	0	0	0	0	0
Pomoxis		0	0	0	0	0	0	0	0	0	0	0
Sciaenidae		0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	80% D	D.O. (mg/l) 20% D	80% D		
08/02/94	F	2115	30.0	395	11.0	30.7	29.6	15.8	14.3		
		Size Groups (mm)									Total
Taxon		3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Number
Atherinidae		0	0	0	0	0	0	0	0	0	2	2
Catostomidae		0	0	0	0	0	0	0	0	0	0	0
Clupeidae		0	0	38	46	8	2	0	0	0	0	94
Cyprinidae		0	0	0	0	0	0	0	0	0	0	0
Ictaluridae		0	0	0	0	0	0	0	0	0	0	0
Lepomis		0	0	0	0	0	0	0	0	0	0	0
Micropterus		0	0	0	0	0	0	0	0	0	0	0
Moronidae		0	0	0	0	0	0	0	0	0	0	0
Percidae		0	0	0	0	0	0	0	0	0	0	0
Pomoxis		0	0	0	0	0	0	0	0	0	0	0
Sciaenidae		0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
08/17/94	A	2015	30.6	320	11.0	31.0	28.9	10.7	6.8

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	4	1	11	6	0	1	0	0	0	23
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
08/17/94	B	2130	30.6	460	14.0	30.6	29.3	11.9	8.2

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	1	1	0	0	0	0	0	0	2
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
08/17/94	C	2150	30.6	332	10.0	35.8	30.8	9.6	5.7

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	2	0	0	0	0	0	0	0	0	2
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
08/17/94	F	2050	30.6	321	10.0	29.6	29.5	9.5	8.9

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	4	4	3	0	1	1	0	0	13
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
08/31/94	A	2040	28.3	381	15.0	30.6	30.0	14.9	13.6

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	3	8	8	2	0	2	0	2	25
Cyprinidae	0	0	0	0	1	1	0	2	0	0	4
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
08/31/94	B	2202	28.3	351	14.0	29.9	29.8	9.5	9.6

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
08/31/94	C	2235	28.3	288	10.0	35.6	34.6	13.2	11.2

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	2	0	0	0	0	0	0	0	0	2
Clupeidae	0	0	0	1	1	1	0	0	0	0	3
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	1	0	0	0	0	0	1
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
08/31/94	F	2125	28.3	393	11.0	30.9	29.8	14.9	11.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 1, continued. Number of larvae in each size group collected at each site on each date.

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
09/21/94	A	2035	27.0	426	15.0	26.7	26.3	8.3	6.0

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	1	0	0	1
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	1	0	3	1	0	0	1	0	6
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
09/21/94	B	2205	27.0	467	16.0	26.7	26.5	8.0	6.4

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	1	0	0	0	1
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
09/21/94	C	2245	27.0	514	13.0	32.5	27.5	7.4	4.9

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	2	0	0	0	1	3
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Date	Area	Time of sample	Air temp.(C)	Volume (m3)	Depth (feet)	H2O temp.(C) 20% D	H2O temp.(C) 80% D	D.O. (mg/l) 20% D	D.O. (mg/l) 80% D
09/21/94	F	2135	27.0	492	10.0	27.2	27.2	7.4	7.5

Taxon	Size Groups (mm) 3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total Number
Atherinidae	0	0	0	0	0	0	0	0	0	0	0
Catostomidae	0	0	0	0	0	0	0	0	0	0	0
Clupeidae	0	0	0	0	0	0	0	0	0	0	0
Cyprinidae	0	0	0	0	0	0	0	0	0	0	0
Ictaluridae	0	0	0	0	0	0	0	0	0	0	0
Lepomis	0	0	0	0	0	0	0	0	0	0	0
Micropterus	0	0	0	0	0	0	0	0	0	0	0
Moronidae	0	0	0	0	0	0	0	0	0	0	0
Percidae	0	0	0	0	0	0	0	0	0	0	0
Pomoxis	0	0	0	0	0	0	0	0	0	0	0
Sciaenidae	0	0	0	0	0	0	0	0	0	0	0

Table 2. Atherinidae larvae collected at all areas during 1994 meter net samples.

Date	Size Groups (mm) 0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	1	0	0	0	0	0	0	0	0	1
04/12/94	0	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	0	0	0	0	0	0	0	0	0	0	0
05/03/94	0	0	0	0	0	0	0	0	0	0	0	0
05/10/94	0	0	0	0	0	0	0	0	0	0	0	0
05/17/94	0	0	2	1	0	0	0	0	0	0	0	3
05/26/94	0	1	0	0	3	0	1	1	0	1	1	8
06/01/94	0	0	0	1	1	0	0	0	0	0	0	2
06/08/94	0	0	0	1	0	3	1	2	0	1	0	8
06/14/94	0	0	1	1	1	0	2	0	2	0	0	7
06/22/94	0	0	2	0	0	4	3	1	0	1	0	11
06/28/94	0	0	3	0	0	0	1	0	1	0	0	5
07/06/94	0	0	3	0	0	0	0	0	1	1	1	6
07/19/94	0	0	0	0	2	2	1	0	0	0	0	5
08/02/94	0	0	0	0	0	0	1	0	0	0	3	4
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	0	0	0	1	0	0	1

Table 3. Catostomidae larvae collected at all areas during 1994 meter net samples.

	Size Groups (mm)											
Date	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	1	0	0	0	0	0	0	0	0	0	1
04/06/94	0	0	14	0	0	0	0	0	0	0	0	14
04/12/94	0	2	7	1	0	0	0	0	0	0	0	10
04/19/94	0	0	1	1	0	0	0	0	0	0	0	2
04/27/94	0	0	19	12	0	0	0	0	0	0	0	31
05/03/94	0	0	25	18	1	0	0	0	0	0	0	44
05/10/94	0	0	2	5	0	0	0	0	0	0	0	7
05/17/94	0	3	33	9	0	0	0	0	0	0	0	45
05/26/94	0	2	53	52	5	0	0	0	0	0	0	112
06/01/94	0	0	136	144	12	2	0	0	0	0	0	294
06/08/94	0	0	3	34	29	5	0	0	0	0	0	71
06/14/94	0	0	3	3	0	0	1	0	0	0	0	7
06/22/94	0	0	1	10	2	0	2	0	0	0	0	15
06/28/94	0	0	14	4	3	0	0	0	1	0	0	22
07/06/94	0	0	6	5	2	0	0	1	1	0	0	15
07/19/94	0	0	0	0	0	0	1	0	0	1	0	2
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	2	0	0	0	0	0	0	0	0	2
09/21/94	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Clupeidae larvae collected at all areas during 1994 meter net samples.

	Size Groups (mm)											
Date	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	1	0	0	0	0	0	0	0	0	1
04/06/94	0	0	6	2	0	0	0	0	0	0	0	8
04/12/94	0	0	20	20	0	0	0	0	0	0	0	40
04/19/94	0	1	1	4	0	0	0	0	0	0	0	6
04/27/94	0	0	10	14	0	0	0	0	0	0	0	24
05/03/94	0	0	14	26	4	0	0	0	0	0	0	44
05/10/94	0	1	14	32	11	0	0	0	0	0	0	58
05/17/94	1	20	52	20	6	1	0	0	0	0	0	100
05/26/94	0	20	373	1634	555	74	9	2	1	1	0	2669
06/01/94	0	0	54	407	214	106	28	4	3	1	1	818
06/08/94	0	16	85	491	569	245	69	37	11	12	6	1541
06/14/94	0	8	9	85	84	189	127	59	27	55	43	686
06/22/94	0	0	9	214	457	139	29	47	32	17	7	951
06/28/94	0	0	18	98	174	135	57	34	21	26	22	585
07/06/94	0	0	8	7	34	22	26	31	21	13	1	163
07/19/94	0	0	7	144	417	118	120	34	42	12	4	898
08/02/94	0	0	1	87	94	27	7	1	0	1	0	218
08/17/94	0	0	4	6	16	9	0	2	1	0	0	38
08/31/94	0	0	0	3	9	9	3	0	2	0	2	28
09/21/94	0	0	0	1	0	3	3	1	0	1	1	10

Table 5. Cyprinidae larvae collected at all areas during 1994 meter net samples.

	Size Groups (mm)											
Date	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	0	2	3	0	0	0	0	0	0	0	5
05/03/94	0	0	1	1	3	0	0	0	0	0	0	5
05/10/94	0	0	0	0	0	1	0	0	0	0	0	1
05/17/94	0	2	17	1	0	0	0	0	0	0	0	20
05/26/94	0	1	7	13	1	0	0	1	0	0	0	23
06/01/94	0	0	3	2	3	0	0	2	0	0	0	10
06/08/94	0	0	0	10	7	1	0	0	0	0	0	18
06/14/94	0	0	0	1	5	7	4	8	0	1	0	26
06/22/94	0	0	1	3	8	19	10	5	4	0	0	50
06/28/94	0	0	0	3	2	0	2	0	1	0	1	9
07/06/94	0	0	0	0	2	1	4	5	4	2	0	18
07/19/94	0	0	0	0	0	0	0	0	0	0	0	0
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	2	0	0	0	0	0	0	0	0	2
08/31/94	0	0	0	0	0	1	1	0	2	0	0	4
09/21/94	0	0	0	0	0	0	0	0	0	0	0	0

Table 6. Ictaluridae larvae collected at all areas during 1994 meter net samples.

	Size Groups (mm)											
Date	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	0	0	0	0	0	0	0	0	0	0	0
05/03/94	0	0	0	0	0	0	0	0	0	0	0	0
05/10/94	0	0	0	0	0	0	0	0	0	0	0	0
05/17/94	0	0	1	0	1	1	0	0	0	0	0	3
05/26/94	0	0	0	0	0	0	0	0	0	0	0	0
06/01/94	0	0	0	2	1	0	0	1	0	0	0	4
06/08/94	0	0	0	0	0	0	0	0	0	0	0	0
06/14/94	0	0	0	0	3	6	0	0	0	0	0	9
06/22/94	0	0	0	0	2	10	0	0	0	0	0	12
06/28/94	0	0	0	0	11	4	0	0	0	0	0	15
07/06/94	0	0	0	0	1	2	0	0	0	0	0	3
07/19/94	0	0	0	0	6	4	0	0	0	0	0	10
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	0	0	0	0	0	0	0

Table 7. Lepomis larvae collected at all areas during 1994 meter net samples.

	Size Groups (mm)											
Date	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	0	0	0	0	0	0	0	0	0	0	0
05/03/94	0	0	0	0	0	0	0	0	0	0	0	0
05/10/94	0	0	0	0	0	0	0	0	0	0	0	0
05/17/94	0	0	0	0	3	1	0	0	0	0	0	4
05/26/94	0	0	0	0	3	0	1	0	0	0	0	4
06/01/94	0	0	0	6	5	7	2	0	0	0	0	20
06/08/94	0	0	0	7	1	0	0	0	0	0	0	8
06/14/94	0	0	0	4	2	1	2	0	0	0	0	9
06/22/94	0	0	0	1	2	2	0	0	0	0	0	5
06/28/94	0	0	0	0	0	1	0	0	0	0	0	1
07/06/94	0	0	13	15	0	0	0	1	0	0	0	29
07/19/94	0	0	0	0	0	0	0	0	0	0	0	0
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	0	0	0	0	0	0	0

Table 8. *Micropterus* larvae collected at all areas during 1994 meter net samples.

	Size Groups (mm)											
Date	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	0	0	1	0	0	0	0	0	0	1
04/27/94	0	0	0	0	1	0	0	0	0	0	0	1
05/03/94	0	0	0	0	0	0	0	0	0	0	0	0
05/10/94	0	0	0	0	0	0	0	0	0	0	0	0
05/17/94	0	0	0	0	0	0	0	0	0	0	0	0
05/26/94	0	0	0	0	0	1	0	0	0	0	0	1
06/01/94	0	0	0	9	57	8	6	6	3	1	1	91
06/08/94	0	0	0	4	2	10	5	2	2	1	0	26
06/14/94	0	0	0	0	1	3	4	8	1	2	0	19
06/22/94	0	0	0	0	0	0	0	0	0	1	0	1
06/28/94	0	0	0	0	0	0	1	0	0	0	1	2
07/06/94	0	0	0	0	0	0	0	0	0	0	0	0
07/19/94	0	0	0	0	0	0	0	0	0	0	0	0
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	0	0	0	0	0	0	0

Table 9. Moronidae larvae collected at all areas during 1994 meter net samples.

	Size Groups (mm)											
Date	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	0	0	7	9	0	0	0	0	0	0	16
05/03/94	0	0	21	23	13	0	0	0	0	0	0	57
05/10/94	0	0	4	5	5	3	1	0	0	0	0	18
05/17/94	0	0	0	3	11	5	0	0	0	0	0	19
05/26/94	0	0	3	17	7	7	2	3	1	0	0	40
06/01/94	0	0	1	11	17	3	1	0	0	0	0	33
06/08/94	0	0	0	8	9	3	1	0	0	0	0	21
06/14/94	0	0	0	0	0	1	1	1	1	0	2	6
06/22/94	0	0	0	1	0	0	0	0	0	0	0	1
06/28/94	0	0	66	38	4	0	0	0	0	0	0	108
07/06/94	0	0	0	0	0	0	0	0	0	0	0	0
07/19/94	0	0	0	0	0	0	0	0	0	0	0	0
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	0	0	0	0	0	0	0

Table 10. Percidae larvae collected at all areas during 1994 meter net samples.

Date	Size Groups (mm) 0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	0	1	0	0	0	0	0	0	0	0	1
04/19/94	0	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	0	0	0	0	0	0	0	0	0	0	0
05/03/94	0	0	0	0	0	0	0	0	0	0	0	0
05/10/94	0	0	0	0	0	0	0	0	0	0	0	0
05/17/94	0	0	0	0	1	0	0	0	0	0	0	1
05/26/94	0	0	0	0	1	0	0	0	0	0	0	1
06/01/94	0	0	0	0	0	0	0	0	0	0	0	0
06/08/94	0	0	0	0	0	0	0	0	0	0	0	0
06/14/94	0	0	0	0	0	0	0	0	0	0	0	0
06/22/94	0	0	0	0	0	0	0	0	0	0	0	0
06/28/94	0	0	0	0	0	0	0	0	0	0	0	0
07/06/94	0	0	0	0	0	0	0	0	0	0	0	0
07/19/94	0	0	0	0	0	0	0	0	0	0	0	0
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	0	0	0	0	0	0	0

Table 11. Pomoxis larvae collected at all areas during 1994 meter net samples.

Date	Size Groups (mm) 0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	0	0	0	0	0	0	0	0	0	0	0
05/03/94	0	0	0	0	0	0	0	0	0	0	0	0
05/10/94	0	0	0	0	0	0	0	0	1	0	0	1
05/17/94	0	0	0	0	0	0	0	0	0	0	0	0
05/26/94	0	0	0	3	5	0	0	0	0	0	0	8
06/01/94	0	0	1	25	61	3	0	0	0	0	1	91
06/08/94	0	0	0	5	2	5	1	0	0	0	0	13
06/14/94	0	0	0	4	0	1	0	0	1	0	1	7
06/22/94	0	0	0	3	1	0	0	0	2	0	0	6
06/28/94	0	1	1	8	0	1	0	0	0	0	0	11
07/06/94	0	0	19	46	6	0	1	0	0	0	0	72
07/19/94	0	0	2	3	0	0	0	0	0	0	0	5
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	1	0	0	0	0	0	1

Table 12. Sciaenidae larvae collected at all areas during 1994 meter net samples.

	Size Groups (mm)											
Date	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24	24-27	27-30	30-33	Total
03/29/94	0	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	0	0	0	0	0	0	0	0	0	0	0
05/03/94	0	0	0	0	0	0	0	0	0	0	0	0
05/10/94	0	0	0	0	0	0	0	0	0	0	0	0
05/17/94	0	0	1	2	0	0	0	0	0	0	0	3
05/26/94	0	15	12	2	0	0	0	0	0	0	0	29
06/01/94	0	10	291	466	58	11	0	0	0	0	0	836
06/08/94	0	28	156	434	306	99	24	1	0	0	0	1048
06/14/94	0	9	70	231	130	54	34	13	8	3	1	553
06/22/94	0	0	8	8	4	2	0	0	0	0	0	22
06/28/94	0	0	1	5	6	0	0	0	0	0	0	12
07/06/94	0	0	0	0	1	0	0	0	0	0	0	1
07/19/94	0	0	0	0	0	0	0	0	0	0	0	0
08/02/94	0	0	0	0	0	0	0	0	0	0	0	0
08/17/94	0	0	0	0	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	0	0	0	0	0	0	0

Table 13. Fish larvae collected from Panther Cove (Area A) during 1994 meter net samples.

Date	Atherinidae	Catostomidae	Clupeidae	Cyprinidae	Ictaluridae	Lepomis	Micropterus	Moronidae	Percidae	Pomoxis	Sciaenidae
03/22/94	0	0	0	0	0	0	0	0	0	0	0
03/29/94	0	0	1	0	0	0	0	0	0	0	0
04/06/94	0	5	6	0	0	0	0	0	0	0	0
04/12/94	0	0	21	0	0	0	0	0	0	0	0
04/19/94	0	2	3	0	0	0	0	0	0	0	0
04/27/94	0	4	8	1	0	0	1	11	0	0	0
05/03/94	0	20	24	1	0	0	0	31	0	0	0
05/10/94	0	4	18	0	0	0	0	15	0	0	0
05/17/94	2	33	11	16	0	4	0	3	1	0	0
05/26/94	0	90	1405	20	0	3	0	21	1	0	6
06/01/94	1	193	316	3	2	0	14	12	0	10	216
06/08/94	2	44	375	16	0	8	7	9	0	5	52
06/14/94	4	4	151	14	0	5	0	3	0	4	46
06/22/94	7	14	633	36	0	0	0	1	0	3	10
06/28/94	5	17	221	5	0	0	0	107	0	10	1
07/06/94	2	10	70	4	0	27	0	0	0	67	0
07/19/94	3	0	747	0	1	0	0	0	0	5	0
08/02/94	0	0	77	0	0	0	0	0	0	0	0
08/17/94	0	0	23	0	0	0	0	0	0	0	0
08/31/94	0	0	25	4	0	0	0	0	0	0	0
09/21/94	1	0	6	0	0	0	0	0	0	0	0

Table 14. Fish larvae collected from Inlet Cove (Area B) during 1994 meter net samples.

Date	Atherinidae	Catostomidae	Clupeidae	Cyprinidae	Ictaluridae	Lepomis	Micropterus	Moronidae	Percidae	Pomoxis	Sciaenidae
03/22/94	0	0	0	0	0	0	0	0	0	0	0
03/29/94	0	0	0	0	0	0	0	0	0	0	0
04/06/94	1	6	2	0	0	0	0	0	0	0	0
04/12/94	0	0	0	0	0	0	0	0	0	0	0
04/19/94	0	0	1	0	0	0	0	0	0	0	0
04/27/94	0	1	9	0	0	0	0	1	0	0	0
05/03/94	0	12	12	0	0	0	0	16	0	0	0
05/10/94	0	2	27	0	0	0	0	1	0	0	0
05/17/94	0	5	55	0	0	0	0	3	0	0	0
05/26/94	1	6	1079	1	0	0	0	15	0	8	19
06/01/94	1	62	194	4	0	5	2	0	0	0	112
06/08/94	0	9	328	2	0	0	4	6	0	1	387
06/14/94	1	1	120	0	1	2	2	0	0	0	167
06/22/94	0	0	108	1	1	4	0	0	0	0	8
06/28/94	0	1	268	1	0	0	1	0	0	0	4
07/06/94	0	0	35	4	2	1	0	0	0	1	0
07/19/94	1	0	38	0	0	0	0	0	0	0	0
08/02/94	1	0	34	0	0	0	0	0	0	0	0
08/17/94	0	0	2	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	1	0	0	0	0	0	0	0	0

Table 15. Fish larvae collected from Outlet Cove (Area C) during 1994 meter net samples.

Date	Atherinidae	Catostomidae	Clupeidae	Cyprinidae	Ictaluridae	Lepomis	Micropterus	Moronidae	Percidae	Pomoxis	Sciaenidae
03/22/94	0	0	0	0	0	0	0	0	0	0	0
03/29/94	0	1	0	0	0	0	0	0	0	0	0
04/06/94	0	3	0	0	0	0	0	0	0	0	0
04/12/94	0	3	0	0	0	0	0	0	0	0	0
04/19/94	0	0	2	0	0	0	1	0	0	0	0
04/27/94	0	17	2	0	0	0	0	1	0	0	0
05/03/94	0	4	3	1	0	0	0	7	0	0	0
05/10/94	0	0	9	0	0	0	0	1	0	1	0
05/17/94	1	5	27	2	2	0	0	8	0	0	2
05/26/94	7	2	179	1	0	1	1	0	0	0	4
06/01/94	0	13	137	2	1	0	1	5	0	0	381
06/08/94	2	5	325	0	0	0	6	0	0	3	397
06/14/94	2	0	207	0	0	0	1	2	0	2	58
06/22/94	0	0	115	4	0	1	0	0	0	2	3
06/28/94	0	3	22	0	0	0	0	1	0	1	0
07/06/94	1	0	12	4	0	0	0	0	0	0	1
07/19/94	0	0	15	0	0	0	0	0	0	0	0
08/02/94	1	0	13	0	0	0	0	0	0	0	0
08/17/94	0	0	0	2	0	0	0	0	0	0	0
08/31/94	0	2	3	0	0	0	0	0	0	1	0
09/21/94	0	0	3	0	0	0	0	0	0	0	0

Table 16 Fish larvae collected from South River Channel (Area F) during 1994 meter net samples.

Date	Atherinidae	Catostomidae	Clupeidae	Cyprinidae	Ictaluridae	Lepomis	Micropterus	Moronidae	Percidae	Pomoxis	Sciaenidae
03/22/94	0	0	0	0	0	0	0	0	0	0	0
03/29/94	0	0	0	0	0	0	0	0	0	0	0
04/06/94	0	0	0	0	0	0	0	0	0	0	0
04/12/94	0	7	19	0	0	0	0	0	1	0	0
04/19/94	0	0	0	0	0	0	0	0	0	0	0
04/27/94	0	9	5	4	0	0	0	3	0	0	0
05/03/94	0	8	5	3	0	0	0	3	0	0	0
05/10/94	0	1	4	1	0	0	0	1	0	0	0
05/17/94	0	2	7	2	1	0	0	5	0	0	1
05/26/94	0	14	6	1	0	0	0	4	0	0	0
06/01/94	0	26	171	1	1	15	74	16	0	81	127
06/08/94	4	13	513	0	0	0	9	6	0	4	212
06/14/94	0	2	208	12	8	2	16	1	0	1	282
06/22/94	4	1	95	9	11	0	1	0	0	1	1
06/28/94	0	1	74	3	15	1	1	0	0	0	7
07/06/94	3	5	46	6	1	1	0	0	0	4	0
07/19/94	1	2	98	0	9	0	0	0	0	0	0
08/02/94	2	0	94	0	0	0	0	0	0	0	0
08/17/94	0	0	13	0	0	0	0	0	0	0	0
08/31/94	0	0	0	0	0	0	0	0	0	0	0
09/21/94	0	0	0	0	0	0	0	0	0	0	0

Table 17. Fish larvae of each taxon collected on each sample date.

Date	Atherinidae	Catostomidae	Clupeidae	Cyprinidae	Ictaluridae	Lepomis	Micropterus	Moronidae	Percidae	Pomoxis	Sciaenidae
03/22/94	0	0	0	0	0	0	0	0	0	0	0
03/29/94	0	1	1	0	0	0	0	0	0	0	0
04/06/94	1	14	8	0	0	0	0	0	0	0	0
04/12/94	0	10	40	0	0	0	0	0	1	0	0
04/19/94	0	2	6	0	0	0	1	0	0	0	0
04/27/94	0	31	24	5	0	0	1	16	0	0	0
05/03/94	0	44	44	5	0	0	0	57	0	0	0
05/10/94	0	7	58	1	0	0	0	18	0	1	0
05/17/94	3	45	100	20	3	4	0	19	1	0	3
05/26/94	8	112	2669	23	0	4	1	40	1	8	29
06/01/94	2	294	818	10	4	20	91	33	0	91	836
06/08/94	8	71	1541	18	0	8	26	21	0	13	1048
06/14/94	7	7	686	26	9	9	19	6	0	7	553
06/22/94	11	15	951	50	12	5	1	1	0	6	22
06/28/94	5	22	585	9	15	1	2	108	0	11	12
07/06/94	6	15	163	18	3	29	0	0	0	72	1
07/19/94	5	2	898	0	10	0	0	0	0	5	0
08/02/94	4	0	218	0	0	0	0	0	0	0	0
08/17/94	0	0	38	2	0	0	0	0	0	0	0
08/31/94	0	2	28	4	0	0	0	0	0	1	0
09/21/94	1	0	10	0	0	0	0	0	0	0	0
Total	61	694	8886	191	56	80	142	319	3	215	2504

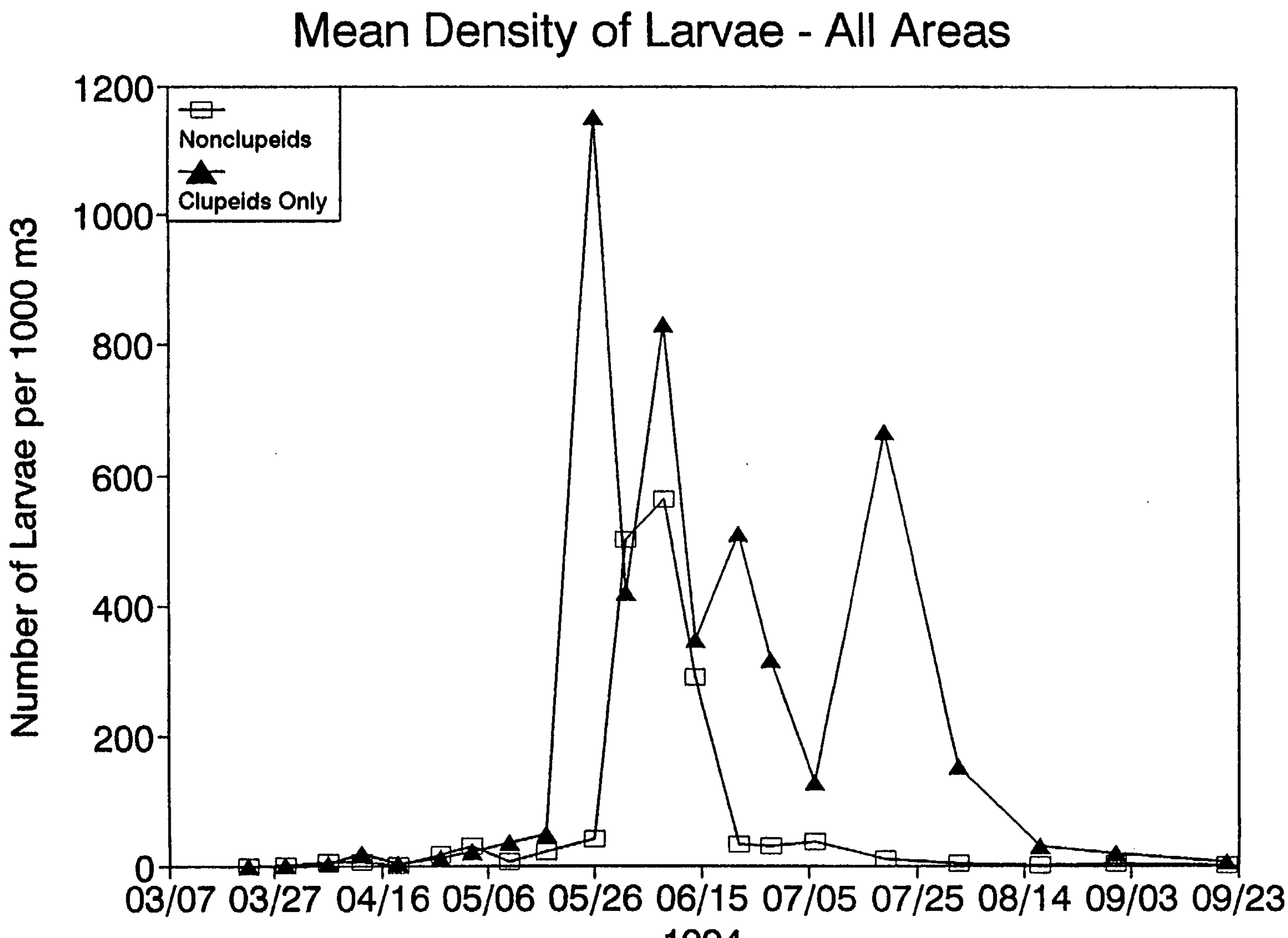


Figure 2. Density of fish larvae by date on Lake Dardanelle. All areas combined.

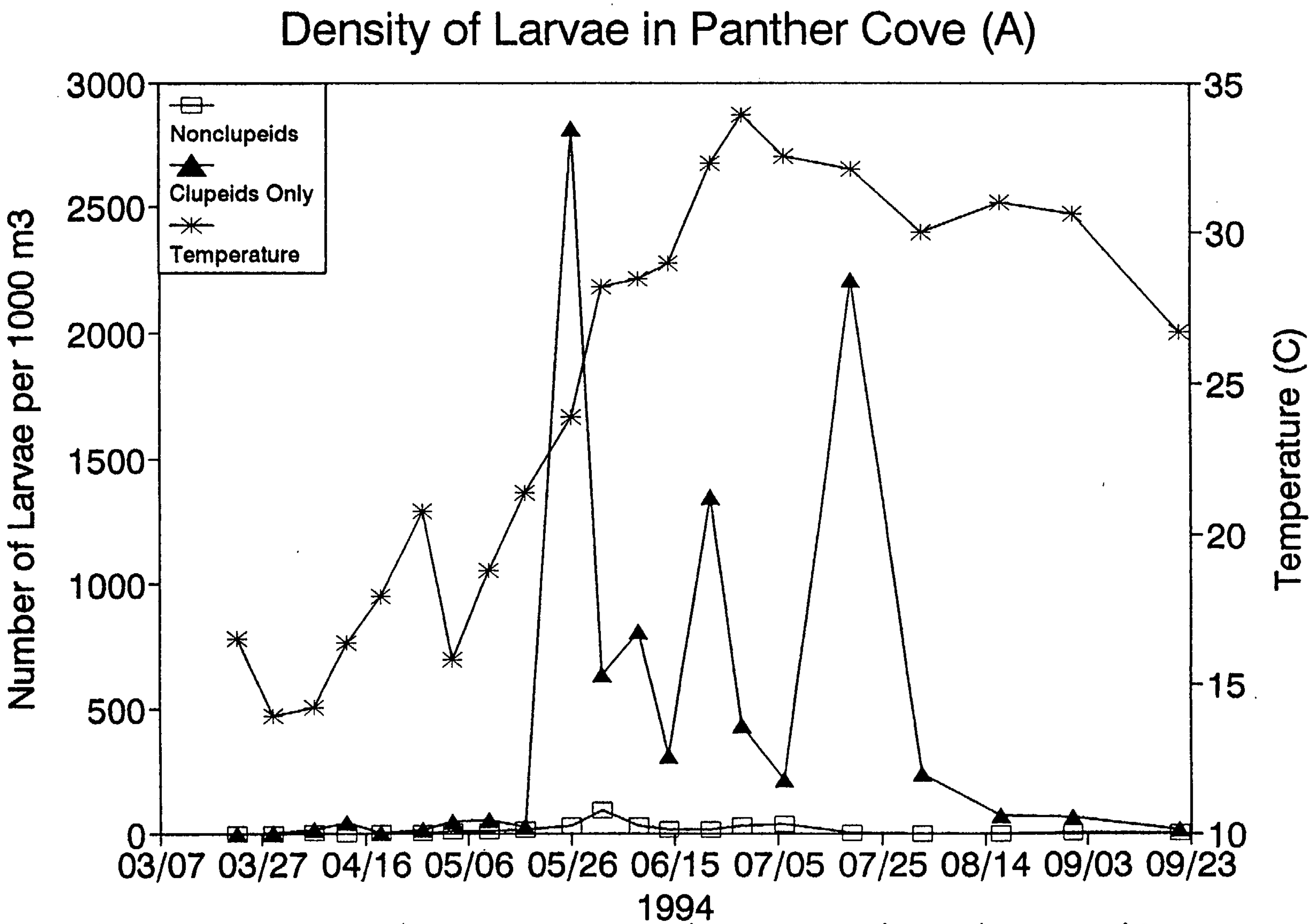


Figure 3. Density of larval clupeids only and all fish larvae (including clupeids) and water temperature from Panther Cove (Area A) during 1994 meter net samples.

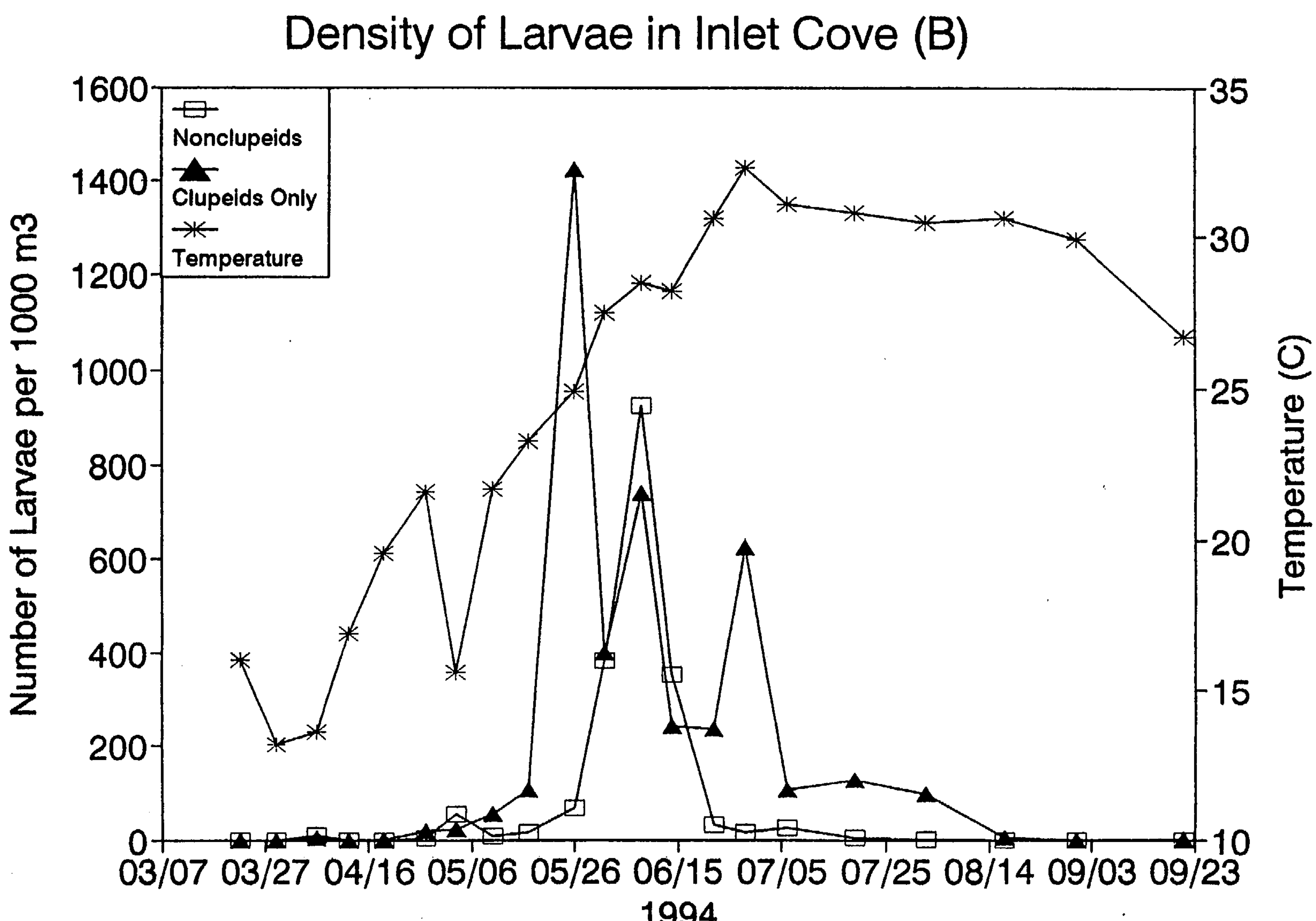


Figure 4. Density of larval clupeids only and all fish larvae (including clupeids) and water temperature from Inlet Cove (Area B) during 1994 meter net samples.

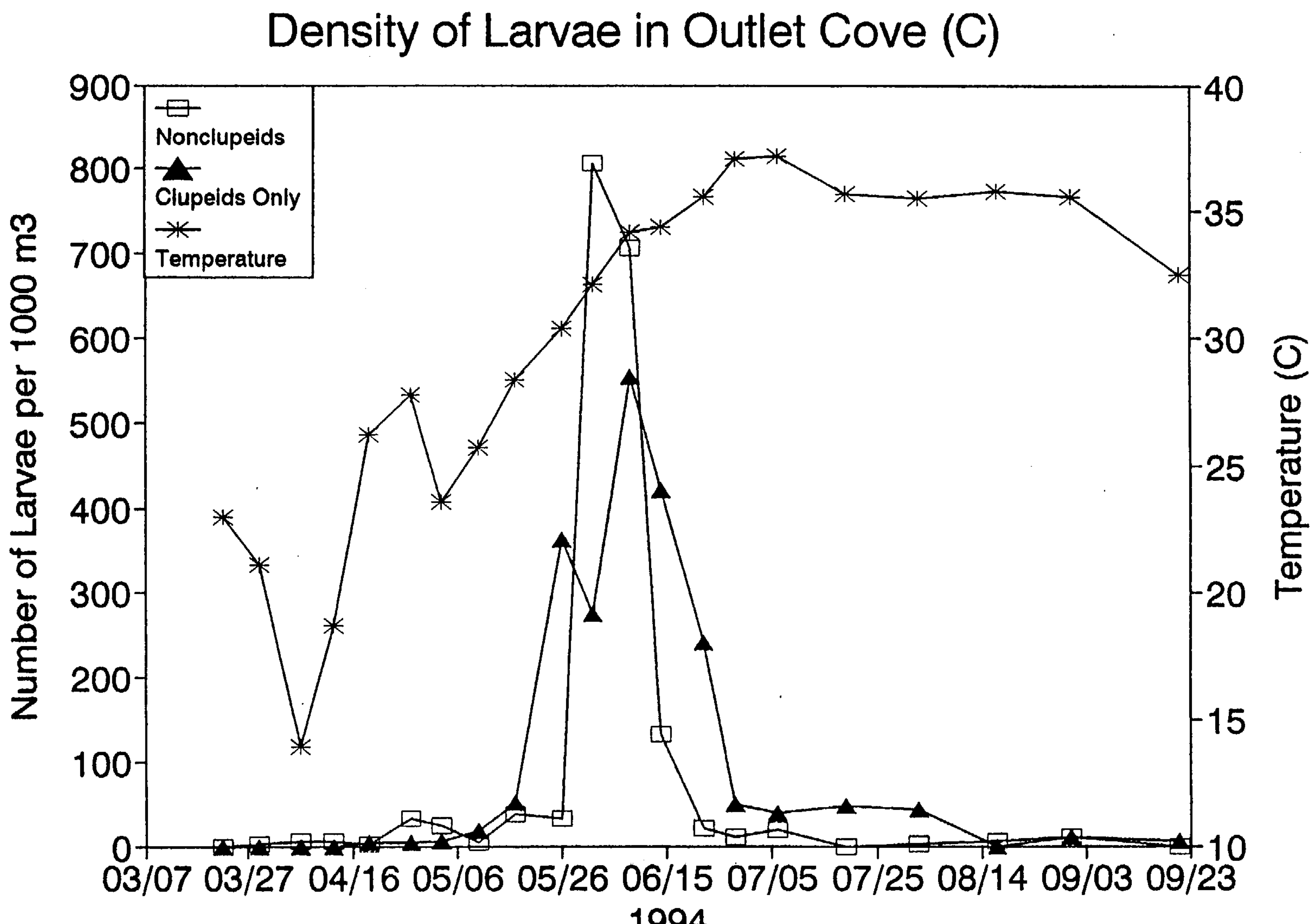


Figure 5. Density of larval clupeids only and all fish larvae (including clupeids) and water temperature from Outlet Cove (Area C) during 1994 meter net samples.

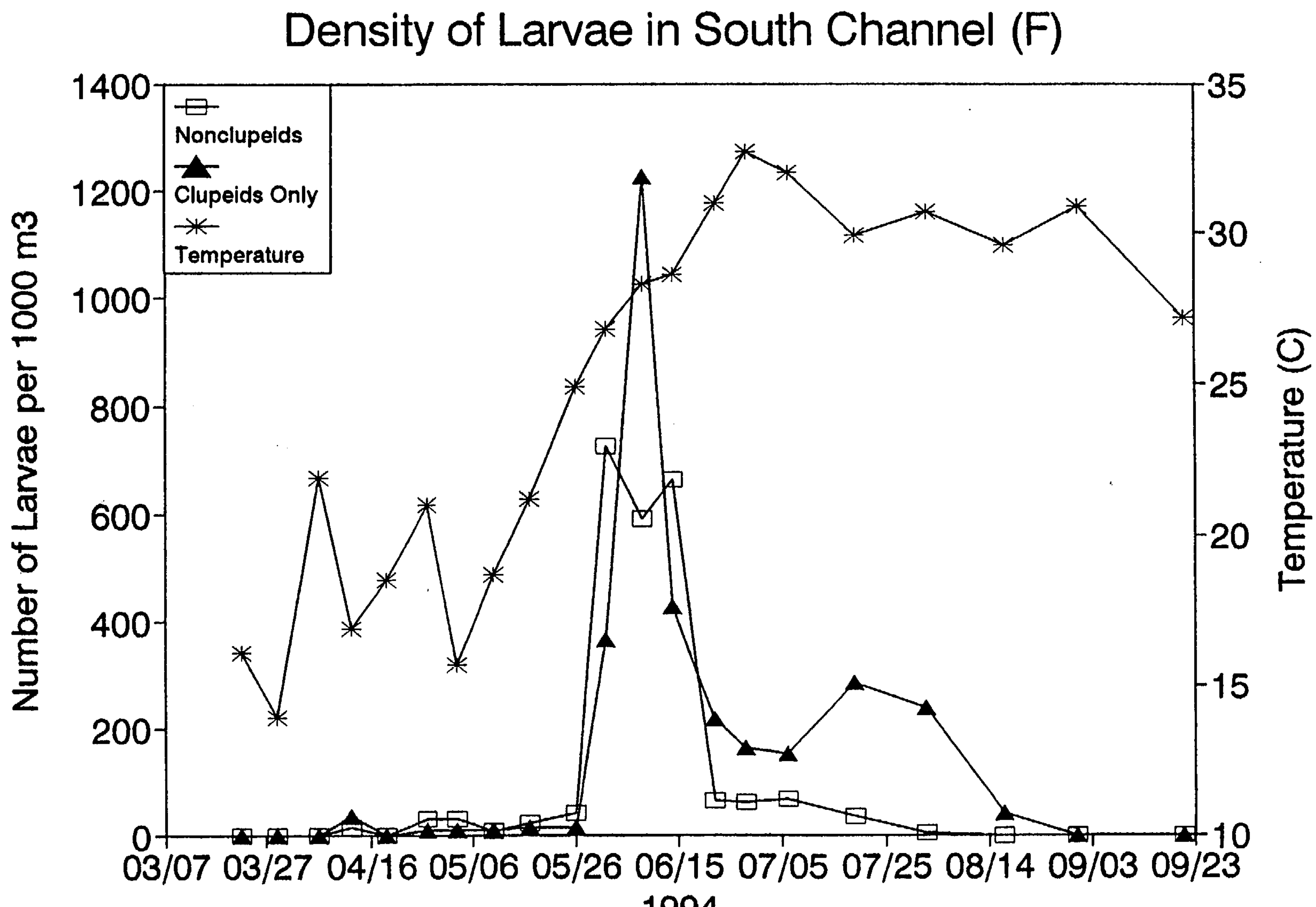


Figure 6. Density of larval clupeids only and all fish larvae (including clupeids) and water temperature from South River Channel (Area F) during 1994 meter net samples.

Impingement samples

Impingement samples were collected monthly from the intake of ANO. To collect impingement samples, screens on the intake were washed and then 24 hours later all impinged fish were identified and enumerated. Thus, each sample represents the number of fish impinged in a 24-hour period. When total weight of all impinged fish and trash exceeded 150 pounds, two 75-pound subsamples were taken and fish in each subsample were sorted and enumerated by species. Subsample information was used to extrapolate values to the entire sample. After fish were identified and enumerated, all individuals of each species were measured and weighed if the total number of individuals within a sample was less than 43; otherwise, 25 plus 1% of the total number of that species were measured and weighed. All sample processing was done on site. Time of sample, intake water temperature, number of circulation pumps in operation, number of screens washed, percent of all fish sampled, total weight of all fish impinged, and total number of all fish impinged are primary headings for each date in Tables 21 through 32. Secondary headings include the species found in each sample; and for each species, the number measured for lengths and weights, minimum and maximum lengths and weights, means and standard deviations of lengths and weights, total number of fish impinged, and total weight of fish impinged. The total number of fish impinged in the 12 monthly samples was 225,556, and the total weight impinged was 1,714 kg. Figure 7 compares numbers of fish of all species impinged and temperatures, among sample dates. Figure 8 compares numbers and weights of fish of all species impinged among sample dates. Figures 9 through 21 compare numbers and weights of individuals impinged among sample dates, by species, for species that occurred in four or more monthly samples.

Table 21. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, January 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
01/26/94	8:00	3.9	3	6	6.2	1034.5	141687

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
THREADFIN SHAD	84	6.8	14.6	9.3	1.6	3.0	28.0	7.1	4.9	125831	927.1
GIZZARD SHAD	61	7.7	11.2	9.3	0.7	4.0	10.0	6.1	1.2	15678	105.5
SKIPJACK HERRING	7	10.4	15.5	13.2	1.8	9.0	23.0	14.6	5.0	113	1.6
WHITE BASS	2	9.3	10.3	9.8	0.5	8.0	11.0	9.5	1.5	32	0.3
INLAND SILVERSIDE	2	6.7	10.0	8.4	1.7	1.0	4.0	2.5	1.5	32	0.1

141,686
99.99%

1034.6
99.7

Table 22. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, February 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
02/09/94	8:00	5.7	3	6	19.1	307.7	39310

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
THREADFIN SHAD	84	8.0	18.0	10.4	2.2	3.0	44.0	9.9	7.7	24409	192.1
GIZZARD SHAD	75	7.6	18.3	10.8	2.8	3.0	48.0	11.9	10.0	14718	113.4
SKIPJACK HERRING	17	11.7	19.7	14.6	1.8	9.0	45.0	18.1	8.1	89	1.6
FRESHWATER DRUM	7	4.7	11.2	8.2	2.4	1.0	11.0	5.6	3.8	37	0.2
BLUE CATFISH	7	6.5	10.0	7.7	1.1	1.0	5.0	2.4	1.3	37	0.1
INLAND SILVERSIDE	2	7.9	10.9	9.4	1.5	2.0	6.0	4.0	2.0	10	0.0
WHITE BASS	1	11.0	11.0	11.0	0.0	11.0	11.0	11.0	0.0	5	0.1
LONGEAR SUNFISH	1	11.0	11.0	11.0	0.0	24.0	24.0	24.0	0.0	5	0.1

Table 23. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, March 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
03/09/94	2:00	8.3	3	6	66.0	52.3	7338

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
GIZZARD SHAD	84	7.8	21.3	9.3	1.6	3.0	57.0	6.7	6.3	6859	46.4
THREADFIN SHAD	52	7.2	14.2	9.3	1.2	4.0	23.0	6.9	3.3	397	2.4
FRESHWATER DRUM	19	5.4	19.6	10.6	4.8	1.0	120.0	20.8	30.9	29	0.6
BLUEGILL SUNFISH	16	3.6	15.1	6.0	2.5	1.0	58.0	6.4	13.4	24	0.2
BLUE CATFISH	8	6.0	25.5	15.8	7.1	3.0	124.0	41.6	43.8	12	0.5
INLAND SILVERSIDE	4	7.6	11.0	9.0	1.3	2.0	5.0	3.3	1.3	6	0.0
CHANNEL CATFISH	2	25.3	34.9	30.1	4.8	72.0	331.0	201.5	129.5	3	0.6
WHITE BASS	2	10.3	11.2	10.8	0.4	11.0	12.0	11.5	0.5	3	0.0
SKIPJACK HERRING	1	11.6	11.6	11.6	0.0	9.0	9.0	9.0	0.0	2	0.0
RIVER CARPSUCKER	1	42.1	42.1	42.1	0.0	896.0	896.0	896.0	0.0	2	1.4
CHESTNUT LAMPRE	1	29.7	29.7	29.7	0.0	64.0	64.0	64.0	0.0	2	0.1

Table 24. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, April 1994.

Date	Time	Intake temp.(C)		No. of pumps operating		No. of screens washed		% of fish sampled		Total kg of fish		Total No. of fish
04/20/94	13:30	19.4		3		6		100.0		22.2		1924

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
FRESHWATER DRUM	31	5.5	14.2	10.8	2.0	1.0	24.0	12.6	5.9	558	5.5
GIZZARD SHAD	30	8.8	20.8	11.4	3.4	5.0	70.0	15.3	15.8	460	3.3
BLUEGILL SUNFISH	28	6.3	18.8	11.2	3.5	3.0	152.0	35.7	36.7	294	1.9
CHANNEL CATFISH	28	6.5	19.5	10.9	3.6	3.0	48.0	13.3	11.0	274	1.6
BLUE CATFISH	27	14.8	39.0	25.0	5.9	17.0	517.0	124.1	107.2	154	5.4
THREADFIN SHAD	27	8.5	17.4	9.8	1.6	2.0	29.0	7.3	4.6	169	2.8
EMERALD SHINER	3	7.0	8.0	7.6	0.4	4.0	6.0	5.3	0.9	3	0.0
LARGEMOUTH BASS	3	10.5	26.0	16.5	6.8	14.0	184.0	72.3	79.0	3	0.2
WHITE CRAPPIE	3	18.6	27.0	23.8	3.7	78.0	338.0	221.3	107.8	3	0.7
BLUNTNOSE MINNO	2	5.6	7.6	6.6	1.0	2.0	2.0	2.0	0.0	2	0.0
BLACK BULLHEAD	1	9.8	9.8	9.8	0.0	12.0	12.0	12.0	0.0	1	0.0
FLATHEAD CATFISH	1	9.6	9.6	9.6	0.0	7.0	7.0	7.0	0.0	1	0.0
RIVER CARPSUCKER	1	35.8	35.8	35.8	0.0	561.0	561.0	561.0	0.0	1	0.6
SPOTTED GAR	1	51.3	51.3	51.3	0.0	238.0	238.0	238.0	0.0	1	0.2

Table 25. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, May 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
05/18/94	9:00	20.7	4	8	100.0	46.0	5621

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
GIZZARD SHAD	42	8.4	11.6	9.8	0.8	4.0	12.0	6.8	1.8	2277	15.7
FRESHWATER DRUM	42	6.4	14.4	9.9	1.6	2.0	21.0	8.8	3.9	2193	18.8
CHANNEL CATFISH	34	5.8	21.5	8.3	2.6	1.0	58.0	6.1	9.3	866	4.9
THREADFIN SHAD	27	8.8	10.8	9.6	0.6	4.0	9.0	6.1	1.4	183	1.2
BLUE CATFISH	26	6.9	32.4	18.7	7.7	2.0	264.0	70.8	71.2	42	2.5
BLUEGILL SUNFISH	28	5.0	16.2	9.5	4.3	1.0	80.0	24.9	28.6	28	0.7
WHITE CRAPPIE	9	9.0	25.6	16.6	6.8	6.0	232.0	89.0	86.8	9	0.9
WHITE BASS	7	9.6	37.3	20.9	9.5	9.0	496.0	159.7	169.7	7	1.2
BROOK SILVERSIDE	4	7.6	11.1	9.1	1.3	2.0	7.0	4.3	1.9	4	0.0
BLUNTNOSE MINNO	3	4.5	7.1	6.2	1.2	1.0	4.0	2.3	1.2	3	0.0
EMERALD SHINER	2	6.8	8.3	7.6	0.8	2.0	5.0	3.5	1.5	2	0.0
LOG PERCH	2	7.1	15.7	11.4	4.3	4.0	36.0	20.0	16.0	2	0.0
FLATHEAD CATFISH	2	15.9	17.0	16.5	0.5	24.0	31.0	27.5	3.5	2	0.1
LARGEMOUTH BASS	2	13.0	22.2	17.6	4.6	21.0	92.0	56.5	35.5	2	0.1
BLACK BULLHEAD	1	9.9	9.9	9.9	0.0	11.0	11.0	11.0	0.0	1	0.0

Table 26. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, June 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
06/15/94	11:00	28.2	4	8	100.0	17.7	992

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
FRESHWATER DRUM	31	7.8	21.8	11.3	2.5	3.0	84.0	14.0	13.9	619	9.4
CHANNEL CATFISH	27	9.6	19.2	12.8	2.7	6.0	50.0	16.3	11.7	161	2.2
BLUE CATFISH	26	7.8	20.6	14.5	3.8	3.0	64.0	25.2	18.9	89	1.8
BLUEGILL SUNFISH	26	6.3	18.5	11.8	3.4	4.0	120.0	37.1	29.2	51	2.1
WHITE BASS	22	4.3	33.2	9.3	7.8	1.0	348.0	36.4	84.0	22	0.9
GIZZARD SHAD	20	5.0	19.0	15.0	4.3	1.0	45.0	25.4	13.7	20	0.5
THREADFIN SHAD	8	4.5	15.2	8.2	4.1	1.0	19.0	6.4	6.9	8	0.1
FATHEAD MINNOW	5	7.4	7.8	7.6	0.1	2.0	4.0	3.0	0.6	5	0.0
WHITE CRAPPIE	4	5.8	27.5	11.6	9.2	1.0	274.0	69.8	117.9	4	0.3
LONGEAR SUNFISH	4	7.8	17.8	11.6	3.7	9.0	114.0	41.5	42.2	4	0.2
SAUGER	3	6.8	7.2	7.0	0.2	2.0	2.0	2.0	0.0	3	0.0
INLAND SILVERSIDE	2	3.6	10.0	6.8	3.2	1.0	3.0	2.0	1.0	2	0.0
FLATHEAD CATFISH	2	10.4	16.8	13.6	3.2	8.0	36.0	22.0	14.0	2	0.0
AMERICAN PADDLEF	1	11.7	11.7	11.7	0.0	3.0	3.0	3.0	0.0	1	0.0
LARGEMOUTH BASS	1	25.8	25.8	25.8	0.0	190.0	190.0	190.0	0.0	1	0.2

Table 27. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, July 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
07/12/94	10:00	30.2	4	8	100.0	5.0	174

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
FRESHWATER DRUM	26	5.4	7.6	6.3	0.5	1.0	4.0	1.8	0.8	89	0.2
BLUEGILL SUNFISH	19	8.5	19.5	15.0	3.3	11.0	165.0	79.9	47.2	19	1.5
BLUE CATFISH	18	9.8	31.7	20.2	5.4	11.0	195.0	67.2	51.4	18	1.3
GIZZARD SHAD	18	4.2	22.0	8.3	5.8	1.0	84.0	13.6	26.7	18	0.2
CHANNEL CATFISH	12	9.7	34.0	17.5	5.7	9.0	329.0	57.2	83.4	12	0.7
STRIPED BASS	9	5.6	38.7	14.0	11.1	1.0	714.0	117.8	220.6	9	1.1
THREADFIN SHAD	9	3.8	7.3	5.3	1.1	1.0	3.0	1.6	0.8	9	0.0

Table 28. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, August 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
08/23/94	08:45	26.9	4	8	100.0	2.8	57

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
THREADFIN SHAD	17	5.6	9.5	7.0	1.0	1.0	8.0	4.3	1.5	17	0.1
STRIPED BASS	11	7.3	29.8	14.5	7.7	4.0	209.0	48.4	61.3	11	0.6
FRESHWATER DRUM	10	6.2	28.6	20.1	7.7	2.0	170.0	83.6	58.8	10	0.9
BLUEGILL	7	10.3	18.5	16.3	2.6	20.0	153.0	102.9	40.5	7	0.7
GIZZARD SHAD	3	5.0	20.5	10.9	6.9	2.0	82.0	29.7	37.0	3	0.1
SKIPJACK HERRING	3	8.5	26.3	14.7	8.2	6.0	83.0	32.0	36.1	3	0.1
BLUE CATFISH	2	13.5	30.6	22.1	8.6	19.0	150.0	84.5	65.5	2	0.2
CHANNEL CATFISH	2	19.5	19.5	19.5	0.0	55.0	64.0	59.5	4.5	2	0.1
BROOK SILVERSIDE	1	8.0	8.0	8.0	0.0	5.0	5.0	5.0	0.0	1	0.0
WHITE CRAPPIE	1	10.3	10.3	10.3	0.0	12.0	12.0	12.0	0.0	1	0.0

Table 29. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, September 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
09/20/94	14:00	26.1	4	8	100.0	3.5	83

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
THREADFIN SHAD	25	6.4	10.5	7.9	1.1	3.0	11.0	5.2	2.3	38	0.2
FRESHWATER DRUM	13	7.6	30.1	20.4	8.6	4.0	270.0	96.6	77.0	13	1.3
STRIPED BASS	10	7.6	23.6	13.6	6.1	5.0	147.0	40.7	50.1	10	0.4
BLUE CATFISH	6	19.2	25.6	22.8	1.9	62.0	135.0	90.0	25.9	6	0.5
SKIPJACK HERRING	5	9.6	26.1	21.3	6.0	5.0	91.0	62.8	30.0	5	0.3
GIZZARD SHAD	4	9.6	17.3	12.0	3.1	8.0	46.0	19.3	15.6	4	0.1
BLUEGILL SUNFISH	4	6.3	19.2	14.4	4.9	5.0	192.0	94.8	66.2	4	0.4
CHANNEL CATFISH	2	22.4	29.7	26.1	3.7	78.0	163.0	120.5	42.5	2	0.2
WHITE CRAPPIE	1	8.6	8.6	8.6	0.0	7.0	7.0	7.0	0.0	1	0.0

Table 30. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, October 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
10/13/94	14:00	20.3	4	8	100.0	5.3	333

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
THREADFIN SHAD	26	5.2	10.5	7.8	1.7	2.0	13.0	5.5	3.2	118	0.6
GIZZARD SHAD	26	7.2	20.0	10.3	2.3	4.0	72.0	12.5	12.4	143	1.2
BLUE CATFISH	25	9.5	25.5	16.9	3.5	7.0	97.0	33.0	20.7	32	0.9
FRESHWATER DRUM	17	7.1	34.3	20.7	7.5	4.0	315.0	83.8	72.6	17	1.4
STRIPED BASS	15	10.0	29.2	16.2	6.1	10.0	213.0	56.9	60.8	15	0.9
SKIPJACK HERRING	3	9.9	26.0	15.3	7.5	9.0	102.0	40.0	43.8	3	0.1
CHANNEL CATFISH	3	13.6	26.6	18.3	5.9	20.0	121.0	55.0	46.7	3	0.2
BLUEGILL SUNFISH	1	5.2	5.2	5.2	0.0	1.0	1.0	1.0	0.0	1	0.0
WHITE CRAPPIE	1	5.7	5.7	5.7	0.0	2.0	2.0	2.0	0.0	1	0.0

Table 31. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, November 1994.

Date	Time	Intake temp.(C)	No. of pumps operating	No. of screens washed	% of fish sampled	Total kg of fish	Total No. of fish
11/23/94	15:30	13.3	3	6	36.6	145.3	19430

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
THREADFIN SHAD	84	5.6	12.0	9.1	1.4	2.0	19.0	8.1	3.2	15160	106.2
GIZZARD SHAD	56	7.5	19.2	9.5	1.7	5.0	42.0	8.9	5.1	2145	16.1
FRESHWATER DRUM	54	7.5	22.4	10.2	3.1	4.0	80.0	13.3	15.9	1568	15.7
WHITE BASS	48	8.2	25.0	12.3	3.9	5.0	140.0	23.5	29.9	208	3.7
BLUEGILL SUNFISH	49	4.5	17.0	5.8	1.9	1.0	60.0	4.1	9.0	240	0.8
SKIPJACK HERRING	20	11.0	15.0	12.4	1.0	9.0	20.0	12.6	3.0	55	0.6
BLUE CATFISH	7	7.5	25.5	14.9	6.4	6.0	74.0	28.4	25.2	19	0.5
BROOK SILVERSIDE	4	8.5	10.5	9.5	0.7	4.0	6.0	4.8	0.8	11	0.1
WHITE CRAPPIE	4	5.3	8.5	6.6	1.2	1.0	5.0	2.5	1.5	11	0.0
CHANNEL CATFISH	3	13.5	40.0	25.6	10.9	12.0	488.0	183.3	216.0	8	1.5
LONGEAR SUNFISH	1	6.8	6.8	6.8	0.0	8.0	8.0	8.0	0.0	3	0.0
ORANGESPOTTED S	1	6.9	6.9	6.9	0.0	5.0	5.0	5.0	0.0	3	0.0

Table 32. Summary of impingement of fish on the screens protecting the water intake at Arkansas Nuclear One during a 24-hour period, December 1994.

Date	Time	Intake temp.(C)		No. of pumps operating		No. of screens washed		% of fish sampled		Total kg of fish		Total No. of fish
12/07/94	14:00	12.5		3		6		40.8		71.8		8607

Species	Number measured	Minimum length(cm)	Maximum length(cm)	Mean length(cm)	Standard deviation	Minimum weight(g)	Maximum weight(g)	Mean weight(g)	Standard deviation	Number per date	Kilograms per date
THREADFIN SHAD	77	6.2	15.0	9.4	1.6	3.0	27.0	8.7	4.4	7284	52.0
FRESHWATER DRUM	53	7.5	28.0	11.0	4.7	4.0	175.0	20.5	35.9	970	9.3
GIZZARD SHAD	51	6.7	21.6	11.9	4.0	4.0	91.0	20.1	22.7	465	4.9
STRIPED BASS	36	8.7	12.2	10.4	1.0	5.0	18.0	10.9	3.2	122	1.3
WHITE BASS	50	8.9	16.0	11.3	1.5	5.0	30.0	14.5	5.4	140	1.9
SKIPJACK HERRING	19	11.3	17.0	13.3	1.3	8.0	26.0	14.5	4.3	47	0.6
BLUEGILL SUNFISH	8	4.7	16.0	9.9	4.4	2.0	70.0	24.9	23.6	20	0.5
BROOK SILVERSIDE	6	8.5	11.1	9.8	0.9	2.0	9.0	5.7	2.2	15	0.1
BLUE CATFISH	8	10.6	28.6	16.9	5.8	7.0	144.0	40.0	43.0	20	0.8
CHANNEL CATFISH	4	8.4	27.0	15.2	7.5	3.0	138.0	42.5	55.6	10	0.4
ORANGESPOTTED S	1	10.0	10.0	10.0	0.0	21.0	21.0	21.0	0.0	2	0.1
BLUNTNOSE MINNO	1	6.6	6.6	6.6	0.0	3.0	3.0	3.0	0.0	2	0.0

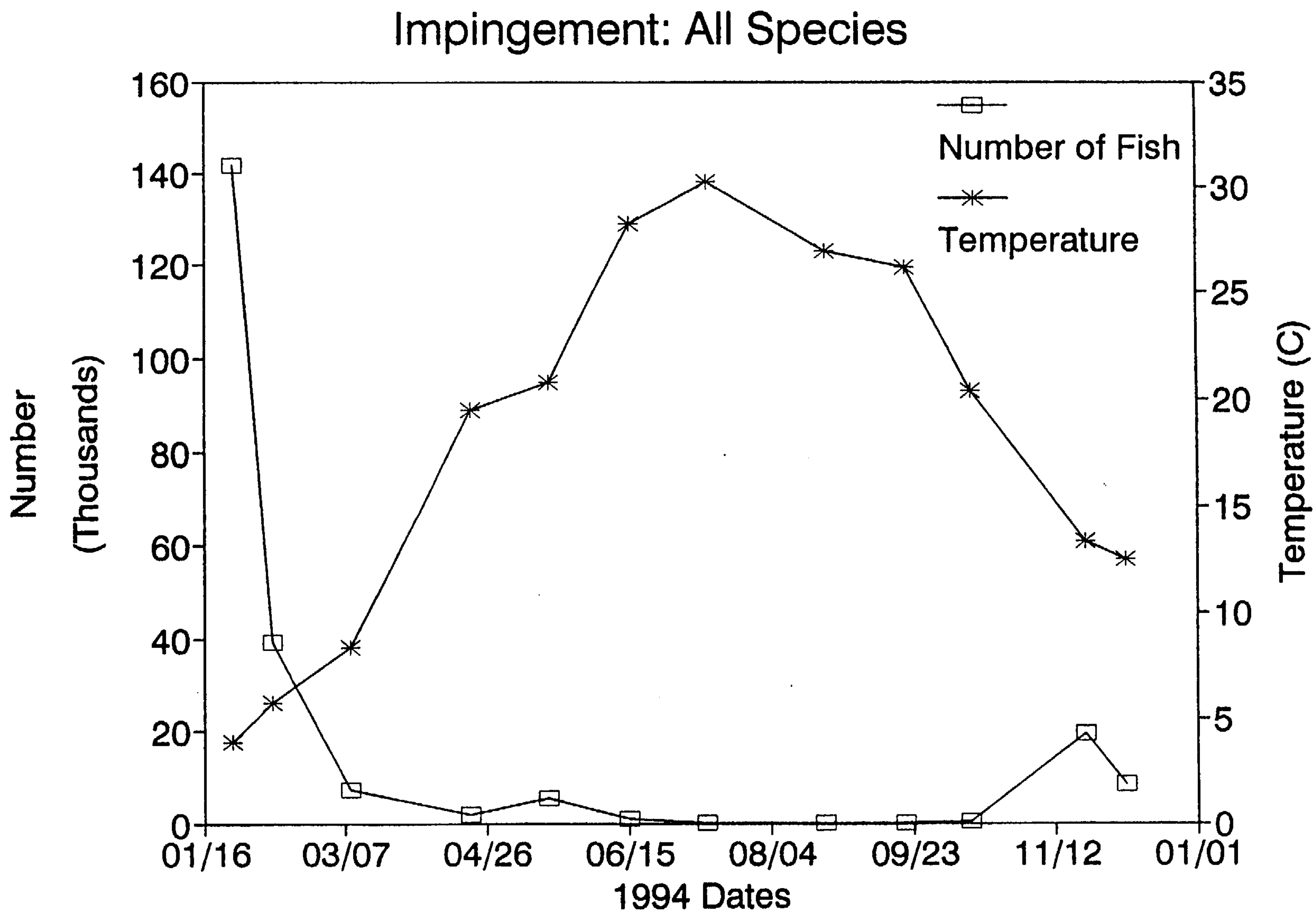


Figure 7. Total number of fish (all species) impinged and intake water temperature on each sample date in 1994.

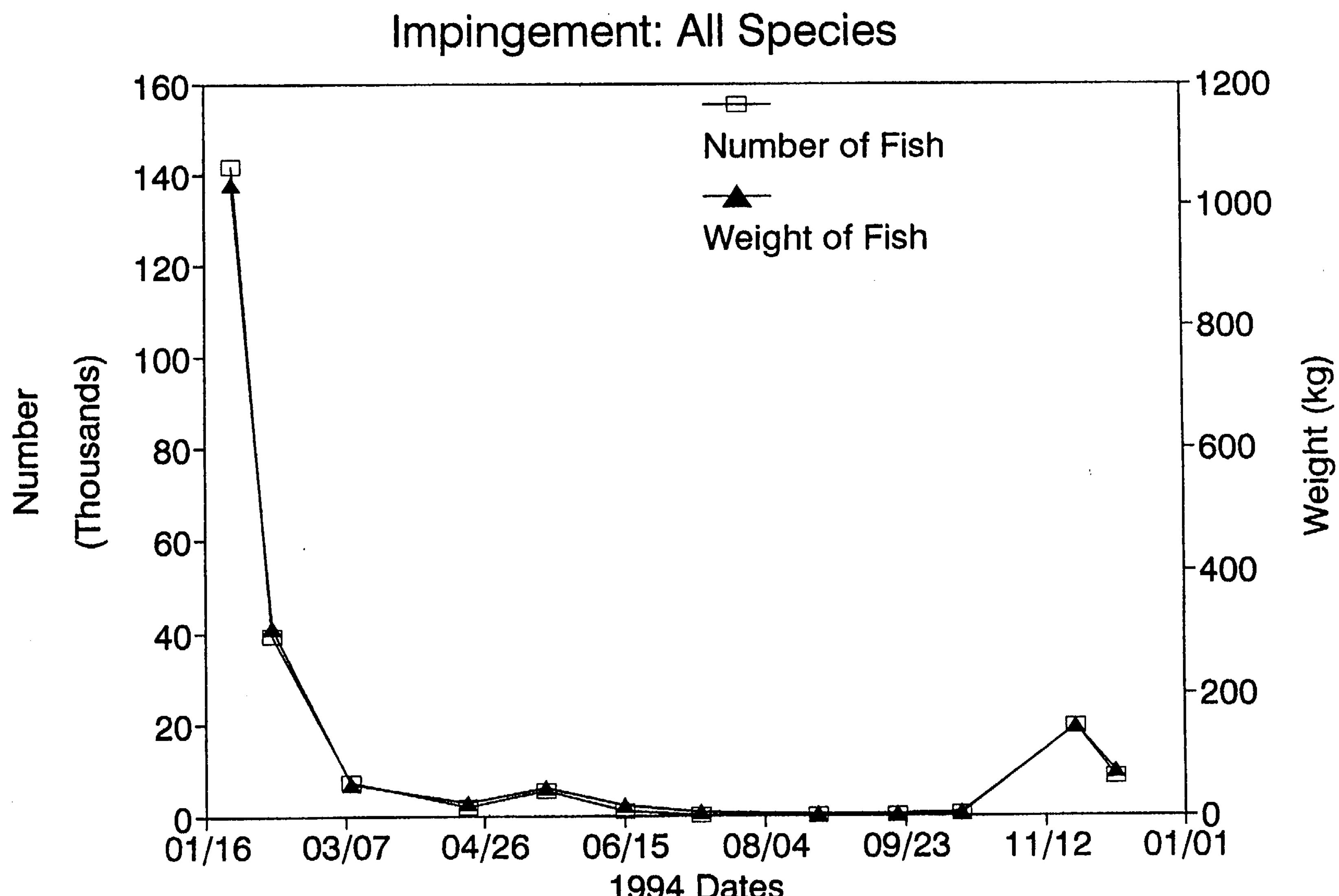


Figure 8. Total number and total weight of fish (all species) impinged on each sample date in 1994.

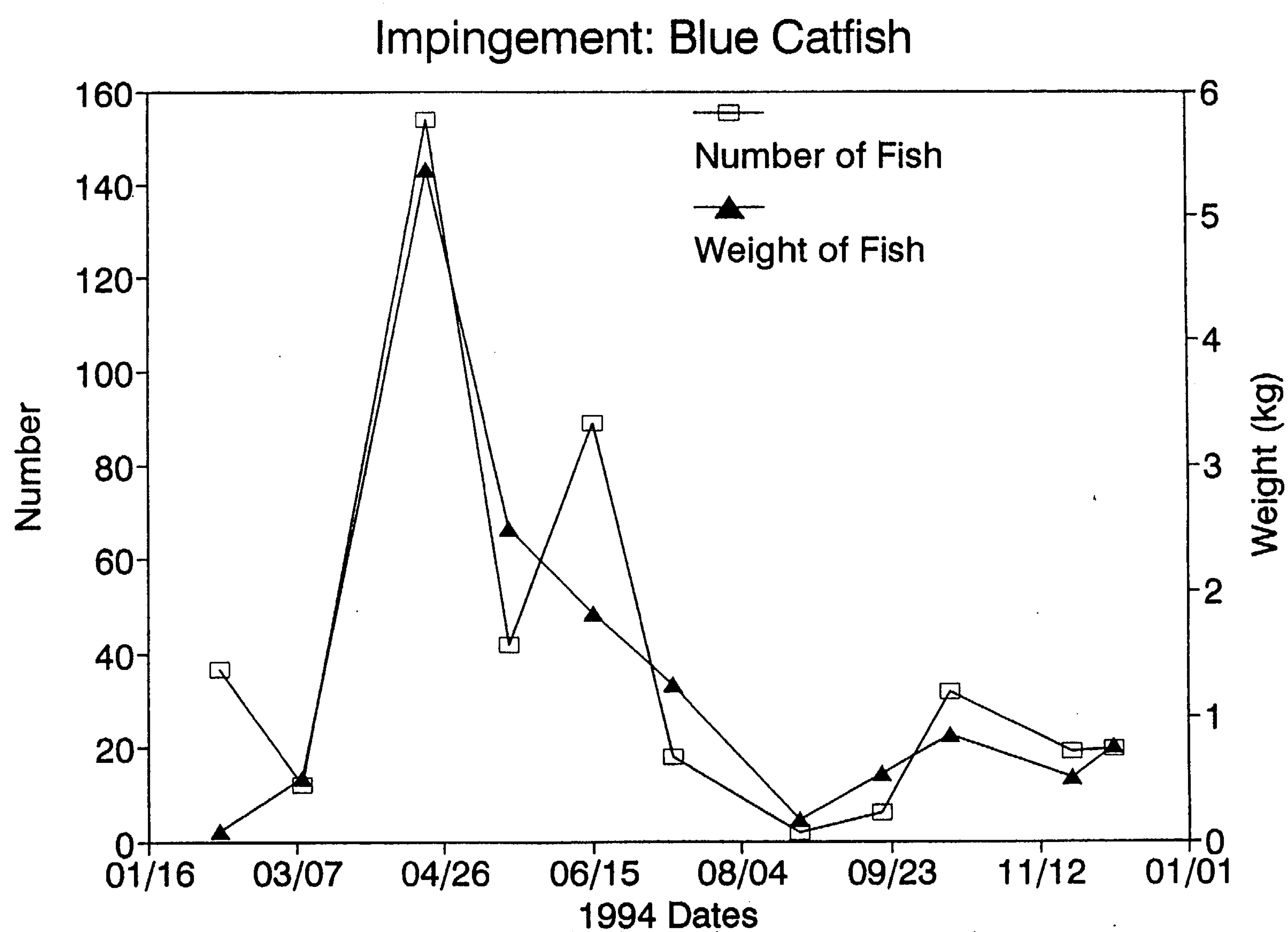


Figure 9. Number and weight of blue catfish impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

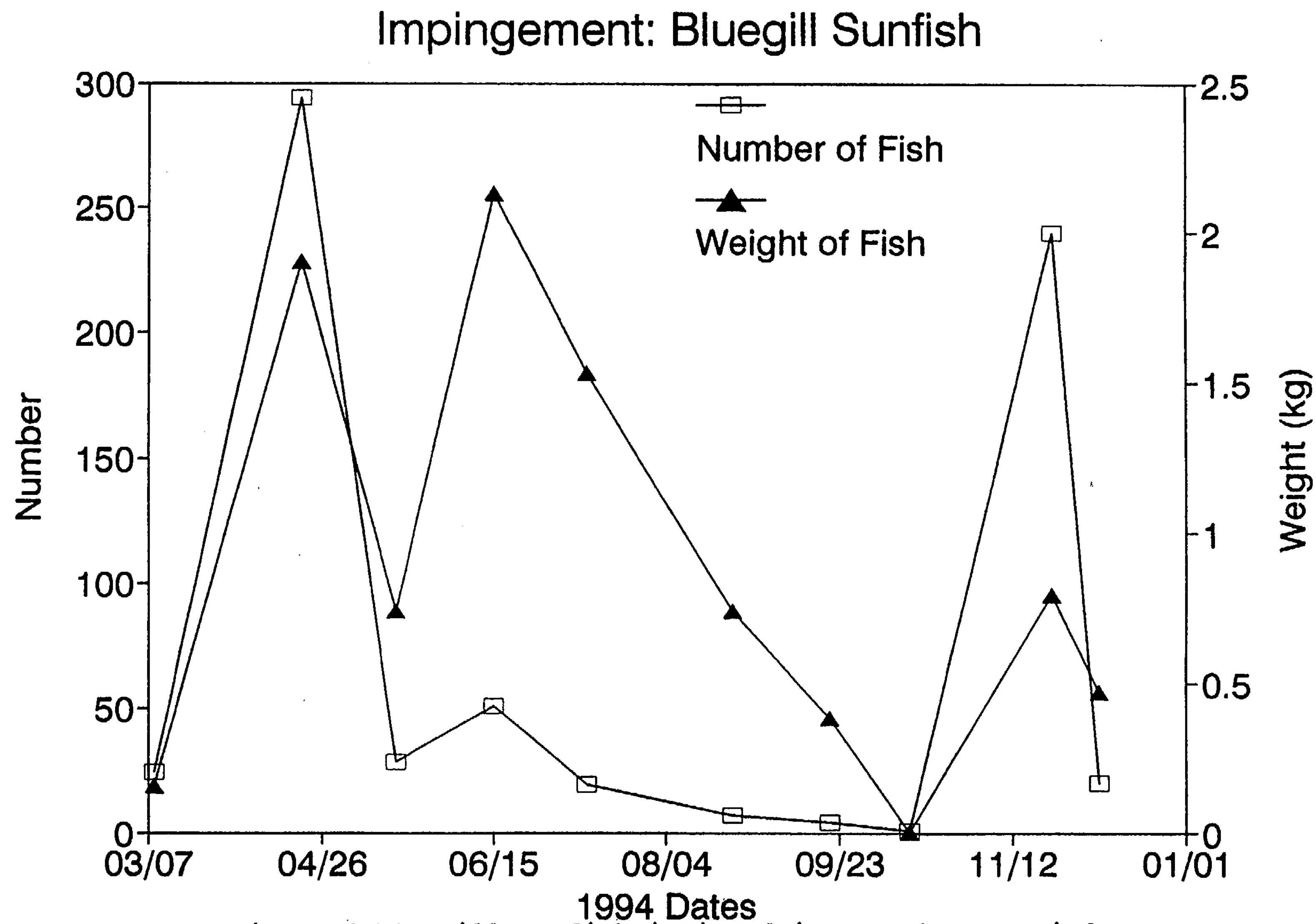


Figure 10. Number and weight of bluegill sunfish impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

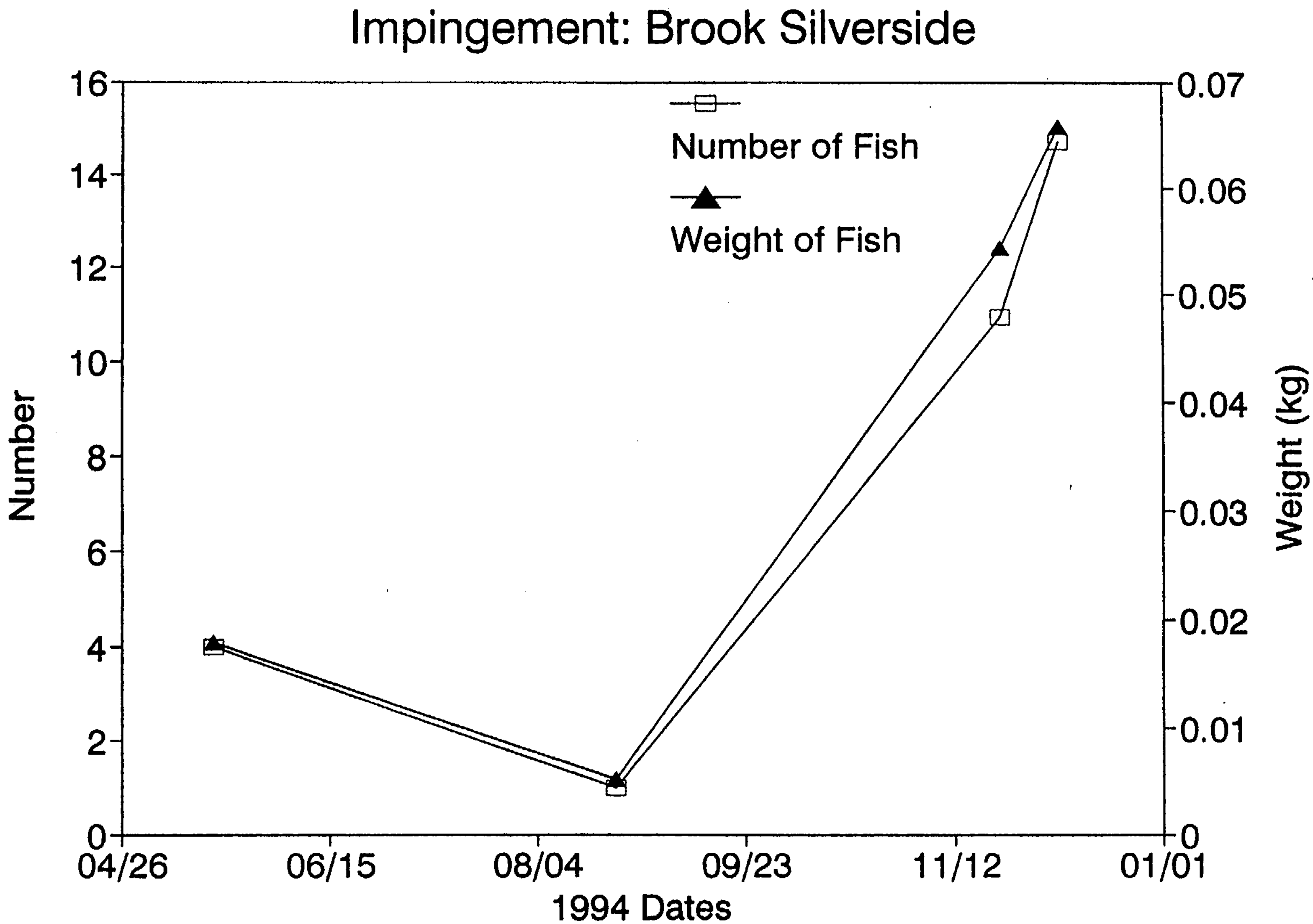


Figure 11. Number and weight of brook silverside minnow impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

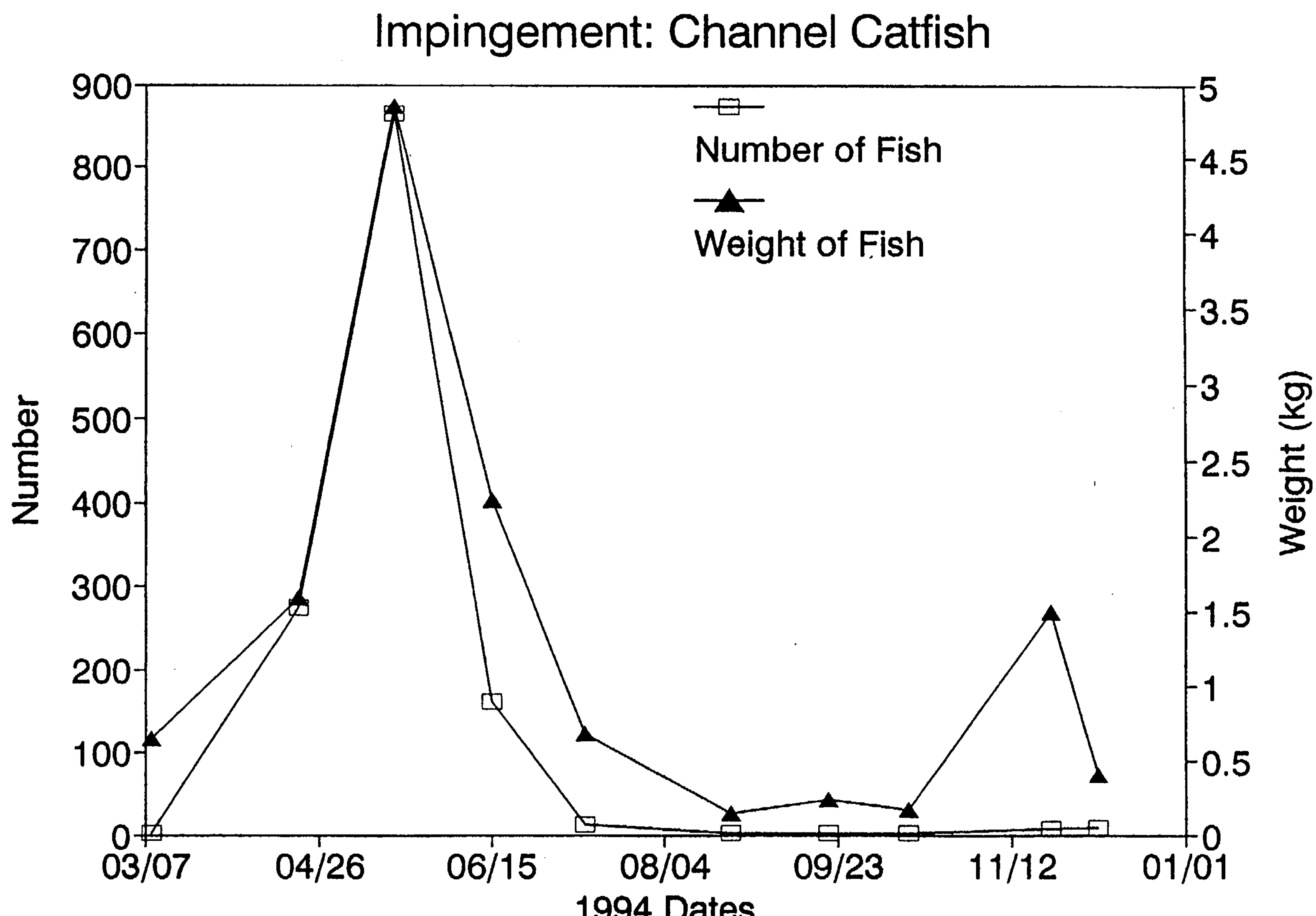


Figure 12. Number and weight of channel catfish impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

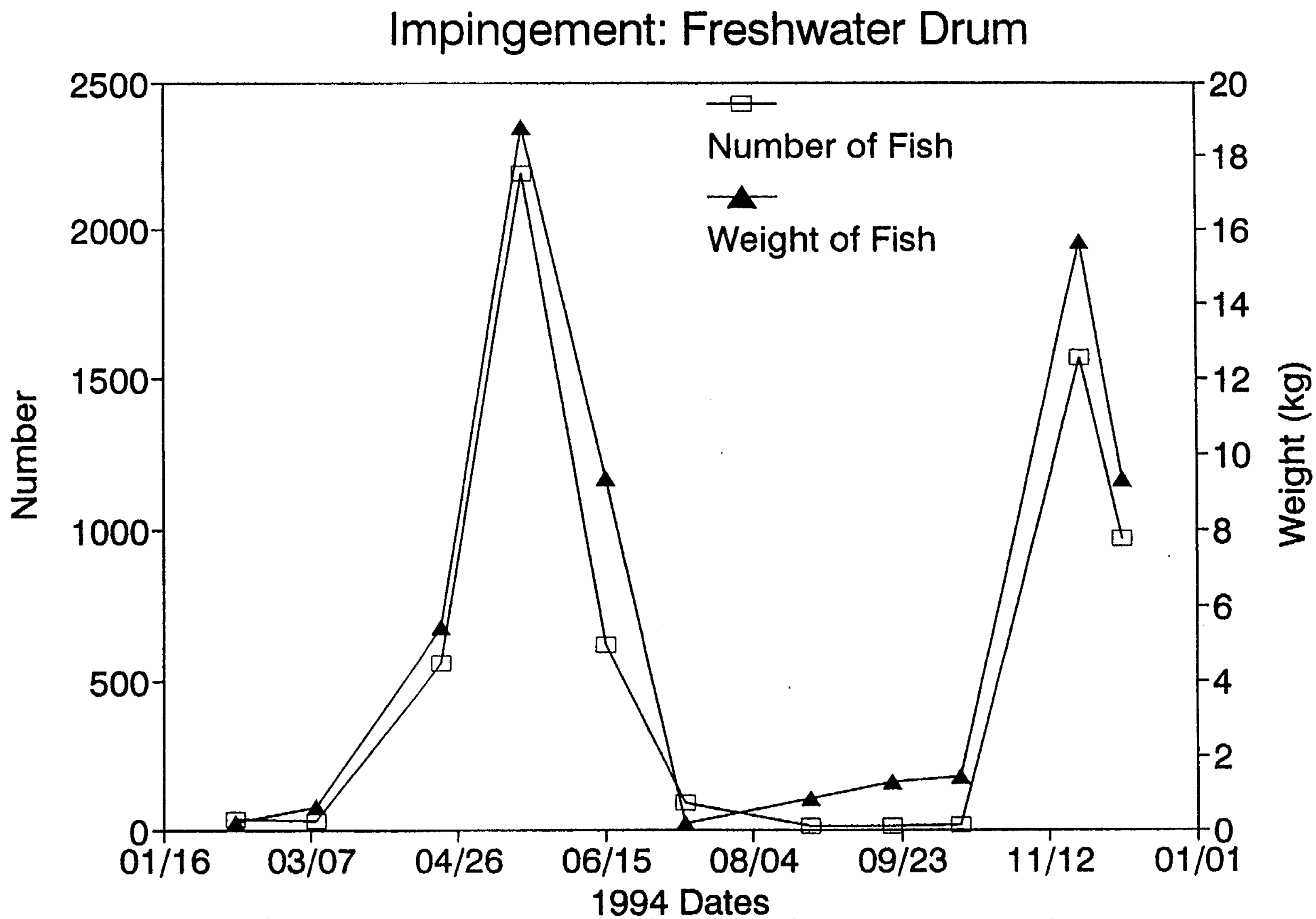


Figure 13. Number and weight of freshwater drum impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

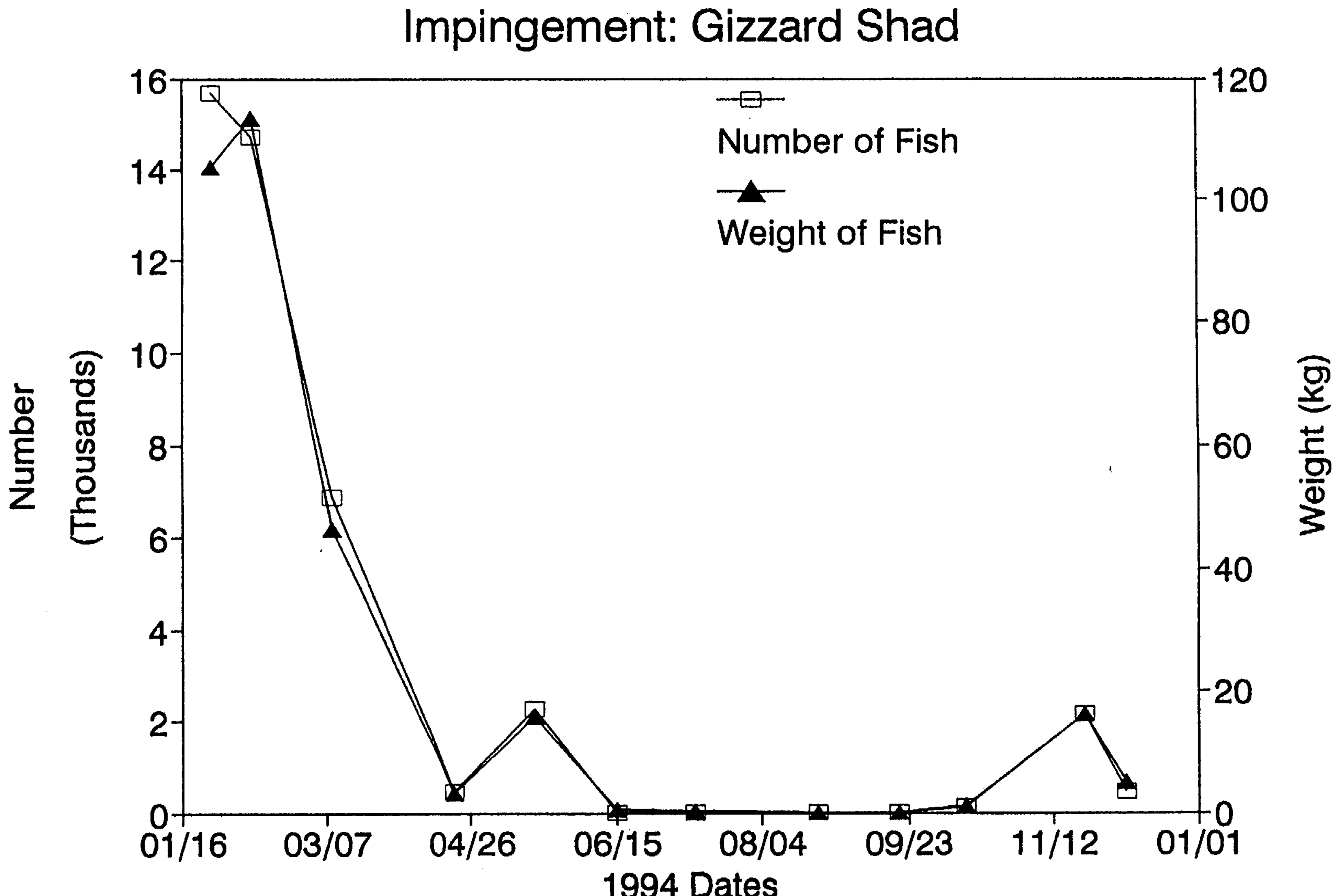


Figure 14. Number and weight of gizzard shad impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

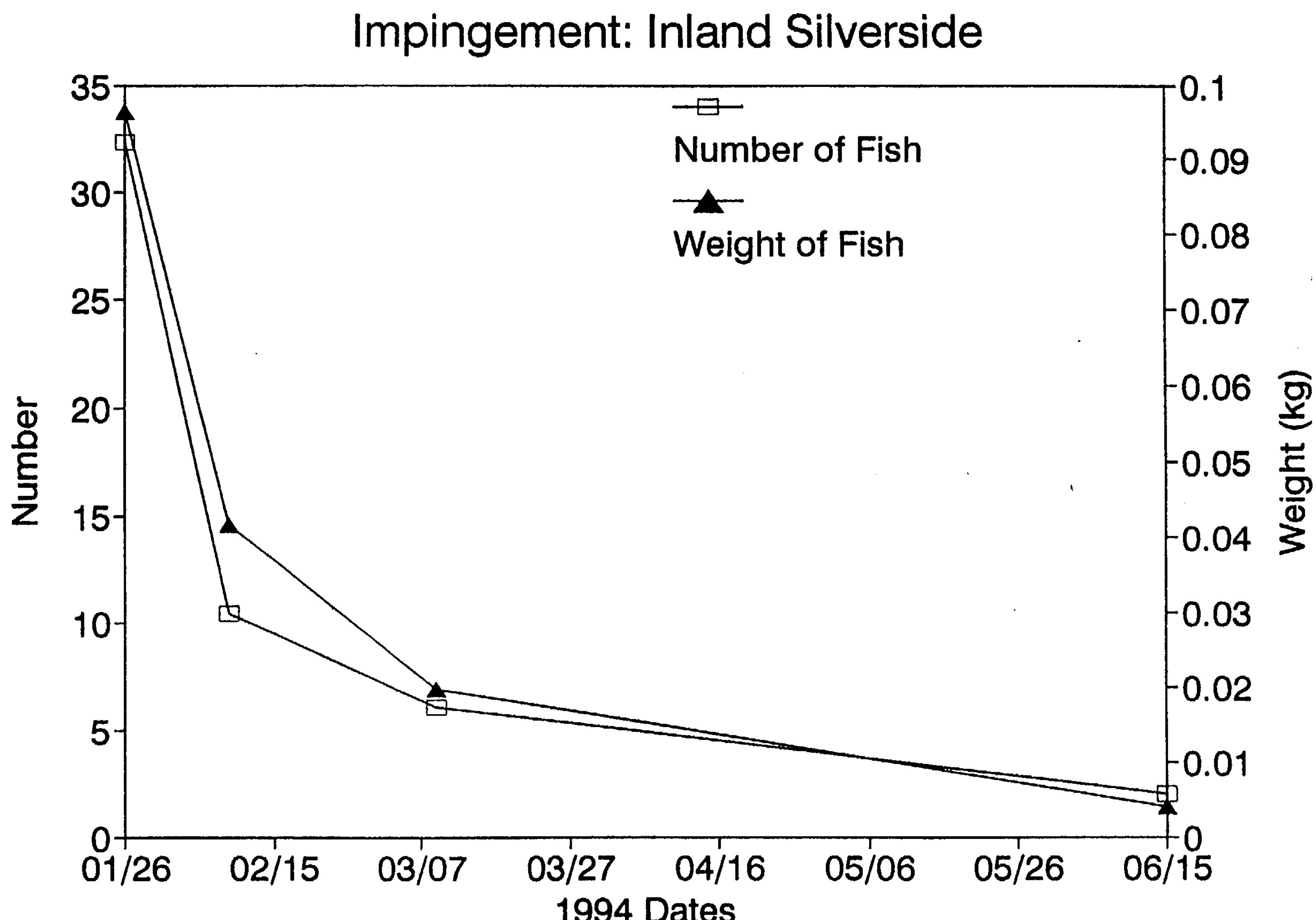


Figure 15. Number and weight of inland silverside impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

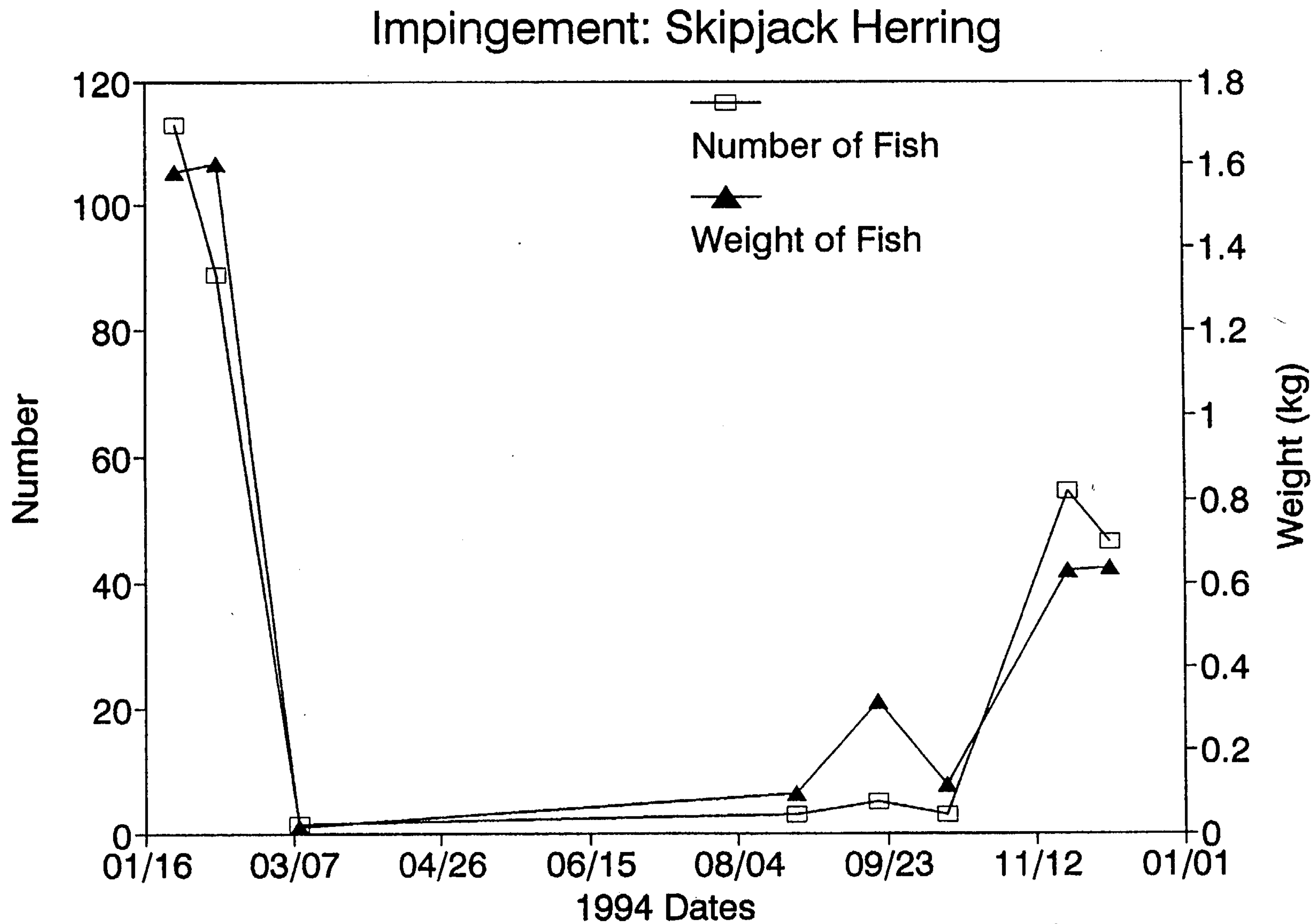


Figure 17. Number and weight of skipjack herring impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

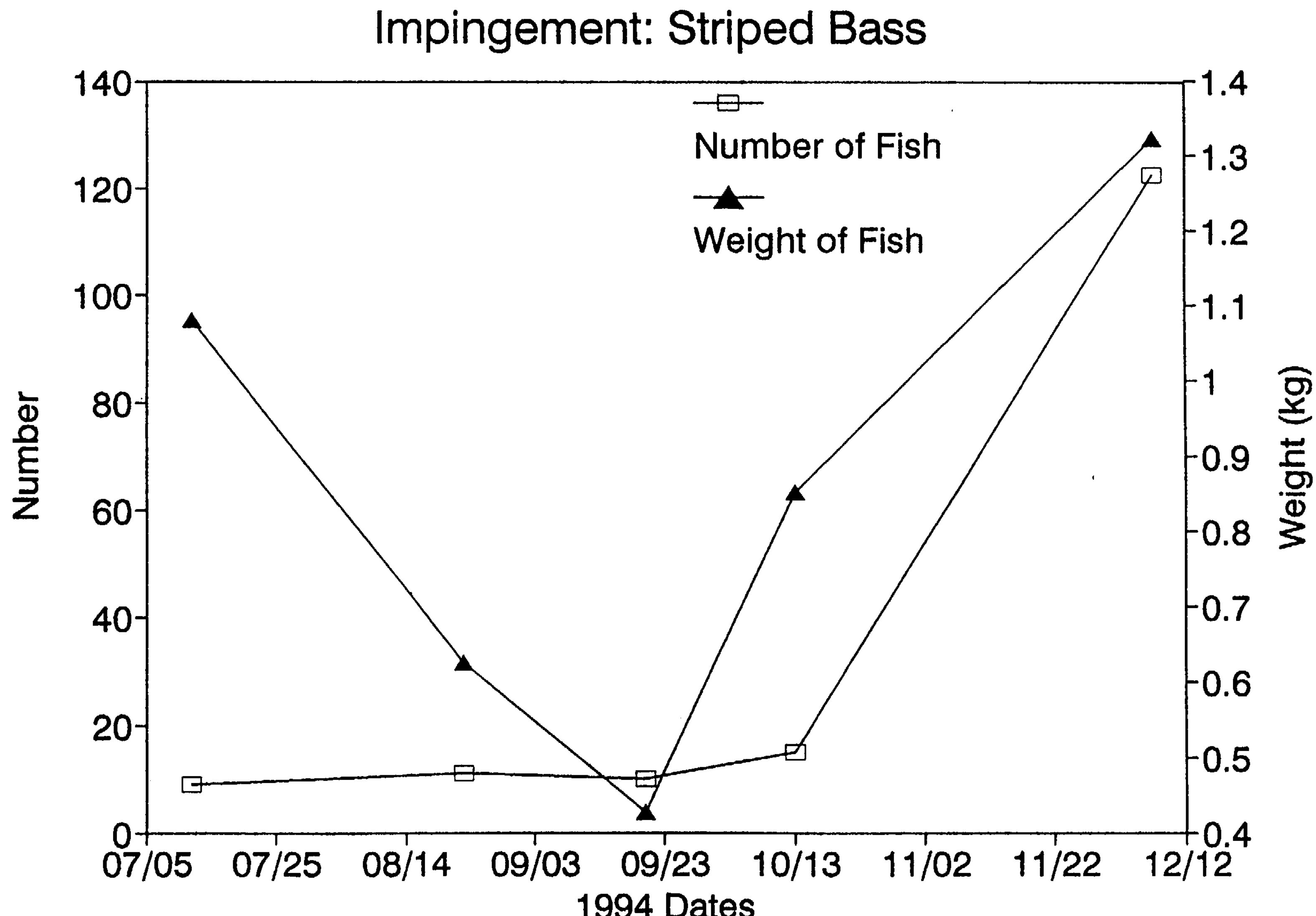


Figure 18. Number and weight of striped bass impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

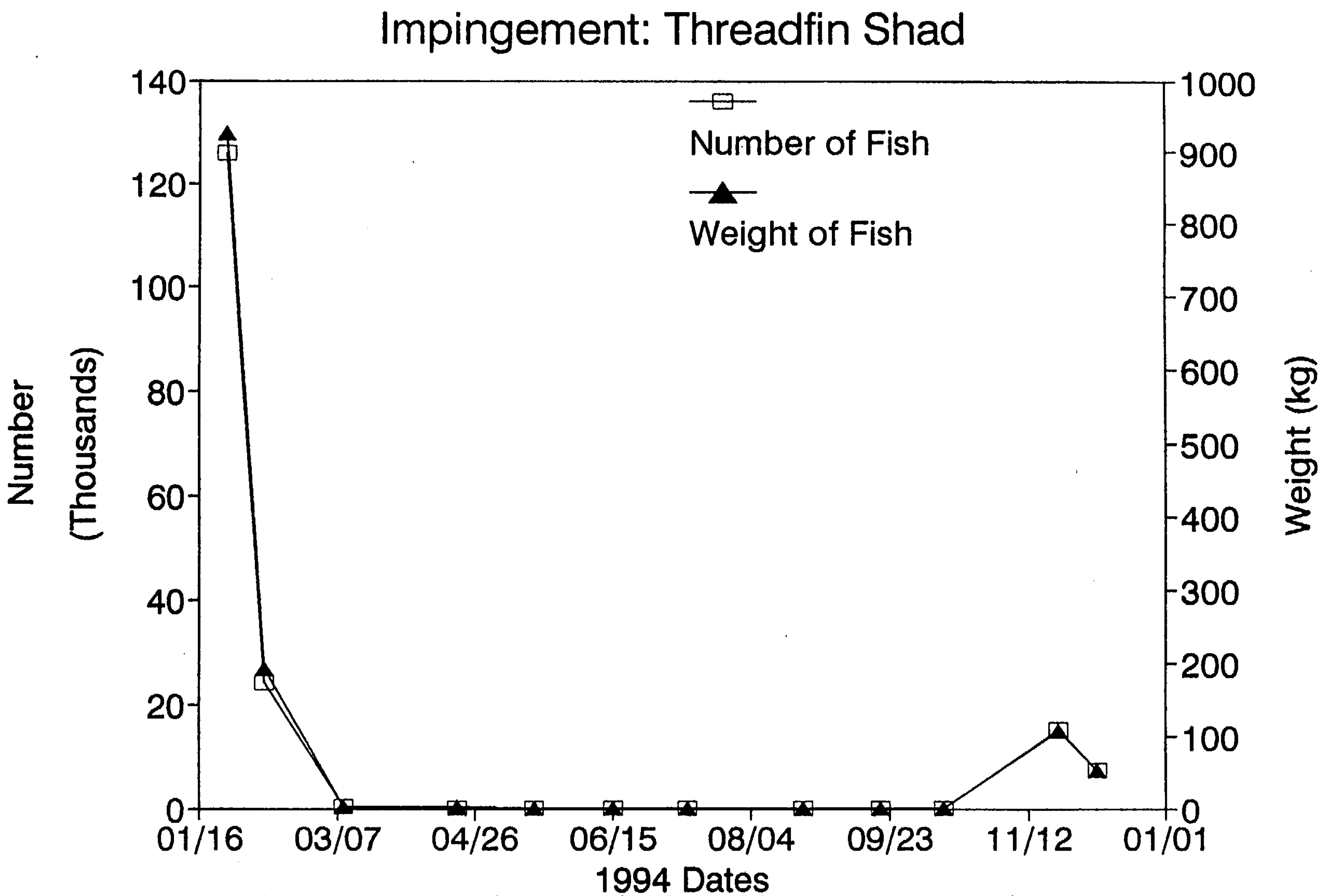


Figure 19. Number and weight of threadfin shad impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

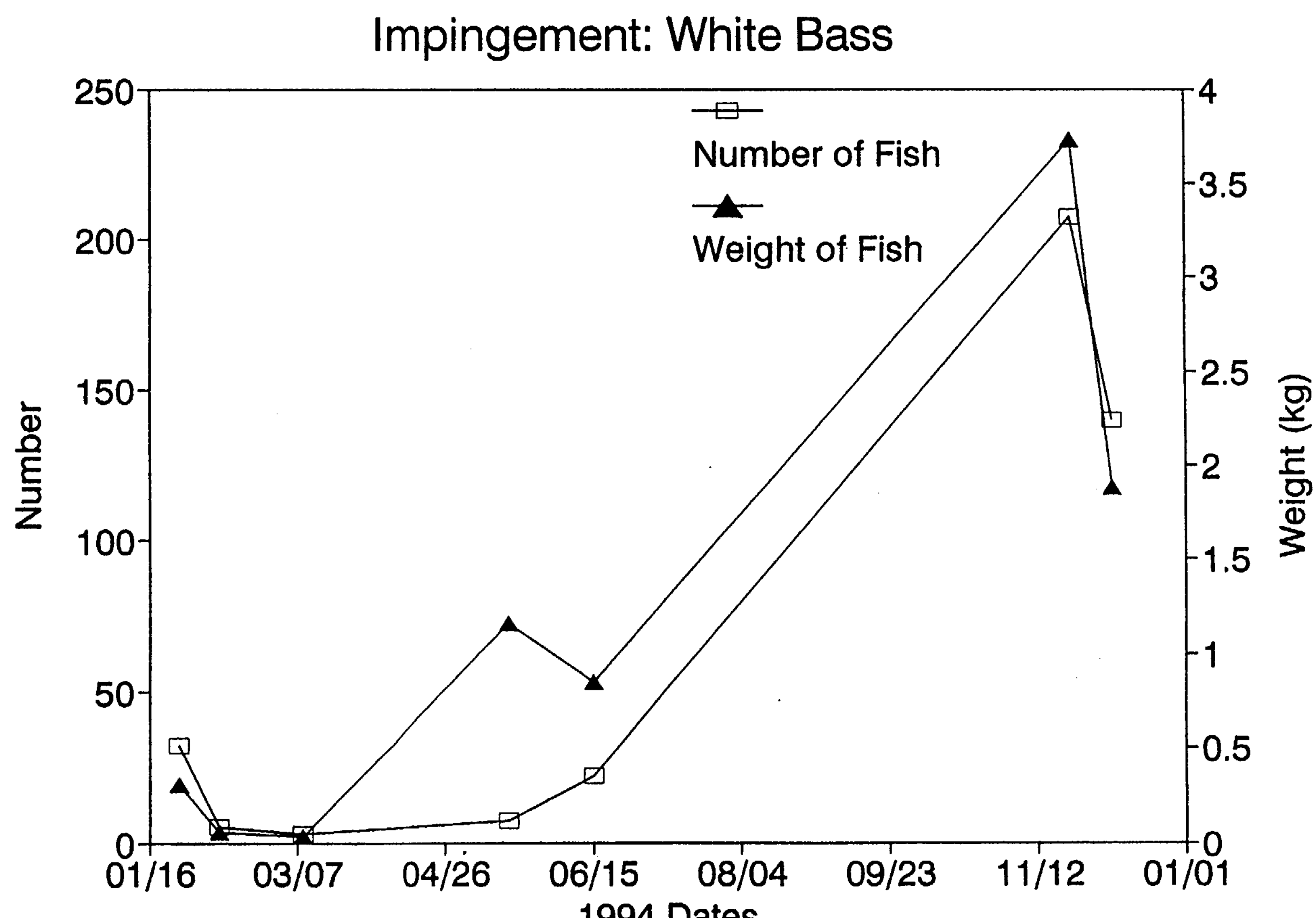


Figure 20. Number and weight of white bass impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

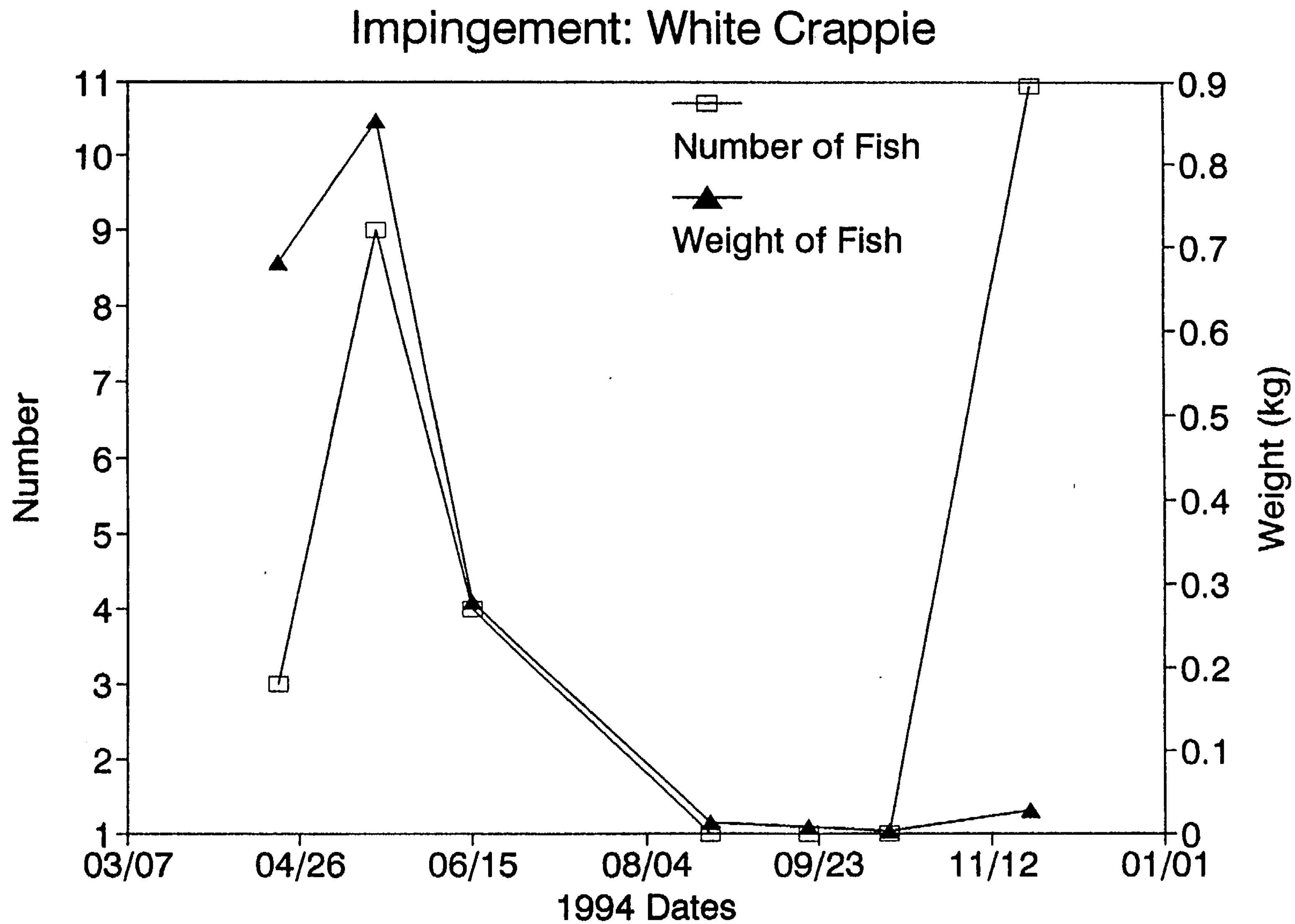


Figure 21. Number and weight of white crappie impinged in a 24-hour period on screens protecting the water intake at Arkansas Nuclear One on each sample date in 1994.

Age and growth determination

Scales and spines for age and growth analysis were collected in conjunction with rotenone sampling (September 12 and 15, 1994). Total length and species of all game fish greater than five inches were recorded on scale envelopes, and then scale or spine samples were collected and placed in the envelope. All samples were subsequently processed at ATU. Scale and spine samples were prepared and mounted on slides, transparent images were projected, and ages were then determined by counting annuli. The scale (or spine) radius and distances from the focus to each annuli were measured, and these values were used to back-calculate lengths at previous ages by using the proportional method (length of a fish divided by its scale radius is directly proportional to length at an annulus divided by the focus to annulus distance). Figures 22 through 34 summarize the results of these analyses. The average, minimum, and maximum total length at each age is plotted for each species at each site.

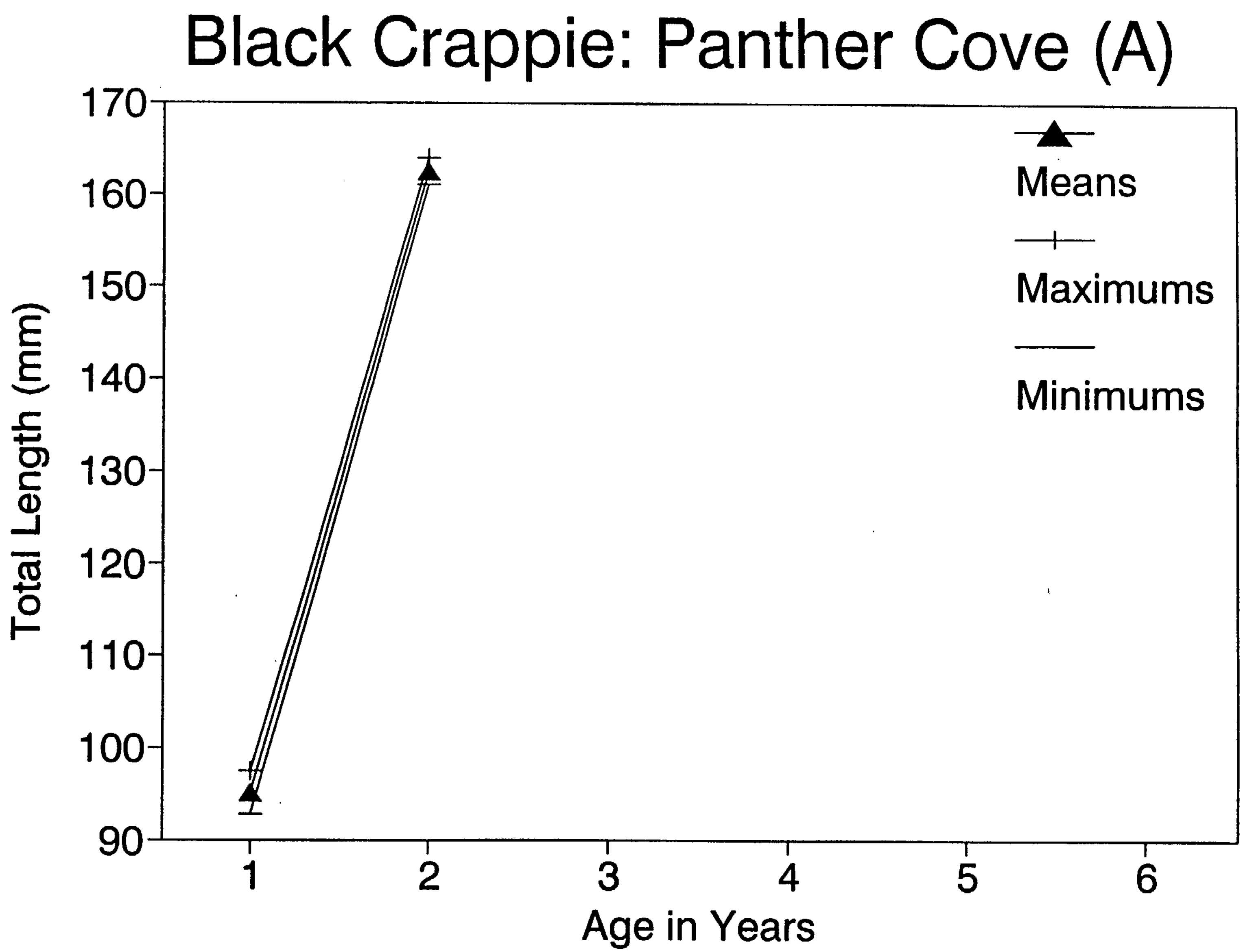


Figure 22. Growth of black crappie collected at Area A.

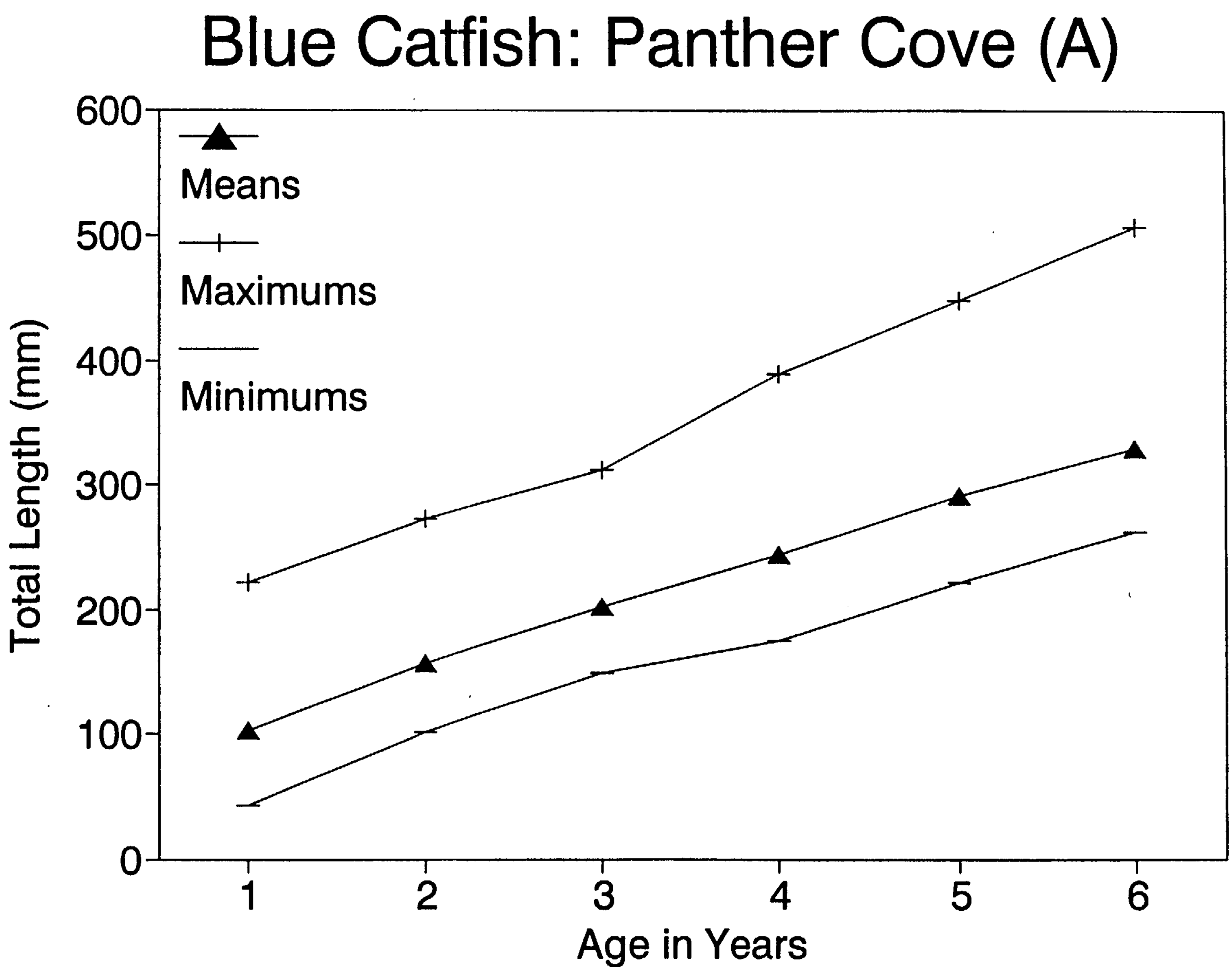


Figure 23. Growth of blue catfish collected at Area A.

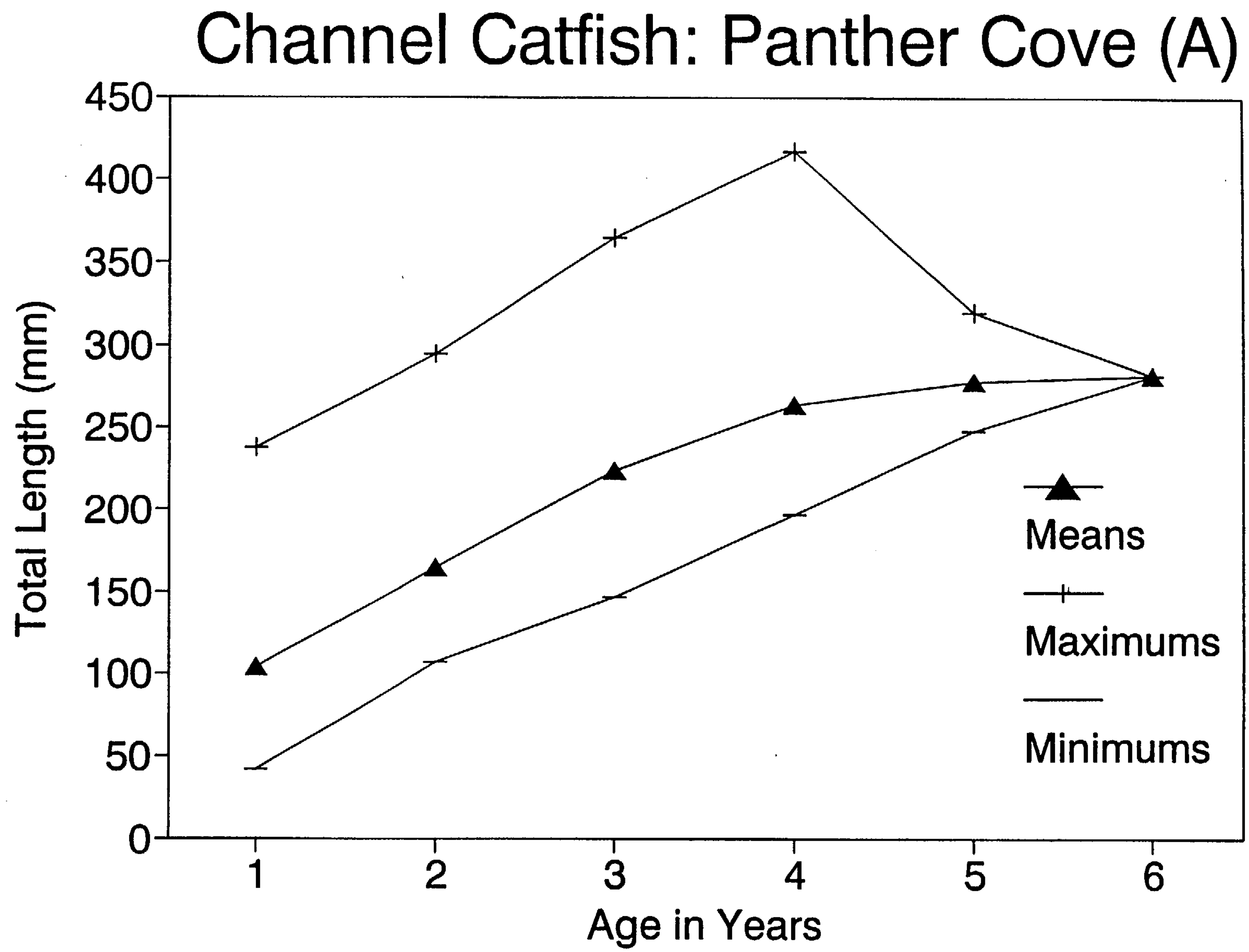


Figure 24. Growth of channel catfish collected at Area A.

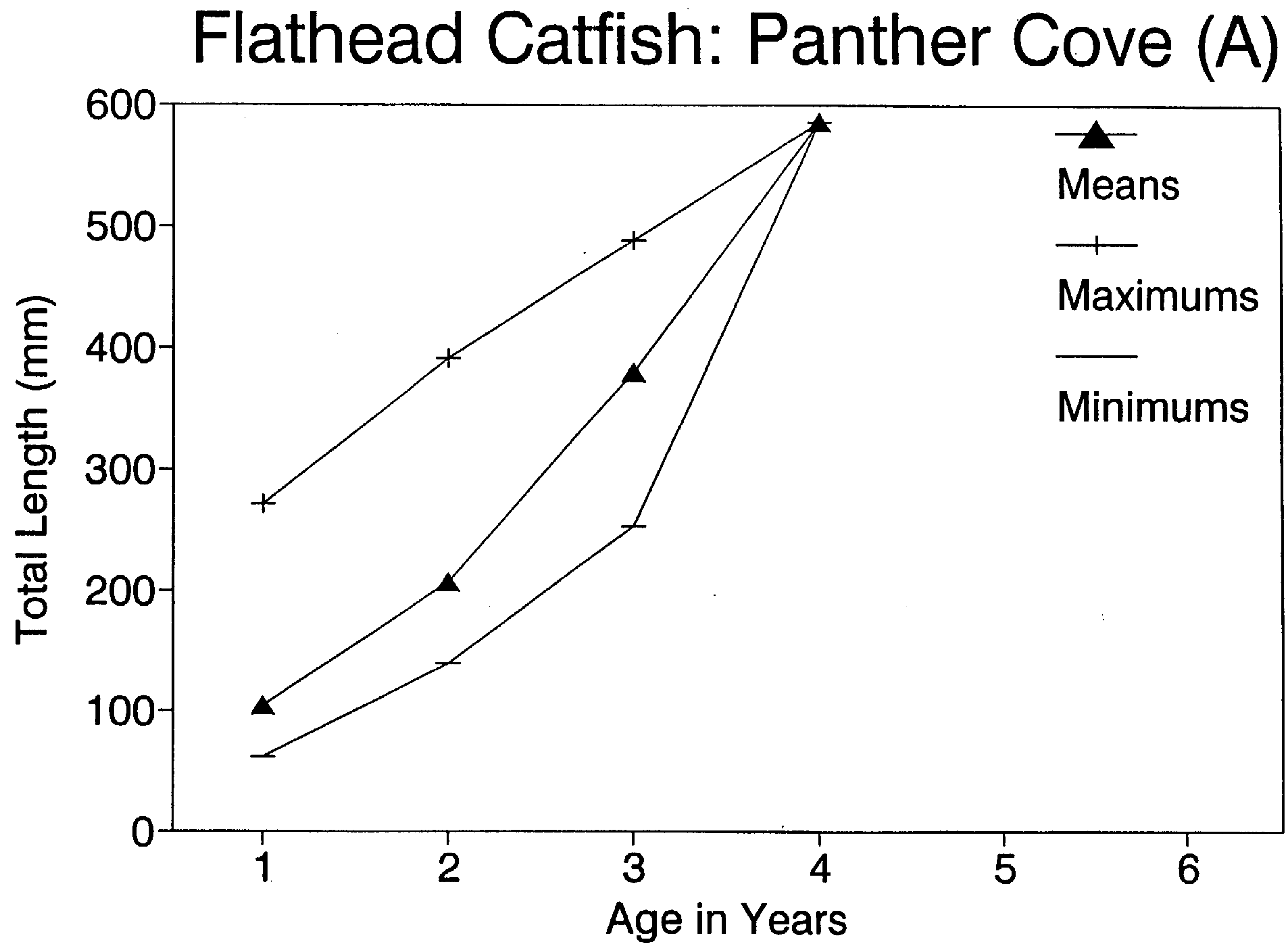


Figure 25. Growth of flathead catfish collected at Area A.

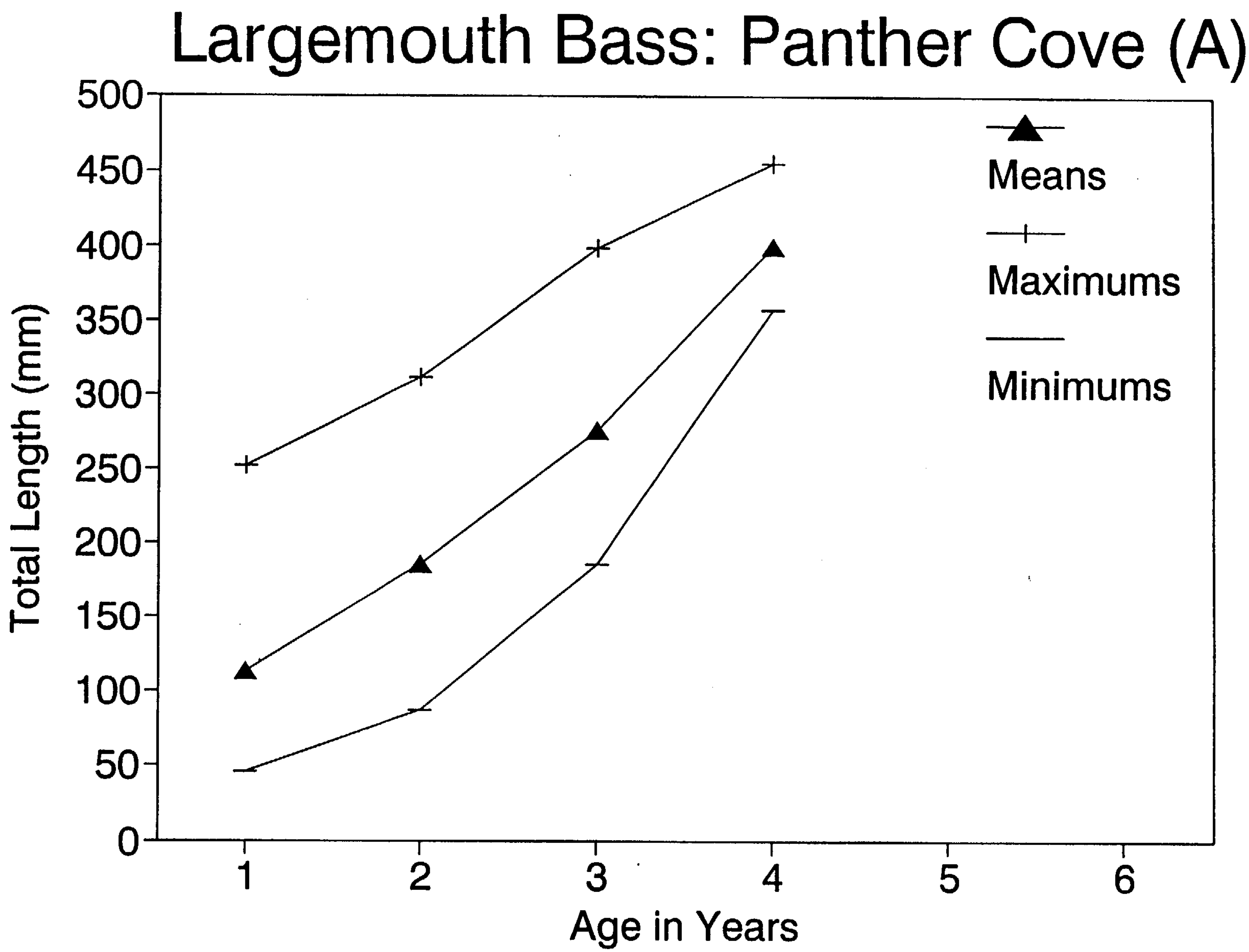


Figure 26. Growth of largemouth bass collected at Area A.

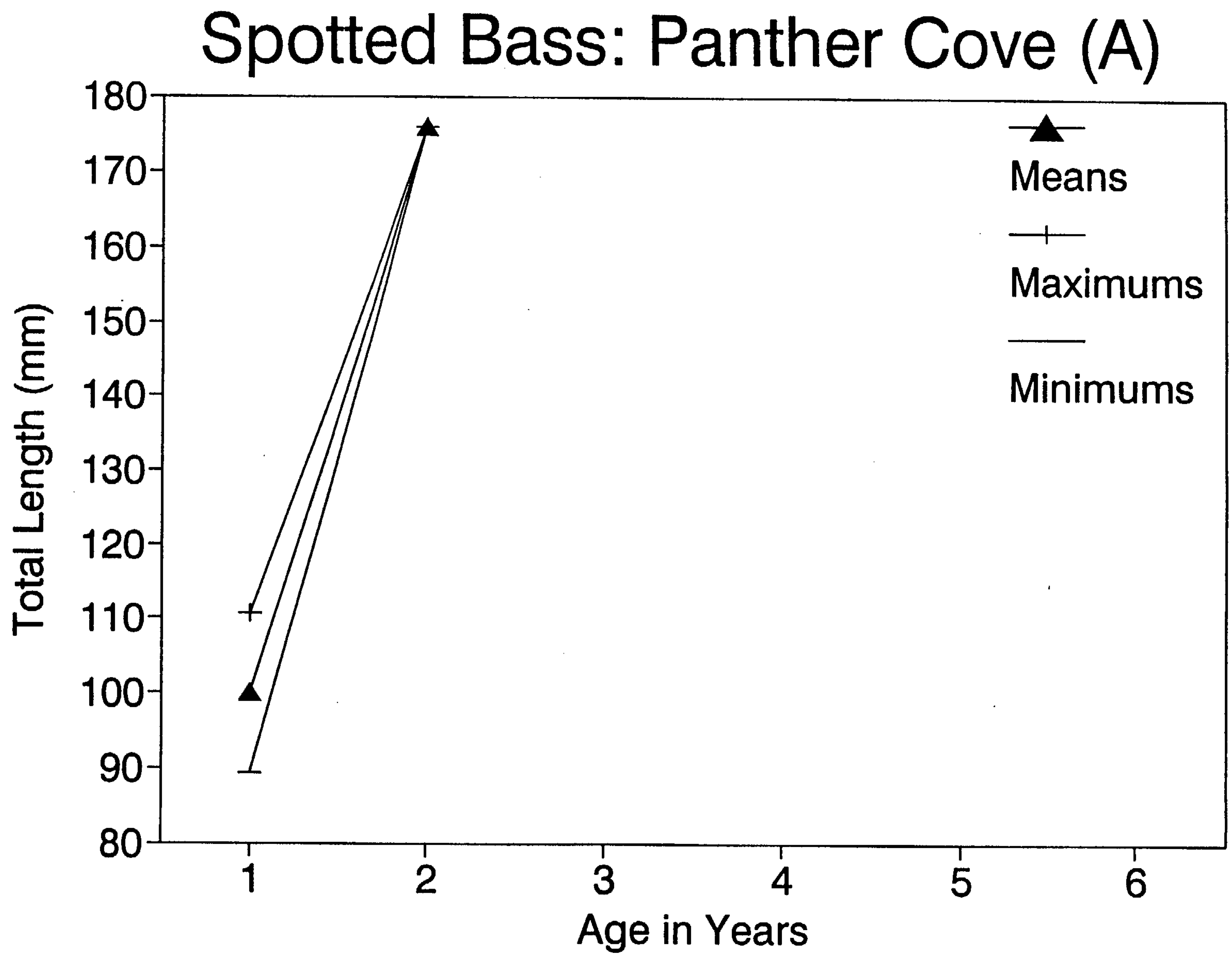


Figure 27. Growth of spotted bass collected at Area A.

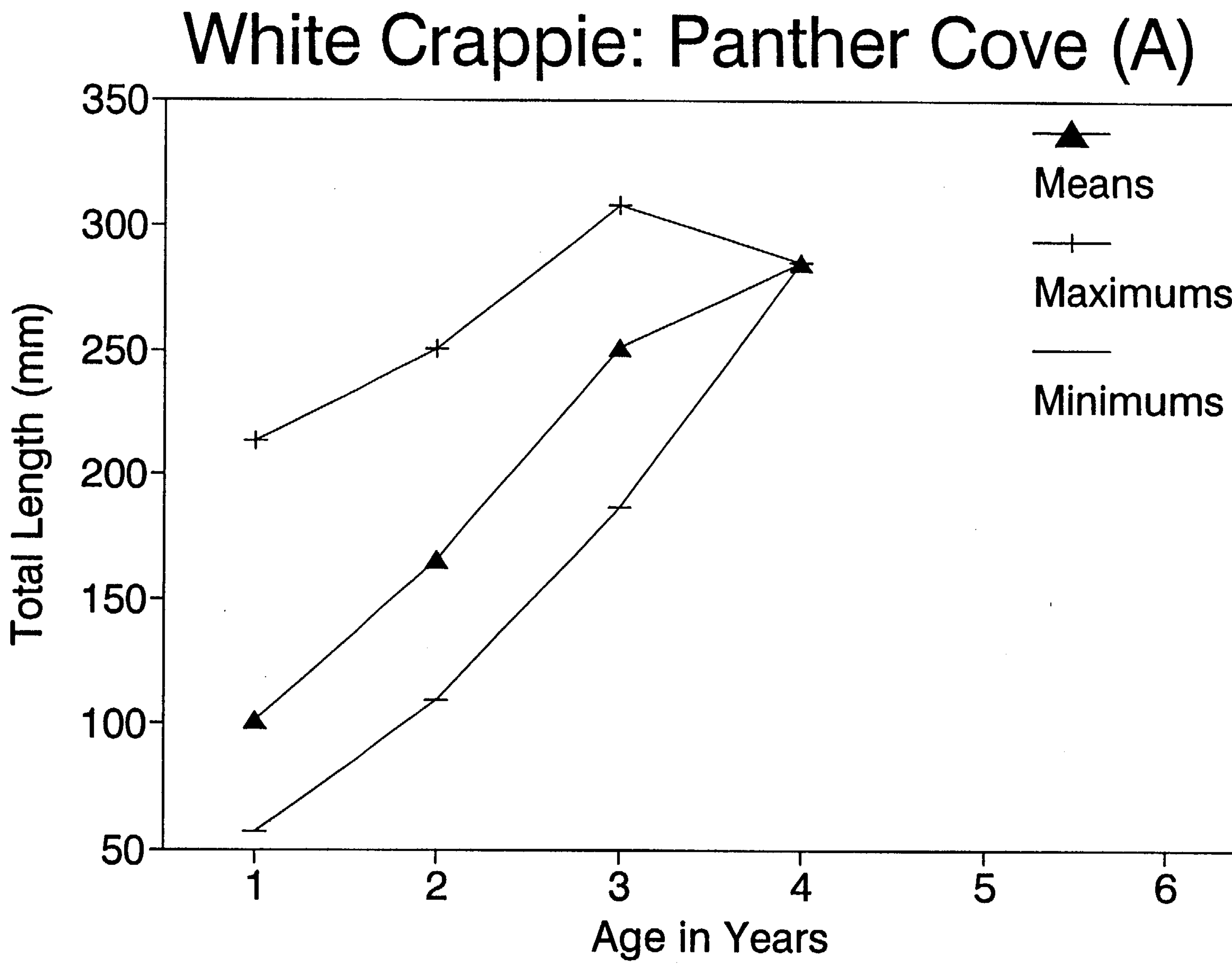


Figure 28. Growth of white crappie collected at Area A.

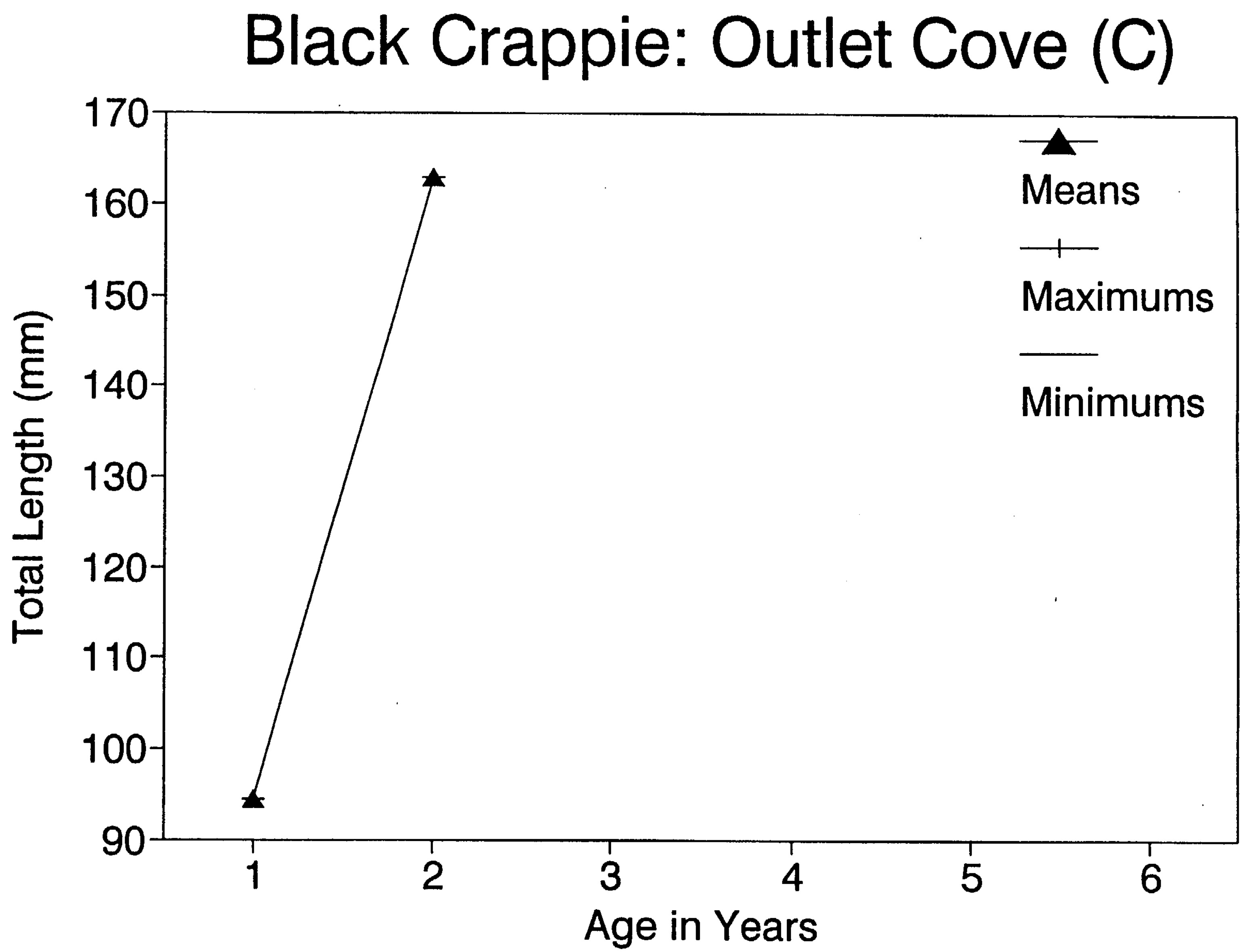


Figure 29. Growth of black crappie collected at Area C.

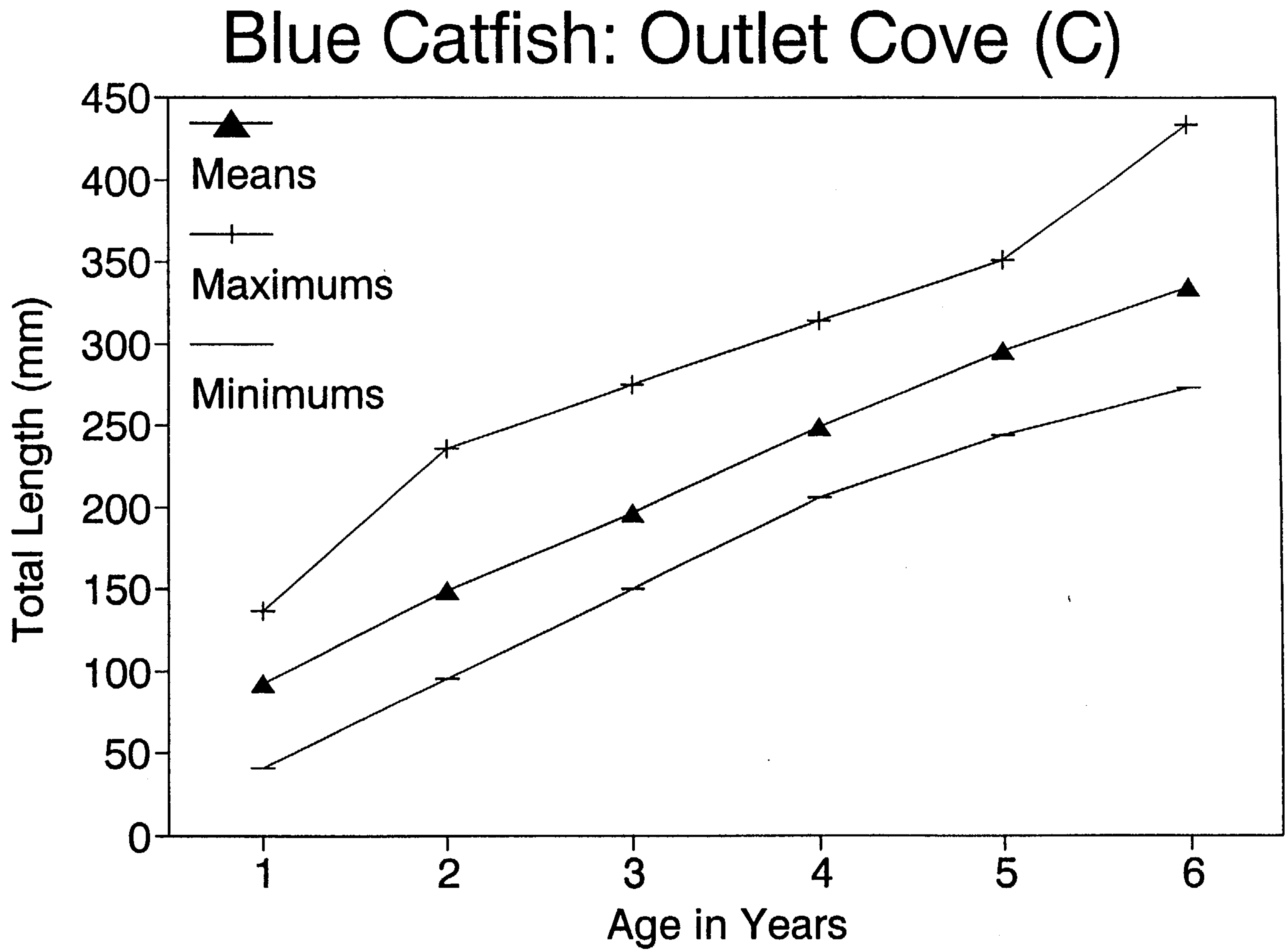


Figure 30. Growth of blue catfish collected at Area C.

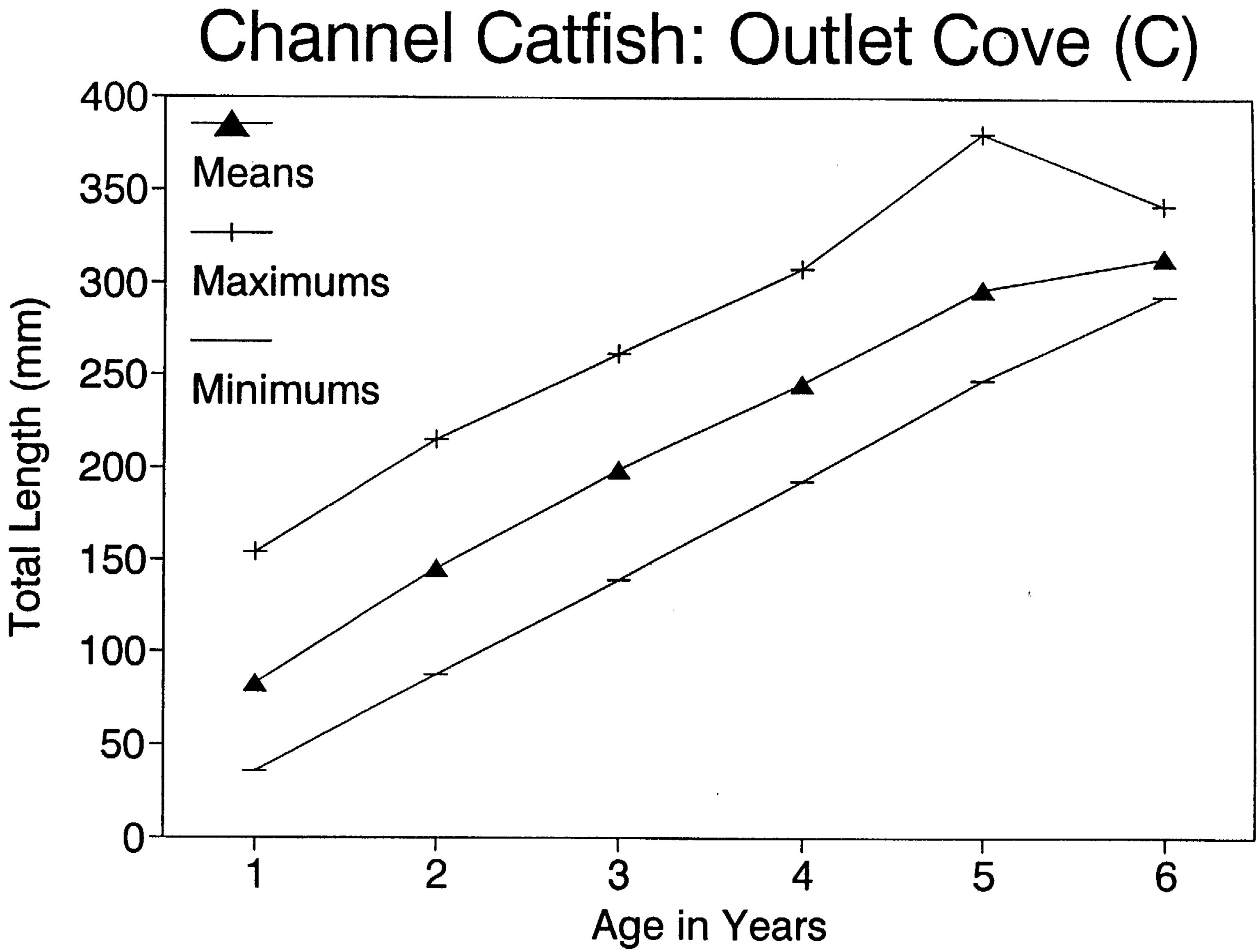


Figure 31. Growth of channel catfish collected at Area C.

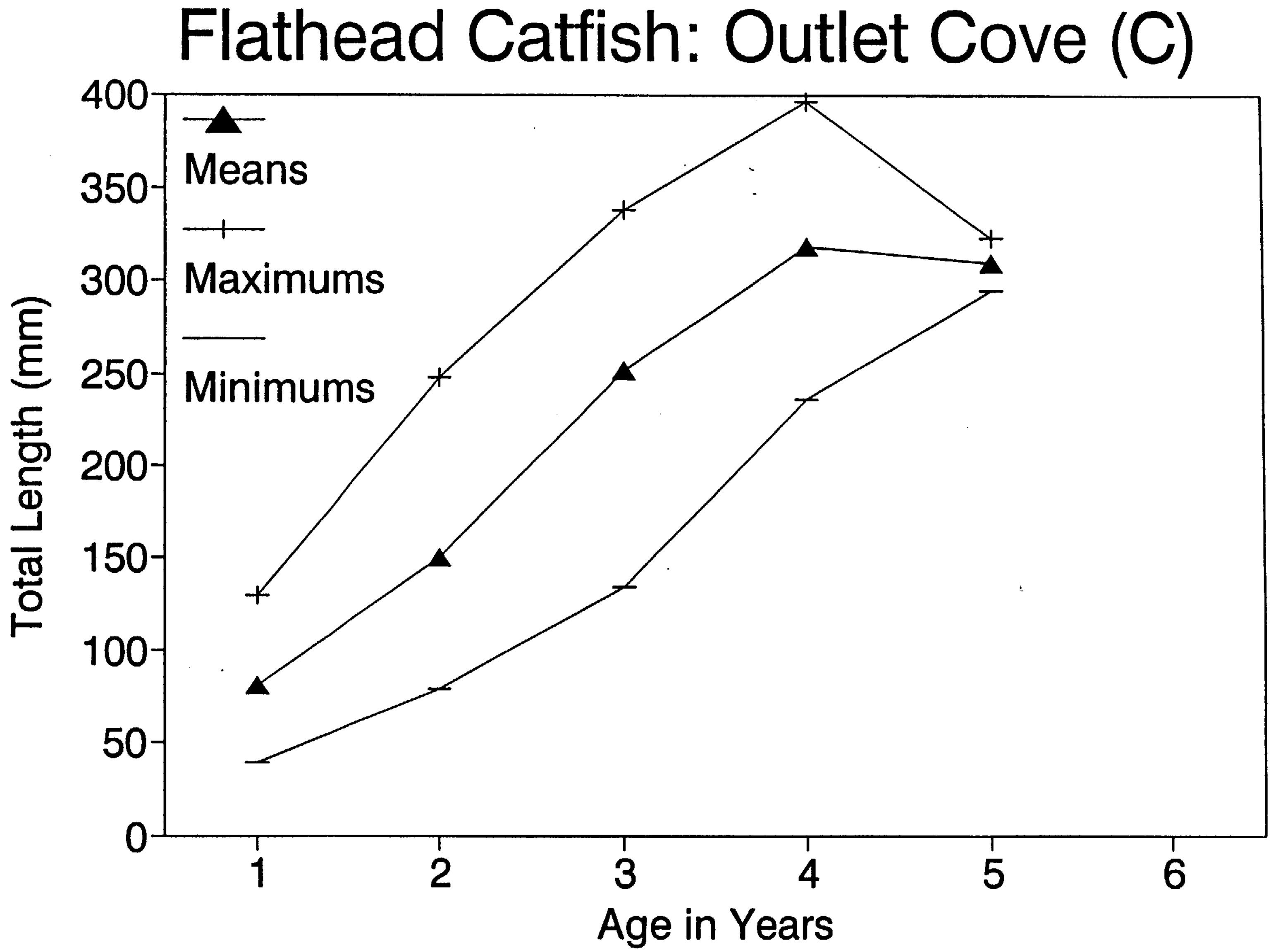


Figure 32. Growth of flathead catfish collected at Area C.

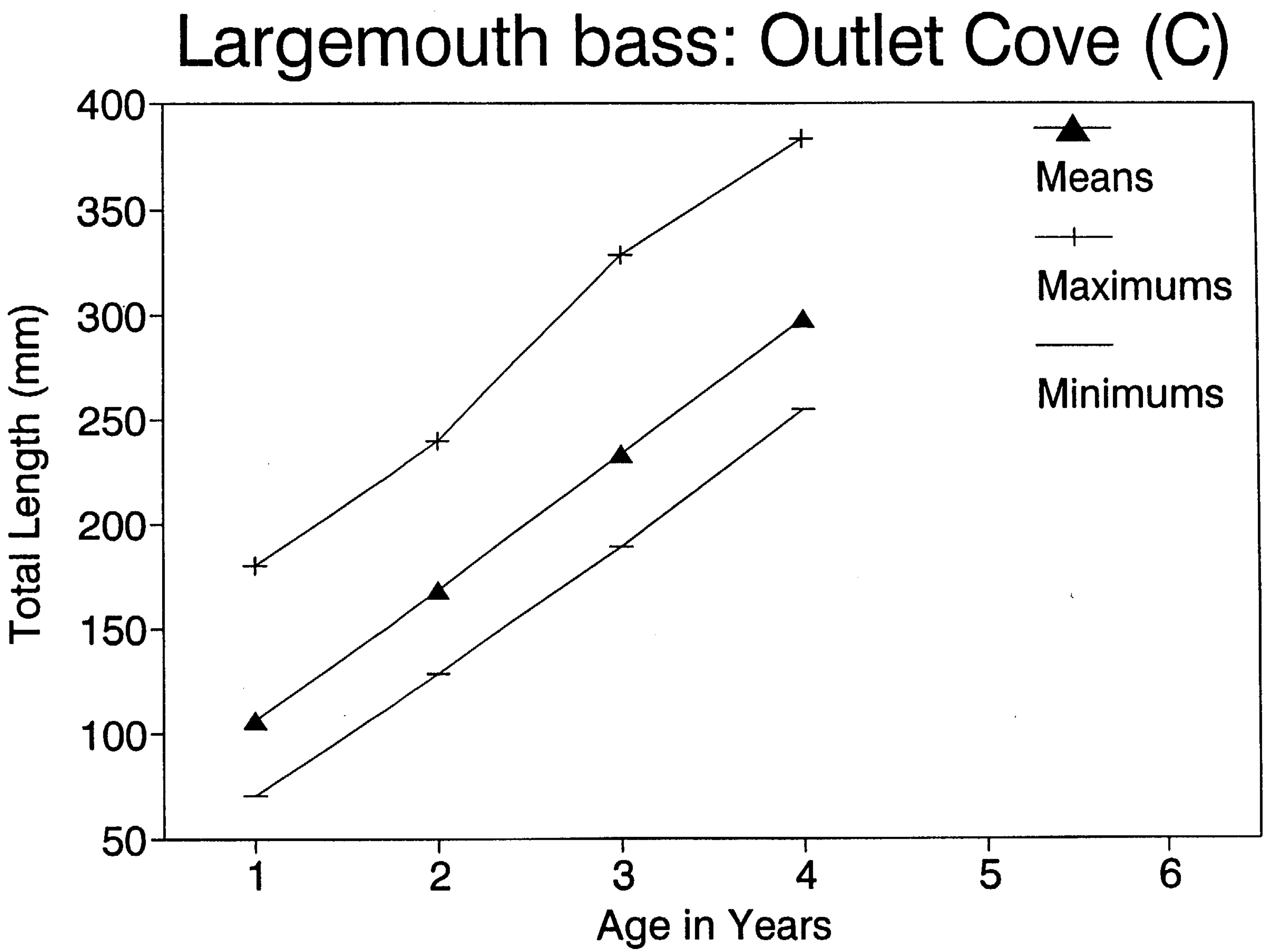


Figure 33. Growth of largemouth bass collected at Area C.

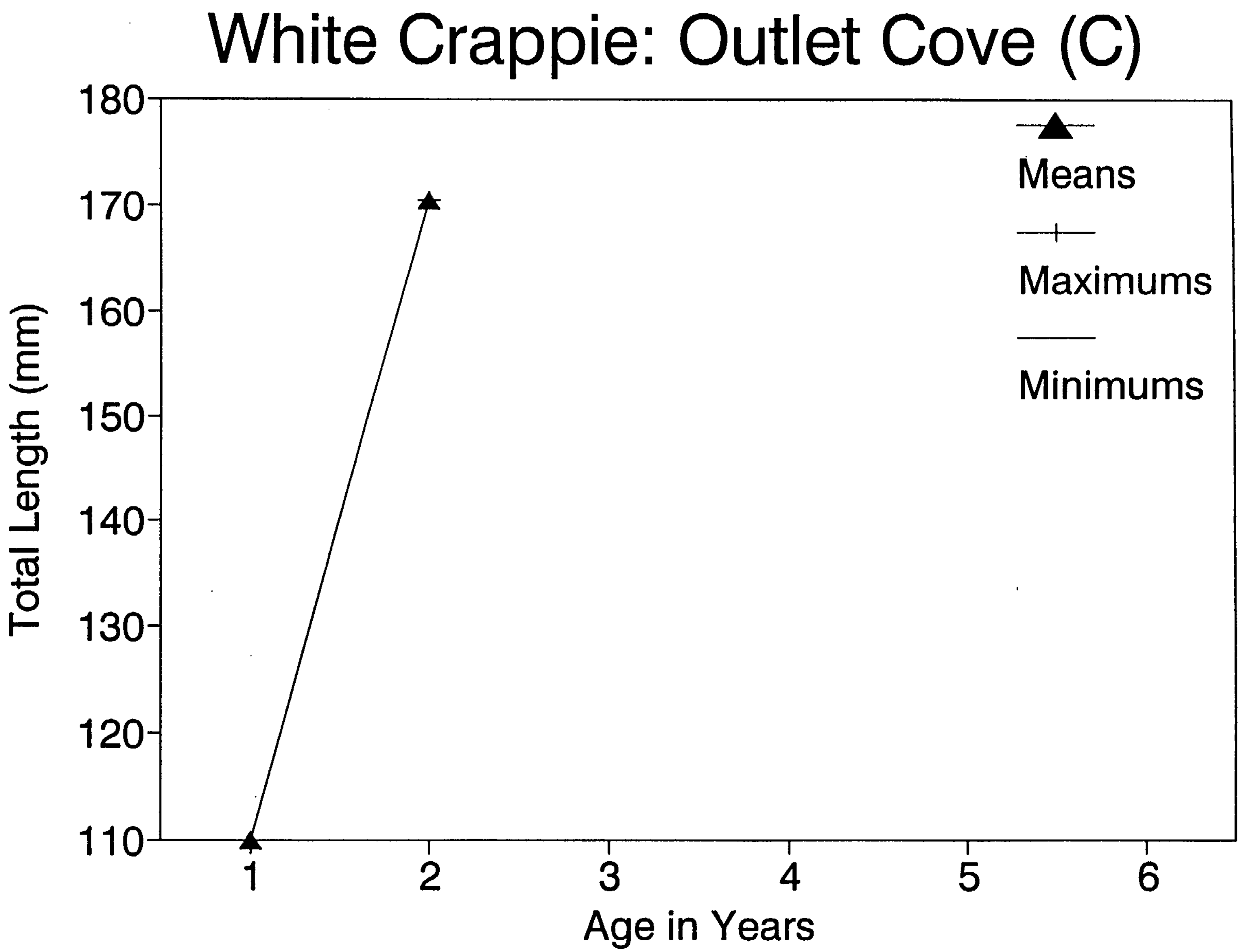


Figure 34. Growth of white crappie collected at Area C.

Zebra mussel sampling

Veliger, juvenile, and adult zebra mussel samples were collected in 1994. Veliger and juvenile zebra mussels were sampled at four fixed stations (Figure 1). Adults were sampled at random sites along the shoreline of Lake Dardanelle. Veliger samples were collected by both pumping water from a depth of three meters through a 64-micron mesh net, and pulling the net vertically from a depth of three meters to the surface. Due to pump failure, only vertical tows were taken on 1 March, 14 April, 29 April and 12 May. Only pump samples were collected on 30 January. Figures 35 and 36 show the differences in densities of zebra mussels and asiatic clams collected by both methods. Because the mean densities collected did not vary significantly by type of sample, results from the two types of samples are combined in this report. A summary of the results of random shoreline surveys to collect adult zebra mussels is contained in Table 33. PVC-plate samplers with attached glass slides were used to sample juvenile zebra mussels. No juveniles zebra mussels were collected on these samplers in 1993. In 1994, a few zebra mussels were recovered from the plates, but settling rates are still very low. A total of seven mussels were recovered from two plates ($15/m^2$) near Station 4 (intake) on April 14, 1994, and one was recovered ($2/m^2$) on October 30, 1994 from the same station. One zebra mussel ($2/m^2$) was also recovered from plates at Station 1 (Piney Bay) that were left out the entire sample season. A summary of the effort at each sample site is contained in Table 34. Figure 37 compares the densities of zebra mussel veligers and asiatic clam veligers among sample dates for all sites combined. Figures 38, 40, 42, and 44 compare the densities of zebra mussel veligers, asiatic clam veligers, and temperature, among sample dates at each site. Figures 39, 41, 43, and 45 compare turbidity, dissolved oxygen, and temperature, among sample dates at each site.

Table 33. Summary of effort to collect zebra mussel adults by shoreline sampling.

Date	Location	Water depth (m)	No. found (size range mm)	Effort (man-hours)
6/21/94	I-40 Bridge of Illinois Bayou	.91-1.52	0	.33
6/21/94	Dike Road Ramp	.91-1.22	0	.33
6/21/94	Dwight Mission Ramp	.61-.91	0	.25
6/24/94	Shoreline next to outlet cove (Area 2)	.91-1.52	1 (28)	NR[1]
7/15/94	ANO inlet channel	.61-.91	48 (6 to 32)	.83
7/19/94	Boat Ramp Lake Dardanelle State Park (Russellville)	.61-1.22	5 (4 to 19)	.83
7/19/94	I-40 Bridge at Mill Creek	.61-1.22	0	.66
7/19/94	East Shoreline off Highway 333 by Tyson Training Center	.61-.91	0	.33
10/20/94	Shoreline near AG&FC Nursery Ponds near Area 1	1-1.52	0	1
10/23/94	Shoreline near outlet cove (Area 2)	1	1 (15)	1.5
11/6/94	Shoreline near inlet cove (Area 4)	1	8 (17 to 27)	3

[1]Not recorded

Table 34. Summary of effort and results to collect juvenile zebra mussels with PVC-plate samplers suspended at a depth of three meters.

Sample Area	Deployment date	Deployment time	Retrieval date	Retrieval time	Water depth (m)	Number recovered[1]
1	11/10/93	14:30	11/13/94	12:40	6.4	0.5[2]
2	11/10/93	14:40	11/13/94	13:50	4.88	0
3	11/10/93	15:00	11/14/94	14:32	3.96	6
4	11/10/93	15:30	11/14/94	15:13	4.88	0
1	11/09/93	13:00	01/30/94	13:15	6.7	0[3]
2	11/10/93	14:20	01/30/94	14:30	5.7	0
3	11/16/93	15:00	01/30/94	15:00	6.9	0[3]
4	11/10/93	15:40	01/30/94	16:00	5.9	0[3]
1	12/15/93	11:15	02/16/94	14:30	6.71	0
2	12/15/93	12:20	02/16/94	15:45	5.18	0
3	12/15/93	12:30	02/18/94	14:20	4.27	0[3]
4	12/15/93	12:40	02/18/94	15:15	4.27	0
1	01/30/94	13:15	03/01/94	14:05	5.64	0
2	01/30/94	14:30	03/01/94	14:37	5.79	0
3	01/30/94	15:00	03/01/94	14:58	4.42	0
4	01/30/94	16:00	03/01/94	15:20	5.03	0
1	02/16/94	14:30	04/14/94	13:40	4.88	0
2	02/16/94	15:45	04/14/94	15:20	5.18	0
3	02/18/94	14:20	04/14/94	16:10	4.27	0
4	02/18/94	15:15	04/14/94	16:45	4.57	3.5
1	03/01/94	14:05	04/29/94	14:20	6.10	0
2	03/01/94	14:37	04/29/94	15:05	6.10	0
3	03/01/94	14:58	04/29/94	15:20	4.88	0
4	03/01/94	15:20	04/29/94	15:50	5.49	0
1	04/14/94	13:40	05/12/94	12:25	9.14	0
2	04/14/94	15:20	05/12/94	13:00	4.88	0
3	04/14/94	16:10	05/12/94	13:16	3.96	0
4	04/14/94	16:45	05/12/94	13:40	4.57	0
1	04/29/94	14:20	05/26/94	11:14	10.97	0
2	04/29/94	15:05	05/26/94	12:15	4.88	0
3	04/29/94	15:20	05/26/94	12:50	4.27	0
4	04/29/94	15:50	05/26/94	13:25	4.88	0
1	05/12/94	12:25	06/10/94	10:05	6.4	0
2	05/12/94	13:00	06/10/94	10:50	5.18	0
3	05/12/94	13:16	06/10/94	11:25	3.66	0
4	05/12/94	13:40	06/10/94	11:50	4.57	0
1	05/26/94	11:14	06/24/94	10:25	12.2	0
2	05/26/94	12:15	06/24/94	11:15	4.57	0
3	05/26/94	12:50	06/24/94	11:50	3.66	0

Table 34 continued. Summary of effort and results to collect juvenile zebra mussels with PVC-plate samplers suspended at a depth of three meters.

Sample Area	Deployment date	Deployment time	Retrieval date	Retrieval time	Water depth (m)	Number recovered
4	05/26/94	13:25	06/24/94	12:35	4.57	0
1	06/10/94	10:05	07/08/94	11:00	8.84	0
2	06/10/94	10:50	07/08/94	12:05	4.88	0
3	06/10/94	11:25	07/08/94	12:30	4.27	0
4	06/10/94	11:50	07/08/94	13:20	4.57	0
1	06/24/94	10:25	07/22/94	9:30	9.75	0
2	06/24/94	11:15	07/22/94	10:05	4.57	0
3	06/24/94	11:50	07/22/94	10:30	3.96	0
4	06/24/94	12:35	07/22/94	11:10	4.57	0
1	07/08/94	11:00	08/04/94	9:20	10.36	0
2	07/08/94	12:05	08/04/94	10:10	4.88	0
3	07/08/94	12:30	08/04/94	10:35	3.96	0
4	07/08/94	13:20	08/04/94	11:05	4.57	0
1	07/22/94	9:30	08/17/94	13:00	9.75	0
2	07/22/94	10:05	08/17/94	13:45	4.57	0
3	07/22/94	10:30	08/17/94	14:10	3.96	0
4	07/22/94	11:10	08/17/94	14:40	4.57	0
1	08/04/94	9:20	09/01/94	16:52	7.32	0
2	08/04/94	10:10	09/01/94	15:52	4.88	0
3	08/04/94	10:35	09/03/94	14:55	3.96	0
4	08/04/94	11:05	09/03/94	15:40	4.57	0
1	08/17/94	13:00	09/18/94	13:08	10.98	0
2	08/17/94	13:45	09/18/94	14:15	5.49	0
3	08/17/94	14:10	09/18/94	14:50	3.96	0
4	08/17/94	14:40	09/18/94	15:30	4.57	0
1	09/01/94	16:52	10/03/94	13:40	8.23	0
2	09/01/94	15:52	10/03/94	12:50	5.18	0
3	09/03/94	14:55	10/02/94	15:35	4.27	0
4	09/03/94	15:40	10/02/94	14:35	4.88	0
1	09/18/94	13:08	10/16/94	15:07	7.47	0
2	09/18/94	14:15	10/16/94	16:05	5.79	0
3	09/18/94	14:50	10/17/94	17:00	3.96	0
4	09/18/94	15:30	10/17/94	17:55	4.88	0
1	10/03/94	13:40	10/30/94	13:53	7.08	0.5
2	10/03/94	12:50	10/30/94	14:40	5.56	0
3	10/02/94	15:35	10/30/94	15:23	4.96	0
4	10/02/94	14:35	10/30/94	16:01	5.60	0
1	10/16/94	15:07	11/13/94	12:40	6.40	0
2	10/16/94	16:05	11/13/94	13:50	4.88	0

Table 34 continued. Summary of effort and results to collect juvenile zebra mussels with PVC-plate samplers suspended at a depth of three meters.

Sample Area	Deployment date	Deployment time	Retrieval date	Retrieval time	Water depth (m)	Number recovered
3	10/17/94	17:00	11/14/94	14:32	3.96	0
4	10/17/94	17:55	11/14/94	15:13	4.88	0
1	10/30/94	13:53	12/11/94	12:20	11.58	0
2	10/30/94	14:40	12/11/94	13:30	5.49	0
3	10/30/94	15:23	12/11/94	14:23	4.42	0
4	10/30/94	16:01	12/11/94	15:20	4.88	0

[1]Average of two plates unless noted otherwise.
[2]First four samples were left out entire sample season.
[3]Only one plate was recovered.

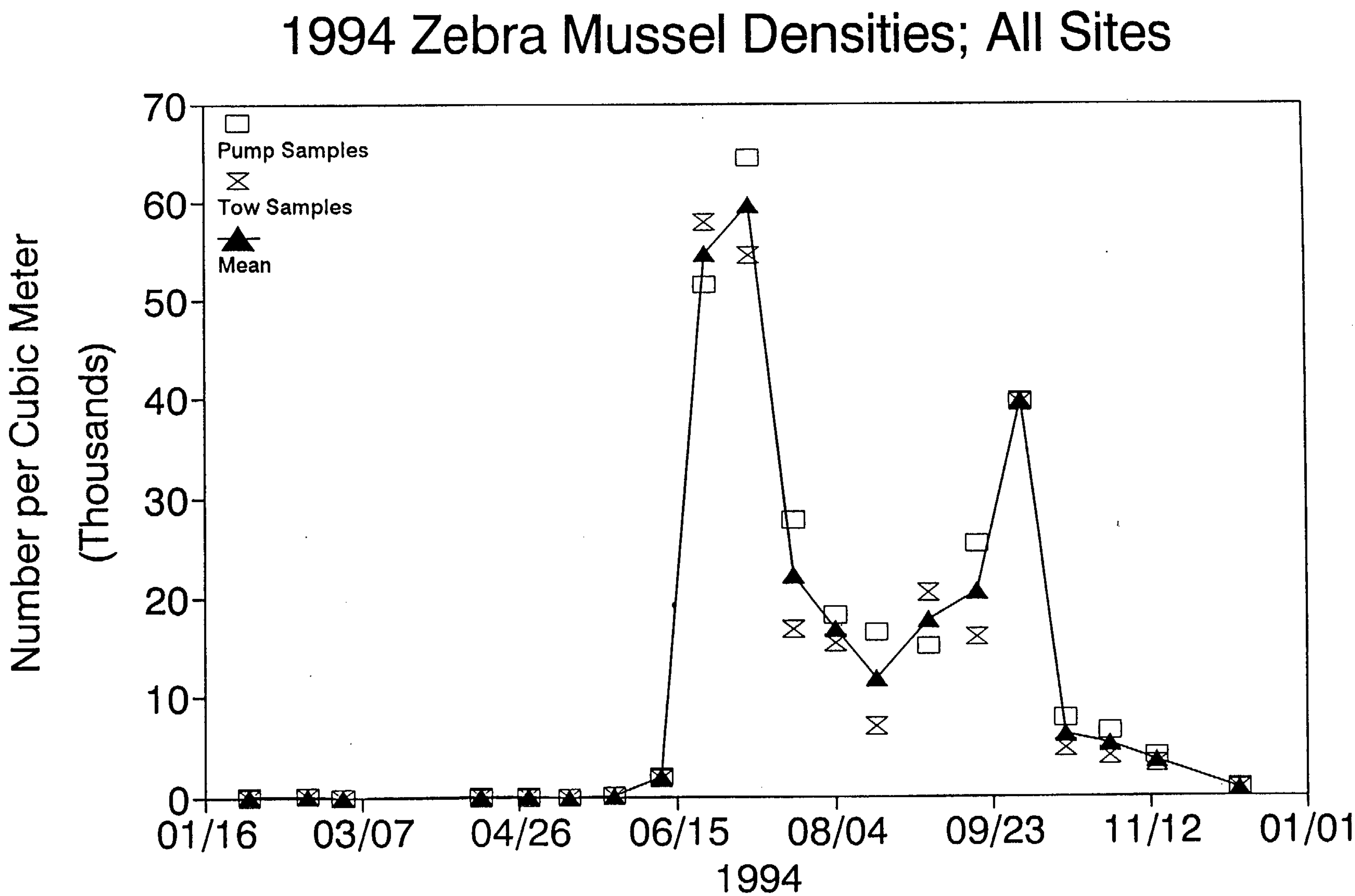


Figure 35. Densities of zebra mussels at all sites combined.

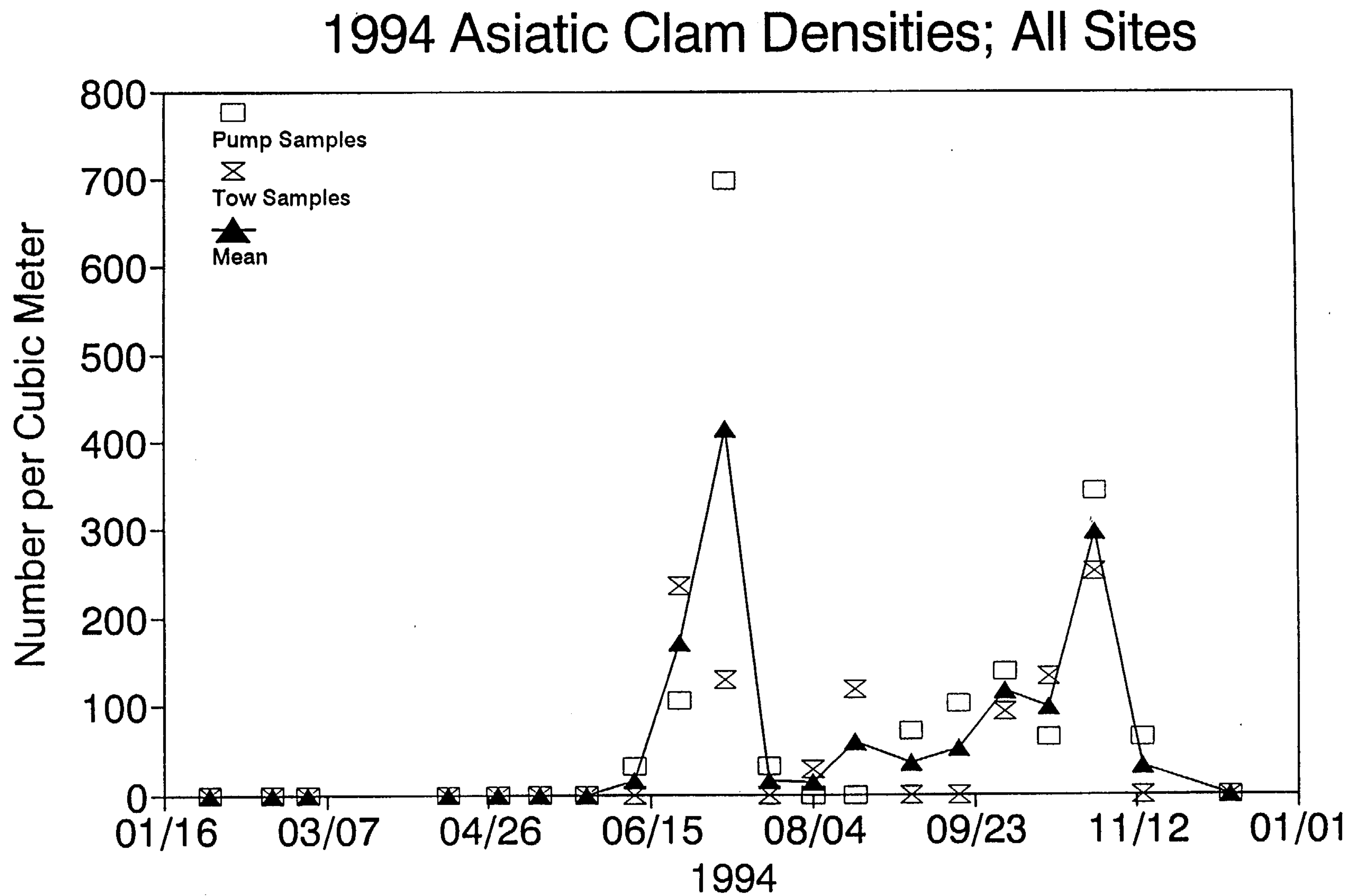


Figure 36. Densities of asiatic clams at all sites combined.

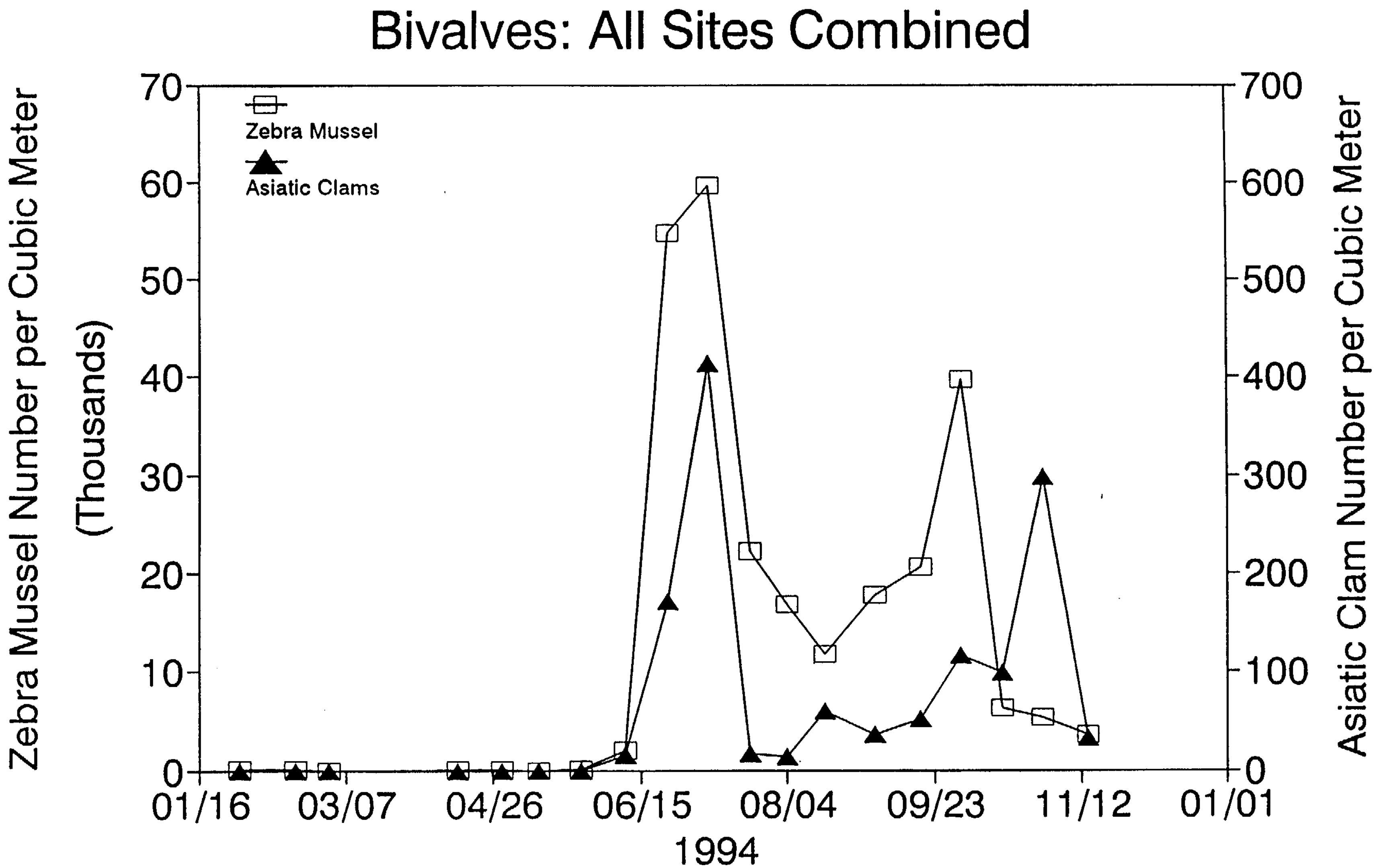


Figure 37. Changes in mean densities of bivalves at four sites on Lake Dardanelle in 1994.

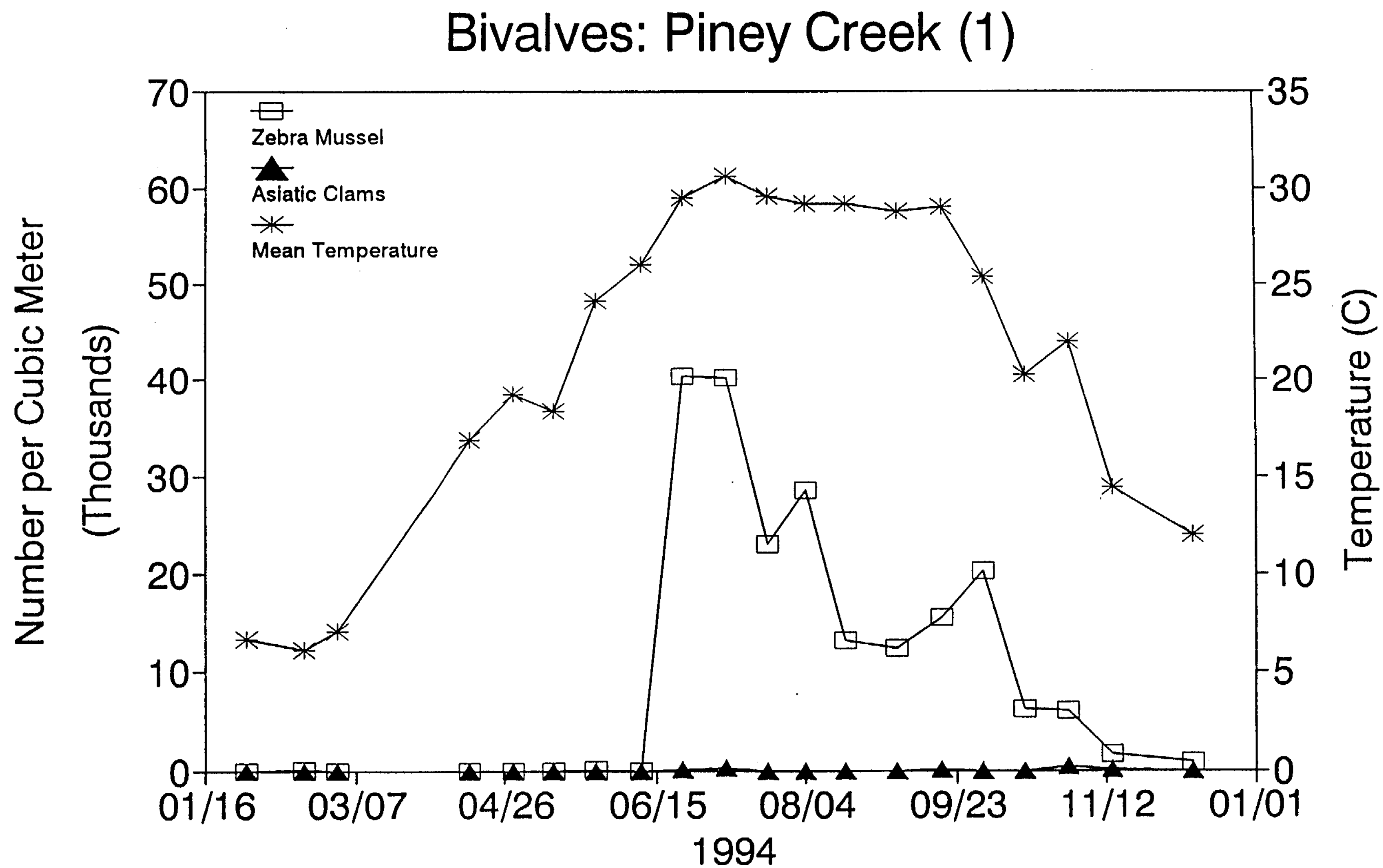


Figure 38. Changes in density of bivalves at Piney Creek (Site 1) in 1994.

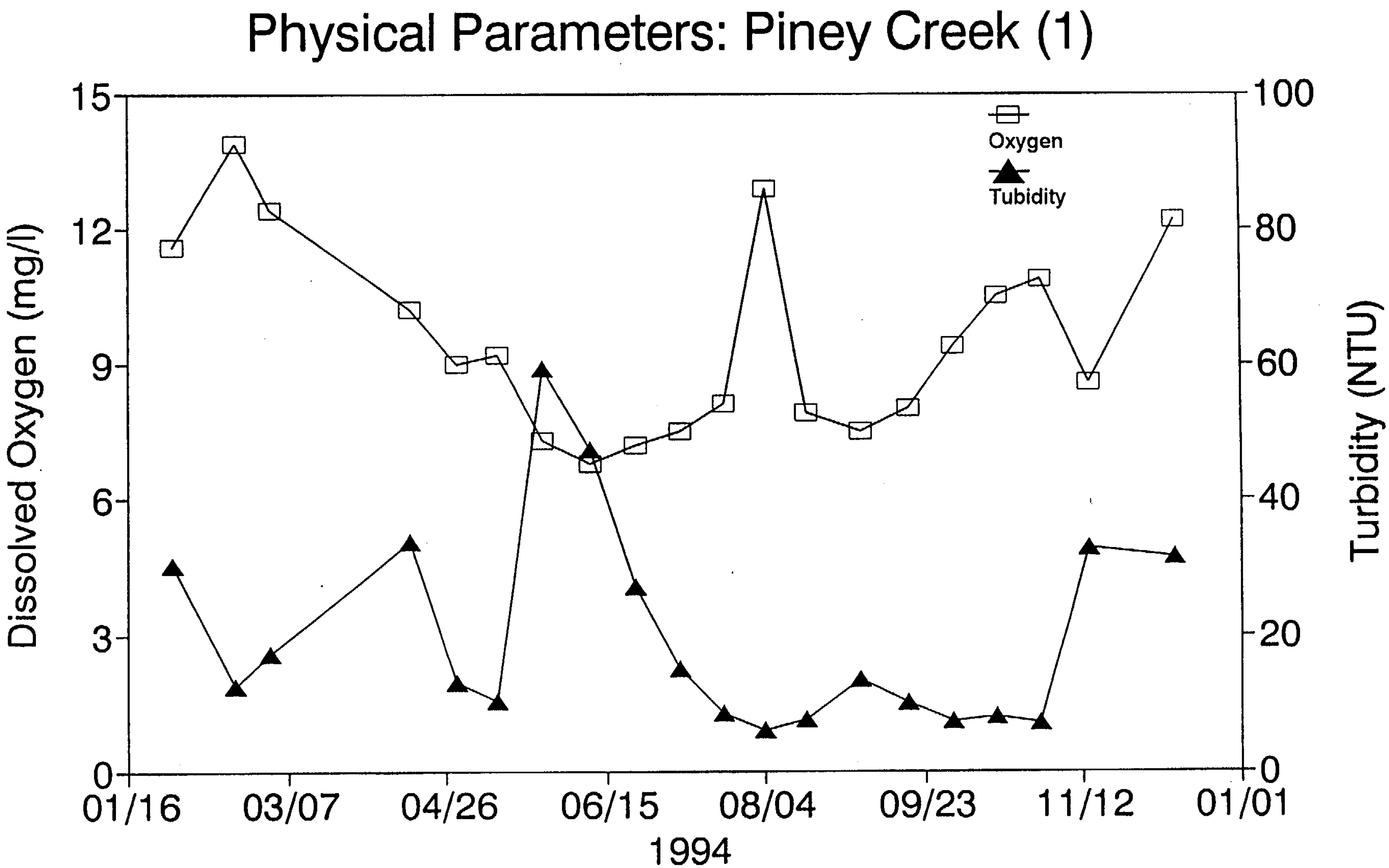


Figure 39. Changes in physical parameters at Piney Creek (Site 1) in 1994.

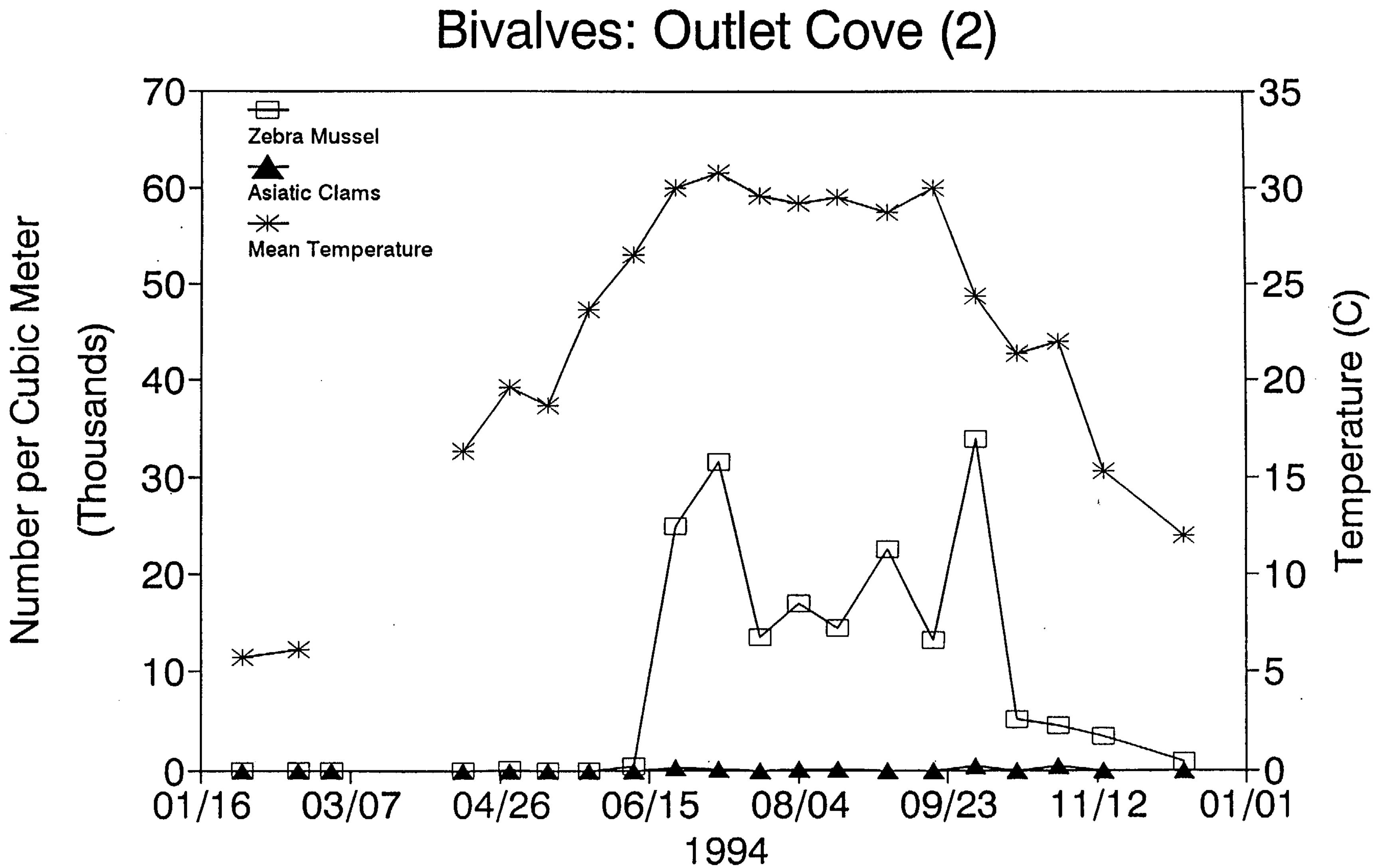


Figure 40. Changes in density of bivalves near Outlet Cove (Site 2) in 1994.

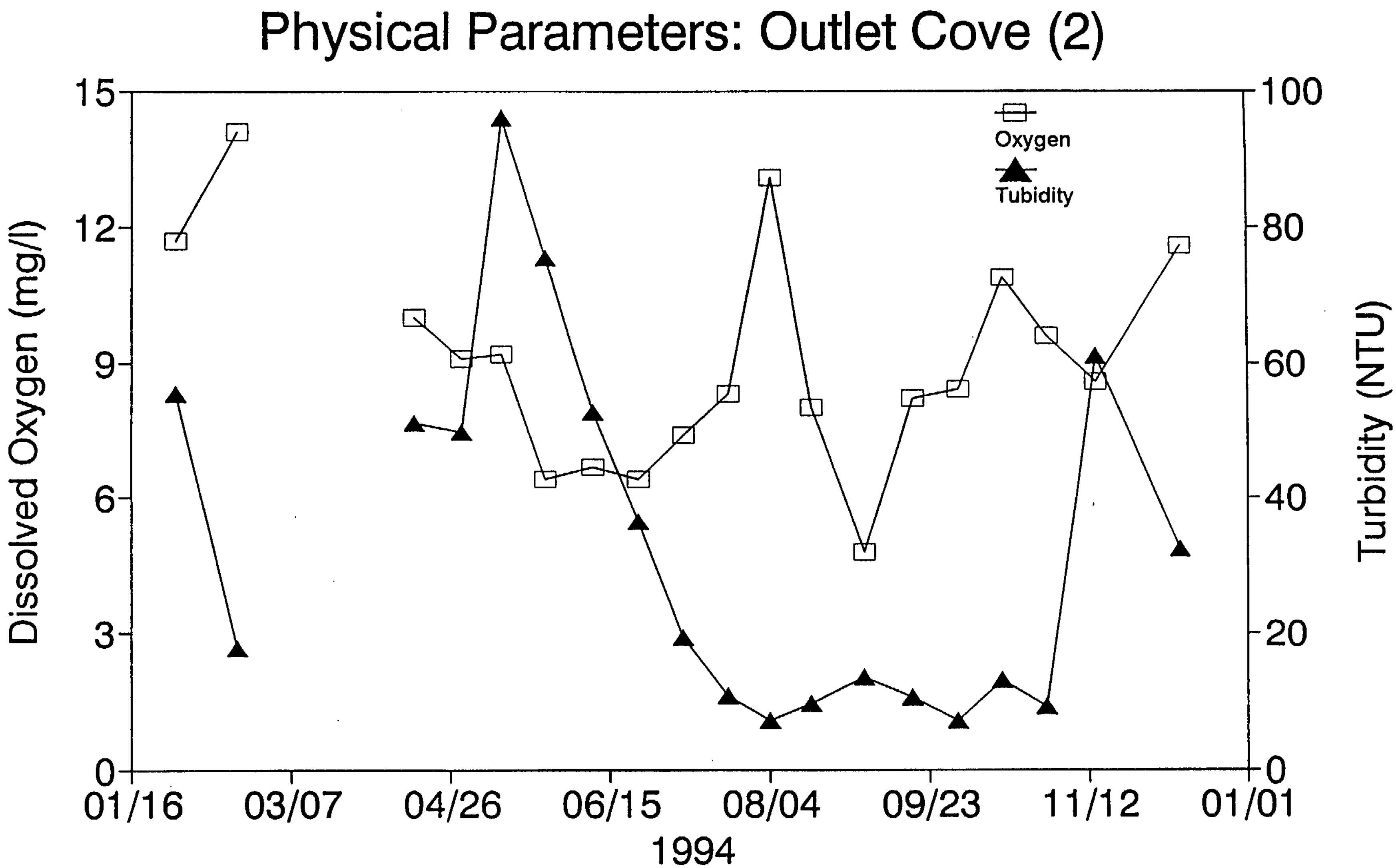


Figure 41. Changes in physical parameters near Outlet Cove (Site 2) in 1994.

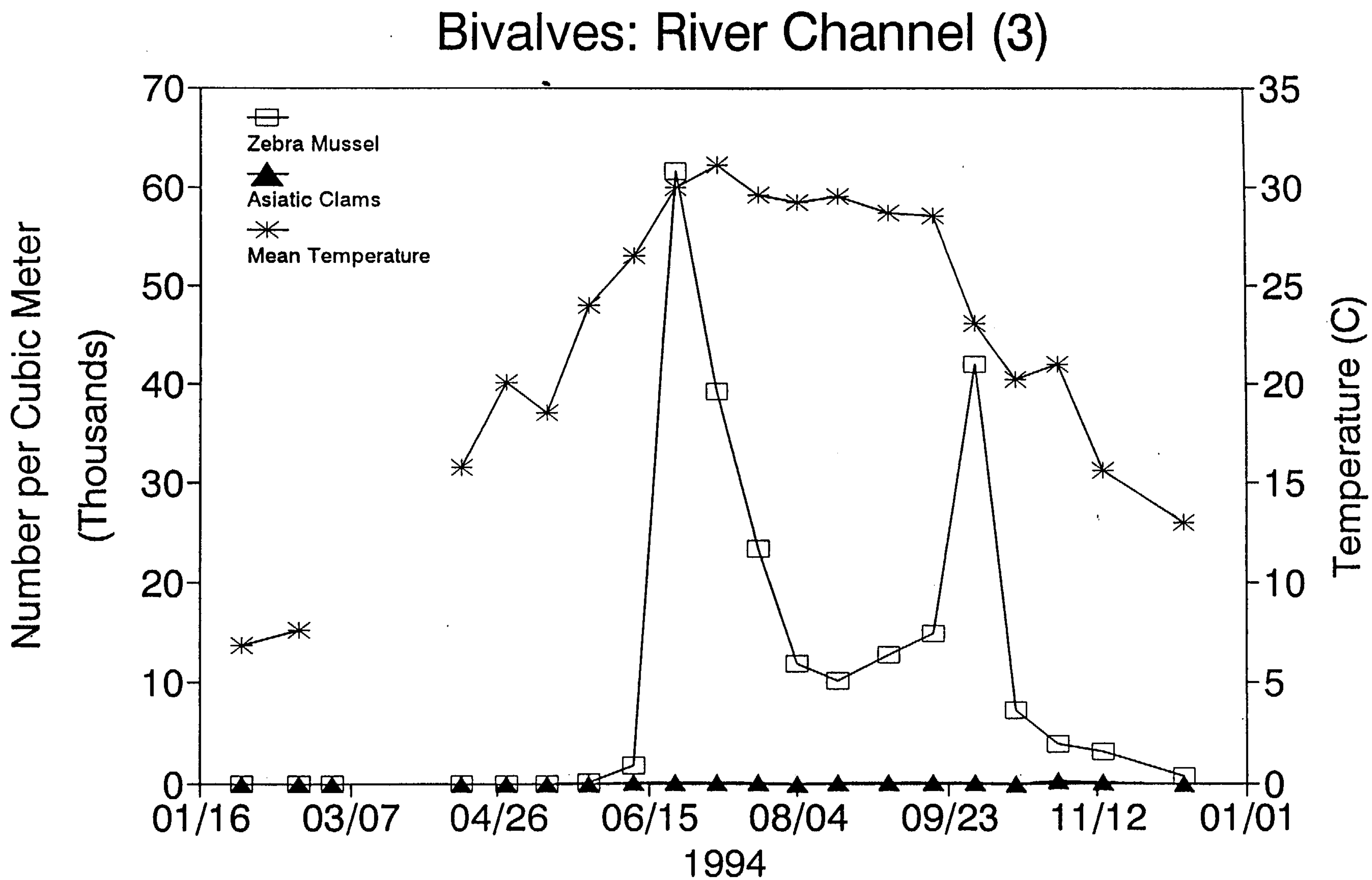


Figure 42. Changes in density of bivalves in the River Channel (Site 3) in 1994.

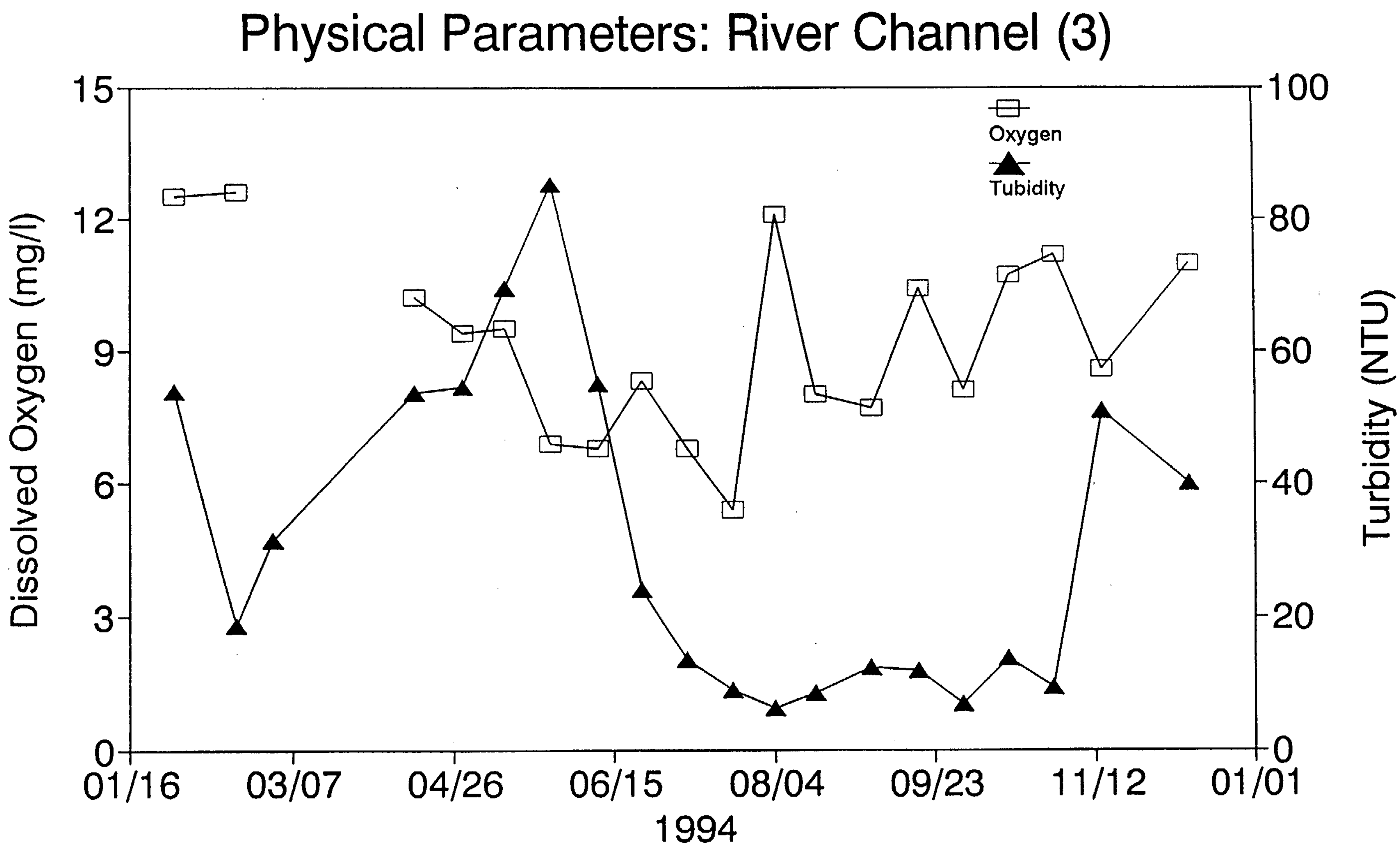


Figure 43. Changes in physical parameters in the River Channel (Site 3) in 1994.

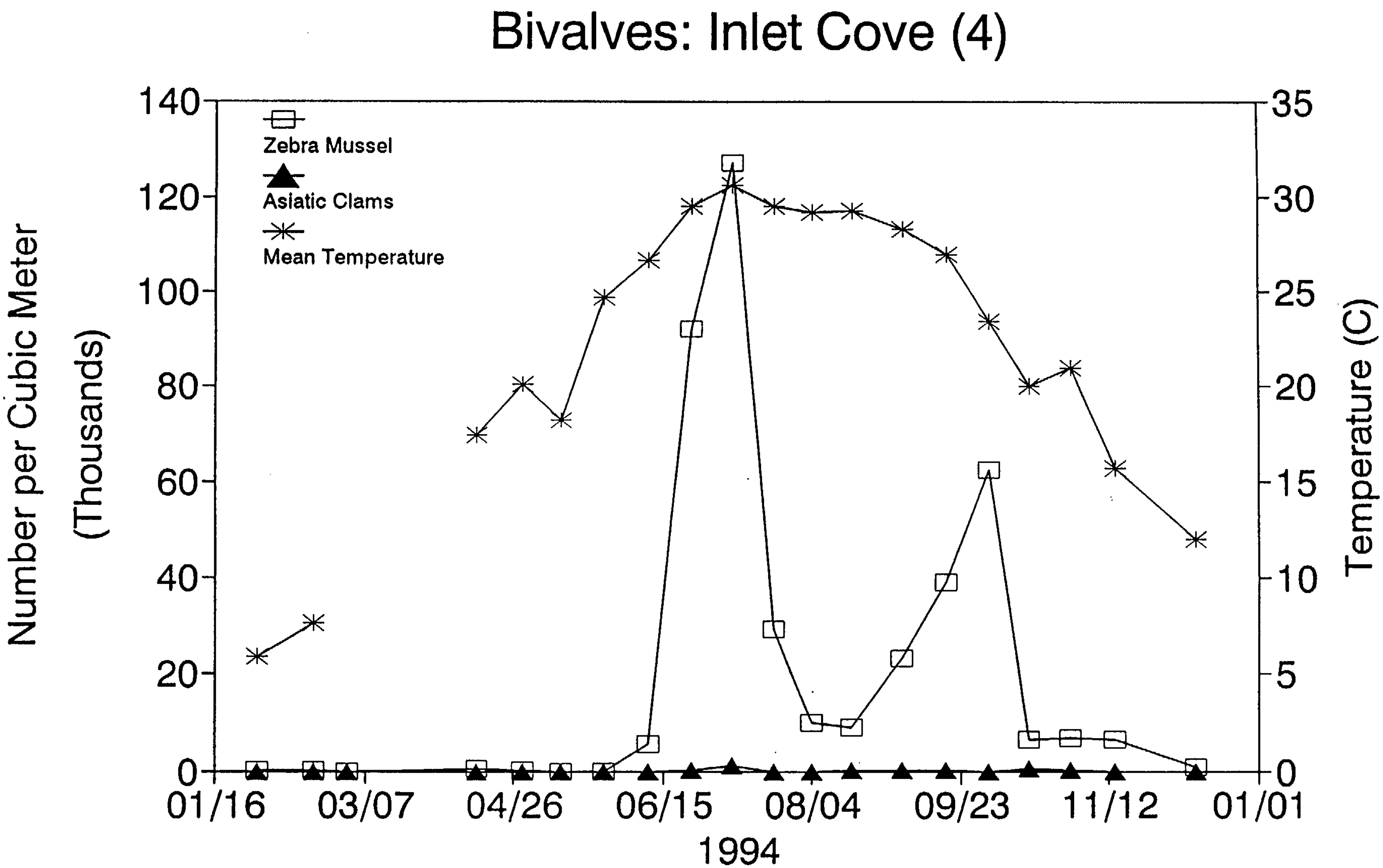


Figure 44. Changes in density of bivalves in the Inlet Cove (Site 4) in 1994.

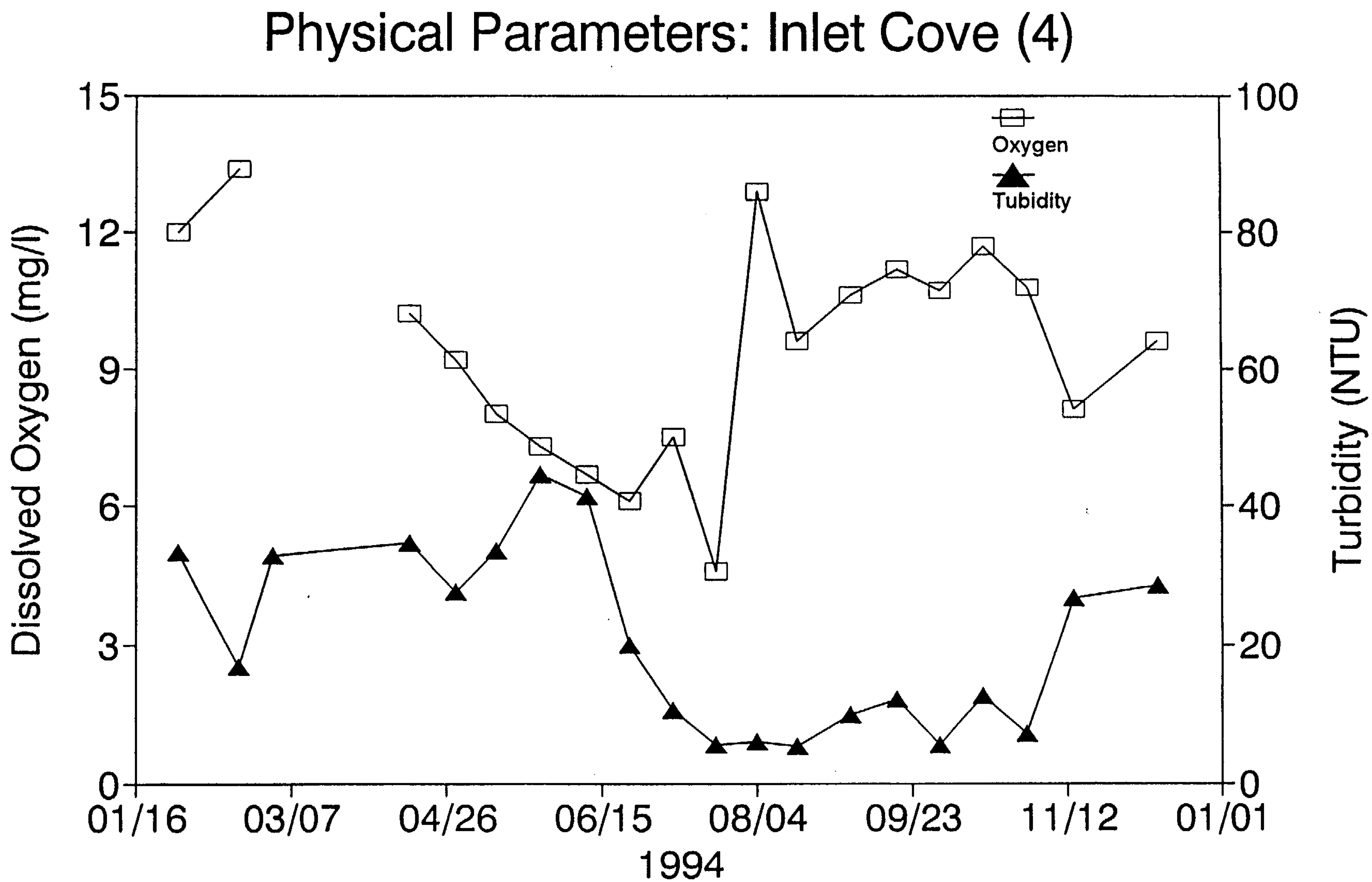
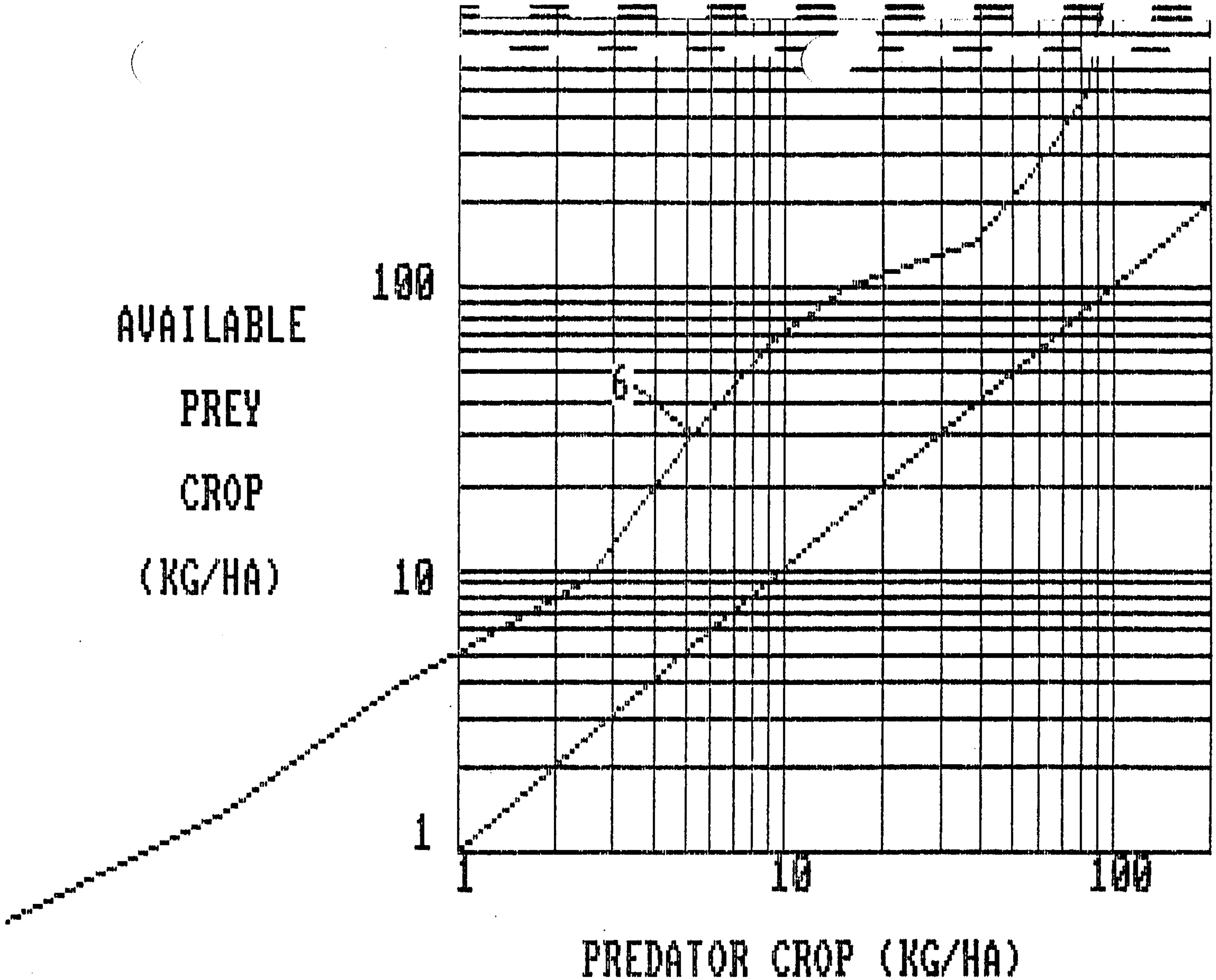


Figure 45. Changes in physical parameters in the Inlet Cove (Site 4) in 1994.

Rotenone samples

Two rotenone samples were collected on Lake Dardanelle during September, 1994. The first site sampled, Area C (Figure 1), is the southern cove located in the effluent bay of ANO, and the second site sampled, Area A (Figure 1), is located within Panther Cove. The cove in Area C was treated with rotenone on 12 September, and the cove in Area A was treated with rotenone on 15 September. Fish were picked up on two consecutive days following treatment. Fish samples collected on both days were used to evaluate species density and diversity, and fish samples collected on day one were used for age and growth studies at both sites (age and growth data were presented in a previous section). The following data summary was provided by the Arkansas Game and Fish Commission in their standard format. Therefore, the figures are not numbered in sequence with the remaining figures of the overall report.



Dardanelle 09/15/1994 Piney/Panther Cove

AVAILABLE PREY/PREDATOR MODEL

danelle 09/15/1994 Piney/Panther Cove % RECAP ADJ. INCLUDED COVE/OPEN WATER ADJ. INCLUDED

PREY

LENGTH GROUP	ΣPRED	ΣPREY	GSHAD+	TSHAD	SUNF	WBASS	BBASS	CARP	CATF	CRAPP	M+S	CATO	YPER	DART	DRUM
	0.01	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.01	0.00
3	0.20	1.44	0.00	0.01	0.94	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.01	0.00
	0.65	3.86	0.08	0.53	1.62	0.00	0.00	0.00	0.02	0.00	0.95	0.00	0.00	0.02	0.65
	2.49	8.94	0.23	1.52	3.55	0.00	0.00	0.00	0.05	0.24	1.35	0.00	0.00	0.10	1.90
	5.33	29.76	4.39	11.24	5.55	0.01	0.01	0.00	0.09	0.50	1.65	0.00	0.00	0.25	6.05
7	8.92	62.04	11.11	26.50	8.36	0.03	0.30	0.00	0.36	1.31	1.68	0.00	0.00	0.32	12.05
8	15.57	101.90	31.85	35.86	11.99	0.40	0.91	0.00	1.40	2.67	1.69	0.00	0.00	0.36	14.77
	37.88	145.90	58.34	42.79	15.85	0.90	2.07	0.00	3.74	4.00	1.69	0.00	0.00	0.36	16.15
	53.06	229.71	115.73	44.34	23.56	1.32	2.47	0.00	11.64	4.85	1.69	0.00	0.00	0.36	23.73
	66.92	323.95	180.54	44.60	31.26	1.72	2.63	0.00	22.63	5.71	1.69	0.00	0.00	0.36	32.80
12	75.13	407.00	223.26	44.64	38.75	1.83	2.63	0.00	39.74	6.11	1.69	0.03	0.00	0.36	47.97
	83.92	488.77	263.83	44.65	46.10	1.90	2.63	0.00	57.53	6.22	1.69	0.07	0.00	0.36	63.79
	87.72	762.34	490.31	44.65	53.11	1.90	2.63	0.00	75.64	6.37	1.69	0.14	0.00	0.36	85.54
	93.15	1025.72	710.77	44.65	58.40	1.90	2.63	0.00	90.71	6.69	1.69	0.22	0.00	0.36	107.70
16	95.26	1241.41	876.14	44.65	63.68	1.90	2.63	0.00	109.36	7.00	1.69	0.36	0.00	0.36	133.63
17	101.17	1426.50	1009.64	44.65	65.61	1.90	2.63	0.00	132.78	7.09	1.69	0.61	0.00	0.36	159.54
	107.28	1460.46	1012.40	44.65	66.20	1.90	2.63	0.00	136.87	7.09	1.69	1.27	0.00	0.36	185.40
	112.89	1488.41	1014.78	44.65	66.77	1.90	2.63	0.00	136.87	7.09	1.69	1.91	0.00	0.36	209.76
	115.65	1511.73	1016.20	44.65	67.30	1.90	2.63	0.00	136.87	7.09	1.69	2.49	0.00	0.36	230.54
21	119.71	1526.14	1017.07	44.65	67.84	1.90	2.63	0.00	136.87	7.09	1.69	2.85	0.00	0.36	243.19
	119.71	1526.23	1017.07	44.65	67.93	1.90	2.63	0.00	136.87	7.09	1.69	2.85	0.00	0.36	243.19
	119.71	1526.23	1017.07	44.65	67.93	1.90	2.63	0.00	136.87	7.09	1.69	2.85	0.00	0.36	243.19
	119.71	1526.23	1017.07	44.65	67.93	1.90	2.63	0.00	136.87	7.09	1.69	2.85	0.00	0.36	243.19
25	119.71	1526.23	1017.07	44.65	67.93	1.90	2.63	0.00	136.87	7.09	1.69	2.85	0.00	0.36	243.19
26	119.71	1526.23	1017.07	44.65	67.93	1.90	2.63	0.00	136.87	7.09	1.69	2.85	0.00	0.36	243.19
	119.71	1526.51	1017.07	44.65	67.93	1.90	2.63	0.28	136.87	7.09	1.69	2.85	0.00	0.36	243.19
	119.71	1526.91	1017.07	44.65	67.93	1.90	2.63	0.68	136.87	7.09	1.69	2.85	0.00	0.36	243.19

PREDATORS

LENGTH GROUP	AP/P RATIO	C-RATIO	ESOX	GAR	WALL	TBASS	CRAPPIE	BOWF	FCAT	OCAT	WBASS	STBASS	SKIPJ	BBASS
	27.95	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
	7.11	0.01	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00
4	5.95	0.03	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.43	0.20	0.00	0.02
	3.60	0.08	0.00	0.21	0.00	1.79	0.00	0.00	0.00	0.00	1.59	0.20	0.00	0.49
	5.59	0.25	0.00	0.87	0.00	2.14	0.00	0.00	0.00	0.00	1.95	0.20	0.00	2.31
	6.95	0.54	0.00	1.42	0.00	3.24	1.61	0.00	0.00	0.00	3.05	0.20	0.00	2.64
8	6.55	0.92	0.00	3.22	0.00	6.00	3.42	0.00	0.00	0.00	5.80	0.20	0.00	2.93
	3.85	1.40	0.00	5.78	0.00	8.34	7.11	0.00	0.00	0.00	8.15	0.20	0.00	16.63
	4.33	2.81	0.00	10.70	0.00	9.36	12.27	0.00	0.00	0.00	9.16	0.20	0.00	20.73
	4.84	4.86	0.00	10.70	0.00	11.54	14.73	0.00	0.00	6.26	11.34	0.20	0.00	23.69
12	5.42	7.71	0.00	10.70	0.00	11.65	14.73	0.00	0.00	10.58	11.45	0.20	0.00	27.47
13	5.82	10.96	0.00	10.70	0.00	11.65	14.73	0.00	0.00	16.09	11.45	0.20	0.00	30.75
	8.69	21.30	0.00	10.70	0.00	11.65	14.73	0.00	0.00	17.52	11.45	0.20	0.00	33.12
	11.01	32.06	0.00	10.70	0.00	11.65	14.73	0.00	0.00	22.95	11.45	0.20	0.00	33.12
	13.03	46.74	0.00	10.70	0.00	11.65	14.73	0.00	0.00	25.07	11.45	0.20	0.00	33.12
17	14.10	58.36	0.00	10.70	0.00	11.65	14.73	0.00	1.02	27.32	11.45	0.20	0.00	35.74
	13.61	78.77	0.00	10.70	0.00	11.65	14.73	0.00	2.09	28.43	11.45	0.20	0.00	39.69
	13.18	119.80	0.00	10.70	0.00	11.65	14.73	0.00	3.75	28.43	11.45	0.20	0.00	43.63
	13.07	221.69	0.00	10.70	0.00	11.65	14.73	0.00	3.75	28.43	11.45	0.20	0.00	46.38
21	12.75	375.82	0.00	10.70	0.00	11.65	14.73	0.00	4.99	28.43	11.45	0.20	0.00	49.20
22	12.75	0.00	0.00	10.70	0.00	11.65	14.73	0.00	4.99	28.43	11.45	0.20	0.00	49.20
	12.75	0.00	0.00	10.70	0.00	11.65	14.73	0.00	4.99	28.43	11.45	0.20	0.00	49.20
	12.75	0.00	0.00	10.70	0.00	11.65	14.73	0.00	4.99	28.43	11.45	0.20	0.00	49.20
	12.75	0.00	0.00	10.70	0.00	11.65	14.73	0.00	4.99	28.43	11.45	0.20	0.00	49.20
26	12.75	0.00	0.00	10.70	0.00	11.65	14.73	0.00	4.99	28.43	11.45	0.20	0.00	49.20
	12.75	0.00	0.00	10.70	0.00	11.65	14.73	0.00	4.99	28.43	11.45	0.20	0.00	49.20
	12.76	0.00	0.00	10.70	0.00	11.65	14.73	0.00	4.99	28.43	11.45	0.20	0.00	49.20

FISH POPULATION SAMPLE

ke: Dardanelle County: Yell

irst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	11	250 - 275	1.8		0.441		
	10	225 - 250	7.1		1.000		
	9	200 - 225	3.5		0.376		
	8	175 - 200	1.8		0.113		
Total				15.3	2.247	76.5%	
SPECIES TOTAL				17.1	2.937		0.2%
River Redhorse	,Intermediate						
	12	275 - 300	1.2		0.268		
	11	250 - 275	0.6		0.103		
Total				1.8	0.371	100.0%	
SPECIES TOTAL				1.8	0.371		0.0%
River Carpsucker	,Adult						
	20	475 - 500	1.8		2.471		
	19	450 - 475	2.9		4.044		
	18	425 - 450	11.8		14.000		
	17	400 - 425	20.0		20.000		
	16	375 - 400	12.9		10.434		
	15	350 - 375	1.2		0.870		
	14	325 - 350	0.6		0.316		
Total				51.2	52.135	98.7%	
River Carpsucker	,Intermediate						
	12	275 - 300	1.2		0.371		
	11	250 - 275	0.6		0.168		
	8	175 - 200	0.6		0.053		
	7	150 - 175	1.8		0.112		
Total				4.1	0.704	1.3%	
SPECIES TOTAL				55.3	52.839		3.9%
TOTAL COMMERCIAL FISH POPULATION				142.3	168.059		12.5%

SUMMARY

	Number/Ha	Weight (Kg/Ha)	Percent of Total
TOTAL PREDATOR FISH POPULATION	4205.3	331.921	24.7%
TOTAL FORAGE FISH POPULATION	22972.9	841.747	62.7%
TOTAL COMMERCIAL FISH POPULATION	142.3	168.059	12.5%
TOTAL FISH POPULATION	27320.5	1341.727	

Shannon-Wiener Species Diversity Function

Based on species only:	2.622
Based on species and length groups:	4.752

FISH POPULATION SAMPLE

'e: Dardanelle County: Yell

irst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Of Total
	19	450 - 475	5.9		10.220		
	18	425 - 450	2.4		3.794		
	17	400 - 425	4.7		5.588		
Total				24.7	49.851	84.3%	
Smallmouth Buffalo	,Intermediate						
	16	375 - 400	3.5		3.382		
	15	350 - 375	1.2		0.882		
	13	300 - 325	6.5		2.960		
	12	275 - 300	5.3		2.029		
Total				16.5	9.253	15.7%	
SPECIES TOTAL				41.2	59.104		4.4%
Bigmouth Buffalo	,Adult						
	24	575 - 600	0.6		2.147		
	23	550 - 575	1.2		3.647		
	22	525 - 550	1.2		3.382		
	21	500 - 525	0.6		1.206		
Total				3.5	10.382	92.2%	
ligmouth Buffalo	,Intermediate						
	14	325 - 350	0.6		0.353		
	12	275 - 300	0.6		0.212		
	11	250 - 275	0.6		0.171		
	9	200 - 225	0.6		0.078		
	8	175 - 200	0.6		0.059		
Total				2.9	0.873	7.8%	
SPECIES TOTAL				6.5	11.255		0.8%
Common Carp	,Adult						
	26	625 - 650	0.6		1.853		
	25	600 - 625	2.9		8.333		
	24	575 - 600	2.4		7.883		
	23	550 - 575	3.5		8.435		
	22	525 - 550	1.2		2.470		
	21	500 - 525	1.8		3.353		
	20	475 - 500	1.2		1.882		
	19	450 - 475	2.4		2.824		
	18	425 - 450	1.2		1.530		
	17	400 - 425	0.6		0.529		
	16	375 - 400	2.4		2.079		
	15	350 - 375	0.6		0.382		
Total				20.6	41.553	100.0%	
SPECIES TOTAL				20.6	41.553		3.1%
Spotted Sucker	,Adult						
	14	325 - 350	0.6		0.271		
	13	300 - 325	1.2		0.419		
Total				1.8	0.690	23.5%	
ɔotted Sucker	,Intermediate						
	12	275 - 300	1.2		0.317		

FISH POPULATION SAMPLE

'e: Dardanelle County: Yell

irst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	5	100 - 125	842.4		9.888		
	4	75 - 100	3171.8		21.786		
Total				4031.2	32.062	95.7%	
Threadfin Shad	,Intermediate						
	3	50 - 75	496.5		1.411		
	2	25 - 50	12.4		0.014		
Total				508.8	1.425	4.3%	
SPECIES TOTAL				4540.0	33.487		2.5%
Blackspotted Topminnow	,Adult						
	4	75 - 100	1.2		0.008		
	3	50 - 75	36.5		0.055		
Total				37.6	0.063	100.0%	
SPECIES TOTAL				37.6	0.063		0.0%
Mosquitofish	,Intermediate						
	2	25 - 50	34.1		0.034		
Total				34.1	0.034	94.4%	
Mosquitofish	,Young						
	1	0 - 25	2.9		0.002		
Total				2.9	0.002	5.6%	
SPECIES TOTAL				37.1	0.036		0.0%
Inland Silverside	,Adult						
	4	75 - 100	7.1		0.014		
	3	50 - 75	56.5		0.097		
Total				63.5	0.111	97.4%	
Inland Silverside	,Intermediate						
	2	25 - 50	2.4		0.003		
Total				2.4	0.003	2.6%	
SPECIES TOTAL				65.9	0.114		0.0%
Central Stoneroller	,Intermediate						
	3	50 - 75	0.6		0.001		
Total				0.6	0.001	100.0%	
SPECIES TOTAL				0.6	0.001		0.0%
Silver Chub	,Intermediate						
	5	100 - 125	0.6		0.007		
	4	75 - 100	57.6		0.214		
Total				58.2	0.221	71.8%	
Silver Chub	,Young						
	3	50 - 75	28.2		0.087		
Total				28.2	0.087	28.2%	
SPECIES TOTAL				86.5	0.308		0.0%
TOTAL FORAGE FISH POPULATION				22972.9	841.747		62.7%
Smallmouth Buffalo	,Adult						
	24	575 - 600	1.2		4.833		
	22	525 - 550	2.4		7.137		
	21	500 - 525	2.9		7.206		
	20	475 - 500	5.3		11.073		

FISH POPULATION SAMPLE

:: Dardanelle County: Yell

irst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
Bullhead Minnow	,Adult						
	3	50 - 75	80.6		0.115		
Total				80.6	0.115	40.2%	
Bullhead Minnow	,Intermediate						
	2	25 - 50	353.5		0.171		
Total				353.5	0.171	59.8%	
SPECIES TOTAL				434.1	0.286		0.0%
Emerald Shiner	.Intermediate						
	3	50 - 75	14.7		0.021		
	2	25 - 50	16.5		0.015		
Total				31.2	0.036	100.0%	
SPECIES TOTAL				31.2	0.036		0.0%
Logperch	,Adult						
	5	100 - 125	4.1		0.049		
Total				4.1	0.049	29.2%	
Logperch	,Intermediate						
	4	75 - 100	17.1		0.119		
Total				17.1	0.119	70.8%	
SPECIES TOTAL				21.2	0.168		0.0%
River Darter	,Adult						
	4	75 - 100	0.6		0.002		
	3	50 - 75	2.9		0.004		
Total				3.5	0.006	46.2%	
River Darter	,Intermediate						
	2	25 - 50	13.5		0.007		
Total				13.5	0.007	53.8%	
SPECIES TOTAL				17.1	0.013		0.0%
Gizzard Shad	,Adult						
	11	250 - 275	19.4		1.941		
	10	225 - 250	44.7		3.863		
	9	200 - 225	2768.2		235.967		
	8	175 - 200	4898.8		323.182		
Total				7731.2	564.953	74.1%	
Gizzard Shad	.Intermediate						
	7	150 - 175	1193.5		57.588		
	6	125 - 150	316.5		92.379		
	5	100 - 125	2850.0		37.469		
	4	75 - 100	1380.0		9.497		
Total				5740.0	196.933	25.8%	
Gizzard Shad	.Young						
	3	50 - 75	71.8		0.215		
Total				71.8	0.215	0.0%	
SPECIES TOTAL				13542.9	762.101		56.8%
Threadfin Shad	,Adult						
	7	150 - 175	0.6		0.017		
	6	125 - 150	16.5		0.371		

FISH POPULATION SAMPLE

ke: Dardanelle County: Yell

irst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	5	100 - 125	57.6		1.340		
	4	75 - 100	355.9		4.397		
Total				413.5	5.737	67.5%	
Longear Sunfish	.Young						
	3	50 - 75	363.5		1.817		
	2	25 - 50	704.1		0.943		
Total				1067.6	2.760	32.5%	
SPECIES TOTAL				1481.2	8.497		0.6%
Redear Sunfish	.Adult						
	9	200 - 225	2.4		0.339		
	8	175 - 200	0.6		0.062		
	7	150 - 175	2.9		0.273		
	6	125 - 150	27.1		0.993		
Total				32.9	1.667	56.6%	
Redear Sunfish	,Intermediate						
	5	100 - 125	41.2		1.133		
	4	75 - 100	12.4		0.135		
Total				53.5	1.268	43.1%	
dear Sunfish	,Young						
	2	25 - 50	4.1		0.009		
Total				4.1	0.009	0.3%	
SPECIES TOTAL				90.6	2.944		0.2%
Black Bullhead	,Adult						
	9	200 - 225	1.8		0.187		
Total				1.8	0.187	63.6%	
Black Bullhead	.Intermediate						
	8	175 - 200	0.6		0.053		
	7	150 - 175	0.6		0.034		
	6	125 - 150	0.6		0.020		
Total				1.8	0.107	36.4%	
SPECIES TOTAL				3.5	0.294		0.0%
Yellow Bullhead	.Adult						
	11	250 - 275	0.6		0.176		
	10	225 - 250	2.9		0.479		
Total				3.5	0.655	48.2%	
Yellow Bullhead	.Intermediate						
	8	175 - 200	0.6		0.051		
	7	150 - 175	6.5		0.350		
	6	125 - 150	4.7		0.160		
	5	100 - 125	7.1		0.085		
Total				18.8	0.646	47.6%	
Yellow Bullhead	,Young						
	4	75 - 100	6.5		0.049		
	3	50 - 75	1.8		0.008		
Total				8.2	0.057	4.2%	
SPECIES TOTAL				30.6	1.358		0.1%

FISH POPULATION SAMPLE

ʼʼe: Dardanelle County: Yell

irst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	5	100 - 125	24.1		0.385		
	4	75 - 100	30.6		0.367		
Total				54.7	0.752	73.6%	
Green Sunfish	,Young						
	3	50 - 75	41.8		0.083		
	2	25 - 50	29.4		0.021		
Total				71.2	0.104	10.2%	
SPECIES TOTAL				128.2	1.022		0.1%
Warmouth	,Adult						
	9	200 - 225	1.2		0.236		
	8	175 - 200	2.4		0.322		
	7	150 - 175	13.5		1.244		
	6	125 - 150	38.8		1.838		
Total				55.9	3.640	60.4%	
Warmouth	,Intermediate						
	5	100 - 125	24.1		0.868		
	4	75 - 100	54.7		0.875		
Total				78.8	1.743	28.9%	
rmouth	,Young						
	3	50 - 75	110.0		0.283		
	2	25 - 50	280.6		0.359		
Total				390.6	0.642	10.7%	
SPECIES TOTAL				525.3	6.025		0.4%
Orangespotted Sunfish	,Intermediate						
	4	75 - 100	18.2		0.110		
Total				18.2	0.110	18.5%	
Orangespotted Sunfish	,Young						
	3	50 - 75	77.1		0.308		
	2	25 - 50	158.2		0.176		
Total				235.3	0.484	81.5%	
SPECIES TOTAL				253.5	0.594		0.0%
Bluegill	,Adult						
	8	175 - 200	1.8		0.255		
	7	150 - 175	48.8		4.069		
	6	125 - 150	160.6		6.848		
Total				211.2	11.172	45.8%	
Bluegill	,Intermediate						
	5	100 - 125	244.7		6.458		
	4	75 - 100	370.6		3.706		
Total				615.3	10.164	41.7%	
Bluegill	,Young						
	3	50 - 75	552.4		2.788		
	2	25 - 50	267.1		0.276		
Total				819.4	3.064	12.6%	
SPECIES TOTAL				1645.9	24.400		1.8%
Longear Sunfish	,Intermediate						

FISH POPULATION SAMPLE

'e: Dardanelle County: Yell

rst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	25	600 - 625	1.2		3.411		
	24	575 - 600	0.6		1.487		
	23	550 - 575	1.8		5.559		
	22	525 - 550	1.8		5.382		
	21	500 - 525	4.1		8.235		
	20	475 - 500	2.4		3.214		
	19	450 - 475	1.8		2.427		
	18	425 - 450	2.9		3.382		
	17	400 - 425	4.7		4.306		
	16	375 - 400	38.8		26.400		
	15	350 - 375	2.9		1.513		
	14	325 - 350	10.6		4.853		
	13	300 - 325	8.2		3.344		
	12	275 - 300	30.6		8.412		
	11	250 - 275	44.1		9.264		
Total				157.1	94.160	54.0%	
Freshwater Drum	.Intermediate						
	10	225 - 250	72.4		11.531		
	9	200 - 225	227.1		21.444		
	8	175 - 200	260.6		17.993		
	7	150 - 175	273.5		13.082		
	6	125 - 150	262.9		8.217		
	5	100 - 125	98.2		1.251		
Total				1194.7	73.518	42.2%	
reshwater Drum	.Young						
	4	75 - 100	783.5		5.431		
	3	50 - 75	328.8		1.136		
	2	25 - 50	0.6		0.001		
Total				1112.9	6.568	3.8%	
SPECIES TOTAL				2464.7	174.246		13.0%
Skipjack Herring	.Adult						
	11	250 - 275	1.2		0.094		
	10	225 - 250	1.2		0.080		
Total				2.4	0.174	24.8%	
kipjack Herring	.Intermediate						
	6	125 - 150	4.7		0.103		
	5	100 - 125	33.5		0.336		
	4	75 - 100	22.4		0.089		
Total				60.6	0.528	75.2%	
SPECIES TOTAL				62.9	0.702		0.1%
TOTAL PREDATOR FISH POPULATION				4205.3	331.921		24.7%
reen Sunfish	.Adult						
	7	150 - 175	1.8		0.139		
	6	125 - 150	0.6		0.027		
Total				2.4	0.166	16.2%	
reen Sunfish	.Intermediate						

FISH POPULATION SAMPLE

e: Dardanelle County: Yell

irst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
White Crappie	,Young						
	3	50 - 75	97.6		0.355		
Total				97.6	0.355	5.3%	
SPECIES TOTAL				457.1	6.733		0.5%
Black Crappie	,Adult						
	15	350 - 375	0.6		0.466		
	13	300 - 325	0.6		0.296		
	11	250 - 275	0.6		0.174		
	10	225 - 250	1.2		0.218		
	9	200 - 225	3.5		0.549		
	8	175 - 200	14.7		1.213		
Total				21.2	2.916	81.0%	
Black Crappie	,Intermediate						
	7	150 - 175	1.8		0.106		
	6	125 - 150	2.4		0.097		
	5	100 - 125	7.6		0.107		
	4	75 - 100	38.2		0.335		
Total				50.0	0.645	17.9%	
ıck Crappie	,Young						
	3	50 - 75	10.0		0.041		
Total				10.0	0.041	1.1%	
SPECIES TOTAL				81.2	3.602		0.3%
Spotted Gar	,Adult						
	28	675 - 700	1.2		1.358		
	27	650 - 675	0.6		0.601		
	26	625 - 650	1.2		1.058		
	25	600 - 625	0.6		0.463		
Total				3.5	3.480	69.5%	
Spotted Gar	,Intermediate						
	23	550 - 575	0.6		0.350		
	20	475 - 500	1.2		0.436		
	17	400 - 425	1.2		0.250		
	16	375 - 400	0.6		0.129		
	14	325 - 350	0.6		0.065		
	13	300 - 325	2.9		0.294		
Total				7.1	1.524	30.5%	
SPECIES TOTAL				10.6	5.004		0.4%
Longnose Gar	,Intermediate						
	23	550 - 575	0.6		0.373		
	22	525 - 550	0.6		0.322		
	20	475 - 500	0.6		0.236		
	13	300 - 325	0.6		0.057		
Total				2.4	0.988	100.0%	
SPECIES TOTAL				2.4	0.988		0.1%
eshwater Drum	,Adult						
	26	625 - 650	0.6		2.971		

FISH POPULATION SAMPLE

: Dardanelle County: Yell

F rst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	7	150 - 175	115.9		3.833		
	6	125 - 150	124.7		2.806		
	5	100 - 125	20.0		0.274		
Total				554.7	35.747	59.5%	
hannel Catfish	,Young						
	4	75 - 100	1.8		0.009		
	3	50 - 75	2.9		0.009		
	2	25 - 50	0.6		0.001		
Total				5.3	0.019	0.0%	
SPECIES TOTAL				622.9	60.105		4.5%
lathead Catfish	,Adult						
	25	600 - 625	1.2		0.942		
	22	525 - 550	1.2		2.074		
	20	475 - 500	0.6		0.776		
	14	325 - 350	0.6		0.186		
	13	300 - 325	1.2		0.369		
Total				4.7	4.347	75.6%	
athead Catfish	,Intermediate						
	12	275 - 300	1.2		0.302		
	11	250 - 275	1.2		0.210		
	10	225 - 250	2.4		0.312		
	9	200 - 225	1.8		0.160		
	8	175 - 200	4.1		0.206		
	7	150 - 175	2.9		0.106		
	6	125 - 150	3.5		0.092		
	5	100 - 125	0.6		0.011		
Total				17.6	1.399	24.3%	
lathead Catfish	,Young						
	4	75 - 100	0.6		0.003		
	3	50 - 75	1.2		0.002		
Total				1.8	0.005	0.1%	
SPECIES TOTAL				24.1	5.751		0.4%
Jhite Crappie	,Adult						
	14	325 - 350	1.2		0.735		
	13	300 - 325	1.8		0.882		
	12	275 - 300	1.2		0.471		
	10	225 - 250	2.4		0.471		
	9	200 - 225	4.1		0.309		
	8	175 - 200	7.1		0.676		
Total				17.6	3.544	52.6%	
White Crappie	.Intermediate						
	7	150 - 175	3.5		0.236		
	6	125 - 150	1.2		0.028		
	5	100 - 125	63.5		0.813		
	4	75 - 100	273.5		1.757		
Total				341.8	2.834	42.1%	

FISH POPULATION SAMPLE

ɜ: Dardanelle County: Yell

.rst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
SPECIES TOTAL				58.2	4.694		0.3%
:triped Bass	.Young						
	4	75 - 100	12.9		0.078		
	3	50 - 75	0.6		0.002		
	2	25 - 50	0.6		0.001		
Total				14.1	0.081	100.0%	
SPECIES TOTAL				14.1	0.081		0.0%
:lue Catfish	.Adult						
	27	650 - 675	0.6		1.714		
	24	575 - 600	1.2		2.765		
	23	550 - 575	0.6		1.176		
	21	500 - 525	0.6		0.794		
	18	425 - 450	0.6		0.494		
	17	400 - 425	1.2		0.706		
	16	375 - 400	2.9		1.568		
	15	350 - 375	7.1		2.263		
	14	325 - 350	5.3		1.412		
	13	300 - 325	11.2		2.622		
Total				31.2	15.514	35.9%	
ɒıue Catfish	.Intermediate						
	12	275 - 300	23.5		4.211		
	11	250 - 275	47.1		10.932		
	10	225 - 250	24.1		2.487		
	9	200 - 225	70.6		6.150		
	8	175 - 200	68.2		3.325		
	7	150 - 175	15.9		0.556		
	6	125 - 150	0.6		0.009		
Total				250.0	27.670	64.1%	
SPECIES TOTAL				281.2	43.184		3.2%
Channel Catfish	.Adult						
	21	500 - 525	0.6		0.618		
	20	475 - 500	1.8		2.071		
	19	450 - 475	1.2		1.164		
	18	425 - 450	1.8		1.459		
	17	400 - 425	2.4		1.529		
	16	375 - 400	9.4		5.251		
	15	350 - 375	13.5		5.615		
	14	325 - 350	10.0		3.000		
	13	300 - 325	22.4		3.632		
Total				62.9	24.339	40.5%	
Channel Catfish	.Intermediate						
	12	275 - 300	38.8		7.946		
	11	250 - 275	57.6		7.812		
	10	225 - 250	47.1		4.706		
	9	200 - 225	44.1		3.046		
	8	175 - 200	106.5		5.324		

FISH POPULATION SAMPLE

'e: Dardanelle County: Yell

.rst day of sampling: 09/15/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
.argemouth Bass	,Adult						
	21	500 - 525	0.6		1.263		
	20	475 - 500	0.6		1.235		
	19	450 - 475	1.2		1.764		
	18	425 - 450	1.2		1.765		
	17	400 - 425	1.2		1.176		
	14	325 - 350	1.8		1.059		
	13	300 - 325	2.9		1.470		
	12	275 - 300	5.3		1.694		
	11	250 - 275	5.3		1.323		
	10	225 - 250	14.7		2.732		
Total				34.7	15.481	57.9%	
Largemouth Bass	,Intermediate						
	9	200 - 225	13.5		9.133		
	8	175 - 200	1.8		0.154		
	7	150 - 175	4.1		0.211		
	6	125 - 150	34.1		1.196		
Total				53.5	10.694	40.0%	
'gemouth Bass	,Young						
	5	100 - 125	32.9		0.549		
	4	75 - 100	2.4		0.018		
Total				35.3	0.567	2.1%	
SPECIES TOTAL				123.5	26.742		2.0%
Spotted Bass	,Intermediate						
	8	175 - 200	0.6		0.051		
	6	125 - 150	0.6		0.018		
	5	100 - 125	1.2		0.020		
Total				2.4	0.089	100.0%	
SPECIES TOTAL				2.4	0.089		0.0%
White Bass	,Adult						
	14	325 - 350	1.2		0.625		
	13	300 - 325	1.8		0.729		
	11	250 - 275	3.5		0.824		
	10	225 - 250	5.3		0.921		
	9	200 - 225	5.3		0.678		
Total				17.1	3.777	80.5%	
White Bass	,Intermediate						
	8	175 - 200	1.8		0.137		
	7	150 - 175	1.2		0.057		
	6	125 - 150	10.6		0.312		
	5	100 - 125	24.7		0.395		
Total				38.2	0.901	19.2%	
'ite Bass	,Young						
	4	75 - 100	2.4		0.015		
	3	50 - 75	0.6		0.001		
Total				2.9	0.016	0.3%	

FISH POPULATION SAMPLE

Lake: Dardanelle Hectares: 13765 County: Yell

rst day of sampling: 09/15/1994 Sample Design: Cove

Ownership: Corps of Engineers Sample Location: Piney/Panther Cove

Sample Size: 1.7 (ha). Water Volume: 3.2 (ha/m) Water Temp.:24.6 Deg.C.

Secchi Disk Reading: 0.60 meters. Water Depth: Max. 5.8 meters Avg. 1.9 meters

Block-off Net: Yes Rotenone Amount: 26.4 kg Rotenone Type: powder

Collectors: Limbird AP&L Van Horn ATU stu

SPECIES SUMMARY

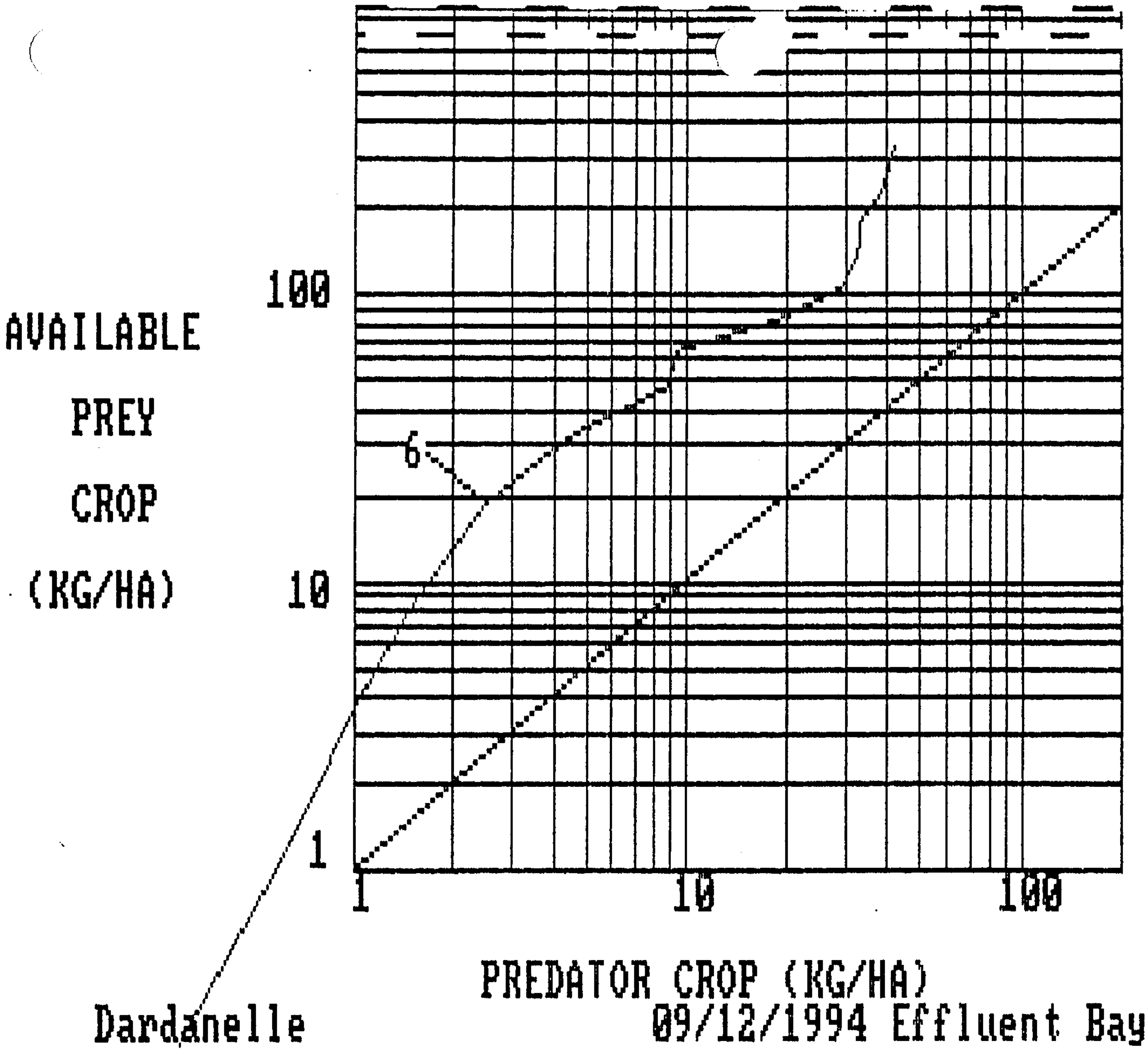
Species	No./ha.	Kg./ha.	% of Total by Weight	Dominant Size Group
Largemouth Bass	123.524	26.742	2.0	6
potted Bass	2.352	0.089	0.0	5
hite Bass	58.234	4.694	0.3	5
Striped Bass	14.117	0.081	0.0	4
Blue Catfish	281.175	43.184	3.2	9
hannel Catfish	622.941	60.105	4.5	6
lathead Catfish	24.113	5.751	0.4	8
White Crappie	457.056	6.733	0.5	4
ack Crappie	81.175	3.602	0.3	4
tted Gar	10.585	5.004	0.4	13
Longnose Gar	2.352	0.988	0.1	13
Freshwater Drum	2464.702	174.246	13.0	4
kipjack Herring	62.941	0.702	0.1	5
Green Sunfish	128.234	1.022	0.1	3
Warmouth	525.293	6.025	0.4	2
rangespotted Sunfish	253.529	0.594	0.0	2
Bluegill	1645.880	24.400	1.8	3
Longear Sunfish	1481.176	8.497	0.6	2
edear Sunfish	90.588	2.944	0.2	5
lack Bullhead	3.528	0.294	0.0	9
Yellow Bullhead	30.588	1.358	0.1	5
Bullhead Minnow	434.114	0.286	0.0	2
merald Shiner	31.177	0.036	0.0	2
Logperch	21.176	0.168	0.0	4
River Darter	17.058	0.013	0.0	2
izzard Shad	13542.941	762.101	56.8	8
hreadfin Shad	4539.999	33.487	2.5	4
Blackspotted Topminnow	37.646	0.063	0.0	3
Mosquitofish	37.059	0.036	0.0	2
nland Silverside	65.883	0.114	0.0	3
Central Stoneroller	0.588	0.001	0.0	3
Silver Chub	86.470	0.308	0.0	4
mallmouth Buffalo	41.173	59.104	4.4	13
gmouth Buffalo	6.468	11.255	0.8	22
mmon Carp	20.586	41.553	3.1	23
otted Sucker	17.058	2.937	0.2	10
iver Redhorse	1.764	0.371	0.0	12
River Carpsucker	55.291	52.839	3.9	17
TOTAL	27320.525	1341.727		

FISH POPULATION HISTORY

for

Dardanelle

Date	09/10/1990	09/16/1991	09/03/1992	09/07/1993	09/12/1994
Location	Effluent Bay	Effluent Bay	Effluent Bay	Effluent Bay	Effluent Bay
Sequence No.	2	2	1	2	1
COMMON NAME	KGS PER HA				
Largemouth Bass	7.331	6.722	12.197	1.711	8.593
potted Bass	0.022	0.000	0.003	0.000	0.000
hite Bass	1.922	0.325	1.307	0.274	0.976
Striped Bass	0.000	0.000	0.013	0.000	0.148
lue Catfish	1.014	0.104	0.000	0.000	2.416
hannel Catfish	31.005	32.855	50.536	5.243	81.294
Flathead Catfish	0.553	0.332	0.556	0.055	3.250
hite Crappie	0.000	0.010	0.737	0.000	0.127
lack Crappie	0.404	0.089	8.418	0.000	0.050
Spotted Gar	0.000	0.000	0.331	0.000	0.458
ongnose Gar	0.158	0.000	0.096	0.000	0.000
reshwater Drum	32.764	13.622	35.444	0.008	38.438
kipjack Herring	0.080	0.000	0.445	0.056	0.183
en Sunfish	0.938	3.570	0.805	0.250	0.116
Warmouth	0.877	1.596	1.174	0.358	0.641
rangespotted Sunfish	0.000	0.000	2.013	0.000	0.154
luegill	25.964	40.564	46.448	3.169	24.680
Longear Sunfish	8.010	12.848	5.199	0.955	4.613
edear Sunfish	0.034	0.143	2.641	1.237	4.278
ellow Bullhead	0.234	0.120	0.387	0.344	0.366
Fathead Minnow	0.000	0.001	0.000	0.000	0.001
luntnose Minnow	0.167	0.000	0.000	0.000	0.095
ullhead Minnow	0.004	0.010	0.060	0.277	0.000
Golden Shiner	0.000	0.000	0.007	0.001	0.000
merald Shiner	0.002	0.000	0.000	0.002	0.004
izzard Shad	177.148	131.703	99.142	64.417	80.831
Threadfin Shad	4.998	0.083	6.476	7.357	5.041
lackspotted Topminnow	0.000	0.000	0.000	0.004	0.000
Mosquitofish	0.001	0.001	0.003	0.005	0.001
nland Silverside	0.002	0.000	0.101	0.036	0.022
ilver Chub	0.002	0.004	0.000	0.000	0.004
Smallmouth Buffalo	80.327	46.207	58.491	12.573	44.592
igmouth Buffalo	35.613	15.967	29.739	20.123	77.970
lack Buffalo	1.815	0.000	4.122	0.500	0.000
mon Carp	6.891	11.546	24.305	0.851	14.868
raeli Carp	0.000	0.815	0.593	0.000	0.741
potted Sucker	0.641	0.000	0.000	0.000	0.000
River Carpsucker	50.618	50.814	110.442	6.236	44.666
OTAL	469.539	370.051	502.231	126.042	439.617


AVAILABLE
PREY
CROP
(KG/HA)
100
10
1
6
1
10
100
PREDATOR CROP (KG/HA)
Dardanelle
09/12/1994 Effluent Bay

AVAILABLE PREY/PREDATOR MODEL

irdanelle 09/12/1994 Effluent Bay % RECAP ADJ. INCLUDED COVE/OPEN WATER ADJ. INCLUDED

H ROUP	ΣPRED	ΣPREY	PREY GSHAD+	TSHAD	SUNF	WBASS	BBASS	CARP	CATF	CRAPP	M+S	CATO	YPER	DART	DRUM
2	0.17	0.08	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00
3	0.57	0.93	0.00	0.03	0.71	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00
4	0.97	3.29	0.10	0.90	1.22	0.05	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.78
5	1.50	8.27	0.30	2.56	2.67	0.15	0.00	0.00	0.02	0.00	0.25	0.00	0.00	0.00	2.30
6	2.54	19.02	0.56	4.08	4.17	0.28	0.01	0.00	0.06	0.00	0.25	0.00	0.00	0.00	9.60
7	4.65	33.49	0.85	5.51	5.61	0.44	0.11	0.00	0.14	0.01	0.25	0.00	0.00	0.00	20.56
8	6.90	40.82	1.16	6.16	6.99	0.59	0.36	0.00	0.48	0.04	0.25	0.00	0.00	0.00	24.81
9	8.63	45.94	1.47	6.49	8.55	0.74	0.84	0.00	1.25	0.06	0.25	0.00	0.00	0.00	26.29
0	9.39	62.38	1.56	6.62	13.31	0.87	1.71	0.00	6.94	0.08	0.25	0.00	0.00	0.00	31.03
1	18.97	81.36	1.59	6.71	18.06	1.00	2.47	0.00	14.60	0.11	0.25	0.00	0.00	0.00	36.56
12	28.98	105.38	1.94	6.72	26.00	1.10	2.47	0.00	24.85	0.13	0.25	0.00	0.00	0.00	41.92
13	32.52	137.25	2.33	6.72	35.98	1.20	2.47	0.00	40.91	0.14	0.25	0.00	0.00	0.00	47.26
4	33.10	178.95	6.99	6.72	45.13	1.20	2.47	0.00	60.36	0.15	0.25	0.00	0.00	0.00	55.67
5	36.97	213.60	14.05	6.72	50.00	1.20	2.47	0.00	75.10	0.15	0.25	0.00	0.00	0.00	63.65
6	39.52	264.08	42.95	6.72	54.87	1.20	2.47	0.00	87.79	0.15	0.25	0.00	0.00	0.00	67.68
17	41.16	306.43	69.19	6.72	56.74	1.20	2.47	0.00	97.74	0.15	0.25	0.11	0.00	0.00	71.86
18	41.63	329.51	84.50	6.72	57.42	1.20	2.47	0.00	99.48	0.15	0.25	0.66	0.00	0.00	76.65
9	41.63	347.48	96.72	6.72	57.93	1.20	2.47	0.00	99.48	0.15	0.25	1.32	0.00	0.00	81.24
0	41.63	357.32	101.48	6.72	57.98	1.20	2.47	0.00	99.48	0.15	0.25	2.23	0.00	0.00	85.36
21	41.63	363.81	104.87	6.72	58.03	1.20	2.47	0.00	99.48	0.15	0.25	2.78	0.00	0.00	87.87
22	41.63	365.06	106.11	6.72	58.04	1.20	2.47	0.00	99.48	0.15	0.25	2.78	0.00	0.00	87.87
3	41.63	365.98	107.02	6.72	58.04	1.20	2.47	0.00	99.48	0.15	0.25	2.78	0.00	0.00	87.87
4	41.63	366.55	107.59	6.72	58.04	1.20	2.47	0.00	99.48	0.15	0.25	2.78	0.00	0.00	87.87
25	41.63	366.92	107.83	6.72	58.04	1.20	2.47	0.14	99.48	0.15	0.25	2.78	0.00	0.00	87.87
26	41.63	367.16	107.83	6.72	58.04	1.20	2.47	0.37	99.48	0.15	0.25	2.78	0.00	0.00	87.87
27	41.63	367.23	107.83	6.72	58.04	1.20	2.47	0.45	99.48	0.15	0.25	2.78	0.00	0.00	87.87
8	41.63	367.23	107.83	6.72	58.04	1.20	2.47	0.45	99.48	0.15	0.25	2.78	0.00	0.00	87.87

ENGTH OUP	AP/P RATIO	C-RATIO	PREDATORS ESOX	GAR	WALL	TBASS	CRAPPIE	BOWF	FCAT	OCAT	WBASS	STBASS	SKIPJ	BBASS
	0.47	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00
	1.65	0.02	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.00	0.20	0.36	0.00	0.00
4	3.39	0.08	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.60	0.36	0.00	0.01
5	5.53	0.20	0.00	0.00	0.00	1.32	0.00	0.00	0.00	0.00	0.96	0.36	0.00	0.18
6	7.50	0.47	0.00	0.00	0.00	1.59	0.00	0.00	0.00	0.00	1.23	0.36	0.00	0.94
7	7.20	0.86	0.00	0.00	0.00	2.18	0.00	0.00	0.00	0.00	1.82	0.36	0.00	2.47
8	5.92	1.10	0.00	0.34	0.00	2.53	0.00	0.00	0.00	0.00	2.17	0.36	0.00	4.03
9	5.32	1.32	0.00	0.82	0.00	2.74	0.00	0.00	0.00	0.00	2.38	0.36	0.00	5.07
0	6.64	1.89	0.00	0.82	0.00	2.74	0.00	0.00	0.00	0.00	2.38	0.36	0.00	5.83
1	4.29	2.52	0.00	0.82	0.00	2.74	0.00	0.00	0.00	8.18	2.38	0.36	0.00	7.23
2	3.64	4.65	0.00	0.82	0.00	2.74	0.00	0.00	0.00	15.41	2.38	0.36	0.00	10.01
13	4.22	10.84	0.00	0.82	0.00	2.74	0.00	0.00	0.00	17.11	2.38	0.36	0.00	11.85
14	5.41	19.64	0.00	0.82	0.00	2.74	0.00	0.00	0.00	17.22	2.38	0.36	0.00	12.32
5	5.78	25.02	0.00	0.82	0.00	2.74	0.00	0.00	0.27	18.47	2.38	0.36	0.00	14.67
6	6.68	56.67	0.00	0.82	0.00	2.74	0.00	0.00	1.11	18.72	2.38	0.36	0.00	16.13
17	7.44	144.84	0.00	0.82	0.00	2.74	0.00	0.00	1.26	20.22	2.38	0.36	0.00	16.13
18	7.91	699.47	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
9	8.35	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
0	8.58	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
1	8.74	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
22	8.77	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
23	8.79	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
4	8.80	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
5	8.81	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
26	8.82	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
27	8.82	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13
8	8.82	0.00	0.00	0.82	0.00	2.74	0.00	0.00	1.73	20.22	2.38	0.36	0.00	16.13

Available Prey-Predator Relationship, Jenkins, R. R., and D. I. Morais 1977. National Reservoir Research Program, Fayetteville, Arkansas 72701

Percent recapture adjustments based on Predator Stocking Evaluation, Grinstead et al, 1978.

Cove/Open water adjustments based on Douglas Lake Rotenone Study, Hayne et al, 1968.

The model prints the following:

1. Cumulative biomass of all predators (spred) by inch class.

2. Cumulative biomass of all prey (sprey) and various species available to predators having a mouth size equivalent to a largemouth bass of the inch class in the left-most column.

3. Cumulative biomass of various predator species by inch class.

4. APP ratio = sprey/spred.

5. C-ratio = Competition ratio is the ratio of the biomass of available prey at a particular size to the biomass of all predators in equal, or larger size classes. It includes all predators which can theoretically consume a particular size of prey. C-ratio less than 1 indicate that the biomass of potential predators exceeds that of potential prey.

See the 30th Annual Proceedings of The Southeastern Association of Fish and Wildlife Agencies for further explaination.

FISH POPULATION SAMPLE

ke: Dardanelle County: Pope

irst day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Of Total
	13	300 - 325	2.6		1.296		
Total				45.9	42.406	94.9%	
River Carpsucker	,Intermediate						
	12	275 - 300	2.2		0.815		
	11	250 - 275	2.6		0.778		
	10	225 - 250	3.3		0.667		
Total				8.1	2.260	5.1%	
SPECIES TOTAL				54.1	44.666		10.2%
TOTAL COMMERCIAL FISH POPULATION				150.0	182.837		41.6%

SUMMARY

TOTAL PREDATOR FISH POPULATION	3234.5	135.933	30.9%
TOTAL FORAGE FISH POPULATION	4664.1	120.847	27.5%
TOTAL COMMERCIAL FISH POPULATION	150.0	182.837	41.6%
TOTAL FISH POPULATION	8048.6	439.617	

Shannon-Wiener Species Diversity Function

Based on species only: 2.970

Based on species and length groups: 4.948

FISH POPULATION SAMPLE

ke: Dardanelle County: Pope

First day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
SPECIES TOTAL				50.7	44.592		10.1%
Bigmouth Buffalo	,Adult						
	29	700 - 725	0.7		5.185		
	28	675 - 700	1.1		7.130		
	27	650 - 675	1.5		8.148		
	26	625 - 650	1.9		9.228		
	25	600 - 625	2.6		10.111		
	24	575 - 600	2.2		7.852		
	23	550 - 575	1.9		6.111		
	22	525 - 550	1.1		2.972		
	21	500 - 525	3.0		7.629		
	20	475 - 500	1.1		2.639		
	19	450 - 475	0.4		0.704		
	17	400 - 425	0.7		1.019		
Total				18.1	68.728	88.1%	
Bigmouth Buffalo	,Intermediate						
	15	350 - 375	3.0		2.408		
	14	325 - 350	4.4		3.056		
	13	300 - 325	5.2		2.851		
	12	275 - 300	1.5		0.667		
	11	250 - 275	0.7		0.260		
Total				14.8	9.242	11.9%	
SPECIES TOTAL				33.0	77.970		17.7%
Common Carp	,Adult						
	22	525 - 550	1.1		2.222		
	20	475 - 500	1.1		1.889		
	19	450 - 475	2.2		3.019		
	18	425 - 450	3.0		3.349		
	17	400 - 425	3.0		3.148		
	16	375 - 400	1.1		1.019		
Total				11.5	14.646	98.5%	
Common Carp	,Intermediate						
	14	325 - 350	0.4		0.222		
Total				0.4	0.222	1.5%	
SPECIES TOTAL				11.9	14.868		3.4%
Israeli Carp	,Adult						
	21	500 - 525	0.4		0.741		
Total				0.4	0.741	100.0%	
SPECIES TOTAL				0.4	0.741		0.2%
River Carpsucker	,Adult						
	19	450 - 475	0.4		0.527		
	18	425 - 450	8.5		9.796		
	17	400 - 425	15.6		15.763		
	16	375 - 400	11.9		10.302		
	15	350 - 375	4.4		3.167		
	14	325 - 350	2.6		1.555		

FISH POPULATION SAMPLE

e: Dardanelle County: Pope

irst day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	3	50 - 75	72.2		0.274		
Total				72.2	0.274	0.3%	
SPECIES TOTAL				789.6	80.831		18.4%
Threadfin Shad	,Adult						
	6	125 - 150	5.6		0.127		
	5	100 - 125	35.2		0.469		
	4	75 - 100	322.2		2.039		
Total				363.0	2.635	52.3%	
Threadfin Shad	,Intermediate						
	3	50 - 75	730.7		2.376		
	2	25 - 50	30.0		0.030		
Total				760.7	2.406	47.7%	
SPECIES TOTAL				1123.7	5.041		1.1%
Mosquitofish	,Intermediate						
	2	25 - 50	1.1		0.001		
Total				1.1	0.001	100.0%	
SPECIES TOTAL				1.1	0.001		0.0%
'nland Silverside	,Adult						
	3	50 - 75	17.0		0.021		
Total				17.0	0.021	95.5%	
Inland Silverside	,Intermediate						
	2	25 - 50	0.7		0.001		
Total				0.7	0.001	4.5%	
SPECIES TOTAL				17.8	0.022		0.0%
Silver Chub	,Young						
	3	50 - 75	1.1		0.003		
	2	25 - 50	1.9		0.001		
Total				3.0	0.004	100.0%	
SPECIES TOTAL				3.0	0.004		0.0%
TOTAL FORAGE FISH POPULATION				4664.1	120.847		27.5%
Smallmouth Buffalo	,Adult						
	22	525 - 550	0.7		1.926		
	21	500 - 525	0.7		1.704		
	20	475 - 500	4.1		8.474		
	19	450 - 475	4.1		7.130		
	18	425 - 450	3.7		5.555		
	17	400 - 425	1.9		2.130		
Total				15.2	26.919	60.4%	
Smallmouth Buffalo	,Intermediate						
	15	350 - 375	1.1		0.944		
	14	325 - 350	4.8		2.869		
	13	300 - 325	18.1		9.330		
	12	275 - 300	9.6		4.025		
	11	250 - 275	1.1		0.333		
	10	225 - 250	0.7		0.172		
Total				35.6	17.673	39.6	

FISH POPULATION SAMPLE

ke: Dardanelle County: Pope

First day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
Yellow Bullhead	,Adult						
	10	225 - 250	0.7		0.122		
	9	200 - 225	0.4		0.045		
Total				1.1	0.167	45.6%	
Yellow Bullhead	,Intermediate						
	8	175 - 200	0.4		0.032		
	7	150 - 175	0.4		0.022		
	6	125 - 150	2.6		0.099		
	5	100 - 125	0.7		0.013		
Total				4.1	0.166	45.4%	
Yellow Bullhead	,Young						
	4	75 - 100	2.6		0.031		
	3	50 - 75	0.4		0.002		
Total				3.0	0.033	9.0%	
SPECIES TOTAL				8.1	0.366		0.1%
Fathead Minnow	,Adult						
	3	50 - 75	0.4		0.001		
Total				0.4	0.001	100.0%	
SPECIES TOTAL				0.4	0.001		0.0%
Bluntnose Minnow	,Adult						
	3	50 - 75	3.3		0.005		
Total				3.3	0.005	5.3%	
Bluntnose Minnow	,Intermediate						
	2	25 - 50	113.3		0.090		
Total				113.3	0.090	94.7%	
SPECIES TOTAL				116.7	0.095		0.0%
Emerald Shiner	,Intermediate						
	2	25 - 50	3.7		0.004		
Total				3.7	0.004	100.0%	
SPECIES TOTAL				3.7	0.004		0.0%
Gizzard Shad	,Adult						
	14	325 - 350	0.4		0.142		
	13	300 - 325	2.2		0.814		
	12	275 - 300	7.4		1.773		
	11	250 - 275	35.6		6.747		
	10	225 - 250	161.9		21.809		
	9	200 - 225	333.0		41.215		
	8	175 - 200	85.2		6.663		
Total				625.6	79.163	97.9%	
Gizzard Shad	,Intermediate						
	7	150 - 175	11.9		0.545		
	6	125 - 150	1.9		0.047		
	5	100 - 125	31.5		0.441		
	4	75 - 100	46.7		0.361		
Total				91.9	1.394	1.7%	
Gizzard Shad	,Young						

FISH POPULATION SAMPLE

'ke: Dardanelle County: Pope

=irst day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
SPECIES TOTAL				23.3	0.641		0.1%
Orangespotted Sunfish	,Young						
	3	50 - 75	34.4		0.146		
	2	25 - 50	4.4		0.008		
Total				38.9	0.154	100.0%	
SPECIES TOTAL				38.9	0.154		0.0%
Bluegill	,Adult						
	8	175 - 200	4.4		0.556		
	7	150 - 175	55.2		4.015		
	6	125 - 150	204.8		10.240		
Total				264.4	14.811	60.0%	
Bluegill	,Intermediate						
	5	100 - 125	213.3		5.581		
	4	75 - 100	104.1		1.407		
Total				317.4	6.988	28.3%	
Bluegill	,Young						
	3	50 - 75	600.7		2.106		
	2	25 - 50	503.7		0.775		
Total				1104.4	2.881	11.7%	
SPECIES TOTAL				1686.3	24.680		5.6%
Longear Sunfish	,Adult						
	6	125 - 150	0.4		0.026		
Total				0.4	0.026	0.6%	
Longear Sunfish	,Intermediate						
	5	100 - 125	11.9		0.323		
	4	75 - 100	121.9		2.031		
Total				133.7	2.354	51.0%	
Longear Sunfish	,Young						
	3	50 - 75	333.7		1.685		
	2	25 - 50	274.1		0.548		
Total				607.8	2.233	48.4%	
SPECIES TOTAL				741.9	4.613		1.0%
Redear Sunfish	,Adult						
	9	200 - 225	0.4		0.054		
	8	175 - 200	1.5		0.183		
	7	150 - 175	15.9		1.041		
	6	125 - 150	52.6		2.712		
Total				70.4	3.990	93.3%	
Redear Sunfish	,Intermediate						
	5	100 - 125	4.4		0.133		
	4	75 - 100	14.4		0.144		
Total				18.9	0.277	6.5%	
Redear Sunfish	,Young						
	3	50 - 75	2.2		0.011		
Total				2.2	0.011	0.3%	
SPECIES TOTAL				91.5	4.278		1.0%

FISH POPULATION SAMPLE

ke: Dardanelle County: Pope

First day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	10	225 - 250	14.8		2.136		
	9	200 - 225	31.1		3.333		
	8	175 - 200	37.4		6.960		
	7	150 - 175	102.6		4.416		
	6	125 - 150	178.9		5.009		
	5	100 - 125	103.7		1.342		
Total				468.5	23.196	60.3%	
Freshwater Drum	,Young						
	4	75 - 100	1528.1		9.933		
	3	50 - 75	327.8		1.379		
Total				1855.9	11.312	29.4%	
SPECIES TOTAL				2337.8	38.438		8.7%
Skipjack Herring	,Adult						
	11	250 - 275	0.4		0.049		
	10	225 - 250	0.4		0.036		
	9	200 - 225	0.4		0.026		
Total				1.1	0.111	60.7%	
Skipjack Herring	,Intermediate						
	5	100 - 125	0.7		0.006		
	4	75 - 100	11.1		0.053		
Total				11.9	0.059	32.2%	
Skipjack Herring	,Young						
	3	50 - 75	7.4		0.013		
Total				7.4	0.013	7.1%	
SPECIES TOTAL				20.4	0.183		0.0%
TOTAL PREDATOR FISH POPULATION				3234.5	135.933		30.9%
Green Sunfish	,Intermediate						
	5	100 - 125	2.6		0.096		
Total				2.6	0.096	82.8%	
Green Sunfish	,Young						
	3	50 - 75	3.7		0.013		
	2	25 - 50	11.9		0.007		
Total				15.6	0.020	17.2%	
SPECIES TOTAL				18.1	0.116		0.0%
Warmouth	,Adult						
	7	150 - 175	2.2		0.214		
	6	125 - 150	4.4		0.210		
Total				6.7	0.424	66.1%	
Warmouth	,Intermediate						
	5	100 - 125	5.2		0.151		
	4	75 - 100	5.2		0.052		
Total				10.4	0.203	31.7%	
Warmouth	,Young						
	3	50 - 75	4.1		0.012		
	2	25 - 50	2.2		0.002		
Total				6.3	0.014	2.2%	

FISH POPULATION SAMPLE

ke: Dardanelle County: Pope

First day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
	10	225 - 250	0.7		0.096		
	9	200 - 225	1.5		0.186		
	8	175 - 200	4.1		0.271		
	7	150 - 175	1.1		0.056		
	6	125 - 150	3.7		0.074		
	5	100 - 125	1.1		0.013		
Total				13.3	0.930	28.6%	
Flathead Catfish	,Young						
	4	75 - 100	0.4		0.004		
	3	50 - 75	1.5		0.005		
Total				1.9	0.009	0.3%	
SPECIES TOTAL				18.9	3.250		0.7%
White Crappie	,Adult						
	9	200 - 225	0.4		0.054		
Total				0.4	0.054	42.5%	
White Crappie	,Intermediate						
	6	125 - 150	0.4		0.013		
	5	100 - 125	1.9		0.028		
	4	75 - 100	5.2		0.031		
Total				7.4	0.072	56.7%	
White Crappie	,Young						
	3	50 - 75	0.4		0.001		
Total				0.4	0.001	0.8%	
SPECIES TOTAL				8.1	0.127		0.0%
Black Crappie	,Adult						
	9	200 - 225	0.4		0.046		
Total				0.4	0.046	92.0%	
Black Crappie	,Intermediate						
	4	75 - 100	0.4		0.004		
Total				0.4	0.004	8.0%	
SPECIES TOTAL				0.7	0.050		0.0%
Spotted Gar	,Intermediate						
	24	575 - 600	0.4		0.269		
	22	525 - 550	0.4		0.189		
Total				0.7	0.458	100.0%	
SPECIES TOTAL				0.7	0.458		0.1%
Freshwater Drum	,Adult						
	18	425 - 450	0.4		0.354		
	17	400 - 425	0.4		0.426		
	15	350 - 375	0.4		0.167		
	14	325 - 350	0.7		0.316		
	13	300 - 325	0.7		0.208		
	12	275 - 300	2.2		0.624		
	11	250 - 275	8.5		1.835		
Total				13.3	3.930	10.2%	
Freshwater Drum	,Intermediate						

FISH POPULATION SAMPLE

ke: Dardanelle County: Pope

First day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
Total				3.3	1.933	80.0%	
Blue Catfish	,Intermediate						
	12	275 - 300	0.4		0.077		
	11	250 - 275	1.1		0.133		
	10	225 - 250	1.1		0.092		
	9	200 - 225	1.1		0.107		
	7	150 - 175	1.5		0.064		
	6	125 - 150	0.4		0.010		
Total				5.6	0.483	20.0%	
SPECIES TOTAL				8.9	2.416		0.5%
Channel Catfish	,Adult						
	23	550 - 575	0.4		0.691		
	20	475 - 500	0.7		0.888		
	19	450 - 475	2.6		2.851		
	18	425 - 450	2.2		1.592		
	17	400 - 425	5.9		3.391		
	16	375 - 400	7.8		4.148		
	15	350 - 375	7.8		3.167		
	14	325 - 350	20.7		6.462		
	13	300 - 325	39.3		9.815		
Total				87.4	33.005	40.6%	
Channel Catfish	,Intermediate						
	12	275 - 300	68.5		13.426		
	11	250 - 275	57.8		7.945		
	10	225 - 250	75.2		7.429		
	9	200 - 225	134.4		9.941		
	8	175 - 200	100.4		5.109		
	7	150 - 175	104.1		3.489		
	6	125 - 150	37.4		0.846		
	5	100 - 125	8.5		0.089		
Total				586.3	48.274	59.4%	
Channel Catfish	,Young						
	4	75 - 100	1.9		0.015		
Total				1.9	0.015	0.0%	
SPECIES TOTAL				675.6	81.294		18.5%
Flathead Catfish	,Adult						
	21	500 - 525	0.4		0.426		
	19	450 - 475	0.7		0.592		
	18	425 - 450	0.4		0.296		
	16	375 - 400	0.7		0.389		
	15	350 - 375	0.7		0.375		
	13	300 - 325	0.7		0.233		
Total				3.7	2.311	71.1%	
lathead Catfish	,Intermediate						
	12	275 - 300	0.7		0.178		
	11	250 - 275	0.4		0.056		

FISH POPULATION SAMPLE

'e: Dardanelle County: Pope

irst day of sampling: 09/12/1994

Species	Size Group	Length (MM)	Number/Ha Of Fish	Number/Ha In Group	Weight (Kg/Ha)	Percent by Wt. In Group	Percent by Wt. Of Total
Largemouth Bass	,Adult						
	16	375 - 400	0.7		0.653		
	15	350 - 375	1.5		1.055		
	14	325 - 350	0.4		0.210		
	13	300 - 325	1.9		0.822		
	12	275 - 300	3.4		1.245		
	11	250 - 275	2.6		0.628		
	10	225 - 250	2.6		0.505		
Total				13.1	5.118	59.6%	
Largemouth Bass	,Intermediate						
	9	200 - 225	5.2		0.692		
	8	175 - 200	11.5		1.043		
	7	150 - 175	18.5		1.016		
	6	125 - 150	15.6		0.511		
Total				50.7	3.262	38.0%	
Largemouth Bass	,Young						
	5	100 - 125	9.3		0.204		
	4	75 - 100	0.7		0.009		
Total				10.0	0.213	2.5%	
SPECIES TOTAL				73.8	8.593		2.0%
White Bass	,Adult						
	11	250 - 275	0.4		0.087		
	9	200 - 225	3.0		0.280		
Total				3.3	0.367	37.6%	
White Bass	,Intermediate						
	8	175 - 200	1.9		0.119		
	7	150 - 175	1.5		0.074		
	6	125 - 150	4.4		0.100		
	5	100 - 125	8.1		0.118		
Total				15.9	0.411	42.1%	
White Bass	,Young						
	4	75 - 100	18.5		0.120		
	3	50 - 75	18.5		0.078		
Total				37.0	0.198	20.3%	
SPECIES TOTAL				56.3	0.976		0.2%
Striped Bass	,Young						
	4	75 - 100	11.5		0.060		
	3	50 - 75	21.9		0.088		
Total				33.3	0.148	100.0%	
SPECIES TOTAL				33.3	0.148		0.0%
Blue Catfish	,Adult						
	26	625 - 650	0.4		0.889		
	16	375 - 400	0.4		0.216		
	15	350 - 375	0.4		0.177		
	14	325 - 350	0.7		0.296		
	13	300 - 325	1.5		0.355		

FISH POPULATION SAMPLE

Lake: Dardanelle Hectares: 13765 County: Pope

First day of sampling: 09/12/1994 Sample Design: Cove

Ownership: Corps of Engineers Sample Location: Effluent Bay

Sample Size: 2.7 (ha). Water Volume: 3.5 (ha/m) Water Temp.:31.9 Deg.C.

Secchi Disk Reading: 0.50 meters. Water Depth: Max. 3.9 meters Avg. 1.3 meters

Block-off Net: Yes Rotenone Amount: 26.4kg Rotenone Type: powder

Collectors: Limbird Ahlert Calloway ATU stu

SPECIES SUMMARY

Species	No./ha.	Kg./ha.	% of Total by Weight	Dominant Size Group
Largemouth Bass	73.820	8.593	2.0	7
White Bass	56.296	0.976	0.2	4
triped Bass	33.333	0.148	0.0	3
lue Catfish	8.886	2.416	0.5	13
Channel Catfish	675.555	81.294	18.5	9
lathead Catfish	18.888	3.250	0.7	8
hite Crappie	8.147	0.127	0.0	4
Black Crappie	0.740	0.050	0.0	4
otted Gar	0.740	0.458	0.1	22
shwater Drum	2337.775	38.438	8.7	4
ipjack Herring	20.368	0.183	0.0	4
Green Sunfish	18.148	0.116	0.0	2
armouth	23.332	0.641	0.1	4
rangespotted Sunfish	38.888	0.154	0.0	3
Bluegill	1686.296	24.680	5.6	3
ongear Sunfish	741.852	4.613	1.0	3
edear Sunfish	91.480	4.278	1.0	6
Yellow Bullhead	8.147	0.366	0.1	4
Fathead Minnow	0.370	0.001	0.0	3
luntnose Minnow	116.666	0.095	0.0	2
Emerald Shiner	3.704	0.004	0.0	2
Gizzard Shad	789.628	80.831	18.4	9
hreadfin Shad	1123.704	5.041	1.1	3
osquitofish	1.111	0.001	0.0	2
Inland Silverside	17.778	0.022	0.0	3
ilver Chub	2.963	0.004	0.0	2
mallmouth Buffalo	50.739	44.592	10.1	13
Bigmouth Buffalo	32.962	77.970	17.7	13
Common Carp	11.851	14.868	3.4	17
sraeli Carp	0.370	0.741	0.2	21
River Carpsucker	54.074	44.666	10.2	17
TOTAL	8048.615	439.617		

Radiological samples

Samples of fish flesh for radiological assessment were collected in March and September, 1994 at locations B (inlet cove) and C (outlet cove). Fish were collected in March with a commercial gill net and a trammel net at each location. In September fish were collected at Area B with a gill net and a trammel net, and by electrofishing; whereas, fish were collected at Area C were collected from rotenone samples. Fish were filleted and stored frozen in a freezer at the Entergy boat house. Upon completion of filling of a gallon ziplock bag with catfish flesh, and a gallon ziplock bag with game-fish flesh for each area, the samples were sent to the lab to be analyzed by personnel of Entergy Light to be analyzed.

Acknowledgments

The following personnel are greatly appreciated for their assistance in field data collection: Jeff Herod, Shannon Shook, Rob Beadel, Coburn Howell, and Phil Penny (students at ATU); Bob Limbird and Jim Ahlert (AG&F Commission, Russellville); and Charlie Adams and Dennis Calloway (Entergy). Jeff Herod, Shannon Shook, Rob Beadel, Coburn Howell, and Phil Penny (students at ATU) helped analyze lab data, and entered data for computer analyses.

Arkansas Game & Fish Commission

2 Natural Resources Drive Little Rock, Arkansas 72205

'teve N. Wilson
Director

Scott Henderson
Assistant Director

bpc: Director's Office
Bob Limbird
Joe Stoeckel (ATU)
Fisheries File

March 8, 1995

Jerry Yelverton, Vice President
Operations ANO
Entergy Operations, Inc.
Route 3, Box 137G
Russellville, AR 72801

Dear Mr. Yelverton:

I am writing in regards to your correspondence of 25 January advising Entergy's decision to terminate components of the Lake Dardanelle ecological survey project. Specifically, I am wanting to convey our regret that the long-term fish community monitoring performed by Arkansas Tech University (ATU) will no longer be funded.

The Arkansas Game and Fish Commission has long appreciated the financial support and spirit of cooperation that Arkansas Power and Light, and more recently, Entergy, Inc. has exhibited towards environmental responsibility in the operation of Arkansas Nuclear One. Baseline fish community monitoring has demonstrated that despite the loss of fish life due to impingement and entrainment at the plant's intake and the impact of the thermal effluent, a quality recreational fishery has been maintained and can co-exist with the operation of ANO. We agree that past monitoring has satisfied our concerns and need not continue as the sole objective of the project. However, we feel that Entergy, Inc. may be overlooking the tremendous benefits the project provides through its educational opportunities provided to the students at ATU who work directly on the project.

The Lake Dardanelle ecological survey project has provided students with invaluable hand-on experience both in the direct field experience associated with the various sampling methodologies employed and data analysis, but also in the relevant situation of how the state and private industry have cooperated to strike a balance between industrial development and sustained resource use. ATU is the only school in the state that offers a fish and wildlife management degree at the bachelor's level. Nearly half of this agency's professional fisheries staff obtained their degree from ATU and "cut their teeth" on the Lake Dardanelle project. We believe the experience made for a more qualified employee. For the relatively small funding required to perform the project, we have tended to view the educational and training benefits generated by the project as suitable compensation for the loss of fish life caused by the plant operation.

In closing I ask that Entergy, Inc. reconsider its decision to terminate the fish sampling components of the Lake Dardanelle ecological survey. We feel that the project provides excellent educational opportunities that is provided no where else in Arkansas, is a unique opportunity to continue long-term baseline monitoring of Lake Dardanelle, and will complement the zebra mussel assessment work that is scheduled to continue. I, or members of my staff, will be glad to discuss this matter with you further.

Sincerely,

Allen Carter

Allen Carter, Chief
Fisheries Division

AC:MA:pm-399

ENTERGY

Entergy Operations, Inc.
Route 3 Box 137G
Russellville, AR 72801
Tel 501-964-8888

Jerry W. Yelverton
Vice President
Operations ANO

January 25, 1995

Mr. Allan Carter
Fisheries Division
Arkansas Game & Fish Commission
2 Natural Resources Drive
Little Rock, Arkansas 72205

Subject: ***Arkansas Nuclear One***
Lake Dardanelle Studies

ANO-95-00189

Dear Mr. Carter:

This letter is in reference to your conversation of January 5, 1995 with Mr. Bill McKelvy of our Chemistry Staff.

As discussed, the Dardanelle Reservoir-Illinois Bayou embayment ecological survey contract that we currently have in place with the University of Arkansas at Little Rock will be terminated effective January, 1995. Our resources will be directed to the fish and mussel monitoring contract with Arkansas Tech University. The work scope will include the following:

- Semiannual fish and sediment sampling for radiological analysis
- Zebra mussel monitoring

Arkansas Nuclear One has been performing the ecological survey for the past twenty years and we believe that the baseline data from this time period shows that the monitoring is no longer necessary. Instead, we believe our resources should be directed toward the zebra mussel monitoring problem. The data from the ecological survey has not differed significantly from year to year in the most recent surveys. We believe the data indicates that any concern regarding plant impact on the fish population in Lake Dardanelle is unwarranted.

Since zebra mussels continue to be a high profile issue that could effect plant operation, as well as the ecological system of the lake, we plan on continuing this monitoring project at this time. This monitoring will be performed by the Arkansas Tech University. The data from the annual report will be provided to your department if you so desire.

If you have any questions or would like to discuss this matter further, we are available to do so at your convenience.

We look forward to a continued good relationship between Arkansas Nuclear One and the Game & Fish Commission and appreciate your cooperation in this matter. If you have any questions regarding this project, please contact W. C. "Bill" McKelvy, Chemistry Superintendent, Arkansas Nuclear One at 501/858-5823, or Mr. Charles Adams, Senior Environmental Specialist, Arkansas Nuclear One at 501/858-5486.

Sincerely,

Jerry W Yelverton

JWY/WCM/agm

cc: Mr. C. R. Adams
Mr. J. L. Blount
Mr. R. N. Buckley
Mr. J. G. Dewease
Mr. W. C. McKelvy
ANO-DCC

Entergy Operations

Entergy Operations, Inc.
Route 3. Box 137G
Russellville. AR 72801
Tel 501-964-3100

January 16, 1995

Dr. John Rickett
University of Arkansas at Little Rock
Office of Research and Sponsored Programs
2801 South University Avenue
Little Rock, AR 72204

Subject: ***Dardanelle Reservoir-Illinois Bayou Embayment Ecological Study***

ANO-95-00047

Dear Sir:

This letter is to inform you that the Dardanelle Reservoir-Illinois Bayou Embayment Ecological Survey with the University of Arkansas at Little Rock is being terminated effective January, 1995. In addition, the fish and mussel monitoring contract with Arkansas Tech University is being significantly streamlined in work scope.

Arkansas Nuclear One is pursuing these actions due to increased competition within the electric utility industry. We appreciate the long standing performance of quality environmental monitoring that you have provided in the past.

If we can provide the use of resources such as boat and boat house (at no cost or liability to Entergy) for research on Lake Dardanelle, please contact me at 858-5823 or Mr. Charles Adams, Sr. Environmental Specialist at ANO, at 858-5486.

Sincerely,

W. C. McKelvy
Chemistry Superintendent

WCM/CRA/agm

cc:	R. N. Buckley	ECH/30
	E. L. Green	A-TCBY-25A
	ANO-DCC	

SUMMARY OF ENTRAINMENT
AT
ARKANSAS NUCLEAR ONE
FROM
1977 THROUGH 1982

INTRODUCTION

Entrainment at Arkansas Nuclear One is defined as the passive movement of organisms in water through the plant's condenser cooling system. Of particular interest are larval fish entrained, and the impact their loss has on Dardanelle Reservoir. Mortality of these organisms is assumed to be 100% due to sudden water temperature increases, pressure, and turbulence.

Approach velocity at the confluence of the intake canal and the reservoir is less than or equal to 0.3 ft./sec., and increases to 3.0 ft./sec. at the most narrow point. It then reduces to approximately 1.5 ft./sec. along the remainder of the canal to the intake forebays. Each forebay is protected from trash, fish, etc. by a vertical traveling screen constructed of 3/8" wire mesh. Very small organisms are able to pass through the screens and enter the ANO condenser cooling system.

METHODS

Entrainment monitoring at ANO has been conducted since the spring of 1977. Nuclear Regulatory Commission technical specifications for this monitoring required once-a-month sampling, three times in a 24-hour period, at three depths, with each sample replicated. In other words, there were 18 five-minute stationary samples in a 24-hour period at the most narrow point in the intake canal (Figure 1).

Meter net data, obtained by Arkansas Tech University, was used for impact assessment. These samples were taken in the daylight hours, at the surface, and were replicated. Sampling was once a week from mid-March through June, and biweekly from July through mid-September. See Figure 1 for meter net sample areas.

DATA AND DISCUSSION

Of the six years of entrainment sampling, three years met minimal technical specifications (1978-1980). The other three years were sampled more frequently, usually twice a month in May and June. Peak spawning occurred in May and June in the meter net samples. Comparison of meter net data and entrainment data (Graphs 1-6) indicates that several peak spawning periods were missed when entrainment sampling was performed once a month. As a result, estimated entrainment losses may have been underestimated for some of the years.

As shown by meter net data, the intake bay area is one of the least productive areas of the four reservoir areas sampled (Table 1). The larvae in the intake area varied randomly from year to year ($P>.05$), as did the number of larvae entrained.

Entrainment samples were taken three times per day (8 a.m., 4 p.m., and 12 midnight), at three depths (surface, mid-depth, and near bottom), and were replicated. Therefore, meter net numbers for fish larvae as reported in past annual reports should be carefully applied to impact assessment of entrainment.

Over the six-year period, larval densities in the entrainment samples were greatest at night at 90.2%, 4.5% in the morning, and 5.3% in the afternoon. A

All species of fish except carp were entrained in the greatest densities in the night samples. Carp were most numerous in the morning samples (Table 4).

The *Clupeidae* species usually first appeared in the intake bay area around mid-to-late-April, and usually first appeared in the entrainment samples a week or so later, from mid-April to mid-May. Peak larval density in the bay occurred early in May, and lasted through late June. Entrainment peaks occurred at approximately the same time. Both meter netting and entrainment indicated two spawns for the *Clupeidae* species in 1980; the latter one began the first of August, and lasted into the first of September. The probable cause for the second spawn might have been due to an extended spawning season caused by an unusually long, hot, dry summer. No other obvious second spawn has been observed for the *Clupeidae* species during the six-year period.

Entrainment data showed the species to be concentrated at mid-depth and the bottom during the daylight hours, then coming to the surface at night (Graph 7). The greatest density was at the surface, and the least at mid-depth and the bottom (Graph 9).

Morone species, usually white bass, first appeared in the bay area around mid-April, and were found in the entrainment samples in late April. The peak spawning period was mid-April through mid-June. Entrainment peaks were in late April to late May. The larvae of this species was not seen in the meter net samples after mid-June.

Morone species made up less than 1% to 12% of the entrainment samples, and were more prevalent in the entrainment samples (Graphs 19-21).

Entrainment data showed the species to be concentrated at mid-depth and the bottom in the daylight hours, and coming to the surface at night (Graph 7). There appeared to be a significant spatial distribution, with the surface usually containing the greatest density (Graph 9).

Pomoxis species usually first appeared in mid-April in the meter net samples, and were usually first seen in the entrainment samples late April into May. Peak densities usually occurred in May, but varied from late April to mid-June. Only two peaks were observed in the entrainment samples, in 1977 and 1982. These were in late April through early June, and mid-May, respectively. The larvae of this species was not seen after late June in the meter net samples. No _Pomoxis_ species was observed in the entrainment samples in 1979 or 1980.

Pomoxis species made up from less than 1% to 1% of the species composition in both the meter net samples and the entrainment samples (Graphs 19-21). They were usually found at the surface in both the daylight hours and at night. The greatest density was observed at night (Graph 7). They were not observed in the entrainment samples from 1978 through 1980. When they were observed in the other years, they were most numerous at the surface, and rarely observed at the bottom (Graph 13).

Lepomis species usually first appeared in the meter net samples around late April into late May. They were first observed in the entrainment samples in late May to early June. Peak densities occurred June through mid-August in the meter net samples, while peak entrainment occurred mid-June to mid-July. The larvae of this species was not observed in the meter net samples after August.

Lepomis species made up from less than 1% to 3% of the meter net samples, and less than 1% to 4% of the entrainment samples. They were slightly more prevalent in the entrainment samples (Graphs 19-21).

The larvae were found exclusively at the surface during the daylight hours, then mixed throughout the water column at night (Graph 7). They were most numerous at the surface (Graph 12).

Cyprinidae species usually first appeared in the entrainment samples, rather than the meter net samples. Their first appearance in the entrainment samples varied from late April through July; they first appeared in the meter net samples late April to June. Peak densities in the meter net samples occurred in early June. There were only two entrainment peaks, one in late May, 1978, and late June through mid-July in 1980. No Cyprinidae species were observed in the entrainment samples in 1979.

They made up less than 1% to 1% of the species composition in the meter net samples and the entrainment samples. They were slightly more prevalent in the entrainment samples (Graphs 19-21).

Cyprinidae species were most often observed at night at the surface (Graph 7). They showed great diversity of distribution throughout the water column in the entrainment samples. In four out of five years they were observed, they were 100% at some particular depth. With the data available, it was impossible to determine whether they dominated any level in the water column (Graph 13).

Freshwater drum larvae usually first appeared in the entrainment samples around mid-May, then were usually observed in the meter net samples in late May to early June. They were usually observed each year in the entrainment samples, but were not observed in the meter net samples in 1978, 1980, and 1981. They reached peak spawning densities in the meter net samples around late May to early June, and were present for a very short period of time. Entrainment peak densities occurred early-to-late June, sometimes at the last of July. Larvae of this species were usually not seen after July in the meter net samples. No freshwater drum were observed in the entrainment samples in 1978.

Freshwater drum made up less than 1% of the meter net samples, and from less than 1% to 7% of the entrainment samples (Graphs 19-21). They were observed exclusively at mid-depth and the bottom during the daylight hours, then mixed in the water column, with the greatest density at night at the surface (Graph 8). They were found 100% at the surface in 1981, and 1982.

Atherinidae species, usually Mississippi silversides, varied greatly in their first appearance in the meter net samples. They were observed as early as late April, and as late as the last of July. They first appeared in the entrainment samples in late April to late June. No Atherinidae species were observed in the entrainment samples in 1978, and 1982. Peak densities in the meter net samples occurred anywhere from May to early August. Only two entrainment peaks were observed, one in late June, 1977, and the other in mid-May, 1981. The time at which the species was last observed in the meter net samples varied from early June to September.

The *Atherinidae* larvae made up less than 1% of the species composition for both meter net and entrainment samples (Graphs 19-21). They were not observed in the morning entrainment samples, some were observed in the afternoon samples, and none were found at the bottom. They were most numerous at night at the surface. At night, no larvae were observed at mid-depth, but were collected from the bottom (Graph 7).

When entrainment sampling was performed more than once per month, *Atherinidae* species were observed at the greatest densities at the surface (Graph 15).

Catostomidae species were usually first observed in the meter net samples in mid-April, and as late as mid-June. When they did appear in the entrainment samples, it was usually in mid-May. Peak densities occurred late in May through June, while they peaked in the entrainment samples in mid-June. No *Catostomidae* species were observed in the entrainment samples in 1977, 1978, 1979, and 1981. They were not observed in the meter net samples after mid-July.

The *Catostomidae* species made up less than 1% of the species composition of the entrainment samples, and from less than 1% to 7% of the meter net samples. They were more prevalent in the meter net samples (Graphs 19-21).

The larvae were observed at the bottom of the water column in the daylight hours, and rising to the surface at night. They were most numerous at the surface at night (Graph 8). When present, they were more prevalent at the surface than at mid-depth and the bottom (Graph 17).

Carp were never identified in the meter net samples, and were only observed twice in the entrainment samples, 1978, and 1982. Their first appearance was late in May, 1978, and late June, 1982. Carp larvae were never observed after June.

They made up less than 1% to 1% of the species entrained (Graphs 19-21). They were never observed in the bottom entrainment samples, nor were they observed at any level in the water column in the afternoon. They were most numerous in the morning at the surface, and when observed at night, they were found exclusively at the surface (Graph 8). The larvae were most prevalent at the surface (Graph 16).

Channel catfish were never observed in the meter net samples, and were only observed once on June 13, 1977, in the entrainment samples. They were located at mid-depth at night (Graphs 8 and 18).

Micropterus species were never observed in the entrainment samples, and were not observed in the meter net samples in 1977, 1978, and 1981. The larvae first appeared in mid-April to early May, and were present for less than a week. They were never observed after early May.

Percidae species were never observed in any of the entrainment samples. They were observed in the meter net samples every year except 1981. They usually first appeared in mid-April. Peak densities occurred in mid-April to the first of May. They were not observed after early June.

In the summer of 1983, a few meter net trawls were performed at night at the surface at all four sample stations. The few samples confirmed the assumption that there were significantly more larvae present at night than during the daylight hours.

CONCLUSION

Since the Clupeidae species were the most entrained fish larvae, and since the species has been able to reestablish itself in the intake area and the reservoir each year, it does not appear that entrainment is having a significant impact on the Clupeidae species, nor is there any evidence that entrainment losses have had a significant impact on the other species of fish observed.

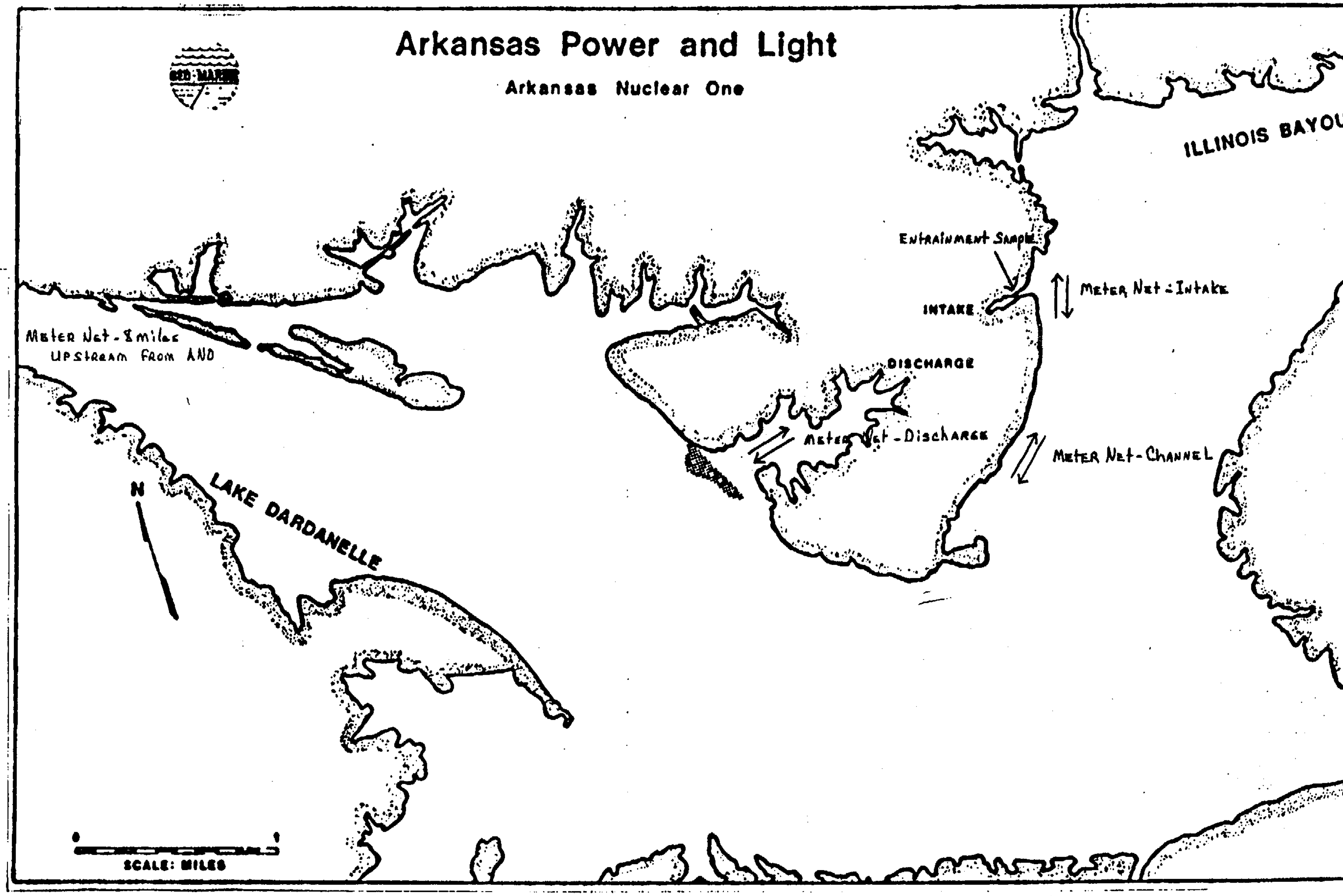


FIGURE 1: MAP SHOWING LOCATION OF ENTRAINMENT SAMPLE AND THE FOUR METER NET SAMPLE AREAS.

TABLE 1: LIST OF LARVAL FISH CAUGHT EACH YEAR FOR ENTRAINMENT SAMPLES AND THE FOUR SAMPLE AREAS IN DARDANELLE RESERVOIR. REPLICATES ARE COMBINED.

YEAR	ENTRAINMENT	INTAKE	DISCHARGE	CHANNEL	BACKWATER
1974		1551	3558	1975	6052
1975		3717	4496	4880	38201
1976		5774	8815	9546	23581
1977	1088	5769	4455	11970	14807
1978	1212	6318	7134	13363	102137
1979	218	6864	12027	13734	60481
1980	554	10763	9692	234896	142937
1981	836	3073	1782	15053	18681
1982	2478	29135	9492	8607	29752

TABLE 2: AVERAGE NUMBER OF LARVAE/1000M^3 FOR ENTRAINMENT SAMPLES (1977-1982 COMBINED) AND THE ESTIMATED NUMBER OF LARVAE/1000M^3 FOR METER NET SAMPLES (1977-1982 COMBINED) IN THE INTAKE BAY AREA.

	8 A.M.			4 P.M.			12 MIDNIGHT		
	SURFACE	MID-DEPTH	BOTTOM	SURFACE	MID-DEPTH	BOTTOM	SURFACE	MID-DEPTH	BOTTOM
METER NET	81575	180721	302456	86595	278611	296181	7197446	2202531	1923921
ENTRAINMENT	56	124	207	59	191	202	4955	1506	1316
PERCENT OF TOTAL	.65%	1.44%	2.41%	.69%	2.22%	2.36%	57.35%	17.55%	15.33%

TABLE 3: PERCENT OF LARVAL FISH DENSITIES ENTRAINED BY TIME OF DAY AND YEAR.

YEAR	8 A.M.	4 P.M.	12 MIDNIGHT
1977	4.11%	9.45%	86.44%
1978	14.63%	16.93%	68.44%
1979	4.86%	1.78%	93.36%
1980	8.09%	8.31%	83.60%
1981	2.30%	1.57%	97.54%
1982	3.95%	3.94%	92.11%

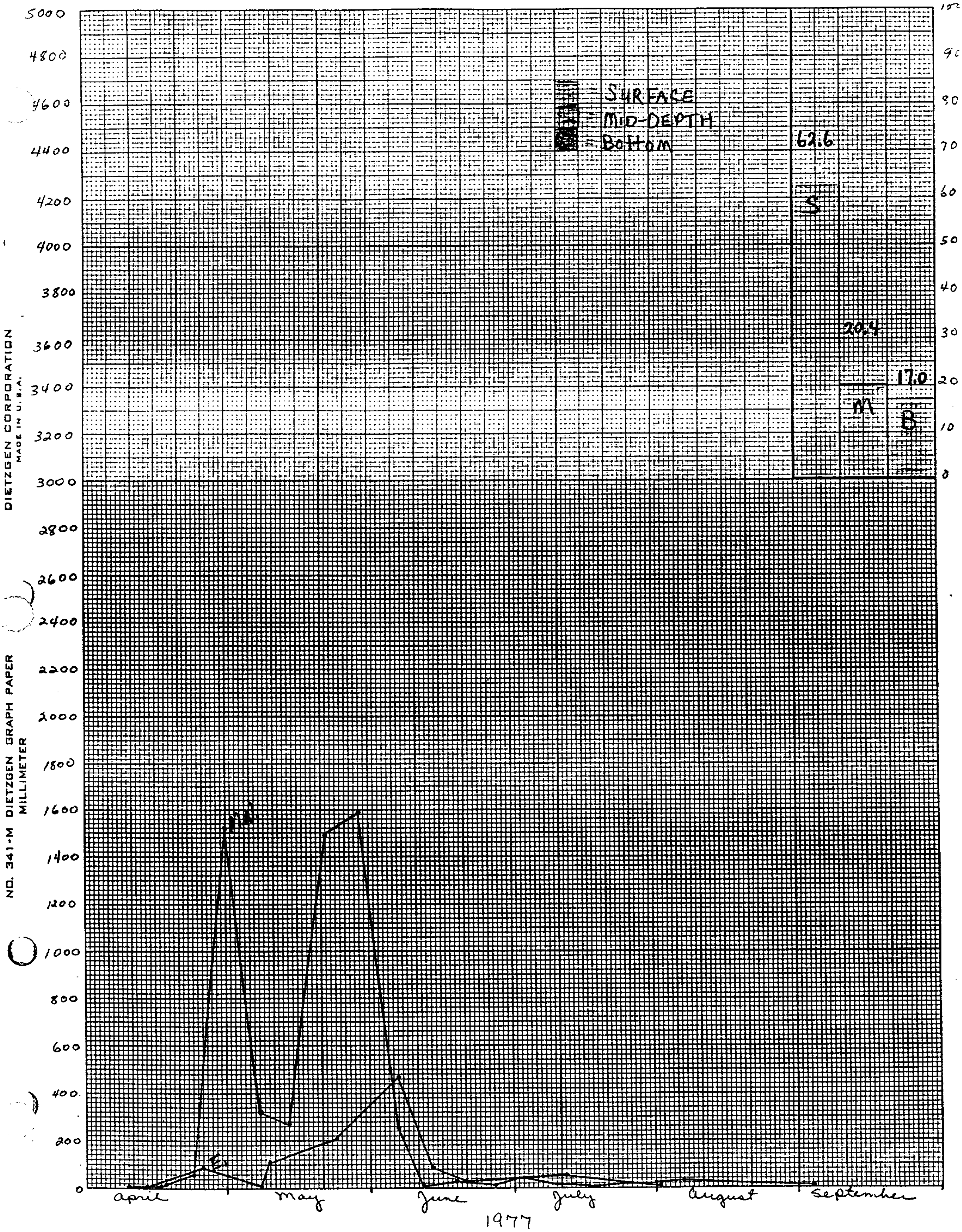
TABLE 4: EACH SPECIES PERCENT DENSITY DURING THE THREE TIME PERIODS WITHIN 24 HOURS AVERAGED OVER THE SIX-YEAR PERIOD OF ENTRAINMENT SAMPLING (1977-1982).

SPECIES	8 A.M.	4 P.M.	12 MIDNIGHT
CLUPEIDAE SPECIES	4.5%	6.8%	88.7%
CYPRINIDAE SPECIES	6.0%	30.0%	64.0%
CHANNEL CATFISH	0.0%	0.0%	100.0%
MORONE SPECIES	12.3%	5.6%	82.1%
LEPOMIS SPECIES	4.2%	1.3%	94.5%
POMOXIS SPECIES	9.0%	2.8%	88.2%
FRESHWATER DRUM	3.7%	2.2%	94.1%
ATHERINIDAE SPECIES	0.0%	11.8%	88.2%
CATOSTOMIDAE SPECIES	16.5%	1.8%	81.7%
CARP	82.3%	0.0%	17.7%

Graph 1. Intake Data
Meter Net ; Entrainment totals

- - = Meter Net
• = ENTRAINMENT

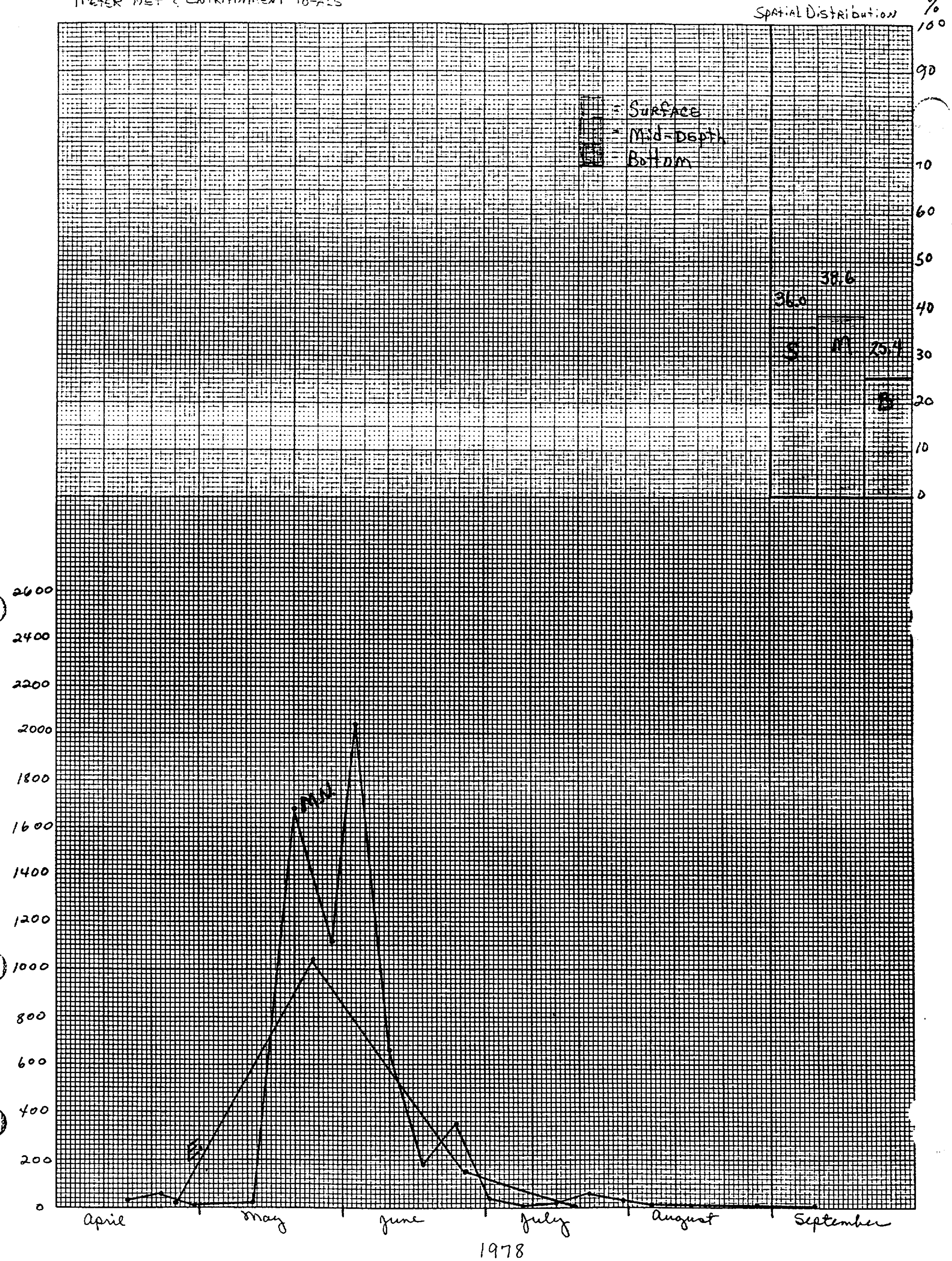
Spatial Distribution - % of Density



GRAPH 2. INTAKE DATA

Meter Net & Entrainment Totals

O = METER NET
● = ENTRAINMENT



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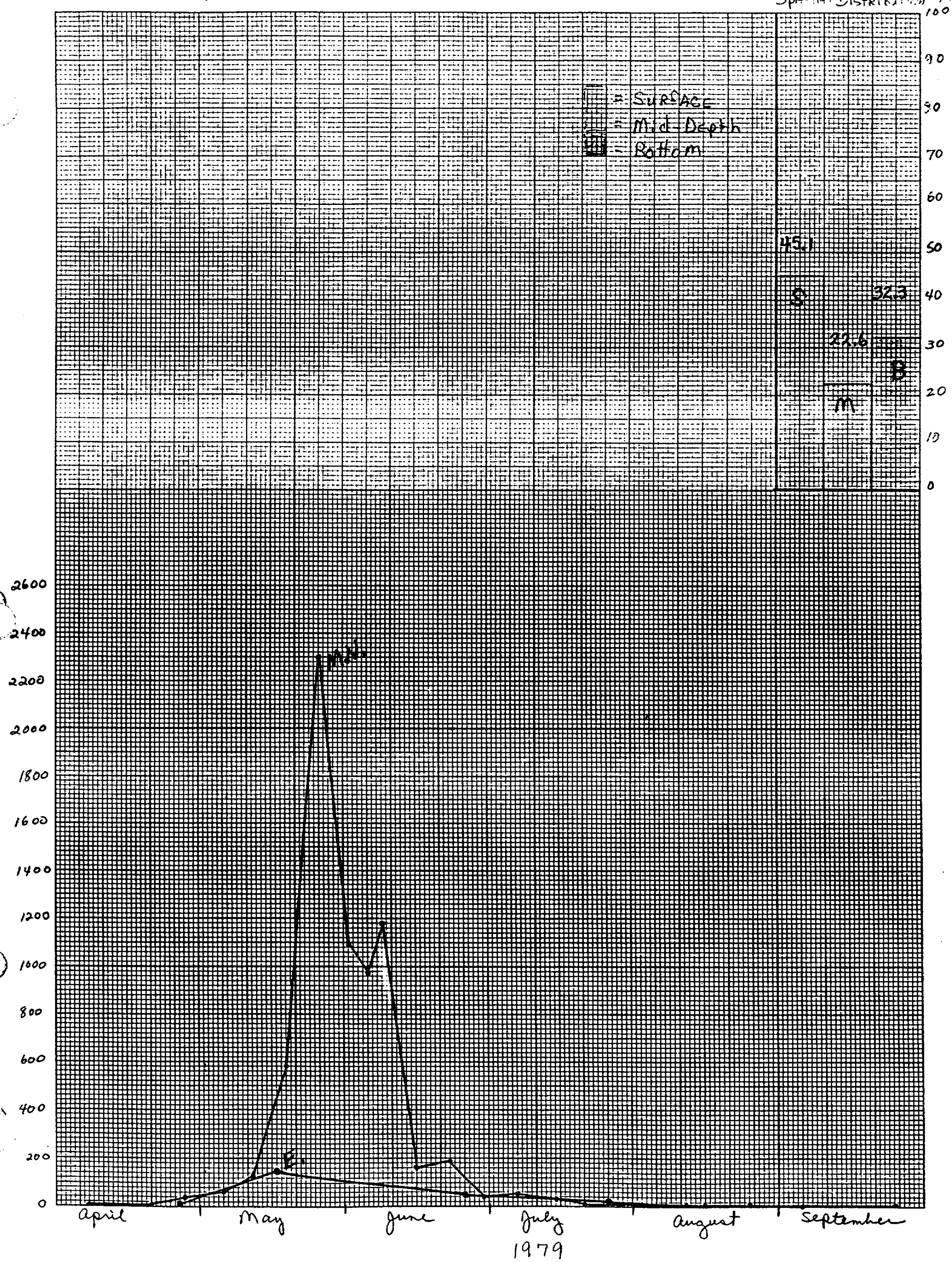
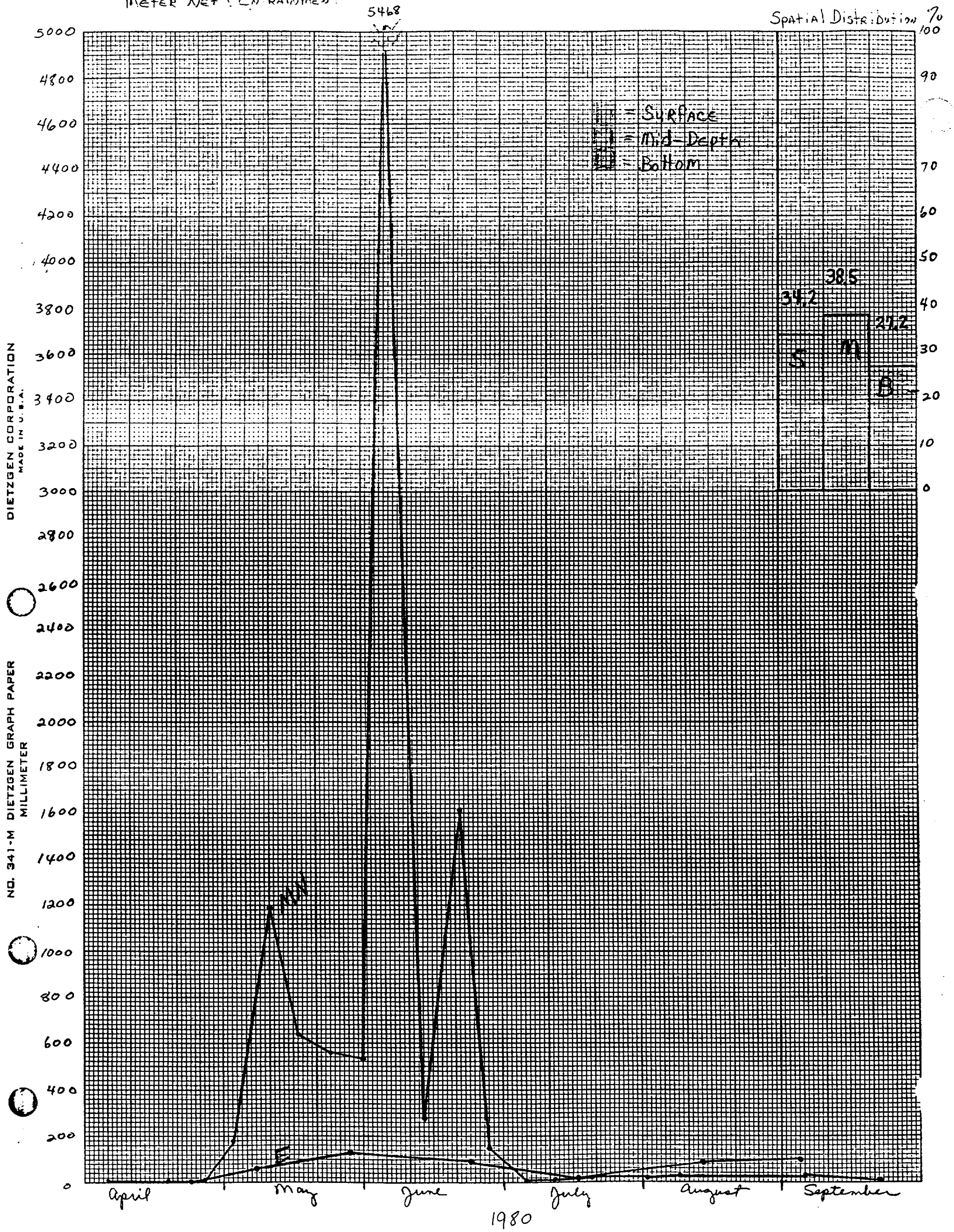
GRAPH 5. INTAKE DATA

Meter Net & Entrainment

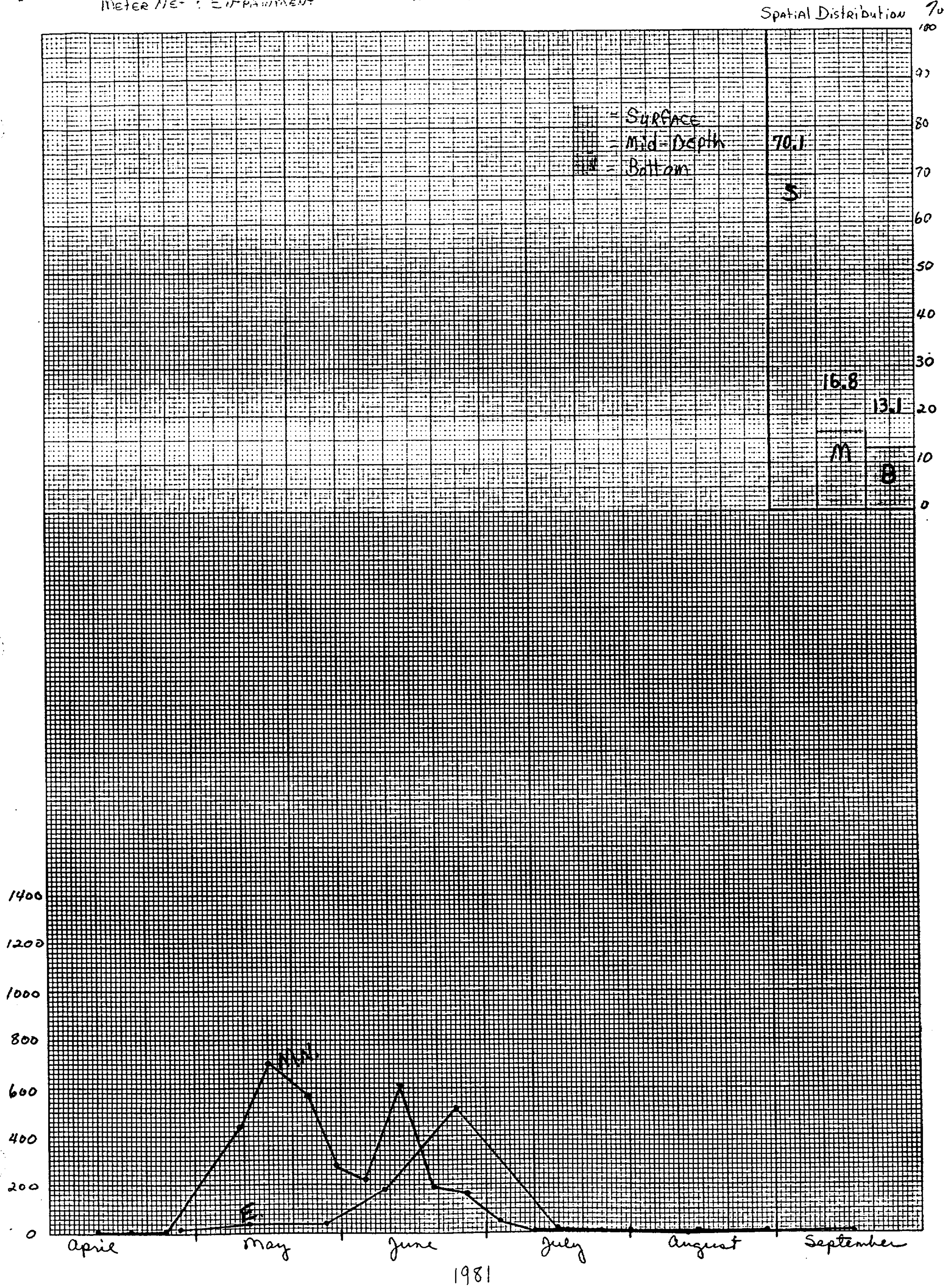
◦ = METER NET
• = ENTRAINMENT



Graph 4. Intake Data
Meter Net & Entrainment
• = Entrainment



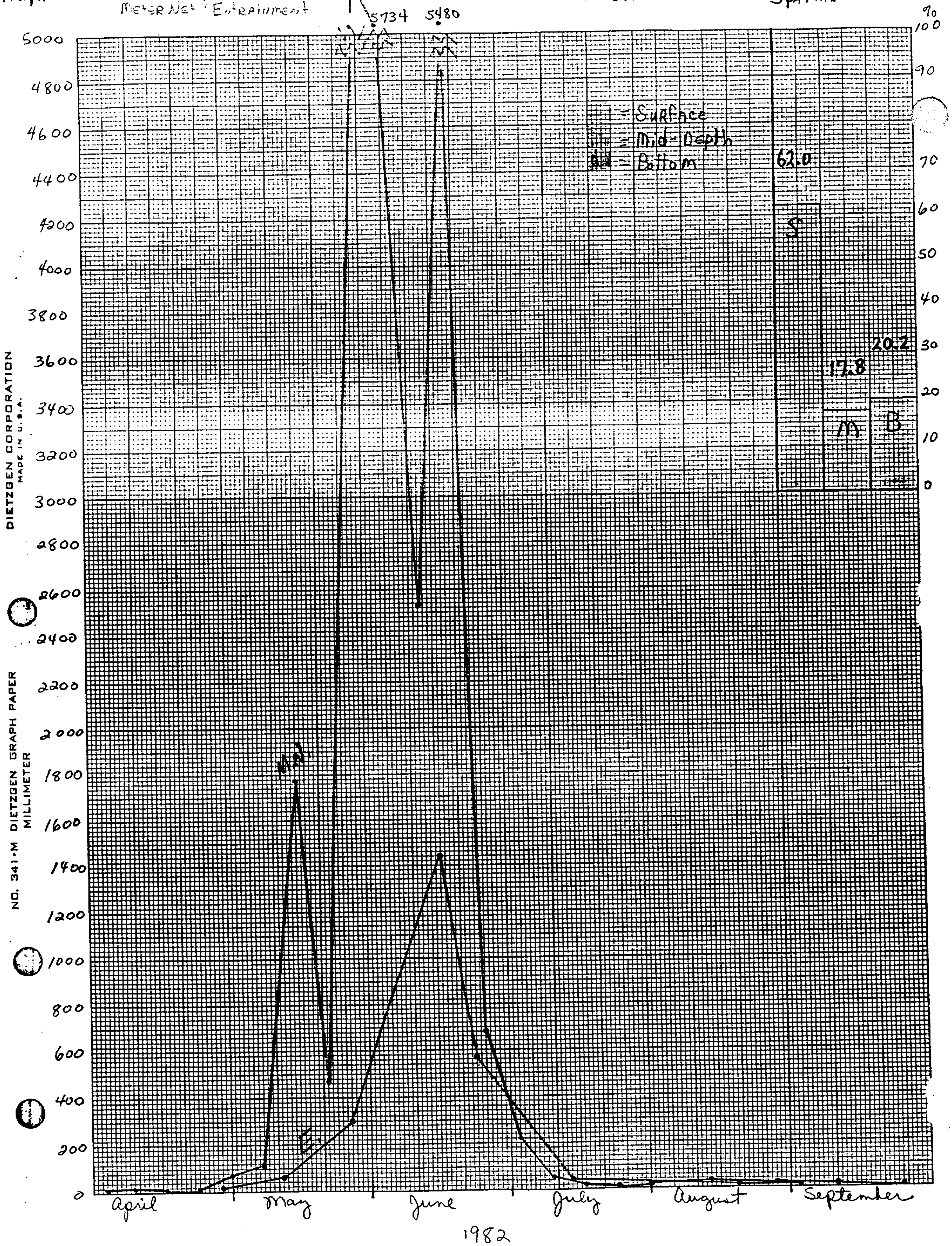
GRAPH 5. INTAKE DATA
Meter Net + Entrainment
• = ENTRAINMENT



Graph 6: Intake Data Meter Net / Entrainment

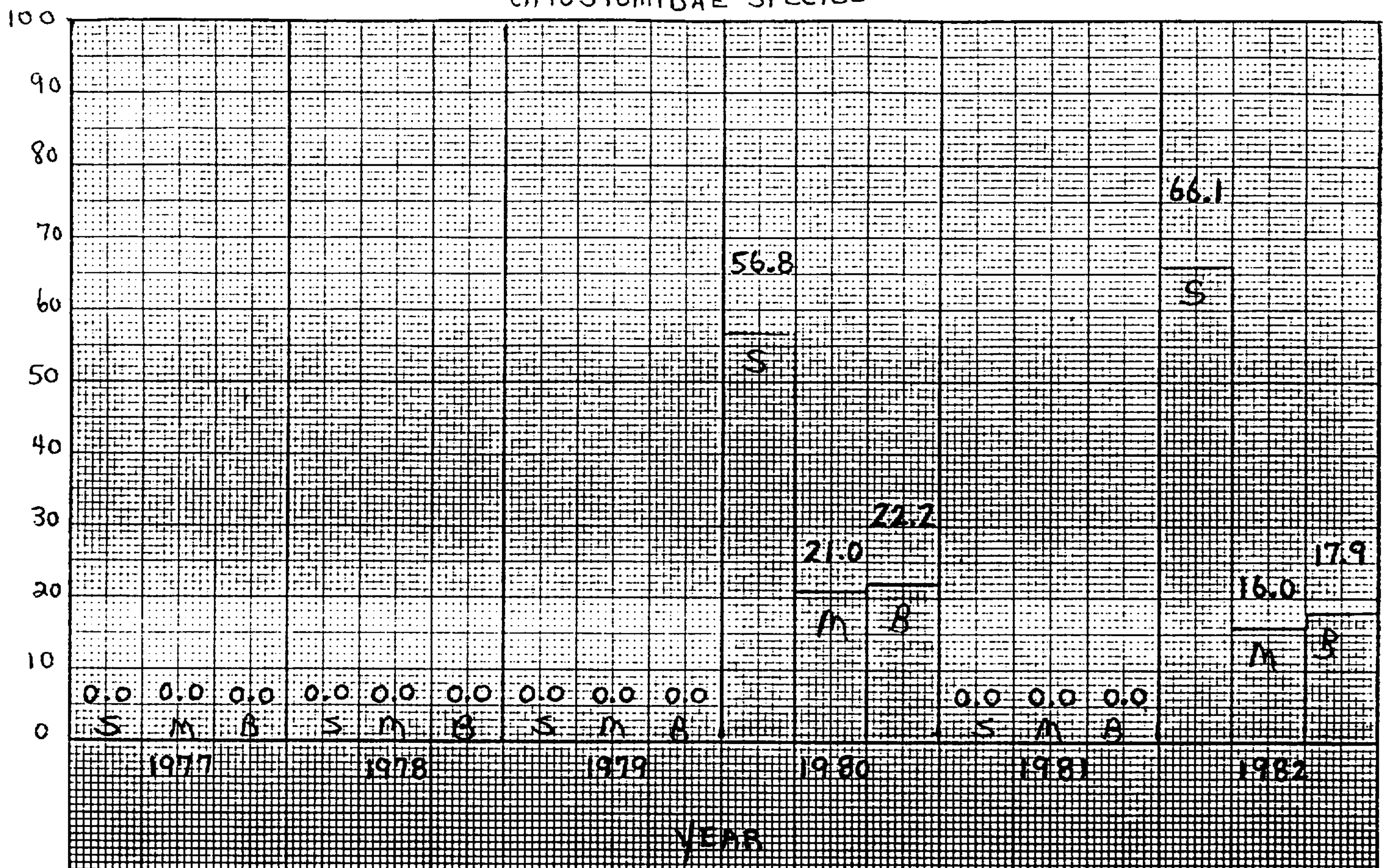
o = Meter Net
• = Entrainment

Spatial Distribution



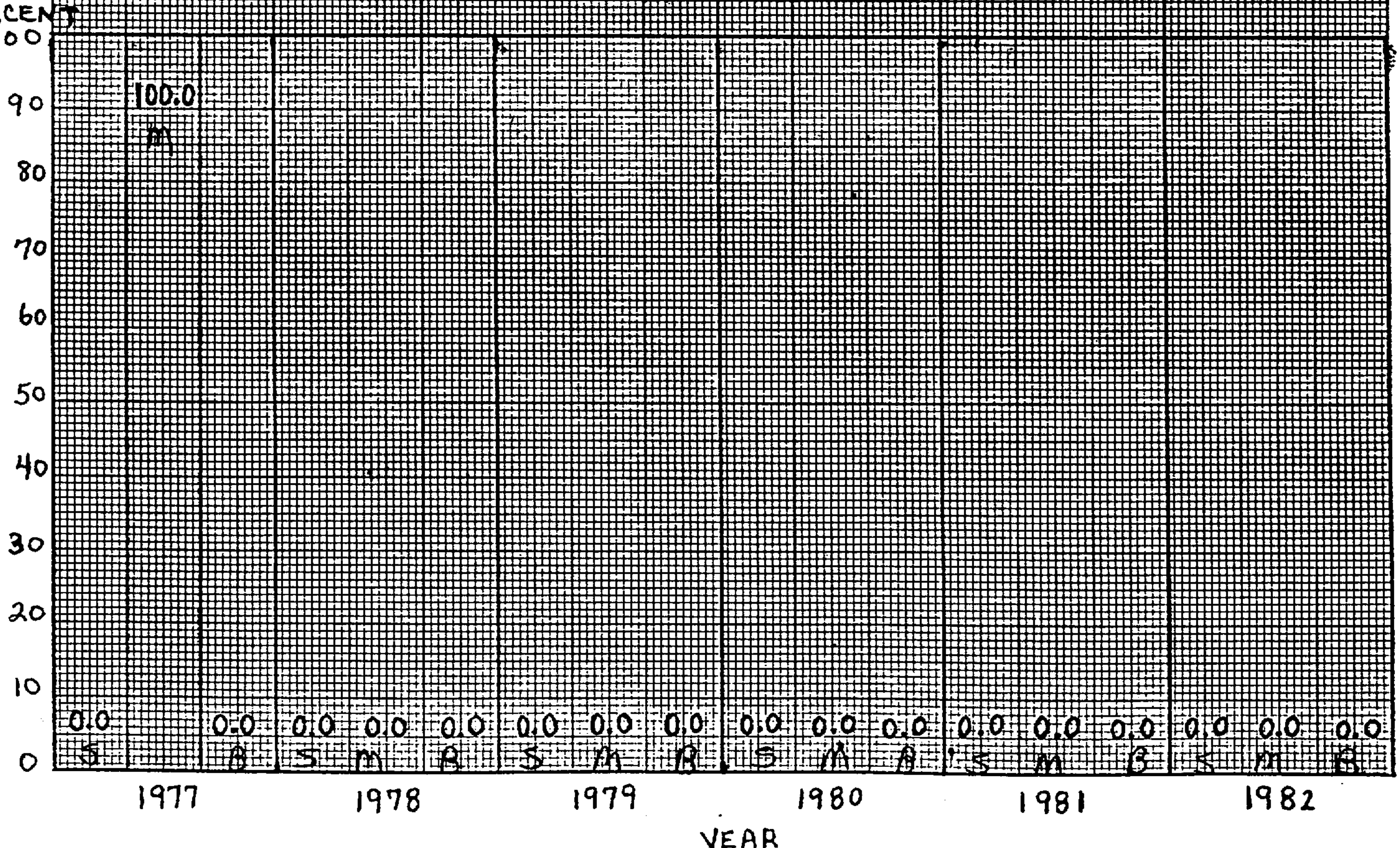
GRAPH 17. SPATIAL DISTRIBUTION BY % YEAR FOR EACH FAMILY/SPECIES OF FISH CAPTURED.

CATOSTOMIDAE SPECIES

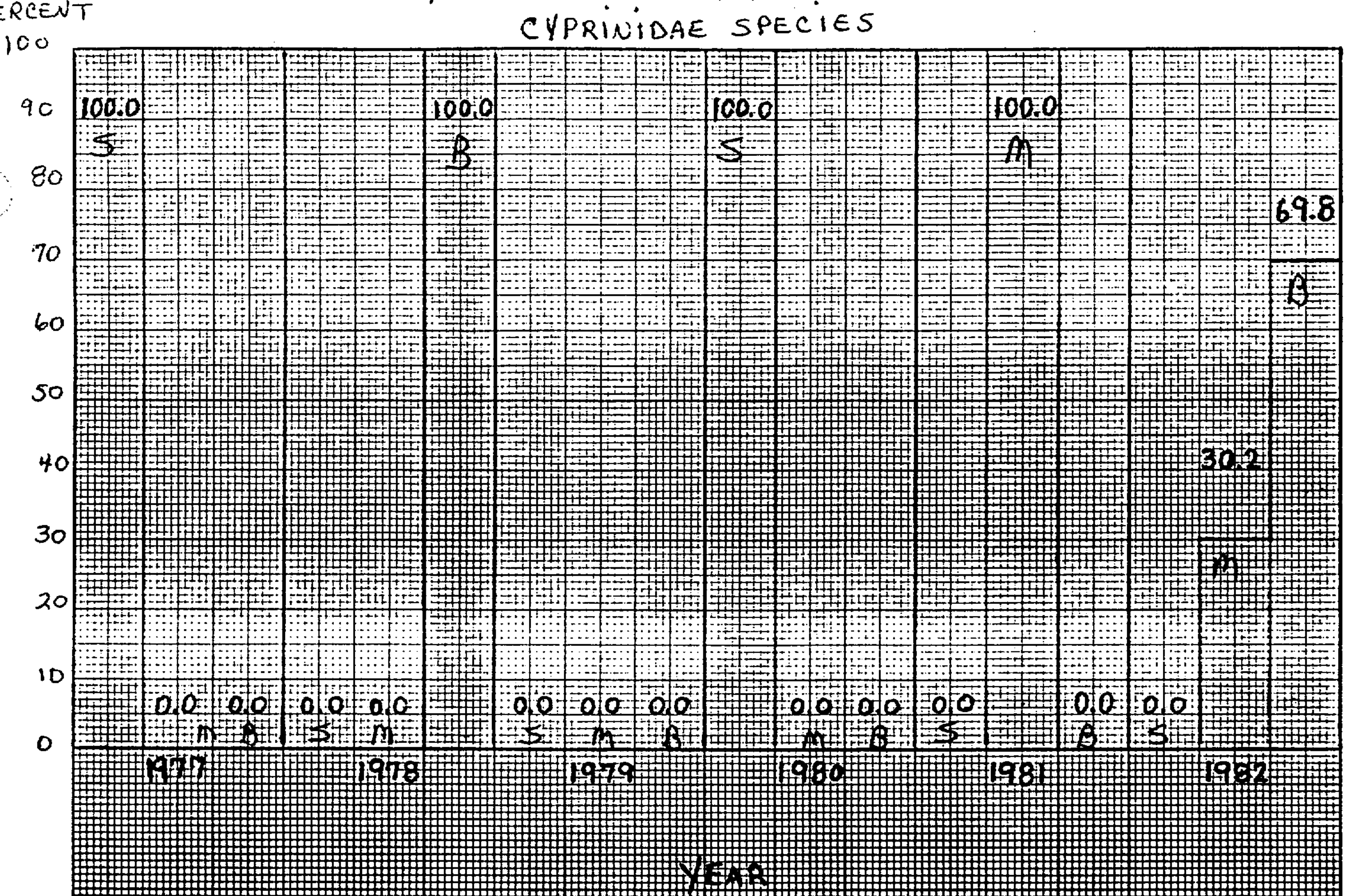


Graph 18.

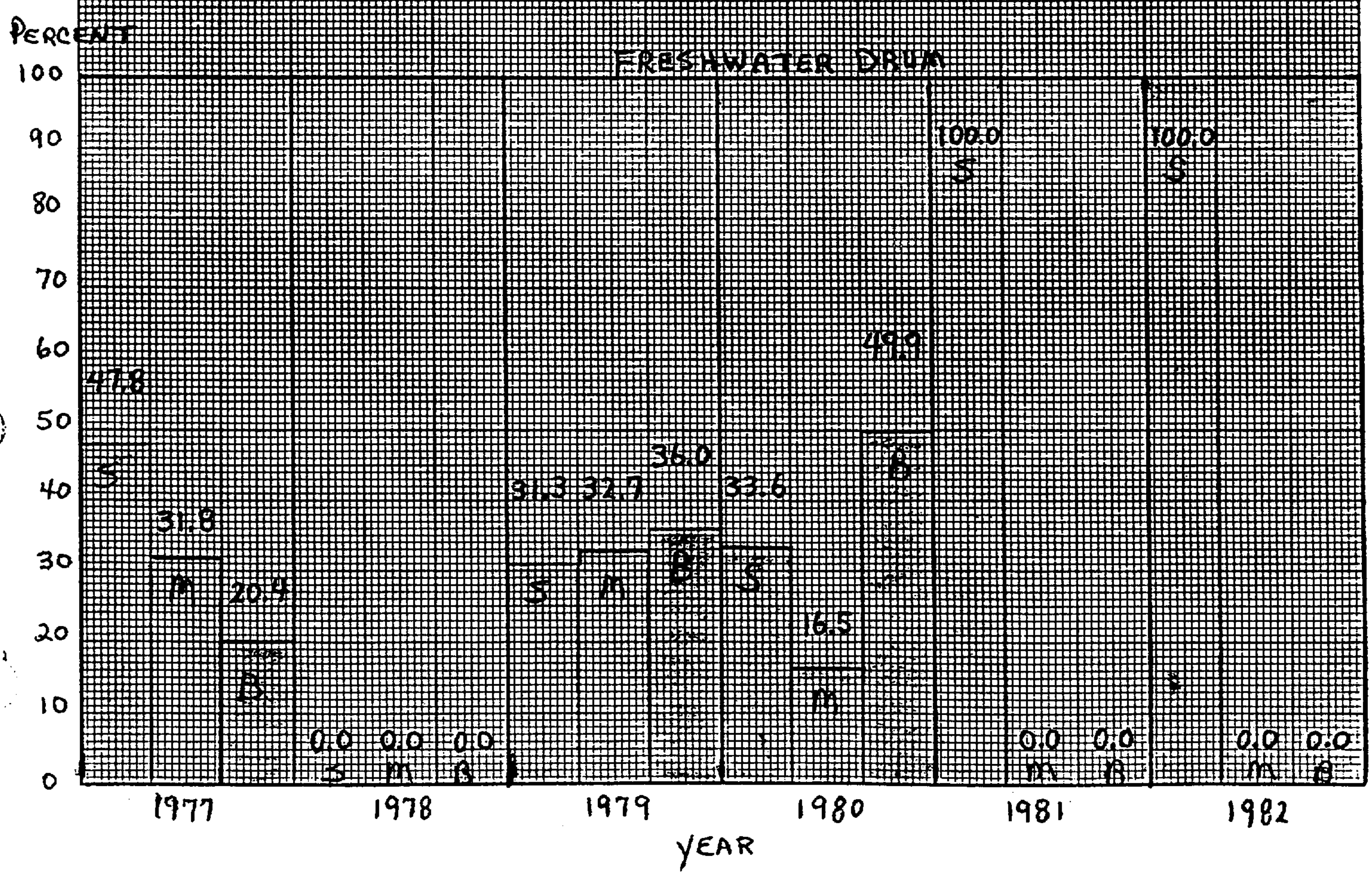
CHANNEL CATFISH



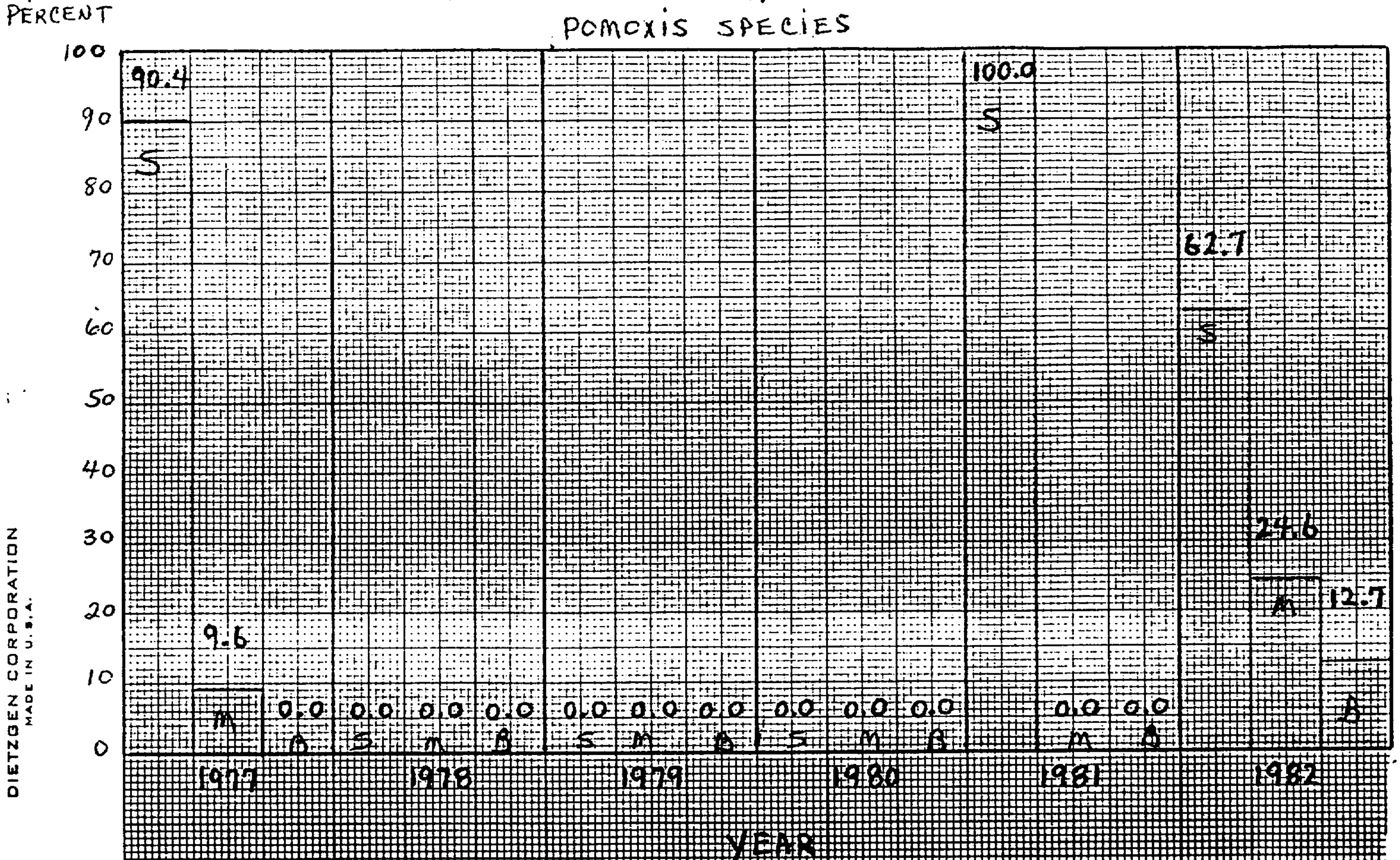
Graph 13. Spatial distribution by year for each family/species of fish entrained.



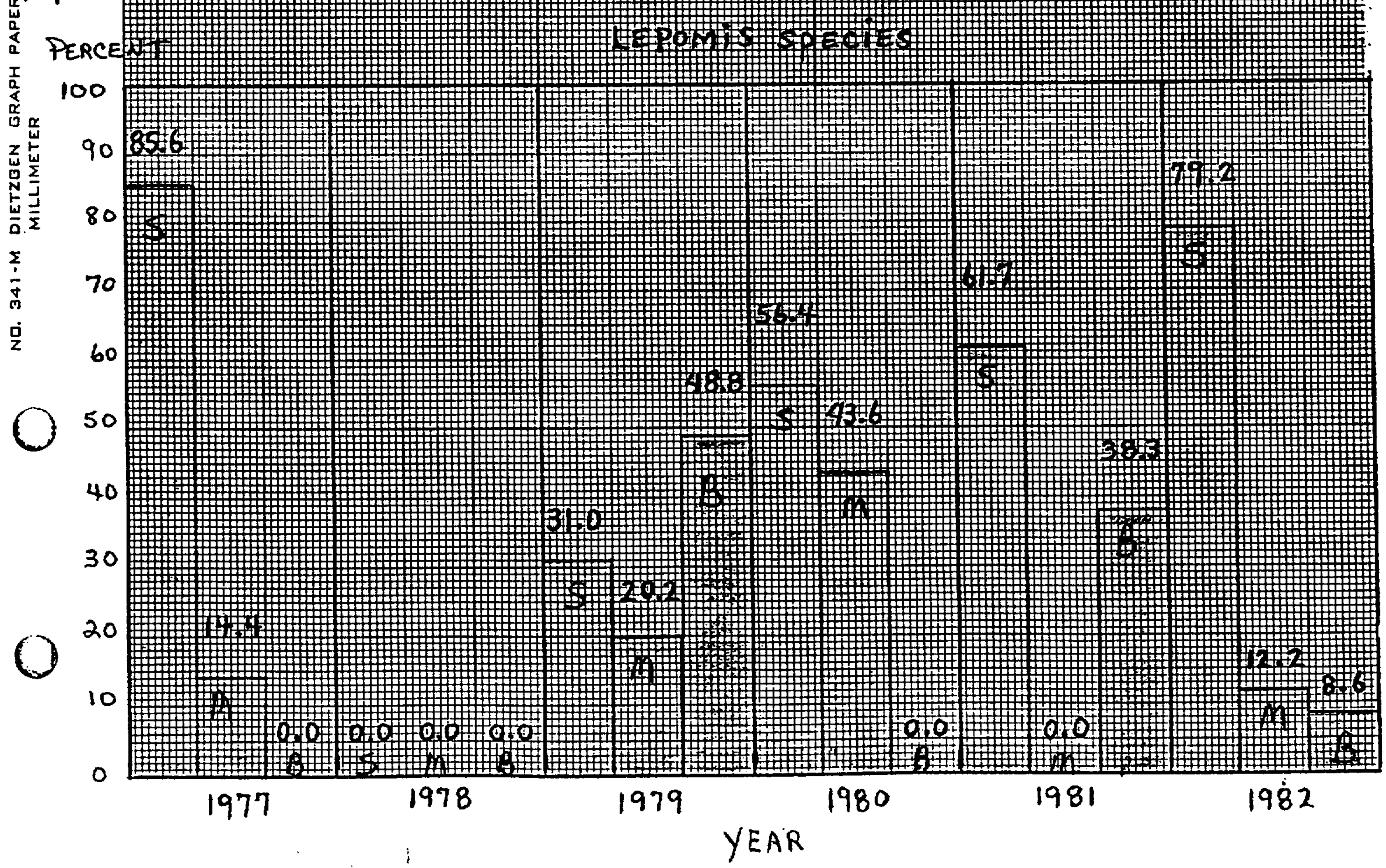
Graph 14.



Graph 11. Spatial distribution by year for each family/species of fish entrain...

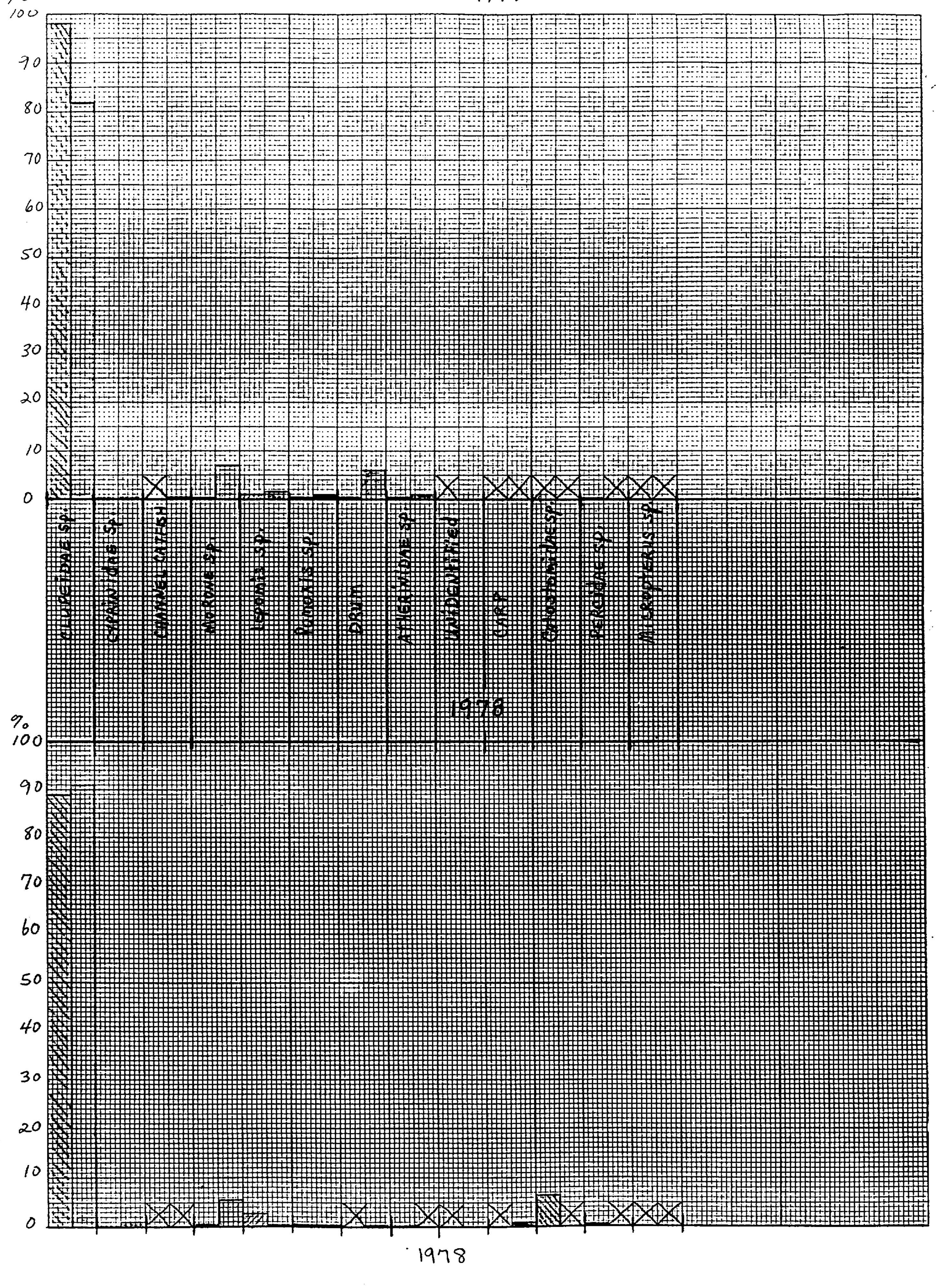


Graph 12.



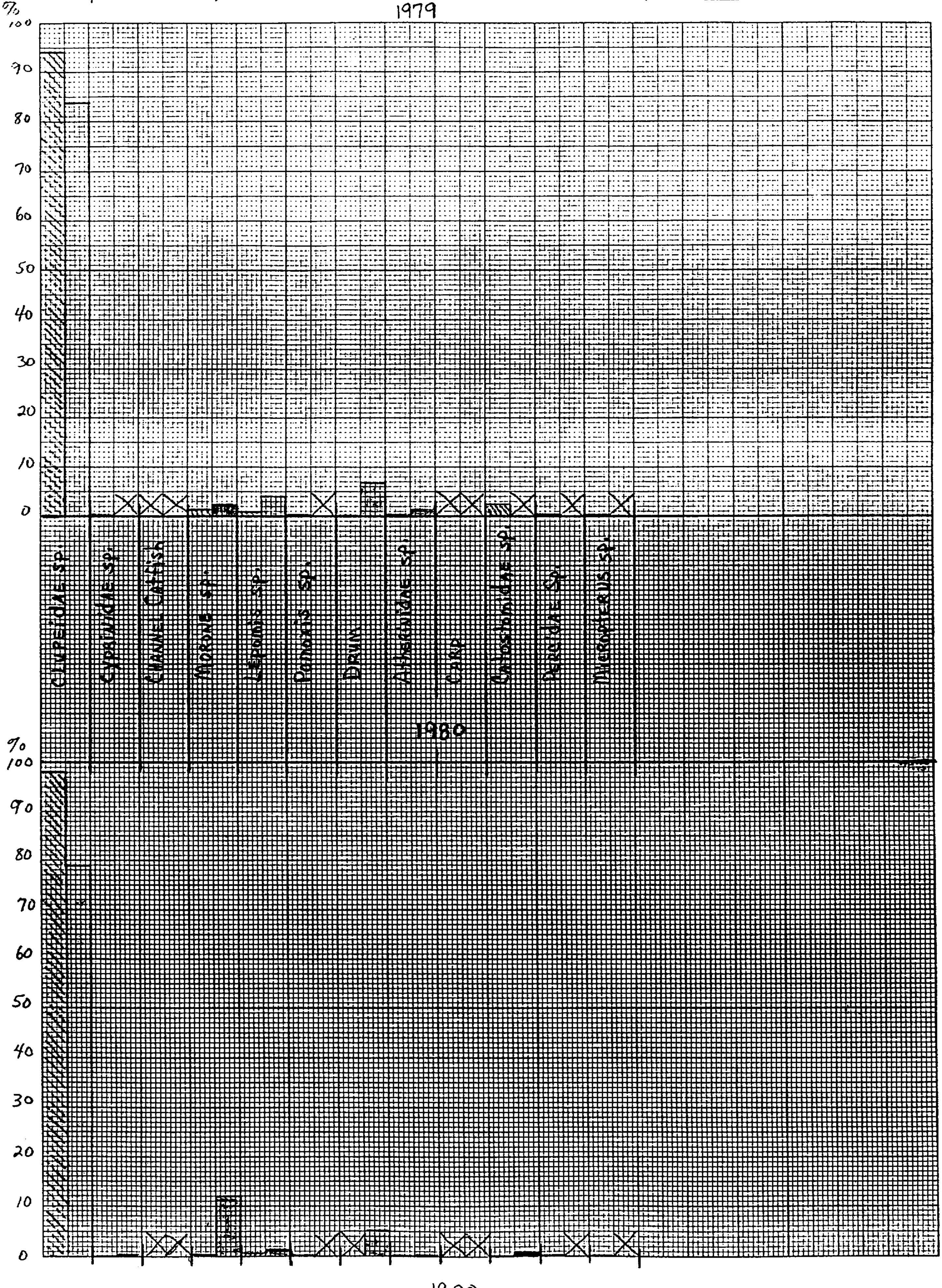
GRAPH 17. 1. Species Composition of Larval Fish in Intake Bay Area - First Column.
2. Species Composition of Larval Fish in Entrainment Samples - Second Column,

1977

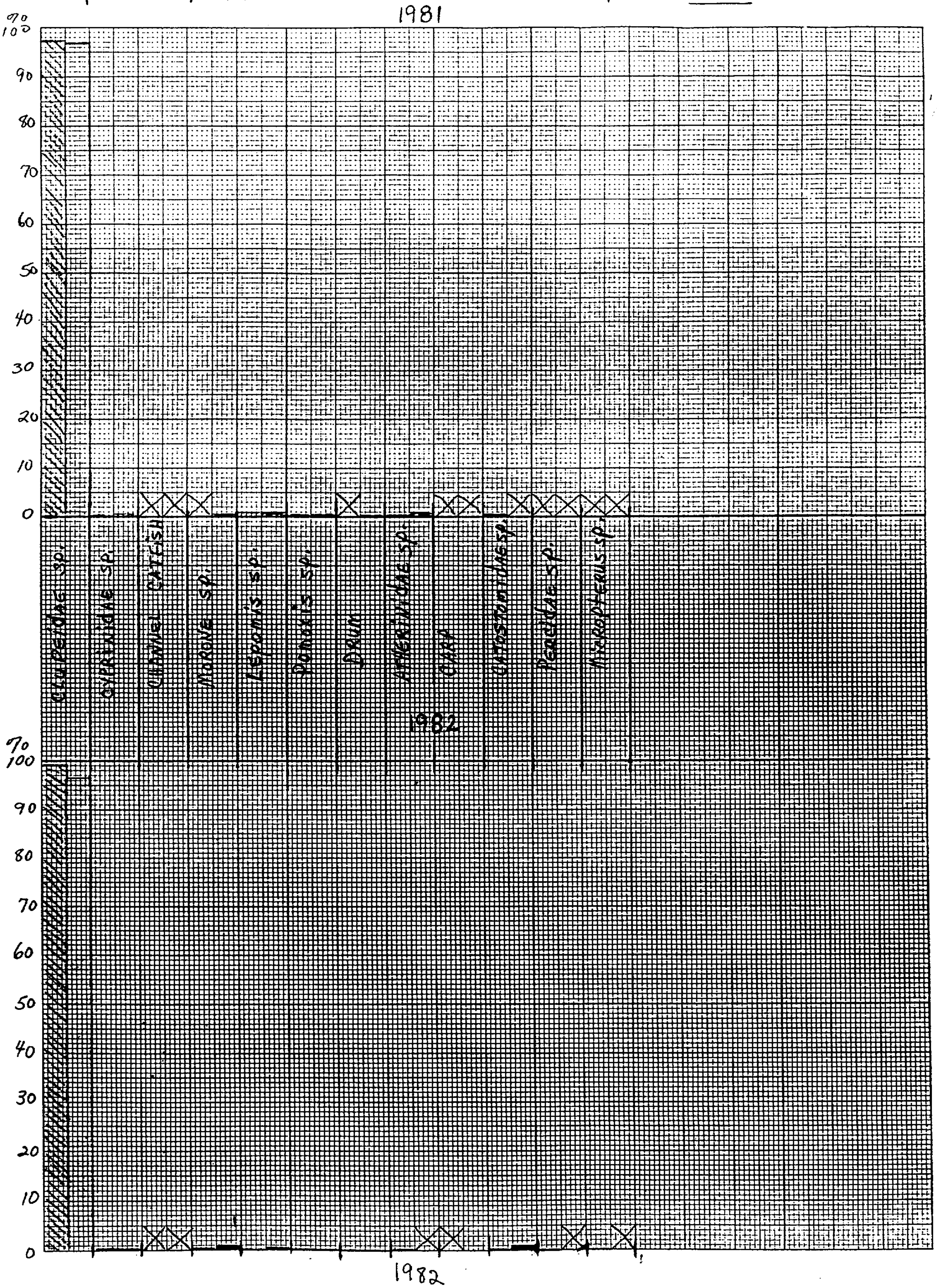


1978

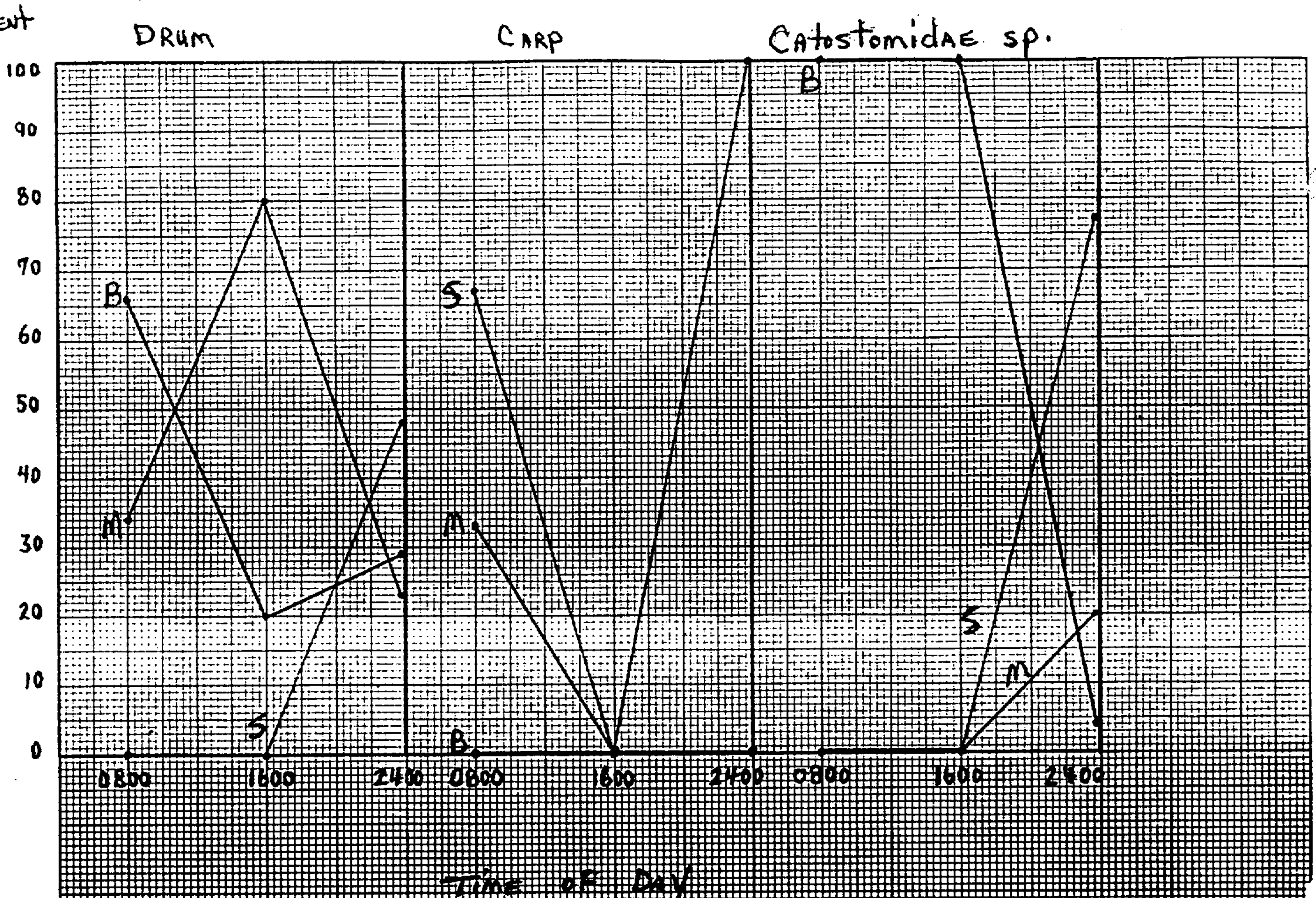
GRAPH NO. 2. Species composition of Larval Fish in Entrainment samples- Second Column.

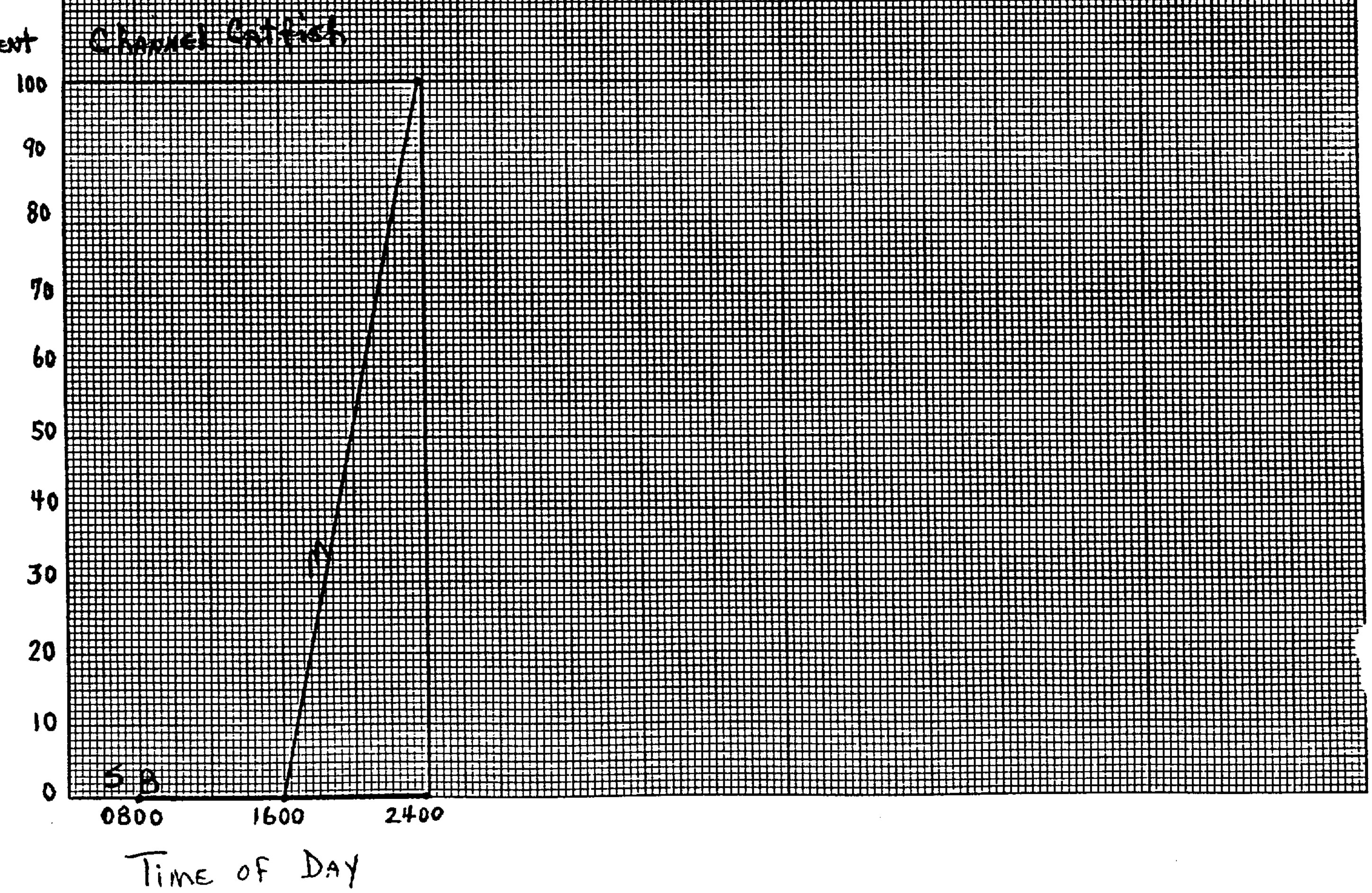


GRAPH 21. 1. Species Composition of Larval Fish in Intake Bay Area - First Column
2. Species Composition of Larval Fish in Entrainment Samples - Second Column



GRAPH 2 Temporal and Spatial Distribution of Species Exhibiting 1977 1978 Averaged.





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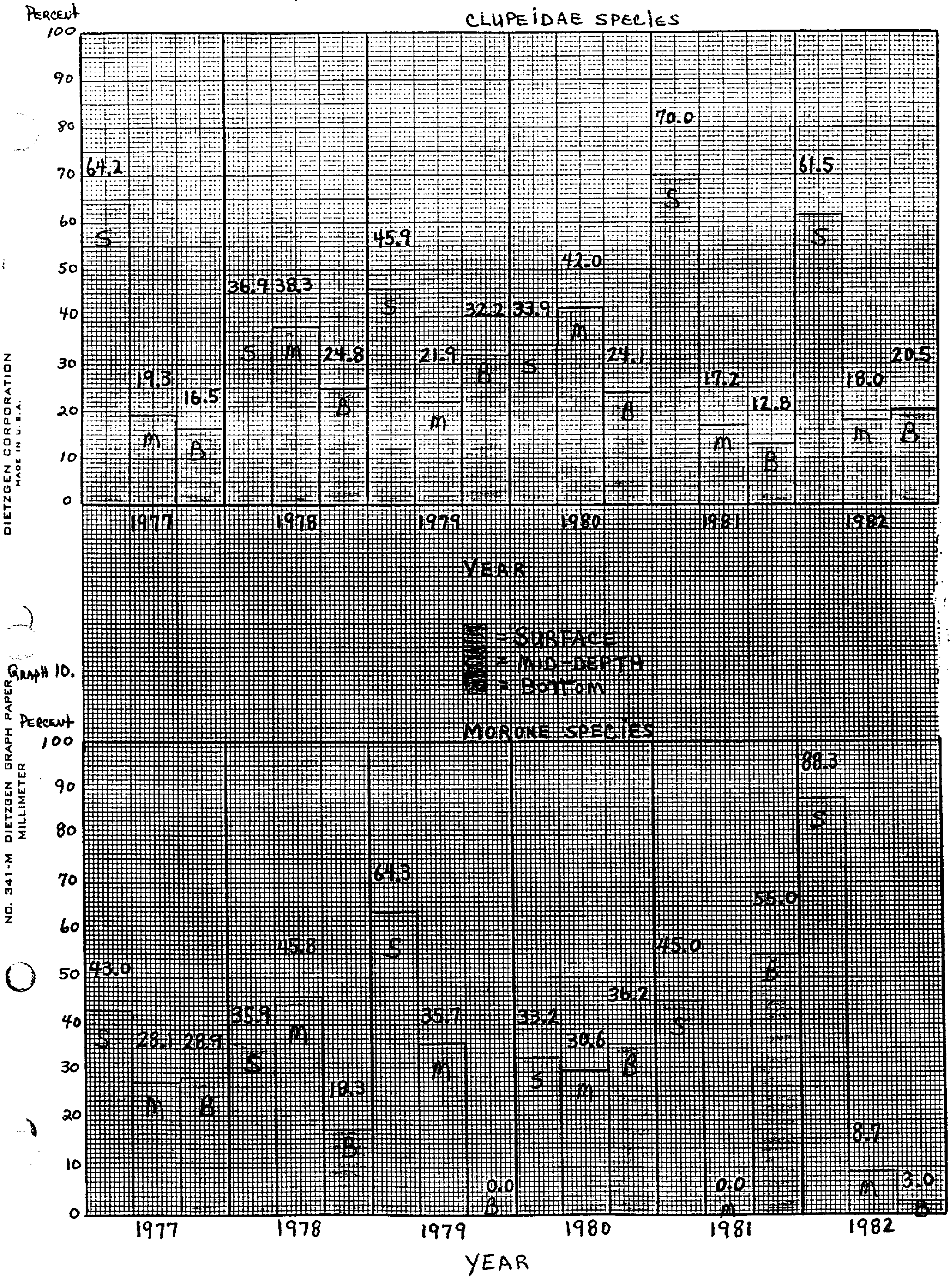
Graph 10.
CLUPEIDAE SPECIES
PERCENT
0
10
20
30
40
50
60
70
80
90
100
64.2
S
19.3
M
16.5
B
36.9
S
38.3
M
24.8
B
45.9
S
21.9
M
32.2
B
33.9
S
42.0
M
24.1
B
70.0
S
17.2
M
12.8
B
61.5
S
18.0
M
20.5
B
1977
1978
1979
1980
1981
1982
YEAR
= SURFACE
= MID-DEPTH
= BOTTOM
MORONE SPECIES
PERCENT
0
10
20
30
40
50
60
70
80
90
100
43.0
S
28.1
M
28.9
B
35.9
S
45.8
M
18.3
B
64.3
S
35.7
M
0.0
B
33.2
S
30.6
M
36.2
B
45.0
S
0.0
M
55.0
B
88.3
S
8.7
M
3.0
B
1977
1978
1979
1980
1981
1982
YEAR
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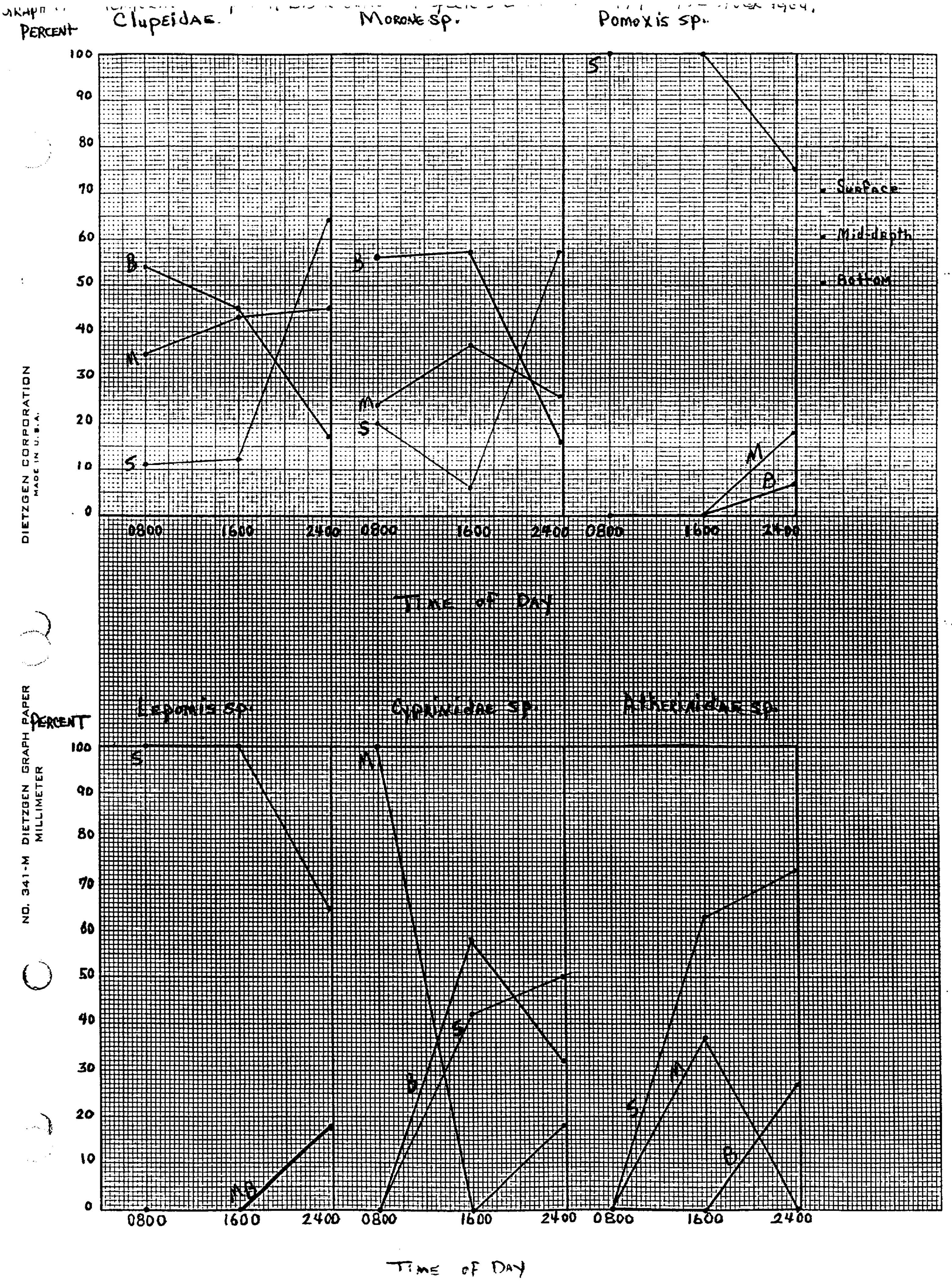
PERCENT
Clupeidae
Morone sp.
Pomoxis sp.
Surface
Mid-depth
Bottom
TIME OF DAY
Lepomis sp.
Cyprinidae sp.
Atherinidae sp.
PERCENT
TIME OF DAY
DIETZGEN CORPORATION
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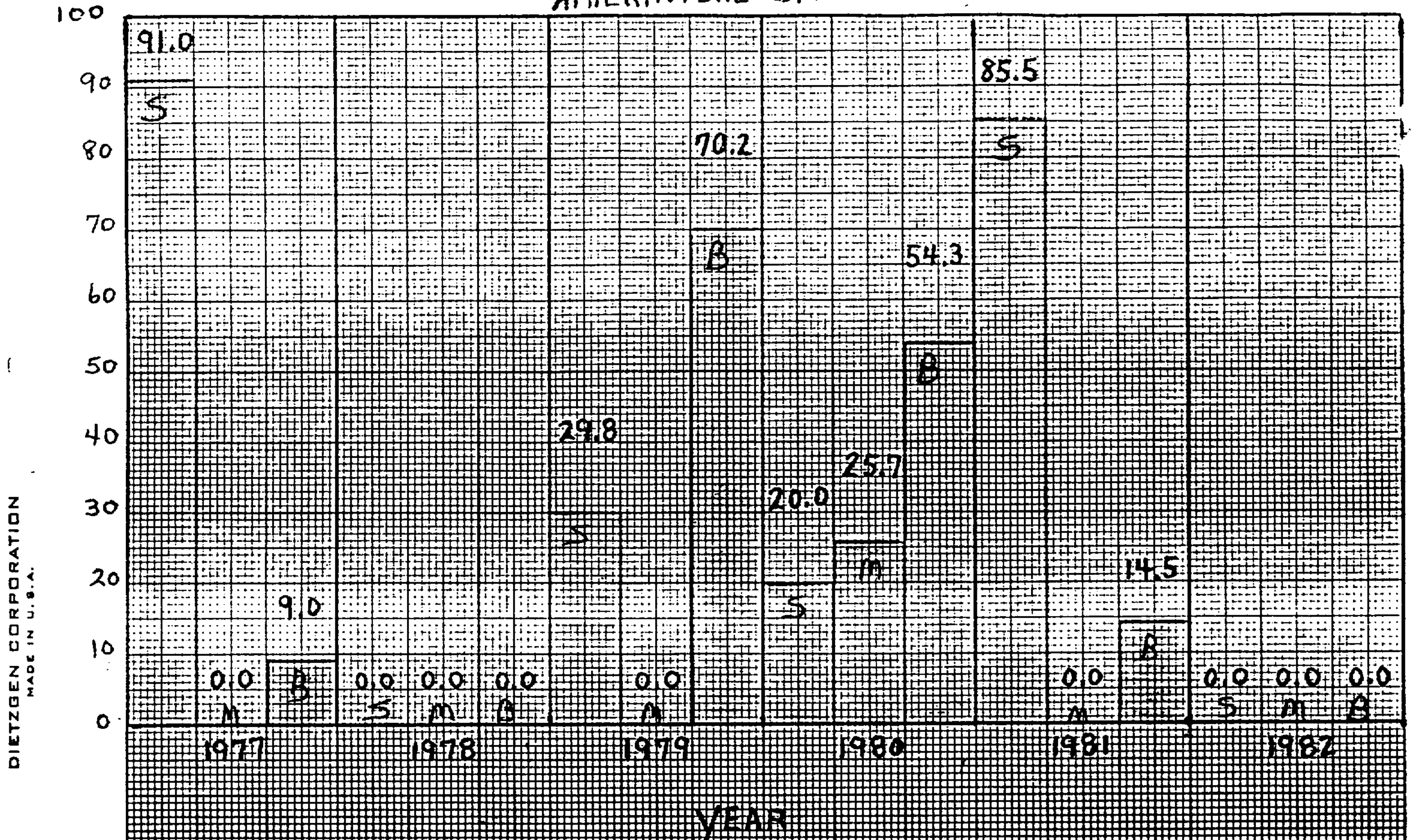
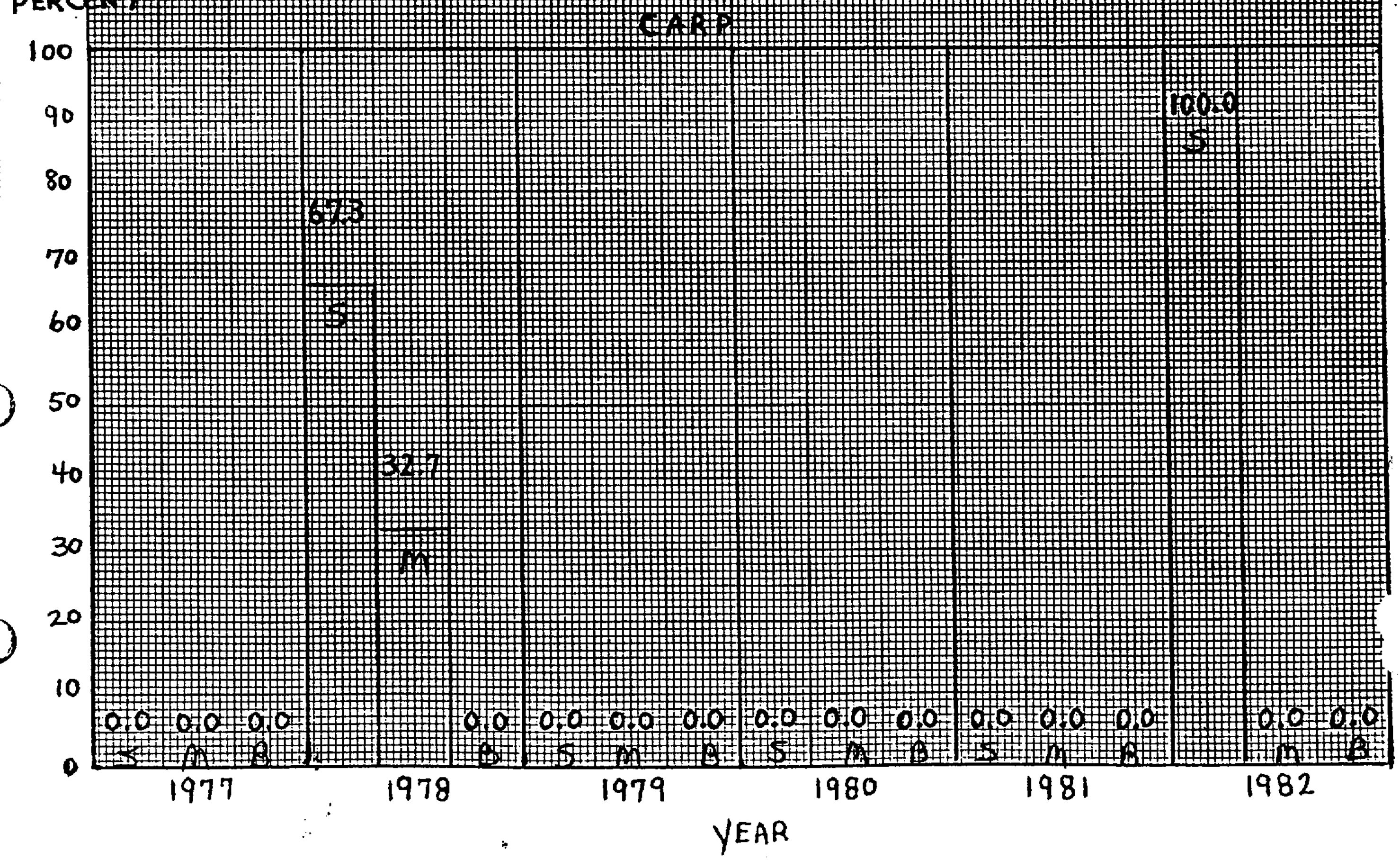
GRAPH 15. SPATIAL DISTRIBUTION BY YEAR FOR EACH FAMILY/SPECIES OF FISH ENTRAINMENT.

ATHERINIDAE SPECIES



Graph 16.

CARP



ANO Entrainment
Species/Family Entrained 1982 Through 1987

Clupeidae
Gizzard Shad
Threadfin Shad
Skipjack Herring
Dorosoma Species
Carp
Striped Bass
Morone Species
Cyprinidae
Catostomidae
Freshwater Drum
Black Crappie
Pomoxis Species
Samllmouth Buffalo
Brook Silverside
Atherinidae
Mississippi Silverside
Percidae
Mosquitofish
Centrarchidae
Lepomis Species
Channel Catfish

Entrainment
Total Density of Fish Entrained Per Sample Date
1984 through 1987

1984		1985		1986		1987	
Date	Number	Date	Number	Date	Number	Date	Number
		4- 8	37	4-17	1252		
4-25	53	4-29	1714	4-28	84	4-20	20
5- 9	18	5-15	33472	5-13	7387	5-7	2125
5-24	40344	5-30	5173	5-29	26910	5-21	21580
6-14	172867	6-10	38844	6-12	74825	6-2	37349
6-27	116609	6-25	2298	6-26	48637	6-23	17079
7-10	3662	7- 9	2596	7-10	4795	7- 9	99048
7-24	503	7-31	506	7-22	4573	7-22	16183
8-14	222	8-13	207	8- 7	2395	8- 3	674
8-30	79	8-28	252	8-21	590	8-19	1072
9-10	46	9- 9	647	9- 4	298	9-10	364
9-19	32	9-25	125			9-29	50
Total	334435		85871		171746		195544

ANO Entrainment

Density By Species/Family Entrained From 1984 Through 1987

Species	1984	1985	1986	1987
Clupeidae	315312	73776	156909	189662
Gizzard Shad	12231	1241	679	179
Threadfin Shad	1521	441	2090	2095
Skipjack Herring	30	185	0	19
Carp	0	49	16	0
Striped Bass	0	34	0	0
Cyprinidae	1304	354	427	0
Black Crappie	0	16	0	0
Catostomidae	0	655	16	111
Brook Silverside	0	17	0	0
Channel Catfish	31	0	17	0
Centrarchidae	18	0	0	0
Morone Species	261	5123	891	736
Mosquitofish	16	0	0	0
Lepomis Species	540	603	1330	718
Pomoxis Species	16	459	454	129
Freshwater Drum	2998	2610	8272	1841
Atherinidae	0	111	118	0
Mississippi Silverside	156	195	525	34
Percidae	0	0	0	20

DARDANELLE RESERVOIR FISHERIES
ABNORMALITIES ON ALL SPECIES 1974 - 1985
LORODOSIS (HUMPBACK) - NUMBER OF INDIVIDUALS/TOTAL FISH CAUGHT

YEAR	AREA A UPSTREAM CONTROL)		AREA B INTAKE		AREA C DISCHARGE		AREA D MAIN RIVER CHANNEL	
	NUMBER	TOTAL FISH	NUMBER	TOTAL FISH	NUMBER	TOTAL FISH	NUMBER	TOTAL FISH
1974	0	6084	0	1562	0	3575	0	1990
1975	0	38399	0	3785	35	5082	0	9992
1976	0	23607	0	6438	120	9145	0	9686
1977	1	14834	0	5801	2	5169	0	12217
1978	5	102205	1	6687	3	7228	0	13584
1979	0	60492	0	6868	2	12089	0	13916
1980	0	143145	2	10820	0	9673	0	235039
1981	1	19738	0	3074	0	1786	0	15087
1982	0	29767	0	29145	0	9510	0	8611
1983	0	47128	0	17169	0	6858	0	48785
							AREA F ACROSS LAKE FROM DISCHARGE	
4	0	27192	0	6087	0	2530	0	4051
5	0	11174	0	12700	0	3572	0	3355

ARKANSAS POWER & LIGHT COMPANY
POST OFFICE BOX 551 LITTLE ROCK, ARKANSAS 72203 (501) 371-4000

**ARKANSAS NUCLEAR ONE
GENERATING STATION**

Dardanelle Reservoir
Environmental Monitoring Program

Summary Report

of

Environmental Impact of Thermal Discharge

October 30, 1984

Arkansas Nuclear One Generating Station, a facility of Arkansas Power & Light Company, is located near Russellville, Arkansas, on Dardanelle Reservoir. The reservoir is formed by the impoundment of the Arkansas River by the U. S. Army Corps of Engineers Lock and Dam #11, located at Arkansas River navigation mile 205.5 ANO is located at navigation mile 212.

ANO is a nuclear powered base-load electric generating facility operated by AP&L under a license issued by the Nuclear Regulatory Commission. In accordance with certain provisions of this license, AP&L has conducted an extensive environmental monitoring program on Dardanelle Reservoir. A portion of this program is designed to assess the impacts of the thermal discharge from the facility on fish and aquatic life. This program was initiated prior to operation and has continued to-date. It includes the collection and analysis of physio-chemical data from the reservoir and aquatic life population surveys. This program has demonstrated that the thermal discharge from ANO meets the Arkansas water quality criteria for Lake Dardanelle of a 95°F maximum and 5°F maximum increase, and that these criteria are protecting the fishery use in the reservoir.

The first component of this program was an intensive analysis of the temperature distribution in the vicinity of ANO. ANO is located on a headland that separates the submerged Arkansas River channel from the Illinois Bayou.

Both units intake cooling water from the Illinois Bayou and discharge into a cove on the northern shore of Dardanelle Reservoir. Unit 1 utilizes a once-through cooling water system, while Unit 2 utilizes a natural draft cooling tower. The temperature distribution survey consisted of a pre-operational survey and a series of 13 monthly post-operational surveys. Data was collected along a cross-section of the reservoir in the area of the reservoir receiving the maximum impact of the discharge plume. This survey indicated that plume behavior was affected by air temperature, wind and reservoir flow-through. Analysis also showed compliance with the water quality criteria of 95°F maximum and 5°F maximum increase.

A second, continuing program implemented in 1973, before operation, involves monthly physio-chemical water sampling at a number of locations and quarterly sampling of benthos and plankton. Monthly water samples are collected upstream, through the discharge area, and downstream of the plant. These samples are analyzed for a wide range of parameters, including temperature. As expected, the cooling water discharge does cause an increase in temperature over the ambient temperature indicated by the upstream sampling station. Sampling locations in the area of discharge routinely show temperatures in excess of 90°F during the summer months of June, July, and August. Based on monthly sampling, the highest recorded temperature is 94°F in July, 1982 and August, 1983. Based on the period 1980-1983, the average of temperatures above 90°F is 92.3°F.

The limit of a 5° maximum increase is approached most often during the cooler winter months. For the period 1980-83, the average increase above ambient was 3°F. Individual monthly readings have been higher, with values falling in the range of 4° to 5°F occurring on an annual basis. Analysis of data collected on temperature by this survey demonstrates that while the criteria of 95°F maximum and 5°F maximum increase have been approached, the discharge from the plant complies with these criteria. This same survey program includes quarterly sampling for benthos and plankton. Analysis of data shows that phytoplankton and zooplankton populations tend to be higher at those sampling points in the area of discharge. Populations are more numerous in this area during January than at those stations more distant from the discharge area. While there are variations by season, population and species diversity are fairly uniform throughout the reservoir. Diverse populations of plankton and benthos are existing within the temperature conditions occurring in the area of the ANO discharge.

A third program begun in 1973 was a fishery survey. The survey was designed to characterize the species composition and growth of fish in Dardanelle Reservoir for the purpose of assessing significant impacts on the fishery due to operation of ANO. Sampling is conducted at various locations to compare unaffected areas with the discharge area. The fish population in Dardanelle Reservoir consists of more than 50 species. The first nine years of data has been subjected to statistical analysis to determine the correlation of temperature in the discharge area with the level of spawning activity. The conclusion of the analysis is that no significant correlation exists. The mean weight of adult fish collected in the discharge area was not significantly different from those collected in other areas. The species composition in the discharge area is not significantly different from other sample locations. In conclusion, the thermal discharge does not have a significant impact on the fishery use of Dardanelle Reservoir.

AP&L has been conducting an environmental survey program on Dardanelle Reservoir beginning prior to actual operation of ANO, and analysis has been made of nine years of data collected during operation. This data demonstrates that the cooling water discharge causes a temperature increase approaching 5°F during the colder winter months. In summer months, the maximum temperature approaches 95°F. The water quality criteria of a 95°F maximum temperature and a 5°F maximum increase are indicative of actual conditions in Dardanelle Reservoir. Concurrent with this temperature data, data has been collected on plankton, benthos, and fish. Analysis has shown that the species diversity and populations are not significantly different in the discharge area as compared to other locations. There is a healthy aquatic community throughout the reservoir. The water quality criteria for temperature in Dardanelle Reservoir are effectively protecting the fishery and other aquatic life.

BIBLIOGRAPHY

Geo-Marine, Inc., "The Distribution of Temperature and Dissolved Oxygen in the Vicinity of Arkansas Nuclear One Dardanelle Reservoir," December 17, 1976

John D. Rickett, "Dardanelle Reservoir - Illinois Bayou Embayment Survey," UALR Department of Biology, 1973-1982.

Sharon Tilley, "A Summary of the Dardanelle Reservoir Fishery Survey Annual Reports," 1983.

okMA

ARKANSAS GAME AND FISH COMMISSION
FISHERIES DIVISION

MEMORANDUM

TO: Mike Armstrong
Assistant Chief

DATE: November 16, 1987

FROM: Bob Limbird
District Fisheries Biologist

COPIES: Director's Office

SUBJECT: SUMMARY OF DARDANELLE LAKE FISH SAMPLES

Three fish samples were conducted on Dardanelle Lake during September. A total of 4.9 hectares were sampled and data recorded in metric measurements. Samples were made near O'Kane Island (upper section), Piney Creek (middle section), and Effluent Bay (lower section). A partial list of species sampled is shown here.

	No/Ha		Kg/Ha	
SPECIES	EFFLUENT	O'KANE	PINEY	EFFLUENT
Largemouth Bass		.4	12.5	9.99
Crappie		.7	8.5	0.23
Channel Catfish		.6	42.8	25.50
Gizzard Shad		[illegible].1	313.8	75.70
Threadfin Shad		4.2	128.4	87.90
Commercial Fish		2.2	241.4	162.20

AR Game & Fish / Bob Limbird
Fish Samples 11/16/87

Good shad, strip ... wns were noted in all sampled areas.

Attached are fish popu... uent Bay and Piney areas based on past data and compiled by Mike Bivin, Computer Analyst.

BL:kr

Attachment

Bob - Need to include sections on Recent Fisheries Management & Recent Fish Stockings or all Cove-Rotenone Samples (required in SSP's)

Also - Have you planned Dardenelle N.P. crop for 1988?

CARTER ....

GIBSON ....

ARKANSAS GAME AND FISH COMMISSION
FISHERIES DIVISION

MEMORANDUM

TO: Allen Carter
Assistant Chief

DATE: November 24, 1986

FROM: Bob Limbird, District Biologist
Jim Ahlert, Asst. Biologist

COPIES: Steve N. Wilson
Carl Hunter

SUBJECT: SUMMARY OF DARDANELLE LAKE FISH SAMPLES

Three fish population samples were conducted on Dardanelle Lake during September, as stipulated in our newly written sampling guidelines. A total of 4.9 hectares (12.18 acres) were sampled and weight was recorded in kilograms. Lengths were recorded in 25mm increments. These lengths are comparable to measuring in inch groups. Samples were located in the upper, middle, and lower sections of the lake. A partial list of species found in sampling is shown below. (Numbers and weights listed are per hectare.)

	Number			Weight		
Species	Piney	Effluent	O'Kane	Piney	Effluent	O'Kane
Largemouth Bass	67	79	76	4.532	9.833	9.817
Crappie	107	11	267	4.796	0.711	11.463
Channel Catfish	360	318	365	26.015	28.964	38.457
Gizzard Shad	7,996	1,190	16,553	381.787	73.500	245.770
Threadfin Shad	6,443	562	1,379	66.137	3.394	9.772
Commercial Fish	164	160	320	163.327	162.389	233.4

We noted threadfin and gizzard shad have good spawns producing abundant forageable shad for the larger sportfish in Dardanelle Lake. Good white bass and channel catfish spawns were also found in sampling. Unit 1 of the Nuclear Power Plant was not in operation during sampling, and the predator population was up 4% over last year, while the water temperature was 15° cooler than normal.

BL:JA:jmc
12/8/86

HENDERSON ....RBG....
CARTER ....AC....
C'3SON ....M.DS....
R..)ER ....LLR....

FISH POPULATION SAMPLE

Lake: Dardanelle　　Hectares: 12146　　County: Logan

First day of sampling: 09/03/1987　　Sample Design: Cove

Ownership: U.S. Corps of Engrs.　　Sample Location: O'Kane Island

Sample Size: .5 (ha).　　Water Volume: 1.4 (ha/m)　　Water Temp: 26 Deg.C.

Secchi Disk Reading: .8 meters.　　Water Depth: Max. 4.9 meters　Avg. 3.1 meters

Block-Off Net: Yes　　Rotenone Amount:　　Rotenone Type: 7.2% Powdr

Habitat (type & %): Steep 70　Grad. 30　Sand 60　Rock 4(

Vegetation (type & %): Wooded 20

Collectors: Limbird　Ahlert　Bivin　Carmichael

SPECIES SUMMARY

Species	No./ha.	Kg./ha.	% of Total by Weight	Dominant Size Group
LARGEMOUTH BASS	91.107	9.399	1.6	5
SPOTTED BASS	35.554	2.621	.4	5
WHITE BASS	71.110	2.814	.5	5
STRIPED BASS	11.111	.142	.0	5
BLUE CATFISH	124.441	102.362	17.6	13
CHANNEL CATFISH	295.555	44.603	7.6	11
FLATHEAD CATFISH	37.774	4.955	.8	3
WHITE CRAPPIE	204.443	7.115	1.2	3
BLACK CRAPPIE	173.333	3.677	.6	4
SPOTTED GAR	2.222	1.944	.3	24
SHORTNOSE GAR	24.442	28.833	4.9	30
FRESHWATER DRUM	1462.223	61.402	10.5	4
SKIPJACK HERRING	59.999	2.310	.4	8
GREEN SUNFISH	55.555	.743	.1	3
WARMOUTH	784.443	2.442	.4	2
ORANGESPOTTED SUNFISH	655.556	1.634	.3	2
BLUEGILL	3160.000	28.191	4.8	2
LONGEAR SUNFISH	1875.556	11.725	2.0	3
REDEAR SUNFISH	2.222	.044	.0	5
YELLOW BULLHEAD	4.444	.008	.0	3
MINNOWS (UNID)	37.778	.038	.0	3
SHINERS (UNID)	2.222	.007	.0	3
LOGPERCH	35.555	.432	.1	5
DARTERS	64.445	.151	.0	3
GIZZARD SHAD	2964.444	99.127	17.0	6
THREADFIN SHAD	1457.780	4.188	.7	2
INLAND SILVERSIDE	4.444	.007	.0	4
SMALLMOUTH BUFFALO	39.997	46.840	8.0	18
BIGMOUTH BUFFALO	6.666	21.223	3.6	23
BLACK BUFFALO	8.888	15.278	2.6	18
CARP	22.222	25.721	4.4	16
RIVER CARPSUCKER	122.221	53.098	9.1	14

PINEY SAMPLE AREA

FISH POPULATION HISTORY
for
Dardanelle

Date	9/01/1983	9/01/1984	9/01/1985	09/11/1986	09/10/1987
Samp_Num	7318	7321	7325	7328	7333
COMMON NAME	KGS PER HA				
LARGEMOUTH BASS	12.629	13.533	22.496	4.370	12.532
SPOTTED BASS	.106	.027	.000	.008	.000
WHITE BASS	6.835	1.281	7.408	3.331	3.423
STRIPED BASS	1.120	.163	.000	.128	.240
BLUE CATFISH	4.293	7.163	2.430	12.067	25.156
CHANNEL CATFISH	32.369	32.420	27.509	25.076	42.849
FLATHEAD CATFISH	4.568	9.952	8.727	6.318	8.873
BOWFIN	.000	.000	.000	1.386	.000
WHITE CRAPPIE	4.046	2.077	5.524	4.156	6.801
BLACK CRAPPIE	.222	1.259	1.124	.496	1.761
SPOTTED GAR	.382	.000	.710	.271	1.296
LONGNOSE GAR	.000	.000	.684	1.115	1.777
SHORTNOSE GAR	.382	.000	.193	.000	.813
FRESHWATER DRUM	94.857	140.322	102.622	69.552	108.034
SKIPJACK HERRING	.575	.081	11.343	.000	2.275
SAUGER	.000	.219	.384	.347	.292
EEL	.000	.000	.762	.226	.207
GREEN SUNFISH	.436	1.368	2.572	4.107	2.041
WARMOUTH	2.543	4.732	8.391	1.694	3.474
ORANGESPOTTED SUNFISH	.930	.765	.300	.384	.040
BLUEGILL	9.866	11.290	8.966	6.382	25.445
LONGEAR SUNFISH	5.384	5.824	6.589	6.105	11.908
REDEAR SUNFISH	.000	.218	.000	.000	.086
BLACK BULLHEAD	.079	.245	.109	.084	.403
YELLOW BULLHEAD	.957	.766	2.786	.992	1.793
BROWN BULLHEAD	.000	.000	.000	.191	.000
BULLHEAD MINNOW	.000	.000	.000	.000	.834
MINNOWS (UNID)	.985	.138	.547	.337	.000
GOLDEN SHINER	.000	.000	.000	.000	.026
EMERALD SHINER	.000	.000	.000	.000	.036
GIZZARD SHAD	284.246	384.654	1138.896	367.987	313.826
THREADFIN SHAD	21.157	14.188	8.146	63.747	128.355
KILLIFISHES-TOPMINNOWS	.000	.000	.000	.000	.007
INLAND SILVERSIDE	.000	.000	.000	.000	.006
SMALLMOUTH BUFFALO	104.808	103.139	84.771	66.217	82.545
BIGMOUTH BUFFALO	11.509	7.271	33.543	.000	1.506
BLACK BUFFALO	6.096	.000	7.791	2.861	7.621
CARP	72.141	99.615	69.595	57.966	77.426
SPOTTED SUCKER	.000	.246	.409	3.743	2.272
GOLDEN REDHORSE	.080	.654	.000	.353	.197
RIVER CARPSUCKER	71.761	40.432	52.539	26.433	67.821
GRASS CARP	.000	.000	.000	.000	1.988
TOTAL	755.362	884.042	1617.865	738.430	945.985

EFFLUENT BAY

FISH POPULATION HISTORY
for
Dardanelle

Date	9/01/1983	9/01/1984	9/01/1985	09/09/1986	09/08/1987
Samp_Num	7319	7322	7324	7327	7332
COMMON NAME			KGS PER HA		
LARGEMOUTH BASS	7.608	11.044	9.679	9.796	9.992
WHITE BASS	.433	.302	1.595	4.297	.313
STRIPED BASS	.101	.050	.050	.241	.064
BLUE CATFISH	2.659	2.907	.462	1.399	14.147
CHANNEL CATFISH	17.518	39.868	21.159	28.490	25.537
FLATHEAD CATFISH	1.344	6.164	.415	1.066	2.468
WHITE CRAPPIE	.300	.068	1.461	.673	.125
BLACK CRAPPIE	.000	.430	.865	.037	.117
SPOTTED GAR	.000	.000	.000	.132	.000
LONGNOSE GAR	.000	.134	3.262	.182	.275
SHORTNOSE GAR	.000	.914	.000	.000	.000
FRESHWATER DRUM	17.266	51.685	28.437	35.051	45.038
SKIPJACK HERRING	.183	.052	.398	2.212	.068
SAUGER	.000	.000	.017	.015	.000
GREEN SUNFISH	.581	1.311	.350	.763	.976
WARMOUTH	1.562	.979	1.580	.639	.968
ORANGESPOTTED SUNFISH	2.142	.300	.085	.099	.100
BLUEGILL	14.380	20.589	12.736	14.870	34.671
LONGEAR SUNFISH	9.167	15.077	8.071	5.581	17.439
REDEAR SUNFISH	.000	.000	.000	.000	.023
YELLOW BULLHEAD	.000	.000	.000	.335	.012
FATHEAD MINNOW	.000	.000	.000	.000	.007
BULLHEAD MINNOW	.000	.000	.000	.000	.126
MINNOWS (UNID)	.299	.050	.415	.083	.000
GOLDEN SHINER	.000	.000	.000	.000	.007
EMERALD SHINER	.000	.000	.000	.000	.013
GIZZARD SHAD	32.478	129.878	121.247	73.279	75.680
THREADFIN SHAD	.349	.019	.135	3.395	87.954
INLAND SILVERSIDE	.000	.000	.000	.196	.101
SMALLMOUTH BUFFALO	82.293	86.144	76.461	63.586	87.051
BIGMOUTH BUFFALO	3.285	1.778	8.602	1.750	10.077
BLACK BUFFALO	2.340	3.453	6.310	2.093	2.014
CARP	25.487	13.433	29.257	29.842	22.185
SPOTTED SUCKER	.000	.000	.000	.159	.000
GOLDEN REDHORSE	.000	.000	.004	.000	.000
RIVER CARPSUCKER	51.161	52.936	65.553	52.176	39.809
GRASS CARP	.000	.000	.000	.000	1.026
TOTAL	272.936	439.565	398.606	332.437	478.383

REMARKS:

This is a different site than 1986. The area sampled in 1986 was filled in by the high water in the winter of 1986. This area is on the south side of the river behind a rock dike on O'Kane Island. A good spawn of threadfin shad and a large number of adult blue catfish were found in the sample area. Catfish composed 26%, shad 17.7%, and commercial species made up 38.2% of the total weight of fish collected in the sampled area.

RECOMMENDATIONS:

1. Commercial fishermen will be monitored to record data relating to species, numbers, and weights of fish caught in commercial tackle.

2. District personnel will conduct experimental netting during fall and spring to locate striped bass and commercial fish species.

3. Electrofishing in or near this area of Dardanelle Lake will be added to sampling areas in 1988.

OK/MH

SUBMITTED BY: Bob Limbird

cc: Director's Office
D-J File
Prof. Buford Tatum
Bob Limbird

1988 [illegible] RD. LAKE SAMPLING

SPECIES	EFFLUENT ~~NO./HA.~~		PINEY		O'KANE	
	No./ha.	Kg/ha	No/ha	Kg/ha	No/ha	Kg/ha
LMB	87	14.1	109	15.8	112	10.0
WHITE BASS	236	7.2	42	1.3	18	0.9
CHANNEL CAT	481	44.5	369	39.1	202	25.3
ALL CATFISH	574	57.5	471	55.5	264	44.3
CRAPPIE	8	1.0	42	3.6	62	17.9
DRUM	837	40.4	1,521	89.4	412	30.9
SUNFISH	7,271	64.6	6,418	66.9	4,464	35.5
GIZ. SHAD	8,247	226.3	3,468	252.1	4,024	52.1
SHAD	12,678	39.5	14,093	35.8	3,400	6.2
BUFF.	90	112.4	83	87.9	24	33.5
CARP	13	18.8	25	37.2	8	8.0
RIV. CARP	32	28.7	39	24.7	42	9.3

1987 SAMPL[illegible]

	O'KANE ~~EFFLUENT~~		EFFLUENT		PINEY	
S[illegible]CIES	No./ha	Kg/ha	No/ha	Kg/ha	No/ha	Kg/ha
LMB	160	74.2	~~[illegible]~~63	7.4	75.[illegible]	13.5
WHITE BASS	75	1.5	30	10	9[illegible]	3.9
Ql. CAT	335	110.8	416	43.6	413	55.2
ALL CATFISH	610	285.3	421	47.1	543	87.3
CRAPPIE	260	16.9	1	0.1	60	3.2
DRUM	900	93.8	1097	34.3	2825	138.[illegible]
SUNFISH	6455	148.4	2282	31.7	3846	57.6
GIZ. SHAD	5885	209.3	1838	276.0	26549	1933
T. SHAD	2785	15.3	13777	29.2	26431	208.[illegible]
BUFF	2860	116.8	[illegible]	[illegible]	124	123.[illegible]
CARP	20	21.2	14	20.6	52	81.1
[illegible] CARP	170	41.8	48	28.7	155	78.[illegible]

FORM AR731-2910
REV 11 70

ARKANSAS POWER & LIGHT COMPANY

INTRA COMPANY CORRESPONDENCE

Little Rock, Arkansas
April 10, 1985

MEMORANDUM

TO: Ms. Sharon Tilley

FROM: Paul N. Means

SUBJECT: ANO Water Quality

Attached is a copy of correspondence from ADPC&E and EPA regarding the water quality standards for Dardanelle Reservoir. In the letter from EPA, six comments are listed. ADPC&E has asked that we prepare a response to items 3, 4, and 5.

After you have looked these over, give me a call.

Paul Means

PNM:kjs

Attachment

cc: Mr. Ray F. Cox

STATE OF ARKANSAS
DEPARTMENT OF POLLUTION CONTROL AND ECOLOGY
8001 NATIONAL DRIVE, P.O. BOX 9583
LITTLE ROCK, ARKANSAS 72209

PHONE: (501) 562-7444

January 30, 1985

Mr. Paul Means
Arkansas Power and Light Co.
P.O. Box 551
Little Rock, Arkansas 72203

Dear Mr. Means,

The Department of Pollution Control and Ecology approved the use attainability analysis for Dardanelle Reservoir and, after approval by the commission on Pollution Control and Ecology, forwarded it with the state Water Quality Standards package to E.P.A. Region VI for their approval. In the department's opinion the analysis as prepared by your company sufficiently justified an exception to the general temperature criteria for Dardanelle Reservoir. E.P.A. has responded by letter to our submittal that generally approves the report but does ask some questions that will need answering before they can formally approve the exception for Dardanelle. Their letter, which is attached, specifically requests additional data in items # 4 and 5.

We request that your company contact E.P.A. Region VI to clarify the questions that they have and then respond to them as soon as it is possible to do so. We would appreciate you providing us with a copy of your responses.

The Department is pleased that your analysis will be approved by E.P.A. and congratulate you in the preparation of your report.

Sincerely,

James R. Shell
Chief, Water Division

cc: Larry Champagne

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

January 10, 198~~4~~ 5

Mr. James R. Shell
Chief, Water Division
Arkansas Department of Pollution
Control and Ecology
8001 National Drive
Little Rock, Arkansas 72209

Dear Mr. Shell:

We have reviewed the use attainability analysis for Dardanelle Reservoir prepared by the Arkansas Power and Light Company and have the following comments:

1. Generally, this study demonstrated a justification for the less stringent temperature criteria of a 95°F maximum and a 5°F maximum increase.

2. The question of impairment to the fishery use during critical conditions and spawning periods seemed to be adequately addressed.

3. The data base appeared to be sufficient for making the statistical determination that there were no significant differences between areas affected by the thermal discharge and areas unaffected, with regards to fish species composition, temperature-related spawning, mean adult weights of fish species, and fish species diversity.

4. It was unclear, however, as to how affected and unaffected areas were determined. A brief explanation of the method of delineation should be included.

5. Table 3, the thermal loading table, is confusing. How are the data in this table used to determine areas in the lake which are affected and unaffected by the thermal discharge?

6. The conclusion that the thermal discharge does not have a significant impact on the fishery use seems justified.

Thank you for the opportunity to review this use attainability analysis. These comments along with those from the Georgia-Pacific and SWEPCO use attainability analyses, will be part of our upcoming comment letter on the Arkansas Water Quality Standards.

If you have any questions about these comments, please contact me at (214)767-8985 or Susan King at (214)767-8987.

Sincerely,

Larry Champagne

Larry Champagne
Arkansas State Coordinator, 6W-QS

cc: John Giese, ADPC&E
Bill Keith, ADPC&E

FORM 731-271
REV 11-70

ARKANSAS POWER & LIGHT COMPANY

INTRA COMPANY CORRESPONDENCE

May 6, 1985

CL-85-171

MEMORANDUM

TO: Mr. Paul N. Means

FROM: Edward L. Green Edward L. Green /ct

SUBJECT: Arkansas Nuclear One Water Quality - Use Attainability

Attached, you will find an appendix to the October 30, 1984 Summary Report of Environmental Impact of Thermal Discharge submitted to the Arkansas Department of Pollution Control and Ecology, and Environmental Protection Agency by AP&L.

Mr. Larry Champagne, EPA coordinator, in his letter of January 10, 1985, raised a few questions about the data requiring an explanation. In a telephone conversation between Mr. Champagne and Ms. Sharon Tilley, AP&L Technical Analysis, May 3, 1985, Mr. Champagne was satisfied with the verbal explanation to his questions, and is looking forward to the written reply. He was also most complimentary of AP&L's report and data summaries.

Please forward copies of this appendix to ADPC&E for them to file with EPA. If you have any questions, please let me know.

ELG/SRT/tlw

Attachment

cc: Dr. D. L. Swindle
Ms. S. R. Tilley ✓

ARKANSAS POWER & LIGHT COMPANY
POST OFFICE BOX 551 LITTLE ROCK, ARKANSAS 72203 (501) 371-4000

ARKANSAS NUCLEAR ONE

GENERATING STATION

DARDANELLE RESERVOIR

ENVIRONMENTAL MONITORING REPORT

APPENDIX TO

SUMMARY REPORT

OF

ENVIRONMENTAL IMPACT OF THERMAL DISCHARGE

OCTOBER 30, 1984

MAY 6, 1985

This appendix to the Summary Report of the Environmental Impact of Thermal Discharge is being submitted to clarify several questions raised by the Environmental Protection Agency in their letter of January 10, 1984, to the Arkansas Department of Pollution Control and Ecology.

The specific questions were as follows:

Item 4. It was unclear how affected and unaffected areas were determined (Dardanelle Reservoir Fishery Survey). A brief explanation of the method of delineation should be included.

Item 5. Table 3, the thermal loading table (Dardanelle Reservoir - Illinois Bayou Embayment Survey), is confusing. How are the data in this table used to determine areas in the lake which are affected and unaffected by the thermal discharge?

In response to Item 4, the location of the sampling stations was briefly discussed in the report under the section heading SAMPLING. The attached Figure 2 shows the location of the four sample stations. Station A is the control station, and is located upstream beyond influence of the thermal discharge. Station C is located in the discharge canal, and Station D is located downstream of the confluence of the thermally-heated discharge water and the main body of the reservoir. Both stations were predicted to be impacted by the thermal plume. Station B is located near the mouth of the intake canal, and is a part of the study to determine impingement and entrainment impacts. It was also predicted in the early days of study design that the thermal plume might spread around Bunker Hill, and loop back to the intake area. This phenomenon has not been observed to occur.

Therefore, affected areas for the fishery study were determined to be Stations B, C, and D, and the unaffected area would be Station A.

In response to Item 5, the affected and unaffected areas of the reservoir survey as it relates to physicochemical parameters were determined by thermal impact studies performed before plant operation, and were characterized by river flow at various times of the year. It was predicted that the discharge canal, Stations 1 and 5, would receive the most significant thermal impact. At the confluence of the discharge and the Arkansas River, it was predicted that the plume would extend out to Stations 3, 10, and 11, and, at times, might extend around Goose Island, Station 7 (Figure 1). Actual data supports most of the predicted areas of impact.

The heated effluent is fairly evenly mixed in the water column at Station 1. The maximum temperature difference between the intake water and that discharged in 1982 was 15°F in January. Actual data indicates that the thermally-heated water rapidly rises to the top few feet by the time it reaches Station 5 near the mouth of the discharge bay. When mixed with the Arkansas River, there is rapid dissipation of the plume, and it usually becomes undefined by the time it reaches Stations 3, 10, and 11 (Table 1).

To clarify the question concerning Table 3, the thermal loading table, proportions were calculated by dividing the station of interest by the intake temperature, Station 16. The proportion could also be expressed as a percent. For example, in January, Station 1, the immediate area of discharge was 38% higher than the intake temperature, and Stations 3 and 10 were 4% and 5% higher, respectively. As can be seen by Table 1, it was not uncommon for some of the unaffected stations to be around 4% higher than the intake temperature.

Based on the data in Table 1 and the conclusions of the other monitoring data, we are in agreement with EPA that the thermal discharge at Arkansas Nuclear One does not have a significant impact on the fishery, and are pleased that Arkansas Power and Light Company has demonstrated a justification for the less-stringent temperature criteria of a 95°F maximum and a 5°F maximum increase.

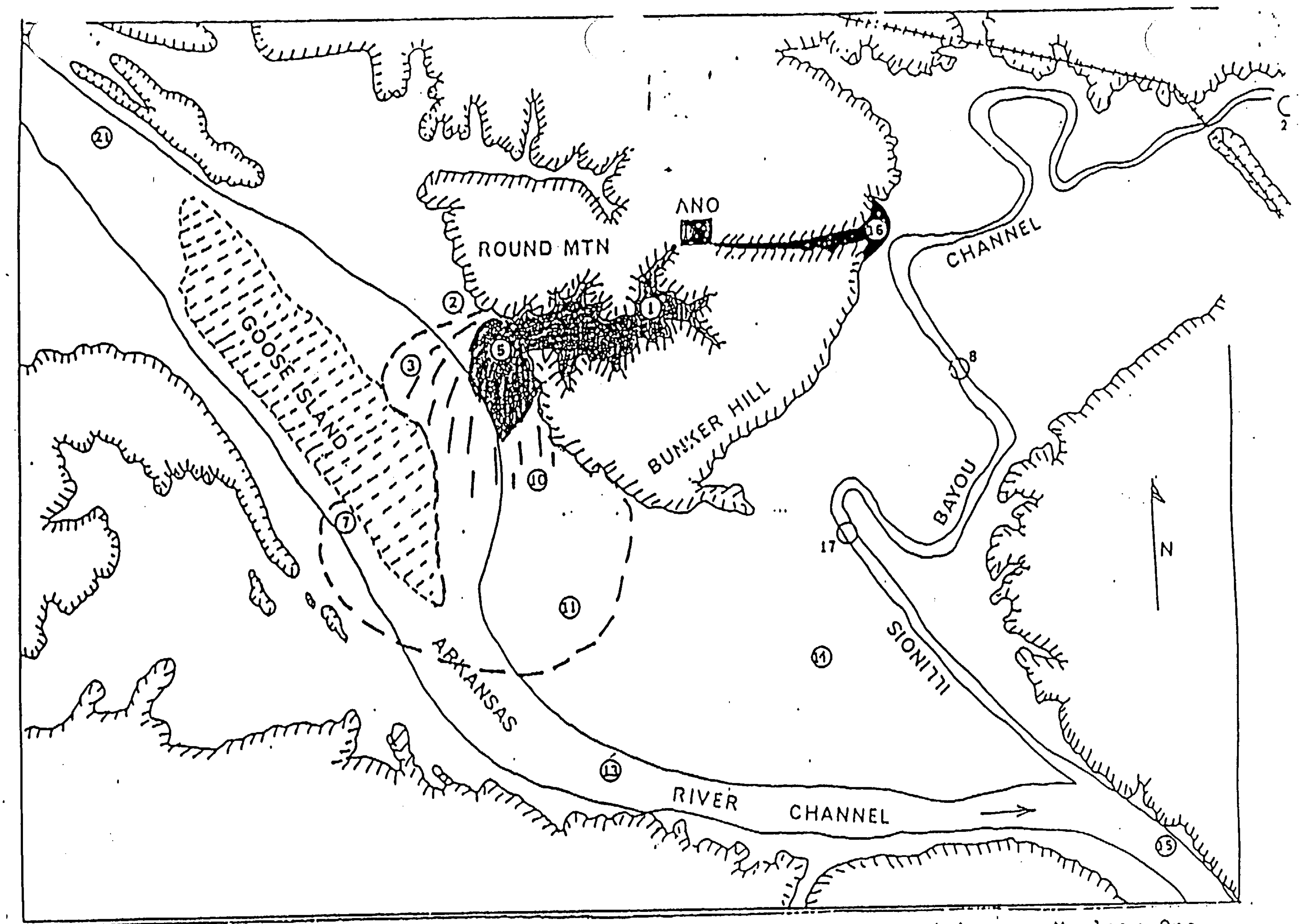


Figure 1. Locations of sampling stations on Lake Dardanelle for Arkansas Nuclear One (ANO) project, 1982.

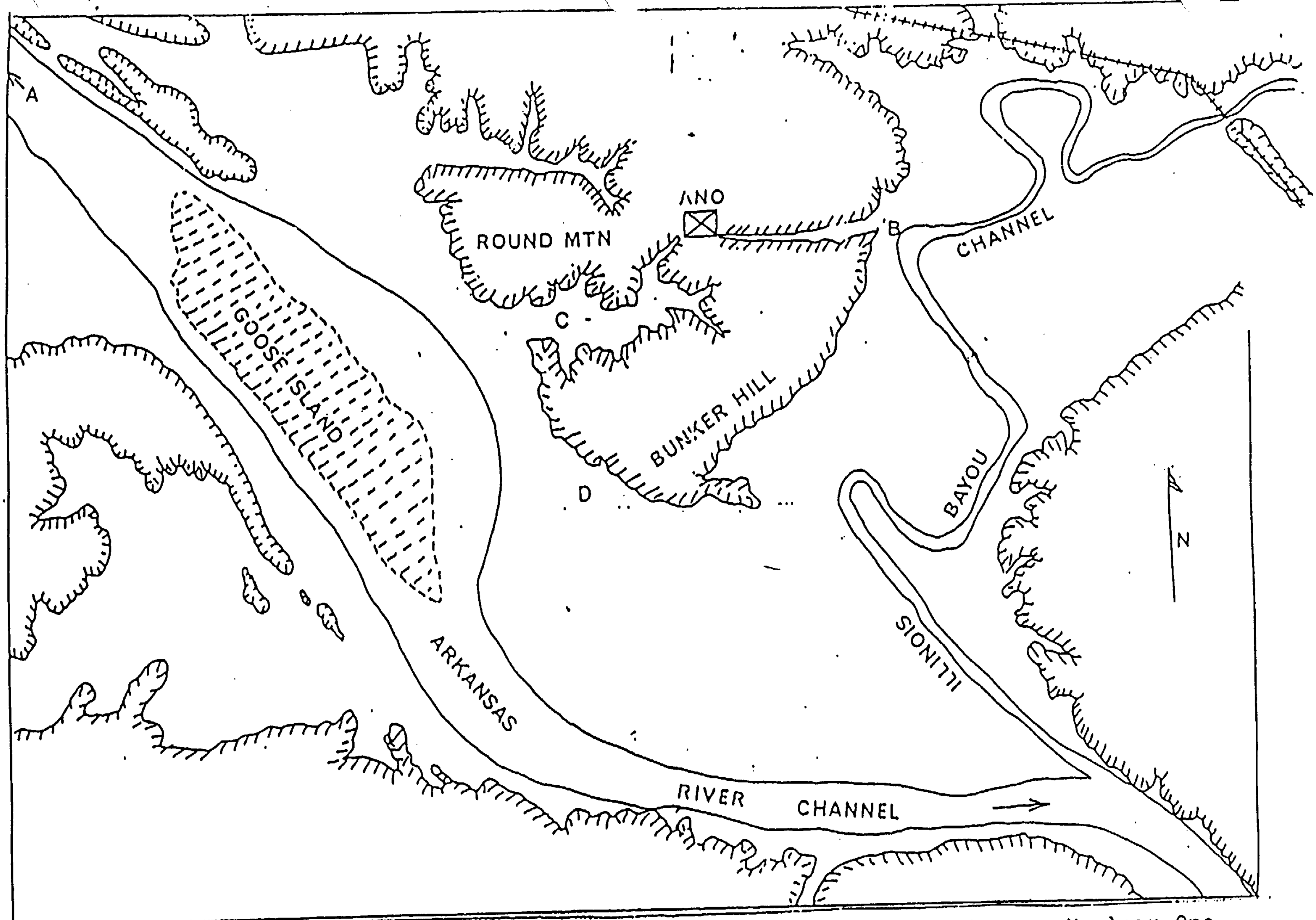


Figure 2. Locations of sampling stations on Lake Dardanelle for Arkansas Nuclear One (ANO) project.

TABLE 1. THERMAL LOADING AND DISPERSAL IN THE UPPER TWO FEET (0.61 m) AT THE SAMPLE STATIONS IN DARDANELLE RESERVOIR, ARKANSAS, 1982.

TEMPERATURE AT EACH STATION, AND THE PROPORTION OF THE TEMPERATURE COMPARED TO STATION 16 (INTAKE)

		INTAKE	AFFECTED AREAS						UNAFFECTED AREAS						
		STATION 16	STATION 1	STATION 5	STATION 3	STATION 10	STATION 11	STATION 7	STATION 8	STATION 13	STATION 14	STATION 15	STATION 17	STATION 20	STATION 21
JANUARY	TEMPERATURE	39.3	54.3	53.2	41.0	41.1	40.9	40.8	-	-	40.8	40.3	40.6	-	40.9
	PROPORTION		1.38	1.35	1.04	1.05	1.04	1.04	-	-	1.04	1.03	1.03	-	1.04
FEBRUARY*	TEMPERATURE	49.0	58.8	57.4	52.5	50.8	48.2	47.1	49.9	48.3	49.7	49.5	49.6	50.9	47.2
	PROPORTION		1.20	1.17	1.07	1.04	.98	.96	1.02	.99	1.01	1.01	1.01	1.04	.96
MARCH	TEMPERATURE	58.6	69.9	68.1	65.2	63.6	62.8	61.7	58.0	61.7	59.5	60.4	58.9	58.2	60.8
	PROPORTION		1.19	1.16	1.11	1.09	1.07	1.05	.99	1.05	1.02	1.03	1.01	.99	1.04
APRIL	TEMPERATURE	56.4	57.3	58.4	55.9	57.2	57.1	56.3	57.0	55.7	55.9	55.9	56.1	55.9	55.0
	PROPORTION		1.02	1.04	.99	1.01	1.01	1.00	1.01	.99	.99	.99	.99	.99	.98
MAY	TEMPERATURE	76.8	82.9	83.0	75.5	79.8	75.1	76.1	74.9	73.4	75.1	75.9	75.9	79.6	76.0
	PROPORTION		1.08	1.08	.98	1.04	.98	.99	.98	.96	.98	.99	.99	1.04	.99
JUNE	TEMPERATURE	81.1	92.2	90.7	78.8	82.6	79.1	80.4	82.0	79.0	81.1	80.2	80.9	83.8	80.1
	PROPORTION		1.14	1.12	.97	1.02	.98	.99	1.01	.97	1.00	.99	1.00	1.03	.99
JULY	TEMPERATURE	91.6	103.4	100.6	95.1	91.0	90.8	92.1	91.7	89.4	91.2	90.6	89.9	91.4	87.7
	PROPORTION		1.13	1.10	1.04	.99	.99	1.01	1.00	.98	.99	.99	.98	1.00	.96
AUGUST	TEMPERATURE	82.9	84.1	83.9	85.6	85.6	83.7	85.6	86.1	86.1	85.9	84.1	87.4	84.7	83.8
	PROPORTION		1.01	1.01	1.03	1.03	1.01	1.03	1.04	1.04	1.04	1.01	1.05	1.02	1.01
SEPTEMBER	TEMPERATURE	84.6	94.7	89.4	86.7	83.0	82.6	82.8	81.3	82.4	81.9	81.8	82.0	82.5	84.7
	PROPORTION		1.12	1.06	1.02	.98	.98	.98	.96	.97	.97	.97	.97	.98	1.00
OCTOBER	TEMPERATURE	70.5	81.5	80.0	72.7	71.0	69.5	69.6	71.1	72.1	71.3	71.2	70.6	69.8	70.0
	PROPORTION		1.16	1.13	1.03	1.01	.99	.99	1.01	1.02	1.01	1.01	1.00	.99	.99
NOVEMBER	TEMPERATURE	56.8	57.4	57.0	58.2	57.2	57.4	57.3	56.5	57.0	57.0	57.0	56.7	56.1	59.0
	PROPORTION		1.01	1.00	1.02	1.01	1.01	1.01	.99	1.00	1.00	1.00	1.00	.99	1.04
DECEMBER	TEMPERATURE	48.1	48.4	48.4	47.5	46.4	46.9	46.5	46.5	47.2	47.1	47.4	47.1	46.1	47.8
	PROPORTION		1.01	1.01	.99	.96	.98	.97	.97	.98	.98	.99	.98	.96	.99

* DUE TO BAD WEATHER, FEBRUARY MEASUREMENTS WERE TAKEN THE FIRST OF MARCH

6-21-85
#2

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
INTERFIRST TWO BUILDING. 1201 ELM STREET
DALLAS, TEXAS 75270

June 18,1985

Mr. James R. Shell
Chief, Water Division
Arkansas Department of Pollution
  Control and Ecology
8001 National Drive
Little Rock, Arkansas 72209

Dear Mr. Shell:

We have reviewed the Arkansas Power and Light Company's response to our comments on their use attainability analysis (UAA), transmitted with your letter of May 31, 1985. The concerns stated in our letter of January 10, 1985, have been adequately addressed, thus the UAA is fully approved. The exception to the Arkansas Water Quality Standards in water temperature for Dardanelle Reservoir is now fully justifiable.

Thank you for your cooperation in this matter. If you have any questions, please do not hesitate to contact us.

Sincerely,

Myron O. Knudson
Director, Water Management Division, 6W

FORM AR731-2910
REV 11 70

ARKANSAS POWER & LIGHT COMPANY

INTRA COMPANY CORRESPONDENCE

Little Rock, Arkansas
June 26, 1985

RECEIVED
JUN 28
ARKANSAS POWER & LIGHT CO.
TECHNICAL ANALYSIS SECTION

MEMORANDUM

TO: Mr. Charles L. Steel
Mr. Jack King

FROM: Ray F. Cox

SUBJECT: ANO - Lake Dardanelle Water Quality Standards

In 1984, EPA made major revisions to the Water Quality Standards Regulations. Part of these revisions required all existing exceptions to State Water Quality Standards to be re-justified. In order to use once-through cooling water on Unit 1 at ANO, AP&L obtained a variance to the temperature standards for Lake Dardanelle. To comply with the new regulations AP&L, and anyone else operating under an exception, was required to re-justify the basis for the variance. A failure to retain this variance would have required the construction of a cooling tower at Unit 1.

AP&L and approximately 15 other businesses and municipalities made the necessary filings to retain their variance. As indicated by the attached letter, EPA accepted our justification and approved a continued variance to the temperature standards on Lake Dardanelle. As a point of interest, EPA rejected all other applications for a variance from the state of Arkansas.

Ray F. Cox

RFC:PNM:kjs

Attachment

cc: Mr. Paul N. Means
Ms. Sharon Tilley
Dr. Dale Swindle

CLIENT CONTACT REPORT

Project/Client:	Arkansas Nuclear One	**Date/Time:**	June 1, 1999
Topic:		**Phone:**	
Contact:	Ms. Cindy Osborne	**By:**	Gary E. Tucker
Firm:	Arkansas Natural Heritage Comm.	**Date:**	
Address:	1400 Tower Building, 323 Center	**Referral:**	
City State Zip:	Little Rock, AR 72201		

Remarks:

I talked w/ Ms. Osborne regarding issues related to the Northern crayfish frog (*Rana areolata circulosa*) in Arkansas. This species does not represent a state-listed species, but it has been tracked by Arkansas Natural Heritage Commission (ANHC). Ms. Osborne indicated that previously ANHC has given the Northern crayfish frog a ranking of S1 (?).

The S1 ranking is applied to those organisms for which ANHC has records to substantiate typically 5 or fewer estimated occurrences in the state or only a few remaining individuals. ANHC considers S1 species to be "extremely rare" and "may be especially vulnerable to extirpation".

Later Ms. Osborne faxed a copy of an element state ranking form for Northern crayfish frog, which was prepared by Dr. Stanley E. Trauth, authority on Arkansas herpetofauna, and dated May 14, 1999. Dr. Trauth recommends a change in ranking from S1 (?) to S3. ANHC categorizes S3 species as "Rare to uncommon. Typically between 20 and 100 estimated occurrences, may have fewer occurrences but with large number of individuals in some populations, may be susceptible to large-scale disturbances." Dr. Trauth provides data indicating that Northern crayfish frog occurs in 18 counties, with the range including Arkansas River Valley (and into northwest counties) eastward into Conway, Faulkner, White, and Jackson counties. Disjunct localities are known from the northeastern and southeastern corners of the state. Dr. Trauth's assessment of State Protection Needs for the species is "none at the present time."

	Routing	**Reviewed**	**Comments/Action**
1	BMW	RW	
2			
3			
4			
5			

Disposition: **Discard** **File** 6045-061 ANO ERS

For Filing Only: ☐ Contact/Correspondence ☐ Contract ☐ Proposal ☐ Other

CLIENT CONTACT REPORT

Project/Client:	ANO UNIT-1 LICENSE RENEWAL	**Date/Time:**	Nove[redacted] 13,1997
Topic:	THERMOPHILIC PATHOGENS	**Phone:**	423-[redacted]
Contact:	DR. RICHARD TYNDALL	**By:**	BM[redacted]
Firm:	OAK RIDGE NATIONAL LAB	**Date:**	No[redacted] 1997
Address:		**Referral:**	[redacted]
City State Zip:	KNOXVILLE, TN		

Remarks:

I called Dr. Tyndall regarding the research he had conducted regarding thermophilic pathogens at ANO in the early 1980's. Specifically, Dr. Tyndall was the project manager for two EPRI projects that involved the sampling and analysis for *Legionella sp.* (Legionairres Disease Bacteria) and pathogenic amoebae in ANO cooling water. Dr. Tyndall had performed numerous studies in the 1980' s at fossil and nuclear plants. He recalled the work at ANO was partially funded by the NRC. (As an Entergy employee, I had supported his work at ANO by coordinating the on-site sampling, and had an opportunity to review and comment on his draft reports.)

Dr. Tyndall remembered me, the trips he made to ANO, and the results of his research there. He sampled cooling water from many power plants across the country and only a "few" had any problems. He specifically remembered that ANO was <u>not</u> one of the problem facilities. He noted that *Legionella sp.* was <u>not</u> found at ANO in concentrations of concern. (The concern level was identified as 2 orders of magnitude above ubiquitous concentrations.) Several taxa of amoebae were found in samples from either the Unit-2 cooling tower or plant discharge embayment, but none were classified as thermophilic or pathogenic.

Dr. Tyndall said that copies of the final reports could be obtained through Oak Ridge, if we had any difficulty obtaining hard copies.

	Routing	Reviewed	Comments/Action
1			
2			
3			
4			
5			

Disposition: ☐ **Discard** ☐ **FileX** 6045-060 ANO UNIT-1 LICENSE RENEWAL

For Filing Only: ☐X **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other** ______

CLIENT CONTACT REPORT

Project/Client:	Entergy	**Date/Time:**	8/31/97
Topic:		**Phone:**	
Contact:	Charles McGrew, Director	**By:**	GET
Firm:	Communicable Diseases	**Date:**	
Address:	Arkansas State Board of Health	**Referral:**	
City State Zip:	Little Rock, AR		

Remarks:

Charles McGrew followed up on my earlier request for information. I called him to as[redacted]whether Arkansas State Board of Health had information on the potential for transmission of water-borne[redacted]ganisms to human populations from contact with warm, shallow waters in the Arkansas River system. I [redacted]ifically ask about Lake Dardanelle or the vicinity of ANO but talked about varying characters of different river reaches from Oklahoma downstream. I said I thought I remembered hearing of a past possible link of Arkansas River waters to public health issues in the Pine Bluff area. Charles said there had been some earlier concern of a possibility that shallow, warm waters in the river system could harbor disease organisms but that the State Board of Health had not really done any studies that would verify the Pine Bluff report. Charles said that he talked with Dr. Charles McChesney, State Epidemiologist, following my earlier call to see if he could get additional information. Dr. McChesney told him that (1) the State Board of Health in the past has not studied the potential for links of disease with Arkansas River waters and has not been involved with anyone else's studies, (2) is not involved at the present time with any such studies, and (3) does not at this time foresee doing so in the near future. Charles pointed out that to some extent the kinds of issues and studies pursued by State Board of Health are related directly to research interests and experiences of individual staff members. There is always a potential that a new staff member might come to the agency with an interest in water-borne disease organisms, and if so new studies might be initiated. At the present time, however, he said he agreed with Dr. McChesney that it is not an issue that the State Board of Health considers an important one.

	Routing	Reviewed	Comments/Action
1	BMW	[illegible]	
2			
3			
4			
5			

Disposition: **Discard** **File** 6045-060 Entergy ANO Support

For Filing Only: ☐ **Contact/Correspondence** ☐ **Contract** ☐ **Proposal** ☐ **Other** ________

INSTITUTE FOR ECONOMIC ADVANCEMENT
AN EDA UNIVERSITY CENTER
University of Arkansas at Little Rock

Series B - Projection Series

Arkansas Population by County, 1990-2010

	1990	1995	2000	2005	2010
Arkansas	21653	22021	22350	22581	22646
Ashley	24319	24922	25428	25840	26129
Baxter	31186	37150	44068	52380	62385
Benton	97499	110833	125003	140673	158255
Boone	28297	30867	33566	36458	39559
Bradley	11793	12174	12464	12699	12894
Calhoun	5826	6147	6430	6685	6936
Carroll	18654	20222	21916	23814	25853
Chicot	15713	15791	15882	15977	16049
Clark	21437	22524	23406	24152	24869
Clay	18107	18615	18980	19271	19487
Cleburne	19411	22452	25782	29532	33753
Cleveland	7781	8324	8884	9474	10048
Columbia	25691	26333	26829	27249	27620
Conway	19151	19984	20714	21435	22147
Craighead	68956	74281	79134	83550	87820
Crawford	42493	47357	52583	58293	64498
Crittenden	49939	51674	53132	54399	55493
Cross	19225	19572	19864	20090	20210

Dallas	9614	9776	9930	10077	10215
Desha	16798	17203	17634	18096	18597
Drew	17369	18575	19824	21087	22341
Faulkner	60006	69581	80063	91405	103850
Franklin	14897	16078	17260	18528	19869
Fulton	10037	10766	11497	12273	13096
Garland	73397	80335	87896	96785	107687
Grant	13948	15292	16687	18130	19624
Greene	31804	33904	36007	38127	40259
Hempstead	21621	23079	24693	26476	28375
Hot Spring	26115	27618	29069	30503	31910
Howard	13569	14196	14873	15607	16366
Independence	31192	33957	36896	40067	43422
Izard	11364	12644	13924	15251	16629
Jackson	18944	19194	19361	19506	19618
Jefferson	85487	88394	90902	93164	95205
Johnson	18221	19629	21114	22679	24320
Lafayette	9643	9829	9992	10137	10239
Lawrence	17457	18093	18689	19253	19792
Lee	13053	12602	12187	11814	11430
Lincoln	13690	14216	14700	14867	14793
Little River	13966	14965	15973	16971	17936
Logan	20557	21568	22673	23882	25178
Lonoke	39268	43209	47411	51982	56864
Madison	11618	12235	12888	13565	14290
Marion	12001	13755	15738	18095	20886
Miller	38467	40169	41822	43483	45118
Mississippi	57525	57926	58035	57945	57728
Monroe	11333	11127	10892	10642	10379
Montgomery	7841	8493	9176	9917	10683
Nevada	10101	10429	10777	11131	11486

	1990	1995	2000	2005	2010
Newton	7666	8243	8896	9638	10451
Ouachita	30574	32586	34702	36974	39389
Perry	7969	8577	9216	9870	10528
Phillips	28838	28238	27690	27227	26741
Pike	10086	10560	11065	11612	12186
Poinsett	24664	24872	24928	24911	24811
Polk	17347	18484	19639	20879	22230
Pope	45883	50821	55907	61153	66685
Prairie	9518	9531	9501	9434	9342
Pulaski	349660	372262	393546	414695	436830
Randolph	16558	17994	19531	21166	22887
Saint Francis	28497	29191	30180	31842	34839
Saline	64183	71992	80351	89402	99158
Scott	10205	10705	11188	11648	12092
Searcy	7841	8076	8311	8577	8862
Sebastian	99590	105569	111417	117413	123644
Sevier	13637	14486	15318	16200	17108
Sharp	14109	16475	19210	22490	26404
Stone	9775	10587	11392	12230	13120
Union	46719	48020	49086	50077	51040
Van Buren	14008	15823	17762	19964	22477
Washington	113409	124038	134285	144453	154882
White	54676	59104	63570	68011	72405
Woodruff	9520	9572	9600	9631	9640
Yell	17759	18790	19750	20664	21537

Source: Projections of the Population of Arkansas,By County, Age, Gender, and Race: 1990 to 2010, Institute for Economic Advancement at the Univ. of Arkansas at Little Rock, 1993.

Note: County projections by age, sex, and race are available from the Institute for Economic Advancement for a small administrative fee by calling (501) 569-8573.

- The Development Information Network of Arkansas
- Back to IEA Research Group

U·A·L·R Institute for Economic Advancement

Title: 10CFR50.59 Review Program Rev. No. 0

Cross Discipline Review	Applicable [X]	Not Applicable [ ]
Quality-Related	Applicable [X]	Not Applicable [ ]
50.59 Review	Applicable [X]	Not Applicable [ ]

Procedure Owner: Original Signature on File in Nuclear Support
Director, Nuclear Safety & Licensing

Approved: Original Signature on File in Nuclear Support
Vice President, Operations Support

	ANO	GGNS	RBS	W3	Echelon
Effective Date:	12/17/99	09/01/99	09/01/99	08/01/99	09/01/99

TABLE OF CONTENTS

1.0 PURPOSE

1.1 This procedure prescribes and establishes:

1.1.1 Controls and methods for implementing the requirements of 10CFR50.59.

1.1.2 Responsibilities for review, approval and documentation of 10CFR50.59 reviews.

1.1.3 Requirements for qualifying personnel performing 10CFR50.59 reviews.

1.1.4 Controls and methods for performing Environmental Evaluation Applicability Reviews.

1.2 Any 50.59 Reviews prepared in accordance with site procedures may be processed in accordance with those procedures for 60 days following implementation of LI-101. Any 50.59 Review prepared after that 60-day period must be prepared in accordance with LI-101.

2.0 REFERENCES

2.1 Regulatory References

2.1.1 Title 10 of Code of Federal Regulations, Part 50.59 (50.59), "Changes, tests or experiments"

2.1.2 10CFR50.54, "Conditions of Licenses"

2.1.3 10CFR50.55a, "Codes and Standards"

2.1.4 10CFR50.2, "Definitions"

2.1.5 10CFR50.12, "Specific Exemptions"

2.1.6 10CFR50.90, "Application for amendment of license or construction permit"

2.1.7 NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants"

2.2 EOI Corporate References

2.2.1 Entergy Operations, Inc. 10CFR50.59 Review Program Guidelines

2.2.2 Entergy Operations, Inc., Licensing Position #2, "Evaluation and Resolution of Degraded and Nonconforming Conditions (Operability Determination vs. 10CFR50.59 Review)"

2.2.3 Entergy Operations, Inc., Quality Assurance Program Manual

2.2.4 AD-102, "Quality Assurance Program Manual Control"

2.3 ANO References

2.3.1 QAO-2, "QA Review Procedure Document"

2.3.2 1000.002, "PSC Operations"

2.3.3 1000.006, "Procedure Control"

2.3.4 1000.104, "Condition Reporting and Corrective Actions"

2.3.5 1000.150, "Licensing Document Maintenance"

2.3.6 1000.151, “QA Requirements for Safety-Related Site Software”

2.3.7 1022.039, “Ventilated Storage Cask 10CFR72.48 Reviews”

2.3.9 1052.034, “Nonradiological Environmental Evaluation Program”

2.4 GGNS References

2.4.1 01-S-01-3, “Plant Safety Review Committee”

2.4.2 01-S-06-3, “Control of Temporary Alterations”

2.4.3 01-S-07-1, “Control of Work on Plant Equipment and Facilities”

2.4.4 01-S-10-3, “Emergency Preparedness Department Responsibilities”

2.4.5 01-S-15-10, “Control of Licensing Documents”

2.4.6 01-S-15-12, “Regulatory Commitment Change Process”

2.4.7 01-S-16-1, “Plant Change Implementation”

2.4.8 01-S-17-5, “Engineering Request”

2.5 RBS References

2.5.1 ADM-002, “Facility Review Committee”

2.5.2 RBNP-001, “Control and Use of RBS Procedures”

2.5.3 RBNP-027, “Initiation and Processing of License Amendment Requests”

2.5.4 RBNP-029, “Commitment Management System”

2.5.5 RBNP-030, “Initiation and Processing of Condition Reports”

2.5.6 RBNP-075, “10CFR50.54 Evaluations”

2.5.7 RBNP-088, “USAR Maintenance”

2.6 W3 References

2.6.1 W2.109, “Procedure Development, Review, & Approval”

2.6.2 W2.300, “10CFR50.54 Review Changes Affecting the Licensed Operator Requalification Program, Security Plan, and the Emergency Plan”

2.6.3 W4.501, “Commitments Management Program”

2.6.4 W4.503, “Changes to the Technical Specifications, Technical Requirements Manual, or Core Operating Limits Report”

2.6.5 W4.504, “Maintaining Fidelity of the Updated Final Safety Analysis Report”

2.6.6 UNT-001-004, “Plant Operations Review Committee”

2.6.7 LP-114, "Preparation for UFSAR Submittal"

2.7 Industry References

2.7.1 NEI 96-07, "Guidelines for 10CFR50.59 Safety Evaluations"

2.7.2 NEI 98-03, "Guidelines for Updating Final Safety Analysis Reports"

3.0 DEFINITIONS

3.1 10CFR50.59 (50.59) - Federal law which deals with evaluations of changes made to the plant facility as described in the Safety Analysis Report (SAR), changes made to procedures described in the SAR, and tests and experiments not described in the SAR to determine if the change, test, or experiment constitutes an unreviewed safety question (USQ) or a change to the Technical Specifications (TS).

3.2 50.59 Evaluation - The record required by 50.59(b)(1) that provides the basis for determining that a change, test, or experiment does or does not involve a USQ.

3.3 50.59 Review - The application of any portion of the 50.59 Review Program as defined in this procedure including a Pre-Screening, Screening, or 50.59 Evaluation.

3.4 Acceptance Limit – The specific parametric value for the plant's response to a particular event accepted by the NRC in licensing the plant.

3.5 Accident Analyses - The accident analyses are typically performed for a bounding set of accidents. The set is chosen to include all credible accidents and anticipated operating occurrences (AOOs) and a limited number of design basis accidents (DBAs) not expected to occur, but which are used to confirm the adequacy of the plant design.

3.6 Accidents previously evaluated in the SAR - The abnormal operation, DBAs, and transients that are analyzed to demonstrate that the plant can operate without undue risk to the health and safety of the public. The accidents considered for the plant involve the possible direct release of radioactive material and are typically found in SAR Chapters 6 and/or 15 (standard SAR format).

3.7 Change - For purposes of 50.59, a change is any activity (including modifications to plant hardware or procedures, changes to methodologies and analyses, new tests or experiments) that may affect the design, function, or method of performing the function of a structure, system, or component (SSC) as described in the SAR. An activity involving an SSC not explicitly described in the SAR that has the potential to impact the function of an SSC that is explicitly described in the SAR is also considered a change.

3.8 Consequences of an accident or malfunction of equipment important to safety - The radiological consequences (dose) that may result from an accident or equipment malfunction. An increase in consequences involves an increase in postulated dose to the public above the Acceptance Limit. Additionally, onsite dose consequences that restrict access to vital areas or otherwise impede actions to mitigate the consequences of reactor accidents may involve a USQ.

3.9 Described in the SAR - SSCs, procedures, tests, descriptions, analyses, drawings, etc. that are described explicitly or implicitly in the SAR.

3.10 Design Bases - As defined in 10CFR50.2, that information which identifies the specific functions to be performed by an SSC and the specific values or range of values chosen for controlling parameters as reference bounds for design.

3.11 Important to Safety - The term "important to safety" usually refers to (1) safety-related equipment and (2) non-safety-related SSCs that have the potential to affect safety-related equipment (Equipment considered important to safety is site-specific.)

It includes SSCs that:

a) Ensure integrity of the reactor coolant pressure boundary

b) Ensure capability to shut down the reactor and maintain it in a safe shutdown condition

c) Prevent or mitigate consequences of accidents that could result in potential offsite exposures comparable to 10CFR100 guidelines.

d) Are non-safety related whose failure could impair the ability of equipment necessary for safe shutdown and accident mitigation equipment/structures to perform as designed

ANO: Equipment “Important to Safety” is that equipment classified as “Q”.

3.12 Incorporated by Reference – A method by which all or part of a separate source document can be made part of the SAR without duplicating the desired information in the SAR. Information appropriate to include in the SAR that is also part of a separate licensee-controlled document or technical report may be incorporated into the SAR by appropriate reference to that information. By relying on information “incorporated by reference,” licensees may simplify their SARs by removing information that is duplicated in separate, controlling program documents such as the Emergency Plan (EP), Offsite Dose Calculation Manual (ODCM), Fire Protection Plan (FPP) and Fire Hazards Analysis Report (FHA), Technical Requirements Manual (TRM), Security Plan, Environmental Protection Plan (EPP) and Quality Assurance Plan (QAP).

3.13 Licensing Basis - The collection of documents describing the safety aspects of the facility used by the NRC for initial license approval and subsequent regulatory actions.

3.14 Licensing Basis Documents (LBDs) (this information is plant-specific.) - For purposes of 50.59, LBDs are defined as the TS and the SAR.

3.15 Malfunction of equipment important to safety previously evaluated in the SAR – The failure of SSCs to perform their intended safety functions (whether or not classified as safety-related in accordance with 10CFR50, Appendix B) described in the SAR.

3.16 Margin of Safety as defined in the basis of any TS - The difference between the regulatory limit (e.g., 10CFR100, 10CFR50.46) or the assumed or design basis failure point in the absence of a regulatory limit, and the NRC Acceptance Limits as defined in the basis for the TS. The failure point is the value of parameters at which a protective boundary (fission product barrier or safety limit) would be compromised. For purposes of this procedure, upper level design margins will also be considered for determining a USQ.

3.17 NRC Safety Evaluation Reports (SER) – The NRC reports (including original SER) documenting the NRC’s evaluation and acceptance of a change to a licensee’s LBDs, such as the TS.

3.18 Plant Safety Review Committee (PSRC) - The generic term used in this document to identify the onsite committee which independently reviews operational activities in order to provide additional assurance that the plant is operated and maintained to ensure nuclear safety.

ANO:	Plant Safety Committee (PSC)
GGNS:	Plant Safety Review Committee (PSRC)
RBS:	Facility Review Committee (FRC)
W3:	Plant Operations Review Committee (PORC)

3.19 Possible accident or malfunction of a different type - An accident or malfunction that involves an initiator or failure not considered in the SAR and one that is not bounded by other events that have been analyzed.

3.20 Pre-Screening - An initial review of the proposed change to determine if it may be excluded from further 50.59 Reviews. A change may be Pre-Screened as not needing further review under 50.59, but may require a review under other regulatory change processes such as 10CFR50.54.

3.21 Preparer - A Qualified Individual who performs a Pre-Screening, Screening, or 50.59 Evaluation.

3.22 Probability of occurrence of an accident or malfunction of equipment important to safety - Refers to the change in probability of accidents and events that have been previously evaluated in the SAR. Changes that result in a change from one frequency class to a more frequent class or that result in a clearly discernible increase in frequency within a frequency class are examples of changes that increase the probability of occurrence.

3.23 Qualified Individual - A person who is qualified per Section 5.9 to function as a Preparer or Reviewer.

3.24 Reviewer - A Qualified Individual who reviews a Pre-Screening, Screening, or 50.59 Evaluation.

3.25 Safety Analysis Report (SAR) - For the purpose of 50.59 review, the SAR is the Updated Final Safety Analysis Report (UFSAR) and pending changes, the QAP, the EP, the FHA, the TRM, the TS Bases, the Core Operating Limits Report (COLR), NRC SERs, and other site-specific documents. The scope of the SAR includes its text, table, figures, and drawings as well as information specifically incorporated by reference.

ANO:	The electronic version of the ANO SARs includes "pending SAR changes" and may be different from that contained in the hard copy version. When differences are identified, please consult the Licensing Department.
RBS:	The FHA is contained in the USAR.

3.26 Safety Review Committee (SRC) - The committee reporting to the site Vice President which independently reviews operational activities in order to provide additional assurance that the plant is operated and maintained in accordance with the OL and applicable regulations which address nuclear safety.

3.27 Screening - A review of the proposed change for applicability to the requirements of 50.59 to determine the need to conduct a 50.59 Evaluation.

3.28 Technical Requirements Manual (TRM) - The TRM provides those limitations upon plant operations which are part of the licensing basis for the facility but do not meet the criteria for continued inclusion in the TS. It also provides information that supplements the TS. The TRM is controlled under the provisions of 50.59.

> GGNS: Information in the TRM may be duplicated in other documents, such as the Offsite Dose Calculation Manual (ODCM) and Process Control Program (PCP). The process for changing these documents should be followed for associated TRM changes.

3.29 Technical Specifications (TS) - The portion of the plant Operating License (OL) that contains the safety limits, the limiting conditions for operation, the surveillance requirements, and other requirements imposed on the operation of the plant. For the purposes of this document, the term "Technical Specifications" also encompasses the OL and NRC Orders.

3.30 Tests and Experiments Not Described in the SAR - Tests and experiments that could degrade the margins of safety during normal operations or anticipated transients or degrade the adequacy of SSCs to prevent accidents or mitigate accident conditions.

3.31 Unreviewed Safety Question (USQ) - A proposed change, test or experiment involves a USQ if:

a) The probability of occurrence or the consequences of an accident or malfunction of equipment important to safety previously evaluated in the SAR may be increased; or

b) A possibility for an accident or malfunction of a different type than any evaluated previously in the SAR may be created; or

c) The margin of safety as defined in the basis for any TS is reduced.

4.0 RESPONSIBILITY

4.1 Executive Vice President and Chief Operating Officer (EVP & COO) is responsible for ensuring that a process is established to meet 10CFR50.59.

4.2 Each site's Vice President, Operations is responsible for implementing this procedure at the site.

4.3 Each site's Department Heads are responsible for:

4.3.1 Assigning Qualified Individuals to perform and review the Pre-Screening, Screening, or 50.59 Evaluations and ensuring that assigned personnel are knowledgeable of the subject being evaluated or reviewed.

4.3.2 Ensuring adequate numbers of Preparers and Reviewers are qualified to perform 50.59 Reviews within their departments.

4.4 Each site's PSRC is responsible for:

4.4.1 Reviewing 50.59 Evaluations for potential USQs.

4.4.2 Documenting review of 50.59 Evaluations.

4.4.3 Assigning 50.59 Evaluation numbers.

4.4.4 Sending a copy of reviewed 50.59 Evaluations to the SRC and NS&RA.

4.4.5 Recommending refresher training or suspension/revocation of the qualification of any Qualified Individual demonstrating unacceptable performance in complying with this procedure or based on recommendation from a member of upper management.

4.5 Each site's SRC is responsible for reviewing 50.59 Evaluations to verify that changes, tests, or experiments completed under the provisions of 50.59 do not constitute a USQ or a change to the TS.

4.6 The site 50.59 Training Coordinator is responsible for:

4.6.1 Ensuring training is provided in support of this procedure.

4.6.2 Ensuring training records of Qualified Individuals are maintained.

4.6.3 Ensuring a list of Qualified Individuals is maintained.

4.7 The corporate Director - Nuclear Safety & Licensing (NS&L) is responsible for maintaining this procedure.

4.8 Each site's Director, Nuclear Safety & Regulatory Affairs (NS&RA) is responsible for:

4.8.1 Implementing this procedure at the site.

4.8.2 Ensuring a periodic review or assessment of the 50.59 Review Program is conducted to assess program effectiveness. Results of this assessment should be reported to the PSRC, SRC, and the quality assurance department.

4.8.3 Obtaining site concurrence for revisions to this procedure.

4.8.4 Submitting the periodic 50.59 Evaluation summary report to the NRC.

ANO:	Director, Nuclear Safety

4.9 Preparer is responsible for:

4.9.1 Performing Pre-Screenings, Screenings, 50.59 Evaluations, and Environmental Evaluation Applicability Reviews in accordance with this procedure.

4.9.2 Ensuring 10CFR50.54 evaluations required for changes to those documents controlled under §50.54 are performed.

4.9.3 Ensuring Environmental Evaluations required for the changes are performed.

4.10 Reviewer is responsible for concurring with the conclusions of the Pre-screening, Screening, or 50.59 Evaluation based on the evidence presented in accordance with Section 5.1.16. (This concurrence is NOT an independent review as defined in ANSI N45-2.11.)

5.0 DETAILS

5.1 General Process Overview

10CFR50.59 constitutes a legal requirement intended to allow a licensee to make changes while still preserving the basis upon which the NRC issued the OL and subsequent amendments. Licensees may make changes to the facility as described in the SAR; make changes in procedures as described in the SAR; or conduct tests or experiments not described in the SAR without prior Commission approval, provided the proposed change, test, or experiment does not involve a USQ or does not result in a change to the TS. In general, the key aspect of 50.59 with regards to applicability to a proposed change, test or experiment is "as described in the SAR". Additional guidance on performing activities with this procedure is contained in the Entergy Operations, Inc. 10CFR50.59 Review Program Guidelines (Reference 2.2.1) and in NEI 96-07 (Reference 2.7.1). Entergy's 10CFR50.59 Review Program conforms to NEI 96-07.

5.1.1 The 50.59 Review process consists of one or more of the following activities:

a) Pre-Screening

b) Screening

c) 50.59 Evaluation

5.1.2 Preparers and Reviewers shall be knowledgeable of the subject being evaluated and be qualified by successfully completing an approved 50.59 training course as outlined in Section 5.9.

5.1.3 For those situations determined to require a 50.59 Evaluation, the Pre-Screening or Screening form is not required. Only one form need be completed to document any 50.59 Review.

5.1.4 For each 50.59 Screening or Evaluation, LBDs (listed on Attachments 9.2 and 9.3, respectively) must be reviewed for impact. The Preparer is responsible for ensuring impacted LBDs are revised in accordance with appropriate processes (this does not apply to NRC SERs).

5.1.5 A proposed change to the facility or to procedures, which affects information contained in the SAR (implicit or explicit) and any new test or experiment not described in the SAR receives a 50.59 Review unless specifically excluded per Sections 5.2 or 5.3. This will include both safety-related and non-safety-related equipment as described in the SAR since both have the potential to involve a USQ.

5.1.6 A copy of the Pre-Screening, Screening, or 50.59 Evaluation forms must accompany the document evaluated, be referenced in the evaluated document, or be maintained in the documentation file.

5.1.7 A single 50.59 Evaluation may be written to address recurring types or categories of changes or activities.

5.1.7.1 The single 50.59 Evaluation must be referenced or attached to the evaluated document.

5.1.7.2 The single 50.59 Evaluation must be reviewed to ensure it is fully applicable to the individual change or activity being considered and is valid (unaffected by plant or procedure changes since the generic Screening or 50.59 Evaluation was originally performed).

5.1.8 If needed, the Preparer may obtain help from other individuals and departments for complex or difficult 50.59 Reviews. The Preparer shall document sources of information especially from outside departments. Regardless of whether or not assistance is obtained, the Preparer maintains sole responsibility for the content of the document.

5.1.9 Computer generated forms containing the same informational requirements as the procedure forms may be used in lieu of actual procedure forms if confirmed to be consistent with the latest revision of this procedure.

5.1.10 Proposed changes in plant design or operation, or proposals to perform tests or experiments shall also include an Environmental Evaluation Applicability Review as described in Section 5.7.

5.1.11 Requests for relief from the requirements of ASME require NRC approval prior to incorporation into the ISI/IST Program Plan as controlled under 10CFR50.55a rather than 50.59. When compliance with ISI/IST requirements is clearly impractical, provisions exist for implementing changes prior to approval pursuant to NUREG-1482 (Reference 2.1.7).

5.1.12 Exemptions to 10CFR rules must be requested in accordance with 10CFR50.12. 50.59 is NOT applicable for implementing such related actions.

5.1.13 The Entergy 10CFR50.59 Review Program and the site 10CFR50.54 process(es) must both be considered when a change is being made. This procedure defines those exceptions when a change is controlled in its entirety by a program under 10CFR50.54. However, it is important to realize that some changes will require both a 50.59 Review and a 10CFR50.54 evaluation.

NOTE

Even though the Security Plan is an LBD, it is classified as safeguards and is not controlled under the 50.59 Review Program. However, the Preparer should notify the Security Department of potential changes to the Security Plan.

5.1.14 For those changes or portions of changes that create a USQ or involve a TS change, prior NRC approval is required via 10CFR50.90. Exceptions to this are:

a) The proposed change involves a change in position titles, or

b) A nonconformance is identified where interim administrative control of the plant in a safe manner is required

Changes that meet one of the exceptions may be implemented under 50.59 Review while the TS change is being processed.

5.1.15 As documented in Entergy's Licensing Position #2, "Evaluation and Resolution of Degraded and Nonconforming Conditions (Operability Determination vs. 10CFR50.59 Review)" (Reference 2.2.2), degraded or nonconforming conditions are evaluated and resolved via the corrective action process. Only the associated compensatory actions require a 50.59 Review. Refer to the position paper for more information.

5.1.16 The minimum Reviewer expectations are as follows (the Reviewer has the discretion to broaden the scope of his/her review):

5.1.16.1 Pre-screening Review

The Reviewer concurs that the activity has been properly excluded from further 50.59 review pursuant to this procedure. This review is to include a review of existing 50.59 Reviews or of any referenced NRC documents, as applicable, that provides approval of the activity.

5.1.16.2 Screening Review

The Reviewer concurs the activity has been properly screened to determine applicability of 50.59. As a minimum, this review will include:

a) Completeness and scope of document search (in general, this review should include electronic search criteria and SAR sections and documents manually reviewed).

b) As necessary, controlled copy review of those LBDs providing the basis for the conclusion.

5.1.16.3 50.59 Evaluation Review

The Reviewer concurs the activity has been properly evaluated under 50.59. As a minimum, the Reviewer should ensure the Evaluation provides adequate justification for the stated conclusions.

5.1.17 Independent Spent Fuel Storage Installations are maintained via a separate license in accordance with 10CFR72. A 10CFR72.48 review similar to that of a 50.59 Review is required.

ANO: See ANO Procedure 1022.039, "Ventilated Storage Cask 10CFR72.48 Reviews, " Section 6.1.6, Dry Fuel Storage (Reference 2.3.8)

5.1.18 Document Searches

5.1.18.1 LBDs are expected to be accurate. If errors or discrepancies are identified in these documents, they should be promptly corrected in accordance with site procedures. Failure to identify changes to LBDs may produce document inaccuracies and will be considered a failure to comply with 50.59.

5.1.18.2 Qualified Individuals are accountable for the completeness of LBD searches that support the 50.59 Review as well as the thoroughness of the Review itself.

5.1.18.3 Pending changes to LBDs must also be included in document searches supporting the 50.59 Review.

5.1.18.4 Electronic versions of LBDs may not be controlled documents; electronic searches should be followed up with reference to controlled documents.

5.1.18.5 Electronic Search

If a keyword search is done using LRS, the Preparer must perform searches in a detailed, comprehensive manner to ensure any potential hits are obtained. If an LBD is potentially impacted, a controlled copy must be reviewed to verify the electronic search results.

5.1.18.6 Manual Search

A manual scan of text and figures must be conducted in those LBD sections that may be affected by the proposed change. The Preparer must document which SAR sections were reviewed for impact.

5.1.19 A change that affects information documented in an NRC SER requires a 50.59 Evaluation. The NRC SER is an historic document that cannot be revised by the licensee.

5.2 Programmatic Exclusion

Certain procedures may be programmatically excluded from the 50.59 Review process.

5.2.1 A one-time Screening is performed to document that the procedure:

a) Is not required by TS; and

b) Does not involve an activity described in the SAR or a test or experiment not described in the SAR; and

c) Has no potential for affecting the operation or functional ability of SSCs described in the SAR; and

d) Has no potential for adversely affecting the environment.

OR

e) Is controlled by other codified processes (e.g., 10CFR50.54) in its entirety.

5.2.2 If 5.2.1a) through d) OR 5.2.1e) are not applicable, the procedure cannot be excluded from the 50.59 Review process.

5.2.3 Once completed, the Preparer transmits the Screening by memorandum to PSRC for review. The Preparer also sends a copy to the 50.59 Program Owner.

5.2.4 When developing a procedure revision, the originator must consider whether or not the exclusion remains valid. If the revision invalidates the exclusion, Steps 5.2.1 and 5.2.2 must be repeated to reestablish the exclusion.

5.2.5 Each site maintains documentation of programmatic exclusions.

5.3 Editorial Changes to Procedures

5.3.1 An editorial change is one that does not affect the specific intent, result, requirements, or performance of the procedure.

5.3.2 A change of intent involves one or more of the following:

a) a change of purpose or scope

b) a reduction of acceptance criteria

c) degraded controls prescribed in administrative procedures

d) reduced level of nuclear safety

5.3.3 Changes to procedures that are determined to be editorial are excluded from the 50.59 Review process.

5.3.4 An editorial change is one that falls into one or more of the following categories:

a) Corrects grammar errors, spelling errors, and/or step numbering errors that do not affect step sequencing.

b) Corrects section and/or attachment numbers

c) Corrects referenced step and data table numbers

d) Corrects reference titles, reference document numbers, revisions, or additions/deletions of references

e) Corrects page numbers

f) Corrects table of contents

g) Corrects pagination and format errors

h) Updates organization titles provided there are no changes to job functions or responsibilities.

i) Corrects equipment designations or locations to be consistent with approved drawings, documents, labels, or procedure content

j) Modifies text to improve clarity without changing process, sequence, or intent

k) Incorporates previously approved procedure change notices (i.e., those changes that do not immediately result in a procedure revision)

5.4 <u>Pre-Screening</u>

Proposed changes described below do not require a Screening or 50.59 Evaluation provided a Pre-Screening is performed unless excluded under Section 5.2 or 5.3. A Pre-Screening form (similar to Attachment 9.1) must accompany the document evaluated or be included in the documentation file to document the applicability of the criteria. Adequate justification must be provided in the BASIS section of the Pre-Screening form such that a third party reviewer can reach the same conclusions. Additional detail on how to apply these criteria may be found in the Entergy 10CFR50.59 Review Program Guidelines.

5.4.1 Pre-Screening criteria includes the following:

NOTE

Section 5.4.1.1 pertains to SAR changes ONLY. Editorial changes to procedures are covered in Section 5.3.

5.4.1.1 *The SAR change is an editorial or typographical correction only.*

Allowed editorial changes to the SAR include:

a) Changing Table of Contents or page numbers

b) Correcting grammar, misspelled words and mistakes made when incorporating information that was previously justified (e.g., correcting mistakes made while typing a document)

c) Reflecting approved changes to document numbers, revision numbers, or other references to documents

NOTE

The change is not editorial if the document, revision, or reference number has been changed due to a revision of the source document.

d) Modifying the format

e) Rewording/Renumbering for clarification

f) Changing position titles when no responsibilities or reporting chain for the positions have changed

g) Rearranging information so that the SAR is more easily understood

h) Adding or modifying information that increases the level of detail in the SAR without changing the intent or scope of the section (i.e., the stated equipment function or performance is not being modified, or existing commitments reduced).

i) Correcting inconsistencies between sections, tables or figures within the SAR where there is documentation supporting accurate information in another SAR or OL section, table or figure

j) Splitting, redrawing or consolidating existing drawings, provided no information is added, deleted or changed on the drawing that would impact system/equipment configuration.

k) Adding or revising identification numbers to components already shown on the drawing (without changing the safety class or material of the component).

5.4.1.2 *The change is a substitute part of SSC only*

A substitute part of SSC only change is defined as a change whose full scope meets one of the following criteria:

a) A change to manufacturer's name and/or part numbers that is administrative only

b) A change that does not impact the part's operation, form, fit, or function, material, or material processes

5.4.1.3 *The change will be controlled in its entirety under 10CFR50.54 instead of 50.59.*

These documents include:

a) Licensed Operator Requalification Program

b) Quality Assurance Program

c) Emergency Plan

d) Security Plan

e) Safeguards Contingency Plan

f) Security Qualification and Training Program

In general when deciding whether to apply 50.59 or 10CFR50.54 criteria, the Preparer must first determine whether the change constitutes a change to the governing plan/program or to the implementing procedures. It is the Preparer's responsibility to ensure a 10CFR50.54 evaluation is performed, if required.

ANO:	QAO-2 (Reference 2.3.1) The Industrial Security Plan (ISP) is not considered an LBD under 50.59. However, if impact to the ISP is identified during the 50.59 Review, notify the Security Department.
GGNS:	AD-102 (Reference 2.2.4), 01-S-10-3 (Reference 2.4.4)
RBS:	RBNP-075 (Reference 2.5.6)
W3:	W2.300 (Reference 2.6.2)

5.4.1.4 *An approved, valid Screening or 50.59 Evaluation covering all aspects of the proposed change already exists.*

5.4.1.4.1 If an existing Screening or 50.59 Evaluation is used, it must be reviewed to ensure (1) it covers the proposed change entirely and (2) subsequent changes to licensing basis documents have not impacted the previous Screening or 50.59 Evaluation. This review shall be documented in the Pre-Screening review.

5.4.1.4.2 The 50.59 Evaluation number must be referenced or a copy of the Screening or 50.59 Evaluation attached to the Pre-Screening form.

5.4.1.5 *The proposed change, in its entirety, has been approved by the NRC.*

If this exclusion is used, a reference must be listed to document formal NRC approval of the proposed change (e.g., SER section, TS amendment number, 10CFR rule change, etc.). NRC Inspection Reports do not constitute NRC approval. Discuss if the subsequent changes have impacted the LBDs since the approved document was issued.

5.4.1.6 *The proposed change is intended to resolve conflicts between the SAR and the actual plant design or operation where the SAR description is correct but the actual plant design or operation is incorrect.*

5.4.2 The Preparer and Reviewer completing the Pre-Screening form shall sign and date the form and shall ensure that their 50.59 qualifications are current.

5.5 Screening

A Screening form similar to Attachment 9.2 must be used to document the Screening of changes, tests, and experiments unless a programmatic exclusion, Pre-Screening, or 50.59 Evaluation is performed. A brief written response providing the basis for answering the questions must be provided. Adequate justification must be provided in the BASIS section of the Screening form such that a third-party reviewer can reach the same conclusions. Simply stating that the change does not affect TS or the SAR is not an acceptable basis.

5.5.1 Changes, tests, and experiments as delineated below shall be Screened for 50.59 applicability unless previously excluded per Sections 5.2 or 5.3.

a) Changes to any existing SSC as described in the SAR or new SSCs added by design changes regardless of the safety classification of the affected portion of the facility unless exempted under the Pre-Screening review.

b) Temporary alterations or modifications

c) Revisions (including temporary changes) to procedures/directives, special instructions and other procedures described in the SAR (e.g., startup test procedures)

d) Tests and experiments not described in the SAR

e) New procedures (both safety related and non-safety related) not excluded by Section 5.2 (this includes temporary procedures)

f) Modification work packages and post-modification tests involving work not already reviewed under 50.59 per this procedure

g) Safety-related plant software changes

RBS:	For Change Notices (CNs) processed in accordance with RBNP-001 (Reference 2.5.2), a documented Screening is required during the temporary approval period.

GGNS: GGNS committed to perform a 50.59 Review for M&TE installed longer than one 12-hour shift.

5.5.2 Changes made under work orders where the SSC is declared INOPERABLE per the TS, or out of service if TS do not apply, do not require a Screening provided the maintenance being performed does not impact any other SSC which is not declared Inoperable or out of service. If the change is to remain in effect after closing the work order or if the SSC is to be declared OPERABLE or put back in service with the change in place, then a Screening would be required unless the change is covered by an existing procedure.

NOTE

Maintenance activities are not required to be reviewed under 50.59 except for those activities which deviate from a SAR procedure, put the plant or any SSC in a condition where it functions differently than described in the SAR, or might violate TS. Maintenance includes, but is not limited to, calibration, refurbishment, replacement with an equivalent component, and housekeeping. Refer to Reference 2.2.1, "Entergy Operations Inc. 10CFR50.59 Review Guidelines," for further guidance.

5.5.3 Maintenance activities, such as special instructions for a work order, or special instructions for an SSC, may require a review to be performed on the work order if the SSC is declared Operable during the activity.

5.5.4 The Preparer and Reviewer completing the Screening form shall sign and date the form and shall ensure their 50.59 qualifications are current. At the discretion of the Preparer, individuals providing assistance may also be listed on the form. However, regardless of whether or not assistance is obtained in performing the Screening, the Preparer maintains sole responsibility for the content of the Screening.

5.5.5 The basis for the search of the SAR shall be documented under the "BASIS" section on the Screening form. The Preparer shall provide a listing of the documents reviewed or referenced in the Screening. The Basis section on the form should (1) clearly discuss the SAR documents and (2) identify the principle SAR sections (current and pending changes) considered for applicability to the proposed change. If an electronic search is performed, the keywords and search criteria used should be discussed. See Sections 5.1.18.4, 5.1.18.5, and 5.1.18.5.

5.6 <u>50.59 Evaluation</u>

If a 50.59 Evaluation is required, it shall be documented with written responses addressing the questions contained in 50.59(a)(2) and documented on the 50.59 Evaluation form (Attachment 9.3). Adequate basis must be provided for the answer to each of the questions such that a third-party reviewer can reach the same conclusions. A negative restatement of the questions is not acceptable. Ensure the answers provided specifically address the question.

The Preparer should summarize the results of the 50.59 Evaluation. This information will be submitted to the NRC in the periodic summary report. The summary must provide sufficient information for the NRC to determine with reasonable assurance that the change or test does not create a USQ. The Executive Summary should be a stand-alone part of the evaluation and should be less than one page in length. As a general rule, use of system numbers and component identification numbers in lieu of system names and component names, as well as most acronyms, should be avoided.

5.6.1 If the answer to any one of the questions is "Yes", the evaluated activity involves a USQ. The proposed change must either be revised to eliminate the USQ or NRC approval must be obtained via 10CFR50.90 prior to implementing the proposed change. Such changes shall be provided to NS&RA for processing.

5.6.2 If the activity requires a SAR change, a 50.59 Evaluation shall be performed unless the SAR change meets the exclusion criteria outlined in Section 5.4. SAR changes shall be processed per the applicable site procedure.

5.6.3 If the validity of the 50.59 Evaluation depends on NRC approval or any non-LBD change other than the one being evaluated, the Preparer will discuss this on the 50.59 Evaluation form.

5.6.4 The Preparer and Reviewer shall sign and date the form. They shall also ensure their 50.59 qualifications are current. At the discretion of the Preparer, individuals providing assistance should also be listed on the form. However, regardless of whether or not assistance is obtained in performing the 50.59 Evaluation, the Preparer maintains sole responsibility for the contents of the 50.59 Evaluation.

5.6.5 The Preparer shall obtain PSRC review prior to implementing the activity.

5.6.6 The PSRC documents its review of the 50.59 Evaluation and assigns the evaluation a consecutive number following its review. Revisions to existing 50.59 Evaluations should be numbered by the Preparer prior to PSRC review.

5.6.7 PSRC sends a copy of the reviewed 50.59 Evaluation to the SRC and NS&RA.

5.6.8 If a 50.59 Evaluation involves a TS change or a USQ whereby the condition already exists in the plant, or in policies/directives or procedures (i.e., performing a 50.59 Evaluation or a SAR change request on a deviation in the as-built plant to the SAR), a Condition Report (CR) must be written to ensure the conditions are appropriately evaluated.

5.7 <u>Environmental Evaluation Applicability Reviews</u>

An Environmental Evaluation Applicability Review will be performed and documented as part of the Screening or 50.59 Evaluation (Attachments 9.2 and 9.3, respectively).

5.7.1 If an Environmental Evaluation is applicable, the Preparer is responsible for ensuring it is performed per Attachment 9.4 or appropriate site procedures. If the activity represents a significant unreviewed environmental impact, the activity shall be submitted to the NRC for review and approval prior to implementation.

ANO:	Environmental Evaluations are performed in accordance with Procedure 1052.034 (Reference 2.3.9)
GGNS:	Qualified Individuals may perform Environmental Evaluations. Send Environmental Evaluations to the Chemistry Department.
RBS:	Qualified Individuals may perform Environmental Evaluations. Provide a copy to the Chemistry department.

W3:	The Chemistry Department reviews and concurs with Environmental Evaluations.

5.8 Revisions to 50.59 Evaluations

Revisions to 50.59 Evaluations require the same review as the original. A revision number will be added to the existing 50.59 Evaluation number and must be entered on each page of the revised Evaluation.

5.9 Qualification of Personnel

5.9.1 Preparers and Reviewers must be qualified in accordance with this procedure. Site supervisors/managers determine site-specific technical competence of a Qualified Individual.

5.9.2 To become qualified, individuals shall attend initial 50.59 training and shall pass a qualification examination. Individuals presently qualified at other EOI sites are exempted from these requirements and must only have site-specific training provided and documented per site requirements.

5.9.3 Once the individual successfully completes training, the site 50.59 Training Coordinator notifies the individual and responsible department head of the results and ensures appropriate entries are made into Training records.

5.9.4 Refresher training is scheduled as deemed necessary by the site 50.59 Review Program Owner, the PSRC, or the SRC.

5.9.5 The site 50.59 Training Coordinator is responsible for ensuring a list of Qualified Individuals is maintained.

5.10 Summary Report of 50.59 Evaluations

NS&RA submits 50.59 Evaluations to the NRC in a summary report in accordance with 50.59(b)(2). This report is to contain summaries of 50.59 Evaluations performed for changes implemented during the reporting period.

6.0 INTERFACES

Refer to the Entergy 10CFR50.59 Review Program Guidelines (Reference 2.2.1)

7.0 RECORDS

7.1 Quality Records

7.1.1 50.59 Evaluation

7.1.2 Environmental Evaluation

7.2 Non-Quality Records

7.2.1 Pre-Screening

7.2.2 Screening

7.2.3 Environmental Evaluation Applicability Review

7.3 Record Retention Requirements

7.3.1 In accordance with 50.59(b)(3), 50.59 Evaluation shall be maintained as follows:

a) 50.59 Evaluations of changes to the facility shall be maintained until the date of termination of the license.

b) 50.59 Evaluations of changes to procedures and valuations of tests and experiments shall be maintained for a period of at least five (5) years.

8.0 REQUIREMENTS AND COMMITMENT CROSS-REFERENCE

ANSI 18.7	LI-101
4.3.4(1)	5.4
4.3.4(2)	5.4

Procedure Revision Statement:

Revision 0 establishes the company process for implementing the requirements of 10CFR50.59.

9.0 ATTACHMENTS

9.1 50.59 Pre-Screening Form

9.2 50.59 Screening Form

9.3 50.59 Evaluation Form

9.4 Environmental Evaluation Form

50.59 REVIEW PRE-SCREENING

Facility: ______________________________ **Page** ___ **of** ___

I. SIGNATURES

Preparer: ____
Signature / Name (print) / Date

Reviewer: ____
Signature / Name (print) / Date

II. OVERVIEW

Document Evaluated: (Include document number, revision, and title)

____

Brief Description of the Proposed Change:

____

____

III. PRE-SCREENING

Check the applicable boxes below. If any of the boxes are checked, neither a Screening nor a 50.59 Evaluation is necessary. Provide supporting documentation or references as appropriate.

☐ The change is editorial as defined in either Section 5.3.4______ or 5.4.1.1______of this procedure. (Insert item # from Section 5.3.4 or 5.4.1.1). Provide document change request to the appropriate department, if required.

☐ The change is a substitute part per Section 5.4.1.2.

☐ The change will be controlled in its entirety under 10CFR50.54 instead of 10CFR50.59 per Section 5.4.1.3 of this procedure.

☐ An approved, valid Screening or 50.59 Evaluation covering all aspects of the change already exists per Section 5.4.1.4. Reference 50.59 Evaluation # ____________ or attach documentation. Verify the previous Screening or 50.59 Evaluation remains valid.

☐ The proposed change, in its entirety, has been approved by the NRC per Section 5.4.1.5. Reference: ____________________

☐ The change is being made to conform to the SAR per Sections 5.4.1.6.

BASIS: (Discuss how the activity meets the Pre-Screening criteria.)

____

____

____

50.59 SCREENING

Facility: ______________________ **Page** ___ **of** ___

I. SIGNATURES

Preparer: ______________________________
Signature / Name (print) / Date

Reviewer: ______________________________
Signature / Name (print) / Date

II. OVERVIEW

Document Evaluated: (Include document number, revision, and title)

____

Brief Description of the Proposed Change:

____

____

III. 50.59 SCREENING

TECHNICAL SPECIFICATION SCREENING

Does the proposed Change represent a change to:

Operating License	☐ Yes ☐ No	If yes, process a change per 10CFR50.90 and obtain NRC approval prior to implementing the Change.
Technical Specifications	☐ Yes ☐ No	If yes, process a change per 10CFR50.90 and obtain NRC approval prior to implementing the Change.
NRC Orders (ANO only)	☐ Yes ☐ No ☐ N/A	If yes, process a change per 10CFR50.90 and obtain NRC approval prior to implementing the Change.

SAR SCREENING

Does the proposed Change represent a change to the facility or procedure which alters information, operation, function or ability to perform the function of a system, structure or component described in the SAR (site-specific documents)**?**

TS Bases section	☐ Yes ☐ No	If yes, perform a 50.59 Evaluation.
SAR (including pending changes)	☐ Yes ☐ No	If yes, perform a 50.59 Evaluation.
TRM	☐ Yes ☐ No	If yes, perform a 50.59 Evaluation.

Core Operating Limits Report	☐ Yes ☐ No	If yes, perform a 50.59 Evaluation.
Fire Hazards Analysis (Included in RBS' USAR)	☐ Yes ☐ No ☐ N/A	If yes, perform a 50.59 Evaluation.
NRC SERs	☐ Yes ☐ No	If yes, perform a 50.59 Evaluation. (See Section 5.1.19.)
Does the proposed Change involve a test or experiment not described in the SAR?	☐ Yes ☐ No	If yes, perform a 50.59 Evaluation.
Does the proposed Change result in any potential impact to equipment or facilities utilized for Ventilated Storage Cask activities? (ANO only)	☐ Yes ☐ No ☐ N/A	If yes, perform a 72.48 Review.

ADDITIONAL SCREENING

Does the proposed Change represent a change to:

Quality Assurance Program Manual	☐ Yes ☐ No	If yes, notify the quality department and ensure a 50.54 Evaluation is performed.
Emergency Plan	☐ Yes ☐ No	If yes, notify the emergency planning department and ensure a 50.54 Evaluation is performed.

BASIS: [A brief written response providing the basis for answering the questions must be provided. Adequate basis must be provided within the Screening such that a third-party reviewer can reach the same conclusions. Simply stating that the change does not affect TS or the SAR is not an acceptable basis. Also discuss the methodology for performing the LBD search. State the location of relevant licensing document information and explain the scope of the review such as electronic search criteria used (e.g., key words) or the general extent of manual searches per Section 5.1.18.6.]

____

____

____

____

IV. ENVIRONMENTAL EVALUATION APPLICABILITY REVIEW

If any of the following questions is answered "YES", then an Environmental Evaluation must be performed.

Will the Change being evaluated:

Yes	No	
☐	☐	Disturb land that is beyond that initially disturbed during construction (i.e., new construction of buildings, creation or removal of ponds, or other terrestrial impact)?
☐	☐	Increase thermal discharges to the river, lake or atmosphere?
☐	☐	Increase concentration or quantity of chemicals discharged to the atmosphere, ground water, or surface water?
☐	☐	Increase quantity of chemicals to cooling lake or atmosphere through discharge canal or tower?
☐	☐	Modify the design or operation of cooling tower that will change flow characteristics?
☐	☐	Install any new transmission lines leading offsite?
☐	☐	Change the design or operation of the intake or discharge structures?
☐	☐	Discharges any chemicals new or different from that previously discharged?
☐	☐	Potentially cause a spill or unevaluated discharge that may effect neighboring soils, surface water or ground water?
☐	☐	Involve burying or placement of any solid wastes in the site area that may effect runoff, surface water or ground water?
☐	☐	Involve incineration or disposal of any potentially hazardous materials on the site?
☐	☐	Result in a change to non-radiological effluents or licensed reactor power level?
☐	☐	Potentially change the type or increase the amount of non-radiological air emissions from the site?

50.59 EVALUATION

Facility: ______________________ **Page** ___ **of** ___

Evaluation #: ______________

I. SIGNATURES

Preparer: ______________________________
Signature / Name (print) / Date

Reviewer: ______________________________
Signature / Name (print) / Date

(PSRC): ______________________________
Chairman's Signature / Name (print) / Date (May be documented on separate form.)

List of Assisting/Contributing Personnel:

Name:	**Scope of Assistance:**

II. OVERVIEW

A. Reference Data

Document Evaluated: ______________________________

System designator(s): ______________________________

References: ______________________________

AFFECTS LBD?	YES	NO	N/A	CHANGE # and/or SECTIONS TO BE REVISED
UFSAR	☐	☐		
TS (includes OL and NRC Orders)	☐	☐		
TS Bases	☐	☐		
TRM	☐	☐		
COLR	☐	☐		
FHA	☐	☐	☐	
SER	☐	☐		If "YES", see Section 5.1.19.
ODCM (GGNS only)	☐	☐	☐	
PCP (GGNS only)	☐	☐	☐	
QAP	☐	☐		
Emergency Plan	☐	☐		

Is the validity of this Evaluation dependent on any non-LBD changes other than the change being evaluated? ☐ Yes ☐ No

If "Yes", list the required changes.

B. **Executive Summary** (Serves as input to NRC summary report; send an electronic copy to NS&RA after PSRC approval, if available)

Brief description of change, test, or experiment

Reason for change, test, or experiment

50.59 Evaluation summary and conclusions

III. UNREVIEWED SAFETY QUESTION DETERMINATION

Does the proposed change:

1. Increase the probability of occurrence of an accident previously evaluated in the SAR? ☐ Yes ☐ No

   BASIS:

2. Increase the consequences of an accident previously evaluated in the SAR? ☐ Yes ☐ No

   BASIS:

3. Increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the SAR? ☐ Yes ☐ No

   BASIS:

4. Increase the consequences of a malfunction of equipment important to safety previously evaluated in the SAR?
   - ☐ Yes
   - ☐ No

   BASIS:

5. Create the possibility of an accident of a different type than any previously evaluated in the SAR?
   - ☐ Yes
   - ☐ No

   BASIS:

6. Create the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the SAR?
   - ☐ Yes
   - ☐ No

   BASIS:

7. Reduce the margin of safety as defined in the basis for any Technical Specification?
   - ☐ Yes
   - ☐ No

   BASIS:

IV. ENVIRONMENTAL EVALUATION APPLICABILITY REVIEW

IF ANY OF THE FOLLOWING QUESTIONS IS ANSWERED "YES", AN ENVIRONMENTAL EVALUATION MUST BE PERFORMED.

Will the Change being evaluated:

Yes	No	
☐	☐	Disturb land that is beyond that initially disturbed during construction (i.e., new construction of buildings, creation or removal of ponds, or other terrestrial impact)?
☐	☐	Increase thermal discharges to the river, lake or atmosphere?
☐	☐	Increase concentration or quantity of chemicals discharged to the atmosphere, ground water, or surface water?
☐	☐	Increase quantity of chemicals to cooling lake or atmosphere through discharge canal or tower?
☐	☐	Modify the design or operation of cooling tower that will change flow characteristics?
☐	☐	Install any new transmission lines leading offsite?
☐	☐	Change the design or operation of the intake or discharge structures?
☐	☐	Discharges any chemicals new or different from that previously discharged?
☐	☐	Potentially cause a spill or unevaluated discharge that may effect neighboring soils, surface water or ground water?
☐	☐	Involve burying or placement of any solid wastes in the site area that may effect runoff, surface water or ground water?
☐	☐	Involve incineration or disposal of any potentially hazardous materials on the site?
☐	☐	Result in a change to non-radiological effluents or licensed reactor power level?
☐	☐	Potentially change the type or increase the amount of non-radiological air emissions from the site?