# 1977 IMPINGEMENT PROGRAM ANALYSIS REPORT

## GINNA NUCLEAR POWER STATION



Data Collected and
Report Prepared by
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# 1977 IMPINGEMENT ANALYSIS REPORT

## GINNA NUCLEAR POWER STATION

### TABLE OF CONTENTS

1977 IMPINGEMENT ANALYSIS REPORT

GINNA NUCLEAR POWER STATION

## LIST OF TABLES

1977 IMPINGEMENT ANALYSIS REPORT

GINNA NUCLEAR POWER STATION

## LIST OF FIGURES

# 1977 IMPINGEMENT ANALYSIS REPORT, GINNA NUCLEAR POWER STATION

## I. INTRODUCTION

The primary aim of the 1977 Impingement Program was to determine the numbers and species of fish subjected to traveling screen (3/8" mesh) impingement at the Ginna Nuclear Power Station. This information was derived from the results of a sampling schedule designed to collect impingement data on a bi-weekly basis throughout the year. The results of this study provide a basis for assessing the impact of impingement on various fish species.

This report contains the analysis of all impingement data collected in 1977 and data are presented for the 26 species collected in 1977. While this report indicates the numbers of each species impinged, it does not indicate the percentage of total lake populations impinged. In order to assess impact other aspects of the biology of these fish must be used. Estimation of the percentage of a species or population impinged requires information on population levels within the lake. To date no satisfactory method of calculating total populations of any one species in the area or in the lake in general has been developed by anyone. Therefore, the only practical means of evaluating the impact of impingement is to examine the seasonal and long-term trends in the variation of numbers of fish impinged, and to determine the various behavior or environmentally related factors which may present impingement problems to fish populations. This is the method employed in this report.

Another purpose of this study was to record the seasonal variations in impingement and to attempt to assess the reason for these variations. There is a natural flux of fish populations manifested in response to various physiological demands and behavioral tendencies. These aspects of fish behavior have a tendency to significantly affect impingement rates at various times. For example, many fish overwinter in deep offshore water or in bays, rivers, or streams off the lake. They are, therefore, relatively far removed from the area near the intake structure, which is located in about 30 feet of water. However, many of these species utilize inshore water during the spring and summer for spawning and/or feeding and may be impinged at increased rates while migrating to these areas during the spring. This is commonly the situation encountered for schooling species such as the alewife, smelt, and particular game fishes. A similar situation may occur during the fall as fish move back into deep water.

Other behavioral and environmental aspects which generally have short-term effects on impingement rates are depth preferences, the volume of water flow into the intake, and the reaction of fish to the intake structure. Echo-soundings conducted near the intake and observed increases in rates of impingement indicate that some fish may use the intake structure as a shelter during periods of heavy wave activity or when stronger currents are moving past the intake (RGE, 1980). This behavior may increase impingement rates depending upon the season of the year. Diurnal trends and temperature changes are also commonly encountered variables which may significantly influence impingement. It has been

generally found that many species are impinged in greater numbers during the early to middle part of the night. It is interesting to note, however, that the results of coordinated impingement and echo-sounding studies indicate that larger percentages of the number of fish present in the immediate area of the intake are impinged during daylight hours (RGE, 1980).

In general, then, the aim of this impingement study was to examine the overall short- and long-term effects of impingement in relation to the number of fish impinged. This study does not, however, indicate the percentage of lake populations impinged. Short-term effects were determined from abundance patterns examined in relation to seasonal and environmental variations. Long-term effects were determined from observed abundances of impinged fish as indicated by sampling conducted during the years of 1973-1977.

The conclusions derived from this impingement study are of necessity confined primarily to the assessment of the observed variation in the numbers of fish impinged as related to changes in behavioral patterns and environmental conditions. While inconclusive, the long-term results of this study indicate that impingement does not adversely affect the stability of lake populations of fish.

The results and conclusions indicated by this impingement study can be summarized as follows:

1) A total of 146,956 fish from 40 species representing 16 families was projected to have been impinged in 1977.

Alewives and smelt were by far the most frequently impinged species, accounting for approximately 80% of the combined annual projection. Approximately 99% of the combined annual projection was represented by 10 fish species.

2) Throughout the year peak periods of impingement occurred during the spring and fall. Onshore-offshore movements of fish appear to be the major factors responsible for the observed peaks. The spring peak was the result of shoreward spawning runs of alewives and smelt. Shoreward movements of smelt appear to have been responsible for the fall peak.

3) The age-classes of species impinged were generally difficult to assess. For the most part, adult sizes were impinged. The alewife was the only species that exhibited distinct age-class trends in impingement. Adult alewives were impinged from February to July while juveniles predominated from August to December.

4) Diel behavioral patterns appear to have a definite effect on impingement rates. The majority of species collected were impinged in greatest numbers at night between the hours of 10 PM - 6 AM. Echo-soundings near the intake, however, indicate that greater percentages of fish in the area at any one time may be impinged during the day (RGE, 1980).

5) Investigations into the relationships between environmental factors and impingement rates suggested a possible influence due to wave height. In many cases, in 1977, correlation analyses indicated that impingement abundances were increased

during periods characterized by increased wave activity. In general, water temperature, wind speed, wind direction, and cloud cover did not have discernable influences on impingement rates.

6) Impingement levels for 1977 were the lowest recorded since studies began in 1973. This situation was the result of reduced abundances of the numerically dominant alewife, smelt, and stickleback. In general, it appears that the lower numbers of fish impinged may be due to increased predator pressure exerted by salmonids and to intake flow levels utilized in 1977. It also appears that the annual impingement variations noted for many species may simply reflect natural fluctuations of population abundances.

## II. METHODS

Data were collected during 120 24-hour studies conducted during 1977. The sampling schedule was designed so that impingement data would be collected at approximately equal intervals throughout the year. A study by Murarka and Sharma (unpublished, 1974) indicated that 120 studies are sufficient to predict actual impingement to a 95% level of confidence within a 15% margin of error.

Impinged fish were collected at four-hour intervals during each 24-hour study. The resulting six time periods sampled pertain to the daily time intervals of 2-6 PM, 6-10 PM, 10 PM-2 AM, 2 AM-6 AM, 6 AM-10 AM, and 10 AM-2 PM. From each period the numbers and species of fish impinged and the average length and weight of each species were recorded. The average daily environmental conditions, such as wind speed, wave height, water temperature, wind direction, and cloud cover were also measured and recorded. This detailed information regarding impingement collections and associated factors are presented in RGE, 1979c.

The impingement projections provided in this report were calculated by summing the actual numbers observed to be impinged on the 120 sampling days and by using a weighted average calculated for each unsampled day. The weighted averages used for unsampled days were calculated by averaging the number of fish impinged during the sampling day before and after an unsampled interval. This average value was then used to indicate the number of fish impinged on each unsampled day. For example, if sampling conducted on January 1 and January 5 produced 10 and 20 fish

respectively, then the weighted average used for each of the unsampled dates (January 2-4) would be 15 fish. Impingement projections were generated after all the necessary weighted averages were calculated. The general expression used to calculate annual and monthly projections was:

$$\sum_{i=1}^{n} \left[ N_i + \left( \frac{N_i + N_{i+1}}{2} \right) \Delta t \right] + N_n$$

where: T = annual or monthly projection

n = number of days for which projection is being calculated

$N_i$ = number of fish impinged on a given sample day

t = number of unsampled days between $N_i$ and $N_{i+1}$

$N_n$ = number of fish impinged on the last study of the projection period.

Biomass projections are presented in this report in relation to the number of kilograms impinged. These projections were generated by multiplying the average weight of an impinged species by the number of fish impinged, then summing these values over the year. A weighted average for unsampled days was calculated for average weight impinged. This was done in the same manner as described above.

The diel trends presented in this report were indicated by the results of computerized polynomial regressions carried out in relation to the six four-hour time periods sampled each day over the year. This process basically involved summing the number of fish impinged during each particular time period. The numbers from each time period were then compared in relation

to all time periods to determine if diel trends in impingement existed. Diel regression plots generated are provided for all dominant species impinged during 1977.

The average length and weight of an impinged species was calculated on a monthly basis. These values were then compared to seasonal abundance patterns to determine if isolated segments or year-classes of a population were subjected to impingement.

Correlation coefficients were calculated to determine if relationships existed between the observed numbers of fish impinged and various environmental factors. This method basically involved comparing levels of environmental factors (temperature, wind speed, etc.) recorded during the year with the respective numbers of fish impinged. The results of correlation analysis provide an indication of the linear relationship between impingement and the environmental variable under consideration.

## III. RESULTS AND DISCUSSION

### A. 1977 Impingement Overview

A total of 146,956 fish from 40 species representing 16 families was projected to have been impinged during 1977. A taxonomic breakdown including the orders, families, and species of fish collected is contained in Table 1. The species composition and projected numbers of fish impinged during 1977 are presented below in decreasing order of magnitude. The first 10 species listed accounted for 98.99% of the entire impingement projection.

| SPECIES | ESTIMATED* # FOR 1977 | % OF ESTIMATED TOTAL FOR SPECIES LISTED |
|---|---|---|
| Alewife (*Alosa pseudoharengus*) | 71,856 | 48.89 |
| Smelt (*Osmerus mordax*) | 45,852 | 31.20 |
| Threespine Stickleback (*Gasterosteus aculeatus*) | 6,416 | 4.36 |
| Mottled Sculpin (*Cottus bairdi*) | 5,003 | 3.40 |
| Spottail Shiner (*Notropis hudsonius*) | 4,801 | 3.27 |
| White Perch (*Morone americana*) | 4,719 | 3.21 |
| Lake Chub (*Couesius plumbeus*) | 2,867 | 1.95 |
| Gizzard Shad (*Dorosoma cepedianum*) | 1,461 | 0.99 |
| Emerald Shiner (*Notropis atherinoides*) | 1,308 | 0.89 |
| White Bass (*Morone chrysops*) | 1,223 | 0.83 |
| Rock Bass (*Ambloplites rupestris*) | 315 | 0.21 |
| Yellow Perch (*Perca flavescens*) | 212 | 0.14 |
| Trout-perch (*Percopsis omiscomaycus*) | 192 | 0.13 |
| Johnny Darter (*Etheostoma nigrum*) | 158 | 0.11 |
| Lake Trout (*Salvelinus namaycush*) | 150 | 0.10 |
| White Sucker (*Catostomus commersoni*) | 112 | 0.08 |
| Pumpkinseed (*Lepomis gibbosus*) | 49 | 0.03 |
| Smallmouth Bass (*Micropterus dolomieui*) | 48 | 0.03 |
| Bluegill (*Lepomis macrochirus*) | 44 | 0.03 |
| Brown Bullhead (*Ictalurus nebulosus*) | 22 | 0.01 |
| Black Crappie (*Pomoxis nigromaculatus*) | 21 | 0.01 |
| Channel Catfish (*Ictalurus punctatus*) | 15 | 0.01 |
| Fantail Darter (*Etheostoma flabellare*) | 11 | <0.01 |
| Goldfish (*Carassius auratus*) | 11 | <0.01 |
| Central Mudminnow (*Umbra limi*) | 11 | <0.01 |

* Estimated using weighted average (See Section II. Methodology)

| SPECIES | ESTIMATED # FOR 1977 | % OF ESTIMATED TOTAL FOR SPECIES LISTED |
|---|---|---|
| Brown Trout (Salmo trutta) | 10 | <0.01 |
| Largemouth Bass (Micropterus salmoides) | 8 | <0.01 |
| Carp (Cyprinus carpio) | 8 | <0.01 |
| Longnose Dace (Rhinichthys cataractae) | 7 | <0.01 |
| Freshwater Drum (Aplodinotus grunniens) | 7 | <0.01 |
| Redhorse Sucker (Moxostoma sp.) | 7 | <0.01 |
| Slimy Sculpin (Cottus cognatus) | 6 | <0.01 |
| Walleye (Stizostedion vitreum vitreum) | 4 | <0.01 |
| Brook Stickleback (Culaea inconstans) | 4 | <0.01 |
| Longnose Gar (Lepisosteus osseus) | 4 | <0.01 |
| Cisco (Coregonus artedii) | 4 | <0.01 |
| American Eel (Anguilla rostrata) | 3 | <0.01 |
| Chinook Salmon (Oncorhynchus tshawytscha) | 3 | <0.01 |
| Bluntnose Minnow (Pimephales notatus) | 1 | <0.01 |
| Spotfin Shiner (Notropis spilopterus) | 1 | <0.01 |
| TOTAL | 146,956* | |

* Estimated using weighted average (See Section II. METHODOLOGY).

Impingement abundances, as indicated by sampling conducted during 1977, exhibited rather rapid and extreme fluctuations throughout much of the year (Figure 1 and Table 2). Although this situation occurred commonly, a number of trends in abundance could be discerned. During January, February, and March impingement abundances were relatively stable with the exception of a number of isolated peaks and valleys. Following an early April peak, however, a distinct reduction in impingement was noted. It appears that the low number of fish impinged during mid and late April may have been related to reduced population abundances near the intake. An echo-sounding study in April indicated that, in general, few fish were present in the area (RGE, 1980).

Following the April reduction, a peak period of impingement occurred. Extending from early May through late June, this peak was by far the greatest experienced during 1977 in relation to both numerical abundance and duration. Impingement projections from May and June represented 50% of the total 1977 projection. As would be expected, this peak corresponds with the seasonal occurrence of alewives. It is of interest that during the May peak considerably reduced intake water levels were being utilized at Ginna (Figure 1).

In July impingement abundances fluctuated erratically until late in the month when a steady decline was noted. Low impingement levels continued through mid-August. It is likely that temperature preference is a major factor affecting impingement during this period. Graham (1956) indicated that the alewife, which was the dominant fish impinged prior to this period, is found in inshore regions during the summer. Another possible explanation is that spawning runs, which bring many fish into contact with water intakes, are by this time completed and the spawners have returned to deeper water away from the influence of the intake. Wells (1968) reported that smelt, after spawning inshore during spring, return to deeper and colder offshore waters where they remain for the summer. Following this summer period, the number of fish impinged increased steadily until a second major peak was experienced during October. This peak was likely related to declining lake temperatures and the concomitant offshore or onshore movements of various species in search of their temperature preferenda. The October peak may also reflect an

avoidance response by fish to more turbulent nearshore areas in the fall. Impingement abundances during November and December were similar to those encountered during the period of January through March.

Biomass estimates generated from 1977 sampling are almost directly proportional to impingement abundances (Figures 1 and 2). The impingement of adults of the alewife and smelt are the major factors responsible for this relation. Although young-of-the-year fish were impinged during various periods, they were at no time during 1977 the dominant form impinged. The total biomass projected for 1977 was 2,081.71 kg (4,589.38 lb) of fish. Figure 2 shows the seasonal distribution of biomass impinged, with the bulk being impinged during the months of May and October, reflecting spring runs of alewives and smelt and fall runs of smelt.

B. Species Composition

1. Alewife (*Alosa pseudoharengus*) (Table 3)

There were 25,299 alewives collected over the 120 study periods, which produced a projected impingement level for 1977 of 71,856. This figure represented 49% of the combined 1977 impingement projection. Alewife impingement during the year was characterized by two peaks in abundance (Figure 3). The initial peak occurred in May with impingement levels also being high early in April and during June. Thc three-month period accounted for 95% of the total 1977 alewife projection. This peak reflects the movement of alewives past the water intakes during spring spawning runs. It is interesting that the

May abundance peak occurred at a time when "plant" operations were utilizing considerably reduced water levels (Figure 1). It is conceivable that greater numbers of alewives could have been impinged if normal intake flow levels were experienced. The second peak occurred during October but accounted for only 3% of the 1977 alewife projection, and may indicate an off-shore movement of juvenile alewives in response to declining water temperatures in inshore areas.

It was found that the two peaks described above were created by alewives of two distinctly different size classes (Figure 3). The average length and weight of alewives during the spring peak were approximately 15 cm and 20 gms, respectively. These values correspond closely with the average adult size of alewives in Lake Ontario reported by Graham (1956). However, beginning in August and continuing through December considerably smaller (size) alewives were impinged. The average length and weight of alewives impinged during this period were approximately 6.5 cm and 3 gms, respectively. Smith (1907) indicated that by fall the lengths of young-of-the-year alewives range from 5.1-7.5 cm. Generally, then, it is apparent that adult alewives were subjected to impingement from February through July, while young-of-the-year alewives were the major form impinged during the remainder of the year. It is also apparent that adults are impinged in considerably greater quantities than the young-of-the-year.

Alewife impingement was characterized by diel trends during all months studied in 1977. Figures 3a-11 provide annual and

various monthly regression plots of impingement in relation to the various time periods studied. From these plots it can be seen that impingement abundances generally peaked during the nighttime periods of 10 PM-2 AM and 2 AM-6 AM. Impingement decreased somewhat during the intermediate 6 PM-10 PM and 6 AM-10 AM periods, while considerably fewer fish were impinged during the strictly daytime study periods (2-6 PM and 10 AM-2 PM).

With respect to the influence of environmental factors, the number of alewives impinged was significantly correlated with wave height. For all periods examined, correlation analyses indicated greater numbers of fish were impinged during periods of increased wave activity (Table 4). Alewife impingement rates did not appear to be influenced by any other environmental factor (Table 4).

2. <u>Rainbow Smelt</u> (<u>Osmerus mordax</u>) (Table 5)

Smelt, the second most commonly collected species, were projected to have 45,852 impinged during 1977. This projection comprised 31% of the total combined annual projection. Smelt were impinged most frequently during the fall, winter, and spring, while considerably fewer numbers were impinged throughout the summer (Figure 12). This finding is expected if impingement is compared to water temperatures near the intake. The reported preferred temperatures of smelt are at or below 59°F (17°C) (Van Oosten, 1953). These temperatures were generally encountered near the intake during periods of greatest impingement. However, during the summer and par-

ticularly during July and August intake temperatures averaged 10-15°F (5.5-8.9°C) above that preferred by smelt (refer to Table 6 for average intake temperatures in 1977). The low numbers impinged during this period indicate that smelt actively avoid the intake area during the summer. The comparatively low numbers of smelt captured in gill nets during the summer near Ginna lends support to the contention that few individuals were in the area at this time (RGE, 1979a).

Peak impingement during October may reflect the combined effect of increased abundances in the area of the intake due to reduced water temperatures and the recruitment of young fish to the local populations. A similar increase of smelt abundances was also observed in gill nets set near Ginna in October (RGE, 1979a).

The size range of smelt during 1977 was quite variable, but several trends were evident (Figure 12). Smaller fish were generally impinged during January and February and again during the summer. The sizes of fish impinged during these periods were similar to those reported for young-of-the-year and one-year-old fish (MacKay, 1958; Scott and Crossman, 1973). The observed sizes of fish impinged at other times of the year indicate that during these periods a variety of year-classes was impinged.

Diel investigations of smelt impingement indicate that this species is most susceptible to impingement at night. Considerably fewer smelt were impinged during daylight hours.

Figure 13 provides the results of time-related regression analysis for smelt impingement.

As discussed above, smelt impingement abundances appeared to be influenced by water temperature, but correlation analysis indicated a significant relationship only during the fall (Table 4). In addition, wave height and, to some extent, wind direction were also indicated to be influencing factors (Table 4).

3. Threespine Stickleback (Gasterosteus aculeatus) (Table 7)

Throughout the 120 studies in 1977, 2,539 sticklebacks were collected, producing a projected impingement level of 6,415 fish. This value represented approximately 4% of the combined 1977 projection. Impingement abundances of sticklebacks were greatest during the spring and early summer (Figure 14). Impingement projections for the four-month period of April through July accounted for 75% of the annual stickleback projection. Stickleback impingement during the remainder of the year was characterized by erratic abundances at generally very reduced levels.

The average length of sticklebacks impinged was fairly constant during 1977 (Figure 14). With the exception of September, the average length of sticklebacks collected was approximately 6 cm. This value corresponds closely with adult sizes reported by Scott and Crossman (1973).

Sticklebacks were impinged at considerably greater frequencies during nighttime hours in 1977. The extent of this tendency is indicated by the shape of the regression plot

provided in Figure 15.

Similar to alewives and smelt, stickleback abundances appeared to be influenced by wave height (Table 4). In addition, correlation analysis indicated possible relationships with wind speed and cloud cover (Table 4).

4. Mottled Sculpin (*Cottus bairdi*) (Table 8)

Annual projections indicated that 5,003 sculpins were impinged during 1977. Sculpins represented approximately 3% of the combined annual projection. These fish were generally impinged in greatest numbers during late fall and winter with impingement also being high during May in 1977 (Figure 15a).

The average length of impinged sculpins was fairly consistent throughout the year (Figure 16). Average lengths of approximately 6.5 cm indicate that adults were the predominant form impinged.

In 1977, sculpins were generally impinged in greater numbers at night (Figure 15a). Also, in relation to environmental factors, correlation analysis indicated that impingement rates were influenced by water temperatures (Table 4). It appears that, in general, greater numbers of sculpins were impinged during periods characterized by low water temperatures. This finding was likely related to the seasonal occurrence of this species.

5. Spottail Shiner (*Notropis hudsonius*) (Table 9)

There were 4,801 spottails projected to be impinged during 1977. With the exception of October, relatively low levels were impinged throughout the year (Figure 17).

October projections accounted for 50% of the annual spottail projection.

The size of impinged spottails varied during 1977, but during most months the average length was approximately 10 cm (Figure 17). If age-length relationships in Lake Ontario are similar to those in Red Lake, Minnesota, as reported by Smith and Kramer (1964), the majority of spottails impinged would be approximately three years old.

Diel investigations of spottail impingement indicate that these fish are impinged most frequently at night. Figure 18 provides the results of time-related regression analysis for spottail impingement.

Correlation analysis indicated that in 1977 spottail shiner impingement rates were significantly influenced by wave height (Table 4). The results of this analysis suggested that greater numbers were impinged during periods of increased wave activity.

6. White Perch (*Morone americana*) (Table 10)

The projected number of white perch impinged during 1977 was 4,719 individuals. This number represented approximately 3% of the total annual projection for all species. These fish were impinged most frequently during the three-month period of October-December. This period accounted for 96% of the annual projection. October projections alone comprised 80% of the annual projection.

Diel investigations indicated that the majority of white perch were impinged at night. Figure 19 provides an illustration of the results of time-related regression analysis.

Correlation analysis indicated no significant relationships between the number of white perch impinged and various environmental factors (Table 4).

7. Lake Chub (*Couesius plumbeus*) (Table 11)

A total of 2,867 lake chub were projected to be impinged during 1977. Lake chub projections comprised approximately 2% of the combined annual projection. These fish were impinged in greatest numbers during the spring and fall.

Diel investigations indicate that comparable numbers of lake chub are impinged throughout both day and night. Regression analysis indicates that impingement rates may be only slightly higher at night (Figure 20).

With regard to the influence of environmental factors, lake chub impingement rates appeared to be significantly affected by wind speed and wave height (Table 4). The results of correlation analysis indicated greater numbers were impinged during periods of increased wind speed and wave height.

8. Gizzard Shad (*Dorosoma cepedianum*) (Table 12)

There were 1,461 gizzard shad projected to be impinged during 1977. This number accounted for approximately 1% of the annual projection. The greatest numbers of gizzard shad were impinged during the three-month period of October-December. Projections from this period comprised 93% of

the annual gizzard shad projection.

Investigations into the influence of environmental factors on impingement rates suggested no significant relationships for gizzard shad (Table 4).

9. Emerald Shiner (Notropis atherinoides) (Table 13)

Projections indicated that 1,307 emerald shiners were impinged during 1977. December projections were considerably greater than during any other month. The 799 fish projected for December accounted for 61% of the annual emerald shiner projection.

Diel investigations carried out on emerald shiners indicate that greater numbers were impinged at night. Figure 21 illustrates the results of time-related regression analysis.

Emerald shiner impingement rates did not appear to be significantly influenced by environmental factors (Table 4).

10. White Bass (Morone chrysops) (Table 14)

A total of 1,223 white bass were projected to be impinged during 1977. December projections represented approximately 78% of the annual projection. White bass were relatively unaffected by intake operation throughout the spring and summer.

Correlation analysis did not indicate any significant relationships between the number of white bass impinged and environmental factors (Table 4).

11. Yellow Perch (Perca flavescens) (Table 15)

An impingement projection of 212 yellow perch resulted from 74 fish collected during 1977. Impingement of this species was very erratic but generally highest during

the fall. Projections from the period of October-November represented approximately 71% of the annual projection for perch.

Impingement rates for yellow perch did not appear to be influenced by environmental factors (Table 4).

12. Johnny Darter (*Etheostoma nigrum*) (Table 16)

There were 158 johnny darters projected to be impinged during 1977. Impingement abundances were generally erratic but somewhat higher in the late spring and early fall.

13. Salmonids (*Salvelinus namaycush*, *Salmo trutta*, *Oncorhynchus tshawytscha*) (Tables 17,18,19)

A total of 163 salmonids were projected to be impinged in 1977. This estimation represents the combined projections for lake trout, brown trout, and chinook salmon. Projections for lake trout comprised 92% of the annual projection for salmonids. Impingement rates were generally highest in the winter and spring when these fish (particularly lake trout) become active near shore. These fish are present in much deeper water at other times during the year.

The average length of lake trout impinged in 1977 was 13.2 cm. This size corresponds well with juvenile sizes (probably 1 or 2 years old) reported by Scott and Crossman (1973).

Correlation analysis indicated that lake trout impingement rates were significantly influenced by wave height (Table 4). Greater numbers were generally impinged during periods of increased wave activity.

14. Smallmouth Bass (Micropterus dolomieui) (Table 20)

A total of 48 smallmouth bass were projected to be impinged in 1977. Although the number of smallmouth bass collected was always very small, these fish were impinged during all seasonal periods except spring.

15. Brown Bullhead (Ictalurus nebulosus) (Table 21)

Twenty-two brown bullhead were projected to be impinged in 1977. These fish were impinged erratically at very low levels throughout the year. Since these fish usually live close to the lake bottom, they are not as susceptible to impingement as some other species. They are, however, very common in the lake (RGE, 1978 and 1979b).

16. Rock Bass (Ambloplites rupestris) (Table 21)

In 1977, a total of 314 rock bass were projected to have been impinged. Seasonally, abundances were greatest during fall and winter and correlation analysis indicated that impingement rates were influenced by wind speed and wave height (Table 4). In general, greater numbers of rock bass were apparently impinged during periods characterized by increased wind speed and wave height.

17. Other Species (Tables 22-43)

In addition to the species discussed above, 22 other species were also collected in 1977. Projections, however, were generally low; the combined projection for all 22 species indicated impingement of only 526 individuals.

This number represented less than 0.4% of the annual projection for all species combined.

Although impingement projections were low, many of the species included in tables 22-43 are fairly abundant in the lake (RGE, 1978, 1979a, 1979b). Since, however, some of these species inhabit the shallower lake regions (sunfish, bluegills) or are strictly bottom dwelling fish (darters, dace) it is likely that various habitat preferences greatly reduce the vulnerability of some species to impingement.

C. Comparison of Impingement from 1973-1977

Impingement levels for 1977 were the lowest recorded at the Ginna Station since studies began in 1973. This situation is mainly related to a fairly steady decline of annual impingement projections for the numerically dominant alewife. Because of this decline, the alewife, which accounted for 92% of the total fish impinged in 1974, represented only 49% of the combined 1977 projection for all species. Table 45 provides a comparison of annual impingement projections generated for the period of 1973-1977 for the ten most frequently impinged species. An analysis of the long-term impingement abundance trends exhibited by various species follows below.

1. Alewife

Overall, impingement sampling has indicated that alewife population abundances have decreased over the years sampled (Figure 22). Alewife projections for 1977 represent

only 4% of the number of alewives estimated to have been impinged in 1974. While the reasons for the observed decline are unclear, it appears that predation by salmonids may in part be responsible. The approximate numbers of salmonids planted in New York waters of Lake Ontario during the years 1971 to 1977 are provided in Figure 23. If it is assumed that salmonids, which are stocked at the age of one year or less, do not become significant predators until approximately two years after being released in the lake, an interesting relation appears to exist. With the exception of alewife projections for 1976, it appears that the numbers of alewives impinged during the years 1973 to 1977 have varied inversely with the numbers of salmonids stocked from 1971 to 1975 (Figures 22 and 23). This relation indicates that during most years, as the numbers of salmonids stocked have increased, the numbers of alewives impinged have decreased accordingly.

It should be mentioned that the comparative lower numbers of alewives impinged in 1977 may be misleading. As noted previously, peak abundances of alewives were impinged in 1977 during a period characterized by reduced water intake flows. It is conceivable, therefore, that larger numbers of this species could have been impinged if normal intake flows had been experienced. Also, a large number of alewife larvae were collected in entrainment samples in 1977. The large number of larvae encountered may be an indication of a strong 1977 year-class of alewives.

2. Smelt

Smelt impingement levels have declined at a fairly steady rate over the years studied (Figure 24) and may, as for alewives, reflect reduced population abundances due to salmonid predation. The reduction of 1977 impingement levels also may reflect a relation to water intake flows. Smelt generally move inshore from deeper waters to spawn during the same period that was characterized by reduced water intake levels during 1977. It is conceivable that greater numbers of smelt could have been impinged if normal intake flows were experienced.

3. Threespine Stickleback

The projected impingement of 6,415 sticklebacks in 1977 represents only 4% of the numbers projected in 1976 (147,320 sticklebacks). However, projected 1977 levels are comparable to levels found in 1973 and 1974 (Figure 25). It is, therefore, felt that the observed variations may reflect normal population fluctuations.

4. Mottled Sculpin

Comparable numbers of mottled sculpins have been projected to be impinged during all years studied (Figure 26). This situation indicates that population abundances have remained fairly stable and that impingement has an insignificant impact on the stability of sculpin populations.

5. Spottail Shiner

Annual projections for spottail shiners declined steadily from 1973 through 1975, then increased slightly in 1976 (Figure 27). Comparable numbers to those projected for 1976 were projected to be impinged in 1977. It is possible that after an initial decline (1973-1975) population abundances in the area have become stabilized at a lower level. The period studied, however, may be too short to provide conclusive evidence.

6. Lake Chub

Impingement sampling has indicated the general reduction in lake chub abundances over the years studied (Figure 28). The greatest number of lake chubs were impinged during 1973. Impingement projections for 1974 and 1975 were at comparable reduced levels from 1973. Comparable reduced levels were again found in 1976 and 1977. Scott and Crossman (1973) indicated that lake chubs may be preyed upon in considerable numbers by lake trout. Recent stocking of lake trout may, therefore, be responsible in part for the observed reductions.

7. Gizzard Shad

Comparable numbers of gizzard shad have been projected to be impinged during all years studied. It appears, therefore, that impingement has little impact on the stability of gizzard shad abundance.

8. Emerald Shiner

Impingement projections from 1973-1977 have been characterized by an initial increase followed by a steady

decrease (Figure 29). Impingement projections for 1977 were comparable to those projected for 1973. This situation may reflect normal fluctuations of population abundances.

9. White Bass

Impingement projections for 1977 were comparable to those projected for 1973 and 1974 (Figure 30). The various impingement levels observed over the years studied appear to indicate normal population fluctuations.

10. Smallmouth Bass

With the exception of 1976, impingement projections for smallmouth bass have declined steadily over the years studied (Figure 31). However, since the annual numbers impinged have been small, impingement is not likely responsible for the observed decline.

11. Johnny Darter

Impingement of johnny darters increased steadily from 1973 through 1976 (Figure 32). Impingement projections for 1977 were down 78% from 1976 levels. Projections for 1977 were comparable to 1973 projections. This situation may indicate a cyclic pattern of population abundances for johnny darters.

12. Salmonids

Salmonids have always been impinged in low numbers (Figure 33). Brown trout first appeared in 1974 when three were projected and have been collected consistently since. Rainbow trout, although collected regularly in gill nets, have never been impinged. Brook trout were impinged only in 1975.

Lake trout first appeared in 1975 and have been impinged at somewhat greater frequencies since. Coho salmon were collected only in 1976 and chinook salmon first appeared in 1977. The increase in impingement rates from 1974-1976 was likely due to increased stocking rates.

13. White Perch

Impingement of white perch during the years studied was characterized by an initial decline followed by a steady increase (Figure 34). Numbers impinged in 1977 were comparable to 1973 projections. The observed abundance patterns of annual projections may indicate normal population fluctuations.

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Table 1
Taxonomic Breakdown of Fish Species Projected to be Impinged in 1977

Class Osteichthyes (Bony Fishes)
  Order Anguilliformes
    Family Anguillidae
      *Anguilla rostrata* (American Eel)

  Order Clupeiformes
    Family Clupeidae (Herrings)
      *Alosa pseudoharengus* (Alewife)
      *Dorosoma cepedianum* (Gizzard Shad)

  Order Salmoniformes
    Family Salmonidae (Trouts)
      *Salmo trutta* (Brown Trout)
      *Salvelinus namaycush* (Lake Trout)
      *Oncorhynchus tshawytscha* (Chinook Salmon)
      *Coregonus artedii* (Cisco)
    Family Osmeridae (Smelts)
      *Osmerus mordax* (Rainbow Smelt)
    Family Umbridae (Mudminnows)
      *Umbra limi* (Central Mudminnow)

  Order Cypriniformes
    Family Cyprinidae (Minnows and Carps)
      *Couesuis plumbeus* (Lake Chub)
      *Notropis atherinoides* (Emerald Shiner)
      *Notropis hudsonius* (Spottail Shiner)
      *Rhinichthys cataractae* (Longnose Dace)
      *Cyprinus carpio* (Carp)
      *Carassius auratus* (Goldfish)
      *Notropis spilopterus* (Spotfin Shiner)
      *Pimephales notatus* (Bluntnose Minnow)
    Family Catostomidae (Suckers)
      *Catostomus commersoni* (White Sucker)
      *Moxostoma Sp.* (Redhorse Sucker)

  Order Siluriformes
    Family Ictaluridae (Catfishes)
      *Ictalurus nebulosus* (Brown Bullhead)
      *Ictalurus punctatus* (Channel Catfish)

  Order Percopsiformes
    Family Percopsidae (Trout-Perches)
      *Percopsis omiscomaycus* (Trout-Perch)

  Order Gasterosteiformes
    Family Gasterosteidae (Sticklebacks)
      *Gasterosteus aculeatus* (Threespine Stickleback)
      *Culaea inconstans* (Brook Stickleback)

  Order Perciformes
    Family Percichthyidae (Temperate Basses)
      *Morone americana* (White Perch)
      *Morone chrysops* (White Bass)

TABLE 1 (con't)
GINNA NUCLEAR POWER STATION
IMPINGEMENT SPECIES LIST

Family Centrarchidae (Sunfishes)
- Micropterus dolomieui (Smallmouth Bass)
- Micropterus salmoides (Largemouth Bass)
- Lepomis gibbosus (Pumpkinseed)
- Lepomis macrochirus (Bluegill)
- Ambloplites rupestris (Rock Bass)
- Pomoxis nigromaculatus (Black Crappie)

Family Percidae (Perches)
- Perca flavescens (Yellow Perch)
- Etheostoma nigrum (Johnny Darter)
- Etheostoma flabellare (Fantail Darter)
- Stizostedion vitreum vitreum (Walleye)

Family Cottidae (Sculpins)
- Cottus bairdi (Mottled Sculpin)
- Cottus cognatus (Slimy Sculpin)

Family Sciaenidae (Drums)
- Aplodinotus grunniens (Freshwater Drum)

Order Semionotiformes

Family Lepisosteidae (Gars)
- Lepisosteus osseus (Longnose Gar)

TABLE 2

IMPINGEMENT SUMMARY FOR TOTAL
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 1143.00 | 7235.50 | 15.80 |
| FEBRUARY | 921.00 | 3843.00 | 23.97 |
| MARCH | 972.00 | 3120.00 | 31.15 |
| APRIL | 2953.00 | 10771.50 | 27.41 |
| MAY | 23182.00 | 63218.50 | 36.67 |
| JUNE | 4002.00 | 9905.50 | 40.40 |
| JULY | 1184.00 | 3134.00 | 37.78 |
| AUGUST | 272.00 | 676.00 | 40.24 |
| SEPTEMBER | 835.00 | 3186.00 | 26.21 |
| OCTOBER | 11122.00 | 27889.00 | 39.88 |
| NOVEMBER | 803.00 | 3069.00 | 26.16 |
| DECEMBER | 3321.00 | 10919.00 | 30.41 |
| TOTAL | 50710.00 | 146967.00 | 34.50 |

TABLE 3

IMPINGEMENT SUMMARY FOR ALEWIFE
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 3.00 | 0.00 |
| FEBRUARY | 9.00 | 59.50 | 15.13 |
| MARCH | 130.00 | 395.00 | 32.91 |
| APRIL | 1859.00 | 6654.50 | 27.94 |
| MAY | 19858.00 | 55277.00 | 35.92 |
| JUNE | 2320.00 | 6038.00 | 38.42 |
| JULY | 70.00 | 256.00 | 27.34 |
| AUGUST | 20.00 | 54.00 | 37.04 |
| SEPTEMBER | 281.00 | 726.50 | 38.68 |
| OCTOBER | 728.00 | 2293.00 | 31.75 |
| NOVEMBER | 21.00 | 83.50 | 25.15 |
| DECEMBER | 3.00 | 16.00 | 18.75 |
| TOTAL | 25299.00 | 71856.00 | 35.21 |

Table 4
Correlation Coefficients for Comparisons of Impingement Rates with Environmental Factors During Seasonal Periods of Abundance.

| Species | Period Impinged | d.f. | Wind Speed | Wave Height | Water Temp. | Wind Direction | Cloud Cover |
|---|---|---|---|---|---|---|---|
| Alewife | Jan-Dec | 85 | 0.138 | 0.216* | -0.094 | -0.146 | 0.007 |
| | Apr-May | 17 | 0.376 | 0.522* | 0.119 | -0.286 | 0.061 |
| | Apr-June | 29 | 0.296 | 0.476** | -0.112 | -0.243 | 0.061 |
| Smelt | Jan-Dec | 112 | 0.145 | 0.230* | 0.013 | 0.128 | -0.004 |
| | Jan-June | 52 | 0.180 | 0.248 | -0.003 | 0.103 | 0.108 |
| | Mar-May | 29 | 0.354 | 0.479** | 0.300 | 0.141 | -0.001 |
| | Oct-Dec | 28 | 0.177 | 0.472** | 0.520** | 0.363* | -0.127 |
| Stickleback | Jan-Dec | 79 | 0.186 | 0.328* | 0.037 | -0.001 | -0.222* |
| | Apr-July | 39 | 0.360* | 0.548** | -0.113 | 0.033 | -0.197 |
| Mottled sculpin | Jan-Dec | 115 | 0.120 | 0.016 | -0.205* | 0.012 | 0.139 |
| Spottail shiner | Jan-Dec | 88 | 0.193 | 0.268* | 0.150 | 0.088 | -0.158 |
| Emerald shiner | Jan-Dec | 30 | 0.108 | 0.152 | -0.165 | 0.198 | -0.343 |
| Gizzard shad | Jan-Dec | 25 | 0.061 | 0.173 | -0.023 | 0.200 | -0.016 |
| Lake chub | Jan-Dec | 76 | 0.224* | 0.325** | 0.084 | 0.110 | -0.076 |
| White perch | Jan-Dec | 37 | 0.165 | 0.300 | 0.289 | 0.149 | -0.063 |
| White bass | Jan-Dec | 20 | 0.105 | 0.050 | -0.185 | 0.308 | 0.026 |
| Rock bass | Jan-Dec | 20 | 0.523* | 0.556** | -0.205 | 0.190 | 0.190 |
| Yellow perch | Jan-Dec | 20 | 0.216 | 0.340 | 0.416 | 0.138 | -0.279 |
| Lake trout | Jan-Dec | 13 | 0.477 | 0.582* | -0.171 | 0.263 | 0.255 |

* significant at 95% confidence level
** significant at 99% confidence level

TABLE 5

IMPINGEMENT SUMMARY FOR SMELT
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 836.00 | 5382.50 | 15.53 |
| FEBRUARY | 806.00 | 3318.00 | 24.29 |
| MARCH | 516.00 | 1646.50 | 31.34 |
| APRIL | 642.00 | 2428.00 | 26.44 |
| MAY | 1545.00 | 3983.50 | 38.78 |
| JUNE | 1211.00 | 2668.00 | 45.39 |
| JULY | 160.00 | 362.00 | 44.20 |
| AUGUST | 146.00 | 358.00 | 40.78 |
| SEPTEMBER | 366.00 | 1689.50 | 21.66 |
| OCTOBER | 6579.00 | 16372.00 | 40.18 |
| NOVEMBER | 404.00 | 1755.50 | 23.01 |
| DECEMBER | 1770.00 | 5888.50 | 30.06 |
| TOTAL | 14981.00 | 45852.00 | 32.67 |

Table 6 GINNA NUCLEAR POWER STATION CONDENSER COOLING AVERAGE INTAKE WATER TEMPERATURES FOR ECOLOGICAL STUDY DATES IN 1977

| | | | |
|---|---|---|---|
| January 3 | 34°F | March 1 | 33°F |
| January 4 | 35°F | March 2 | 33°F |
| January 5 | 35°F | March 3 | 35°F |
| January 10 | 34°F | March 7 | 35°F |
| January 11 | 34°F | March 8 | 35°F |
| January 19 | 34°F | March 9 | 36°F |
| January 20 | 34°F | March 14 | 36°F |
| January 24 | 37°F | March 15 | 37°F |
| January 25 | 37°F | March 16 | 38°F |
| January 26 | 35°F | March 17 | 39°F |
| February 1 | 34°F | March 21 | 35°F |
| February 2 | 35°F | March 22 | 37°F |
| February 7 | 34°F | March 23 | 37°F |
| February 8 | 33°F | March 28 | 38°F |
| February 9 | 33°F | March 29 | 37°F |
| February 14 | 35°F | March 30 | 38°F |
| February 15 | 34°F | March 31 | 40°F |
| February 16 | 34°F | April 4 | 39°F |
| February 22 | 35°F | April 5 | 38°F |
| February 23 | 35°F | April 6 | 39°F |
| February 24 | 35°F | April 11 | 41°F |
| February 28 | 35°F | April 12 | 38°F |

Table 6 (con't) GINNA NUCLEAR POWER STATION CONDENSER COOLING AVERAGE INTAKE WATER TEMPERATURES FOR ECOLOGICAL STUDY DATES IN 1977 (continued)

| | | |
|---|---|---|
| April 13 - 41°F | May 23 - 49°F | July 5 - 63°F |
| April 14 - 39°F | May 24 - 50°F | July 6 - 62°F |
| April 18 - 37°F | May 25 - 53°F | July 7 - 54°F |
| April 19 - 39°F | May 26 - 52°F | July 11 - 55°F |
| April 20 - 40°F | May 31 - 45°F | July 12 - 56°F |
| April 25 - 38°F | June 6 - 49°F | July 13 - 62°F |
| April 26 - 38°F | June 7 - 50°F | July 14 - 66°F |
| April 27 - 38°F | June 8 - 52°F | July 17 - 65°F |
| April 28 - 37°F | June 9 - 52°F | July 18 - 69°F |
| May 2 - 42°F | June 12 - 55°F | July 19 - 73°F |
| May 3 - 41°F | June 13 - 56°F | July 20 - 73°F |
| May 4 - 41°F | June 14 - 55°F | July 21 - 75°F |
| May 5 - 42°F | June 15 - 55°F | July 25 - 74°F |
| May 9 - 46°F | June 16 - 55°F | July 26 - 73°F |
| May 10 - 46°F | June 20 - 56°F | July 27 - 72°F |
| May 11 - 44°F | June 21 - 59°F | July 28 - 71°F |
| May 12 - 44°F | June 22 - 60°F | August 1 - 71°F |
| May 15 - 47°F | June 23 - 59°F | August 2 - 72°F |
| May 16 - 46°F | June 27 - 65°F | August 3 - 70°F |
| May 17 - 47°F | June 28 - 63°F | August 4 - 71°F |
| May 18 - 49°F | June 29 - 67°F | August 8 - 72°F |
| May 19 - 51°F | June 30 - 60°F | August 9 - 73°F |

Table 6 (con't) GINNA NUCLEAR POWER STATION CONDENSER COOLING AVERAGE INTAKE WATER TEMPERATURES FOR ECOLOGICAL STUDY DATES IN 1977 (continued)

| | |
|---|---|
| August 10 - 72°F | September 16 - 65°F |
| August 11 - 71°F | September 18 - 65°F |
| August 15 - 73°F | September 19 - 65°F |
| August 16 - 72°F | September 20 - 62°F |
| August 17 - 71°F | September 21 - 62°F |
| August 18 - 70°F | September 22 - 61°F |
| August 22 - 67°F | September 25 - 45°F |
| August 23 - 66°F | September 26 - 45°F |
| August 24 - 67°F | September 27 - 47°F |
| August 25 - 66°F | September 28 - 58°F |
| August 28 - 68°F | September 29 - 60°F |
| August 29 - 69°F | October 3 - 60°F |
| August 30 - 70°F | October 4 - 59°F |
| August 31 - 69°F | October 5 - 59°F |
| September 1 - 68°F | October 6 - 59°F |
| September 6 - 71°F | October 11 - 55°F |
| September 7 - 71°F | October 12 - 54°F |
| September 8 - 65°F | October 13 - 54°F |
| September 12 - 66°F | October 17 - 53°F |
| September 13 - 65°F | October 18 - 53°F |
| September 14 - 65°F | October 19 - 54°F |
| September 15 - 65°F | October 20 - 55°F |

Table 6 (con't) GINNA NUCLEAR POWER STATION CONDENSER COOLING AVERAGE INTAKE WATER TEMPERATURES FOR ECOLOGICAL STUDY DATES IN 1977 (continued)

| | |
|---|---|
| October 23 - 54°F | November 29 - 45°F |
| October 24 - 54°F | November 30 - 45°F |
| October 25 - 54°F | December 5 - 43°F |
| October 26 - 55°F | December 6 - 41°F |
| October 27 - 55°F | December 7 - 38°F |
| October 31 - 46°F | December 8 - 38°F |
| November 1 - 46°F | December 12 - 40°F |
| November 2 - 47°F | December 13 - 40°F |
| November 3 - 47°F | December 14 - 40°F |
| November 7 - 44°F | December 15 - 40°F |
| November 8 - 44°F | December 19 - 38°F |
| November 9 - 44°F | December 20 - 39°F |
| November 10 - 44°F | December 21 - 38°F |
| November 14 - 45°F | December 22 - 39°F |
| November 15 - 49°F | December 23 - 38°F |
| November 16 - 49°F | December 27 - 37°F |
| November 21 - 48°F | December 28 - 36°F |
| November 22 - 48°F | December 29 - 36°F |
| November 28 - 43°F | |

TABLE 7

IMPINGEMENT SUMMARY FOR STICKLEBACK
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 9.00 | 90.50 | 9.94 |
| FEBRUARY | 6.00 | 35.00 | 17.14 |
| MARCH | 54.00 | 177.50 | 30.42 |
| APRIL | 146.00 | 542.50 | 26.91 |
| MAY | 1200.00 | 2585.50 | 46.41 |
| JUNE | 271.00 | 613.50 | 44.17 |
| JULY | 466.00 | 1214.00 | 38.39 |
| AUGUST | 4.00 | 8.00 | 50.00 |
| SEPTEMBER | 1.00 | 61.00 | 1.64 |
| OCTOBER | 193.00 | 484.50 | 39.83 |
| NOVEMBER | 59.00 | 201.00 | 29.35 |
| DECEMBER | 130.00 | 402.50 | 32.30 |
| TOTAL | 2539.00 | 6415.50 | 39.58 |

TABLE 8

IMPINGEMENT SUMMARY FOR MOTTLED SCULPIN
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 165.00 | 720.00 | 22.92 |
| FEBRUARY | 63.00 | 255.50 | 24.66 |
| MARCH | 55.00 | 184.00 | 29.89 |
| APRIL | 72.00 | 271.00 | 26.57 |
| MAY | 312.00 | 761.50 | 40.97 |
| JUNE | 139.00 | 373.00 | 37.27 |
| JULY | 110.00 | 302.00 | 36.42 |
| AUGUST | 43.00 | 99.00 | 43.43 |
| SEPTEMBER | 81.00 | 213.50 | 37.94 |
| OCTOBER | 256.00 | 675.50 | 37.90 |
| NOVEMBER | 192.00 | 556.00 | 34.53 |
| DECEMBER | 192.00 | 592.00 | 32.43 |
| TOTAL | 1680.00 | 5003.00 | 33.58 |

TABLE 9

IMPINGEMENT SUMMARY FOR SPOTTAIL SHINER
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 15.00 | 95.00 | 15.79 |
| FEBRUARY | 9.00 | 49.00 | 18.37 |
| MARCH | 51.00 | 178.00 | 28.65 |
| APRIL | 84.00 | 299.00 | 28.09 |
| MAY | 67.00 | 153.50 | 43.65 |
| JUNE | 20.00 | 56.00 | 35.71 |
| JULY | 283.00 | 747.00 | 37.88 |
| AUGUST | 49.00 | 135.00 | 36.30 |
| SEPTEMBER | 88.00 | 360.50 | 24.41 |
| OCTOBER | 1082.00 | 2402.50 | 45.04 |
| NOVEMBER | 8.00 | 28.50 | 28.07 |
| DECEMBER | 85.00 | 297.00 | 28.62 |
| TOTAL | 1841.00 | 4801.00 | 38.35 |

TABLE 10

IMPINGEMENT SUMMARY FOR WHITE PERCH
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 1.00 | 32.50 | 3.08 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 4.00 | 14.00 | 28.57 |
| APRIL | 3.00 | 13.50 | 22.22 |
| MAY | 5.00 | 15.00 | 33.33 |
| JUNE | 2.00 | 6.50 | 30.77 |
| JULY | 24.00 | 64.00 | 37.50 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 22.00 | 0.00 |
| OCTOBER | 1498.00 | 3765.50 | 39.78 |
| NOVEMBER | 51.00 | 167.00 | 30.54 |
| DECEMBER | 180.00 | 619.00 | 29.08 |
| TOTAL | 1768.00 | 4719.00 | 37.47 |

TABLE 11

IMPINGEMENT SUMMARY FOR LAKE CHUB
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 25.00 | 183.50 | 13.62 |
| FEBRUARY | 16.00 | 70.00 | 22.86 |
| MARCH | 125.00 | 398.00 | 31.41 |
| APRIL | 109.00 | 426.00 | 25.59 |
| MAY | 135.00 | 317.00 | 42.59 |
| JUNE | 20.00 | 79.50 | 25.16 |
| JULY | 37.00 | 103.00 | 35.92 |
| AUGUST | 2.00 | 6.00 | 33.33 |
| SEPTEMBER | 4.00 | 44.00 | 9.09 |
| OCTOBER | 379.00 | 887.00 | 42.73 |
| NOVEMBER | 16.00 | 74.00 | 21.62 |
| DECEMBER | 85.00 | 278.50 | 30.52 |
| TOTAL | 953.00 | 2866.50 | 33.25 |

TABLE 12

IMPINGEMENT SUMMARY FOR GIZZARD SHAD
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 1.00 | 66.00 | 1.52 |
| FEBRUARY | 1.00 | 7.00 | 14.29 |
| MARCH | 2.00 | 6.50 | 30.77 |
| APRIL | 2.00 | 7.50 | 26.67 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 1.00 | 3.00 | 33.33 |
| SEPTEMBER | 1.00 | 13.00 | 7.69 |
| OCTOBER | 164.00 | 399.50 | 41.05 |
| NOVEMBER | 25.00 | 90.50 | 27.62 |
| DECEMBER | 284.00 | 868.00 | 32.72 |
| TOTAL | 481.00 | 1461.00 | 32.92 |

TABLE 13

IMPINGEMENT SUMMARY FOR EMERALD SHINER
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 42.00 | 274.50 | 15.30 |
| FEBRUARY | 2.00 | 10.50 | 19.05 |
| MARCH | 6.00 | 21.00 | 28.57 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 1.00 | 1.00 | 100.00 |
| AUGUST | 1.00 | 1.00 | 100.00 |
| SEPTEMBER | 5.00 | 15.50 | 32.26 |
| OCTOBER | 67.00 | 175.50 | 38.18 |
| NOVEMBER | 3.00 | 9.50 | 31.58 |
| DECEMBER | 225.00 | 799.00 | 28.16 |
| TOTAL | 352.00 | 1307.50 | 26.92 |

TABLE 14

IMPINGEMENT SUMMARY FOR WHITE BASS
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 16.00 | 151.50 | 10.56 |
| FEBRUARY | 2.00 | 7.00 | 28.57 |
| MARCH | 1.00 | 3.50 | 28.57 |
| APRIL | 1.00 | 3.50 | 28.57 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 1.00 | 0.00 |
| OCTOBER | 31.00 | 84.50 | 36.69 |
| NOVEMBER | 3.00 | 16.00 | 18.75 |
| DECEMBER | 306.00 | 956.00 | 32.01 |
| TOTAL | 360.00 | 1223.00 | 29.44 |

TABLE 15

IMPINGEMENT SUMMARY FOR YELLOW PERCH
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 4.00 | 30.00 | 13.33 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 2.00 | 7.00 | 28.57 |
| APRIL | 3.00 | 10.50 | 28.57 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 1.00 | 3.00 | 33.33 |
| SEPTEMBER | 1.00 | 12.00 | 8.33 |
| OCTOBER | 51.00 | 107.00 | 47.66 |
| NOVEMBER | 6.00 | 24.50 | 24.49 |
| DECEMBER | 6.00 | 18.00 | 33.33 |
| TOTAL | 74.00 | 212.00 | 34.91 |

TABLE 16

IMPINGEMENT SUMMARY FOR JOHNNY DARTER
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 1.00 | 4.00 | 25.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 3.00 | 12.00 | 25.00 |
| MAY | 29.00 | 66.50 | 43.61 |
| JUNE | 11.00 | 38.50 | 28.57 |
| JULY | 12.00 | 26.00 | 46.15 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 4.00 | 8.00 | 50.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 1.00 | 3.00 | 33.33 |
| TOTAL | 61.00 | 158.00 | 38.61 |

TABLE 17

IMPINGEMENT SUMMARY FOR LAKE TROUT
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 6.00 | 42.00 | 14.29 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 6.00 | 21.00 | 28.57 |
| APRIL | 13.00 | 45.50 | 28.57 |
| MAY | 2.00 | 7.00 | 28.57 |
| JUNE | 0.00 | 2.50 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 1.00 | 5.50 | 18.18 |
| DECEMBER | 8.00 | 26.00 | 30.77 |
| TOTAL | 36.00 | 149.50 | 24.08 |

TABLE 18

IMPINGEMENT SUMMARY FOR BROWN TROUT
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 1.00 | 3.00 | 33.33 |
| NOVEMBER | 1.00 | 4.00 | 25.00 |
| DECEMBER | 1.00 | 3.00 | 33.33 |
| TOTAL | 3.00 | 10.00 | 30.00 |

TABLE 19

IMPINGEMENT SUMMARY FOR CHINOOK SALMON
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 1.00 | 3.00 | 33.33 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 1.00 | 3.00 | 33.33 |

TABLE 20

IMPINGEMENT SUMMARY FOR SMALLMOUTH BASS
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 2.00 | 15.00 | 13.33 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 1.00 | 3.50 | 28.57 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 2.00 | 6.00 | 33.33 |
| AUGUST | 1.00 | 1.00 | 100.00 |
| SEPTEMBER | 1.00 | 4.50 | 22.22 |
| OCTOBER | 3.00 | 8.00 | 37.50 |
| NOVEMBER | 1.00 | 3.50 | 28.57 |
| DECEMBER | 2.00 | 6.50 | 30.77 |
| TOTAL | 13.00 | 48.00 | 27.08 |

TABLE 21

IMPINGEMENT SUMMARY FOR BROWN BULLHEAD
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 1.00 | 7.00 | 14.29 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 1.00 | 3.50 | 28.57 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 1.00 | 1.00 | 100.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 1.00 | 3.00 | 33.33 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 2.00 | 7.00 | 28.57 |
| TOTAL | 6.00 | 21.50 | 27.91 |

TABLE 22

IMPINGEMENT SUMMARY FOR ROCK BASS
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 13.00 | 103.50 | 12.56 |
| FEBRUARY | 2.00 | 7.00 | 28.57 |
| MARCH | 9.00 | 31.50 | 28.57 |
| APRIL | 6.00 | 21.00 | 28.57 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.50 | 0.00 |
| JULY | 8.00 | 24.00 | 33.33 |
| AUGUST | 3.00 | 7.00 | 42.86 |
| SEPTEMBER | 0.00 | 6.00 | 0.00 |
| OCTOBER | 27.00 | 70.50 | 38.30 |
| NOVEMBER | 3.00 | 10.00 | 30.00 |
| DECEMBER | 8.00 | 33.50 | 23.88 |
| TOTAL | 79.00 | 314.50 | 25.12 |

TABLE 23

IMPINGEMENT SUMMARY FOR TROUT PERCH
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 1.00 | 7.00 | 14.29 |
| FEBRUARY | 1.00 | 3.50 | 28.57 |
| MARCH | 5.00 | 17.00 | 29.41 |
| APRIL | 8.00 | 28.50 | 28.07 |
| MAY | 19.00 | 37.00 | 51.35 |
| JUNE | 7.00 | 26.00 | 26.92 |
| JULY | 3.00 | 7.00 | 42.86 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 6.00 | 16.00 | 37.50 |
| NOVEMBER | 3.00 | 16.00 | 18.75 |
| DECEMBER | 10.00 | 34.00 | 29.41 |
| TOTAL | 63.00 | 192.00 | 32.81 |

TABLE 24

IMPINGEMENT SUMMARY FOR WHITE SUCKER
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 1.00 | 3.50 | 28.57 |
| MARCH | 1.00 | 2.00 | 50.00 |
| APRIL | 1.00 | 5.00 | 20.00 |
| MAY | 1.00 | 1.00 | 100.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 5.00 | 15.00 | 33.33 |
| AUGUST | 1.00 | 1.00 | 100.00 |
| SEPTEMBER | 4.00 | 10.00 | 40.00 |
| OCTOBER | 19.00 | 48.00 | 39.58 |
| NOVEMBER | 3.00 | 9.50 | 31.58 |
| DECEMBER | 5.00 | 16.50 | 30.30 |
| TOTAL | 41.00 | 111.50 | 36.77 |

TABLE 25

IMPINGEMENT SUMMARY FOR PUMPKINSEED
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 2.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 1.00 | 3.50 | 28.57 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 1.00 | 2.00 | 50.00 |
| OCTOBER | 7.00 | 22.50 | 31.11 |
| NOVEMBER | 0.00 | 1.00 | 0.00 |
| DECEMBER | 6.00 | 18.00 | 33.33 |
| TOTAL | 15.00 | 49.00 | 30.61 |

TABLE 26

IMPINGEMENT SUMMARY FOR BLUEGILL
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 11.00 | 31.00 | 35.48 |
| NOVEMBER | 3.00 | 12.50 | 24.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 14.00 | 43.50 | 32.18 |

TABLE 27

IMPINGEMENT SUMMARY FOR BLACK CRAPPIE
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 4.00 | 14.00 | 28.57 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 2.00 | 7.00 | 28.57 |
| TOTAL | 6.00 | 21.00 | 28.57 |

TABLE 28

IMPINGEMENT SUMMARY FOR FANTAIL DARTER
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 2.00 | 7.00 | 28.57 |
| JUNE | 0.00 | 2.50 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 1.00 | 1.00 | 100.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 3.00 | 10.50 | 28.57 |

TABLE 29

IMPINGEMENT SUMMARY FOR LARGEMOUTH BASS
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 1.00 | 2.00 | 50.00 |
| OCTOBER | 2.00 | 5.50 | 36.36 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 3.00 | 7.50 | 40.00 |

TABLE 30

IMPINGEMENT SUMMARY FOR LONGNOSE DACE
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 1.00 | 3.50 | 28.57 |
| FEBRUARY | 1.00 | 3.50 | 28.57 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 2.00 | 7.00 | 28.57 |

TABLE 31

IMPINGEMENT SUMMARY FOR CHANNEL CATFISH
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 2.00 | 15.00 | 13.33 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 2.00 | 15.00 | 13.33 |

TABLE 32

IMPINGEMENT SUMMARY FOR GOLDFISH
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 1.00 | 3.00 | 33.33 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 2.00 | 8.00 | 25.00 |
| TOTAL | 3.00 | 11.00 | 27.27 |

TABLE 33

IMPINGEMENT SUMMARY FOR MUDMINNOW
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 2.00 | 7.00 | 28.57 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 1.00 | 4.00 | 25.00 |
| TOTAL | 3.00 | 11.00 | 27.27 |

TABLE 34

IMPINGEMENT SUMMARY FOR CARP
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 1.00 | 0.00 |
| DECEMBER | 2.00 | 7.00 | 28.57 |
| TOTAL | 2.00 | 8.00 | 25.00 |

TABLE 35

IMPINGEMENT SUMMARY FOR FRESHWATER DRUM
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 1.00 | 1.50 | 66.67 |
| DECEMBER | 1.00 | 5.50 | 18.18 |
| TOTAL | 2.00 | 7.00 | 28.57 |

TABLE 36

IMPINGEMENT SUMMARY FOR REDHORSE SUCKER
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 2.00 | 6.50 | 30.77 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 2.00 | 6.50 | 30.77 |

TABLE 37

IMPINGEMENT SUMMARY FOR SLIMY SCULPIN
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 6.00 | 6.00 | 100.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 6.00 | 6.00 | 100.00 |

TABLE 38

IMPINGEMENT SUMMARY FOR WALLEYE
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 1.00 | 4.00 | 25.00 |
| TOTAL | 1.00 | 4.00 | 25.00 |

TABLE 39

IMPINGEMENT SUMMARY FOR BROOK STICKLEBACK
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 1.00 | 3.50 | 28.57 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 1.00 | 3.50 | 28.57 |

TABLE 40

IMPINGEMENT SUMMARY FOR CISCO
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 1.00 | 3.50 | 28.57 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 1.00 | 3.50 | 28.57 |

TABLE 41

IMPINGEMENT SUMMARY FOR LONGNOSE GAR
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 1.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 1.00 | 2.50 | 40.00 |
| TOTAL | 1.00 | 3.50 | 28.57 |

TABLE 42

IMPINGEMENT SUMMARY FOR AMERICAN EEL
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 1.00 | 3.00 | 33.33 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 1.00 | 3.00 | 33.33 |

TABLE 43

IMPINGEMENT SUMMARY FOR BLUNTNOSE MINNOW
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 1.00 | 1.00 | 100.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 0.00 | 0.00 | 0.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 1.00 | 1.00 | 100.00 |

TABLE 44

IMPINGEMENT SUMMARY FOR SPOTFIN SHINER
R.E. GINNA NUCLEAR STATION, 1977

| MONTH | NUMBER COUNTED | NUMBER PROJECTED | % ACTUALLY COUNTED |
|---|---|---|---|
| JANUARY | 0.00 | 0.00 | 0.00 |
| FEBRUARY | 0.00 | 0.00 | 0.00 |
| MARCH | 0.00 | 0.00 | 0.00 |
| APRIL | 0.00 | 0.00 | 0.00 |
| MAY | 0.00 | 0.00 | 0.00 |
| JUNE | 0.00 | 0.00 | 0.00 |
| JULY | 1.00 | 1.00 | 100.00 |
| AUGUST | 0.00 | 0.00 | 0.00 |
| SEPTEMBER | 0.00 | 0.00 | 0.00 |
| OCTOBER | 0.00 | 0.00 | 0.00 |
| NOVEMBER | 0.00 | 0.00 | 0.00 |
| DECEMBER | 0.00 | 0.00 | 0.00 |
| TOTAL | 1.00 | 1.00 | 100.00 |

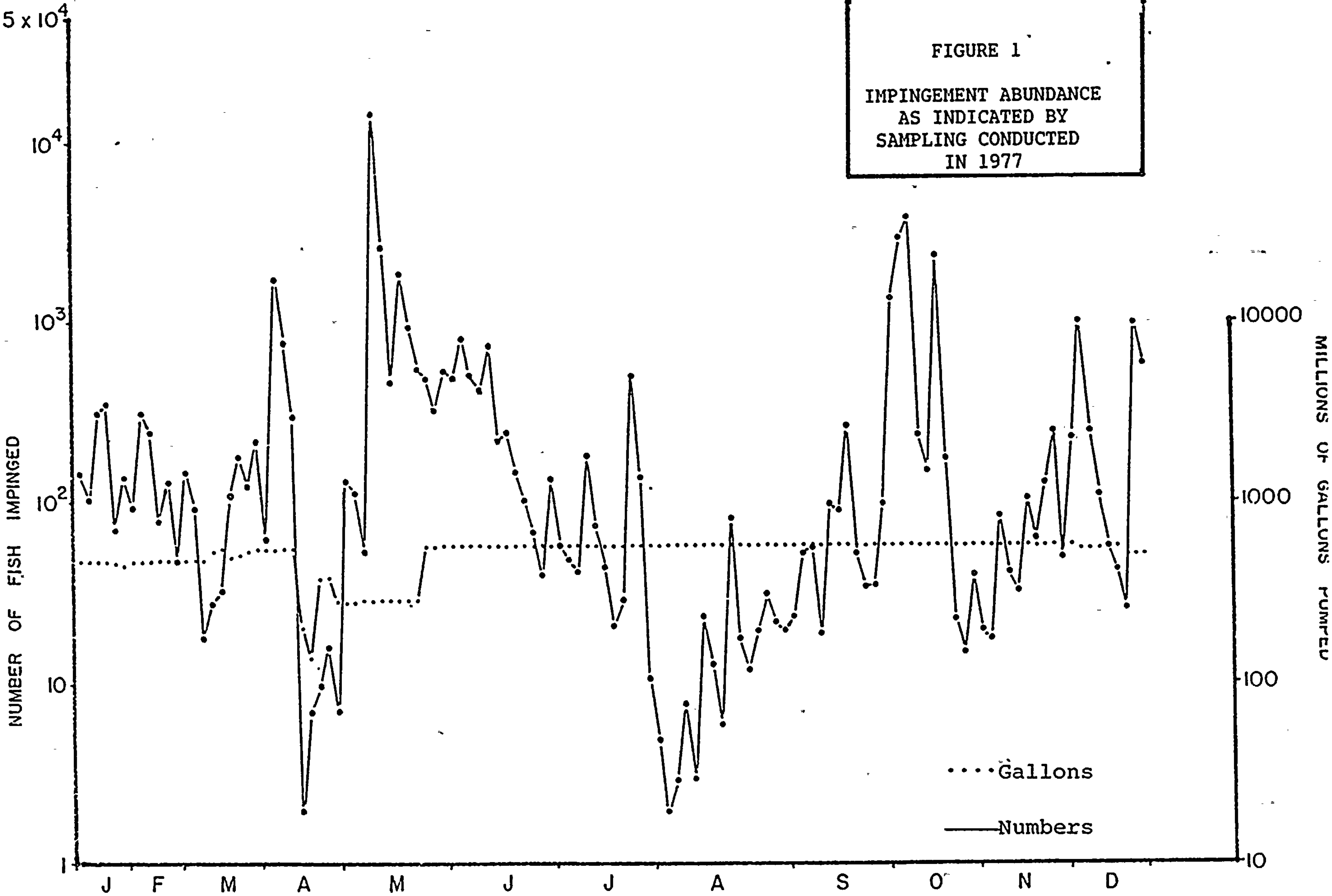
TABLE 45
TEN MOST ABUNDANT SPECIES IMPINGED IN 1977*

| | ESTIMATED NUMBER IMPINGED/YEAR | | | | |
|---|---|---|---|---|---|
| | 1973 | 1974 | 1975 | 1976 | 1977 |
| Alewife | 2,384,862 | 1,871,427 | 225,547 | 672,548 | 71,856 |
| Smelt | 180,938 | 122,704 | 121,350 | 89,922 | 45,852 |
| Stickleback | 17,296 | 4,859 | 34,205 | 147,320 | 6,415 |
| Mottled Sculpin | 8,207 | 5,220 | 6,956 | 4,867 | 5,003 |
| Spottail Shiner | 25,141 | 8,693 | 2,987 | 6,191 | 4,801 |
| White Perch | 6,839 | 1,034 | 141 | 221 | 4,719 |
| Lake Chub | 8,974 | 3,974 | 4,750 | 2,389 | 2,866 |
| Gizzard Shad | 1,382 | 1,748 | 1,971 | 1,302 | 1,461 |
| Emerald Shiner | 2,008 | 13,917 | 15,228 | 3,912 | 1,307 |
| White Bass | 1,301 | 1,501 | 449 | 5,268 | 1,223 |

* These ten species accounted for 99% of all projected impingement during 1977.

TABLE 46
SALMONIDS IMPINGED AT THE GINNA STATION BY YEAR

| | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|
| Brown Trout | 0 | 3 | 16 | 17 | 10 |
| Rainbow Trout | 0 | 0 | 0 | 0 | 0 |
| Brook Trout | 0 | 0 | 26 | 0 | 0 |
| Lake Trout | 0 | 0 | 29 | 368 | 150 |
| Coho Salmon | 0 | 0 | 0 | 1 | 0 |
| Chinook Salmon | 0 | 0 | 0 | 0 | 3 |




ROCHESTER GAS AND ELECTRIC

FIGURE 1

IMPINGEMENT ABUNDANCE AS INDICATED BY SAMPLING CONDUCTED IN 1977

RG&E ROCHESTER GAS AND ELECTRIC

FIGURE 2

BIOMASS ESTIMATES GENERATED FROM 1977 SAMPLING

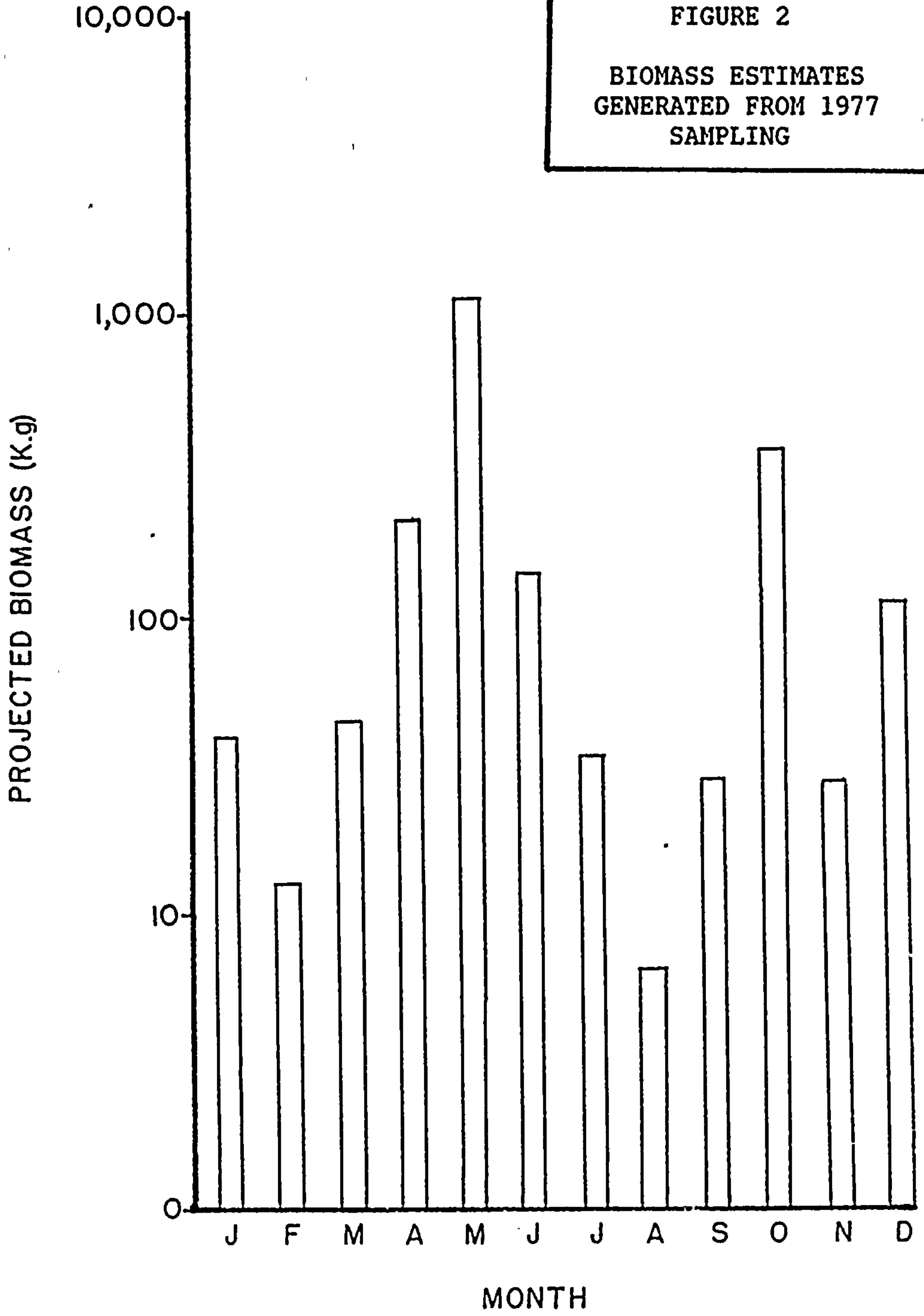
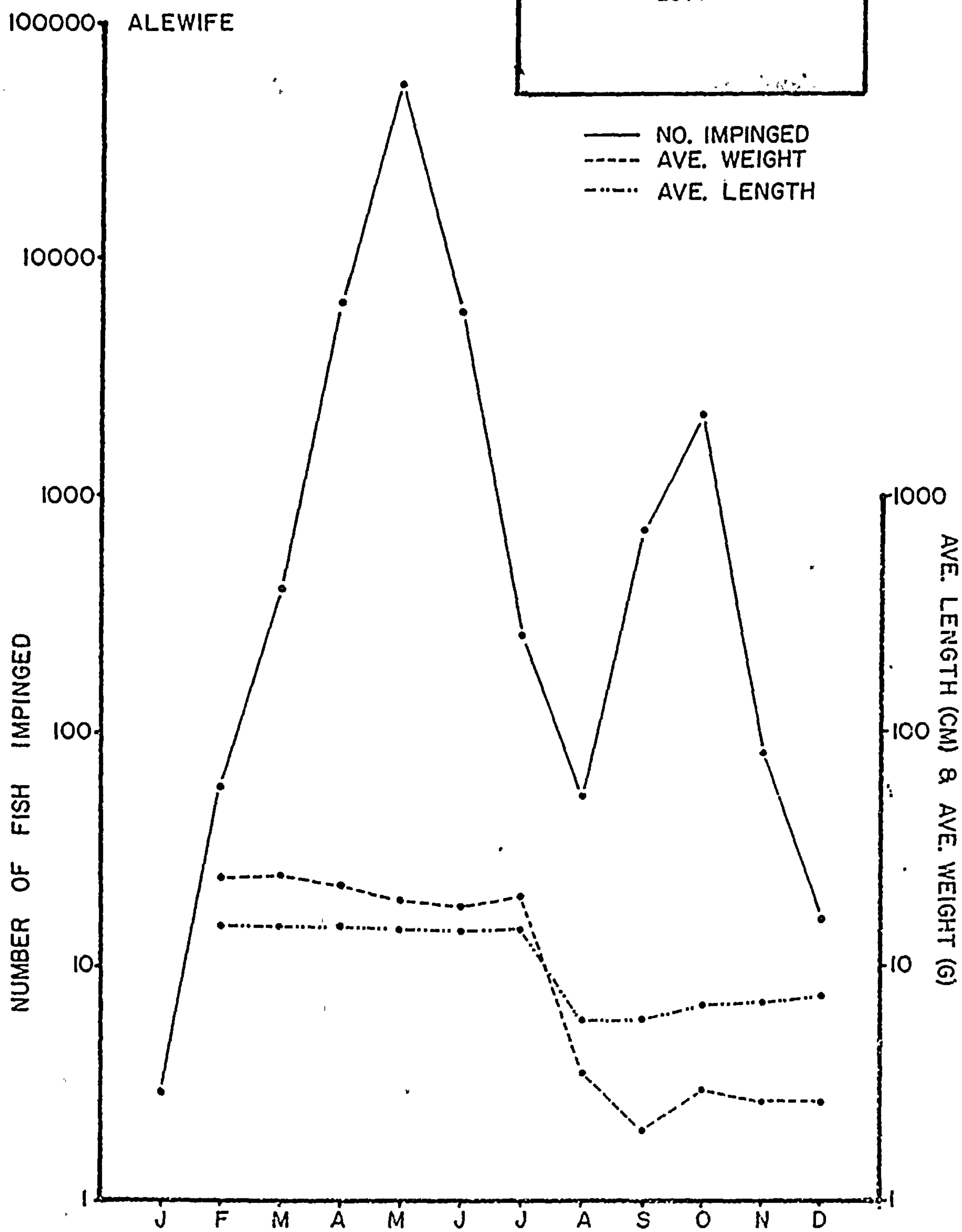
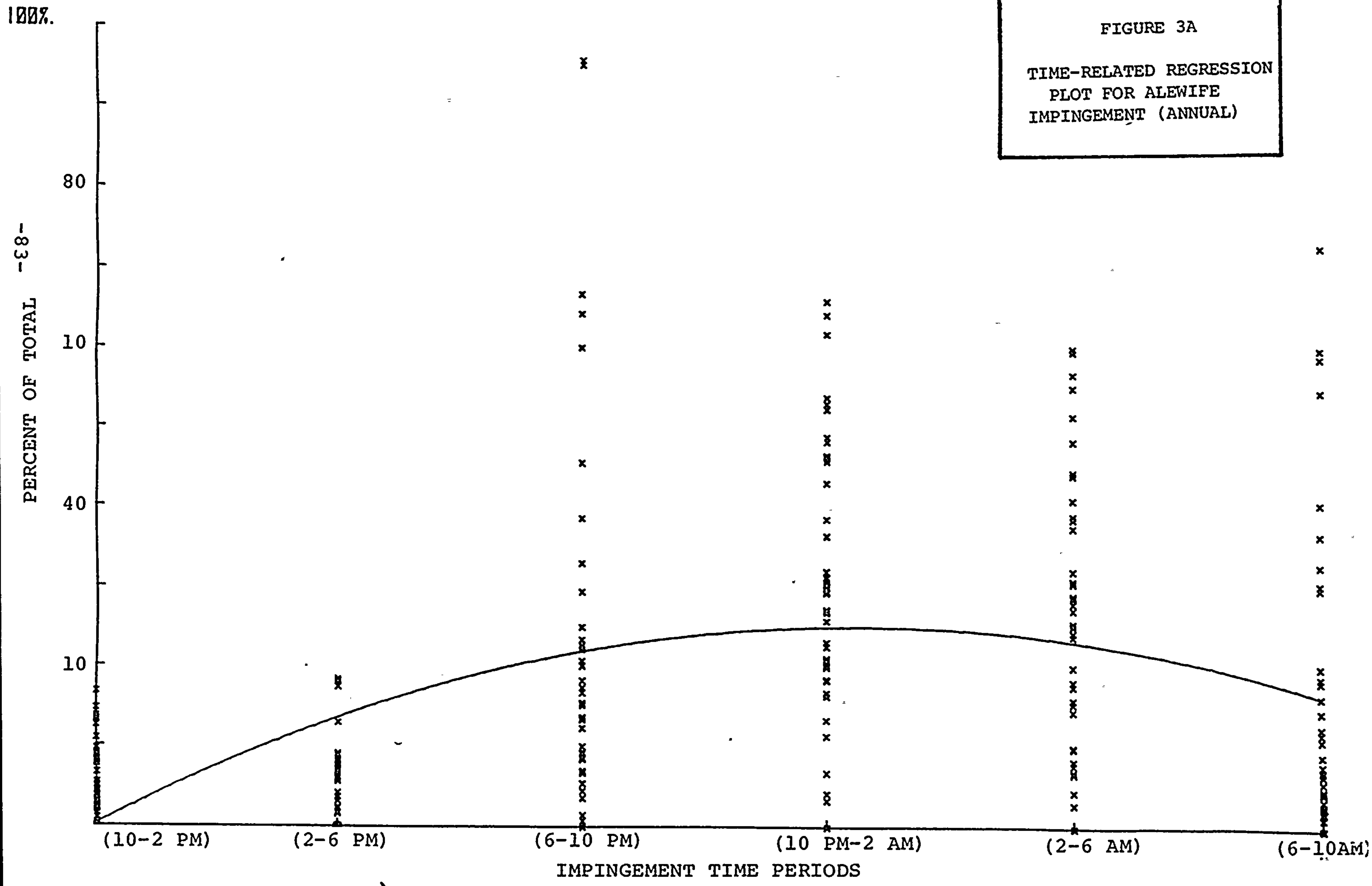


FIGURE 3

ALEWIFE IMPINGEMENT
1977






RG&E ROCHESTER GAS AND ELECTRIC

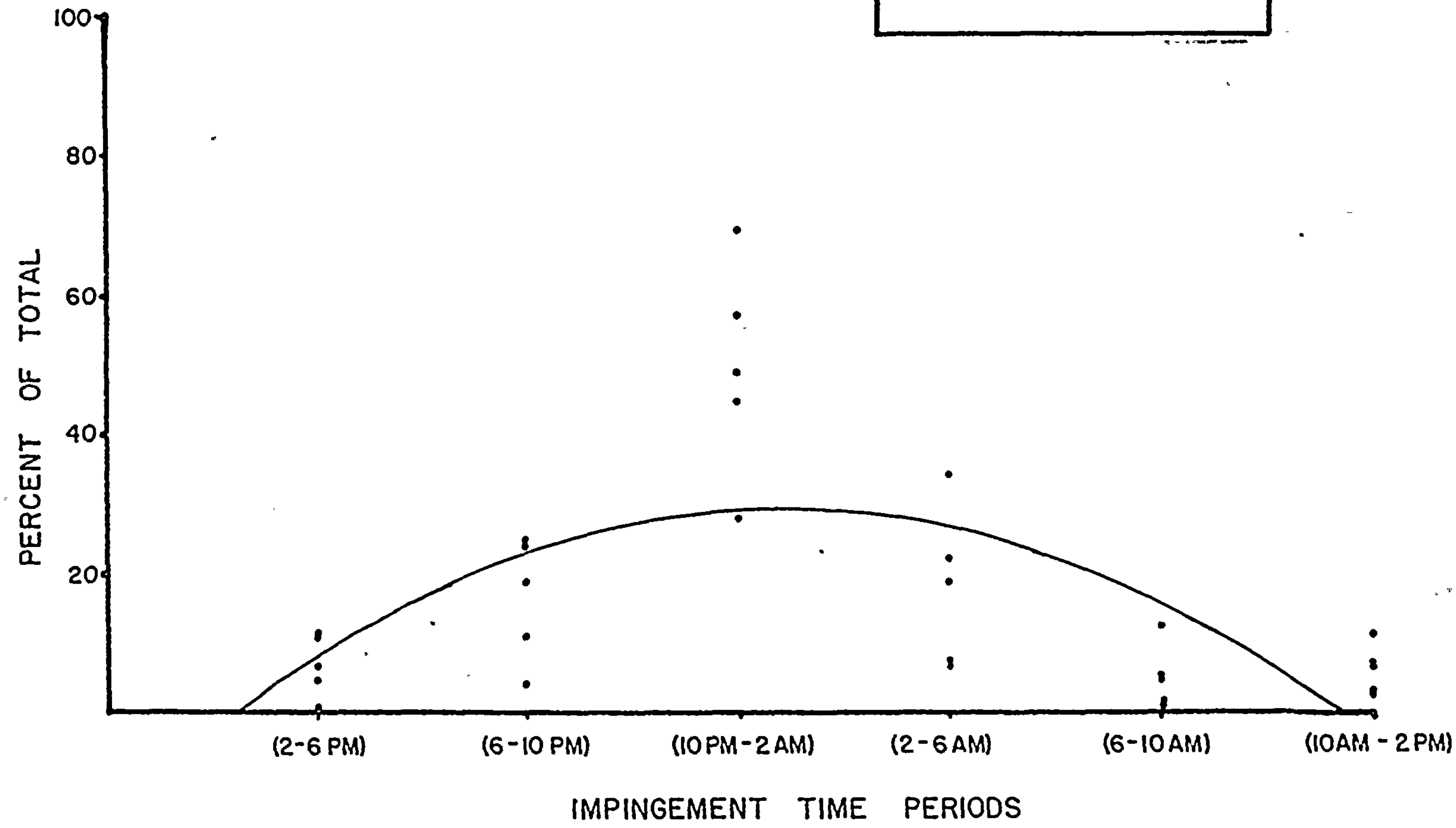
FIGURE 3A

TIME-RELATED REGRESSION PLOT FOR ALEWIFE IMPINGEMENT (ANNUAL)

ROCHESTER GAS AND ELECTRIC
ROCHESTER N.Y.

FIGURE 4

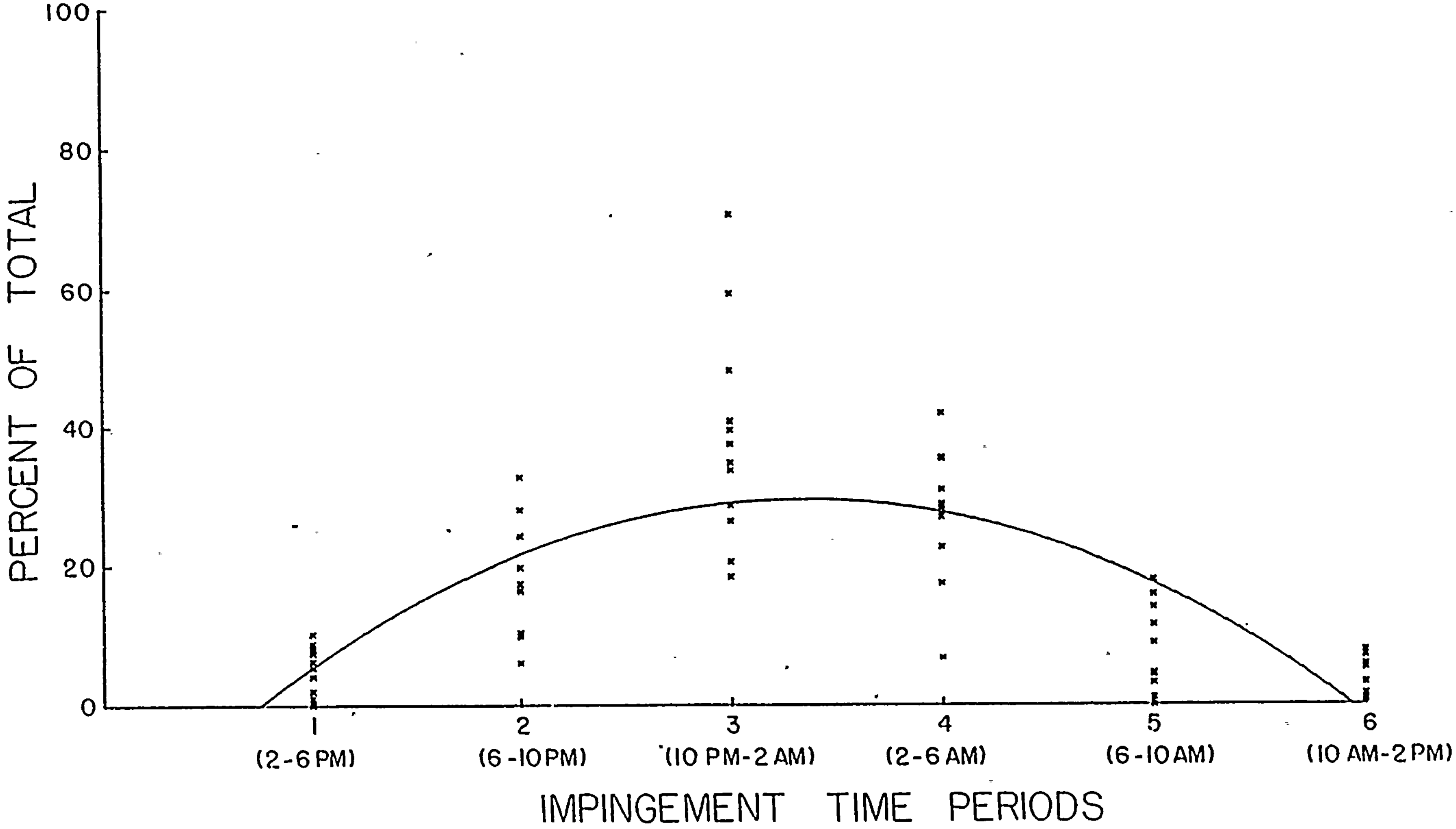
ALEWIFE IMPINGEMENT
MARCH 1977



ROCHESTER GAS AND ELECTRIC
ROCHESTER, N.Y.

FIGURE 5

ALEWIFE IMPINGEMENT
APRIL 1977



ROCHESTER GAS AND ELECTRIC

FIGURE 6

ALEWIFE IMPINGEMENT
MAY 1977

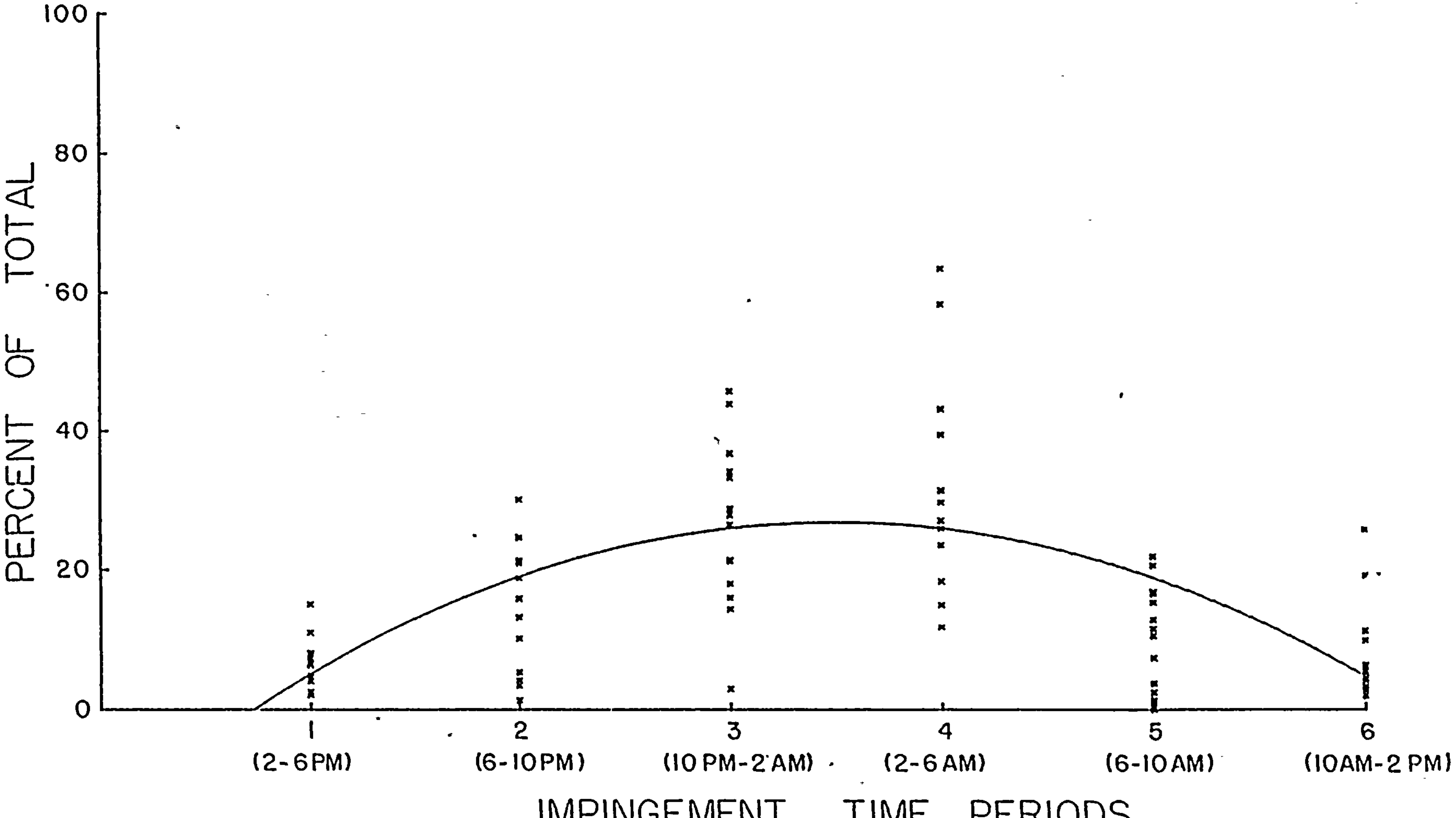


FIGURE 7

ALEWIFE IMPINGEMENT
JUNE 1977

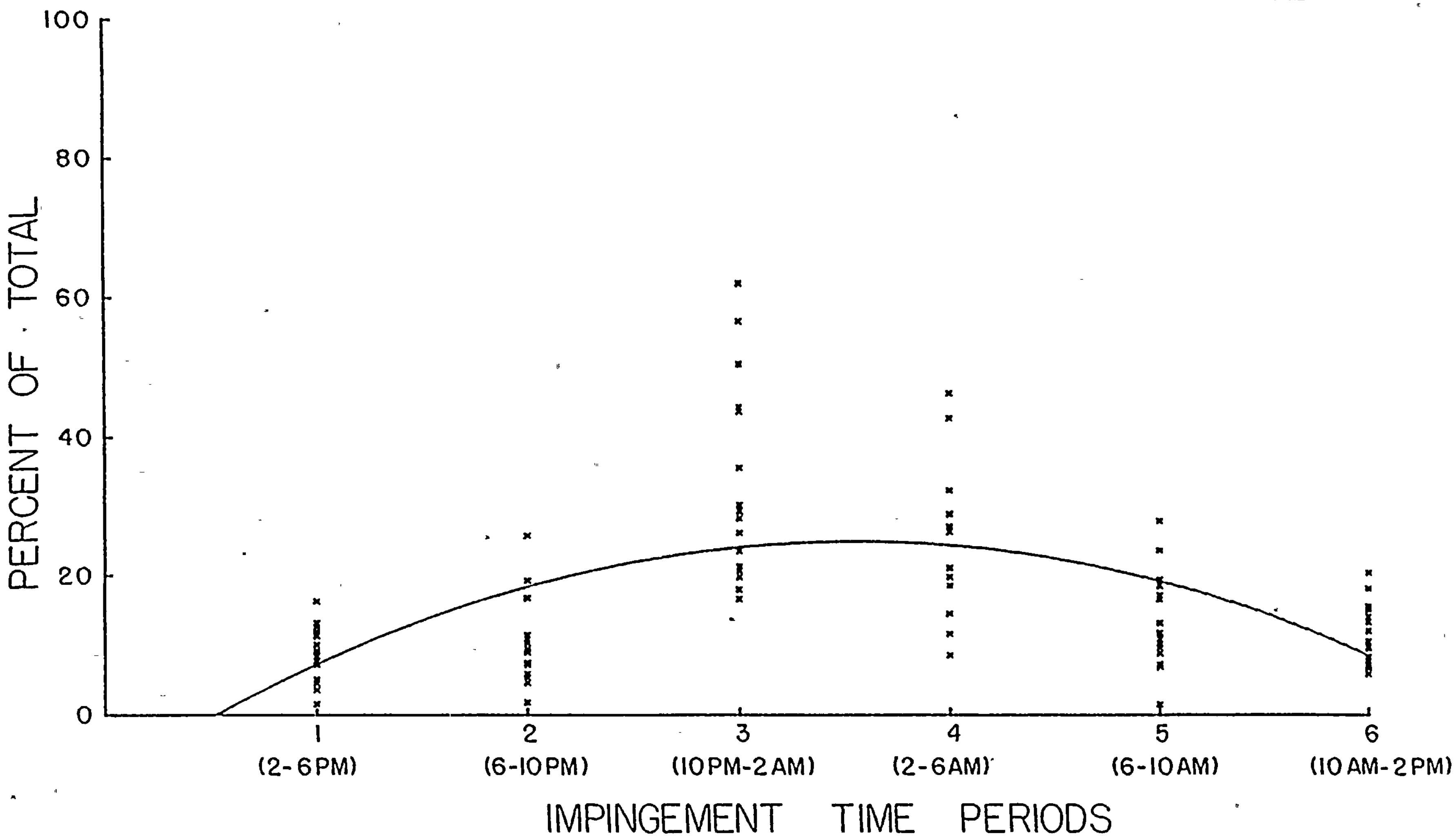
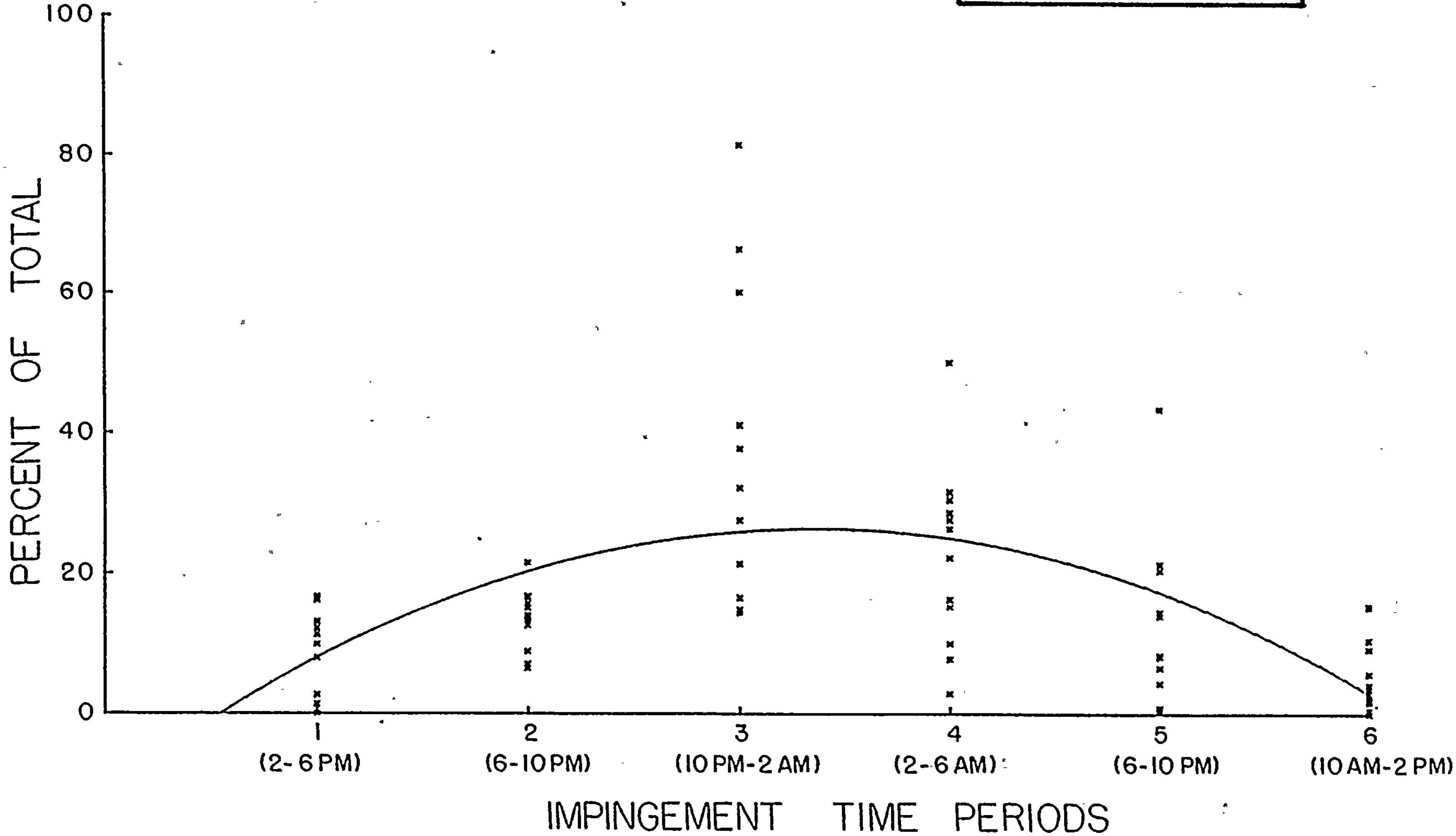


FIGURE 8

ALEWIFE IMPINGEMENT
JULY 1977



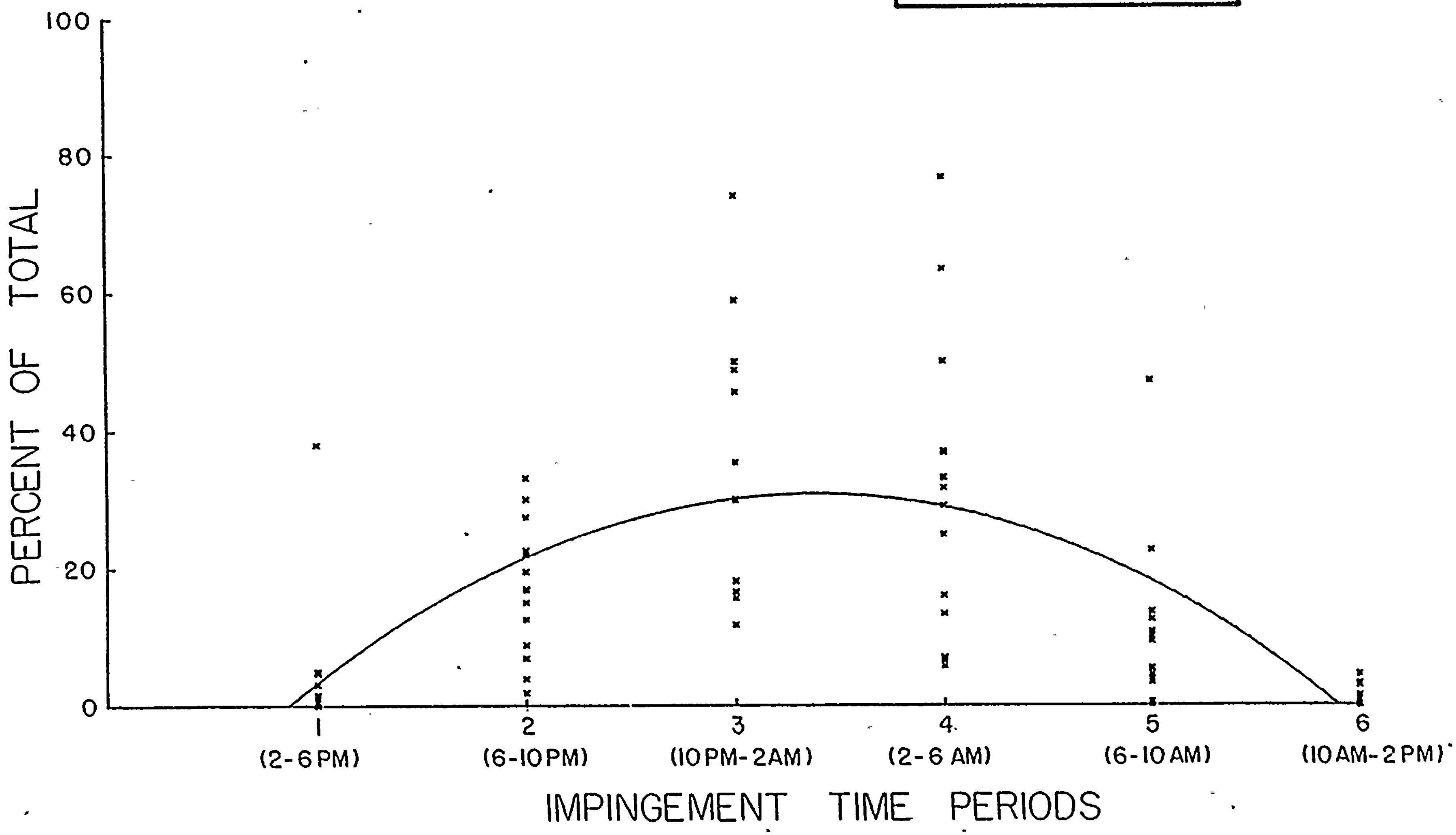


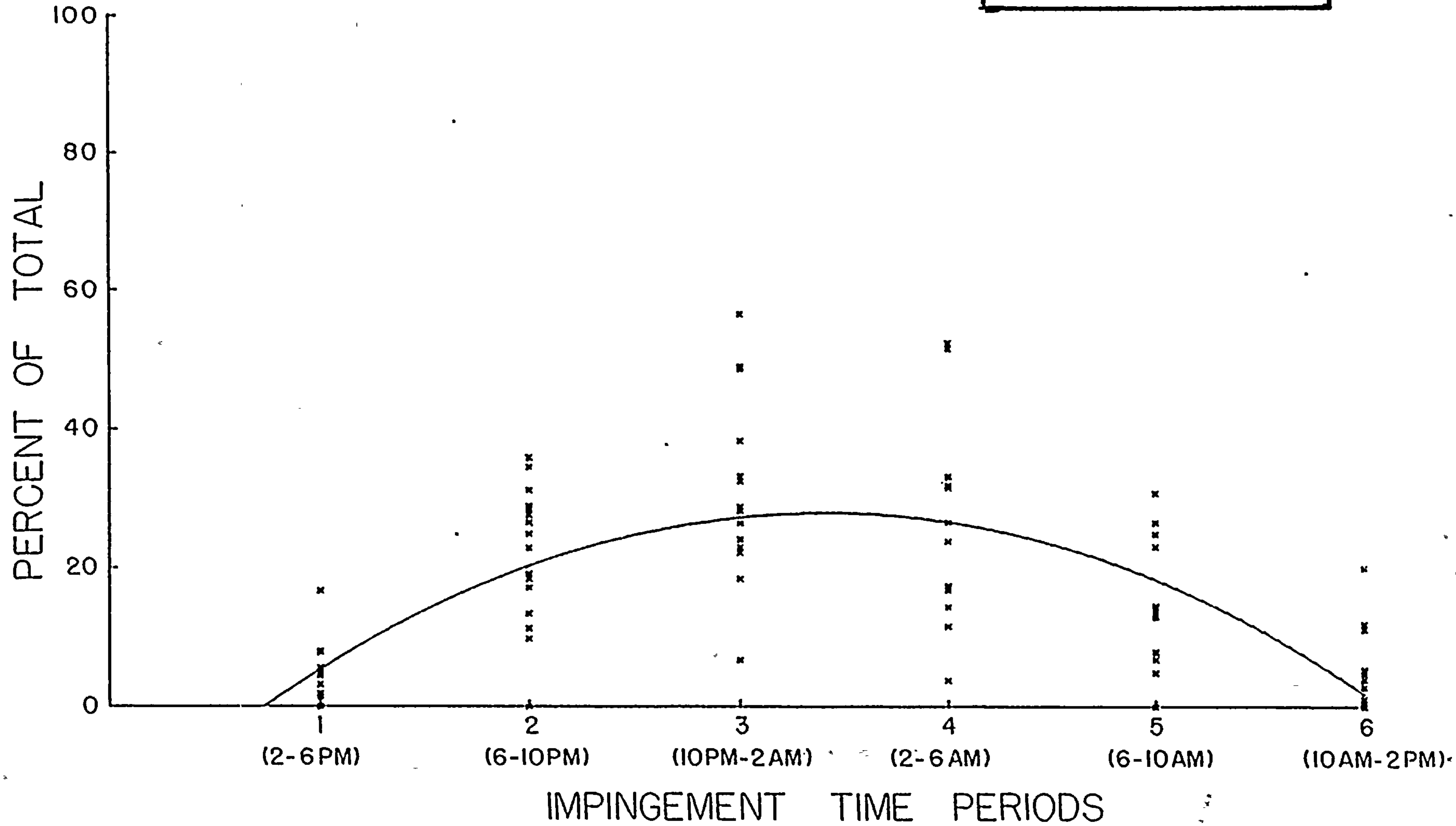

FIGURE 9

ALEWIFE IMPINGEMENT
SEPTEMBER 1977

RGE ROCHESTER GAS AND ELECTRIC

FIGURE 10

ALEWIFE IMPINGEMENT
OCTOBER 1977



ROCHESTER GAS AND ELECTRIC

FIGURE 11

ALEWIFE IMPINGEMENT
NOVEMBER 1977

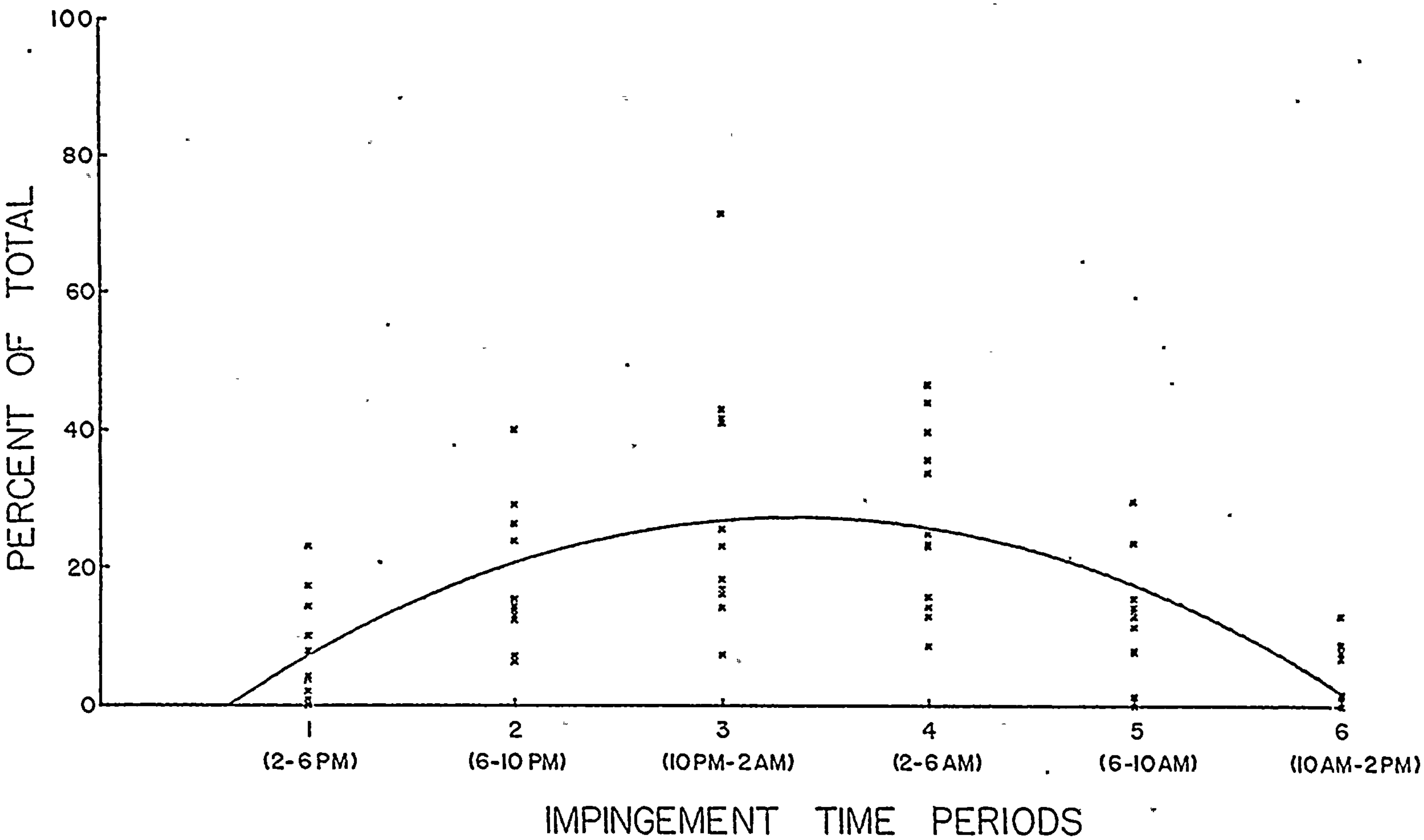
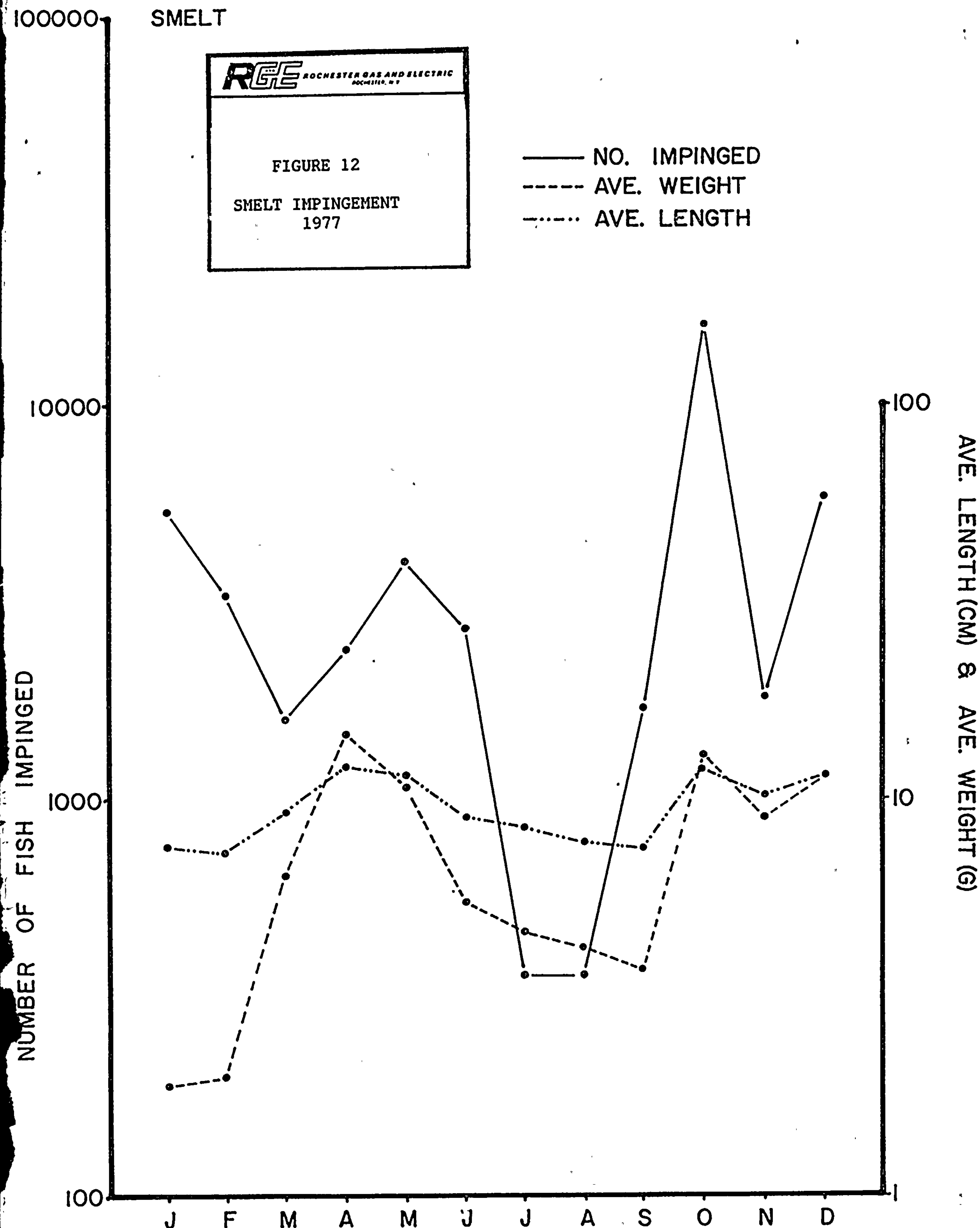


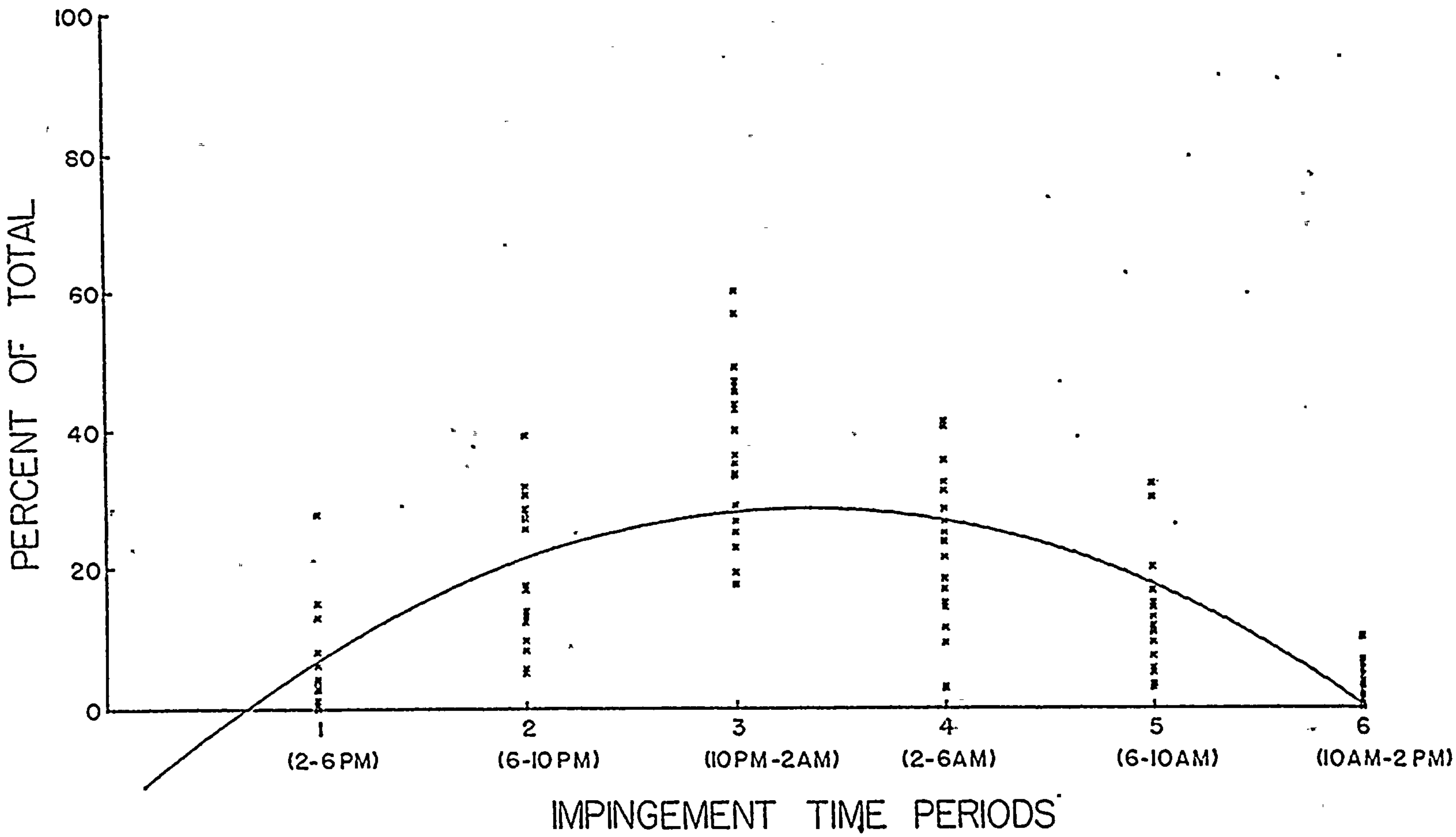

FIGURE 3

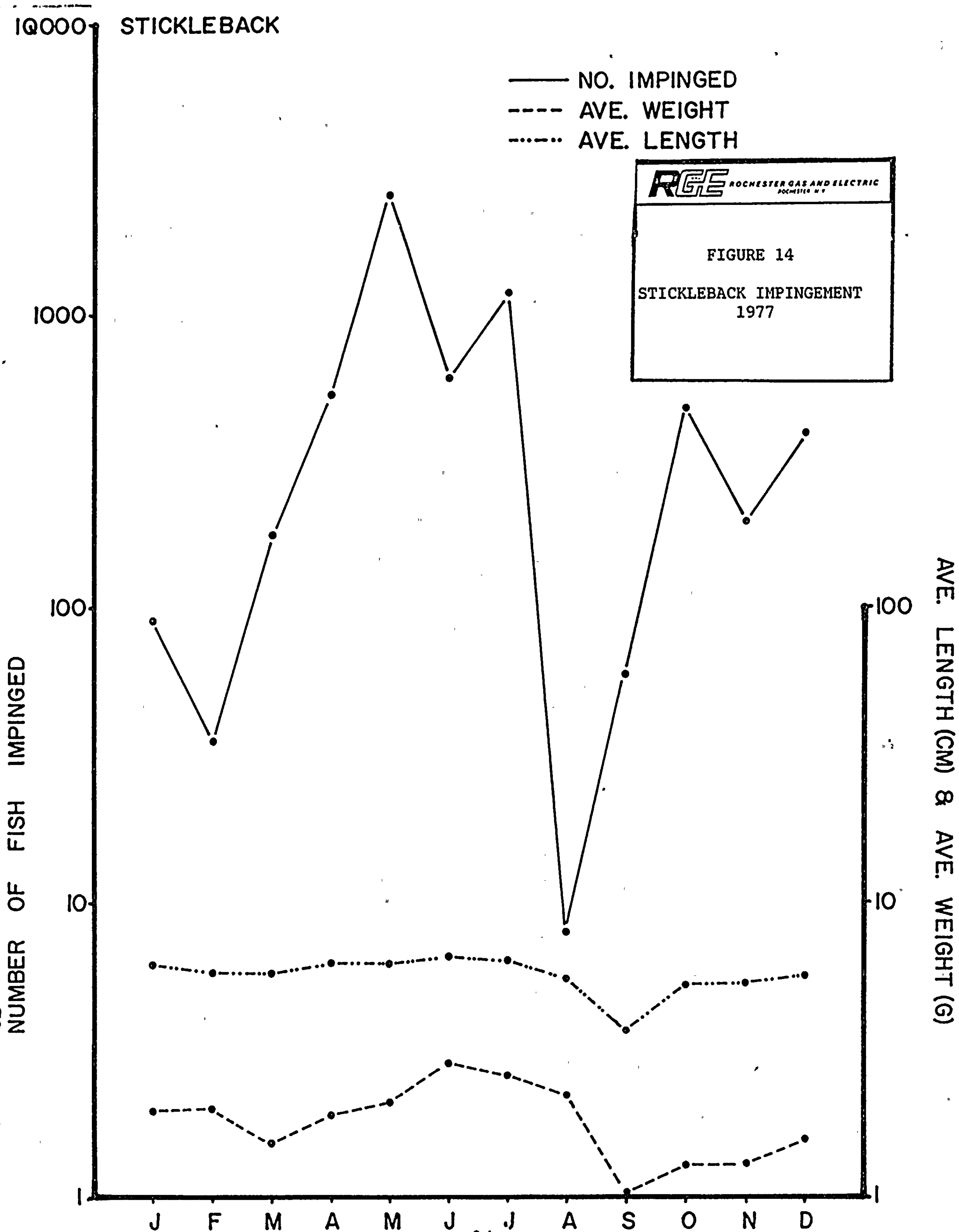

SMELT
ROCHESTER GAS AND ELECTRIC
FIGURE 12
SMELT IMPINGEMENT
1977
NO. IMPINGED
AVE. WEIGHT
AVE. LENGTH
100000
10000
1000
100
NUMBER OF FISH IMPINGED
100
10
1
AVE. LENGTH (CM) & AVE. WEIGHT (G)
J
F
M
A
M
J
J
A
S
O
N
D

RGE ROCHESTER GAS AND ELECTRIC

FIGURE 13

TIME-RELATED REGRESSION ANALYSIS FOR SMELT IMPINGEMENT

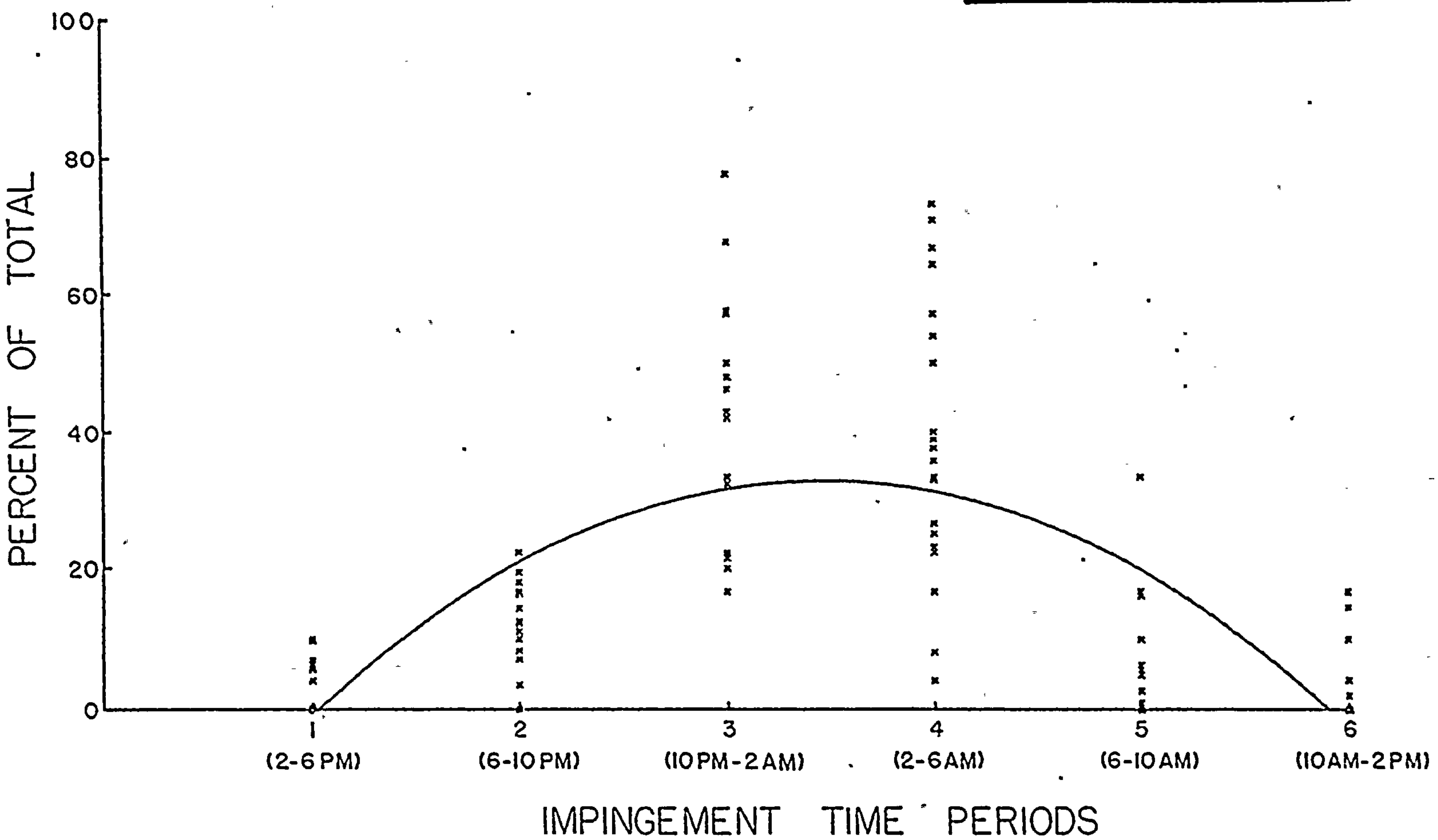



STICKLEBACK
NO. IMPINGED
AVE. WEIGHT
AVE. LENGTH
RG&E ROCHESTER GAS AND ELECTRIC
FIGURE 14
STICKLEBACK IMPINGEMENT 1977
10000
1000
100
10
1
NUMBER OF FISH IMPINGED
AVE. LENGTH (CM) & AVE. WEIGHT (G)
J F M A M J J A S O N D

ROCHESTER GAS AND ELECTRIC
ROCHESTER N.Y.

FIGURE 15

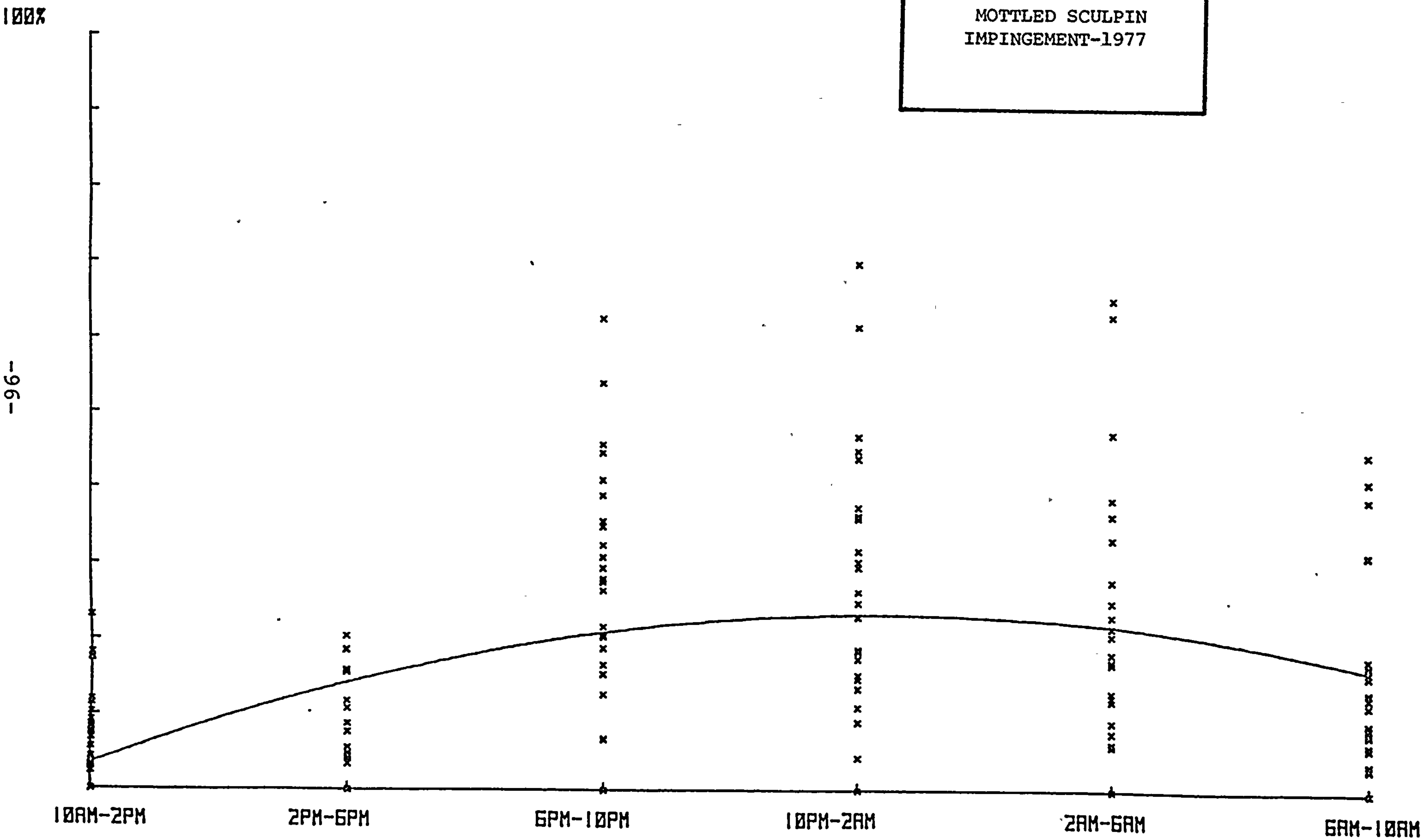
TIME RELATED
REGRESSION ANALYSIS FOR
STICKLEBACK IMPINGEMENT



RG&E ROCHESTER GAS AND ELECTRIC
ROCHESTER, N.Y.

FIGURE 15A

MOTTLED SCULPIN
IMPINGEMENT-1977



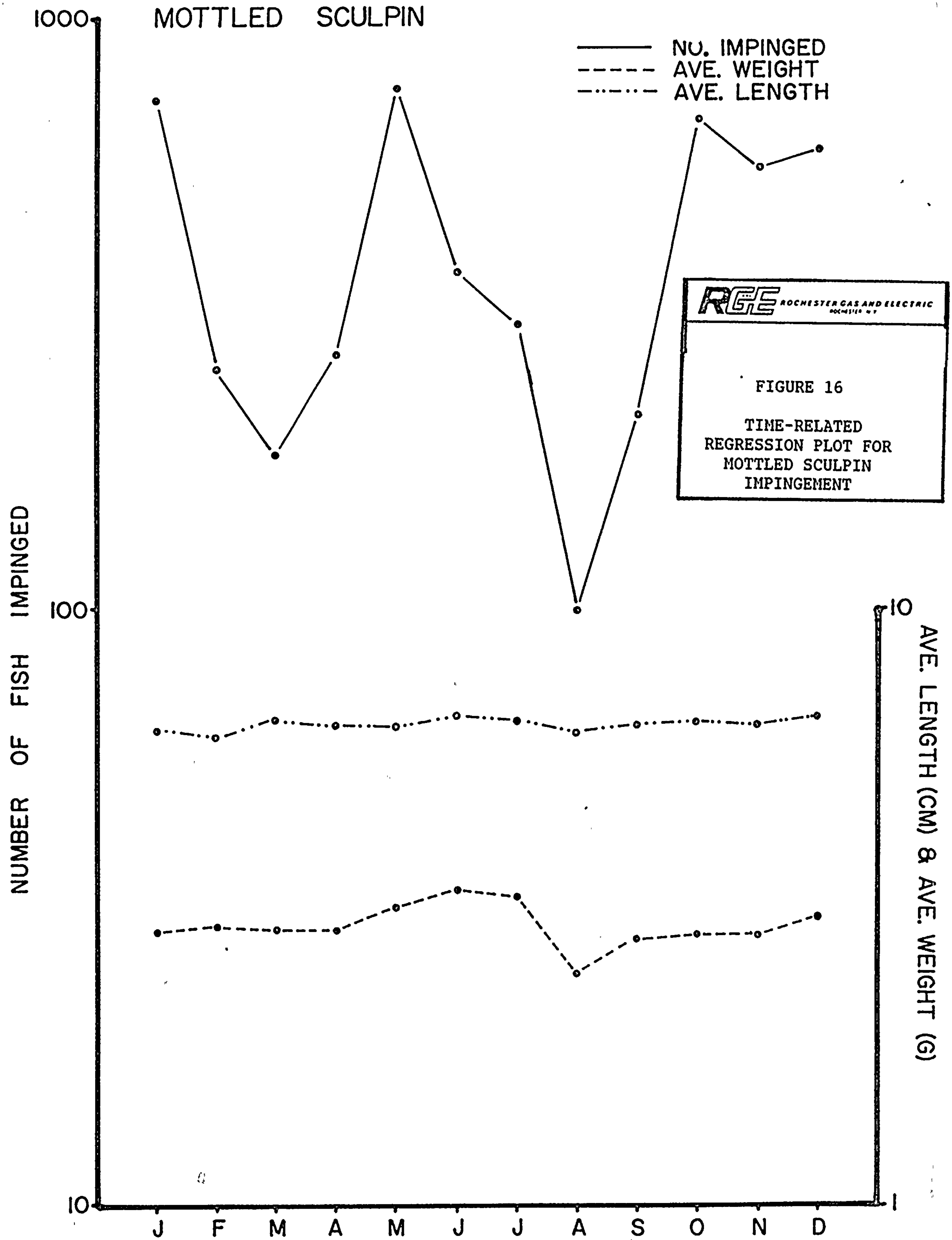
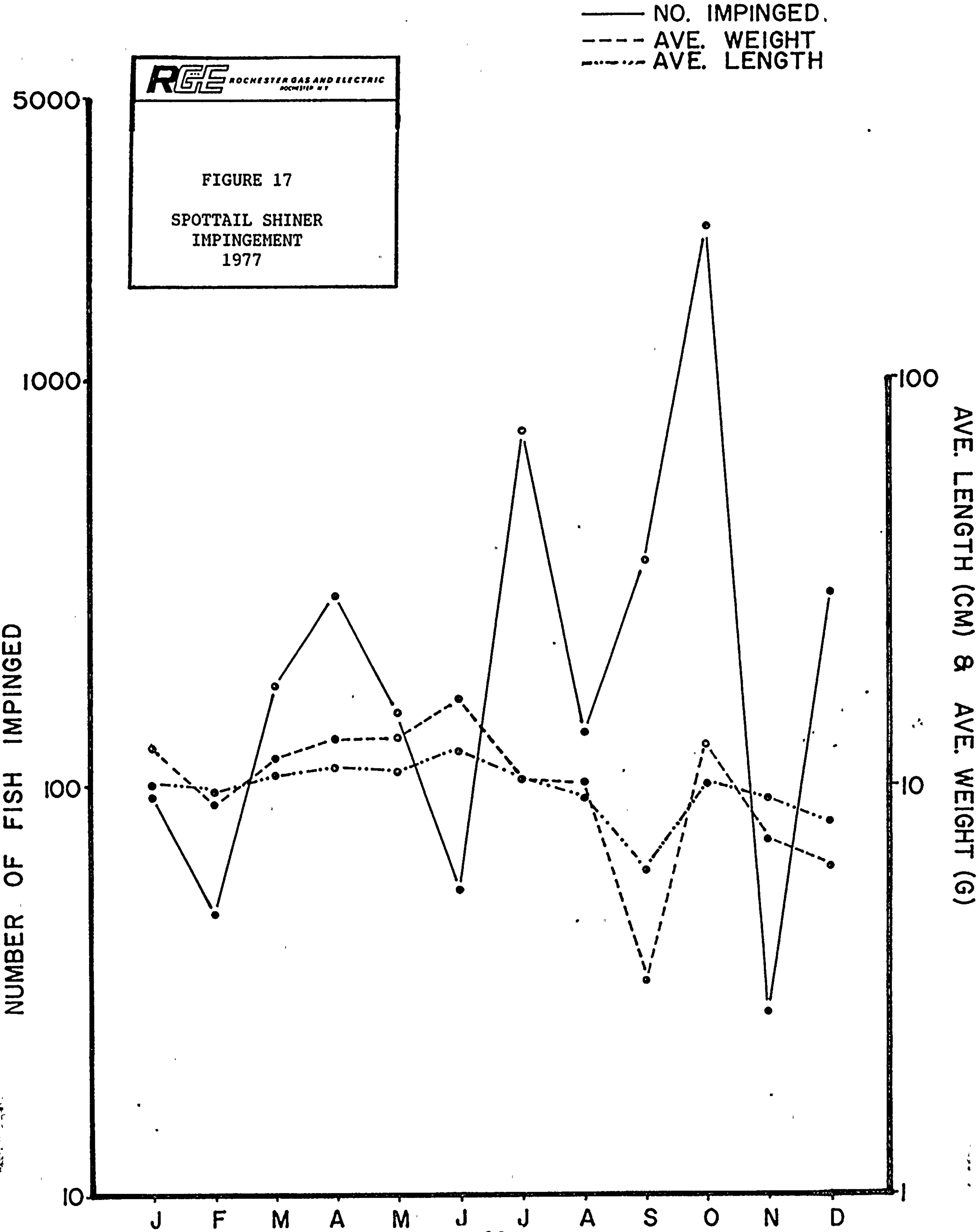



FIGURE 16

TIME-RELATED REGRESSION PLOT FOR MOTTLED SCULPIN IMPINGEMENT

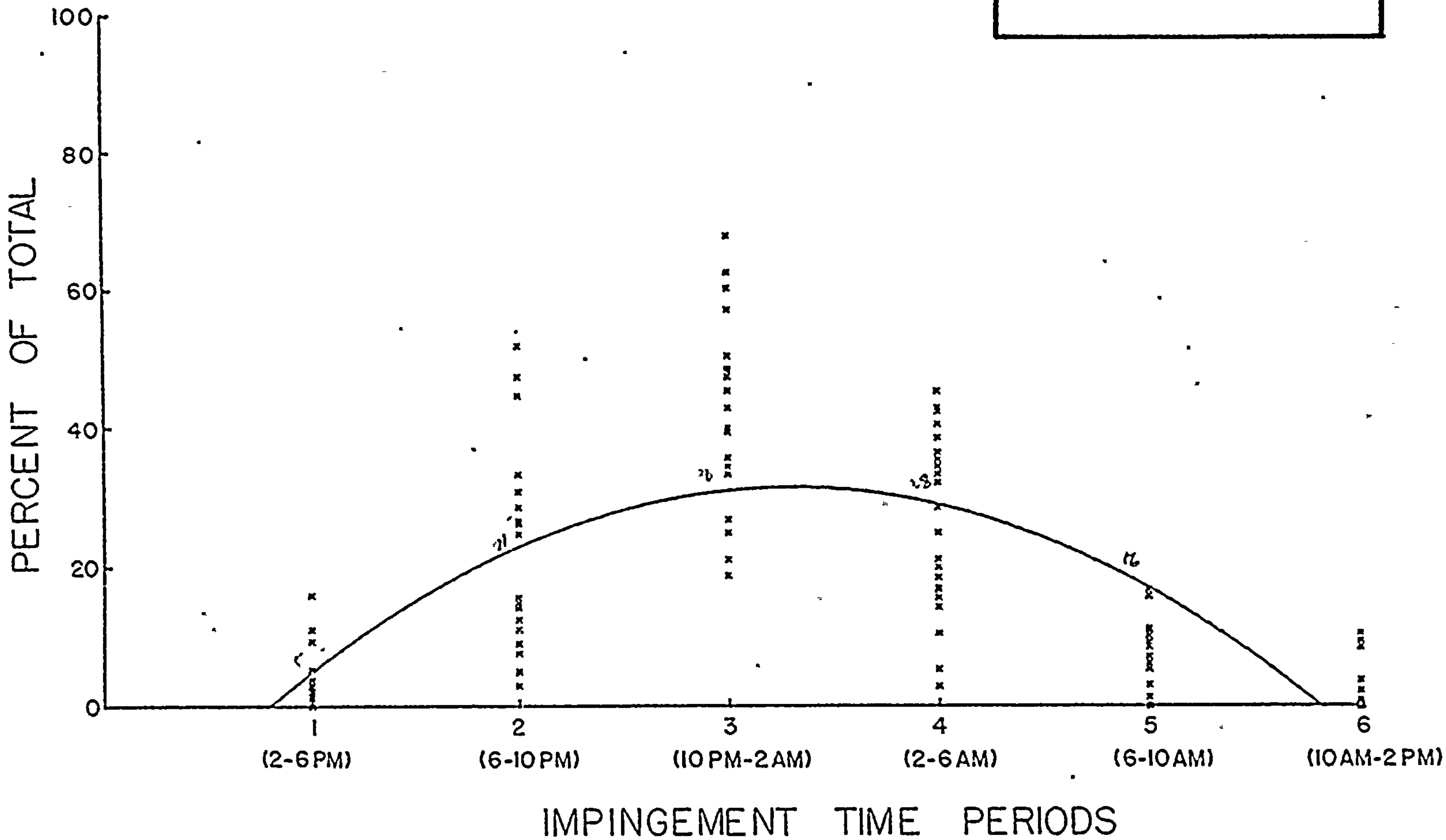


NO. IMPINGED.
AVE. WEIGHT
AVE. LENGTH
ROCHESTER GAS AND ELECTRIC
FIGURE 17
SPOTTAIL SHINER
IMPINGEMENT
1977
5000
1000
100
10
NUMBER OF FISH IMPINGED
100
10
1
AVE. LENGTH (CM) & AVE. WEIGHT (G)
J
F
M
A
M
J
J
A
S
O
N
D

ROCHESTER GAS AND ELECTRIC

FIGURE 18

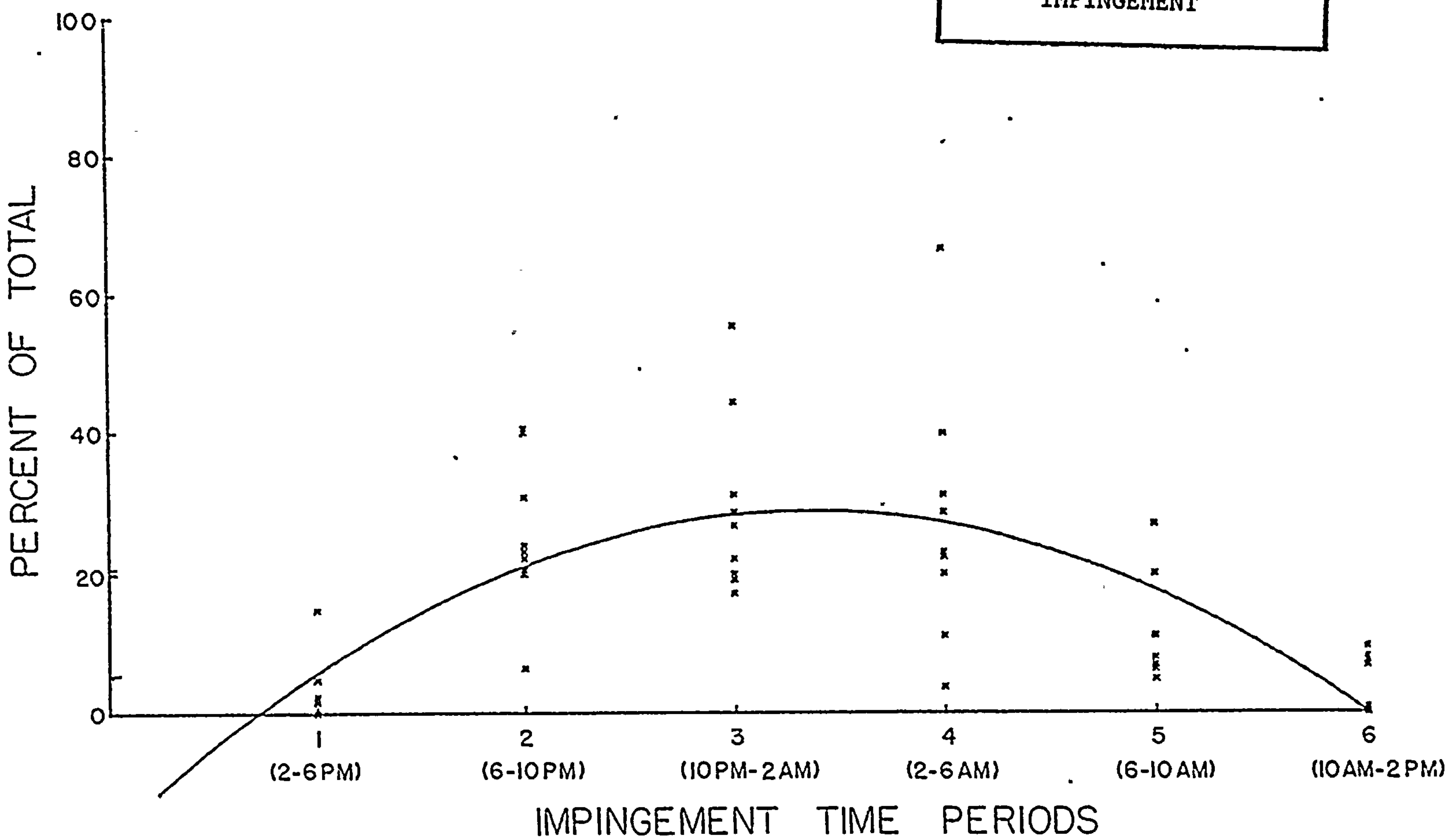
TIME-RELATED REGRESSION ANALYSIS FOR SPOTTAIL SHINER IMPINGEMENT



RGE ROCHESTER GAS AND ELECTRIC
ROCHESTER N.Y.

FIGURE 19

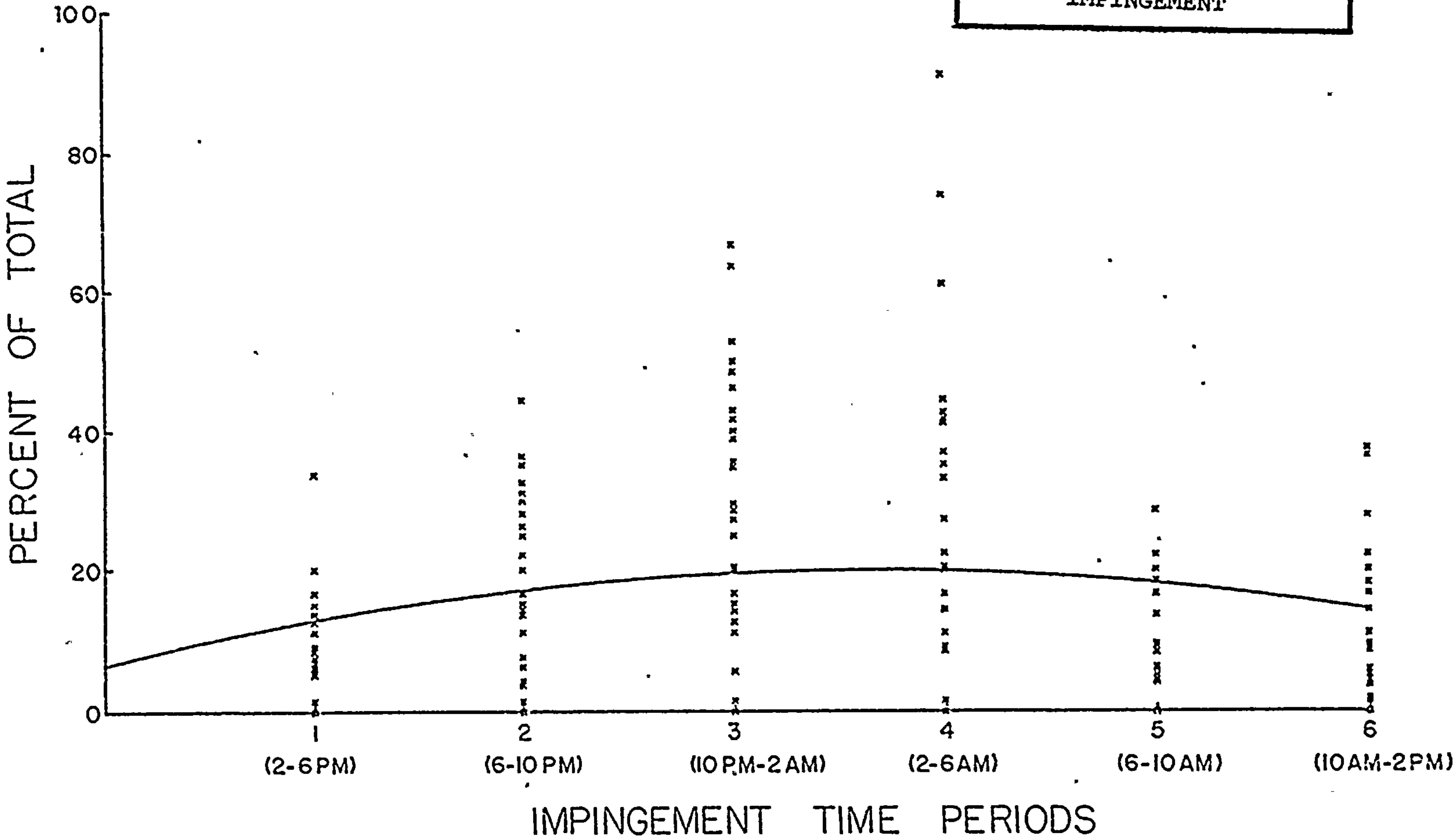
TIME-RELATED
REGRESSION ANALYSIS
FOR WHITE PERCH
IMPINGEMENT



ROCHESTER GAS AND ELECTRIC

FIGURE 20

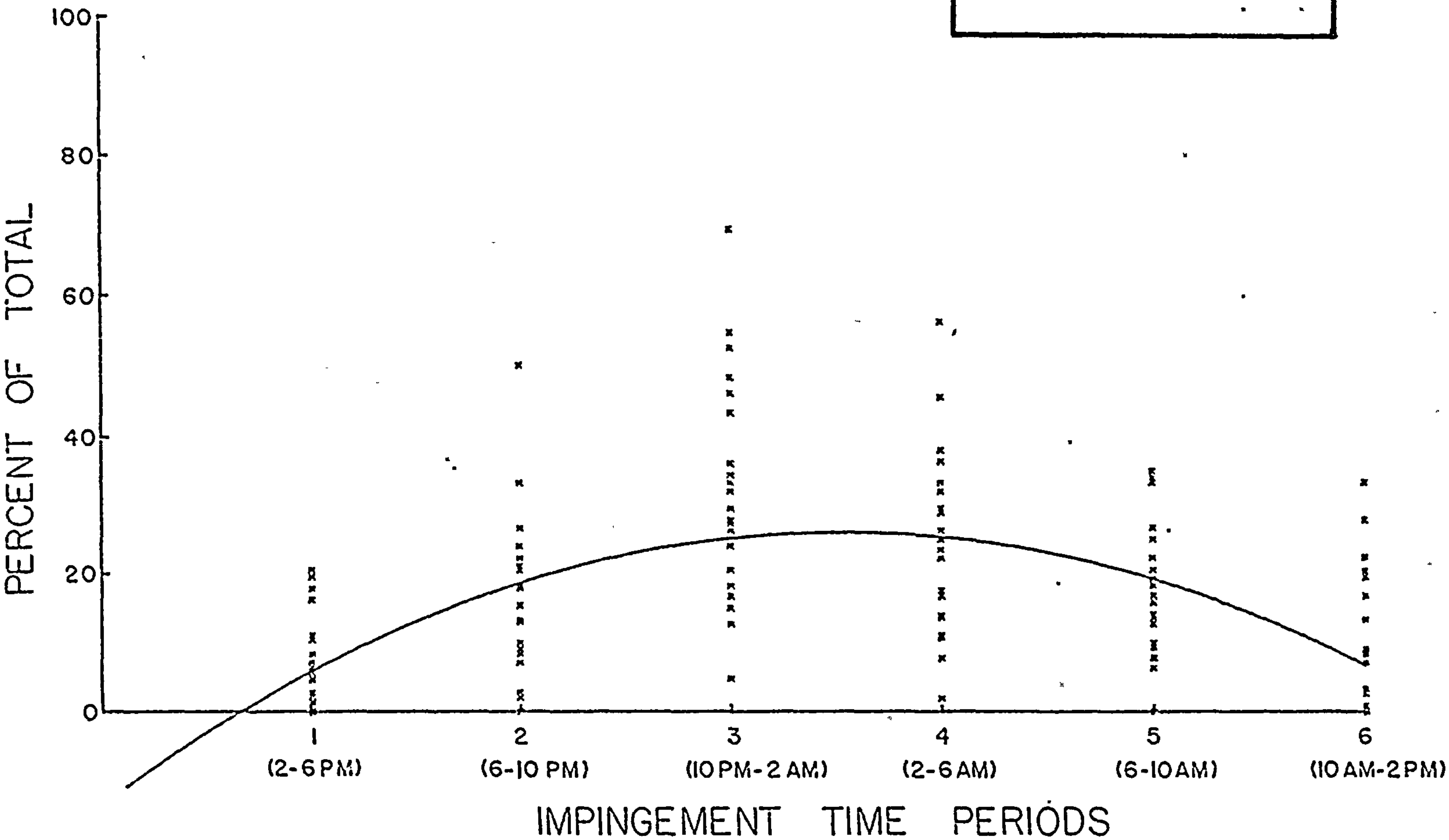
TIME-RELATED
REGRESSION ANALYSIS
FOR LAKE CHUB
IMPINGEMENT



RG&E ROCHESTER GAS AND ELECTRIC

FIGURE 21

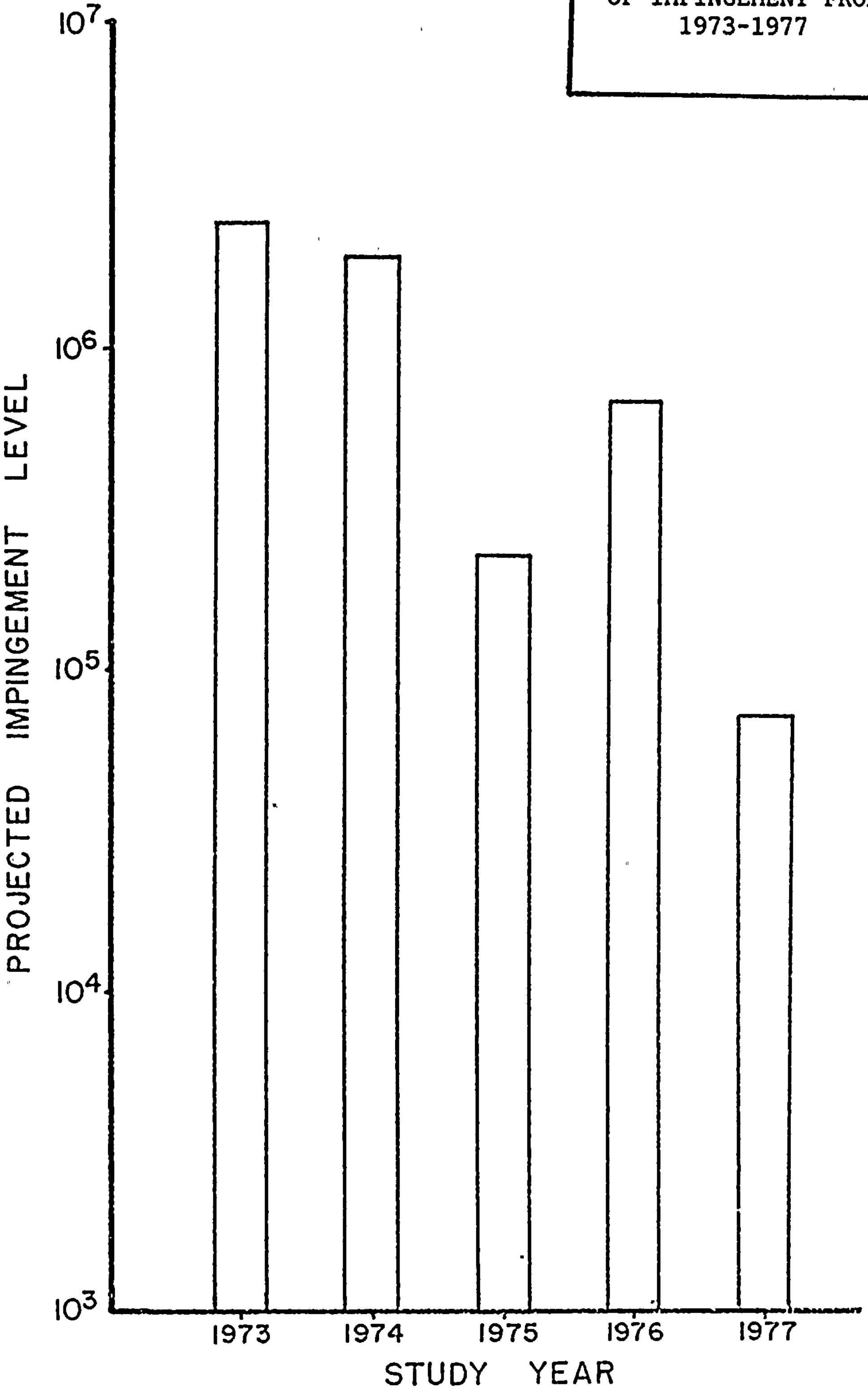
TIME-RELATED REGRESSION ANALYSIS FOR EMERALD SHINER IMPINGEMENT



ROCHESTER GAS AND ELECTRIC

FIGURE 22

ALEWIFE-COMPARISON OF IMPINGEMENT FROM 1973-1977

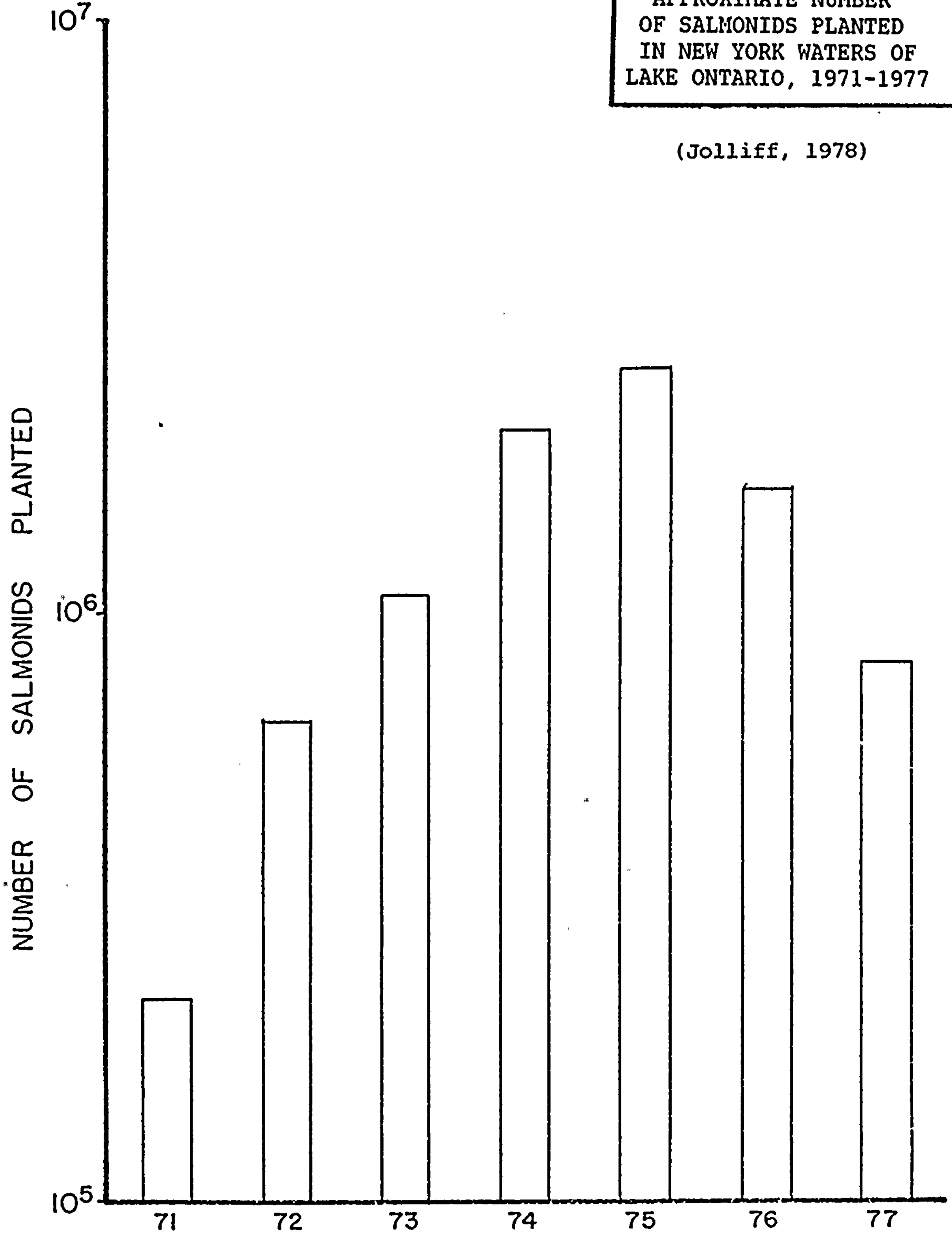


ROCHESTER GAS AND ELECTRIC

FIGURE 23

APPROXIMATE NUMBER
OF SALMONIDS PLANTED
IN NEW YORK WATERS OF
LAKE ONTARIO, 1971-1977

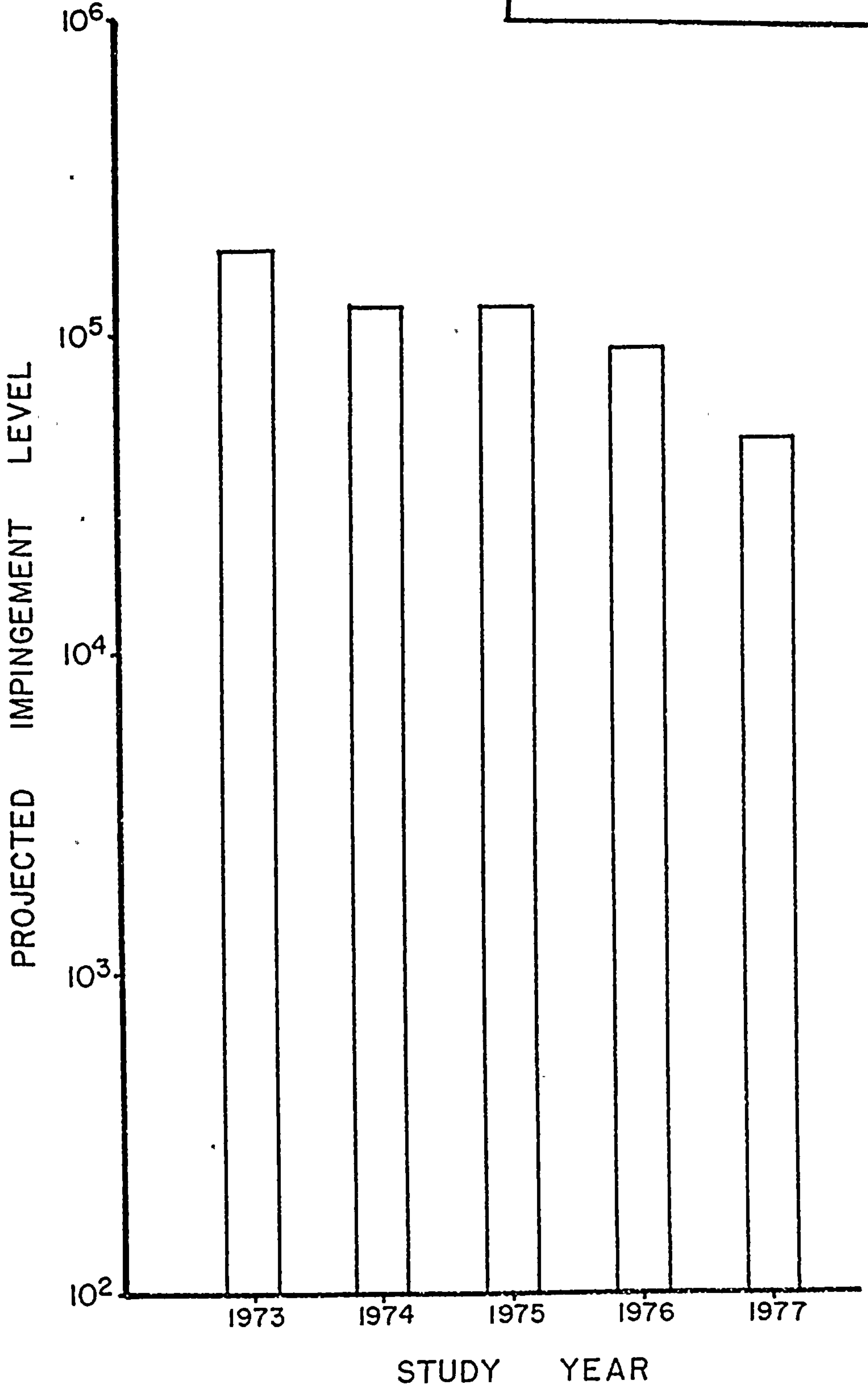
(Jolliff, 1978)



ROCHESTER GAS AND ELECTRIC

FIGURE 24

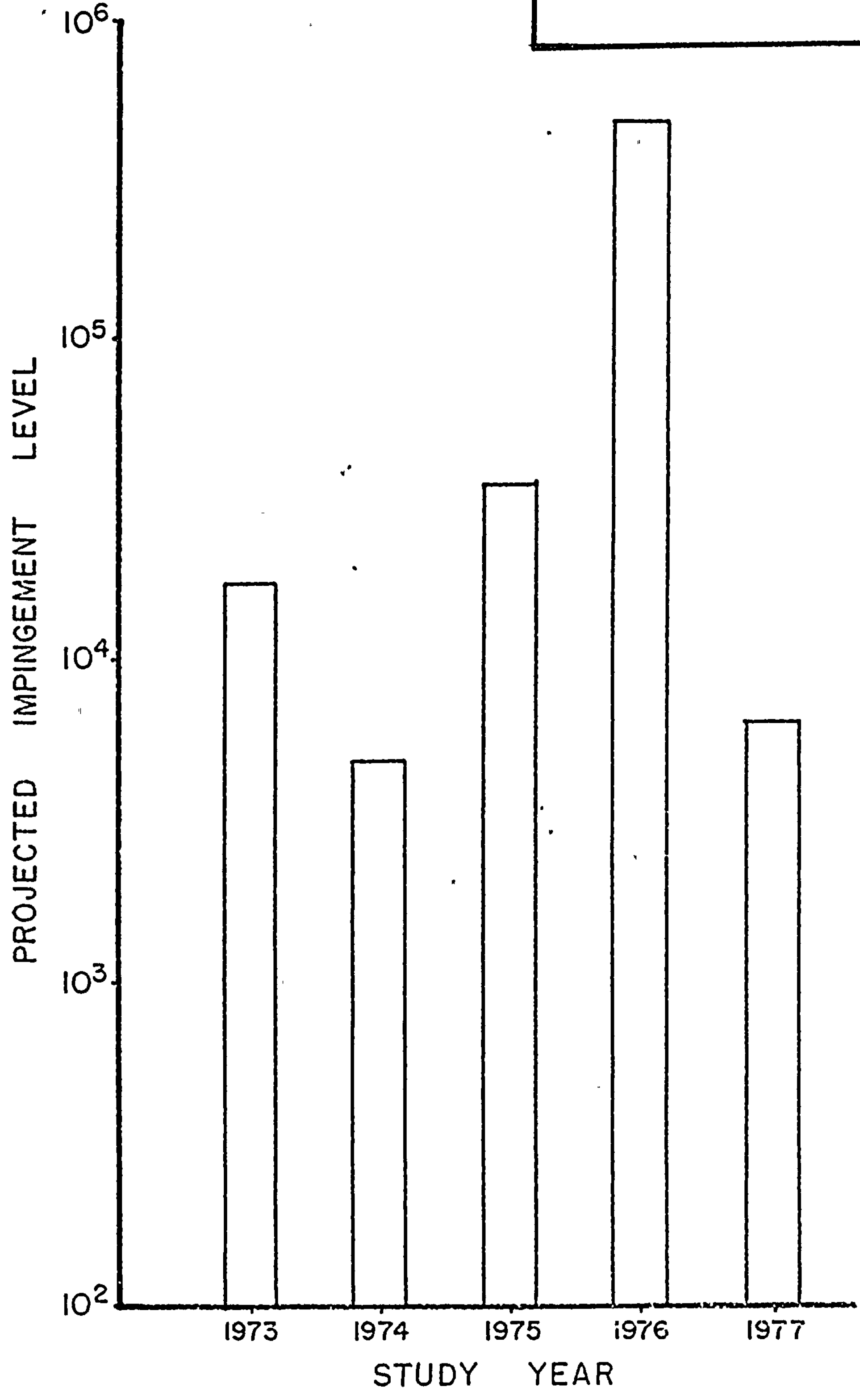
SMELT-COMPARISON OF IMPINGEMENT FROM 1973-1977



ROCHESTER GAS AND ELECTRIC
ROCHESTER N.Y.

FIGURE 25

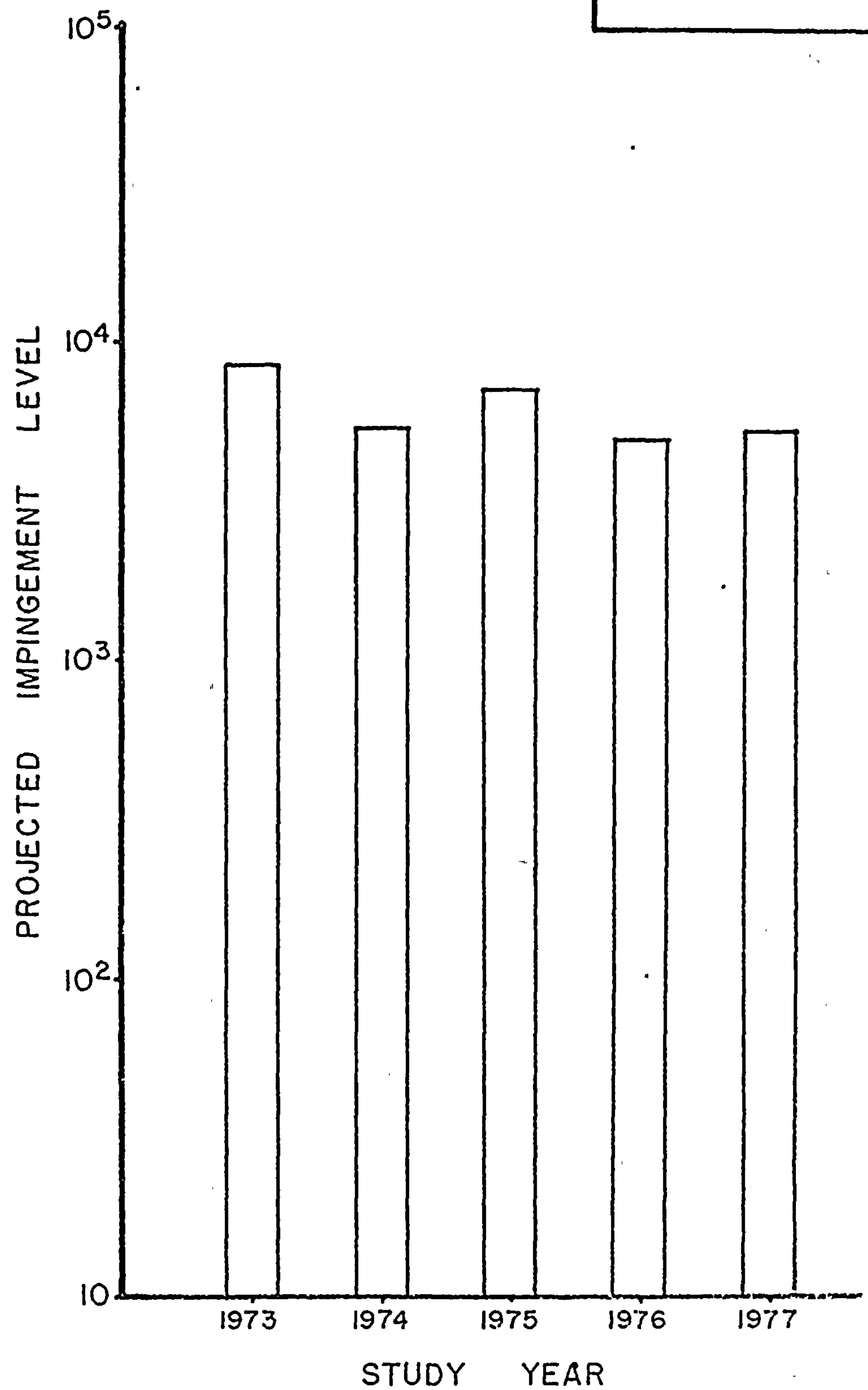
STICKLEBACK-COMPARISON OF IMPINGEMENT FROM 1973-1977



ROCHESTER GAS AND ELECTRIC

FIGURE 26

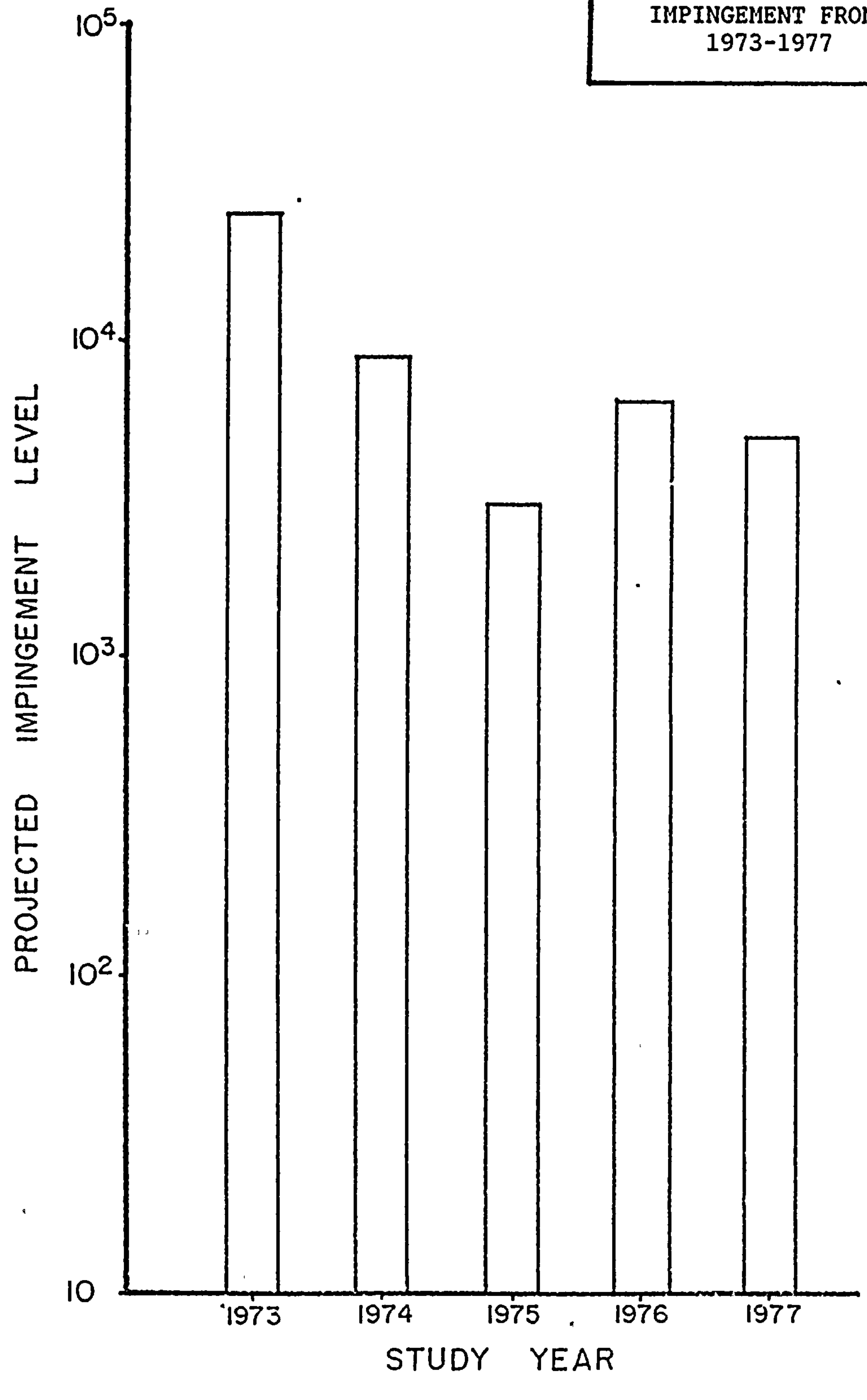
MOTTLED SCULPIN-
COMPARISON OF IMPINGEMENT
FROM 1973-1977



ROCHESTER GAS AND ELECTRIC

FIGURE 27

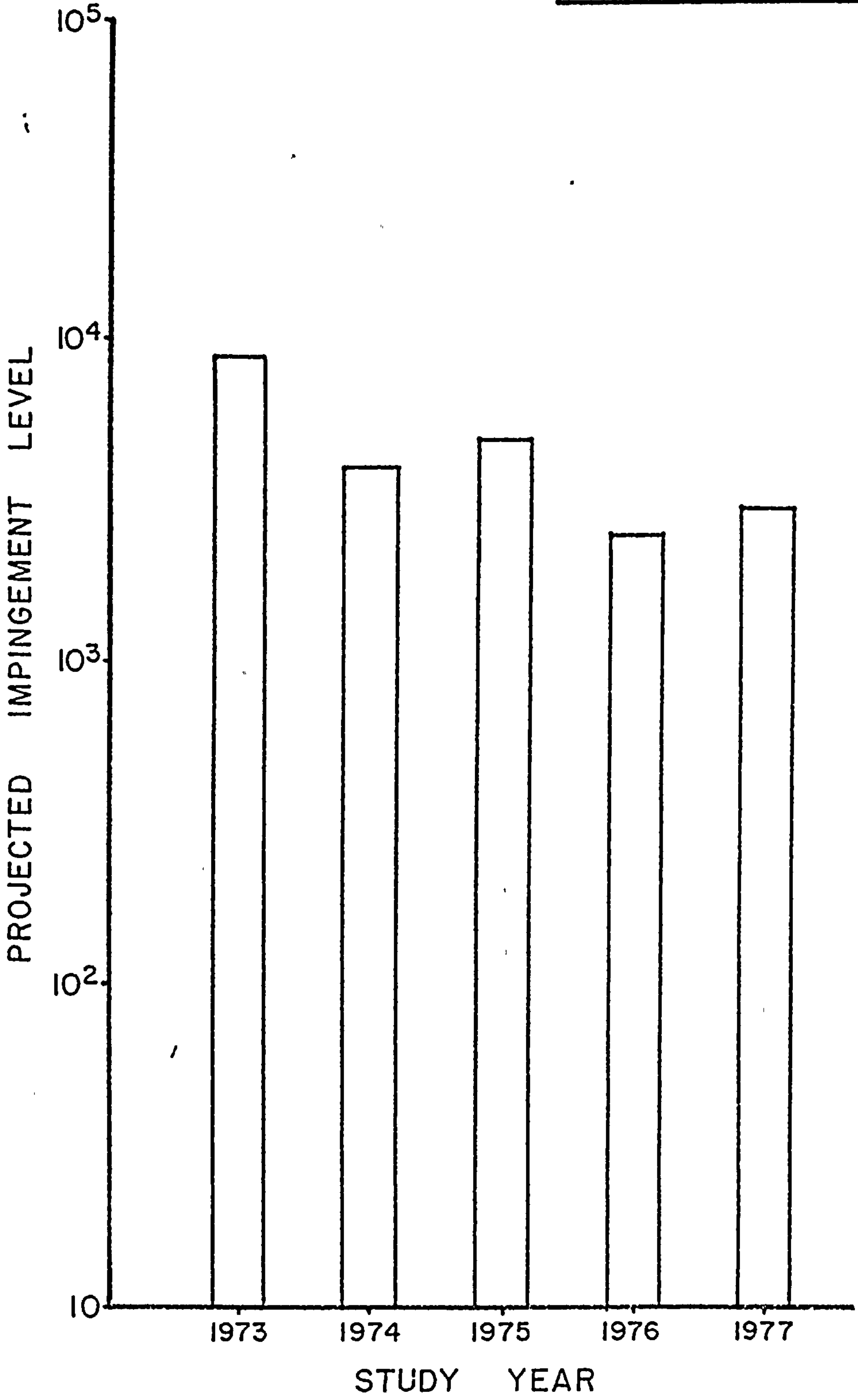
SPOTTAIL SHINER-
COMPARISON OF
IMPINGEMENT FROM
1973-1977



ROCHESTER GAS AND ELECTRIC

FIGURE 28

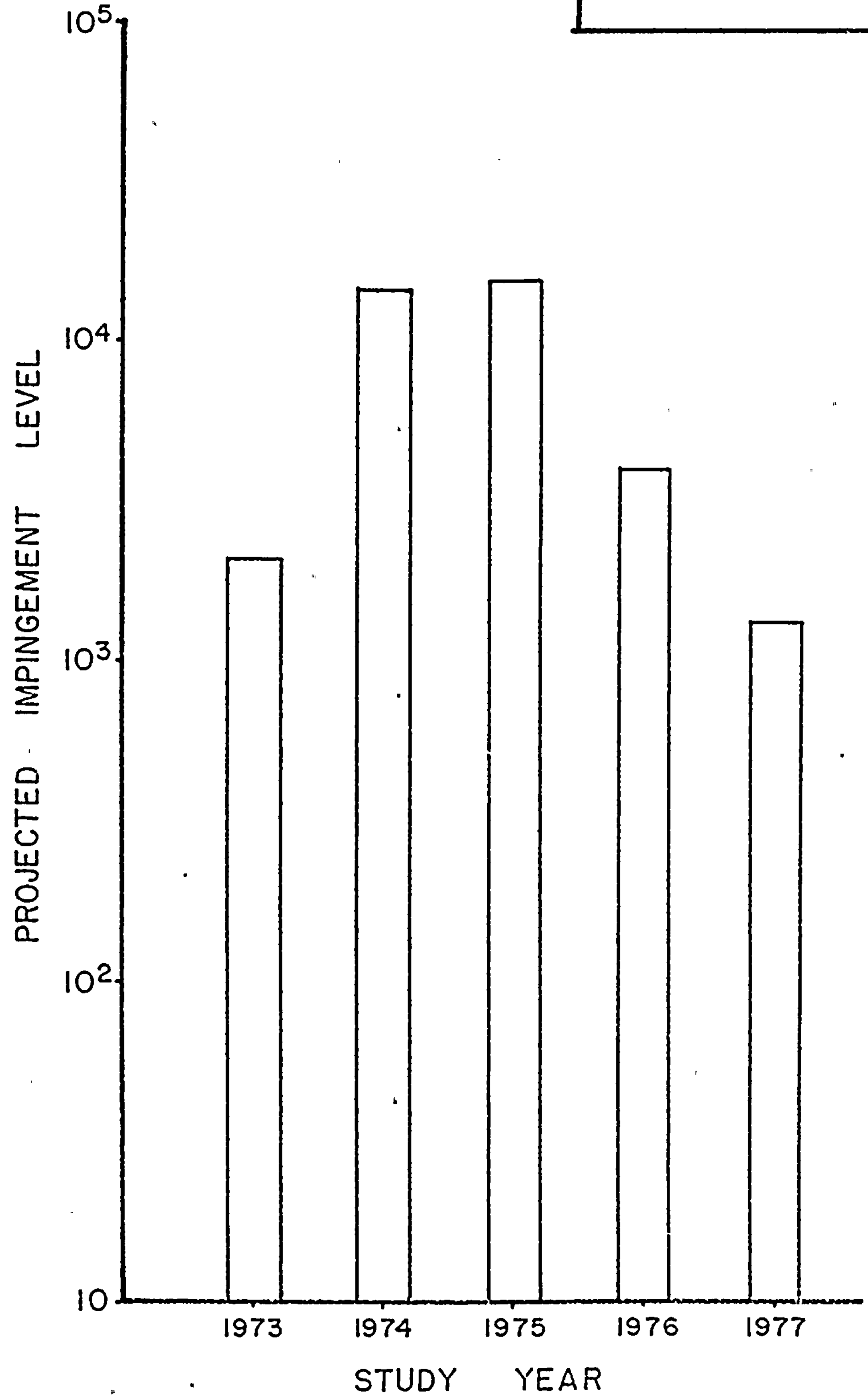
LAKE CHUB-COMPARISON OF IMPINGEMENT FROM 1973-1977



ROCHESTER GAS AND ELECTRIC

FIGURE 29

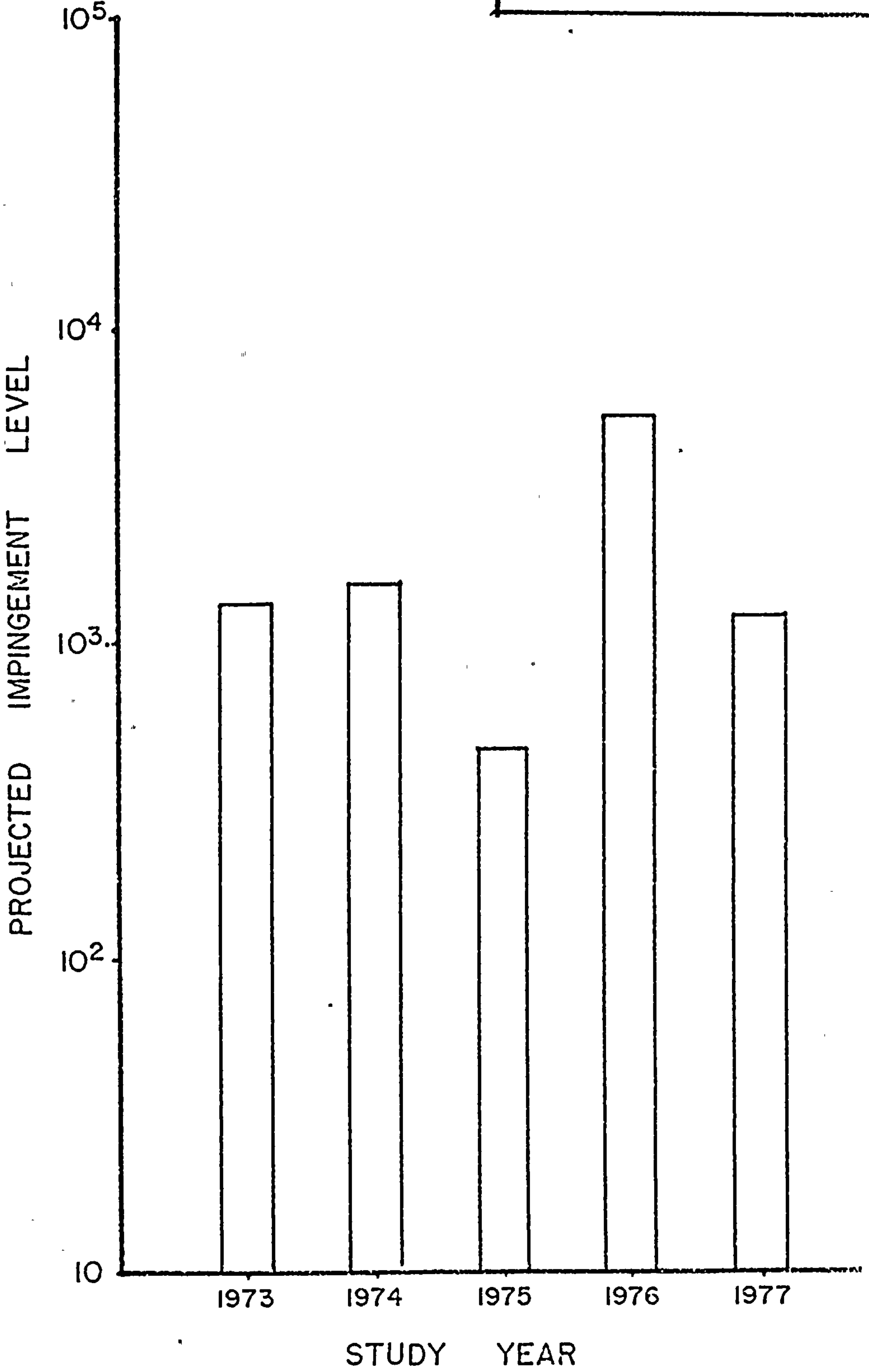
EMERALD SHINER-COMPARISON OF IMPINGEMENT FROM 1973-1977



ROCHESTER GAS AND ELECTRIC
ROCHESTER N.Y.

FIGURE 30

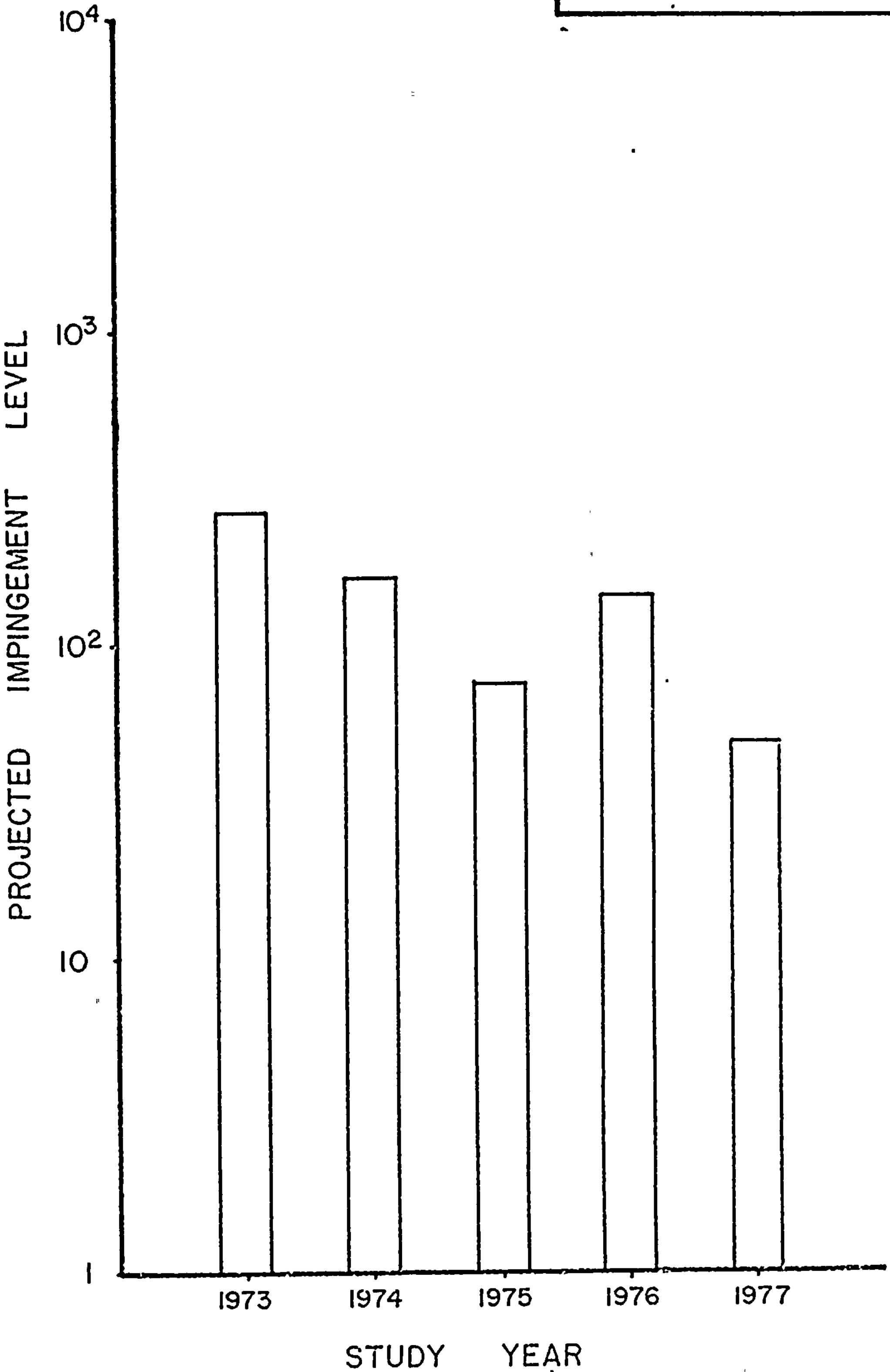
WHITE BASS-COMPARISON
OF IMPINGEMENT FROM
1973-1977



ROCHESTER GAS AND ELECTRIC

FIGURE 31

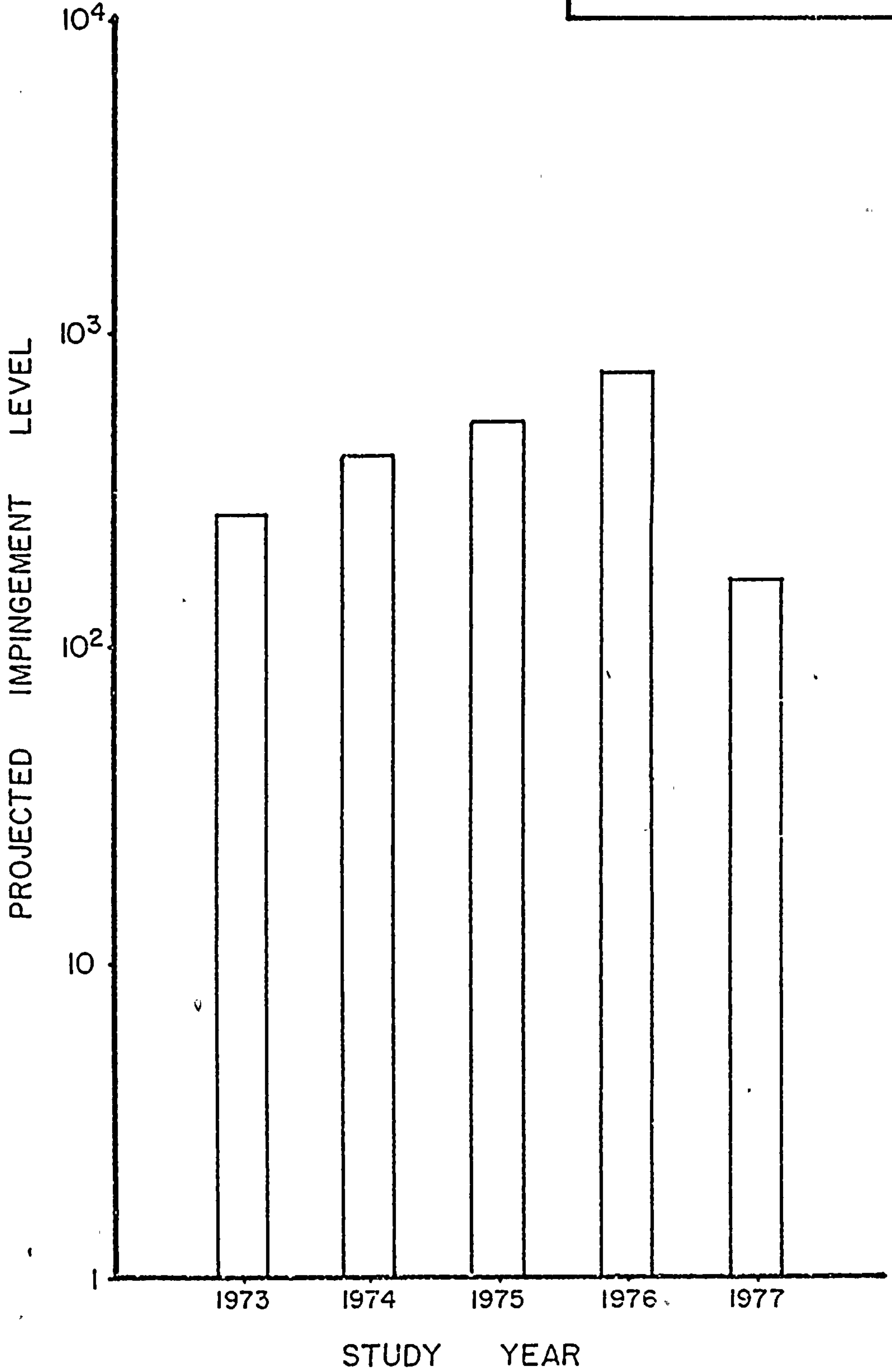
SMALLMOUTH BASS-
COMPARISON OF IMPINGEMENT
FROM 1973-1977



ROCHESTER GAS AND ELECTRIC

FIGURE 32

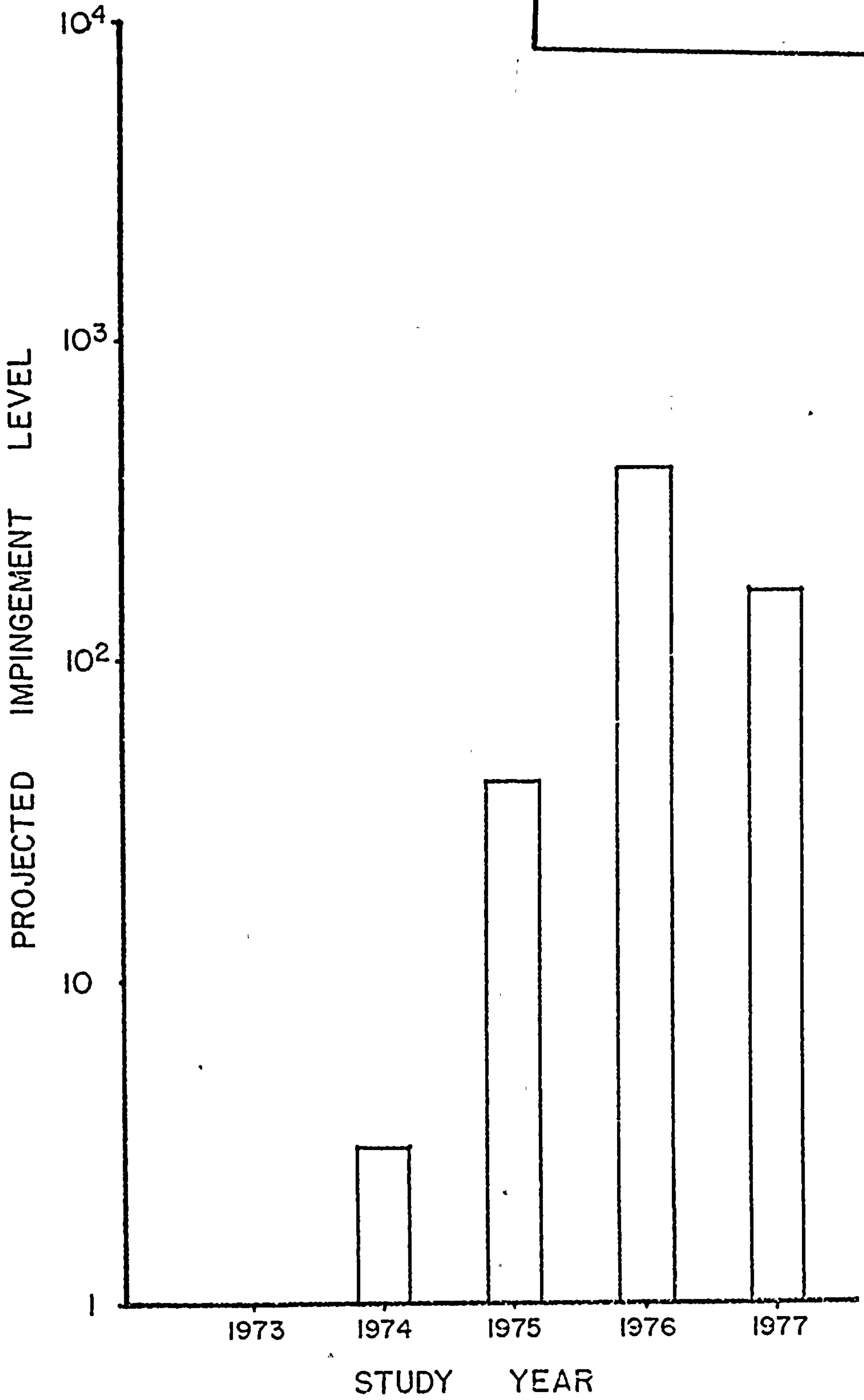
JOHNNY DARTER-
COMPARISON OF IMPINGEMENT
FROM 1973-1977



ROCHESTER GAS AND ELECTRIC

FIGURE 33

TOTAL TROUT-COMPARISON OF IMPINGEMENT FROM 1973-1977



ROCHESTER GAS AND ELECTRIC

FIGURE 34

WHITE PERCH-COMPARISON OF IMPINGEMENT FROM 1973-1977