Report of Fisheries Investigations

Underwater Observations of Fish Populations in Clear Water Lakes of Central Texas, including the Effect of Various Sound Frequencies on Fish

by

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Dingell-Johnson Project F-2-R-7, Job E-5
February 1, 1959 - January 31, 1960

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A B S T R A C T

Netting studies were conducted to determine the effects of underwater sound on movement of fish in Lake Travis. Three squares of nets of varying mesh sizes were set to enclose a sound source.

Five frequencies were transmitted, each for a period of approximately two weeks. Pure frequencies of 720 cps, 4,150 cps and 620 cps apparently had no effect on the movement of fish to the sound source. However, 2,300/400 cps mixed evenly showed a definite repelling effect and 1,750 cps had some repelling influence although less pronounced than the mixed tone.

Job Completion Report

State of TEXAS

Project No. F-2-R-7 Name: Fisheries Investigations and Surveys of the Waters of Region 6-B

Job No. E-5 Title: Underwater Observations of Fish Populations in Clear Water Lakes of Central Texas, including the Effect of Various Sound Frequencies on Fish

Period Covered: February 1, 1959 through January 31, 1960

OBJECTIVES

To test the response of fish to various frequencies of sound transmitted underwater. In addition, the sound producing capabilities of freshwater fish to be determined by underwater recordings of selected fish species. Underwater observations of fish populations to be continued with the use of SCUBA equipment.

PROCEDURE

Job E-5 was set up with three distinct phases including: (1) a continuation of visual observations of fish using SCUBA equipment, (2) recording fish sounds and other underwater sounds with subsequent rebroadcasting in an effort to attract fish and, (3) the transmission of pure frequencies underwater in an effort to attract or guide fish to a certain area. Because of the large amount of time required for the broadcast of pure frequencies, only a limited amount of time could be devoted to the other phases of the work. In addition, generally turbid water conditions hampered diving activity. Diving was largely confined to specific needs in conjunction with other phases of the work.

Experimental work was continued in recording underwater sounds, particularly those made by freshwater fish. The limited data obtained will be incorporated with those gathered in forthcoming segments of the project and no attempt will be made to present the results in this report.

The greatest time expenditure was used in phase three of the program, attempting to attract fish with pure frequencies. The experimental procedures used were formulated with the help and advice of Dr. Richard Davis, Texas Agricultural and Mechanical College at College Station in an effort to make the data lend themselves to statistical analysis. The basic experimental procedure is that used in the previous segment and described in Segment Completion Report F-2-R-6, Job E-5. The entire system was expanded and incorporated two complete sampling units replacing the single system previously used.

Each unit was composed of nine gill nets hanging 8 feet, including three 1" mesh nets 75' long, three 1½" mesh nets 100' long, and three 2" mesh nets 125' in length. Three distinct squares were set, effectively enclosing and blocking access

by fish to the sound source from open water. The nets were set with an inner square of 1" mesh, a middle square of 1½" mesh, and an outer square of 2" mesh. (In all cases the shoreline makes the fourth side of the square. See Figure 1.)

The actual sites chosen for the experiments were shallow flats with a maximum depth of 8 feet and relatively smooth bottom to prevent access under the weighted nets. Although no single square was completely closed because of small holes in the nets and occasional small openings at the corners, the unit was considered tight enough to effectively block the sound source.

The purpose in using two complete units operated simultaneously, was to increase the collected data and to provide a simultaneous control which was not possible with the single unit sampling method used in the previous segment. Because the sound system used for transmission had a range of approximately one mile underwater, the two sampling units were always set over one mile apart to prevent sound overlap.

The experiments consisted of setting up the two units in similar environmental situations and alternating sound transmissions between the two on successive nights. Only complete overnight collections were found practical and the sound was transmitted continuously for a period of approximately 14 hours, being started late in the afternoon and taken in the following morning. The net squares were set up on the same time basis.

The two unit system thus gave two possible comparisons with controls. That is, the data from a collection with sound could be compared both to that of the second unit, or simultaneous collection, or back on the previous night's collection at the same location.

Data collected included numbers of fish taken by species, including total lengths of all individuals, the specific net each individual was taken from, direction of movement (into or away from the sound source), and wind direction during the collection period. Simultaneous data was collected from both sampling units.

Because the majority of fish taken were considered undesirable, all fish were removed from the lake.

Frequencies Utilized

In order to compare results and analyze the collected data, it was necessary to maintain a constant frequency covering as many collection nights as possible. Because observations from previous segments indicated a sharp reduction in the number of fish taken after 10 or more night's netting in the same locality, it was considered necessary to set the limit of continuous operation at a maximum 14-night period. Because of equipment failure and weather conditions which prohibited work, actual experimental periods vary from 10 to 14 days. The variance in time was inconsequentail since each experimental period was a separate entity and no cross comparisons between experiments were contemplated.

The frequency generator and transmitting equipment utilized in the experiment had a frequency range of 200 to 20,000 cps. Because of the infinite numbers of pure frequencies and mixed frequencies possible to produce, the selection of frequencies to transmit was largely a random selection.

Sounds produced by freshwater fish and recorded in Lake Travis have shown a predominance of low frequency on the order of 90 to 1,000 cps. To try and simulate natural sources, half of the experimental work was conducted with frequencies below 1,000 cps. However, all frequencies utilized within this range were picked at random.

A frequency meter was incorporated into the sound system and frequency drift was observed to be less than 0.01 percent for all frequencies used.

The June experiment was conducted with a frequency of 720 cps; 2,300/400 cps mixed evenly in July; 1,750 cps in August; 4,150 cps in November; and 620 cps in December.

FINDINGS

The pure frequencies transmitted in June, November, and December apparently had no effect on the movement of fish as the numbers taken in the control and experimental situations showed random catches. These data are presented in Graphs 1 through 3.

The July experiment using 2,300/400 cps mixed evenly apparently repelled a segment of the fish population as the experimental situations with sound took 24 percent less fish than did the control situations. Each sampling unit consisting of the averaged figures for a two-night period (one experimental and one control at each location) shows a significantly lower catch with sound than without.

The collected data involves the total nettable fish population. The fish species involved are shown in Table 1. No attempt will be made to ascertain the size ranges repelled or the individual species most affected until more experiments are conducted. The data for the July experiment are presented in Graph 4.

The August experiment using a frequency of 1,750 cps also indicates a limited effect on the nettable fish population. Graph 5 shows the results of the August experiments.

CONCLUSIONS

In the experiments conducted during July and August, the frequencies utilized exhibited a significant repelling effect on the nettable fish population. The frequencies used in the June, November, and December experiments showed no effect on the movement of the fish population.

Other collected data including direction of movement, species and sizes repelled, and species and size ranges collected in the three mesh sizes will be compiled and statistically analyzed with additional data compiled at a later date.

RECOMMENDATIONS

It is felt that the result of the experiments conducted during the segment show enough promise to justify the continuance of the project. It is recommended that all phases be continued.

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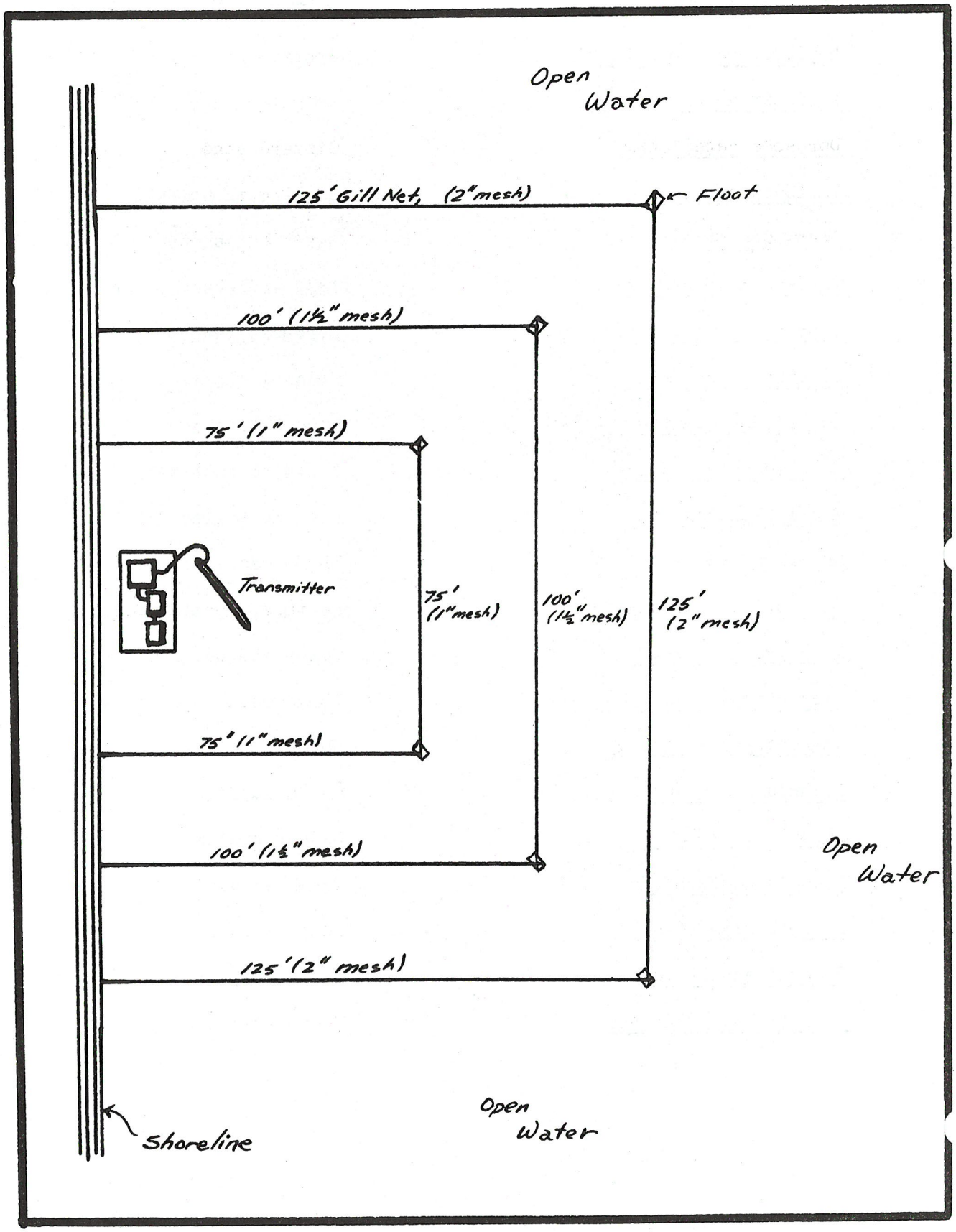
Approved by Marion Toole
Director Inland Fisheries Division

Date August 12, 1960

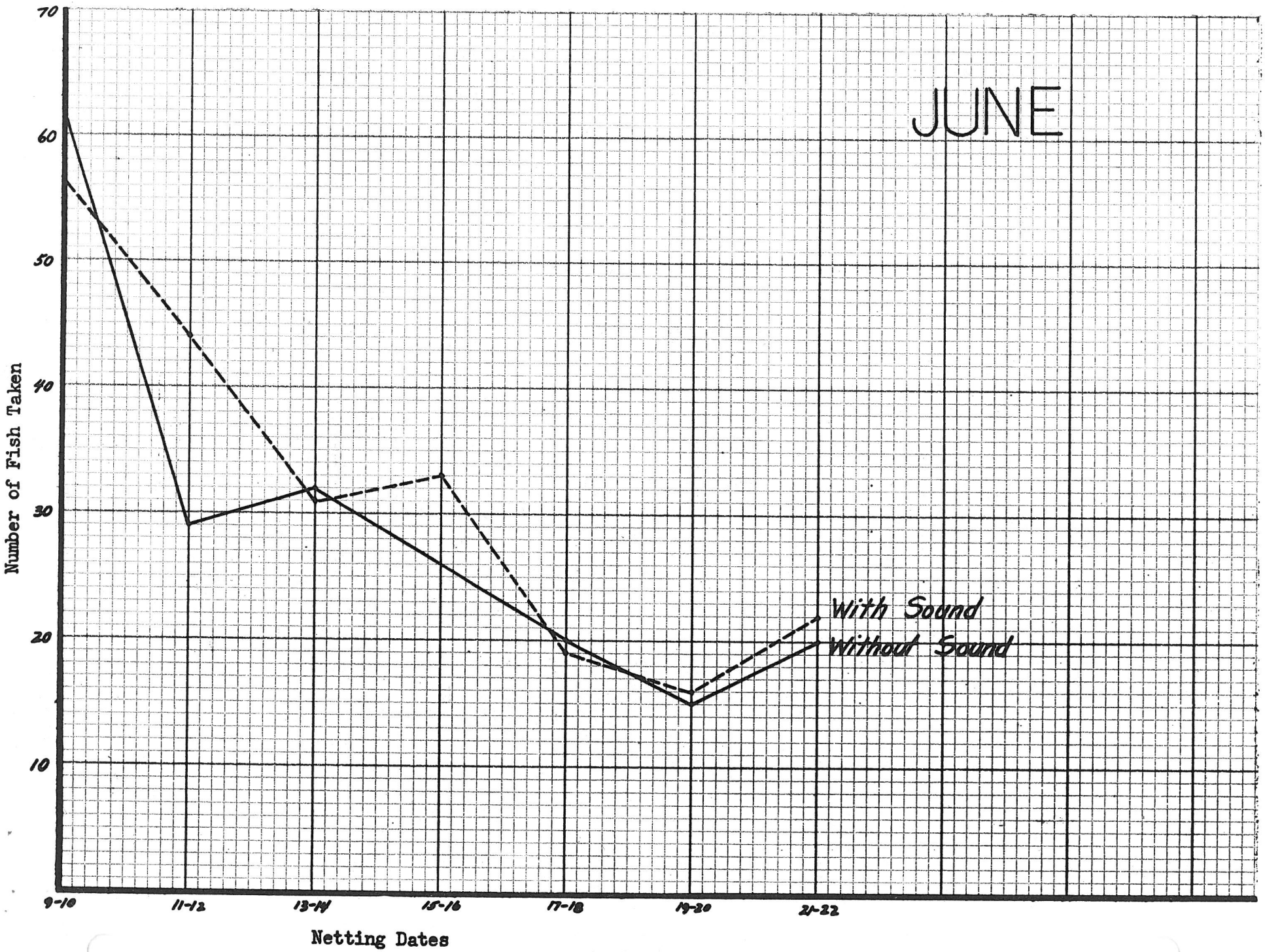
Table 1. - Checklist of species, Lake Travis

Scientific name	Common name
Lepisosteus productus	Spotted gar
Lepisosteus osseus	Longnose gar
Dorosoma cepedianum	Gizzard shad
Ictiobus bubalus	Smallmouth buffalo
Carpiodes carpio	River carpsucker
Moxostoma congestum	Gray redhorse sucker
Cyprinus carpio	European carp
Ictalurus punctatus	Channel catfish
Ictalurus furcatus	Blue catfish
Pylodictus olivaris	Flathead catfish
Mugil cephalus	Striped mullet
Roccus chrysops	White bass
Micropterus punctulatus	Kentucky spotted bass
Micropterus treculi	Texas spotted bass
Micropterus salmoides	Largemouth black bass
Chaenobryttus gulosus	Warmouth
Lepomis cyanellus	Green sunfish
Lepomis microlophus	Redear sunfish
Lepomis macrochirus	Bluegill sunfish
Lepomis megalotis	Longear sunfish
Pomoxis annularis	White crappie
Aplodinotus grunniens	Freshwater drum

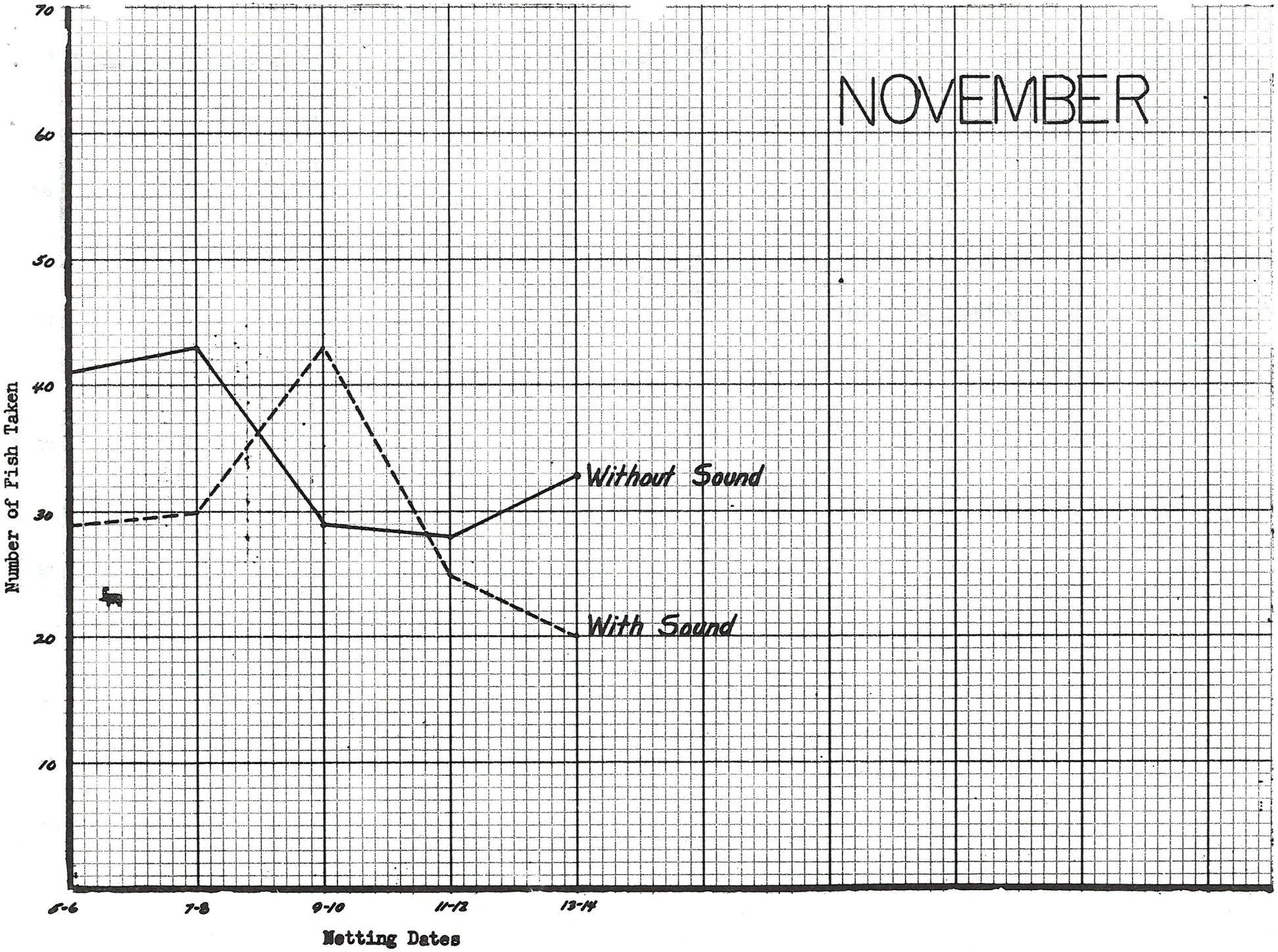
Figure 1. Diagram of Sampling Unit

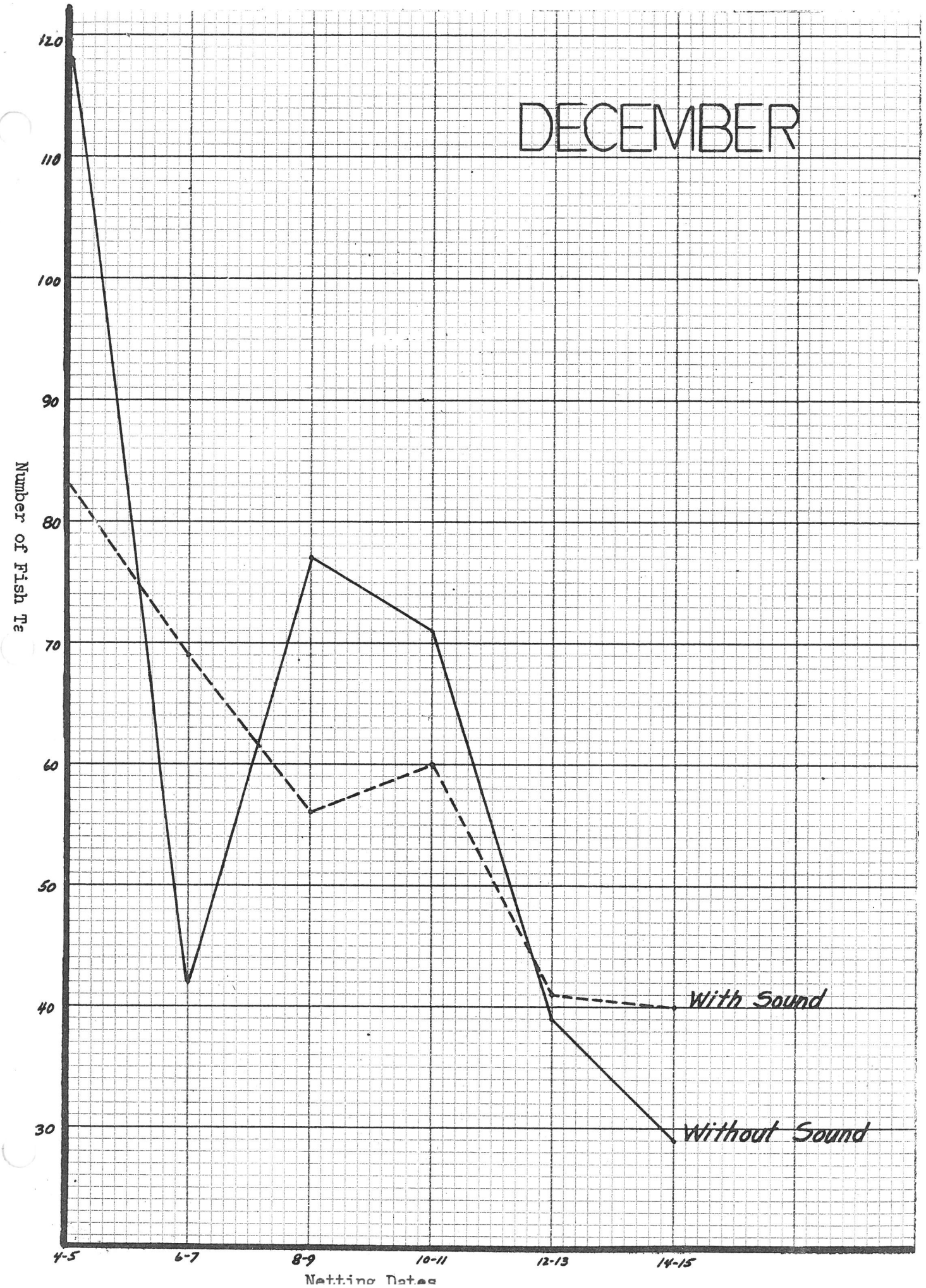


Graph 1. June Netting Results.



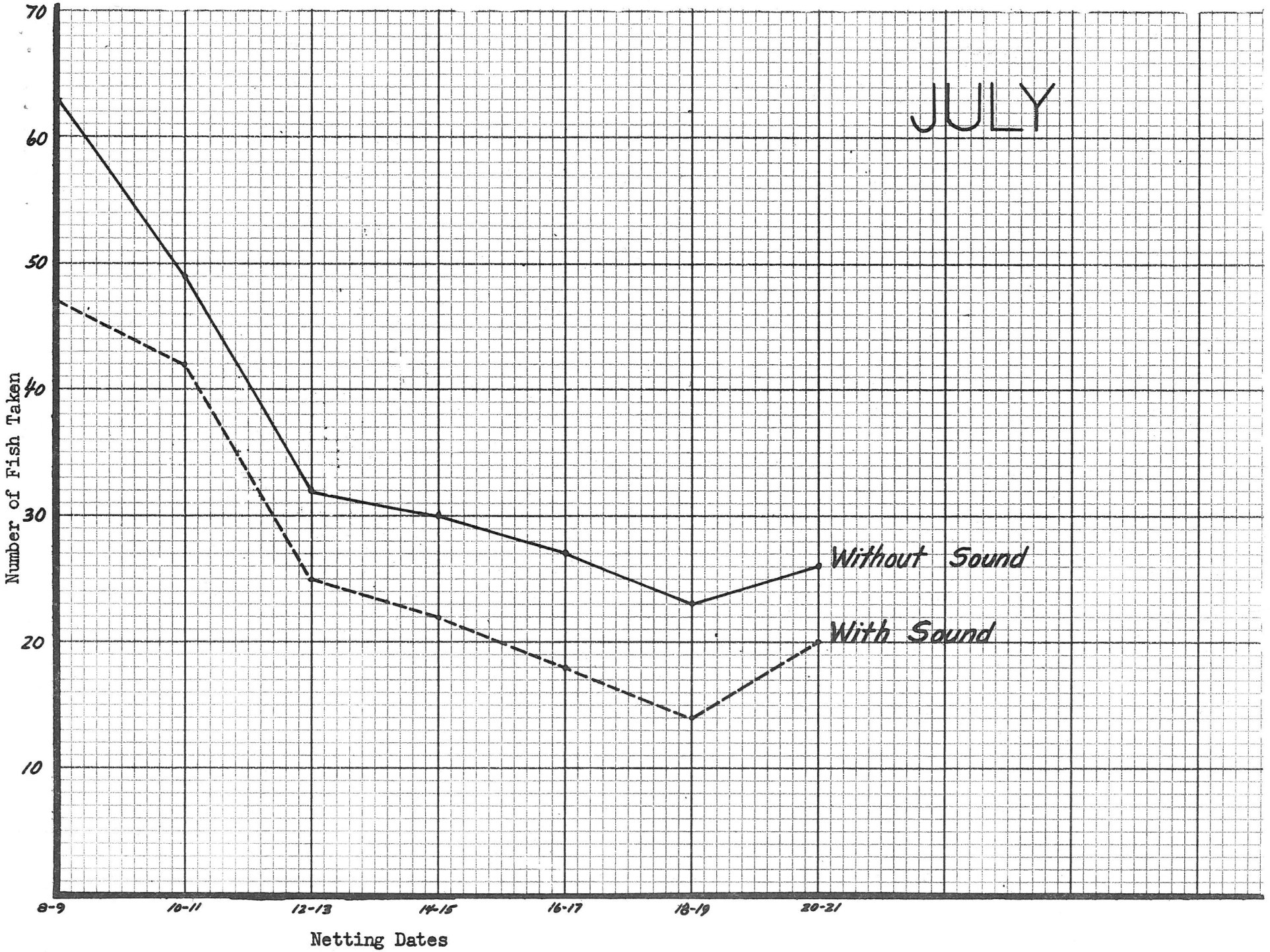
Graph 2. November Netting Results.





Graph 3. December Netting Results.

Graph 1. July Netting Results.



Graph 5. August Netting Results.