AN ICHTHYOLOGY OF FOUR ADIRONDACK LAKES
(July, 1974)

By

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INTRODUCTION

The studies reported on here were commissioned of the two authors under the auspices of the Rensselaer Fresh Water Institute at Lake George for the Adirondack Park Agency of the State of New York. The studies were directed toward defining the character of fish populations in four small lakes, Lake of the Pines in Lewis County; Crystal Lake in Warren County; Bass Lake in Franklin County, and Second Lake in Warren County, prior to development as proposed by private interests. Site study for each lake was restricted to two days during July of 1974.

The primary intent was the preliminary evaluation of 1) species composition, 2) length, weight and age relationships, 3) trophic relationships of the species for mid-summer, and 4) the establishment of a reference collection including both scales and whole specimens.

METHODS

The four lakes were each visited for two days in July (Table 1). Collecting methods involved:

1. Gill netting (125' x 6', 5 panel gang-type, bar mesh of 3/4", 1", 1-1/4", 1-1/2", 2" with 25 linear feet per net).
2. Shore seine (60' bag type with 4' depth, 1/4" diameter openings in bag and 1/4" bar mesh in wings).
3. Traps (4' x 16" wire-mesh, cylindrical type; double-cone, 5" opening; 1" chicken-wire mesh)
4. Tackle and lures.

Additional observations were made by echosounding equipment (NJA Model 155A, 50 khz, 10 cm tape width). Routine physical and chemical sampling, as reported on elsewhere, was accomplished concurrently.

Each sampling event was assigned a lot number and detailed in terms of catch by species per unit and type of collecting effort and localities of collection indicated by maps (Figures 3a-3d). Separate log sheets document these efforts (Appendix 1).

All specimens were assigned sublot numbers and then lengthed in terms of millimeters for both standard and total lengths (i.e., SL and TL), weighed to tenths of a gram, and descaled and scale sets stored in identified envelopes for age analysis. Stomachs were removed in the field and iced for later analysis for one series and a second and comparable series was preserved in buffered 10% formulin solution as reference material. The heads of bullheads of the first series were preserved similarly for possible later ageing.

Scales were read with binocular compound microscope equipped with a mechanical stage providing excellent viewing potential. Usually, only one scale per fish was read, however, confusing scales were replaced with second and third scales when necessary. Remaining scales of each set are presented as part of the reference collection.

Stomachs and intestines were examined in water with binocular dissecting and/or binocular compound scope(s), and contents were identified to broad taxa and quantified where possible. Lengths and weights for larger, ingested fishes were reconstructed when possible. These results along with other data were placed on analysis sheets which are related to field data sheets (Appendix 1).

Condition indices following Lagler, 1966, were generated from length and weight data for all specimens. For species represented by larger numbers, lengths, and weights were converted to $\log_{10}$ form and plotted to produce the a and n coefficients (LeCren, 1951). Weights and ages were also plotted for these larger series using grouped data.

Trophic relationships were tabulated by lake to illustrate the current dietary preferences.

RESULTS

The numbers of fish sampled by species and lake are presented in Table 2. The condition indices for each specimen is

presented by lake in Appendix 2. The length and weight relationships in $\log_{10}$ form are presented in Figures 1a-1k and Appendix 2 for selected series. Weight and age relationships, again for selected series, appear in Figures 2a-2g. Diet is detailed by species and by lake in Tables 4, 5, 6 and 7. Echograms for each lake, exclusive of the shallow Lake of the Pines, are presented in Figures 4a-4d, 5a-5d and 6.

DISCUSSION (By Lake)

Lake of the Pines

Lake of the Pines is a man-made impoundment of recent origin (dammed October, 1971). The parent stream was apparently well stocked with the brown bullhead and this hardy species probably contributes the largest biomass of any species present. The populations probably also include the most senior (i.e., in terms of age group) fishes. Yellow perch have colonized the lake and now exhibit great strength in the 0+ and 1+ age groups; however, larger specimens are present but rare. The golden shiner is another prominent species and should continue to serve as a forage base for the dynamic and expanding largemouth bass and chain pickeral populations, if brush shelters and rooted macrophytes remain intact. Fry were observed in abundance, but not taken in submerged brush piles in the north end of the lake. The larger individuals of the species appeared to be more widely ranging and reached 60 g in their third year of growth. Currently the population appears to be dominated by the 2+ age group; however, the sample was small, including only 28 specimens.

Largemouth exhibited excellent growth and condition reaching 650 g in their fourth year of life. The condition indices for the 35 specimens collected ranged from 10.1 (for fry) to 17.8 for a 524 g - 309 mm fish, values considerably higher than for the other lakes examined. Although the representative numbers are small, growth appears to be especially dramatic between the 1+ and 2+ age groups. Growth then appears to slow and then to recover. The chain pickerel, another piscivore, is comparable and shows excellent growth reaching 527 g in its fourth growing season.

Fishing pressure is currently light. Development will, however, be associated with much more fishing and thus a stock decline, especially for the senior year classes of largemouth bass and chain pickerel, must be expected. The small size of the lake and the vulnerability of these two species will probably accelerate the decline.

This water body will probably show only minor thermal stratification due to its riparian character and shallow depth and will probably retain good levels of production because of its connection with flowing waters, even though seasonal. Its productivity is also reflected in its somewhat broader taxonomic diversity including white sucker (fry only collected) and pumpkinseeds.

Rainbow trout were stocked (i.e., 200 6" fish) about four weeks prior to the study however none were taken or observed.

Crystal Lake

Crystal Lake is a natural water body having a rounded and regular shore reflective of its glacial origin. It is fed and drained by minor streams which flow, but with considerable, variation, throughout the year. Connections with other water bodies are not well developed and are probably not conducive to stock recruitment or loss.

The waters are clear and unstained with secchi disc depths up to 5.9 m at the time of the study. The lake is well stratified and echograms mark the distinctive absence of fish targets below 8 m (25') depths, which seems associated with low O_2 levels below 7 m (22').

Redbreast sunfish predominated marking the sandy and rocky nature of the littoral zone. Twenty-one males were noted tending nests around the entire perimeter. Forty-four other nests were observed and may have included those of the pumpkinseed which may have already completed spawning and nest tending. Growth for both species is slow but sustained (see Figures on growth). Nursery areas for the two species consist of beds of rooted macrophytes, especially the marshes at the inlet-outlet. The diets of the two

are again similar emphasizing the larvae of aquatic insects, although the pumpkinseed tends to favor molluscs.

Yellow perch are also important in Crystal Lake, especially in the offshore waters where they harvest the fry of their own species. The absence of cladocera and copepods in their diet was unexpected. Like the sunfishes, they depend heavily upon larval insects and molluscs.

Large specimens of the species are abundant but appear to be slow growing and long-lived with 9+ age groups (527 g) occurring.

The two senior predators are again the largemouth bass and the chain pickerel. We must postulate their dependence upon the three aforementioned species along, their own fry, and crayfish for forage. Condition indices for older year classes of chain pickerel range from 5.47 to 5.99 (average 5.66) in comparison with an average condition index of 5.98 for Lake of the Pines. Condition indices for largemouth bass ranged from 13.8 to 15.4 (average 14.53) in comparison to Lake of the Pines where the indices ranged from 12.0 to 17.8 (average 15.72).

Fishing pressure appears to be heavy and has already harvested senior age groups of largemouth bass and pickerel to an extreme degree. At the same time, minows and killifishes are uncommon, perhaps due in part to water clarity and the scarcity of macrophyte cover.

Trout were reportedly stocked six to seven years ago, however, none have been taken or observed in recent years. Original stocked populations thus appear to have been caught or to have died out. Reproduction has also probably been unsuccessful due to lack of a suitable spawning habitat. The low oxygen content of the deeper waters of this lake is a further detriment to salmonids.

Bass Lake (or Pond)

Bass Lake (or Pond) a man-modified beaver impoundment is the least productive of the four lakes examined with only brown bullheads of poor condition (e.g., range 9.4 to 13.7, average 11.3) present. The low productivity and absence of any other fish

species is probably related to the extremely low pH of the lake and its present seasonally land-locked condition. A survey conducted in June of 1954 by the New York State Conservation Department found brown bullheads and brook trout, but the latter species has not been observed in recent years.

Curiously, the bullhead population appears strongly dependent upon zooplankton, and specifically Cladocera, for nutrient support. Echosounding marked their mid-water foraging activities & night-time echograms also marked the presence of many small targets suggesting the off-bottom movement of organisms.

Second Lake

Second Lake was the most vigorous and faunistically diverse lake of the four studied. The open connection with both up-stream and down-stream lakes probably plays a major role in this regard allowing both stock recruitment and nutrient supply.

Eleven species were present (Table 2), among which the yellow perch was most frequently collected. Other prominent species were the brown bullhead, white sucker, the northern pike and several species of minnow including the cutlips, spot-tail shiner, common shiner and the fall fish, suggesting a complex and productive trophic system.

The catholic diet of the yellow perch is again well marked with heavy dependence upon larval insects.

Senior predators were the largemouth bass and the northern pike. Condition indices for the northern pike ranged from 5.4 to 6.2 with an average of 5.7. The single largemouth bass had a condition index of 16.1 which compares favorably with Lake of the Pines.

A distinctive feature of Second Lake is the wide vertical distribution of the fishes, and their apparent concentration, as marked by echograms, near the inlet. The influence of the connected running waters is well reflected in this observation. The maximum depth noted along the acoustic transects was 12 m (40') and targets were noted at or near the bottom of these depths which is surprising because analysis on 7/30/74 indicates extremely low oxygen concentrations below 4 m. The echogram, run at 1600

(Figure 6) may illustrate the known ability of yellow perch to briefly tolerate low O_2 concentrations during periods of foraging. Gill nets were, unfortunately, set only at night at these depths and caught nothing.

Rooted macrophytes abounded in waters up to depths of 2 m (6') for about 75% of the shoreline. These plants act as cover for younger fish and smaller species and thus help to explain the presence of senior predators of good condition even though not common. The relative paucity of largemouth bass was surprizing in light of the apparently protected status (i.e., fishing prohibited) of the lake.

IMPLICATIONS

The authors did not attempt to evaluate the impact of development on the fish populations of the four lakes and strongly suggest that experienced fisheries biologists of the Department of Environmental Conservation or other agencies review the data for this purpose.

REMARKS

Sampling methods and data reduction was the best possible given the time and resources available. Ageing for bullheads, for example, could have been accomplished with more time. The heads, however, have been supplied with our reference material if age determinations prove necessary. The sampling of both senior and juvenile age groups could have been accomplished to a more satisfactory degree if more time had been available. Electroshocking might also have been a useful additional technique; however, the softness of the waters involved will limit the utility of the method.

Further studies of the materials in hand might involve the back-calculation of length on the basis of scale to body proportionality. This would provide much more information using a relatively small number of specimens (comments of reviewers). The procedure would involve the making of scale impressions in acetate

and the projecting of an image at about 40 X for direct measurement of scale annuli. The projection equipment would constitute a significant expense if not already available.

Some time might be saved by eliminating the collection of standard lengths (recommended by W. Flick). Weights of larger fishes might be taken to the nearest gram (recommended by W. Flick) while increased attention might be given to the highly indicative (i.e., in sense of "indicater species") cyprinids where .1 gram accuracy might be sustained (several reviewers).

The time of collection is a difficult issue to deal with. The sexes of the perciforms will tend to sort out in the spring and thus sampling will commonly collect one sex or the other more heavily and thus length-weight relationships would grow more complicated in analysis. At the same time extremely useful data on sexual maturity and gonad condition may be derived. Fall sampling allows a better comprehension of recruitment over the breeding and growing season and comprehension of reproductive vigor of selected salmonids.

Mid-summer sampling has advantages in terms of the availability of personnel who can perform the many laborious components of the analytical schedule. At the same time weather conditions are more amenable to collecting. In the long run the logistics of personnel may prove most controlling because of the dollars involved.

The data processing could be extended almost ad infinitum to include many of the conventional statistical descriptives and tests. It is possible that the Adirondack Park Agency could provide a program in computer card format which would process the gathered data in a manner maximizing utility. If such a system could be devised the analysis sheet of the survey could include a part where the data would be presented in a form appropriate for the card punch operator.

The question of comparison is another difficult one. The work of Kenneth D. Carlander (1969, Handbook of Freshwater Fishery Biology, Volume 1, Iowa State University Press, Iowa, 752 pp.) is exceedingly useful here but the Perciformes are not included and

thus a diverse literature must be considered. Again, the problem of time and finances enters.

The summarization of the stocking records for the lakes concerned is grantedly also a good item to include in a further report.

The generation of reliable estimates of total population does not seem appropriate for the circumstances. Large numbers of fish must be collected and processed in an overt and potentially damaging manner. Some species which are not easily taken will always escape good evaluation. Gear, best suitable for these methods is expensive and vulnerable to theft and disturbance and a private party commonly encounters public resentment in the process. It thus seems that surveys of this nature must be content with catch per unit of effort and relative abundance as key indicators of abundance with much more intensive analysis being applied to the fish in hand (i.e., back-calculation, condition index, diet, sex condition, length-weight relationships, etc.). If a total population estimate does prove absolutely essential acoustic methods where only minimal species definition sampling is needed might well serve.

ACKNOWLEDGEMENTS

The courtesy of access by each developer is herewith gratefully acknowledged. The assistance of the Department of Environmental Conservation in making earlier sampling records is also greatly appreciated. Finally the coauthors with to express their appreciation to Mr. Shigeru Kobayashi, Drs. Nicholas Clesceri, James Ferris, and Carl George for their guidance and assistance in the development and execution of the study. The field and laboratory assistance of Mr. Russell Kiggins, Mr. John Schaninger, Mr. Paul Marean and Ms. Andrea Marean is also heartily acknowledged.

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TABLE 1. General Characteristics of the Four Lakes Studied

Name	Field Study Dates	Area (Acres)	Max. Depth (Ft)	Secchi Depth (Ft)	Basin Character	Origin	Human Influences
Lake of the Pines	7/15/74-7/16/74	39.4	9	1.7	Shallow, mud-silt bottom, "Tea stained," few rooted macrophytes.	Impound-ment 10/71	Four houses presently constructed on lake shores. Fishing pressure apparently light. No motor boats observed.
Crystal Lake (Round Pond)	7/22/74-7/23/74	53	50	5.9	Clear, unstained, sand-gravel, cobble stone base rock bottom with collected silts in a greater depth; marsh growth at north end; lilies and other rooted macrophytes common.	Glacial	Fishing pressure heavy especially on largemouth bass and chain pickerel. No gasoline motors allowed, electric motors permitted.
Bass Lake (Bass Pond)	7/24/74-7/25/75	8	25	3.8	Mud-ooze floor in depths with sand and "bog iron" in shallows; wood debris common; rooted macrophytes sparse; transparent but slightly stained water.	Glacial kettle modified by beaver and man	Fishing pressure on brown bullheads moderate. No boating activity observed. Shores bulldozed but no construction on shores.

TABLE 1. General Characteristics of the four lakes studied (Continued)

Name	Field Study Dates	Area (Acres)	Max. Depth (Ft)	Secchi Depth (Ft)	Basin Character	Origin	Human Influences
Second Lake	7/29/74-7/30/74	8	40	3.9	Mud-sand-gravel floor with abundant lilies and other rooted macrophytes in shallow waters; moderate clarity water slight staining.	Glacial and riparian	Fishing not allowed at present. Boating activity heavy from motor boat used for water skiing. No new construction on lake.

TABLE 2. Numbers of Specimens by Species of Fish for the Four Lakes Examined.

Species	Lake of the Pines	Crystal	Bass	Second
Yellow perch (Perca flavescens)	43	24		31
Brown bullhead (Ictalurus nebulosus)	52		41	10
Pumpkinseed (Lepomis gibbosus)	18	31		6
Redbreast sunfish (L. auritus)		43		
Largemouth bass (Micropterus salmoides)	35	6		1
Chain pickerel (Esox niger)	16	14		
Northern pike (E. lucius)				7
White sucker (Catostomus commersoni)	6			13
Golden shiner (Notemigonus crysoleucas)	28			
Cutlips minnow (Exoglossum maxillingua)				4
Fallfish (Semotilus corporalis)				17
Spottail shiner (Notropis hudsonius)				6
Common shiner (N. cornutus)				1
Banded Killifish (Fundulus diaphanus)		1		
Rockbass (Ambloplites rupestris)				4

TABLE 3. Coefficients for the Log_{10} Transformation of the Parabolic Length-weight Equation of LeCren (1951), for the indicated lakes[a]. (See Figures 1a thru 1k for graphic representations.)

$$Log_{10} W_g = Log_{10} a + n \, Log_{10} L_{mm}$$

Lake	Species[b]	(N)[c]	Log_{10} a	n
Lake of the Pines	Largemouth bass	(35)	-5.23	3.17
	Chain pickerel	(16)	-6.07	3.33
	Brown bullhead	(42)	-5.21	3.23
Crystal Lake	Largemouth bass	(06)	-4.92	3.05
	Chain pickerel	(14)	-5.51	3.10
	Pumpkinseed	(31)	-5.21	3.23
	Redbreast	(42)	-5.15	3.18
	Yellow perch	(19)	-5.59	3.27
Bass Lake	Brown bullhead	(41)	-4.56	2.83
Second Lake	Yellow perch	(31)	-6.16	3.53
	Fallfish	(17)	-5.09	3.02

[a] Caution should be used in the broad application of these numbers because of high predictive error.

[b] See Table 2 for Latin names.

[c] Number of specimens included in the analysis.

TABLE 4. Frequency of Diet Type by Species for Fishes Collected 7/15/74 and 7/16/74 from Lake of the Pines, New York.

	Diet																			
Predator	Yellow perch	Bullhead	Golden shiner	Pickerel	Unidentified fish	Ephemeroptera	Diptera	Trichoptera	Coleoptera	Hymenoptera	Hydracarina	Bryozoa	Decapoda	Amphipoda	Copepoda	Isopoda	Cladocera	Gastropoda	Pelycopoda	Plant Matter
Yellow perch					1	1	12	8			3		1		7		3			
Brown bullhead							10					3							1	6
Pumpkinseed							7	9	1		1					1		2	2	4
Largemouth bass	6	9			7		6	2				1			7		2			
Chain pickeral	1	1		1									1							
Sucker																				1
Golden shiner																				5

TABLE 5. Frequency of Diet Type by Species for Fishes Collected 7/22/74 and 7/23/74 Crystal Lake, New York.

	Diet															
Predator	Yellow perch	Unidentifiable Fish	Diptera	Trichoptera	Hymenoptera	Decapoda	Amphipoda	Coleoptera	Orthoptera	Odonata	Lepidoptera	Unidentified Insect Remains	Gastropoda	Pelecypoda	Plant Matter	
Yellow perch	5	1	3	2		3	4			6			3	2	1	
Pumpkinseed			6	4		1	5			3	1		9	3	1	
Largemouth bass		1														
Redbreast sunfish			7	11	7			7	3	3	9	4	2	1	2	
Chain pickerel		1				2										

TABLE 6. Frequency of Diet Type by Species for Fishes Collected 7/24/74 and 7/25/74 for Bass Lake.

	Diet									
Predator	Diptera	Trichoptera	Unidentified Insect Remains	Unidentified Invertebrates	Crustacea	Benthic Crustacea	Cladocera	Plant Material	Eggs	
Brown bullheads	11	1	1	1	1	1	21	1	11	

TABLE 7. Frequency of Diet Type by Species for Fishes Collected 7/29/74 and 7/30/74 at Second Lake, New York.

	Diet															
Predator	Yellow perch	Unidentifiable Fish Remains	Cyprinids	Trichoptera	Diptera	Odonata	Insect Parts	Acanthocephala	Cladocera	Amphipoda	Invertebrates	Decapoda	Pelycepoda	Gastropoda	Plant Matter	
Largemouth bass		1														
Yellow perch		1		2	1	2	2			4		2		2	2	
Northern pike	1	2														
Bullhead			1		1				2	2	1			1	2	
Rock bass			1			1								1	1	
Sucker								1					3	2		
Fallfish				3								1		2	2	

FIGURE 1a. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for brown bullhead taken from Lake of the Pines.

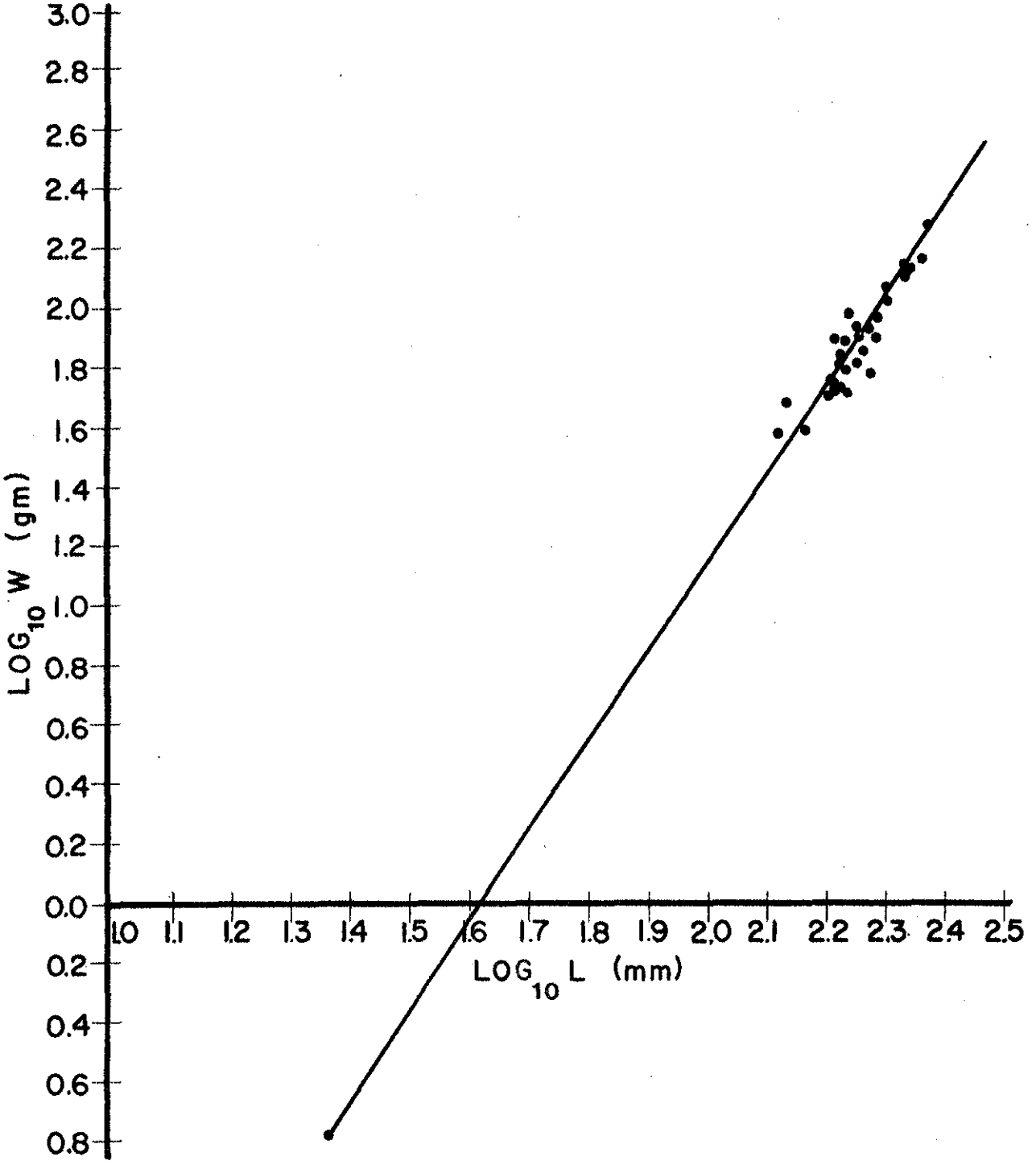


FIGURE 1b. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for largemouth bass taken from Lake of the Pines.

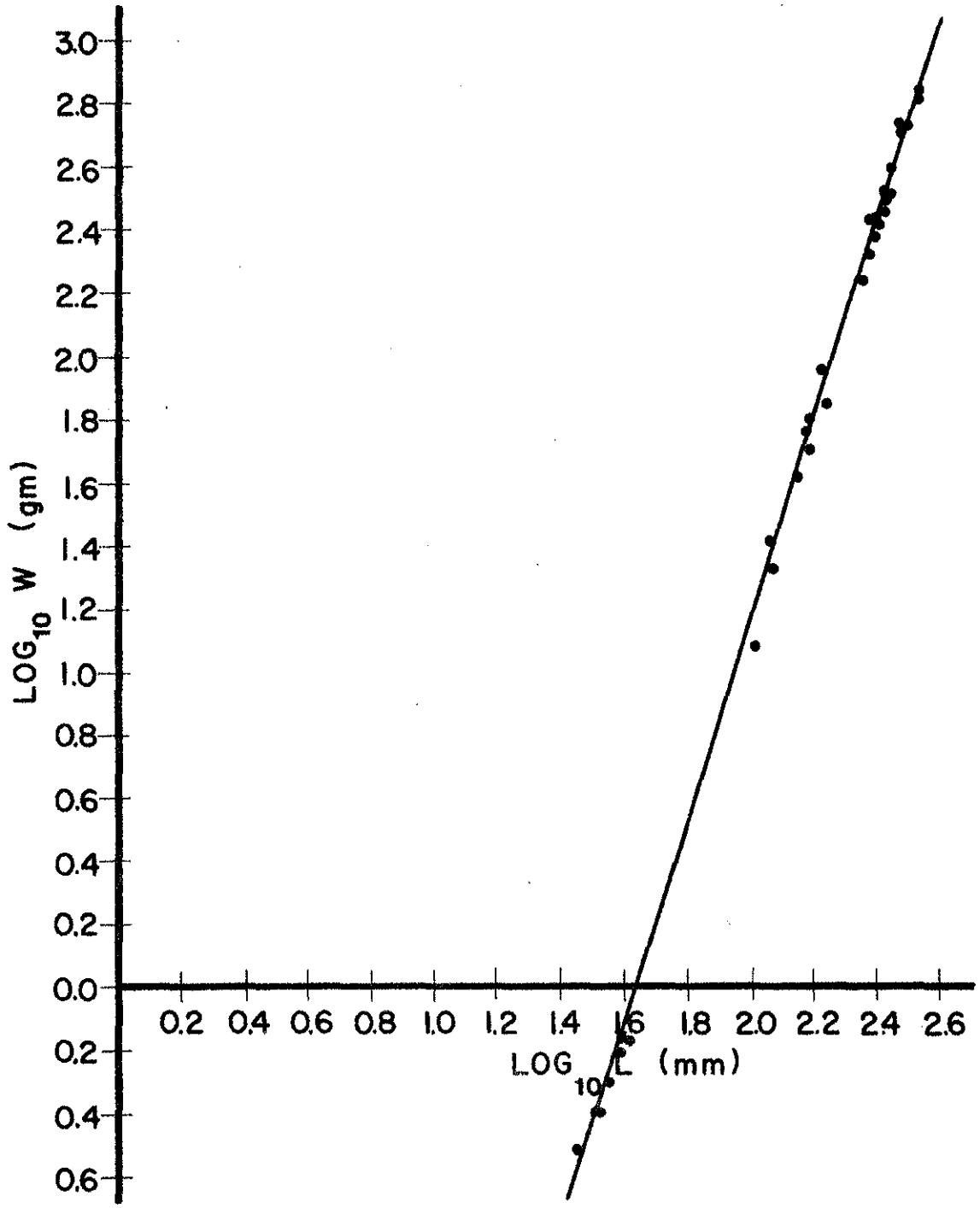


FIGURE 1c. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for chain pickerel taken from Lake of the Pines.

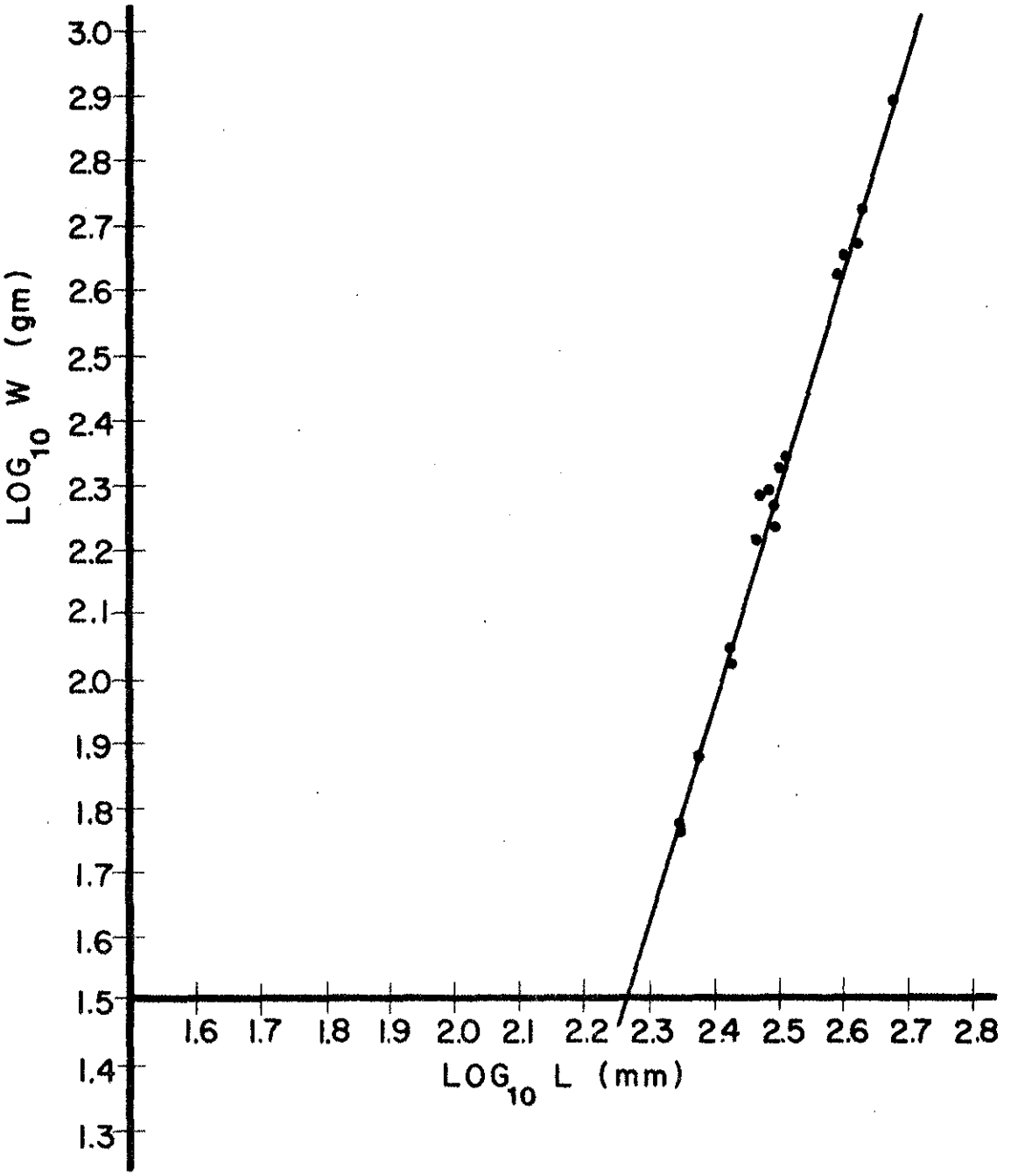


FIGURE 1d. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for yellow perch taken from Crystal Lake.

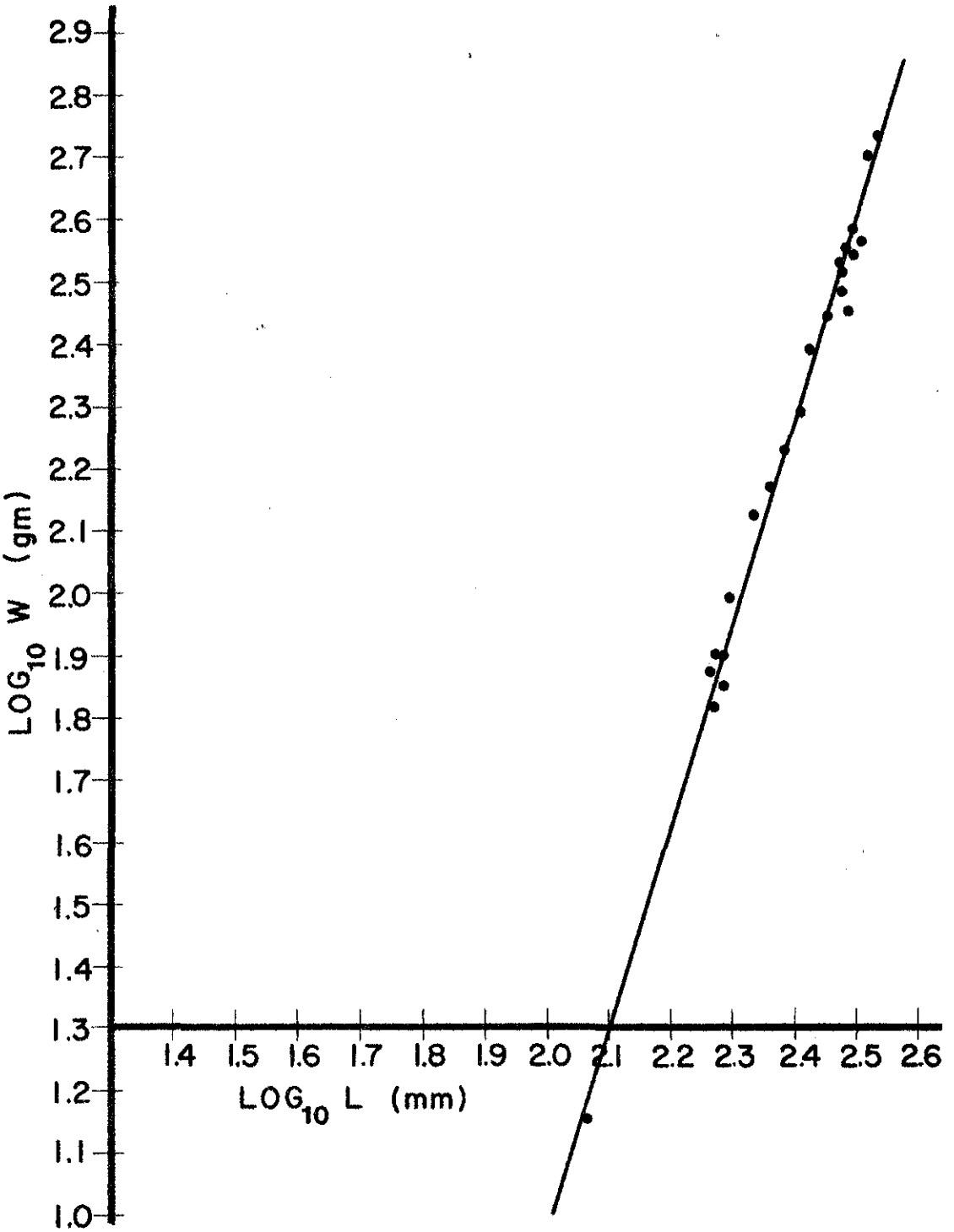


FIGURE 1e. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for pumpkinseed sunfish taken from Crystal Lake.

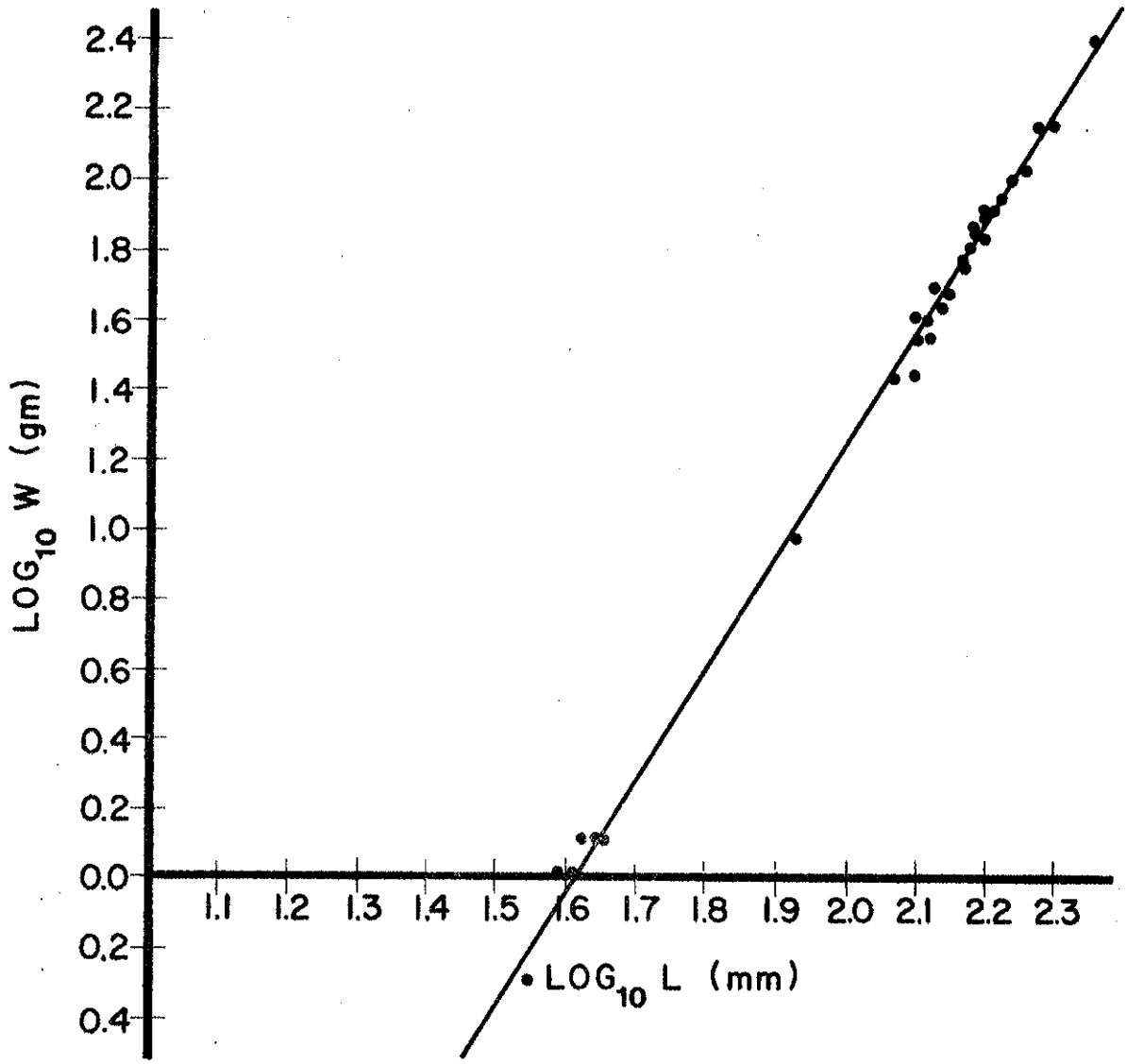
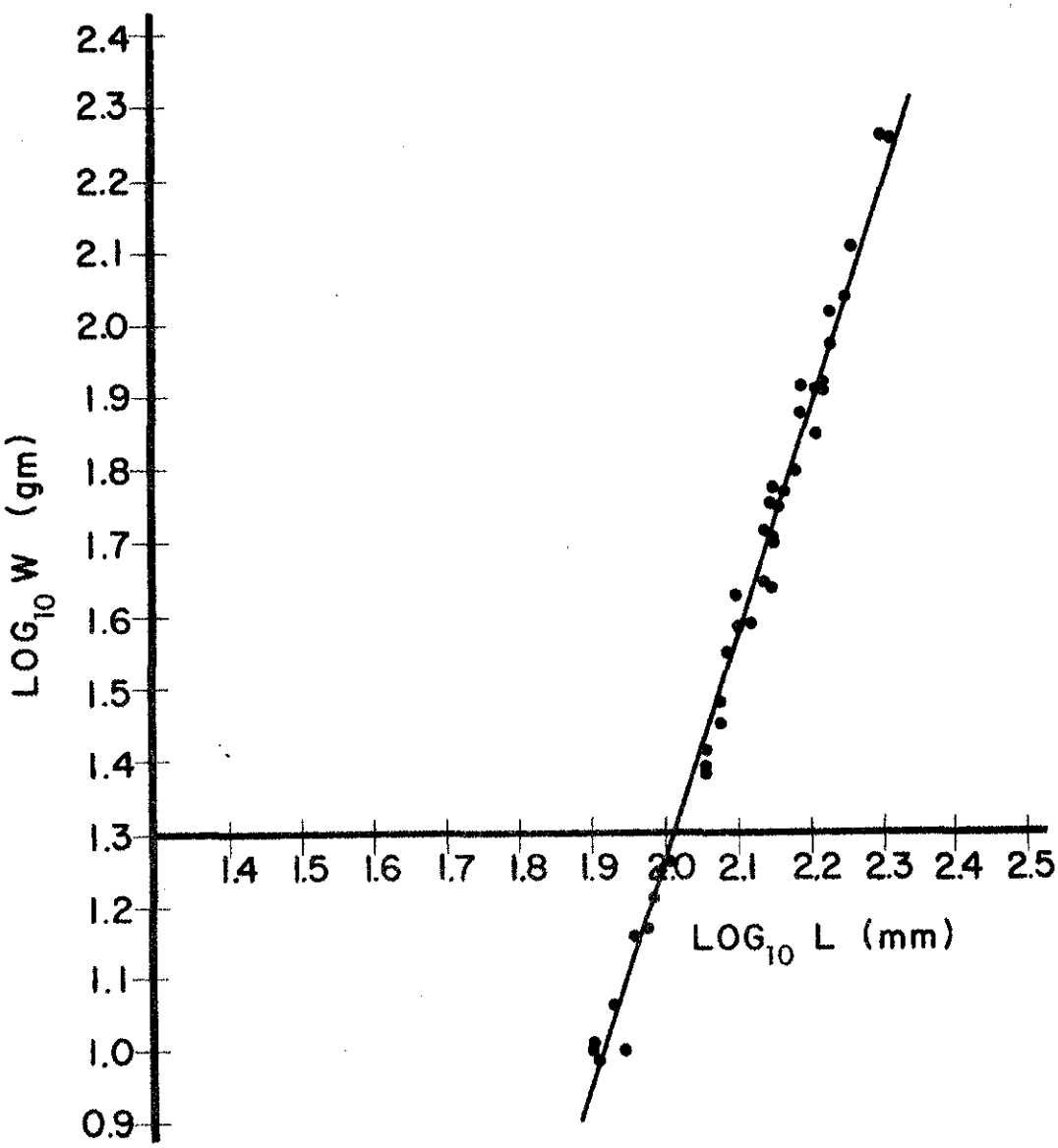


FIGURE 1f. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for redbreast sunfish taken from Crystal Lake.



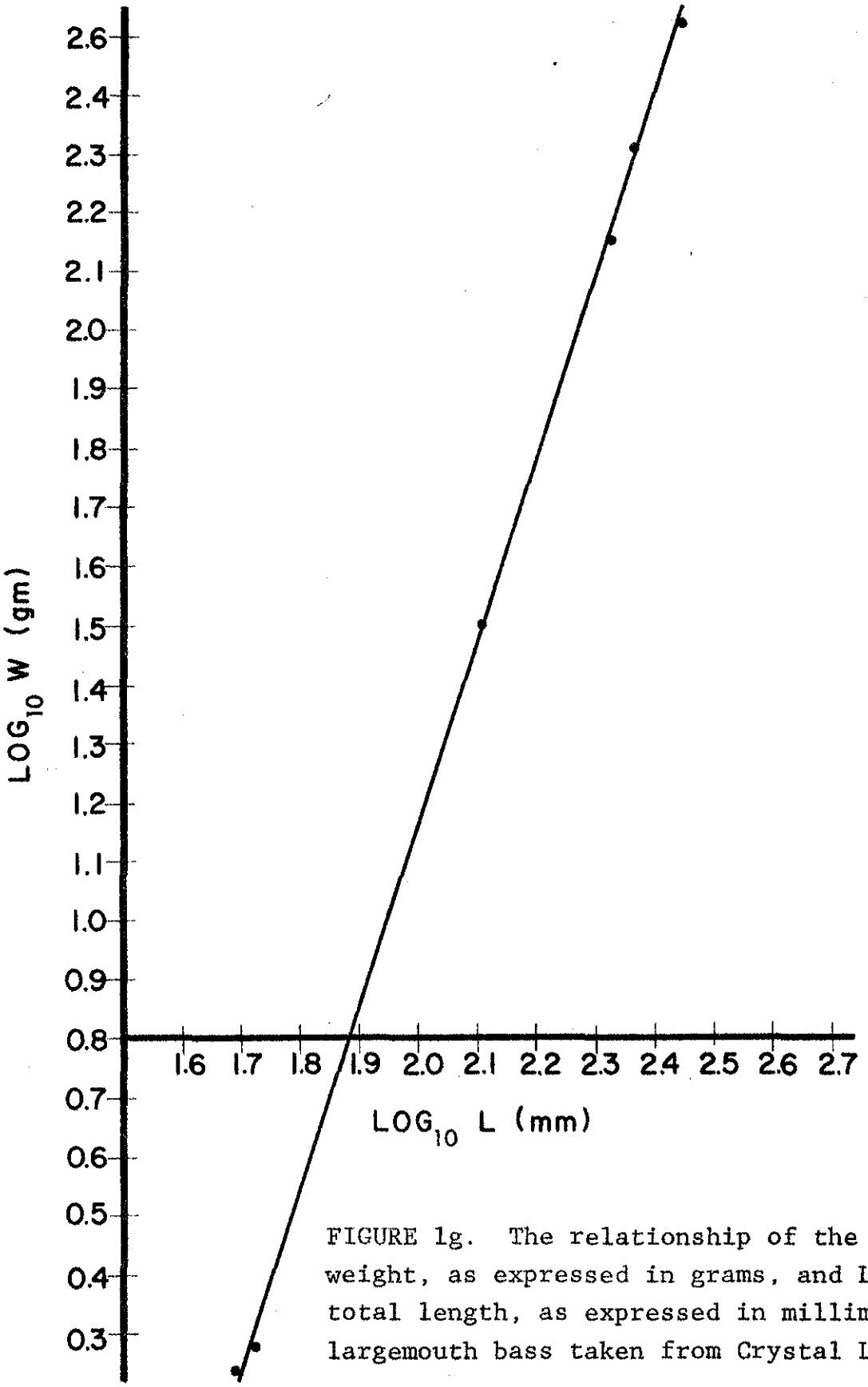


FIGURE 1g. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, f largemouth bass taken from Crystal Lake.

FIGURE 1h. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for chain pickerel taken from Crystal Lake.

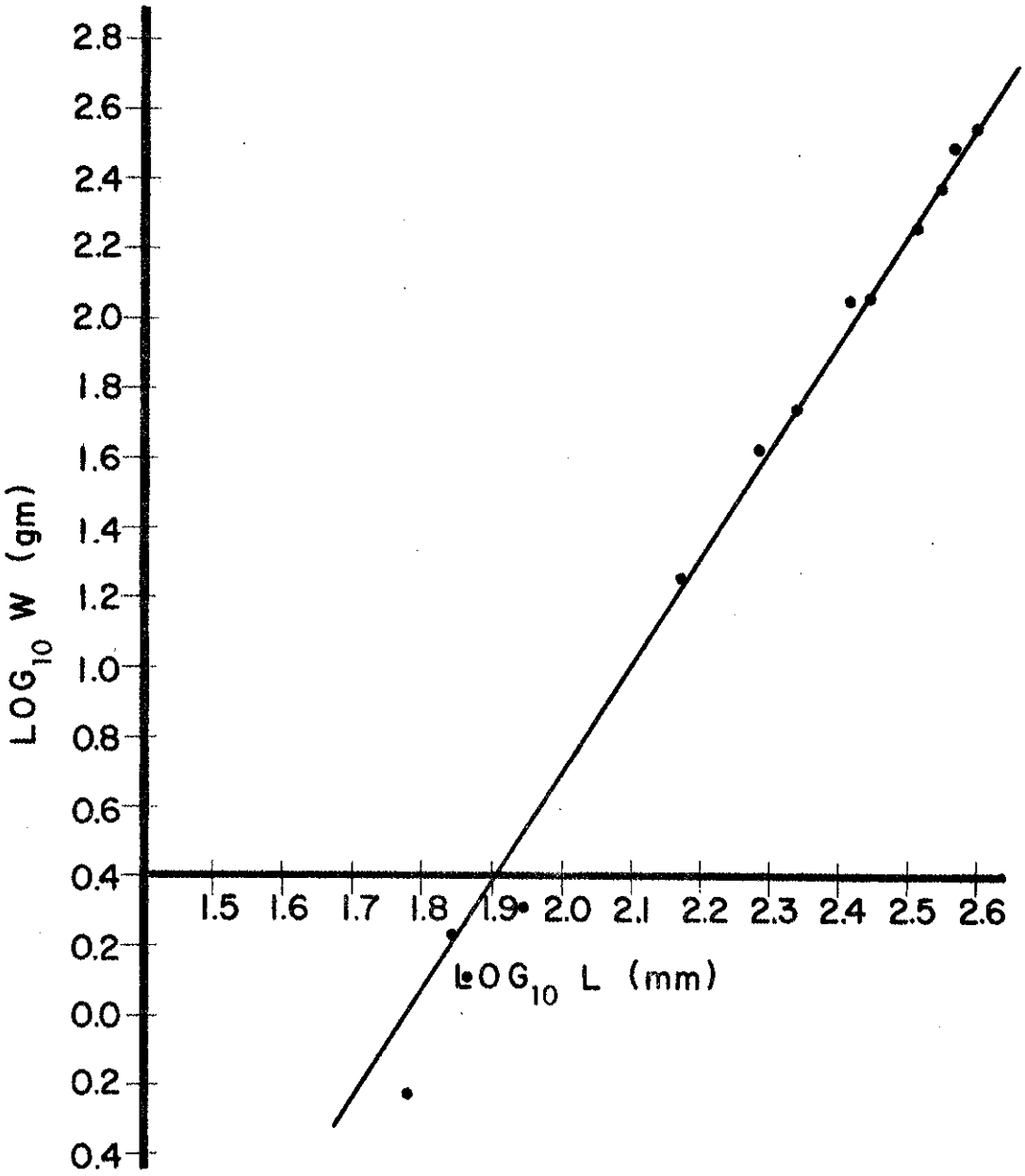


FIGURE 1i. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for brown bullheads taken from Bass Lake.

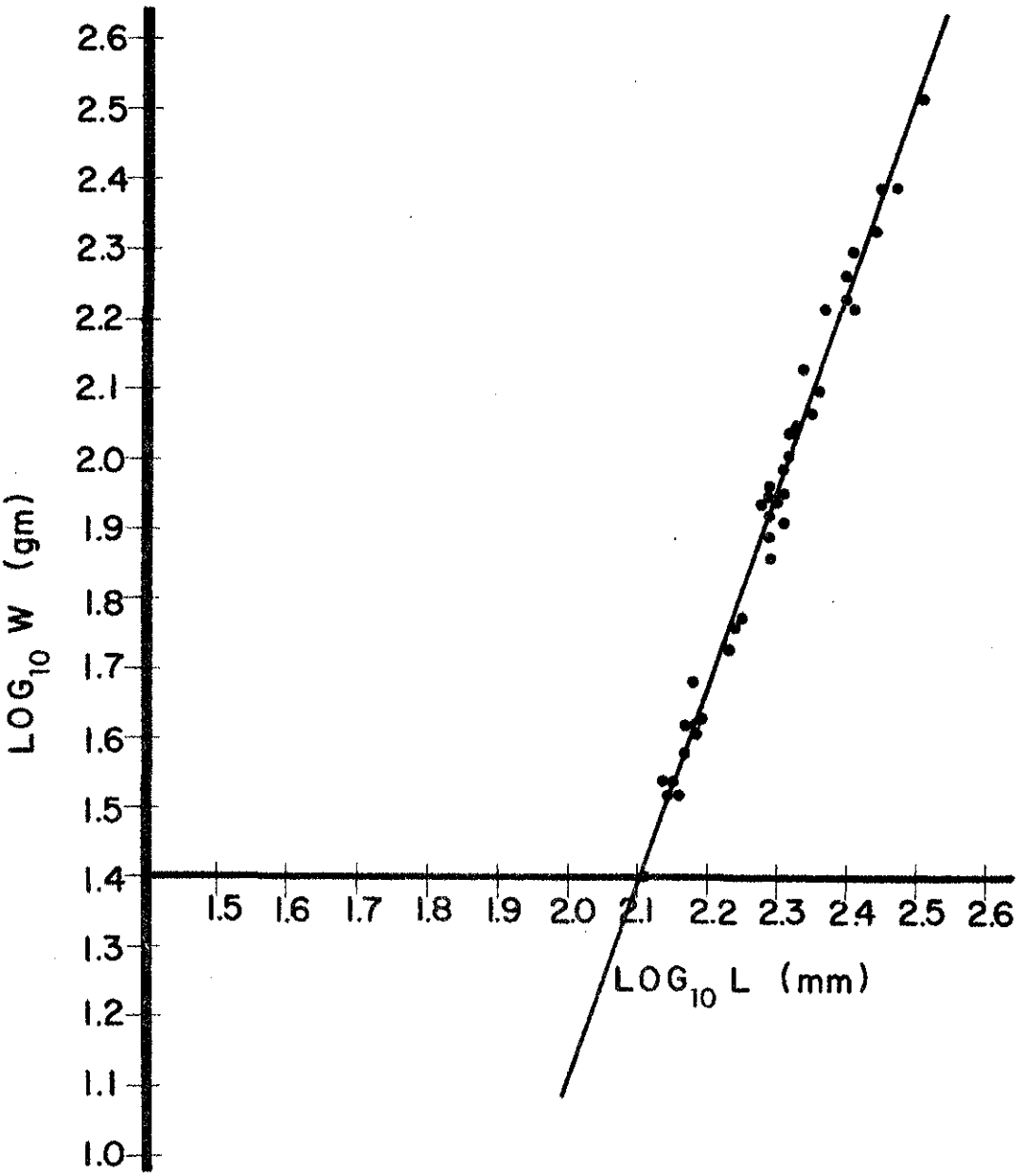


FIGURE 1j. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for yellow perch taken from Second Lake.

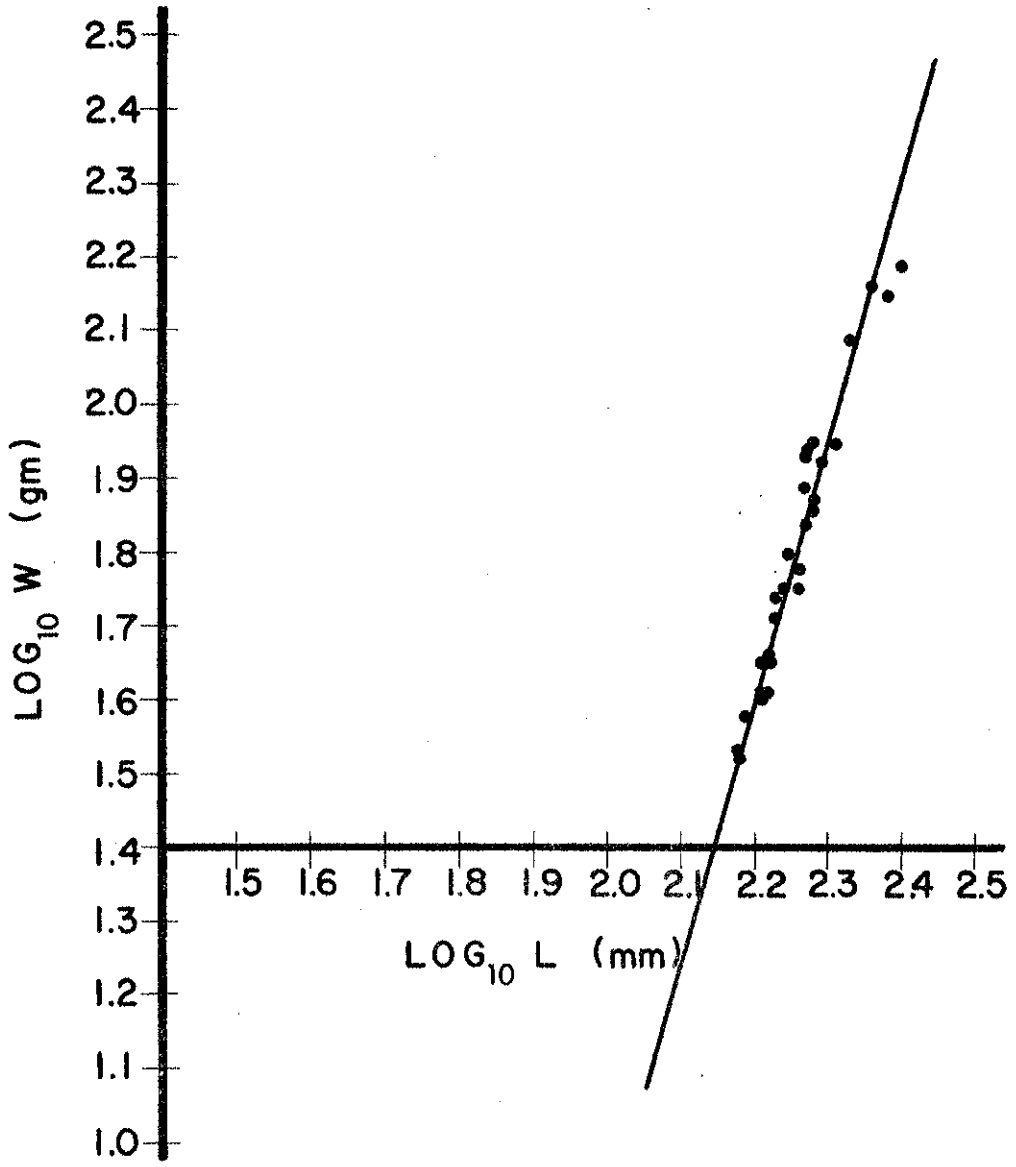


FIGURE 1k. The relationship of the Log_{10} of weight, as expressed in grams, and Log_{10} of total length, as expressed in millimeters, for fallfish taken from Second Lake.

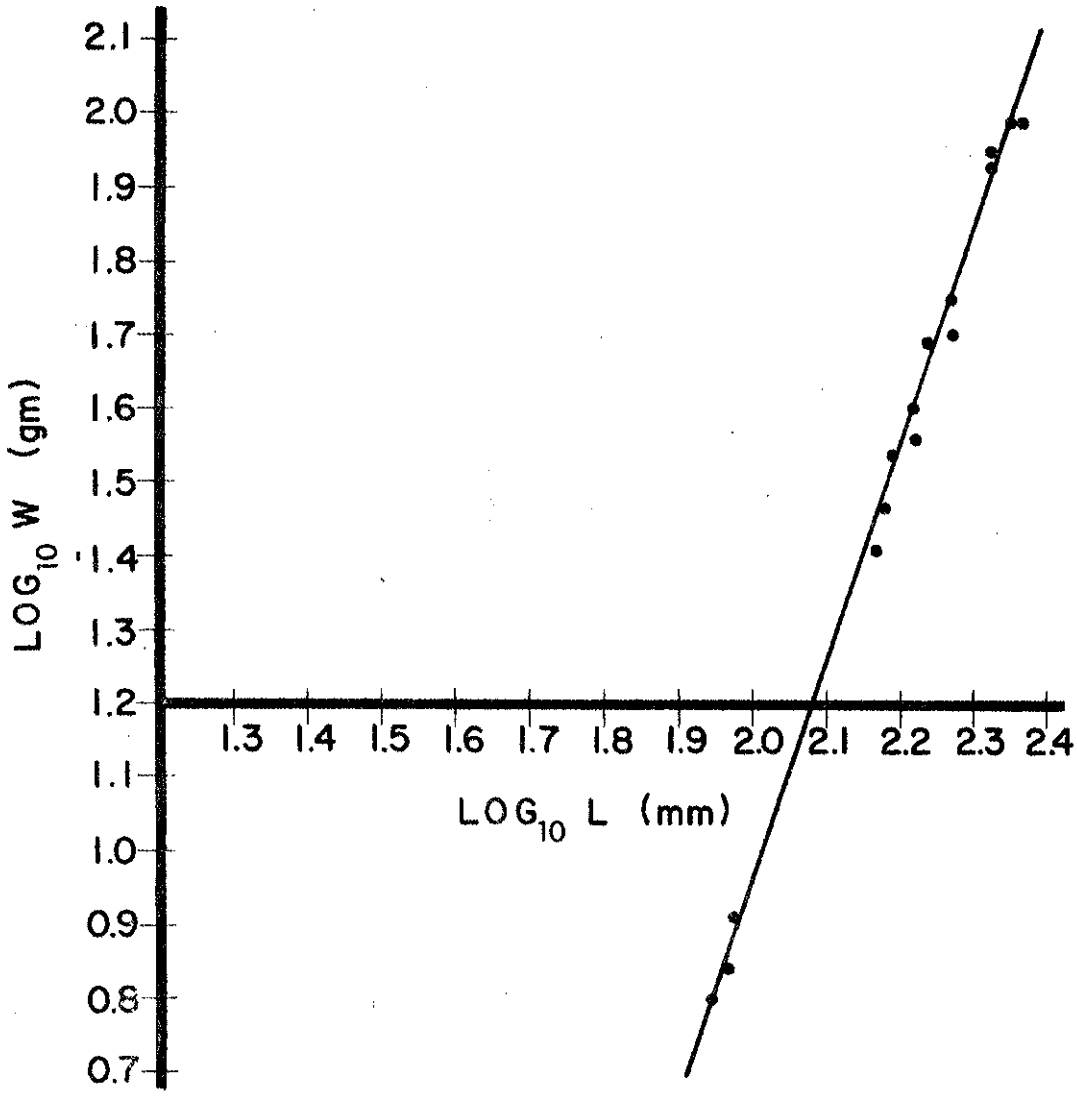


FIGURE 2a. Approximations on the relationship of age and weight, in grams, for largemouth bass from Lake of the Pines.

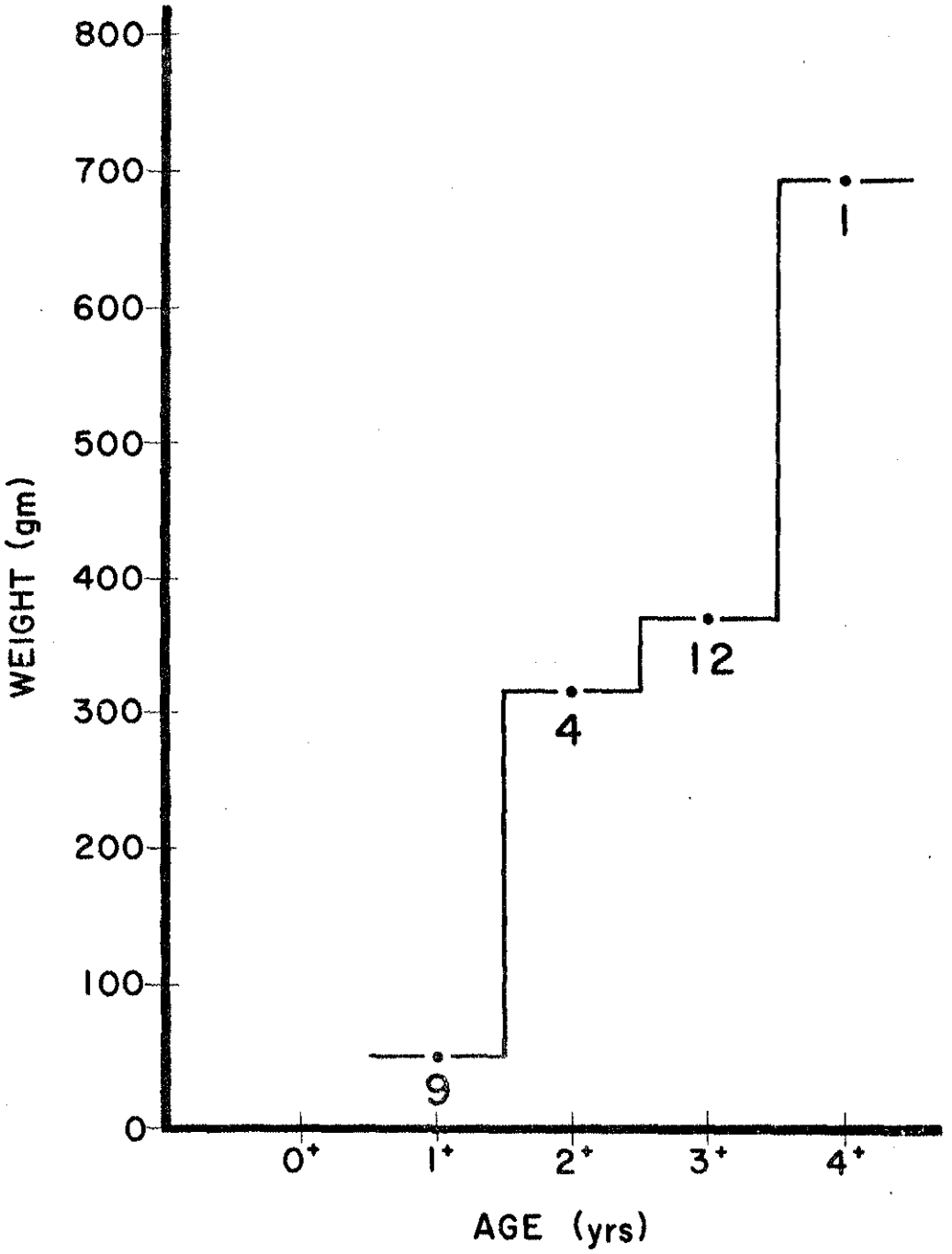


FIGURE 2b. Approximations on the relationship of age and weight, in grams, for chain pickerel from Lake of the Pines.

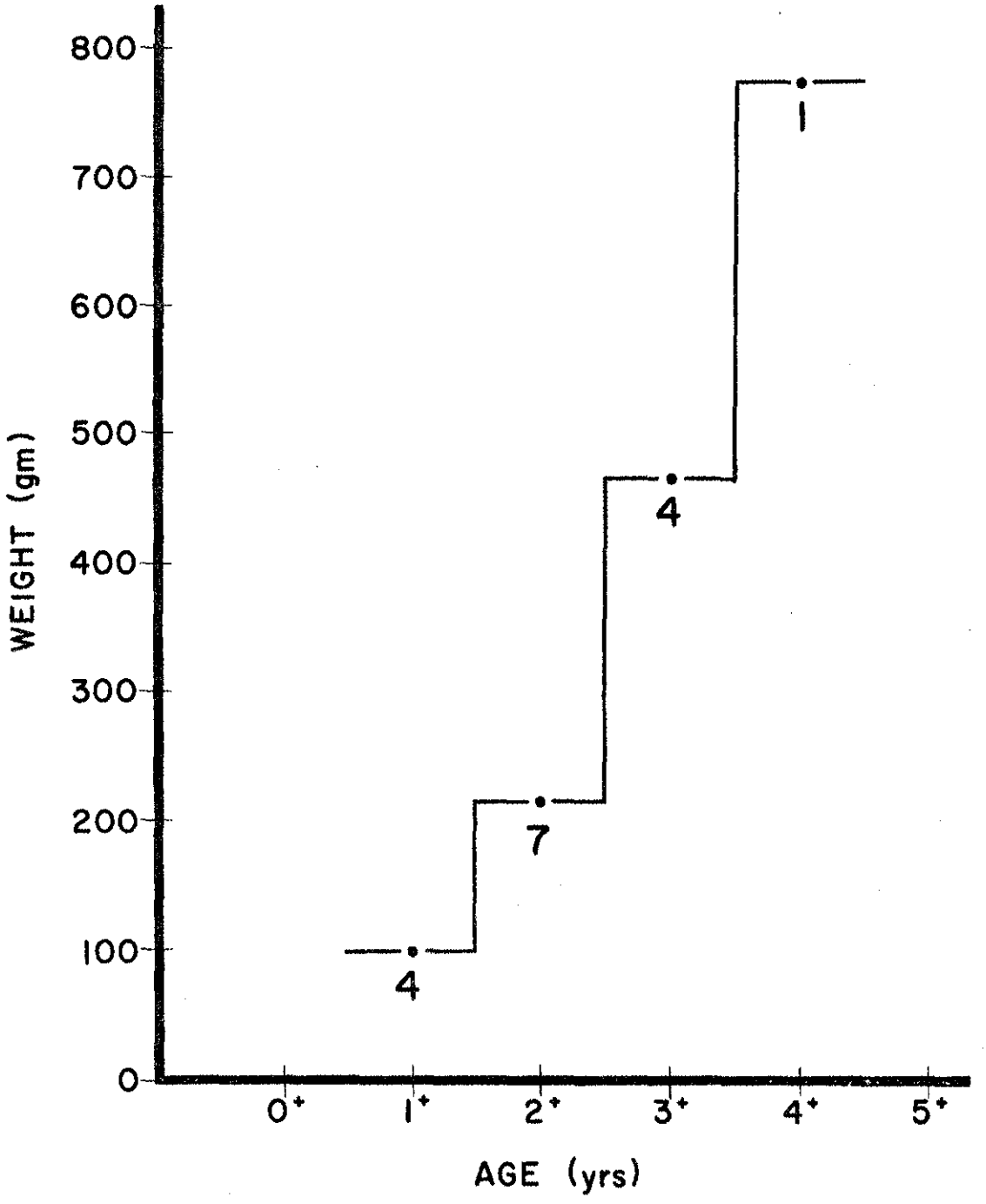


FIGURE 2c. Approximations on the relationship of age and weight, in grams, for yellow perch from Crystal Lake.

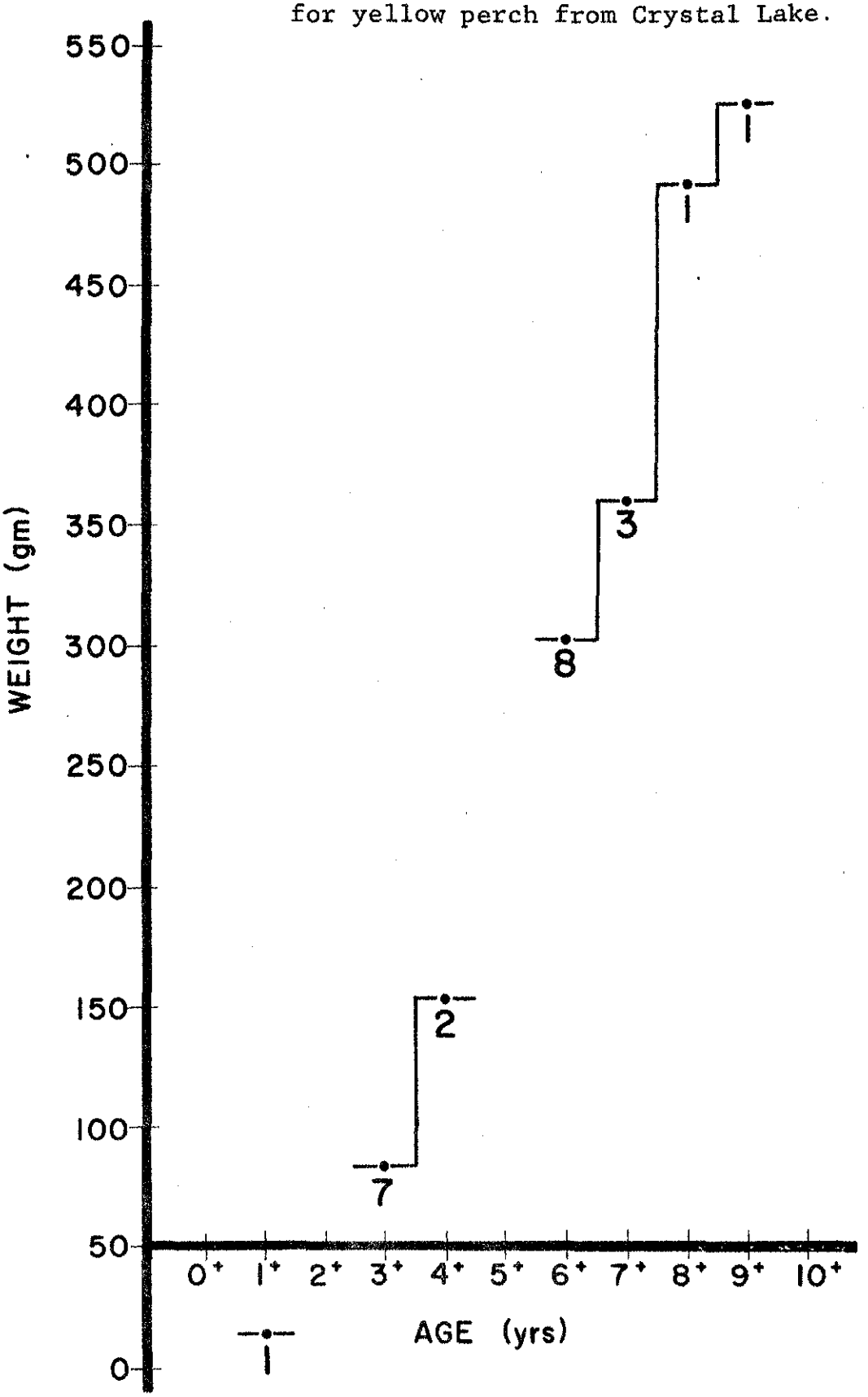


FIGURE 2d. Approximations on the relationship of age and weight, in grams, for pumpkinseed sunfish from Crystal Lake.

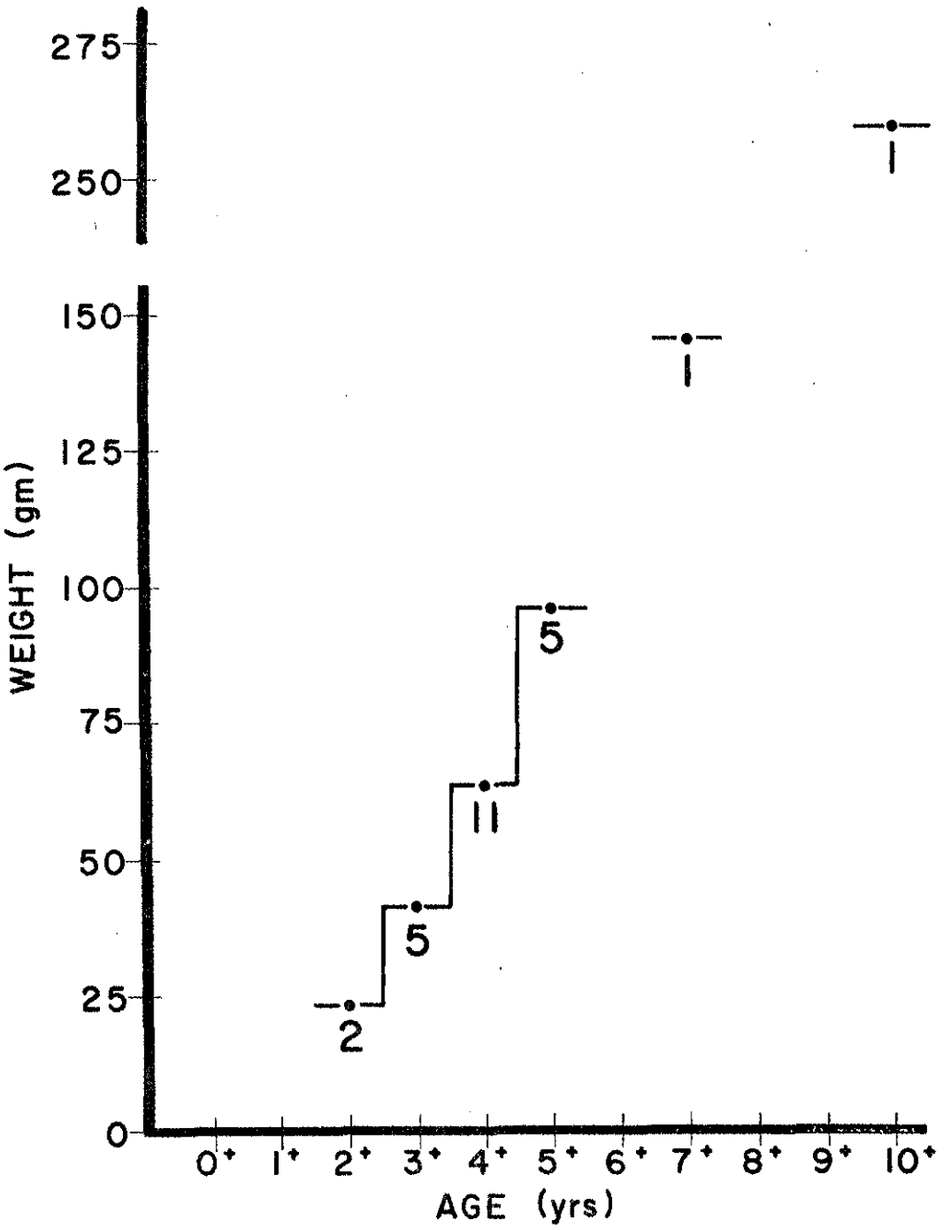


FIGURE 2e. Approximations on the relationship of age and weight, in grams, for redbreast sunfish from Crystal Lake.

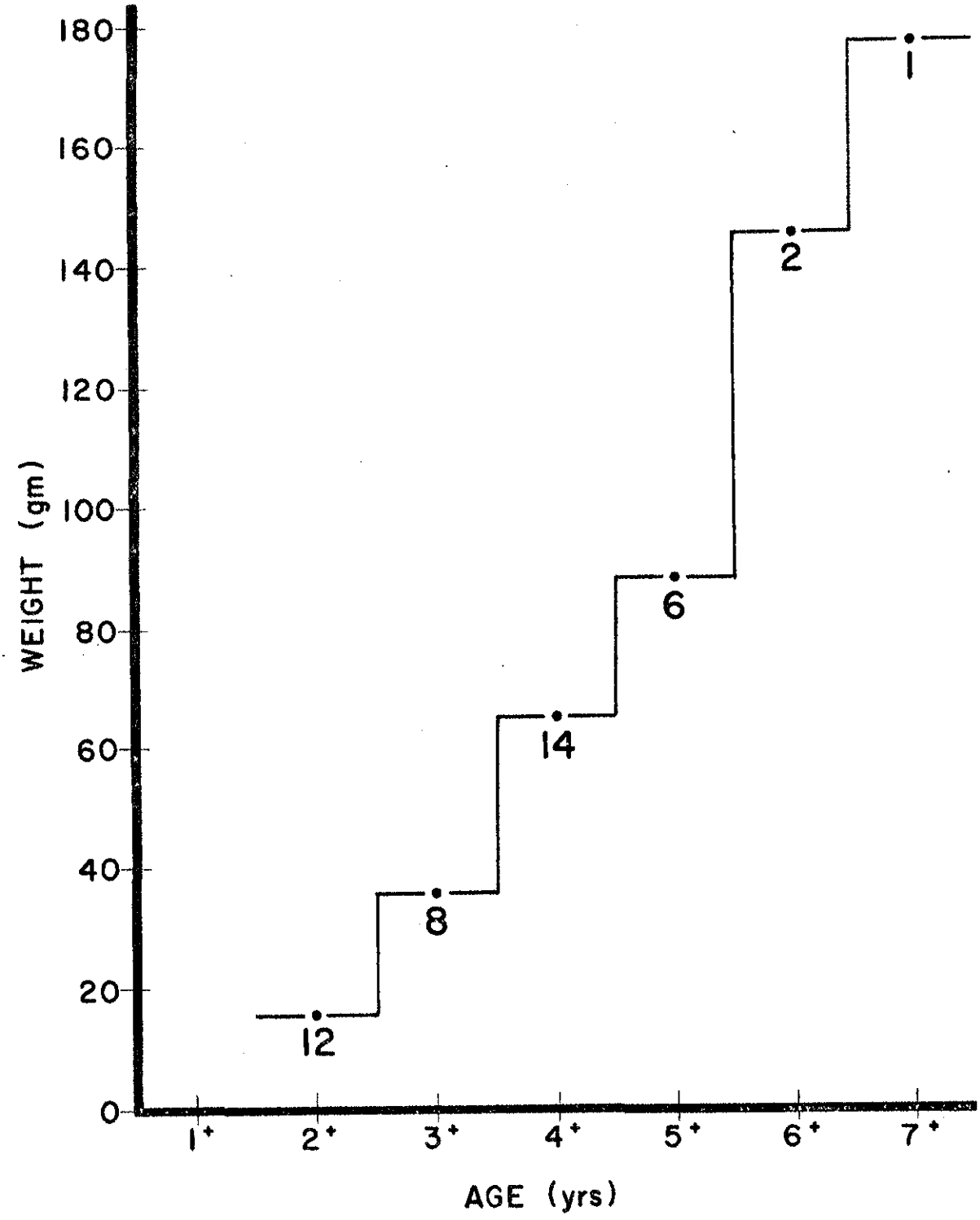


FIGURE 2f. Approximations on the relationship of age and weight, in grams, for yellow perch from Second Lake.

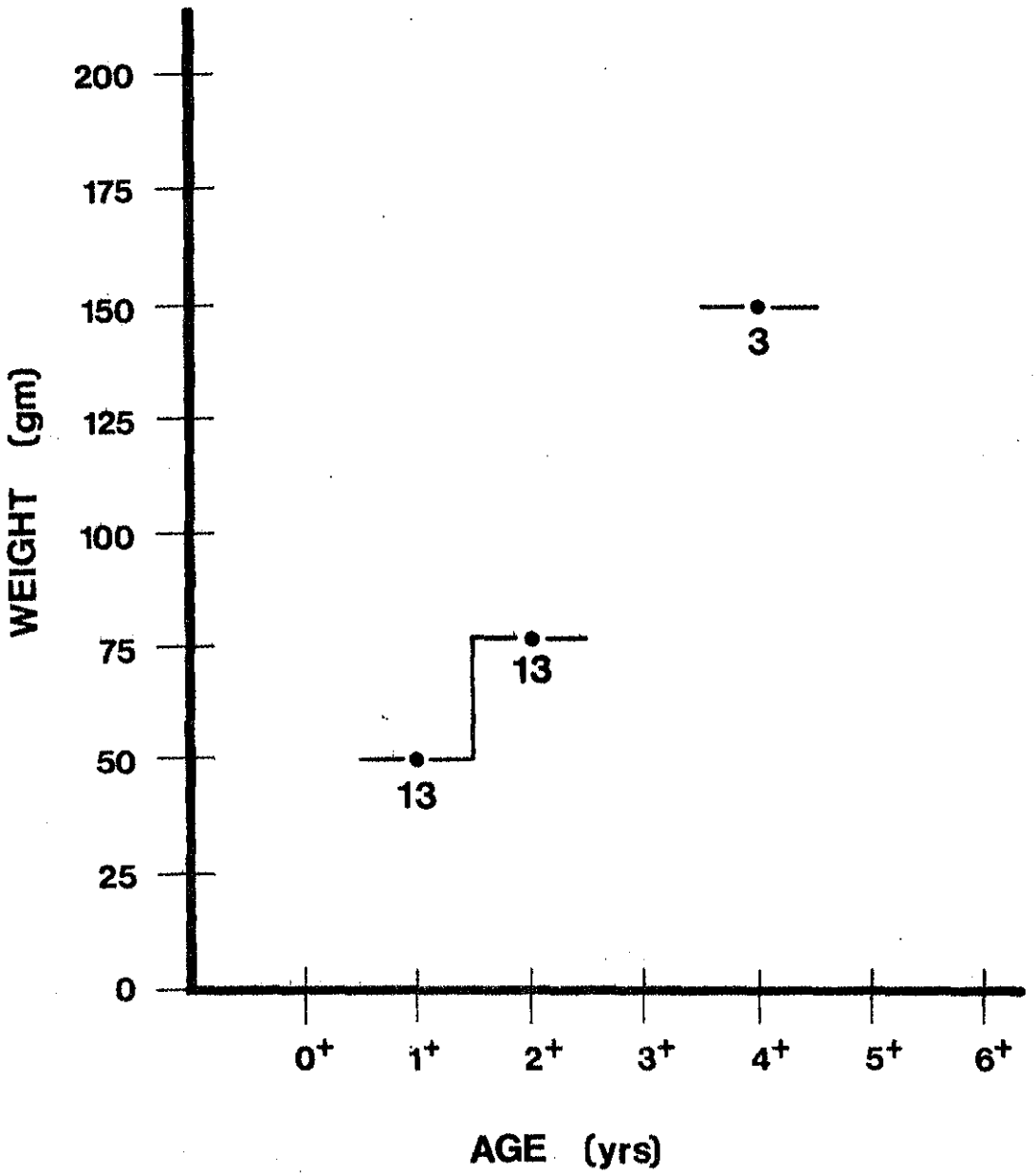


FIGURE 2g. Approximations on the relationship of age and weight, in grams, for fallfish from Second Lake.

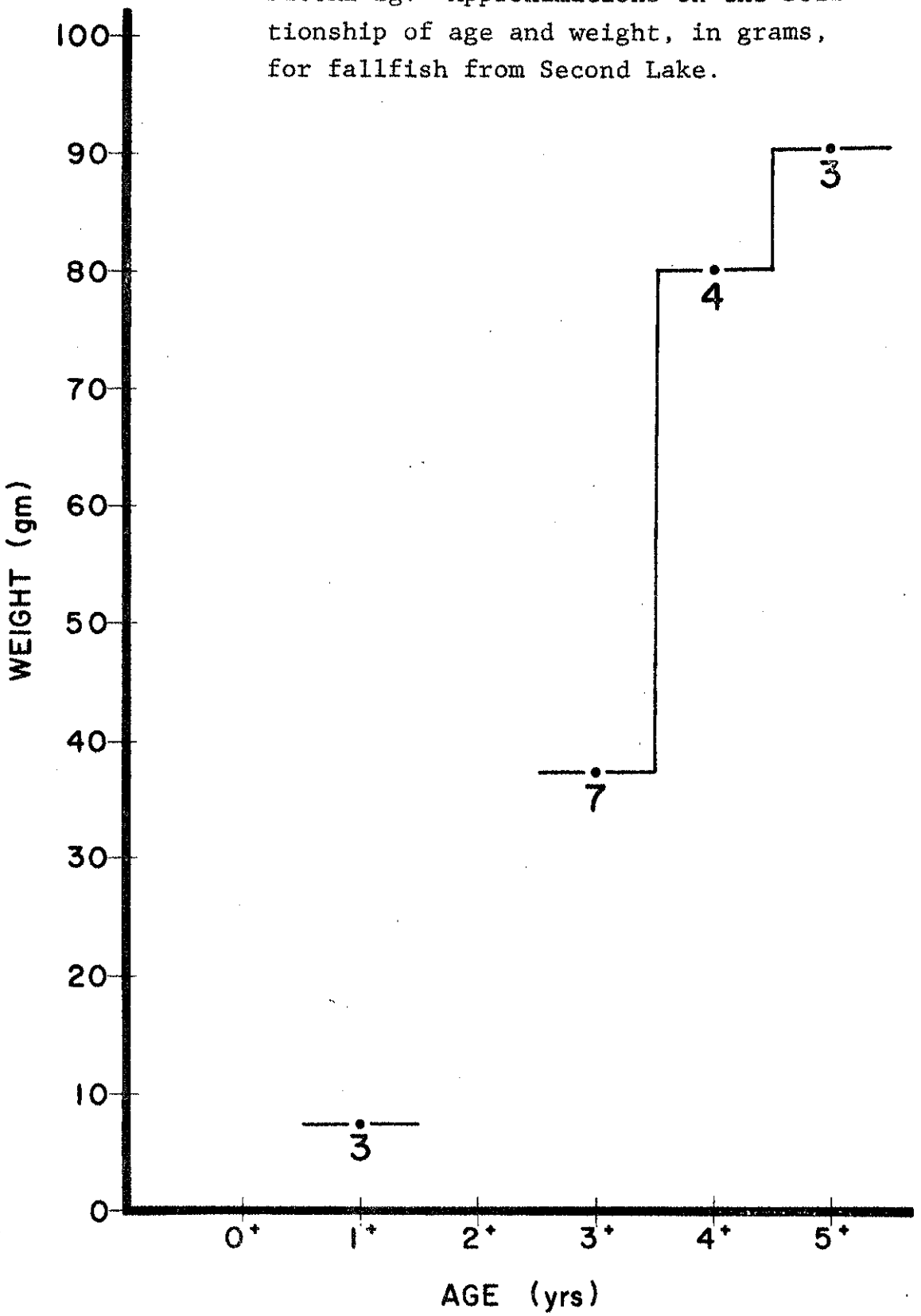


FIGURE 3a

MAP OF LAKE OF THE PINES
INDICATING SAMPLING AREAS

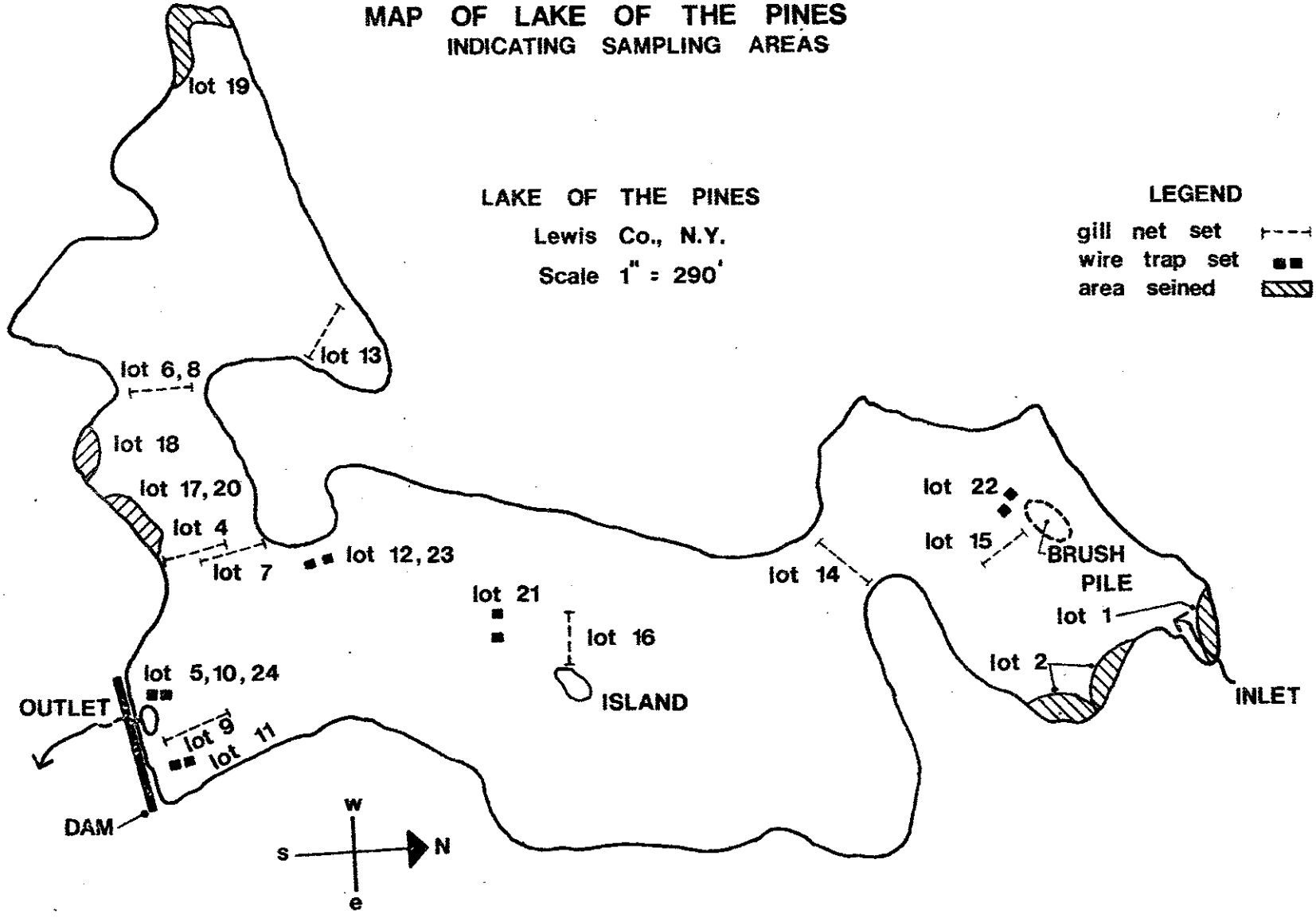


FIGURE 3b

MAP OF CRYSTAL LAKE
INDICATING SAMPLING AREAS

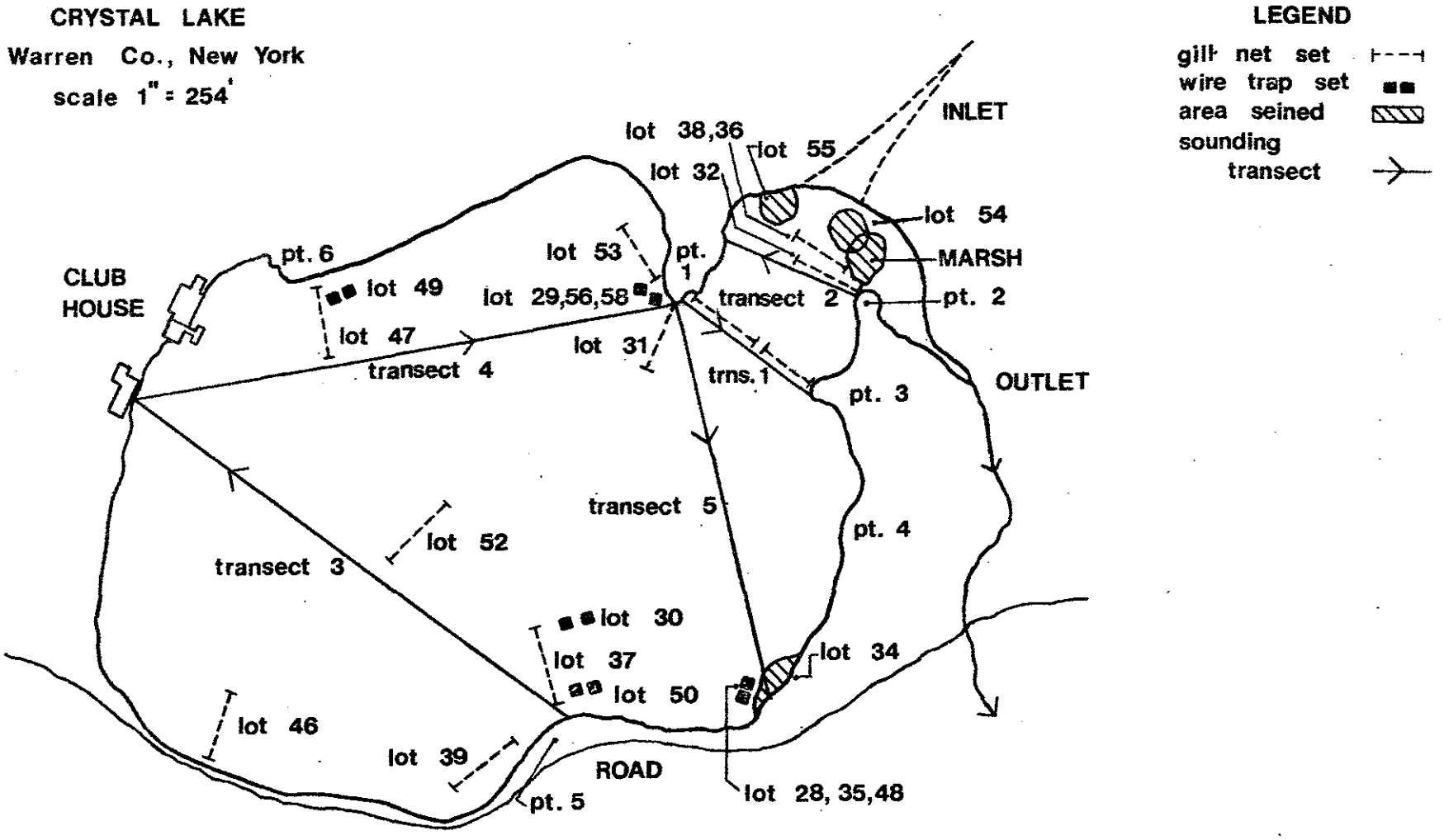


FIGURE 3c

MAP OF BASS LAKE
INDICATING SAMPLING AREAS

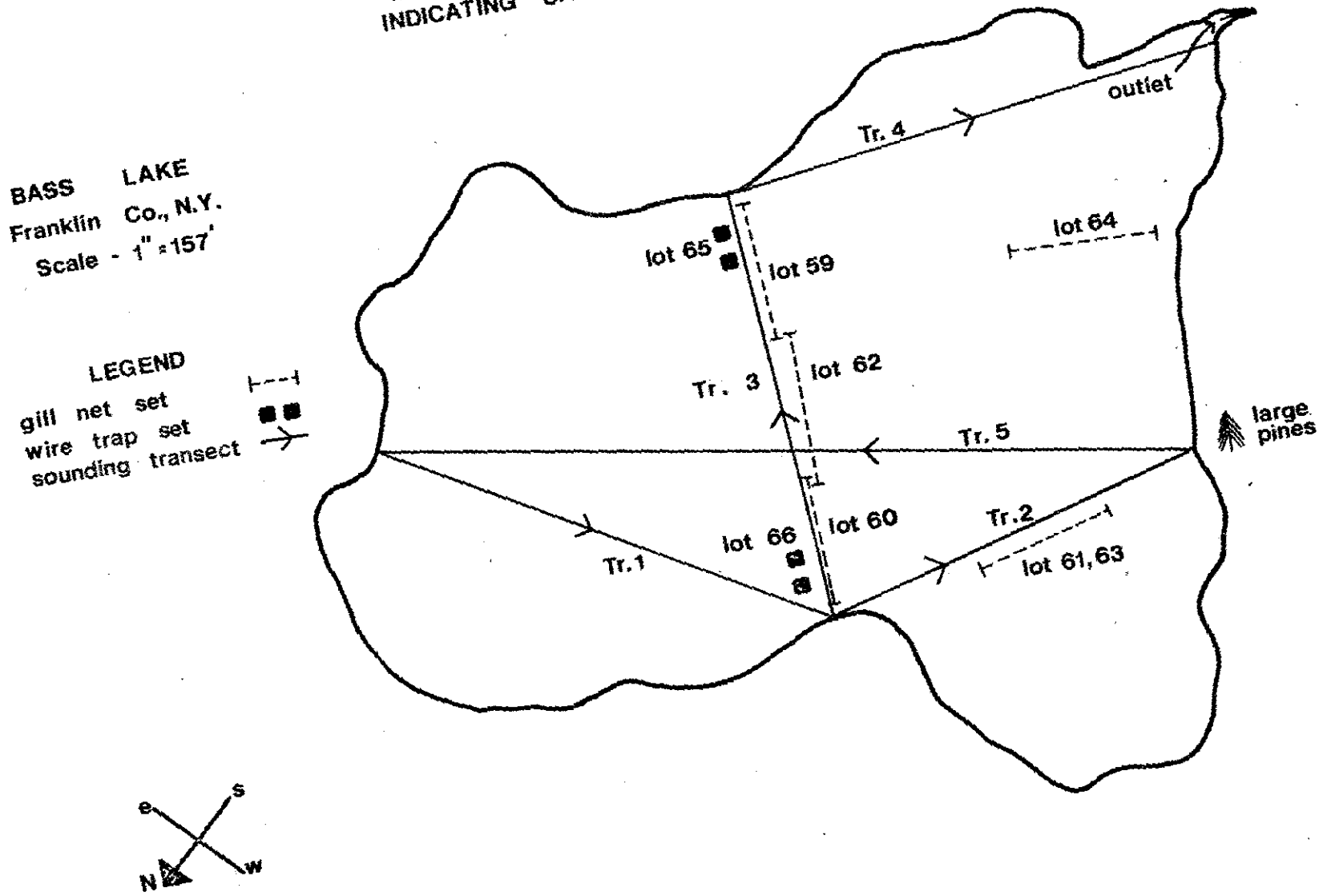


FIGURE 3d

MAP OF SECOND LAKE
INDICATING SAMPLING AREAS

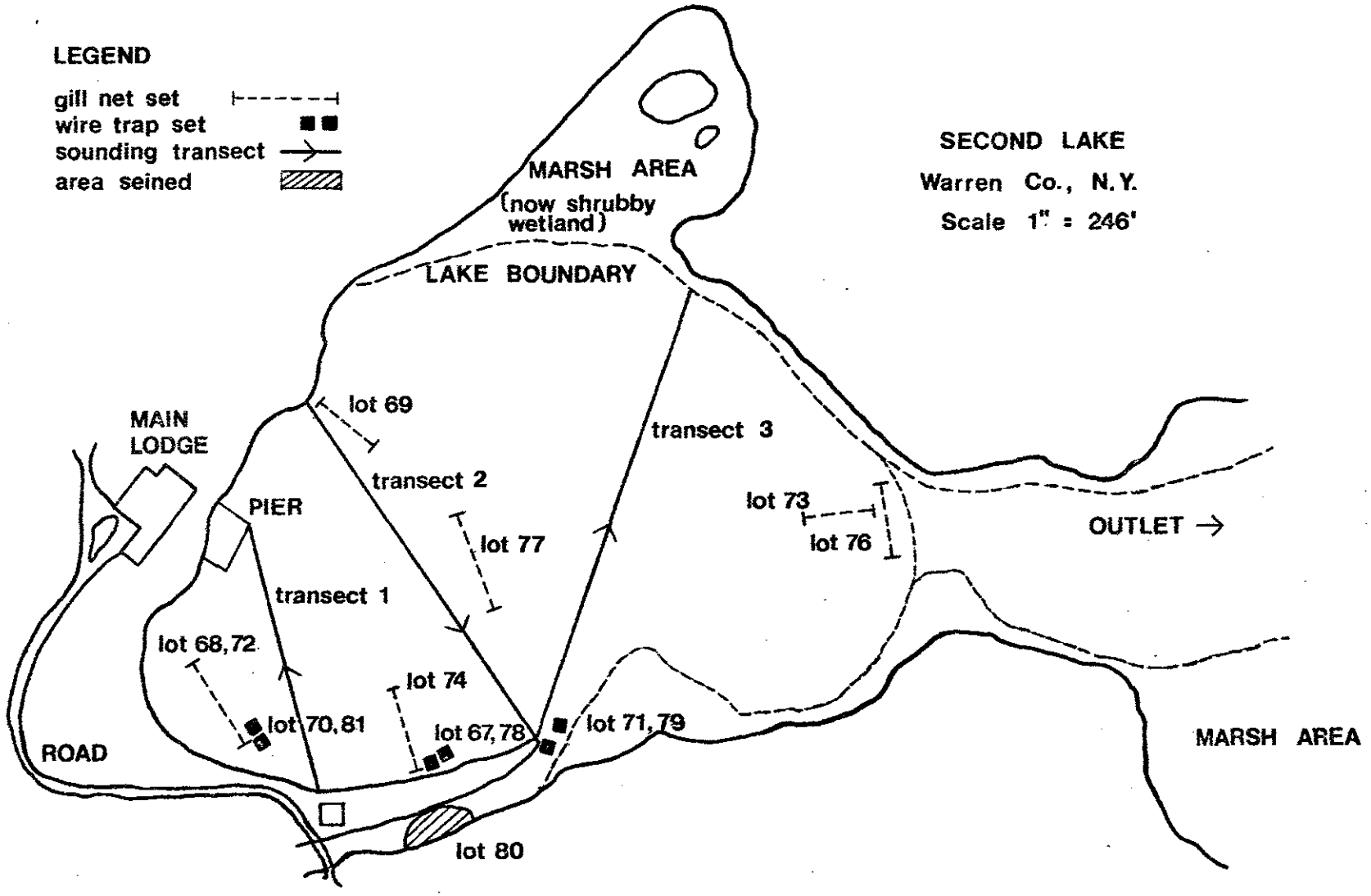
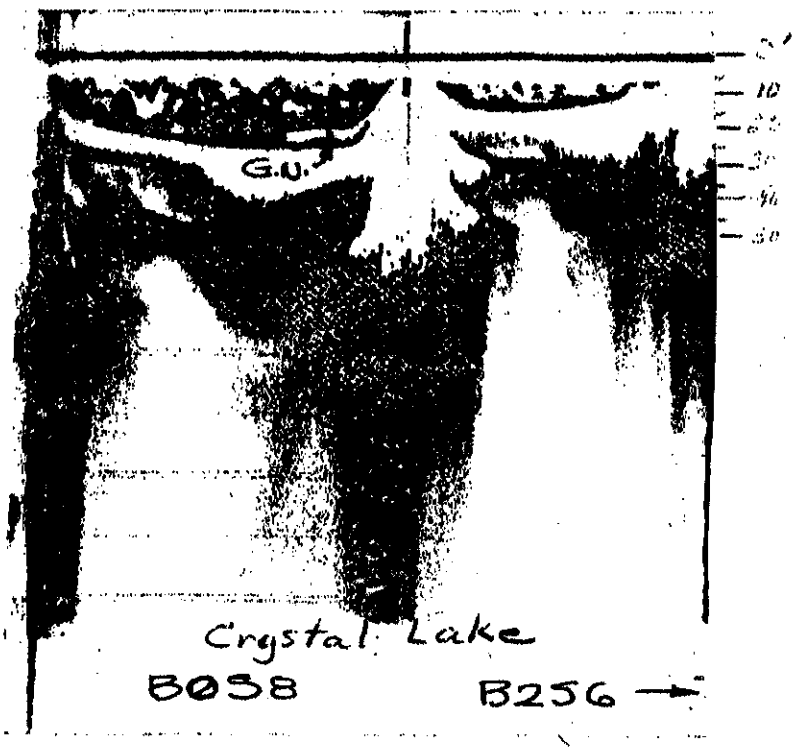


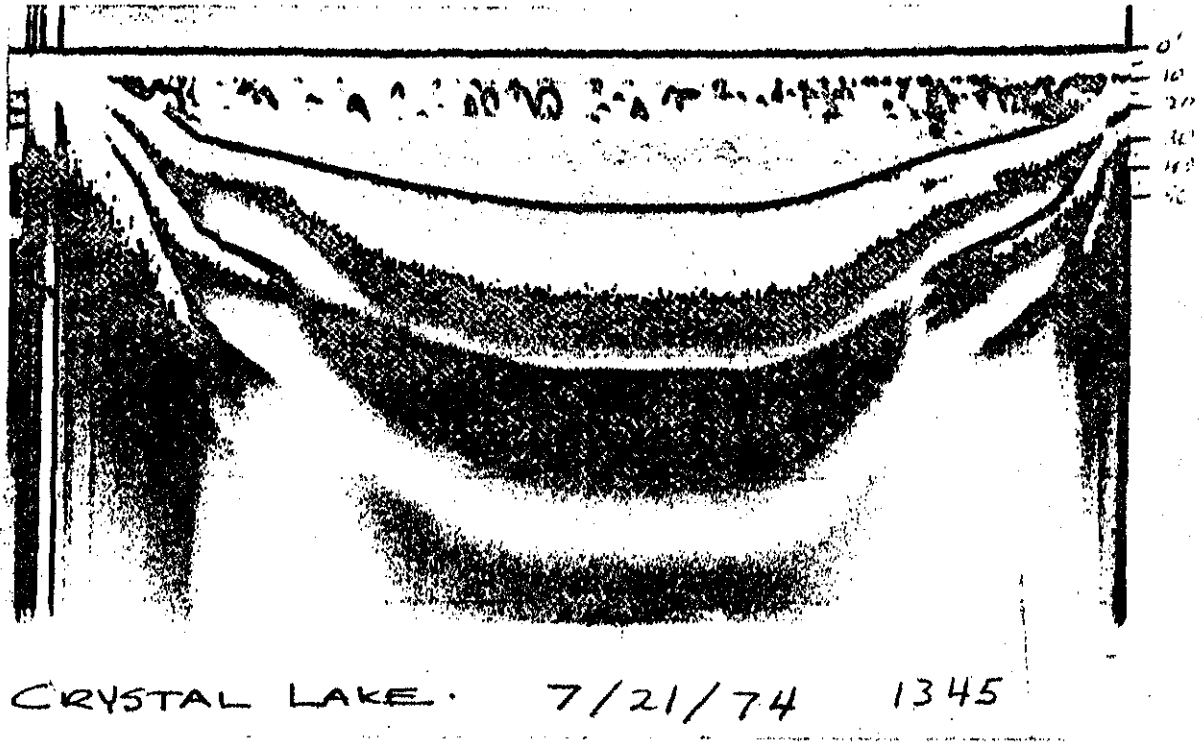
FIGURE 4a. Echogram transects for Crystal Lake, New York, 1230 and 1240 on 7/21/74 as indicated in Figure 3b. Note the depths, in feet, as indicated on the right. The "0" mark denotes the surface below which is a 10' deep electronically damped zone where targets are not recorded. Next note the bottom line at about 30'. Chevron-shaped targets are abundant throughout much of the water column. A gill net is indicated with the letters "g.n." The lower 10 to 12 feet of the water column are heavily laden with smaller targets creating a shaded appearance. The echogram is produced from left to right, i.e., the targets on the left were recorded first. Depths for this and all echograms are in feet as indicated along the right hand margin of each echogram.



Transects 1 and 2

FIGURES 4b-4d. Comparable acoustic transects for Crystal Lake, New York, commencing at 1345 on 7/21/74 and 1900 on 7/22/74 as indicated in Figure 3b. Note the extensive presence of fish in the epilimnion and general absence of fish in depths below 25'. Note also the abundance of demersal targets over the low prominence at mid-lake. The targets of the open waters are probably both centrachids and yellow perch. A zone of smaller targets occurs at 20' to 30' depths beneath which is a layer of featureless water. Maximum depths over a well smoothed bottom are about 50'.

FIGURE 4b



Transect 3

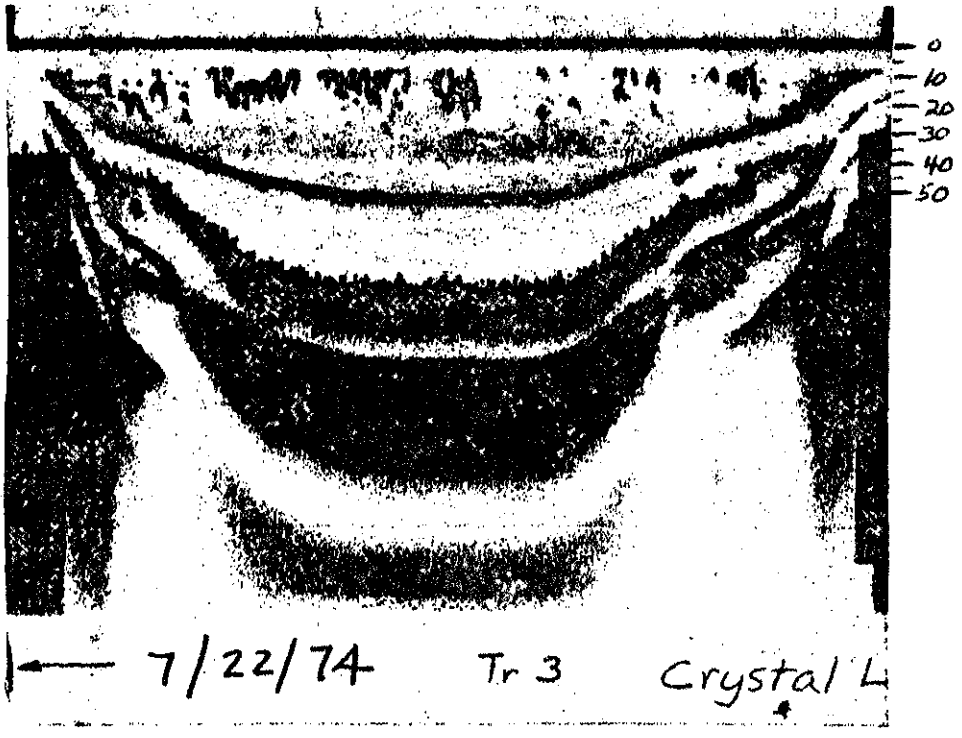
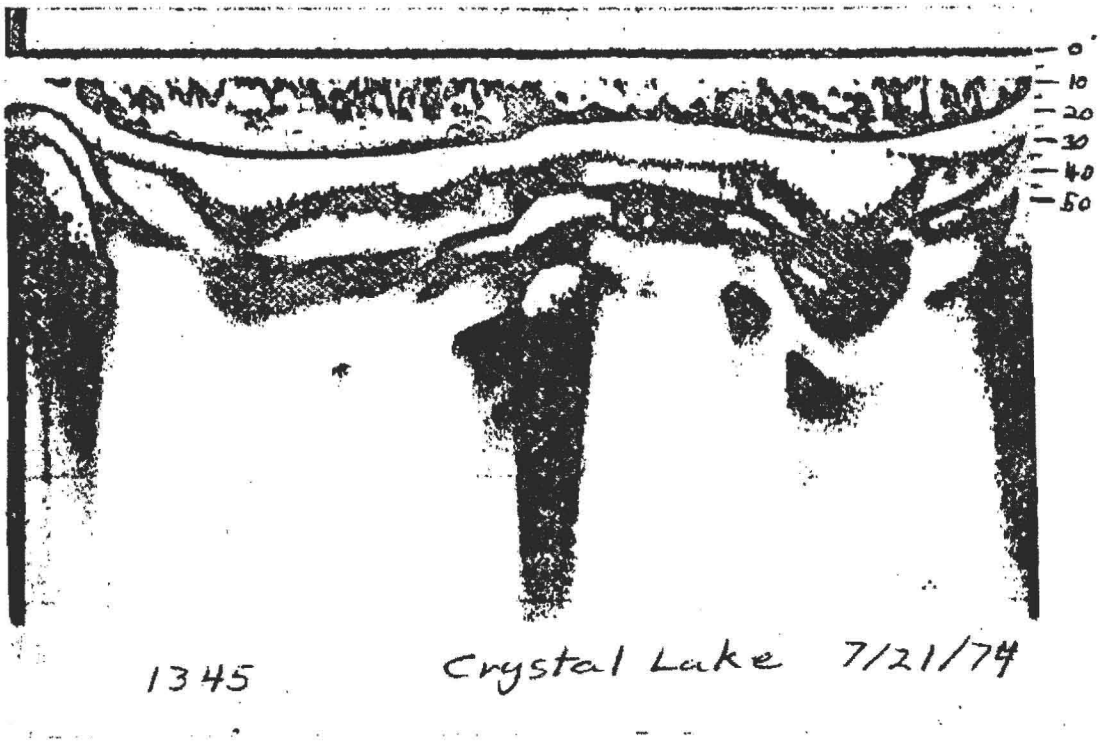


FIGURE 4c



Transect 4

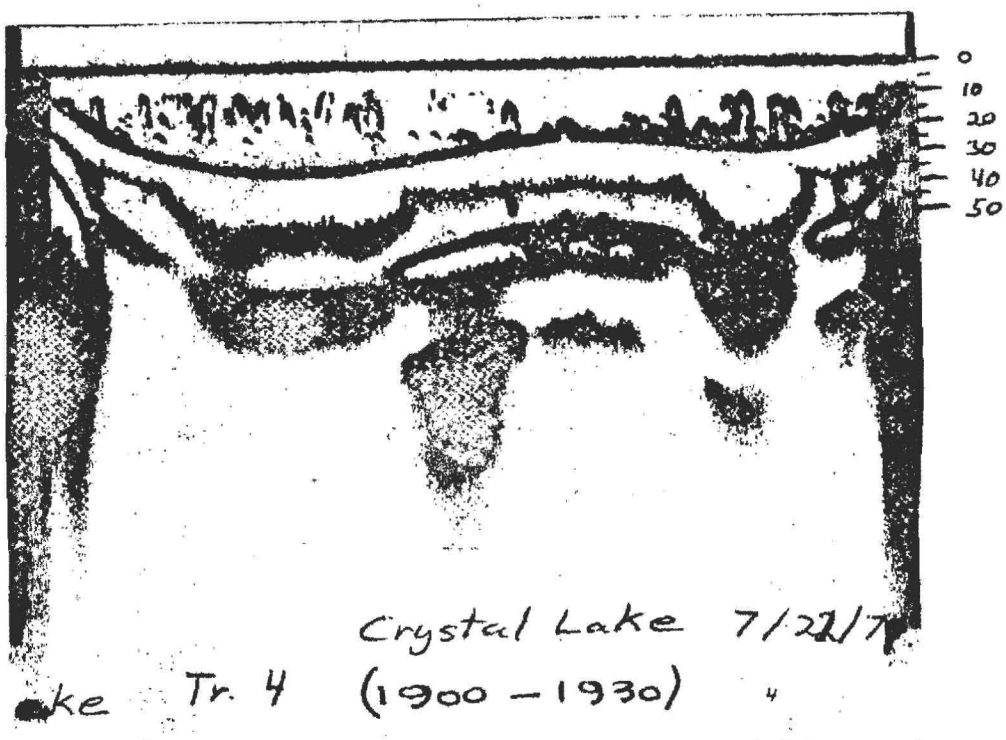
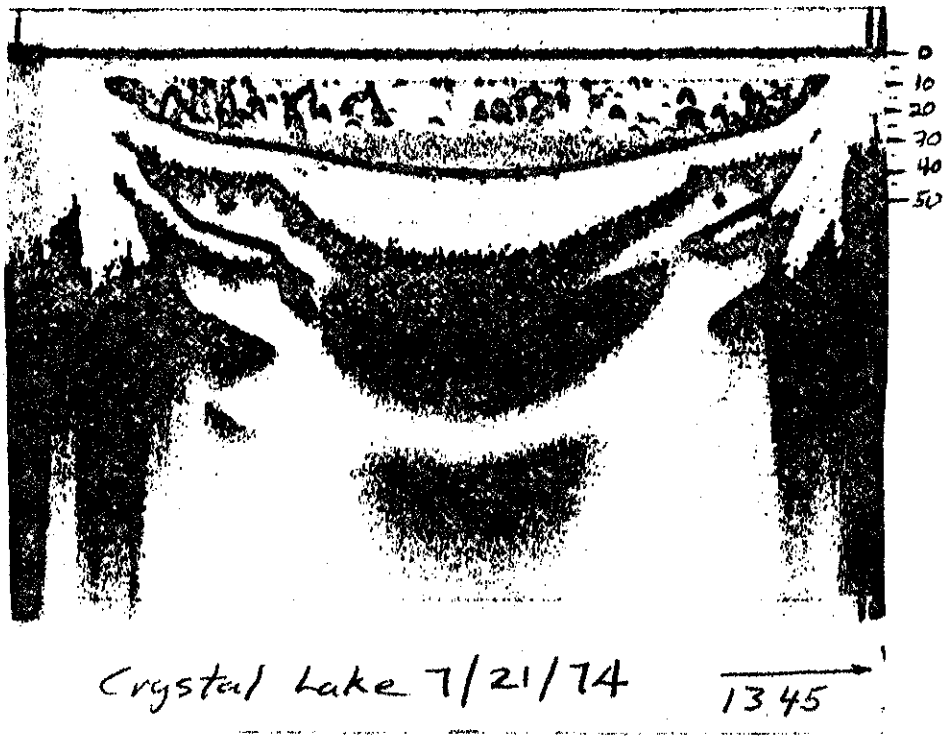
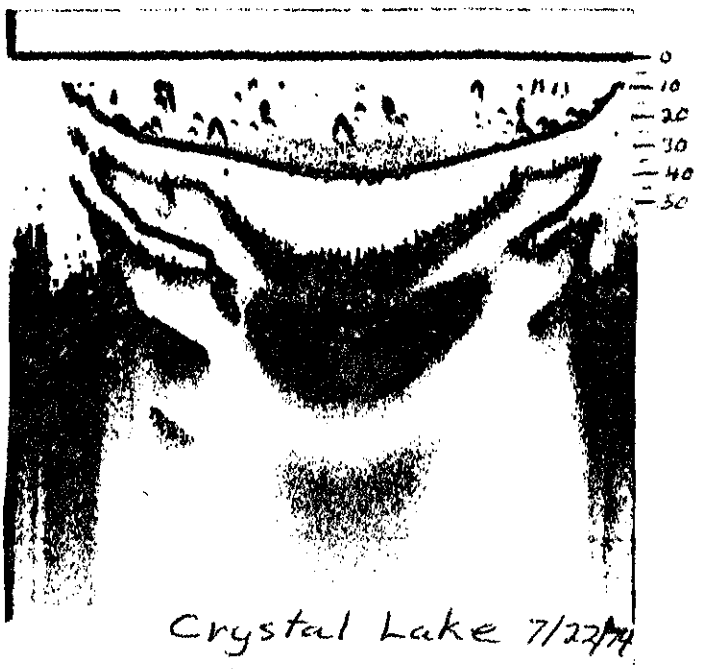


FIGURE 4d



Transect 5



FIGURES 5a-5d. Acoustic transects for Bass Lake, New York (see Figure 3c) as repeated at 1400, 1800, 2100 on 7/24/74 and 1100 on 7/25/74. Gill netting and trapping reveal the brown bullhead to be the only fish species present. Curiously it appears to enter mid-waters, even during the day. Stomach analyses confirm this mid-water habit through the presence of abundant Cladocera. The exceedingly dark night transect (Figure 5c) suggests the upward movement of zooplankton from the bottom at night. A thermocline is suggested at about 15' by the contrasting upper dark zone and lower clear zone. Note that targets are present throughout the water column but are concentrated in the upper 15'.

FIGURE 5a

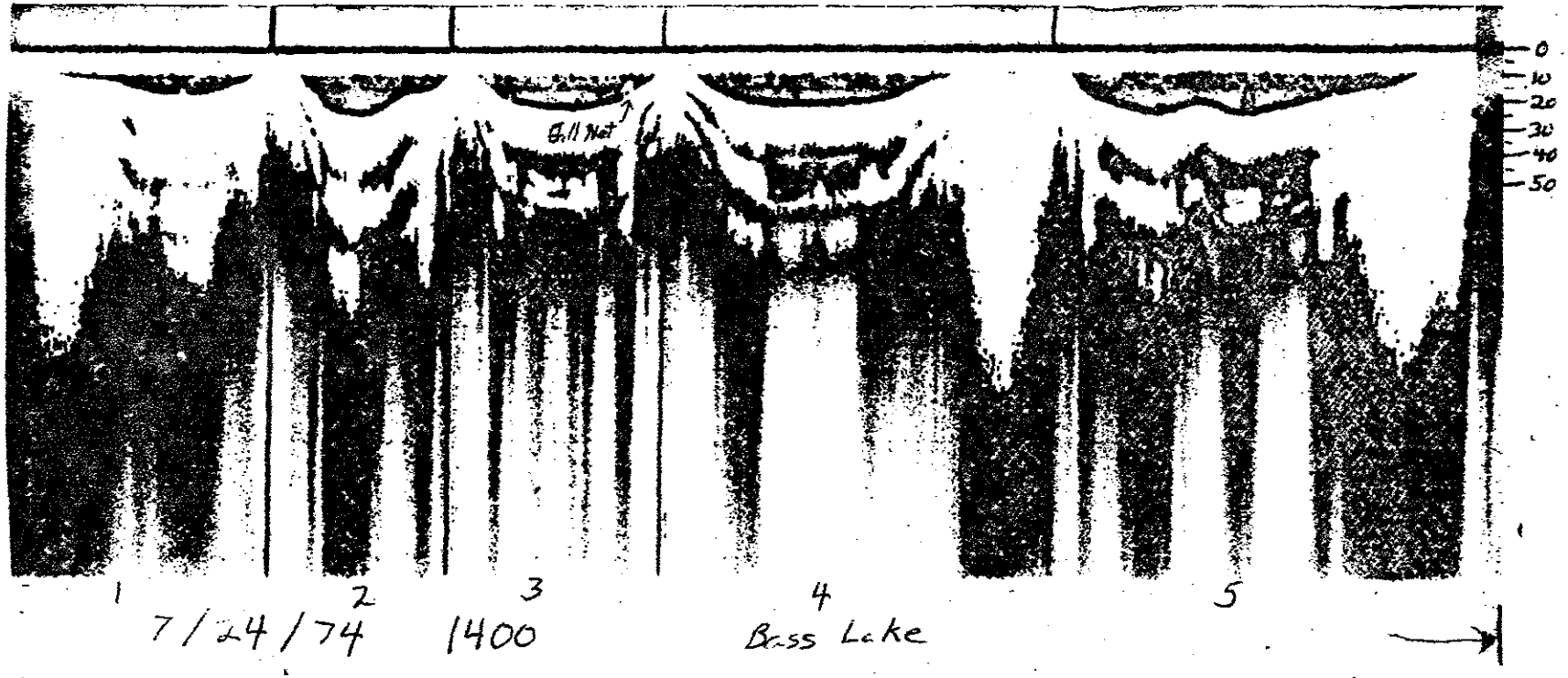


FIGURE 5b

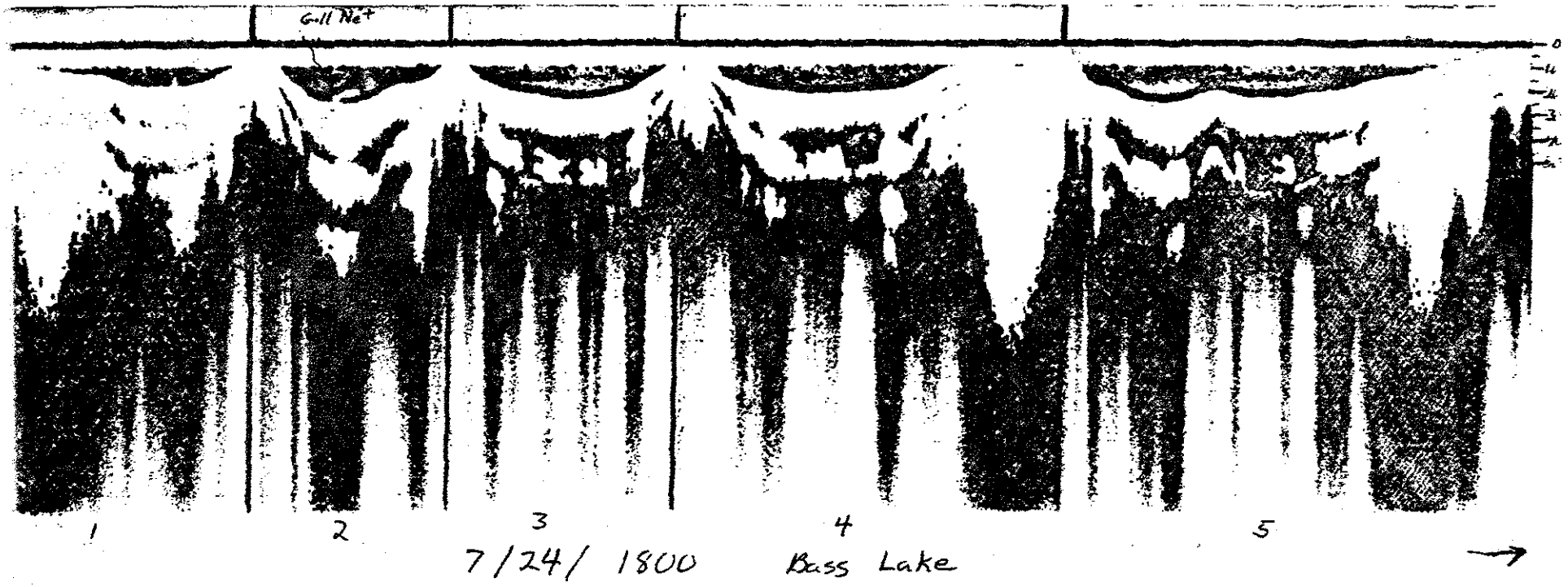


FIGURE 5c

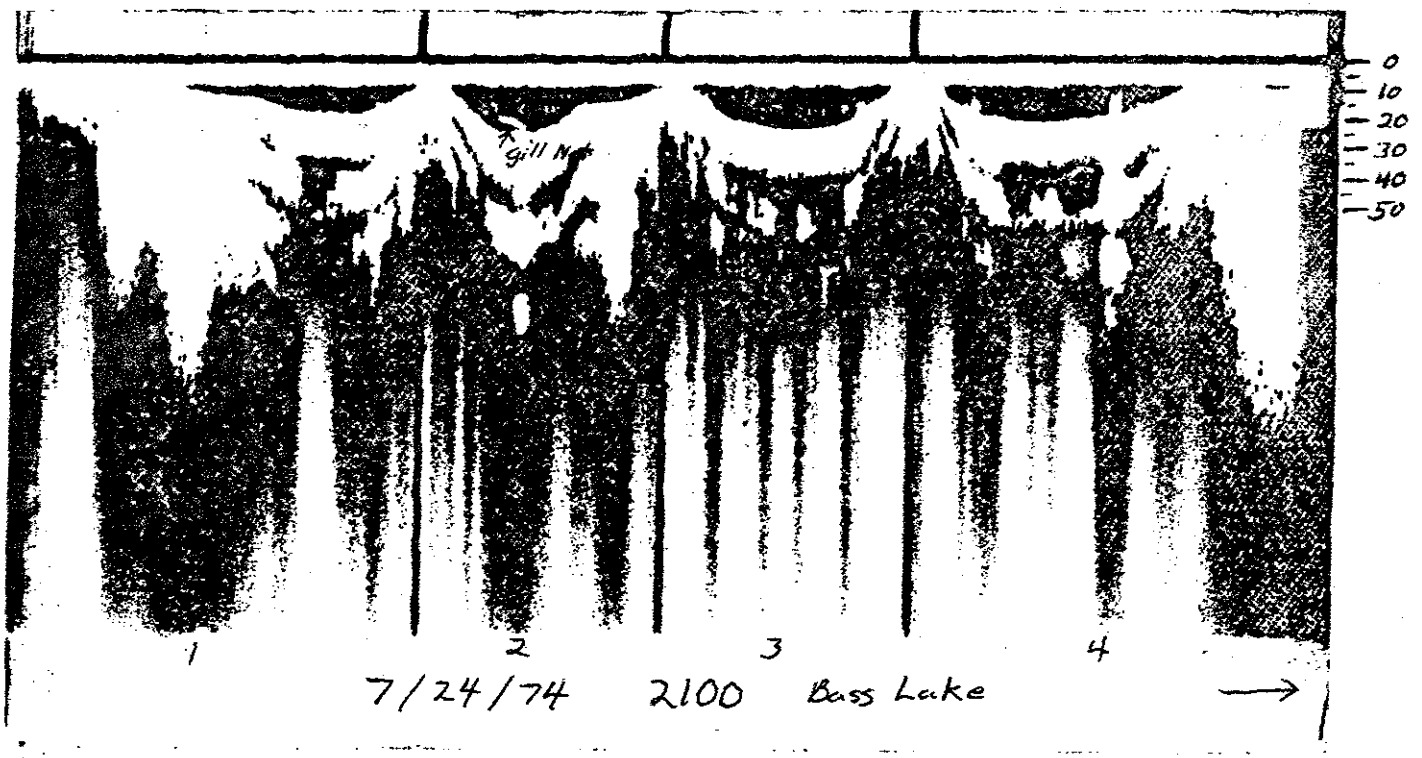


FIGURE 5d

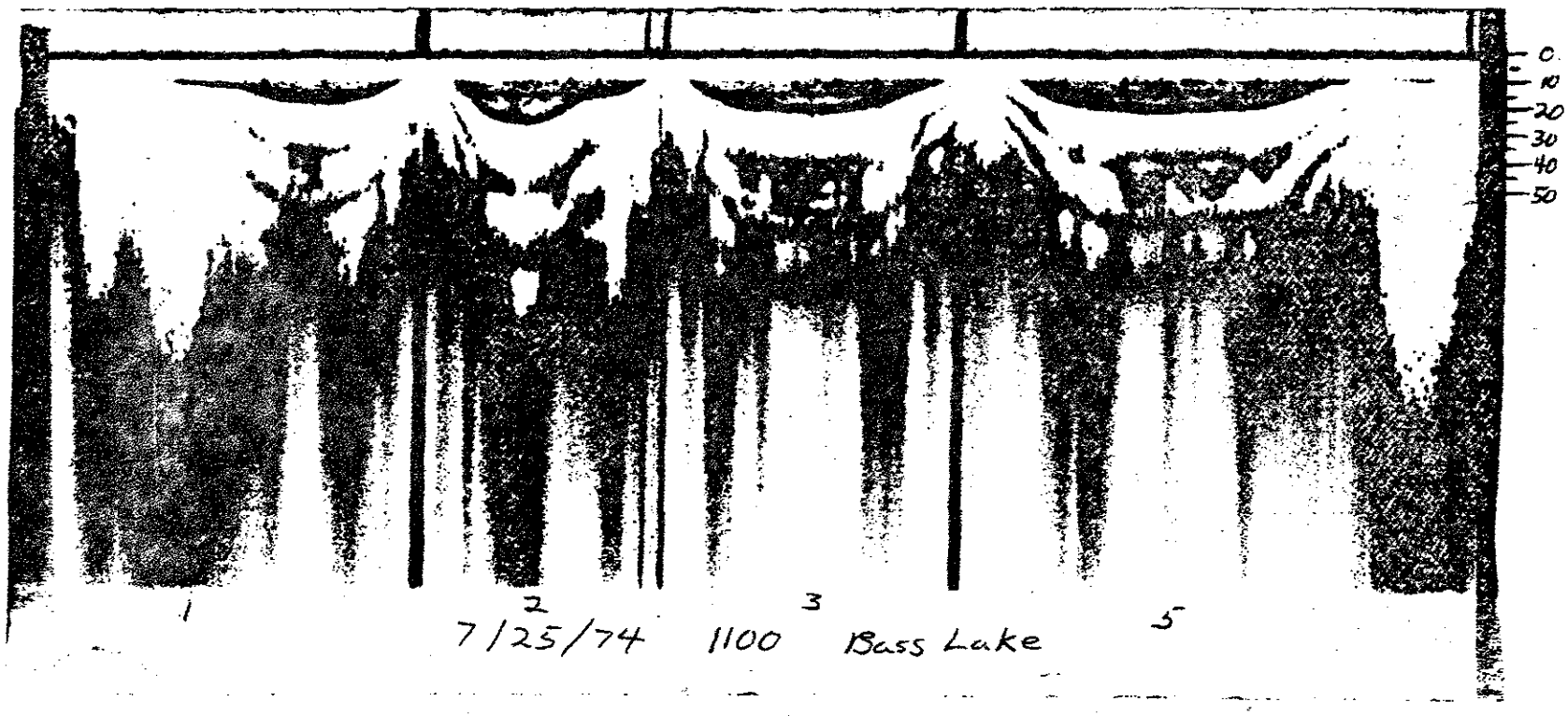
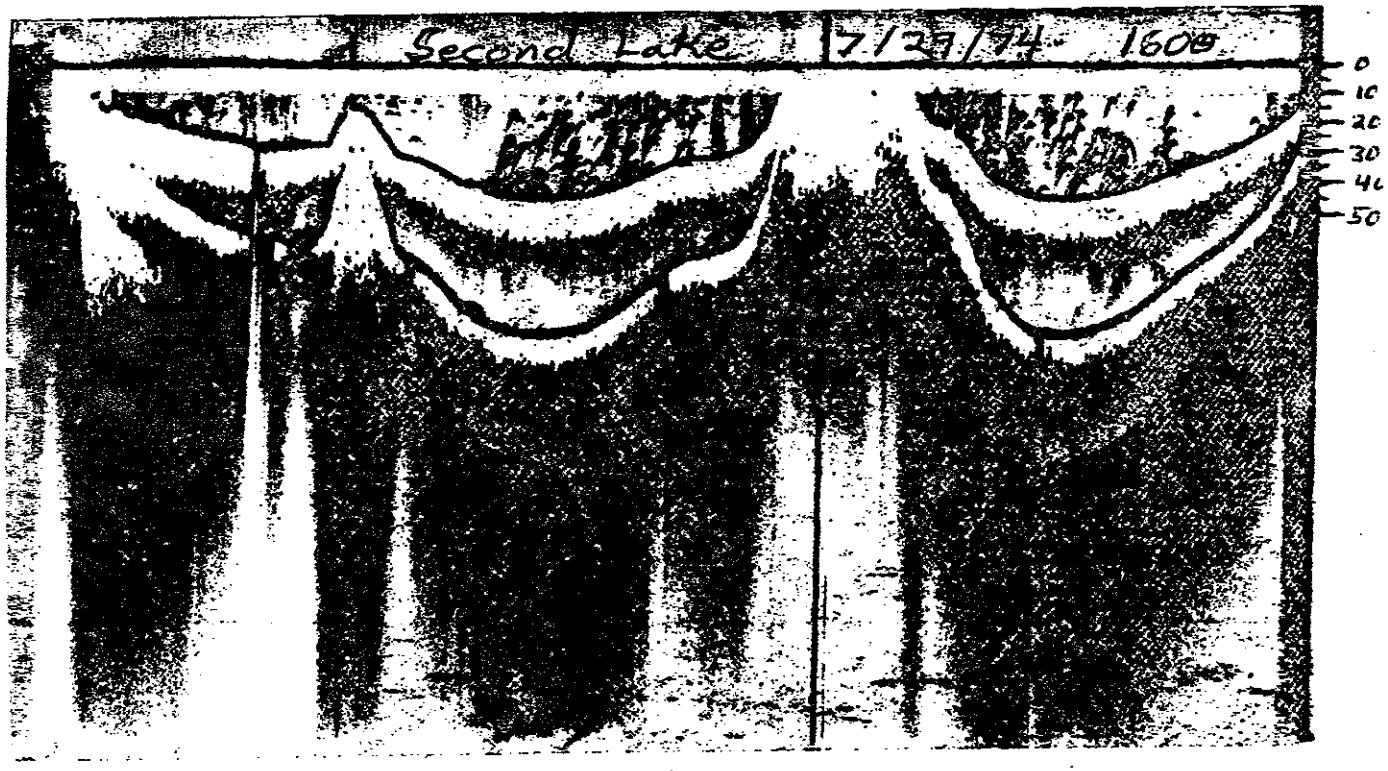


FIGURE 6. Three transects at Second Lake, New York (See Figure 3d) run commencing at 1600 on 7/29/74. Note the distinctive second and third echoes evident. The asymmetry of the targets is due to a slight angle of the transducer. The general absence of targets at the sandy beach of the girls camp and a tendency for targets to concentrate near the mouth of the inlet is notable in these traverses. The absence of signature stratification and widespread vertical presence of fish are additional distinctive points. A well-oxygenated vertical profile throughout the recorded 45' is suggested but oxygen level determinations (7/30/74) contradict this. Yellow perch probably constitute most of the mid-water targets.

FIGURE 6



APPENDIX I*

Lake of the Pines
Lot Numbers 1-25

Crystal Lake
Lot Numbers 26-58

Bass Lake
Lot Numbers 59-66

Second Lake
Lot Numbers 67-81

APPENDIX II*

SPECIMEN CHARACTERISTICS BY LOT AND SUBLOT NUMBER FOR ALL FISHES MEASURED. NOTE THE CONDITION INDICES (k_{tl}) FOR EACH IN THE RIGHT-HAND COLUMN.

*The length of these appendices prohibited their reproduction and inclusion in this report. The appendices may be viewed at either the Fresh Water Institute office at Rensselaer Polytechnic Institute, Troy, New York, or at the Adirondack Park Agency in Ray Brook, New York.