Aquatic Control
Aquatic & Terrestrial Study
Lake Management
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LAKE SURVEY REPORT

PAPAKEECHIE LAKE

1977

Introduction

Papakeechie Lake, a 178 acre lake located in Kosciusko County, Indiana, was surveyed on June 1-2, 1977, by Aquatic Control, Inc. of Seymour, Indiana.

The objective of this survey was to sample and observe various physical, chemical, and biological parameters associated with the lake, with respect to their effect on the sport fishery and aesthetic value of the lake. Additional information relative to the lake use and problems were obtained from property owners. The collection of information and data analysis has been done from an unbiased standpoint based on data collected, available guidelines, and the experience of the author with no reflection on any group or individual associated with Papakeechie Lake Association. This survey is by no means an exhaustive study of the lake. The study was designed to collect a maximum amount of information related to the fishery in the shortest period of time to limit the cost of the survey. The data collected are adequate for determining the status of the fishery and for development of a fish mangement program. All fish numbers used in the report are based on the samples

collected and should not be interpreted as absolute or estimated numbers of fish in the lake. This type of data is beyond the scope of the survey and is not necessary for the survey objectives.

Methods and Materials

This survey included the collection of data in two primary areas: water chemistry and fish.

Two sampling stations were established for water chemistry evaluation due to the unusual bottom contours of the lake. The stations were established in the two deepest basins of the lake. These were located with the assistance of residents and by using a Rayethon recording fathometer. The approximate locations of the sampling stations are shown on Figure 1.

Field measurements were taken with an International Biophysics oxygen-temperature meter, a Hach DR/2 portable laboratory kit, and a Yellow Springs S.C.T. meter. Laboratory analyses were done on a Hach DR/2 spectrophotometer.

Fishes were collected by three methods: gill netting, frame-trap netting, and electrofishing. Three collection methods were used to reduce the bias in sampling introduced by species and size selectivity of each type of equipment (Bennett 1971). Six 125 ft. x 6 ft. monofilament experimental gill nets were fished overnight at the locations shown on Figure 1. Four 1/2 inch mesh frame trapnets were set at the locations shown on Figure 1 and fished for approximately 12-16 hours.

Electrofishing equipment consisted of a boat-mounted boom-type shocker using a Smith-Root Type VI electrofisher powered by a 3400 watt Homelite generator. The unit was operated at 60 and 120 pulse per second 565 volt pulsating direct current. Electrofishing was conducted around the periphery of the lake and around weed beds, stickups, docks, and islands. Electrofishing samples were taken after dark on June 1 and 2.

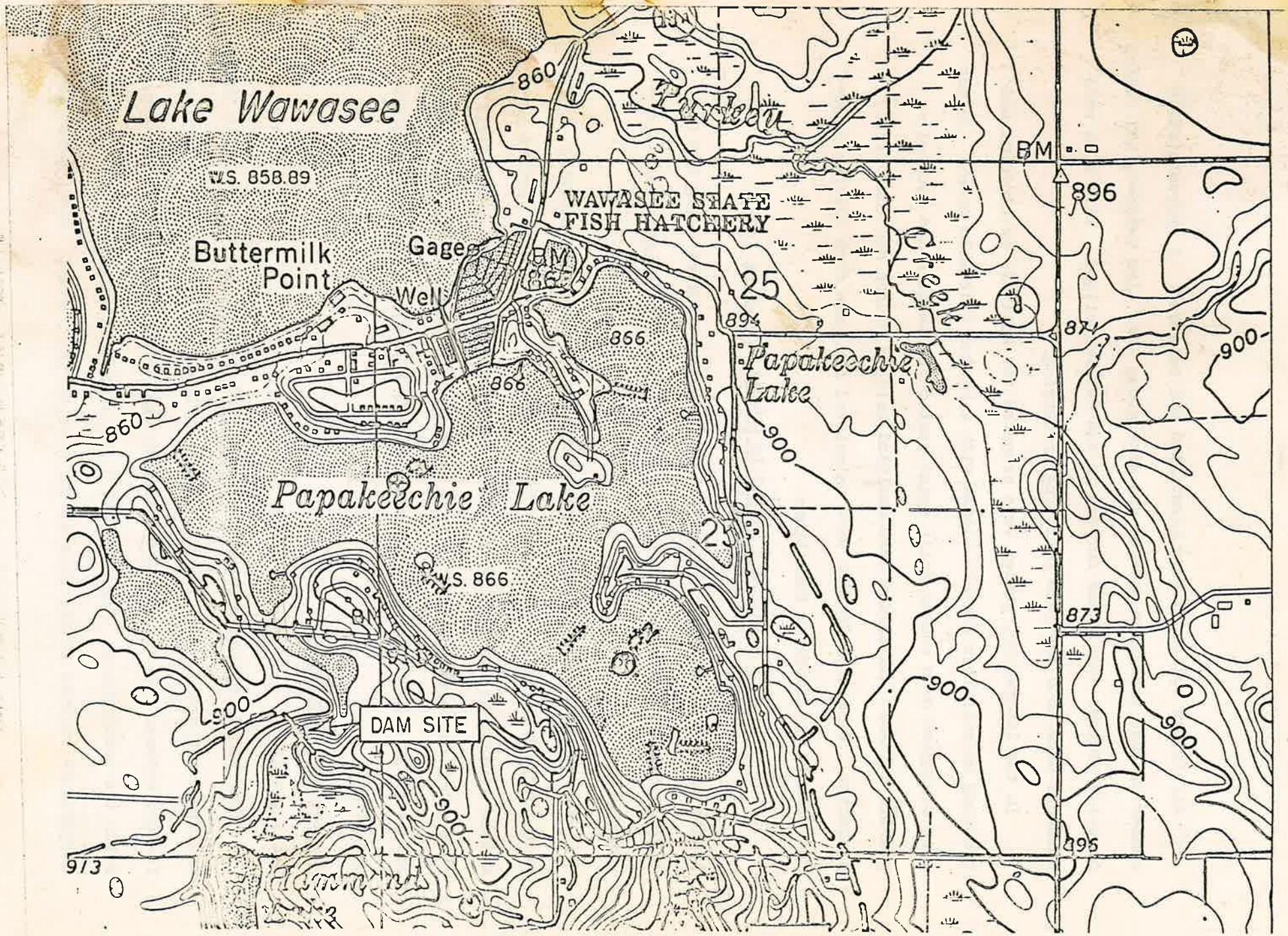

Figure 1 Location of water quality sampling stations (⊘), gill nets (⋯), and traps (⊃—), Papakeechie Lake survey, June 1-2, 1977.

All fishes collected were identified and measured. A representative number of each important species and size group were also weighed, and scale or spine samples were taken for use in age determinations. Live fish were released back into the lake following processing.

In the laboratory, scales were prepared for analysis by cleaning and pressing on cellulose acetate slides with a heated hydraulic press. Spines were sectioned on a custom built spine sectioning machine and mounted on plastic slides. All slides were analyzed using a Bausch and Lomb micro-projector. Condition factors were calculated for game fish species using the formula for Index of Condition:

$$C = \frac{10{,}000 \times \text{weight in pounds}}{\text{total length in inches}}$$ (Bennett 1971).

Length at each annulus was calculated for gamefish species using the Lee (1920) method which assumes a non-directly proportional linear body-scale relationship.

Two unpublished IDNR lake survey reports, Wawasee and Flatbelly, 1975, were obtained and used extensively in comparative analysis of various parameters related to the fish population. These were used more extensively than other references listed because of the close proximity to Papakeechie. Reference is made to these two survey reports throughout this report without citation.

Results and Discussion

Water Quality

The results of water chemistry and associated factors are shown in Table 1 and Figures 2 and 3. The results show that there is essentially no great difference between the two sampling stations except the degree of oxygen depletion below the metalimnion. Figure 2 and 3 are a graphic display of the oxygen and temperature regimes in the lake at the time of the survey. These were prepared

Table 1. Results of selected physical and chemical determinations, Papakeechie Lake, June 1-2, 1977.

Parameter	Station 1 Surface	Station 1 Bottom (55 ft.)	Station 2 Surface	Station 2 Bottom (48 ft.)
Temperature	71.6	44.6	69.8	46.4
Dissolved Oxygen	10.4	0.0	11.6	0.2
Total Alkalinity	170	170	170	170
Total Hardness	160	160	160	160
Calcium Hardness	110	110	110	110
pH	9.0	8.0	9.4	7.0
Carbon Dioxide	0.0	48.0	4.0	40.0
Specific Conductivity	280	220	280	221
Hydrogen Sulfide	0.0	1.0	0.0	5.0
Ortho Phosphate	0.06	0.38	0.05	0.62
Total Phosphate	1.28	2.00	0.38	1.27
Ammonia Nitrogen	0.0	0.94	0.00	0.50
Nitrate Nitrogen	0.2	0.05	0.02	0.03
Total Iron	0.16	0.10	0.10	0.55

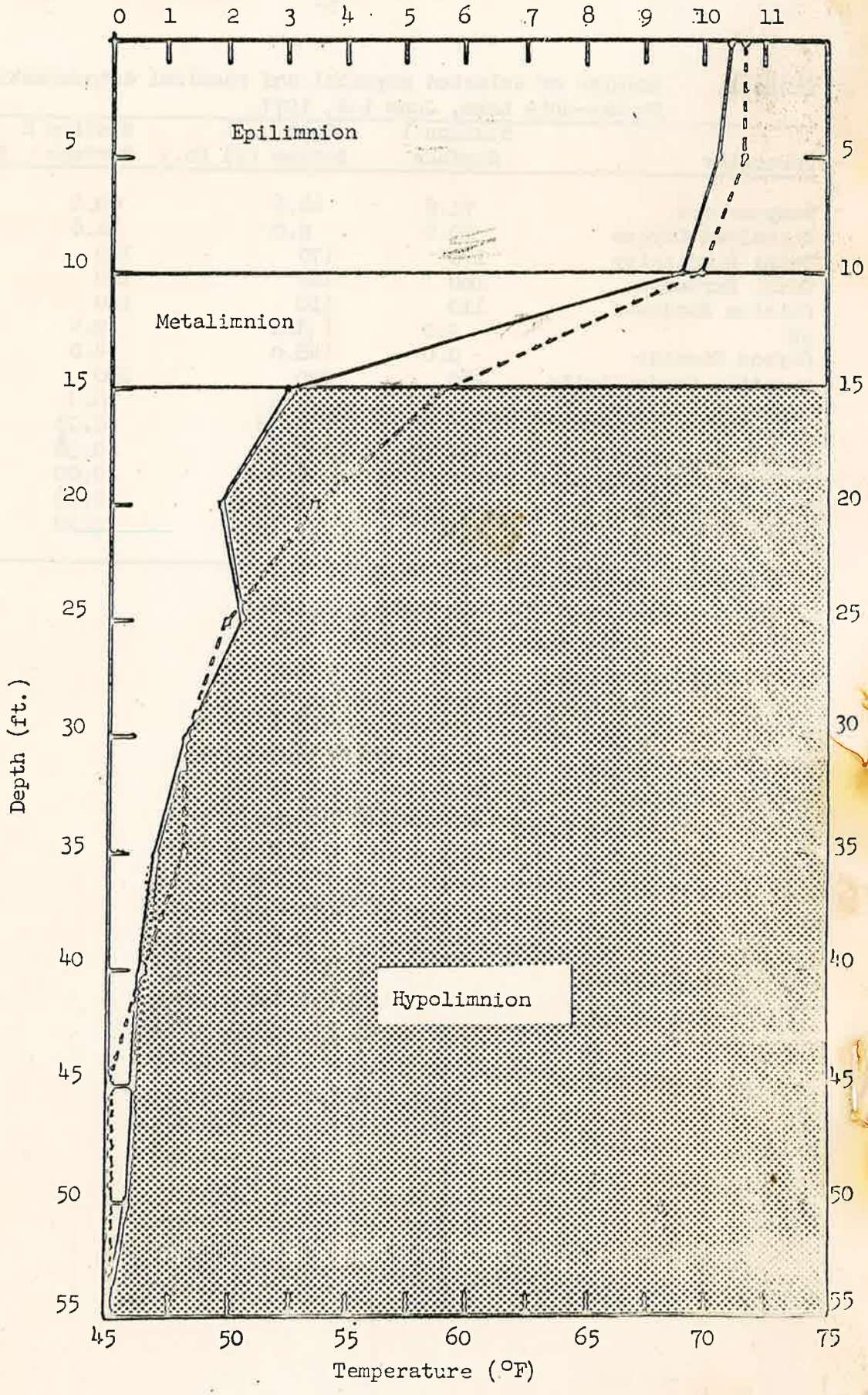

Figure 2 Temperature (- - -) and dissolved oxygen (——) profiles, Station 1, Papakeechie Lake, June 1, 1977.

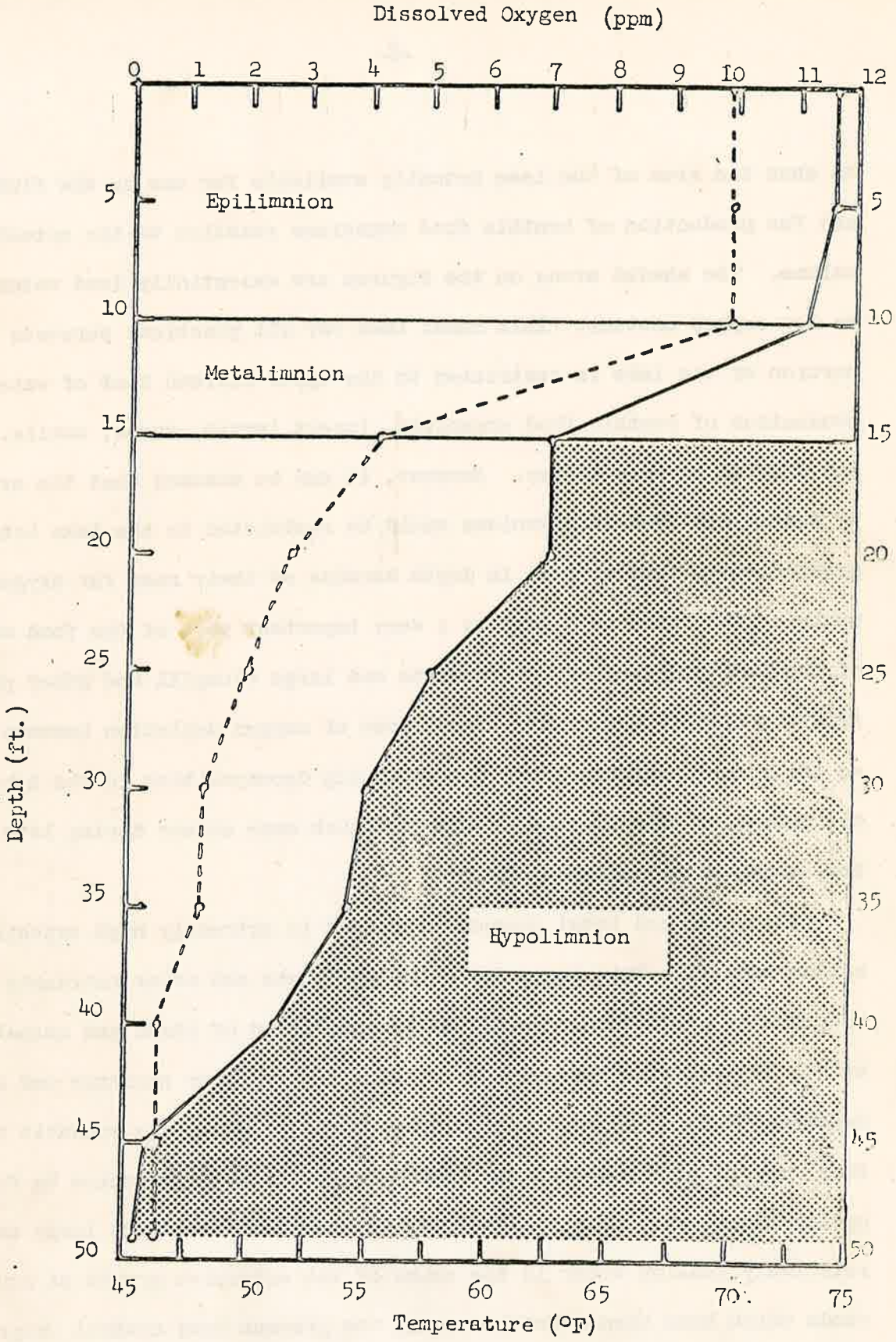

Figure 3 Temperature (---) and dissolved oxygen (——) profiles, Station 2, Papakeechie Lake, June 1, 1977.

to show the area of the lake actually available for use by the fish population and for production of benthic food organisms relative to the actual lake volume. The shaded areas on the figures are essentially dead water areas due to low oxygen content. This shows that for all practical purposes the usable portion of the lake is restricted to the upper fifteen feet of water. The production of benthic food organisms, insect larvae, worms, snails, etc. was not checked in this survey. However, it can be assumed that the areas usable by nearly all benthic organisms would be restricted to the lake bottom in areas fifteen feet or less in depth because of their need for oxygen. The benthic production in a lake is a very important part of the food web as much of the food utilized by intermediate and large bluegill and other panfish is from the benthic organisms. The degree of oxygen depletion becomes more serious as the summer progresses due to continuing decomposition in the hypolimnion so the extent of this problem is probably much more severe during late summer than that shown in the present survey.

The ortho and total phosphate content is extremely high especially in the bottom samples. This accumulation of phosphate and other nutrients is a result of years of production, death, and decomposition of plant and animal tissue with a low exchange rate of water. With little water exchange and anaerobic decomposition in the hypolimnion, phosphorus is kept in a soluable and usable form, and is recycled from the bottom waters to the epilimnion by fall and spring turnovers. This high nutrient content combined with large areas of relatively shallow water is the cause of the extensive growth of aquatic weeds which have been a problem until the present weed control program was implemented. This program should be continued; however, oxygen levels and algae populations should be monitored and controlled to prevent oxygen depletion and a resultant fish kill. This is very important because the nutrients

formerly tied up in weed growth are now available for plankton or filamentous algae growth. This growth must be watched closely and controlled to avoid problems of dominance by filamentous algae or species of blue-green algae. Further monitoring of dissolved oxygen is recommended to determine the need for artificial aeration. Suggested program and equipment needs are given in the recommendations section. Destratification and continual circulation of the lake would undoubtedly improve the lake in several ways including:

1. Prevention of possible summer or winterkills of fish due to low oxygen.

2. Increase the area of the lake usable by fish due to increased oxygen which essentially increases the lake size.

3. Increases food supply for fish by maintaining oxygen on the lake bottom allowing development of aerobic organisms such as insect larvae.

4. Speed up decay of dead vegetation and other organic matter on lake bottom, including accumulated muck.

5. Help reduce available phosphates by precipitation in an unsoluble form due to adequate oxygenation.

The actual system design and cost requires additional data which was beyond the scope of the present survey. Consideration of using an aeration-circulation system in the long range lake maintenance program is recommended. Several of the other parameters are recorded to establish a baseline for future comparison and are considered in the evaluation as they relate to lake productivity. Overall the water chemistry data show that the lake is in an advanced state of eutrophication and has the capacity for high fish production.

Fish

A total of 1064 fishes representing 16 species were collected during this survey (Table 2). Detailed data on all species is given in Tables 3 and 4

Table 2. Species composition and relative abundance of fishes collected from Papakeechie Lake, June 1-2, 1977.

Common Name	Scientific Name	Number	Percentage
Bluegill	Lepomis macrochirus	457	43.0
Golden shiner	Notemigonus crysoleucas	202	18.98
Redear sunfish	Lepomis microlophus	109	10.24
Pumpkinseed	Lepomis gibbosus	55	5.17
Largemouth bass	Micropterus salmoides	51	4.79
Brown bullhead	Ictalurus nebulosus	43	4.04
Yellow bullhead	Ictalurus natalis	34	3.20
Grass Pickerel	Esox americanus	30	2.82
Yellow perch	Perca flavescens	22	2.06
Warmouth	Chaenobryttus gulosus	22	2.06
Spotted gar	Lepisosteus oculatus	14	1.32
Black crappie	Pomoxis nigromaculatus	12	1.13
Lake chubsucker	Erimyzon sucetta	7	0.66
Brook silverside	Labidesthes sicculus	3	0.28
Green sunfish	Lepomis cyanellus	2	0.19
Bowfin	Amia calva	1	0.09
		1064	

pages 23 - 28. Seven of the species collected could be considered to be desirable sport species: bluegill, redear sunfish, largemouth bass, brown and yellow bullhead, yellow perch and black crappie. These seven species accounted for 68.5 percent of the sample. This compares quite well with Flatbelly Lake and Wawasee where recent surveys show a total of 70 percent and 64 percent gamefish respectively.

Bluegill was the most abundant species collected with 457 individuals making up 43 percent of the sample. The status of this species has probably been used as an indicator of fish population balance more than any other single species. This is due to many factors including its ubiquitous occurrence and the propensity of the species to overpopulation and stunting. Of the 457 bluegill collected in this sample, 342 or nearly 75 percent were in the 4 to 5.5 inch size. These fish were found to be slow growing when compared to averages for northern Indiana lakes (IDNR unpublished). The average age of northern Indiana bluegill in the 4 to 5.5 inch size is reported to be 2-3 years while Papakeechie bluegill in this size range were found to be 3-5 years old. Growth rates of adult bluegill (3 years plus) is slow as shown in Figure 4; with an average growth of slightly less than one inch per year. This is significantly slower growth than shown for bluegill from Flatbelly and Wawasee. The graph indicates that growth of bluegill is comparable or better than the other lakes for the first two years of life but drops below for older bluegill. The growth rates are nearly identical to those found by Gerking in his study of Wyland Lake, Kosciusko County. In that study, Gerking noted that bluegill growth was "one of the slowest recorded in populations from a large number of lakes" (Gerking 1962). This is a reflection of the abundant source of planktonic food for small bluegill and an apparent severe competition for larger food organisms in Papakeechie.

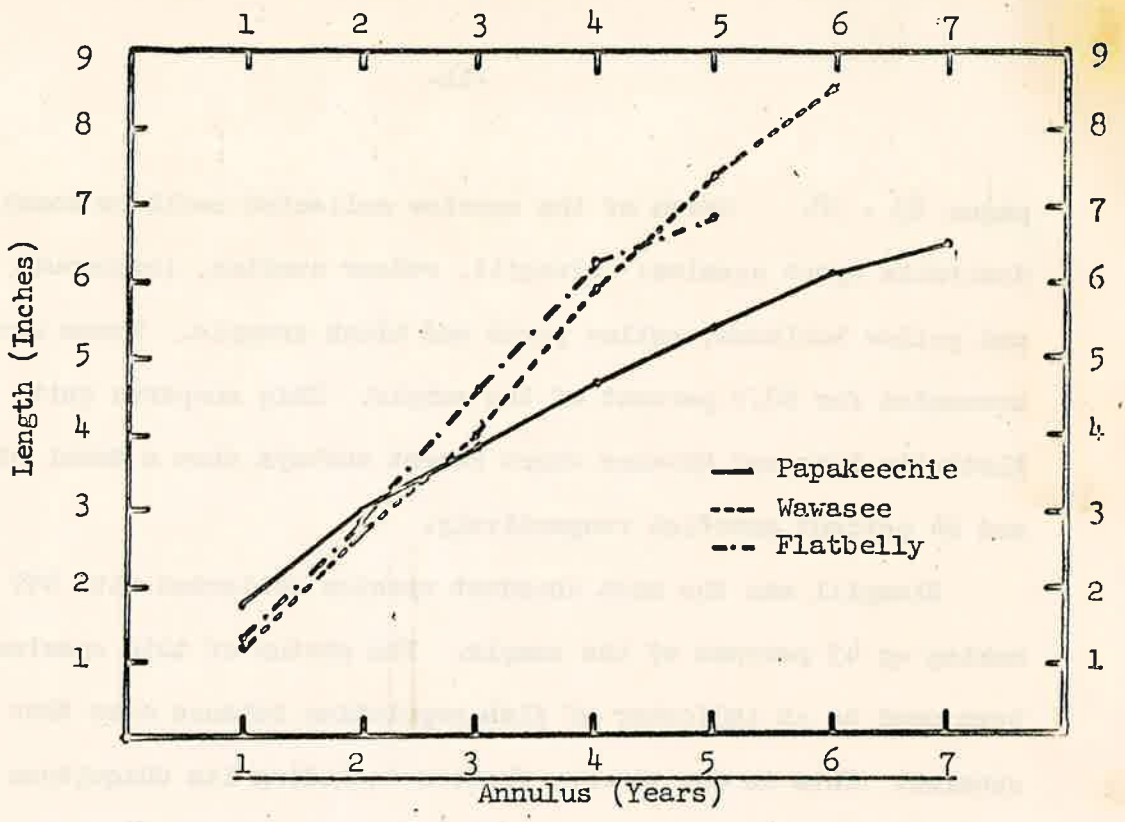

Figure 4 Comparison of total length at annulus formation for bluegill from three northern Indiana lakes.

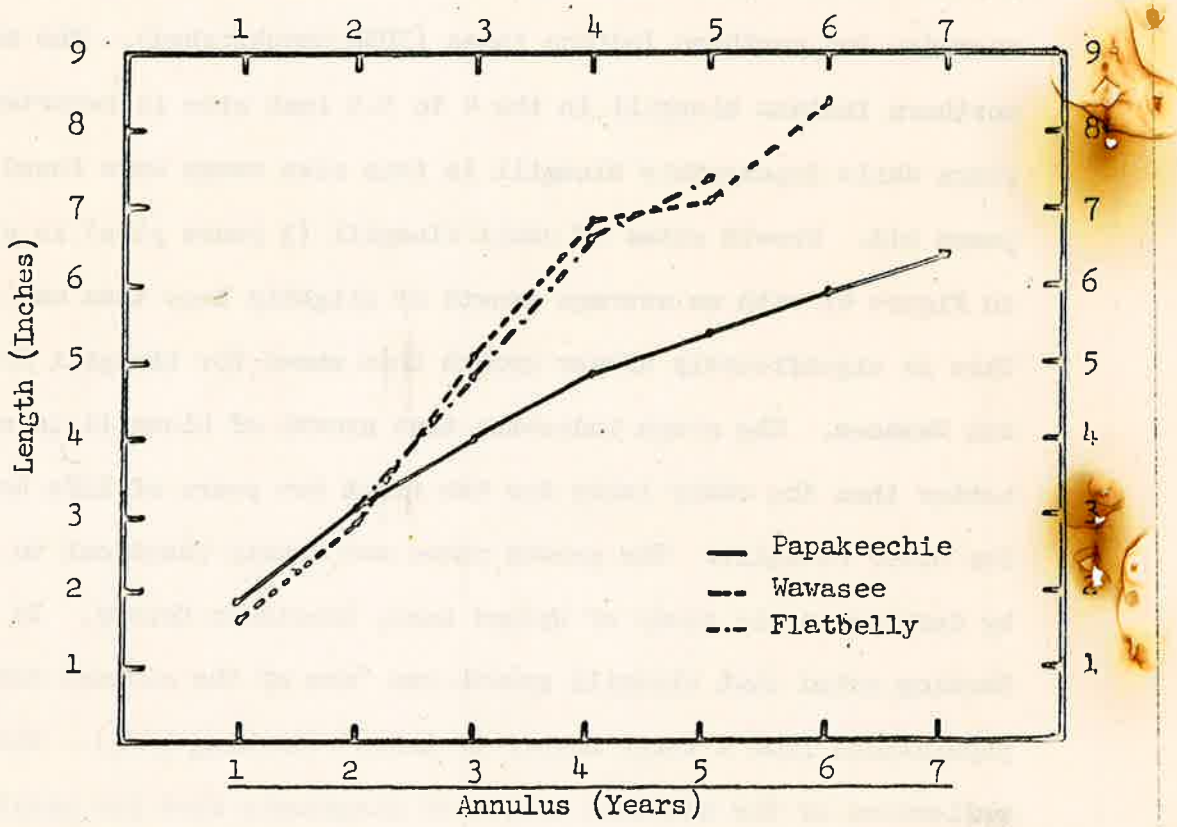

Figure 5 Comparison of total length at annulus formation for redear sunfish from three northern Indiana lakes.

This competition is probably a combination of interspecific competion with golden shiners, pumpkinseed sunfish, warmouth, and bullheads, as well as intraspecific competion due to overproduction and recruitment of young bluegill.

In a comparison of catchable size bluegill (6 inch plus) collected in the three surveys, it is readily apparent that Papakeechie is well below other local lakes:

Papakeechie - 9.4 percent
Flatbelly - 41.5 percent
Wawasee - 55.0 percent.

This is the "bottom line" of the bluegill analysis; the fish available to the fisherman.

The bluegill population as a whole shows three definite signs of unbalance comparable to Anderson's (1973) findings in Missouri ponds and Price's (1977) study of Michigan bluegill populations. First, both report poor growth of adults as a major characteristic which is very pronounced in this survey. Secondly, dominant year classes are reported in both of the above and in our sample. The third characteristic, presence of many fish of age 2 and 3 with few fish beyond 5 as shown by Anderson, did not hold true in Price's study or in the Papakeechie sample. We find a situation of dominance by 3 and 4 year old bluegill compared to Price's findings of dominance by 4 and 5 year olds in Michigan, which substantiates Price's hypothesis that the shift in age class may be due to longer lived fish in more northerly latitudes. It is apparent that the bluegill population in Papakeechie is in an unbalanced state and will require some corrective management in order to produce a desirable fishery. Several alternatives will be discussed in the recommendations section.

The second most abundant species taken in the survey was the golden shiner. This is a common forage type minnow which prefers weedy, relatively clear lakes. It feeds on planktonic crusteceans, insect larvae and small mollusks which makes it a competitor with sunfish and small bass. The golden shiner is also a very good forage species for bass and other predatory species. This species made up nearly 19 percent of the fish collected in this sample (Table 2). A large percentage of the shiners collected, 86 percent, were seven inches or more in length which is too large to be utilized by bass under 14 inches (Lawrence 1958). The only other predators large enough to utilize this abundant large forage in Papakeechie are the spotted gar and the bowfin. Because of this situation, the golden shiner in this lake is an unnecessary forage species. They are competing with the sunfish and small bass for food, and at the same time providing an alternate food supply for the largemouth bass population which reduces their effectiveness as a bluegill predator. Successful introduction of an additional large predator such as the northern pike could have a significant direct effect on the golden shiner population and an indirect effect on the sunfish population.

Redear sunfish was third in abundance in the sample with 109 individuals accounting for 10 percent of the sample. The redear collected ranged from 4.0 inch, 3+, fish to a 7.4 inch, 7+ individual. Nearly 24 percent of the redear sampled were in the harvestable size range. This is somewhat better than Papakeechie bluegill but is still considerably below redear in Wawasee with 51.6 percent catchable and Flatbelly with 42.9 percent catchable. Figure 5 shows a growth pattern similar to bluegill with calculated growth up to two year old fish comparable to other area lakes and a rather severe stunting of growth in older fish. Condition factors of redear collected

were average for fish up to about 6 inches and slightly below average for larger individuals. A later sample would very likely show considerably lower condition due to loss of weight during spawning. This again indicates a shortage of larger food organisms as a result of either low production of food or severe competition, with the latter probably being the most important factor.

Fifty-five pumpkinseed sunfish were collected in the survey and accounted for slightly over 5 percent of the sample. The pumpkinseed is generally not considered to be a desirable species in Indiana lakes because it is slow growing and rarely provides a significant crop of harvestable size panfish in combination with bluegill and redear sunfish. This species prefers lakes with soft bottoms and weed patches. They feed on small mollusks, insects, and small fishes. The food habits are similar to the other more desirable sunfish which increases the interspecific competition and resultant stunting. This species is quite common in northern Indiana. They appeared in the Wawasee sample fifth in numerical abundance and ninth in abundance in Flatbelly.

The largemouth bass was represented by 51 individuals ranging in size from 4 to 18.6 inches and accounted for nearly 5 percent of the sample. The sample of bass indicates successful reproduction and recruitment of bass and, although numerical abundance appears to be low, it compares quite favorably with Wawasee (7 percent) and Flatbelly (4.2 percent). Figure 6 shows that growth to intermediate size (10-12 inches) is somewhat better than the adjacent lakes; however, growth of larger individuals is somewhat slower. The relative abundance of harvestable bass (14 inch plus) of nearly 10 percent of the sample compares favorably with the adjacent lakes with 4 percent for Wawasee and 6 percent for Flatbelly.

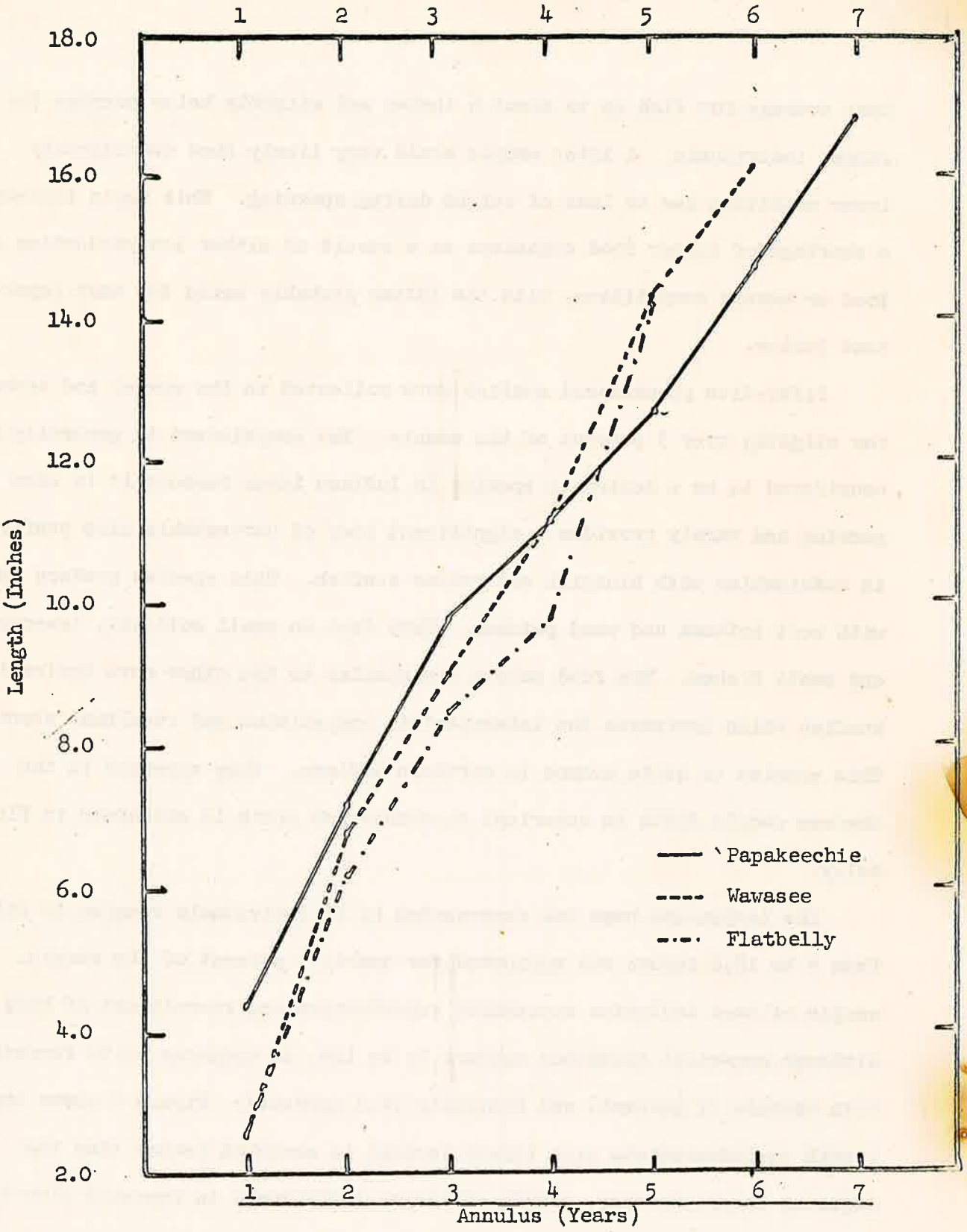

Figure 6 Comparison of total length at annulus formation for largemouth bass from three northern Indiana lakes.

Condition factors of bass in the sample were found to be in the average range for northern Indiana lakes (IDNR unpublished).

These data indicate that the apparent low level of bass in Papakeechie may be a more normal regional situation than an actual undesirable population. This does not prove that the bass population is at a maximum or even an acceptable level of production due to possible differences in efficiency of electrofishing equipment used in the various surveys and other variables. The sample does strongly indicate that introduction of fingerling largemouth bass alone could not be expected to significantly improve the bass population structure. The low percentage of harvestable size bass with reasonably adequate numbers of small bass suggests that the bass population is suffering from an overharvest of intermediate size bass (10-12 inches) leaving few to grow to larger sizes. This overharvest of bass also reduces the effective predation on forage species by the bass which increases the severity of stunting in the panfish population.

Two species of catfish, brown and yellow bullheads, collectively made up 7 percent of the sample. Both species included harvestable size individuals with nearly 70 percent of the brown bullheads collected being 10 inches or larger. These species are probably underutilized due to fisherman preference for other species. The reasonably high abundance of these species probably has an affect on the overall fish population due to their utilization of available food which could be used by other more desirable species.

Thirty grass pickerel ranging in size from 6 to 14.5 inches were collected. This species is the smallest of the pike family, seldom exceeding 15 inches. Food preferences are primarly crusteceans by grass pickerel up to 6 inches and small fish for individuals over 6 inches. Habitat preference of this species is shallow, weedy lakes, swamps and streams with soft bottoms. Due to this

preference, their abundance may decrease in the future as a result of the current weed control program in Papakeechie. Their impact on the overall fish population is probably negligible due to the abundance of available forage. This species is often thought to be young northern pike due to their close resemblance.

Twenty-two yellow perch were collected during the survey. These fish ranged in size from 5.5 to 10 inches and exhibited average growth rates and condition for northern Indiana lakes. Thirty-six percent of the perch collected were of a harvestable size (8 inches plus) which compares favorably with other collections from Indiana lakes (IDNR unpublished).

Warmouth, a common native sunfish, accounted for 2 percent of the sample. This species, like the pumpkinseed, generally does not contribute to the panfish harvest due to its slow growth and small size. It is often confused with the rock bass due to the similarity in appearance of the two species. Its impact on the fish population would be the additional competition for available food because of the similarity of its food habits to that of bluegill and redear sunfish.

The only other significant sport fish collected was the black crappie with 12 individuals ranging from 3 inch one year old to 15 inch plus five year old fish being taken. The abundance of this species in lakes fluctuates widely with occasional large year classes being produced followed by very low production. This results in sporadic good crappie fishing interspersed with very poor fishing. The population dynamics of crappie are not well understood; however, the erratic pattern appears to be, at least partially, a function of spawning success. In small lakes crappie often produce such large year classes that stunting and interspecific competition with largemouth bass results.

The crappie population appears to be in a low part of the cycle now, however, more than adequate brood stock is available to perpetrate the species. All three of the largest individuals collected were ripe females. These three specimens alone would be adequate to replenish the entire lake if they successfully spawned.

Other species collected included the spotted gar (1.32%), lake chubsucker (1.66%), brook silversides (0.28%), green sunfish (0.19%), and the bowfin (0.09%). The spotted gar were all large adults, ranging from 24.5 to 31.6 inches. This species as well as the bowfin, or dogfish, is a predator on small fish. Although they are not considered to be a gamefish, their presence in the lake is beneficial due to their predatory food habits. The abundance of these species may decline as a result of the habitat change resulting from the weed control program.

The lake chubsucker is a desirable forage fish for bass and other predators and is another species which prefers weedy lakes.

The brook silversides is a small forage minnow whose presence is probably insignificant although it is probably contributing to the forage base of the lake.

The two green sunfish collected are again insignificant compared to other species.

Summary and Recommendations

This survey shows that Papakeechie Lake has a very diversified fish population very similar to other northern Indiana lakes. A cursory comparison of relative abundance, age-growth, condition factors, and other parameters indicate that the fish population is quite similar in many aspects to other lakes in the immediate vicinity. A closer look at selected parameters reveal that the population structure of game species in Papakeechie shows a classic

unbalanced, stunted panfish population and a mediocre to poor largemouth bass fishery. Most Indiana lakes are managed for maximum production of a few selected species, usually largemouth bass, bluegill, redear, and possibly channel catfish, northern pike and crappie. Such populations have enough interactions and variables to make management difficult. The addition of six forage species, three predators and a few omnivores compounds the variables to an overwhelming number. Due to these complex interactions between and within species of fish, their food supply, the physical and chemical makeup of the habitat, and the variable preferences of fishermen, there is no single foolproof program which can instantly result in an excellent fishery. In spite of all the variables, the basic problem with the Papakeechie fish population is poor production of harvestable size fish of all species. This is basically a food problem, that is, especially with the panfish, more mouths to feed than food available. There are numerous alternative programs which could be used to improve the current situation and any one could be discussed at great length; however, the governing factors are going to be primarily finances and preference of the Association. Because of these factors, several suggested alternatives are outlined below with the general cost estimates for consideration by the Association. A more detailed program will be prepared for the alternatives which are acceptable to the Association.

1. Total eradication of fish followed by a fingerling stocking of largemouth bass, redear sunfish, bluegill, and channel catfish.

This is a very drastic program; however, in the long run it would stand the best chance of producing a more balanced population. The stocking could be changed to include northern pike, crappie, and a suitable forage if desired. Problems with the program are a delay in fishing for approximately two years

and the possible reintroduction of undesirable species from adjacent lakes.

Cost:	Eradication	- $10,000.
	Restocking	- 20,000.
	Total	$30,000.

2. Partial eradication of present fish population followed by stocking of largemouth bass fingerlings at 100 per acre.

This partial eradication can be over the entire lake or could be restricted to one or more major bays. It can also be done with two alternative fish toxicants, rotenone or Fintrol. Rotenone is not as species or size selective as Fintrol; however, it is cheaper and more readily available at present. Fintrol is also very pH sensitive which may be a problem in Papakeechie except in late fall or very early spring. Estimates for partials of the lake are as follows:

Rotenone	- $2,340.00
Fintrol	- 3,105.00
18,000 Largemouth bass fingerlings	- 7,000.00

3. Experimental Stocking

Introduction of large fingerling northern pike or walleye to increase predation on forage species. We recommend the northern pike based on the available forage and habitat. Stocking rate could vary with available funding. We recommend from 2,000 to 5,000 8-12 inch fingerlings. This would probably need to be repeated every 2-3 years. The minimum order we can arrange would be for 2,000.

Approximate Cost - $3,700. - $8,300.

4. Consideration should be given to doing a Clean Flo feasibility to determine the feasibility of using that program for reversal of eutrophication and long range lake restoration and maintenance. (See attached material.)

Study Cost - $3,560.

5. Other possible programs requiring intensive involvement and cooperation of property owners:

a. Supplemental feeding of panfish.
b. Large scale removal of panfish by trapping or seining.

6. Independently of any above programs, we recommend the following:

a. Initiation of an oxygen profile sampling program by lake personnel. Sampling should be done weekly from ice out to freeze up and at least monthly during ice cover. Samples should be collected at five foot intervals at Station 1 and 2.

Cost for oxygen sampling kit - $50.00

b. Initiate a 12 or 14 inch size limit on largemouth bass.

c. Remove any limit on other species and encourage heavy removal.

d. Continue the present weed control program with modifications as required by changes in weed coverage and species.

The above recommendations, if properly implemented and successfully executed, should have a significant beneficial impact on the fishery of Papakeechie. The results will depend upon the alternatives chosen; however, any one of them will definitely benefit the lake.

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September 7, 1977

RLJ/ran

Table 3. Length frequency, average weight, condition factor, and age of fishes collected from Papakeechie Lake, June 1-2, 1977.

Size group (inches)	Number	Percentage	Average Weight (lbs.)	Condition Factor	Age
		Bluegill			
1.5-1.9	2	0.43	-	-	1+
2.0-2.4	1	0.21	0.0044	4.8	1+
2.5-2.9	-	-	-	-	-
3.0-3.4	-	-	-	-	-
3.5-3.9	18	3.93	0.03	6.0	2+3+4+
4.0-4.4	122	26.69	0.05	6.0	3+4+
4.5-4.9	121	26.47	0.06	5.5	4+5+
5.0-5.4	99	21.66	0.07	5.7	5+
5.5-5.9	51	11.15	0.10	5.5	5+
6.0-6.4	36	7.87	0.18	5.9	6+7+
6.5-6.9	6	1.31	0.20	6.5	6+7+
7.0-7.4	1	0.21	0.26	7.1	7+
	457				
		Golden shiner			
5.0-5.4	2	0.99	0.03		2+
5.5-5.9	4	1.98	0.09		3+
5.0-6.4	10	4.95	0.1		3+4+
6.5-6.9	12	5.94	1.4		3+
7.0-7.4	60	29.70	0.14		2+3+4+
7.5-7.9	84	41.58	0.17		3+4+
8.0-8.4	18	8.91	0.23		3+4+
8.5-8.9	8	3.96	0.25		4+5+
9.0-9.5	3	1.48	0.26		5+
9.5-9.9	1	.49	0.31		5+
	202				
		Redear			
4.0-4.4	14	12.84	0.07	6.7	3+4+
4.5-4.9	26	23.85	0.07	6.3	4+
5.0-5.4	31	28.44	0.09	6.7	4+
5.5-5.9	12	11.00	0.13	6.8	4+5+
6.0-6.4	17	15.59	0.15	6.6	5+6+
6.5-6.9	8	7.33	0.29	6.8	6+7+
7.0-7.4	1	0.91	0.23	6.7	7+
	109				
		Pumpkinseed			
3.0-3.4	1	1.81	0.02	8.2	2+
3.5-3.9	7	12.72	0.04	7.1	3+4+
4.0-4.4	13	23.63	0.05	7.5	4+
4.5-4.9	15	27.27	0.07	7.0	4+5+6+
5.0-5.4	5	9.09	0.09	6.8	5+6+
5.5-5.9	8	14.54	0.13	6.8	6+
6.0-6.4	5	9.09	0.17	7.2	6+
6.5-6.9	1	1.81	0.23	7.2	7+
	55				

Table 3. Continued

Size Group (inches)	Number	Percentage	Average Weight (lbs.)	Condition Factor	Age
		Grass pickerel			
6.0-6.4	1	3.33	0.05		1+
6.5-6.9	1	3.33	0.07		1+
7.0-7.4	1	3.33	0.08		1+
7.5-7.9	2	6.66	0.09		1+
8.0-8.4	3	10.00	0.11		1+
8.5-8.9	6	20.00	0.12		1+2+
9.0-9.4	2	6.66	0.13		2+
9.5-9.9	2	6.66	0.18		2+3+
10.0-10.4	3	10.00	0.21		3+
10.5-10.9	-	-	-		-
11.0-11.4	1	3.33	0.33		4+
11.5-11.9	1	3.33	0.27		4+
12.0-12.4	2	6.66	0.35		4+
12.5-12.9	2	6.66	0.44		4+
13.0-13.4	-	-	-		-
13.5-13.9	-	-	-		-
14.0-14.4	1	3.33	0.32		6+
14.5-14.9	2	6.66	0.62		6+
	30				
		Yellow Perch			
5.5-5.9	1	4.54	-	-	-
6.0-6.4	1	4.54	0.10	4.0	3+
6.5-6.9	1	4.54	0.12	4.0	3+
7.0-7.4	3	13.63	0.17	4.4	4+
7.5-7.9	8	36.36	0.19	4.0	4+
8.0-8.4	3	13.63	0.22	3.9	5+
8.5-8.9	3	13.63	0.27	4.2	5+
9.0-9.4	1	4.54	0.30	4.1	5+
9.5-9.9	-	-	-	-	-
10.0-10.4	1	4.54	0.40	4.0	6+
	22				
		Warmouth			
4.0-4.4	4	18.18	0.06		3+4+
4.5-4.9	3	13.63	0.07		4+
5.0-5.4	10	45.45	0.10		4+5+
5.5-5.9	5	22.72	0.13		6+7+
	22				

Table 3. Continued

Size Group (inches)	Number	Percentage	Average Weight (lbs.)	Condition Factor	Age
		Largemouth bass			
4.0-4.4	1	1.96	0.03	4.2	1+
4.5-4.9	2	3.92	0.04	4.4	1+
5.0-5.4	5	9.80	0.06	4.5	1+
5.5-5.9	6	11.76	0.09	4.6	1+
6.0-6.4	-	-	-		-
6.5-6.9	-	-	-		-
7.0-7.4	2	3.92	0.19	4.6	2+
7.5-7.9	12	23.52	0.21	4.4	2+
8.0-8.4	5	9.80	0.22	4.7	2+
8.5-8.9	3	5.88	0.34	5.2	2+
9.0-9.4	4	7.84	0.38	4.7	2+
9.5-9.9	2	3.92	0.33	3.7	2+
10.0-10.4	1	1.96	0.40	3.9	-
10.5-10.9	-	-	-	-	-
11.0-11.4	-	-	-	-	-
11.5-11.9	1	1.96	0.72	4.6	3+
12.0-12.4	1	1.96	1.00	5.8	3+
12.5-12.9	1	1.96	1.10	5.1	4+
14.5-14.9	2	3.92	1.76	5.3	6+
15.0-15.4	1	1.96	1.77	5.3	6+
17.5-17.9	1	1.96	3.04	5.4	6+
18.5-18.9	1	1.96	3.86	5.7	7+
	51				
		Brown bullhead			
8.0-8.4	1	2.32	0.23		4+
8.5-8.9	1	2.32	0.35		4+
9.0-9.4	6	13.95	0.47		4+5+
9.5-9.9	5	11.62	0.46		4+5+
10.0-10.4	7	16.27	0.49		5+
10.5-10.9	8	18.60	0.62		6+
11.0-11.4	9	20.93	0.62		5+
11.5-11.9	5	11.62	0.65		5+6+
12.0-12.4	-	-	-		-
12.5-12.9	1	2.32	1.15		7+
	43				
		Yellow bullhead			
5.0-5.4	1	2.94	-		
5.5-5.9	1	2.94	0.08		
6.0-6.4	3	8.82	0.11		3+
6.5-6.9	1	2.94	0.15		3+
7.0-7.4	5	14.70	0.18		4+5+
7.5-7.9	5	14.70	0.20		5+
8.0-8.4	9	26.47	0.26		5+6+
8.5-8.9	3	8.82	0.31		6+
9.0-9.4	-	-	-		-
9.5-9.9	3	8.82	0.50		6+

Table 3. Continued

Size Group (inches)	Number	Percentage	Average Weight (lbs.)	Condition Factor	Age
		Spotted gar			
24.5-24.9	1	7.14	2.82		
25.0-25.4	2	14.28	2.71		
25.5-25.9	1	7.14	3.23		
26.0-26.4	1	7.14	3.20		
26.5-26.9	1	7.14	2.93		
27.0-27.4	1	7.14	3.15		
27.5-27.9	2	14.28	3.62		
28.0-28.4	1	7.14	3.37		
28.5-28.9	-	-	-		
29.0-29.4	1	7.14	5.09		
29.5-29.9	1	7.14	5.16		
30.0-30.4	-	-	-		
30.5-30.9	1	7.14	4.94		
31.0-31.4	-	-	-		
31.5-31.9	1	7.14	5.80		
	14				
		Black crappie			
3.0-3.4	1	8.33	0.02	4.5	1+
7.5-7.9	1	8.33	0.22	4.7	2+
8.0-8.4	2	16.66	0.25	4.6	2+
8.5-8.9	2	16.66	0.29	4.6	2+
9.0-9.4	1	8.33	0.35	4.7	3+
9.5-9.9	-	-	-	-	-
10.0-10.4	1	8.33	0.56	5.2	4+
10.5-10.9	-	-	-	-	-
11.0-11.4	-	-	-	-	-
11.5-11.9	1	8.33	0.71	4.5	5+
15.0-15.4	3	25.0	2.05	5.9	5+
	12				
		Lake chubsucker			
4.5-4.9	1	14.28	0.06		1+
5.0-5.4	-	-	-		-
5.5-5.9	1	14.28	0.09		1+
6.0-6.4	-	-	-		-
6.5-6.9	-	-	-		-
7.0-7.4	-	-	-		-
7.5-7.9	1	14.28	0.25		3+
8.0-8.4	1	14.28	0.27		3+
8.5-8.9	1	14.28	0.35		3+
9.0-9.4	-	-	-		-
9.5-9.9	1	14.28	0.47		4+
10.0-10.4	1	14.28	0.61		4+
	7				

Table 3. Continued

Size Group (inches)	Number	Percentage	Average Weight (lbs.)	Condition Factor	Age
		Brook Silverside			
3.0-3.5	1	33.33	0.01		
3.5-3.9	2	66.66	0.01		
	3				
		Green sunfish			
3.5-3.9	1	50.0	0.04		4+
5.5-5.9	1	50.0	0.17		5+
		Bowfin			
25.5-25.9	1	100.0	6.81		

Table 4 Mean back-calculated total length in inches at annulus formation and mean annual growth increment ( ) for five selected species of fish collected from Papakeechie Lake, June 1-2, 1977.

Species	Annulus 1	2	3	4	5	6	7
Bluegill	1.7 (1.7)	3.0 (1.2)	3.8 (0.9)	4.6 (0.8)	5.4 (0.7)	6.1 (0.7)	6.5 (0.4)
Redear sunfish	1.9 (1.9)	3.1 (1.1)	4.0 (0.9)	4.8 (0.9)	5.4 (0.6)	5.9 (0.5)	6.4 (0.5)
Largemouth bass	4.4 (4.4)	7.2 (2.8)	9.8 (2.6)	11.1 (1.3)	12.7 (1.6)	14.7 (2.0)	16.8 (2.0)
Yellow perch	3.7 (3.7)	5.5 (1.7)	6.5 (1.0)	7.4 (0.9)	8.1 (0.7)	9.1 (1.0)	
Black crappie	4.1 (4.1)	7.3 (3.2)	9.4 (2.1)	11.5 (2.0)	13.4 (1.9)		

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