MAINE DEPARTMENT OF INLAND FISHERIES AND GAME

Fish Survey Report No. 5

A Biological Survey of Lakes and Ponds of the Central Coastal Area of Maine

BY

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TO

MAINE DEPARTMENT OF INLAND FISHERIES AND GAME

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ANNOUNCEMENT

The present report is the fifth of a series of reports dealing with the results of biological surveys of lakes and streams in Maine. These surveys are being conducted by the Maine State Department of Inland Fisheries and Game working in cooperation with the Zoology Department of the University of Maine. The previous surveys were made on waters in the southwestern quarter of the State, mostly in York, Cumberland, Oxford, Androscoggin, Kennebec and Franklin counties. The principal river drainage systems involved in these previous surveys were the Presumpscot, Saco, Androscoggin and, in part, the Kennebec.

The present survey has dealt with 61 of the larger lakes and ponds in south-central Maine, in an area including most of Waldo, Knox and Lincoln counties and the eastern parts of Kennebec and Sagadahoc counties. The drainage systems involved are the Kennebec (in part), Sheepscot, Damariscotta, Pemaquid, Medomak, St. George, Megunticook, Ducktrap, Passagassawaukeag, and Goose rivers, and Marsh Stream (a tributary of the Penobscot River). The part of the Kennebec drainage which is involved is the area on the east side of the river and south of the Sebasticook River which is one of its larger tributaries. All of the above rivers, except the Kennebec, are small coastal waters, the largest among them being the Sheepscot and St. George. Of the 61 lakes and ponds under consideration, 38 are in either the Kennebec, Sheepscot or St. George river drainages.

With the completion of the study of the present group of lakes during the summer of 1941, the survey has covered somewhat more than one-fourth of the total area of Maine, starting during the summer of 1937 in the southwestern corner of the State and progressing northward and eastward. The areas still to be studied by the survey are the upper half of the Kennebec River drainage, the entire Penobscot River drainage, and all drainages east and north of the Penobscot.

Within the area which has been covered, the survey has studied mostly only the larger lakes and ponds; even some of the larger lakes have been missed, as well as a great many smaller ponds and most of the streams. In other words, while the Maine Fish Survey is attempting to obtain some of the basic facts upon which an intelligent fish-management program must be based, for some of the more important fishing waters, it is not producing any complete inventory of all waters or of all pertinent facts concerning any given body of water. To point out that the present fish survey, as well as all fish surveys in general, is very incomplete in the sense that there remains much more to be learned than is discovered, will seem superfluous to the fisheries worker and to the enlightened fisherman; but to point out this obvious fact appears necessary because there are some fishermen who believe that the survey should give the answers to all fishery problems for all waters which are studied.

It is anticipated that the next fish survey, in the summer of 1942, will be concerned with lakes and ponds in the lower part of the Penobscot River drainage and in the Union River drainage.

The four previous reports on the State's fish surveys, published as Fish Survey Reports of the Maine Department of Inland Fisheries and Game, are as follows:

Cooper, G. P.

1939. A biological survey of the waters of York County and the southern part of Cumberland County, Maine. *Fish Surv. Rept. No. 1, pp. 1-58. Publ. by the Kennebec Journal, Augusta.*

1939. A biological survey of thirty-one lakes and ponds of the upper Saco River and Sebago Lake drainage systems in Maine. *Fish Surv. Rept. No. 2, pp. 1-147. Publ. by the Kennebec Journal, Augusta. August, 1939.*

1940. A biological survey of the Rangeley Lakes, with special reference to the trout and salmon. *Fish Surv. Rept. No. 3, pp. 1-182. Publ. by The Augusta Press, Augusta. November 7, 1940.*

1941. A biological survey of lakes and ponds of the Androscoggin and Kennebec river drainage systems in Maine (with a section on Plankton of the lakes and ponds by *Harry A. Goodwin*, and Appendix A — A biological survey of Anasagunticook Lake by *Joel W. Marsh.*) *Fish Surv. Rept. No. 4, pp. 1-238. Publ. by The Augusta Press, Augusta. December 10, 1941.*

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Fish Survey Report No. 5

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INTRODUCTION

This fifth Fish Survey Report of the Maine Department of Inland Fisheries and Game deals with the results of a study of 61 lakes and ponds of the central coastal area of Maine. The section of Maine including these lakes[1] takes in all of Waldo, Knox and Lincoln counties and parts of Kennebec and Sagadahoc counties. This area has 104,400 people or 12 per cent of Maine's total resident population of 847,226 (1940 census). Within this area there are approximately 205 lakes and ponds which are shown on the United States Geological Survey Topographic Sheets. The 61 lakes which were studied include all of the larger lakes and ponds of the area. The remaining 140 ponds are the smaller ones, and are mostly less than 30 acres in area.

It was reported by the State Fish and Game Wardens that the major part of the fresh-water fishing in the area is done on these 61 lakes which were studied. Most of the hatchery trout or salmon, planted by the State in this area (see page 183) are liberated in these 61 lakes or their immediate tributaries. The purposes of the survey have been to obtain a knowledge of the facts necessary to put this stocking program on as scientific a basis as possible in order to ensure a good survival of the stocked fish, and to determine what other methods of fish management are desirable for lakes in this area. In substance, then, one main purpose of the survey has been to aid in the State's efforts to provide better fishing for the fishermen through the stocking program. In comparison to this immediately practical aspect of the survey of making stocking recommendations, some of the other aims may appear to be incidental or of less importance.

[1] The term "lake" is used here, and throughout much of this report, in a general sense to include both lakes and ponds. There are no absolute criteria to distinguish between lakes and ponds, as these terms are employed for Maine waters.

The point in question concerns such studies as that of the geographical and ecological distribution of fresh-water fishes, and studies on the food habits and age and growth of the game species. Such studies are, however, of fundamental importance as a background on which all fish management recommendations should be based.

The field investigations of the present survey were made from June 15 to September 15, 1941, by Messers. Joye H. Severaid, Stanley P. Linscott, Virgil S. Pratt, Robert H. Dyer (all students in the Department of Wildlife Conservation at the University of Maine) Dr. John L. Fuller of the Zoology Department of the University of Maine, and the writer. The following have contributed to the laboratory analyses of data and samples obtained by the field party: Mr. Linscott on the tabulation of various data, Mr. Merwin A. Marston on summarizing the water-analysis data and on the preparation of lake maps, and Mr. Michael J. Takos on analyses of the samples of bottom fauna and fish stomach samples. The services of Messers. Severaid, Linscott and Marston were terminated by their entrance into United States armed forces. Mr. Harry A. Goodwin made the analyses of plankton samples and has prepared the section of this report dealing with plankton (page 56). Dr. Fuller made the analyses on phosphorus content of lake water, and he has prepared a report on this subject (page 52). Much information on the character of the fish populations, fishing intensity, and tributary streams was obtained from the State Fish and Game Wardens for waters in their respective areas. The expenses of the field survey and of personnel for laboratory assistance were borne by the Maine Department of Inland Fisheries and Game. Laboratory space and facilities were made available by the University of Maine.

A procedure of field observations was adopted, which would give a considerable amount of factual information on a large number of lakes for the short period of field study. This reconnaissance type of survey to obtain a quick inventory of Maine lakes is justifiable on the grounds of expediency in the conservation of hatchery fish. In making the field studies, a schedule was followed whereby most of the observations on certain aspects of the survey were made within a relatively short period, so that comparability of the results would not be nullified by seasonal variation. The best examples of this attempt were in the case of water analyses and the collection of plankton samples, all of which were done during the last two weeks in August. Almost all of the bottom sampling was done during the period from July 16 to August 14. Collection of fishes by seining in shallow water was done entirely during the second half of the summer. Most lakes were sounded during the early half of the summer. Collection of fishes by gill netting was done throughout the summer, since the nature of such collecting made it impossible to

speed up this phase of the work. The chronological order of study on each lake was, therefore, mostly as follows: depth soundings were made during the early part of the summer; bottom sampling, if done on the lake, was next; then water analyses and plankton collections, during late August; and, finally, seining collections of fishes, from the middle of August to the middle of September.

The results obtained by the survey are summarized briefly at this point. Soundings of water depth were made on all of the lakes and ponds. The vertical distribution of temperature, dissolved oxygen and pH (acid intensity) during late August was determined. From these data on water depth and vertical distribution of temperature and dissolved oxygen, the amount of good "trout water" present in each lake during late summer was calculated. The food-producing capacity of each lake was appraised on the basis of plankton production in all of the lakes and abundance of bottom fauna in 17 lakes. Analyses of phosphorus content of the water were made in an attempt to determine whether or not the amount of this element was correlated with food productivity. Collections of fishes by gill nets and seines were made to determine the present status of the fish populations. Estimates of abundance of different species of fishes, made on the basis of these collections, were supplemented by information obtained from the local Fish and Game Wardens. The stomach contents of the game fishes have been analyzed. Studies on age and growth of the game species have not yet been completed. The records of fish stocking by the State Fish and Game Department have been analyzed and compared with the results of our net collections. A stocking policy and other methods of management are recommended on the basis of the survey results. The more pertinent facts of the survey methods are given in the respective sections of this report. For a more complete account of methods used in the study of morphometry, water analyses and plankton, the reader is referred to Appendix B of Fish Survey Report No. 2 (Cooper, 1939b:142).[2]

SOME CHARACTERISTICS OF LAKES IN RELATION TO REQUIREMENTS OF GAME FISHES

The purpose of this section of the report is to give a brief account of some of the physical, chemical and biological properties of different types of lakes, and to point out the relationships of these properties to the requirements of some of our important game fishes. A knowledge of these relationships is a prerequisite to an understanding of the remainder of this report. The following account has been

[2] See literature cited, page 184.

made extremely brief, for the sake of economy and because the subject is treated more thoroughly in Survey Report No. 4 (Cooper, 1941) which still can be obtained from the State Department of Inland Fisheries and Game. The reader is referred, also, to the text on Limnology by Welch (1935) and to the bulletin on Improvement of Lakes for Fishing by Hubbs and Eschmeyer (1938) for further information on the subject.

The chief purpose of the present survey is the evaluation of various waters in relation to the State's fish planting program. At present, Maine hatcheries are propagating trout and salmon exclusively; on the other hand, previous and present survey recommendations are that considerable effort be made in the propagation of bass. Consequently, the emphasis of the present account is on the characteristics of trout and salmon waters and the question as to whether the lakes are best suited for salmonid fishes or for bass and other warm-water game fishes.

The seasonal change in temperature of lake water is one of the most important factors affecting fish life. In temperate lakes this change occurs as follows: Under the ice during winter, lake water has a temperature of 32° F. at the surface, and is progressively and slightly warmer at lower depth levels, with a maximum temperature at the bottom of approximately 39° F. (never higher). After the ice "goes out" in the spring, and as the lake absorbs heat at the surface, the lake soon reaches the stage where temperature is uniform from top to bottom at approximately 39° F. After this spring overturn stage of uniform vertical temperature distribution has been reached, subsequent warming of the surface water of the lake affects mostly the upper 15 to 30 feet, the extent of the effect depending upon the size of the lake. By the latter part of August the lake has reached its "summer stagnation" stage at which time the upper 15 to 30 feet of water is warm and of nearly uniform temperature; the deep water, if present, is of a nearly uniform and cold temperature; and between these two layers of uniform temperature is a layer, known as the thermocline, through which temperature decreases very rapidly with increase in depth. Following the warm, summer period the course of temperature change is reversed, with a subsequent fall overturn stage followed by winter conditions. In shallow lakes the thermocline and the underlying, cold-water layer, of the "summer stagnation" period, are not present because of shallow water.

A seasonal cycle of dissolved oxygen occurs in lake water, and it is closely dependent upon the temperature cycle. Controlling the oxygen cycle are two factors: oxygen is added to lake water by wave disturbances at the surface, and through photosynthesis by aquatic

plants; and it is taken out of the water by the decomposition of organic material, and by animals and plants for their respiration. During winter, under the ice, the chief source of oxygen is from photosynthesis. When the lake surface is free of ice, the absorption of oxygen at the surface plays an important role. During the spring and fall overturn stages when the water of a lake is being mixed from top to bottom, the effect is to maintain a high percentage of dissolved oxygen at all depths. During the summer stagnation stage a high percentage of oxygen is maintained in the upper, warm-water layer by the circulation throughout this upper layer. The cold-water layer, "trapped" below the thermocline, can not be reaerated from the surface because the thermocline prevents the free circulation of water from the surface to the deep layer. This "trapped" layer of deep and cold water keeps most of its oxygen throughout the summer stagnation period if there is little or no organic material present to decompose; it loses part or all of its oxygen if organic decomposition is considerable.

All fish need dissolved oxygen in the water for respiration. The amount which is needed depends upon the species, and varies with temperature, and probably with other factors. Salmonid fishes require more oxygen in the water than do many of our other game species. The minimum oxygen requirement for good trout and salmon water has been set, for the purposes of this and our previous Survey Reports, at 5 parts per million. The various species of fishes have certain temperature requirements; or, in other words, certain temperature ranges afford optimum conditions for breeding, for growth, or for mere existence. With some species the requirements are for cold water, and such fishes can not thrive in the warmest of our natural waters. Other species thrive in our warmest waters, and require fairly warm water for good growth and successful reproduction. Trouts and salmons are distinctly cold-water fishes; the maximum temperature range which they can tolerate is approximately 75 to 80° F., varying with the different species. Their maximum optimum temperature is nearer 70° F. than 80° F.; and the temperature threshold of 70° F. has been used, in the present survey, as the upper limit in defining "good" trout and salmon water. The fact that salmonids *can live* at temperatures above 70° F. should not be confused with the fact that they *thrive best* at temperatures of less than 70° F. Other cold-water fishes in Maine lakes include the Whitefish, and, to some extent at least, the Smelt and the Cusk. The warm-water game fishes include the Small-mouthed Bass, Common Pickerel, Yellow Perch, White Perch and Large-mouthed Bass. The available evidence indicates that these species thrive in our warmest waters.

The important question, as to the type of fish for which each lake is best suited with respect to its water supply, can be answered by the extent to which conditions of depth, temperature and dissolved oxygen, at the various stages of the seasonal cycle, satisfy the requirements of the different species. In the case of salmonid fishes, limiting conditions are apt to occur during the late-summer stagnation stage, and possibly, in some lakes, during the mid-winter stage; but not during the spring and fall overturns. During winter warm water is not a problem for salmonids; but there is the possibility that, in some lakes with considerable organic decomposition, the minimum of at least 5 p.p.m. of dissolved oxygen is not maintained. Our knowledge of conditions of dissolved oxygen in Maine lakes during the winter is entirely inadequate. However, this lack of knowledge of winter conditions probably does not invalidate our classification of Maine trout and salmon waters which is based on the summer surveys, because the good trout and salmon lakes are not of the type which would be expected to experience oxygen deficiency during the winter. Limiting conditions for salmonids occur in many lakes and ponds during the summer stagnation stage. In all lakes and ponds the upper, 15- to 30-foot layer of water becomes too warm; and whether or not a body of water is a good trout or salmon lake depends, first, upon the presence of a layer of deep and cold water (i.e., below the thermocline) and, secondly, upon the presence of a high content of dissolved oxygen in this deep water. Theoretically, the more water present below the thermocline and the higher its content of dissolved oxygen, the better suited is the lake for salmonid fishes. The above can be summarized by stating that the good trout and salmon waters are limited to a certain type of lake. The above-mentioned, warm-water game species, so far as their requirements are understood, find conditions for existence favorable in all types of lakes in Maine: in the shallow and uniformly warm lakes; and in the upper, warm water of deep lakes irrespective of whether the lower, cold water has a high oxygen content or (with the possible exception of some species) a low oxygen content. It is unquestionably true that the warm-water species have definite requirements by virtue of which certain types of lakes are more favorable habitats than are others; but the fact still remains that the requirements of trout and salmon limit these fishes to a more specific type of lake and, therefore, to fewer lakes. In an area where it is desirable to promote fishing for both the cold-water and the warm-water game fishes, it is the logical procedure to favor the salmonids in the type of lake for which they are best suited, and to favor the basses, perches and pickerel only in those lakes not suitable for salmonids.

There is practically unlimited evidence that any program to promote trout and salmon fishing in any waters must include efforts to limit the populations of warm-water game fishes in those waters.

This necessity is due to the fact that the salmonids do not thrive in waters where the warm-water species are abundant. Although the reasons for this failure of salmonids to survive in the presence of bass, perch and pickerel are still somewhat obscure, it seems safe to state that predation, competition for food, and possibly competition for space are important factors. The role of competition for food, as a factor which limits salmonid populations, assumes particular significance when the type of lake which is best suited for trout and salmon is considered. As stated previously, the lakes best adapted to salmonids are those which maintain a high oxygen content in the deep water because there is little decomposing organic material. The dearth of organic material on the bottom of such lakes results in a very scant population of bottom food organisms. Therefore there exists the anomalous condition that those lakes, which are the most suitable for trout and salmon from the standpoint of the water, are inherently the poorest in production of bottom food organisms. Since scarcity accentuates competition, the obvious consequence is that competition among game fishes for bottom food is probably more severe in trout lakes than in non-trout lakes.

GENERAL DESCRIPTION OF THE LAKES AND PONDS

The 61 lakes and ponds considered in this report, together with their pond reference numbers, locations by township and county, elevations, areas, and maximum depths, are listed in Table I.

Individual pond reference numbers have been given to Maine lakes and ponds on a state-wide basis. The system of numbering has been described in Fish Survey Report No. 1 (Cooper, 1939a). By giving each lake and pond a separate number, it is possible to avoid some of the confusion resulting from the frequent repetition of many common names.

The 61 fresh-water lakes and ponds considered in this report are scattered over an area of approximately 1,800 square miles in the south-central part of Maine — in Waldo, Knox, Lincoln, Kennebec and Sagadahoc counties. This area is roughly square in outline, with the cities of Bath, Rockland, Bucksport and Waterville approximately at the corners. The entire area is within 50 miles of the Atlantic Coast. The coast in this area is the most irregular section of Maine's very irregular coast line, with every river mouth a deeply flooded arm of salt and brackish water. These tide-water sections of the Kennebec, Sheepscot, Damariscotta, Medomak and St. George

TABLE I. The locations, elevations, and areas, and a partial summary of data on depth, temperature, and dissolved oxygen, for the lakes and ponds of the 1941 survey

Name of pond	Pond number	Township and county	Elevation above sea level:* feet	Area: acres	Date of water analyses: 1941**	Maximum depth of pond: feet	Water level, July and August, 1941: feet below normal	Depth in feet above which temperature in excess of 70° F.		Depth in feet above which oxygen more than 5 p.p.m.	
								As of analyses	During most critical summer period (estimated)	As of analyses	During most critical summer period (estimated)
Nequasset Pond	638	Woolwich in Sagadahoc	15	430	Aug. 16	63	6	4	25	30	30
Gardiner Pond	640	Wiscasset in Lincoln	168	58	Aug. 17	21	2	Surface	15	17	17
Togus Pond	649	Augusta in Kennebec	185	648	Aug. 18	49	1	Surface	32	32	32
Little Togus Pond	650	Augusta in Kennebec	185	93	Aug. 18	22	2	Surface	Bottom	Bottom	Bottom
Threecornered Pond	651	Augusta in Kennebec	195	195	Aug. 18	33	2	Surface	22	22	22
Weber Pond	688	Vassalboro in Kennebec	135	1,252	Aug. 19	42	1	Surface	32	35 (bottom)	Bottom
Spectacle Pond	691	Vassalboro and Augusta in Kennebec	220+	139	Aug. 18	100	0	8	20	88	88
Dam Pond	692	Augusta in Kennebec	200+	87	Aug. 18	22	0	Surface	Bottom	Bottom	Bottom
Tolman Pond	693	Augusta in Kennebec	200+	62	Aug. 18	26	0	Surface	19	19	19
Threemile Pond	694	China, Vassalboro, and Windsor in Kennebec	177	1,077	Aug. 19	37	1	Surface	Bottom	Bottom	Bottom
China Lake West Part	736	China and Vassalboro in Kennebec	195	1,661	Aug. 15	85	4	Surface	30	47	47
East Part	736	China in Kennebec	195	2,261	Aug. 15	51	4	22	32	32	32
Pattee Pond	739	Winslow in Kennebec	120+	712	Aug. 16	27	1	2	Bottom	Bottom	Bottom
Lovejoy Pond	744	Albion in Kennebec	160+	324	Aug. 16	32	2	Surface	Bottom	Bottom	Bottom

Dutton Pond	745	China in Kennebec	230	56	Aug. 28	33	1	Surface	16	16	16
Unity Pond	746	Unity, Burnham, and Troy in Waldo	175	2,528	July 30 & 31, 1938	41	0	23	25	21	20
Sandy Pond or Freedom Pond	751	Freedom in Waldo	467	430	Aug. 23	11	9	Surface	Bottom	Bottom	Bottom
Dyer Long Pond	1331	Jefferson in Lincoln	128	392	Aug. 23	16	3	Surface	Bottom	Bottom	Bottom
Pleasant Pond or Clary Lake	1334	Jefferson and Whitefield in Lincoln	145	467	Aug. 23	22	3	Surface	Bottom	Bottom	Bottom
Branch Pond	1342	Palermo in Waldo and China in Kennebec	345	322	Aug. 19	38	2	Surface	18	16	18
Long Pond	1345	Somerville and Jefferson in Lincoln, and Windsor in Kennebec	190	747	Aug. 15	16	6	Surface	Bottom	Bottom	Bottom
Turner Pond	1346	Somerville in Lincoln and Palermo in Waldo	223	145	Aug. 28	7	5	Surface	Bottom	Bottom	Bottom
Sheepscot Pond	1349	Palermo in Waldo	281	1,158	Aug. 15	132	3	Surface	23	Bottom	Bottom
West Harbor Pond	1361	Boothbay Harbor in Lincoln	5+	64	Aug. 16	34	0	Surface	21	24	24
Damariscotta Pond	1367	Jefferson, Nobleboro, and Newcastle in Lincoln	51	836	Aug. 21	38	3	4	30	30	30
Damariscotta Lake North Part	1368	Jefferson and Nobleboro in Lincoln	51	2,068	Aug. 21	97	3	Surface	35	60	60
South Part	1368	Jefferson and Nobleboro in Lincoln	51	1,559	Aug. 21	41	3	2	Bottom	Bottom	Bottom
Boyd Pond	1376	Bristol in Lincoln	20+	50	Aug. 26	21	1	12	Bottom	Bottom	Bottom
Biscay Pond	1379	Bremen, Bristol, and Damariscotta in Lincoln	76	253	Aug. 25	62	0	5	27	34	34
Pemaquid Pond	1381	Damariscotta, Bremen, Nobleboro, and Waldoboro in Lincoln	76	1,515	Aug. 25 & 26	61	1	25	30	32	32

TABLE I. The locations, elevations, and areas, and a partial summary of data on depth, temperature, and dissolved oxygen, for the lakes and ponds of the 1941 survey — Concluded

Name of pond	Pond number	Township and county	Elevation above sea level:* feet	Area: acres	Date of water analyses: 1941**	Maximum depth of pond: feet	Water level, July and August, 1941: feet below normal	Depth in feet above which temperature in excess of 70° F.: As of analyses	Depth in feet above which temperature in excess of 70° F.: During most critical summer period (estimated)	Depth in feet above which oxygen more than 5 p.p.m.: As of analyses	Depth in feet above which oxygen more than 5 p.p.m.: During most critical summer period (estimated)
Muddy Pond	1382	Damariscotta in Lincoln	114	156	Aug. 27	11	1	Bottom	Bottom	Bottom	Bottom
Duckpuddle Pond	1383	Nobleboro and Waldoboro in Lincoln	76	249	Aug. 27	23	1	17	Bottom	Bottom	Bottom
McCurdy Pond	1385	Bremen in Lincoln	76	207	Aug. 25	41	0	20	22	27	27
Webber Pond	1387	Bremen in Lincoln	40+	253	Aug. 25	31	2	12	22	22	22
Medomak Pond	1394	Waldoboro in Lincoln	125	228	Aug. 21	25	3	2	Bottom	Bottom	Bottom
Washington Pond	1400	Washington in Knox	319	581	Aug. 20	36	2	Surface	Bottom	Bottom	Bottom
Chickawaukie Pond	1409	Rockland and Rockport in Knox	123	343	Aug. 25	33	0	Surface	Bottom	Bottom	Bottom
Mirror Lake or Oyster River Pond	1413	Rockport in Knox	373	110	Aug. 27	66	4	Surface	22	55	55
North Pond	1414	Warren in Knox	34	326	Aug. 25	41	3	Surface	27	27	27
South Pond	1415	Warren in Knox	35	517	Aug. 25	18	3	Surface	Bottom	Bottom	Bottom
Seven Tree Pond	1419	Union and Warren in Knox	33	490	Aug. 22	45	4	Surface	32	34	34
Round Pond	1420	Union in Knox	33	184	Aug. 28	34	2	Surface	25	27	25
Crawford Pond	1422	Union and Warren in Knox	110	585	Aug. 22	57	1	5	25	28	28
Lermond Pond	1423	Hope in Knox	266	156	Aug. 22	30	2	Surface	Bottom	Bottom	Bottom
Alford Lake	1424	Hope in Knox	269	542	Aug. 22	78	3	Surface	32	35	32
Fish Pond	1428	Hope in Knox	355	131	Aug. 22	12	3	Surface	Bottom	Bottom	Bottom
Hobbs Pond	1429	Hope in Knox	356	278	Aug. 22	20	3	Surface	Bottom	Bottom	Bottom
Sennebec Pond	1431	Appleton and Union in Knox	85	511	Aug. 22	57	1	Surface	37	37	37
Quantabacook Pond	1434	Searsmont and Morrill in Waldo	181	612	Aug. 19	51	2	Surface	26	28	28
Stevens Pond	1443	Liberty in Waldo	306	396	Aug. 19	43	0	Surface	17	22	22
St. George Lake	1445	Liberty in Waldo	505	1,017	Aug. 15	60	3	Surface	35	51	51
Megunticook Lake North Part	1449	Lincolnville in Waldo, and Hope and Camden in Knox	139	444	Aug. 20	64	3	Surface	22	30	30
South Part	1449	Camden in Knox and Lincolnville in Waldo	139	776	Aug. 20	64	3	Surface	25	34	34
Norton Pond	1451	Lincolnville in Waldo	139	112	Aug. 20	55	1	Surface	19	20	20
Pitcher Pond	1454	Lincolnville and Northport in Waldo	203	371	Aug. 21	38	2	Surface	Bottom	Bottom	Bottom
Knight Pond	1455	Northport in Waldo	203	102	Aug. 21	13	2	Surface	Bottom	Bottom	Bottom
Tilden Pond	1456	Belmont in Waldo	228	343	Aug. 21	11	1	Surface	Bottom	Bottom	Bottom
Cross Pond	1460	Morrill in Waldo	211	162	Aug. 27	10	2	Bottom	Bottom	Bottom	Bottom
Mixer Pond	1461	Knox in Waldo	365	35	Aug. 29	29	1	Surface	26	26	26
Sanborn Pond	1462	Brooks and Knox in Waldo	292	87	Aug. 19	66	1	Surface	17	28	28
Dutton Pond	1463	Knox in Waldo	293	35	Aug. 21	22	1	2	18	18	18
Passagassawaukeag Lake or Randall Pond	1466	Brooks in Waldo	304	118	Aug. 20	40	1	Surface	22	27	27
Swan Lake	1469	Swanville, Searsport, and Frankfort in Waldo	200	1,370	Aug. 20	87	5	Surface	30	55	55
Toddy Pond	1478	Swanville and Brooks in Waldo	284	156	Aug. 20	25	1	Surface	Bottom	24	Bottom

*Taken from United States Geological Survey Topographic Sheets.

**Data on Unity Pond are based on water analyses made during 1938.

rivers are from 10 to 30 miles long. The inland extension of these arms of salt water makes the distance of many of the ponds from salt water, small as compared to their distance from the coast line proper. The 61 lakes are located with respect to river drainages, as follows: 16 lakes (Pond Numbers 638 to 751, incl.) in the Kennebec River drainage; 7 lakes (Nos. 1331 to 1361) in the Sheepscot; 2 lakes (Nos. 1367 and 1368) in the Damariscotta; 6 lakes (Nos. 1376 to 1385) in the Pemaquid; 3 lakes (Nos. 1387 to 1400) in the Medomak; 15 lakes (Nos. 1409 to 1445) in the St. George; 2 lakes (Nos. 1449 and 1451) in the Megunticook; 3 lakes (Nos. 1454 to 1456) in the Ducktrap; 5 lakes (Nos. 1460 to 1466) in the Passagassawaukeag; Swan Lake, tributary to Goose River; and Toddy Pond, tributary to Marsh Stream and the Penobscot River.

The elevations above mean sea level of these 61 lakes vary from a minimum of about 5 feet in the case of West Harbor Pond to a maximum of 505 feet in St. George Lake. Ten of these lakes are over 300 feet in elevation, the higher ones in addition to St. George Lake being Sandy Pond in Freedom (467 ft.), Mirror Lake in Rockport (373 ft.), Mixer Pond in Knox (365 ft.), and Hobbs and Fish ponds in Hope (356 and 355 ft.). The majority (36) of the lakes are at elevations of from 100 to 300 feet. The 15 lakes at elevations of less than 100 feet are mostly in the Pemaquid and lower St. George drainages. West Harbor Pond at Boothbay Harbor is an artificial, fresh-water pond, converted from an arm of salt water about 70 years ago (according to a local report) by a permanent dyke at the Highway No. 27 crossing. The present outlet (pipe) to salt water is about 2 feet above the high-tide mark, which is sufficient to keep the water in the pond nearly, if not entirely, "fresh." All of the other lakes are free from contamination by salt water.

These 61 lakes have a combined area of 33,572 acres, as based on measurements of individual lake outlines on United States Geological Survey Topographic Sheets. More than half (18,686 acres) of this area is attributable to 10 lakes: the largest being China Lake with 3,922 acres; Damariscotta Lake next with 3,627 acres; then Unity Pond with 2,528 acres; and Pemaquid, Swan, Weber, Megunticook, Sheepscot, Threemile and St. George, each of which are over 1,000 acres in area. Ten of the ponds have areas of less than 100 acres; the smallest are Mixer and Dutton in Knox, each with areas calculated to be 35 acres. Within the area there are numerous ponds, of less than 100 acres in area, which were not included in the present survey.

These lakes of the present survey (of Waldo, Knox, Lincoln, Kennebec and Sagadahoc counties) are, in general, quite shallow. They

are not so deep on the average as are the lakes in other sections of Maine studied by previous surveys. The average of the maximum depths for the 61 lakes of the present survey, according to our soundings, was 40 feet; the average of maximum depths for the 53 lakes in the Androscoggin drainage and western half of the Kennebec drainage (Cooper, 1941) was 59 feet; the average for 30 lakes in the Saco River and Sebago Lake drainages, exclusive of Sebago Lake (Cooper, 1939b), was 52 feet (60 ft. if Sebago is included). This lesser average maximum depth of the present group of lakes is only in small part attributable to the scant rainfall and low lake levels which prevailed during the summer of 1941; water levels in these 61 lakes during July and August were 2.1 feet below normal, on the average (see Table I). The deepest water (132 ft.) was found in Sheepscot Pond. Spectacle Pond, with a maximum depth of 100 feet, was the next deepest; it was the only small pond especially deep. Other notably deep lakes were Damariscotta Lake (97 ft.), Swan (87 ft.), China (85 ft.) and Alford (78 ft.). Especially shallow lakes included: Turner, with a maximum depth of 7 feet; Cross, 10 feet; Sandy, Muddy and Tilden, each 11 feet; Fish, 12 feet; and Knight, 13 feet. Ponds notably shallow in proportion to their large areas were Dyer Long (16 ft.), Long (16 ft.) and South (18 ft.).

The average depth of each lake and pond has not been computed, except in an indirect manner in the calculations of amount of water between different depth zones (Table III). Some idea of average depths may be obtained, however, from the data on soundings given on maps for the individual lakes in Figures 1 to 59.

The fact of low elevation, coupled with fairly deep water, results in the rather unusual circumstance that the deeper water in some of the lakes is actually below sea level. (The circumstance is of no particular significance in the case of West Harbor Pond which is artificial and formed by damming an arm of salt water.) In Nequasset Pond, with an elevation of 15 feet and a maximum depth of 63 feet, the lower 48 feet of water is below mean sea level; in Damariscotta Lake the lower 46 feet is below sea level; in Seven Tree Pond, 12 feet; and in North Pond, 7 feet.

The lake bottom soil in shallow water is predominantly rocky in almost all of the larger lakes, and in many of the smaller ponds. This bottom material is mostly of rocks ranging from three inches to one foot in diameter, partly of smaller gravel, and to a lesser extent of ledge. Sand beaches are confined to about 2 to 10 per cent of the shore line in a few of the lakes, particularly the larger ones, such as China, Swan, Pemaquid, Hobbs and Sandy. Sand beaches are practically non-existent in the remainder of the larger lakes and in almost all of the smaller ponds. Mud bottom in shallow water in the larger lakes occurs sparingly and only in the protected coves and stream mouths; but mud occupies approximately 50 per cent of the shore shallows in about half of the smaller ponds. The type of bottom soil in deeper water in some of the lakes and ponds of the present group was observed in connection with studies on the bottom fauna, see page 67.

The distribution of rooted vegetation in shallow water was closely related to the type of bottom soil and to the degree to which the shore line was protected from wave erosion. It is well known that these factors are very important in controlling growth of vegetation in lakes.

The higher aquatic vegetation encountered in the lakes of the present area consisted of emergent and submergent types confined mostly to the shore line and shoal areas. Among the most common types were bullrushes, pickerel weed, pond weeds and water lilies. This vegetation was moderately to very abundant in many of the smaller ponds; namely, Gardiner, Little Togus, Weber, Tolman, Lovejoy, Dutton in China, Turner, Muddy, Duckpuddle, Medomak, Chickawaukie, North, South, Round, Stevens, Knight, Cross, and Dutton in Knox. On the other hand, in about half of the smaller ponds the substratum is too rocky to allow a luxuriant growth of vegetation. In most of the larger lakes the rocky shoals, together with exposure to wave action, confines the scant vegetation to a few protected coves and stream mouths.

The land surrounding these various lakes and ponds, and within a distance of one-fourth mile from their shore lines, is approximately 75 per cent wooded land, 20 per cent cleared land, and 5 per cent bog and swamp. These figures apply to the land around all of the lakes as a whole. The lakes which are surrounded mostly by agricultural land include China, Unity, Weber, Seven Tree, North and Round; this cleared land is used mostly for grazing. Most of the smaller ponds are entirely surrounded by woodlands. The bog and swamp areas are confined mostly to the immediate shore lines.

The summer of 1941 experienced a dearth of rainfall in Maine with the result that water levels in lakes and streams were unusually low. A steady drop in water levels was noted to occur in many of the lakes studied by the survey, especially during the months of July and August. Our estimations of drop in lake level, as based on the height of the normal water line on shore rocks, at the time of depth soundings on each lake, are given in Table I. The greatest drop in water level

(approximately 9 ft.) occurred in Sandy Pond in Freedom, in which the volume of water was reduced to considerably less than half its normal amount. Long and Turner ponds had also dropped greatly in proportion to their shallow depths. A considerable drop in water level occurred in many of the larger lakes, including Swan, China, Damariscotta, Megunticook, St. George and Sheepscot; but the loss of water in these lakes was relatively small in proportion to the total amount of water present. We found no evidence that the drop in water level had any bad effect on the success of spawning of the Small-mouthed Bass. The drop in level occurred slowly and mostly in July and August after bass spawning had been completed. It is a certainty that the low water greatly affected the marginal aquatic vegetation in these lakes. It was reported to the writer by Mr. Joel W. Marsh, Leader of the Maine Pittman-Robertson project dealing with restoration of aquatic vegetation for waterfowl, that the 1941 low water had a very bad, killing effect on shore line aquatic vegetation in many Maine lakes. One probable effect of low water in the "good" and "marginal" trout and salmon lakes was the reduction in amount of available "trout water"; although absolute proof for this theory would require a comparative study by water analyses during successive years with high and low water levels, it seems logical to assume that the loss of water at the surface of a lake would be, in effect, the elimination of a layer of corresponding depth from the deeper trout and salmon zone during late summer conditions (see page 14). In the better trout and salmon waters (Swan, Damariscotta Lake, Sheepscot, China and Mirror) the percentage loss of "trout water" due to low water conditions must have been small in proportion to the amount of "trout water" still present. In three marginal trout and salmon lakes (Megunticook, St. George and Nequasset) a large part of the normally limited trout zone was probably eliminated; while Alford and Seven Tree may be fair trout lakes under high water conditions but definitely were not during the summer of 1941. No allowances have been made for this low water condition, in the stocking recommendations for trout and salmon (see page 175). Making such allowances would not materially alter the stocking policy except in the case of the poorest of the trout and salmon waters; and the advisability of stocking salmonids in these waters would be doubtful, even though allowances for low water were made.

SUITABILITY OF THE WATER IN THE LAKES AND PONDS FOR TROUT AND SALMON

The present account of the kinds of game fishes to which each of the 61 lakes and ponds is best suited, from the standpoint of the water supply, is based on the results of depth soundings and analyses of the depth distribution of temperature and dissolved oxygen. The standards set for suitable trout and salmon water are: water temperature of less than 70° F., and dissolved oxygen of at least 5 parts per million. The results of pH analyses have not been used directly in this classification of lakes, because the importance of pH as a limiting factor in the environment of fishes has not been adequately evaluated. However, since the vertical variation in pH in lakes is closely correlated with vertical variations in temperature and dissolved oxygen, the pH values serve a useful purpose in substantiating the trends of change which are indicated by the temperature and oxygen tests. The water analyses were made during the latter part of the summer, which is presumably the season when conditions of temperature and oxygen in lakes are most critical for the salmonids; and the present account deals with conditions as they occur during this critical, late-summer period.

Methods. Each lake was sounded by use of a brass chain marked at 2-foot intervals, and a 2-pound, lead weight. The figures on depth were located on outline maps copied by pantograph from United States Geological Survey Topographic Sheets. Lake areas were measured by use of a planimeter. Analyses of temperature, oxygen and pH were made at or near the deepest part of each lake, and at only one station on most lakes. The tests on temperature, oxygen and pH were made for various depth intervals so distributed as to indicate the points of depth at which each of these factors changed considerably. Temperatures were determined by the use of Negretti and Zambra Deep Sea Reversing Thermometers. Samples of water for analyses of oxygen and pH were obtained with Foerst Improved Water Samplers of 2,000 c.c. capacity. Oxygen tests were made by the unmodified Winkler Method. All pH tests were made with LaMotte Indicator Solutions and LaMotte Color Standard Solutions.

The amount of water suitable for trout and salmon during late summer, and the amount not suitable, were calculated for each lake by the following procedure. The depth to which the warm (over 70° F.), surface water had extended, and the depth below which dissolved oxygen was less than 5 p.p.m., were determined for each lake from the water analysis data. These two depths (given in Table I) were considered to be the upper and lower limits of the zone of good

trout and salmon water, with a zone of warm water above, and a zone of oxygen-deficient water below. The volume of water in each of these three zones was calculated by assuming the lake to be a series of frustums. The limits of each frustum were defined by depth contour lines (from 3 to 6 on each lake) drawn on the sounding maps. The area of lake bottom in contact with the water of these three zones was calculated; it was assumed to be in proportion to the area within contour lines as drawn on the sounding maps.

Results. The results of analsyes on the vertical distribution of temperature, dissolved oxygen and pH in each lake are given in Table II, along with the location, date, time, wind direction, and amount of wave disturbance at each station. The depth soundings are given, and each water analysis station is indicated (by the symbol ⊗), on the lake outline maps in Figures 1 to 59. The depths which delimit the trout or salmon zone, in juxtaposition to the warm-water zone above, and the oxygen-deficient zone below, are given in Table I. The volume of water in acre-feet and by percentage, and the bottom area in acres and by percentage, are given for each of these zones in each lake in Table III, and are represented graphically in the cross-section diagrams for each lake in Figures 1 to 59.

The surface water temperatures in the 61 lakes, obtained during the water analyses, ranged from 66.6 to 73.0° F., and were mostly from 68 to 71° F. Surface water temperatures (approximately 100 tests in the open water on 20 of these lakes) taken in connection with gill net sets during the period from June 20 to September 10 revealed that the late August temperatures, obtained during the water analyses, were considerably below the summer maxima. During the last part of June the surface temperatures averaged about 70° F.; during the first half of July the temperatures were mostly in the low seventies; during the last half of July and the first week in August they were in the high seventies (maximum of 79° F. in Pemaquid Pond on July 28); and during the second week in August the surface temperatures dropped to the low seventies. Therefore the late-August water analyses were made about one to two weeks after the peak of summer surface temperatures, and at the time when these surface temperatures were dropping below 70° F. which is considered in this report to be the critical temperature limit for salmonids. Since oxygen depletion in deep water is a continual process throughout the summer, it follows that the water analyses were made at that time during the summer when conditions in the deeper lakes were most critical for salmonids. The occurrence of surface temperatures in the high seventies during late July and early August is adequate evidence that a zone of "upper, warm, non-trout water" was present in all of these 61 lakes during mid-summer.

TABLE II. Water analyses. Vertical distribution of temperature, oxygen, pH and phosphorus in the lakes and ponds, from analyses made during the summer of 1941#**

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature:* °F.	Oxygen: p.p.m.	pH†	Phosphorus: parts per billion††
NEQUASSET POND, P. 638. Woolwich Twp., Sagadahoc Co. Aug. 16, 3:00 to 4:10 P.M. Station: 1/5 mile off mouth of George's Creek. Depth of water: 61 ft. No wind or waves.	Surface	72.5	9.0	7.0	11.7
	5	69.8	...	...	....
	10	69.4	...	...	....
	15	69.4	...	...	....
	20	69.3	...	...	....
	25	68.7	8.4	6.7	....
	27	62.8	7.0	6.4	....
	30	59.5	...	...	....
	35	57.7	2.1	5.8	....
	40	56.8	...	...	....
	45	56.5	1.4	5.8	....
	50	56.1	...	...	....
	60	55.8	0.3	5.8	14.7
GARDINER POND, P. 640. Wiscasset Twp., Lincoln Co. Aug. 17, 3:00 to 3:30 P.M. Station: 100 yds. south of the center of the pond. Depth of water: 20 ft. Northwest wind. Waves: 5 inches high.	Surface	69.6	8.1	6.4	....
	5	69.6	...	...	....
	10	69.4	7.8	6.0	15.0
	15	66.2	7.4	6.0	....
	19	59.0	...	...	....
	20	....	1.0	5.8	29.7
TOGUS POND, P. 649. Augusta Twp., Kennebec Co. Aug. 18, 10:30 to 11:00 A.M. Station: near center of the pond. Depth of water: 49 ft. West breeze. Waves: 4 inches.	Surface	68.7	9.4	7.0	17.6
	5	68.7	...	...	....
	10	68.4	...	...	....
	15	68.4	8.7	6.9	....
	20	68.4	...	...	....
	25	68.2	...	...	....
	30	67.6	7.4	6.6	12.7
	35	62.1	1.9	6.2	....
	40	60.6	...	...	....
	45	60.3	0.0	6.2	63.0
	48	59.7	...	...	....
LITTLE TOGUS POND, P. 650. Augusta Twp., Kennebec Co. Aug. 18, 1:00 to 1:30 P.M. Station: 1/10 mile off the southwest shore. Depth of water: 18 ft. West breeze. Waves: 4 inches.	Surface	68.4	8.9	6.7	....
	5	68.2	...	...	....
	10	67.3	8.7	6.6	....
	15	66.7	8.4	6.6	17.9
	18	66.6	...	...	....

* All temperatures were taken with Negretti and Zambra Deep Sea Reversing thermometers, with the exception of a few surface temperatures which were taken with a pocket thermometer and are here marked by an asterisk.

**The location of each water-analysis station is indicated by the symbol ⊗ on the accompanying outline maps of the lakes, see Figs. 1 to 59.

All analyses were made during the summer of 1941, except for one series of analyses on Threemile Pond made during 1940 and four series of analyses on Unity Pond made during 1938; these exceptions are so indicated in the table.

† With few exceptions, all pH values of 5.7 to 6.3 inclusive were from tests made with Bromcresol Purple indicator, all values of 6.4 to 7.3 were with Bromthymol Blue, and values of 7.4 to 8.1 were with Phenol Red indicator. The exceptions are so indicated in the table.

†† Analyses of phosphorus made by Dr. John L. Fuller. The methods and results of these analyses are discussed on page 52.

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
THREECORNERED PD., P. 651 Augusta Twp., Kennebec Co. Aug. 18, 2:30 to 3:00 P.M. Station: 100 yds. off the middle of the south shore. Depth of water: 32 ft. West breeze. Waves: 3 inches high.	Surface	69.6	8.9	7.0	16.3
	5	69.4	...	...	....
	10	68.7	...	...	....
	15	67.8	8.8	6.9	....
	20	66.4	7.4	6.7	....
	25	57.0	0.8	6.1	....
	30	54.5	0.0	6.2	13.7
	32	54.3	...	...	....
WEBER POND, P. 688. Vassalboro Twp., Kennebec Co. Aug. 19, 10:00 to 11:00 A.M. Station: ½ mile south of Church Isl. Depth of water: 36 ft. Southwest breeze. Waves: 8 inches.	Surface	68.2	10.0	7.1	Trace
	5	68.2	...	...	...
	10	68.2	...	...	....
	15	68.0	10.0	7.0	16.0
	20	68.0	...	...	....
	25	67.5	9.6	7.0	25.8
	30	67.1	9.0	...	....
	32	66.9	...	...	....
	35	61.9	9.5	7.1	10.5
SPECTACLE POND, P. 691. Vassalboro Twp., Kennebec Co. Aug. 18, 1:30 to 3:15 P.M. Station: 300 yds. south of the center of the pond. Depth of water: 97 ft. West breeze. Waves: 4 inches.	Surface	70.7	9.2	7.2	25.1
	5	70.5	...	...	....
	10	69.8	...	...	....
	15	69.4	...	...	....
	20	69.1	9.0	7.0	....
	23	62.2	9.0	7.0	....
	25	58.3	9.6	6.8	....
	30	51.8	...	...	....
	35	47.5	7.0	6.4	....
	40	44.6	...	...	....
	45	43.3	...	...	....
	50	42.6	5.8	6.2	7.8
	60	42.1	5.7	6.2	....
	70	41.7	5.6	6.2	....
	80	41.4	5.3	6.2	....
	90	41.4	...	...	....
	95	41.2	4.8	6.2	11.1
DAM POND, P. 692. Augusta Twp., Kennebec Co. Aug. 18, 12:10 to 12:40 P.M. Station: 1/5 mile north of south end of the pond. Depth of water: 21 ft. West breeze. Waves: 4 inches.	Surface	69.6	9.0	6.8	Trace
	5	69.3	...	...	....
	10	68.4	...	...	....
	15	68.0	8.7	6.8	....
	20	67.3	8.4	6.6	14.0
TOLMAN POND, P. 693. Augusta Twp., Kennebec Co. Aug. 18, 9:00 to 10:00 A.M. Station: 100 yds. off the southeast end of the pond. Depth of water: 24 ft. No wind or waves.	Surface	69.4	9.0	7.0	9.8
	5	69.4	...	...	....
	10	69.4	...	...	....
	15	69.3	8.9	6.9	....
	18	67.5	7.9	6.8	....
	20	60.6	3.2	6.6	....
	23	54.3	0.4	6.0	10.7

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temper-ature: °F.	Oxy-gen: p.p.m.	pH	Phos-phorus: parts per billion
THREEMILE POND, P. 694.	Surface	75.2	7.7	8.1*	....
China Twp., Kennebec Co.	5	75.0	...	...	....
Aug. 18, 1940. 4:30 to 5:30 P.M.	10	75.0	9.7	8.1*	....
Station: near center of the pond.	15	75.0	...	...	....
Depth of water: 32 ft.	20	72.3	5.2	6.8	....
Southwest wind. Waves: 10 inches high.	25	70.7	1.8	6.2	....
	28	66.6	0.3	6.2	....
* *High pH value coincided with a "plankton bloom."*	30	64.9	0.1	6.2	....
	32	64.4	...	...	....
THREEMILE POND, P. 694.	Surface	68.0	9.1	6.9	....
China Twp., Kennebec Co.	5	68.0	...	...	....
Aug. 19, 1941. 1:00 to 2:00 P.M.	10	68.0	...	...	....
Station: near center of the pond.	15	68.0	9.1	6.8	....
Depth of water: 36 ft.	20	68.0	...	...	....
South wind and rain. Waves: 14 inches.	25	68.0	...	...	....
	30	67.8	8.8	6.8	21.2
	35	67.3	9.5	6.8	....
CHINA LAKE, P. 736.	Surface	69.4	9.2	7.2	43.0
China Twp., Kennebec Co.	5	69.4	...	...	....
Aug. 15, 9:00 to 11:00 A.M.	10	69.4	...	...	....
Station: in west half of the lake, ½ mile east of Bradley Isl.	15	69.3	...	...	....
Depth of water: 81 ft.	20	69.3	...	...	....
South breeze. Waves: 6 inches.	25	69.3	9.0	7.2	....
	30	68.9	9.0	7.2	....
	35	61.3	5.8	6.6	....
	40	59.9	5.5	6.6	24.5
	45	58.5	...	...	....
	50	57.6	...	...	....
	60	57.0	4.0	6.4	....
	70	56.7	...	...	....
	80	56.5	3.4	6.4	27.4
CHINA LAKE, P. 736.	Surface	70.2	9.1	7.1	....
China Twp., Kennebec Co.	5	70.2	...	...	....
Aug. 15, 2:00 to 3:00 P.M.	10	70.2	...	...	....
Station: in east half of the lake, 1 mile south of China village.	15	70.2	...	...	....
Depth of water: 51 ft.	20	70.2	...	...	....
South wind. Waves: 12 inches.	25	69.8	8.8	7.1	....
	30	68.9	8.7	7.1	....
	35	61.2	2.8	6.5	....
	40	59.2	1.8	6.4	....
	45	58.1	1.2	6.4	....
	50	57.6	...	...	....
PATTEE POND, P. 739.	Surface	70.5	8.9	7.2	....
Winslow Twp., Kennebec Co.	5	68.7	...	...	....
Aug. 16, 12:45 to 1:30 P.M.	10	68.4	...	...	....
Station: 1/3 mile off the mouth of Prentice Brook.	15	68.2	8.1	7.1	....
Depth of water: 24 ft.	20	68.0	7.8	7.1	....
North breeze. Waves: 3 inches.					

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temper-ature: °F.	Oxy-gen: p.p.m.	pH	Phos-phorus: parts per billion
LOVEJOY POND, P. 744.	Surface	68.7	8.8	7.2	44.3
Albion Twp., Kennebec Co.	5	68.7	...	...	....
Aug. 16, 10:00 to 11:00 A.M.	10	68.5	...	...	....
Station: near center of the pond.	15	68.5	...	...	....
Depth of water: 32 ft.	20	68.5	...	...	....
No wind or waves.	25	68.5	8.6	7.2	48.0
	30	68.4	8.4	7.2	....
DUTTON POND, P. 745.	Surface	68.4	9.0	7.2	Trace
China Twp., Kennebec Co.	5	68.4	...	...	....
Aug. 28, 3:45 to 4:30 P.M.	10	68.4	9.0	7.2	19.6
Station: near center of the pond.	15	68.2	...	...	....
Depth of water: 32 ft.	20	59.5	2.9	6.5	....
No wind or waves.	25	54.0	...	...	14.7
	30	52.3	0.0	6.6	....
UNITY POND, P. 746.	Surface	77.7	8.9	7.2	....
Unity Twp., Waldo Co.	5	77.0	...	...	....
July 30, 1938. 4:30 to 5:00 P.M.	10	75.4	...	...	....
Station: 1/5 mile off the point of "Horseback."	15	74.8	8.5	7.2	....
Depth of water: 40 ft.	20	73.8	...	...	....
West breeze. Waves: 4 inches.	25	66.2	2.0	6.4#	....
	30	62.2	0.3	6.3	....
# *pH of 6.4 with Bromcresol Purple indicator.*	35	60.8	0.2	6.3	....
	39	59.5	0.2	6.3	....
UNITY POND, P. 746.	Surface	77*	8.6	...	....
Unity Twp., Waldo Co.	5	76.5	...	...	....
July 31, 1938. 10:30 to 11:30 A.M.	10	74.3	...	...	....
Station: ½ mile south of Big Isl.	15	73.2	7.4	...	....
Depth of water: 32 ft.	18	72.9	7.2	...	....
West breeze. Waves: 4 inches.	20	72.7	6.9	...	....
	22	71.8	6.0	...	....
	25	69.5	3.3	...	....
	28	63.7	...	...	....
	30	62.9	0.3	...	....
	32	62.9	...	...	....
UNITY POND, P. 746.	Surface	77*	...	...	....
Unity Twp., Waldo Co.	5	76.5	...	...	....
July 31, 1938. 12:30 to 2:45 P.M.	10	73.8	...	...	....
Station: 1/5 mile east of "Horse-back" and 1/5 mile from south end of the lake.	15	73.6	...	...	....
Depth of water: 30 ft.	18	73.2	...	...	....
No wind or waves.	20	72.8	6.8	...	....
	22	72.3	6.0	...	....
	25	69.8	2.7	...	....
	28	62.4	0.6	...	....
	30	62.2	...	...	....

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
UNITY POND, P. 746.	Surface	78*	8.5	7.2	....
Unity Twp., Waldo Co.	5	76.8	...	...	....
July 31, 1938. 3:00 to 3:45 P.M.	10	76.1	...	...	....
Station: halfway beween Big Isl.	15	73.9	...	...	....
and Pleasant Point.	18	73.8	...	6.9	....
Depth of water: 37 ft.	20	72.1	...	6.7	....
No wind or waves.	22	71.1	4.4	6.5	....
	25	68.2	1.6	6.4	....
	28	63.3	0.0	6.4#	....
	30	61.3	...	...	....
#These two pH values of 6.4 with	35	60.4	0.0	6.4#	....
Bromcresol Purple indicator.	37	60.4	...	...	....
UNITY POND, P. 746.	Surface	71.1	9.6	7.2	....
Unity Twp., Waldo Co.	5	70.7	...	...	....
Aug. 23, 1941. 12:45 to 1:30 P.M.	10	67.8	9.6	7.2	....
Station: 1/5 mile off the point of	15	67.6	...	...	....
"Horseback."	20	67.3	9.0	7.1	....
Depth of water: 38 ft.	25	67.3	...	...	....
Southwest breeze. Waves: 7	30	66.9	8.9	7.0	....
inches.	35	66.6	8.3	6.9	....
	37	65.8	...	...	....
SANDY POND, P. 751.	Surface	66 7	10.1	7.6	78.5
Freedom Twp., Waldo Co.	6	66.4	9.7	7.4	52.0
Aug. 23, 8:30 to 9:00 A.M.	8	66.2	...	...	....
Station: 1/5 mile east of Lamson Isl.					
Depth of water: 8 ft.					
Southwest breeze. Waves: 3 in.					
DYER LONG POND, P. 1331.	Surface	69.6	9.2	6.8	18.6
Jefferson Twp., Lincoln Co.	5	68.9	...	...	....
Aug. 23, 10:30 to 11:00 A.M.	10	68.5	9.2	6.8	....
Station: 50 yds. off middle of the	15	68.0	8.9	6.7	....
east shore.					
Depth of water: 16 ft.					
No wind or waves.					
PLEASANT POND or CLARY	Surface	68.5	9.3	6.9	....
LAKE, P. 1334.	5	68.4	...	...	....
Jefferson Twp., Lincoln Co.	10	68.0	9.3	6.9	....
Aug. 23, 9:00 to 9:30 A.M.	15	67.6	...	...	....
Station: near center of the pond.	20	66.9	8.9	6.7	....
Depth of water: 21 ft.					
No wind or waves.					

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
BRANCH POND, P. 1342.	Surface	66.9	8.6	6.9	13.9
China Twp., Kennebec Co.	5	66.9	...	...	....
Aug. 19, 2:30 to 3:30 P.M.	10	66.7	...	...	....
Station: ½ mile north of the	15	65.8	7.8	6.7	9.9
outlet.	18	58.1	0.3	6.2	....
Depth of water: 36 ft.	20	54.5	...	...	....
South wind and rain. Waves: 6	25	50.2	0.3	6.1	....
inches high.	30	48.0	...	...	....
	35	46.9	0.0	6.3	51.0
LONG POND, P. 1345.	Surface	69.6	8.9	6.8	36.6
Somerville Twp., Lincoln Co.	5	69.8	...	...	....
Aug. 15, 4:00 to 4:45 P.M.	10	69.8	...	...	....
Station: 100 yds. off the middle of	13	69.8	...	...	....
the east shore.	14	....	8.8	6.8	19.7
Depth of water: 15 ft.					
Southeast wind. Waves: 10 in.					
TURNER POND, P. 1346.	Surface	70.0	9.8	6.9	17.0
Somerville Twp., Lincoln Co.					
Aug. 28, 1:00 to 1:15 P.M.					
Station: ½ mile north of the					
outlet.					
Depth of water: 3 ft.					
Northwest wind. No waves.					
SHEEPSCOT POND, P. 1349.	Surface	68.9	8.8	6.8	....
Palermo Twp., Waldo Co.	5	68.5	...	...	....
Aug. 15, 9:00 to 11:00 A.M.	10	68.4	...	...	....
Station: ¼ mile north of Oak Point.	15	68.4	...	...	....
Depth of water: 128 ft.	20	68.4	8.8	6.8	....
Southwest breeze. Waves: 3	23	66.6	8.5	6.7	....
inches.	24	65.7	...	...	....
	25	60.4	6.8	6.6	....
	30	55.9	...	...	....
	35	54.0	7.5	6.2	....
	40	52.2	...	...	....
	45	49.6	...	...	....
	50	48.0	8.0	6.1	....
	60	46.0	...	...	....
	70	45.1	...	...	....
	75	....	8.3	6.0	9.4
	80	44.6	...	...	....
	90	44.4	...	...	....
	100	44.1	7.8	6.0	....
	110	43.9	...	...	....
	120	43.9	6.8	6.0	18.7
	125	43.9	...	...	....

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
WEST HARBOR POND, P. 1361.	Surface	69.8	8.4	6.9	8.4
Boothbay Harbor Twp., Lincoln Co.	5	69.8	...	...	....
Aug. 16, 10:45 to 11:30 A.M.	10	69.8	...	...	....
Station: ½ mile north of the outlet.	15	69.8	...	...	....
Depth of water: 34 ft.	20	69.6	8.1	6.9	....
No wind or waves.	23	65.5	8.0	6.8	....
	25	58.3	0.2	6.4#	....
#pH of 6.4 with Bromcresol Purple indicator.	30	50.5	0.0	6.4#	....
DAMARISCOTTA POND, P. 1367.	Surface	71.2	9.5	7.0	Trace
Nobleboro Twp., Lincoln Co.	5	69.4	...	...	....
Aug. 21, 1:15 to 2:15 P.M.	10	69.1	...	...	....
Station: near center of the pond.	15	68.7	...	...	....
Depth of water: 37 ft.	20	68.4	...	...	....
Northwest breeze. Waves: 3 in.	25	68.0	9.0	6.8	....
	30	67.5	...	...	....
	33	59.9	3.8	6.3	...
	35	59.4	0.9	6.2	37.5
DAMARISCOTTA LAKE, P. 1368.	Surface	69.1	9.5	7.0	Trace
Jefferson Twp., Lincoln Co.	5	68.5	...	...	....
Aug. 21, 9:00 to 10:30 A.M.	10	68.4	...	...	....
Station: 1/8 mile off Flagg Point.	15	68.2	...	...	....
Depth of water: 96 ft.	20	68.0	...	...	....
No wind or waves.	25	68.0	9.5	7.0	16.3
	30	68.0	...	...	....
	35	67.8	9.3	7.0	7.7
	40	60.1	4.9	6.1	10.0
	45	57.6	...	...	....
	50	56.8	5.1	6.1	....
	60	55.0	5.0	6.0	....
	70	54.1	...	...	....
	75	54.0	4.3	6.0	....
	80	53.6	...	...	....
	85	53.6	4.2	6.0	....
	90	53.4	...	...	....
	95	53.2	3.6	6.0	13.3
DAMARISCOTTA LAKE, P. 1368.	Surface	70.2	9.5	6.9	Trace
Nobleboro Twp., Lincoln Co.	5	68.9	...	...	....
Aug. 21, 11:45 A.M. to 12:30 P.M.	10	68.7	...	...	....
Station: ¼ mile east of	15	68.5	...	...	....
"East Neck."	20	68.5	...	...	....
Depth of water: 41 ft.	25	68.4	9.3	6.8	....
No wind or waves.	30	68.2	...	...	....
	35	68.0	9.1	6.8	....
	40	67.6	8.8	6.8	16.3

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
BOYD POND, P. 1376.	Surface	71.1	9.2	6.7	13.7
Bristol Twp., Lincoln Co.	5	70.9	...	...	....
Aug. 26, 3:00 to 3:30 P.M.	10	70.5	9.1	6.6	....
Station: near center of the pond.	15	68.7	...	...	....
Depth of water: 21 ft.	20	66.6	6.5	6.4	16.0
South wind. Waves: 6 in. high.					
BISCAY POND, P. 1379.	Surface	70.0	9.5	6.8	Trace
Bremen Twp., Lincoln Co.	5	70.0	...	...	....
Aug. 25, 9:30 to 10:30 A.M.	10	69.8	...	...	....
Station: ½ mile from north end	15	69.6	...	...	....
of the pond.	20	69.4	...	...	....
Depth of water: 59 ft.	25	68.0	8.9	6.7	....
Southeast breeze. Waves: 4 in.	30	65.1	8.9	6.5	....
	35	59.2	4.7	5.9	....
	40	54.5	4.2	5.9	Trace
	45	53.6	...	...	....
	50	52.9	3.5	5.8	....
	55	52.5	...	...	....
	58	52.5	2.6	5.8	Trace
PEMAQUID POND, P. 1381.	Surface	70.7	9.5	6.9	13.7
Nobleboro Twp., Lincoln Co.	5	70.7	...	...	....
Aug. 25, 4:00 to 4:45 P.M.	10	70.7	...	...	....
Station: ½ mile south of north end	15	70.7	9.5	6.9	....
of the pond.	20	70.5	...	...	....
Depth of water: 41 ft.	25	70.0	...	...	....
South wind and rain. Waves:	30	65.7	5.2	6.2	....
12 inches.	35	59.9	0.1	6.3	....
	40	58.3	0.0	6.6	....
PEMAQUID POND, P. 1381.	Surface	70.3	9.2	6.8	11.7
Damariscotta Twp., Lincoln Co.	5	70.2	...	...	....
Aug. 26, 9:45 to 10:30 A.M.	10	69.8	...	...	....
Station: 1/5 mile off Cook's Point.	15	69.6	...	...	....
Depth of water: 60 ft.	20	69.3	...	...	....
South wind. Waves: 12 inches.	25	69.1	9.0	6.8	....
	30	69.1	...	...	....
	35	67.8	...	...	....
	40	66.7	8.9	6.5	....
	45	59.7	1.8	5.9	....
	50	58.3	0.5	5.9	....
	55	57.7	...	...	....
	59	57.4	0.2	6.1	....
MUDDY POND, P. 1382.	Surface	73.0	10.3	7.5	35.5
Damariscotta Twp., Lincoln Co.	5	73.0	...	...	....
Aug. 27, 1:00 to 1:45 P.M.	10	72.9	9.7	7.4#	15.7
Station: near center of the pond.					
Depth of water: 11 ft.					
Southwest breeze. Waves: 4 in.					
#pH of 7.4 with Bromthymol Blue indicator.					

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temper-ature: °F.	Oxy-gen: p.p.m.	pH	Phos-phorus: parts per billion
DUCKPUDDLE POND, P. 1383. Nobleboro Twp., Lincoln Co. Aug. 27, 5:00 to 5:30 P.M. Station: near center of the pond. Depth of water: 22 ft. Northwest wind. Waves: 12 inches high.	Surface	71.6	9.1	6.8	27.0
	5	71.6	...	...	....
	10	70.7	8.9	6.7	23.6
	15	70.5	...	...	....
	20	68.9	7.8	6.5	....
McCURDY POND, P. 1385. Bremen Twp., Lincoln Co. Aug. 25, 1:30 to 2:45 P.M. Station: ¼ mile south of the north end of the pond. Depth of water: 40 ft. South wind. Waves: 12 inches.	Surface	70.7	9.6	6.7	Trace
	5	70.7	...	...	....
	10	70.7	...	...	....
	15	70.5	9.5	6.7	....
	20	70.3	...	...	....
	25	66.9	7.5	6.4	....
	30	60.6	2.2	5.8	Trace
	35	57.6	0.0	6.1	....
	38	57.2	0.0	6.1	Trace
WEBBER POND, P. 1387. Bremen Twp., Lincoln Co. Aug. 25, 2:45 to 3:30 P.M. Station: 1/5 mile northeast of Keene Isl. Depth of water: 29 ft. South breeze. Waves: 5 inches.	Surface	70.9	9.5	6.8	12.6
	5	70.9	...	...	....
	10	70.7	...	...	....
	15	68.7	...	...	....
	20	67.6	7.5	6.1	....
	22	65.1	...	...	....
	25	59.0	0.3	6.1	....
	28	57.7	0.0	6.1	....
MEDOMAK POND, P. 1394. Waldoboro Twp., Lincoln Co. Aug. 21, 4:00 to 4:30 P.M. Station: 1/5 mile northeast of the outlet. Depth of water: 23 ft. Southwest breeze. Waves: 8 in.	Surface	70.3	9.5	7.1	17.1
	5	69.4	...	...	....
	10	67.5	...	...	....
	15	67.3	8.9	6.9	....
	20	65.8	8.6	6.8	....
	23	65.7	...	...	....
WASHINGTON POND, P. 1400. Washington Twp., Knox Co. Aug. 20, 5:15 to 6:00 P.M. Station: near center of the pond. Depth of water: 36 ft. Northwest wind. Waves: 8 in.	Surface	68.9	9.5	6.9	8.8
	5	68.7	...	...	....
	10	68.7	...	...	....
	15	68.7	...	...	....
	20	68.7	9.4	6.9	....
	25	67.8	...	...	....
	30	67.6	9.1	6.8	6.7
	35	67.1	9.1	6.8	8.8

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temper-ature: °F.	Oxy-gen: p.p.m.	pH	Phos-phorus: parts per billion
CHICKAWAUKIE POND, P. 1409. Rockport Twp., Knox Co. Aug. 25, 12:15 to 12:45 P.M. Station: near center of the pond. Depth of water: 31 ft. South wind. Waves: 14 inches high.	Surface	68.9	9.9	7.3	8.3
	5	68.7	...	...	....
	10	68.7	...	...	....
	15	68.5	...	...	....
	20	68.0	9.3	7.2	....
	25	68.0	9.3	7.2	....
	30	67.6	9.3	7.2	7.0
MIRROR LAKE or OYSTER RIVER POND, P. 1413. Rockport Twp., Knox Co. Aug. 27, 2:30 to 3:45 P.M. Station: 1/10 mile off the southeast shore. Depth of water: 66 ft. Northwest wind. Waves: 18 inches.	Surface	69.8	9.8	7.0	Trace
	5	69.8	...	...	....
	10	69.8	...	...	....
	15	69.8	...	...	....
	20	69.4	10.0	7.0	....
	25	65.5	10.3	6.8	Trace
	30	58.8	10.9	6.8	....
	35	52.5	...	...	....
	40	49.1	8.6	6.4	....
	45	47.5	...	...	....
	50	46.4	5.7	5.8	....
	55	46.0	...	...	....
	60	45.9	...	...	....
	65	45.7	2.7	5.7	....
NORTH POND, P. 1414. Warren Twp., Knox Co. Aug. 25, 9:00 to 9:45 A.M. Station: 1/3 mile south of the center of the pond. Depth of water: 40 ft. No wind or waves.	Surface	69.4	9.1	6.9	30.3
	5	69.4	...	...	....
	10	69.3	...	...	....
	15	69.1	...	...	....
	20	68.0	8.9	6.8	....
	25	66.7	6.6	6.6	16.0
	28	65.1	...	...	....
	30	62.8	2.4	6.2	....
	35	58.3	...	...	....
	39	57.4	0.0	6.5	75.6
SOUTH POND, P. 1415. Warren Twp., Knox Co. Aug. 25, 10:45 to 11:00 A.M. Station: near center of the pond. Depth of water: 18 ft. Southwest wind. Waves: 5 inches.	Surface	69.8	9.5	6.9	8.0
	5	69.8	...	...	....
	10	69.6	...	...	....
	15	68.2	...	...	....
	17	68.0	8.2	6.6	26.0
SEVEN TREE POND, P. 1419. Union Twp., Knox Co. Aug. 22, 2:30 to 3:15 P.M. Station: ½ mile north of the outlet. Depth of water: 44 ft. Southwest wind. Waves: 7 inches.	Surface	69.3	9.3	7.0	18.6
	5	69.3	...	...	....
	10	68.9	...	...	....
	15	68.9	...	...	....
	20	68.0	...	...	....
	25	67.5	8.2	6.6	....
	30	67.3	...	...	....
	32	66.9	7.4	6.6	....
	35	61.2	4.2	6.2	....
	40	59.7	0.3	6.0	....
	42	59.0	...	...	....

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
ROUND POND, P. 1420.	Surface	68.2	9.0	6.9	....
Union Twp., Knox Co.	5	68.2	...	...	....
Aug. 28, 10:45 to 11:30 A.M.	10	68.2	...	...	....
Station: near center of the pond.	15	68.2	...	6.9	....
Depth of water: 33 ft.	20	68.2	...	...	....
Strong northwest wind. Waves:	25	68.0	9.0	6.9	12.1
2 ft. high.	30	59.0	0.1	6.5	....
CRAWFORD POND, P. 1422.	Surface	70.0	9.5	6.9	....
Union Twp., Knox Co.	5	70.0	...	...	....
Aug. 22, 11:45 A.M. to 1:00 P.M.	10	69.4	...	...	....
Station: 50 yds. off Salmon Point.	15	69.1	...	...	....
Depth of water: 55 ft.	20	68.7	...	...	....
Southwest wind. Waves: 5	25	68.4	9.1	6.8	....
inches.	28	61.9	5.1	6.2	....
	30	58.3	3.6	6.0	....
	35	54.0	...	...	....
	40	50.9	0.5	6.0	....
	45	49.8	...	...	....
	50	49.6	0.2	6.0	36.3
	53	49.5	...	...	....
LERMOND POND, P. 1423.	Surface	69.1	9.9	6.8	11.4
Hope Twp., Knox Co.	5	68.7	...	...	....
Aug. 22, 9:30 to 10:00 A.M.	10	68.7	...	...	....
Station: 100 yds. off the southeast shore.	15	68.2	9.3	6.8	....
	20	68.0	...	...	....
Depth of water: 28 ft.	25	67.6	...	...	....
No wind or waves.	27	66.2	7.8	6.4	23.5
ALFORD LAKE, P. 1424.	Surface	68.5	10.8	6.9	15.0
Hope Twp., Knox Co.	5	68.5	...	...	....
Aug. 22, 11:00 A.M. to 12:30 P.M.	10	68.4	...	...	....
Station: near center of the pond.	15	67.6	...	...	....
Depth of water: 78 ft.	20	67.5	...	...	....
Southwest wind. Waves: 6	25	67.1	9.6	6.7	....
inches.	30	66.0	8.9	6.6	....
	35	59.4	...	...	....
	40	56.1	3.3	5.9	....
	45	54.7	...	...	....
	50	53.2	0.8	5.9	....
	60	50.2	0.2	5.9	....
	70	49.1	...	...	....
	77	48.7	0.0	6.1	....
FISH POND, P. 1428.	Surface	69.1	10.0	...	....
Hope Twp., Knox Co.	5	69.1	...	...	....
Aug. 22, 3:20 to 3:40 P.M.	10	69.1	9.9	...	12.4
Station: near center of the pond.					
Depth of water: 12 ft.					
Strong south wind. Waves: 10 inches.					

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
HOBBS POND, P. 1429.	Surface	68.5	9.7	6.9	Trace
Hope Twp., Knox Co.	5	68.5	...	...	....
Aug. 22, 1:45 to 2:15 P.M.	10	68.0	9.6	6.9	....
Station: near center of the pond.	15	67.3	...	...	....
Depth of water: 19 ft.	18	67.3	9.5	6.8	10.8
South breeze. Waves: 3 in. high.					
SENNEBEC POND, P. 1431.	Surface	68.7	9.3	7.0	....
Appleton Twp., Knox Co.	5	68.7	...	...	....
Aug. 22, 9:45 to 11:45 A.M.	10	67.5	...	...	....
Station: 1/5 mile northwest of Turtle Rock.	15	67.1	...	...	....
	20	66.9	...	...	....
Depth of water: 53 ft.	25	66.7	8.6	6.8	....
Southwest breeze. Waves: 3	30	66.4	...	...	....
inches.	35	66.0	8.0	6.7	14.0
	40	62.6	3.6	6.2	....
	45	59.7	1.1	6.1	....
	50	57.7	0.5	6.1	....
QUANTABACOOK POND, P. 1434	Surface	67.6	9.0	6.9	13.1
Searsmont Twp., Waldo Co.	5	67.6	...	...	....
Aug. 19, 2:30 to 3:30 P.M.	10	67.6	...	...	....
Station: 1/5 mile west of "Wood Isl."	15	67.6	...	...	....
	20	67.6	9.0	6.9	....
Depth of water: 50 ft.	25	66.4	...	...	....
South wind. Waves: 8 inches.	27	62.8	7.2	6.5	....
	30	57.9	3.0	6.0	32.0
	35	56.7	...	...	....
	40	55.9	1.7	6.0	....
	45	55.0	...	...	....
	48	54.5	0.6	6.0	39.4
STEVENS POND, P. 1443.	Surface	68.0	9.2	6.8	....
Liberty Twp., Waldo Co.	5	68.0	...	...	....
Aug. 19, 8:00 to 9:00 A.M.	10	68.0	...	...	....
Station: 100 ft. off Rock Ledge.	15	67.8	9.0	6.8	....
Depth of water: 36 ft.	17	67.3	8.7	6.8	....
No wind or waves.	20	59.9	...	...	....
	25	51.8	6.1	5.9	....
	30	47.5	...	...	....
	35	46.2	0.0	5.8	....
STEVENS POND, P 1443.	Surface	67.6	8.8	6.7	13.7
Liberty Twp., Waldo Co.	5	67.5	...	...	....
Aug. 19, 9:45 to 10:15 A.M.	10	67.5	...	...	....
Station: just off south shore of	15	66.7	8.5	6.6	....
the large island in the center of	17	65.8	7.8	6.2	....
the pond.	20	55.4	2.3	5.9	....
Depth of water: 30 ft.	25	51.6	...	...	....
Southwest wind. Waves: 5 in.	28	50.7	0.0	6.2	14.7

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temper-ature: °F.	Oxy-gen: p.p.m.	pH	Phos-phorus: parts per billion
ST. GEORGE LAKE, P. 1445.	Surface	69.8	9.4	6.8	7.5#
Liberty Twp., Waldo Co.	5	69.6	...	...	....
Aug. 15, 1:00 to 2:45 P.M.	10	69.6	...	...	....
Station: Halfway between Mill-	15	69.4	...	...	....
stone Isl. and Martha Jane Isl.	20	69.4	9.2	6.8	7.2#
Depth of water: 60 ft.	25	69.4	...	...	....
Southeast wind. Waves: 10 in.	30	69.3	...	...	....
	35	69.1	9.1	6.8	....
	37	66.9	9.2	6.7	....
	40	60.8	9.1	6.5	....
	45	55.4	...	...	....
#Phosphorus samples taken on	50	50.4	5.5	5.9	....
September 4.	55	48.2	2.8	5.8	11.1#
MEGUNTICOOK LAKE, P. 1449.	Surface	68.4	9.1	7.0	12.4
Lincolnville Twp., Waldo Co.	5	68.4	...	...	....
Aug. 20, 12:15 to 1:15 P.M.	10	68.4	...	...	....
Station: at the "Trout hole."	15	68.2	...	...	....
Depth of water: 61 ft.	20	68.0	9.1	7.0	....
Northwest wind. Waves: 6 in.	22	68.0	...	...	....
	25	59.7	7.4	6.8	....
	30	53.2	...	...	....
	35	48.4	4.3	6.1	....
	40	46.4	...	...	....
	45	45.1	3.2	6.0	....
	50	44.9	...	...	....
	55	44.6	1.1	5.9	15.0
	59	44.4	...	...	....
MEGUNTICOOK LAKE, P. 1449.	Surface	68.7	9.1	6.9	....
Camden Twp., Knox Co.	5	68.7	...	...	....
Aug. 20, 2:10 to 3:15 P.M.	10	68.4	...	...	....
Station: 1/5 mile east of the	15	68.4	...	...	....
mouth of Carl Brook.	20	68.2	9.1	6.9	....
Depth of water: 61 ft.	22	68.0	...	...	....
Northwest wind. Waves: 5 in.	25	68.0	9.1	6.9	....
	30	64.4	7.7	6.5	....
	35	59.7	4.4	6.2	....
	40	56.3	...	...	....
	45	54.9	1.2	6.0	....
	50	53.8	...	...	....
	55	52.2	0.2	6.0	....
	58	51.1	...	...	....
NORTON POND, P. 1451.	Surface	68.0	8.9	7.0	10.7
Lincolnville Twp., Waldo Co.	5	67.8	...	...	....
Aug. 20, 9:15 to 10:30 A.M.	10	67.6	...	...	....
Station: ½ mile northeast of the	15	67.6	8.9	6.9	....
outlet.	17	67.3	...	...	....
Depth of water: 51 ft.	19	67.3	...	...	....
Southwest breeze. Waves: 3 in.	20	59.5	...	...	....
	22	53.6	3.5	6.1	....
	25	50.9	3.1	6.1	....
	30	48.4	2.9	6.1	11.7
	35	47.3	...	...	....
	40	46.6	1.1	6.0	....
	45	46.4	...	...	....
	50	46.2	0.3	6.0	10.4

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temper-ature: °F.	Oxy-gen: p.p.m.	pH	Phos-phorus: parts per billion
PITCHER POND, P. 1454.	Surface	68.9	9.6	6.8	15.1
Lincolnville, Twp. Waldo Co.	5	68.7	...	...	....
Aug. 21, 10:45 to 11:45 A.M.	10	68.2	...	...	....
Station: 100 yds. south of Loon Isl.	15	68.2	9.6	6.7	....
Depth of water: 38 ft.	20	68.2	...	...	....
Northwest breeze. Waves: 4 in.	25	68.0	...	...	....
	30	68.0	9.6	6.7	....
	35	68.0	9.5	6.7	....
KNIGHT POND, P. 1455.	Surface	68.5	9.8	6.6	....
Northport Twp., Waldo Co.	5	68.0	...	...	....
Aug. 21, 1:15 to 1:45 P.M.	10	66.7	9.6	6.6	11.5
Station: ¼ mile from the east end of the pond.					
Depth of water: 12 ft.					
Southeast wind. Waves: 6 in.					
TILDEN POND, P. 1456.	Surface	66.6	9.5	6.8	....
Belmont Twp., Waldo Co.	5	66.4	...	...	....
Aug. 21, 9:00 to 9:30 A.M.	10	66.4	9.5	6.8	....
Station: near center of the pond.					
Depth of water: 11 ft.					
No wind or waves.					
CROSS POND, P. 1460.	Surface	71.6	8.9	7.0	Trace
Morrill Twp., Waldo Co.	5	71.6	...	...	....
Aug. 27, 10:00 to 10:15 A.M.	8	71.6	8.9	7.0	....
Station: 1/5 mile from north end of the pond.					
Depth of water: 9 ft.					
West wind. Waves: 5 inches.					
MIXER POND, P. 1461.	Surface	67.5	9.4	6.7	7.2
Knox Twp., Waldo Co.	5	67.5	...	...	....
Aug. 29, 11:15 A.M. to 12:00 M.	10	67.5	...	...	....
Station: 100 yds. off the middle of the west shore.	15	67.1	9.3	6.7	12.1
Depth of water: 29 ft.	20	66.9	...	...	....
Northwest wind. Waves: 6 in.	25	66.6	9.1	6.6	....
	28	58.8	0.7	5.9	....

TABLE II. Water analyses — Continued

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
SANBORN POND, P. 1462.	Surface	67.8	9.6	6.9	....
Brooks Twp., Waldo Co.	5	67.8	...	...	....
Aug. 19, 12:00 M. to 1:00 P.M.	10	67.6	...	...	....
Station: 100 yds. off the south-west shore.	15	66.2	9.6	6.8	11.4
Depth of water: 64 ft.	17	64.8	9.4	6.7	....
Southwest wind and rain. Waves: 3 inches.	20	54.3	8.7	6.1	....
	25	47.5	...	...	....
	30	44.9	4.5	5.8	11.1
	35	44.2	...	...	....
	40	43.2	...	...	....
	45	42.8	2.3	5.8	....
	50	42.6	...	...	....
	60	42.3	0.7	5.8	....
DUTTON POND, P. 1463.	Surface	70.2	9.3	6.8	....
Knox Twp., Waldo Co.	5	68.9	...	...	....
Aug. 21, 3:30 to 4:00 P.M.	10	67.5	9.6	6.7	12.7
Station: near center of the pond.	15	66.4	...	...	....
Depth of water: 21 ft.	17	64.4	6.3	6.2	....
No wind or waves.	20	58.1	0.7	6.1	15.3
PASSAGASSAWAUKEAG LAKE or RANDALL POND, P. 1466.	Surface	68.7	9.1	6.8	21.5
Brooks Twp., Waldo Co.	5	68.7	...	...	....
Aug. 20, 4:10 to 5:15 P.M.	10	68.0	...	...	....
Station: 1/5 mile from the north end of the pond.	15	67.6	...	...	....
Depth of water: 38 ft.	20	67.3	8.8	6.8	....
No wind or waves.	25	61.7	7.2	6.5	....
	30	52.3	0.4	6.0	....
	35	49.3	...	...	....
	37	49.1	0.0	6.7	14.3

TABLE II. Water analyses — Concluded

Lake, location, date, time, station, water depth, etc.	Depth in feet	Temperature: °F.	Oxygen: p.p.m.	pH	Phosphorus: parts per billion
SWAN LAKE, P. 1469.	Surface	67.3	9.6	6.9	....
Swanville Twp., Waldo Co.	5	67.3	...	...	....
Aug. 20, 9:10 to 11:00 A.M.	10	67.3	...	...	....
Station: near center of the lake.	15	67.1	...	...	....
Depth of water: 85 ft.	20	66.9	9.5	6.9	Trace
Northwest wind. Waves: 8 inches.	25	66.9	...	...	....
	30	66.7	...	...	....
	35	64.4	9.5	6.8	....
	40	56.3	8.0	6.4	Trace
	45	54.5	...	...	....
	50	53.8	5.3	6.1	....
	60	53.1	4.5	6.1	6.2
	70	52.9	4.3	6.1	....
	80	52.7	...	...	....
	84	52.7	3.9	6.1	30.6
TODDY POND, P. 1478.	Surface	68.5	9.2	6.7	Trace
Swanville Twp., Waldo Co.	5	68.5	...	...	....
Aug. 20, 2:45 to 3:15 P.M.	10	68.2	...	...	....
Station: near center of the pond.	15	67.3	9.6	6.7	....
Depth of water: 24 ft.	20	67.1	...	...	....
Northwest wind. Waves: 6 inches.	23	65.5	...	...	....
	24	....	4.1	6.2	10.4

TABLE III. An evaluation of the ponds with respect to the suitability of temperature and of dissolved oxygen content of the water for trout or salmon during the most critical, late-summer period

Name of pond	Pond number	How much of the pond is, and is not, available to trout or salmon during the most critical late-summer period*: Volume of water: Acre feet: Upper: warm, non-trout, above 70° F.	Volume of water: Acre feet: Middle layer: trout or salmon water	Volume of water: Acre feet: Lower: oxygen deficient, non-trout	Volume of water: % of total: Upper: warm, non-trout, above 70° F.	Volume of water: % of total: Middle layer: trout or salmon water	Volume of water: % of total: Lower: oxygen deficient, non-trout	Area of bottom: Acres: Upper: warm, non-trout, above 70° F.	Area of bottom: Acres: Middle layer: trout or salmon water	Area of bottom: Acres: Lower: oxygen deficient, non-trout	Area of bottom: % of total: Upper: warm, non-trout, above 70° F.	Area of bottom: % of total: Middle layer: trout or salmon water	Area of bottom: % of total: Lower: oxygen deficient, non-trout
Nequasset Pond	638	7,786	996	2,598	68	9	23	204	52	174	47	12	41
Gardiner Pond	640	612	37	26	91	5	4	35	9	14	60	16	24
Togus Pond	649	10,105	0	553	95	0	5	573	0	75	88	0	12
Little Togus Pond	650	584	0	0	100	0	0	93	0	0	100	0	0
Threecornered Pond	651	1,992	0	42	98	0	2	180	0	15	92	0	8
Weber Pond	688	18,970	622	0	97	3	0	1,080	172	0	86	14	0
Spectacle Pond	691	1,787	2,158	32	45	54	1	77	54	8	55	39	6
Dam Pond	692	929	0	0	100	0	0	87	0	0	100	0	0
Tolman Pond	693	635	0	16	98	0	2	56	0	6	91	0	9
Threemile Pond	694	17,035	0	0	100	0	0	1,077	0	0	100	0	0
China Lake West Part	736	35,810	8,446	3,689	75	17	8	960	383	318	58	23	19
East Part	736	36,757	0	1,817	95	0	5	1,970	0	291	87	0	13
Pattee Pond	739	10,092	0	0	100	0	0	712	0	0	100	0	0
Lovejoy Pond	744	4,432	0	0	100	0	0	324	0	0	100	0	0
Dutton Pond	745	661	0	236	74	0	26	27	0	29	48	0	52
Unity Pond	746	42,286	0	8,117	91	0	18	1,877	0	972	74	0	38
Sandy Pond or Freedom Pond	751	4,169	0	0	100	0	0	430	0	0	100	0	0
Dyer Long Pond	1331	4,085	0	0	100	0	0	392	0	0	100	0	0
Pleasant Pond or Clary Lake	1334	5,764	0	0	100	0	0	467	0	0	100	0	0
Branch Pond	1342	1,669	0	112	94	0	6	302	0	20	94	0	6
Long Pond	1345	6,550	0	0	100	0	0	747	0	0	100	0	0
Turner Pond	1346	359	0	0	100	0	0	145	0	0	100	0	0
Sheepscot Pond	1349	20,846	27,432	0	57	43	0	482	676	0	42	58	0
West Harbor Pond	1361	782	35	31	92	4	4	48	8	8	75	13	12
Damariscotta Pond	1367	12,034	0	115	99	0	1	793	0	43	95	0	5
Damariscotta Lake North Part	1368	44,584	10,450	3,033	77	18	5	1,421	422	225	69	20	11
South Part	1368	23,334	0	0	100	0	0	1,559	0	0	100	0	0
Boyd Pond	1376	463	0	0	100	0	0	50	0	0	100	0	0
Biscay Pond	1379	5,760	1,010	1,561	69	12	19	77	61	115	30	24	46
Pemaquid Pond	1381	26,600	429	1,874	92	2	6	1,261	77	177	83	5	12
Muddy Pond	1382	1,034	0	0	100	0	0	156	0	0	100	0	0
Duckpuddle Pond	1383	3,589	0	0	100	0	0	249	0	0	100	0	0

TABLE III. An evaluation of the ponds with respect to the suitability of temperature and of dissolved oxygen content of the water for trout or salmon during the most critical, late-summer period — Concluded

Name of pond	Pond number	How much of the pond is, and is not, available to trout or salmon during the most critical late-summer period*											
		Volume of water						Area of bottom					
		Acre feet			% of total			Acres			% of total		
		Upper: warm, non-trout, above 70° F.	Middle layer: trout or salmon water	Lower: oxygen deficient, non-trout	Upper: warm, non-trout, above 70° F.	Middle layer: trout or salmon water	Lower: oxygen deficient, non-trout	Upper: warm, non-trout, above 70° F.	Middle layer: trout or salmon water	Lower: oxygen deficient, non-trout	Upper: warm, non-trout, above 70° F.	Middle layer: trout or salmon water	Lower: oxygen deficient, non-trout
McCurdy Pond	1385	3,064	212	153	89	6	5	150	28	29	72	14	14
Webber Pond	1387	3,207	0	83	97	0	3	225	0	28	89	0	11
Medomak Pond	1394	2,328	0	0	100	0	0	228	0	0	100	0	0
Washington Pond	1400	8,416	0	0	100	0	0	581	0	0	100	0	0
Chickawaukie Pond	1409	7,129	0	0	100	0	0	343	0	0	100	0	0
Mirror Lake or Oyster River Pond	1413	1,888	1,066	65	63	35	2	52	46	12	47	42	11
North Pond	1414	5,585	0	365	94	0	6	251	0	75	77	0	23
South Pond	1415	5,442	0	0	100	0	0	517	0	0	100	0	0
Seven Tree Pond	1419	9,856	159	363	95	2	3	394	32	64	80	7	13
Round Pond	1420	2,707	0	130	95	0	5	153	0	31	83	0	17
Crawford Pond	1422	8,629	225	708	90	2	8	502	16	67	86	3	11
Lermond Pond	1423	1,895	0	0	100	0	0	156	0	0	100	0	0
Alford Lake	1424	12,301	0	1,342	90	0	10	345	0	197	64	0	36
Fish Pond	1428	715	0	0	100	0	0	131	0	0	100	0	0
Hobbs Pond	1429	3,053	0	0	100	0	0	278	0	0	100	0	0
Sennebec Pond	1431	8,583	0	323	96	0	4	453	0	58	89	0	11
Quantabacook Pond	1434	9,631	139	649	93	1	6	526	23	63	86	4	10
Stevens Pond	1443	3,398	458	461	79	10	11	282	43	71	71	11	18
St. George Lake	1445	23,137	1,472	90	93	6	1	843	144	30	83	14	3
Megunticook Lake North Part	1449	5,698	787	1,338	73	10	17	339	13	92	76	3	21
South Part	1449	13,953	1,383	471	88	9	3	590	77	109	76	10	14
Norton Pond	1451	1,716	67	965	63	2	35	42	6	64	38	5	57
Pitcher Pond	1454	4,647	0	0	100	0	0	371	0	0	100	0	0
Knight Pond	1455	624	0	0	100	0	0	102	0	0	100	0	0
Tilden Pond	1456	2,516	0	0	100	0	0	343	0	0	100	0	0
Cross Pond	1460	931	0	0	100	0	0	162	0	0	100	0	0
Mixer Pond	1461	479	0	2	99	0	1	33	0	2	94	0	6
Sanborn Pond	1462	1,123	414	444	57	21	22	42	14	31	48	16	36
Dutton Pond	1463	398	0	27	94	0	6	25	0	10	71	0	29
Passagassawaukeag Lake or Randall Pond	1466	1,809	170	92	87	8	5	70	26	22	59	22	19
Swan Lake	1469	29,380	11,225	2,539	68	26	6	722	372	276	53	27	20
Toddy Pond	1478	1,702	0	0	100	0	0	156	0	0	100	0	0

*Based on depths above which water is too warm (above 70° F.) and below which oxygen is deficient (less than 5 p.p.m.) for trout and salmon. Note overlap of the upper, warm-water layer with the lower, oxygen-deficient layer in Unity Pond.

The depth of penetration of the upper, warm-water zone (epilimnion) in each lake (Table I) has been determined from the water analysis data (Table II). The depth of this surface layer of warm water, at the time of the separate analyses, ranged from 15 feet to 35 feet in the 37 lakes which had a distinct thermocline; while this warm-water layer extended to the bottom in the deepest water, to depths ranging from 7 to 40 feet, in the 25 lakes which are so shallow that no thermocline was found in them. (Note that the two parts of Damariscotta Lake are here counted as separate lakes.) Of the 37 lakes which had a thermocline, in seven lakes (Gardiner Pond, Weber Pond, Damariscotta Pond, Round Pond, Mixer Pond, Dutton Pond in Knox, and Toddy Pond) the thermocline was confined to the bottom 5 to 8 feet of the deepest water; i.e., these seven lakes are intermediate between the type (Order 2) with a well defined thermocline and the type (Order 3) with no thermocline. From these observed depths of warm-water penetration, the depths for individual lakes to which this warm water zone would extend by the end of the critical (for salmonid fishes) summer period were estimated (Table I). These estimated depths differed considerably from the depths above which the water was found to exceed 70° F., but they differed little from the depths of the epilimnion in the lakes at the time of analyses (Table II).

These estimated depths of the surface, warm-water zone ranged from 15 feet to 37 feet in the 36 deeper lakes; and to the bottom at depths ranging from 7 feet to 41 feet in the remaining 26 shallower lakes (Damariscotta again counted as two lakes). That the distance to which this warm-water zone extends downward from the surface is dependent upon the size of the particular lake, and therefore upon the severity of wave action, is demonstrated by the following summary for the present group of lakes (those with a thermocline) of the average depths of the epilimnion by late summer in lakes of different areas (the two parts of China and Megunticook lakes here each considered as separate lakes):

18.9 feet in lakes of 35 to 100 acres, average for 7 lakes.
22.8 feet in lakes of 101 to 500 acres, average for 15 lakes.
29.6 feet in lakes of 501 to 1,000 acres, average for 7 lakes.
30.0 feet in lakes of 1,001 to 2,000 acres, average for 6 lakes.
30.7 feet in lakes of over 2,000 acres, average for 3 lakes.

If to the above figures are added corresponding figures (from Cooper, 1941) for lakes of previous Maine surveys in the Saco, Presumpscot, Rangeley, Androscoggin and Kennebec waters, the following average depths of the epilimnion during late summer are obtained:

18.1 feet in lakes of 35 to 100 acres, average for 12 lakes.
19.0 feet in lakes of 101 to 500 acres, average for 54 lakes.
24.9 feet in lakes of 501 to 1,000 acres, average for 18 lakes.
26.8 feet in lakes of 1,001 to 2,000 acres, average for 18 lakes.
29.6 feet in lakes of over 2,000 acres, average for 16 lakes.

The above figures, for lakes in the southwestern quarter of Maine, represent the stratum of surface water which is not available to trout or salmon during late summer because of high temperature. In other words, lakes of given areas must have greater depths than the corresponding figures given above in order to have suitable water for salmonids. The larger the lake, the greater is the depth which is necessary. (Incidentally, the above average figures indicate the depths below which fishermen should fish for trout or salmon during July and August to obtain the best results.) Deep water alone does not ensure good trout and salmon water. The second factor which determines the amount of water available for salmonids is dissolved oxygen; the cold water below the thermocline may, or may not, have sufficient oxygen for these fishes.

Practically no oxygen deficiency, from the standpoint of the oxygen requirements of fishes, was detected by the August analyses in the 25 lakes in which the thermocline was found to extend to the bottom in the deepest water. In other words, these 25 shallow lakes were suitable for fish life at all depths from the standpoint of dissolved oxygen. In the 37 lakes which had a distinct thermocline, no oxygen deficiency was encountered in the surface waters (epilimnion) of any except Unity Pond (1938 analyses). In the deepest water of these 37 lakes oxygen depletion had been extreme in most of them and moderate in a few of them. The lakes which contained a large amount of dissolved oxygen, adequate for fish life, throughout much of the hypolimnion included: Sheepscot Pond, Spectacle Pond, Mirror Lake and Swan Lake. Those which had a moderate amount of oxygen below the thermocline included: China Lake (west part), Damariscotta Lake (north part), St. George Lake, Megunticook Lake, Nequasset Pond, Biscay Pond, Sanborn Pond and Passagassawaukeag Lake. In the remainder of the 37 deeper lakes oxygen deficiency in the deep water was more or less extreme, resulting in generally unfavorable habitats for most fishes and especially for the salmonids. Examples of this extreme oxygen depletion in deep water may be cited in the instances of Togus Pond, Threecornered Pond, Dutton Pond in China, Unity Pond (1938 analyses), Branch Pond, Webber Pond and Alford Lake; in all of these lakes a complete absence of dissolved oxygen (0.0. p.p.m.) was encountered in the deepest samples.

The pH (acid intensity) tests of the water in these 61 lakes had an overall range of 5.7 to 8.1. The exceptional pH values of 8.1 in Threemile Pond in 1940, of 7.6 to 7.4 in Sandy Pond, and of 7.5 to 7.4 in Muddy Pond, were associated with "blooms" of blue-green algae. The pH of 6.4 in Gardiner Pond was exceptionally low for surface water in these lakes. The surface pH (in August) in the remaining 56 lakes (no test made on Fish Pond) ranged from 6.6 to 7.3; the range for 54 of these lakes was 6.7 to 7.2; and the average for the 56 lakes was 6.9. This condition of the pH of surface water being close to neutrality during mid-summer is quite typical of lakes of southwestern Maine, judging from results of the present and previous lake surveys. In the 25 shallow lakes there was little difference between the pH of surface and of bottom waters. In most of the 37 deeper lakes in which the maintenance of a thermocline presumably allowed the accumulation of carbon dioxide in the deepest water, the pH of bottom waters was invariably lower (average about 0.9 pH unit lower) than of surface waters. In the deeper water below the thermocline of 36 lakes the minimum pH values ranged from 5.7 to 6.5, and averaged 6.0. A somewhat unusual vertical distribution of pH was recorded for several of the lakes, in which the pH was lower at intermediate levels than at or near the bottom. This increase in pH with increase in depth was most striking in Passagassawaukeag, Pemaquid, McCurdy, North and Stevens ponds, and occurred to a lesser extent in Alford, Branch, Dutton (P.745), Weber and Threecornered ponds.

In the following summary of the types of lakes represented by the 61 lakes and ponds of the present survey, the two parts of China, Damariscotta and Megunticook lakes are here considered as separate bodies of water. This is done both for the sake of convenience and because these lakes are very large, and even though, in each case, the two parts are broadly joined by an area with essentially lake conditions. The resultant 64 bodies of water may be grouped on the basis of their depth, temperature and dissolved oxygen into the following five categories:

1. Deep water, with a considerable volume of water below the thermocline. No oxygen deficiency, or almost none; i.e., with more than 5 p.p.m. of dissolved oxygen in most or all of the deep water .... 4 lakes and ponds
2. Deep water, with a considerable volume of water below the thermocline. Partial oxygen deficiency; i.e., with more than 5 p.p.m. of dissolved oxygen in from ½ to ¾ of the deep water .... 6 lakes and ponds
3. Deep water, with a considerable volume of water below the thermocline. Extreme oxygen deficiency; i.e., with less than 5 p.p.m. of dissolved oxygen in most or all of the deep water .... 7 lakes and ponds

4. Sufficient depth of water to maintain a thermocline, but thermocline confined to bottom water or else restricted to a very limited area. This type of lake, for all practical purposes, should be considered as the shallow, warm-water type .... 21 lakes and ponds
5. Water warm to the bottom at all depths; i.e., no thermocline during late summer .... 26 lakes and ponds

The above grouping has involved certain difficulties in that a graded series has been divided into groups without recognizing intermediate cases. The difficulty has been mostly overcome by the recognition of group "4" for lakes intermediate between the shallow type with no thermocline and the deep type with well defined thermocline and extensive hypolimnion.

Depth, temperature and dissolved oxygen are here considered to be the most important factors in determining the suitability of each lake for different types of fishes. Therefore, the grouping given in the preceding paragraph has been used in a classification of the lakes and ponds as to the kinds of game fishes for which they are best suited. This following classification is based on the relative amounts of water volume and bottom area within the "trout or salmon zone" during late summer.

Excellent trout or salmon water, with at least 40 per cent of the entire volume of the lake within the trout or salmon zone; 2 ponds: Spectacle Pond and Sheepscot Pond. Total area of these two ponds is 1,297 acres.

Good trout or salmon water, with from 25 to 40 per cent of the water volume within the trout or salmon zone; 2 lakes: Mirror Lake and Swan Lake. Total area of these lakes is 1,480 acres.

Fair trout or salmon water, with from 10 to 25 per cent of the water volume within the trout or salmon zone; 8 lakes and ponds: Nequasset Pond, China Lake (west part), Damariscotta Lake (north part), Biscay Pond, St. George Lake, Megunticook Lake, Sanborn Pond and Passagassawaukeag Lake. Total area of these lakes is 6,854 acres.

Bass, perch or pickerel waters, i.e., with very little or no water suitable for trout or salmon; 51 lakes and ponds: Gardiner Pond, Togus Pond, Little Togus Pond, Threecornered Pond, Weber Pond, Dam Pond, Tolman Pond, Threemile Pond, China Lake (east part), Pattee Pond, Lovejoy Pond, Dutton Pond (P.745), Unity Pond, Sandy Pond, Dyer Long Pond, Pleasant Pond or Clary Lake, Branch Pond, Long Pond, Turner Pond, West Harbor Pond, Damariscotta Pond, Damariscotta Lake (south part), Boyd Pond, Pemaquid Pond, Muddy Pond, Duckpuddle Pond, McCurdy Pond, Webber Pond, Medomak Pond, Washington Pond, Chickawaukie Pond, North Pond, South Pond, Seven Tree Pond, Round Pond, Crawford Pond, Lermond Pond, Alford Lake, Fish Pond, Hobbs Pond, Sennebec Pond, Quantabacook Pond, Stevens Pond, Norton Pond, Pitcher Pond, Knight Pond, Tilden Pond, Cross Pond, Mixer Pond, Dutton Pond (P.1463) and Toddy Pond. Total area of these lakes is 23,941 acres.

It should be noted that this classification according to the types of game fishes for which each lake is best suited is based on, but not the same as, the classification given in the preceding paragraph. For examples: the 4 lakes with little oyxgen deficiency include the 2 "excellent" trout or salmon lakes and the 2 "good" ones; and the 51 "bass, perch, or pickerel waters" include all of groups "4" and "5" and part of group "3". The status of some of the lakes, in connection with the above classification, merits further comment. The distinction between "excellent" trout and salmon water and "good" trout and salmon water is entirely relative, based on the percentage of trout and salmon water as compared to the total volume of water in the lake. Since the classification is based on percentages, it does not represent differences in actual volume of water or the extent of suitable habitat; and it might appear that the resultant discrepancies partially invalidate the present classification. For Spectacle Pond, as an example, the amount of water contained in the "trout" zone was calculated to be 2,158 acre-feet (54%), whereas for the much larger Swan Lake the corresponding figure was 11,225 acre-feet (26%). Even though Swan Lake had over five times as much "good trout water" as did Spectacle Pond, the latter is here regarded as the "better" trout pond because it rates higher on a percentage basis.

The lakes and ponds in the above category of *"fair trout or salmon water"* may be regarded as the problem waters from the standpoint of stocking. China and Damariscotta lakes are large bodies of water, each almost completely divided into two lakes, and each with fairly good trout or salmon water confined to one part. The problem is whether these two lakes should be regarded as trout or salmon waters on the basis of the fact that half of each is suitable for these fishes, or whether each lake should be considered as bass, perch or pickerel water in its entirety; a program of stocking salmonids in one part of each lake, while favoring warm-water game fishes in the other part, can not be regarded as a reasonable procedure, and would not be in accordance with the management programs recommended in previous lake surveys in Maine. Biscay and Sanborn ponds are among the better of the eight "fair trout or salmon ponds," while Nequasset and Passagassawaukeag approach marginal conditions for salmonids.

Of the eight lakes in the category of "fair trout or salmon water," Megunticook Lake and St. George Lake more closely approach marginal conditions for salmonids. The decision to retain these two lakes in the category of "trout waters," rather than to list them as "bass, perch, or pickerel waters," has been based on three pertinent facts: (1) both lakes support populations of salmonids, as evidenced by fishing returns and by the results of survey gill netting; (2) both lakes are large, so that the amount of suitable trout water is large even though it represents a small percentage; and (3) there are relatively few good trout or salmon lakes in the section of the state concerned in this report, and it is desirable to have as much trout and salmon fishing as possible in this group of lakes among which bass, perch or pickerel waters are decidedly in the majority.

Among the 51 lakes listed above as *"bass, perch, or pickerel waters,"* several are either very shallow throughout, or are mostly shallow and with vegetation very abundant; these lakes are better adapted to Common Pickerel than to Small-mouthed Bass and White Perch. These "pickerel waters" include Little Togus Pond, Sandy Pond, Dyer Long Pond, Pleasant Pond or Clary Lake, Branch Pond, Turner Pond, Muddy Pond, Medomak Pond, Fish Pond, Knight Pond, Tilden Pond, Cross Pond, and Dutton Pond in Knox.

The area of the present survey (in Waldo, Knox, Lincoln, Kennebec and Sagadahoc counties) has relatively fewer good trout and salmon lakes, and a smaller acreage of such waters, than were found during the 1940 survey in the Androscoggin and Kennebec drainages or during the 1938 survey in the Sebago Lake and Saco River areas. This difference may be seen in the following summary:

Area	Trout or salmon lakes		Bass, perch, or pickerel lakes	
	Number	Total area	Number	Total area
1941 Survey	12	9,631 acres	51	23,941 acres
1940 "	27	21,573 "	26	37,839 "
1938 "	14	11,414 "	16	7,466 "

The classification of the present group of 61 lakes into 12 trout and salmon lakes and the remainder as bass, perch or pickerel waters is the basis for our recommendations on stocking and other management given in a later section (see page 171).

NOTES ON PHOSPHORUS IN MAINE LAKES SURVEYED DURING 1941

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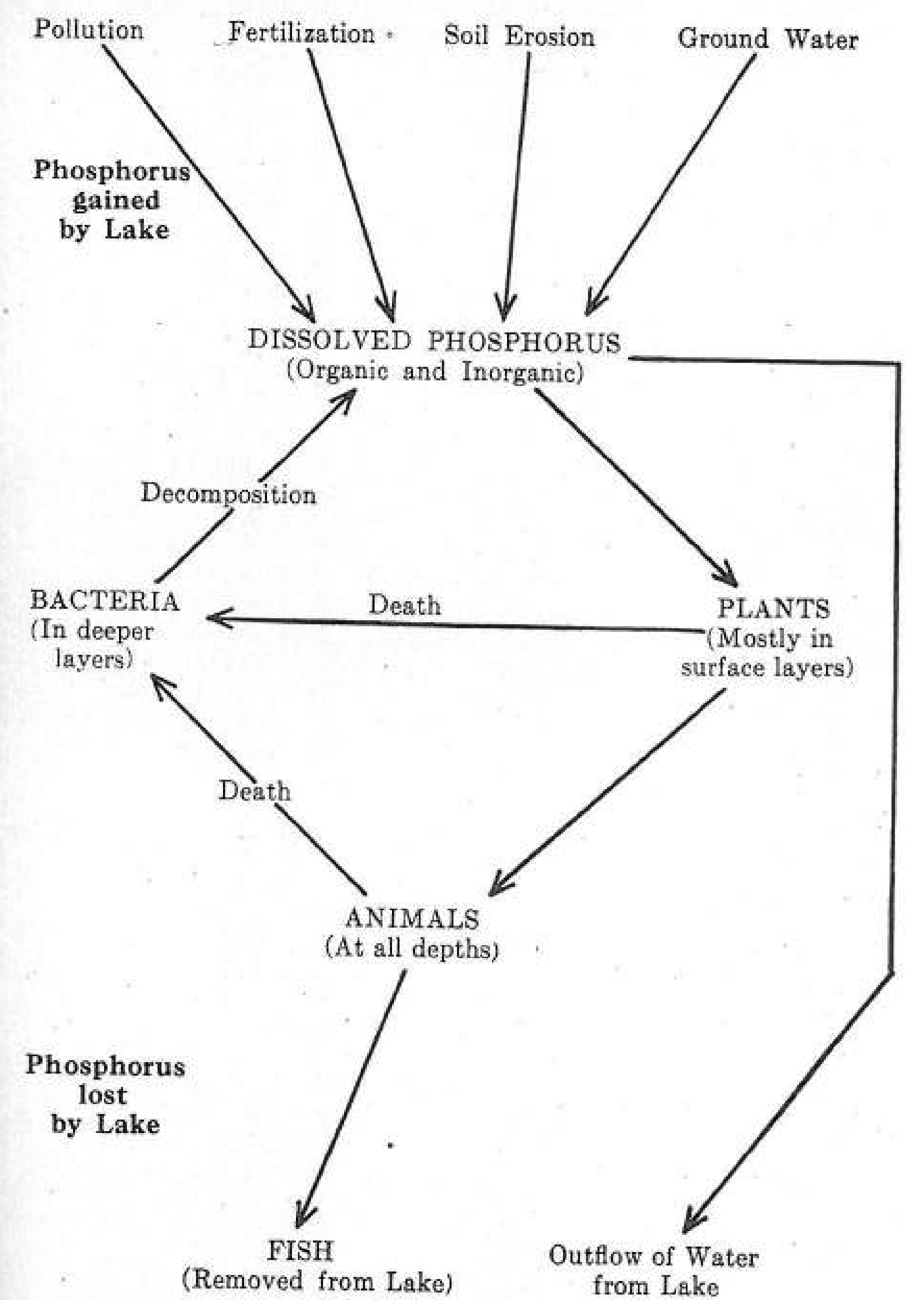
During the summer of 1941 phosphorus analyses were made on the majority of the lakes and ponds studied by the survey. Such analyses have seldom been done as a routine fisheries survey procedure, since they are time consuming and require facilities not always available in the field. Studies in the State of Connecticut[3] have shown a definite correlation between the total phosphorus content of a lake and its productivity. The reason for this may be simply explained. The plant life of a lake, like the plant life of a cultivated field, is dependent upon a balanced supply of mineral nutrients. The most important of these are potassium, nitrogen and phosphorus. If any one of these is deficient, the growth of plants in the lake will be limited. Since phosphorus is generally scanty in natural waters it is reasonable to assume that a lack of this element will frequently be the chief factor limiting plant production. The plants, particularly the minute floating plants of the plankton, serve as food for the crustacea upon which young game fish and forage fishes feed. Theoretically it is possible that there should be a relation between the growth of game fish and the abundance of phosphorus. Of course there are other factors influencing fish production, and a lake may not produce well even though phosphorus is abundant. It does not appear possible, however, that a lake deficient in phosphorus or other basic fertilizers could ever support a heavy population of fish.

In natural waters there is a cycle of phosphorus which continuously restores some of that used up by organisms. The diagram (on the following page) of the phosphorus cycle in lakes, adapted in part from Deevey and Bishop, summarizes our knowledge of the factors concerned.

It will be noted that not all of the phosphate is retained within the lake, and that if the rate of outgo exceeds that of input the lake will lose in basic fertility. A 100-acre pond averaging 20 feet in depth will contain only 109 pounds of phosphorus if the concentration is

[3] Deevey, E. S. and J. S. Bishop. 1941. Section on Limnology *in* A Fishery Survey of Important Connecticut Lakes. *Bull. No. 63, State of Conn., Geol. Nat. Hist. Survey.*



20 parts per billion which is above the average of the lakes studied. No accurate figures are available to tell how the balance is shifting, but when phosphorus intake is low, there is little doubt that the loss of fertility from removal of fish and other organisms is serious. In some parts of the country artificial fertilization has been used to restore productivity of ponds used for fish rearing.[4,5] Experience has shown that under some conditions this is a cheap and efficient way of raising bass, bluegill and similar pondfish. Juday and coworkers[6] found an increase in the growth rate of Small-mouthed Bass and Yellow Perch in a small, land-locked lake following fertilization with soybean meal. Extensive fertilization of large bodies of water would be expensive, and is unlikely in Maine which has more acres of fishing waters than many states. The fishing load is not evenly distributed, however, and heavily fished waters may be depleted rather rapidly. In such cases, it might prove more economical to restore minerals to the water and promote natural growth, rather than to increase the stocking program. Even if fertilization is not practiced, the knowledge of the potential productivity of a lake may aid in its management for fishing.

Method. Analyses of phosphorus were made by the method of Farber and Youngburg[7] with oxidation of organic matter according to the method of Youngburg and Youngburg.[8] A 175-c.c. sample is evaporated with sulfuric acid until the acid begins to fume. The organic matter is oxidized with 30 per cent hydrogen peroxide. After diluting the sample with phosphate-free water, sodium molybdate in acid solution is added. The addition of stannous chloride causes the formation of a blue color, the depth of which is proportional to the amount of phosphorus present. The color is compared with that of a standard phosphorus solution in a Dubosq colorimeter. All analyses were made on total phosphorus, and included that present in plankton as well as that dissolved in the water. Some trouble was found in decolorizing the more deeply stained waters, and values below 5 parts per billion were difficult to judge under lighting conditions in the field laboratory. They are reported as traces.

Results. The results of phosphorus analyses are given along with other water-analysis data in Table II. Analyses were made on all ponds, but experimental difficulties forced the discarding of a considerable number of tests. In many cases it would have been desirable to run additional confirmatory analyses, but the factor of time made this impossible. Insofar as the data permit, an effort has been made to average the results of the tests on each pond, with allowance for the volume of water at each depth. The values range from 7.4 p.p.b. in St. George Lake to 67.5 p.p.b. in Sandy Pond. The larger and deeper lakes, with the exception of China Lake, average lower in phosphorus than do the shallow and small ponds. The mean phosphorus concentration in 57 lakes and ponds is 15 p.p.b. which is almost exactly that reported in Connecticut, although 50 per cent lower than the average reported for the Connecticut lowland area.

Phosphorus and Productivity. An attempt has been made graphically to correlate the plankton production with the phosphorus concentration in each lake. No agreement has been found between phosphorus and the volume of net plankton, or phosphorus and the number of phytoplankton organisms caught in the net. The correlation coefficient between phosphorus and plankton volume by the method of rank differences is 0.11. Statistically this indicates no significant relation. There are three possible reasons for the lack of agreement: (A) The data on phosphorus are not as complete or as accurate as is desirable. (B) The net plankton does not include a considerable volume of microorganisms which pass through its meshes. (C) The phosphorus content of the lakes in this area may not be the limiting factor in productivity. It is possible, however, that measures of chlorophyll production such as were used in the Connecticut Survey would have yielded a significant correlation.

It is planned to continue and extend this work during the summer of 1942, in an effort to determine the value of the procedure in fisheries survey work.

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[4] Smith, E. V. and Swingle, H. S. 1939. *Trans. Am. Fish. Soc., Vol. 69, pp. 257-262.*

[5] Viosca, Percy Jr. 1937. Pondfish Culture. *The Pelican Publishing Company, New Orleans.*

[6] Juday, C., C. L. Schloemer, and C. Livingston. 1938. *Prog. Fish. Cult. No. 40, pp. 24-27.*

[7] Farber and Youngburg, 1932. *Jour. Ind. Eng. Chem., Anal. Ed., Vol. 4, p. 107.*

[8] Youngburg and Youngburg, 1930. *Jour. Lab. Clin. Med., Vol. 16, p. 158.*

PLANKTON OF THE LAKES AND PONDS

By Harry A. Goodwin

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The biotic community of a lake or pond contains a complex association of animals and plants that is collectively called plankton. The plankton consists of minute organisms which are free living in the water and have such weak powers of locomotion that they are unable to make headway against currents. They range from those of microscopic size up to those which attain a tenth of an inch or more in length. According to whether or not they will pass through the openings of number twenty silk bolting cloth (6,000 meshes to the square centimeter), of which the plankton net is constructed, they are arbitrarily split into net plankton and nannoplankton; net plankton includes those organisms which are retained in the plankton net. For convenience, the net plankton is divided into macroplankton and microplankton: the two groups of crustaceans, copepods and cladocerans, are referred to as macroplankton, because of their large size; and all other net plankton, as the microplankton.

The plankters occupy an important position in the food chain of game fishes; and their abundance determines, to a large degree, the fish-producing capacity of any lake. The abundance and growth of fish in a lake or pond are controlled by the amount of food which is furnished during the growing season. Therefore, natural food must be present in the lake in sufficient abundance at all times if a substantial population of fish is to be maintained. It must be capable of reproducing itself abundantly throughout the year, and most especially in the spring and early summer to furnish a ready source of food for the multitudes of young fish that hatch during this time of year. The water fleas (macroplankton) meet these conditions admirably. They are, almost without exception, utilized by the newly hatched fry of all fishes. They are also used as food by such organisms as insect larvae, smelts and minnows, which in turn serve as food for the larger fishes. Water fleas are also fed upon by the adults of the Smelt, minnows, alewives, lake herring, and whitefish; and even voracious fishes such as bass and trout feed to some extent on the larger forms of water fleas.

If the water fleas are to multiply in sufficient numbers to feed the fish, they must themselves have a sufficient supply of food. This

they obtain in the form of the smaller microplankters which are mostly plants. By eating and digesting these plant forms, the water fleas convert large amounts of vegetable matter into available animal tissue which is more readily used by, and is far more nourishing to, most fishes. The plant forms are able to synthesize their food, in the presence of light, from gases and soluble inorganic materials present in the water. There is thus a complex food chain from the dissolved inorganic substances in the water to the adult game fishes.

From the standpoint of available fish food the plankton population is very irregular; it varies in abundance according to conditions of light, nutrition, predation and water temperature. In late summer during periods of sustained heat many of the forms multiply so rapidly that they cause "blooms"; and "blooms" of plant plankton may often so deplete the water of oxygen at night that a serious mortality of fish results. In Maine lakes "blooms" of *Ceratium, Synura, Micratinium, Ulothrix, Anabaena* and *Nostoc* have been encountered. In general, the yearly cycle of abundance of plankton may be represented by a graph having two maxima and two minima; the peaks of maximum abundance usually appear in the spring and in the fall, and the periods of least abundance occur during the summer and during the winter. Also, the maximum abundance of the plankton population in any lake or pond occurs in the upper few feet of water. These phenomena of plankton abundance must be taken into consideration in evaluating the production of plankton in a lake from a single series of samples.

The following account of the plankton of the present group of lakes and ponds is based upon samples collected with a Birge Closing Net (of number twenty silk bolting cloth) during the last half of the month of August in 1941. In most lakes and ponds samples were taken at only one location, and on only one day. Two hauls were made between each of the following depth strata: from 15 feet to the surface, 35 feet to 15 feet, 75 feet to 35 feet, and from the bottom up to 75 feet. The depth range of the deepest haul depended upon the depth of the lake. The locations of the sites where plankton samples were taken are described in Table IV and are indicated by the symbol ⊗ on Figures 1 to 59. The plankton net was hauled vertically through the desired depth stratum at a rate of approximately one meter per two seconds, and the efficiency factor of the net was assumed to be 1.2;[9] the theoretical volume of water was multiplied by 1/1.2 to obtain a figure on the volume of water which actually passed through the net. The samples were preserved separately, according

[9] The efficiency factor of 1.2 for this type of net hauled at the rate of one meter per two seconds was given by Kemmerer, Bovard, and Boorman, 1923; page 65.

TABLE IV. The average numbers of different types of plankters, and the average volumes of all plankton, per cubic foot of lake water within different depth strata in the lakes and ponds, as calculated from survey collections

Name of lake or pond	Date: 1941 Time: A=A.M. P=P.M. M=Noon	Depth range of sample in feet	Average vol. of plankton per cu. ft. of lake water, in c.c.	Average number of plankton organisms per cu. foot of lake water									
						In thousands — add ,000							
				Copepoda (water fleas)	Cladocera (water fleas)	Rotifera	Protozoa	Zoophyta	Desmidiaceae (desmids)	Chlorophyceae (other green algae)	Bacillarieae (diatoms)	Myxophyceae (blue-green algae)	All plankters
Nequasset	Aug. 16 3:15 P	15–0 35–15 55–35	0.19 0.14 0.07	280 273 75	19 4 ..	19 4 7	.. .. ..	.. .. ..	.. .. ..	9	9 60 14	.. .. ..	38 64 21
Gardiner	Aug. 17 3:00 P	15–0	0.71	1,611	427	5	81	..	..	..	71	38	196
Togus	Aug. 18 11:00 A	15–0 35–15	0.24 0.04	593 185	246 14	.. ..	.. ..	.. ..	.. ..	.. 4	.. ..	228 28	228 32
Little Togus	Aug. 18 1:30 P	15–0	0.62	882	204	..	..	..	..	57	47	..	105
Threecornered	Aug. 18 3:30 P	15–0	0.24	522	95	5	52	..	..	5	114	..	176
Weber (P. 688)	Aug. 19 10:45 A	15–0 25–15	0.47 0.21	1,213 319	649 248	9 ..	19 ..	.. ..	.. ..	.. ..	9 21	57 14	97 36
Spectacle	Aug. 18 1:30 P	15–0 35–15 75–35 95–75	0.71 0.14 0.05 0.07	337 479 160 135	242 18 11 11	5	.. 11 4 4	.. ..	.. ..	19	.. .. 5 ..	5	29 11 9 4
Dam	Aug. 18 12:15 P	15–0	0.38	578	28	24	24	..	5	33	19	..	105
Tolman	Aug. 18 9:15 A	15–0	0.28	787	71	24	24	..	..	28	14	..	91
Threemile	Aug. 19 1:30 P	15–0 34–15	0.24 0.14	1,048 368	403 82	9 ..	38 5	.. ..	.. ..	19 ..	24 41	5 ..	96 46
China West Part	Aug. 15 11:45 A	15–0 35–15 75–35	0.43 0.10 0.04	934 375 334	403 89 7	5 4 4	5 7 ..	.. .. ..	5	5	156 42 4	.. 4 ..	177 57 7
East Part	Aug. 15 3:00 P	15–0 35–15	0.19 0.07	574 1,430	308 142	.. ..	9 ..	.. ..	.. ..	.. ..	24 7	.. ..	34 9
Pattee	Aug. 16 1:00 P	15–0	0.47	312	943	19	14	..	14	284	24	806	1,163
Lovejoy	Aug. 16 11:00 A	15–0 25–15	0.43 0.28	1,275 206	484 149	.. ..	28 7	.. ..	.. ..	142 50	142 262	9 ..	324 319
Dutton (P. 745)	Aug. 28 4:15 P	15–0 25–15	0.52 0.21	849 170	261 36	.. 7	28 7	.. ..	.. ..	14 7	190 78	.. ..	233 99
Unity	Aug. 23 12:45 P	15–0 35–15	0.43 0.07	545 121	782 46	14 ..	5 ..	.. ..	.. ..	9 11	95 28	14 ..	139 39
Sandy	Aug. 23 9:00 A	5–0	17.10	1,226	257	..	..	..	29	86	..	8,123	8,238
Dyer Long	Aug. 23 11:00 A	12–0	0.60	1,297	405	36	12	..	..	48	321	..	418
Pleasant	Aug. 23 9:30 A	15–0	0.38	545	360	24	..	..	5	5	..	5	39
Branch	Aug. 19 3:15 P	15–0 35–15	0.14 0.04	308 46	24 ..	.. ..	33 4	.. ..	.. ..	5 ..	5 7	14 18	27 28
Long	Aug. 15 4:15 P	13–0	0.87	946	870	22	43	87	11	33	11	11	219
Turner	Aug. 28 1:00 P	4–0	1.79	3,142	1,571	71	357	36	..	..	286	..	754
Sheepscot	Aug. 15 9:30 A	15–0 35–15 75–35 120–75	0.47 0.28 0.11 0.13	379 117 164 507	166 25 2 3	.. ..	43 11	38 11 4 6	.. ..	.. ..	90 61 9 3	14 4 .. 3	185 85 12 13
West Harbor	Aug. 16 10:45 A	15–0 25–15	1.33 0.28	967 333	389 71	5 ..	1,014 92	.. ..	.. ..	.. ..	.. 7	.. ..	1,021 100

TABLE IV. The average numbers of different types of plankters, and the average volumes of all plankton — Continued

Name of lake or pond	Date: 1941 Time: A=A.M. P=P.M. M=Noon	Depth range of sample in feet	Average vol. of plankton per cu. ft. of lake water, in c.c.	Average number of plankton organisms per cu. foot of lake water									
				*		In thousands — add ,000							
				Copepoda (water fleas)	Cladocera (water fleas)	Rotifera	Protozoa	Zoophyta	Desmidiaceae (desmids)	Chlorophyceae (other green algae)	Bacillarieae (diatoms)	Myxophyceae (blue-green algae)	All plankters
Damariscotta Pond	Aug. 21 1:30 P	15–0 30–15	0.47 0.24	275 100	66 62	14 9	33 9	. . . .	. . . .	. . 47	194 218	. . . .	242 286
Damariscotta Lake North Part	Aug. 21 9:15 A	15–0 35–15 75–35 90–75	0.95 0.39 0.07 0.05	199 50 141 71	43 32 9 38	47 4 2 . .	9 14 . . 5	. . 7	. . 4 2 . .	260 60 2 . .	237 160 16 14	9 4	564 252 21 19
South Part	Aug. 21 12:00 M	15–0 35–15	0.57 0.18	38 75	24 11	38 4	19 11	. . . .	. . . .	194 50	147 167	. . . .	398 231
Boyd	Aug. 26 3:15 P	15–0	0.24	1,071	19	33	5	. .	. .	62	9	. .	110
Biscay	Aug. 25 10:45 A	15–0 35–15 55–35	0.57 0.14 0.07	483 56 181	156 18 7	5	47 4 7	 4	. . . . . .	28 . . 4	251 96 11	5	337 99 25
Pemaquid North Part	Aug. 25 4:45 P	15–0 35–15	0.57 0.07	920 170	327 18	5 4	5 4	. . . .	. . . .	5 . .	9 11	19 . .	44 18
South Part	Aug. 26 10:15 A	15–0 35–15 55–35	0.62 0.11 0.11	716 82 53	* 379 21 11	5	. . . . . .	 7	5	. . . . . .	24 11 . .	14 . . 4	48 11 11
Muddy	Aug. 27 1:30 P	8–0	6.23	356	409	. .	. .	. .	. .	. .	. .	676	677
Duckpuddle	Aug. 27 5:15 P	15–0	0.38	749	180	9	5	. .	. .	5	119	24	162

McCurdy	Aug. 25 2:30 P	15–0 35–15	0.57 0.11	289 50	175 107	. . 7	5 4	. . . .	9 4	66 7	24 . .	5 . .	109 22
Webber (P. 1387)	Aug. 25 2:45 P	15–0 25–15	0.76 0.21	488 184	313 28	. . 14	38 7	. . . .	14 7	28 . .	9 . .	5 . .	87 29
Medomak	Aug. 21 4:00 P	15–0	0.47	659	374	5	9	. .	9	5	379	. .	409
Washington	Aug. 20 5:30 P	15–0 30–15	0.47 0.09	318 38	52 14	. . . .	5 . .	. . . .	5 5	. . 5	33 5	5 9	48 24
Chickawaukie	Aug. 25 12:15 P	15–0 25–15	0.33 0.14	574 284	417 121	9 14	14 . .	. . . .	. . . .	. . . .	81 21	9 . .	115 36
Mirror	Aug. 27 2:45 P	15–0 35–15 60–35	0.09 0.11 0.06	. . 50 88	. . . . . .	. . . . . .	9 7 . .	. . . . . .	. . . . . .	. . . . . .	. . 4 6	 3	9 11 9
North	Aug. 25 9:00 A	15–0 35–15	0.14 0.07	370 618	393 46	5 7	66 4	. . . .	. . . .	. . . .	47 4	. . . .	119 15
South	Aug. 25 10:45 A	15–0	0.09	251	28	28	14	. .	. .	. .	9	. .	52
Seven Tree	Aug. 22 2:30 P	15–0 35–15	0.24 0.07	185 128	261 160	9 . .	9 . .	. . . .	. . . .	. . . .	299 60	. . . .	318 61
Round	Aug. 28 11:45 A	15–0	0.24	166	242	19	147	. .	. .	24	237	. .	427
Crawford	Aug. 22 12:00 M	15–0 35–15 50–35	0.28 0.07 0.05	654 283 52	265 74 5	19	. . . . . .	. . . . . .	14	5	194 32 5	5	238 32 5
Lermond	Aug. 22 10:00 A	15–0	0.24	1,536	152	14	14	. .	. .	38	28	. .	96
Alford	Aug. 22 12:15 P	15–0 35–15 70–35	0.28 0.21 0.06	474 287 76	95 103 6	. . 4 . .	38 124 16	. . . . . .	. . 14 2	5 11 . .	62 18 2	. . . . . .	105 170 20
Fish	Aug. 22 3:30 P	8–0	1.05	2,782	35	70	438	. .	18	18	70	. .	615

TABLE IV. The average numbers of different types of plankters, and the average volumes of all plankton — Concluded

Name of lake or pond	Date: 1941 Time: A=A.M. P=P.M. M=Noon	Depth range of sample in feet	Average vol. of plankton per cu. ft. of lake water, in c.c.	Copepoda (water fleas)	Cladocera (water fleas)	Rotifera	Protozoa	Zoophyta	Desmidiaceae (desmids)	Chlorophyceae (other green algae)	Bacillarieae (diatoms)	Myxophyceae (blue-green algae)	All plankters
				Average number of plankton organisms per cu. foot of lake water									
						In thousands — add ,000							
Hobbs	Aug. 22 2:15 P	15–0	0.47	697	337	..	19	..	5	190	119	5	338
Sennebec	Aug. 22 9:45 A	15–0 35–15 45–35	0.28 0.14 0.14	1,242 412 298	384 60 36	.. 4 ..	.. .. ..	 14	.. .. ..	5 14 ..	199 138 57	 7	206 157 78
Quantabacook	Aug. 19 2:45 P	15–0 35–15 45–35	0.38 0.11 0.14	379 96 106	199 25 57	19	19 4 ..	.. .. ..	.. .. ..	9	9	9 11 ..	67 14 0
Stevens North Part	Aug. 19 8:15 A	15–0 30–15	0.57 0.19	976 773	247 62	5 5	19 9	.. ..	.. ..	33 5	341 152	.. 5	399 176
South Part	Aug. 19 10:00 A	15–0 25–15	0.76 0.21	403 50	76 14	28 21	.. ..	.. ..	.. ..	19 ..	237 92	.. ..	285 114
St. George	Aug. 15 1:15 P	15–0 35–15 55–35	1.19 0.50 0.18	1,142 277 3,844	270 57 53	.. .. ..	33 11 21	.. .. ..	.. .. ..	242 78 ..	62 18 14	.. .. ..	338 107 39
Megunticook North Part	Aug. 20 12:15 P	15–0 35–15 55–35	0.24 0.11 0.04	597 305 138	142 50 36	.. 4 4	14 7 ..	.. .. ..	.. .. ..	.. .. ..	81 28 18	.. .. ..	96 39 22
South Part	Aug. 20 2:15 P	15–0 35–15 55–35	0.43 0.11 0.04	199 138 25	109 46 4	.. 4 ..	14 11 7	.. .. ..	5	9 7 ..	38 25 ..	9	76 46 7

Name of lake or pond	Date: 1941 Time: A=A.M. P=P.M. M=Noon	Depth range of sample in feet	Average vol. of plankton per cu. ft. of lake water, in c.c.	Copepoda (water fleas)	Cladocera (water fleas)	Rotifera	Protozoa	Zoophyta	Desmidiaceae (desmids)	Chlorophyceae (other green algae)	Bacillarieae (diatoms)	Myxophyceae (blue-green algae)	All plankters
Norton	Aug. 20 9:30 A	15–0 35–15 45–35	0.38 0.07 0.07	540 249 135	265 75 43	5 4 7	 7	.. .. ..	.. .. ..	33 4 ..	280 28 28	5	293 36 43
Pitcher	Aug. 21 11:45 A	15–0 35–15	0.19 0.07	228 142	71 284	5 ..	.. 7	.. ..	.. ..	9 ..	43 138	5 4	62 150
Knight	Aug. 21 1:30 P	8–0	0.35	1,067	88	35	53	..	..	..	18	..	106
Tilden	Aug. 21 9:15 A	8–0	0.18	245	..	105	18	..	..	..	18	..	140
Cross	Aug. 27 10:00 A	15–0	0.62	1,081	62	62	125	..	..	..	..	..	188
Mixer	Aug. 29 11:45 A	15–0 25–15	0.28 0.14	706 177	190 425	5 ..	9 64	.. 7	19 7	24 14	5 21	.. ..	63 114
Sanborn	Aug. 19 12:00 M	15–0 35–15 60–35	0.19 0.07 0.09	294 188 256	152 .. 77	14 4 3	.. .. ..	.. .. ..	.. .. ..	14	57 7 12	.. 4 ..	86 14 15
Dutton (P. 1463)	Aug. 21 4:00 P	15–0	0.43	574	90	..	62	..	..	..	5	..	67
Passagassawaukeag	Aug. 20 5:00 P	15–0 35–15	0.28 0.11	493 78	322 43	5 ..	.. 4	.. ..	5 ..	24 7	19 22	19 4	72 36
Swan	Aug. 20 10:45 A	15–0 35–15 75–35	0.19 0.11 0.04	569 181 121	71 75 32	33 4 2	9 4 ..	.. .. ..	.. .. ..	 2	.. 7 ..	.. .. ..	43 14 4
Toddy	Aug. 20 3:15 P	15–0	0.71	246	71	..	33	..	9	14	142	14	214

TABLE V. The average numbers of different types of plankters, and the average volumes of all plankton, per cubic foot of lake water within different depth strata of the lakes combined, during the last half of August in 1941

Figures given in this table are averages of all data given in Table IV

Depth range in feet	Average volume of plankton per cu. ft. of lake water, in c.c.	Average number of plankton organisms per cu. ft. of lake water									
				In thousands, add ,000							
		Copepoda (water fleas)	Cladocera (water fleas)	Rotifera	Protozoa	Zoophyta	Desmidiaceae (desmids)	Chlorophyceae (other green algae)	Bacillariae (diatoms)	Myxophyceae (blue-green algae)	All plankters
15–0	0.81	699	264	14	49	2	3	33	85	154	341
35–15	0.15	243	74	3	14	0	1	9	50	3	78
75–35	0.08	347	22	2	3	2	0	0	11	0	19
120–75	0.08	257	14	0	3	2	0	0	5	1	12

to depth range and lake, in five per cent formalin. These samples were analyzed in the laboratory on both qualitative and quantitative bases. To facilitate the calculations, each field sample was diluted or condensed to 100 c.c. The total volume of plankton in the sample was measured, by "settling" for at least twenty-four hours, in a glass graduate with a tapered bottom. Readings were made to the nearest 0.1 c.c., and were taken to the top of the mass of plankton as it had settled to the bottom of the tube. Counts were made of the microplankton in a Sedgwick-Rafter cell (50 x 20 x 1 mm.). A single one-c.c. sample was taken from the field sample which had been thoroughly mixed by blowing into it through a pipette. Ten separate counts were made of the organisms in one cubic millimeter, giving a total count on 0.01 c.c. of the sample. Macroplankters were counted in a cell of 63 x 8 x 2 mm.; and counts were made on the total number of water fleas in ten of these one-c.c. samples. These volumes and numbers were used in calculating the average volume of all plankton, the average numbers of different types of plankters, and the average numbers of all plankters, per cubic foot of lake water within the different depth strata of each lake. The data are given for each lake individually in Table IV, and are averaged for all of the lakes and ponds combined in Table V. The figures on average number and average volume per cubic foot of water are averages for the range in depth through which the samples were taken; they do not

reveal probable differences in concentration of plankton within each stratum. Identifications of the plankton organisms were made mostly to genera, and records of the occurrence of different genera are based on those organisms encountered while making the sample counts.

The organisms as enumerated from the samples represented nine major taxonomic groups of animals and plants. These groups and the important genera, together with some of the species of water fleas, are considered in the following (generic names follow Ward and Whipple, 1918; and Smith, 1933):

Copepoda. The copepods, commonly called water fleas, are an important source of food for fish in fresh-water lakes and ponds. The important species encountered in the samples were *Diaptomus pallidus* Herrick, *Cyclops leuckarti* Claus, and *Cyclops viridis* Jurine. *D. pallidus* and *C. leuckarti* were common forms in most of the samples, while *C. viridis* was only rarely found. In some samples the immature forms of copepods (nauplii) were extremely abundant.

Cladocera. Along with the preceding group, the cladocera comprise the macroplankton or water fleas. This group provided a great number of species representing several genera. The species encountered in the samples were *Diaphanosoma brachyurum* (Lieven), *Daphnia pulex* (de Geer), *Daphnia pulex* var. *obtusa* Kurz, *Daphnia longispina* (O. F. Müller), *Daphnia longispina* var. *longiremis* Sars, *Daphnia retrocurva* Forbes, *Ceriodaphnia reticulata* (Jurine), *Bosmina longispina* Leydig, *Bosmina longirostris* (O. F. Müller), *Holopedium gibberum* Zaddach, *Latona setifera* (O. F. Müller), *Sida crystallina* (O. F. Müller), *Ilyocryptus spinifer* Herrick, *Alona guttata* Sars, *Leptodora kindtii* (Focke), and *Polyphemus pediculus* (Linné). The cladocerans were generally most abundant in the surface waters as were the copepods.

Rotifera. This group of minute but highly organized animals is characteristic of fresh-water plankton. The genera encountered in the samples were *Anuraea*, *Polyarthra*, *Conochilus*, *Gastropus*, *Rattulus* and *Notholca*.

Protozoa. This important group of animals has some common representatives in fresh-water plankton. The genera enumerated from the samples were *Ceratium*, *Dinobryon*, *Synura*, *Epistylis*, *Actinophrys* and *Mallomonas*. The greatest concentration of protozoans was found in West Harbor Pond where there was calculated to be more than 1,000,000 individuals of *Ceratium* and *Dinobryon* per cubic foot in the upper levels of water.

Zoophyta. This group consists of forms of uncertain position which are claimed by both botanists and zoologists. They were not abundant in the plankton samples. Only two genera, *Volvox* and *Eudorina*, were listed.

Desmidiaceae. This group of unicellular plants is a family of the green algae (Chlorophyceae). They were not usually abundant in the samples. The genera encountered were *Cosmarium*, *Staurastrum* and *Xanthidium*.

Chlorophyceae. All of the grass-green algae, except the desmids, were placed in this group. It is an important group of plant plankton and is abundantly represented by a great variety of forms. The genera listed from the samples were *Ulothrix*, *Micractinium*, *Scenedesmus*, *Dictyosphaerium*, *Botryococcus*, *Protococcus* and *Pediastrum*.

Bacillarieae. The forms that make up this group are commonly called diatoms. They were widespread in the plankton samples. The genera listed were *Tabellaria*, *Asterionella*, *Fragilaria* and *Stephanodiscus*.

Myxophyceae. Another group of plant plankton that was commonly represented in the samples was the blue-green algae. Genera that were present in the samples were *Anabaena*, *Microcystis*, *Nostoc*, *Coelosphaerium*, *Merismopedia* and *Spirulina*.

All Plankton. Since the samples were taken at a time when the plankton population in a lake or pond is ordinarily on the decline, these samples presumably are not indicative of the maximum plankton production of these lakes and ponds. There were relatively few genera recorded because the sampling collected mostly limnetic plankters which are rather limited in number of forms. In general the deep, cold-water lakes were poor in plankton; and the shallow, warm-water lakes were abundantly supplied. The greatest concentration of plankton was recorded from Sandy Pond in Freedom where there was calculated to be 8,237,983 individuals per cubic foot of water. This abundance was caused by a "bloom" of *Anabaena flos-aquae* and a large population of water fleas. The amount of plankton in the present group of samples was approximately the same as was found in samples from lakes in southwestern Maine, but was considerably more than was encountered in the samples from the Rangeley Lakes in western Maine (see previous Maine Survey Reports).

BOTTOM SOIL AND BOTTOM FAUNA OF THE LAKES AND PONDS

This account of bottom soil and bottom fauna is based on 521 samples taken from 17 of the lakes and ponds concerned in this report. These samples were taken during daylight, mostly between the hours of 9:00 A.M. and 5:00 P.M.; and during the period from July 16 to September 11, 1941, mostly during the months of July and August. All samples were collected with Ekman dredges having a bottom area 9 inches by 9 inches square. Each sample was screened through a brass sieve of No. 20 mesh (twenty openings, each 0.0328 inch square, to the linear inch), and all bottom organisms found on the screen were preserved in 70 per cent alcohol for later study. The water depth and type of bottom were recorded for each sample. The points of sampling were distributed over the lakes and ponds approximately at predetermined locations scattered fairly uniformly over the surface of each lake. Therefore, the samples should present a fairly accurate picture of the average bottom conditions for each lake as a whole — to the degree that the number of samples was adequate.

The bottom organisms were identified in the laboratory, mostly to orders and families. The number of individuals of each type of animal was counted, and the total number of organisms in each sample determined. The volume of each entire sample was first measured by water displacement, after which the volume of all organisms of each type was measured. The excess moisture clinging to the organisms was blotted off before determining their displacement, and care was taken to dry all organisms by approximately the same amount. Tapered glass graduates were used to measure the amount of displacement. The volume readings of displacements of from 0.02 c.c. to 1 c.c. were measured to the nearest 0.02 c.c.; and volumes of less than 0.02 c.c. were estimated in some instances, or were determined by lumping several small organisms, measuring their total volume and estimating the relative size of each kind.

Bottom Soil. Gravel, sand, wood debris, mud, and combinations of these materials with each other, or with clay, were the principle bottom soil types encountered among the 521 bottom samples. The distinct soil types and combinations of soil types were classed into ten different categories (listed in Table VII). The occurrence of the various types of bottom soils differed from lake to lake, and with variations in depth of water in most individual lakes. Materials classed as mud were the predominant type of bottom soil: mud was found in 306 samples. The term "mud" was used to include a variety of finely divided materials: some fine and light silt, some silt mixed with various amounts of partly decomposed organic material, and some fibrous or flocculent material. Mud in combination with gravel, sand, clay or wood debris was found in an additional 140 samples. Sand was the next most common bottom soil material: sand alone was found in 44 samples, while mixtures of sand and clay occurred in 6 samples. Gravel was the third most abundant bottom soil, being found in 20 samples; 3 samples of a mixture of gravel and sand were encountered. Wood debris, chiefly sawdust, made up 2 samples. Wood debris mixed with mud was found in several of the lakes, particularly in Spectacle Pond. Large gravel and bedrock were encountered in some lakes; on these types of bottom attempts at sampling with the Ekman dredge were unsuccessful, and such attempts have not been included among the 521 samples considered here. It is believed that the failure to obtain samples from rocky bottom does not invalidate the general conclusions obtained in this report, since only a few sampling attempts encountered this type of bottom.

The distribution of the different types of bottom soil by depth for all samples from the 17 lakes is indicated in Table VII. Among the samples taken from waters 4 to 10 feet in depth, mud was the predominant soil type, sand was a close second, and gravel was the least abundant. Mud occurred more frequently in the samples taken at depths ranging from 11 to 20 feet than did all other types of bottom soils together; sand was second in frequency of occurrence; and gravel, third. Sand and gravel bottom soils were infrequent at depths below 30 feet, and the bottom here was chiefly mud. Mud and mixtures of mud and clay were the most frequent bottom soils encountered below a depth of 40 feet.

Bottom Fauna. All animals collected from the bottom samples are here considered to be of the bottom fauna, except for a few large bivalve mollusks and two young White Perch (*Morone americana*). These animals, of the bottom fauna, which were found in the 521 samples were all invertebrates. They were classified into 19 major groups of varying taxonomic rank — classes, orders, families, or genera. The bottom fauna of these 17 lakes included: representatives of three phyla of worms, namely, flatworms, roundworms and the annelid or segmented worms; snails and clams among the mollusks; and, among the arthropods, water mites representing the arachnids, fresh-water shrimp representing the crustaceans, and 7 orders of aquatic insects. The flatworms were represented by turbellarians (Class, Turbellaria); the roundworms, by free-living hairworms of the order Gordioidea (Class, Nematomorpha); and the annelid worms, by the leeches (Hirudinea) and aquatic earthworms (Oligochaeta). The aquatic insects included: alderfly larvae (Neuroptera), Mayfly nymphs (Ephemerida), dragonfly and damselfly nymphs (Odonata), beetle larvae (Coleoptera), caddisfly larvae (Trichoptera), moth larvae (Lepidoptera), and midge and mosquito larvae (Diptera). Table VI summarizes the volume and number of each type of bottom organism in all of the samples from each lake, together with the number and range in depth of these samples.

There was a considerable degree of variation in the abundance of the different organisms found in the bottom samples. This variation is apparent in the following summary, for the 17 lakes, of the number of lakes from which each type of organism was obtained:

Midge larvae, mosquito larvae (*Corethra*), snails (Amnicolidae), pill clams (Sphaeridae), alderfly larvae (*Sialis*), and Mayfly nymphs were taken from all	17 lakes
Snails, other than Amnicolidae; aquatic earthworms; and fresh-water shrimp were taken from	16 "
Caddisfly larvae, from	15 "
Dragonfly nymphs (Anisoptera), from	10 "
Leeches, from	9 "
Hairworms (Gordioidea), from	8 "
Young clams (other than Sphaeridae) and beetle larvae, from	7 "
Water mites (Hydracarina) and damselfly nymphs (Zygoptera), from	6 "
Aquatic larvae of moths (Lepidoptera), from	2 "
Flatworms (Turbellaria), from	1 "

The relative importance of these organisms in the bottom fauna is also indicated by the total number and volume of each type in all samples from the 17 lakes (bottom of Table VI). The 521 samples yielded 18,311 organisms having a total volume of 88.044 c.c. The total number and volume of each type, and the calculated average volume (in cubic millimeters) per organism of each type, are given in the following:

5,153 midge larvae	tot. vol.,	18.019 c.c.;	av. vol.,	3.5 cu.mm.
4,214 pill clams (Sphaeridae)	" " ,	15.669 c.c.;	" " ,	3.7 cu.mm.
3,461 fresh-water shrimp	" " ,	5.617 c.c.;	" " ,	1.6 cu.mm.
2,316 mosquito larvae (*Corethra*)	" " ,	3.758 c.c.;	" " ,	1.6 cu.mm.
1,155 snails (Amnicolidae)	" " ,	7.943 c.c.;	" " ,	6.9 cu.mm.
397 other snails	" " ,	10.687 c.c.;	" " ,	26.9 cu.mm.
515 Mayfly nymphs	" " ,	8.499 c.c.;	" " ,	16.5 cu.mm.
302 alderfly larvae (*Sialis*)	" " ,	3.900 c.c.;	" " ,	12.9 cu.mm.
367 aquatic earthworms	" " ,	1.627 c.c.;	" " ,	4.4 cu.mm.

(*List continued next page*)

197 caddisfly larvae	tot. vol.,	1.244 cc.;	av. vol.,	6.3 cu.mm.
24 young clams (other than Sphaeridae) ..	" " ,	6.795 c.c.;	" " ,	283.1 cu.mm.
26 dragonfly nymphs ..	" " ,	2.184 c.c.;	" " ,	84.0 cu.mm.
93 leeches	" " ,	1.698 c.c.;	" " ,	18.3 cu.mm.
25 flatworms (Turbellaria) ...	" " ,	0.173 c.c.;	" " ,	6.9 cu.mm.
12 damselfly nymphs	" " ,	0.100 c.c.;	" " ,	8.3 cu.mm.
21 water mites (Hydracarina)	" " ,	0.042 c.c.;	" " ,	2.0 cu.mm.
15 beetle larvae	" " ,	0.042 c.c.;	" " ,	2.8 cu.mm.
12 hairworms (Gordioidea)	" " ,	0.014 c.c.;	" " ,	1.2 cu.mm.
6 aquatic larvae of moths (Lepidoptera)	" " ,	0.033 c.c.;	" " ,	5.5 cu.mm.

It is evident from the above figures that there was considerable variation in size between the different types of bottom organisms. The young clams (other than the Sphaeridae) had by far the greatest average volume of all the organisms; clams in this category were the young of the larger species, and they were selected and included in the present bottom samples because they were small enough to allow fishes of the local fauna to feed on them. The dragonfly nymphs, snails other than Amnicolidae, leeches, and Mayfly nymphs were also of relatively large average size. These larger snails were mostly of the family Planorbidae, but the genera *Physa*, *Lymnaea* and *Valvata* were also fairly numerous; a few large specimens of *Campeloma* were present. Fresh-water shrimp, *Corethra* larvae, pill clams, and midge larvae were among the smallest organisms of the bottom fauna. The midges were mostly of four distinct types (unidentified), plus several larvae of the genus *Ceratopogon*.

The character of the bottom fauna varied somewhat in relation to the depth of water and the type of bottom soil; some of the data on distribution of organisms by depth and bottom soil are given in Table VII. In general, the samples from shallower water were found to contain more organisms and a greater volume of organisms, than did the samples from deeper water. There was also a greater variety in the kinds of organisms found in the shallower waters. The quantity of bottom organisms was also greatly influenced by the type of bottom soil. Mud was the most productive type of bottom soil in these lakes, then sand, then gravel — see bottom of Table VII. This difference in fauna according to soil type is well demonstrated by the data on samples from the shallow water areas, especially the 4- to 10-foot range. The deviations from this general tendency (greatest fertility in mud bottom, then sand, then gravel) are believed to have been caused by the presence of vegetation on some of the usually less

productive (sand and gravel) bottoms, making it possible for more life to be supported than these soils would ordinarily be able to maintain.

The bottom samples furnish data which make possible a comparison of the different lakes as to their production of bottom fauna available as food for fishes. The average volume and number of organisms per square foot of lake bottom for each lake was calculated from the data, and these figures are here used for comparing the productivity of bottom food in the different lakes. These figures should be representative of the average quantity of bottom organisms in each lake as a whole, since the bottom samples were taken from points scattered fairly uniformly over the surface of each lake and presumably represent average bottom conditions. The number of bottom samples, the total volume and number of all organisms in all samples from each lake, the average volume and number per sample, and the calculated volume and number of organisms per square foot of lake bottom, are given for each lake, and for all lakes combined, in Table VIII. The considerable variation in the quantities of organisms found in the individual samples is indicated by the standard deviations (σ = S.D.) of the numbers and volumes of organisms in samples for each lake (also given in Table VIII). The average for all 521 samples (9″ x 9″) was 35.4 organisms having a total volume of 0.17 c.c., or a calculated 59.0 organisms of 0.28 c.c. volume per square foot of lake bottom. Sheepscot Pond had the least number and volume of organisms per square foot of bottom: 12.5 organisms of 0.05 c.c. volume. Alford Lake was the next least productive lake as regards bottom fauna. Among the lakes most productive of bottom fauna, Threemile Pond had the greatest volume (0.88 c.c.), and Lermond Pond had the greatest number (130.7) of organisms per square foot of bottom. It is believed that the variations in average numbers and volumes of organisms shown (in Table VIII) for the lakes and ponds represent real differences in basic fertility of the lake bottoms, rather than that they were caused mostly by seasonal variations resulting from differences in the dates of sampling. The sampling was done during a two-month period; and, although the average quantity of bottom fauna per lake tended to increase somewhat for lakes sampled at later dates, the seasonal variation was small as compared to differences attributable to other causes.

TABLE VI. Volumes in cubic centimeters and numbers (in parentheses) of each type of organism in all bottom samples from each of 17 lakes and ponds

All samples (9" x 9") were taken with an Ekman Dredge

Name of lake or pond	Samples: Date: 1941	Range in depth of water in feet	Number of samples	Flat worms (Turbellaria)	Hair Worms (Gordioidea)	Leeches (Hirudinea)	Aquatic earthworms (Oligochaeta)	Fresh-water shrimp (Amphipoda)	Alderfly larvae (*Sialis*)	Mayfly nymphs (Ephemerida)	Dragonfly nymphs (Anisoptera)	Damselfly nymphs (Zygoptera)	Beetle larvae (Coleoptera)	Caddisfly larvae (Trichoptera)	Aquatic moth larvae (Lepidoptera)	Midge larvae (Chironomidae)	Mosquito larvae (*Corethra*)	Water mites (Hydracarina)	Snails (Amnicolidae)	Other snails (Gastropoda)	Pill clams (Sphaeridae)	Other clams (Pelecypoda)
Spectacle	Aug. 11–13	6–98	20	.....	0.002 (2)	0.328 (14)	0.022 (8)	0.492 (343)	0.182 (21)	0.292 (10)	0.005 (1)	0.005 (2)	0.004 (1)	0.053 (6)	.....	0.84 (255)	0.06 (37)	0.007 (5)	0.118 (26)	0.153 (31)	0.049 (59)	0.025 (1)
Threemile	Aug. 5–6	5–35	23	.....	0.001 (1)	0.185 (23)	0.11 (32)	0.328 (224)	0.285 (12)	0.812 (25)	.....	.....	.....	0.012 (6)	.....	3.362 (478)	0.117 (90)	0.002 (2)	1.78 (260)	1.052 (42)	0.252 (162)	3.84 (12)
China	Aug. 4–5	5–85	46	.....	0.001 (1)	0.016 (6)	0.13 (28)	0.157 (99)	0.109 (18)	0.651 (30)	0.12 (1)	.....	.....	0.012 (6)	.....	0.575 (244)	0.263 (152)	.....	0.844 (114)	1.229 (64)	0.129 (102)	2.3 (5)
Pattee	Aug. 14	11–22	19	.....	0.001 (1)	.....	.....	.....	0.005 (1)	0.295 (8)	.....	.....	.....	.....	.....	1.569 (262)	0.786 (421)	0.012 (4)	0.007 (2)	0.087 (8)	0.238 (104)	.....
Sheepscot	Aug. 6–7	5–98	34	.....	0.001 (1)	.....	0.003 (2)	0.003 (3)	0.09 (11)	0.2 (17)	.....	0.004 (2)	.....	0.037 (3)	.....	0.391 (137)	0.042 (26)	0.001 (1)	0.141 (20)	0.102 (11)	0.111 (22)	.....
Biscay	Aug. 1–7	5–59	21	.....	0.001 (1)	.....	0.017 (7)	0.073 (68)	0.037 (2)	0.182 (13)	0.224 (5)	0.01 (1)	.....	0.027 (5)	.....	0.294 (141)	0.347 (338)	.....	0.191 (30)	0.234 (19)	0.84 (236)	0.4 (1)
Pemaquid	Aug. 8–13	7–55	45	.....	.....	.....	0.018 (5)	0.083 (48)	0.145 (7)	0.679 (38)	0.151 (2)	.....	.....	0.009 (3)	.....	0.851 (242)	0.77 (448)	.....	0.21 (34)	0.958 (7)	1.521 (224)	.....
North	July 23	11–42	22	.....	.....	.....	0.221 (38)	0.001 (1)	0.143 (4)	0.103 (15)	.....	.....	.....	.....	.....	0.607 (180)	0.245 (124)	.....	0.104 (12)	0.312 (13)	0.121 (23)	0.08 (1)
Crawford	July 21	9–50	29	.....	.....	.....	0.08 (19)	0.039 (27)	0.173 (12)	0.48 (35)	0.2 (1)	.....	0.005 (2)	0.046 (5)	.....	0.537 (158)	0.248 (140)	.....	0.443 (91)	0.41 (17)	0.234 (100)	.....
Lermond	July 23	10–21	10	.....	0.004 (1)	0.005 (1)	0.009 (2)	0.143 (78)	0.2 (8)	0.15 (7)	.....	.....	0.007 (3)	0.045 (5)	.....	0.567 (286)	0.04 (31)	.....	0.735 (155)	0.02 (1)	0.535 (226)	.....
Alford	July 22	8–78	21	.....	.....	.....	0.013 (4)	0.008 (7)	0.055 (2)	0.133 (10)	.....	0.041 (1)	.....	0.01 (1)	.....	0.555 (151)	0.02 (16)	.....	0.1 (12)	.....	0.029 (9)	.....
Quantabacook	Sept. 10–11	4–45	47	.....	.....	0.473 (15)	0.024 (9)	0.617 (550)	0.58 (52)	1.747 (81)	0.55 (9)	0.03 (4)	0.002 (1)	0.146 (37)	0.003 (1)	0.371 (166)	0.377 (261)	0.014 (5)	0.477 (69)	2.095 (51)	0.432 (140)	.....
St. George	Aug. 14–Sept. 9	4–53	66	0.173 (25)	0.003 (4)	0.572 (27)	0.318 (52)	1.88 (1183)	0.326 (30)	1.475 (101)	0.014 (1)	.....	0.008 (2)	0.318 (55)	0.03 (5)	1.76 (380)	0.038 (19)	0.006 (4)	0.622 (69)	1.14 (36)	7.741 (1903)	0.12 (2)
Megunticook	July 18–25	4–60	56	.....	.....	0.01 (1)	0.272 (100)	1.536 (691)	0.853 (54)	0.481 (46)	0.26 (2)	0.01 (2)	0.014 (5)	0.108 (26)	.....	3.548 (857)	0.13 (79)	.....	0.849 (106)	2.037 (69)	2.43 (652)	.....
Norton	July 18–24	10–54	20	.....	.....	0.003 (2)	0.094 (21)	0.01 (5)	0.295 (21)	0.414 (25)	0.09 (1)	.....	.....	0.011 (4)	.....	1.177 (518)	0.122 (65)	.....	0.17 (19)	0.15 (5)	0.21 (94)	.....
Pitcher	July 16–17	11–35	20	.....	.....	0.106 (4)	0.235 (28)	0.239 (125)	0.21 (9)	0.288 (43)	0.57 (3)	.....	0.002 (1)	0.394 (30)	.....	0.145 (93)	0.141 (61)	.....	0.401 (53)	0.6 (13)	0.747 (153)	0.03 (2)
Swan	Aug. 8	6–76	22	.....	.....	.....	0.061 (12)	0.008 (9)	0.212 (38)	0.117 (11)	.....	.....	.....	0.016 (5)	.....	0.87 (625)	0.012 (8)	.....	0.751 (83)	0.108 (10)	0.05 (5)	.....
Totals (17 ponds)	July 16–Sept. 11	4–98	521	0.173 (25)	0.014 (12)	1.698 (93)	1.627 (367)	5.617 (3461)	3.9 (302)	8.499 (515)	2.184 (26)	0.100 (12)	0.042 (15)	1.244 (197)	0.033 (6)	18.019 (5153)	3.758 (2316)	0.042 (21)	7.943 (1155)	10.687 (397)	15.669 (4214)	6.795 (24)

TABLE VII. The average volumes, in cubic centimeters, and numbers (in parentheses) of bottom organisms per 9" x 9" sample for 17 lakes and ponds combined, and based on a total of 521 samples, arranged according to depth of water and type of bottom soil

Averages based on five or more samples are given in heavy type

Depth in feet	Gravel	Gravel, sand	Sand	Sand, clay	Wood debris	Mud, gravel	Mud, sand	Mud, wood debris	Mud, clay	Mud	All bottom types
	Type of bottom soil										
4–10	0.355 (90)	0.090 (36)	0.177 (35.4)	0.195 (19)	.....	.....	0.333 (46.9)	0.186 (43.6)	0.175 (48)	0.339 (68.2)	0.271 (54.9)
11–20	0.076 (7.4)	0.135 (18)	0.058 (15)	0.053 (10)	0.086 (20.5)	0.302 (19)	0.199 (24.3)	0.135 (19.4)	0.380 (21)	0.104 (29.7)	0.159 (25.6)
21–30	0.031 (8.1)	.....	0.145 (44.4)	0.342 (6.3)	.....	0.255 (17)	0.144 (34.2)	0.108 (23.8)	0.176 (19.7)	0.148 (35.6)	0.147 (31.3)
31–40	0.335 (80.5)	.....	.....	.....	.....	0.298 (62)	0.441 (96.4)	0.100 (36.5)	0.172 (33.3)	0.207 (62.4)	0.222 (56.9)
41–50	.....	.....	0.161 (33.5)	.....	.....	.....	0.045 (23)	0.010 (4)	.....	0.126 (29.1)	0.122 (28.4)
51–60	.....	.....	.....	.....	.....	.....	.....	0.039 (15)	0.085 (62)	0.174 (41.1)	0.146 (39.3)
61–70	.....	.....	.....	.....	.....	.....	.....	.....	0.087 (53.1)	0.045 (13.5)	0.073 (39.9)
71–80	.....	.....	.....	.....	.....	.....	.....	.....	0.186 (129)	0.105 (34.5)	0.130 (38.6)
81–90	.....	.....	.....	.....	.....	.....	.....	.....	0.050 (24)	0.052 (13)	0.061 (15.7)
91–98	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.160 (38.5)	0.160 (36.5)
All samples, all depths	0.126 (27.4)	0.120 (24)	0.130 (29.8)	0.221 (9.6)	0.086 (20.5)	0.295 (27)	0.190 (39.4)	0.115 (23.7)	0.171 (34.7)	0.174 (37.3)	0.169 (35.1)

TABLE VIII. The total and average volumes and numbers of organisms in bottom samples, and the calculated average volumes and numbers of organisms per square foot of lake bottom, for the 17 lakes and ponds

Name of pond	Pond number	Number of samples	Totals of organisms in all samples		Average volume and number of organisms per sample				Organisms per square foot (calculated)	
					Volume		Number			
			Volume in c.c.	Number	Mean	σ=S.D.	Mean	σ=S.D.	Volume in c.c.	Number
Spectacle Pond	691	20	2.637	822	0.13	0.13	41.1	37.5	0.22	68.5
Threemile Pond	694	23	12.138	1,369	0.53	0.36	59.5	49.8	0.88	99.2
China Lake	736	46	6.536	870	0.15	0.28	18.9	14.6	0.25	31.5
Pattee Pond	739	19	3.000	811	0.16	0.12	42.7	19.4	0.27	71.2
Sheepscot Pond	1349	34	1.126	256	0.03	0.03	7.5	0.2	0.05	12.5
Biscay Pond	1379	21	2.877	867	0.14	0.12	41.3	28.8	0.23	68.8
Pemaquid Pond	1381	45	5.395	1,058	0.12	0.12	23.5	23.4	0.20	39.2
North Pond	1414	22	1.937	411	0.09	0.06	18.7	11.6	0.15	31.2
Crawford Pond	1422	29	2.895	607	0.10	0.08	20.9	15.1	0.17	34.8
Lermond Pond	1423	10	2.460	784	0.25	0.14	78.4	48.7	0.42	130.7
Alford Lake	1424	21	0.964	213	0.05	0.05	10.1	9.8	0.08	16.8
Quantabacook Pond	1434	47	7.938	1,451	0.17	0.19	30.9	42.1	0.28	51.5
St. George Lake	1445	66	16.544	3,898	0.25	0.24	59.1	46.0	0.42	98.5
Megunticook Lake	1449	56	12.538	2,690	0.22	0.18	39.0	27.8	0.37	65.0
Norton Pond	1451	20	2.746	780	0.14	0.08	39.0	39.7	0.23	65.0
Pitcher Pond	1454	20	4.108	618	0.21	0.11	30.9	17.1	0.35	51.5
Swan Lake	1469	22	2.205	806	0.11	0.07	40.3	43.1	0.18	67.2
Totals	17	521	88.044	18,311	....	....	....	....	....	......
Averages for lakes	....	....	....	....	0.17	....	35.4	....	0.28	59.0

FISHES OF THE LAKES AND PONDS

The present account of the fish fauna of the lakes studied during the 1941 survey is based on collections made with gill nets and seines, and on information obtained from the State Fish and Game Wardens for lakes in their respective territories.

Two gill nets were used, each of the same type; each net was 375 feet long by 6 feet deep and consisted of five 75-foot sections with the following mesh sizes: 4, 2, 6, 3 and 5 inches stretched measure (twice bar measure), and with the 5 units tied together in that order. These nets were set in 20 of the 61 lakes for a total of 102 individual net sets, from June 20 to September 10, 1941, during which the nets fished for a total of 2,563½ hours (average of 1,281 ¾ hrs. per net). Of these 102 gill net sets, 95 sets were for periods extending through one night; 4 were for 2 nights; and 3 were for 3 nights. Thus the 102 net sets represented 112 overnight sets. The average time interval for these 112 overnight sets was 22.9 (range 11 to 30½) hours. In most instances the nets were set during the morning, and the fish were removed that evening and the following morning. An attempt was made to distribute the net sets according to depth somewhat in proportion to water depths of the lakes, insofar as this was possible with the limited number of sets in these 20 lakes. The over-all range of water depth through which the 112 sets were made was 6 to 86 feet In 51 sets at least part of the net was in water less than 20 feet deep; and in 29 sets at least part of the net was in more than 40 feet of water. Since the thermocline was mostly above a depth of 40 feet in most of the lakes, the net sets at depths of over 40 feet were deep enough to catch cold-water fishes if present. Among the 20 lakes in which the gill nets were fished, St. George Lake received one-fourth of the netting effort; Quantabacook, Sheepscot and China together received one-fourth; and the remaining net sets were distributed among the remaining 16 lakes somewhat in proportion to the relative sizes of these lakes. In 10 of the 112 over-night sets the nets did not catch any fish. The remaining 102 sets yielded 2,118 fish representing 14 species.

Seining collections were made with 15-, 30-, and 40-foot Common Sense minnow seines and with a 50-foot seine of 3/8-inch mesh. Seventy-one seining collections were made from 46 of the 61 lakes during the period from August 7 to September 11, 1941, all during daylight. These 46 collections represented 33½ hours of actual seining effort. The collections were made on shore shallows, in water less than 5 feet deep, and over boulder, gravel, sand, mud and weedy bottoms. The

seine collections which are here described included all individuals of the rarer species of fishes taken by the seining and a considerable number of individuals (but not necessarily all) of the more common species. The 71 seine collections included over 27,000 specimens representing 20 species of fishes.

The information obtained from the Maine State Fish and Game Wardens included each warden's estimate of abundance of the different types of fishes in each lake in his territory.

The records of distribution of the species collected by gill nets and seines are given in Table IX. The estimates of abundance of the different species in each lake, as given by the Fish and Game Wardens and as judged from survey collections, are given in Table X. While the records of distribution as based on survey collections represent reliable observations, the estimates of abundance based on these collections are believed to be not so reliable, in most instances, as the estimates of abundance made by the wardens; this applies particularly in the case of many ponds from which survey collections were made only by seining. In the case of St. George Lake, Sheepscot Pond, Quantabacook Pond and China Lake the estimates of abundance, as based on more extensive survey collections, are presumably fairly reliable. In the case of the Eel, the lack of agreement between the wardens' reports of abundant eel populations and the almost total absence of eels in our survey collections is due to the ability of this fish in escaping from gill nets and seines.

The known fish fauna of the present group of lakes includes possibly 29 species representing 14 families. Of these 29 species, 23 were taken by the survey collecting. The remaining 6 species include the Chum Salmon (*Oncorhynchus keta*), Togue or Lake Trout, Brown Trout and Rainbow Trout, all of which have been planted recently in some of these lakes; the status of the Large-mouthed Bass and Cusk (*Lota lota maculosa*) in lakes of the area is uncertain.

The open-water fauna of the larger fishes in these lakes is dominated largely by the White Perch and the Common Sucker: of the 2,118 fish caught by the gill nets, 55 per cent were White Perch and 21 per cent were Common Suckers. Other abundant species include the Small-mouthed Bass, Common Pickerel, Yellow Perch, Common Sunfish, Horned Pout, and, undoubtedly, the Eel. While the catches by gill net indicated that the White Perch and Common Sucker are the most abundant in this group of lakes as a whole, the Yellow Perch, Common Pickerel and Eel are more widespread in their distribution — they were recorded from a greater number of lakes. The Small-mouthed Bass is more limited in its distribution than are the two

TABLE IX. The distribution of fishes in the lakes and ponds* as determined by survey collections with gill nets (G), seines (S), or both gill nets and seines (GS)

The presence of the symbols G, S, or GS indicates that the species was collected by that type of gear

Name of pond	Pond number**	Type of gear	Land-locked Salmon *Salmo sebago*	Chinook Salmon *Oncorhynchus tshawytscha*	Brook Trout *Salvelinus f. fontinalis*	White Perch *Morone americana*	Yellow Perch *Perca flavescens*	Small-mouthed Bass *Micropterus d. dolomieu*	Common Pickerel *Esox niger*	Smelt *Osmerus mordax*	Alewife *Pomolobus pseudo-harengus*	Horned Pout *Ameiurus n. nebulosus*	Eel *Anguilla bostoniensis*	Pumpkinseed Sunfish *Lepomis gibbosus*	Red-bellied Sunfish *Lepomis auritus*	Common Sucker *Catostomus c. commersonnii*	Golden Shiner *Notemigonus c. crysoleucas*	Lake Chub *Couesius p. plumbeus*	Creek Chub *Semotilus a. atromaculatus*	Fallfish *Leucosomus corporalis*	Fine-scaled Dace *Pfrille neogaea*	Red-bellied Dace *Chrosomus eos*	Common Shiner *Notropis c. cornutus*	Banded Killifish *Fundulus d. diaphanus*	Nine-spined Stickleback *Pungitius pungitius*
Nequasset	638	S	..	..	..	..	..	..	S	..	S	..	..	S	..	..	S	..	..	..	..	..	..	S	..
Togus Pond	649	S	..	..	..	S	..	..	..	..	..	..	..	S	..	..	S	..	..	..	..	..	..	S	..
Threecornered Pond	651	S	..	..	..	..	S	S	..	..	..	S	..	S	..	..	..	..	..	..	..	..	..	S	..
Weber Pond	688	S	..	..	..	..	S	S	..	..	..	..	..	S	S	S	..	..	..	S	..	..	..	S	..
Spectacle Pond	691	GS	..	..	..	G	G	..	GS	..	..	G	..	..	S	G	..	..	..	..	..	..	..	S	..
Dam Pond	692	S	..	..	..	..	S	..	S	..	..	..	..	S	..	..	S	..	..	..	..	..	..	..	..
Threemile Pond	694	GS	..	..	..	G	..	GS	G	..	..	G	..	S	S	G	S	..	..	S	..	..	..	S	..
China Lake	736	GS	..	G	..	GS	GS	GS	GS	GS	..	GS	..	GS	S	GS	S	..	..	..	..	..	..	S	..
Pattee Pond	739	S	..	..	..	..	S	S	..	..	..	..	..	S	S	..	..	..	..	..	..	..	..	..	..
Lovejoy Pond	744	S	..	..	..	..	S	..	S	..	..	..	..	S	..	S	S	..	..	..	..	..	..	S	..
Unity Pond	746	S	..	..	..	..	..	S	S	..	..	..	..	..	S	..	S	..	..	..	..	..	S	S	..
Dyer Long Pond	1331	S	..	..	..	..	S	..	S	..	..	..	..	S	..	..	S	..	..	..	..	..	..	..	..
Pleasant Pond or Clary Lake	1334	GS	..	..	..	GS	..	..	GS	..	..	G	..	GS	..	..	G	..	..	..	..	..	..	..	..
Branch Pond	1342	S	..	..	..	..	..	..	S	..	..	..	..	S	..	..	S	..	..	..	..	..	..	..	..
Sheepscot Pond	1349	GS	G	..	..	GS	G	..	GS	..	..	..	G	GS	..	G	S	..	..	..	..	..	..	S	..
Damariscotta Pond	1367	GS	..	..	..	G	..	GS	S	..	..	G	..	S	..	..	..	..	..	..	..	..	..	..	..
Damariscotta Lake	1368	GS	G	G	..	GS	GS	S	S	..	S	G	..	GS	..	S	S	..	..	S	..	..	..	S	..
Biscay Pond	1379	GS	G	..	..	G	..	..	G	..	..	..	..	S	..	G	..	..	..	..	..	..	..	S	..
Pemaquid	1381	GS	..	..	..	GS	S	..	GS	..	..	GS	..	GS	..	G	GS	..	..	..	..	..	..	S	..
McCurdy Pond	1385	S	..	..	..	..	..	..	S	..	..	..	..	S	..	..	..	..	..	..	..	..	..	..	..
Webber Pond	1387	S	..	..	..	S	..	..	..	..	..	..	..	S	..	..	..	..	..	..	..	..	..	..	..
Medomak Pond	1394	S	..	..	..	..	S	..	S	..	..	..	..	S	..	..	S	..	..	..	..	..	..	..	..
Chickawaukie Pond	1409	S	..	..	..	..	..	S	S	..	..	..	..	S	..	..	S	..	..	..	..	..	..	S	..
Mirror Lake or Oyster River Pond	1413	S	..	..	..	..	..	..	S	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
North Pond	1414	GS	..	..	..	G	S	..	S	..	..	..	..	S	..	GS	S	..	..	..	..	..	..	S	..
South Pond	1415	S	..	..	..	..	S	S	S	..	S	..	..	S	..	S	S	..	..	..	..	..	..	S	..
Seven Tree Pond	1419	S	..	..	..	..	S	..	S	..	..	S	..	S	..	S	S	..	..	..	..	..	..	S	..
Round Pond	1420	S	..	..	..	..	S	..	S	..	..	..	..	S	..	..	S	..	..	..	..	..	..	..	..
Crawford Pond	1422	GS	..	..	..	GS	..	..	GS	..	..	..	..	S	..	GS	..	..	..	..	..	..	..	S	..
Alford Lake	1424	GS	..	..	..	GS	..	..	S	S	..	..	..	S	..	G	..	..	..	..	..	..	..	S	..
Fish Pond	1428	S	..	..	..	..	..	..	S	..	..	..	..	S	..	..	..	..	..	..	..	..	..	..	..
Hobbs Pond	1429	S	..	..	..	S	..	..	S	..	..	..	..	S	..	S	..	..	..	..	..	..	..	S	..
Sennebec Pond	1431	GS	G	..	..	G	S	S	GS	..	..	..	..	S	..	G	..	..	..	..	..	..	..	S	..
Quantabacook Pond	1434	GS	..	..	..	GS	G	G	G	..	..	G	..	GS	..	GS	..	..	..	..	..	..	..	S	..
St. George Lake	1445	GS	G	..	..	GS	GS	GS	..	S	..	..	..	GS	..	G	S	..	..	..	..	..	..	S	..
Megunticook Lake	1449	GS	G	..	G	GS	S	GS	S	..	..	G	..	S	..	..	S	..	..	..	..	..	..	S	..

TABLE IX. The distribution of fishes in the lakes and ponds*— Concluded

Name of pond	Pond number**	Type of gear	Land-locked Salmon *Salmo sebago*	Chinook Salmon *Oncorhynchus tshawytscha*	Brook Trout *Salvelinus f. fontinalis*	White Perch *Morone americana*	Yellow Perch *Perca flavescens*	Small-mouthed Bass *Micropterus d. dolomieu*	Common Pickerel *Esox niger*	Smelt *Osmerus mordax*	Alewife *Pomolobus pseudo-harengus*	Horned Pout *Ameiurus n. nebulosus*	Eel *Anguilla bostoniensis*	Pumpkinseed Sunfish *Lepomis gibbosus*	Red-bellied Sunfish *Lepomis auritus*	Common Sucker *Catostomus c. commersonnii*	Golden Shiner *Notemigonus c. crysoleucas*	Lake Chub *Couesius p. plumbeus*	Creek Chub *Semotilus a. atromaculatus*	Fallfish *Leucosomus corporalis*	Fine-scaled Dace *Pfrille neogaea*	Red-bellied Dace *Chrosomus eos*	Common Shiner *Notropis c. cornutus*	Banded Killifish *Fundulus d. diaphanus*	Nine-spined Stickleback *Pungitius pungitius*
Norton Pond	1451	GS	..	..	G	S	S	S	S	..	..	..	..	..	..	GS	..	..	..	..	..	..	..	..	..
Pitcher Pond	1454	GS	..	..	..	G	S	G	S	..	GS	..	..	GS	..	..	S	..	..	..	..	..	..	..	..
Knight Pond	1455	S	..	..	..	..	S	S	..	..	S	..	S	S	..	..	S	..	..	..	..	..	..	..	..
Tilden Pond	1456	S	..	..	..	..	S	S	S	..	..	..	..	..	..	..	..	..	..	..	..	..	..	S	..
Cross Pond	1460	S	..	..	..	..	S	..	..	..	..	..	..	S	..	..	S	..	..	..	..	..	..	..	..
Mixer Pond	1461	S	..	..	..	..	..	..	..	..	..	..	..	S	..	..	S	..	..	..	S	S	..	S	..
Sanborn Pond	1462	G	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Dutton Pond	1463	S	..	..	..	..	S	..	S	..	..	..	..	S	..	..	S	..	..	..	..	..	..	..	..
Passagassawaukeag Lake or Randall Pond	1466	S	..	..	..	..	S	..	S	..	..	..	..	S	..	S	..	..	..	..	..	..	..	S	..
Swan Lake	1469	GS	..	G	G	..	G	GS	..	..	..	S	..	..	..	GS	S	S	S	..	..	..	..	S	S
Toddy Pond	1478	S	..	..	..	..	..	S	S	..	..	..	..	..	S	..	..	..	..	..	..	..	..	..	..

*Listed in this table are 47 of the 61 lakes and ponds which are considered in this report; no fish collections were made by the survey from the remaining 14 ponds.
**For stream drainage systems of these lakes, see page 20.

perches and the pickerel. Both the gill net collections and the wardens' reports indicated definitely that the four species of warm-water game fishes are much more abundant than are the salmonids in almost all of the present group of 61 lakes and ponds.

The fish fauna of the lake shallows, as revealed by the seine collections, included several species of minnows and other small forage fishes and the young of all of the larger, warm-water species. The Banded Killifish (not a true minnow) was by far the most abundant and widespread of the species encountered in these collections. Among the minnows the Golden Shiner was the only species which was widespread and abundant; the Fallfish was found to be abundant in only one lake. The remaining 5 species of minnows were either very rare in the collections or confined to one lake. Young of the Alewife were encountered in a few lakes and a particularly large collection was obtained from Nequasset Pond. Among the young game fishes in the seining collections, the White Perch was by far the most abundant. Young Yellow Perch, Small-mouthed Bass and Common Pickerel were also taken in considerable numbers. The young of the Pumpkinseed Sunfish were both widespread and abundant; while the Red-bellied Sunfish was found to be rather rare and very restricted in its distribution. Young Common Suckers were fairly abundant. The Smelt, Horned Pout and Eel were rare in the seine collections.

The abundance and the frequency of occurrence of the species of fishes encountered by gill netting and seining are summarized in the following:

Kind of fish	Total number taken by gill nets	Total number in seine collections	Number of lakes: fish taken by gill net or seine
Land-locked Salmon	21	..	6
Chinook Salmon	4	..	3
Brook Trout	17	..	3
White Perch	1,170	1,741	21
Yellow Perch	95	607	28
Small-mouthed Bass	162	378	20
Common Pickerel	41	140	36
Smelt	1	11	3
Alewife	6	6,360*	5
Horned Pout	107	6	12
Eel	1	1	2
Pumpkinseed Sunfish	35	4,191	39
Red-bellied Sunfish	..	100	7
Common Sucker	446	459	21
Golden Shiner	12	3,655	27
Lake Chub	..	3	1
Creek Chub	..	1	1
Fallfish	..	243	3
Fine-scaled Dace	..	76	1
Red-bellied Dace	..	3	1
Common Shiner	..	1	1
Banded Killifish	..	9,798	27
Nine-spined Stickleback	..	1	1

*6,113 young alewives in one collection from Nequasset Pond.

The abundance of young Small-mouthed Bass in these lakes is of particular importance in connection with the State's fish-planting program and the desirability to promote bass fishing in suitable waters. In this connection the results of the seine collections are of particular significance, in that they should indicate the abundance or scarcity of young bass in the lakes and the need for supplementing natural reproduction by stocking hatchery-reared bass or bass transferred from other waters. It is known from survey collections and the reports by Fish and Game Wardens that the Small-mouthed Bass is present in at least 33 of the 61 lakes under consideration. Forty-four seining collections were made in 28 of these 33 lakes, for a total of 21 hours of actual seining effort. This seining collected 378 bass which were almost all young-of-the-year, and were from 1¼ to 3 inches in length. This represented an average of 18 young bass per hour of seining. This figure would tend to indicate a larger population of young bass in lakes of the present area than was encountered in lakes of the 1938 and 1940 surveys (in Cumberland, Oxford, Androscoggin and Kennebec counties) where comparable seining took 7 and 3.5 young bass per hour, respectively. The indication of a much larger population of young bass in the present group of lakes is, in part, misleading, because more than half of the 378 young bass were obtained from 2 lakes (Swan and China). The average figure for the remaining 26 lakes was 7.4 young bass per hour of seining, or little more than was obtained in lakes of the 1938 and 1940 surveys.

As to the status of the trout and salmon populations in these lakes, certain conclusions may be made from the results of the seine and gill net collecting, and these conclusions have an important bearing on the question of stocking these coldwater fishes. The complete absence of young salmonids in our seine collections confirms the conclusion made in previous Maine Fish Survey Reports that the shore shallows of lakes in southern Maine during the summer are not suitable habitats for young trout and salmon. Young salmonids have access to all of the present group of lakes, either from tributaries or from artificial stocking, and their absence from the lake shallows may be regarded as a matter of choice. Furthermore, a considerable amount of circumstantial evidence (the absence of young salmonids in the stomachs of adult game fishes from lakes) indicates that fry and fingerling Brook Trout and salmons do not frequent the deep water of these lakes. By elimination, streams are the only suitable habitat for fry and fingerling trouts and salmons (presumably not Togue) in southern Maine.

The 102 gill net sets in 20 lakes yielded 21 Land-locked Salmon, 4 Chinook Salmon, and 17 Brook Trout, but no Browns, Rainbows, Togue or Chum Salmon; the 42 salmonids were from 9 lakes. These

figures are of significance in an evaluation of the results of the fish planting program. During the 8 years from July 1, 1933 to June 30, 1941 the State Fish and Game Department planted 197,000 Brook Trout, 179,000 Brown Trout, 64,000 Rainbows, 9,000 Togue, 329,000 Land-locked Salmon, 312,000 Chinook Salmon, and 113,000 Chum Salmon in 26 of these 61 lakes, and 678,000 Brook, Brown and Rainbow trouts in the tributaries of 21 of the lakes (Table XIX). If it is assumed that the above plantings in tributaries would contribute mostly to stream fishing, we are concerned in this evaluation with the 1,203,000 (or 150,000 per year) trouts and salmons which were planted in the lakes with the intention that they would contribute mostly to lake fishing. Among the 26 lakes in which salmonid plantings had been made, 78 gill net sets were made in 12 lakes, and the nets took 36 salmonids from 7 lakes. The number of lakes in which each of the 7 species of salmonids was planted, the number of lakes in which both a species was planted and gill nets were fished, the extent of gill net fishing, the number of lakes from which each species was caught, and the number of fish caught, are summarized in the following (For example, Brook Trout had been planted in 16 of the 61 lakes; 37 gill net sets were made in 7 of these 16 lakes for a total of 992½ hours; and this fishing took 12 Brook Trout from 2 of the 7 lakes):

Species	Number of lakes planted	Number of lakes netted	Number of net sets	Total hours of netting	Number of lakes, fish caught	Total number fish caught
Brook Trout	16	7	37	992½	2	12
Brown Trout	8	4	37	946½	0	0
Rainbow Trout	4	1	7	205½	0	0
Togue	1	1	7	205½	0	0
Land-locked Salmon	9	8	69	1,759½	5	20
Chinook Salmon	8	7	32	876½	3	4
Chum Salmon	3	3	14	407	0	0
Some type of salmonid	26	12	78	1,978½	7	36

On the basis of comparison of the results of gill netting in the present group of lakes with the results obtained in other Maine lakes known to have abundant populations of salmonids, it is apparent that the above catch of salmonids in the present group of lakes was relatively small. If we consider only the 7 "excellent," "good" and "fair" trout and salmon lakes (see page 49) in which salmonids had been planted during the past 8 years (Table XIX): these lakes were stocked with an average of 103,000 salmonids per year over the 8 years previous to this study; the lakes have a total area calculated to be 12,567 acres; and these lakes were fished by gill nets for a total of 1,666½ hours

TABLE X. The distribution and abundance of fishes in the lakes and ponds as reported by local State Fish and Game Wardens,* and as estimated from survey collections

The wardens reported the separate species as: abundant (AB), common (C), rare (R), or known to be absent (.). A ? indicates that the warden was not certain whether or not the species was present; a ? following an estimate indicates that the warden was in doubt concerning that estimate of abundance. An indication that a species was absent, as based on the survey collections (Sur), means only that the species was not taken by our collecting with gill nets and seines. For pond numbers, see Table IX

Name of lake or pond	Reported by*	Land-locked Salmon	Chinook Salmon	Chum Salmon	Brook Trout	Togue (Lake Trout)	Brown Trout	Rainbow Trout	White Perch	Yellow Perch	Small-mouthed Bass	Large-mouthed Bass	Common Pickerel	Smelt	Alewife	Cusk (*Lota*)	Horned Pout	Eel	Sunfish	Sucker	Minnows** (several species)
Nequasset	H	.	.	.	R	.	.	.	C	C	C	.	AB	C?	C	.	C	C	C	C	C
	Sur	.	.	.	.	.	.	.	.	.	.	.	C	.	AB	.	.	.	C	.	C
Gardiner	H	.	.	.	R	.	.	.	.	C	C	.	R	.	.	.	.	C	C	.	C
Togus	F	.	.	.	.	.	R	.	AB	AB	C	.	C	.	.	.	C	AB	AB	C	C
	Sur	.	.	.	.	.	.	.	C	.	.	.	.	.	.	.	.	.	C	.	AB
Little Togus	F	.	.	.	.	.	.	.	AB	AB	C	.	C	.	.	.	C	AB	AB	?	?
Threecornered	F	.	C	.	.	.	.	.	AB	AB	C	.	C	.	.	.	C	AB	C	C	C
	Sur	.	.	.	.	.	.	.	.	C	R	.	.	.	.	.	R	.	AB	.	C
Weber (P.688)	F	.	.	.	.	.	.	.	AB	AB	C	.	C	C	.	.	R	AB	C	C	C
	Sur	.	.	.	.	.	.	.	.	C	AB	.	.	.	.	.	.	.	C	C	AB
Spectacle	F	.	.	.	.	.	.	.	R	R	.	.	C	.	.	.	R	C	R	?	?
	Sur	.	.	.	.	.	.	.	R	AB	.	.	C	.	.	.	R	.	C	C	C
Dam	F	.	.	.	.	.	.	.	.	R	.	.	C	.	.	.	.	C	R	?	?
	Sur	.	.	.	.	.	.	.	.	R	.	.	R	.	.	.	.	.	C	.	C
Tolman	F	.	.	.	.	.	.	.	.	R	.	.	C	.	.	.	.	C	R	?	?
Threemile	F	.	.	.	.	.	.	.	AB	AB	C	.	C	C	.	.	C	AB	C	C	C
	Sur	.	.	.	.	.	.	.	AB	.	R	.	C	.	.	.	R	.	AB	C	AB
China	F	C	C	C	.	R	.	.	AB	AB	AB	.	C	C	.	.	C	AB	C	AB	C
	Sur	.	R	.	.	.	.	.	C	R	AB	.	C	C	.	.	C	.	C	AB	AB
Pattee	R	.	.	.	.	.	.	.	AB	AB	R	.	C	.	.	.	C	C	C	C	C
	Sur	.	.	.	.	.	.	.	.	C	R	.	.	.	.	.	.	.	R	.	R
Lovejoy	R	.	.	.	R	.	.	.	AB	AB	.	.	AB	.	.	.	C	C	C	C	C
	Sur	.	.	.	.	.	.	.	.	AB	.	.	C	.	.	.	.	.	AB	C	AB
Dutton (P. 745)	R	.	.	.	.	.	.	.	AB	AB	.	.	C	.	.	.	C	C	C	C	C
Unity	R	.	.	.	R	.	.	R	AB	AB	AB	.	C	R	.	R	C	C	C	C	C
	Sur	.	.	.	.	.	.	.	.	.	AB	.	R	.	.	.	.	.	R	.	AB
Sandy	D	.	.	.	.	.	.	.	.	R	.	.	C	.	.	.	AB	C	C	R	C
Dyer Long	F	.	.	.	R	.	.	.	AB	AB	C	.	AB	.	AB	.	C	AB	C	C	C
	Sur	.	.	.	.	.	.	.	.	C	.	.	C	.	.	.	.	.	AB	.	R
Pleasant	F	.	.	.	R	.	.	.	AB	C	.	.	AB	.	.	.	C	AB	C	C	C
	Sur	.	.	.	.	.	.	.	AB	.	.	.	AB	.	.	.	AB	.	AB	.	C
Branch	F	.	.	.	R	.	.	.	.	C	.	.	AB	.	.	.	.	AB	C	C	C
	Sur	.	.	.	.	.	.	.	.	.	.	.	AB	.	.	.	.	.	AB	.	AB
Long	F	R	.	.	C	.	.	.	AB	C	.	.	C	.	.	.	.	AB	C	C	C
Turner	F	.	.	.	.	.	.	.	.	C	.	.	AB	.	.	.	.	C	.	R	AB
Sheepscot	D	C	.	.	C	R?	.	.	AB	C	.	.	C	C	.	.	R	AB	C	C	C
	Sur	C	.	.	.	.	.	.	R	C	.	.	C	.	.	.	.	C	C	AB	AB
West Harbor	H	.	.	.	.	.	.	.	C	R	C	C	.	.	.	.	.	AB	C	C	C
Damariscotta Pond	H	C	C	R	R	.	.	.	AB	C	AB	.	C	C	AB	.	C	AB	C	C	R
	Sur	.	.	.	.	.	.	.	C	.	C	.	R	.	.	.	C	.	R	.	.
Damariscotta Lake	H	C	AB	R	R	.	.	.	AB	C	AB	.	C	C	AB	.	C	AB	C	C	R
	Sur	R	R	.	.	.	.	.	C	C	C	.	C	.	C	.	C	.	R	R	AB
Biscay	H	R	C	.	R	.	.	.	AB	.	.	.	C	C	.	.	C	C	C	C	R
	Sur	C	.	.	.	.	.	.	C	.	.	.	R	.	.	.	.	.	R	AB	AB
Pemaquid	H	R	R	.	R	.	.	.	AB	R	.	.	C	C	.	.	C	C	C	C	R
	Sur	.	.	.	.	.	.	.	AB	R	.	.	AB	.	.	.	C	.	C	R	AB
Muddy	H	.	.	.	.	.	.	.	.	C	.	.	AB	.	.	.	?	C	C	.	?
Duckpuddle	H	.	.	.	R	.	.	.	AB	C	.	.	AB	R?	.	.	C	C	C	C	C
McCurdy	H	.	.	.	R	.	.	.	AB	C	.	.	AB	.	.	.	C	C	C	.	C
	Sur	.	.	.	.	.	.	.	.	.	.	.	C	.	.	.	.	.	C	.	.
Webber (P. 1387)	H	.	.	.	R	.	.	R	C	R	.	.	C	.	.	.	C	C	C	C	C
	Sur	.	.	.	.	.	.	.	R	.	.	.	.	.	.	.	.	.	AB	.	.
Medomak	E	.	.	.	R	.	.	.	AB	AB	AB	.	AB	?	.	.	C	AB	AB	C	C
	Sur	.	.	.	.	.	.	.	.	C	.	.	C	.	.	.	.	.	AB	.	C

TABLE X. The distribution and abundance of fishes in the lakes and ponds — Concluded

Name of lake or pond	Reported by*	Land-locked Salmon	Chinook Salmon	Chum Salmon	Brook Trout	Togue (Lake Trout)	Brown Trout	Rainbow Trout	White Perch	Yellow Perch	Small-mouthed Bass	Large-mouthed Bass	Common Pickerel	Smelt	Alewife	Cusk (*Lota*)	Horned Pout	Eel	Sunfish	Sucker	Minnows** (several species)
Washington	E	.	.?	.	.	.	.	.	.	C	AB	.	R	.	.	.	C	AB	AB	C	C
Chickawaukie	E Sur	R .	. .	. .	. .	. .	. .	. .	AB .	AB .	AB C	. .	AB C	AB .	. .	. .	C .	AB .	AB C	AB .	AB AB
Mirror	E Sur	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	. .	R AB	. .	. .	. .	. .	R? .	. .	. .	. .
North	E Sur	. .	. .	. .	. .	. .	. .	. .	C R	C C	AB .	. .	AB C	.? .	AB .	. .	C .	AB .	AB C	C AB	AB AB
South	E Sur	. .	. .	. .	. .	. .	R .	. .	C .	C AB	AB C	. .	AB C	.? .	AB AB	. .	C .	AB .	AB C	C AB	AB C
Seven Tree	E Sur	R .	. .	. .	R .	. .	. .	. .	C .	C AB	AB .	. .	AB C	.? .	AB .	. .	C R	AB .	AB AB	C C	AB C
Round	E Sur	R .	. .	. .	R .	. .	. .	. .	C .	C R	C .	. .	C AB	R .	AB .	. .	C .	AB .	C AB	C .	C C
Crawford	E Sur	C .	. .	. .	R .	. .	. .	. .	AB C	. .	. .	. .	C C	AB .	. .	. .	C .	C .	R C	AB AB	C C
Lermond	E	R	.	.	R	.	.	.	AB	C	.	.	R	AB	.	.	R	C	R	C	C
Alford	E Sur	C .	. .	. .	C .	. .	. .	. .	AB R	.? .	. .	. .	R C	AB C	. .	. .	R .	C .	R R	C AB	AB AB
Fish	E Sur	R .	. .	. .	R .	. .	. .	. .	C .	C .	. .	. .	C AB	. .	. .	. .	C .	AB .	C AB	C .	C .
Hobbs	E Sur	R .	. .	. .	R .	. .	. .	. .	C R	C .	. .	. .	C C	. .	. .	. .	C .	AB .	C C	C R	C C
Sennebec	E Sur	R R	. .	. .	R .	. .	. .	. .	C R	C AB	C R	. .	C R	C .	. .	. .	C .	AB .	AB C	C C	AB .
Quantabacook	D Sur	R .	. .	. .	R .	. .	.? .	. .	C C	R R	AB AB	. .	AB AB	C .	. .	. .	AB AB	AB .	C C	AB AB	C R
Stevens	D	.	.	.	.	.	.	.	.	AB	AB	.	AB	.	.	.	AB	AB	C	.?	R
St. George	D Sur	R R	. .	. .	R? .	. .	. .	. .	AB AB	R R	AB AB	. .	R .	R R	. .	. .	R .	C .	C C	R R	AB AB
Megunticook	D Sur	C C	C .	R? .	R R	. .	R .	. .	AB AB	R AB	AB AB	. .	R C	C .	. .	. .	R? R	AB .	C C	C .	C AB
Norton	D Sur	R? .	R? .	. .	R C	. .	. .	. .	R C	R C	C AB	. .	R R	C .	. .	. .	R? .	C .	R .	R C	C .
Pitcher	D Sur	. .	. .	. .	. .	. .	. .	. .	C AB	C C	C C	. .	C AB	R .	AB AB	. .	R .	AB .	C C	R .	C C
Knight	D Sur	. .	. .	. .	. .	. .	. .	. .	R .	C C	C R	. .	C .	R .	AB AB	. .	C .	AB C	C C	R .	C R
Tilden	D Sur	. .	. .	. .	. .	. .	. .	. .	R .	R R	AB C	. .	C R	R .	AB .	. .	.? .	C .	C .	R .	C C
Cross	D Sur	. .	. .	. .	. .	. .	. .	. .	. .	C C	. .	. .	C .	. .	. .	. .	C .	C .	C C	R .	R C
Mixer	D Sur	R .	. .	. .	R .	. .	. .	. .	. .	. .	. .	. .	. .	R .	. .	. .	. .	. .	C AB	. .	R AB
Sanborn	W Sur	. .	. .	. .	. .	. .	. .	. .	. .	C .	. .	. .	C .	.? .	. .	. .	C .	C .	C .	C .	C .
Dutton (P. 1463)	W Sur	. .	. .	. .	. .	. .	. .	. .	? .	C AB	.? .	. .	C R	.? .	. .	. .	C .	C .	C AB	C .	C C
Passagassawaukeag	W Sur	. .	. .	. .	. .	. .	. .	. .	C .	C R	C .	. .	R R	.? .	. .	. .	C .	C .	C AB	C R	R C
Swan	W Sur	R .	AB R	R? .	C C	. .	. .	R .	. .	AB R	AB AB	. .	. .	C .	. .	. .	R R	C .	R .	C AB	R C
Toddy	W Sur	. .	. .	. .	. .	. .	. .	. .	C .	C .	C AB	. .	C C	.? .	. .	. .	C .	C .	C C	C .	R .

*Reports were by the following Deputy Wardens: (D) Arnold Davis, (E) William Davis, (F) Winfield Foster, (H) Charles Head, (R) Stanley Richardson, and (W) Duane Whitten. Estimates based on survey collections are indicated by (Sur).
**The term minnow is here used to include several species of cyprinids and the Banded Killifish (*Fundulus*).

during which the nets took 36 salmonids. In comparison, the 6 Rangeley lakes, with a combined area of 38,000 acres, were fished during the summer of 1939 with similar gill nets for a total of 1,145 ¾ hours of fishing which caught 280 salmonids; these Rangeley lakes had been stocked during the preceding 6 years with an average of 720,000 salmonids per year (Cooper, 1940). Thus, in the Rangeleys which had been stocked with 2 1/3 times as many fish per unit of area, the gill nets caught 11 times as many salmonids per hour of fishing than were caught in the 7 best trout and salmon lakes of the present area. The obvious fact is that the better trout and salmon lakes of the present coastal area of Maine do not have so large populations of salmonids as are present in the Rangeleys, not even in proportion to the extent of artificial stocking. The fact that there are relatively few salmonids in the better trout and salmon lakes of the area under consideration can not be attributed largely to a poor selection of lakes in the recent stocking program, for of the 1,203,000 salmonids planted in the 26 lakes during the 8 years previous to the survey, 824,000 (see Table XIX) or 68 per cent were planted in lakes which were found by the survey to have excellent, good or fair water for salmonids (see page 49). Rather, the smaller population of salmonids in these lakes can, in the writer's opinion, be attributed to the abundance of, and competition by, several species of warm-water game fishes.

Further notes on the distribution and abundance of the fishes known, or believed, to occur in the present group of lakes are given in the following annotated list. All records of fish distribution cited in this list are based on either survey collections or reports by the Fish and Game Wardens; i.e., no records from the literature are cited.

Family **Clupeidae,** Herrings

Alewife (*Pomolobus pseudo-harengus*). The spawning run of the Alewife from salt water extends to, and the species tends to be very abundant in, most of the lakes of the present coastal area which are accessible to the fish. The run reaches Nequasset Pond from the lower Kennebec tidal waters; a large population of young was encountered in this pond on August 16. Alewives run the lower Sheepscot River and one of its tributaries (the Dyer River) for about 10 miles up to Dyer Long Pond where the species is abundant. They are reported to be abundant in both Damariscotta Pond and Damariscotta Lake. In the St. George River the run, in abundance, reaches North, South, Seven Tree and Round ponds. In the Ducktrap River it reaches Pitcher, Knight and Tilden ponds.

Family **Osmeridae,** Smelts

Smelt (*Osmerus mordax*). The Smelt was collected by gill nets and seines from only 3 lakes. So few were taken as to indicate that the species is very rare in this area; but this is undoubtedly not the case. That the Smelt occurs, and is fairly common, in at least one-third of the present group of lakes was reported by the Fish and Game Wardens, and their reports were substantiated by the frequent occurrence of smelts in stomachs of game fishes from the area. It is probably true, however, that the fresh-water Smelt is not nearly so abundant in these lakes as it should be to provide an adequate food supply for salmon and trout.

Family **Salmonidae,** Trouts and salmons

Chum or Dog Salmon (*Oncorhynchus keta*). Fingerling Chum Salmon (native to the West Coast of North America) were introduced during 1938 into lakes of the present area, as follows: 29,000 in Damariscotta Lake during July, 59,000 in Megunticook Lake during June and July, and 25,000 in Swan Lake during June. Assuming a normal rate of growth in these lakes, these Chums should have reached a weight of several pounds by the summer of 1941. Under any conditions they should have been large enough to be caught by the experimental gill nets. The failure to catch any Chum Salmon by the 14 gill net sets in these 3 lakes seems to be proof that these introductions were not particularly successful.

Chinook or King Salmon (*Oncorhynchus tshawytscha*). The Chinook or King Salmon is also a native of the West Coast; it has been introduced into numerous lakes of southern Maine during the past several years. The 8 lakes of the present area into which it has been introduced are mostly the larger lakes of this region. The introduction of the Chinook has been much more successful than that of the Chum. The best success from Chinook plantings in the present area has been obtained in Swan and Damariscotta lakes, judging from the wardens' reports which are based on a knowledge of fishermen's catches. In these two lakes the Chinook commonly attains a weight of from 6 to 10 pounds.

Land-locked Salmon (*Salmo sebago*). The Land-locked Salmon is not native to any of the present group of lakes. The 9 lakes into which it has been planted during the past 8 years are mostly the larger lakes of this area. The best lake of the area for this species, from the standpoint of water supply, is Sheepscot Pond; other suitable salmon waters include Swan, Biscay, China, St. George, Megunticook, and

Damariscotta Lake. Our gill netting indicated that the native (to Maine) Landlock is much more abundant than is the Chinook in the present group of lakes, even though the two species have been planted in about equal numbers over the past 8 years, from which fact it might be argued that our native salmon should receive the most attention in future plantings.

Brown Trout (*Salmo trutta*). Plantings of Brown Trout have been made in 8 lakes and ponds of the area of which only 2 lakes (China and St. George) may be regarded as "trout water." The extensive plantings in China Lake were distributed throughout the years of 1936 to 1941, and the fish of the earlier plantings should have been large enough to be caught in the gill nets. The absence of Browns in our collections is evidence that the species is not being established very successfully.

Rainbow Trout (*Salmo gairdnerii irideus*). Recent plantings of Rainbow Trout were made in tributaries of Sennebec and Quantabacook ponds, in Weber Pond in Vassalboro, China Lake, Webber Pond in Bremen, and in Unity Pond. The recent plantings of several hundred adult Rainbows in Unity Pond produced, according to reports by local fishermen, some Rainbow fishing in the outlet of this pond. Our collecting was not sufficient to evaluate these Rainbow plantings. The reports by wardens indicate that the species is rare, and confined to 3 lakes, in this area.

Togue or Lake Trout (*Cristivomer n. namaycush*). The possibility of Togue being present in lakes of the present area is based on the limited plantings made in China Lake and the slight possibility of the species occurring in Sheepscot Pond. Potentially the best Togue water in the area is Sheepscot Pond, but the 3 gill net sets in fairly deep water in Sheepscot did not catch any Togue. It is probable that plantings of this species in Sheepscot would be successful.

Brook Trout or "Square-tail" (*Salvelinus f. fontinalis*). The extensive plantings of the native Brook Trout in this area have been made mostly in tributary streams, but the species has also been planted more widely in lakes of the area than has any other salmonid, and particularly in many of the smaller ponds. The water analyses revealed that most of the smaller ponds are not suitable Brook Trout waters. The scarcity of Brook Trout in the gill net collections, except from Swan Lake, is in agreement with the wardens' reports to the effect that the species is rare or absent in most lakes of this area. In addition to some of the larger lakes such as Swan, Sheepscot and Megunticook, which contain both trout and salmon, the best of the smaller trout ponds include Spectacle, Mirror, Biscay, Sanborn and Passagassawaukeag ponds.

Family **Catostomidae** Suckers

Common Sucker (*Catostomus c. commersonnii*). The Common Sucker is one of the most abundant of the larger fishes in the present group of lakes, judging from the results of the gill net and seine collections. Of the fishes taken by gill net from the 20 lakes in which gill nets were fished, the 446 suckers had a greater combined weight than that of any other species; in half of these lakes the aggregate weight of the suckers was more than that of all other species combined. Lakes in which the Common Sucker was found to be particularly abundant include Swan, Sheepscot, Quantabacook and China. The species is very rare in St. George Lake, judging from results of the extensive gill netting and seining in this lake.

Family **Cyprinidae,** Minnows

Of the 7 species of minnows listed below, the Fallfish, Creek Chub, and Common Shiner usually occur in streams rather than in lakes; and their scarcity in the present group of lakes should not be construed to mean that they are necessarily scarce in the streams of this region.

Fallfish (*Leucosomus corporalis*). Our records of collecting this typically stream minnow are for three lakes: Damariscotta Lake, Three-mile Pond and Weber Pond in Vassalboro.

Creek Chub (*Semotilus a. atromaculatus*). A single specimen from Swan Lake is the only record for this species.

Lake Chub (*Couesius p. plumbeus*). This typically lake minnow is apparently rare in the present coastal area of Maine. The only records of the Lake Chub are of three specimens from Swan Lake.

Fine-scaled Dace (*Pfrille neogaea*). An abundant population of this fish was encountered in Mixer Pond, but the species was found in no other waters.

Red-bellied Dace (*Chrosomus eos*). Three specimens of this dace were obtained from Mixer Pond in the same collection with the Fine-scaled Dace, its common associate.

Common Shiner (*Notropis c. cornutus*). A single specimen from Unity Pond was the only record for this species.

Golden Shiner (*Notemigonus c. crysoleucas*). The Golden Shiner is the only species of true minnow which is abundant and widespread in the present group of lakes. Consequently it is the only minnow of much potential value as food for game fishes in these lakes.

Family **Ameiuridae,** Bullheads

Horned Pout or Brown Bullhead (*Ameiurus n. nebulosus*). This unpopular (in Maine) food fish occurs in most of the present group of lakes, where it is mostly common in abundance. The individuals taken by gill net were mostly from 8 to 10 inches in length. The species was found to be especially abundant in Quantabacook and Pleasant ponds.

Family **Esocidae,** Pickerel

Common Pickerel or Chain Pickerel (*Esox niger*). The native pickerel and the Yellow Perch are the two most widespread species of game fishes in lakes of the region. The wardens reported the Pickerel to be common or abundant in most of the lakes, and the net collections, in general, substantiated their reports. The absence of pickerel in Swan Lake is noteworthy, and fortunate in view of the value of this lake for salmonids.

Family **Anguillidae,** Eels

Eel (*Anguilla bostoniensis*). The Eel was reported by the wardens to be common or abundant in every lake except Mixer and Mirror ponds. The proximity of these lakes to salt water, and the Eel's ability to surmount obstacles in its upstream migration account for the abundance of this fish in the area. The gill nets failed to catch eels in these lakes, except for one individual from Sheepscot Pond, because of the Eel's ability to escape from these nets. It was common experience to find a ring of slime completely covering the thread of a single mesh of the gill net, unquestionably left by an eel.

Family **Cyprinodontidae,** Killifishes

Banded Killifish (*Fundulus d. diaphanus*). The Banded Killifish or top-minnow is a fresh-water, close relative of the salt-water Mummichog. Our seining records indicated that it is, by far, the most abundant and widespread species of forage fish in shallow waters in

the present group of lakes. The Killifish is much more abundant in this central coastal region of Maine than it was found to be, during the summers of 1938 and 1940, in Maine lakes on the west side of the Kennebec River (Cooper, 1939b and 1941).

Family **Moronidae,** River basses

White Perch (*Morone americana*). The White Perch is undoubtedly the most abundant species of game fish in lakes of the present region, and it is probably the most important lake fish of the area to the fishermen. The 102 gill net sets took 1,170 White Perch as compared to 948 individuals of all other species and 340 individuals of all other species of game fishes. Also, the wardens reported the species as being abundant in 27 of these lakes. Our gill net catches indicated that the species is particularly abundant in Pemaquid, Threemile, St. George, Pleasant, Pitcher and Megunticook. The apparent absence of White Perch in Swan Lake, Sanborn Pond and Mirror Lake is fortunate, in view of the value of these lakes for salmonids.

Family **Percidae,** Perches

Yellow Perch (*Perca flavescens*). The Yellow Perch and the Common Pickerel are the most widespread species of game fishes in these lakes. The Yellow Perch is more widespread, but, according to the gill net catches, much less abundant than the White Perch. The Yellow Perch is less popular than the White Perch among fishermen, because it does not reach so large a size on the average, and it is commonly infested with "grubs."

Family **Centrarchidae,** Basses and sunfishes

Small-mouthed Black Bass (*Micropterus d. dolomieu*). This species of bass has been so widespread and abundant throughout the waters of southern Maine for so long that it may be in order to remind Maine fishermen that it is not native to this State. According to Hubbs and Bailey (1938) the original distribution of the Small-mouthed Bass extended eastward to the region of Lake Champlain in eastern Vermont. The distribution of the smallmouth in the present coastal area of Maine is spotty due to the fact that the species has not been introduced into certain stream systems. The bass is apparently not present in lakes of the upper Sheepscot River drainage (Pleasant, Branch, Long, Turner and Sheepscot), in the Pemaquid River drainage (Biscay, Pemaquid, Muddy, Duckpuddle and McCurdy), in the Crawford Pond drainage (Crawford, Lermond, Alford, Fish and Hobbs), and in several other ponds of the area. In the 33 lakes of the present region in which the Small-mouthed Bass does occur, this species, together with the White Perch and (to a lesser extent) the salmonids, affords most of the lake fishing.

Large-mouthed Black Bass (*Huro salmoides*). Our only record that the Large-mouthed Bass might occur in the present region is the Warden's report that the species is reported to be common in West Harbor Pond.

Red-bellied Sunfish (*Lepomis auritus*). This is the rarer of the two species of sunfishes in Maine. The net collections contained a total of 100 specimens from 7 lakes, as compared to 4,226 specimens of the Pumpkinseed Sunfish from 39 lakes. The distribution of the Red-bellied Sunfish in the present area is confined to lakes which are tributary to the Kennebec River and to Toddy Pond which is tributary to the Penobscot; none were taken from lakes tributary to the several coastal rivers between the Kennebec and Penobscot.

Pumpkinseed or Common Sunfish (*Lepomis gibbosus*). According to the netting records the Pumpkinseed is the most widespread species of fish in the present group of lakes, and one of the most abundant species on the lake shallows. According to the wardens' reports it occurs in almost all of these lakes.

Family **Gasterosteidae,** Sticklebacks

Nine-spined Stickleback (*Pungitius pungitius*). Our only record for this species is a single specimen from Swan Lake.

Family **Gadidae,** Codfishes

Cusk (*Lota lota maculosa*). The only record for this species in the present group of lakes is the Warden's report that it is present in Unity Pond.

FOOD HABITS OF FISHES

The present account of the food habits of fishes is based on examinations of the stomach contents of 1,124 White Perch (*Morone americana*), 290 Small-mouthed Bass (*Micropterus d. dolomieu*), 95 Common Pickerel (*Esox niger*), 108 Yellow Perch (*Perca flavescens*), 101 Common Sunfish (*Lepomis gibbosus*), 44 Horned Pout (*Ameiurus n. nebulosus*), 17 Land-locked Salmon (*Salmo sebago*), 6 Chinook Salmon (*Oncorhynchus tshawytscha*) and 133 Brook Trout (*Salvelinus f. fontinalis*). These 1,918 individuals of the 9 species were collected from 44 lakes and ponds in Maine. Twenty of these lakes were of the group studied by the 1941 survey (for their locations, see Table I); all fishes from these lakes were collected during the period from June 21 to September 10, 1941. Most of the remaining 24 lakes are located in the southwestern part of the state, and were studied by the 1937 and 1938 lake survey parties. The fish from these 24 lakes were collected during the period from August, 1936 to October, 1941, mostly during the summer months. The locations of these 24 lakes, by township and county, are as follows:

Bunganut Pond, P. 56, Lyman in York.
Mousam Pond, P. 63, Shapleigh in York.
Lone Pond, P. 96, Waterboro in York.
Moose Pond, P. 182, Bridgton in Cumberland.
Beaver Pond, P. 183, Bridgton in Cumberland.
Burnt Meadow Pond, P. 195, Brownfield in Oxford.
Long Pond, P. 211, Denmark in Oxford.
Trickey Pond, P. 303, Naples in Cumberland.
Long Lake, P. 309, Harrison in Cumberland.
Stearns Pond, P. 315, Sweden in Oxford.
Moose Pond, P. 319, Waterford in Oxford.
Bear Pond, P. 321, Waterford in Oxford.
Keoka Lake, P. 322, Waterford in Oxford.
Crystal Lake, P. 324, Harrison in Cumberland.
Long Pond, P. 332, Waterford in Oxford.
Thomas Pond, P. 356, Casco in Cumberland.
Rattlesnake Pond, P. 359, Casco in Cumberland.
Sabbathday Lake, P. 372, New Gloucester in Cumberland.
Torsey Pond, P. 678, Mount Vernon in Kennebec.
Long Pond of Belgrades, P. 713, Rome in Kennebec.
Great Pond of Belgrades, P. 719, Belgrade in Kennebec.
Pushaw Pond, Hudson in Penobscot.
South Branch Lake, Sebeois in Penobscot.
Rainbow Deadwater, T. 2, R. 11 in Piscataquis.

The numbers of each species examined from each of the lakes are given in the accompanying tables. Of the 1,918 fish considered here, the following were collected by hook and line: 109 of the bass from St. George Lake, the one bass from Torsey Pond, the 7 bass from Long Pond of the Belgrades, the 9 bass from South Branch Lake, one of the Land-locked Salmon from Sheepscot Pond, the one Land-locked Salmon from Crawford Pond, the one Brook Trout from Long Pond of the Belgrades, and the 90 Brook Trout from Rainbow Deadwater; the following were collected by seine: the 40 White Perch from Alford Lake, the 17 Common Sunfish from Chickawaukie Pond, and the 69 Common Sunfish from Pitcher Pond; and the remaining 1,573 fish were collected by experimental gill nets. These nets were of the type described on page 76, or of a similar type, and were designed to catch fish of various sizes above a length of approximately 6 inches. The collections of bass by hook and line from St. George Lake contained many 4- to 6-inch fish, but practically all of the other fish were of an adult size or were over 6 to 8 inches in length. The fish collected by gill nets were taken by both over-night and daylight sets, but the great majority were taken by the former. To recapitulate, the data from this study represent food habits mostly of adult-sized fish in southern Maine lakes during the summer months, and mostly of fish caught by nets at night.

Viscera of the fish were preserved in formalin within a few hours after the fish were collected. In the laboratory analyses, only the contents of the stomachs were considered. The total volume of all food in each stomach was first measured by water displacement; then the number of each type of organism was counted, and the volume of each type was measured by displacement. Remains of bait, when recognizable as such, were excluded from the tabulations. The precision obtained in the measurements of volume of organisms was similar to that obtained in the measurements of the bottom fauna (see page 67). Many of the food organisms were identified to families, genera or species, but mostly they have been lumped into major taxonomic groups for this report. Also the data for different dates and for different sizes of fish have been lumped, in part, thus giving summaries for the individual lakes. In the case of large collections, particularly of White Perch and Small-mouthed Bass from St. George Lake and Brook Trout from Rainbow Deadwater, the data are summarized according to size of fish, date of collection, type of gear used in the collection, or time of day. The volumes and numbers of the different types of food organisms found in the stomachs of the fish, along with the numbers and lengths of the fish examined and the dates of collection, are given by lake for the different species in Tables XI and XIII to XVII. Totals for all lakes are given for each species of fish at the bottom of the tables.

White Perch. (See Table XI.) The 1,124 White Perch were from 17 lakes of the present coastal area, and were all collected during the summer of 1941. Nearly half (458) of these perch were from St. George Lake, and Pemaquid and Threemile ponds were also repre-

sented by particularly large collections. Therefore the totals given for all perch at the bottom of Table XI do not represent averages for the individual lakes. These White Perch ranged from 5.3 to 14.7 inches in total length, and the great majority were from 6 to 10 inches in length. Of the 1,124 fish, 988 had food in their stomachs — a total of 230,752 organisms of 730.984 c.c. in volume. This food was mostly crustaceans, aquatic insects, and fish. From the standpoint of volume the most important types of food organisms were smelt, Mayfly nymphs, fresh-water shrimp, and cladocerans. Numerically the minute water fleas and shrimp far outnumbered all other types of food organisms. The degree to which 6- to 10-inch, and even larger, White Perch feed on the small water fleas and shrimp is indicated by the occurrence of approximately 63,500 water fleas and 57,000 shrimp in the stomachs of those 443 perch from St. George Lake which contained food. In addition to the Mayfly nymphs, other important aquatic insects were dragonfly nymphs, *Sialis* larvae and midge larvae. Ants were the only terrestrial insects of much importance. It is noteworthy that the Smelt was the only important fish item in the diet. The volumes, by per cent, of the different types of food organisms in the 1,124 White Perch, with the types of food listed in more detail than is given in Table XI, are as follows:

Leeches	0.50	Adult terrestrial beetles	0.03
Gordioidea	0.00+	Adult Neuroptera	0.07
Water fleas	9.75	Ants	6.09
Fresh-water shrimp	13.47	Other Hymenoptera	0.00+
All crustaceans	**23.22**	Adult Diptera	0.01
Alderfly larvae	3.94	**All terrestrial insects**	**6.90**
Mayfly nymphs	15.82	Water mites	0.00+
Dragonfly nymphs	3.89	Pill clams	0.10
Damselfly nymphs	0.23	Snails	0.03
Stonefly nymphs	0.02	**All molluscs**	**0.13**
Water boatmen	0.03	Alewives	0.14
Back swimmers	0.01	Smelt	33.18
Beetle larvae	0.09	Banded Killifish	0.06
Caddisfly larvae	1.27	Horned Pout	0.02
Midge larvae	2.50	White Perch	2.18
Mosquito larvae	0.93	Yellow Perch	0.06
Other Diptera pupae	0.00+	Sunfish	1.92
Chauliodes larvae	0.00+	Fish remains	2.02
All aquatic insects	**28.73**	**All fish**	**39.58**
Adult Mayflies	0.70	Vegetation and debris	0.94
		Total	100.00

A comparison of the present data on food habits of the White Perch with the data on stomach contents of perch collected during previous summers from other Maine lakes reveals some pronounced differences in the principal types of food eaten. The results of stomach analyses on 1,252 fish collected during the summer of 1940 from 25 lakes in the Androscoggin and Kennebec River drainages were published in Fish Survey Report No. 4 (Cooper, 1941: Table XI).

TABLE XI. Volumes in cubic centimeters and numbers (in parentheses) of food organisms in stomachs of 1,124 White Perch from 17 lakes

Name of lake or pond	Date of collection: 1941	Fish examined: Number of fish; and number of fish, in (), containing food	Fish examined: Range in total length in inches	Fish examined: Total stomach contents	Water fleas (Cladocera)	Fresh-water shrimp (Amphipoda)	Alderfly larvae (*Sialis*)	Mayfly nymphs (Ephemerida)	Dragonfly and Damselfly nymphs (Odonata)	Caddisfly larvae (Trichoptera)	Midge larvae (Chironomidae)	Mosquito larvae (*Corethra*)	Miscellaneous aquatic invertebrates*	Terrestrial insects**	Pill clams and snails (Mollusca)	Smelt (*Osmerus mordax*)	White Perch (*Morone americana*)	Sunfish (*Lepomis*)	Other fish*** and fish remains	Plant remains and misc. debris
pectacle	Aug. 12	1(1)	12.4	1.31 (6)	....	......	....	......	0.01 (1)	....	......	....	....	......	....	......	....	1.3 (5)	....	....
Threemile	June 30–July 1	122(78)	6.2–7.6	9.9 (15,825)	4.111 (15,329)	0.038 (22)	....	2.778 (55)	....	0.159 (18)	0.402 (154)	0.455 (225)	0.006 (3)	1.147 (12)	....	......	....	....	0.049 (2)	0.755 (5)
	July 1	2(2)	11.8–11.9	0.2 (6)	....	......	....	0.098 (2)	....	0.022 (2)	......	....	....	......	....	......	....	....	0.08 (2)	....
China	June 26–27	23(16)	6.2–7.7	0.846 (4437)	0.488 (4221)	......	....	0.018 (3)	....	0.034 (50)	0.163 (158)	0.003 (2)	0.001 (3)	......	....	......	....	....	....	0.139 ....
	Aug. 3–5	35(21)	6.2–7.5	2.337 (2065)	0.497 (1272)	0.138 (107)	0.166 (17)	0.293 (61)	0.068 (4)	0.06 (12)	0.378 (496)	0.03 (22)	0.175 (25)	0.077 (6)	0.06 (39)	......	....	....	0.329 (3)	0.066 (1)
	Aug. 5	3(2)	8.5–10.3	0.8 (43)	....	......	0.09 (5)	0.499 (8)	....	0.01 (2)	0.002 (2)	....	....	0.199 (26)	....	......	....	....	....	....
Pleasant	Aug. 24–26	39(38)	6.6–11.7	6.649 (4581)	1.007 (3437)	0.017 (21)	....	0.754 (61)	0.493 (4)	0.303 (22)	0.473 (376)	1.239 (629)	0.002 (1)	0.076 (26)	....	......	....	1.64 (1)	0.06 (3)	0.585 ....
Sheepscot	June 25–Sept. 10	13(13)	6.2–9.8	3.42 (3546)	1.359 (2735)	0.353 (142)	0.082 (8)	0.51 (28)	0.2 (12)	0.26 (27)	0.072 (65)	0.057 (29)	0.014 (3)	0.307 (494)	....	0.156 (2)	....	....	0.05 (1)	....
Damariscotta Pond	July 31–Aug. 1	17(15)	6.3–12.6	5.692 (396)	....	0.358 (193)	1.088 (89)	0.482 (23)	0.95 (9)	0.055 (10)	0.043 (51)	....	0.008 (2)	0.31 (7)	....	0.1 (1)	....	....	1.013 (11)	1.285 ....
Damariscotta Lake	July 30	7(6)	6.7–10.4	6.48 (42)	....	0.02 (13)	0.02 (2)	0.08 (3)	4.95 (16)	....	......	....	....	0.025 (2)	0.03 (1)	0.32 (3)	....	....	0.65 (2)	0.385 ....
Biscay	Aug. 2–9	22(22)	6.1–9.5	9.913 (5479)	2.396 (3578)	0.019 (6)	0.223 (19)	0.175 (17)	3.235 (32)	0.275 (25)	0.084 (32)	1.64 (1758)	....	0.036 (2)	0.01 (7)	1.82 (3)	....	....	....	....
Pemaquid	July 29–Aug. 1	144 (117)	5.9–10.0	22.726 (6720)	1.78 (3822)	0.773 (487)	0.105 (13)	7.814 (202)	6.131 (28)	0.538 (87)	1.114 (677)	1.745 (1179)	0.132 (23)	1.685 (184)	0.038 (14)	......	....	0.2 (2)	0.176 (2)	0.495 ....
	July 29–30	3(1)	13.1–14.8	1.2 (1)	....	......	....	......	....	....	......	....	....	......	....	......	1.2 (1)	....	....	....

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North	July 24	1(1)	9.8	0.02 (7)	....	......	0.008 (1)	0.007 (1)	....	....	0.003 (2)	0.002 (3)	....	....	....	....	....	....	....	....
Crawford	July 22–23	22(15)	6.5–9.9	1.79 (509)	0.038 (100)	......	....	......	0.004 (1)	0.074 (69)	0.568 (226)	0.186 (100)	0.019 (3)	0.107 (3)	0.002 (1)	0.5 (4)	....	....	0.103 (2)	0.189
Alford	Sept. 3	40(38)	5.7–7.9	55.21 (5303)	....	0.002 (1)	....	0.048 (4)	0.19 (7)	....	0.012 (9)	....	0.117 (14)	26.579 (5232)	....	26.962 (32)	....	....	1.3 (4)	....
Sennebec	June 29	4(3)	6.9–7.8	1.5 (10)	....	......	0.01 (1)	......	0.44 (2)	....	0.008 (2)	0.002 (1)	....	......	....	0.94 (3)	....	....	0.1 (1)	....
Quantabacook	July 8–Sept. 6	62(54)	5.3–14.5	144.713 (6597)	0.163 (443)	0.006 (6)	0.019 (4)	0.339 (32)	0.93 (13)	0.001 (1)	0.11 (41)	0.9 (700)	0.005 (4)	16.82 (5262)	....	105.42 (65)	13.22 (6)	....	6.61 (18)	0.17 (2)
St. George	June 21–23	32(31)	6.7–13.0	17.25 (5468)	2.776 (2590)	4.127 (1993)	5.916 (295)	1.651 (150)	0.939 (24)	0.555 (89)	0.376 (248)	0.05 (38)	0.106 (13)	0.383 (26)	0.001 (1)	......	....	....	0.1 (1)	0.27
	Aug. 21–30	83(83)	5.9–7.4	59.108 (34,888)	1.372 (2303)	30.789 (27,159)	0.608 (48)	21.66 (3066)	0.205 (6)	0.937 (280)	1.863 (1935)	....	1.515 (66)	0.009 (2)	....	......	....	....	0.035 (1)	0.115 (22)
	Aug. 15–30	71(69)	5.3–9.2	43.744 (22,119)	9.328 (17,942)	6.167 (2908)	3.159 (201)	2.394 (290)	0.629 (5)	0.096 (16)	1.847 (664)	0.059 (13)	0.328 (5)	0.356 (10)	0.128 (25)	16.795 (24)	1.408 (6)	0.74 (5)	0.222 (3)	0.088 (2)
	Aug. 14–30	241(234)	7.4–10.3	221.63 (76,341)	23.27 (36,182)	42.261 (24,721)	11.909 (1109)	67.375 (8346)	5.22 (48)	3.756 (693)	6.656 (4663)	0.056 (22)	2.126 (85)	0.329 (42)	0.562 (197)	45.009 (93)	0.095 (1)	10.15 (75)	1.905 (18)	0.952 (46)
	Aug. 23–28	10(10)	7.8–11.6	13.03 (3615)	2.838 (2932)	0.535 (503)	0.232 (28)	1.773 (89)	....	0.001 (1)	0.066 (46)	....	0.13 (3)	......	....	7.45 (13)	....	....	....	....
	Aug. 16–27	11(10)	10.7–12.3	28.64 (2000)	2.5 (1585)	0.017 (8)	0.11 (7)	1.446 (126)	0.05 (1)	.....	0.932 (234)	0.001 (1)	....	0.019 (1)	0.007 (3)	22.525 (29)	....	....	1.033 (5)	....
	Aug. 22–23	10(6)	12.4–13.6	12.1 (34)	0.001 (6)	......	0.02 (1)	0.28 (2)	....	....	......	0.001 (1)	....	0.01 (1)	....	11.788 (23)	....	....	....	....
Megunticook	July 16–18	60(58)	7.6–12.7	42.832 (28,145)	16.767 (23,372)	10.536 (3493)	4.378 (279)	4.563 (374)	1.275 (17)	0.506 (53)	0.925 (495)	....	0.048 (19)	0.619 (18)	0.09 (8)	2.308 (2)	....	....	0.47 (15)	0.347
Pitcher	July 15–16	46(44)	7.2–11.2	17.944 (2569)	0.558 (310)	2.342 (953)	0.632 (83)	0.63 (97)	4.214 (22)	1.665 (110)	2.181 (771)	0.368 (153)	....	1.332 (57)	....	0.435 (5)	....	....	2.539 (8)	1.048
All White Perch	June 21–Sept. 10	1124 (988)	5.3–14.8	730.984 (230,752)	71.249 (122,159)	98.498 (62,736)	28.775 (2210)	115.667 (13,040)	30.133 (252)	9.307 (1567)	18.278 (11,347)	6.794 (4876)	4.736 (272)	50.425 (11,413)	0.928 (296)	242.528 (302)	15.923 (14)	14.03 (88)	16.824 (102)	6.889 (78)

* Includes worms of the class Gordioidea, leeches, aquatic beetle larvae, corixids and notonectids, stonefly nymphs, larvae of *Chauliodes*, and water mites.
** Includes adults of Neuroptera, Mayflies, beetles, flies, ants and other Hymenoptera. Ants made up 98% of this category.
*** Includes 2 Alewives, 2 *Fundulus diaphanus*, 1 Horned Pout and 1 Yellow Perch. Fish remains were unidentifiable to species; presumably they were mostly smelts.

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TABLE XII. Percentages of volumes and numbers of different types of bottom organisms in the bottom fauna, and percentages of volumes and numbers of each type of bottom organism to all bottom organisms in stomachs of White Perch

The table is based on a total of [illegible] bottom samples and [illegible] perch stomachs collected during the summer of [illegible] from 11 lakes.
For numbers of bottom samples and perch stomachs from each lake, see Tables VI and XI.
For locations of the lakes, see Table I. Percentages of less than 0.1 are listed as trace (tr.)

Name of lake or pond	Bottom organisms from:	[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		Other bottom organisms*	
		Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.	Vol.	No.
Threemile	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
China	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Biscay	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pemaquid	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Crawford	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Alford	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Quantabacook	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
St. George	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Megunticook	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Pitcher	Perch stomachs Bottom samples	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Totals for all perch stomachs Totals for all bottom samples		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

*Other bottom organisms include planarians, Chaoborus, stoneflies, corixids, notonectids, and aquatic moth larvae.

TABLE XIII. Volumes in cubic centimeters and numbers (in parentheses) of food organisms in stomachs of 290 Small-mouthed Bass from 19 lakes

Name of lake or pond	Date of collection*	Fish examined			Water fleas (Cladocera)	Crayfish (*Cambarus* sp.)	Alderfly larvae (*Sialis*)	Mayfly nymphs (Ephemerida)	Dragonfly nymphs (Anisoptera)	Caddisfly larvae (Trichoptera)	Stonefly nymphs (Plecoptera)	Midge larvae (Chironomidae)	Miscellaneous aquatic arthropods**	Mayfly adults (Ephemerida)	Ants (Formicidae)	Miscellaneous terrestrial arthropods***	Smelt (*Osmerus mordax*)	Common Sunfish (*Lepomis gibbosus*)	White Perch (*Morone americana*)	Other fish and fish remains****	Misc. animal matter and unidentified
		Number of fish; and number of fish, in ( ), containing food	Range in total length in inches	Total stomach contents																	
Threemile	July 1	1(1)	13.5	0.35 (1)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	..	0.35 (1)	..
China	June 27–Aug. 3	2(1)	8.0–18.9	0.07 (4)	....	..	...	...	..	...	...	...	...	0.07 (4)	...	...	....	..	..	....	..
Damariscotta Pond	Aug. 2	1(1)	15.6	0.1 (1)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	..	0.1 (1)	..
Quantabacook	Sept. 3–5	18(12)	7.4–17.8	25.49 (22)	....	..	...	...	..	...	...	...	...	...	...	...	22.99 (17)	..	1.5 (1)	1.0 (4)	..
St. George (Gill net)	June 21–22	7(3)	7.8–19.0	5.1 (10)	....	..	...	...	0.22 (2)	...	...	...	...	...	...	0.12 (1)	4.76 (7)	..	..	....	..
St. George (Gill net)	Aug. 14–30	63(32)	7.4–11.6	9.441 (960)	0.901 (821)	..	0.01 (1)	1.292 (43)	0.99 (4)	0.078 (6)	0.17 (2)	0.09 (20)	...	...	0.438 (39)	0.19 (1)	2.095 (6)	1.43 (6)	..	1.677 (10)	0.08 (1)
St. George (Gill net)	Aug. 14–26	40(13)	12.3–19.4	13.45 (76)	0.05 (42)	..	...	...	..	...	...	...	0.05 (1)	0.03 (2)	...	...	10.8 (26)	..	..	1.84 (5)	0.68 (7)
St. George (Gill net)	Aug. 27	3(2)	8.4–16.7	0.415 (2)	....	..	0.015 (1)	...	0.4 (1)	...	...	...	...	...	...	...	....	..	..	....	..
St. George (Hook and line)	Aug. 14–20	28(25)	4.4–7.4	6.01 (5594)	3.025 (5454)	..	0.015 (1)	0.483 (52)	..	0.033 (7)	0.155 (5)	0.001 (1)	0.156 (4)	0.12 (6)	0.98 (35)	0.292 (23)	0.62 (4)	..	..	0.13 (2)	..
St. George (Hook and line)	Aug. 22–29	53(38)	4.6–9.5	17.145 (1578)	1.721 (1296)	..	0.025 (1)	0.922 (82)	0.04 (1)	0.02 (5)	0.41 (7)	0.006 (6)	0.03 (1)	0.728 (61)	0.973 (108)	0.04 (4)	....	..	..	12.23 (6)	..
St. George (Hook and line)	Aug. 14–25	28(15)	7.4–11.3	3.21 (504)	0.645 (420)	..	0.015 (1)	0.115 (11)	0.06 (1)	...	0.12 (1)	...	0.01 (44)	0.155 (6)	0.37 (14)	0.25 (2)	0.5 (1)	..	..	0.97 (3)	..
Megunticook	July 15–18	6(3)	11.9–18.7	11.59 (6)	....	..	...	0.08 (2)	..	...	...	...	0.06 (1)	...	...	...	0.01 (1)	..	11.0 (1)	0.44 (1)	..
Pitcher	July 15–16	3(1)	9.9–15.7	1.5 (1)	....	..	...	...	..	...	...	...	...	...	...	...	....	1.5 (1)	..	....	..

Name of lake or pond	Date of collection*	Number of fish; and number of fish, in ( ), containing food	Range in total length in inches	Total stomach contents	Water fleas (Cladocera)	Crayfish (*Cambarus* sp.)	Alderfly larvae (*Sialis*)	Mayfly nymphs (Ephemerida)	Dragonfly nymphs (Anisoptera)	Caddisfly larvae (Trichoptera)	Stonefly nymphs (Plecoptera)	Midge larvae (Chironomidae)	Miscellaneous aquatic arthropods**	Mayfly adults (Ephemerida)	Ants (Formicidae)	Miscellaneous terrestrial arthropods***	Smelt (*Osmerus mordax*)	Common Sunfish (*Lepomis gibbosus*)	White Perch (*Morone americana*)	Other fish and fish remains****	Misc. animal matter and unidentified
Swan	July 13–15	6(3)	7.8–18.0	15.75 (21)	....	..	...	...	..	...	...	...	...	...	...	...	14.96 (14)	..	..	0.79 (7)	..
Totals for 8 lakes of 1941 Survey	June 21–Sept. 5	259(150)	4.4–19.4	109.621 (8780)	6.342 (8033)	..	0.08 (5)	2.892 (190)	1.71 (9)	0.131 (18)	0.856 (15)	0.097 (27)	0.306 (51)	1.103 (79)	2.761 (196)	0.892 (31)	56.735 (76)	2.93 (7)	12.5 (2)	19.527 (40)	0.76 (1)
Bunganut Pond (P. 56)	Aug. 4–11, 1937	2(1)	12.8–16.5	0.06 (21)	0.06 (21)	..	...	...	..	...	...	...	...	...	...	...	....	..	..	....	..
Long Lake (P. 309)	July 8, 1938	1(0)	15.0	0.0 (0)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	..	....	..
Bear Pond (P. 321)	July 29, 1938	4(1)	11.6–15.4	0.1 (2)	....	..	...	0.02 (1)	..	...	...	...	...	...	...	...	....	..	..	0.08 (1)	..
Crystal Lake (P. 324)	July 28, 1938	1(0)	10.7	0.0 (0)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	..	....	..
Long Pond (P. 332)	Aug. 4, 1938	1(0)	11.2	0.0 (0)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	..	....	..
Thomas Pond (P. 356)	Aug. 19, 1938	1(0)	17.5	0.0 (0)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	..	....	..
Rattlesnake Pond (P. 359)	Aug. 23, 1938	3(1)	9.6–13.1	1.0 (1)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	1.0 (1)	....	..
Torsey Pond (P. 678)	June 24, 1937	1(0)	14.2	0.0 (0)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	..	....	..
Long Pond of Belgrades (P.713)	Aug., 1936 to June, 1937	7(6)	10.5–13.6	16.5 (39)	....	13.0 (5)	...	0.02 (1)	1.0 (4)	...	...	...	...	0.05 (3)	0.04 (4)	0.69 (18)	....	..	..	1.7 (4)	..
Pushaw Pond	Sept. 27, 1937	1(1)	17.1	0.14 (1)	....	..	...	...	..	...	...	...	...	...	...	...	....	..	..	0.14 (1)	..
South Branch Lake	June 2, 1938	9(4)	12.9–17.2	1.805 (18)	....	..	...	...	1.45 (4)	0.03 (1)	...	...	0.01 (2)	...	0.2 (7)	0.115 (4)	....	..	..	....	..
Totals for 11 other lakes	Aug., 1936 to Aug., 1938	31(14)	9.6–17.5	19.605 (82)	0.06 (21)	13.0 (5)	...	0.04 (2)	2.45 (8)	0.03 (1)	...	...	0.01 (2)	0.05 (3)	0.24 (11)	0.805 (22)	....	..	1.0 (1)	1.92 (6)	..
Totals for all lakes	Aug., 1936 to Sept., 1941	290(164)	4.4–19.4	129.226 (8862)	6.402 (8054)	13.0 (5)	0.08 (5)	2.932 (192)	4.16 (17)	0.161 (19)	0.855 (15)	0.097 (27)	0.316 (53)	1.153 (82)	3.001 (207)	1.697 (53)	56.735 (76)	2.93 (7)	13.5 (3)	21.447 (46)	0.76 (1)

* For the first 8 lakes, the dates of collection were in 1941.

** Includes amphipods, aquatic Hemiptera, *Chauliodes* larvae, aquatic Diptera pupae (other than midges), aquatic Coleoptera larvae, and water mites.

*** Includes adult damselflies, adult dragonflies, Homoptera, adult beetles, grasshoppers, wasps, and spiders.

**** Includes 1 Small-mouthed Bass, several spiny-rayed fishes, and probably the remains of many unidentified smelts.

TABLE XIV. Volumes in cubic centimeters and numbers (in parentheses) of food organisms in stomachs of 95 Pickerel (*Esox niger*) from 20 lakes

Name of lake or pond	Date of collection*	Fish examined: Number of fish; and number of fish, in ( ), containing food	Fish examined: Range in total length in inches	Fish examined: Total stomach contents	Dragonfly nymphs (Anisoptera)	Smelt (*Osmerus mordax*)	Chinook Salmon (*Oncorhynchus tshawytscha*)	Golden Shiner (*Notemigonus c. crysoleucas*)	Horned Pout (*Ameiurus n. nebulosus*)	Common Pickerel (*Esox niger*)	White Perch (*Morone americana*)	Yellow Perch (*Perca flavescens*)	Common Sunfish (*Lepomis gibbosus*)	Fish remains	Frogs	Frog tadpoles
Spectacle	Aug. 13	3(1)	17.7–18.8	6.7 (1)	....	....	....	....	....	....	....	....	....	....	6.7 (1)	....
Threemile	July 1	3(0)	18.0–23.1	0.0 (0)	....	....	....	....	....	....	....	....	....	....	....	....
China	Aug. 4–5	2(1)	20.5–23.2	17.4 (1)	....	....	....	....	....	....	....	17.4 (1)	....	....	....	....
Pleasant	July 24–25	3(3)	12.2–20.7	79.2 (4)	....	....	....	70.0 (1)	....	....	9.2 (3)	....	....	....	....	....
Sheepscot	June 26–Sept. 10	6(3)	14.4–16.9	22.1 (3)	....	....	....	....	....	....	....	17.2 (1)	....	....	....	4.9 (2)
Biscay	Aug. 8–9	2(1)	11.8–15.7	1.0 (1)	....	....	....	....	....	....	....	....	....	1.0 (1)	....	....
Pemaquid	July 29–30	5(0)	14.5–15.9	0.0 (0)	....	....	....	....	....	....	....	....	....	....	....	....
Crawford	July 22–23	2(0)	14.2–15.4	0.0 (0)	....	....	....	....	....	....	....	....	....	....	....	....
Sennebec	June 29	1(0)	16.5	0.0 (0)	....	....	....	....	....	....	....	....	....	....	....	....
Quantabacook	Sept. 3–6	12(4)	11.5–16.9	8.3 (9)	....	3.0 (5)	....	....	....	....	....	5.3 (4)	....	....	....	....
Lone Pond (P.96)	Aug. 27, 1938	3(0)	13.5–16.7	0.0 (0)	....	....	....	....	....	....	....	....	....	....	....	....
Long Pond (P.211)	July 12, 1938	2(0)	15.5–17.0	0.0 (0)	....	....	....	....	....	....	....	....	....	....	....	....
Trickey Pond (P.303)	Aug. 16, 1938	2(2)	11.7–11.9	4.5 (2)	....	....	....	....	....	....	....	....	3.95 (1)	0.55 (1)	....	....
Long Lake (P.309)	July 7, 1938	1(1)	16.7	75.0 (1)	....	....	75.0 (1)	....	....	....	....	....	....	....	....	....
Moose Pond (P.319)	July 30, 1938	2(2)	16.5–21.0	4.5 (2)	....	....	....	....	....	....	....	....	....	1.0 (1)	....	3.5 (1)
Thomas Pond (P.356)	Aug. 19, 1938	2(0)	15.0–17.2	0.0 (0)	....	....	....	....	....	....	....	....	....	....	....	....
Rattlesnake Pond (P.359)	Aug. 23, 1938	4(3)	13.0–16.4	8.5 (4)	....	....	....	....	....	2.5 (1)	....	4.5 (1)	....	1.5 (2)	....	....
Sabbathday Lake (P.372)	Aug. 19, 1937	1(1)	15.9	0.2 (2)	....	....	....	....	0.1 (1)	....	....	....	....	0.1 (1)	....	....
Pushaw Pond	Sept., 1937 and Oct., 1941	37(15)	12.8–22.6	85.54 (23)	....	....	....	....	....	....	68.0 (13)	17.44 (9)	....	0.1 (1)	....	....
South Branch Lake	June 2, 1938	2(2)	16.9–17.0	1.11 (2)	0.21 (1)	....	....	....	....	....	....	....	....	0.9 (1)	....	....
Totals	Aug., 1937 to Oct., 1941	95(39)	11.5–23.2	314.05 (55)	0.21 (1)	3.0 (5)	75.0 (1)	70.0 (1)	0.1 (1)	2.5 (1)	77.2 (16)	61.84 (16)	3.95 (1)	5.15 (8)	6.7 (1)	8.4 (3)

* For the first 10 lakes, the dates of collection were in 1941.

TABLE XV. Volumes in cubic centimeters and numbers (in parentheses) of food organisms in stomachs of 108 Yellow Perch from 17 lakes

Name of lake or pond	Date of collection*	Fish examined: Number of fish; and number of fish, in ( ), containing food	Fish examined: Range in total length in inches	Fish examined: Total stomach contents	Water fleas (Cladocera)	Fresh-water shrimp (Amphipoda)	Mayfly nymphs (Ephemerida)	Dragonfly nymphs (Anisoptera)	Caddisfly larvae (Trichoptera)	Midge larvae (Chironomidae)	Mosquito larvae (Corethra)	Other aquatic arthropods**	Mayfly adults (Ephemerida)	Pill clams and snails (Mollusca)	Smelt (Osmerus mordax)	Yellow Perch (Perca flavescens)	Sculpin (Cottus cognatus)	Fish remains	Vegetable matter and debris***
Spectacle	Aug. 11–13	42(31)	7.2–12.4	17.88 (156)	0.065 (89)	0.001 (1)	0.03 (3)	0.12 (1)	0.173 (3)	0.016 (6)	...	0.051 (4)	...	...	1.785 (33)	11.0 (1)	...	4.635 (14)	0.004 (1)
China	Aug. 3	1(1)	7.8	0.04 (1)	...	...	...	0.04 (1)	...	...	...	...	...	...	...	...	...	...	...
Sheepscot	June 24–Sept. 10	27(14)	6.5–12.2	5.415 (74)	0.014 (10)	0.003 (1)	0.15 (3)	1.007 (3)	1.015 (42)	0.005 (4)	...	0.013 (2)	...	...	0.217 (3)	0.4 (1)	...	2.561 (5)	0.03 ...
Damariscotta Pond	July 31	1(0)	8.2	0.0 (0)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Quantabacook	Sept. 3–4	4(3)	10.6–11.9	1.85 (16)	...	...	0.11 (8)	1.74 (8)	...	...	...	...	...	...	...	...	...	...	...
St. George	Aug. 26	1(1)	12.2	0.1 (7)	...	...	...	...	...	0.001 (1)	...	...	0.025 (1)	0.074 (5)	...	...	...	...	...
Swan	July 15	2(2)	8.3–9.1	1.03 (5)	...	...	0.03 (2)	1.0 (3)	...	...	...	...	...	...	...	...	...	...	...
Totals for 7 lakes of 1941 survey	June 24–Sept. 10	78(52)	6.5–12.4	26.315 (259)	0.079 (99)	0.004 (2)	0.32 (16)	3.907 (16)	1.188 (45)	0.022 (11)	...	0.064 (6)	0.025 (1)	0.074 (5)	2.002 (36)	11.4 (2)	...	7.196 (19)	0.034 (1)
Moose Pond (P.182)	July 18, 1938	2(0)	7.7–7.8	0.0 (0)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Beaver Pond (P.183)	July 22, 1938	3(2)	8.0–9.7	1.1 (79)	0.099 (78)	...	...	...	...	...	0.001 (1)	...	...	...	...	...	...	...	1.0 ...
Burnt Meadow Pond (P.195)	July 16, 1938	5(5)	7.6–8.6	1.04 (610)	0.057 (201)	0.017 (9)	0.08 (1)	...	0.06 (1)	0.785 (360)	0.036 (36)	0.005 (2)	...	...	...	...	...	...	...
Long Pond (P.211)	July 12, 1938	1(1)	7.9	0.14 (12)	0.006 (5)	0.004 (2)	...	...	0.13 (5)	...	...	...	...	...	...	...	...	...	...
Trickey Pond (P.303)	Aug. 16, 1938	4(1)	8.5–9.3	7.5 (1)	...	...	...	...	...	...	...	...	...	...	...	...	7.5 (1)	...	...
Stearns Pond (P.315)	July 26, 1938	1(1)	9.8	0.14 (1)	...	...	...	...	...	...	...	...	...	...	0.14 (1)	...	...	...	...
Bear Pond (P.321)	July 29, 1938	6(3)	9.0–9.6	2.0 (37)	...	...	...	0.1 (1)	...	...	...	...	...	...	1.5 (34)	...	...	...	0.4 (2)
Long Pond (P.332)	Aug. 4, 1938	4(3)	9.3–12.5	0.22 (3)	...	...	0.02 (2)	...	...	...	...	...	...	...	...	0.2 (1)	...	...	...
Rattlesnake Pond (P.359)	Aug. 23, 1938	3(1)	7.6–9.1	0.7 (5)	...	...	0.7 (5)	...	...	...	...	...	...	...	...	...	...	...	...
Great Pond of Belgrades (P.719)	June 23, 1938	1(1)	12.4	0.21 (14)	...	...	0.21 (14)	...	...	...	...	...	...	...	...	...	...	...	...
Totals for 10 other lakes	June 23 to Aug. 23, 1938	30(18)	7.6–12.5	13.05 (762)	0.162 (284)	0.021 (11)	1.01 (22)	0.1 (1)	0.19 (6)	0.785 (360)	0.037 (37)	0.005 (2)	...	...	1.64 (35)	0.2 (1)	7.5 (1)	...	1.4 (2)
Totals for all lakes	June, 1938 to Sept., 1941	108(70)	6.5–12.5	39.365 (1021)	0.241 (383)	0.025 (13)	1.33 (38)	4.007 (17)	1.378 (51)	0.807 (371)	0.037 (37)	0.069 (8)	0.025 (1)	0.074 (5)	3.642 (71)	11.6 (3)	7.5 (1)	7.196 (19)	1.434 (3)

* For the first 7 lakes, the dates of collection were in 1941.
** Includes 2 *Sialis* larvae, 1 aquatic beetle larva and 2 water mites.
*** Includes remains of 2 frog tadpoles and an insect egg mass.

TABLE XVI. Volumes in cubic centimeters and numbers (in parentheses) of food organisms in stomachs of 101 Common Sunfish and 44 Horned Pout

Name of lake or pond	Date of collection	Fish examined: Number of fish; and number of fish, in ( ), containing food	Fish examined: Range in total length in inches	Fish examined: Total stomach contents	Moss animals (Bryozoa)	Water fleas (Cladocera)	Fresh-water shrimp (Amphipoda)	Mayfly nymphs (Ephemerida)	Dragonfly nymphs (Anisoptera)	Water bugs (*Corixa* and *Notonecta*)	Caddisfly larvae (Trichoptera)	Midge larvae (Chironomidae)	Aquatic insect larvae*	Adult terrestrial beetles	Other terrestrial insects**	Pill clams (Sphaeridae)	Snails (Gastropoda)	Fish remains	Algae and other plant remains
Common Sunfish																			
Chickawaukie	Sept. 8, 1941	17(7)	5.4–7.2	1.045 (183)	...	...	...	...	...	0.005 (1)	0.07 (4)	...	0.005 (1)	0.005 (1)	0.055 (2)	0.676 (132)	0.229 (42)	...	...
Quantabacook	Sept. 3–6, 1941	2(2)	8.1–8.3	1.9 (44)	...	...	...	0.05 (1)	...	...	...	...	...	...	...	...	1.85 (43)	...	...
St. George	Aug. 21–28, 1941	3(2)	5.3–7.3	0.15 (12)	...	...	0.004 (2)	0.01 (1)	...	...	...	...	...	0.01 (1)	...	...	0.046 (8)	...	0.08 ...
Pitcher	July 15–Sept. 2, 1941	70(5)	4.6–7.2	0.481 (42)	...	...	...	...	...	0.1 (1)	0.01 (10)	...	...	0.2 (5)	0.16 (23)	...	0.011 (3)	...	...
Mousam Pond (P.63)	July 30, 1937	1(0)	6.7	0.0 (0)	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Thomas Pond (P.356)	Aug. 19, 1938	4(3)	5.2–9.0	1.42 (17)	...	...	...	0.19 (4)	...	...	0.01 (1)	...	...	...	...	...	0.3 (12)	...	0.92 ...
Rattlesnake Pond (P.359)	Aug. 23, 1938	3(1)	6.7–7.7	0.06	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.06 ...
Sabbathday Lake (P.372)	Aug. 14, 1937	1(1)	6.1	0.02 (14)	...	0.01 (13)	...	...	...	...	...	...	...	...	...	...	0.01 (1)	...	...
All Sunfish	Aug., 1937 to Sept., 1941	101(21)	4.6–9.0	5.076 (312)	...	0.01 (13)	0.004 (2)	0.25 (6)	...	0.105 (2)	0.09 (15)	...	0.005 (1)	0.215 (7)	0.215 (25)	0.676 (132)	2.446 (109)	...	1.06 ...
Horned Pout																			
Quantabacook	Sept. 3, 1941	37(17)	7.9–11.7	4.333 (97)	...	0.006 (5)	0.029 (18)	0.843 (32)	0.067 (1)	...	...	0.036 (40)	0.01 (1)	...	...	...	...	...	3.342 ...
Moose Pond (P.182)	July 18, 1938	1(1)	8.1	1.02 (31)	...	0.002 (1)	0.02 (26)	...	...	0.015 (1)	...	0.003 (2)	...	...	...	...	...	0.98 (1)	...
Trickey Pond (P.303)	Aug. 16, 1938	1(1)	7.9	0.1 (12)	...	...	0.005 (2)	0.02 (1)	0.05 (1)	...	0.008 (3)	0.001 (1)	...	...	0.01 (2)	...	0.006 (2)	...	...
Rattlesnake Pond (P.359)	Aug. 23, 1938	2(2)	9.8–10.7	0.18 (2)	...	...	...	...	...	...	...	...	...	...	...	...	...	0.18 (2)	...
Great Pond of Belgrades (P.719)	June 23, 1937	1(1)	12.8	0.99 (28)	...	...	0.003 (3)	0.73 (18)	0.2 (2)	...	...	0.002 (2)	0.065 (3)	...	...	...	...	...	...
Pushaw Pond	Sept. 27, 1937	2(2)	11.4–11.5	7.4 (16)	1.6 (?)	0.002 (1)	...	0.252 (3)	0.1 (3)	...	...	0.003 (1)	...	...	0.06 (6)	...	0.003 (2)	...	5.38 ...
All Horned Pout	June, 1937 to Sept., 1941	44(24)	7.9–12.8	14.023 (186)	1.6 (?)	0.01 (7)	0.057 (49)	1.845 (54)	0.417 (7)	0.015 (1)	0.008 (3)	0.045 (46)	0.065 (4)	...	0.07 (8)	...	0.009 (4)	1.16 (3)	8.722 ...

* Includes 2 *Sialis* larvae, and the aquatic larva of a moth.

** Includes ants, adult Mayflies, grasshopper remains, wasps, and unidentified insect fragments.

TABLE XVII. Volumes in cubic centimeters and numbers (in parentheses) of food organisms in stomachs of 17 Land-locked Salmon, 6 Chinook Salmon, and 133 Brook Trout

Name of lake or pond	Date of collection	Fish examined: Number of fish; and number of fish, in ( ), containing food	Fish examined: Range in total length in inches	Fish examined: Total stomach contents	Aquatic earthworms and leeches	Water fleas (Cladocera)	Fresh-water shrimp (Amphipoda)	Alderfly larvae (*Sialis*)	Burrowing Mayfly nymphs (Ephemerinae)	Non-burrowing Mayfly nymphs (Baetinae)	Damselfly and dragonfly nymphs	Midge larvae (Chironomidae)	Other aquatic insects*	Terrestrial insects and spiders**	Water mites (Hydracarina)	Molluscs (Mostly snails)	Smelt (*Osmerus mordax*)	White Perch (*Morone americana*)	Other fish*** and fish remains	Newt and frog (Amphibia)
Land-locked Salmon																				
Sheepscot	June 24–25, 1941	2(2)	15.0–15.4	7.1 (2)	...	...	...	...	....	.....	....	....	....	...	...	...	7.0 (1)	..	0.1 (1)	..
Damariscotta Lake	July 27, 1941	1(1)	17.0	2.0 (6)	...	...	...	...	....	.....	....	....	....	...	...	...	2.0 (6)	..	...	..
Biscay	Aug. 7–8, 1941	4(0)	13.8–17.2	0.0 (0)	...	...	...	...	....	.....	....	....	....	...	...	...	...	..	...	..
Crawford	July 22, 1941	1(1)	19.6	0.15 (1)	...	...	...	...	....	.....	....	....	....	...	...	...	0.15 (1)	..	...	..
Sennebec	June 29, 1941	1(1)	10.0	0.6 (11)	...	...	...	...	....	.....	....	....	....	...	...	...	0.6 (11)	..	...	..
St. George	June 21–22, 1941	5(4)	25.0–27.4	26.2 (44)	...	...	...	...	....	.....	....	....	....	...	...	...	26.2 (44)	..	...	..
Megunticook	July 17–18, 1941	3(2)	15.7–25.0	10.2 (11)	...	...	...	...	....	.....	....	....	....	...	...	...	10.2 (11)	..	...	..
All Land-locked Salmon	June to Aug., 1941	17(11)	10.0–27.4	46.25 (75)	...	...	...	...	....	.....	....	....	....	...	...	...	46.15 (74)	..	0.1 (1)	..
Chinook Salmon																				
China	July 28, 1941	1(0)	25.7	0.0 (0)	...	...	...	...	....	.....	....	....	....	...	...	...	...	..	...	..
Damariscotta Lake	July 27, 1941	2(1)	19.3–19.8	0.5 (2)	...	...	...	...	....	.....	....	....	....	...	...	...	0.5 (2)	..	...	..
Swan	July 11, 1941	1(0)	27.0	0.0 (0)	...	...	...	...	....	.....	....	....	....	...	...	...	...	..	...	..
Mousam Pond (P.63)	July 15, 1937	1(1)	17.4	1.5 (12)	...	...	...	...	....	.....	....	....	....	...	...	...	...	1.5 (12)	...	..
Long Lake (P.309)	July 7, 1938	1(1)	14.5	1.6 (1)	...	...	...	...	....	.....	....	....	....	...	...	...	...	..	1.6 (1)	..
All Chinook Salmon	July, 1937 to July, 1941	6(3)	14.5–27.0	3.6 (15)	...	...	...	...	....	.....	....	....	....	...	...	...	0.5 (2)	1.5 (12)	1.6 (1)	..
Brook Trout																				
Norton	July 18–19, 1941	5(0)	11.3–12.6	0.0 (0)	...	...	...	...	....	.....	....	....	....	...	...	...	...	..	...	..
Swan	July 13–15, 1941	8(5)	8.9–12.3	2.92 (18)	...	...	...	0.025 (4)	0.19 (2)	.....	0.04 (1)	....	0.04 (1)	0.471 (7)	...	...	2.0 (2)	..	0.154 (1)	..
Lone Pond (P.96)	Sept. 23–25, 1941	23(21)	8.7–10.2	18.065 (351)	...	0.005 (2)	...	...	0.009 (3)	.....	0.81 (4)	0.005 (1)	16.133 (156)	0.889 (113)	0.062 (60)	0.152 (12)	...	..	...	..
Keoka Lake (P.322)	Aug. 3, 1938	1(1)	14.8	0.25 (14)	...	...	...	...	0.25 (14)	.....	....	....	....	...	...	...	...	..	...	..
Sabbathday Lake (P.372)	Aug., 1937 to July, 1941	5(4)	7.8–9.9	1.9 (218)	...	0.178 (124)	...	...	....	.....	....	0.005 (7)	0.012 (3)	0.57 (1)	0.125 (67)	0.21 (12)	0.69 (1)	..	0.11 (3)	..
Long Pond of Belgrades (P.713)	June 24, 1937	1(1)	10.1	0.75 (7)	...	...	...	...	0.1 (2)	.....	0.4 (1)	....	0.25 (4)	...	...	...	...	..	...	..
Rainbow Deadwater	May 25, 1940; 7 to 11 A.M	38(38)	8.5–12.5	180.92 (5329)	0.37 (2)	...	1.525 (47)	4.945 (80)	34.805 (174)	110.549 (4155)	20.718 (73)	2.188 (779)	0.47 (14)	0.15 (2)	...	...	...	..	0.7 (1)	4.5 (2)
Rainbow Deadwater	May 25, 1940; 2 to 7 P.M.	52(52)	7.9–11.6	147.58 (7746)	1.374 (24)	...	1.630 (74)	2.272 (70)	36.429 (221)	63.628 (2972)	23.57 (121)	10.765 (4139)	1.093 (21)	2.643 (91)	...	0.112 (9)	...	..	3.825 (3)	0.23 (1)
All Brook Trout	June, 1937 to Sept., 1941	133(122)	7.8–14.8	352.385 (13,683)	1.744 (26)	0.183 (126)	3.164 (121)	7.242 (154)	71.783 (416)	174.177 (7127)	45.538 (200)	12.963 (4926)	17.998 (199)	4.723 (214)	0.187 (127)	0.474 (33)	2.69 (3)	..	4.789 (8)	4.73 (3)

* Includes caddisfly larvae, cranefly pupa, mosquito larvae (*Corethra*), adult aquatic beetles, aquatic beetle larvae, water boatmen and back swimmers.
** Includes terrestrial beetles, ants, wasps, adult Mayflies, adult midges, adult March flies and adult dragonflies.
*** Other fish includes one *Pfrille neogaea* and one other minnow.

Data on 505 fish collected, in part, during the summer of 1938 from lakes in the Saco and Presumpscot River drainages, and, in part, from other lakes and during other years, also have been published (*ibid.*: Table XII). The volumes, in per cent, of the principal types of food organisms in the stomachs of these three lots of White Perch (practically all 6- to 12-inch fish) may be compared in the following:

		Volume of food in per cent				
Summer collected	Number of fish	Crustaceans	Aquatic insects	Terrestrial insects	Fish	Other food
1941	1,124	23.22	28.73	6.90	39.58	1.57
1940	1,252	12.00	60.29	0.86	26.27	0.58
1938, etc.	505	5.32	59.47	Trace	31.84	3.37
Total	2,881	15.93	46.13	3.41	33.07	1.46

The 1941-fish had fed to a much greater extent on crustaceans (water fleas and fresh-water shrimp) and terrestrial insects, and to a correspondingly lesser extent on aquatic insects, than had the 1940- and 1938-fish. While there was a greater proportion of smelts as compared to spiny-rayed fishes in the diet of the 1941-perch, there was little difference in the total fish content among the three lots of perch. The above percentages for the 2,881 fish, which have been figured by lumping the data for all stomach contents, presumably give a fairly accurate picture of the diet of adult (over 6 inches in length) White Perch in lakes of southern Maine during the summer months.

The studies on bottom fauna (see page 67) and on the food habits of the White Perch have afforded an opportunity to make a comparison of the food eaten by this fish with the available supply of bottom food. Collections of perch stomachs and collections of the bottom fauna were obtained from each of 11 lakes by the 1941 survey — a total of 1,055 perch stomachs and 408 bottom samples for the 11 lakes. These 11 lakes are listed in Table XII. The 408 perch ranged from 5.3 to 14.8 inches in total length. The perch were collected from June 21 to September 10, mostly during July and August (Table XI). The bottom samples were collected during the period from July 16 to September 11, mostly during July and August. Within this period from June 21 to September 11, there was some conformity in the dates of collection of perch stomachs and bottom samples from individual lakes: from 5 lakes, all samples from a particular lake were collected within a period of 15 days; the collection of perch stomachs and bottom samples from 3 lakes extended throughout much of the summer; and for the 3 remaining lakes the time interval between bottom sampling and perch collecting was approximately a month.

On each lake the bottom samples were from points distributed fairly evenly over the entire lake area, and presumably the samples represent the average composition of the bottom fauna for each lake as a whole (see page 67). The perch were collected by gill nets which were set at from 2 to 27 separate stations in the individual lakes, and the 80 individual net sets in these 11 lakes were in water with an over-all depth range of 7 to 82 feet. The disparity, of from a few days to a month, between the dates of collection of bottom samples and of perch stomachs possibly invalidates the present comparison for some of the lakes to a certain extent. The fact that the perch were collected at from only 2 to 4 separate stations from some of the lakes may also partially invalidate the comparison, but this factor can not be properly evaluated because the extent to which the White Perch migrates throughout a lake is not known. The effect of these discrepancies of sampling in individual lakes is probably mostly eliminated by lumping the data for the 11 lakes. The comparison of the two sets of data should indicate the degree of selectivity exercised by the White Perch as it feeds on the bottom fauna. The selectivity might be willful; or it might be the result of differences in availability of the various types of organisms as these are buried to different depths in the bottom soil; or, recognizing preferences for certain depths of water on the part of both fish and bottom organisms, any apparent selectivity might be the result of differences in depth distribution between predator and prey. In any event, the comparison indicates the differences between the types of bottom food consumed by the perch populations in these lakes as a whole and the types of organisms in the standing crop of bottom fauna in the lakes — i.e., for adult-sized fish, and during the summer months.

For this study of the selectivity exhibited by the White Perch in feeding on the bottom fauna, the data on volumes and numbers of the different types of organisms in all bottom samples from each of the 11 lakes (from Table VI) have been converted to percentages. The percentages of the volumes and numbers of each type of bottom organism to all bottom organisms in the perch stomachs have been calculated from the data given in Table XI. These percentage figures for perch stomachs and bottom samples are given for the individual lakes in Table XII. The figures at the bottom of this table are totals for all perch stomachs and all bottom samples, and not averages for the lakes.

Some obvious conclusions may be drawn from this comparison (Table XII). An abundant bottom fauna of small molluscs, mostly Sphaeridae and Amnicolidae, was being almost completely avoided by these White Perch. A scanty, although consistently present, population of aquatic earthworms was also being completely avoided. Because the molluscs were being avoided, the data show an almost consistent preference for the larger aquatic insects such as Mayflies, dragonflies and caddisflies. No particular preference was indicated for midge and *Corethra* larvae, possibly because these organisms were relatively small. An apparently very great preference for fresh-water shrimp is indicated by the totals for all fish and all bottom samples, but this preference was mostly attributable to perch from five of the lakes, while the fish from the remaining six lakes showed little or no preference for this item.

Small-mouthed Bass. (Table XIII). The 290 bass which were examined for stomach contents were collected from 8 lakes of the 1941 survey area, and from 11 other lakes most of which are located in the southwestern part of Maine. The great majority (222) of these fish were from St. George Lake in Liberty. These bass from St. George Lake ranged from 4.4 to 19.4 inches in total length, and more than half of them were less than 10 inches in length. The 68 bass from the remaining 18 lakes were mostly over 10 inches in length. Therefore, the total stomach contents of these 290 bass as a group (figures given at the bottom of Table XIII) mostly represent the diet of 4- to 10-inch bass in St. George Lake, and the diet of 10- to 19-inch bass of which about half were from St. George and the remainder were from the other 18 lakes. Of the 290 bass, 164 contained food. Seventy-five per cent, by volume, of this food was fish; and the fish were mostly smelts. The remaining food was mostly insects, crayfish and water fleas. The small bass from St. George Lake accounted for almost all of the water fleas and most of the aquatic insects. Crayfish were found in bass from only one pond.

Common Pickerel. (Table XIV.) Of the 95 pickerel (*Esox niger*) considered here, 39 were from lakes of the 1941 survey area, and the remaining fish were from other lakes scattered over the southern half of Maine. Their stomach contents were almost entirely fish, frogs, and tadpoles, with the amphibians of rare occurrence. White Perch, Yellow Perch, a single large Golden Shiner, and a single Chinook Salmon made up most of the total volume of food. The scarcity of smelts in the diet of these pickerel appears worthy of note, especially since the Smelt is known to be present in most of these lakes. A scarcity of smelts and a preponderance of White Perch and Yellow Perch were noted also in the stomachs of 110 pickerel from lakes of the 1940 survey area (Cooper, 1941: Table XVII). It is tempting to conclude that the pickerel feeds mostly on the young of such fishes as the White Perch, Yellow Perch, sunfishes and Golden Shiner because it inhabits mostly the warm and weedy lake shallows where these other fishes abound; and that it feeds only to a small extent on the Smelt which lives mostly in the deep and cold water. The recognition of such an ecological barrier between the Pickerel and the Smelt, by virtue of which pickerel feed on perch rather than on smelts, would at least partially vindicate the pickerel as being somewhat of an asset

to, rather than a despoiler of, trout and salmon lakes, i.e., for those lakes which have perch populations. Much more data on the food habits of the pickerel are needed for an elucidation of this important problem.

Yellow Perch. (Table XV.) The 108 adult-sized Yellow Perch from 17 lakes contained 76 per cent fish, by volume, and the remainder was mostly aquatic insects. Thus the fish content in the diet of the Yellow Perch was much greater than that of the White Perch in these same lakes. That the Yellow Perch is the more ichthyophagous of the two was also noted among perch from lakes of the Androscoggin and Kennebec drainages (Cooper, 1941).

Common Sunfish. (Table XVI, in part.) The 101 adult sunfish were taken mostly by seining in shallow water in two lakes. Only 21 of these contained food which was mostly molluscs, terrestrial insects, and plant material.

Horned Pout. (Table XVI, in part.) The stomach contents of the 44 bullheads, which were mostly from Quantabacook Pond, consisted mostly of algae and other plant remains, fish remains, bryozoans, and aquatic insects.

Land-locked and Chinook Salmon. (Table XVII, in part.) Seventeen Land-locked Salmon from lakes of the 1941 survey area contained smelts exclusively. Of the 6 Chinook Salmon which were examined, 3 contained food which was exclusively fish — White Perch and smelts.

Brook Trout. (Table XVII, in part.) Among the 133 Brook Trout considered here, the collection of 90 trout from Rainbow Deadwater is worthy of special note. This is one of the numerous small and shallow warm-water ponds in the more remote north-central section of Maine which produce good trout fishing for the few anglers who visit them. The absence of any other species of competing game fish, along with the light fishing intensity, probably accounts for the maintenance of large trout populations in these ponds. Trout in Rainbow Deadwater reach a maximum length of approximately 9 to 13 inches. Their diet, on May 25, 1940, was found to be mostly Mayfly nymphs of both the burrowing and non-burrowing types; other aquatic insects, particularly the larger forms, were also of considerable importance. The 38 trout collected from Rainbow Deadwater during the morning (7 to 11 A.M.) of May 25 contained, on the average, nearly twice as great a volume of food in their stomachs as did the trout collected during the afternoon (2 to 7 P.M.); and the fish in the two lots were of practically the same average length. The 43 Brook Trout from the 6 other lakes contained mostly aquatic and terrestrial insects, and fish.

Size of fishes eaten by game species. Of the fish and fish remains which were found in the stomachs of the above game fishes, 706 individuals were identified to species (listed in Tables XI and XIII to XVII). Measurements of total length to the nearest millimeter were obtained for 704 of these food items. Where partial digestion made accurate measurements impossible, lengths were estimated on the basis of the size of individual bones in the remains. These length measurements, grouped into 10-millimeter frequency classes, by species of predator and prey, are as follows:

Fish examined	Fish in their stomachs	Total length in millimeters of fish in stomachs																			
		8–17	18–27	28–37	38–47	48–57	58–67	68–77	78–87	88–97	98–107	108–117	118–127	128–137	138–147	148–157	:	178–187	188–197	:	208–217
Yellow Perch	Smelt	46	25	.	.	.	.	.	.	.	.	.	.	.	.	.		.	.		.
	Other fish	.	1	2	.	.	.	.	.	.	1	.	.	.	.	.		.	.		.
White Perch	Smelt	2	17	34	52	70	59	38	19	7	3	.	.	.	.	1		.	.		.
	Sunfish	14	63	10	1	.	.	.	.	.	.	.	.	.	.	.		.	.		.
	Other fish	1	6	3	5	3	1	1	.	.	.	.	.	.	.	.		.	.		.
Salmons and trout	Smelt	2	13	18	21	9	9	5	1	1	.	.	.	.	.	.		.	.		.
	Other fish	7	5	.	.	.	.	.	1	.	.	.	.	.	.	.		.	.		.
Smallmouth Bass	Smelt	2	3	18	19	15	6	6	4	2	.	.	1	.	.	.		.	.		.
	Sunfish	.	5	1	1	.	.	.	.	.	.	.	.	.	.	.		.	.		.
	Other fish	.	.	1	.	.	.	1	.	1	1	.	.	.	.	.		.	.		.
Common Pickerel	Yellow Perch	.	.	2	3	3	1	2	.	.	2	.	1	.	.	.		.	.		.
	White Perch	.	.	1	3	1	2	2	1	2	1	1	.	.	1	.		1	.		.
	Other fish	.	.	.	.	3	1	4	.	.	.	.	.	.	.	.		.	1		1

Average lengths of these fish food items have been computed on the basis of 5-millimeter frequencies. These average lengths for the most frequent species found in each species of predator, the average lengths for all other fish, and the average lengths for all fish, together with the numbers (in parentheses) of individuals on which the averages are based, are as follows:

Fish examined	Average length of fish in their stomachs					
	Smelt	Sunfish	Yellow Perch	White Perch	Other fish	All fish
Yellow Perch	16.1 (71)	....	....	....	47.5 (4)	17.7 (75)
White Perch	54.4 (302)	21.5 (88)	....	....	37.0 (20)	46.5 (410)
Salmons and trout	42.8 (79)	....	....	....	21.9 (13)	39.9 (92)
Small-mouthed Bass	48.8 (76)	26.4 (7)	....	....	75.0 (4)	48.2 (87)
Common Pickerel	....	....	63.6 (14)	80.0 (16)	91.0 (10)	77.0 (40)

The most obvious facts revealed by the above averages are: the small size of the smelts eaten by Yellow Perch, as compared to those eaten by other fish; the small size of the sunfishes consumed; the similarity in size of fishes eaten by the White Perch, Small-mouthed Bass, and salmons and trout; and the large size of the fishes eaten by the Common Pickerel. The small average size of all fish eaten by the Yellow Perch, based mostly on smelts from two lakes, is of doubtful significance. The other averages are presumably more reliable. On the other hand, much more data are needed to give a complete picture of this important problem of the size selectivity exercised by different species of game fishes in feeding on forage fishes.

MAPS OF THE LAKES AND PONDS

The following outline maps and cross-section diagrams for the lakes (Figures 1 to 59) are included to show the results of depth soundings and our evaluations of the suitability of the water for trout or salmon. The lake outlines have been copied from United States Geological Survey Topographic Sheets, and in some instances have been modified slightly based on our own field observations. The numbers of soundings were presumably adequate for our evaluation of the water for different types of fishes; however, the intensity of soundings in some lakes was probably not sufficient to indicate the greatest depth of water. Areas of water of greater depth than is indicated on these maps must of necessity be very limited in extent. Data from Table III were used in preparing the cross-section diagrams headed "suitability for trout or salmon during late summer." The symbols, figures and terms used on these maps are explained in the following:

All numerical figures within outline of lake represent soundings in feet.

Water-analysis stations indicated by the symbol ⊗.

In the cross-section diagram headed by "suitability for trout or salmon during late summer":

"Suitability" means only from the standpoint of temperature and oxygen.

"Late summer" means during the end of the hot part of the summer, mostly during August.

"Water volume" refers to all water in the lake.

"Bottom area" refers to the entire lake bottom.

"Warm" means above 70° Fahrenheit.

"Trout" means trout, togue, or salmon.

"Low oxygen" means less than 5 p.p.m. of dissolved oxygen in the water.

Blackened area represents proportionate amount of water volume or bottom area not available to trout or salmon during late summer.

White area represents amount of water volume and bottom area available to trout or salmon during late summer.

"No trout or salmon water" means during late summer.

Pond reference numbers are indicated in the following form:
P 638, P 1368, P 1478.

"Elev" means elevation in feet above mean sea level, obtained from United States Topographic Sheets.

For those lakes in which the water level was considerably below normal at the time of depth soundings, the extent to which the level was below normal is given, following elevation and area.

Area in acres obtained by using planimeter on lake outline on United States Topographic Sheets.

Direction arrows indicate true north.

All maps by M. A. Marston.

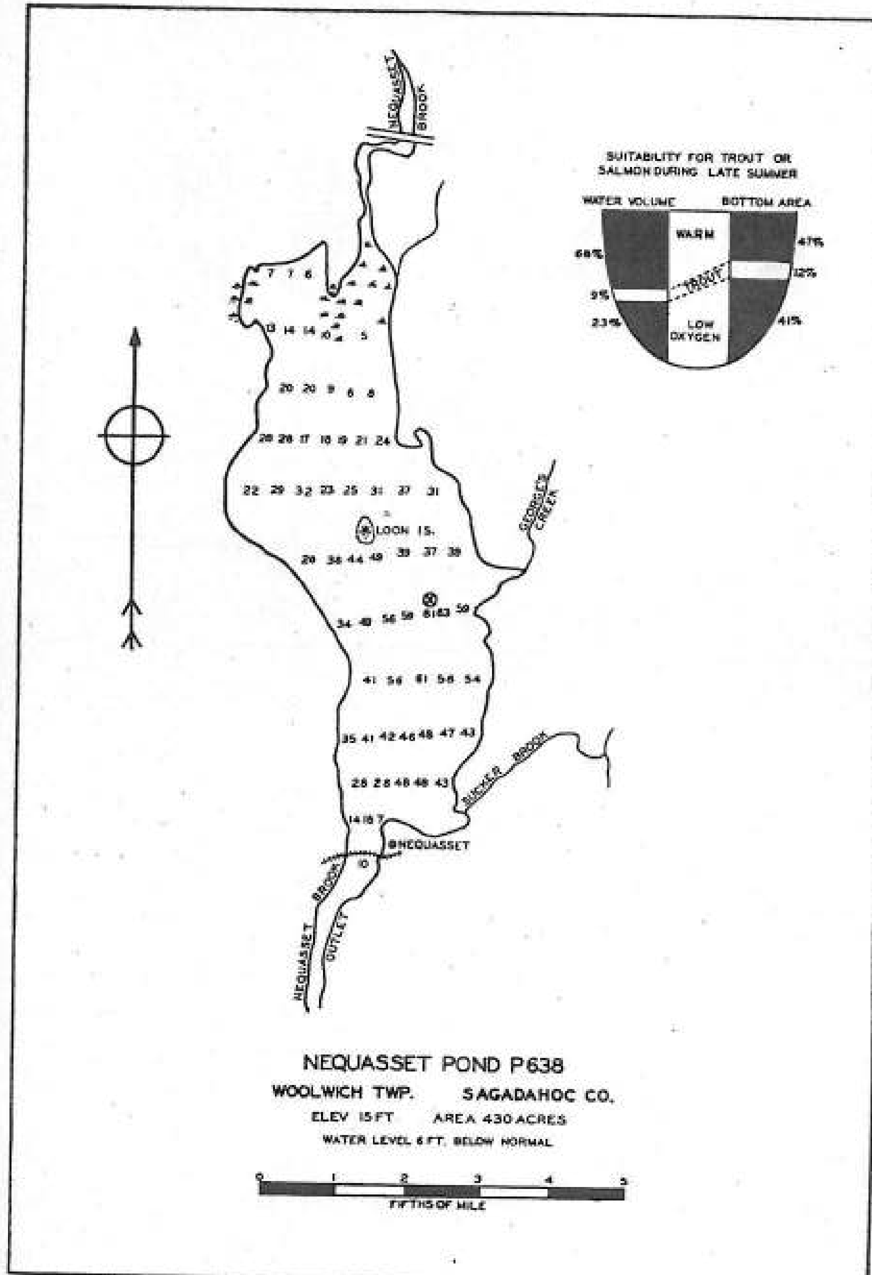

Figure 1. Nequasset Pond. Soundings in feet and suitability of the water for trout or salmon.

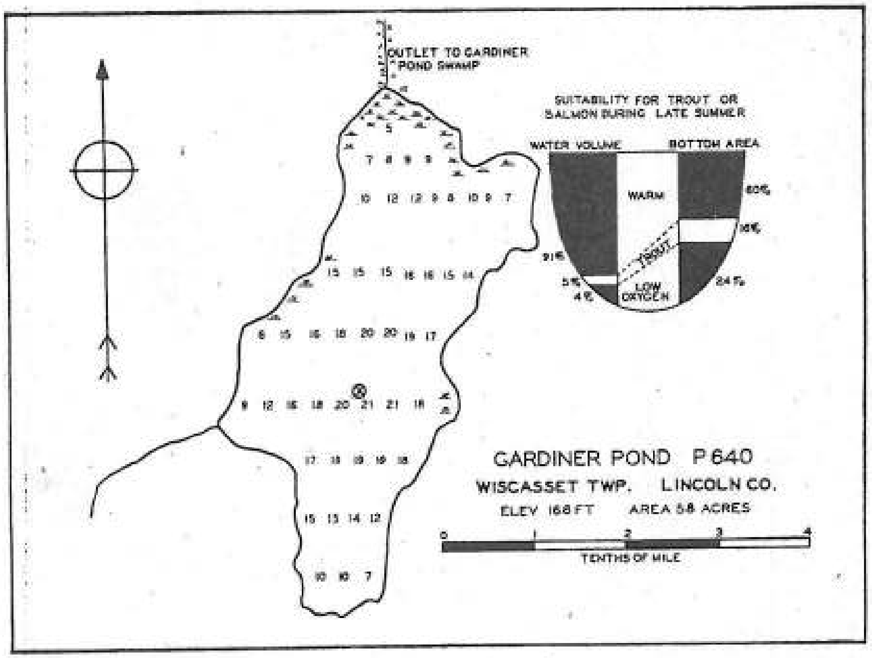

Figure 2. Gardiner Pond. Soundings in feet and suitability of the water for trout or salmon.

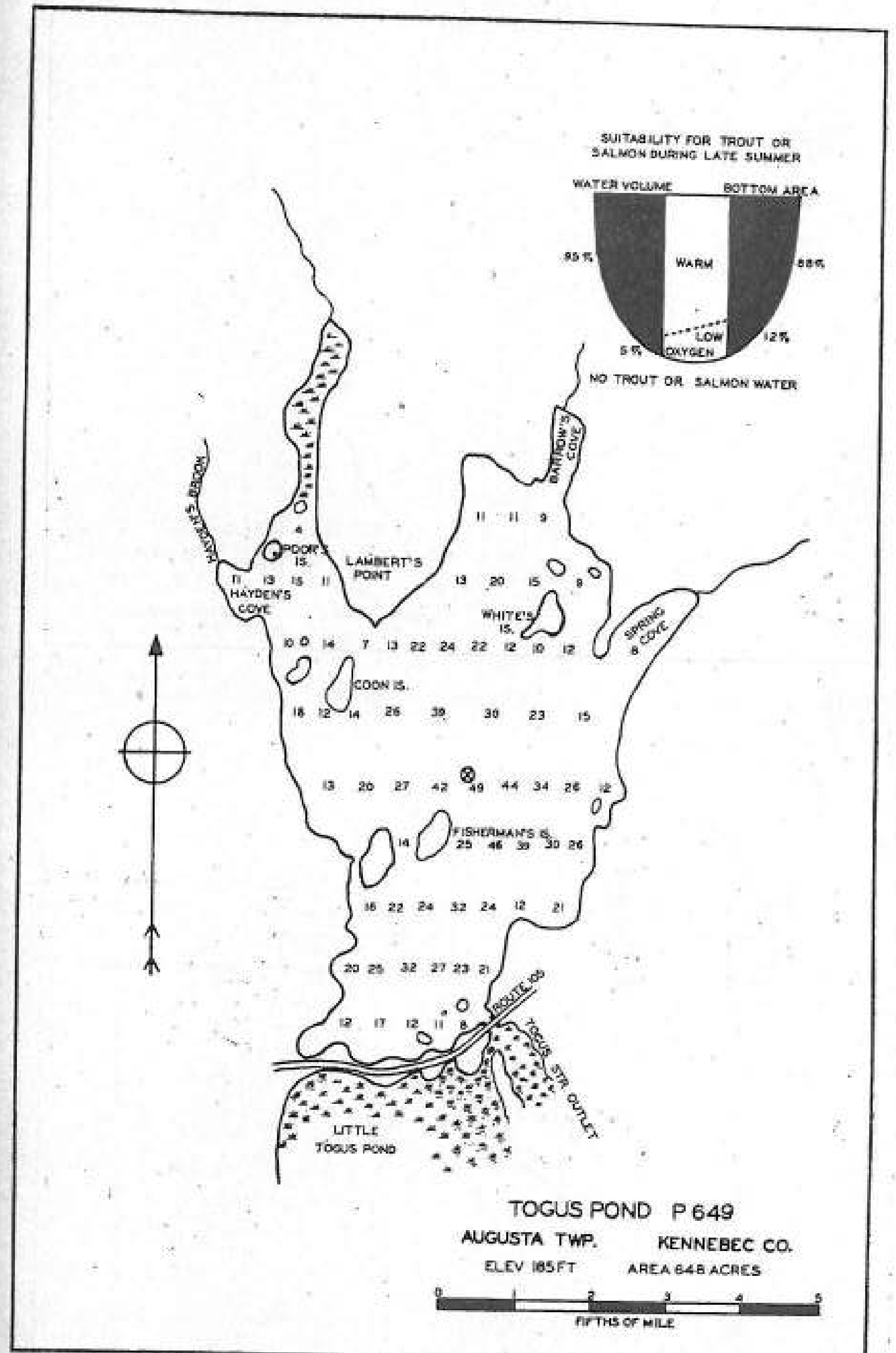

Figure 3. Togus Pond. Soundings in feet and suitability of the water for trout or salmon.

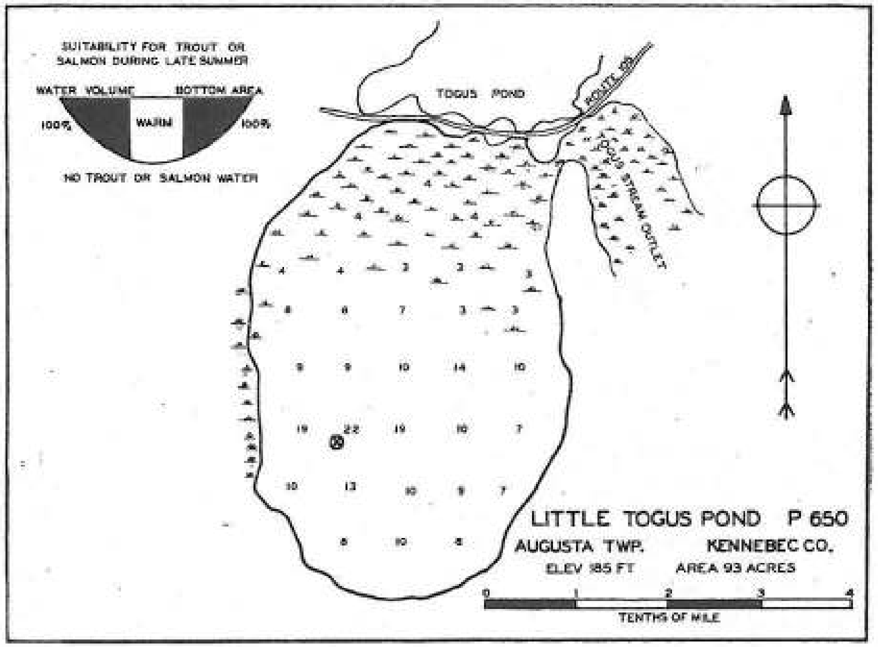

Figure 4. Little Togus Pond. Soundings in feet and suitability of the water for trout or salmon.

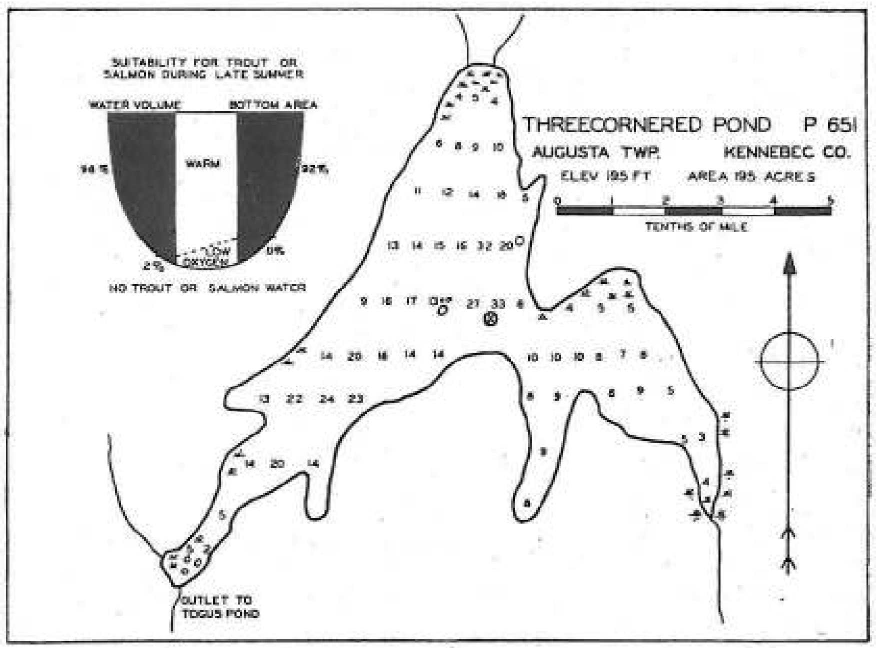

Figure 5. Threecornered Pond. Soundings in feet and suitability of the water for trout or salmon.

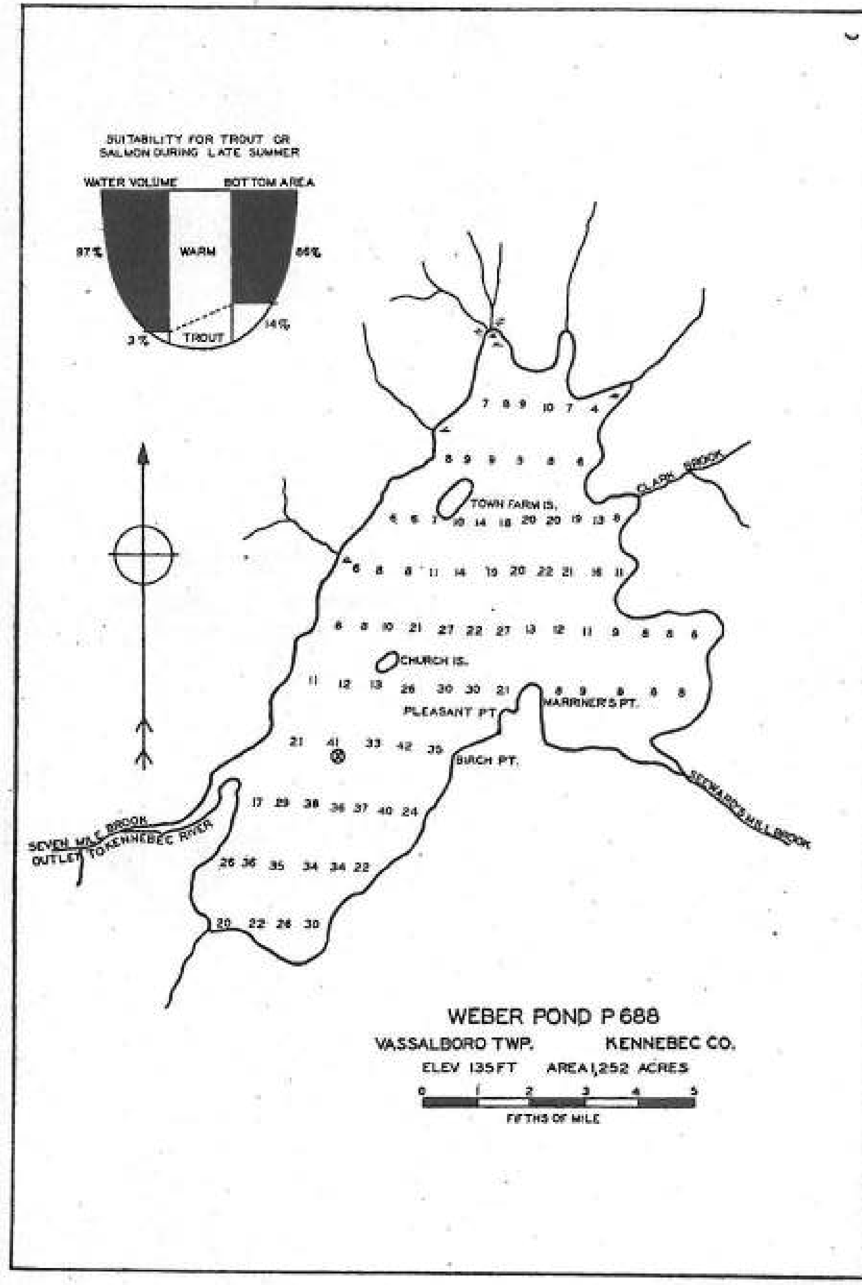

Figure 6. Weber Pond. Soundings in feet and suitability of the water for trout or salmon.

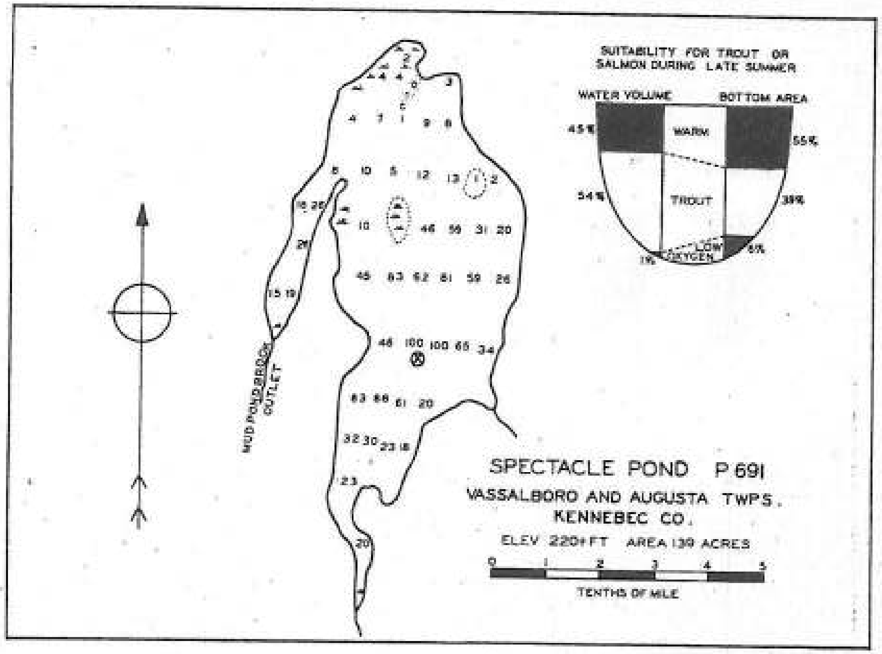

Figure 7. Spectacle Pond. Soundings in feet and suitability of the water for trout or salmon.

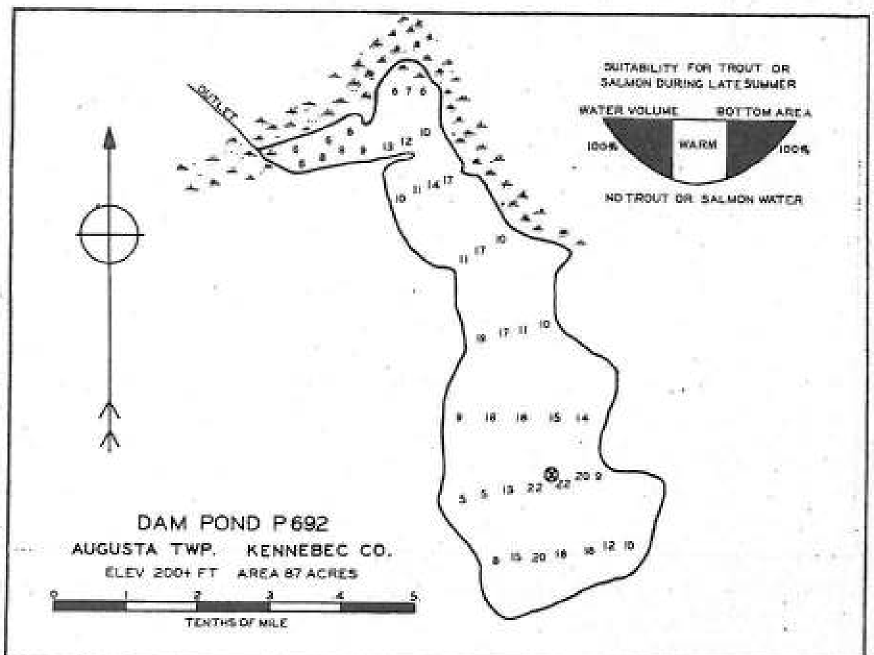

Figure 8. Dam Pond. Soundings in feet and suitability of the water for trout or salmon.

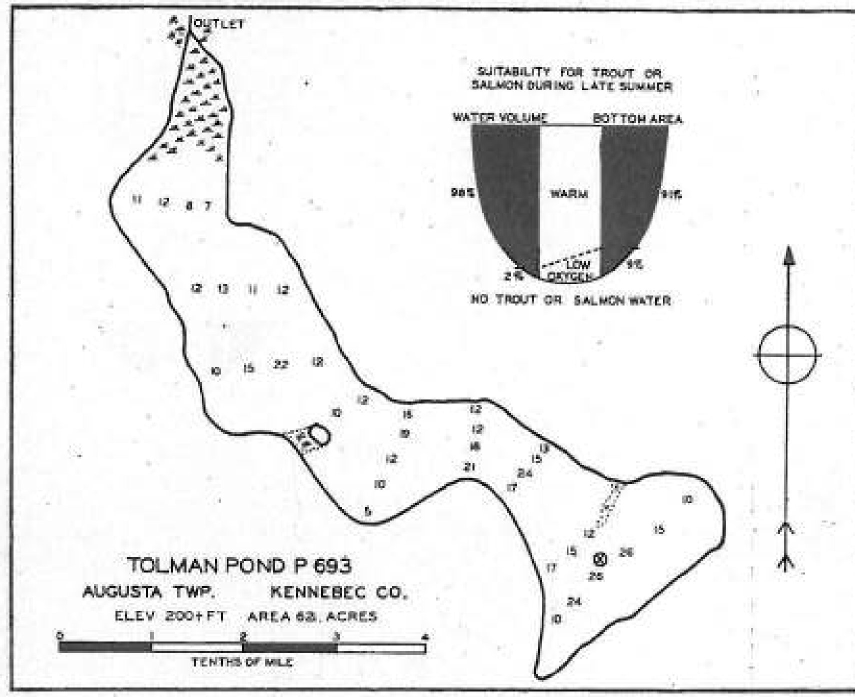

Figure 9. Tolman Pond. Soundings in feet and suitability of the water for trout or salmon.

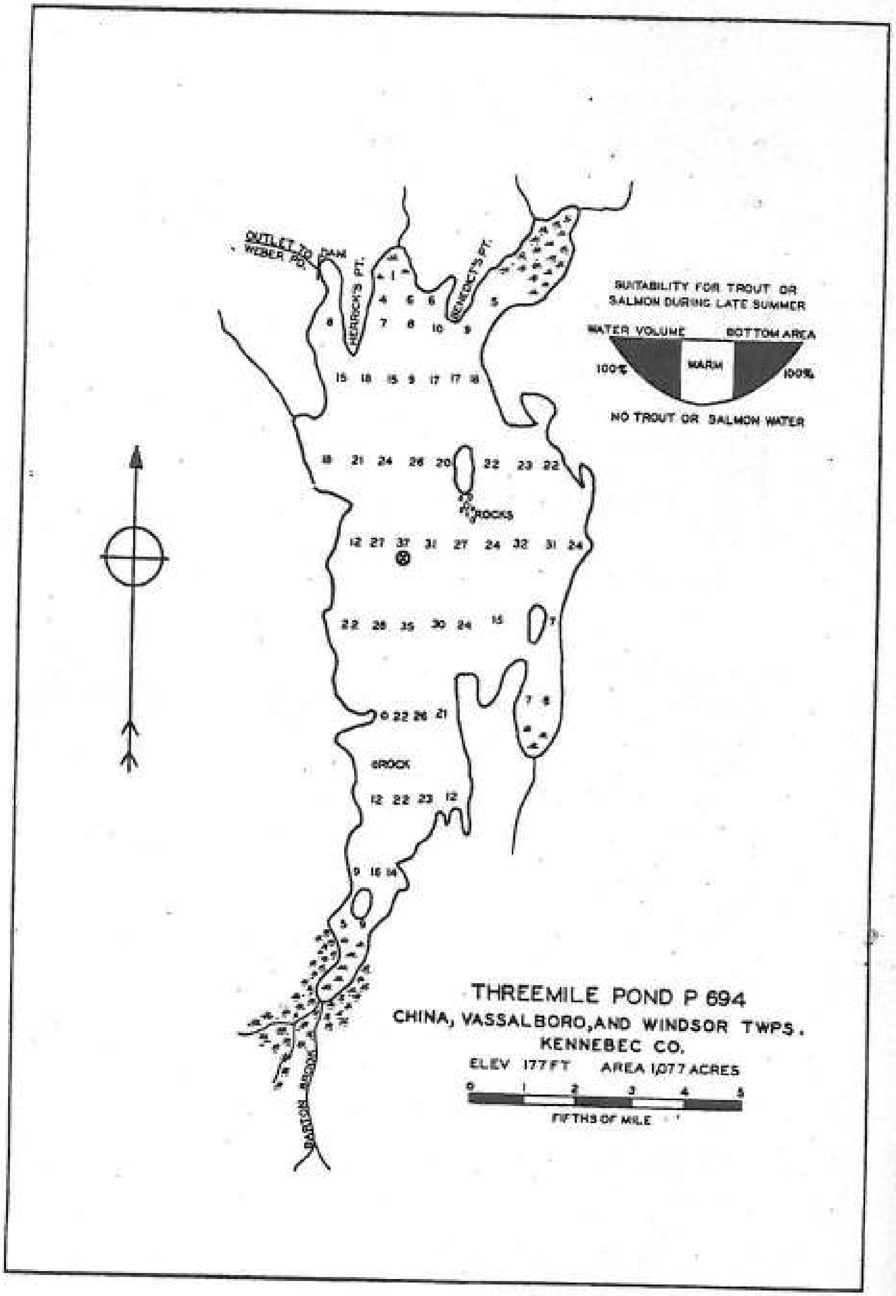

Figure 10. Threemile Pond. Soundings in feet and suitability of the water for trout or salmon.

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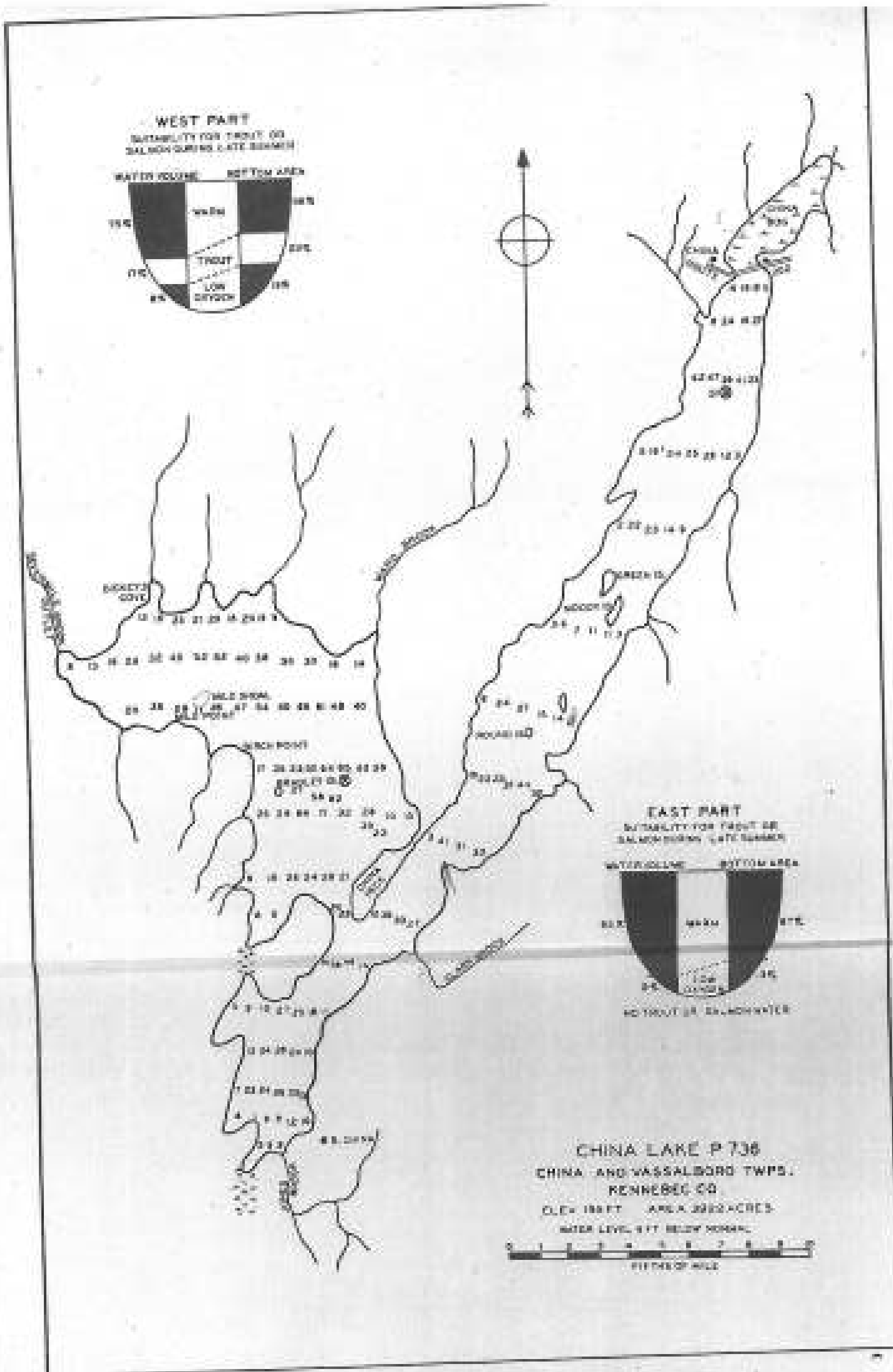

Figure 11. China Lake. Soundings in feet and suitability of the water for trout or salmon.

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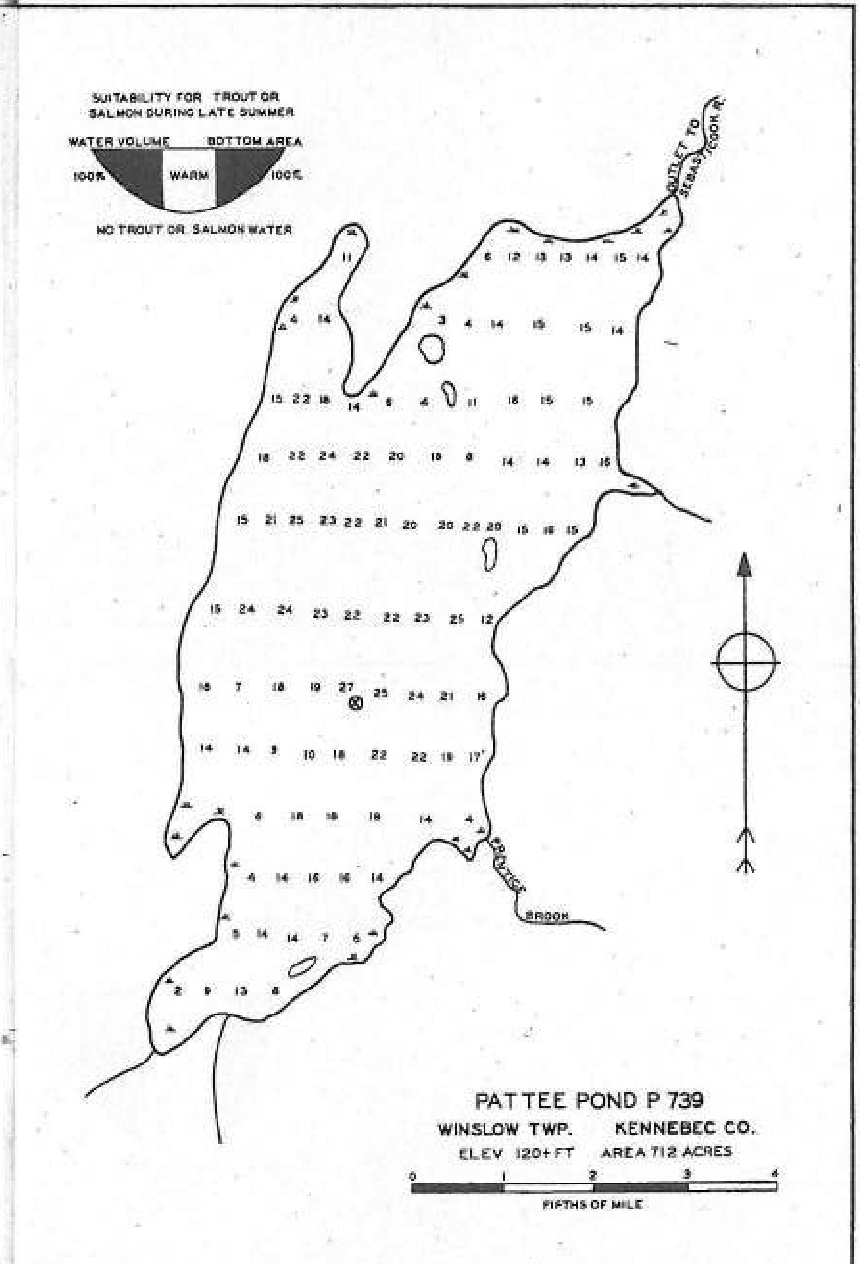

Figure 12. Pattee Pond. Soundings in feet and suitability of the water for trout or salmon.

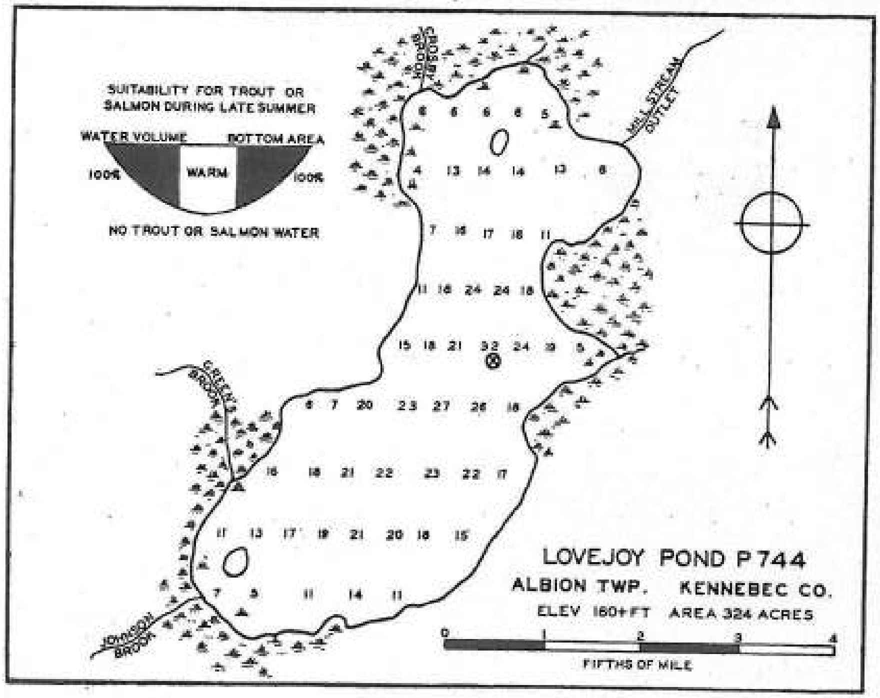

Figure 13. Lovejoy Pond. Soundings in feet and suitability of the water for trout or salmon.

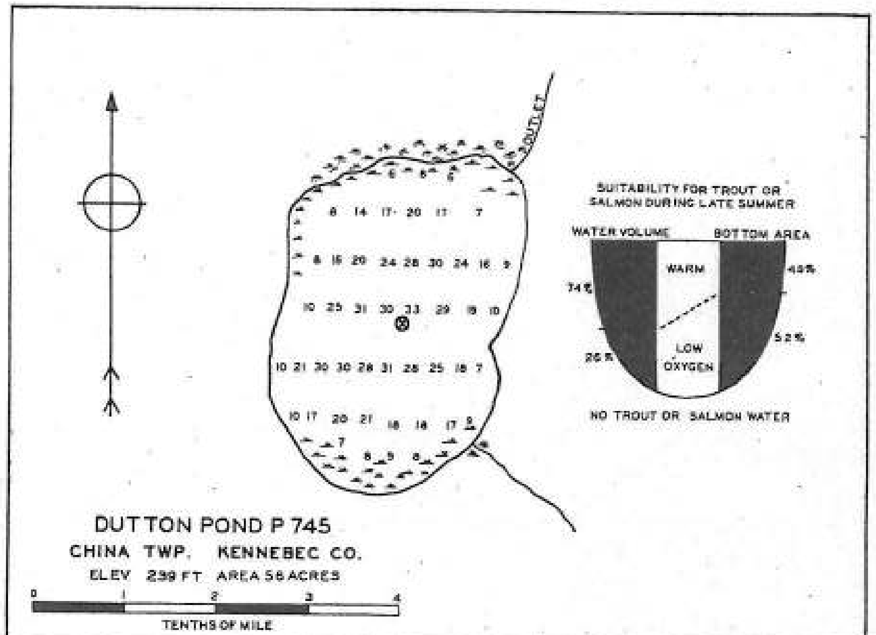

Figure 14. Dutton Pond. Soundings in feet and suitability of the water for trout or salmon.

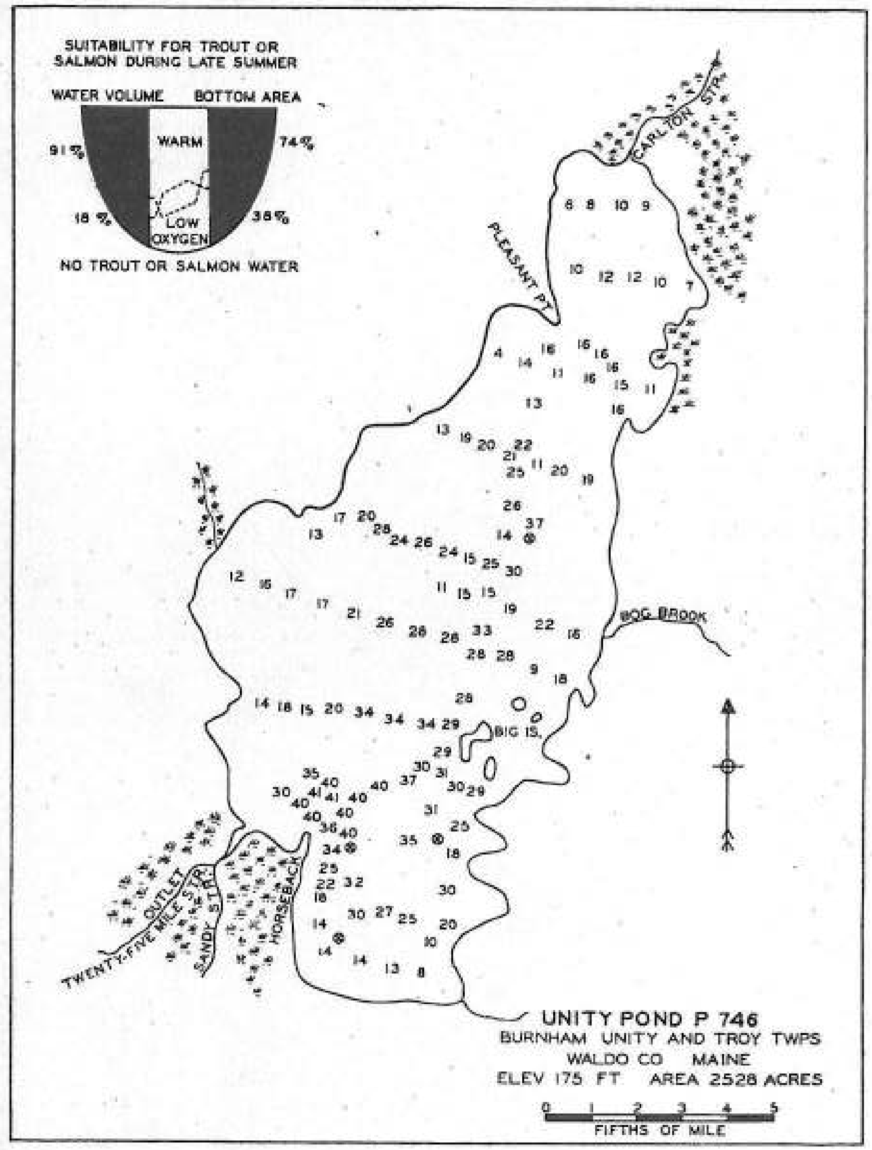

Figure 15. Unity Pond. Soundings in feet and suitability of the water for trout or salmon.

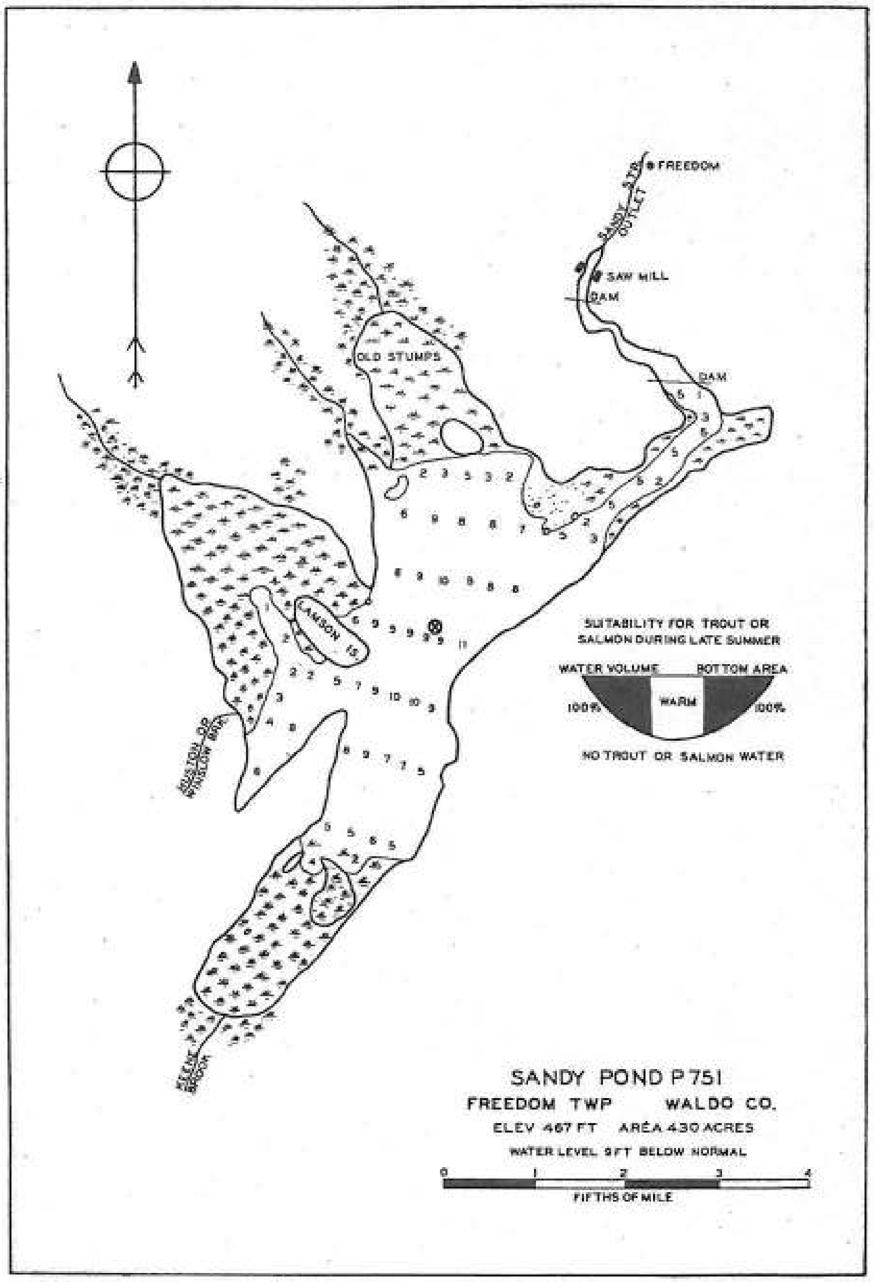

Figure 16. Sandy Pond or Freedom Pond. Soundings in feet and suitability of the water for trout or salmon.

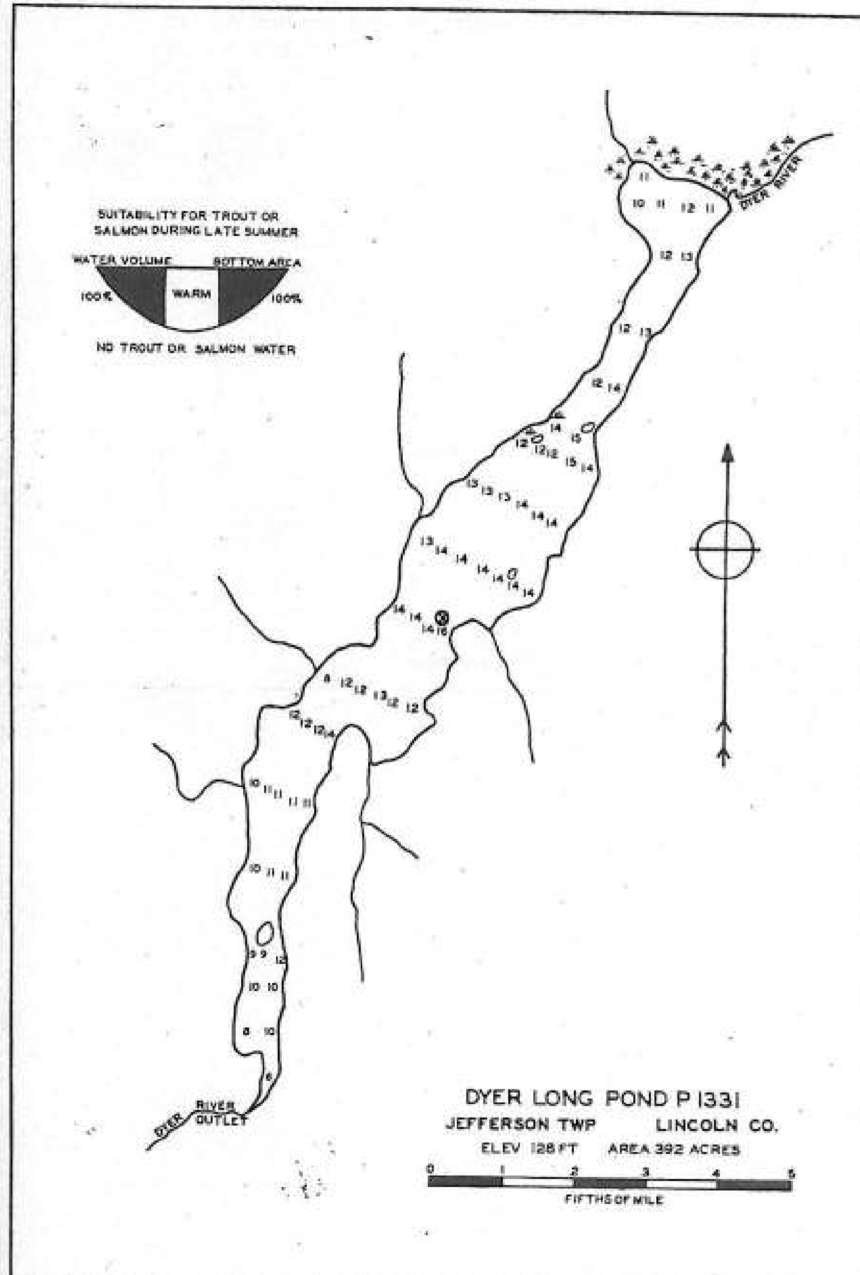

Figure 17. Dyer Long Pond. Soundings in feet and suitability of the water for trout or salmon.

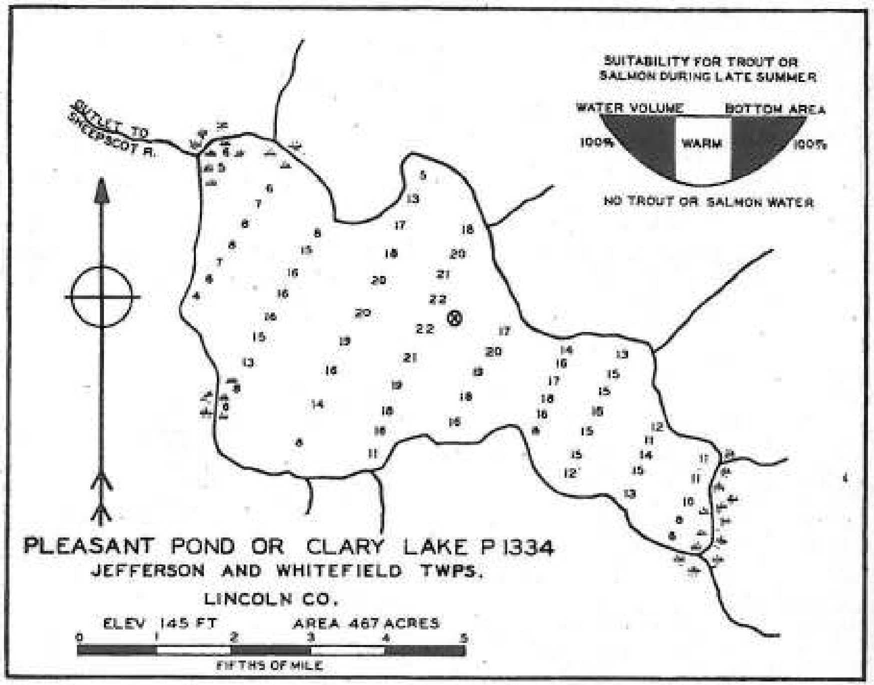

Figure 18. Pleasant Pond or Clary Lake. Soundings in feet and suitability of the water for trout or salmon.

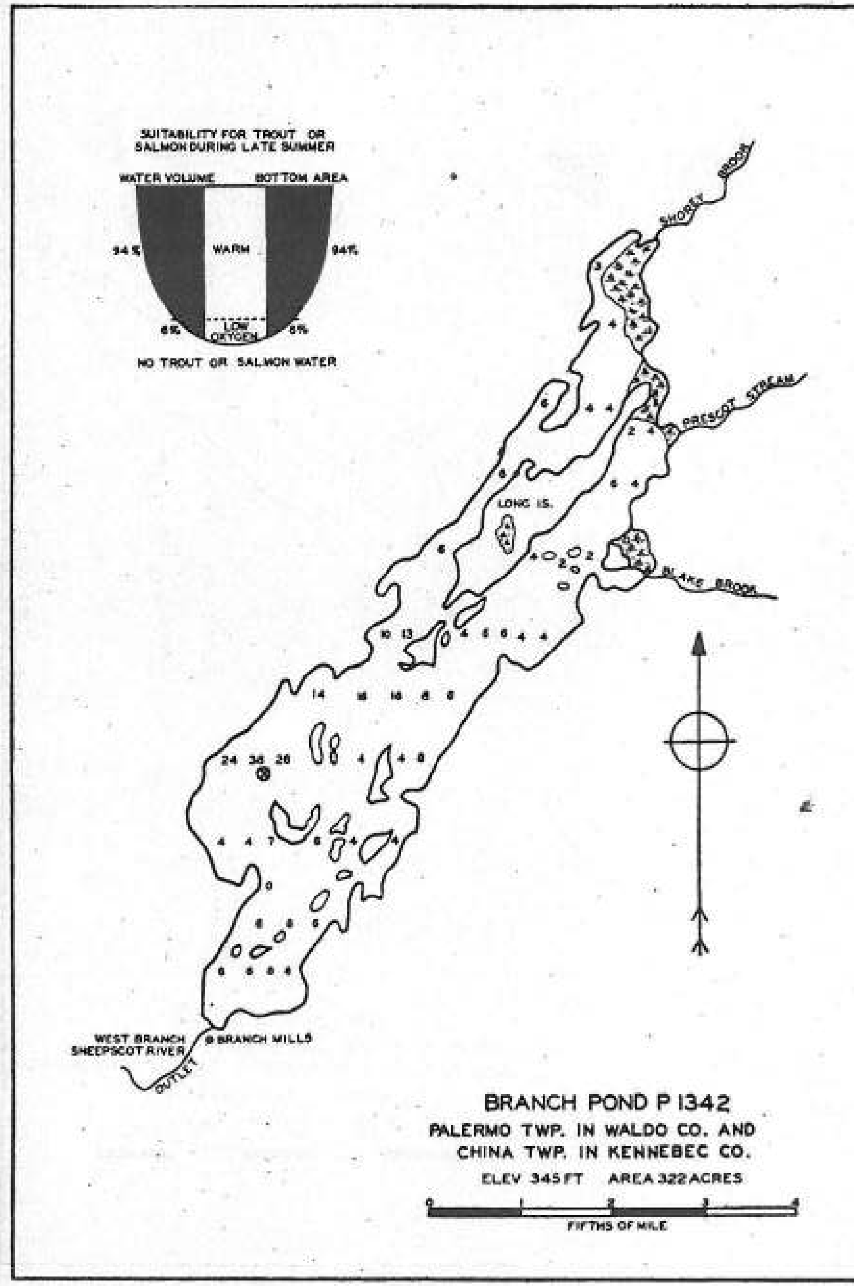

Figure 19. Branch Pond. Soundings in feet and suitability of the water for trout or salmon.

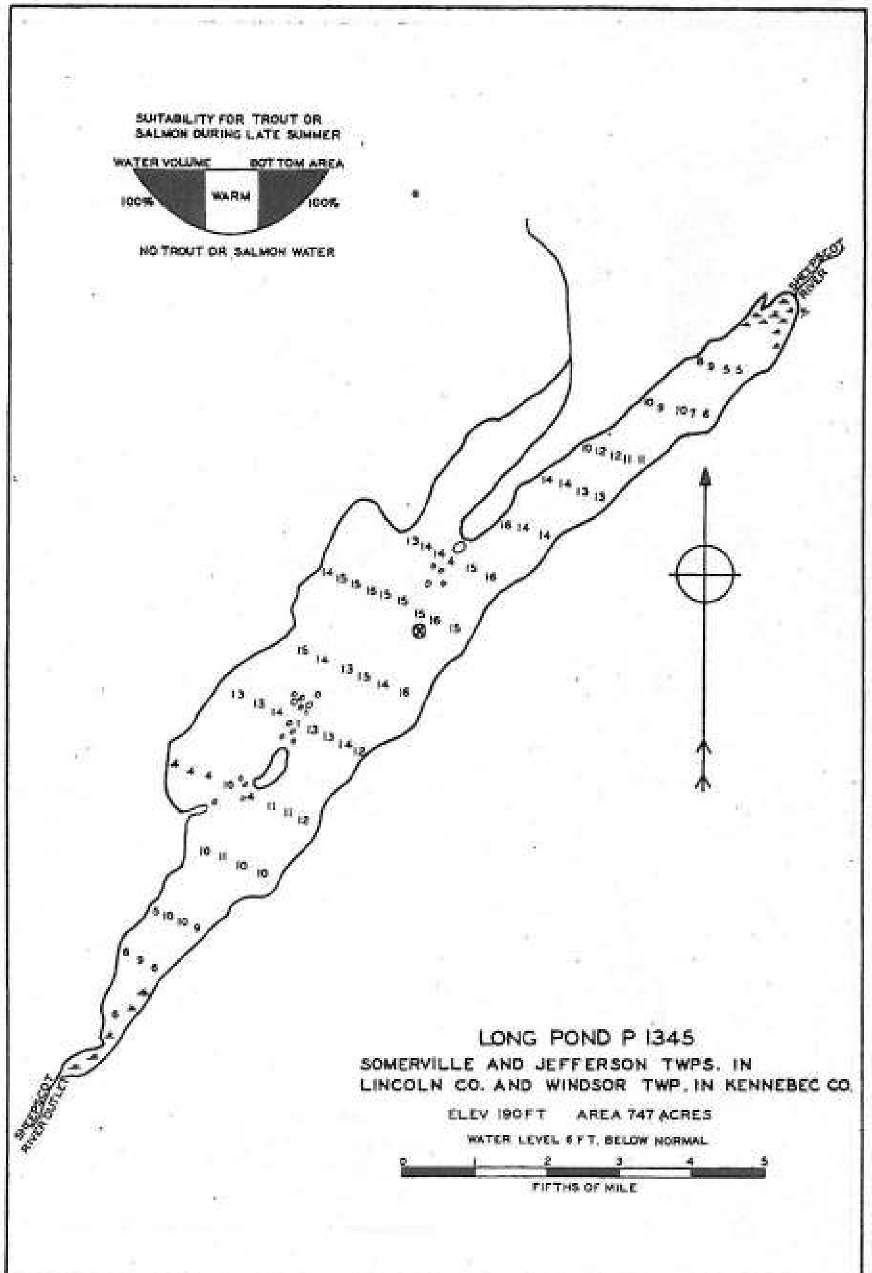

Figure 20. Long Pond. Soundings in feet and suitability of the water for trout or salmon.

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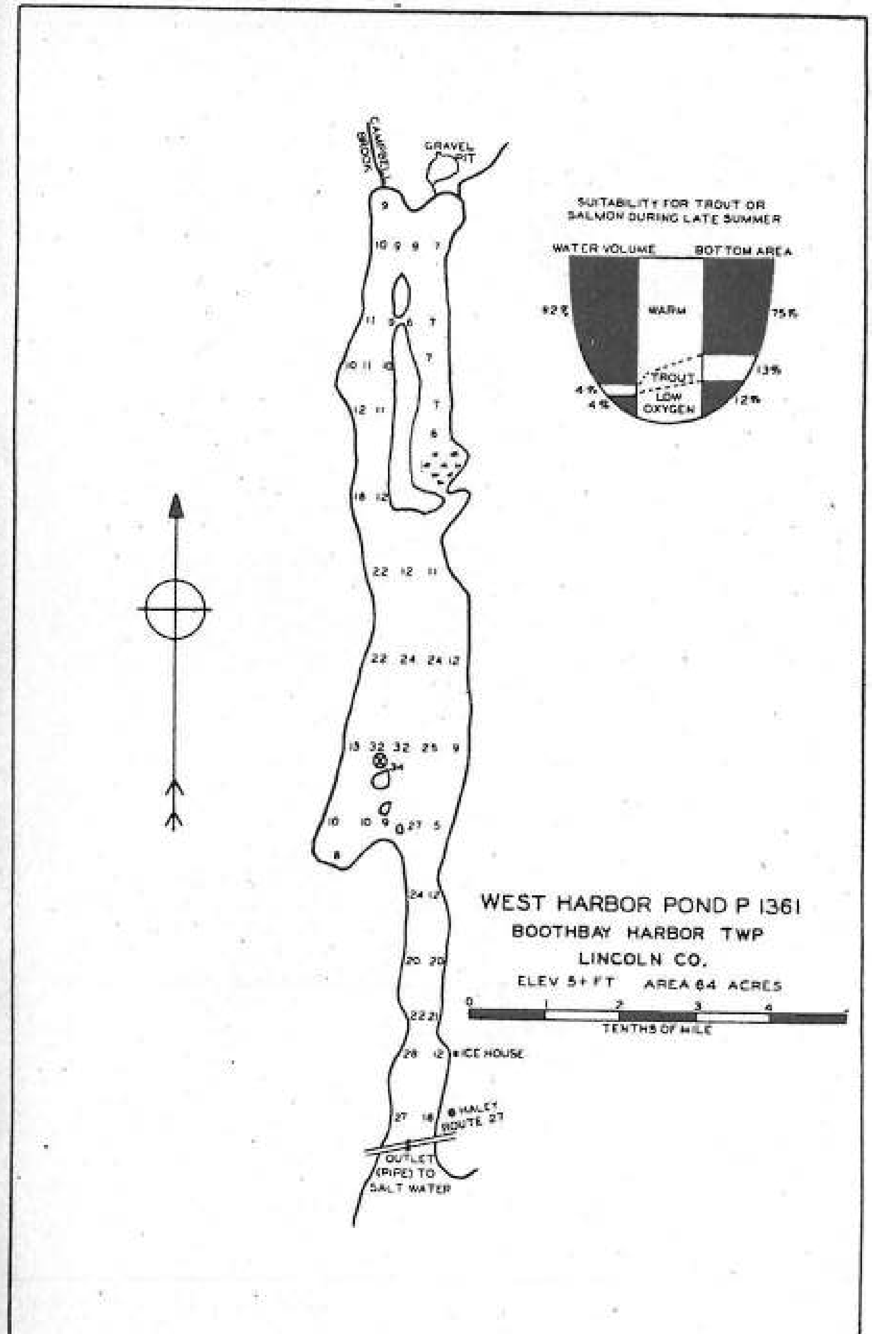

Figure 23. West Harbor Pond. Soundings in feet and suitability of the water for trout or salmon.

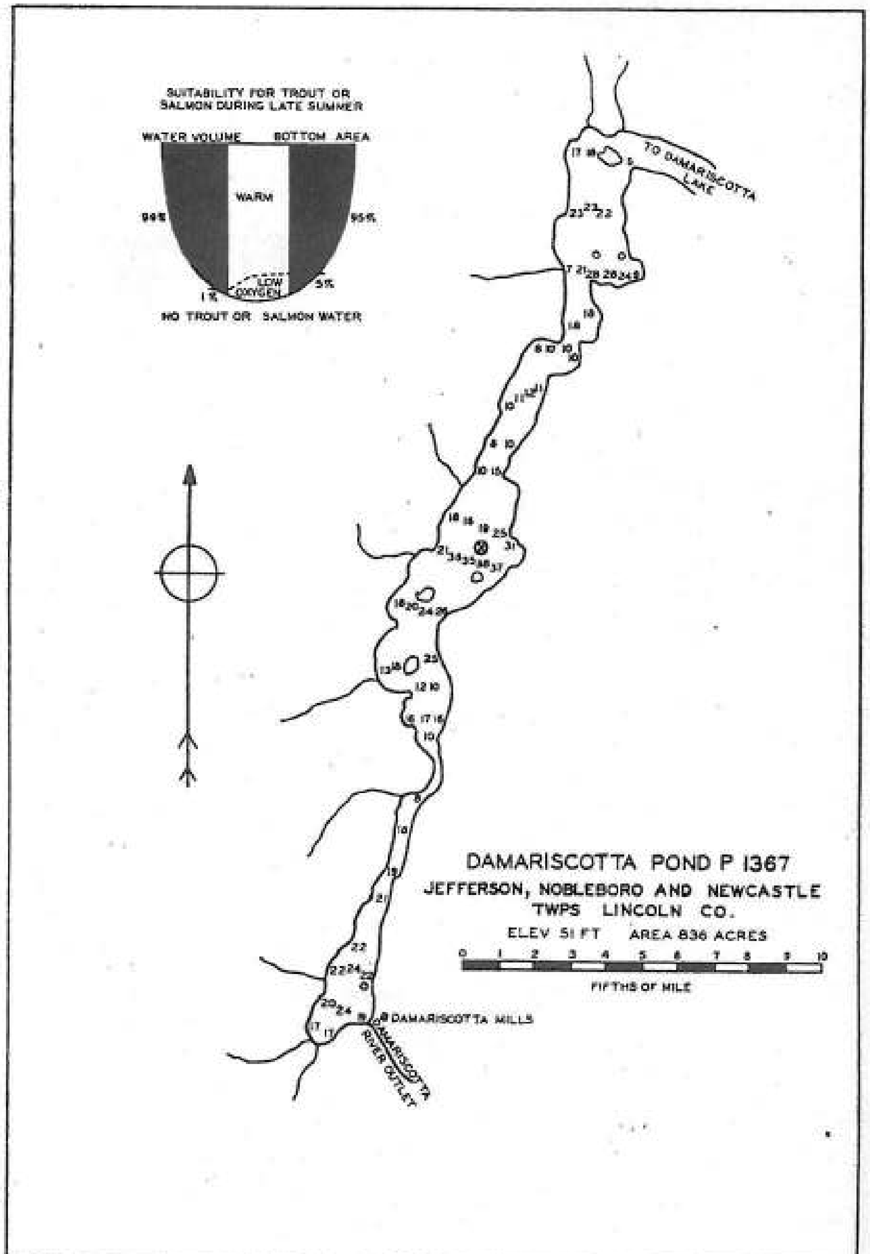

Figure 24. Damariscotta Pond. Soundings in feet and suitability of the water for trout or salmon.

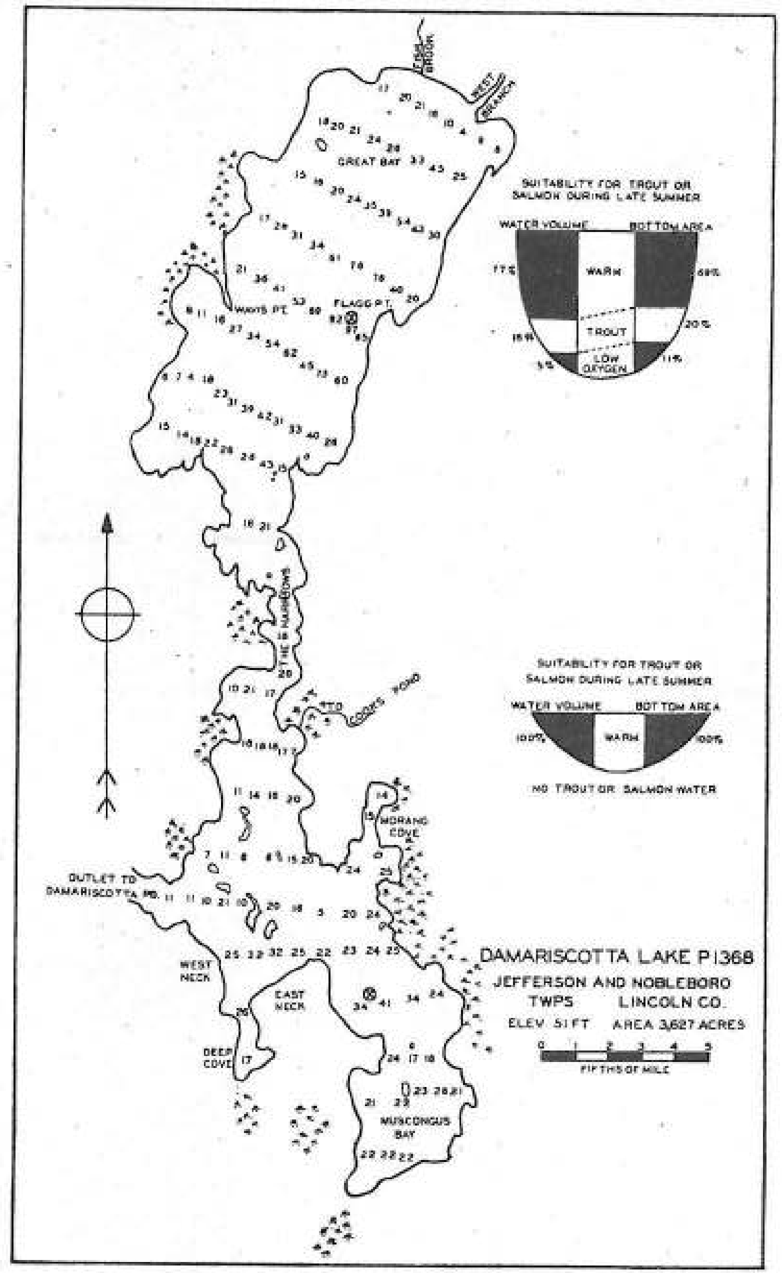

Figure 25. Damariscotta Lake. Soundings in feet and suitability of the water for trout or salmon.

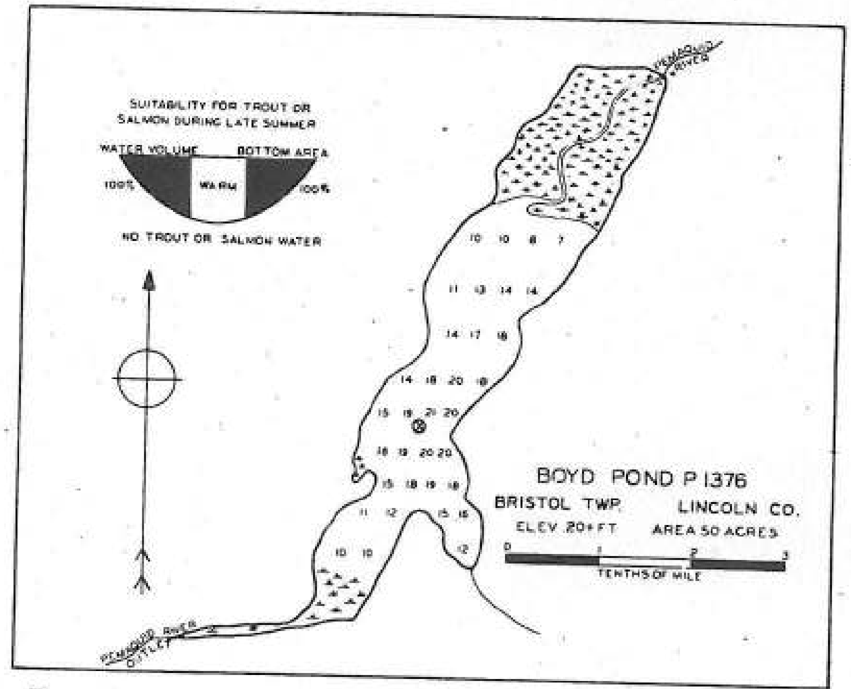

Figure 26. Boyd Pond. Soundings in feet and suitability of the water for trout or salmon.

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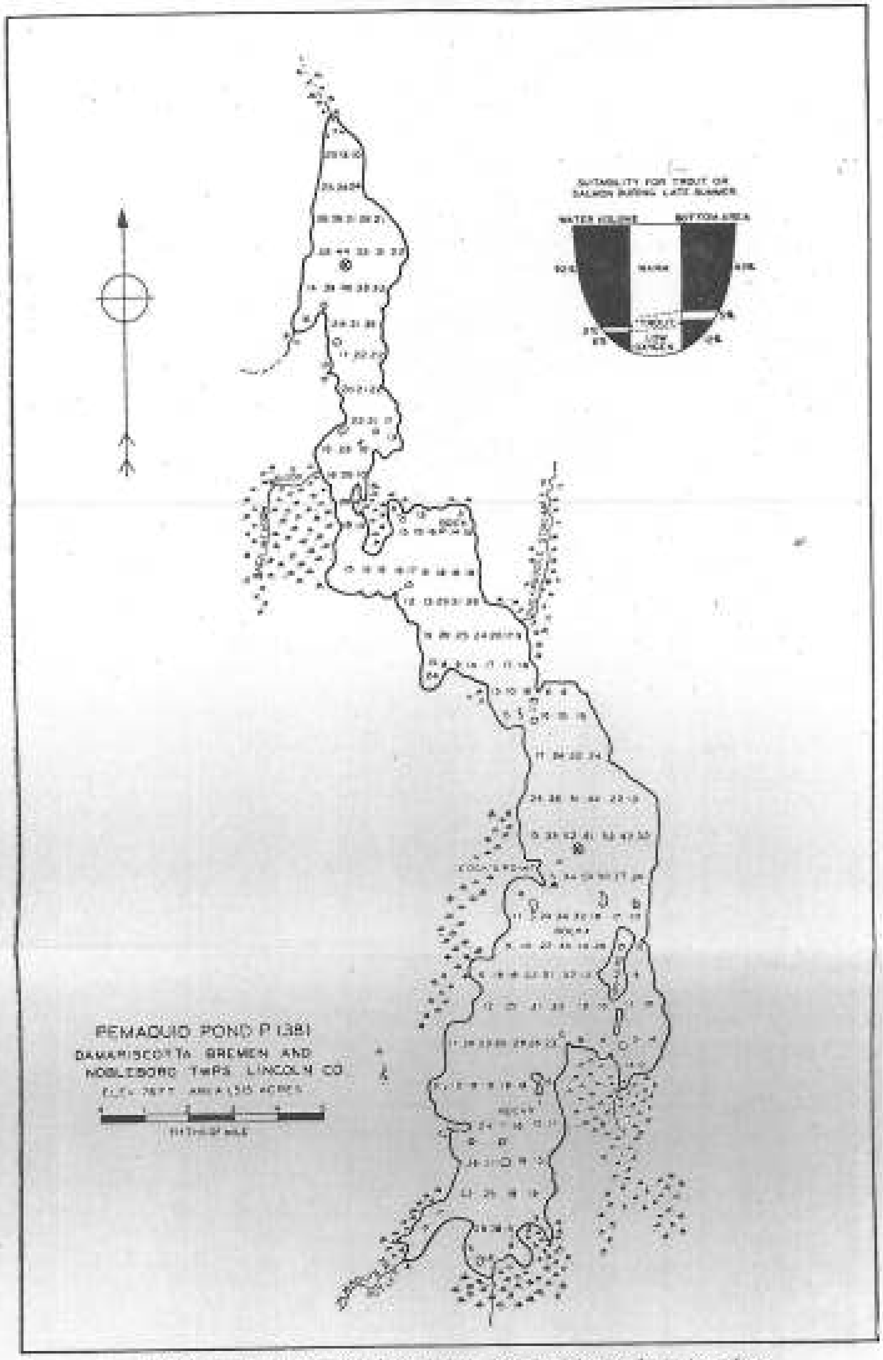

Figure 28. Pemaquid Pond. Soundings in feet and suitability of the water for trout or salmon.

TABLE XIX. The total numbers (in thousands) of game fishes of different sizes planted in the lakes and ponds* and their immediate tributary inlets by the Maine State Department of Inland Fisheries and Game during the eight years from July 1, 1933 to June 30, 1941, as summarized from department records

Name of pond	Pond number	Fish planted** (in thousands add 000)																						
		Brook Trout				Brown Trout			Rainbow Trout			Togue (Lake Trout)		Land-locked Salmon				Chinook Salmon				Chum Salmon	Small-mouthed Bass	
		Fry	2"-4"	4"-6"	Matures over 6"	2"-4"	4"-6"	Matures over 6"	2"-4"	4"-6"	Matures over 6"	Fry	4"-6"	Fry	2"-4"	4"-6"	Matures over 6"	Fry	2"-4"	4"-6"	Matures over 6"	2"-4"	Fry	2"
Nequasset Pond	638																							
Tributaries			2	2	6																			
Gardiner Pond	640			6																				
Togue Pond	649			10		25	25																	
Threecornered Pond	651				4		5																	
Weber Pond	688								20						7	7			13	13			3	
Threemile Pond	694			15		15	10	2											9					
China Lake	739			4		40	25		10			2	4	20	44	7			5		5			
Unity Pond	746										5												1	5
Tributaries				15	4																			
Dyer Long Pond	1331																							
Tributaries		7	27	26	8																			
Pleasant Pond or Clary Lake	1334																							
Tributaries			8																					
Branch Pond	1340			5																				
Long Pond	1343			2																				
Tributaries			41	25	10																			
Sheepscot Pond	1349			2	2										25	20								
Tributaries			7	20	15																			
Damariscotta Pond	1357																							
Tributaries			7																					
Damariscotta Lake	1358														20			25	21	20	14	20	4	3
Tributaries		7	22	27	6																			
Biscay Pond	1370				2										6	6				8	5			
Tributaries				17																				
Pemaquid Pond	1381																				20			
Muddy Pond	1383				5																			
Duckpuddle Pond	1380			1																				
Tributaries				6																				
McCurdy Pond	1382			1	20																			
Webber Pond	1387								6	27														
Medomak Pond	1394																							
Tributaries			3	12																				
Chickawaukie Pond	1409																							
Tributaries		3	2	2	5																			
North Pond	1414						6																	
South Pond	1415						19																	
Tributaries		3		5	1																			
Seven Tree Pond	1417																							
Tributaries			2																					
Crawford Pond	1422		2	20	6																			
Tributaries		12	10	21	3																			
Lermond Pond	1423			3																				
Alford Lake	1424				7										25	17								
Hobbs Pond	1429						3																	
Sennebec Pond	1431																							
Tributaries		3	4	25	8	15		2	25															
Quantabacook Pond	1434																							
Tributaries			26	34	9				43															
St. George Lake	1443					15									28	28	9							
Megunticook Lake	1446			30	31										17	33	4	30	19			30		
Tributaries		22		5																				
Tilden Pond	1450																							
Tributaries			4	12	3																			
Mirror Pond	1451																							
Tributaries				4	2																			
Swan Lake	1460			20											11	18			2	1	30	31		
Tributaries				7																				
Total for lakes only			5	121	71	95	93	7	36	27	1	2	4	20	207	229	13	55	70	60	20	112	8	4
Total for tributaries		51	170	271	38	15		2	68															

*The following ponds included by the survey, had no records of stocking: Little Togue, Spectacle, Dam, Tolman, Patten, Lovejoy, Dutton (P.740), Sandy, Turner, West Halbo bays, Washington, Mirror, Round, Fish, Stevens, Norton, Pitcher, Knight, Cross, Seaboro, Dutton (P.1461), Passagassawakeag and Toddy.

**Of the fish listed above as 2"-4" fish, 155,000 Brook Trout, 3,000 Rainbow Trout, 20,000 Land-locked Salmon and 30,000 Chinook Salmon were listed in the stocking records as 2"-3" fish, instead of
2" to 4" fish.

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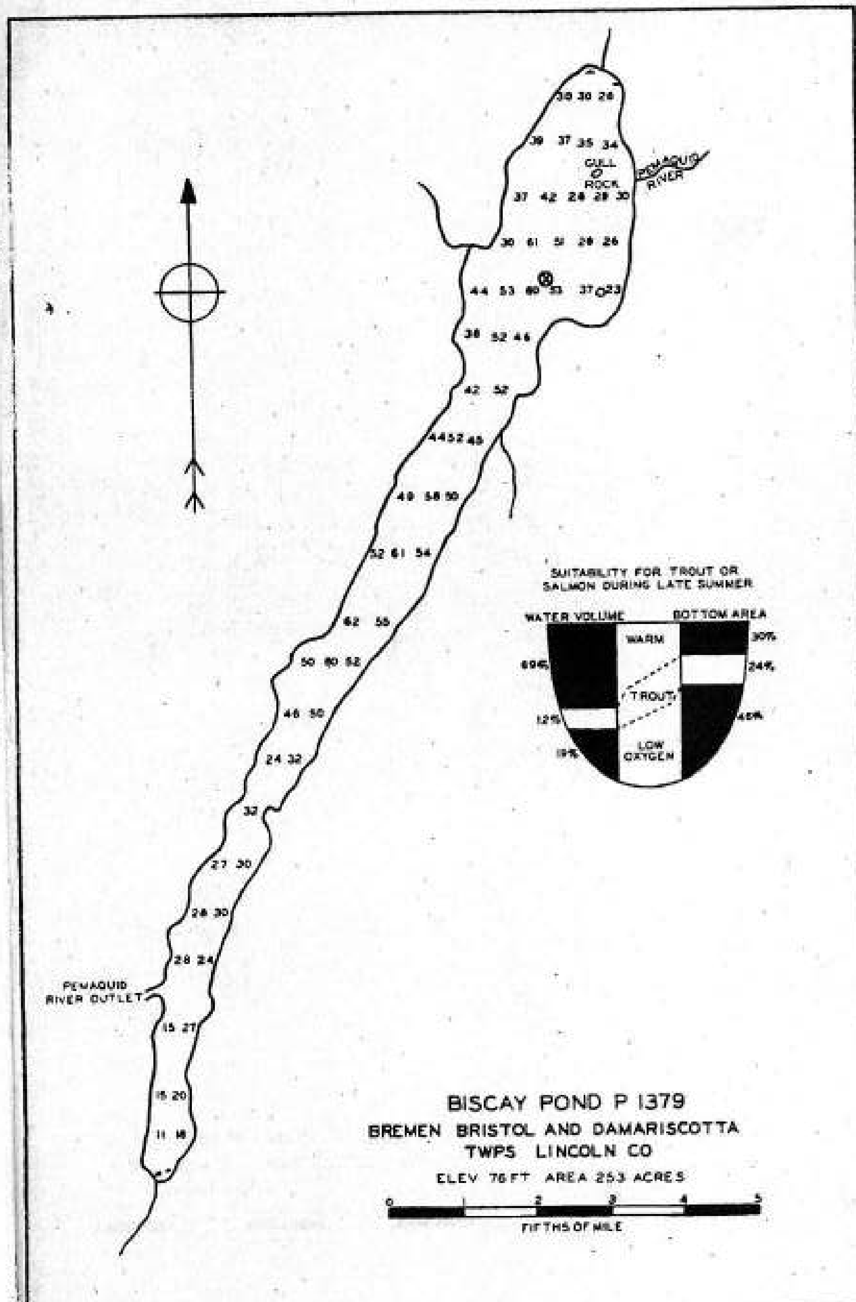

Figure 27. Biscay Pond. Soundings in feet and suitability of the water for trout or salmon.

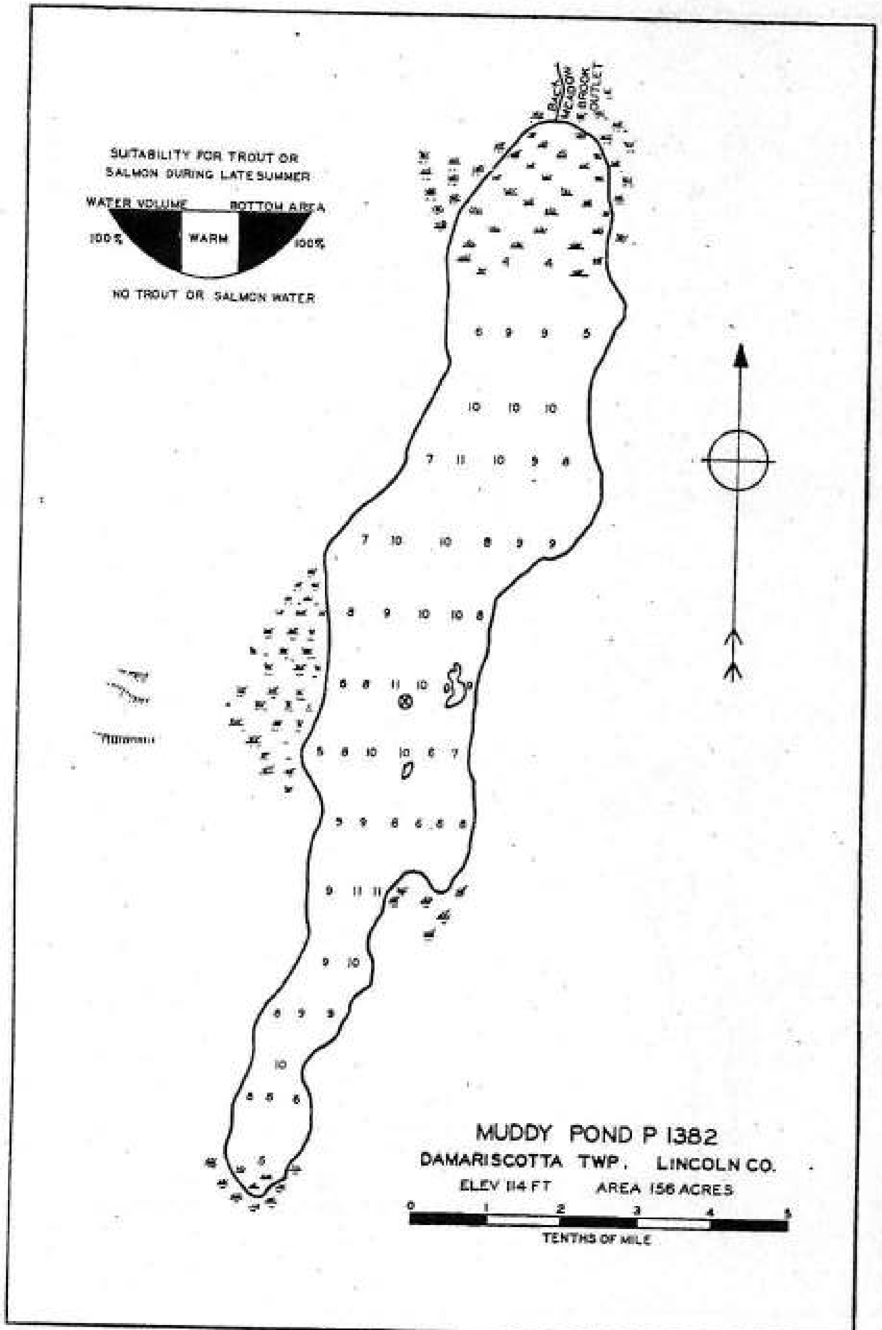

Figure 29. Muddy Pond. Soundings in feet and suitability of the water for trout or salmon.

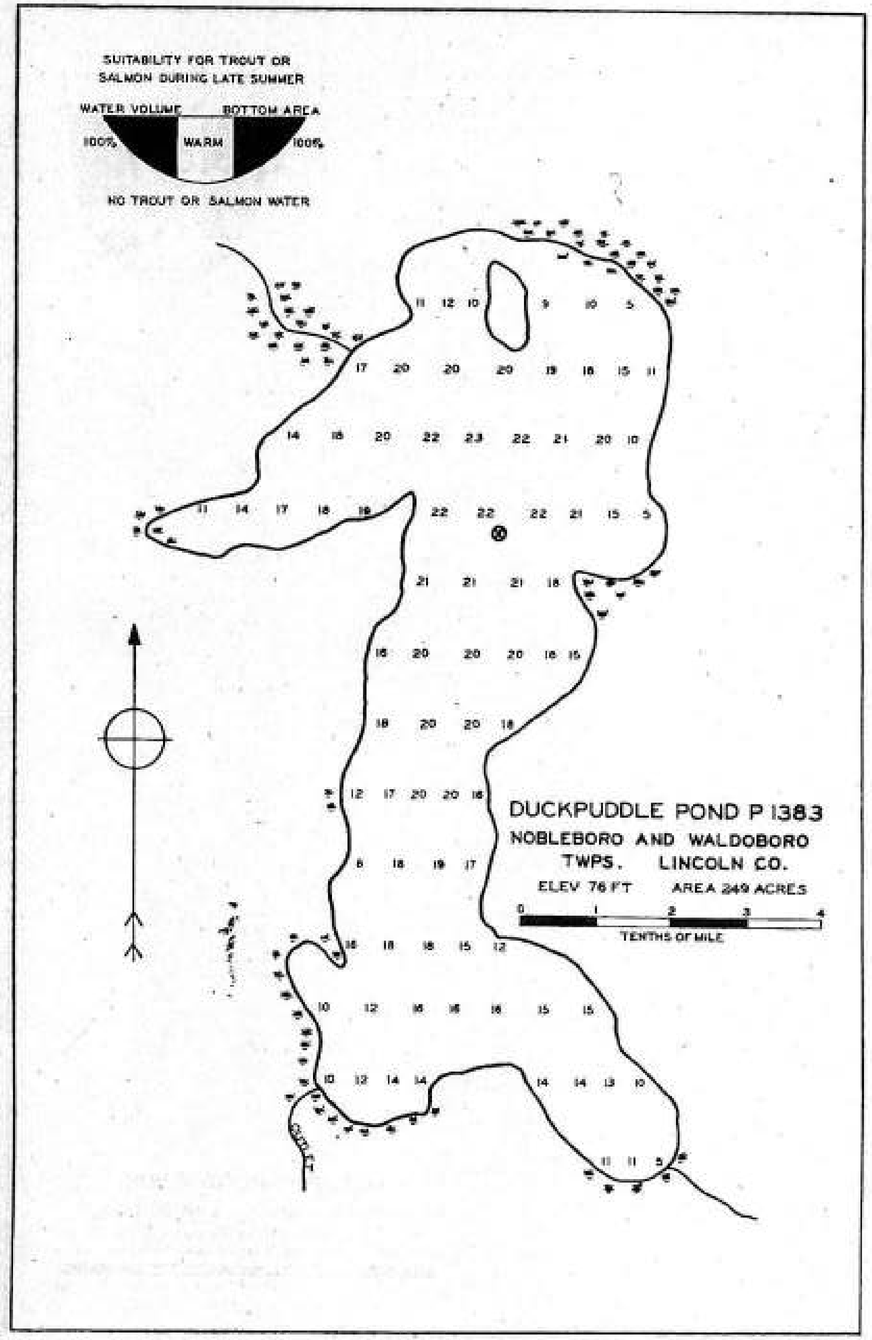

Figure 30. Duckpuddle Pond. Soundings in feet and suitability of the water for trout or salmon.

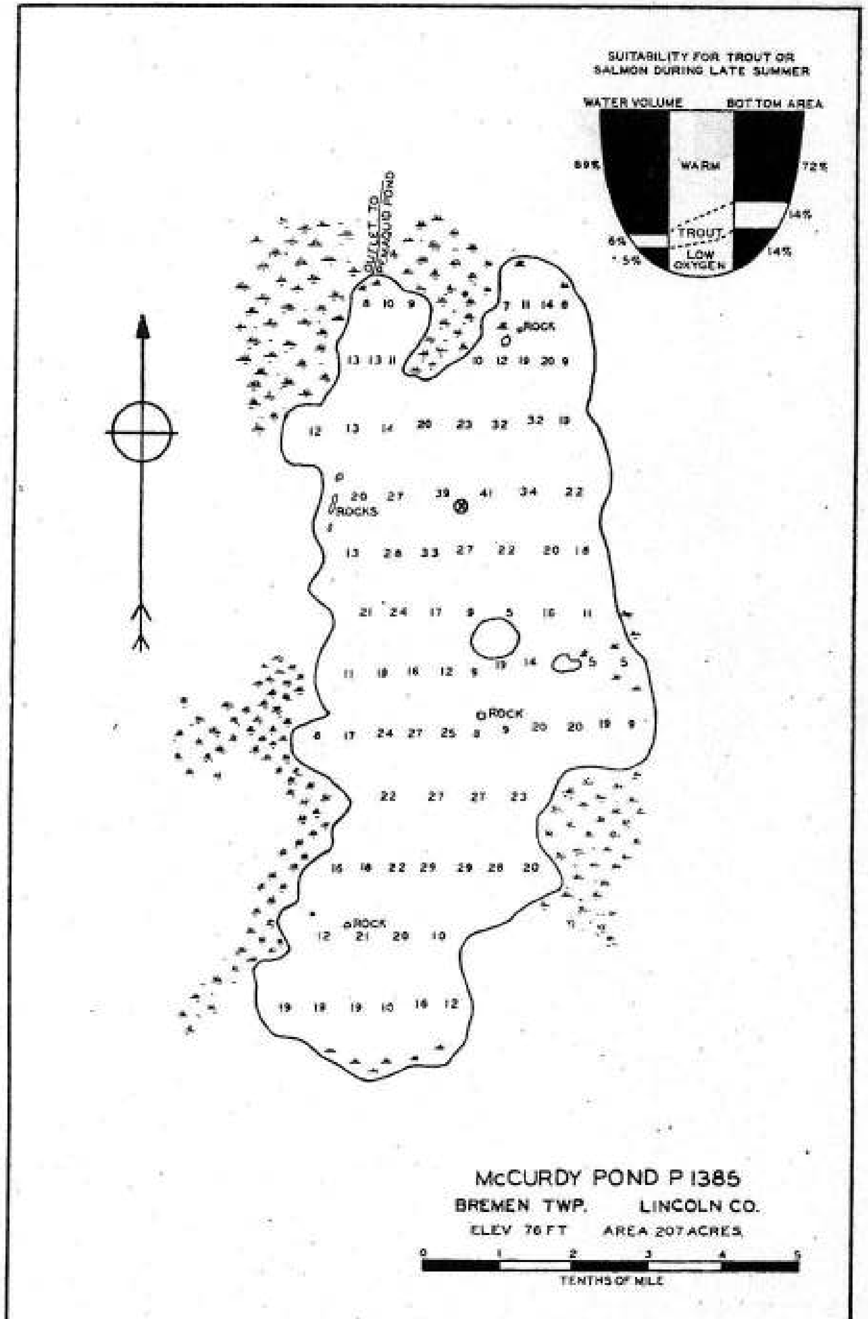

Figure 31. McCurdy Pond. Soundings in feet and suitability of the water for trout or salmon.

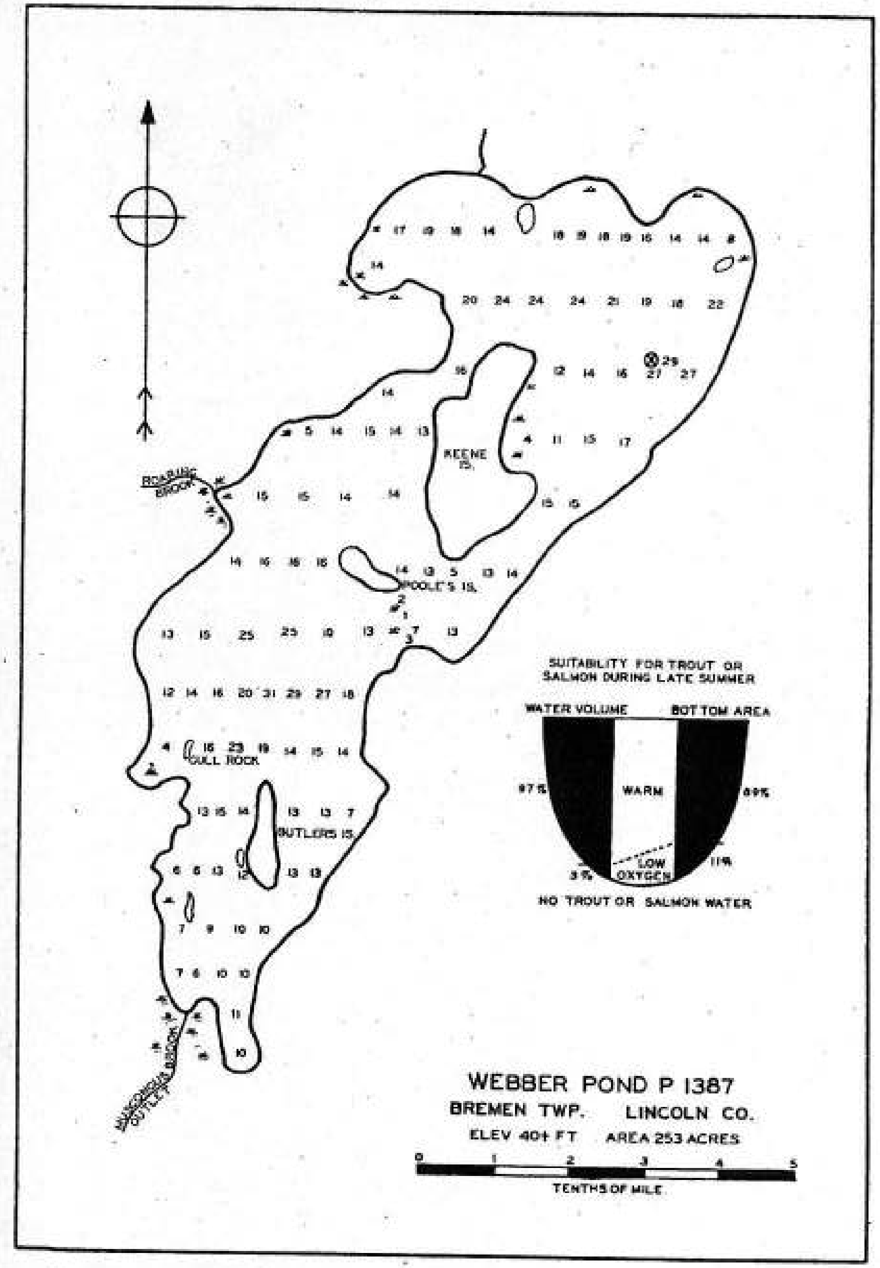

Figure 32. Webber Pond. Soundings in feet and suitability of the water for trout or salmon.

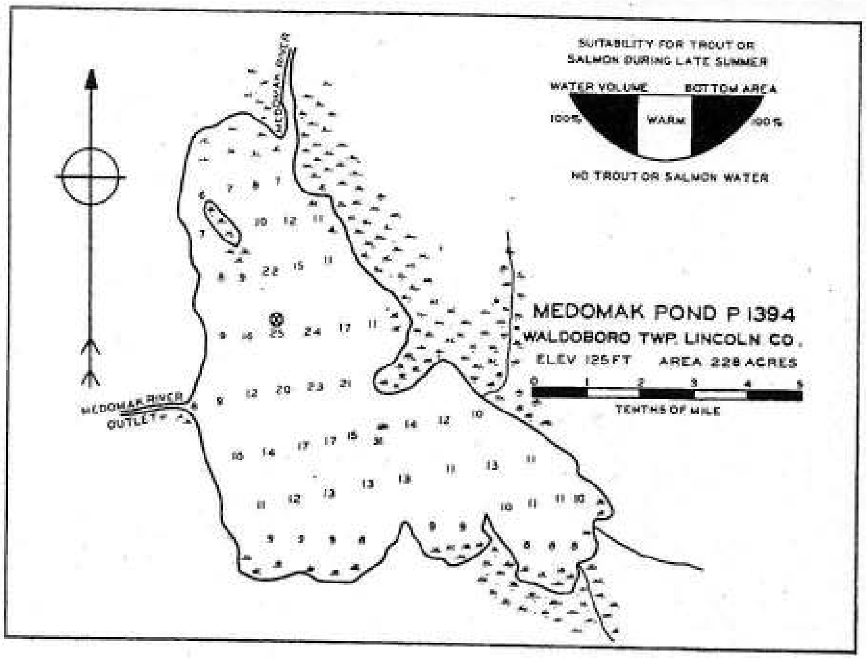

Figure 33. Medomak Pond. Soundings in feet and suitability of the water for trout or salmon.

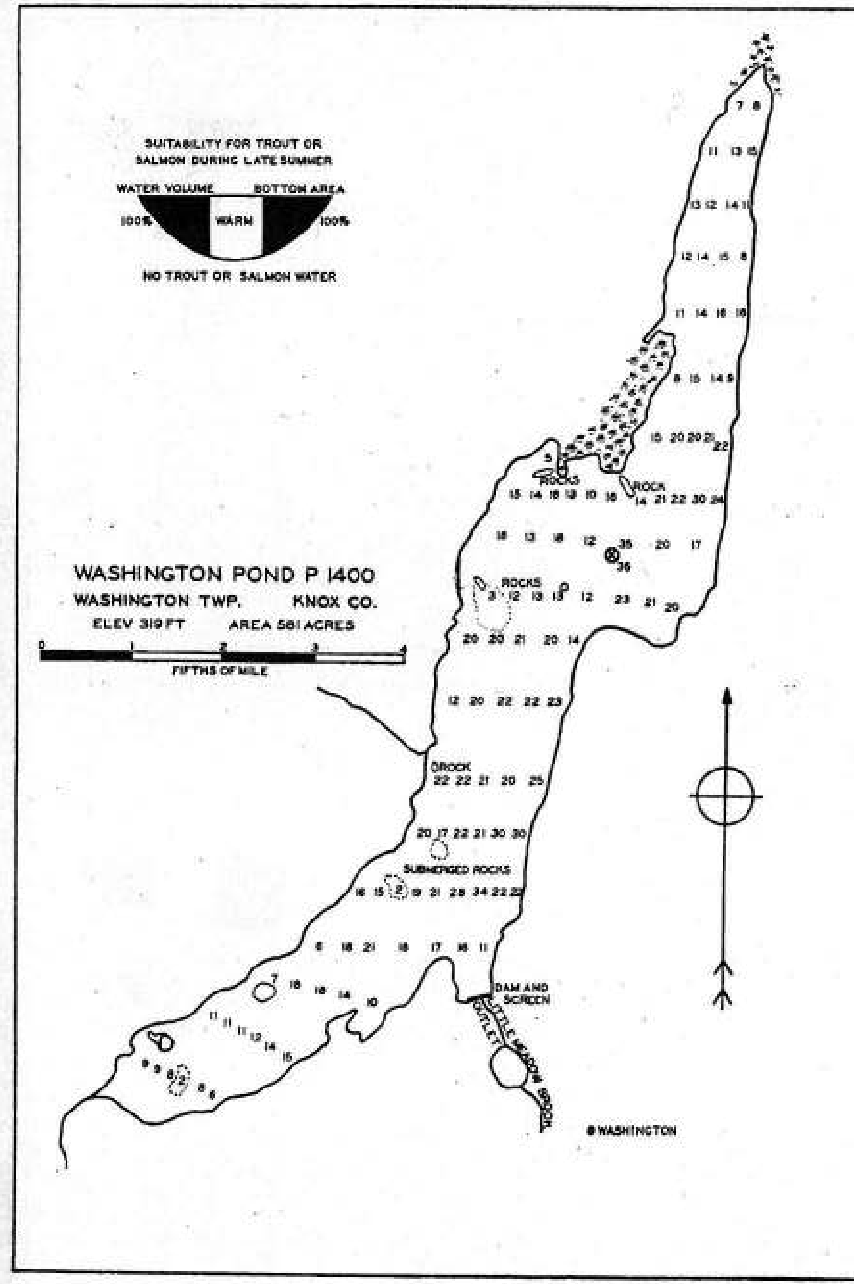

Figure 34. Washington Pond. Soundings in feet and suitability of the water for trout or salmon.

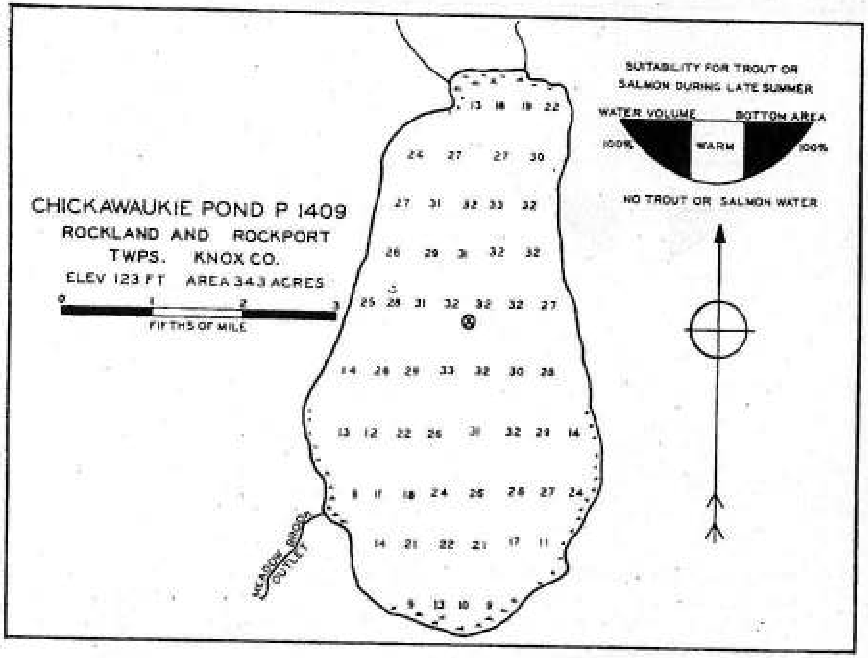

Figure 35. Chickawaukie Pond. Soundings in feet and suitability of the water for trout or salmon.

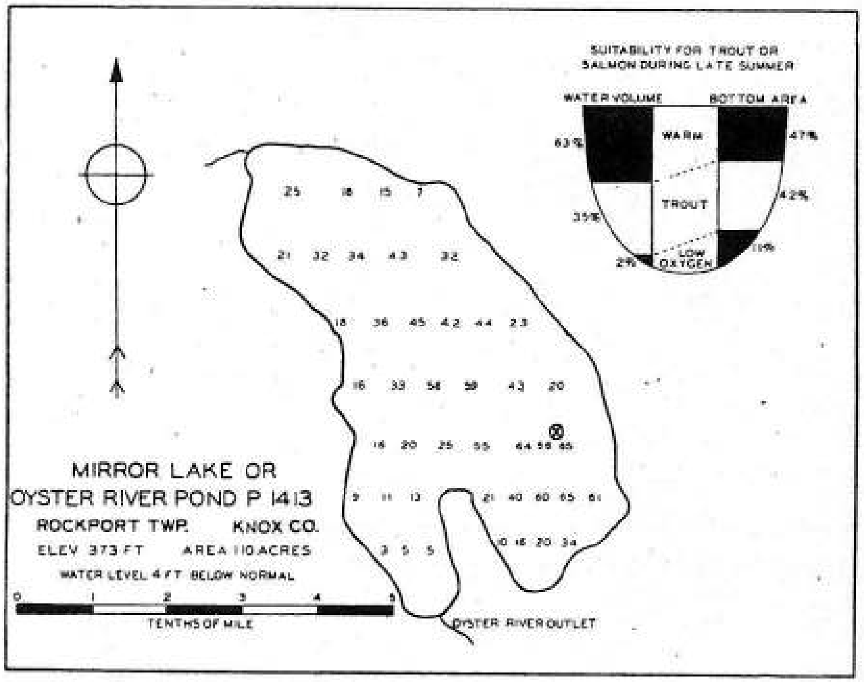

Figure 36. Mirror Lake or Oyster River Pond. Soundings in feet and suitability of the water for trout or salmon.

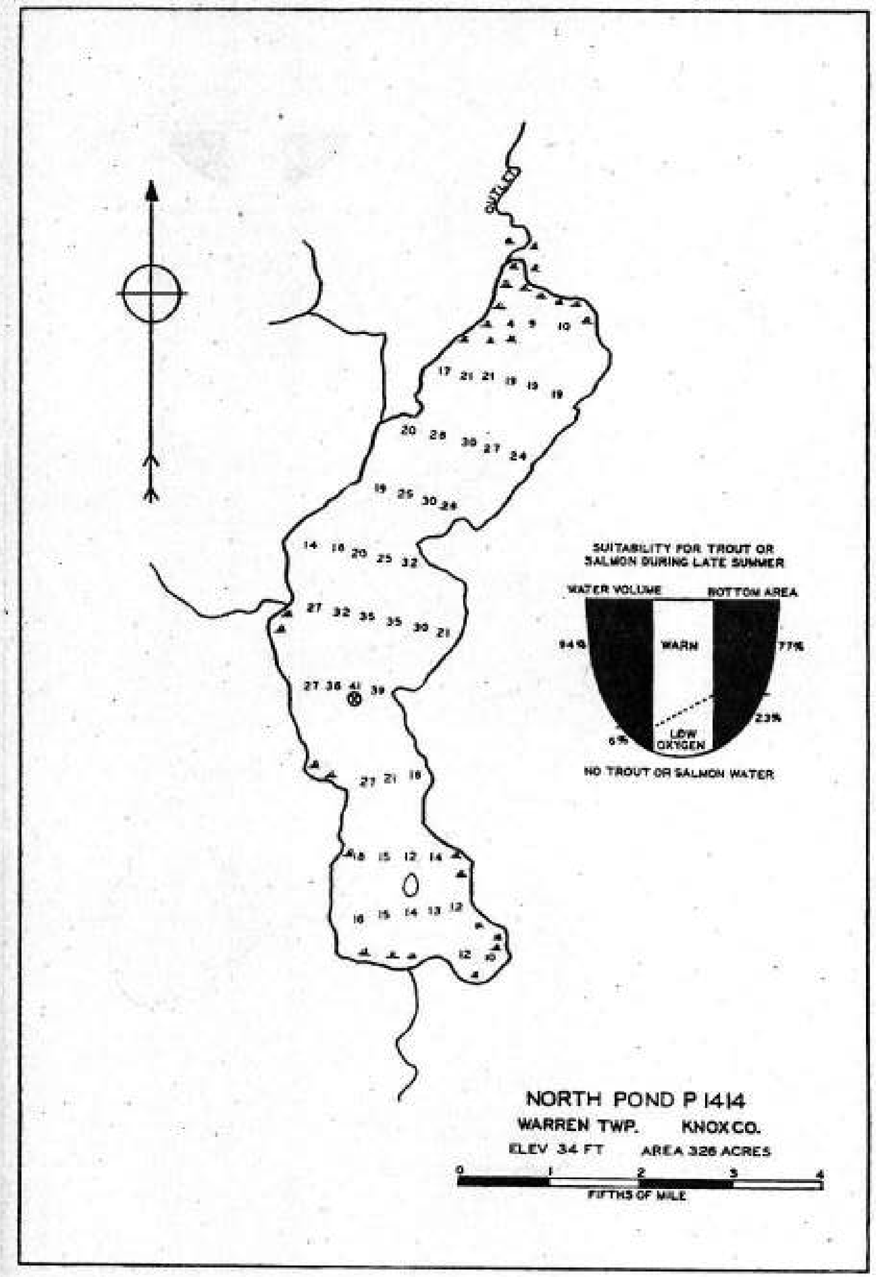

Figure 37. North Pond. Soundings in feet and suitability of the water for trout or salmon.

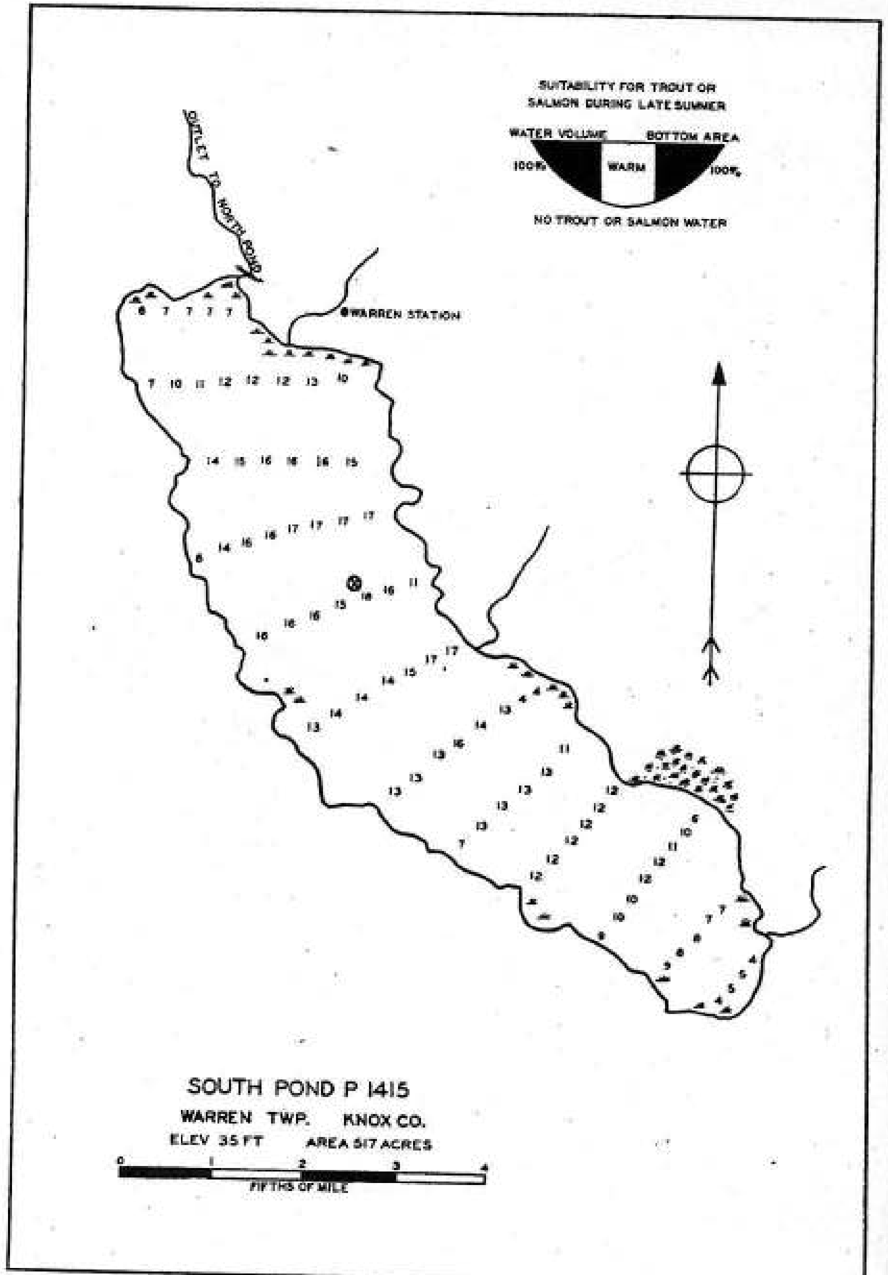

Figure 38. South Pond. Soundings in feet and suitability of the water for trout or salmon.

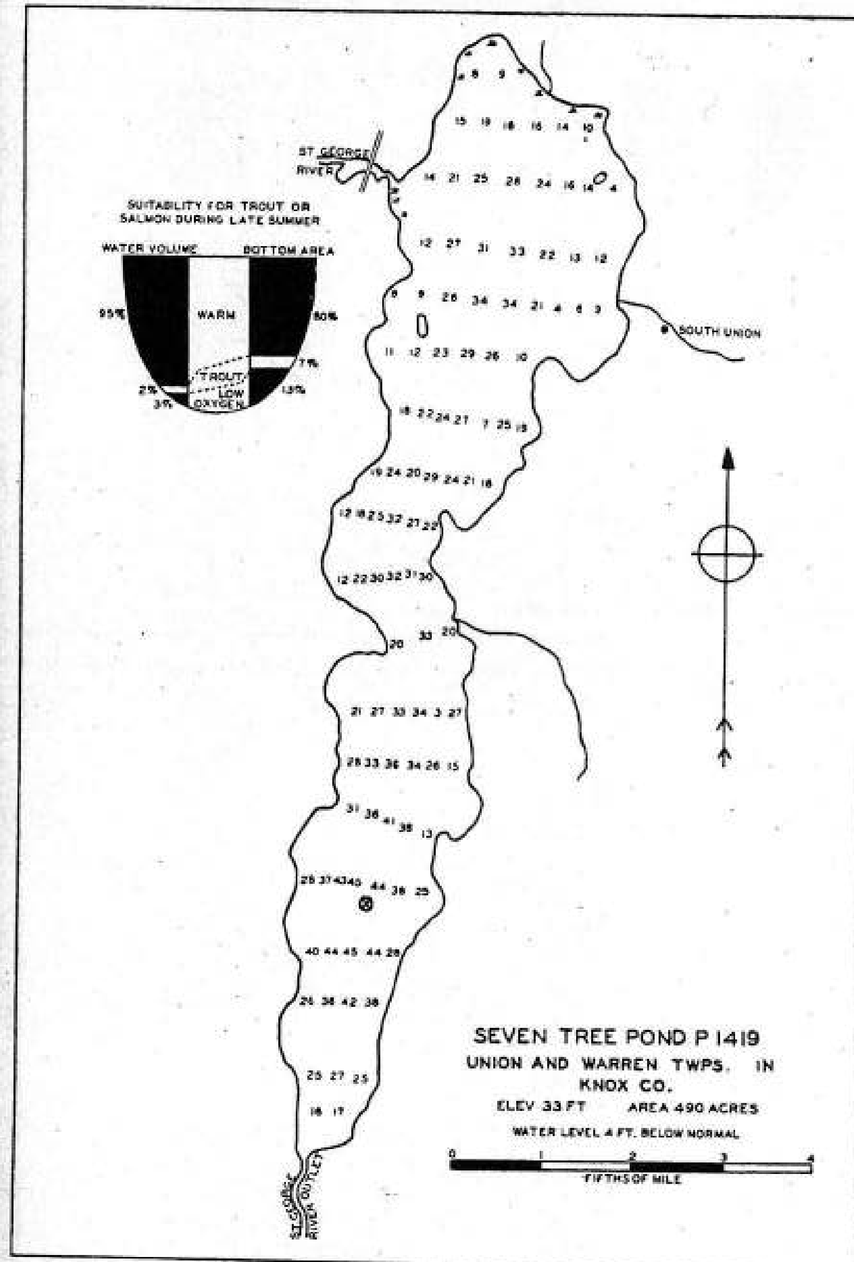

Figure 39. Seven Tree Pond. Soundings in feet and suitability of the water for trout or salmon.

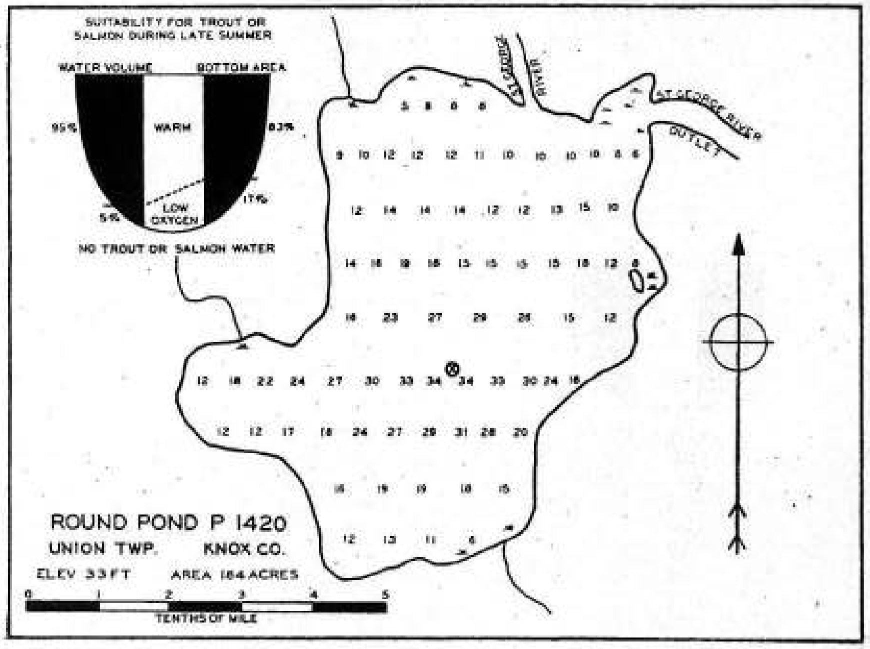

Figure 40. Round Pond. Soundings in feet and suitability of the water for trout or salmon.

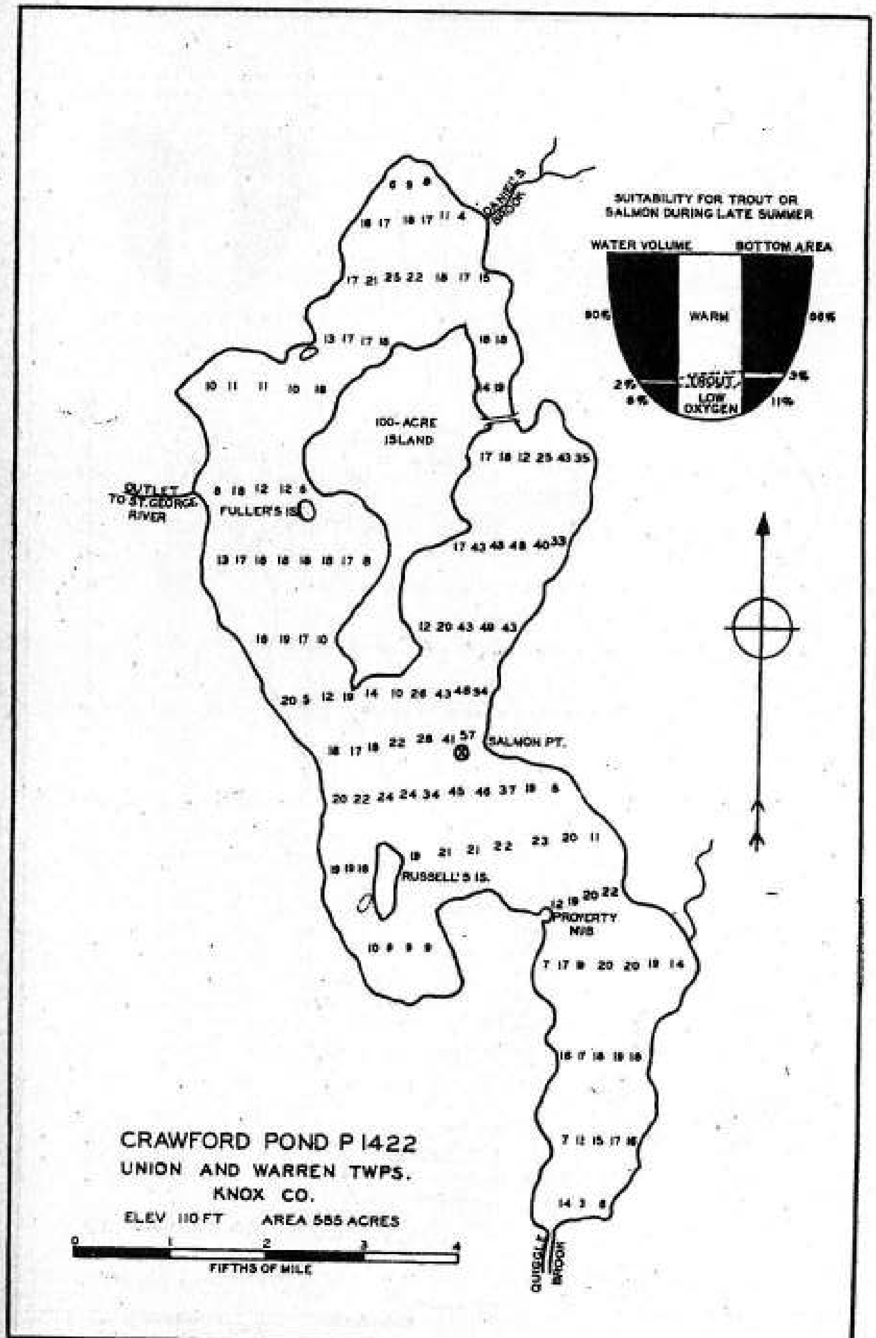

Figure 41. Crawford Pond. Soundings in feet and sitability of the water for trout or salmon.

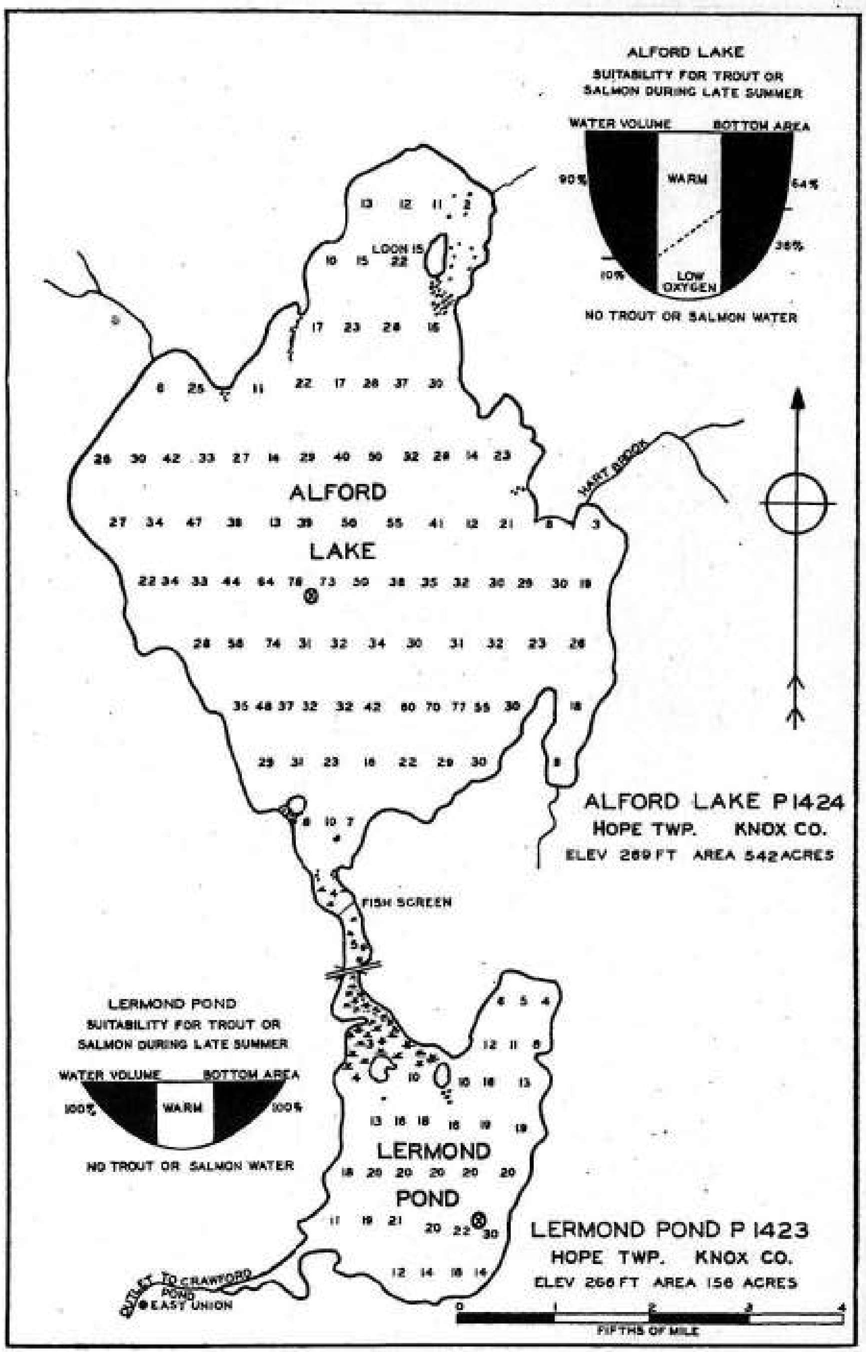

Figure 42. Lermond Pond and Alford Lake. Soundings in feet and suitability of the water for trout or salmon.

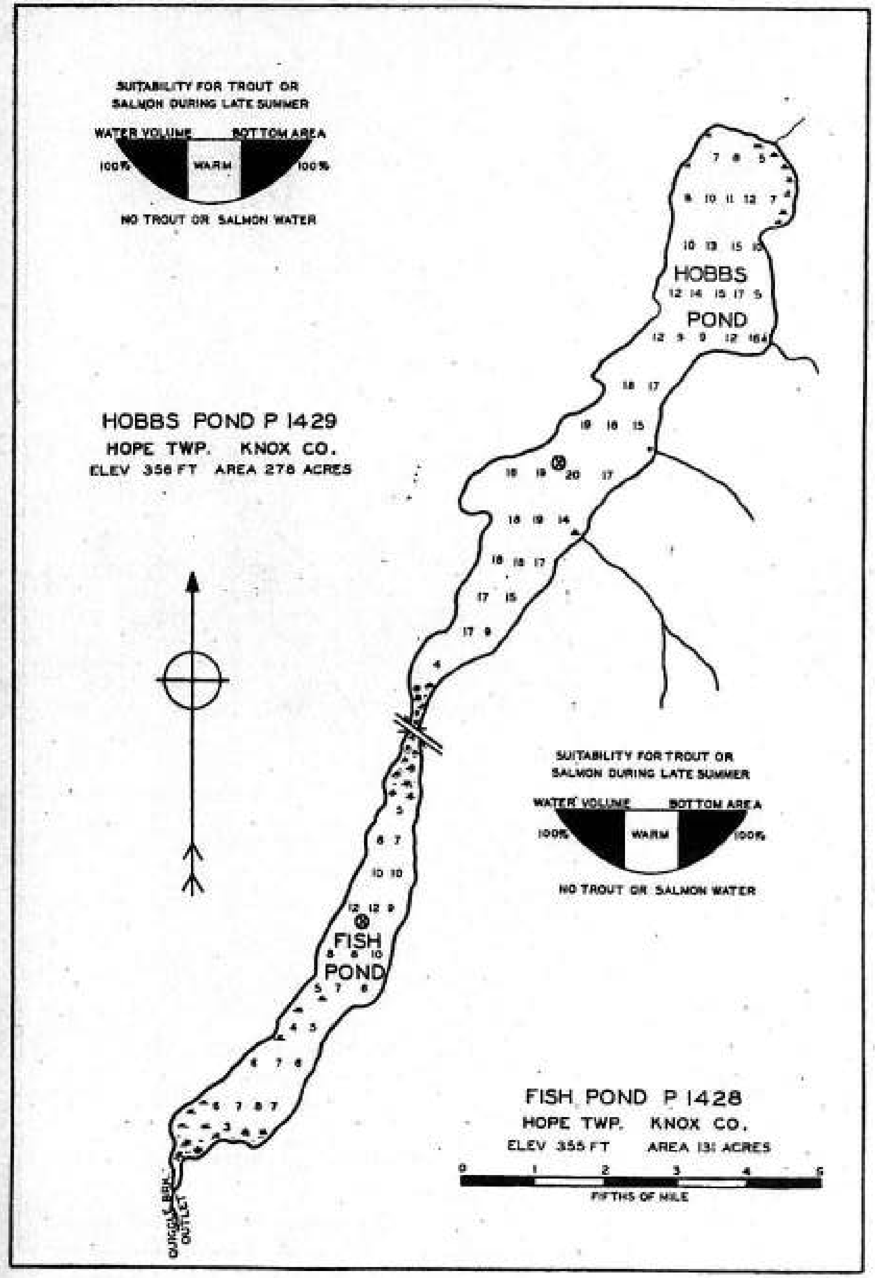

Figure 43. Fish and Hobbs ponds. Soundings in feet and suitability of the water for trout or salmon.

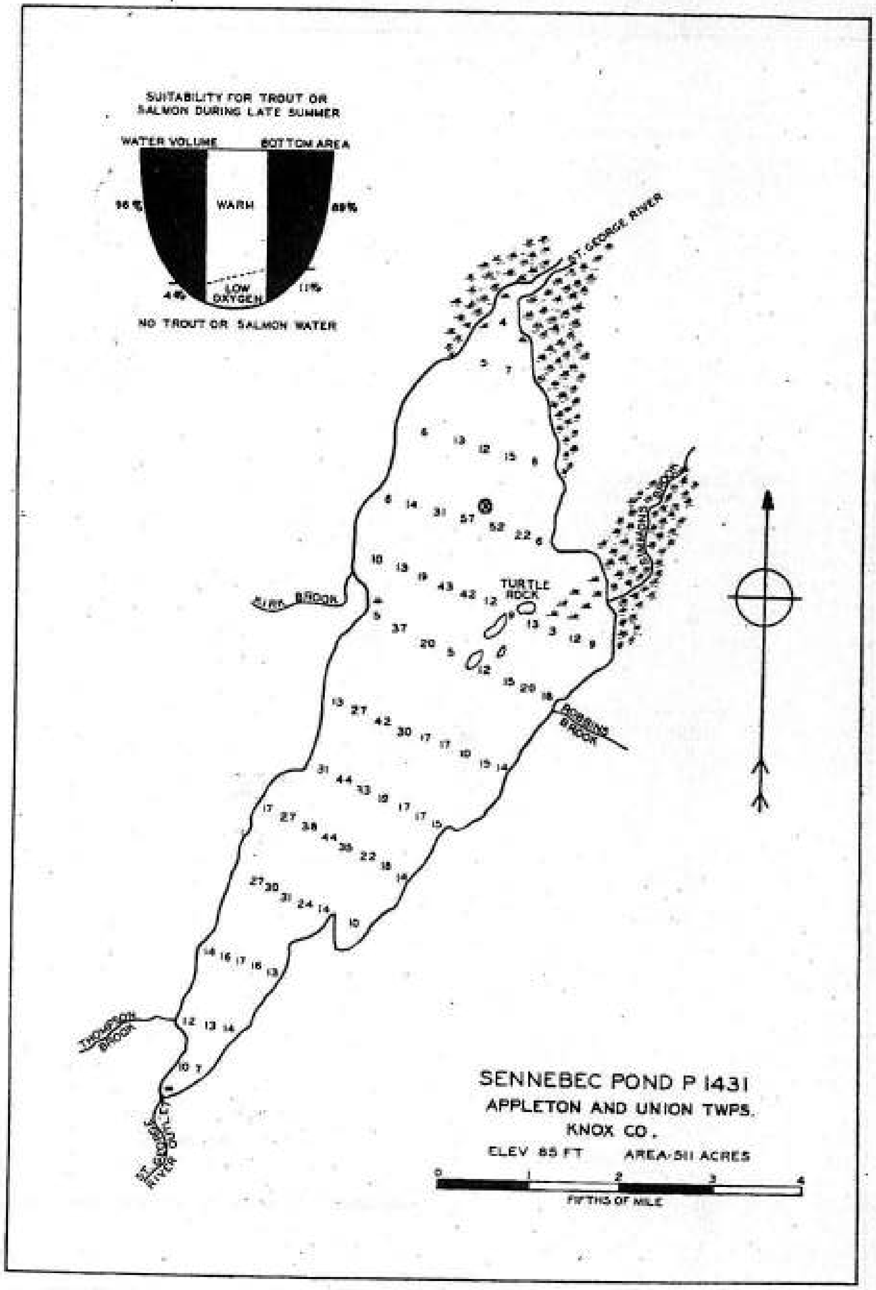

Figure 44. Sennebec Pond. Soundings in feet and suitability of the water for trout or salmon.

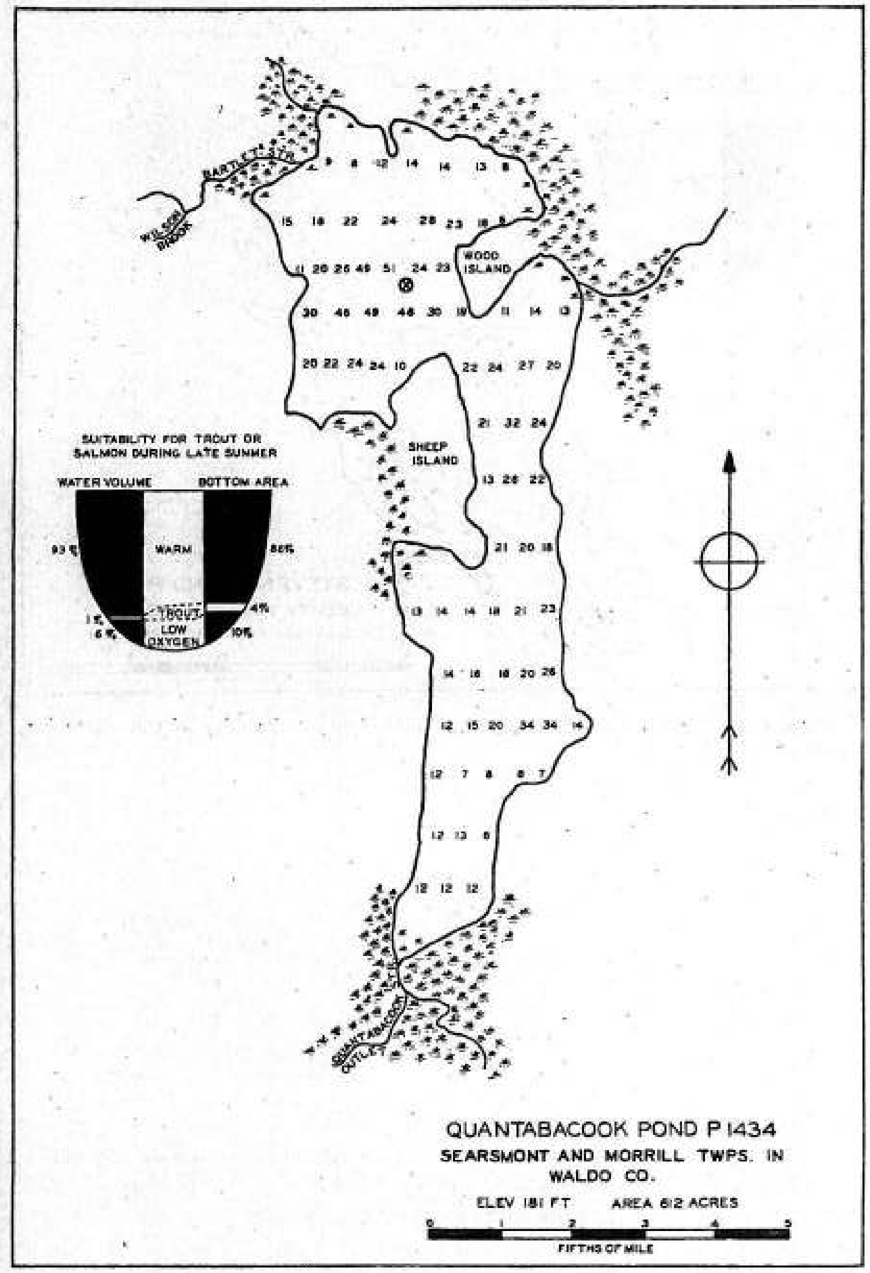

Figure 45. Quantabacook Pond. Soundings in feet and suitability of the water for trout or salmon.

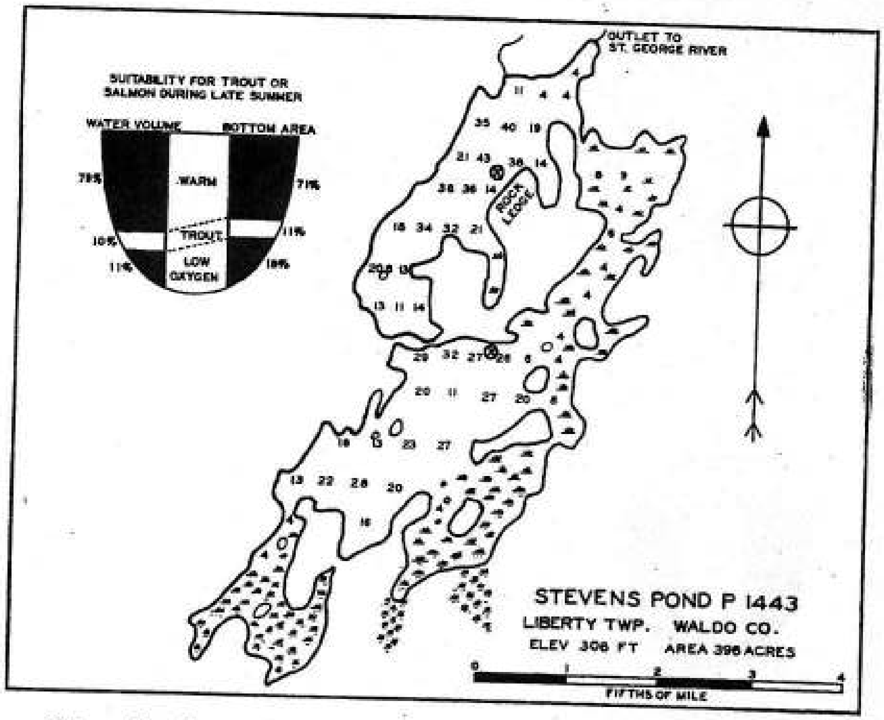

Figure 46. Stevens Pond. Soundings in feet and suitability of the water for trout or salmon.

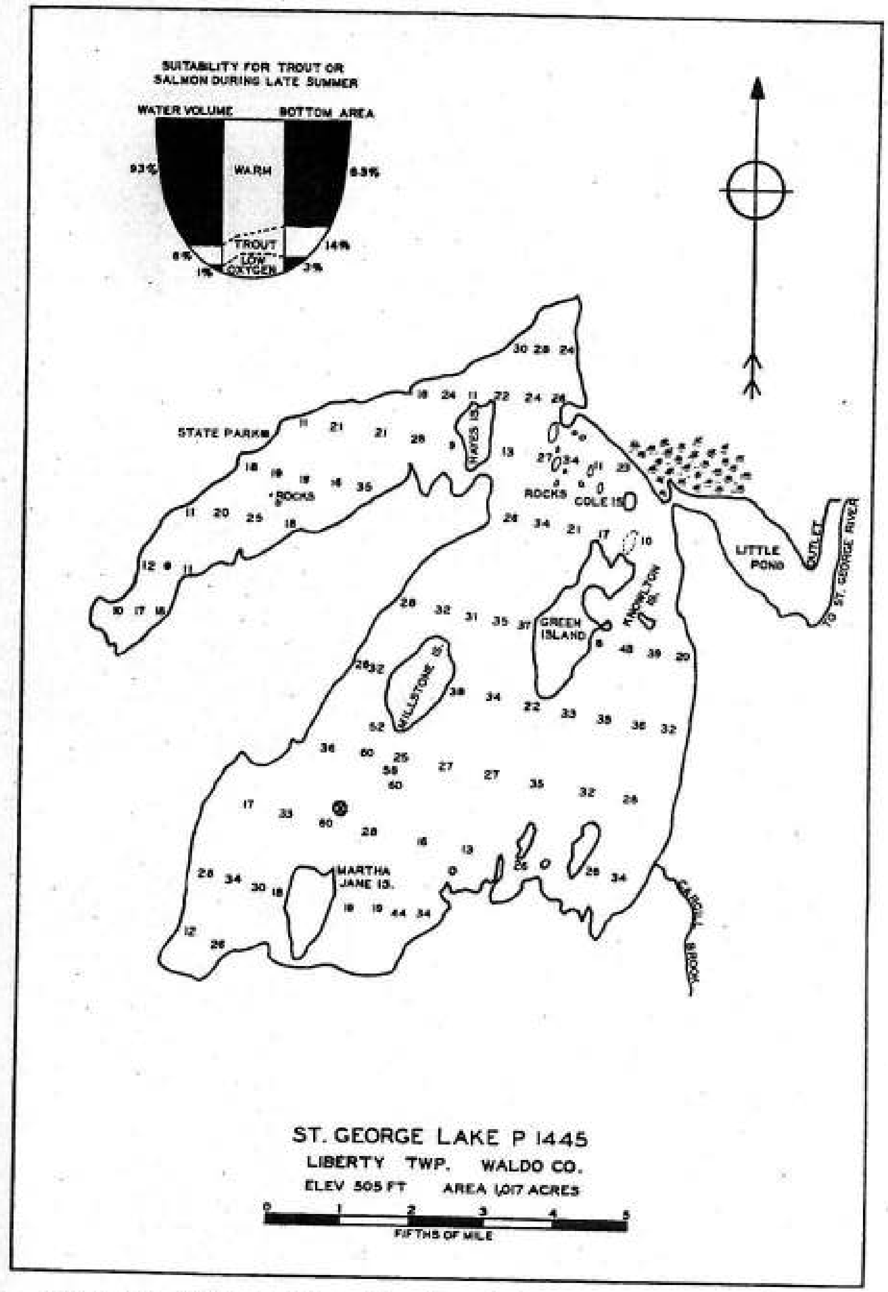

Figure 47. St. George Lake. Soundings in feet and suitability of the water for trout or salmon.

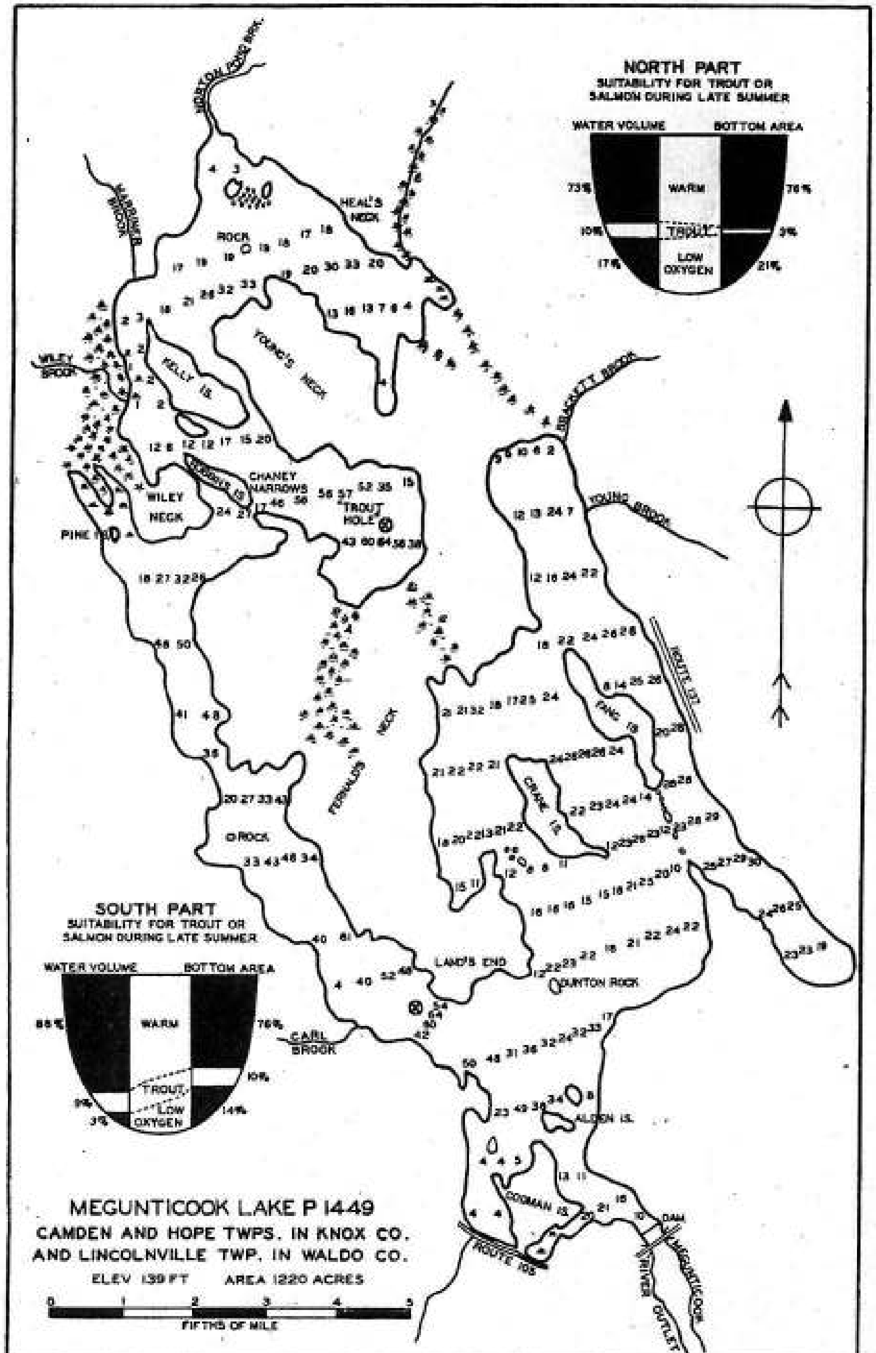

Figure 48. Megunticook Lake. Soundings in feet and suitability of the water for trout or salmon.

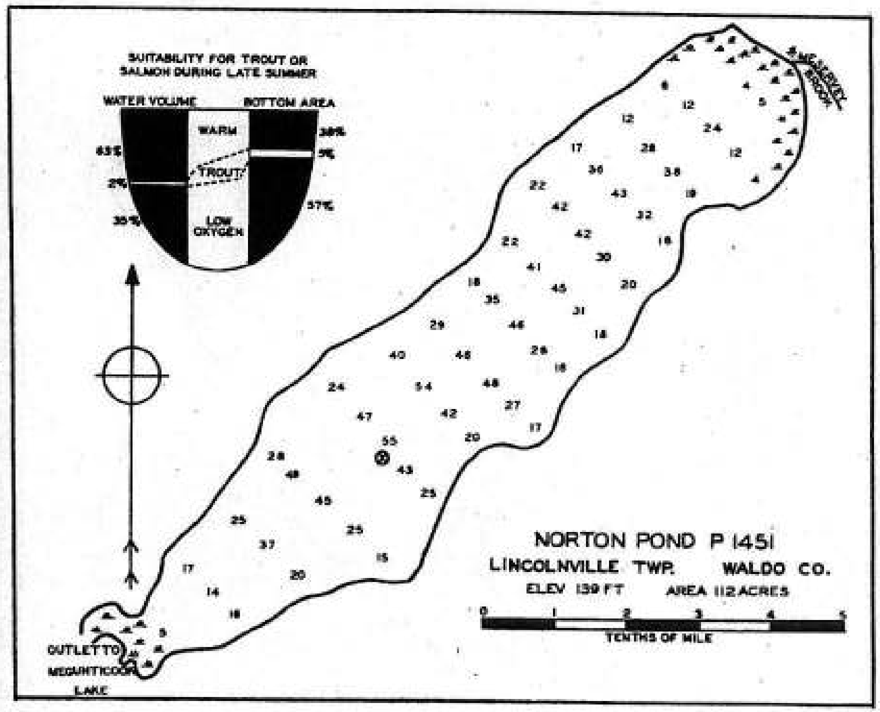

Figure 49. Norton Pond. Soundings in feet and suitability of the water for trout or salmon.

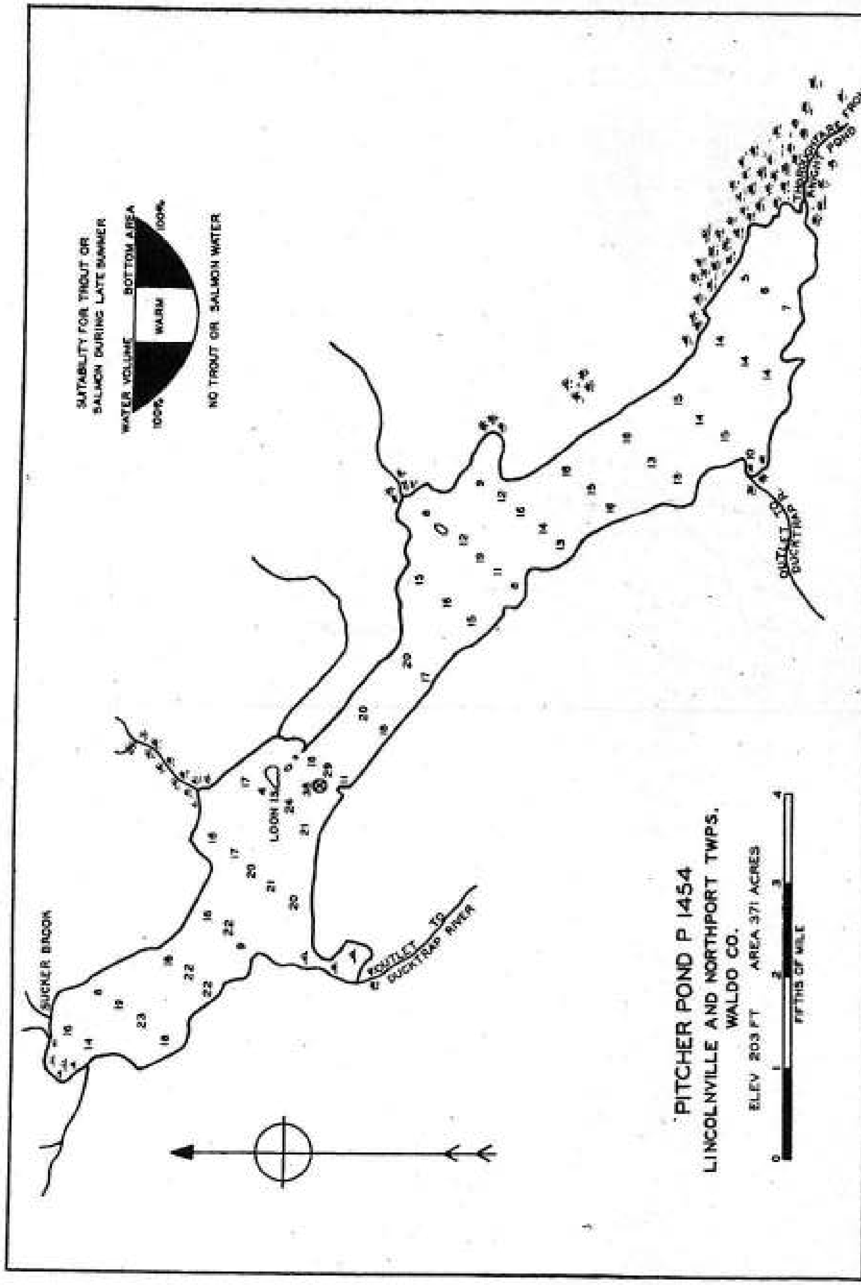

Figure 50. Pitcher Pond. Soundings in feet and suitability of the water for trout or salmon.

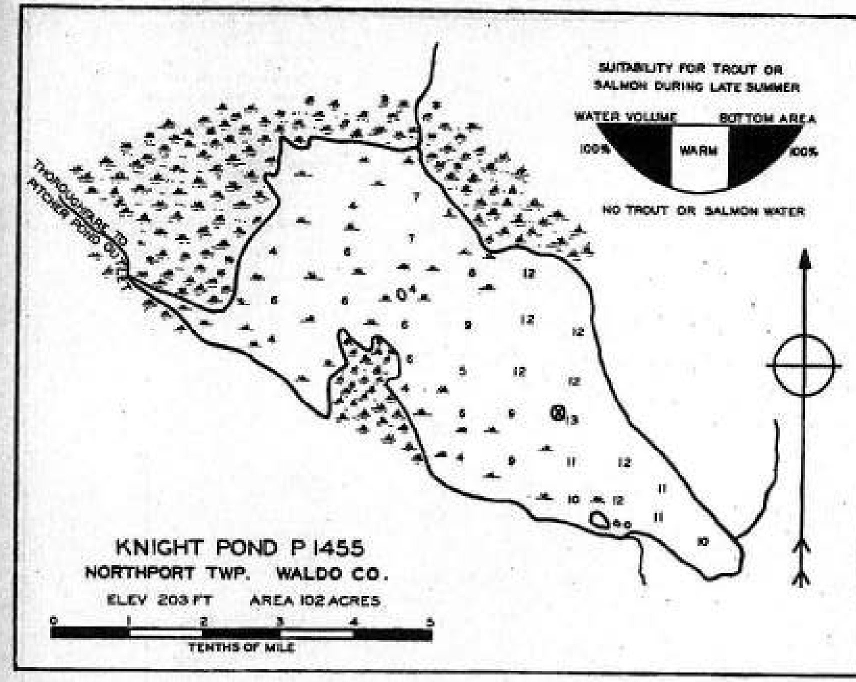

Figure 51. Knight Pond. Soundings in feet and suitability of the water for trout or salmon.

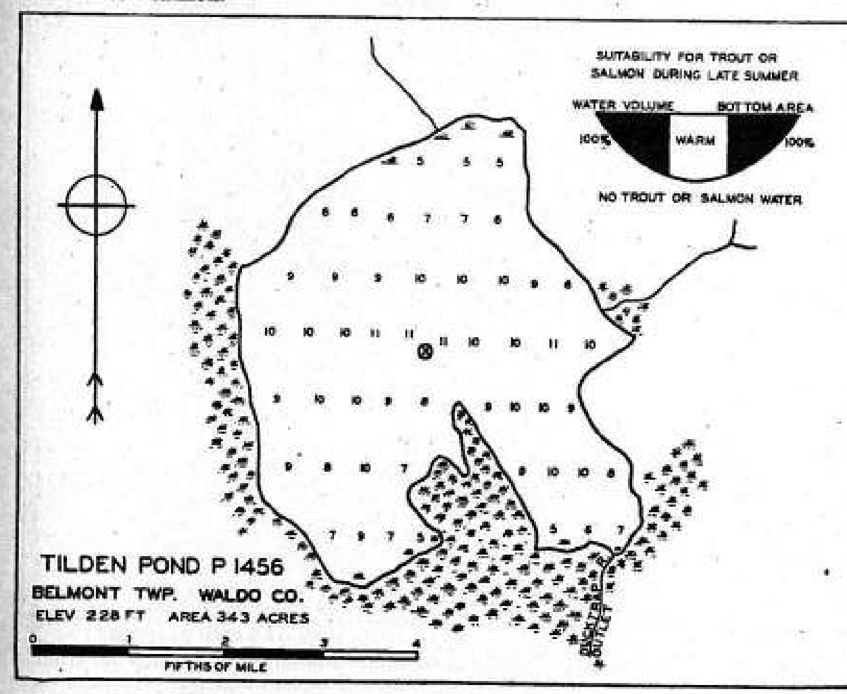

Figure 52. Tilden Pond. Soundings in feet and suitability of the water for trout or salmon.

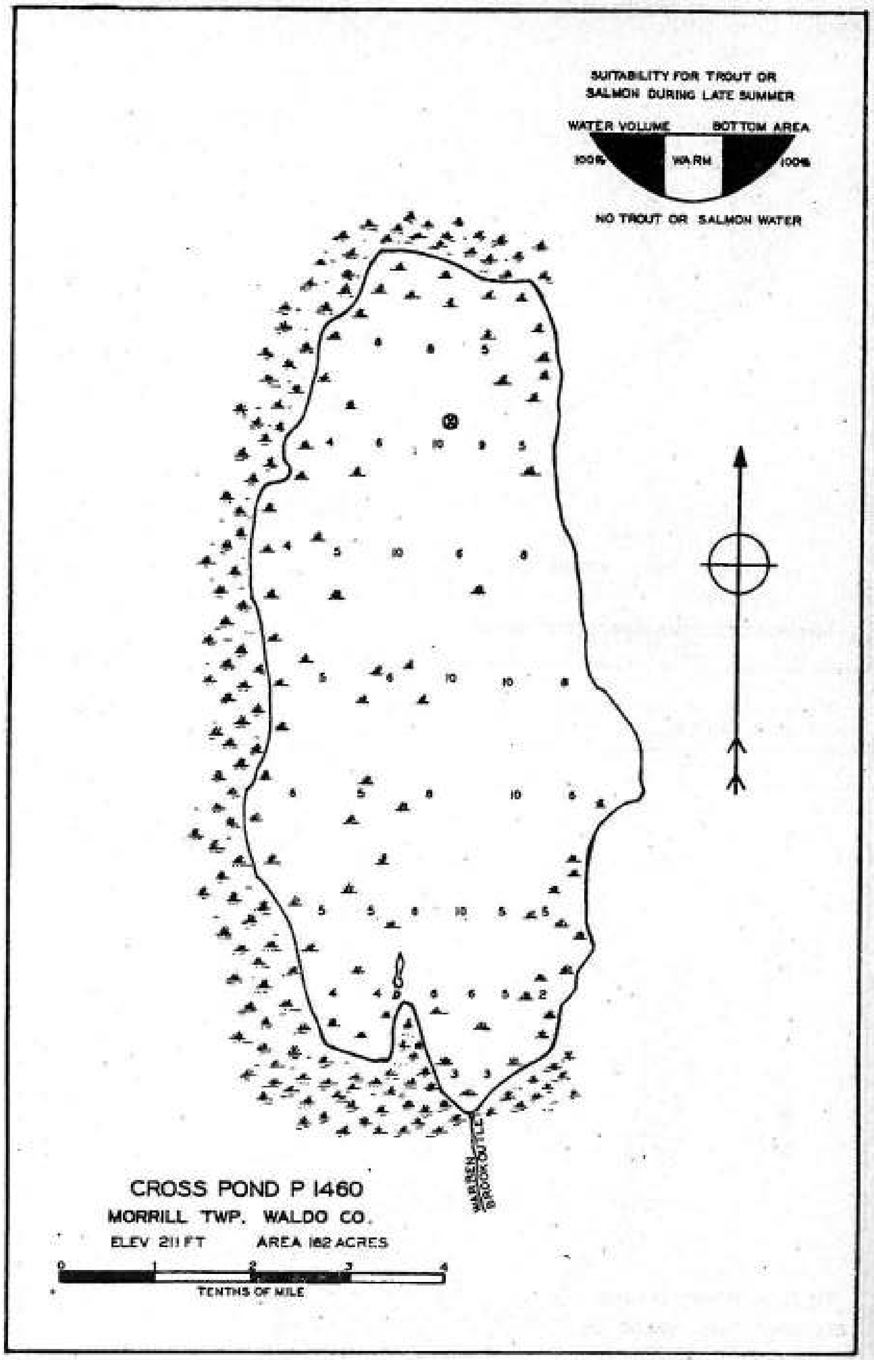

Figure 53. Cross Pond. Soundings in feet and suitability of the water for trout or salmon.

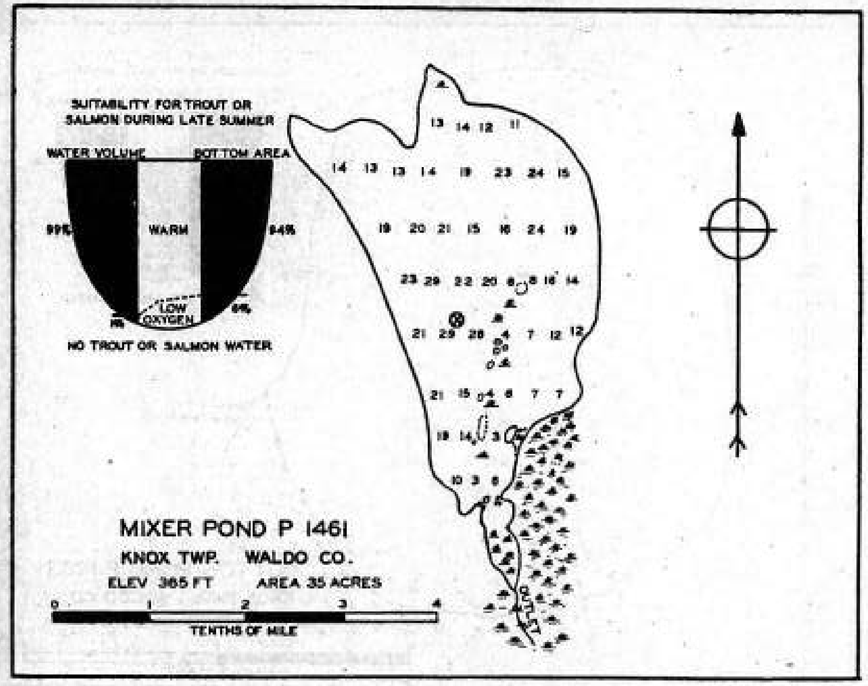

Figure 54. Mixer Pond. Soundings in feet and suitability of the water for trout or salmon.

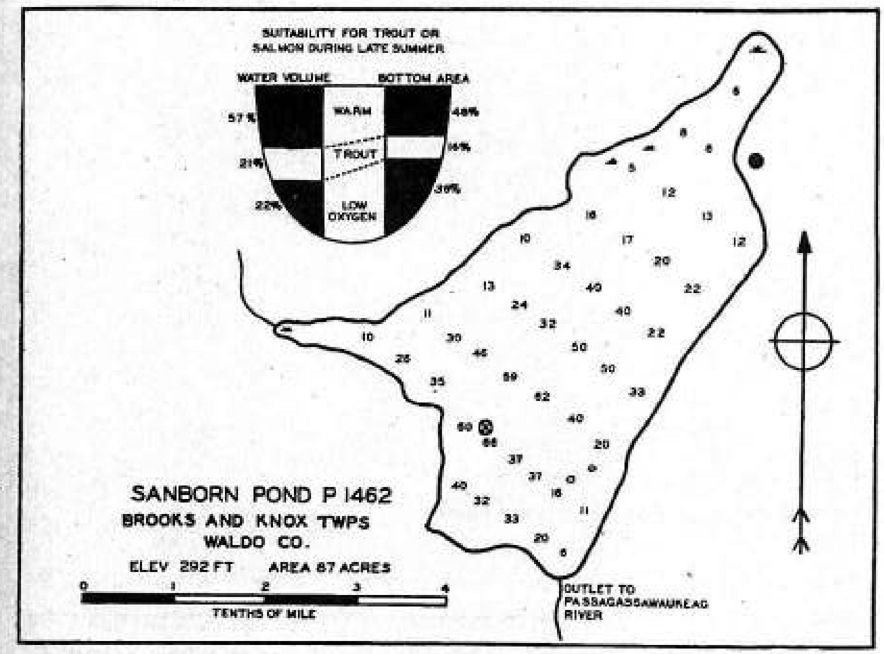

Figure 55. Sanborn Pond. Soundings in feet and suitability of the water for trout or salmon.

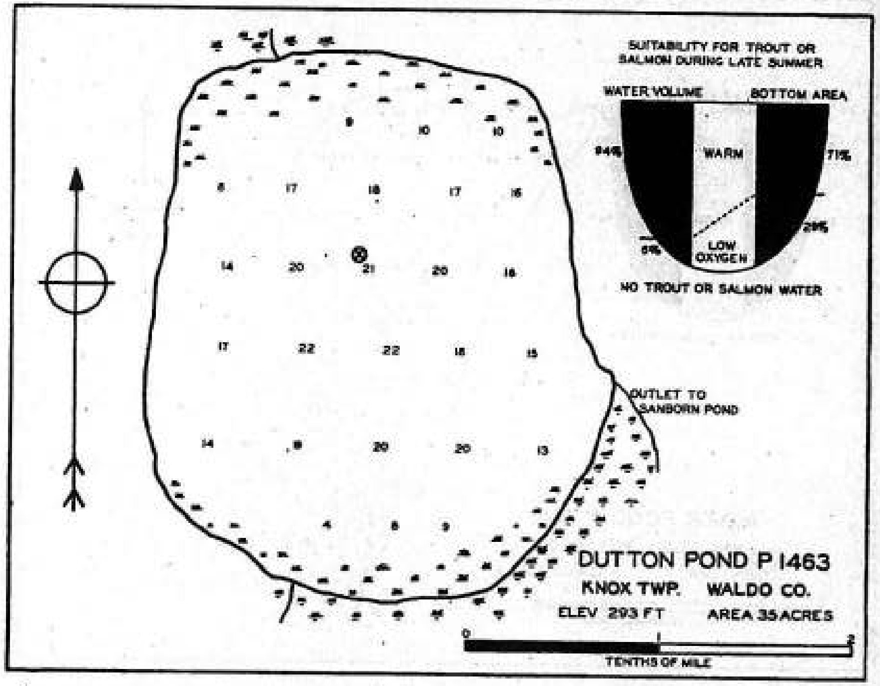

Figure 56. Dutton Pond. Soundings in feet and suitability of the water for trout or salmon.

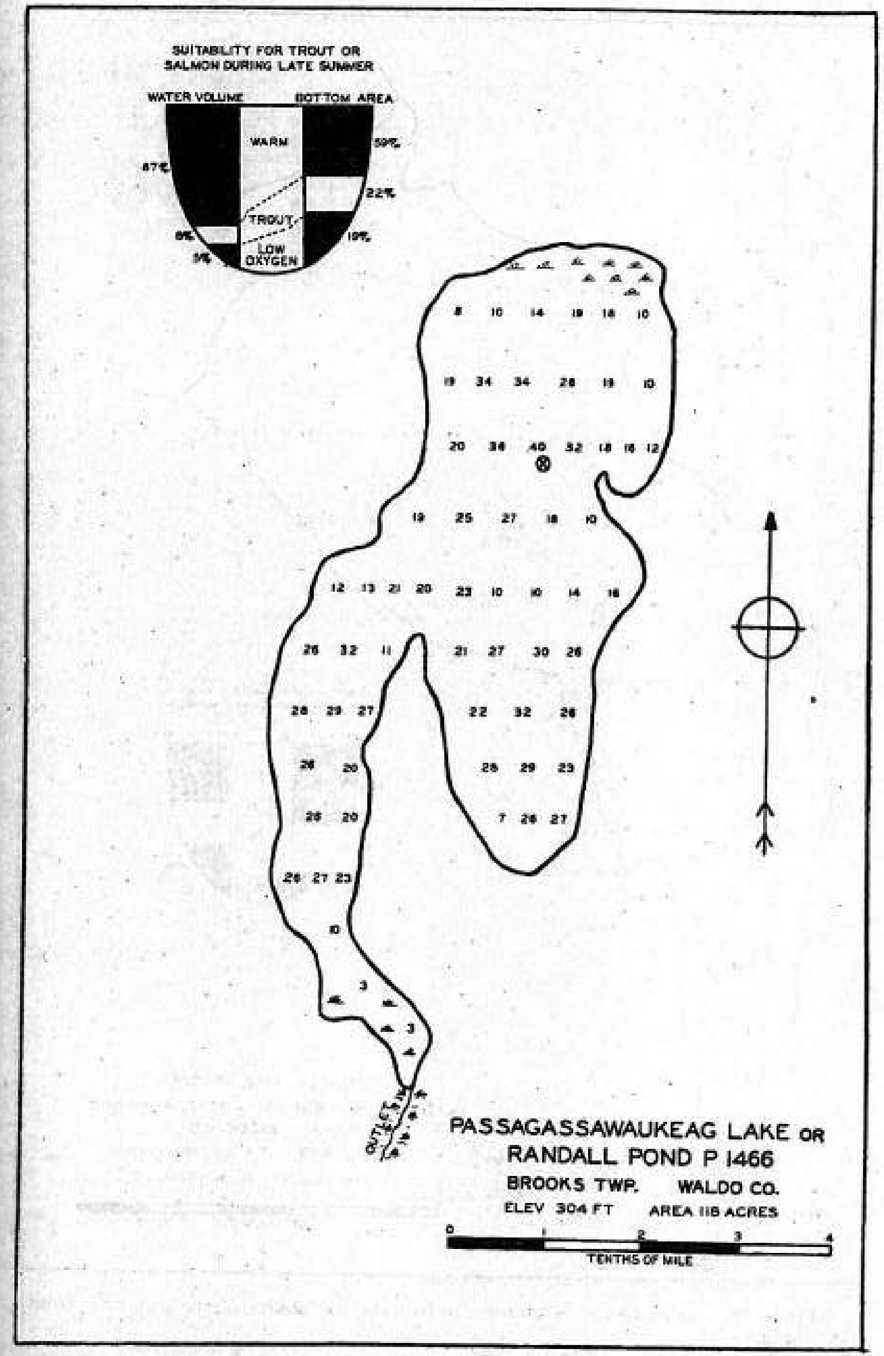

Figure 57. Passagassawaukeag Lake or Randall Pond. Soundings in feet and suitability of the water for trout or salmon.

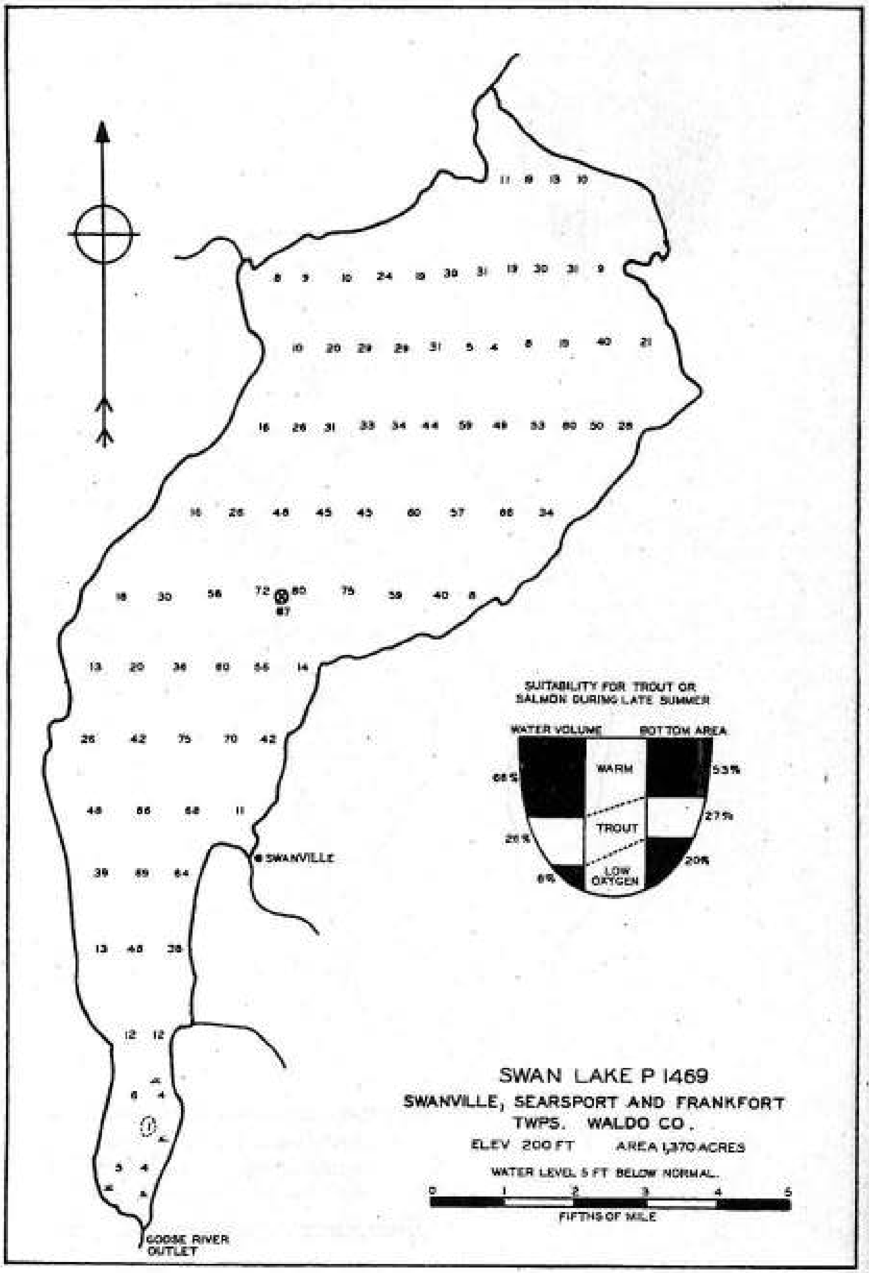

Figure 58. Swan Lake. Soundings in feet and suitability of the water for trout or salmon.

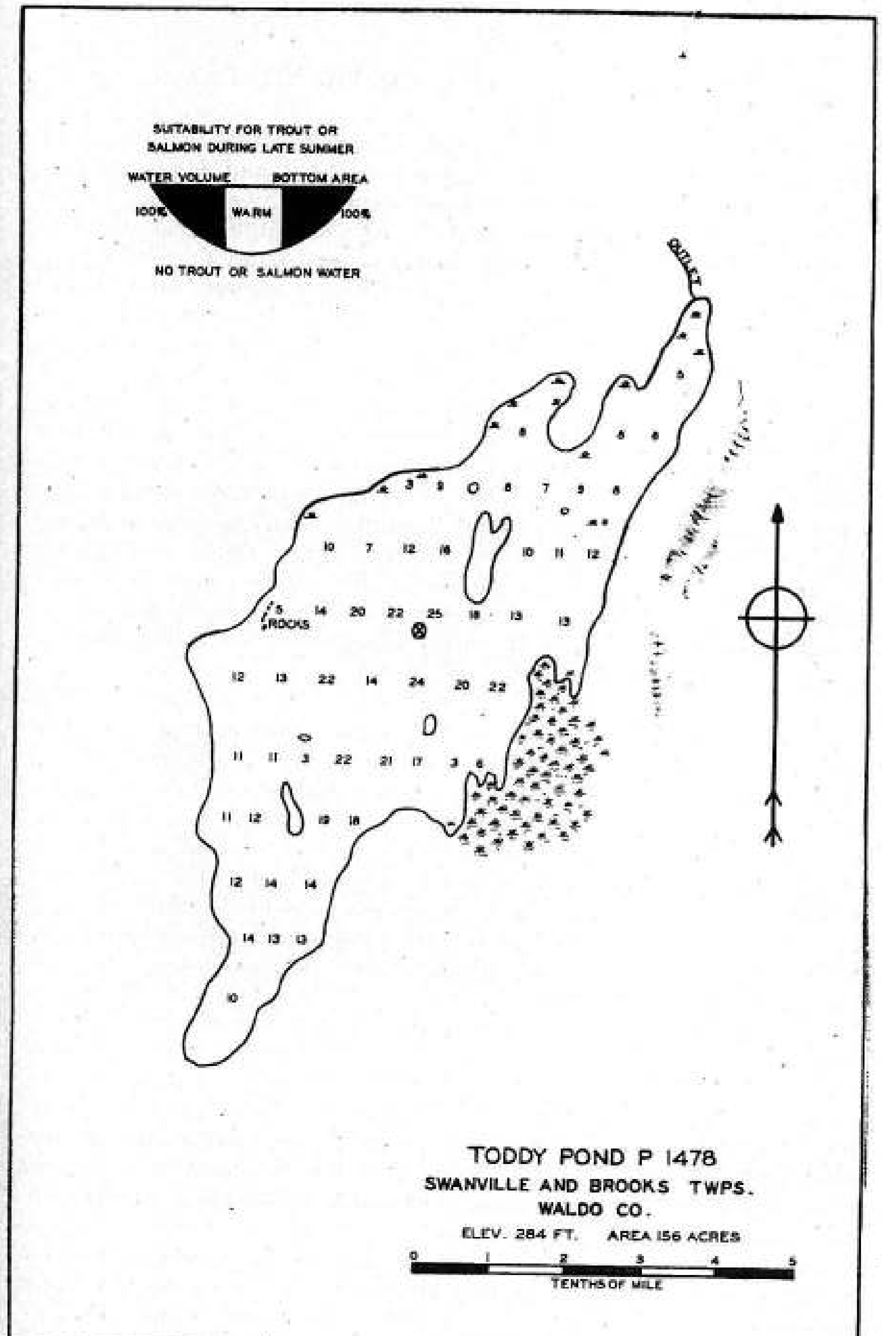

Figure 59. Toddy Pond. Soundings in feet and suitability of the water for trout or salmon.

CONCLUSIONS AND RECOMMENDATIONS

According to the survey data on depth, temperature and dissolved oxygen of the water, the present group of 61 lakes and ponds includes 4 lakes which are "excellent" to "good" trout or salmon waters and 8 lakes which are "fair" to "marginal" trout or salmon waters. The better of these 12 lakes, from the standpoint of trout or salmon, are Sheepscot, Swan, Mirror, Spectacle, China, Damariscotta Lake, Sanborn and Biscay; the more marginal ones are Passagassawaukeag, Nequasset, St. George and Megunticook. These 12 lakes offer the best, and the only good, prospects for maintaining good trout and salmon fishing in lakes of this coastal region. The remaining 49 lakes and ponds either are shallow and warm or experience extreme oxygen deficiency, and are therefore not good trout and salmon waters. This ratio of 12 trout and salmon lakes to 49 non-trout lakes is very different from that which was found during previous surveys of Maine lakes to the west of the Kennebec River (Cooper, 1939b and 1941); the region to the west of the Kennebec River has a more favorable balance between trout and salmon lakes, on the one hand, and perch, bass and pickerel lakes, on the other hand, from the standpoints of both number of lakes and total lake area.

In the management recommendations given in this report for the present group of lakes, the demands of anglers for the different species of game fishes are considered in connection with the suitability of the lakes to support these different species. Since there is considerable demand in the present section of Maine, as well as in all other parts of the State, for trout and salmon fishing, and since the number of suitable waters for salmonids in this region is decidedly in the minority, it is recommended that trout and salmon fishing be promoted in all of the lakes which have suitable water for these fishes. By utilizing all suitable salmonid waters, this coastal region will still afford less trout and salmon fishing than perch, bass and pickerel fishing. The promotion of trout and salmon fishing in these lakes requires continued stocking of hatchery fish; the necessity of stocking is evident from past experience, and is due to the fact that these lakes have very few tributaries which are suitable spawning and rearing grounds for salmonids. It is also evident, from the results of the present survey, that the survival of stocked fish, even in the better trout and salmon lakes, has not been so good as might be expected. The abundant populations of perch, bass or pickerel unquestionably have been one of the most important factors in limiting the survival of these stocked trout and salmon. Judging from the survey gill net catches, another limiting factor has resulted from the planting of some of these hatchery

fish in "marginal" trout waters and in entirely unsuitable waters. It is anticipated that better survival of hatchery salmonids will result from the elimination of unsuitable waters from the stocking program. In order to ensure a better survival in the good trout and salmon lakes, future planting of salmonids in these waters should be supplemented by methods of controlling the warm-water game species and restoring the more or less depleted smelt food supply. In most of the 49 warm-water lakes, as well as in most of the 12 trout and salmon lakes, the White Perch, Yellow Perch, Common Pickerel and, to some extent, the Small-mouthed Bass are very successful in their natural propagation. The White Perch tends to be overabundant in most lakes where it occurs. Of these 4 warm-water game species the bass is the only one which does not maintain a sufficient abundance to satisfy the desires of the anglers; and management methods to favor the Small-mouthed Bass appear to be desirable.

That the four species of warm-water game fishes dominate the fish populations in the lakes of the present coastal area, and even in the good trout and salmon lakes in spite of heavy stockings of salmonids, is indicated by the results of survey gill net collections. The 102 gill net sets made in 20 of these 61 lakes, including 12 lakes in which plantings of salmonids had been made during the preceding 8 years, took a total of 42 salmonids as compared to 1,170 White Perch and a total of 298 Yellow Perch, Pickerel and Small-mouthed Bass. Furthermore, the comparison (page 83) of the results of gill netting indicate that the 7 best trout and salmon lakes of the present coastal region have much sparser populations of salmonids than are present in the Rangeley lakes, both in proportion to lake areas and in proportion to the rates of past stocking.

Among the 49 warm-water lakes the Small-mouthed Bass, White Perch and Pickerel are the important game species; the Yellow Perch is little-prized by Maine anglers, and therefore of little importance. While the Small-mouthed Bass is present in many of these lakes, it is also absent in many of them. Furthermore, the survey seining records indicate that in those lakes where bass now occur, with the possible exception of Swan and China, the young bass are not very abundant; in other words, natural propagation is not producing large populations of bass of the late-summer, fingering stage. It is believed that attempts to increase the bass populations would be one of the most promising methods for the improvement of fishing in these warm-water lakes. The methods recommended for the improvement of the status of the bass in the warm-water lakes are: (1) the introduction of the Small-mouthed Bass into certain lakes, of those in which it does not now occur; (2) the stocking of hatchery bass, or bass reclaimed from other waters, in most of the warm-water lakes which are best adapted to the species; and (3) affording further protection of bass on their spawning grounds in those lakes where it is desirable to promote bass fishing, by eliminating the present fly-fishing for bass during the period from June 1 to 20. It is emphasized at this point that the desirability of stocking young bass and of protecting spawning bass does not apply to all of the 61 lakes (see recommendations, below).

Thirteen of the 49 warm-water lakes might best be described as "pickerel waters." These are mostly small and very shallow ponds with abundant aquatic vegetation throughout a large part of their areas and with mostly mud-bottomed and swampy shore lines. The Fish and Game Wardens reported that these ponds have produced mostly pickerel fishing. These ponds are not well suited to the Small-mouthed Bass, and no stockings of bass are recommended for them.

The gill net catches revealed that the White Perch is by far the most abundant, and one of the most widespread, species of game fishes in lakes of the present coastal area. It is a popular species to the summer angler; and, because of its abundance, it affords probably more fishing than does any other species in this region. There appears to be no problem of poor reproduction or under-stocking; rather, the White Perch tends to become overabundant and dwarfed in many lakes, both in warm-water lakes, and, to the detriment of the salmonids, in the better trout and salmon lakes. Judging from the data for lakes in other regions of Maine (Cooper, 1941) the growth of the White Perch in this State is very slow as compared to our other game species.

The Common Sucker is one of the most abundant and most widespread species of larger fishes in the present group of lakes. Judging from the gill net collections, suckers make up a large part of the total bulk of fishes in many of these lakes, particularly in Quantabacook, Swan, China, Sheepscot and Alford. A rare exception is the scarcity of suckers in St. George Lake. Extensive studies on the food habits of the White Perch, Small-mouthed Bass and Pickerel in many lakes of southern Maine have failed, thus far, to reveal that the sucker is an important food of these game species. The sucker, on the other hand, competes with the White Perch, Brook Trout and other bottom-feeding game fishes for food. At the present stage of our knowledge on the ecological relationships between the sucker and the game species, the sucker should be regarded more as a liability than as an asset to the production of game fishes in lakes of southern Maine. Methods of sucker control therefore appear to be desirable.

The three principal types of food eaten by game fishes are forage fish, bottom fauna, and plankton, of which the last two are the basic food supply in lakes. While adult game fishes can, and do to some extent, feed on plankton and bottom fauna, they are not so well adapted to feed on these types of food (particularly on plankton). The small forage fishes feed more readily on the plankton and smaller organisms

of the bottom fauna, and therefore their role is to serve as a link in converting bottom fauna and plankton into adult game fish. Forage fishes to serve as the intermediate link in this food cycle are a necessity to the production of large salmon, trout, pickerel and bass; according to our studies on Maine lakes, the two perches are somewhat less dependent upon a forage fish in their food cycle. The most important of these forage fishes in lakes of southern Maine are the Smelt, and the young of the White Perch and Yellow Perch. Thus the Smelt is the only non-game species which is serving this important role of a forage to a large extent. The salmonids are more completely dependent upon the Smelt, because the two live together in deep water. Pickerel, bass and the two perches feed extensively on smelts; but they also feed extensively on young White Perch and Yellow Perch, because they can live and feed in the warm surface waters where the young perch occur. The maintenance of a large, smelt population is a necessity to the production of salmon, and a big asset to the production of most other game species in lakes of southern Maine. The Smelt is present in many of the 61 lakes considered in this report, as indicated by the occurrence of smelts in the stomachs of game fishes and the reports by the Fish and Game Wardens. However, the wardens' reports, based on a knowledge of smelt spawning runs, are to the effect that the Smelt is not abundant in most of these lakes. All necessary measures should be taken to increase these smelt populations.

The Alewife is a forage species of great potential value to the production of game fishes in lakes. It is adapted specifically for feeding on plankton. The young remain in fresh-water lakes until they reach a length of from 2 to 4 inches, judging from survey seine collections. At least 11 of these 61 lakes have abundant populations of Alewives. However, the data obtained by the present survey, unfortunately, are not adequate to determine the extent to which these young alewives are fed upon by the game species.

Recommendations. In the following recommendations for stocking and other management methods, the 61 lakes are grouped according to the type of game fishes for which the lakes are best suited, and the recommendations are meant to apply to each group as a whole. The recommendations on stocking are given in detail, and other recommendations are given in part, in Table XVIII.

For the 12 trout or salmon lakes:

Nequasset Pond
Spectacle Pond
China Lake (east and west parts)
Sheepscot Pond
Damariscotta Lake
Biscay Pond
Mirror Lake
St. George Lake
Megunticook Lake
Sanborn Pond
Passagassawaukeag Lake
Swan Lake

1. Stock salmonids as recommended in the following section and in Table XVIII.
2. Give the Smelt complete protection in all lakes stocked with salmon.
3. Do not stock any bass, perch, pickerel or any other type of warm-water game species.
4. Remove all legal restrictions on fishing for bass, pickerel and perch in these lakes.
5. Reduction of the populations of White Perch and Small-mouthed Bass in these lakes is desirable in the interest of better trout or salmon fishing. These perch and bass should be reclaimed by netting and transplanted to bass and perch lakes.
6. Drastic reduction of suckers in China, Sheepscot, Damariscotta, Biscay and Swan is recommended.

The factors on which the stocking policy for salmonids has been based are discussed later, see page 175. It is important not only to give the Smelt complete protection in lakes stocked with salmon, but to maintain an abundant population of smelts in these lakes—by plantings, if necessary. Since there are no White Perch in Swan Lake and no Small-mouthed Bass in Sheepscot, every precaution should be taken so that these species are not introduced, since Sheepscot and Swan are the two best salmon lakes of the area. Other precautions against introducing warm-water game species into trout or salmon waters in which they do not now occur: Do *not* introduce Small-mouthed Bass into Spectacle Pond, bass into Biscay Pond, perch or bass into Mirror Lake, or White Perch or bass into Sanborn Pond. Reclaiming of Small-mouthed Bass from Swan and China lakes for transplanting to other waters is recommended.

For the 13 pickerel lakes:

Little Togus Pond
Sandy Pond
Dyer Long Pond
Pleasant Pond
Branch Pond
Turner Pond
Muddy Pond
Medomak Pond
Fish Pond
Knight Pond
Tilden Pond
Cross Pond
Dutton Pond (in Knox)

1. No stocking of trout or salmon of any kind, or of bass.
2. Stock White Perch in Sandy and Branch ponds (see Table XVIII).

For 31 bass and perch lakes:

Gardiner Pond
Togus Pond
Threecornered Pond
Weber Pond (in Vassalboro)
Threemile Pond
Pattee Pond
Lovejoy Pond
Dutton Pond (in China)
Unity Pond
Damariscotta Pond
Boyd Pond
Pemaquid Pond
Duckpuddle Pond
McCurdy Pond
Webber Pond (in Bremen)
Washington Pond
Chickawaukie Pond
North Pond
South Pond
Seven Tree Pond
Round Pond
Crawford Pond
Lermond Pond
Alford Lake
Hobbs Pond
Sennebec Pond
Quantabacook Pond
Stevens Pond
Norton Pond
Pitcher Pond
Toddy Pond

1. Stock Small-mouthed Bass as recommended in the following section and in Table XVIII.
2. In addition to bass, plant White Perch, reclaimed from other waters, in North, South, Seven Tree, Round and Stevens ponds, as recommended in Table XVIII.
3. Do not stock trout or salmon of any kind.
4. Complete protection of the Smelt and maintaining the smelt populations are desirable.
5. Give adult bass on spawning grounds more protection from fishing.
6. Drastic reduction of sucker populations in all lakes where heavy spawning runs make this feasible.

Protection of adult bass on the spawning grounds should be facilitated either by (1) eliminating the present fly fishing for bass from June 1 to 20, or by (2) prohibiting fishing on the principal bass spawning grounds, in lakes where bass spawning is confined to small areas.

Other lakes, and special recommendations:

For Mixer Pond in Knox, experimental plantings of Brown Trout (see Table XVIII) to extend over a period of five years are recommended. This pond has no warm-water game fishes of any kind, and none should be introduced, at least for the present time. According to our water analyses, the pond is not "good trout water," but the complete absence of warm-water game species is a factor favorable to the survival of salmonids. According to reports by the local Fish and Game Warden, past stocking of Brook Trout and salmon has produced some trout and salmon fishing. Brown Trout are favored over Brook Trout, for future plantings, on the assumption that browns may be better able to survive the warm water. Results of the plantings will be of considerable experimental value in indicating whether or not other warm-water ponds of southern Maine could be reclaimed for salmonids by the eradication of the warm-water game species. Annual plantings over a five-year period should be sufficient to determine the desirability of further stocking with salmonids.

Plantings of White Perch are recommended for Long Pond in Somerville and West Harbor Pond. In addition, White Perch have been recommended for five of the bass lakes and for two of the pickerel lakes (see above). The numbers of White Perch recommended (Table XVIII) for these plantings are not intended to be annual quotas which should be filled every year; rather, the perch which can be reclaimed from the trout and salmon lakes should be distributed among these lakes in proportion to the numbers here recommended. These perch should be reclaimed from the trout and salmon lakes in which they are now abundant, such as Sheepscot, China, Damariscotta Lake, Biscay, St. George and Megunticook.

No plantings of any game species are recommended for Dam and Tolman ponds in Augusta. According to available information these ponds have no bass and possibly no White Perch. Neither pond is suitable for salmonids. Both ponds are closely connected to Spectacle Pond which is good trout water, and for which plantings of Brook Trout are recommended. Plantings of bass or perch into Dam and Tolman ponds would jeopardize Spectacle Pond as trout water, and are therefore undesirable.

The proposed stocking recommendations for bass need further comment in order to avoid certain misunderstandings.

No bass are recommended for Long Pond or for any other pond in the Sheepscot River drainage; and there are no bass in this drainage at the present time. The only pond for which bass would have been

recommended, on the basis of type of water, is Long Pond in Somerville. Sheepscot Pond is the largest pond in the drainage, the best salmon water in the present coastal area, and merits first consideration among the ponds of the Sheepscot drainage. Bass are not recommended for Long Pond, in order to avoid the possibility of the species gaining entrance to Sheepscot Pond.

The introduction of Small-mouthed Bass into lakes of the Pemaquid River drainage is recommended; bass do not occur in these waters at the present time. This recommendation does not appear to be in accordance with the proposal to exclude bass from Sheepscot waters, since Biscay Pond in the Pemaquid drainage is good salmon water. The two situations are not at all comparable, however. In the Pemaquid drainage there are four good bass lakes (Boyd, Pemaquid, Duckpuddle and McCurdy) with a combined area of over 2,000 acres as compared to only one good trout and salmon lake (Biscay) with an area of 253 acres. The exclusion of bass from these four bass lakes, for the benefit of Biscay Pond which already has large populations of White Perch and Pickerel, does not seem justifiable.

Introductions of Small-mouthed Bass are recommended for Crawford, Lermond, Alford and Hobbs ponds, in all of which the species is now absent. Large plantings of trout and salmon have been made in these ponds during the past few years, and local reports indicate that these ponds have produced some trout and salmon fishing. However, none of these ponds are good trout or salmon waters, according to survey data on depth, temperature and oxygen; and no future plantings of salmonids are recommended for them. The introduction of bass is recommended because these lakes are well suited only to warm-water species.

It is recommended that a policy of drastic reduction of sucker populations in lakes of the present coastal area be adopted. Destruction of suckers in the spring spawning runs would probably be most effective. Control of suckers is recommended for Quantabacook, Swan, China, Sheepscot, Damariscotta Lake, Alford, Crawford, Biscay, North, South and Chickawaukie; these are the waters which, according to survey findings and wardens' reports, have abundant sucker populations. It is entirely possible that other lakes in this region have dense sucker populations, in which event their control is desirable.

The formulation of the stocking policy, upon which the recommendations for stocking trout, salmon and bass (given in Table XVIII) have been based, is given in the following section:

Stocking policy. Stocking of trout, togue or salmon is here recommended for the 12 lakes and ponds which were found by the present survey to contain "excellent," "good" or "fair" trout or salmon water. These lakes had more than approximately 10 per cent of their total water volume or total bottom area within the zone of good trout

TABLE XVIII. Yearly stocking recommendations for the lakes and ponds, with a partial summary of the factors upon which the stocking recommendations are based, and a partial summary of other management recommendations

For explanation, see text

Name and number of pond, and township	Food grade	Game fish competition factor: CF	Spawning streams for trout or salmon (for lakes suitable for these fish)	Area supporting trout or salmon: acres	Fishing intensity	Yearly stocking recommendations: number of 6-inch trout or salmon; or number of 3-inch Small-mouthed Bass; or number of 3-inch White Perch	Some additional recommendations (see text)
Nequasset Pond (P.638), in Woolwich	II	12	Fair	241	Medium	3,000 Brook Trout	
Gardiner Pond (P. 640), in Wiscasset	I	7	....	Small per cent	Light	500 Small-mouthed Bass	Protect spawning bass
Togus Pond (P.649), in Augusta	II	15	....	None	Heavy	8,000 Small-mouthed Bass	Protect spawning bass
Little Togus Pond (P.650), in Augusta	III	14	....	None	Light	Pickerel water. No stocking	
Threecornered Pond (P.651), in Augusta	II	14	....	None	Medium	1,600 Small-mouthed Bass	Protect spawning bass
Weber Pond (P.688), in Vassalboro	I	15	....	Small per cent	Heavy	22,000 Small-mouthed Bass	Protect spawning bass
Spectacle Pond (P.691), in Vassalboro and Augusta	II	8	None	97	Light	2,200 Brook Trout	Plant no bass or perch
Dam Pond (P.692), in Augusta	II	5	....	None	Light	No stocking recommended	Plant no perch or bass
Tolman Pond (P.693), in Augusta	III	5	....	None	Light	No stocking recommended	Plant no perch or bass
Threemile Pond (P.694), in China, Vassalboro and Windsor	I	14	....	None	Heavy	19,000 Small-mouthed Bass	Protect spawning bass
China Lake (P.736), in China and Vassalboro	II	15	Fair	2,153	Heavy	28,000 Land-locked Salmon or Chinook Salmon	Protect and maintain smelt population. Control suckers. Reclaim bass and perch
Pattee Pond (P.739), in Winslow	II	13	....	None	Heavy	9,000 Small-mouthed Bass	Protect spawning bass
Lovejoy Pond (P.744), in Albion	II	13	....	None	Medium	2,600 Small-mouthed Bass	Introduce bass
Dutton Pond (P.745), in China	II	12	....	None	Light	500 Small-mouthed Bass	Introduce bass
Unity Pond (P.746), in Unity, Burnham and Troy	II	15	....	None	Heavy	30,000 Small-mouthed Bass	Protect spawning bass
Sandy Pond or Freedom Pond (P.751), in Freedom	I	8	....	None	Light	Pickerel water. 5,000 White Perch	
Dyer Long Pond (P.1331), in Jefferson	II	16	....	None	Medium	Pickerel water. No stocking	
Pleasant Pond or Clary Lake (P.1334), in Jefferson and Whitefield	II	13	....	None	Heavy	Pickerel water. No stocking	Plant no bass
Branch Pond (P.1342), in Palermo and China	I	8	....	None	Heavy	Pickerel water. 8,000 White Perch	Plant no bass
Long Pond (P.1345), in Somerville, Jefferson and Windsor	I	10	....	None	Light	9,000 White Perch	Plant no bass
Turner Pond (P.1346), in Somerville and Palermo	I	7	....	None	Heavy	Pickerel water. No stocking	Plant no bass
Sheepscot Pond (P.1349), in Palermo	II	11	Fair	917	Heavy	12,000 Land-locked Salmon and 5,000 Togue (Lake Trout)	Protect and maintain smelt population. Control suckers. Plant no bass. Reclaim White Perch
West Harbor Pond (P.1361), in Boothbay Harbor	II	10	....	Small per cent	Light	2,000 White Perch	
Damariscotta Pond (P.1367), in Jefferson, Nobleboro and Newcastle	II	15	....	None	Heavy	10,000 Small-mouthed Bass	Protect spawning bass
Damariscotta Lake (P.1368), in Jefferson and Nobleboro	II	15	Fair	2,025	Heavy	26,000 Land-locked Salmon or Chinook Salmon	Protect and maintain smelt population. Control suckers. Reclaim bass and perch

TABLE XVIII. Yearly stocking recommendations for the lakes and ponds — Continued

Name and number of pond, and township	Food grade	Game fish competition factor: CF	Spawning streams for trout or salmon (for lakes suitable for these fish)	Area supporting trout or salmon: acres	Fishing intensity	Yearly stocking recommendations: number of 6-inch trout or salmon; or number of 3-inch Small-mouthed Bass; or number of 3-inch White Perch	Some additional recommendations (see text)
Boyd Pond (P.1376), in Bristol	III	7	....	None	Light	500 Small-mouthed Bass	Introduce bass
Biscay Pond (P.1379), in Bremen, Bristol and Damariscotta	II	9	None	157	Medium	3,200 Land-locked Salmon	Protect and maintain smelt population. Control suckers. Plant no bass. Reclaim White Perch
Pemaquid Pond (P.1381), in Damariscotta, Bremen, Nobleboro and Waldoboro	II	10	....	Almost none	Medium	12,000 Small-mouthed Bass	Introduce bass
Muddy Pond (P.1382), in Damariscotta	III	7	....	None	Light	Pickerel water. No stocking	
Duckpuddle Pond (P.1383), in Nobleboro and Waldoboro	II	12	....	None	Light	1,500 Small-mouthed Bass	Introduce bass
McCurdy Pond (P.1385), in Bremen	II	12	....	Small per cent	Light	1,200 Small-mouthed Bass	Introduce bass
Webber Pond (P.1387), in Bremen	I	9	....	None	Light	2,000 Small-mouthed Bass	Introduce bass
Medomak Pond (P.1394), in Waldoboro	II	17	....	None	Heavy	Pickerel water. No stocking	
Washington Pond (P.1400), in Washington	II	11	....	None	Light	3,500 Small-mouthed Bass	Protect spawning bass
Chickawaukie Pond (P.1409), in Rockland and Rockport	I	17	....	None	Heavy	4,000 Small-mouthed Bass	Protect spawning bass. Control suckers
Mirror Lake or Oyster River Pond (P.1413), in Rockport	III	2	Poor	78	Light	1,000 Brook Trout	Plant no bass or perch

North Pond (P.1414), in Warren	II	15	....	None	Medium	2,500 Small-mouthed Bass and 4,000 White Perch	Protect spawning bass. Control suckers
South Pond (P.1415), in Warren	II	15	....	None	Heavy	6,000 Small-mouthed Bass and 8,000 White Perch	Protect spawning bass. Control suckers
Seven Tree Pond (P.1419), in Union and Warren	II	15	....	Almost none	Medium	4,000 Small-mouthed Bass and 6,000 White Perch	Protect spawning bass
Round Pond (P.1420), in Union	II	13	....	None	Medium	1,500 Small-mouthed Bass and 2,500 White Perch	Protect spawning bass
Crawford Pond (P.1422), in Union and Warren	II	9	....	Almost none	Heavy	7,000 Small-mouthed Bass	Introduce bass. Control suckers
Lermond Pond (P.1423), in Hope	I	9	....	None	Light	1,000 Small-mouthed Bass	Introduce bass
Alford Lake (P.1424), in Hope	I	7	....	None	Heavy	10,000 Small-mouthed Bass	Introduce bass. Control suckers
Fish Pond (P.1428), in Hope	II	11	....	None	Light	Pickerel water. No stocking	
Hobbs Pond (P.1429), in Hope	II	11	....	None	Light	1,000 Small-mouthed Bass	Introduce bass
Sennebec Pond (P.1431), in Appleton and Union	I	13	....	None	Medium	6,000 Small-mouthed Bass	Protect spawning bass
Quantabacook Pond (P.1434), in Searsmont and Morrill	II	15	....	Almost none	Medium	5,000 Small-mouthed Bass	Protect spawning bass. Control suckers
Stevens Pond (P.1443), in Liberty	III	15	....	Small per cent	Light	1,000 Small-mouthed Bass and 2,000 White Perch	Protect spawning bass
St. George Lake (P.1445), in Liberty	II	11	None	580	Medium	9,000 Land-locked Salmon	Protect and maintain smelt population. Reclaim perch and bass
Megunticook Lake (P.1449), in Lincolnville, Hope and Camden	II	12	Fair	655	Heavy	11,000 Land-locked Salmon or Chinook Salmon	Protect and maintain smelt population. Reclaim perch and bass
Norton Pond (P.1451), in Lincolnville	II	8	....	Almost none	Heavy	1,300 Small-mouthed Bass	Protect spawning bass
Pitcher Pond (P.1454), in Lincolnville and Northport	II	12	....	None	Light	2,000 Small-mouthed Bass	Protect spawning bass

TABLE XVIII. Yearly stocking recommendations for the lakes and ponds — Concluded

Name and number of pond, and township	Food grade	Game fish competition factor: CF	Spawning streams for trout or salmon (for lakes suitable for these fish)	Area supporting trout or salmon: acres	Fishing intensity	Yearly stocking recommendations: number of 6-inch trout or salmon; or number of 3-inch Small-mouthed Bass; or number of 3-inch White Perch	Some additional recommendations (see text)
Knight Pond (P.1455), in Northport	II	12	....	None	Light	Pickerel water. No stocking	
Tilden Pond (P.1456), in Belmont	III	9	....	None	Heavy	Pickerel water. No stocking	
Cross Pond (P.1460), in Morrill	II	8	....	None	Light	Pickerel water. No stocking	
Mixer Pond (P.1461), in Knox	II	0	....	None	Light	1,200 Brown Trout annually for next 5 years	Continue stocking Brown Trout if successful. Stock no perch, bass or pickerel
Sanborn Pond (P.1462), in Brooks and Knox	II	8	None	50	Light	1,100 Brook Trout	Plant no bass or perch
Dutton Pond (P.1463), in Knox	II	8	....	None	Light	Pickerel water. No stocking	
Passagassawaukeag Lake or Randall Pond (P.1466), in Brooks	II	11	None	72	Light	1,200 Brook Trout	
Swan Lake (P.1469), in Swanville, Searsport and Frankfort	II	9	Poor	871	Heavy	22,000 Land-locked Salmon or Chinook Salmon	Protect and maintain smelt population. Control suckers. Plant no White Perch. Reclaim bass
Toddy Pond (P.1478), in Swanville and Brooks	I	12	....	None	Light	1,000 Small-mouthed Bass	Protect spawning bass

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or salmon water during late summer. Lakes with less than approximately 10 per cent of their water volume and bottom area capable of supporting trout or salmon throughout the summer are here considered as unsuitable for stocking with salmonids. (One exception was made, however, in the case of Mixer Pond, for which experimental stocking with Brown Trout is recommended.) For border line or marginal trout and salmon waters, i.e., with percentage values near 10, the question of planting salmonids has been decided on the basis of the reported degree of success of previous plantings, and the occurrence of salmonids in survey gill net collections. The particular species of salmonids for these plantings have been recommended partly on the basis of the characteristics of the individual lakes and partly in view of the success of the past stocking program. The annual rate of stocking has been based on the "planting table for trout and salmon in lakes" given in *Fish Survey Report No. 2* (Cooper, 1939b, Table XI). This planting table is being applied generally by the Survey to lakes and ponds of southern Maine. In the application of this planting table, the rate of stocking is in proportion to the amount of lake area which will support trout or salmon, and is dependent on the abundance of food, suitability of spawning grounds, competition by warm-water game species, and fishing intensity. An appraisal of these factors for each lake, together with recommendations for annual stocking of trout, togue and salmon in the 12 trout and salmon lakes, is given in Table XVIII. In this table the "area supporting trout or salmon" is listed as "none" for those lakes with no "trout or salmon zone" during late summer; as "almost none" for those lakes with less than 5 per cent of their water volume and bottom area within the "trout and salmon zone"; and as "small per cent" for lakes for which the figures are approximately 5 to 10 per cent. For those lakes with more than approximately 10 per cent of their water volume or bottom area within the "trout or salmon zone," and for which plantings of salmonids are here recommended, the "area supporting trout or salmon" has been calculated as the average between the total area of the lake (from Table I) and the bottom area confined to the trout and salmon zone during late summer (from Table III). The abundance of food is expressed roughly in terms of three grades: I = abundant, II = common and III = rare. The food grades are based on the abundance of plankton, bottom fauna, smelts, minnows and other forage fishes, as indicated by available data. The food grades have been assigned to individual lakes with respect to the food requirements of the types of fishes for which each lake is best suited. "Spawning streams for trout or salmon" are evaluated as good, fair, poor or none on the basis of available spawning grounds and the capacity of the tributaries to rear young salmonids through the fingerling stage. The "game-fish competition factor" is a numerical expression of the occurrence and abundance of warm-water game species, and has been obtained by adding abundance factors of 3 (= abundant), 2 (= common) and 1 (= rare) for White Perch, Yellow Perch, bass, pickerel, horned pout and eels. The idea in applying this competition factor in the stocking policy for trout and salmon is to decrease the numbers of salmonids to be stocked with an increase in the abundance of the competing warm-water game species (Cooper, 1939b:64). The numbers of trout, togue, or salmon recommended for stocking refer to six-inch fish. All trout and salmon, except togue, should be reared in the hatcheries up to a length of at least 5 to 6 inches for plantings in lakes of southern Maine; if fish of different sizes are to be planted, multiply the figures given in Table XVIII by the following conversion factors which are based on the expected rate of mortality:

For 8- to 10-inch fish, multiply by 0.6.

For 6- to 8-inch fish, multiply by 0.8.

For 4- to 6-inch fish, multiply by 1.1.

For 2- to 4-inch fish, multiply by 2.

For 1-inch fry, multiply by 20.

Annual stocking of the Small-mouthed Bass is recommended for 20 warm-water lakes in which the species is now present, and the introduction and continued annual stocking of bass is recommended for 11 warm-water lakes in which the species does not now occur. These lakes for which bass are recommended are either shallow and warm to the bottom or are deep and with extreme oxygen deficiency in the deep water. The recommended annual rate of stocking of bass in these waters has been based on the "stocking table for Small-mouthed Bass" given in *Fish Survey Report No. 2* (Cooper, 1939b, Table XIII). The recommended rate of stocking is in proportion to the total acreage of each lake, the abundance of food, the inadequacy of spawning grounds, and fishing intensity. The numbers of 3-inch bass recommended for annual stocking are given in Table XVIII.

The proposed stocking recommendations for the present group of 61 lakes and ponds calls for a total annual stocking of 349,600 fish: 125,900 six-inch salmonids, 177,200 three-inch Small-mouthed Bass, and 46,500 White Perch. A more detailed résumé of these plantings, as summarized from Table XVIII, is as follows:

8,500 six-inch Brook Trout for 5 lakes of a total area of 884 acres.
1,200 " " Brown Trout for 1 lake of 35 acres.
12,200 " " Land-locked Salmon for 2 lakes of 1,270 acres.
12,000 " " Land-locked Salmon and } for 1 lake of 1,158 acres.
5,000 " " Togue }
87,000 " " Salmon (either Land-locked or Chinook) for 4 lakes of 10,139 acres.
162,200 three-inch Small-mouthed Bass for 26 lakes of 14,207 acres.
15,000 " " Small-mouthed Bass and } for 5 lakes of 1,913 acres.
22,500 " " White Perch }
24,000 " " White Perch for 4 lakes of 1,563 acres.
No stocking for 13 lakes of 2,403 acres.

The recommended rate of stocking for salmonids, on an area basis, is practically the same as that for bass, as seen in the following:

125,900 salmonids for 13 lakes of 13,486 acres.

177,200 bass for 31 lakes of 16,120 acres.

The principal differences involved in the stocking program for the two types of lakes are the greater number and greater total area of bass waters and the greater average acreage of the salmon waters.

The adoption of this proposed stocking program for the present group of lakes will require a considerable change from the procedure followed during the past eight years. A summary of the fish plantings in these lakes and their tributaries during the period from July 1, 1933 to June 30, 1941 is given in Table XIX. According to these records the Maine hatchery service planted 1,203,000 salmonids in 26 of these 61 lakes, and 12,000 Small-mouthed Bass in 3 of these lakes, during this eight-year period. These hatchery fish ranged from fry to "mature" fish over six inches in length. If, for the sake of comparison of past and proposed hatchery effort, these fish in past plantings are evaluated in terms of their equivalents in six-inch fish by employing the conversion factors given on page 182, these 1,203,000 salmonids were equivalent to 918,000 six-inch fish for the eight-year period, or 115,000 six-inch fish per year. The total plantings, and the total and average annual equivalents in terms of six-inch fish, for each species for this eight-year period, and the proposed annual stocking for each species, can be compared in the following (figures are in thousands):

Species	Total planted	Total equivalent of 6" fish	Average annual equivalent of 6" fish	Proposed annual plantings of 6" fish
Brook Trout	197	202	25	9
Brown Trout	179	128	16	1
Rainbow Trout	64	48	6	..
Togue (Lake Trout)	9	5	1	5
Land-locked Salmon	329	222	28	67*
Chinook Salmon	312	256	32	44*
Chum Salmon	113	57	7	...
Three-inch bass	12	8**	1**	177**
All salmonids	1,203	918	115	126

* Land-locked Salmon and Chinook Salmon in part interchangeable, see Table XVIII.

** Figures for bass refer to three-inch fish.

The principal differences between the past fish-planting program and the one here proposed are that salmonid plantings are restricted to fewer lakes and fewer species, and a large-scale program of stocking bass is initiated. The number of lakes suitable for stocking with salmonids is here reduced from 26 to 13. The important change is the removal of a few of the larger ponds (Togus, Weber, Threemile, McCurdy, Webber, South, Crawford and Alford), which have received large salmonid plantings, from the list of suitable trout and salmon waters, and the redistribution of approximately the same number of salmonids to the smaller number of suitable lakes. The total allotments of Brook Trout and Brown Trout are greatly reduced, and the allotments of Rainbow Trout and Chum Salmon are eliminated; but the demands for Land-locked Salmon and/or Chinook Salmon are greatly increased. The increased demand for these two salmons about balances the decrease for the other salmonids, so that the proposed rate of stocking for the salmonids as a whole is approximately the same as the average annual rate of stocking over the past eight years.

The adoption of the bass-planting program in this area will be a major undertaking both in terms of fish-cultural effort and in expense to the Department; because these recommendations call for maintaining the propagation of salmonids at the present rate, and adding to this a bass-propagation program of equal proportions.

LITERATURE CITED

Cooper, Gerald P.

1939a. A biological survey of the waters of York County and the southern part of Cumberland County, Maine. *Maine Dept. Inland Fish. and Game, Fish Survey Rept. No. 1, pp. 1-58.*

1939b. A biological survey of thirty-one lakes and ponds of the upper Saco River and Sebago Lake drainage systems in Maine. *Maine Dept. Inland Fish. and Game, Fish Survey Rept. No. 2, pp. 1-147.*

1940. A biological survey of the Rangeley Lakes, with special reference to the trout and salmon. *Maine Dept. Inland Fish. and Game, Fish Survey Rept. No. 3, pp. 1-182.*

1941. A biological survey of lakes and ponds of the Androscoggin and Kennebec River drainage systems in Maine. *Maine Dept. Inland Fish. and Game, Fish Survey Rept. No. 4, pp. 1-238.*

Hubbs, Carl L., and Bailey, Reeve M.

1938. The Small-mouthed Bass. *Bull. Cranbrook Inst. Sci., No. 10, pp.1-89.*

Hubbs, Carl L., and Eschmeyer, R. W.

1938. The improvement of lakes for fishing. *Bull. Inst. Fish. Res., No. 2, pp. 1-233.*

Kemmerer, George; Bovard, J. F.; and Boorman, W. R.

1923. Northwestern lakes of the United States: biological and chemical studies with reference to possibilities in production of fish. *Bull. U. S. Bur. Fish., Vol. 39, pp. 49-140.*

Smith, Gilbert M.

1933. The fresh-water algae of the United States. *McGraw-Hill Book Co., pp. 1-716.*

Ward, Henry Baldwin, and Whipple, George Chandler.

1918. Fresh-water biology. *John Wiley and Sons, pp. 1-1111*

Welch, Paul S.

1935. Limnology. *McGraw-Hill Book Co., pp. 1-471.*

PLATES I TO IX

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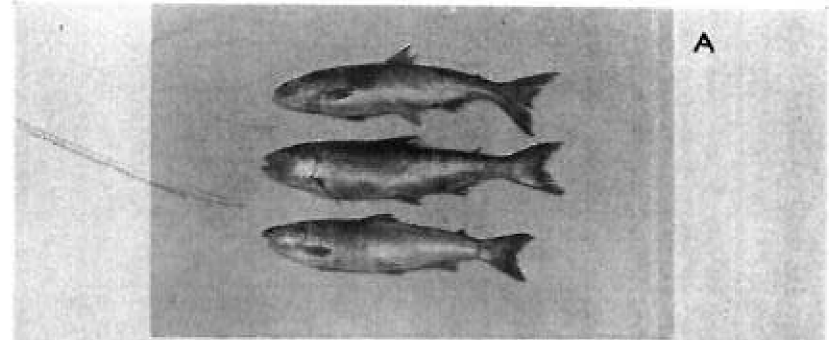


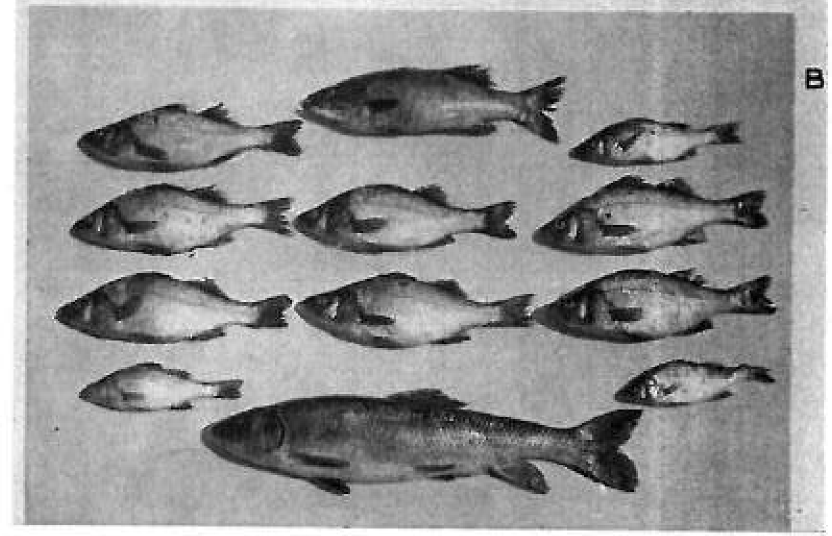


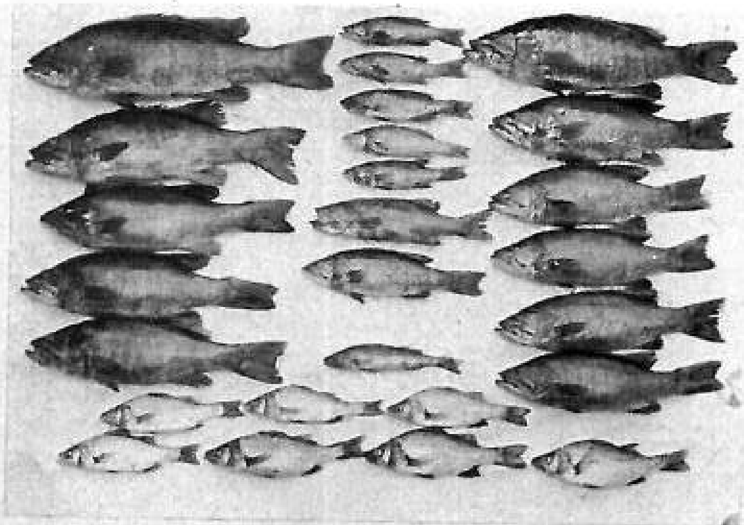
PLATE I

Gill net catches by the 1941 survey:

A — Damariscotta Lake in Jefferson. July 27. Chinook Salmon (2) and Land-locked Salmon (1). The Land-locked Salmon (at the bottom in the photograph) was a female, 17.0 inches long, 1 lb. 11 oz. in weight. The two Chinooks were females, 19.3 and 19.7 inches long, 2 lb. 4 oz. and 2 lb. 2 oz. in weight.

B — St. George Lake in Liberty. August 16. Small-mouthed Bass (1), White Perch (10) and Common Sucker (1). The sucker (largest fish) was 22.6 inches long, and 4 lb. 9 oz. in weight. The bass and four of the perch were over a pound in weight.

C



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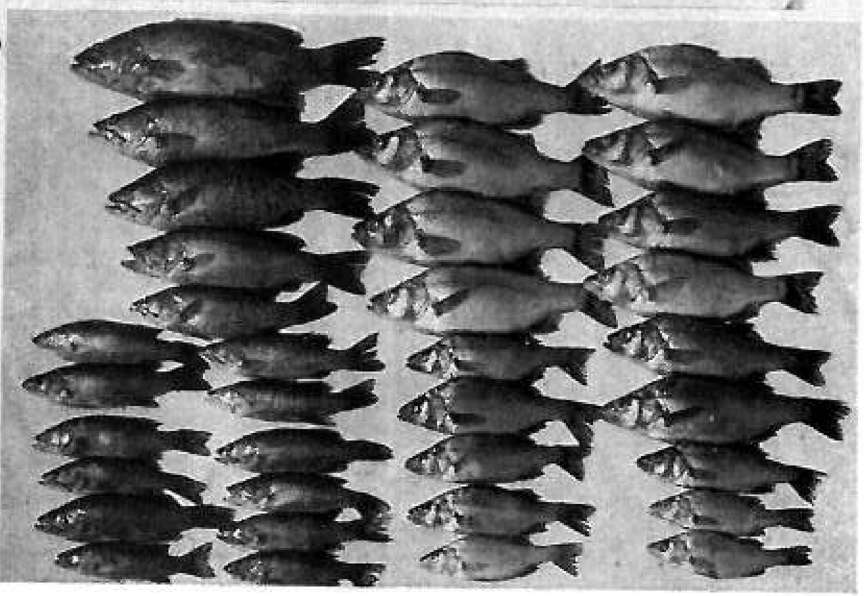


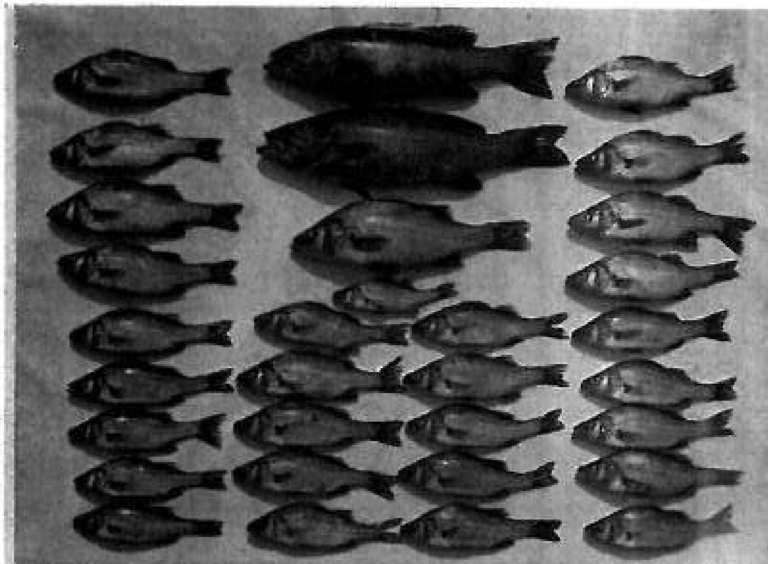
PLATE II

Gill net catches by the 1941 survey:

C — St. George Lake in Liberty. August 14. Small-mouthed Bass (18), White Perch (7) and Yellow Perch (1). The largest bass was a female, 19.4 inches long, 3 lb. 7 oz. in weight. Eleven of the bass were over a pound in weight.

D — St. George Lake in Liberty. August 23. Small-mouthed Bass (17) and White Perch (18). The largest bass was a female, 16.3 inches long, 2 lb. 1 oz. in weight. Three bass and nine perch were over a pound in weight.

E



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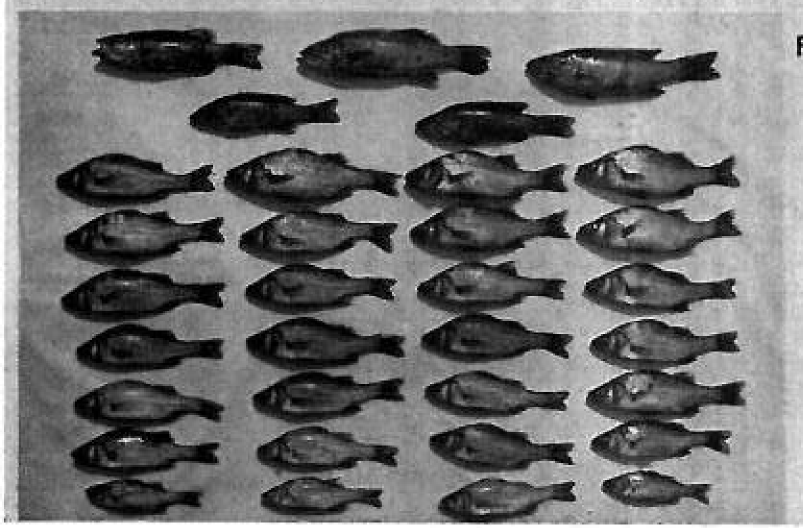


PLATE III

Gill net catches by the 1941 survey:

E — St. George Lake in Liberty. August 22. Small-mouthed Bass (2) and White Perch (30). The largest bass was a female, 13.3 inches long, 2 lb. 1 oz. in weight. Twenty-eight of the 30 perch were from 7.7 to 10.3 inches in length.

F — St. George Lake in Liberty. August 22. Small-mouthed Bass (5) and White Perch (28). The bass ranged from 8.5 to 11.2 inches in length; the perch, from 6.4 to 10.0 inches in length.

G

H

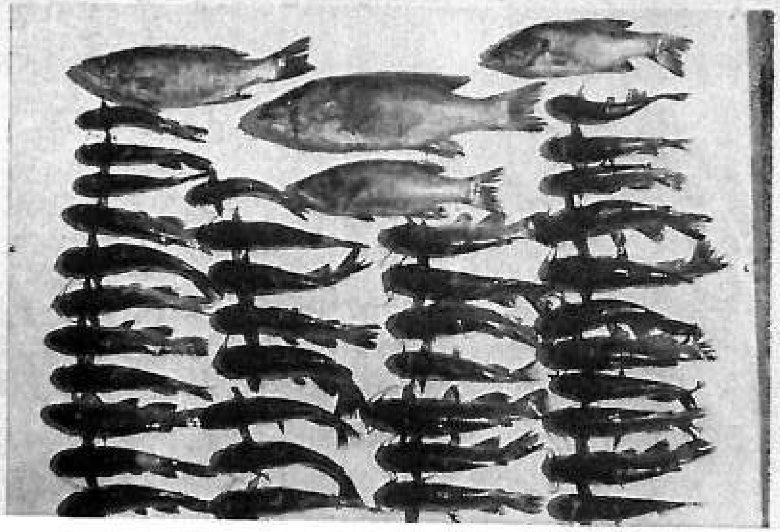


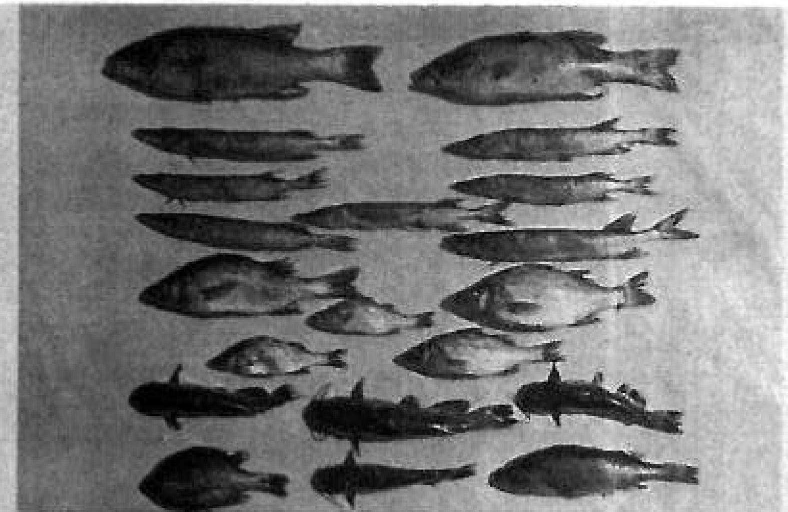
PLATE IV

Gill net catches by the 1941 survey:

G — Four Horned Pout (*Ameiurus n. nebulosus*) in the gill net. Quantabacook Pond in Searsmont. September 3.

H — Quantabacook Pond in Searsmont. September 3. Small-mouthed Bass (4) and Horned Pout (37). The largest bass was a female, 17.8 inches long, 2 lb. 15 oz. in weight. The 37 bullheads ranged in length from 7.9 to 11.7 inches.

I



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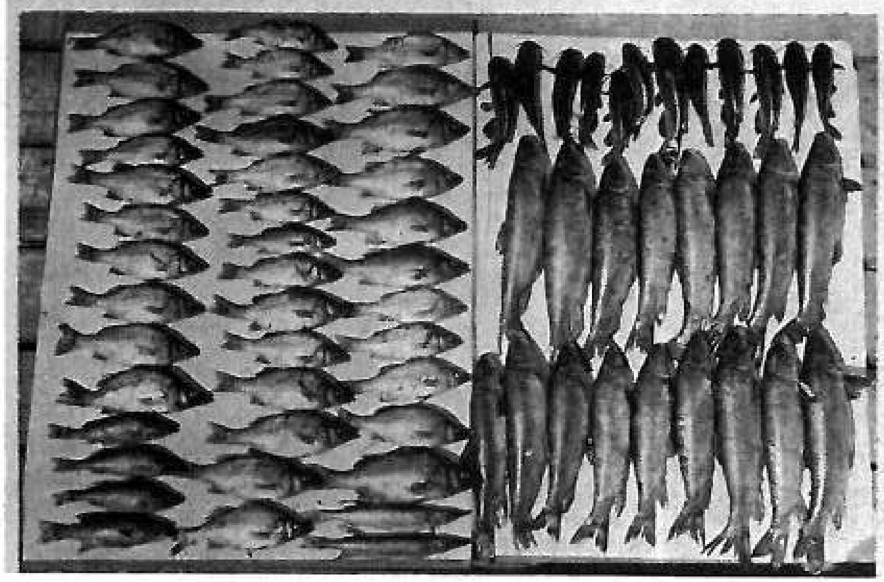


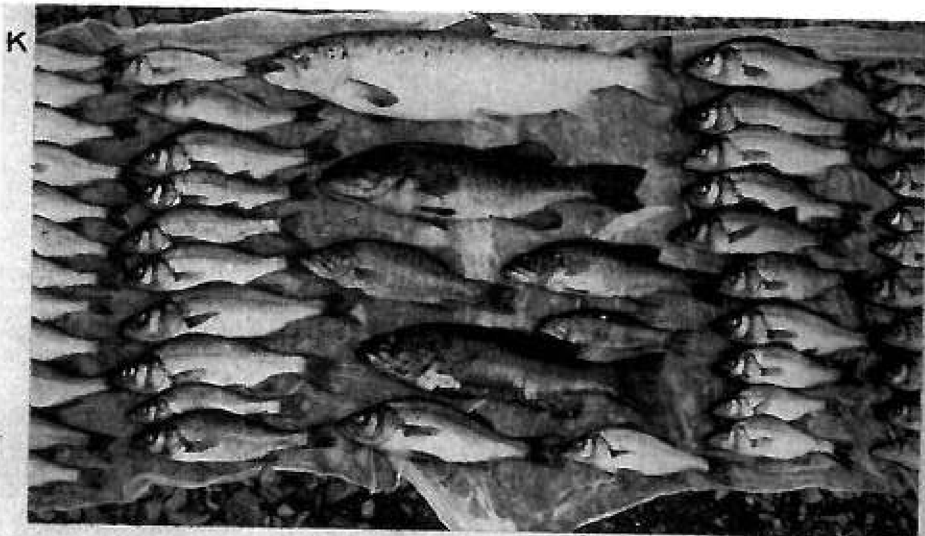
PLATE V

Gill net catches by the 1941 survey:

I — Quantabacook Pond in Searsmont. September 3. Small-mouthed Bass (2), Common Pickerel (7), White Perch (5), Horned Pout (4), Pumpkinseed Sunfish (1) and Yellow Perch (1). The largest bass was a female, 16.1 inches long, 2 lb. 1 oz. in weight. The largest White Perch was 1 lb. in weight.

J — Quantabacook Pond in Searsmont. September 4. White Perch (35), Yellow Perch (3), Small-mouthed Bass (1), Common Pickerel (2), Horned Pout (12) and Common Suckers (17). The 17 suckers ranged from 16.7 to 20.8 inches in length, from 2 lb. 1 oz. to 4 lb. 2 oz. in weight. The largest White Perch was 1 lb. 12 oz. in weight. Ten of the White Perch were over a pound in weight.

K



L

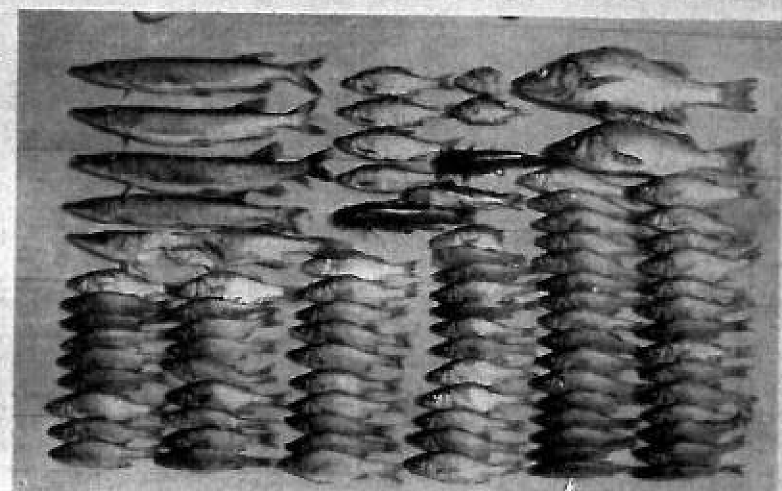


PLATE VI

Gill net catches by the 1941 survey:

K — Megunticook Lake in Camden. July 17. Land-locked Salmon (1), Small-mouthed Bass (5) and White Perch (45). The salmon was a female, 25.0 inches long, 6 lb. 9 oz. in weight. The largest bass was a female, 18.7 inches long, 2 lb. 12 oz. in weight.

L — Pemaquid Pond in Nobleboro. July 30. Common Pickerel (5), Golden Shiners (4), Pumpkinseed Sunfish (2), Horned Pout (3) and White Perch (72). Several fish partly eaten (by turtles?). The largest perch was a female, 14.8 inches long, 1 lb. 6 oz. in weight. Seventy of the perch ranged from 6.2 to 7.9 inches in length, from 1.6 to 3.4 oz. in weight.

PLATE VII

Upper: St. George Lake, looking south.

Lower: The south end of Togus Pond, Little Togus Pond, and Togus Stream, looking south.

PLATE VIII

Upper: Megunticook Lake, looking southeast; the village of Camden in the right background.

Lower: Quantabacook Pond, looking northeast; the village of Searsmont in the foreground.

PLATE IX

Upper: Swan Lake, looking south.

Middle: The northwest arm of China Lake, looking southeast, the village of East Vassalboro in the right foreground.

Lower: Sandy Pond in Freedom, looking east. Note the extensive mud-flats due to low water; the water level of the pond was approximately 9 feet below normal.