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ADULT FISH POPULATIONS BY HAUL SEINE IN SEVEN FLORIDA LAKES

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INTRODUCTION

This study presents an evaluation and comparison of the statics of the principal adult fish populations in several of the larger Florida lakes. The data were gathered in connection with the operation of the State Game and Fresh Water Fish Commission's rough fish control unit under supervision of the author. The lakes are analyzed qualitatively as well as quantitatively in terms of pounds of the several species available to this sampling device and taken in each of the lakes studied. The size distributions within the various species are noted and compared by means of length-frequency studies. The observed physiographic characteristics of the bodies of water are presented; and the relative yields to the net are discussed and compared.

METHODS

Fish were sampled by means of a haul seine varying in length from 750 to 835 yards with a constant minimum mesh size of three inches (stretched), operated by three experienced fishermen and supervised by the Commission's biologist. Equipment consisted of a gasoline-powered launch for pulling the net, two or three fish boats, a seine boat, and the seine. The unit was provided with trucks and trailers to effect its mobility by land. Since the site of operations was often in remote localities, a tent with camping equipment was also included.

The game fishes taken in the operations were released while catfishes were sold dressed, usually to the wholesale fish dealer bidding highest. The other rough fishes: gizzard shad, garfishes, chub sucker, mudfish, stingray, and golden shiner, were destroyed or sold to fertilizer companies. Dressed turtles and gizzard shad roe were sometimes sold to the market for food.

The proceeds from the sale of the fish and fish products were used to help defray the cost of operations—three-quarters of the

total amount went to the fishermen as their pay and the remaining one-quarter was retained by the Commission to aid in paying its operational and maintenance costs.

The dip-net method (Dequine, 1951) was used in estimating total populations of game fishes taken in the seine hauls. Largemouth bass were counted as they were released from each haul, and individuals were weighed at random in order to arrive at the average weight per bass. This average was used as the basis for determining the total weight of bass taken in the haul. The fish removed were weighed.

As many fish as possible were measured at random as time and their abundance permitted. Measuring was done by means of a thirty-inch board graduated at half-inch intervals. The graduations were made in such a manner as to group all measured fishes into inch and half-inch classes. For example: a fish in the 7.5-inch size class is between 7.3 and 7.7 inches total length, inclusive; and a fish in the 8.0-inch size class is within the limits of 7.8 and 8.2 inches, inclusive, etc.

Water analysis was made by means of the Schleicher-Dequine Water Analysis Kit. Dissolved oxygen and carbon dioxide in parts per million were determined by titration with sodium thiosulfate and sodium hydroxide respectively, and pH was ascertained by the colorimetric method. Air and water temperatures were taken at the surface.

It was inevitable for varying conditions to exist in the operation of the seine, within the same lake as well as from lake to lake. Seldom were any two hauls alike. Weather conditions, bottom characteristics, state of the net, and fishermen's vagaries were some of the factors affecting the area of the haul ground pulled and fishing success.

It is believed that the circumstances which affected fishing success did not bias the data. Therefore: (1) the amounts of fish caught by the rough fish net are considered representative of the populations within the net selectivity in each lake during the period of study, and (2) the populations thus determined for one lake are compared quantitatively as well as qualitatively with those similarly determined in another lake at about the same season of the year. It is admitted that the comparisons may be very approximate ones, but it is felt that within the limitations of the data they are dependable.

The lakes are summarized in terms of average pounds of fish taken per haul during the given periods, and in terms of the percentage composition by weight of each species taken in that average haul.

Lake Ashby

Lake Ashby, in Volusia County, has an area of 1,192 acres or 1.86 square miles. It is a shallow saucer-shaped lake with wide sandy beaches in a pine flatwoods region. The average depths in the central area during the period of stay were five to six feet. The water stage was moderately low. Littoral areas were extensive, and consisted partly of sloughs and swamps. The bottom was chiefly of hard sand, although some black mud, varying in depth from about two inches to two feet, was present in a few places. Mussels were observed living on the bottom of the lake in considerable numbers. A light plankton bloom was present in the water at the time of operations. Maiden cane (*Panicum* sp.) grew on the edges of the beach and some eel grass (*Vallisneria americana*) was found in a few areas in the lake. In times of moderately high water Lake Ashby is remotely connected with the St. Johns River by a branch of Deep Creek which flows from Lake Harney and enters Ashby from the south. This branch goes periodically dry when the River is at a low stage. On the west shore a canal drains water from adjacent low flatwoods into the lake. On July 16, 1951 at 10:25 A.M. the water temperature was 90° F. and the air 89° F., the pH 7.0, dissolved oxygen 6.8 ppm, and CO_2 2.5 ppm.

At the time of operations, in July 1951, available adult fish populations were low: 482 pounds constituted the average haul. The channel catfish (*Ictalurus punctatus*) was the most abundant species; it comprised 41.6 per cent by weight of the catch. The shellcracker (*Lepomis microlophus*) was the next most abundant species: it made up 21.0 per cent of the weight of the catch. Few gizzard shad (*Dorosoma cepedianum*) were taken at the time, and they represented about five per cent of the total weight caught. For other species see Table 1.

Lake Harney

Lake Harney is in Seminole and Volusia Counties, and is part of the St. Johns River. It is an oblong saucer-shaped lake, in a pine flatwoods region, with about 8.73 square miles (5,558 acres)

TABLE 1

Adult Fish Populations in Lakes Ashby, Harney, and Monroe as Determined by Haul Seine Samples.

Name of Waters	Lake Ashby			Lake Harney			Lake Monroe		
County	Volusia			Seminole			Volusia and Seminole		
Approximate Area	1,192 Acres			5,558 Acres			8,814 Acres		
Average Depth Surveyed	3 - 6 Feet			3 - 6 Feet			4 - 7 Feet		
Predominant Bottom Type	Hard Sand			Hard Sand			Hard Sand		
Dates of Survey	July 13 - 20, 1951			July 26 - August 3, 1951			August 17 - 23, 1951		
Length of Haul Seine	835 Yards			825 Yards			753 Yards		
Minimum Mesh (Stretched)	3 Inches			3 Inches			3 Inches		
Species	Pounds Taken	Average Pounds per Haul	Composition by Percent	Pounds Taken	Average Pounds per Haul	Composition by Percent	Pounds Taken	Average Pounds per Haul	Composition by Percent
Stingray	-----	-----	-----	17	2	0.4	116	29	4.7
Mudfish	33	5	1.0	17	2	0.4	-----	-----	-----
Longnose Gar	156	22	4.6	391	49	9.7	88	22	3.6
Florida Spotted Gar	133	19	3.9	19	2	0.5	22	5	0.9
Gizzard Shad	164	23	4.9	1,495	184	36.6	1,246	311	50.7
Eastern Chub Sucker	24	3	0.7	-----	-----	-----	-----	-----	-----
Golden Shiner	3	-----	-----	-----	-----	-----	-----	-----	-----
Channel Catfish	1,404	201	41.6	630	79	15.6	192	48	7.8
White Catfish	176	24	5.2	21	3	0.5	19	5	0.8
Speckled Bullhead	12	2	0.3	4	0.5	-----	2	0.5	0.1
Yellow Bullhead	1	-----	-----	-----	-----	-----	-----	-----	-----
Chain Pickerel	-----	-----	-----	-----	-----	-----	-----	-----	-----
Warmouth	-----	-----	-----	-----	-----	-----	-----	-----	-----
Shellcracker	707	101	21.0	92	11	2.3	121	30	4.9
Bluegill	213	30	6.3	201	25	5.0	130	33	5.3
Black Crappie	136	19	4.0	181	23	4.5	160	40	6.5
Redbreast	1	-----	-----	3	-----	-----	10	3	0.4
Black Bass	207	30	6.1	860	107	21.4	237	59	9.6
Croaker	-----	-----	-----	3	-----	-----	-----	-----	-----
Mullet	1	-----	-----	110	14	2.7	115	29	4.7
Mud Eel	-----	-----	-----	-----	-----	-----	-----	-----	-----
Totals	3,371	482		4,024	503		2,458	615	
Number of hauls		7			8			4	
Pounds rough fish removed		2,107			2,687			1,800	
Pounds rough fish removed per acre			1.77			0.48			0.20
Predatory turtles	9	1		125	16		22	5	
Non-predatory turtles	1,458	208		588	74		97	24	

of surface area. Littoral areas were large and of the same general character as those of Lake Ashby. The bottom rose gently on all sides to the conspicuous, wide, sandy beaches. At mean low water the average depth in the middle is six feet. The water was at this stage during the period of operations. The bottom was a hard sand, covered in some places by several inches of black mud. Numerous mussels were observed living on the bottom. A light plankton bloom was present in the water. Maiden cane was noted growing near the edges of the shore, and sparse growths of eel grass were found in the lake. On July 26, 1951 at 10:25 A.M. the pH of the water was 7.0; dissolved oxygen 4.20 ppm, and the temperature of the water was 84° F. when the air temperature was 85° F.

Low populations of adult fishes were available to the seine during the period of operations—July 26 to August 23, 1951—only 503 pounds were taken in the average haul. The predominant species found was gizzard shad, which composed 36.6 per cent by weight of the catch. Next in abundance was the largemouth bass, *Micropterus salmoides floridanus* (LeSueur), which represented 21.4 per cent by weight of the catch—the highest percentage found in any of the seven lakes discussed. Channel catfish followed the bass in order of abundance, and comprised 15.6 per cent by weight of the catch. For average weights per haul and additional data see Table 1.

Lake Monroe

Lake Monroe is a part of the St. Johns River and is bounded by Seminole and Volusia Counties. It is about 13.77 square miles (8,814 acres) in area, saucer-shaped and roughly circular in outline. The margins were gently sloping, with wide sandy beaches and extensive sloughs and marshes, resembling Lakes Ashby and Harney except for the bulkheaded shore on the Sanford side. The depth was fairly uniform—it averaged about seven feet in the middle. The water stage was low during the operational period. The bottom type was predominantly hard sand, but a great deal of black mud was present at the south end. No plankton bloom was noticeable in the water at the time of operations; *Panicum* and *Vallisneria* were present as in Lakes Ashby and Harney. On August 21, 1951 at 8:50 A.M. the pH was 7.0; dissolved oxygen 10.0 ppm; and the water temperature was 86° F. when the air temperature was 86° F.

Lake Monroe, like Lakes Harney and Ashby, yielded low adult fish populations during August 1951—615 pounds were taken in the average haul. The predominant species represented here was the gizzard shad, comprising 50.7 per cent by weight of the catch. Next in abundance, as in Lake Harney, was the largemouth bass, representing 9.6 per cent by weight of the catch. Again as in Lake Harney, channel catfish was third and composed 7.8 per cent by weight of the catch (Table 1).

Lake Jessup

Lake Jessup is approximately fifteen miles southeast of Sanford in Seminole County. It is 12.38 square miles (7,922 acres) in size and is roughly crescent-shaped. Jessup is one of the St. Johns Chain of lakes, although it does not lie directly within the River, as do Lakes Harney and Monroe. It is connected to the River by a short channel on the eastern end. This channel is divided by a muddy island. The lake is fed by a number of springs, some of them sulphurous, from its bed as well as from its shores. Littoral areas are very large, although the shore falls off less gently than that of Ashby, Harney, or Monroe. The margins are generally soft: sand and mud, with some shell. The entire eastern half is surrounded by a marshy margin about one-half mile in width which is composed of inlets, sloughs, and creeks. The western half has a more solid shoreline. The bottom of the lake is composed mostly of soft black mud, mixed with some sand, snail shells, and clay. It is not so uniform in depth as Ashby, Harney, and Monroe. At mean low water (the stage found during the unit's stay) the depth varies from three to seven feet. Adjacent to Bird Island, in the middle of the lake, the bottom was of hard sand and sloped up gently to a water depth of about a foot within two hundred feet of the island. The lake was colored with a fairly heavy greenish plankton bloom at the time of operations. Luxuriant grasses and emergents grew along the shallow places near the shore, and there were numerous beds of eel grass in the lake. On September 10, 1951, at 11:45 A.M., the pH of the water was 7.5, the water temperature 84° F. and the air 84° F. Dissolved oxygen was 10.30 ppm, and CO_2 3.0 ppm.

In Lake Jessup large numbers of fishes were available to the net during the period August 29 to October 9, 1951. The average

weight per haul was 2,318 pounds. Gizzard shad was the dominant species and comprised 48.3 per cent of the total weight of the catch. White catfish, *Ictalurus catus*, was the species second most abundant, and represented 22.2 per cent by weight. Bluegill was third—11.1 per cent; and channel catfish, stingray, longnose gar, black bass, and black crappie followed, respectively, in order of abundance (Table 2).

Lake Panasoffkee

In Sumter County about six miles north of Bushnell lies Lake Panasoffkee with an area of 7.32 square miles (4,685 acres). It is situated in a climax hammock region of many large oaks, hickories, and magnolias, and is surrounded by extensive cypress and saw-grass marshes. Panasoffkee is a kidney-shaped lake directly connected with the Withlacoochee River by the Panasoffkee River, which drains the lake from its west shore. The lake is relatively shallow, and at the time of operations had an average depth of about five feet (a low water stage). The bottom is composed of a deep, soft, yellowish silt. Large dense beds of eel grass were present in the lake and were especially thick and wide at its northern and southern ends, and on the eastern side. Personal observation revealed a pronounced green plankton bloom manifested in the water through the fall, spring, and summer months. The lake supported a dense population of the snail, *Vivipara g.*, and considerable numbers of mussels. The water is derived principally from springs. At the time of operations it exhibited a milky appearance underlying its greenish plankton layer. Littoral areas are extensive, and large beds of giant pickerel weeds (*Pontederia* sp.) figure prominently in the dense vegetation. From the marshy saw-grass ringed shoreline the silty bottom slopes gently to five foot depths. On May 1, 1951 the water temperature was 78° when the air was 75° F., the pH was 8.3, dissolved oxygen 7.6 ppm, and CO_2, zero ppm.

Lake Panasoffkee exhibited high fish populations during April and the first two days in May 1951. The average weight per haul was 3,439 pounds. The species of fish taken most abundantly was the longnose gar, *Lepisosteus osseus*, which represented 34.9 per cent by weight of the catch. Second in abundance was the gizzard shad, composing 30.5 per cent. Shellcracker ranked third—16.3 per cent; and bluegill fourth, comprising 5.4 per cent (Table 2).

TABLE 2

Adult Fish Populations in Lakes Jessup and Panasoffkee and Black Lake as Determined by Haul Seine Samples.

Name of Waters	Lake Jessup			Lake Panasoffkee			Black Lake		
County	Seminole			Sumter			Orange		
Approximate Area	7,922 Acres			4,685 Acres			408 Acres		
Average Depth Surveyed	3 - 7 Feet			3 - 7 Feet			3 - 10 Feet		
Predominant Bottom Type	Mud and Shell			Silt and Shell			Sand and Mud		
Dates of Survey	Aug. 29 - Oct. 9, 1951			April 6 - May 2, 1951			March 30, 1951		
Length of Haul Seine	753 Yards			835 Yards			835 Yards		
Minimum Mesh (Stretched)	3 Inches			3 Inches			3 Inches		
Species	Pounds Taken	Average Pounds per Haul	Composition by Percent	Pounds Taken	Average Pounds per Haul	Composition by Percent	Pounds Taken	Average Pounds per Haul	Composition by Percent
Stingray	2,190	95	4.1	-----	-----	-----	-----	-----	-----
Mudfish	-----	-----	-----	33	2	0.1	-----	-----	-----
Longnose Gar	1,390	60	2.6	15,628	1,202	34.9	1,250	-----	73.5
Florida Spotted Gar	233	10	0.4	1,266	97	2.8	70	-----	4.1
Gizzard Shad	25,750	1,119	48.3	13,658	1,051	30.5	125	-----	7.3
Eastern Chub Sucker	-----	-----	-----	183	14	0.4	-----	-----	-----
Golden Shiner	3	-----	-----	7	-----	-----	-----	-----	-----
Channel Catfish	2,715	118	5.1	113	9	0.3	235	-----	13.8
White Catfish	11,836	515	22.2	18	1	-----	-----	-----	-----
Speckled Bullhead	123	5	0.2	1,639	126	3.7	5	-----	0.3
Yellow Bullhead	-----	-----	-----	2	-----	-----	-----	-----	-----
Chain Pickerel	-----	-----	-----	4	-----	-----	-----	-----	-----
Warmouth	-----	-----	-----	1	-----	-----	-----	-----	-----
Shellcracker	624	27	1.2	7,272	559	16.3	-----	-----	-----
Bluegill	5,939	258	11.1	2,400	185	5.4	2	-----	0.1
Black Crappie	903	39	1.7	1,071	82	2.4	10	-----	0.6
Redbreast	1	-----	-----	-----	-----	-----	-----	-----	-----
Black Bass	1,426	62	2.7	1,413	109	3.2	4	-----	0.2
Croaker	141	6	0.3	-----	-----	-----	-----	-----	-----
Mullet	49	2	0.1	-----	-----	-----	-----	-----	-----
Mud Eel	-----	-----	-----	-----	-----	-----	-----	-----	-----
Totals	53,323	2,318		44,708	3,439		1,701		
Number of hauls		23			13			1	
Pounds rough fish removed		42,099			32,547			1,685	
Pounds rough fish removed per acre			5.31			6.95			4.13
Predatory turtles	80	3		55	4				
Non-predatory turtles	361	16		10,405	800				

An outstanding fact about Lake Panasoffkee was the abundance of the hard-shell turtle or "cooter", *Pseudemys floridana peninsularis*. In no other lake, to the writer's knowledge, was it found so abundantly. A total weight of 10,405 pounds were taken, representing 18.9 per cent of the combined weight of the catch. The weight of the average cooter was about eight pounds.

Johns Lake

Johns Lake is located several miles WSW of Winter Garden in the western part of Orange County and extends into eastern Lake County. It is 4.24 square miles (2,714 acres) in size, very irregular in outline, and is divided into three sections by narrow channels. The easternmost portion is nearly separated from the middle one by an island—Deer Island—and a peninsula—Williams Peninsula. The west section of the lake, known locally as "Clear Lake" because of the transparency of its water (in contrast to the dark colored appearance of that of the other two divisions), is differentiated from the middle section by a second narrowing. The bottom is hilly, rolling, and uneven. Depths in the central portions varied from four to twenty-five feet. Littoral areas were usually small and the shore, in general, had a fairly steep slope. The shoreline was generally high, although there were a few marshy areas where heavy growths of aquatic and emergent vegetation were in evidence.

Chemical and Physical Characteristics

Date	Time	pH	ppm	Temperature °F.	
			Dissolved Oxygen	Water	Air
November 14, 1950	10:00 A.M.	6.2	7.9	69	70
December 14, 1950	8:30 A.M.	6.5	8.2	56	50
March 14, 1951	9:55 A.M.	6.5	7.6	64	49

Except for these scattered areas there was almost no vegetation growing at the shoreline, and none was observed at greater depths. The bottom is composed of sand and black mud with some clay. No plankton bloom was observed in the water at the time, nor was found on subsequent occasions when the lake was revisited. The only body of water with which Johns Lake has any known connection

TABLE 3

Adult Fish Populations in Johns Lake as Determined by Haul Seine Samples.

Name of Waters	Johns Lake								
County	Orange and Lake								
Approximate Area	2,714 Acres								
Average Depth Surveyed	8 - 12 Feet								
Predominant Bottom Type	Mud and Sand								
Dates of Survey	Nov. 15 - Dec. 28, 1950			March 14 - 28, 1951			Nov. 24 - Dec. 28, 1950		
Length of Haul Seine	825 Yards			835 Yards			825 Yards		
Minimum Mesh (Stretched)	3 Inches			3 Inches			3 Inches		
Type of Haul	Unbaited			Unbaited			Baited		
Species	Pounds Taken	Average Pounds per Haul	Composition by Percent	Pounds Taken	Average Pounds per Haul	Composition by Percent	Pounds Taken	Average Pounds per Haul	Composition by Percent
Stingray	-----	-----	-----	-----	-----	-----	-----	-----	-----
Mudfish	5	0.3	-----	-----	-----	-----	-----	-----	-----
Longnose Gar	1,828	101	4.7	717	80	6.2	-----	-----	-----
Florida Spotted Gar	617	34	1.6	176	19	1.5	3	-----	-----
Gizzard Shad	9,466	526	24.4	1,834	204	15.9	554	79	3.5
Eastern Chub Sucker	58	3	0.1	36	4	0.3	6	1	-----
Golden Shiner	35	2	0.1	1	-----	-----	2	-----	-----
Channel Catfish	16,976	943	43.7	3,377	375	29.3	12,576	1,797	80.5
White Catfish	1,563	87	4.0	955	106	8.3	1,252	179	8.0
Speckled Bullhead	291	16	0.7	937	104	8.1	45	6	0.2
Yellow Bullhead	-----	-----	-----	12	1.3	0.1	28	4	0.1
Chain Pickerel	18	1	-----	6	0.6	-----	-----	-----	-----
Warmouth	6	0.3	-----	15	2	0.1	-----	-----	-----
Shellcracker	51	3	0.1	91	10	0.8	10	1	-----
Bluegill	4,893	272	12.6	2,355	262	20.4	769	110	4.9
Black Crappie	1,409	78	3.6	696	77	6.0	252	36	1.6
Redbreast	-----	-----	-----	-----	-----	-----	-----	-----	-----
Black Bass	1,597	89	4.1	311	35	2.7	115	16	0.7
Croaker	-----	-----	-----	-----	-----	-----	-----	-----	-----
Mullet	-----	-----	-----	-----	-----	-----	-----	-----	-----
Mud Eel	1	-----	-----	-----	-----	-----	-----	-----	-----
Totals	38,813	2,156	-----	11,519	1,280		15,612	2,230	
Number of hauls		18			9			7	
Pounds rough fish removed		30,838			8,045			14,466	
Pounds rough fish removed per acre			11.36			2.96			5.32
Predatory turtles				14	1				
Non-predatory turtles	134	7		108	12				

is Black Lake, about a mile to the east. It is joined to it by a canal draining a marsh between the two lakes.

The seine hauls pulled in Johns Lake are separated into three groups: (1) unbaited ones made at random in the lake during the first period of operations, (2) baited ones made at a single location during the first period, and (3) random unbaited hauls made about two months later.

Random hauls made during the first period yielded high fish populations—the average weight per haul was 2,156 pounds (Table 3). Channel catfish was the dominant species taken, and composed 43.7 per cent of the weight of the catch. Second most abundant was the gizzard shad, 24.4 per cent of the combined weight of populations caught. Third was the bluegill, 12.6 per cent of the total weight. Longnose gar was fourth, largemouth bass fifth, white catfish sixth, and black crappie (*Pomoxis nigromaculatus*) seventh.

In the second period of operations, after a two months lapse of time, random hauls yielded smaller total populations. The average weight per haul had dropped to 1,280 pounds. The dominant species remained the channel catfish, but it comprised only 29.3 per cent by weight of the catch. Bluegill had become the second most abundant species—it represented 20.4 per cent of the weight taken. Third, fourth, and fifth in order of abundance were, respectively, gizzard shad, white catfish, and speckled bullhead. Sixth and seventh were longnose gar and black crappie (Table 3).

Johns Lake was the only lake extensively baited for catfishes included in this study. The purpose of baiting is to attract large numbers to an area. The area should be baited repeatedly so as to accustom them to come there to feed. The haul ground area selected in Johns Lake was baited every day for a week before the first haul was made, and was baited daily and fished about twice a week thereafter. All the gizzard shad, garfishes, and other rough fishes (with the exception of catfishes, no parts of which were used for bait) caught were cooked, salted, and placed in the baited area. Seine hauls were made early in the morning before the "cats" had a chance to leave after eating the bait.

Baited hauls in Johns Lake proved extremely successful. The average weight per haul of all fishes was 2,230 pounds, of which 88.7 per cent by weight consisted of catfishes. The principal species

caught was the channel catfish, which represented 80.5 per cent by weight of the catch. Second was the white catfish, 8.0 per cent; third, the bluegill, 4.9 per cent; fourth, gizzard shad, 3.5 per cent; black crappie, fifth, 1.6 per cent; and black bass, sixth, 0.7 per cent by weight of the total catch. No longnose garfish were caught from baited hauls in Johns Lake (Table 3).

Black Lake

Black Lake lies about a mile east of Johns Lake and is located in Orange County. It was 0.64 square miles (408 acres) in size, and was roughly circular in shape. Littoral areas were wide, the lake was shallow—four to five feet deep in the middle; the bottom was chiefly of sand with some black mud. No plankton bloom was observed on its waters, which like those of most of Johns Lake were dark colored in appearance. Some maiden cane grew along the shoreline, together with pickerel weed and other emergents. There is a large marsh contiguous with Black Lake extending eastward approximately three miles. Black Lake is connected directly with Johns by a canal about a mile long.

A single haul was made in Black Lake. Because of the lake's small size and because the haul was pulled near its central part, it is believed that the sample can be considered representative of the fish populations available to the net on March 30, 1951.

The total weight of all fishes taken was 1,701 pounds: 73.5 per cent of this weight consisted of longnose gar; 13.8 per cent, of channel catfish; and 7.3 per cent of gizzard shad. Black crappie, bluegill, and black bass, jointly, represented only about 0.9 per cent of the total weight of the catch (Table 2).

Size Distributions

Size distributions among the populations of the several species are summarized in Table 4. The average lengths presented were determined from length-frequency data by multiplying the number of fish measured in each size group by the total-length measurement of that size group, summing up the products and dividing by the total number of fish in the sample. Occasionally where average lengths were not available, average weights are presented instead, and in the few cases where data were available the average

weight corresponding to the average length of the species in question is also given. It is regrettable that the volume of work attendant on the supervision of the rough fish unit precluded length-weight studies, particularly for the bass, bream, and crappie, which had to be released alive.

It is believed that the size distributions presented in Table 4 may be considered representative for the populations of the lakes during the periods of study. Large samples were generally taken for analysis, and efforts were made to keep them uniformly random.

Comparison

In drawing comparisons from lake to lake it should be recognized that the abundance of fishes available to the haul seine in a given body of water is subject to "seasonal and cyclic fluctuations" (Dequine 1951) caused perhaps principally by fish movements in connection with spawning and feeding activities which lead them to shallow water where the seine cannot go, or even outside the lake itself (H. L. Moody, Unpublished Data). It is apparent, therefore, that bodies of water sampled at about the same time of year should be more readily comparable than bodies sampled at different times. Ashby, Harney, and Monroe are logically comparable in this respect; Panasoffkee is comparable with Black Lake; and, although the sampling in Jessup was done in early fall almost a year after the first period of operations in Johns in late fall, striking over-all population similarities justify their comparison.

Lakes Harney and Monroe, similar type lakes in the St. Johns River, yielded nearly equal yet low average poundages of fishes to the sampling device, and there was a close similarity in their species composition. The three most abundant fishes in the two lakes were respectively, gizzard shad, black bass, and channel catfish. Nearby Lake Ashby, of the same bottom type as the former lakes, yielded about the same total average poundages, but yielded an extremely low shad population. Channel catfish and shellcracker were, respectively, the two most abundant species taken in Lake Ashby.

Lake Panasoffkee and Black Lake are similar in two respects only: (1) the high proportions of garfishes present and (2) the high average poundages taken. The 1,320 pounds of garfishes caught in Black Lake represented 77.6 per cent of the total weight of the

TABLE 4

Minimum, Average and Maximum Sizes of Adult Fishes Caught by Haul Seine in the Seven Lakes. The Lakes Are Listed in Descending Order of Abundance by weight of the Various Species in the Several Lakes.

Species	Lake	Sizes		
		Minimum	Average	Maximum
Black bass *(Micropterus salmoides floridanus)*	Panasoffkee	7.5 inches	12.84 inches	26.0 inches
	Harney	10.0 inches	14.12 inches	25.5 inches
	Johns	8.5 inches	17.27 inches	27.0 inches
	Jessup	10.5 inches	16.37 inches	24.0 inches
	Monroe	10.5 inches	13.36 inches	21.0 inches
	Ashby	8.0 inches	12.05 inches	22.0 inches
	Black	-------	-------	-------
Black crappie *(Pomoxis nigro-maculatus)*	Johns	5.0 inches	7.85 inches	11.5 inches
	Panasoffkee	6.5 inches	12.80 inches	15.0 inches
	Monroe	8.5 inches	11.65 inches	13.5 inches
	Jessup	7.0 inches	11.59 inches	15.0 inches
	Harney	8.5 inches	11.74 inches	13.5 inches
	Ashby	8.5 inches	10.92 inches	12.5 inches
	Black	-------	-------	-------
Bluegill *(Lepomis macrochirus)*	Johns	4.5 inches	6.56 inches	10.0 inches
	Jessup	4.5 inches	7.88 inches	9.5 inches
	Panasoffkee	5.0 inches	8.37 inches	12.0 inches
	Monroe	5.5 inches	8.07 inches	9.5 inches
	Ashby	5.0 inches	7.19 inches	9.0 inches
	Harney	4.5 inches	6.56 inches	9.5 inches
	Black	-------	-------	-------
Shellcracker *(Lepomis microlophus)*	Panasoffkee	6.0 inches	10.37 inches	14.0 inches (3.25 pounds)
	Ashby	5.5 inches	8.26 inches	13.0 inches
	Monroe	8.0 inches	9.18 inches	10.5 inches
	Jessup	5.5 inches	9.76 inches	12.0 inches
	Harney	7.5 inches	9.26 inches	11.5 inches
	Johns	-------	-------	-------
	Black	-------	-------	-------
Channel catfish *(Ictalurus punctatus)*	Johns	8.5 inches	16.26 inches	41.0 inches
	Black	-------	-------	-------
	Ashby	9.5 inches	14.90 inches	34.0 inches
	Jessup	10.0 inches	18.46 inches	36.0 inches
	Harney	9.5 inches	12.36 inches	22.0 inches
	Monroe	-------	-------	-------
	Panasoffkee	-------	4.31 pounds	27.0 inches (9.0 pounds)
White catfish *(Ictalurus cactus)*	Jessup	10.0 inches	12.69 inches	15.5 inches
	Johns	9.5 inches	11.08 inches	13.5 inches
	Ashby	9.5 inches	10.96 inches	15.0 inches
	Harney	-------	-------	-------
	Monroe	-------	-------	-------
	Panasoffkee	-------	13.50 inches	(1 fish)
	Black	-------	-------	-------

TABLE 4—(Concluded).

Species	Lake	Sizes		
		Minimum	Average	Maximum
Speckled bullhead (*Ameiurus nebulosus marmoratus*)	Panasoffkee	14.5 inches	16.21 inches (2.6 pounds)	18.0 inches
	Ashby	9.5 inches	14.50 inches	16.0 inches
	Johns	-------	14.50 inches (1.14 pounds)	16.0 inches
	Jessup	-------	1.75 pounds	-------
	Monroe	-------	1.70 pounds	-------
	Harney	-------	2.00 pounds	-------
	Black	-------	-------	-------
Longnose gar (*Lepisosteus osseus*)	Black	-------	11.26 pounds	-------
	Panasoffkee	-------	9.72 pounds	-------
	Johns	-------	13.99 pounds	-------
	Jessup	-------	11.80 pounds	-------
	Harney	-------	13.96 pounds	-------
	Monroe	-------	8.32 pounds	-------
	Ashby	-------	8.56 pounds	-------
Florida spotted gar (*Lepisosteus platyrhinchus*)	Panasoffkee	-------	1.50 pounds	-------
	Black	-------	-------	-------
	Johns	-------	2.27 pounds	26.5 inches
	Ashby	-------	1.15 pounds	-------
	Jessup	-------	2.09 pounds	-------
	Monroe	-------	2.75 pounds	-------
	Harney	-------	2.38 pounds	-------
Gizzard shad (*Dorosoma cepedianum*)	Jessup	-------	-------	-------
	Panasoffkee	7.0 inches	12.58 inches	16.5 inches
	Johns	6.5 inches	9.07 inches	15.0 inches
	Monroe	-------	-------	-------
	Harney	8.0 inches	15.71 inches	18.0 inches
	Black	-------	-------	-------
	Ashby	9.0 inches	12.92 inches	18.0 inches
Yellow bullhead (*Ameiurus natalis*	Johns	-------	0.67 pounds	-------
	Panasoffkee	-------	2.00 pounds	-------
	Ashby	-------	1.00 pounds	-------
	(None were caught in the remaining four lakes)			
Eastern chub sucker (*Erimyzon sucetta sucetta*)	Panasoffkee	-------	1.74 pounds	-------
	Johns	-------	1.54 pounds	-------
	Ashby	-------	1.20 pounds	-------
	(None were caught in the remaining four lakes)			
Mudfish (*Amia calva*)	Ashby	-------	4.13 pounds	-------
	Panasoffkee	-------	4.76 pounds	-------
	Harney	-------	4.25 pounds	-------
	Johns	-------	2.30 pounds	-------
	(None were caught in the remaining three lakes)			
Chain Pickerel (*Esox niger*)	Johns	-------	2.50 pounds	-------
	Panasoffkee	-------	3.38 pounds	-------
	(None were caught in the remaining five lakes)			

catch, while in Panasoffkee the average weight per haul of 1,299 pounds of garfishes amounted to only 37.7 per cent of the total weight. In Black Lake the garfishes greatly outweighed all the other species caught, while in Panasoffkee they represented about one-third of the total weight.

Lake Jessup (August-October 1951) and Johns Lake during the first period (November-December 1950) produced about the same total average poundages of fishes to the haul. The two principal species, in order of abundance by weight, were gizzard shad and white catfish in Jessup, and channel catfish and gizzard shad in Johns Lake. In both lakes bluegill, longnose gar, and black bass represented the next most important segments of the populations. The removal of 16.68 pounds of rough fishes per surface acre of water from Johns Lake (Table 3) during November and December 1950 may have accounted for the decline in the average catch per haul in March 1951, since this decline was nearly identical with the decline in the average pounds taken per haul of rough fishes, and the average weight per haul of game fishes taken showed an increase during the second period (Table 5). However, the cyclic, seasonal fluctuations of abundance previously mentioned cannot

TABLE 5

Comparisons of Poundages of Fish Taken During Two Periods of Stay in Johns Lake.

	November 15 - December 28, 1950	March 14-28, 1951	Differences
Average weight per haul—all fishes (includes baited and unbaited hauls)	2,177 pounds	1,280 pounds	897 pounds (decline)
Average weight per haul—rough fishes removed: principally channel catfish, white catfish, gizzard shad, and garfishes	1,812 pounds	894 pounds	918 pounds (decline)
Average weight per haul—game fishes taken: principally bass, crappie, bluegill, and shellcracker	365 pounds	386 pounds	21 pounds (increase)

be ruled out, and the over-all catch decline might, on the other hand, not have been due to fish removal.

A comparison of baited hauls with unbaited ones (Table 3) made over the same period of time discloses almost equal total average poundages per haul. Baited hauls, however, proved highly selective for catfishes—they comprised nearly 90.0 per cent of the total weight of the catch, while less than 50.0 per cent by weight were taken from the unbaited hauls.

Comparisons of the average sizes of fish in the several lakes are drawn with a recognition of their static nature. The samples were not taken concurrently, the factor of growth is ignored, and fish movements due to seasonal spawning and feeding activities are not taken into account. Nevertheless certain facts brought out by Table 4 are interesting.

In Lake Panasoffkee nine of the fourteen species of fish for which measurements are available were of larger average sizes than those found in any of the other lakes discussed. Shellcracker were taken more abundantly in Lake Panasoffkee than elsewhere, and their average size was much greater. Black crappie, bluegill, white catfish, speckled bullhead, yellow bullhead, chub sucker, mudfish, and chain pickerel were also of larger average sizes in Lake Panasoffkee. Seven of these nine species, viz., black crappie, shellcracker, speckled bullhead, yellow bullhead, chub sucker, mudfish, and chain pickerel held either first or second place in order of abundance by weight in the catches from the seven lakes.

Discussion

Certain salient features of the data will be underlined in this section and they will be commented upon as occasion arises.

The haul seine is doubtless the most efficient instrument in existence for sampling adult fish populations in the large shallow Florida lakes with relatively level bottoms. However, an inspection of Tables 1, 2, and 3 will reveal certain obvious limitations: (1) the seine does not yield adequate quantitative samples of the populations of those fishes whose habitat is limited mainly to the peripheral areas of the water—warmouth, redbreast, mudfish, and several other species; and (2) when the sampling is not carried on over a protracted period of time it is possible for dispersal or schooling to result in low or high catches which are not representa-

tive of the true value of the productivity, or of the size of the populations of a given body of water.

Low catches in Lakes Ashby, Harney, and Monroe during July and August 1951 could be illustrative of the latter case. It is interesting to note by comparison that during the period of the "Controlled Seining Program" in Lake Crescent (July 1952 to February 1953) the average catch per haul was similarly low in July, August, and September, but more than tripled in weight during the months of November, December, and January (Dequine 1953). It seems extremely probable, therefore, that had the sampling continued over a longer period in Ashby, Harney, and Monroe similar catch increases would have become evident.

Schoolings and dispersals of fish in Florida's fresh waters cannot be predicted since their causes are not definitely known, but directed and integrated investigation cannot fail to uncover these secrets. Tagging studies now in progress should do much to determine whether fish leave or enter lakes in large numbers, or, alternately, whether they merely move into and out of areas of availability within them.

The close correspondence in average pounds per haul, and in the species composition of the catch in Harney and Monroe suggest that the linkage of these lakes by the St. Johns River might be the cause of a homogeneity in their populations.

Interesting differences in the populations of the several lakes raise many unanswered questions. Why, for example, was the population of Johns Lake composed principally of channel catfish, when catfishes of all species were extremely scarce in Panasoffkee? Was the tremendous abundance of the hard-shelled cooter in Panasoffkee associated with the presence of huge beds of eel-grass? Could the marsh contiguous with Black Lake be a factor contributing to its large garfish population? What reason could be advanced to explain the large sizes of the fish in Panasoffkee? Why did Lake Jessup yield large poundages of fish to the unit haul while nearby lakes in the same chain yielded low poundages? Why was the gizzard shad scarce in Lake Ashby, when in all the other lakes, with the exception of Black Lake, it came close to being the dominant species?

Nearly all these lakes have an admitted past history of commercial seining and, in some, rumor has it continuing illegally at the time of this writing. Needless to say it is not possible to secure

data from such operations. Perhaps significant changes have been brought about by large scale "manipulations" of the populations. If the past history of these and other lakes were definitely known a great contribution would have been made toward intelligent management of Florida's fresh water fishing.

Johns Lake is the only lake in this study from which rough fish were removed by haul seine where it was possible to return at a later period and compare results. After removing 45,384 pounds of rough fish (chiefly channel catfish), or 16.68 pounds per acre of total water surface (Table 3) the net left at the end of December 1950 and returned two and one-half months later. It was found that the average catch per haul was reduced to nearly one-half that of the first period, and that the combined weight of rough fishes per average haul was also reduced by about one-half (Table 5). Here the net appeared astonishingly effective in reducing the populations of rough fishes. The slight rise in average weight per haul of game fishes is probably not significant as a real increase since insufficient time had elapsed between the two periods for reproduction to occur.

Conclusion

The haul seine is a useful and efficient tool for sampling adult fish populations in shallow level bottom Florida lakes. In five of the seven lakes discussed, garfishes and gizzard shad constituted about half or more of the total weights of the populations taken. In all seven of the lakes, rough fishes, including catfishes, composed sixty per cent or more of the total weight of the catch.

Summary

Fish population studies were made by the author in Lakes Ashby, Harney, Monroe, Jessup, Panasoffkee, Johns Lake, and Black Lake by means of a rough fish removal unit employing a haul seine of about 800 yards in length, deep enough to fish the bottom, and with a minimum mesh size of three inches, stretched measure. The minimum average water depth in which the net was used was about three feet, and the maximum twelve. The mesh size permitted no fishes smaller than those of the size of bluegills of 4.5 inches in total length to be taken.

Harney and Monroe in the St. Johns River chain yielded low fish populations. Gizzard shad made up the bulk of the catch

in both lakes. Lake Ashby also yielded low populations; channel catfish and shellcracker were the more abundant species. Lake Jessup, connected with the St. Johns River, was found to have high populations, but about fifty per cent of the catch was gizzard shad, and about twenty-seven per cent catfishes. Lake Panasoffkee hauls revealed high fish populations, but about seventy per cent of the catch was composed of rough fishes, principally gizzard shad and garfishes. Despite this fact the average sizes of the individuals of numerous species, particularly the shellcracker, were larger than those found in the other lakes. The hard-shelled cooter, *Pseudemys*, was taken in very large numbers. The fish populations in Johns Lake were dominanted by the channel catfish and the gizzard shad. Baiting a haul area for catfishes was practiced with considerable success. A check on the effectiveness of the rough fish removal here was made possible by a re-entry two and one-half months later. The catch of rough fish was found reduced by one-half. In Black Lake more than seventy-seven per cent of the total weight of the populations taken consisted of garfishes, and about one per cent of gamefishes.

List of Species Taken

Fishes:

Stingray: *Dasyatis* spp.
Mudfish: *Amia calva* Linnaeus
Longnose Gar: *Lepisosteus osseus* (Linnaeus)
Florida Spotted Gar: *Lepisosteus platyrhinchus* DeKay
Gizzard Shad: *Dorosoma cepedianum* (LeSueur)
Eastern Chub Sucker: *Erymyzon sucetta sucetta* (Lacépède)
Golden Shiner: *Notemigonus crysoleucas bosci* (Cuvier and Valenciennes)
Channel Catfish: *Ictalurus punctatus* (Rafinesque)
White Catfish: *Ictalurus catus* (Linnaeus)
Speckled Bullhead: *Ameiurus nebulosus marmoratus* (Holbrook)
Yellow Bullhead: *Ameiurus natalis* Jordan
Chain Pickerel: *Esox niger* LeSueur
Warmouth: *Chaenobryttus coronarius* (Bartram)
Shellcracker: *Lepomis microlophus* (Gunther)
Bluegill: *Lepomis macrochirus purpurescens* Cope
Black Crappie: *Pomoxis nigromaculatus* (LeSueur)
Redbreast: *Lepomis auritus* (Linnaeus)

Black Bass: *Micropterus salmoides floridanus* (LeSueur)
Croaker: *Micropogon undulatus* (Linnaeus)
Mullet: *Mugil* spp.

AMPHIBIANS:

Mud eel: *Siren lacertina* Linnaeus

REPTILES:

Florida cooter or "Hard-shelled" Turtle: *Pseudemys floridana peninsulari* Carr, and other spp.
Southeastern Soft-shelled Turtle: *Amyda ferox* (Schneider)

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[Begin Page: Page 147]

ADULT FISH POPULATIONS BY HAUL SEINE IN SEVEN FLORIDA LAKES

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Introduction

This study presents an evaluation and comparison of the statics of the principal adult fish populations in several of the larger Florida lakes. The data were gathered in connection with the operation of the State Game and Fresh Water Fish Commission's rough fish control unit under supervision of the author. The lakes are analyzed qualitatively as well as quantitatively in terms of pounds of the several species available to this sampling device and taken in each of the lakes studied. The size distributions within the various species are noted and compared by means of length-frequency studies. The observed physiographic characteristics of the bodies of water are presented; and the relative yields to the net are discussed and compared.

Methods

Fish were sampled by means of a haul seine varying in length from 750 to 835 yards with a constant minimum mesh size of three inches (stretched), operated by three experienced fishermen and supervised by the Commission's biologist. Equipment consisted of a gasoline-powered launch for pulling the net, two or three fish boats, a seine boat, and the seine. The unit was provided with trucks and trailers to effect its mobility by land. Since the site of operations was often in remote localities, a tent with camping equipment was also included.

The game fishes taken in the operations were released while catfishes were sold dressed, usually to the wholesale fish dealer bidding highest. The other rough fishes: gizzard shad, garfishes, chub sucker, mudfish, stingray, and golden shiner, were destroyed or sold to fertilizer companies. Dressed turtles and gizzard shad roe were sometimes sold to the market for food.

The proceeds from the sale of the fish and fish products were used to help defray the cost of operations — three-quarters of the

[Begin Page: Page 148]

total amount went to the fishermen as their pay and the remaining one-quarter was retained by the Commission to aid in paying its

operational and maintenance costs.

The dip-net method (Dequine, 1951) was used in estimating total populations of game fishes taken in the seine hauls. Largemouth bass were counted as they were released from each haul, and individuals were weighed at random in order to arrive at the average weight per bass. This average was used as the basis for determining the total weight of bass taken in the haul. The fish removed were weighed.

As many fish as possible were measured at random as time and their abundance permitted. Measuring was done by means of a thirty-inch board graduated at half -inch intervals. The graduations were made in such a manner as to group all measured fishes into inch and half-inch classes. For example: a fish in the 7.5-inch size class is between 7.3 and 7.7 inches total length, inclusive; and a fish in the 8.0-inch size class is within the limits of 7.8 and 8.2 inches, inclusive, etc.

Water analysis was made by means of the Schleicher-Dequine Water Analysis Kit. Dissolved oxygen and carbon dioxide in parts per million were determined by titration with sodium thio-sulfate and sodium hydroxide respectively, and pH was ascertained by the colorimetric method. Air and water temperatures were taken at the surface.

It was inevitable for varying conditions to exist in the operation of the seine, within the same lake as well as from lake to lake.

Seldom were any two hauls alike. Weather conditions, bottom characteristics, state of the net, and fishermen's vagaries were some of the factors affecting the area of the haul ground pulled and fishing success.

It is believed that the circumstances which affected fishing success did not bias the data. Therefore: (1) the amounts of fish caught by the rough fish net are considered representative of the populations within the net selectivity in each lake during the period of study, and (2) the populations thus determined for one lake are compared quantitatively as well as qualitatively with those similarly determined in another lake at about the same season of the year. It is admitted that the comparisons may be very approximate ones, but it is felt that within the limitations of the data they are dependable.

[Begin Page: Page 149]

The lakes are summarized in terms of average pounds of fish taken per haul during the given periods, and in terms of the percentage composition by weight of each species taken in that average haul.

Lake Ashby

Lake Ashby, in Volusia County, has an area of 1,192 acres or 1.86 square miles. It is a shallow saucer-shaped lake with wide sandy beaches in a pine flatwoods region. The average depths in the central area during the period of stay were five to six feet. The water stage was moderately low. Littoral areas were extensive, and consisted partly of sloughs and swamps. The bottom was chiefly of hard sand, although some black mud, varying in depth from about two inches to two feet, was present in a few places. Mussels were observed living on the bottom of the lake in considerable numbers. A light plankton bloom was present in the water at the time of operations. Maiden cane (Panicum sp.) grew on the edges of the beach and some eel grass (Vallisneria americana) was found in a few areas in the lake. In times of moderately high water Lake Ashby is remotely connected with the St. Johns River by a branch of Deep Creek which flows from Lake Harney and enters Ashby from the south. This branch goes periodically dry when the River is at a low stage. On the west shore a canal drains water from adjacent low flatwoods into the lake. On July 16, 1951 at 10:25 A.M. the water temperature was 90° F. and the air 89° F., the pH 7.0, dissolved oxygen 6.8 ppm, and C0 2 2.5 ppm.

At the time of operations, in July 1951, available adult fish populations were low: 482 pounds constituted the average haul. The channel catfish (Ictalurus punctatus) was the most abundant species; it comprised 41.6 per cent by weight of the catch. The shellcracker (Lepomis microlophus) was the next most abundant species: it made up 21.0 per cent of the weight of the catch. Few gizzard shad (Dorosoma cepedianum) were taken at the time, and they represented about five per cent of the total weight caught.

For other species see Table 1.

Lake Harney

Lake Harney is in Seminole and Volusia Counties, and is part of the St. Johns River. It is an oblong saucer-shaped lake, in a pine flatwoods region, with about 8.73 square miles (5,558 acres)

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of surface area. Littoral areas were large and of the same general character as those of Lake Ashby. The bottom rose gently on all sides to the conspicuous, wide, sandy beaches. At mean low water the average depth in the middle is six feet. The water was at this stage during the period of operations. The bottom was a hard sand, covered in some places by several inches of black mud. Numerous mussels were observed living on the bottom. A light

plankton bloom was present in the water. Maiden cane was noted growing near the edges of the shore, and sparse growths of eel grass were found in the lake. On July 26, 1951 at 10:25 A.M. the pH of the water was 7.0; dissolved oxygen 4.20 ppm, and the temperature of the water was 84° F. when the air temperature was 85° F. Low populations of adult fishes were available to the seine during the period of operations — July 26 to August 23, 1951 — only 503 pounds were taken in the average haul. The predominant species found was gizzard shad, which composed 36.6 per cent by weight of the catch. Next in abundance was the largemouth bass, Micropterus salmoides floridanus (LeSueur), which represented 21.4 per cent by weight of the catch — the highest percentage found in any of the seven lakes discussed. Channel catfish followed the bass in order of abundance, and comprised 15.6 per cent by weight of the catch. For average weights per haul and additional data see Table 1.

Lake Monroe

Lake Monroe is a part of the St. Johns River and is bounded by Seminole and Volusia Counties. It is about 13.77 square miles (8,814 acres) in area, saucer-shaped and roughly circular in outline. The margins were gently sloping, with wide sandy beaches and extensive sloughs and marshes, resembling Lakes Ashby and Harney except for the bulkheaded shore on the Sanford side. The depth was fairly uniform — it averaged about seven feet in the middle. The water stage was low during the operational period. The bottom type was predominantly hard sand, but a great deal of black mud

was present at the south end. No plankton bloom was noticeable in the water at the time of operations; Panicum and Vallisneria were present as in Lakes Ashby and Harney. On August 21, 1951 at 8:50 A.M. the pH was 7.0; dissolved oxygen 10.0 ppm; and the water temperature was 86° F. when the air temperature was 86° F.

[Begin Page: Page 152]

Lake Monroe, like Lakes Harney and Ashby, yielded low adult fish populations during August 1951 — 615 pounds were taken in the average haul. The predominant species represented here was the gizzard shad, comprising 50.7 per cent by weight of the catch. Next in abundance, as in Lake Harney, was the largemouth bass, representing 9.6 per cent by weight of the catch. Again as in Lake Harney, channel catfish was third and composed 7.8 per cent by weight of the catch (Table 1).

Lake Jessup

Lake Jessup is approximately fifteen miles southeast of Sanford in Seminole County. It is 12.38 square miles (7,922 acres) in size and is roughly crescent-shaped. Jessup is one of the St. Johns Chain of lakes, although it does not lie directly within the River, as do Lakes Harney and Monroe. It is connected to the River by a short channel on the eastern end. This channel is divided

by a muddy island. The lake is fed by a number of springs, some of them sulphurous, from its bed as well as from its shores. Littoral areas are very large, although the shore falls off less gently than that of Ashby, Harney, or Monroe. The margins are generally soft: sand and mud, with some shell. The entire eastern half is surrounded by a marshy margin about one-half mile in width which is composed of inlets, sloughs, and creeks. The western half has a more solid shoreline. The bottom of the lake is composed mostly of soft black mud, mixed with some sand, snail shells, and clay. It is not so uniform in depth as Ashby, Harney, and Monroe. At mean low water (the stage found during the unit's stay) the depth varies from three to seven feet. Adjacent to Bird Island, in the middle of the lake, the bottom was of hard sand and sloped up gently to a water depth of about a foot within two hundred feet of the island. The lake was colored with a fairly heavy greenish plankton bloom at the time of operations. Luxuriant grasses and emergents grew along the shallow places near the shore, and there were numerous beds of eel grass in the lake. On September 10, 1951, at 11:45 A.M., the pH of the water was 7.5, the water temperature 84° F. and the air 84° F. Dissolved oxygen was 10.30 ppm, and C0 2 3.0 ppm.

In Lake Jessup large numbers of fishes were available to the net during the period August 29 to October 9, 1951. The average

[Begin Page: Page 153]

weight per haul was 2,318 pounds. Gizzard shad was the dominant species and comprised 48.3 per cent of the total weight of the catch. White catfish, Ictalurus catus, was the species second most abundant, and represented 22.2 per cent by weight. Bluegill was third — 11.1 per cent; and channel catfish, stingray, longnose gar, black bass, and black crappie followed, respectively, in order of abundance (Table 2).

Lake Panasoffkee

In Sumter County about six miles north of Bushnell lies Lake Panasoffkee with an area of 7.32 square miles (4,685 acres). It is situated in a climax hammock region of many large oaks, hickories, and magnolias, and is surrounded by extensive cypress and sawgrass marshes. Panasoffkee is a kidney-shaped lake directly connected with the Withlacoochee River by the Panasoffkee River, which drains the lake from its west shore. The lake is relatively shallow, and at the time of operations had an average depth of about five feet (a low water stage). The bottom is composed of a deep, soft, yellowish silt. Large dense beds of eel grass were present in the lake and were especially thick and wide at its northern and southern ends, and on the eastern side. Personal observation revealed a pronounced green plankton bloom manifested in the water through the fall, spring, and summer months. The lake supported a dense population of the snail, Vivipara g. 9 and considerable numbers of mussels. The water is derived principally

from springs. At the time of operations it exhibited a milky appearance underlying its greenish plankton layer. Littoral areas are extensive, and large beds of giant pickerel weeds (Pontederia sp.) figure prominently in the dense vegetation. From the marshy saw-grass ringed shoreline the silty bottom slopes gently to five foot depths. On May 1, 1951 the water temperature was 78° when the air was 75° F., the pH was 8.3, dissolved oxygen 7.6 ppm, and C0 2 , zero ppm.

Lake Panasoffkee exhibited high fish populations during April and the first two days in May 1951. The average weight per haul was 3,439 pounds. The species of fish taken most abundantly was the longnose gar, Lepisosteus osseus, which represented 34.9 per cent by weight of the catch. Second in abundance was the gizzard shad, composing 30.5 per cent. Shellcracker ranked third — 16.3 per cent; and bluegill fourth, comprising 5.4 per cent (Table 2).

[Begin Page: Page 154]

Black Lake
Orange
408 Acres
3 - 10 Feet
Sand and Mud
March 30, 1951

CO

H

o

Oj

np

0)

Pm

[Begin Page: Page 155]

An outstanding fact about Lake Panasoffkee was the abundance of the hard-shell turtle or "cooter", Fseudemys fioridana peninsularis. In no other lake, to the writer's knowledge, was it found so abundantly. A total weight of 10,405 pounds were taken, representing 18.9 per cent of the combined weight of the catch. The weight of the average cooter was about eight pounds.

Johns Lake

Johns Lake is located several miles WSW of Winter Garden in the western part of Orange County and extends into eastern Lake County. It is 4.24 square miles (2,714 acres) in size, very irregular in outline, and is divided into three sections by narrow channels. The easternmost portion is nearly separated from the middle one by an island — Deer Island — and a peninsula — Williams Peninsula. The west section of the lake, known locally as "Clear Lake" because of the transparency of its water (in contrast to the dark colored appearance of that of the other two divisions), is differentiated from the middle section by a second narrowing. The bottom is hilly, rolling, and uneven. Depths in the central portions varied from four to twenty-five feet. Littoral areas were usually small and the shore, in general, had a fairly steep slope. The shoreline was generally high, although there were a few marshy areas where heavy growths of aquatic and emergent vegetation were in evidence.

Chemical and Physical Characteristics

Time

pH

ppm_

Dissolved

Oxygen

Temperature °F.

70

50

49

Except for these scattered areas there was almost no vegetation growing at the shoreline, and none was observed at greater depths. The bottom is composed of sand and black mud with some clay. No plankton bloom was observed in the water at the time, nor was found on subsequent occasions when the lake was revisited. The only body of water with which Johns Lake has any known connection

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is Black Lake, about a mile to the east. It is joined to it by a canal draining a marsh between the two lakes.

The seine hauls pulled in Johns Lake are separated into three groups: (1) unbaited ones made at random in the lake during the first period of operations, (2) baited ones made at a single location during the first period, and (3) random unbaited hauls made about two months later.

Random hauls made during the first period yielded high fish populations — the average weight per haul was 2,156 pounds (Table 3). Channel catfish was the dominant species taken, and composed 43.7 per cent of the weight of the catch. Second most abundant was the gizzard shad, 24.4 per cent of the combined weight of populations caught. Third was the bluegill, 12.6 per cent of the total weight. Longnose gar was fourth, largemouth bass fifth, white catfish sixth, and black crappie (Pomoxis nigromaculatus) seventh.

In the second period of operations, after a two months lapse of time, random hauls yielded smaller total populations. The average weight per haul had dropped to 1,280 pounds. The dominant species remained the channel catfish, but it comprised only 29.3 per cent by weight of the catch. Bluegill had become the second most abundant species — it represented 20.4 per cent of the weight taken. Third, fourth, and fifth in order of abundance were, respectively, gizzard shad, white catfish, and speckled bullhead. Sixth and seventh were longnose gar and black crappie (Table 3).

Johns Lake was the only lake extensively baited for catfishes included in this study. The purpose of baiting is to attract large numbers to an area. The area should be baited repeatedly so as to accustom them to come there to feed. The haul ground area selected in Johns Lake was baited every day for a week before the first haul was made, and was baited daily and fished about twice a week thereafter. All the gizzard shad, garfishes, and other rough fishes (with the exception of catfishes, no parts of which

were used for bait) caught were cooked, salted, and placed in the baited area. Seine hauls were made early in the morning before the "cats" had a chance to leave after eating the bait.

Baited hauls in Johns Lake proved extremely successful. The average weight per haul of all fishes was 2,230 pounds, of which 88.7 per cent by weight consisted of catfishes. The principal species

[Begin Page: Page 158]

caught was the channel catfish, which represented 80.5 per cent by weight of the catch. Second was the white catfish, 8.0 per cent; third, the bluegill, 4.9 per cent; fourth, gizzard shad, 3.5 per cent; black crappie, fifth, 1.6 per cent; and black bass, sixth, 0.7 per cent by weight of the total catch. No longnose garfish were caught from baited hauls in Johns Lake (Table 3).

Black Lake

Black Lake lies about a mile east of Johns Lake and is located in Orange County. It was 0.64 square miles (408 acres) in size, and was roughly circular in shape. Littoral areas were wide, the lake was shallow — four to five feet deep in the middle; the bottom was chiefly of sand with some black mud. No plankton bloom was observed on its waters, which like those of most of Johns Lake were

dark colored in appearance. Some maiden cane grew along the shoreline, together with pickerel weed and other emergents. There is a large marsh contiguous with Black Lake extending eastward approximately three miles. Black Lake is connected directly with Johns by a canal about a mile long.

A single haul was made in Black Lake. Because of the lake's small size and because the haul was pulled near its central part, it is believed that the sample can be considered representative of the fish populations available to the net on March 30, 1951.

The total weight of all fishes taken was 1,701 pounds: 73.5 per cent of this weight consisted of longnose gar; 13.8 per cent, of channel catfish; and 7.3 per cent of gizzard shad. Black crappie, bluegill, and black bass, jointly, represented only about 0.9 per cent of the total weight of the catch (Table 2).

Size Distributions

Size distributions among the populations of the several species are summarized in Table 4. The average lengths presented were determined from length-frequency data by multiplying the number of fish measured in each size group by the total-length measurement of that size group, summing up the products and dividing by the total number of fish in the sample. Occasionally where average lengths were not available, average weights are presented instead, and in the few cases where data were available the average

[Begin Page: Page 159]

weight corresponding to the average length of the species in question is also given. It is regrettable that the volume of work attendant on the supervision of the rough fish unit precluded length-weight studies, particularly for the bass, bream, and crappie, which had to be released alive.

It is believed that the size distributions presented in Table 4 may be considered representative for the populations of the lakes during the periods of study. Large samples were generally taken for analysis, and efforts were made to keep them uniformly random.

Comparison

In drawing comparisons from lake to lake it should be recognized that the abundance of fishes available to the haul seine in a given body of water is subject to "seasonal and cyclic fluctuations" (Dequine 1951) caused perhaps principally by fish movements in connection with spawning and feeding activities which lead them to shallow water where the seine cannot go, or even outside the lake itself (H. L. Moody, Unpublished Data). It is apparent, therefore, that bodies of water sampled at about the same time of year should be more readily comparable than bodies sampled at different times. Ashby, Harney, and Monroe are logically comparable in this re-

spect; Panasoffkee is comparable with Black Lake; and, although the sampling in Jessup was done in early fall almost a year after the first period of operations in Johns in late fall, striking over-all population similarities justify their comparison.

Lakes Harney and Monroe, similar type lakes in the St. Johns River, yielded nearly equal yet low average poundages of fishes to the sampling device, and there was a close similarity in their species composition. The three most abundant fishes in the two lakes were respectively, gizzard shad, black bass, and channel catfish. Nearby Lake Ashby, of the same bottom type as the former lakes, yielded about the same total average poundages, but yielded an extremely low shad population. Channel catfish and shellcracker were, respectively, the two most abundant species taken in Lake Ashby.

Lake Panasoffkee and Black Lake are similar in two respects only: (1) the high proportions of garfishes present and (2) the high average poundages taken. The 1,320 pounds of garfishes caught in Black Lake represented 77.6 per cent of the total weight of the

[Begin Page: Page 160]

TABLE 4

Minimum, Average and Maximum Sizes of Adult Fishes Caught by Haul Seine in the Seven Lakes. The Lakes Are Listed in Descending Order of

pounds of garfishes amounted to only 37.7 per cent of the total weight. In Black Lake the garfishes greatly outweighed all the other species caught, while in Panasoffkee they represented about one-third of the total weight.

Lake Jessup (August-October 1951) and Johns Lake during the first period (November-December 1950) produced about the same total average poundages of fishes to the haul. The two principal species, in order of abundance by weight, were gizzard shad and white catfish in Jessup, and channel catfish and gizzard shad in Johns Lake. In both lakes bluegill, longnose gar, and black bass represented the next most important segments of the populations. The removal of 16.68 pounds of rough fishes per surface acre of water from Johns Lake (Table 3) during November and December 1950 may have accounted for the decline in the average catch per haul in March 1951, since this decline was nearly identical with the decline in the average pounds taken per haul of rough fishes, and the average weight per haul of game fishes taken showed an increase during the second period (Table 5). However, the cyclic, seasonal fluctuations of abundance previously mentioned cannot

TABLE 5

Comparisons of Poundages of Fish Taken During Two Periods of Stay

in Johns Lake.

November 15 -

December 28, 1950	March 14-28, 1951	Differences
Average weight per haul — all fishes (includes baited and unbaited hauls)	2,177 pounds	1,812 pounds
Average weight per haul — rough fishes removed: principally channel catfish, white catfish, gizzard shad, and garfishes		
Average weight per haul — game fishes taken: principally bass, crappie, bluegill, and shellcracker		

365 pounds

1,280 pounds

894 pounds

386 pounds

897 pounds
(decline)

918 pounds
(decline)

21 pounds
(increase)

[Begin Page: Page 163]

be ruled out, and the over-all catch decline might, on the other hand, not have been due to fish removal.

A comparison of baited hauls with unbaited ones (Table 3) made over the same period of time discloses almost equal total average poundages per haul. Baited hauls, however, proved highly selec-

tive for catfishes — they comprised nearly 90.0 per cent of the total weight of the catch, while less than 50.0 per cent by weight were taken from the unbaited hauls.

Comparisons of the average sizes of fish in the several lakes are drawn with a recognition of their static nature. The samples were not taken concurrently, the factor of growth is ignored, and fish movements due to seasonal spawning and feeding activities are not taken into account. Nevertheless certain facts brought out by Table 4 are interesting.

In Lake Panasoffkee nine of the fourteen species of fish for which measurements are available were of larger average sizes than those found in any of the other lakes discussed. Shellcracker were taken more abundantly in Lake Panasoffkee than elsewhere, and their average size was much greater. Black crappie, bluegill, white catfish, speckled bullhead, yellow bullhead, chub sucker, mudfish, and chain pickerel were also of larger average sizes in Lake Panasoffkee. Seven of these nine species, viz., black crappie, shellcracker, speckled bullhead, yellow bullhead, chub sucker, mudfish, and chain pickerel held either first or second place in order of abundance by weight in the catches from the seven lakes.

Discussion

Certain salient features of the data will be underlined in this section and they will be commented upon as occasion arises.

The haul seine is doubtless the most efficient instrument in existence for sampling adult fish populations in the large shallow Florida lakes with relatively level bottoms. However, an inspection of Tables 1, 2, and 3 will reveal certain obvious limitations: (1) the seine does not yield adequate quantitative samples of the populations of those fishes whose habitat is limited mainly to the peripheral areas of the water — warmouth, redbreast, mudfish, and several other species; and (2) when the sampling is not carried on over a protracted period of time it is possible for dispersal or schooling to result in low or high catches which are not representa-

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tive of the true value of the productivity, or of the size of the populations of a given body of water.

Low catches in Lakes Ashby, Harney, and Monroe during July and August 1951 could be illustrative of the latter case. It is interesting to note by comparison that during the period of the "Controlled Seining Program" in Lake Crescent (July 1952 to February 1953) the average catch per haul was similarly low in July, August, and September, but more than tripled in weight during the months of November, December, and January (Dequine 1953). It seems extremely probable, therefore, that had the sampling continued over a longer period in Ashby, Harney, and Monroe similar catch

increases would have become evident.

Schoolings and dispersals of fish in Florida's fresh waters cannot be predicted since their causes are not definitely known, but directed and integrated investigation cannot fail to uncover these secrets. Tagging studies now in progress should do much to determine whether fish leave or enter lakes in large numbers, or, alternately, whether they merely move into and out of areas of availability within them.

The close correspondence in average pounds per haul, and in the species composition of the catch in Harney and Monroe suggest that the linkage of these lakes by the St. Johns River might be the cause of a homogeneity in their populations.

Interesting differences in the populations of the several lakes raise many unanswered questions. Why, for example, was the population of Johns Lake composed principally of channel catfish, when catfishes of all species were extremely scarce in Panasoffkee? Was the tremendous abundance of the hard-shelled cooter in Panasoffkee associated with the presence of huge beds of eel-grass? Could the marsh contiguous with Black Lake be a factor contributing to its large garfish population? What reason could be advanced to explain the large sizes of the fish in Panasoffkee? Why did Lake Jessup yield large poundages of fish to the unit haul while nearby lakes in the same chain yielded low poundages? Why was the gizzard shad scarce in Lake Ashby, when in all the other lakes, with the exception of Black Lake, it came close to being the dominant species?

Nearly all these lakes have an admitted past history of commercial seining and, in some, rumor has it continuing illegally at the time of this writing. Needless to say it is not possible to secure

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data from such operations. Perhaps significant changes have been brought about by large scale "manipulations" of the populations. If the past history of these and other lakes were definitely known a great contribution would have been made toward intelligent management of Florida's fresh water fishing.

Johns Lake is the only lake in this study from which rough fish were removed by haul seine where it was possible to return at a later period and compare results. After removing 45,384 pounds of rough fish (chiefly channel catfish), or 16.68 pounds per acre of total water surface (Table 3) the net left at the end of December 1950 and returned two and one-half months later. It was found that the average catch per haul was reduced to nearly one-half that of the first period, and that the combined weight of rough fishes per average haul was also reduced by about one-half (Table 5). Here the net appeared astonishingly effective in reducing the populations of rough fishes. The slight rise in average weight per haul of game fishes is probably not significant as a real increase

since insufficient time had elapsed between the two periods for reproduction to occur.

Conclusion

The haul seine is a useful and efficient tool for sampling adult fish populations in shallow level bottom Florida lakes. In five of the seven lakes discussed, garfishes and gizzard shad constituted about half or more of the total weights of the populations taken. In all seven of the lakes, rough fishes, including catfishes, composed sixty per cent or more of the total weight of the catch.

Summary

Fish population studies were made by the author in Lakes Ashby, Harney, Monroe, Jessup, Panasoffkee, Johns Lake, and Black Lake by means of a rough fish removal unit employing a haul seine of about 800 yards in length, deep enough to fish the bottom, and with a minimum mesh size of three inches, stretched measure. The minimum average water depth in which the net was used was about three feet, and the maximum twelve. The mesh size permitted no fishes smaller than those of the size of bluegills of 4.5 inches in total length to be taken.

Harney and Monroe in the St. Johns River chain yielded low fish populations. Gizzard shad made up the bulk of the catch

[Begin Page: Page 166]

in both lakes. Lake Ashby also yielded low populations; channel catfish and shellcracker were the more abundant species. Lake Jessup, connected with the St. Johns River, was found to have high populations, but about fifty per cent of the catch was gizzard shad, and about twenty-seven per cent catfishes. Lake Panasoffkee hauls revealed high fish populations, but about seventy per cent of the catch was composed of rough fishes, principally gizzard shad and garfishes. Despite this fact the average sizes of the individuals of numerous species, particularly the shellcracker, were larger than those found in the other lakes. The hard-shelled cooter, Pseudemys, was taken in very large numbers. The fish populations in Johns Lake were dominanted by the channel catfish and the gizzard shad. Baiting a haul area for catfishes was practiced with considerable success. A check on the effectiveness of the rough fish removal here was made possible by a re-entry two and one-half months later. The catch of rough fish was found reduced by one-half. In Black Lake more than seventy-seven per cent of the total weight of the populations taken consisted of garfishes, and about one per cent of gamefishes.

List of Species Taken

Fishes:

Stingray: Dasyatis spp.

Mudfish: Amia calva Linnaeus

Longnose Gar: Lepisosteus osseus (Linnaeus)

Florida Spotted Gar: Lepisosteus platyrhinchus DeKay

Gizzard Shad: Dorosoma cepedianum (LeSueur)

Eastern Chub Sucker: Erymyzon sucetta sucetta (Lacepede)

Golden Shiner: Note?nigonus crysoleucas bosci (Cuvier and Valenciennes)

Channel Catfish: Ictalurus punctatus (Rafinesque)

White Catfish: Ictalurus catus (Linnaeus)

Speckled Bullhead: Ameiurus nebulosus marmoratus (Holbrook)

Yellow Bullhead: Ameiurus natalis Jordan

Chain Pickerel: Esox niger LeSueur

Warmouth: Chaenobryttus coronarius (Bartram)

Shellcracker: Lepomis microlophus (Gunther)

Bluegill: Lepomis macrochirus purpurescens Cope

Black Crappie: Pomoxis nigromacidatus (LeSueur)

Redbreast: Lepomis auritus (Linnaeus)

[Begin Page: Page 167]

Black Bass: Micropterus salmoides floridanus (LeSueur)

Croaker: Micropogon undulatus (Linnaeus)

Mullet: Mugil spp.

Amphibians:

Mud eel: Siren lacertina Linnaeus

Reptiles:

Florida cooter or "Hard-shelled" Turtle: Pseudemys floridana

peninsulari Carr, and other spp.
Southeastern Soft-shelled Turtle: Amy da ferox (Schneider)

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