SAMPLING SHALLOW WATER FISH POPULATIONS USING THE WEGENER RING

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ABSTRACT

The Wegener Ring was designed to sample fish populations of shallow, vegetated habitats in Lake Tohopekaliga, Florida. The sampler is portable and simple to use. Ten transects in water 0-18 inches deep were sampled within consecutive 3 inch contours. As depth of water increased, non-centrarchid forage fish decreased while numbers of centrarchids increased. Total numbers of fish decreased from an average of 216,042 per acre in 0-3 inches to 20,326 per acre in 15-18 inches of water. Standing crop was relatively constant, averaging 91 pounds per acre for all water depths. The monetary values per acre based on the fishery ranged from $6,511 in 0-3 inches to $2,524 in 15-18 inches of water. The average value per acre for water 0-18 inches deep was $3,788.

INTRODUCTION

It is often stated and generally assumed by experienced field biologists that shallow, vegetated portions of a lake function as important nursery, feeding and rearing areas for many species of sport and forage fish, fish food organisms and other aquatic oriented wildlife. Without such areas it is doubtful a lake system could support a dynamic, self-sustaining sport fishery.

Lake Tohopekaliga is a 22,700 acre lake located in western Osceola County, Florida, and is one of the larger lakes in the Kissimmee watershed. Lake Tohopekaliga's morphometry is typical of many Florida lakes, being quite shallow with gently sloping shorelines and wide expanses of rooted emergent vegetation. As a result of fluctuating water levels, plant communities include true aquatic, semi-aquatic and terrestrial forms throughout the floodplain.

The Central and Southern Florida Flood Control District regulates the lake water level annually from a high pool stage of 55 ft. MSL (mean sea level) to 52 ft. MSL at low pool stage.

Since 1970 Lake Tohopekaliga has been a study area for evaluating lake basin dewatering as a fish management tool. An extreme drawdown was implemented during 1971. As a result of drought, refilling to normal regulation pool was not completed until March 1973. One beneficial effect of the drawdown was an increase in the littoral zone, or area of rooted emergent aquatic vegetation, from 40% to approximately 50% of the total surface acreage - nearly 11,350 acres.

Shallow vegetated areas of Lake Tohopekaliga harbor numerous small fish which cannot be adequately evaluated using conventional techniques. It therefore became necessary to develop a portable apparatus which would provide reliable quantitative data for evaluating these populations.

Kushlan (in press) described several quantitative sampling devices used to survey shallow water fish populations in Florida. These include drop traps (Kahl, 1963), pull-up traps (Higer & Kolipinski, 1967) and pole nets. Other devices used include garbage cans and wash tubs with bottoms removed.

Drop and pull-up traps are cumbersome, require on-site installation, and a waiting period to allow fish populations to re-distribute before actual sampling. The framework of such traps alters the natural habitat and it must be assumed they affect normal fish distribution. Pole nets, garbage cans and wash tubs require no installation or waiting period, but are influenced by close proximity and activity of the operator at the sample site. The latter two methods also sample a limited area.

The objectives of this paper are to describe a sampling tool and procedure, to quantitatively evaluate fish populations in shallow, vegetated areas, and to estimate the monetary value of such populations in Lake Tohopekaliga.

MATERIALS AND METHODS

The Wegener Ring Sampler (Figure 1,a) consists of two 7 feet 5 inch diameter hoops (circ. = 23 feet 4 inches) one of 2 inch by ⅛ inch strap steel serving as a lead line, the other of 1¾ inch O.D. plastic pipe, which functions as a float. Pop rivets were used to fasten a length of aluminum trailer awning rail (Figure 1,b) around the outside of the steel hoop. Bolts located at one end of the rail release it for net replacement (Figure 1,c). The net was sewn onto a length of 3/16 inch diameter rope and threaded through the rail. A loop was machine sewn into the upper margin of the netting, through which the plastic pipe was passed. The pipe ends were then joined with a coupling and glued to form a watertight floating ring (Figure 1,d). The vertical slit remaining in the netting was sewn together by hand. For further ease in construction the steel strap can be machine bent into a circular shape. The amount and size of netting hung between hoops depends upon water depth and size of fish to be sampled. In this instance 20 inches of ⅛ inch ace netting was considered adequate. The sampler weighs approximately 30 pounds, and can be built at a cost of less than $50, excluding labor.

Holding opposite sides of the sampler, two operators can easily throw it a distance of 15-20 feet. The steel ring is immediately checked to make certain that it has properly settled, then pressed into the bottom to insure fish entrapment. In the event the sampler has not properly surrounded a selected area, or adequately settled to the bottom, it can be reset in an adjacent area with a minimum of effort and distrubance. Nox-fish fish toxicant is then liberally applied within the net to narcotize or kill the fish. After 10-15 minutes fish are removed by thoroughly sweeping the enclosed area with ⅛ inch mesh dip nets. Fish may become entraped in vegetation and bottom detritus when narcotized, so it is necessary to remove some bottom sediment and vegetation during this sweeping activity in order to collect all fish within the sampler. Fish are separated from detritus, placed in 10% formalin, and taken to the laboratory. There species are sorted, counted and weighed.

Ten transects were established at various sites along the shoreline (Figure 2) to provide reference points for quarterly sampling during daylight hours. Efforts were made to secure one sample within each 3 inch depth increment along the transect lines. This provided approximately ten samples per quarter for each of the following depth ranges; 0-3, 3-6, 6-9, 9-12, 12-15, and 15-18 inches. Where dense bands of water hyacinth (*Echhornia crassipes*) or rapid contour change made sampling within certain areas impossible a smaller number of samples were collected. No attempt was made to sample identical sites during successive sample periods due to fluctuating water levels.

Data collected at each depth range during quarterly sampling periods were totaled and expanded to a per acre basis. A gram scale was used because it was more accurate for weighing low numbers of small fish. Data were converted to standing crop as pounds/acre.

Estimated numbers (Table 1) and weights (Table 2) were obtained by averaging the four quarterly expanded totals. Monetary values (Table 3) were derived from Table 1 using accepted figures published in *Fish Values,* (State of Florida Department of Air and Water Pollution Control, 1971).

RESULTS AND DISCUSSION

The Wegener Ring is bulky and must be tied to a car top or boat for transporting. It requires two men for easy operation, and like any sampler, is not effective in extremely rank vegetation. Conversely, it is lightweight and fairly portable, inexpensive and simple to build and has no moving parts. It requires no "set up" period, thereby eliminating disturbance at the sample site. Using two sampling rings, a two man crew can collect 12 to 15 samples during a 8 hour work day. The 7 feet 5 inch diameter net encompasses an area of .001 acres, thereby facilitating data expansion as well as providing larger, less biased samples. We believe 7 ft. 5 inch is the maximum size at which this device can properly function. Smaller, less cumbersome nets can be used by one operator, but sample size is reduced accordingly.

As with any sampling tool, the Wegener Ring must be used properly for best results. Care must be taken in shallow areas to minimize disturbances. This tool has proven very applicable to the task for which it was designed and is presently being used in other studies within Florida.

Figure 3 is a checklist of fishes collected from Lake Tohopekaliga, representing 26 species and 13 families. Cyprinodontidae (killifishes), Poeciliidae (livebearers) and Centrarchidae (sunfish) were the common families represented.

The estimated numbers of fish per acre for each species at various water depths in Lake Tohopekaliga are shown in Table 1. There was a marked trend of declining total numbers as water depth increased. This was attributed to reduction in the four major species encountered; flagfish, mosquitofish, least killifish, and sailfin molly; species rarely collected during routine blocknet surveys. Collectively, they comprised 94% by number of the total population in 0-3 inches of water, declining to 21% in 15-18 inches, and represented 84% of the combined average number per acre for all water depths. Comparing these species as water depth increases, nearly a 50 fold reduction occurs from 0-3 to 15-18 inches. Some of the forage minnows, brook silverside, taillight shiner, gizzard and threadfin shad, were never found in water depths less than 9 inches. Brown bullhead, the most common catfish present in Lake Tohopekaliga, was collected at all water depths. Centrarchids begin to appear in the 0-3 inch depth, increase up to the 9-12 inch depth, and remain comparatively constant thereafter. Species diversity increased with water depth.

Table 2 indicates expanded weights in pounds/acre of collected species. Comparing total average weights per acre with total average numbers per acre (Table 1), numbers decrease 10 fold with increasing depth, but standing crop remains relatively stable due to the presence of larger centrarchids in deeper areas.

Table 3 lists the average monetary value per acre of fish collected at selected water depths from Lake Tohopekaliga. These values were obtained by applying the data in Table 1 to *Fish Values* for fish killed by pollution in the state of Florida (State of Florida Department of Air and Water Pollution Control, 1971). Such computations illustrate the economic importance of maintaining productive littoral areas which are permanently eliminated by floodplain development.

Wegener and Holcomb (1972) have estimated the value of the littoral fishery in Lake Tohopekaliga at $1333 per year. However, they stated, "No sampling was done in areas having a water depth less than one foot. In such areas the tremendous production of smaller fishes which make up the forage base for larger predatory fishes would greatly increase the value of our littoral estimates. Therefore, the data presented for littoral standing crop are believed conservative." The data presented in Table 3 substantiate this statement. The estimated fishery value for an "average" acre ranging in depth from 0-18 inches

was approximately $3788. This was considerably higher than the values of Wegener and Holcomb (1972), for deeper littoral waters of the lake and was due primarily to the extremely large number of forage minnows.

The estimated average value of the fishery in 0-3 inches of water was the highest at $6511 per acre. This value represented mainly forage minnows, and flagfish was the dominant species. The lowest estimated average was in 15-18 inch water, about $2524 per acre. This value represented predominantly centrarchids.

Figure 4 illustrates seasonal standing crop (pounds/acre) of centrarchids and non-centrarchids at various water depths from September 1972 to June 1973. Centrarchids represent the largest standing crop in deeper water (15-18 inches), decreasing as water depth decreased. The non-centrarchids crop was greatest in 0-3 inch water and represented a much smaller portion in deeper areas. Non-centrarchids include species other than forage minnows, but their total weight represented only a slight percentage of the total standing crop.

It appeared that seasonal shifts occurred in the centrarchid population. During September 1972 centrarchids were not collected in water less than 9 inches in depth. Nocturnal movement may have occurred into shallower water, but sampling time for this study was limited to daylight hours (mid-morning to mid-afternoon). Centrarchid movement into shallower water was evident during the January and March samples, and by June 1973 they were found at all depths. Young of the year fish made up a substantial portion of the centrarchid standing crop at all water depths and during all seasons.

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Table 1. Estimated number of fish per acre at various water depths from Lake Tohopekaliga (data represents an average of 4 quarterly estimates from September 1972 to June 1973).

Water Depth	0"-3"	3"-6"	6"-9"	9"-12"	12"-15"	15"-18"	Average
Flagfish	91,086	43,513	31,482	29,803	9,676	1,310	34,478
Mosquitofish	38,041	19,796	23,068	23,618	11,183	1,760	19,578
Least killifish	50,984	14,056	13,814	10,560	4,869	1,018	15,884
Sailfin molly	24,039	12,796	6,492	4,836	250	160	8,096
Bluefin killifish	8,398	7,004	7,877	7,982	6,508	5,153	7,154
Golden topminnow	3,337	3,127	1,716	3,915	1,820	1,238	2,526
Seminole killifish		56	414	1,203	700	521	482
Golden shiner			350	353	693	732	355
Lake chubsucker		56	200	225	40	36	93
Brook silverside				350	143	260	126
Taillight shiner				25			4
Gizzard shad				500	100	750	225
Threadfin shad					675	100	129
Swamp darter						97	16
Bowfin				31			5
Florida gar				25			4
Brown bullhead	94	250	25	50	140	105	111
Largemouth bass		416	500	307	489	496	368
Warmouth	63	472	225	1,041	758	1,009	595
Bluegill		28	125	433	1,378	2,877	807
Redear sunfish			100	566	658	555	313
Dollar sunfish		250	450	1,189	519	1,181	598
Bluespotted sunfish			875	2,025	1,171	943	836
Spotted sunfish		28					5
Black crappie						25	4
Everglades pygmy sunfish					36		6
Total numbers	216,042	101,849	87,713	89,037	41,806	20,326	92,798
Total species	8	14	16	21	20	21	

Table 2. Estimated weight (pounds) of fish per acre at various water depths from Lake Tohopekaliga (data represents an average of 4 quarterly estimates from September 1972 to June 1973).

Water Depth	0"-3"	3"-6"	6"-9"	9"-12"	12"-15"	15"-18"	Average
Flagfish	70.5	43.4	42.8	25.4	12.3	1.1	32.6
Mosquitofish	9.8	6.7	9.8	11.6	4.7	0.7	7.2
Least killifish	4.8	2.4	3.3	1.8	1.0	0.2	2.3
Sailfin molly	10.4	11.3	6.7	4.1	0.6	0.3	5.6
Bluefin killifish	2.2	4.1	5.4	4.1	3.7	3.2	3.8
Golden topminnow	2.2	3.9	3.1	5.9	2.2	1.9	3.2
Seminole killifish		0.1	3.4	4.1	7.2	3.3	3.0
Golden shiner			0.1	0.3	0.5	0.8	0.3
Lake chubsucker		0.1	0.1	0.3	3.1	<0.1	0.6
Brook silverside				0.3	0.2	0.4	0.2
Taillight shiner				0.1			<0.1
Gizzard shad				1.1	0.3	4.1	0.9
Threadfin shad					1.1	0.2	0.2
Swamp darter						0.3	<0.1
Bowfin				0.2			<0.1
Florida gar				0.6			0.1
Brown bullhead	0.2	0.6	0.1	0.1	0.7	1.9	0.6
Largemouth bass		1.2	2.1	2.5	7.5	13.1	4.4
Warmouth	4.0	8.7	18.0	15.0	12.8	19.9	13.1
Bluegill		0.1	0.4	4.2	7.7	14.2	4.4
Redear sunfish			0.6	8.1	5.0	12.3	4.3
Dollar sunfish		0.3	2.1	6.5	3.0	7.6	3.3
Bluespotted sunfish			0.3	1.1	0.9	0.7	0.5
Spotted sunfish		0.2					<0.1
Black crappie						0.2	<0.1
Everglades pygmy sunfish					<0.1		<0.1
Total	104.1	83.1	98.3	97.4	74.5	86.4	90.6

Table 3. Average monetary value per acre of fish collected at selected water depths from Lake Tohopekaliga from September 1972 to June 1973 (values derived from data shown in Table 1).

Water Depth	0″-3″	3″-6″	6″-9″	9″-12″	12″-15″	15″-18″	Average value
Flagfish	$2,732.58	$1,305.39	$ 944.46	$ 894.09	$ 290.28	$ 39.30	$1,034.34
Mosquitofish	1,141.23	593.91	692.04	708.54	335.49	52.80	587.34
Least killifish	1,529.52	421.68	414.42	316.80	146.07	30.54	476.52
Sailfin molly	721.17	383.88	194.76	145.08	7.50	4.80	242.88
Bluefin killifish	251.94	210.12	236.31	239.46	195.24	154.59	214.62
Golden topminnow	100.14	93.81	51.48	117.45	54.60	37.14	75.78
Seminole killifish		1.68	12.42	36.09	21.00	15.63	14.46
Golden shiner			10.50	10.59	20.79	21.96	10.65
Lake chubsucker		11.20	40.00	45.00	8.00	7.20	18.60
Brook silverside				35.00	14.30	26.00	12.60
Taillight shiner				.75			.12
Gizzard shad				25.00	5.00	37.50	11.25
Threadfin shad					33.75	5.00	6.45
Swamp darter						9.70	1.60
Bowfin				1.55			.25
Florida gar				2.50			.40
Brown bullhead	9.40	25.00	2.50	5.00	14.00	10.50	11.10
Largemouth bass		208.00	250.00	153.50	244.50	271.25	187.86
Warmouth	25.20	188.80	90.00	416.40	303.20	403.60	238.00
Bluegill		7.00	31.25	108.25	344.50	719.25	201.75
Redear sunfish			25.00	141.50	164.50	138.75	78.29
Dollar sunfish		62.50	112.50	297.25	129.75	295.75	149.50
Bluespotted sunfish			218.75	506.25	292.75	235.75	209.00
Spotted sunfish		11.20					1.87
Black crappie						7.50	1.25
Everglades pygmy sunfish					9.00		1.50
Total	$6,511.18	3,524.17	3,326.39	4,206.05	2,634.22	2,524.51	3,787.98

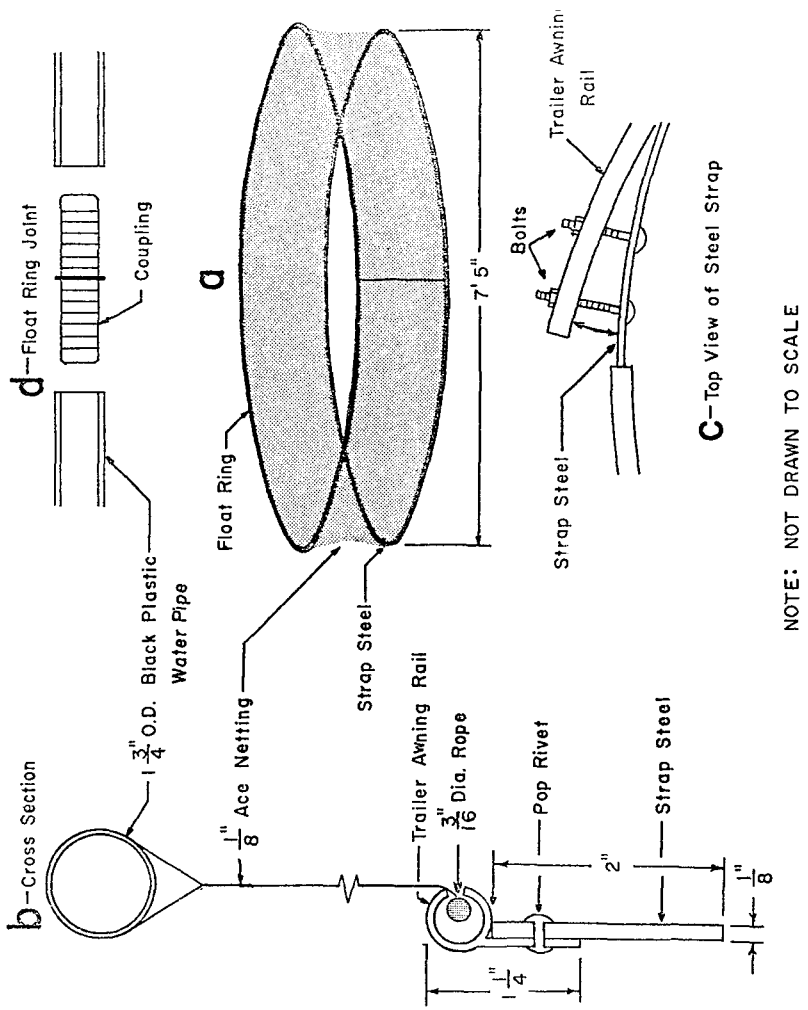

Figure 1. A construction diagram of the Wegener Ring Sampler.

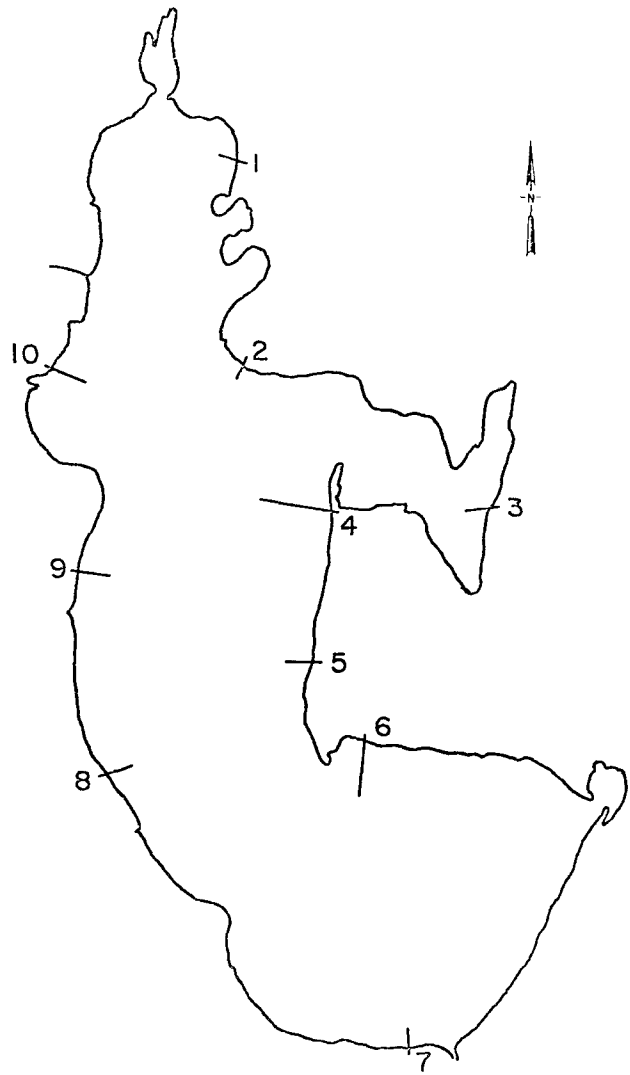

Figure 2. Outline map of Lake Tohopekaliga showing locations of ten transect lines used as reference points in sampling shallow water fish populations.

Scientific name*	Common name
Lepisosteidae	
Lepisosteus platyrhincus	Florida gar
Amiidae	
Amia calva	Bowfin
Clupeidae	
Dorosoma cepedianum	Gizzard shad
Dorosoma petenense	Threadfin shad
Cyprinidae	
Notemigonus crysoleucas	Golden shiner
Notropis maculatus	Taillight shiner
Catostomidae	
Erimyzon sucetta	Lake chubsucker
Ictaluridae	
Ictalurus nebulosus	Brown bullhead
Cyprinodontidae	
Fundulus chrysotus	Golden topminnow
Fundulus seminolis	Seminole killifish
Jordanella floridae	Flagfish
Lucania goodei	Bluefin killifish
Poeciliidae	
Gambusia affinis	Mosquitofish
Heterandria formosa	Least killifish
Poecilia latipinna	Sailfin molly
Atherinidae	
Labidesthes sicculus	Brook silverside
Centrarchidae	
Elassoma evergladei	Everglades pygmy sunfish
Enneacanthus gloriosus	Bluespotted sunfish
Lepomis gulosus	Warmouth
Lepomis macrochirus	Bluegill
Lepomis marginatus	Dollar sunfish
Lepomis microlophus	Redear sunfish
Lepomis punctatus	Spotted sunfish
Micropterus salmoides	Largemouth bass
Pomoxis nigromaculatus	Black crappie
Percidae	
Etheostoma fusiforme	Swamp darter

*Bailey (1970)

Figure 3. A checklist of fishes collected from Lake Tohopekaliga, Florida, September 1972 - June 1973.

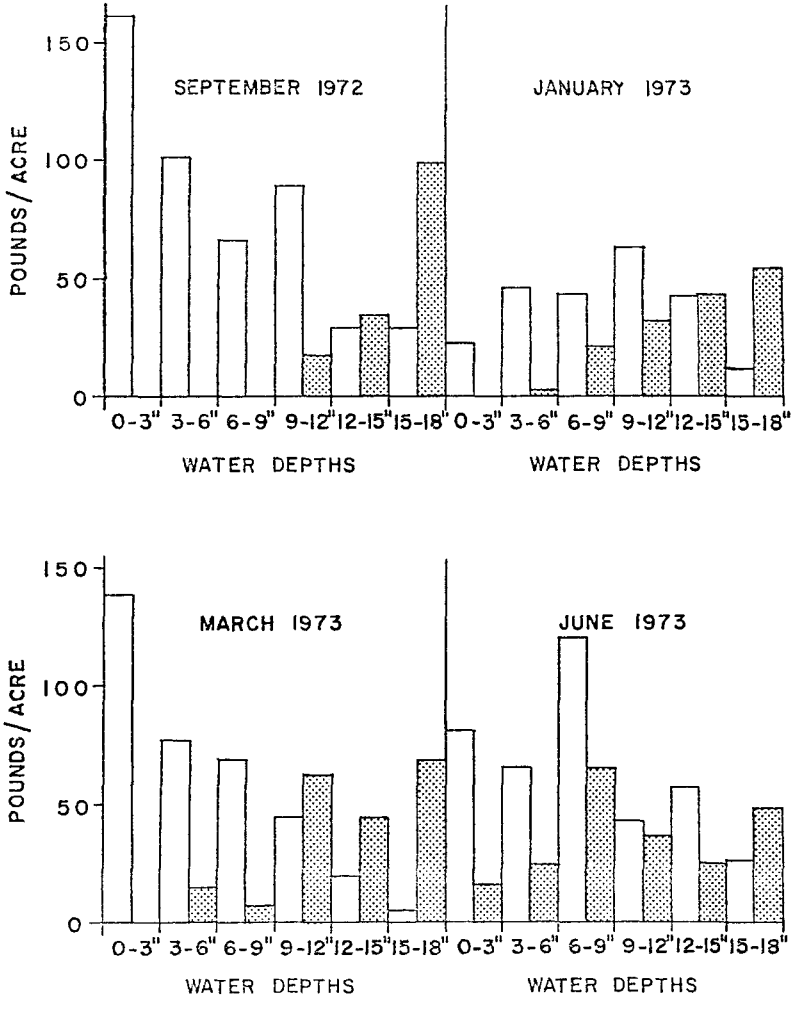

Figure 4. Seasonal standing crop of centrarchid and non-centrarchid species at various water depths (shaded areas indicate centrarchid).