

ROUTING SLIP

DIVISION OF WILDLIFE REFUGES

DATE: 10-4 1941

~~MR. ~~ELMER~~~~

JCS

SECTION OF HABITAT IMPROVEMENT:

① ~~MRS. WOODIN~~

MHW

~~Mr. Kubichek~~

~~MR. ELMER~~

ACE

~~Mr. Smith~~

RSH 11/27

~~MRS. GARVIN~~

~~Mr. Griffith~~

PEG 10/18/41

~~MR. DUMONT~~

PAD 12/29

~~Miss Cook~~

zwc 12-15-41

SECTION OF OPERATIONS:

SECTION OF ERA:

~~Mr. Krummel~~

WK 12/18

~~Mr. Regan~~

~~Mr. Gustafson~~

~~Dr. Bourn~~

~~Miss Baum~~

Mrs. Fishman

Mrs. Kricun

SECTION OF LAND MANAGEMENT:

STENOGRAPHERS:

~~Mr. Marshaw~~

~~Miss Whorley~~

~~Mr. Ackerman~~

SECTION OF STRUCTURES:

~~Mr. Taylor~~

WVZ 11/5

REMARKS:

Biologists Hayden Carter

Quarterly Report for the period

May - July 1941

Return to:

Des Files

R
Okefenokee
Fish

October 31, 1941

Mr. James Silver
Regional Director
316 Glenn Building
Atlanta, Georgia

Dear Mr. Silver:

Reference is made to Mr. H. A. Carter's quarterly biological report for the Okefenokee Refuge for the May-July period, which was received at this office on October 6.

We feel that Mr. Carter's analysis of the fish take on the Okefenokee area is a good beginning for a detailed investigation of the Okefenokee fisheries problem, which we have previously requested on several occasions receive the attention of fisheries personnel available, particularly those assigned to your region. While Mr. Carter has made a fine contribution and should continue his fisheries studies and field investigations as they may relate to the biological management of the area, we agree with your comment that we should draw on personnel specializing in fisheries work for assistance and advice in organizing and carrying out the fisheries investigation on Okefenokee and in evaluating the data obtained. Inasmuch as the age and growth studies which Mr. Carter indicated he intended to carry out pertain to fisheries research, his work program in this connection should be outlined and submitted for approval, in accordance with the terms of A.F.O. Memorandum No. 334.

Mr. Carter's recommendations for prohibiting fishing during the spawning season of bream and also the establishment of rearing pools within the refuge proper will be given full consideration upon Mr. Salyer's return from the field.

Sincerely yours,

A. C. Elmer
Acting Chief
Division of Wildlife Refuges

REG/MAB

MAILED NOV 4 - 1941

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

Okefenokee National Wildlife Refuge

Quarterly Report
of
Biological Investigations

Hayden A. Carter

August 7, 1941.

LETTER OF TRANSMITTAL

Regional Director
Glenn Building
Atlanta, Georgia

Dear Mr. Silver:

Transmitted herewith are two copies of my quarterly report of biological investigations.

This is not the report which I intended to submit at this time. When it became apparent that more time would be needed for the other report, I turned to this work, which I started last winter, on the fisheries of Okefenokee.

I realize that some of my interpretations of the data presented are open to question. For example, someone will probably think my conclusions on black bass are untenable, and based upon erroneous interpretation of the facts. Since we have no way of knowing how many fishermen are primarily fishing for bass, I can do nothing about evaluating that factor. As I state in the report, I am drawing no fine distinctions. I am seeking merely to discover trends. The report covers the Okefenokee fishery as I see it today.

I have made certain recommendations in this report. All these, however, are decidedly secondary to the recommendation made in my report dated February 8, 1941, adoption of which, I believe, would go far in fish restoration in Okefenokee Swamp.

Very truly yours,

Refuge Biologist.

Okefenokee National Wildlife Refuge,
August 7, 1941.

A PRELIMINARY COMMUNICATION

ON
THE FISHERIES OF OKEFENOKEE

One of the purposes of our work on the aquatic environments of Okefenokee is the achievement of an understanding of the fisheries biology of the area. We must know how to handle populations of game and food fishes in order to afford sport and food at a more or less constant level. We seek to achieve that sustained yield which is the objective of all management.

Organization of the Work

The purposes mentioned above can only be reached through a tremendous volume of work. In order to guard against waste of time and effort, I have organized my work along certain broad lines and have arranged to refer to specialists in various fields special problems requiring museum or library facilities not available at this station.

For example, a cooperative arrangement, approved by Mr. Salyer, has been set up between Dr. Carl Hubbs, of the University of Michigan Museum of Zoology, and myself, whereby Dr. Hubbs will identify all specimens collected in Okefenokee. Dr. Hubbs will divide the collection into three parts. One will go to the United States National Museum. Another will remain on deposit in the University of Michigan Museum of Zoology. The third portion will be

returned to the Okefenokee laboratory, where it will serve as a reference collection for future work. Dr. Hubbs and I have settled these details and the collection of specimens has begun. It is possible that this collaboration may lead to the publication of a paper on the fishes of the Okefenokee.

When a larger number of fishermen come to Okefenokee this fall, at the time when most of the bass are taken, I plan to begin the accumulation of data for a study of the age and rate of growth of the Okefenokee Black Bass. Length and weight can be recorded and a few scales taken from each fish, and the laboratory work and tabulation of data can be done at night or during stormy weather. Thus by taking advantage of every opportunity to gather data, we will make steady progress on our fisheries studies.

Such investigations as these, however, are simply studies of the end products themselves. If the aquatic ecology of Okefenokee is ever to be understood, it must be learned in terms of the chemical, physical, and biological characteristics of the environment. A limnological program has been discussed with Mr. Salyer, and may be undertaken at some future time.

Hellige comparator made available to Okefenokee for about 6 weeks this summer but was not used

Meanwhile, what is the condition of the Okefenokee fishery? *REG.*

Can we let Nature run her course while we study? Or, must some form of regulation and management be instituted for the benefit of the fish fauna? By a study of all available information, begun in November 1940, this report seeks to answer these questions.

I present my data, conclusions, and recommendations in that order.

Source of Data

The information upon which this first report on fisheries is based is contained in the official files as a series of monthly statements covering the number of fish taken, the number of fishermen, and the number of visitors to the Refuge. The series of reports was started in June, 1938.

These reports summarize the take of fish in five groups, which include perhaps nine species of fish.

The term bass refers to the southern large-mouth bass, Muro salmoides.

The term perch includes the smaller Centrarchidae, or sunfishes, of which there are seven or more in Okefenokee. The definition of these species is being studied and will be reported subsequently. Of those taken as pan-fish and reported as perch, there are at least three and perhaps four species. When Dr. Hubbs furnishes us the zoological equivalents for the Okefenokee names "warmouth, blue bream, thin-gizzard, and stumpknocker," this group will be more accurately defined.

The term jack covers two species; Esox reticulatus and E. americanus. Similarity of habits makes this grouping acceptable for this study.

The term catfish also covers two species; Amiurus natalis and A. erebennus, according to present understanding.

The term mudfish indicates only one species, Amia calva.

A few comments on the value of the figures contained in this report are in order.

Fine distinctions and conclusions based thereon cannot be developed. While the figures undoubtedly indicate something of the relative abundance of the various species involved, it is impossible to use the data given as a representative sample of Okefenokee fishes. Most of the catfish taken, for example, are caught on trot-lines, a method of fishing which will not yield black bass. Catfish are not taken on artificial lures, and cannot be compared with bass. Occasionally some bit of data offers a fascinating conclusion, but careful consideration soon shows such conclusions to be scientifically unsound. These have been discarded in this summary of the study.

Methods of Study

Two methods were used in analyzing the data secured from the monthly refuge reports. The first was a simple examination of the figures themselves. The second was a reduction of the figures to a mathematical fraction representing the number of fish per creel. These fractions were then plotted on rectilinear coordinates as a means of discovering trends. Fractions which appear in Table I were originally run off to the fifth decimal, and the third digit read in terms of the fourth and fifth; e. g., 1.63588 was read 1.636 and 1.63523 was read as 1.635. Any discrepancies in the factors will be found in the third digit of the fraction and are therefore negligible. Since the purpose of the study was discovery of trends rather than minute correlations, I dispensed with the cumbersome fifth-decimal fractions.

	MONTH	BASS	N/F	PERCH	N/F	JACK	N/F	MUD	N/F	CATFISH	N/F	TOTAL	N/F	No. ANGLERS
1938	June	456	.163	58009	20.750	966	.345	1544	.552	1472	.522	62447	22.34	2795
	July	186	.145	17445	13.620	489	.382	994	.776	2254	1.760	21368	16.69	1280
	August	193	.444	674	1.552	196	.451	182	.419	448	1.032	1693	3.90	434
	Sept.	335	.626	4332	8.090	511	.955	472	.882	628	1.173	6278	11.73	535
	Oct.	125	.293	1048	2.460	271	.636	332	.779	518	1.216	2294	5.38	426
	Nov.	96	.530	602	3.325	90	.497	305	1.685	365	2.016	1458	8.05	181
	Dec.	60	1.710	47	1.340	31	.885	27	.771	35	1.000	200	5.71	35
1939	Jan.	116	1.017	73	.640	42	.360	68	.596	71	.622	370	3.24	114
	Feb.	136	.539	320	1.270	119	.472	472	1.873	191	.758	1238	4.91	252
	March	138	.207	1567	2.359	148	.222	670	1.009	928	1.396	3451	5.19	664
	April	75	.207	1114	3.077	59	.163	425	1.160	637	1.760	2310	6.38	362
	June	276	.269	3700	3.606	344	.335	1049	1.022	1194	1.164	6563	6.39	1026
	July	127	.323	383	.974	130	.330	615	1.564	814	2.070	2069	5.26	393
	August	111	.458	120	.495	69	.285	262	1.080	391	1.610	953	3.93	242
	Sept.	127	.518	73	.298	34	.138	135	.551	398	1.620	767	3.13	245
	Oct.	123	.768	174	1.090	25	.156	74	.462	107	.668	503	3.14	160
	Nov.	85	1.660	157	3.080	45	.882	31	.608	7	.137	325	6.37	51
	Dec.	37	1.320	26	.928	12	.428	52	1.860	38	1.350	165	5.89	28
1940	Jan.	16	1.140	0	.000	3	.214	12	.857	0	.000	31	2.22	14
	Feb.	36	1.380	9	.346	13	.500	4	.154	10	.384	72	2.76	26
	March	122	.404	541	1.790	61	.202	62	.205	268	.887	1054	3.49	302
	April	58	.148	1822	4.660	86	.220	102	.260	450	1.150	2518	6.43	391
	June	193	.117	21363	13.000	423	.257	697	.424	2030	1.230	24706	15.03	1643
	July	73	.098	4089	5.510	137	.185	544	.733	1135	1.530	5978	8.05	742
	August	159	.342	184	.395	118	.254	314	.675	1145	2.460	1920	4.13	465
	Sept.	122	.317	308	.802	117	.305	568	1.479	175	.456	1290	3.36	384
	Oct.	50	.286	706	4.030	76	.434	165	.943	463	2.640	1460	8.34	175
	Nov.	6	.136	208	4.730	18	.409	64	1.450	72	1.640	368	8.36	44
	Dec.	7	.170	78	1.903	21	.512	34	.829	35	.853	175	4.27	41
1941	Jan.	10	.833	6	.500	6	.500	9	.750	4	.333	35	2.91	12
	Feb.	9	.321	2	.071	0	.000	37	1.320	28	1.000	76	2.71	28
	March	46	.356	108	.837	75	.581	106	.822	124	.961	459	3.56	129
	April	21	.066	590	1.867	51	.161	339	1.070	700	2.215	1701	5.38	316
	June	69	.930	3506	4.725	84	.113	484	.652	2062	2.780	6205	8.36	742
	TOTAL	3974		123384		4870		11250		19197		162505		14677
	AVERAGE		.270		8.406		.331		.766		1.307		11.080	

Numerical Analysis

Upon examination of the totals in fish and time, it might be concluded that the Okefenokee fishery is in thriving condition. To report that 162, 675 fish were taken in 34 months for an average of 4,784 fish per month sounds like a bid for the headlines. Such an average, if sustained, were a satisfactory yield from any fresh-water area.

But the average is purely a mathematical figure. It exists, but it is so far at variance with the real picture as to be entirely meaningless. Its only function is to provide what turned out to be an index as to the one-sidedness of fisheries yield in Okefenokee.

Examine the facts.

In one month, June, 1938, out of a total of 162,675 fish, 62,447 fish were taken. This means that in 2.94% of the total time, 38.3% of the entire catch was taken.

July 1938, and June 1940 were other months of high take. They total 46,074 fish. These figures, added to those for June 1938, bring the three-month total to 108,521 fish.

In 8.82% of total time, 66.7% of the total catch was taken.

Sustained yield?

Four other months show catches above the mathematical average. These were September 1938, June 1939, July 1940, and June 1941. The total for these four months was 25,024 fish. Thus for the months of above-average catches, 133,545 fish were taken.

This means simply that 82.1% of the catch was taken in 20.58% of the total time.

In the remaining 27 months, 28,955 fish were taken, or 17.9% of the catch in 79.42% of the time.

In plain words, this means one-fifth of the catch in four-fifths of the time on one side of the mathematical average, and four-fifths of the catch in one-fifth of the time on the other. My statement that the mathematical average was meaningless except as an index to the one-sidedness of the yield may now be signed

QED

We can learn something interesting from an examination of the frequency and distribution of months by take. This information is summarized herewith in Table II. Particular attention should be given periods of minimum take.

Table II

Total Catch	No. of Months.
0- 999	14
1000--1999	8
2000--2999	4
3000--3999	1
4000--4999	0 (Mathematical average 4784)
5000--5999	1
6000--6999	3
7000-and over	3

The question next arises as to how much of this is due to the seasonal factor, or the willingness, so to speak, of the fish to bite? An answer has been sought by projecting the figures of Table II on a graph (Figure I) If we use the mathematical average to divide

the months of high and low yield, we find that months above the average are distributed with the following frequency:

June	4
July	2
September	1

It will be shown later in this report that figures for the average take are so heavily weighted by figures for the catch of perch as to make the entire average curve reflect primarily the take of perch.

Another June must not and will not be allowed to pass without examination of extensive series of the various sunfishes to determine whether that month actually represents the peak of spawning as well as the peak of the catch. If such should be the case, we will find ourselves in the position of having permitted wholesale violation of the cardinal principle of management - protection of breeding stock at the time of breeding. I am assured by Patrolman Gay and Guide Roddenberry that June is the month when perch are in roe.

It is proverbial in rural Georgia that the "perch bite their best when they are over their beds." This reflects, incidentally, the average level of conservation thought in Georgia.

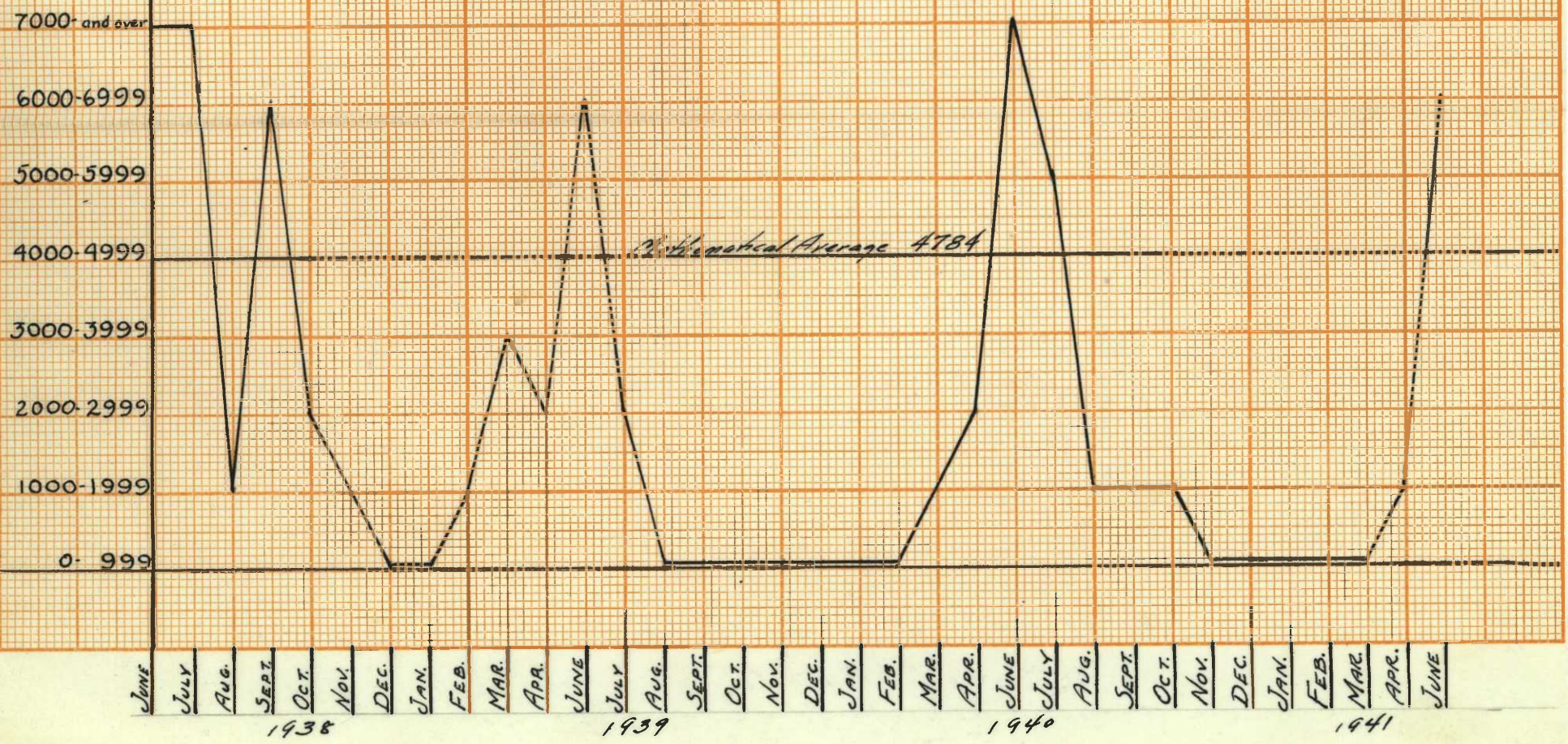
This hypothesis - as yet it is nothing more - may be only partially correct. I have evidence that the stage of water in Okefenokee may be a factor worthy of evaluation. See graph, Figure II.

FIGURE II

Precipitation, in inches
Catch, in thousands



FIGURE I
Distribution of Catch
in thousands



Little information can be gleaned from a study of numerical data by the graphs they would produce. Plotting figures from zero to 58,009 perch would require such spacings as to throw the lower values out of sight. This was overcome by reducing the gross figures to factors for the preliminary study. This method produced satisfactory units for plotting, but the maze produced by six curves on one sheet was more confusing than enlightening. The final result was separation into three graphs, Figures III, IV, and V.

Figure III shows the average curve for all species, and the curve for perch, plotted on the same values. In this figure, note the high parallelism of the two curves, which indicates the extent to which the general average is weighted by this single group.

Figure IV shows the average curve and the curves for catfish and mudfish. Figure V shows the average curve and the curves for jack and bass. In order to portray more clearly the fluctuations of the species curves, they have been plotted on values x5 their actual values on the average curve. Unity on the species curve corresponds to 5 on the average curve; therefore a reading of 0.5 as at present plotted for the species has an actual value of 0.1 in terms of the average curve, and a reading of 2.0 has an actual value of 0.4. This vertical exaggeration must be kept in mind in reading the curves. At first glance the graphs present the anomolous picture of components exceeding the average in value.

The graphs tell their own story. To expand this compact information in narrative form would waste time in both writing and reading.

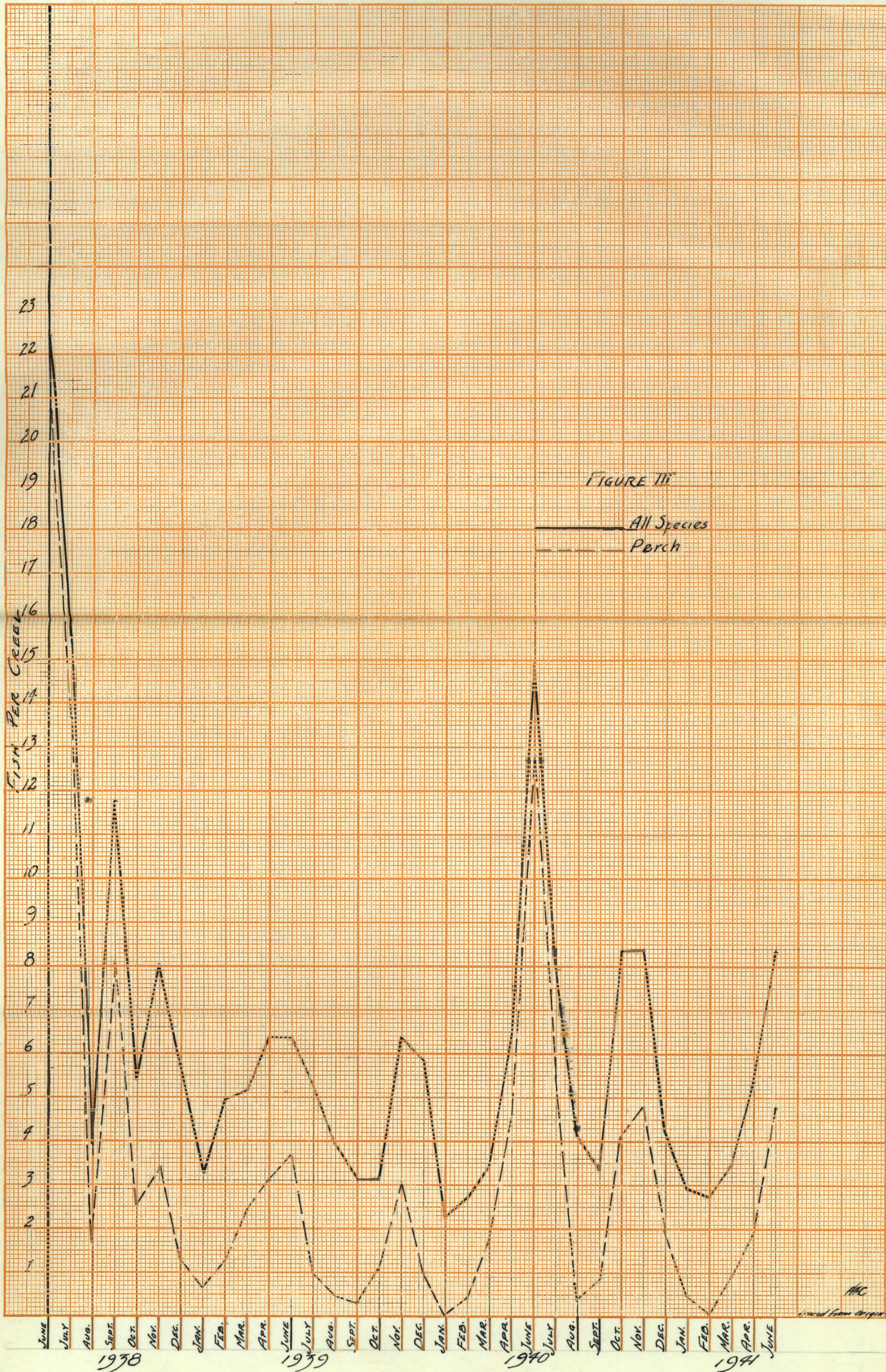
A few pertinent remarks of a general nature may well be included. It will be observed that the seasonal fluctuation in the take of catfish and mudfish move toward maxima and minima in fairly close agreement with the general curve. Trends of the average for all species and for catfish and mudfish have at least a semblance of harmony, in the main.

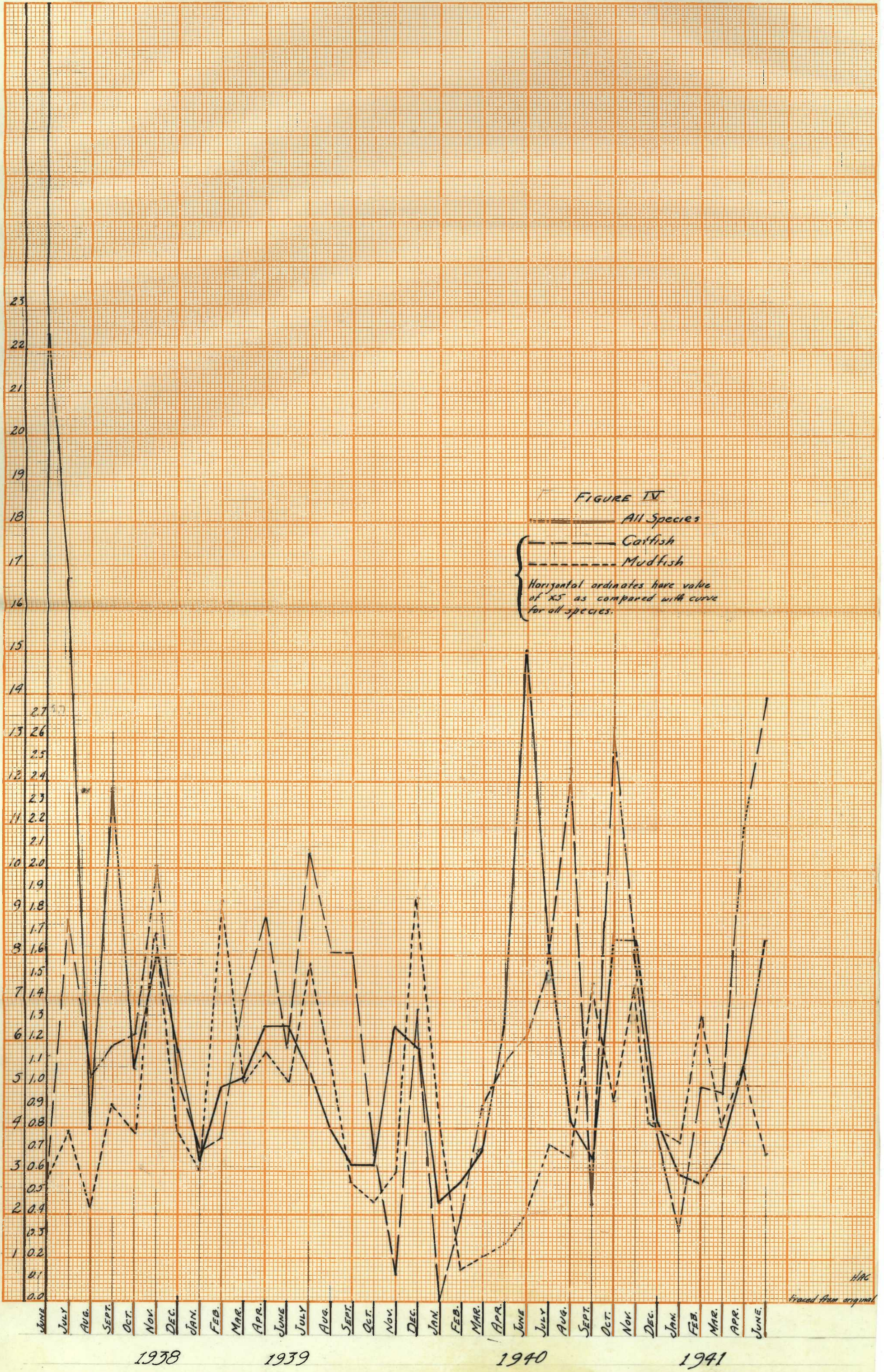
Figure IV reveals a similarity of seasonal behavior in jack and bass. It also shows that this behavior is inverse to that of perch as reflected in the average curve. The species curves tend to reach their maxima in late fall and winter months, as contrasted with June and July for the small sunfishes.

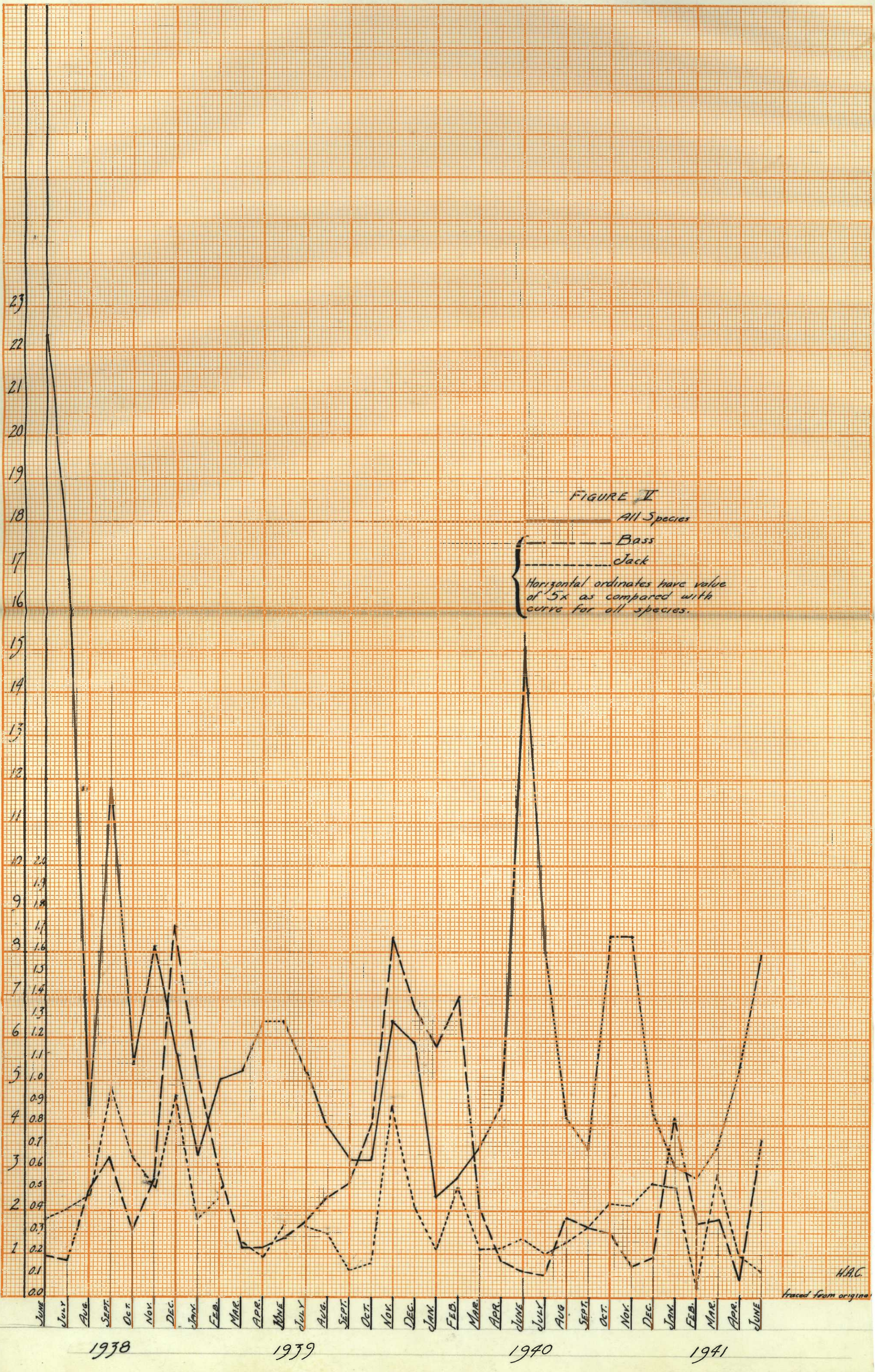
Finally, we may appraise our fishery on the basis of relative ratings of the components of the total catch. In descending order of abundance, these are as follows:

Species or Group	Fish per Creel	Number Taken
Perch	8.406	123,384
Catfish	1.307	19,197
Mudfish	.766	11,250
Jack	.331	4,870
Bass	.270	3,974
All species	11.080	162,675

These figures indicate a serious condition insofar as the welfare of our black bass is concerned. Our most prized game fish runs a poor third to the mudfish and an even poorer fourth to the catfish.







HAG

traced from original

*Okefenokee
has been fished
heavily for many
years prior to
the establishment
of the refuge.
There is probably
less actual
removal now
than in the
past. REG*

Perch are in a class by themselves, of course. We have had so far, record months of perch fishing - and will continue to have as long as the month of June remains open season and the population can stand such reduction of breeding fish. There is an end-point to this. How long it will take to reach that end-point cannot be estimated on present information.

Without knowing relative population densities of our species under more or less normal conditions (and without attempting to evaluate or determine just what the "normal" actually is,) we cannot say whether the proportions stated above are significant. From the fisherman's viewpoint, they are most significant.

*There is less
demand for
fishing when
bass bite
best i.e.
Dec-Feb.
see Fig 1*

From the practical standpoint of refuge administration they are also significant. They indicate that we have a pan-fish refuge rather than a black-bass area. They indicate that, aside from perch, we have almost no fishing at all, and that in the four groups other than perch, the most desirable species is a pathetic last in standing. Those of us who have caught bass in Okefenokee for several winters are likely to be shocked by the facts. Many of our visitors, coming here for the first time, inquire eagerly about the bass fishing, having heard tales of its excellence. The bass fishing, relatively speaking, is all but non-existent.

So much for the data.

Conclusions.

The available facts point quite clearly to seven conclusions.

1. The small sunfishes taken from Okefenokee outnumber the other species in the ratio of about 4:1.
2. The take of black bass as compared with the total take is approximately 0.27:10.80, or 2.4% of the total. There are 41 times as many fish of all types taken as there are bass.
3. The peak months of the take of sunfish coincide with the peak months of spawning (Patrolman Gay and Guide Roddenberry state that more sunfish are taken with roe in June and July than in other months, but this will be confirmed by examination).
4. The peak months of the take of black bass are winter months, so it appears that little damage is done the spawning fish, though spawning usually begins before the Georgia closed season.
5. There is a correlation, but not a particularly close one, between rainfall maxima and months of highest catch.
6. More study is needed on the physical, chemical, and biological factors of Okefenokee aquatic environments.
7. Some specific changes in regulations on fishing are needed.

Recommendations.

Our present creel limits, based upon those established by Georgia law, appear to be entirely too high. We permit a take of not more than 15 black bass, nor more than 35 in the aggregate of all kinds.

Mudfish are not considered game fish, but by inference, are included in the aggregate.

To reduce this limit will undoubtedly arouse antagonism, but the Service has already demonstrated to the nation that it is in business for the benefit of wildlife as an immediate objective, and for the benefit of the sportsmen as a secondary, long-term objective. I therefore recommend a reduction in creel limits to a maximum of five bass and twenty of all kinds.

Further, I recommend that mudfish be specifically excluded from the game list, and creel limits. Many are now taken, killed, and thrown away, so that they are not regularly included in creel reports - a fact, incidentally, which is probably reflected in our figures. I cannot quote figures to support my belief that the mudfish is detrimental to the bass, but it has been my experience in fishing for bass that waters in which mudfish have gained dominance are never good bass waters. I realize that I am putting myself in position for thorough criticism, but I do so in the hope that I will actually receive such criticism from someone qualified to give it. My conclusion and recommendation on mudfish may not be tenable. If not, I shall be the first to admit their falsity upon proof. My basic assumption is that we should develop a first rate bass area.

As to seasons, I am tentatively recommending closing the month of June as well as the preceding six weeks prescribed by Georgia law, in the interest of protection for spawning sunfishes. Here, too,

I realize that I am open to criticism. I freely admit that I know nothing of the possible effect of a dense population of sunfishes upon a bass population, if there be such an effect. Here is still another field for investigation. However, it does seem to me that such a move might be seriously considered.

Since restrictive measures are almost never completely effective in achieving a management objective, I am prepared to offer a suggestion for a positive measure.

It is herewith proposed that a series of fish rearing pools be constructed on the refuge, in which black bass can be brought to an advanced fingerling stage, and some number to yearlings, before liberation in Okefenokee waters.

Such pools could easily be built in the canal basin between the guide's cabin and the Trail Ridge truck trail. These ponds would extend for almost half a mile, and should give us more than one acre of water surface. They would be rectangular in shape, measuring 200 x 25 feet. Ten such pools could be placed in the stretch of canal just described, providing 50,000 square feet of water surface.

The first requisite for fish rearing pools is a water supply. The canal basin in question is full of springs, one rather large, and several smaller ones at convenient intervals. The water flow has not been measured, but it appears to be rather constant and will probably improve when basins are cleared out.

To provide a flow there is sufficient fall in the basin from east to west to permit circulation of fresh water through the pools.

Furthermore, the water is naturally productive. I have seen black bass fingerlings, from April spawn, reach four inches in August, in the basin for the proposed pools.

It would involve some expense to make these pools snake,-turtle-, and heron-proof. The first two purposes could be achieved by a hardware-cloth fence, set in a lean concrete grout. Such an installation is so durable as to be practically permanent. Protection against herons could be secured by the use of salvaged salmon nets, hung over number 9 wire strung crosswise to the pools at ten-foot intervals. Such nets, if cared for, would last two and perhaps three years.

Three of the ten pools could be devoted to propagation of top minnows, *Gambusia patruellis*, for use as forage fish in the other pools. The fecundity of *Gambusia* is well known. I know from personal experience how the top-minnows are relished by small bass.

Construction of rearing pools and stocking of Okefenokee with fingerling and yearling bass need not be done to the exclusion of stocking with fry. Rather, it should be a measure to bolster stocking with fry. After a year of critical consideration of Okefenokee's bass, I am thoroughly convinced of the need for a sound and adequate bass planting program.

Summary

1. The Okefenokee fishery is in a serious condition.
2. The maxima of catches reflect maxima of catches of small sunfishes primarily, and seem to coincide with the months of spawning of these species.
3. The black bass, first in public appreciation, comprises only 2.4% of the total number of fish taken.
4. The mudfish, which I think (at present) is detrimental to the bass population, is dominant over the black bass today.
5. Reduction in bass and aggregate creel limits is deemed advisable, as a step toward conserving a breeding stock of bass.
6. Explicit exclusion of mudfish from aggregate creels is recommended.
7. Closing the Refuge to fishing in June is recommended in the light of paragraph (2) above.
8. An adequate stocking program, including the construction of fish rearing pools for the production of fingerlings and yearlings, is urged for large-mouth black bass.





is planned for large-scale work.

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Sincerely,
