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Relative abundance of young fishes in Virginia estuaries

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TECHNICAL SESSIONS

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COASTAL AND MARINE RESOURCES

RELATIVE ABUNDANCE OF YOUNG FISHES IN VIRGINIA ESTUARIES

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Watermen have expressed the opinion that commercial fish production varies considerably from one Virginia estuary to another. Preliminary surveys of the young fishes present in the various rivers have suggested that the relative abundance of young fishes also differs from river to river. The surface trawl (Massmann, Ladd, and McCutcheon, 1952) has been used to obtain quantitative information on the distribution and relative abundance of young fishes in five major Virginia estuaries.

Sampling was done in tidal fresh waters of the Rappahannock River from September 26 to October 1, 1951, and in the James, Chickahominy, Pamunkey, Mattaponi, and Rappahannock Rivers from August 3 to September 25, 1952 (Figure 1). In 11 hours of trawling in 1952, more than 196,000 fishes were captured. Although 27 species were identified, 99 per cent of this catch was composed of seven clupeoid species, namely, the young of glut herring (*Pomolobus aestivalis*), alewife (*P. pseudoharengus*), hickory shad, (*P. mediocris*), American

[1]The author wishes to express his appreciation to Jesse Hobbs and Ernest Ladd for assistance in the field and to Mrs. Doris Lewis for making the illustrations.

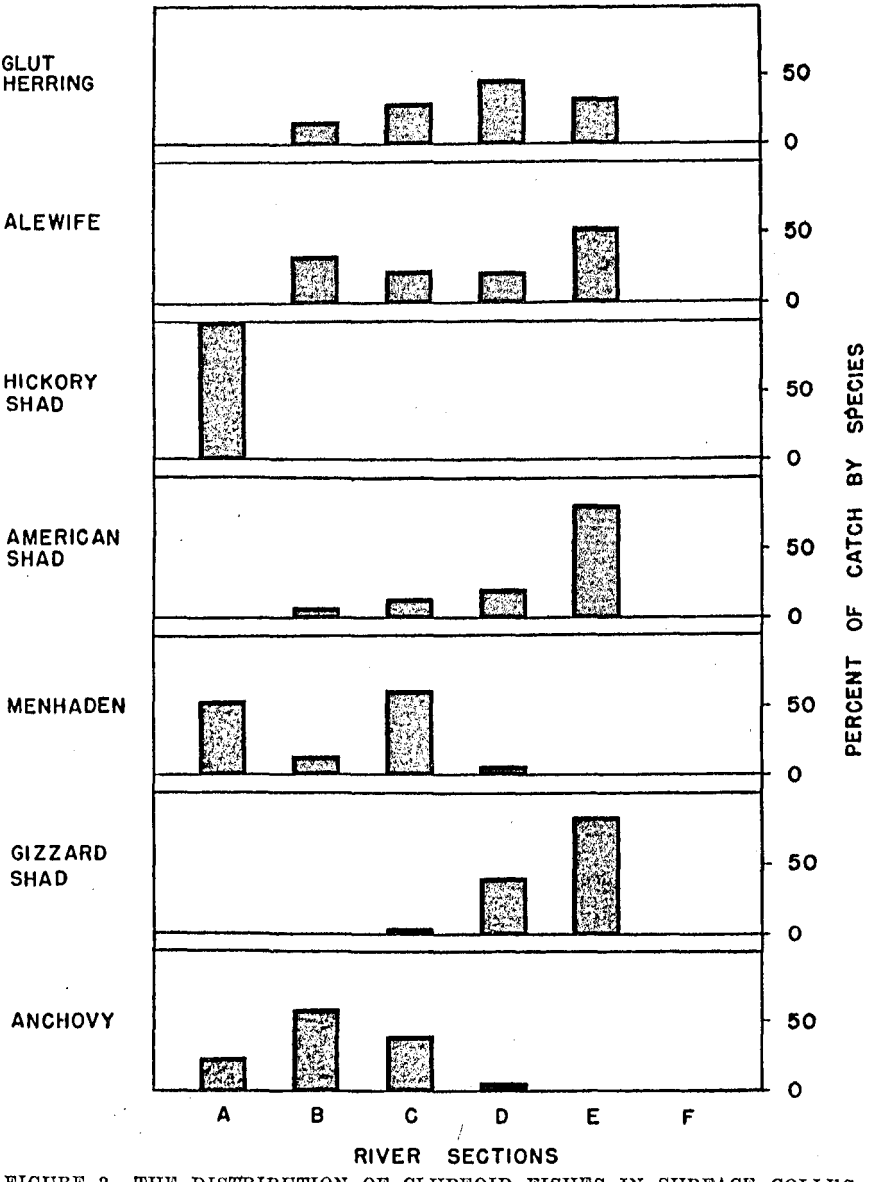

FIGURE 2. THE DISTRIBUTION OF CLUPEOID FISHES IN SURFACE COLLECTIONS FROM SIX DIFFERENT RIVER SECTIONS. SECTIONS IN ALL RIVERS HAVE BEEN MADE COMPARABLE TO A 10-MILE SECTION OF THE JAMES RIVER, SECTION A BEING LOCATED JUST UPRIVER FROM BRACKISH WATER AND SECTION F BEING LOCATED NEAR THE VICINITY OF THE HEAD OF TIDE. SINCE MORE THAN 80 PER CENT OF THE GLUT HERRING WERE CAUGHT IN THE CHICKAMONINY RIVER, DATA ON GLUT HERRING OBTAINED FROM THIS RIVER HAVE NOT BEEN INCLUDED.

tions nearest brackish water. This might be expected, for both are primarily marine species. Hickory shad were captured only in Section A.

RELATIVE ABUNDANCE

The relative abundance of young clupeoids in the five rivers was calculated from the average number taken within each river. For those species found in only a portion of the river, such as menhaden and anchovy, only the samples taken within their range were used in calculating mean abundance. The means, summarized in Table 2, have been plotted as percentage frequencies in Figure 3. Glut herring, abundant in all rivers, were most numerous in the Chickahominy, where 83 per cent of the total number was caught. Alewives, also most abundant in the Chickahominy, were least numerous in the Pamunkey. Hickory shad were taken only in the Pamunkey River. Since this river was sampled first, it is possible that most young hickory shad (adults of which are known to be abundant spring spawners in the Pamunkey, Mattaponi, and Rappahannock Rivers) had already moved downriver when the survey began. The Pamunkey and Mattaponi Rivers, tributaries of the York, produced 77 per cent of the entire catch of American shad. Few shad were obtained in the Chickahominy River.

TABLE 2. AVERAGE NUMBER OF FISHES CAUGHT PER 15-MINUTE SURFACE TRAWL HAUL IN FRESH, TIDAL WATERS OF FIVE VIRGINIA RIVERS AUGUST 18 TO SEPTEMBER 25, 1952. WITH THE EXCEPTION OF THE JAMES RIVER, ALL HAULS WERE MADE BETWEEN SUNSET AND DAWN.

Species and no. of hauls	James	Chickahominy	Pamunkey	Mattaponi	Rappahannock
No. of hauls	14	4	9	7	10
Glut herring	748	30,125	2,448	1,349	1,460
Alewife	152	448	105	309	293
Hickory shad	0	0	46	0	0
American shad	22	2	59	47	7
Menhaden	6	0	14	9	29
Gizzard shad	9	14	0	0	0
Anchovy	558	451	621	167	802

Somewhat more abundant in the Rappahannock than in other rivers, menhaden were present only in small numbers in the Chickahominy during the late summer survey.[3] Gizzard shad were trawled only in the James and Chickahominy although they are known to be present in small numbers in the other rivers. Anchovy were generally abundant in all rivers.

[3]Trawl hauls made in the Chickahominy on April 8 and 9, 1952, averaged 250 small menhaden per 15-minute tow.

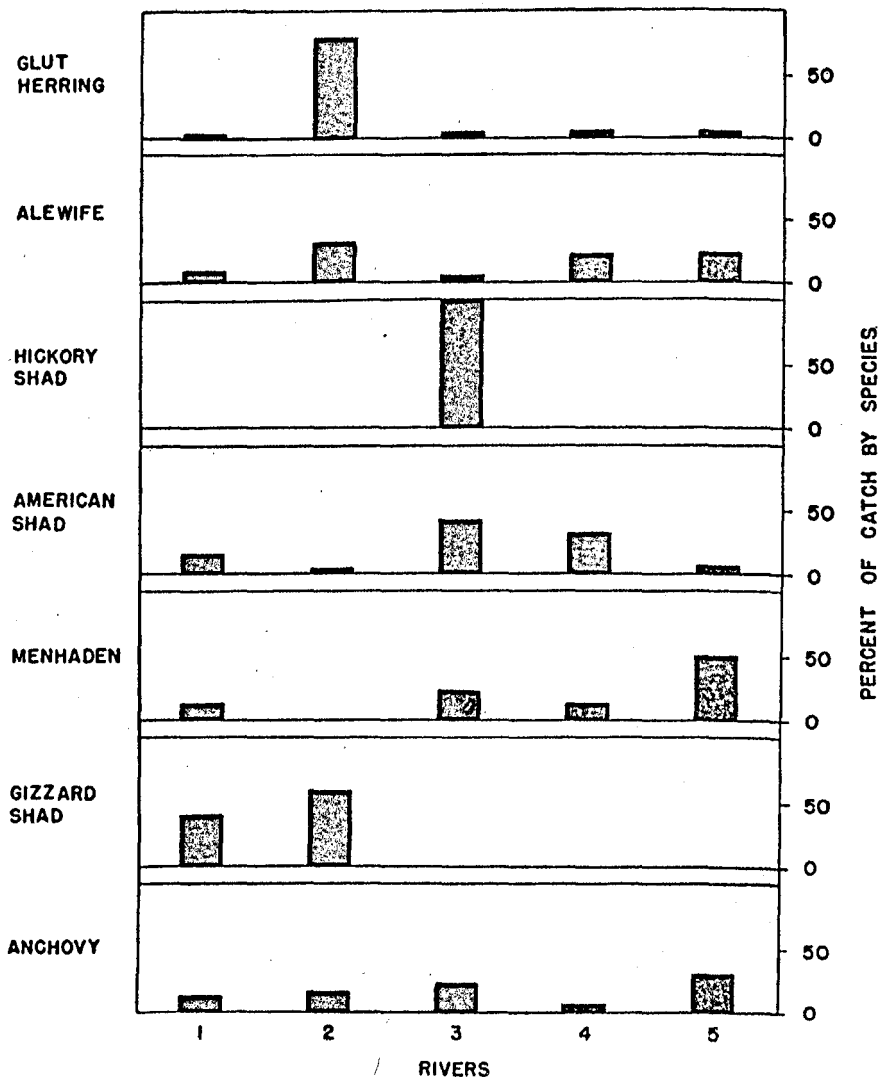

FIGURE 3. RELATIVE ABUNDANCE OF CLUPEOID FISHES IN FRESH TIDAL WATERS OF FIVE VIRGINIA RIVERS. THE DATA ARE BASED ON 15-MINUTE HAULS MADE IN EACH RIVER WITH A SURFACE TRAWL, AT FIVE-MILE INTERVALS FROM BRACKISH WATER TO NEAR THE HEAD OF TIDE, DURING AUGUST AND SEPTEMBER 1952. KEY TO RIVERS: 1—JAMES, 2—CHICKAHOMINY, 3—PAMUNKEY, 4—MATTAPONI, 5—RAPPAHANNOCK.

TABLE 3. AVERAGE NUMBER OF FISHES CAUGHT PER 15-MINUTE SURFACE TRAWL TOW IN THE RAPPAHANNOCK RIVER IN 1951 AND 1952.

Species	Average number of fishes 1951	1952
Glut herring	468	1,460
Alewife	54	293
American shad	4	7
Menhaden	668	29
Anchovy	207	802

ANNUAL VARIATIONS IN ABUNDANCE

Comparative collections for two successive years are available for the Rappahannock River only. In 1951, eight 15-minute night hauls were made at eight approximately equal intervals, spaced from brackish water to the head of tide. These tows are compared with ten 15-minute tows made at five-mile intervals in the same river section from September 23 to 25, 1952 (Table 3). Ratios of abundance in 1952 as compared with 1951 (Figure 4) were 5:1 for alewife, 4:1 for anchovy, about 2:1 for American shad, and 1:28 for menhaden.

SUMMARY AND CONCLUSIONS

Night sampling with a surface trawl during August and September 1952 in fresh, tidal waters of five Virginia rivers has demonstrated that young glut herring, alewife and American shad and gizzard shad are present in greatest abundance well upstream from

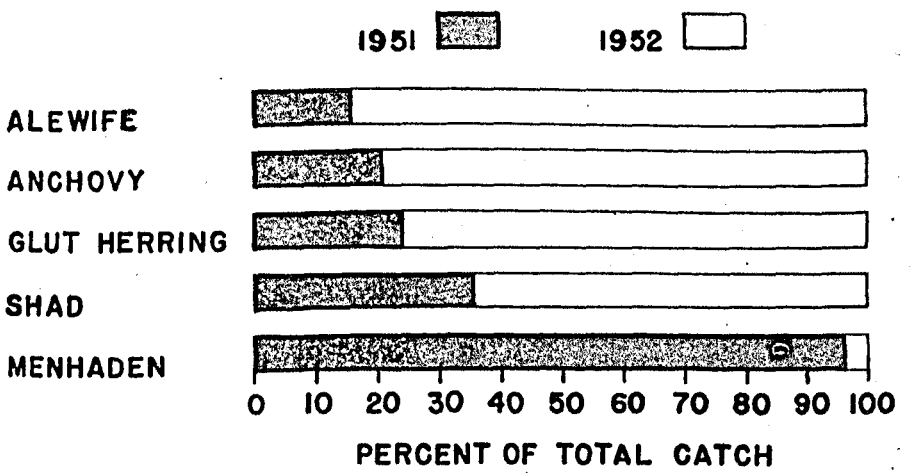

FIGURE 4. RELATIVE ABUNDANCE OF YOUNG CLUPEOID FISHES IN THE RAPPAHANNOCK RIVER IN TWO SUCCESSIVE YEARS. THE DATA WERE BASED ON A SERIES OF NIGHT SURFACE TRAWL TOWS MADE AT STATIONS BETWEEN BRACKISH WATERS AND THE HEAD OF TIDE DURING THE PERIODS SEPTEMBER 25 TO OCTOBER 1, 1951, AND SEPTEMBER 23 TO 25, 1952.

brackish water. It appears that for these species in summer, each river may be considered as an isolated lake with one end situated near salt water and the other near the fall line. Young menhaden and anchovy, on the other hand, although present in these regions in considerable numbers, are not restricted to fresh water. The distribution and abundance of young hickory shad suggests that this species may migrate into salt water earlier than shad, alewife, or glut herring.

The relative abundance of these seven clupeoid fishes varied considerably in the five rivers. Some rivers perhaps are suited particularly to the production of certain species, but none appeared to be most productive of all species.

Variations in the relative abundance of these clupeoid species may be caused by two factors: (a) differences in the numbers of adults spawning in each river and (b) differences in environmental conditions. With the possible exception of the American shad, which is subject to an intensive fishery both in Chesapeake Bay and in each of the rivers, it appears that variations in environmental conditions are most important. A growing body of data is accumulating to indicate that these rivers differ greatly in ecological characteristics.

LITERATURE CITED

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1952. A surface trawl for sampling young fishes in tidal rivers. Trans. 17th N. Amer. Wildl. Conf.: 386-392.

DISCUSSION

DR. J. L. MCHUGH (Virginia Fisheries Laboratory): I think this problem of trying to estimate future abundance of fisheries by means of survey on the nursery ground has occupied the attention of a good many fishery biologists in this country and other parts of the world to today. We think this particular method is possibly going to be quite useful for Virginia waters. Particularly we feel that this surface trawl is very adaptable to sampling fisheries in rivers where their boundaries are more or less limited, and they cannot get away too easily from the nets.

I know the California State Fisheries Laboratory has done a good bit of work along these lines, particularly with reference to future abundance of the sardine. Perhaps you might have some comments on that, John, as to the values of this method, and your idea as to whether it seems useful in determining future abundance.

MR. JOHN E. FITCH (California Department of Fish and Game): This sampling device has been used mostly in the ocean. It has not been dragged along the bottom. I do not know whether that differs from the device which is used in the Chesapeake area. But I do not really believe they have stopped to determine exactly how important it is. It seems to be the main device for sampling young fish offshore, and for determining the number of eggs in any particular area. It has proven very helpful for determining the size of the parent stock which was spawning in the area; but they believe on the Coast, that they have other means of determining the size of the parent stock. They are tending to go more toward those other means than they are toward the sampling with the tow nets.

DR. MCHUGH: Thank you. Dr. Tiller is here. Perhaps your experience in Maryland might put you in a position to make some comments on this subject.

DR. R. E. TILLER (Maryland State Fisheries Laboratory): Thank you, Larry.

I have been watching the progress of this sampling with very, very great interest because, in past years, our sampling for juveniles on this very problem of crop prediction has been very limited. It has been done principally with 100-foot or 200-foot quarter-inch haul-seines, and we have found very striking selectivity of species which are found, as Gillman has indicated, inshore. The Muraenides, the sand perch, the Haemulons, and so forth, are easily taken by beach seine. But we had very, very poor success in working up any prediction methods on populations. I am looking forward to learning a little and getting a little instruction from Bill in developing this method for the Maryland fisheries.

CHAIRMAN HUBBS: I wonder if we could have a brief discussion of the surface trawl.

MR. MASSMANN: This surface trawl is nothing more than a regular trawl, an ordinary net bag which is pulled along through the water, except that we tie one end to one boat, another end to another boat, and pull it along the top of the water, just like pulling a hand seine through the water. There is really nothing to it, except for the fact that we apparently are able to collect fishes which were previously not very available to ordinary methods of collection. Not only that, but it seems to have some use quantitatively. For instance, we can trawl a certain number of acres if we want to. Our hauls are fifteen-minute hauls with, say, seven-tenths of an acre of water; but, just by pulling a little bit longer, we can increase the size of our hauls. It is really a method for straining a lot of water; that is what we are after, rather than just catching fish.

CHAIRMAN HUBBS: What is the dimension?

MR. MASSMANN: The cod end is lined with a one-quarter-inch liner, square bar mesh rather, one-quarter-inch bar; and the net itself is one-inch mesh, the wings and the sides.

However, we assume, perhaps wrongly so, that, as the net is being pulled through the water in this direction, those one-inch holes are not really one inch as the net goes through the water, but much smaller.

CHAIRMAN HUBBS: What is the size of bag and the length of wing?

MR. MASSMANN: The nets are 20 feet from one wing to the other, when we are pulling it as we do with the two boats and the nets extended; it is ten feet deep in the water, down ten feet from the surface.

DR. MCHUGH: I am sure some of you have some questions about the adequacy.

MR. VERNE DAVISON (Soil Conservation Service): Are we getting material evidence of a detrimental effect of side streams, compared with the clear ones, the James against the others?

MR. MASSMANN: Well, I am afraid that, at this point, as far as siltation evidence is concerned, we do have great differences in the turbidity of our streams, but the Chickahominy and Mattaponi are considered clear streams. I cannot, offhand, remember the Secchi-disk ranges; however, the James and Pamunkey Rivers are much more turbid.

However, the curve we get in the number of young fishes or the relative number of young fishes does not seem to coincide. For instance, in the Chickahominy, we get large numbers of one species; however, the Pamunkey, which is one of the most silty streams, gives very large numbers of shad.

There is some evidence that, in one particular river, in the James River, where they have cut through a number of buoys, those particular cut-offs have changed the river enough so that it appears that fishes normally found in rivers are not so prevalent anymore, as far as shad is concerned, since the cut-off has been made. That is one change; but, as far as evidence of turbidity, we just do not have it right now.

MR. ROLAND SMITH (New Jersey): I know you mentioned you had trouble in the James River with logs and so forth; but how much trouble do you have with floating debris clogging up your mesh surface, small stalks or something like that?

MR. MASSMANN: We have had almost no trouble at all with debris in the water. In the James River, it was primarily the big trees; we kept bumping into them, and some of them went right through the nets.

Of course, at night, we could not see them. However, under normal conditions, we had no trouble at all with clogging. After doing some minnow-seine sampling and some bottom trawling, it was a very great pleasure to work with these almost pure cultures which we were able to get.

We did some trawling up in the upper part of the Chesapeake Bay, around Havre de Grace, and an area where there is a considerable amount of *Vallisneria* and other weeds and we did get some weed clogging there.

Also, we stopped when we got to brackish waters, in regard to our sampling. In brackish and salt waters, we have had some trouble with jellyfishes clogging the nets.

DR. HUGH BENNETT: I am sort of a journal fisherman; I use corn for bait. I was wondering if there is any danger of this machine you have there being widely adopted. You catch fish at a rate there which would make it seem that some of us fishermen might want to adopt that method. (Laughter)

MR. MASSMANN: I would feel very flattered if I thought anybody would want to adopt a method like that.

Of course, by law, in Virginia waters, trawling in the bay or the rivers is absolutely verboten; it just cannot be done. Although we get tremendous numbers of small fishes, these are mostly young herring and so forth; they are of absolutely no value. We have cooked them up and eaten them, and they are not much good; I would just as soon as eat my manuscript. (Laughter)

DR. BENNETT: Another small question. Did I understand you to say you caught more shad where you had more silt?

MR. MASSMANN: The river which had the greatest number of young shad is one of the rivers which we consider a more silty river than the others. There are some differences in the silting of some of those rivers, just the over-all differences. Of course, that can change from day to day and from hour to hour. But the Pamunkey River is generally more turbulent than some of the others; however, the Pamunkey River is one of the best shad rivers. At least, so it seems from our sampling.

MR. ROMEO MANSWARDI (Chesapeake Biological Laboratory): Bill, have you noticed that, during the sampling season, during the span of the spawning season of those seven major species, did you find wide fluctuation and relative abundance of the seven major forms during that seasonal sample?

MR. MASSMANN: We really have not much of an idea of the variations in the relative abundance of the adults. We have no method for obtaining catch statistics, which is the only way to obtain information on the abundance of adults. Our general observations are, I consider, almost worthless in that regard.

I do know, however, that, in the Chickahominy River, as far as the herring are concerned, there are tremendous numbers of adult herring as compared with the other rivers during the spawning season. But, other than that, we just do not know.

DR. MCHUGH: I am sorry to chop off this interesting discussion, but our time is running out. Those of you who have any other questions, perhaps, can talk to Mr. Massmann after the meeting. I am sure he would be glad to tell you what he can about this work.

I will turn the meeting back to Dr. Hubbs.

CHAIRMAN HUBBS: I am very happy that we did start out here with some very good and lively discussion. I hope you will continue that through the entire session. You may give us a little headache here, trying to manipulate the time; but I think we will probably gain somewhere along the line. That one took just about the scheduled time for discussion.

(Announcements)

CHAIRMAN HUBBS: The next talk, which I hope also will induce discussion, is by my neighbor, John E. Fitch, of the California Department of Fish and Game, at the California State Fisheries Laboratory on Terminal Island, San Pedro. He will discuss, "Decline of Yield in Pacific Mackerel," one of the lines of research for which he has been responsible on the program of that unit.