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AGE AND SIZE COMPOSITION OF COMMERCIAL CATCHES OF BLUEBACK HERRING AND ALEWIFE IN ALBEMARLE SOUND, N.C. AND ITS TRIBUTARIES[1]

by

Preston P. Pate, Jr.

North Carolina Department of Natural and Economic Resources

Division of Commercial and Sports Fisheries

ABSTRACT

Data on commercial catches of blueback herring and alewife were collected at eight locations in the Albemarle Sound area. Scale samples were taken from 1,214 bluebacks and 787 alewife. Bluebacks ranged in age from three to nine years. Alewife ranged in age from three to eight years. Age groups IV and V dominated catches of both species. Data from all locations combined indicated that virgin fish comprised 50 and 57 percent of the landings of blueback and alewife respectively. Samples from Scuppernong River contained 78 percent virgin bluebacks and 92 percent virgin alewife. Data from Scuppernong River were compared to data from Alligator River in 1973. Blueback samples from Scuppernong River contained 79 percent virgins while samples from Alligator River contained 45 percent virgin bluebacks. A possible problem of over-exploitation exists in Scuppernong River.

INTRODUCTION

Albemarle Sound provides an exceptionally favorable habitat for spawning and nursery areas of anadromous fishes. This body of water is located in northeastern North Carolina (Figure 1). Currituck Sound and eight rivers, including the Roanoke and Chowan, are tributary to Albemarle Sound which in turn drains into northern Pamlico Sound through Coratan and Roanoke Sounds. Large volumes of freshwater input from rivers and lack of seawater exchange make Albemarle Sound an essentially freshwater habitat. Salinities in the eastern portion of the sound occasionally reach 1 to 2 parts per thousand depending upon wind direction and rainfall.

Seven species of anadromous fishes occur in North Carolina: Striped bass *(Morone saxatilis)*, American shad (*Alosa sapidissima*), hickory shad (*A.* mediocris), blueback herring (*A. aestivalis*), alewife (*A. pseudoharengus*), Atlantic sturgeon (*Acipenser oxyrhynchus*), and shortnose sturgeon (*A.* brevirostrum). Spawning migrations of these species during the spring support large commercial and recreational fisheries in Albemarle Sound and its tributaries.

The North Carolina Division of Commercial and Sports Fisheries began a long term study of adadromous fishes in 1971 to gather data pertinent to management of these stocks. Data is now being collected on spawning, eggs and larvae distribution, nursery areas, growth, movements within the estuary, age of fish in the inshore commercial and recreational fisheries, and characteristics of the oceanic and high seas fisheries.

Blueback herring and alewife are the most abundant of the seven anadromous species in North Carolina. Herring landings from North Carolina waters have ranged from 6.5 million pounds in 1952 to 19.8 million pounds in 1969. Approximately 95 percent of the total catch is landed in the Albemarle Sound region, particularly in Chowan River. Both species are sold fresh and salted for human consumption, but the largest portion of the landings is used as crab bait and fertilizer.

Age and size composition of commercial catches of blueback herring and alewife in 1972, and preliminary results from sampling in 1973, are presented herein.

The author would like to express his appreciation to Division personnel for their assistance in collection of data and preparation of this manuscript. Special thanks go to Ed McCoy, Chief, Research and Development Section, and John V. Merriner, Virginia Institute of Marine Science for review of this report, and Mrs. Ruth Thompson, typist.

MATERIALS AND METHODS

Twelve sites in the Albemarle Sound area were selected for sampling commercial landings of anadromous fishes (Figure 1). Data collected at these sites were considered to be representative of the total commercial landings in this area. Each sampling site was visited weekly, beginning with the second week in February and continuing until catches dropped to a level which did not warrant sampling. Types of gear employed by the fishermen included anchor gill nets, drift gill nets, haul seines, and pound nets. Use of drift gill nets was limited to Roanoke River while other gears were fished in the sound and its tributaries. Pound nets were set for river herring although all species of anadromous fish were captured.

An unculled sample of the day's catch was obtained when possible to determine species composition and sex ratios. When an unculled sample was not available, data were recorded from as many fish as possible without interferring with the normal operation of the fishermen or dealers. Sample size varied with the number of fish available at a site and time permitted for sampling. Samples usually did not exceed 100 fish.

Fork lengths were measured to the nearest millimeter and weights were recorded to the nearest two grams using a 500 gram platform scale. Scales were taken from the left side, below the insertion of the dorsal fin and above the midline as suggested by Rothschild (1963) and Marcy (1969). Approximately 20 scales were taken from each fish to avoid loss of data due to a high incidence of regenerated scales.

At least three of the most legible scales from each fish were read under a binocular microscope. Two independent readings were made of scales from each fish. Data from those fish for which scale readings were not in agreement were deleted from further analysis. It was assumed that each fish had completed a full year's growth at the time of capture, thus, the scale-edge was counted as a year mark.

RESULTS AND DISCUSSION

Data were obtained from 2,564 blueback herring and 1,271 alewife. Scale samples from 1,214 bluebacks and 787 alewife were taken from catches landed at eight of the twelve sample sites. Catches of river herring in the early part of the season were comprised mostly of alewife, but this species represents only a small portion of the total catch of river herring for a season. These data should not be interpreted as a true proportion of alewife to blueback in the natural population since no attempt was made to keep sample size proportionate to the total catch, nor were unculled camples available at all sample sites. Unculled samples from Chowan and Scuppernong Rivers contained 1,258 (70 percent) bluebacks and 544 (30 percent) alewife. This proportion more closely estimates the species composition of the run. Age frequency data did not provide a meaningful description of the dominance of particular age groups during the run due to small sample size.

Landings of blueback herring and alewife include fish ranging in age from three to nine years with four and five-year-old fish dominating in each species (Tables 1 and 2). These two age groups made up 66 percent of blueback catches and 67 percent of alewife catches. Sex ratio was approximately 1:1 in every age group with the exception of three and four-year-old bluebacks and three-year-old alewife where males were dominant. Males are expected to outnumber females in landings of year classes III and IV since male river herring usually mature and spawn one to two years earlier than females.

Occurrence of age groups one and two in the spawning areas in North Carolina has not been previously reported with information on migrations of non-spawning juvenile river herring. Previous reports conclude that alewife and blueback herring live in saltwater until they reach sexual maturity at ages three and four (Bigelow and Schroeder, 1953). Several two-year-old blueback herring and alewife were collected from commercial catches in the Albemarle Sound area during the 1973 season. Fishermen also reported sightings of these fish escaping from gear too large to hold fish in that size range (120-170mm). It remains to be proven whether this is a normal pattern for Albemarle Sound river herring or these fish represent only a few individuals migrating with spawning adults, though the latter is most probable.

Spawning marks appear on scales of fishes in the genus *Alosa* as scar-like rings and are formed through erosion or absorption of the scale margin during the spawning migration. These are considered year marks since they are formed at approximately the same time as annuli (Cating, 1953; Judy, 1961; Rothschild, 1963; Marcy, 1969).

Spawning marks provide a means of determining age at first spawn and number of successive spawning migrations each fish has made. However, scales without spawning marks from six and seven-year-old fish indicate that either formation of these markings may not occur invariably on scales from spawning fish or age at first spawn is extremely variable in these species. Fish showing no evidence of previous spawning will be referred to as virgins.

Virgin fish comprised 50 and 57 percent of the landings of blueback herring and alewife, respectively (Table 3). Virgin fish of both species were predominantly three and four-year-old individuals. Little variation existed in the number of virgin fish between sexes, but the percentage of virgin male alewife (66 percent) was slightly higher than virgin female alewife (49 percent).

Over 90 percent of the commercial catch of river herring in Nrth Carolina had spawned fewer than three times. Scales from blueback herring indicated as many as six previous spawns, but only 5 percent of the total blueback sample had three or more spawning marks. Scales from alewife had up to five spawning marks, but only 8 percent of the total alewife sample had two spawn marks.

Recruitment to the spawning population occurs predominantly at ages four and five for both species. Thus, these two age groups are expected to dominate commercial catches by non-selective gear such as pound nets at even a moderate fishing pressure.

Spawning frequencies for each location were similar to those for all locations combined with a single exception in the pound net fishery of Scuppernong River (Table 4). Virgin bluebacks represented 78 percent of the sample, and virgin alewife represented 92 percent of the alewife sample from Scuppernong River. Declining catches of river herring from Scuppernong River and a high percentage of virgin fish indicate a possible depletion of river herring in this river through overfishing. Harvest of river herring in Scuppernong River is exclusively by pound nets set in the lower one-third of the river. During the 1973 fishing season 28 pound nets were fished in this area. This represents extremely heavy fishing pressure for a river with a total surface area of only 3200 acres.

Spawning frequencies of catches from Scuppernong River in 1973 were compared with those from the Alligator River where only two pound nets were fished in 1973 (Tables 5 and 6). Alligator River supports a run of river herring, but fishing pressure remains light due to inaccessibility of the area. It has a surface area of 64,000 acres and is three miles wide at its mouth. Virgin bluebacks made up 79 percent of Scuppernong River samples and 45 percent of those from Alligator River in 1973. Virgin alewife made up 59 percent of the sample in Scuppernong River and 56 percent in Alligator River. Older individuals (ages six, seven and eight years) with two or more spawn marks were present more frequently in samples of both species from Alligator River. Although the sample of bluebacks from Alligator River was smaller than desired, the data indicate a marked difference in fishing mortality for both alewife and blueback between the two rivers.

Laboratory investigations by Reed (MS 1964) provided proof of the ability of blueback herring to return to their native stream to spawn. Thus, the effects of heavy exploitation would be a reduction in numbers of fish from older age groups and increased dependency on recruitment of virgin fish to support the fishery. This appears to be the case relative to other rivers tributary to Albemarle Sound. Heavy dependence of the river herring fishery in Scuppernong River upon new recruits provides an unstable management situation subject to drastic fluctuations in response to year class strength and mortality factors operable in the prerecruitment phase of life. Factors such as unfavorable spawning conditions and exploitation of juvenile fishes by the high seas fishery could result in poor year classes and marked reductions in landings of river herring in this and other rivers tributary to Albemarle Sound. Further investigations will provide mortality estimates for each river included in the Albemarle Sound area and substantive data for practical management - on a river by river basis if necessary of the stocks of anadromous species therein.

Table 1. Total number, percent of total sample, mean fork length, and length range in mm of each age group by sex for blueback herring, 1972.

Sex	Age	Total number	Percent of total sample	Mean fork length (mm)	Length range (mm)
Female	III	76	14	245	226-275
	IV	140	25	252	235-272
	V	217	39	258	236-281
	VI	97	18	264	251-281
	VII	22	4	268	250-290
	VIII	1	1	280	
	IX	1	1	307	
		554			
Male	III	112	16	231	210-247
	IV	243	36	241	212-264
	V	201	30	245	221-269
	VI	85	12	251	230-283
	VII	18	2	258	243-270
	VIII	1	2	270	
		660			

Table 2. Total number, percent of total sample, mean fork length, and length range in mm of each age group by sex for alewife, 1972.

Sex	Age	Total number	Percent of total sample	Mean fork length (mm)	Length range (mm)
Female	III	26	6	254	238-276
	IV	146	36	261	230-290
	V	113	28	270	239-292
	VI	75	18	277	251-298
	VII	35	8	283	255-311
	VIII	8	4	287	264-296
		403			
Male	III	81	21	236	220-263
	IV	171	44	249	226-275
	V	95	24	256	230-279
	VI	27	7	259	240-280
	VII	8	2	268	255-276
	VIII	2	1	279	264-281
		384			

Table 3. Spawning history of male and female blueback herring and alewife, for all locations combined in 1972. Numbers in parentheses are percentages of total for that sex.

Blueback herring

No times Spawned	0		1		2		3		4		5		Total	
Age	M	F	M	F	M	F	M	F	M	F	M	F	M	F
III	112	76										112	76	
IV	154	104	89	36									243	140
V	66	68	73	79	62	70							201	217
VI	4	16	12	17	53	46	16	18					85	97
VII		4	1		1	5	15	9	1	4			18	22
VIII									1	4			1	1
IX												1		1
Total	336	268	175	132	116	121	31	27	2	5		1	660	554
Pct.	(51)	(49)	(27)	(24)	(18)	(22)	(51)	(5)	(1)	(1)				

Alewife

III	81	26											81	26
IV	136	128	35	18									171	146
V	36	38	43	52	16	23							95	113
VI	1	5	6	13	14	46	6	11					27	75
VII				2		7	7	21	1	5			8	35
VIII							1	4		3	1	1	2	8
Total	254	197	84	85	30	76	14	36	1	8	1	1	384	403
Pct.	(66)	(49)	(22)	(21)	(8)	(19)	(4)	(9)	(1)	(2)	(1)	(1)		

Table 4. Spawning history of male and female blueback herring and alewife sampled from Scuppernong River in 1972. Numbers in parentheses are percentages of total for that sex.

Blueback Herring

No times spawned	0		1		2		3		4		5		Total	
Age	M	F	M	F	M	F	M	F	M	F	M	F	M	F
III	32	28											32	28
IV	18	33	8	2									26	35
V	6	7	1	6	4	6							11	19
VI		2				6								8
VII							3						3	
Total	56	70	9	8	4	12	3						79	90
Pct.	(78)	(78)	(13)	(9)	(6)	(13)	(4)							

Alewife

III	16	4											16	4
IV	24	24											24	24
V	3	2	2	1									5	3
VI				1	1	1							1	2
Total	43	30	2	2	1	1							46	35
Pct.	(94)	(91)	(4)	(6)	(2)	(3)								

Table 5. Spawning history of male and female blueback herring and alewife sampled from Scuppernong River in 1973. Numbers in parentheses are percentages of total for that sex.

Blueback Herring

No times spawned	0		1		2		3		4		5		Total	
Age	M	F	M	F	M	F	M	F	M	F	M	F	M	F
III	11	2											11	2
IV	58	29	1										59	29
V	24	26	24	9									48	35
VI				1		3								4
VII						2		1						3
VIII														
Total	93	57	25	10		5		1					118	73
Pct.	(79)	(78)	(21)	(14)		(7)		(1)						

Alewife

III	2	2											2	2
IV	20	13	1										21	13
V	4	14	9	16	1								14	30
VI	1		2	2		4							3	6
VII							1	2					1	2
VIII										1				1
Total	27	29	12	18	1	4	1	2		1			41	54
Pct.	(66)	(54)	(29)	(33)	(2)	(7)	(2)	(4)						

Table 6. Spawning history of male and female blueback herring and alewife sampled from Alligator River in 1973. Numbers in parentheses are percentages of total for that sex.

Blueback Herring

No times spawned	0		1		2		3		4		5		Total	
Age	M	F	M	F	M	F	M	F	M	F	M	F	M	F
III	1												1	
IV	11	6	5										16	6
V	14	3	22	7									36	10
VI		1	1	1	5	1							6	3
VII						1	1						1	1
VIII														
Total	26	10	28	8	5	2	1						60	20
Pct.	(43)	(50)	(47)	(40)	(8)	(10)	(2)							

Alewife

III	1	1											1	1
IV	35	24	2										37	24
V	7	4	11	9									18	13
VI			5	9	8	5		3					13	17
VII					2	2	7	7					9	9
VIII								2		6				8
Total	43	29	8	18	10	7	7	12		6			78	50
Pct.	(55)	(58)	(23)	(36)	(20)	(14)	(19)	(24)		(12)				

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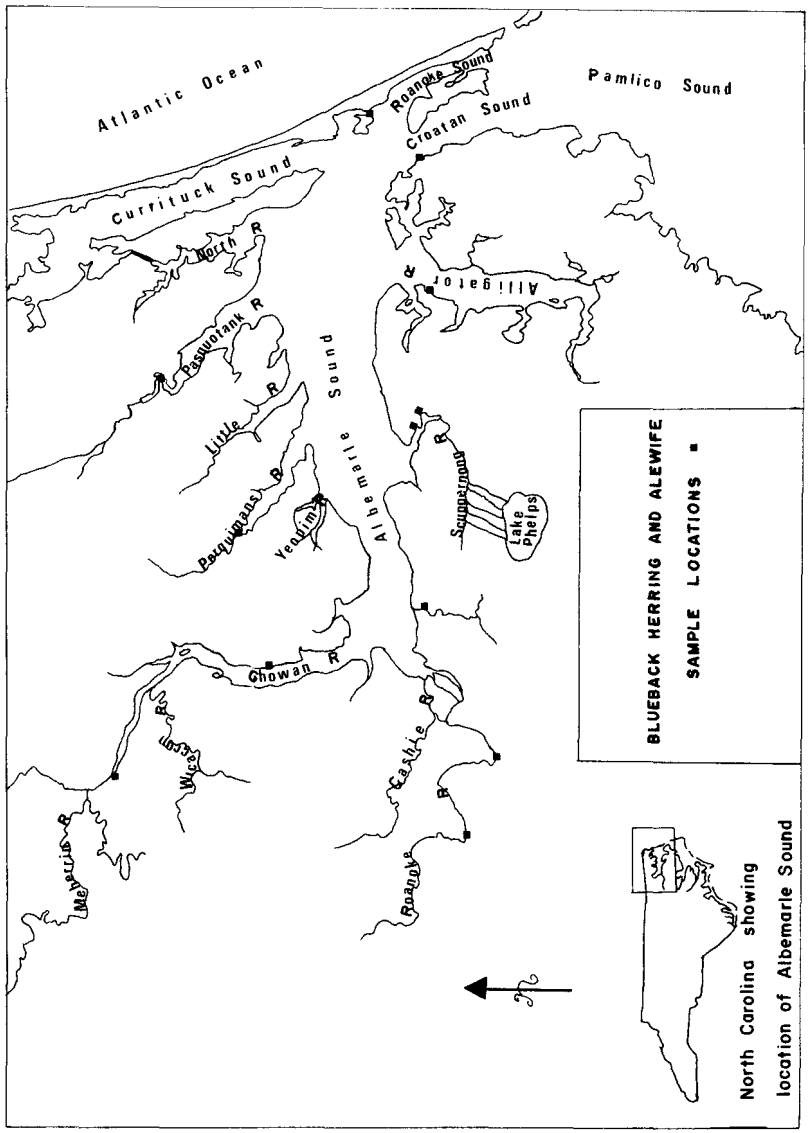

Figure 1. Location of Albemarle Sound and fish sampling sites therein.