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Annual Report, 1988

Project Title: Study of Alosa stock composition and year-class strength in Virginia

Project Number: AFC 20-2

Project Period: 1 February 1988 - 31 January 1989

Prepared by

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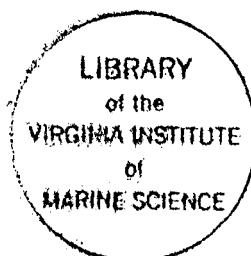


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PREFACE

This presentation is the annual report for P. L. 89-304, AFC 20-2 project "Study of Alosa stock composition and year-class strength in Virginia," for the period 1 February 1988 to 31 January 1989. The fishes of concern were the alewife (Alosa pseudoharengus), American shad (A. sapidissima), and the blueback herring (A. aestivalis).

The abundance of the Alosa stocks, once an important component of the landings of Virginia fisheries, dramatically decreased in the last decade. The 1981 landings of Alosa species in Virginia were the lowest ever recorded. American shad and river herring are also pursued by recreational fishermen in Virginia, but the extent and success of this activity is largely unknown. Additionally, these species have a vital ecological role. Young-of-the-year Alosa are the dominant pelagic prey species in their extensive freshwater and upper estuarine nursery grounds. After spawning, adults return to the sea and are prey of many marine piscivores. It is important that studies of the Alosa stocks in Virginia be continued. Current data, as well as historical data, are needed in order that data analyses may make constructive contributions to rational management strategies.

The research presented herein directly addresses research concerns stated in the Shad and River Herring Action Plan and augments on-going monitoring research and extant data bases. These data will be a pertinent contribution to the total data base that is being constructed to assist in the formulation of management strategies for the east coast Alosa stocks.

The following job was contracted by the Virginia Institute of Marine Science.

Evaluation of the Alosa Stocks and Fisheries in Virginia

Objectives

1. Estimate fishing effort, landings, and catch-per-unit-of-effort of adult river herring (alewife and blueback herring) and American shad in Virginia during the 1988 fisheries.
2. Determine the present status of the stocks relative to former years by comparison of landings and CPUE.
3. Estimate current biological statistics (age and size frequencies, species composition, etc.) of river herring and American shad.

ACKNOWLEDGMENTS

We are indebted to the following Virginia Institute of Marine Science personnel for their assistance in this project: Joice Davis, Connie Darouse, Steve Gornak, Marion Hennigar, Bruce Hill, Curtis Leigh, Jennifer Mathews, James Owens, Sandy Ring, Edward Sismour, Roanne Trapani, Hank Wooding, and Paula Williams. We also express our thanks to the many commercial fishermen who have so kindly helped us when we asked for their assistance. The Virginia landings data were supplied by the Virginia Marine Resources Commission.

The project was funded, in part, by the United States National Marine Fisheries Service, Northeast Region, through Public Law 89-304.

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EXECUTIVE SUMMARY

1. Landings in Virginia of all Alosa species decreased in 1988 relative to 1987. Overall gill net effort declined, accompanied by an increase in catch-per-unit-of-effort (CPUE).
2. Gill net fishermen landed an estimated 126 MT of American shad in the James, York and Rappahannock rivers.
3. The ocean intercept fishery off the shores of Virginia reported 91.1 MT of American shad in gill nets. Peak landings of 77.6 MT occurred during March.
4. Ages 5 and 6 were the modal groups of alewives in the Rappahannock and York rivers, respectively. The modal group of blueback herring was age 4 in the Rappahannock River, but its relative frequency was not significantly different than that of age 6. Blueback herring age 6 were the modal group in the York River.

Evaluation of the Alosa Stocks and Fisheries in Virginia

INTRODUCTION

The Virginia Institute of Marine Science (VIMS) continued its annual assessment of the Alosa stocks and fisheries in Virginia inshore waters in 1988. These data are a contribution to the extant data base and necessary for any consideration of a revision to the fisheries management plan.

MATERIALS AND METHODS

Semi-monthly samples of river herring were collected in 1988 from 9 March to the first week of May from the York and Rappahannock rivers. American shad samples were collected in March from the James and York and in April from the Rappahannock fisheries (Table 1).

When available, 22.7 kg of river herring were randomly sampled from commercial pound net catches in the York and Rappahannock rivers. These nets employ a 50.8 mm stretched mesh in their entrapment section, and are assumed to be nonselective for river herring age 3 or older.

Random samples of up to 100 American shad were taken from commercial stake gill net catches. The fishery primarily employs gill nets with 12.4 to 14.0 cm stretched mesh which favors the capture of females, the larger of the sexes.

River herring samples were returned to VIMS where species, sex, fork length (mm), and weight (g) were recorded. These data were used to partition the log-book estimates of landings in each sampling period into biomass and numbers-at-age. American shad data, except for age, were

collected at the sampling site. Ages of river herring were determined from otoliths, while the scales that were collected are held in reserve. American shad were aged from scales by the method of Cating (1953), i.e., counting the number of annuli and spawning check marks, and adding a year for the scale edge. A sonic digitizer microcomputer complex was used to "read" American shad scales (Loesch et al. 1985).

Pound net catch estimates for fisheries in the Rappahannock River were determined by multiplying the catch-per-unit-of-effort (CPUE) (kg/net per half-month) of the index nets by the number of nets actively fishing (weighted by net size) in each mile block of the river. Index nets are those for which daily records were kept by cooperating fishermen. Effort was determined by semi-monthly aerial counts of active pound nets (Table 2 and Fig. 1). Yearly pound net CPUE was calculated by dividing the total landings (kg) by effort. To obtain effort, the sum of the number of active pound nets in each half month was divided by two. This number was then multiplied by the number of days between pound net flight dates. The summation of these pound net days was then divided by the sum of the number of days between pound net flights to yield yearly effort.

Pound net fishermen in the lower strata of the Rappahannock River have not supplied catch and effort data since 1982. An estimate of the missing data for the lower portion of the river was made from its average proportion of the total catch in the upper and lower portions in the years 1978-1982. River herring samples were obtained downriver in 1988, but the CPUE was based upon index nets located upriver.

The catch and effort data for alewife and blueback herring were pooled because the fishery does not target one species or the other, and both federal and state agencies report all river herring landings as alewife.

Estimates of American shad catches by commercial stake gill net fishermen in the James, York, and Rappahannock rivers were determined by multiplying the CPUE (kg/m of net per half-month) of index nets by meters of stake gill netting in 5-nautical mile strata of the river. Effort was determined by a count of stake gill nets during the peak of the American shad fishing season (Table 3). Yearly stake gill net CPUE was determined by dividing total landings by total netting fished for shad.

Annual Alosa landings data from all Virginia waters and the Potomac River for the years 1968-1972 were obtained from the respective U.S. Fishery Statistical Digests. The 1973-1976 data were from the annual summaries of Current Fisheries Statistics, National Marine Fisheries Service (NMFS), Division of Statistics and Market News. Since 1976, total landings data for Virginia have been obtained from the Virginia Marine Resources Commission (VMRC). As was reported in 1987, estimates of the 1988 catches of river herring in the Rappahannock and York rivers were made from VIMS logbook data. The total catch in Virginia was determined by adding our estimates to the landings reported by VMRC for river herring fisheries other than in the Rappahannock and York rivers.

The PRIME 9955-II computer at VIMS was used in conjunction with the statistical package SPSS (Nie et al. 1975) to analyze data, and to construct tables and figures.

RESULTS AND DISCUSSION

Total Virginia Landings

VMRC preliminary data indicate that about 357 metric tons (MT) of river herring were landed in Virginia in 1988 (Fig. 2). The landings were a 8.7% decrease relative to their estimated 1987 catch (391 MT). VMRC data also

indicate that 241 MT of American shad were landed in 1988, a decrease of 23% relative to their estimate of 316 MT in 1987 (Fig. 3).

Decline in Alosa landings in 1988 probably do not reflect further decreases in stock sizes. The onset of cold weather shortly after the commencement of spawning reduced Alosa availability. Also, reported landings have been reduced by the method of handling catches of Alosa, particularly river herring. Increasing numbers of river herring, and to some degree American shad, are simply being sold as scrap. This condition notwithstanding, the Alosa stocks are low relative to their abundance one and a half to two decades ago.

Some specific contributions to the total 1988 landings of alosids are considered below.

James River Landings

Our aerial observations of pound net effort showed that no pound nets were set in the lower James River during 1988; however, six pound nets were fished from January 1988 through April 1988 at river mile 73 for gizzard shad (Dorosoma cepedianum). The nets were set in the heated outflow of an electric power plant and were fished throughout the winter months. The capture of finfishes has been severely restricted since 1975 as a result of kepone contamination. Pound net operations in the river ceased, except in the upper river, until the Summer of 1988 when one net was set at mile 20, after the kepone ban was lifted on 1 July 1988.

It was estimated from the logbooks of cooperating fishermen that stake gill nets caught about 12 MT of American shad in 1988 (Table 4), a 34% increase relative to 1987 (Table 5). Peak landings in 1988 occurred during the second half of March. No landings were reported for miles 20-60.

Chickahominy River Landings

Landings data collected through interviews with fishermen showed that approximately 236 MT of river herring were caught in the haul seine fishery in the Chickahominy River in 1988. The landings were about 57 MT more than the 1987 catch, and represented an increase of 24% relative to 1987 river herring landings in the river. No other alosid fisheries were reported in the Chickahominy River.

York River Landings

Estimated landings from logbook data showed a 7.8% increase in both stake gill net landings of American shad (sexes pooled) and the associated CPUE in 1988 relative to 1987 (Tables 5 and 6). American shad females also showed a slight increase, 0.16%, in 1988 relative to 1987. The dramatic decline that began in 1984 can be due to a decline in the spawning population. Peak landings of 44 MT of shad occurred during the second half of April (Table 7).

Rappahannock River Landings

Analysis of logbook data from cooperating pound net fishermen indicated that about 0.2 MT of American shad and 241 MT of river herring were landed in the Rappahannock River in 1988 (Table 8). Shad landings showed a substantial decrease (68.5%) compared to 1987 landings, while river herring landings in 1988 increased 27% compared to those of 1987. In addition to the reported landings, river herring are sold for scrap and thus are not included in the landings. Much of the scrap is then sold in southern states when the local supply of crab pot bait is depleted.

Stake gill netters in the Rappahannock River landed about 1.3 MT of American shad in 1988 (Table 9), about a 51% decline relative to the 1987 landings (2.7 MT). The decrease in landings is in part due to a decrease in effort as a result of the closure of the river to striped bass fishing from 1 December through 31 May.

Ocean-side Intercept Fishery

Landings data obtained from VMRC for the intercept fishery of American shad in Virginia oceanside waters, showed that 91.1 MT of American shad were caught in drift, stake and anchor gill nets. This represents 37.8% of the 1988 Virginia annual landings. Peak landings for the intercept fishery occurred during March, with 77.6 MT, compared to 36.5 MT for the James, York, and Rappahannock rivers combined (Tables 4,7,8, and 9).

Age Composition

The age frequencies of river herring (sexes pooled) determined from the 1988 samples of commercial catches in pound nets in the York and Rappahannock River fisheries are presented in Tables 10-13. The 1982 yearclass (age 6) of alewife was the modal group (14.9%) in the York River while the 1983 and 1984 yearclasses (ages 5 and 4, respectively) both accounted for 12.8% of the sample. On the Rappahannock River, however, the 1983 yearclass was the modal group (19.0%). The 14.9% and 19.0% representations of the 1982 and 1983 yearclasses on the York and Rappahannock rivers (Tables 10 and 12) exceed the highest occurrence of these ages of alewives, 13.4% and 1.6%, respectively, in 1975 (Hoagman and Kriete 1975). Like the alewife, the blueback on the York River had the 1982 yearclass (age 6) as its modal group (Table 11). Although the modal group

of blueback herring on the Rappahannock River was age 4, its relative frequency of 9.8% was not significantly different from the relative frequency of 9.5% for age 6 ($t = 0.91$, $P > 0.36$).

As in past years, American shad data reflect gill-net selectivity for large females (Table 14). Since females are larger at age than males, the female age structure is older. The female age frequency distribution in 1988 was not significantly different than in 1987 ($\chi^2 = 5.80$; $P = 0.32$) (Blumberg and Loesch 1987).

The river herring age composition data were used in conjunction with sex ratio and mean weight-at-age data to estimate year-class contributions to the total landings.

Length and Weight Analysis

Mean values for fork length and total body weight for river herring, derived from samples of the pound net catches in the York and Rappahannock rivers, are presented in Table 15. Similar data for American shad, derived from samples of gill net catches in the James, York, and Rappahannock rivers, are presented in Table 16.

As stated above, river herring mean weight-at-age data were used in conjunction with age composition and sex ratio data to estimate year-class contributions to the annual landings.

Species Composition

Alewife constituted 30.8% of the river herring sampled in the York and Rappahannock rivers in 1988 (Table 1), but were only 15% of the total landings in these two rivers (Table 6). The difference occurs each year because the samples are a constant weight (22.7 kg) rather than a constant

proportion of the catch. Alewife are the major proportion of the river herring samples only in periods when landings are low (March and early April). The proportion of blueback herring in the samples is superior when landings are much greater. Thus, the proportion of alewife in our total sample is enhanced relative to the actual contribution to the biomass of river herring landed. Each estimate of species percentages was therefore weighted by landings in the sampling period. The weighted estimates were then summed throughout the season to obtain the contribution of each species to the total biomass landed.

Sex Ratios

The sex ratio data (Table 1) were used in conjunction with species age structure and mean weight-at-age data to estimate year-class contributions to the total landings.

Recommendations

Monitoring of Alosa abundance in Virginia waters should be continued. Based on our calculations, landings in 1988 followed the declining trend that started in the late 1970's. Given the depressed condition of this fishery, reducing the length of the season of Alosa spp. may give the stock a chance to recover. We believe a major step toward the enhancement of the American shad populations would be the elimination of the ocean-side gill net fisheries.

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Table 1. Summary of sample data from the Alosa commercial fisheries during the 1988 spawning run in the major Virginia tributaries to Chesapeake Bay.

River and Month	Alewife		Blueback		American Shad	
	Male	Female	Male	Female	Male	Female
<u>James</u>					24	67
<u>York</u>						
March	63	101	17	5	56	89
April	2	20	95	145	-	-
May	-	2	74	66	-	-
<u>Rappahannock</u>						
March	86	96	-	-	-	-
April	7	11	97	141	18	69
May	13	28	41	49	-	-
Totals(M&F)	429		730		323	

Table 2. Number of active pound net stands in Chesapeake Bay and its Virginia tributaries during January - May 1988*.

Area	27 Jan	7 Mar	24 Mar	6 Apr	25 Apr	10 May	23 May
A James River	6	6	6	6	6	0	0
B Back River	0	0	0	0	0	0	0
C Poquoson River	0	0	0	0	0	0	0
D York River	0	3	5	9	11	10	12
E Mobjack Bay	0	0	1	0	2	2	1
F Piankatank River	0	1	1	0	1	1	1
G Rappahannock River	0	4	9	10	11	15	17
H Great Wicomico River	0	0	0	0	0	0	0
I Potomac River	0	15	26	36	46	58	60
Virginia tributaries to Potomac River	1	2	2	2	2	2	2
J Cape Henry-Fort Wool	0	0	2	4	4	5	3
K Old Point-Tue Marsh Point	0	1	1	1	0	0	0
L York Spit	0	0	0	0	1	1	3
M New Point-Stingray Point	0	4	5	9	9	9	10
N Windmill Point-Smith Point	0	2	4	9	8	8	9
<u>Eastern Shore</u>							
O Above Hungar Creek	0	0	0	0	0	1	2
P Below Hungar Creek	0	0	9	26	24	29	22
Total	7	38	71	112	125	141	142

* Funding unavailable in February.

Table 3. Number of stake gill net stands fished in Virginia rivers 1986-1988 (A) and linear meters of gill netting fished primarily for American shad per 5-mile block (B) in 1988. Figures in parentheses represent the total meters of gill netting in the James, York, and Rappahannock rivers.

A. River		Number of Gill Net Stands		
		1986	1987	1988
James		88	22	23
York		132	119	112
Rappahannock		8	9	11

B. River	Mile	Number of Stands	Number of Sections	Average Length/section	Meters of Net
James					
	05-10	16	354	9.1	(3,221) 3,221
	10-15				
	15-20	5	70	9.1	(637) (a)
	20-25	2	29	12	(348) (a)
	Total	23	453		(4,206) 3,221
York					
	05-10	1	15	14.2	(213) 213
	10-15	39	741	14.2	(10,522)10,507
	15-20	21	325	14.2	(4,615) 4,608
	20-25	24	446	7.6	(3,390) 3,290
	25-30	27	461	7.6	(3,504) 3,401
	Total	112	1,988		22,244 22,019
Rappahannock					
	25-30	4	68	15.7	(1,068) 417
	30-35	7	118	15.7	(1,853) 724
	Total	11	186		2,921 1,141

(a) Data unavailable for upriver miles.

Table 4. Estimated catch in kg of American shad by stake gill nets for 5-mile sections in the James River 1988 by half-month intervals and by sex. Effort from Table 3. Index in kg/m of net.

Half-month Period	River Mile	American Shad				Total Estimated Catch
		Male		Female		
		Index	Estimated Catch	Index	Estimated Catch	
March 2nd	05-10	0.2840	915	1.0664	3,435	4,350
	10-15		-			
	Total		915		3,435	
April 1st	05-10	0.2203	710	2.1482	6,919	7,629
	10-15					
	Total		710		6,919	
Total			1,625		10,354	11,979
Grand Total						

Table 5. Yearly landings in kg of American shad by pound nets and stake gill nets, and river herring by pound nets, 1977-1988.

	Stake Gill Net		Pound Net			
	American Shad		American Shad		River Herring	
	M	F	M	F	Alewife	Blueback
James River						
1977	11,612	186,495				
1978	116,348	574,935				
1979	17,328	263,203			(a)	
1980	59,003	343,026				
1981	12,056	105,550				
1982	21,811	37,731				
1983	46,822	146,715				
1984	35,531	169,990				
1985	16,922	71,232				
1986	11,772	17,977				
1987	913	7,052				
1988	1,625	10,354				
York River						
1977	3,376	137,748	8,894	3,217	10,298	87,966
1978	31,666	174,780	16,676	13,141	16,021	135,954
1979	23,460	186,074	5,492	10,224	22,256	195,150
1980	25,012	246,719	2,267	6,453	43,391	176,955
1981	23,453	158,905	2,361	630	5,454	189,769
1982	23,811	134,676	5,236	179	15,499	197,621
1983	45,717	167,590	2,780	2,157	2,714	40,979
1984	58,104	196,550	2,469	1,056	4,131	40,066
1985	36,786	120,951	1,336	645	5,175	14,850
1986	32,886	72,542				
1987	12,362	88,237			(a)	
1988	20,758	88,380				
Rappahannock River						
1977	2,298	22,053	2,949	1,268	84,688	209,163
1978	10,909	45,870	2,096	1,871	130,804	381,734
1979	2,199	21,619	2,046	1,562	56,016	423,633
1980	1,366	8,831	614	1,038	23,283	195,354
1981	2,621	10,015	824	832	33,767	287,963
1982	2,616	5,256	2,395	1,487	87,689	327,893
1983	2,113	4,969	1,629	747	103,066	313,873
1984	5,043	12,949	2,225	936	113,787	413,839
1985	3,284	6,152	602	248	49,104	152,696
1986	888	1,958	382	191	21,860	60,284
1987	927	1,771	465	148	40,004	136,060
1988	404	878	156	37	52,530	188,350

(a) Data not available.

Table 6. Yearly catch-per-unit-of-effort for American shad in stake gill nets and river herring in pound nets for the years 1976-1988. Stake gill net effort is in meters of netting. Pound net effort is in number of net-days per season.

	Stake Gill Net			Pound Net	
	Effort	American Shad		Effort	River Herring
		M	F		
James River					
1977	26,884	0.4	6.9	(a)	
1978	28,134	4.1	20.4		
1979	37,207	0.5	7.1		
1980	41,739	1.4	8.2		
1981	38,250	0.3	2.8		
1982	15,088	1.4	2.5		
1983	18,485	2.5	7.9		
1984	16,911	2.1	10.0		
1985	23,143	0.7	3.1		
1986	11,968	1.0	1.4		
1987	4,104	0.2	1.7		
1988	3,221	0.5	3.2		
York River					
1977	19,326	0.2	7.1	9.88	9,946
1978	15,954	2.0	10.9	12.74	11,929
1979	13,968	1.7	13.3	12.00	18,117
1980	19,940	1.3	12.4	15.95	13,815
1981	21,298	1.1	7.5	17.50	11,156
1982	28,262	0.8	4.8	21.05	10,124
1983	30,404	1.5	5.5	11.82	3,696
1984	23,515	2.5	8.4	8.33	5,306
1985	25,595	1.2	4.7	7.34	2,189
1986	18,303	1.8	4.0	(a)	
1987	23,670	0.5	3.7		
1988	22,019	0.9	4.0		
Rappahannock River					
1977	13,595	0.2	1.6	32.01	6,534
1978	13,681	0.8	3.4	27.28	18,788
1979	13,497	0.2	1.6	34.93	13,732
1980	8,758	0.2	1.0	28.00	7,808
1981	11,591	0.2	0.9	45.53	7,066
1982	6,736	0.4	0.8	32.44	12,811
1983	6,836	0.3	0.7	34.80	11,981
1984	5,742	0.9	2.3	34.26	15,401
1985	4,453	0.7	1.4	15.24	13,241
1986	1,102	0.8	1.8	24.11	3,406
1987	1,356	0.7	1.3	13.90	12,666
1988	1,141	0.4	0.8	10.86	22,027

(a) Data not available.

Table 7. Estimated catch in kg of American shad by stake gill nets for 5-mile sections in the York River 1988 by half-month intervals. Effort from Table 3. Index in kg/m of net.

Half-month Period	River Mile	American Shad				Total Estimated Catch
		Male		Female		
		Index	Estimated Catch	Index	Estimated Total	
February 2nd	05-10					
	10-15	(a)		(a)		
	15-20					
	20-25	0.1080	355	0.1055	347	702
	25-30		367		359	726
	Total		722		706	1,428
March 1st	05-10		26		29	55
	10-15	0.1216	1,277	0.1344	1,412	2,689
	15-20		560		619	1,179
	20-25	0.2524	830	0.2533	834	1,664
	25-30		858		861	1,719
	Total		3,551		3,755	7,306
March 2nd	05-10		51		138	189
	10-15	0.2375	2,496	0.6488	6,817	9,313
	15-20		1,095		2,990	4,085
	20-25	0.3805	1,252	1.2253	4,031	5,283
	25-30		1,294		4,167	5,461
	Total		6,188		18,143	24,331
April 1st	05-10		29		136	165
	10-15	0.1351	1,419	0.6392	6,716	8,135
	15-20		622		2,945	3,567
	20-25	0.1529	503	1.0398	3,421	3,924
	25-30		520		3,537	4,057
	Total		3,093		16,755	19,848
April 2nd	05-10		14		130	144
	10-15	0.0673	708	0.6115	6,425	7,133
	15-20		310		2,817	3,127
	20-25	0.7207	2,370	4.2593	14,013	16,383
	25-30		2,451		14,485	16,936
	Total		5,853		37,870	43,723
May 1st	05-10		6		28	34
	10-15	0.0284	298	0.1295	1,361	1,659
	15-20		130		596	726
	20-25	0.1370	451	1.3699	4,507	4,958
	25-30		466		4,659	5,125
	Total		1,351		11,151	12,502
Total			20,758		88,380	
Grand Total						109,138

(a) No effort in these strata during this period.

Table 8. Estimated catch in kg of American shad and river herring by pound nets in the Rappahannock River 1933 by half-month intervals. Number of index nets has been rounded to the nearest whole number.

Half Month Period	Mile	Number of Nets	American Shad				River Herring				Number of Index Nets		
			Male		Female		Estimated Index	Estimated Total	Alewife			Blueback	
			Index	Estimated Total	Index	Estimated Total			% Estimated	Total		% Estimated	Total
March 1st	31-70	1		(a)		(a)	28.0	28	100	28		(b)	1
March 2nd	31-70	2	2.0	4		(a)	83.0	166	100	166		(b)	1
April 1st	31-70	5	1.6	8	0.6	3	108.2	541	95	514	5	27	3
April 2nd	31-70	7	4.5	32	0.5	4	1,051.3	7,359	10	736	90	6,623	4
May 1st	31-70	7	0.5	4	0.8	6	1,824.5	12,772	31	3,959	69	8,813	4
May 2nd	31-70	7	8.0	56	1.7	12	1,303.3	9,123	31	2,828	69	6,295	3
June 1st	31-70	5	2.3	12		(a)	24.1	121	31	37	69	84	1
June 2nd	31-70	1	1.0	<u>1</u>		<u>(a)</u>				<u>(b)</u>		<u>(a)</u>	1
Total				<u>117</u>		<u>25</u>				<u>8,268</u>		<u>21,842</u>	
Grand Total						142						30,110	
Estimated landings mile 0-30				<u>39</u>		<u>12</u>				<u>44,262</u>		<u>166,508</u>	
						51						210,770	
Grand Total for Rappahannock River						193						240,880	

(a) None reported by index fishermen.

(b) River herring percentages based on ratios from first half of May.

Table 9. Estimated catch in kg of American shad by stake gill nets in the Rappahannock River 1988 by half-month intervals. Effort from Table 3. Index in kg/m of net.

American Shad						
Half-Month Period	River Mile	Male		Female		Total Estimated Catch
		Index	Estimated Catch	Index	Estimated Catch	
March 1st	25-30		1		2	3
	30-35	.0020	2	0.0040	3	5
	Total		3		5	8
March 2nd	25-30		63		73	136
	30-35	0.1509	109	0.1741	126	235
	Total		172		199	371
April 1st	25-30		26		111	137
	30-35	0.0614	44	0.2673	194	238
	Total		70		305	375
April 2nd	25-30		33		94	127
	30-35	0.0781	57	0.2272	165	222
	Total		90		259	349
May 1st	25-30		25		40	65
	30-35	0.0607	44	0.0959	69	113
	Total		69		109	178
		Total	404		877	
		Grand Total				1,281

Table 10. Year-class frequency of alewife (sexes pooled) in the York River commercial fishery samples, 1988.

CATEGORY LABEL	* CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	79.	1	0.5	1.1	1.1
	80.	1	0.5	1.1	2.1
	81.	14	7.4	14.7	16.8
	82.	28	14.9	29.5	46.3
	83.	24	12.8	25.3	71.6
	84.	24	12.8	25.3	96.8
	85.	3	1.6	3.2	100.0
	9.	93	49.5	MISSING	100.0
	TOTAL	188	100.0	100.0	
MEAN	82.653	STD ERR	0.122	MEDIAN	82.646
MODE	82.000	STD DEV	1.192	VARIANCE	1.421
KURTOSIS	-0.246	SKEWNESS	-0.256	RANGE	6.000
MINIMUM	79.000	MAXIMUM	85.000		
VALID CASES	95	MISSING CASES	93		

* Age code

9 - This code refers to otoliths that were not readable or not collected.

Table 11. Year-class frequency of blueback herring (sexes pooled) in the York River commercial fishery samples, 1988.

CATEGORY LABEL	* CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	79.	6	1.5	4.5	4.5
	80.	12	3.0	9.0	13.5
	81.	20	5.0	15.0	28.6
	82.	40	10.0	30.1	58.6
	83.	29	7.2	21.8	80.5
	84.	26	6.5	19.5	100.0
	9.	269	66.9	MISSING	100.0
	TOTAL	402	100.0	100.0	
MEAN	82.143	STD ERR	0.120	MEDIAN	82.212
MODE	82.000	STD DEV	1.382	VARIANCE	1.911
KURTOSIS	-0.470	SKEWNESS	-0.435	RANGE	5.000
MINIMUM	79.000	MAXIMUM	84.000		
VALID CASES	133	MISSING CASES	269		

* Age Code.

9 - This code refers to otoliths that were not readable or not collected.

Table 12. Year-class frequency of alewife (sexes pooled) in the Rappahannock River commercial fishery samples, 1988.

CATEGORY LABEL	* CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	79.	1	0.4	0.8	0.8
	80.	7	2.9	5.5	6.3
	81.	13	5.4	10.2	16.4
	82.	35	14.5	27.3	43.8
	83.	46	19.0	35.9	79.7
	84.	23	9.5	18.0	97.7
	85.	3	1.2	2.3	100.0
	9.	114	47.1	MISSING	100.0
		-----	-----	-----	
	TOTAL	242	100.0	100.0	
MEAN	82.555	STD ERR	0.104	MEDIAN	82.674
MODE	83.000	STD DEV	1.176	VARIANCE	1.383
KURTOSIS	0.151	SKEWNESS	-0.487	RANGE	6.000
MINIMUM	79.000	MAXIMUM	85.000		
VALID CASES	128	MISSING CASES	114		

*Age code

9 - This code refers to otoliths that were not readable or not collected.

Table 13. Year-class frequency of blueback herring (sexes pooled) in the Rappahannock River commercial fishery samples, 1988.

CATEGORY LABEL	* CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
	75.	1	0.3	0.9	0.9
	78.	1	0.3	0.9	1.8
	79.	1	0.3	0.9	2.6
	80.	9	2.7	7.9	10.5
	81.	18	5.5	15.8	26.3
	82.	31	9.5	27.2	53.5
	83.	21	6.4	18.4	71.9
	84.	32	9.8	28.1	100.0
	9.	214	65.2	MISSING	100.0
	TOTAL	328	100.0	100.0	
MEAN	82.307	STD ERR	0.144	MEDIAN	82.371
MODE	84.000	STD DEV	1.535	VARIANCE	2.356
KURTOSIS	3.457	SKEWNESS	-1.234	RANGE	9.000
MINIMUM	75.000	MAXIMUM	84.000		
VALID CASES	114	MISSING CASES	214		

*Age code

9 - This code refers to otoliths that were not readable or not collected.

Table 14. Year-class frequency of American shad in the Virginia commercial gill net fishery, 1988.

Sex	Year Class	James	York	Rappahannock	Total	Frequency (%)
Male	1979	1			1	1.12
	1980	1			1	1.12
	1981	4	1	1	6	6.74
	1982	11	13	4	28	31.46
	1983	4	28	8	40	44.94
	1984		<u>10</u>	<u>3</u>	<u>13</u>	14.61
Total		21	52	16	89	
Female	1979	1	1	1	3	1.51
	1980	8	3	1	12	6.06
	1981	18	6	9	33	16.67
	1982	25	42	20	87	43.94
	1983	7	22	22	51	25.76
	1984	<u>3</u>	<u>5</u>	<u>4</u>	<u>12</u>	6.06
Total		62	79	57	198	

Table 15. Length (mm) and weight (g) statistics for river herring in the York and Rappahannock rivers, 1988.

Species	Sex		York			Rappahannock		
			N	Mean	Std. Error	N	Mean	Std. Error
Alewife	Male	Length	65	241.6	1.764	107	244.2	1.551
		Weight	65	215.1	4.763	107	213.2	4.037
	Female	Length	123	253.4	1.367	133	255.9	1.328
		Weight	121	253.3	4.514	133	256.9	4.804
Blueback	Male	Length	186	231.5	1.326	137	229.2	1.394
		Weight	186	159.9	2.479	137	155.9	2.355
	Female	Length	216	240.5	0.997	191	241.7	1.101
		Weight	216	182.6	2.652	189	188.8	2.986

Table 16. Length (mm) and weight (g) statistics for American shad in the James, York, and Rappahannock gill net fisheries 1988.

Sex		James			York			Rappahannock		
		N	Mean	Std. Error	N	Mean	Std. Error	N	Mean	Std. Error
Male	Length	24	420.3	4.887	56	401.6	2.143	18	413.4	7.449
	Weight	24	1,296.2	47.372	56	1,110.9	15.823	18	1,186.7	77.635
Female	Length	67	454.8	3.840	89	441.6	2.846	69	454.6	3.294
	Weight	67	1,655.5	40.930	89	1,538.7	28.942	69	1,683.1	41.403

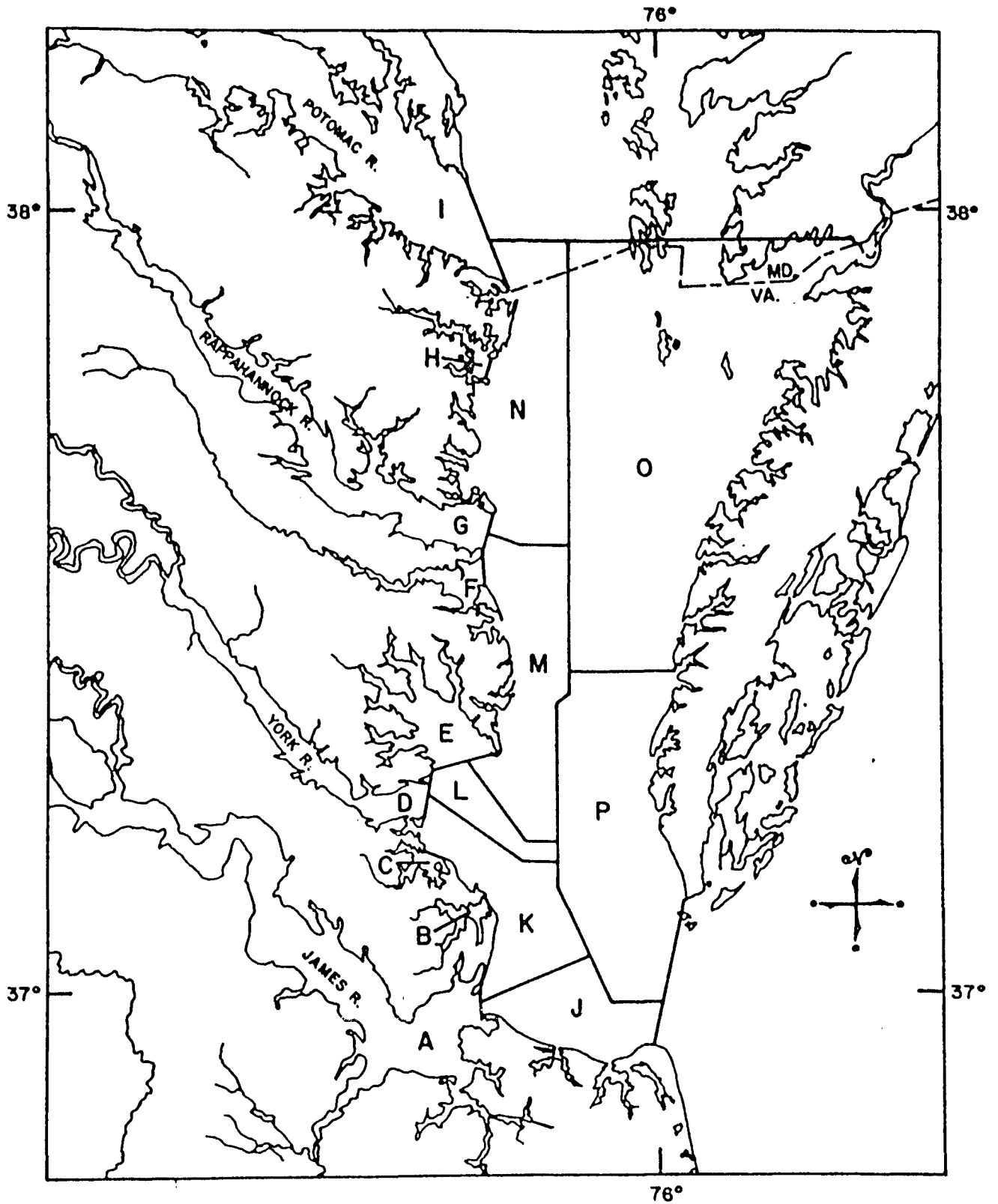
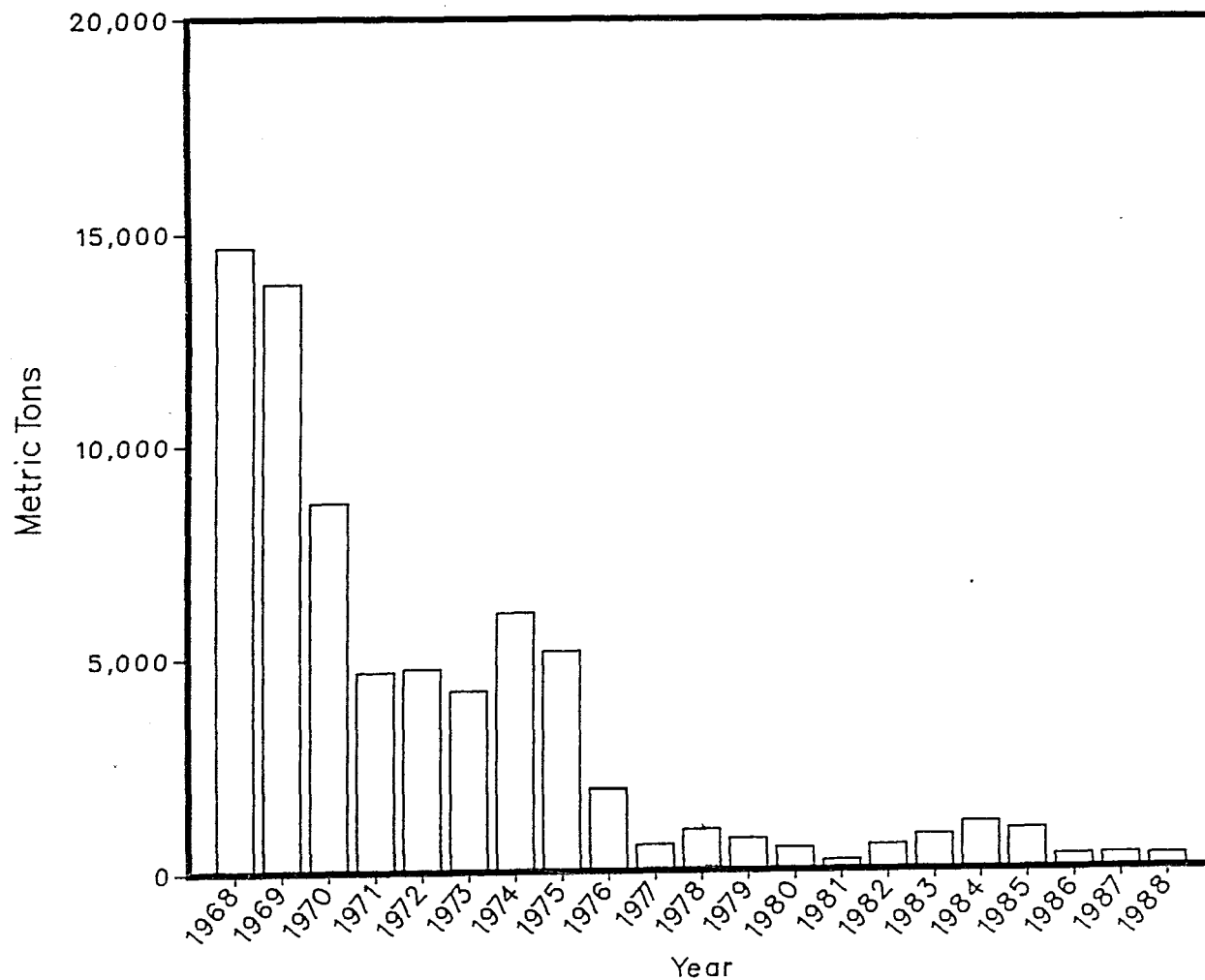


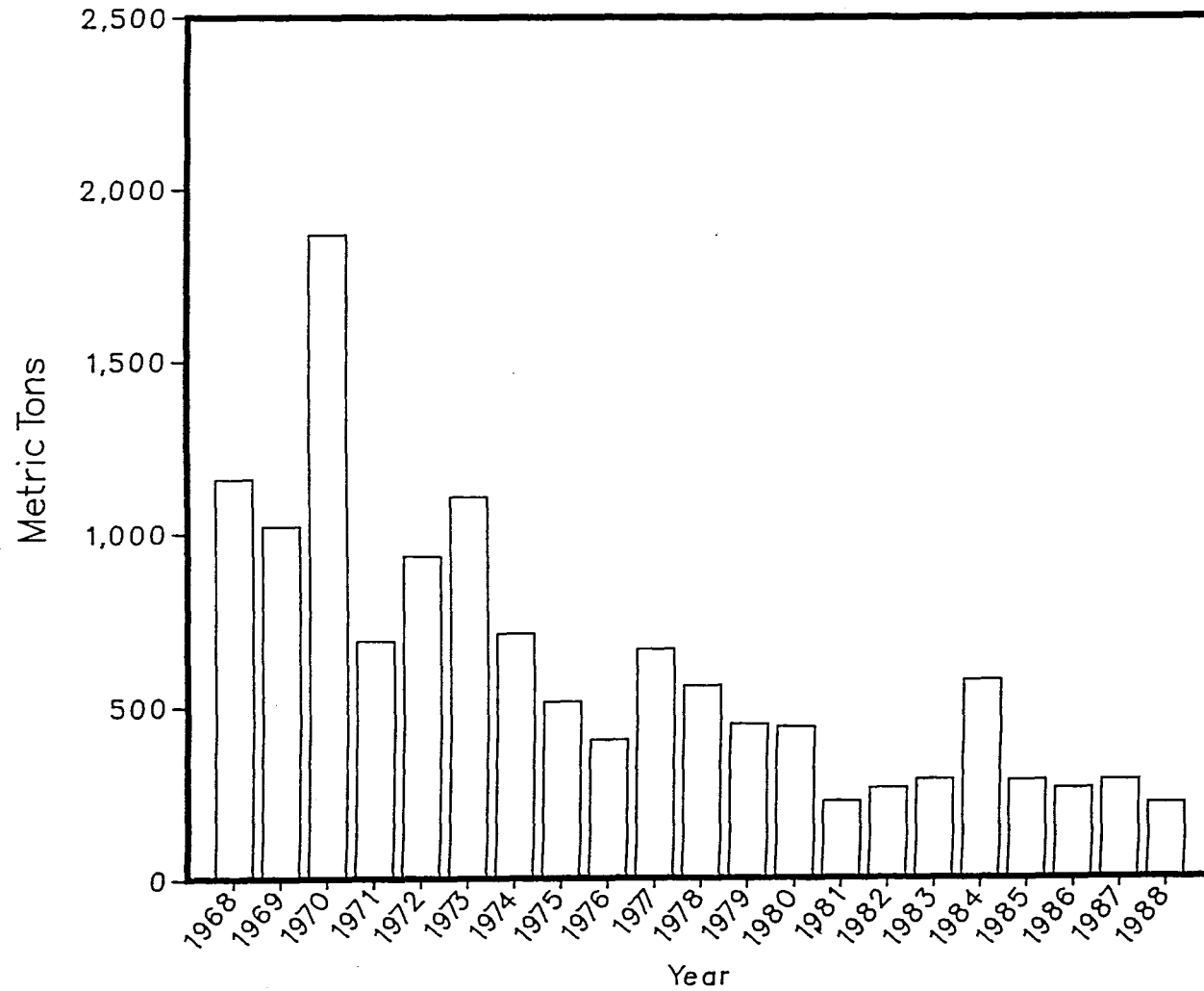
Figure 1. Area designations utilized during aerial pound net counts.

Figure 2. Virginia Landings of River Herring
1968 – 1988.



1 metric ton = 2205 lb.

Figure 3. Virginia Landings of American Shad
1968 – 1988.



1 metric ton = 2205 lb.