CONCLUSION 3 BY THE REVIEWING AGENCY

About three-fourths of the expected use will be local in character, drawn from counties closely related to the reservoir.

Comment: On Saturday, 26 April 1969, there were no hotel or motel reservations to be had in the entire city of Eufaula. The available establishments for commercial lodging consist of six large motels and one hotel. Just about every parking space was occupied by an out-of-state automobile with a fishing boat on a trailer.

CONCLUSION 4

It appears improbable that state authorities will be interested in installing and operating reservoir-side parks.

Comment: At Cowikee Creek, Lake Walter F. George, the Alabama Department of Conservation is proposing to develop a multi-million-dollar recreation complex, perhaps the largest in the State.

From the above conclusions it can be seen that the predictions were logical and would have been correct, except the fish and the people did not bother to observe the predictions.

The point to all this is that we just don't know enough about the fish dynamics in lakes such as these to either predict the future fisheries conditions, or to accurately pin-point what is right or wrong with existing conditions of impoundment management. It is difficult to argue with success, and the fisheries resource at these lakes can be classed as a success. To be honestly frank about the situation, this success may be because of our manipulation, or it may be in spite of our manipulation. The Corps does not know for sure, but we are carrying out the procedures given by the fish and game agencies.

In the meantime, the Corps and the fish and game agencies will continue to manage pool elevations for what they believe to be to the benefit of the fisheries resources. So far we have been able to have flood control, power generation, navigation, recreation and good fishing. It will take a lot of doing to come with a better program with greater benefit to all concerned.

PRELIMINARY RESULTS FROM STRIPED BASS TAGGING IN VIRGINIA, 1968-1969 [1]

By GEORGE C. GRANT, VICTOR G. BURRELL, JR., C. E. RICHARDS, and EDWIN B. JOSEPH

Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

ABSTRACT

A total of 8525 striped bass, *Morone saxatilis* (Walbaum), were tagged and released in Virginia during 1968 and 1969. Releases were grouped in three periods: (1) 3195 in winter 1968, (2) 2439 during summer-fall 1968, and (3) 2891 in winter 1969. Streamer disc tags, employed in winter 1968, were subsequently replaced by internal anchor tags (Floy Tag No. FD-67). This substitution shortened application time and eliminated a source of bias introduced by the entanglement of disc tags in gill nets. Releases were made in the James, York, and Rappahannock rivers in all three periods. Rewards of one dollar have been paid for return of tags.

Percentages of returns within tagged year-classes increased with age, indicating change in fishing mortality rates of striped bass during their initial 3 to 4-year residence in the lower Chesapeake Bay system. The

[1] Virginia Institute of Marine Science Contribution No. 350.

older the pre-migrating tagged fish, the more likely its recapture. Proportions of total catch taken by different types of fishing gear are being estimated. Seasonal and annual differences, and differences between neighboring rivers are evident. The recreational share of total catches varied, depending on locale and season, between 10% and 50%. Estimates of annual fishing mortality rates, although preliminary, are included in a discussion of our utilization of tag return data in estimation of population parameters. Inferences on the behavior and migration of stocks are included.

INTRODUCTION

Various aspects of the biology of striped bass, *Morone saxatilis* (Walbaum), have been explored in studies of Chesapeake Bay stocks. Particular attention has been directed toward age and growth (Pearson, 1938; Tiller, 1943, 1950; Vladykov and Wallace, 1952; and Mansueti, 1955, 1961), and the migratory habits of striped bass populations (Pearson, 1938; Vladykov and Wallace, 1938, 1952; Mansueti, 1956, 1961; Chapoton and Sykes, 1961; Massmann and Pacheco, 1961). The last coordinated effort to obtain necessary data from striped bass populations in this area was that of the Chesapeake Bay Cooperative Striped Bass Program (Sykes, 1961).

Estimates of those parameters necessary for management of Virginia striped bass stocks were still lacking in 1967, when the present study [2] of local populations was initiated. Principal objectives are estimates of age composition, proportions of total catch taken by the various fishing gear-types, age selectivity of these gear types, total and fishing mortality rates, and relative abundance of individual year classes. Two of these objectives (division of catch among gear types and mortality estimates) depend on tag-and-recapture methods. The present report is limited to a preliminary summary of tag return data through July 1, 1969.

The authors gratefully acknowledge the long and continuous assistance of Captain R. J. Hochban of the R/V *Pathfinder;* the field efforts of William H. Kriete, George R. Thomas, and James C. Owens; and the laboratory and office assistance of Evelyn N. White, Alice Lee Tillage, and Joice S. Davis. Mrs. Jane Davis prepared the figures.

METHODS AND MATERIALS

Tagged striped bass have been released in Virginia waters, to date, within three distinct periods. Returns from these tagging periods will be treated separately in the following tabulations and discussion. The initial period, January-March 1968, will be referred to as winter 1968. Remaining tagging periods were summer-fall 1968 and winter 1969 (Table 1).

Five types of tags have been applied, three of them only variations in tying materials or tying methods. Our initial choice of the streamer disc tag resulted from perusal of published reports of tag comparisons (Davis, 1959; Lewis, 1961) and the desirability of using a tag widely employed on striped bass in the past. Streamer disc tags were tied in three ways: (1) with 27-pound nylon fishing line using knots identical to those employed in earlier Chesapeake Bay studies, (2) with 27-pound dacron fishing line, knotted as above, and (3) tags spliced on 27-pound dacron, then tied to fish with a bowline knot. A dart tag (Floy Tag and Manufacturing, Inc., No. FT-6B) was applied in limited numbers during the initial tagging period. The fifth type of tag was an internal anchor tag (Floy No. FD-67), described by Dell (1968).

Striped bass were obtained for winter tagging, in large part, by trawling in river channels with a 30-foot semi-balloon trawl. Local movements of these populations into shoal areas during warm months necessitated use of other gear types. Fish were tagged during the summer-

2 This project was financed in part with Anadromous Fish Act (P. L. 89-304) funds through the Bureau of Sport Fisheries and Wildlife.

fall 1968 period from pound nets in the James and Rappahannock rivers, and from hook-and-line catches in the York River. Tagging of haul seine catches in the winter of 1969 will be discussed below.

TABLE 1. Releases of tagged striped bass in Virginia rivers, 1968-1969.

Date	River	Number of Fish Tagged	Tag Types	Fishing Gear Employed
Winter 1968				
Jan. 29-Feb. 7	York	1468	Streamer disc and dart	30′ trawl
Feb. 13-20	Rappahannock	1178	"	"
Feb. 27-28	James	85	"	"
Mar. 5-6	York	464	"	"
	Total	3195		
Summer-Fall 1968				
June 17-Nov. 26	York	392	Internal anchor	Hook-and-line
July 3, 8	Rappahannock	1494	"	Pound net
July 29-Aug. 2	James	553	"	"
	Total	2439		
Winter 1969				
Jan. 8-Feb. 25	York	114	Internal anchor	30′ trawl
Jan. 15-Feb. 19	Rappahannock	1161	"	"
Mar. 12-18	James	301	"	"
Mar. 25	York	771	"	Haul seine
Apr. 1	James	544	"	"
	Total	2891		

Scales were removed from the site of tag insertion for aging, and the fork length of each tagged fish was recorded along with tag number on the scale envelope. Scale impressions were formed on cellulose acetate with a heated Carver hydraulic press and examined under 15x magnification. A data card for each released tag contains the following information: species and gear type (coded), date, river of release, tag number, tag type, fork length, sex and gonad condition (if known), year class and release location. Card columns are reserved for return data, including: fishing gear type, date, location, river of return, number of days at large, minimum distance traveled, length, weight, sex and gonad condition, and back-calculated lengths at ages I-III.

The tagging program was advertised through the mail to licensed commercial fishermen, announcements in Bureau of Commercial Fisheries market reports, dissemination of leaflets and posters, newspaper and television coverage, and personal contact at sport-fishing club meetings and at landing sites.

RESULTS AND DISCUSSION

A total of 8525 tagged striped bass were released in Virginia waters during 1968 and 1969. A listing of these by river and date of release is provided in Table 1. Streamer disc tags were snagged by gill nets, causing capture of striped bass too small to be taken ordinarily in this gear. Thus, the assumption that tagged and untagged fish have an equal chance of being caught (an important one for our objectives) was not

met. This basic fault and an additional disadvantage of slow application in cold weather led us to use cartridge-fed internal anchor tags, starting in summer 1968.

Tag cartridges should be carefully inspected for excess bits of plastic that cause jamming of tagging guns, and for duplication or omission of numbers. Growth of algae, bryozoans, and barnacles on the tags has been excessive at times. These organisms have abraded the side of the tagged fish, causing severe injury and subsequent infection. Although this problem could be lessened by shortening the trailing nylon tube, visibility of tags to fishermen would be reduced. Tag numbers should be positioned near the anchor end of the message to avoid loss of information. Trailing ends were frequently severed in apparent attempts to clean the tag with a knife.

Winter 1968 Tagging

Large numbers of striped bass from the 1966 and 1967 year classes were caught by trawling in the channels of the York and Rappahannock rivers during the winter of 1968. Tagging during this period was conducted on the Virginia Institute of Marine Science R/V *Pathfinder*. Identical efforts in the James River failed because of the scarcity of the 1966 year class (Grant and Joseph, 1968).

The age distribution of tagged striped bass released during this period is given in Table 2, and age distribution of returns from these 3195 tags in Table 3. Overall return rates for the James, York, and Rappahannock rivers are 2.4%, 12.6%, and 20.5%, respectively, but a decided increase in return rates among older year classes is evident (Figure 1).

In estimating proportional catches of striped bass among fishing gear types correction for snagging of streamer disc tags by gill nets was required. Length-frequency data from an extensive winter and spring gill net fishery in the Rappahannock River were examined to determine the minimum sizes of striped bass normally taken by 3½ and 5 inch nets. Early gill net returns from tagged striped bass smaller than these minimum lengths (270 and 298 mm fork length, respectively) were considered invalid. The corrected number of returns is appended to raw data in Table 4.

Tag returns declined rapidly as time at large increased. The number of returns, grouped in 30-day intervals, is shown in Figure 2. Excluded from this figure are the sparse James River data (two returns at large 24 and 54 days) and two returns from York River tags for which no date of recapture was obtainable. A slight increase in return rates at approximately 225 days was a seasonal effect of fall sport catches in the York and fall pound net catches in the Rappahannock River. Another at 360 days reflects winter gill net catches in both rivers.

Only 3.7% of returns from York River tagging, and 0.8% of those from Rappahannock tagging, were recaptured outside the river system of release (Table 5). Two- and three-year-old striped bass appeared to move from the rivers into Chesapeake Bay in warmer months, and mixing between river stocks occurred on their return to river channels in cooler months. The single return from southern New England waters was a five-year-old that joined the migrating Atlantic Coast population, presumably after the 1968 spawning run. Both James River returns were recaptured within that river system.

TABLE 2. Age distribution of striped bass tagged in Virginia rivers, winter 1968

River System	Year Class							
	Unknown	1967	1966	1965	1964	1963	1962	1961	Total
James	0	35	39	8	3	0	0	0	85
York	1	588	1301	37	3	1	0	1	1932
Rappahannock	0	134	1005	38	0	1	0	0	1178

TABLE 3. Age distribution of returns through July 1, 1969, from striped bass tagged during winter 1968

River System	Year Class 1967	1966	1965	1964	1963	1962	1961	Total
James	0	1	0	1	.	.	.	2
York	44	192	5	1	1	.	0	243
Rappahannock	13	210	18	.	1	.	.	242

TABLE 4. Returns from winter 1968 striped bass tagging, within categories of fishing gear. Numbers in parentheses have been corrected for gill-net snagging of small fish

River System	Commercial Gear pound nets	haul seines	gill nets	fyke nets	other	Sport Catch	Unknown	Total
James	0	0	2	0	0	0	0	2
York	13	0	164 (72)	12	0	43	11*	243 (151)
Rappahannock	33	2	156 (47)	0	3	36	12	242 (133)

* Includes 1 return from VIMS trawl.

A chi-square analysis of returns from the four types of tags used during winter 1968 (Table 6) demonstrated that both dart tags and bowlinetied spliced streamer discs were returned at a much lower rate than streamer disc tags tied with crossed running knots (as used in the Chesapeake Bay Cooperative Striped Bass Program of 1957-1958). Differences were highly significant ($p=0.005$). There was no evidence of difference in returns of nylon- and dacron-tied streamer tags.

Summer-Fall 1968 Tagging

Striped bass caught in pound nets in the James and Rappahannock rivers during the summer of 1968 were tagged with internal anchor tags and released outside the channel ends of the nets. Hook-and-line catches were tagged in the York River during this period, since no commercial gear was catching striped bass in numbers sufficient for tagging.

The age distribution of these 2438 tagged striped bass is given in Table 7, and that of returns in Table 8. Overall rates of return were 20.1%, 8.2%, and 17.7% for the James, York, and Rappahannock rivers, respectively, as of July 1, 1969. Nearly 95% of James River returns

TABLE 5. List of tag returns from areas outside river of tag release-winter 1968 tagging

River of Release	Number of Days at Large	Year Class	Recapture Area	Minimum Distance (naut. miles)	Month of Recapture
York	72	1966	Mid-Chesapeake Bay	56	April 1968
York	77	1966	Mid-Chesapeake Bay	59	April 1968
York	78	1966	Upper Chesapeake Bay	115	May 1968
York	155	1965	Upper Chesapeake Bay	75	July 1968
York	187	1963	So. New England	385	August 1968
York	224	1966	Rappahannock River	82	October 1968
York	232	1966	Piankatank River	47	October 1968
York	380	1967	Rappahannock River	70	February 1969
York	432	1966	Upper Chesapeake Bay	115	April 1969
Rappahannock	124	1966	Upper Chesapeake Bay	75	June 1968
Rappahannock	359	1966	James River	200	February 1969

TABLE 6. Chi-square analysis of returns from four different tag types employed in winter 1968 striped bass tagging

	Tag Type				
	Streamer Disc			Dart	
	Tied Dacron	Tied Nylon	Spliced Dacron	(Floy FT-6B)	Total
Number Released	1491	1396	99	209	3195
Number of Returns	246	221	4	15	487
Expected Returns	227.26	212.78	15.09	31.86	
Chi-square	1.23	0.32	8.15	8.92	18.62
P	>0.25	>0.50	<0.005	<0.005	<0.005

were recaptured within six weeks of release and at the site of tagging. The immobility of this population was a major factor in the high return rate for James River tags. An increase in return rates among older year classes, similar to that observed in winter 1968 returns (Figure 1), was again evident. Percent returns within year classes for the combined rivers were as follows:

1967	12.4%
1966	17.5%
1965	26.3%
1964	37.5%
1961	0%

Recaptures by fishing gear type are given in Table 9. Use of James River data in estimating proportions of total catch taken by fishing gear types would be unrealistic in view of the failure of marked fish to move from the tagging site. Estimates from York and Rappahannock returns are considered to reasonably reflect proportional catches, but are still influenced by seasonal use of different gears. More specifically, that gear-type fishing in the season immediately following tag releases will produce more returns relative to its share of total annual catches than will gear types fishing later in the year, when mortality, tag loss, and emigration have reduced availability of tagged fish. The high proportion of Rappahannock returns from pound nets compared with those from gill nets may be a direct effect of such seasonal fishing (pound nets in late summer and fall; gill nets in winter and spring).

The number of recaptures within 30-day intervals is given in Table 10. Modes in the Rappahannock tag return distribution at 75 and 225 days were caused by fall pound net fishing and winter gill-netting. The even distribution of York River returns may be a result of fairly continuous tagging over an extended period (June-November).

TABLE 7. Age distribution of striped bass tagged in Virginia rivers, summer-fall 1968

	Year Class					
River System	1967	1966	1965	1964	1961	Total
James	404	118	23	6	2	553
York	212	162	17	1	0	392
Rappahannock	225	1,251	17	1	0	1,494

TABLE 8. Age distribution of returns, through July 1, 1969, from striped bass tagged during summer-fall 1968

	Year Class						
River System	1967	1966	1965	1964	1961	Unknown*	Total
James	66	34	9	2	0	0	111
York	17	12	0	1	–	2	32
Rappahannock	21	222	6	0	–	16	265

* Tags returned with severed numbers.

TABLE 9. Returns from summer-fall 1968 striped bass tagging within categories of fishing gear

River System	Commercial Gear pound nets	haul seines	gill nets	fyke nets	other	Sport Catch	Unknown	Total
James	105	1	1	0	0	4	0	111
York	3	1	9	1	0	15	3	32
Rappahannock	171	8	24	0	6	45	11	265

Returns from outside the river of release were all members of the 1966 year class. None of the James River returns were taken in other areas. This is considered more an effect of tagged stock reduction than an indication of stock integrity. Movement out of river systems was evidenced in 3.1% and 2.6% of York and Rappahannock returns (Table 11). The recapture of one Rappahannock River striped bass on the coast south of Chesapeake Bay is considered unusual, and its importance will become evident in discussion of winter 1969 tagging. None of the summer-fall 1968 tags have been returned from waters north of Chesapeake Bay.

Winter 1969 Tagging

The expected abundance of striped bass in river channels during the winter months of 1969 failed to materialize. Trawling was effective only in the Rappahannock River, where 1,161 were tagged. Repeated efforts during two months resulted in only 114 tagged fish in the York, and 301 in the James River.

Trawler landings of striped bass in the Hampton Roads region of Virginia increased from 50,000 pounds in 1968 to over 800,000 pounds in 1969. Most of these fish were caught south of the Virginia capes in winter months. Direct evidence of the identity of these stocks is lacking, since no tags have been returned from this fishery. However, this coastal congregation of striped bass was tagged by the North Carolina Division of Commercial and Sport Fisheries; all early spring returns came from lower Chesapeake Bay rivers (James S. Sterling, personal communication). Coincident with these returns was the reappearance of large numbers of striped bass in haul seine catches in lower reaches of the James, York, and Rappahannock rivers. Further tagging by VIMS in winter 1969 (Table 1) utilized such catches. The single tag return from Virginia coastal waters referred to in the previous section was taken by a haul seiner, and is our clearest indication that this winter coastal congregation had a Chesapeake Bay origin. Lack of returns from the trawl fishery may be attributed to "non-response."

TABLE 10. Numbers of returns within 30-day intervals from date of individual tag release—summer-fall 1968 tagging

Days at Large	James River	York River	Rappahannock River
0 - 30	102	5	32
31 - 60	6	4	39
61 - 90	0	7	80
91 - 120	0	1	49
121 - 150	0	3	22
151 - 180	2	3	6
181 - 210	0	3	7
211 - 240	0	3	12
241 - 270	1	1	7
271 - 300	0	0	3
301 - 330	0	0	4
Unknown	0	2	4
TOTAL	111	32	265

TABLE 11. List of tag returns from areas outside river of tag release—summer-fall 1968 tagging

River of Release	No. of Days at Large	Year Class	Recapture Area	Minimum Distance (Naut. Miles)	Month of Recapture
York	169	1966	Mid-Chesapeake Bay	68	April 1969
Rappahannock	77	1966	Potomac River	70	Sept. 1968
Rappahannock	85	1966	Potomac River	70	Oct. 1968
Rappahannock	89	1966	Upper Chesapeake Bay	127	Oct. 1968
Rappahannock	136	1966	James River	72	Nov. 1968
Rappahannock	252	1966	Atlantic Coast, South of Chesapeake Bay	75	Mar. 1969
Rappahannock	262	1966	York River	60	Mar. 1969
Rappahannock	279	1966	Mid-Chesapeake Bay	44	April 1969

The age distribution of striped bass tagged in winter 1969 is given in Table 12 and that of returns from these 2,891 tags in Table 13. Returns within year classes, all rivers combined, are as follows:

1968	2.1%
1967	7.1%
1966	11.7%
1965	13.0%
1964	12.5%
1963–1961	0%

Return rates from the James, York, and Rappahannock rivers through July 1, 1969, were 9.1%, 6.8%, and 8.1%, respectively. The James River return rate is notably high for tags at large only three months.

Numbers of returns within categories of fishing gear are given in Table 14. Since a full year had not elapsed subsequent to tag releases, these data provide only a seasonal estimate of proportional catches. The relatively high proportion of returns from haul seines and gill nets is a seasonal effect.

Recaptures within 30-day intervals from date of individual tag release are given in Table 15, and a list of recaptures outside the river of release in Table 16. The percentage of migrating fish from the James and York rivers in this three-month period is a distinct departure from previous observations, where approximately 3% of returns were recaptured outside the river of origin. These striped bass, tagged in the lower James and York rivers immediately after their return from coastal waters, were apparently distributing themselves among Chesapeake tributaries prior to the spawning season.

Use of Tag Return Data for Estimates of Population Parameters

Two principal objectives are 1) estimates of the proportions of total striped bass catch taken by the various gear types in Virginia and 2) estimates of annual fishing mortality within resident river populations. Both estimates are prerequisites to intelligent stock management.

Errors associated with such estimates of catch proportions include selective catching of tagged fish by certain gear types and a positive bias toward a gear type heavily fished in the season immediately following tag releases. The problem of selection by gill nets (see Table 4) has been eliminated by substituting internal anchor tags for streamer disc tags. The remaining bias that results from seasonal gear employment could be removed by an adjustment based on return rates within seasons, or by repeated seasonal application of tags.

The use of age composition data in estimates of mortality rates is severely limited for striped bass populations. The indirect method of Jackson (1939) has been applied to winter trawl catches during the years 1967-1969, yielding total mortality estimates of from 0.25 to 0.83, a wide range of values resulting from inconstant recruitment. Analysis by simple catch curves (Ricker, 1958) is similarly inhibited by this characteristic fluctuation in recruitment.

TABLE 12. Age distribution of striped bass tagged in Virginia rivers, winter 1969

River System	Unknown	1968	1967	Year Class 1966	1965	1964	1963	1962	1961	Total
James	0	6	528	298	7	5	1	0	0	845
York	0	9	594	259	15	3	3	1	1	885
Rappahannock	2	128	922	108	1	0	0	0	0	1,161

TABLE 13. Age distribution of returns, through July 1, 1969, from striped bass tagged during winter 1969

River System	Unknown	1968	1967	Year Class 1966	1965	1964	1963	1962	1961	Total
James	0	0	45	29	2	1	0	–	–	77
York	0	0	41	19	0	0	0	0	0	60
Rappahannock	1*	3	59	30	1	–	–	–	–	94

* Returned tag with missing number.

TABLE 14. Returns from winter 1969 striped bass tagging, within categories of fishing gear

River System	Commercial Gear pound nets	haul seines	gill nets	fyke nets	other	Sport Catch	Unknown	Total
James	6	35	11	0	0	15	10	77
York	7	5	23	1	0	17	7	60
Rappahannock	18	43	13	0	1	10	9	94

TABLE 15. Number of returns within 30-day intervals from date of individual tag release—winter 1969 tagging.

Days at Large	James River	York River	Rappahannock River
0 - 30	44	22	37
31 - 60	17	13	26
61 - 90	9	17	13
91 - 120	1	4	6
121 - 150	–	–	4
Unknown	6	4	8
TOTAL	77	60	94

TABLE 16. List of tag returns from areas outside river of tag release—winter 1969 tagging

River of Release	Recapture Area	No. of Returns	% of Total Returns
James	Lower Chesapeake Bay	4	
"	York River	8	
"	Mid-Chesapeake Bay	2	
"	Rappahannock River	2	
"	Potomac River	3	
"	Upper Chesapeake Bay	3	
"	So. New England	1	
	Total James River	23	29.9%
York	Lower Chesapeake Bay	1	
"	Mid-Chesapeake Bay	2	
"	Upper Chesapeake Bay	6	
"	Gulf of Maine	1	
	Total York River	10	16.7%
Rappahannock	Lower Chesapeake Bay	1	
"	Mid-Chesapeake Bay	1	
"	Upper Chesapeake Bay	1	
	Total Rappahannock River	3	3.2%

Variation due to differences in recruitment from year to year may be eliminated by calculating mortality rates for individual year-classes. Tag-and-recapture methods provide the most efficient means of making such estimates. A first order approximation of annual fishing mortality rate is given in Table 17. These estimates are based on simple ratios of tag returns to tag releases, with 10% corrections for tagging mortality and "non-response", and are for the 1966 year-class only. Total returns are those returned within one year from the date of tagging. Similar estimates will become available for the 1966 year-class, and others, after winter 1970.

The principal method of mortality rate calculation to be used is the direct approach of Ricker (1958:128), but limited to individual year classes within river systems. Since this method depends on returns from two successive years of tagging, our substitution of internal anchor tags for streamer tags has delayed such estimates.

TABLE 17. Currently available estimates of annual fishing mortality rates among Virginia resident populations of striped bass (1966 year class only). See text.

River System	Tagging Season	Total Number Tagged	Corrected Total (A)	Total Returns	Corrected Total (B)	Annual Fishing M'tality (B/A)
Rappahannock	Winter 1968	1,006	905	205	225	0.249
Rappahannock	Sum. 1968	1,251	1,126	222	244	0.217
York	Winter 1968	1,302	1,172	238	262	0.224

LITERATURE CITED

Chapoton, R. B., and J. E. Sykes. 1961. Atlantic coast migration of large striped bass as evidenced by fisheries and tagging. *Trans. Amer. Fish. Soc.* 90:13-20.

Davis, W. S. 1959. Field tests of Petersen, streamer, and spaghetti tags on striped bass, *Roccus saxatilis* (Walbaum). *Ibid.* 88:319-329.

Dell, M. B. 1968. A new fish tag and rapid, cartridge-fed applicator. *Ibid.* 97:57-59.

Grant, G. C., and E. B. Joseph. 1969. Comparative strength of the 1966 year class of striped bass, *Roccus saxatilis* (Walbaum), in three Virginia rivers. *Trans. 22nd Ann. Conf., S. E. Assoc. Game & Fish Comm.* p. 501-509.

Jackson, C. H. N. 1939. The analysis of an animal population. *J. Animal Ecology* 8:238-246.

Lewis, R. M. 1961. Comparison of three tags on striped bass in the Chesapeake Bay area. *Chesapeake Sci.* 2:3-8.

Mansueti, R. J. 1955. Life history of the striped bass in Maryland waters. *Md. Tidewater News* 11(9): Suppl. (3): 1-2.

————. 1956. Recaptures of tagged striped bass, *Roccus saxatilis* (Walbaum), caught in deep water of Chesapeake Bay, Maryland. *Md. Dept. Res. and Educ., Resource Study Rept.* No. 10, 9 pp.

————. 1961. Age, growth, and movements of the striped bass, *Roccus saxatilis*, taken in size selective fishing gear in Maryland. *Chesapeake Sci.* 2:9-36.

Massman, W. H., and A. L. Pacheco. 1961. Movements of striped bass tagged in Virginia waters of Chesapeake Bay. *Ibid.* 2:37-44.

Pearson, J. C. 1938. The life history of the striped bass, or rockfish, *Roccus saxatilis* (Walbaum). *Bull. U. S. Bur. Fish.* 49(28):825-851.

Ricker, W. E. 1958. Handbook of computations for biological statistics of fish populations. *Fish Res. Bd. Canada, Bull. No. 119*, 300 pp.

Sykes, J. E. 1961. The Chesapeake Bay cooperative striped bass program. *Chesapeake Sci.* 2:1-2.

Tiller, R. E. 1943. Indications of compensatory growth in the striped bass, *Roccus saxatilis* (Walbaum), as revealed by a study of the scales. *Chesapeake Biol. Lab. Pub. No. 57*, 16 pp.

————. 1950. A five-year study of the striped bass fishery of Maryland, based on analyses of the scales. *Ibid.* No. 85, 30 pp.

Vladykov, V. D., and D. H. Wallace. 1938. Is the striped bass (*Roccus lineatus*) of Chesapeake Bay a migratory fish? *Trans. Amer. Fish. Soc.* 67:67-86.

————, and ————. 1952. Studies of the striped bass, *Roccus saxatilis* (Walbaum), with special reference to the Chesapeake Bay region during 1936-1938. *Bull. Bingham Oceanogr. Coll.* 14(1):132-177

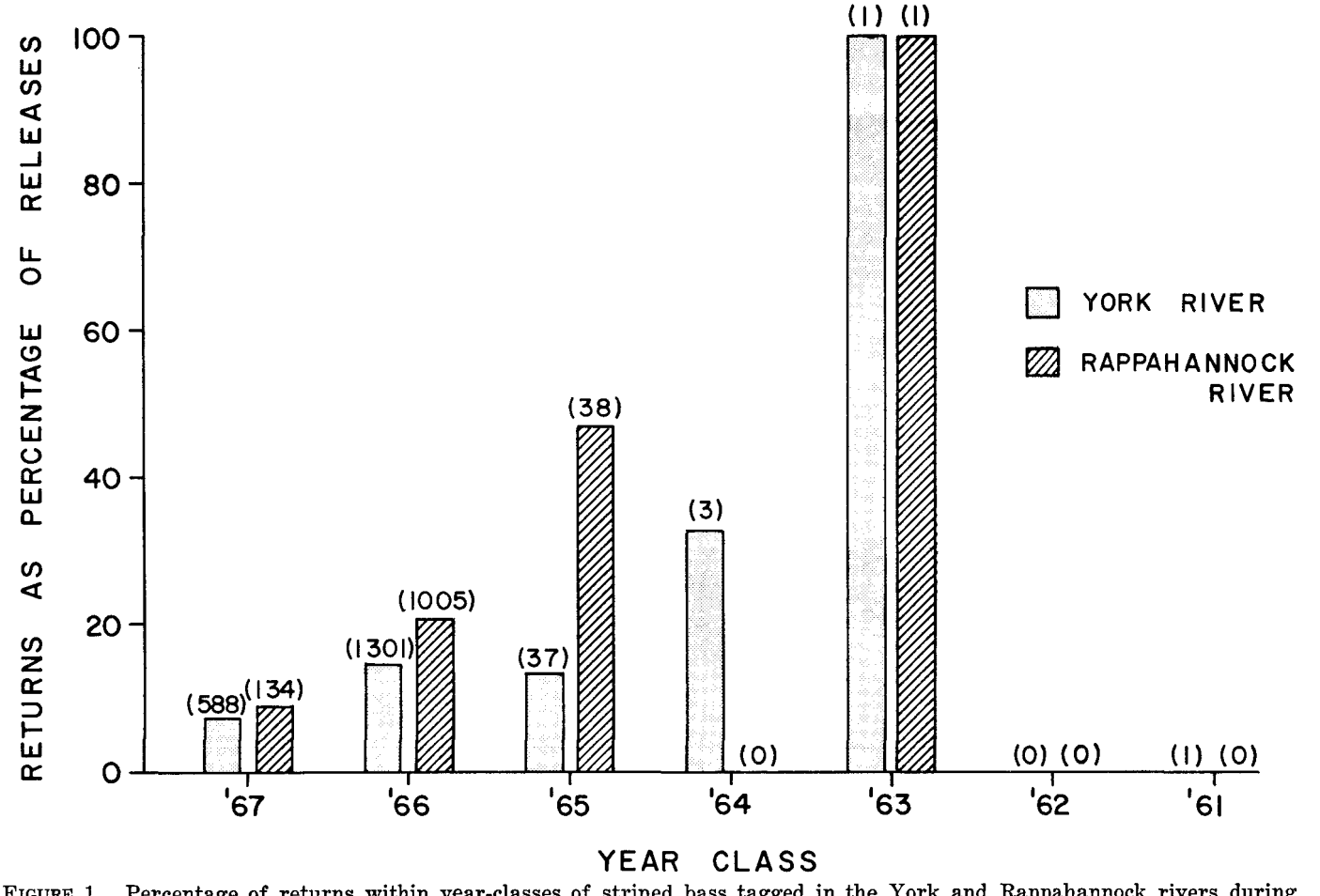

FIGURE 1. Percentage of returns within year-classes of striped bass tagged in the York and Rappahannock rivers during winter 1968. Numbers in parentheses indicate total number of releases.

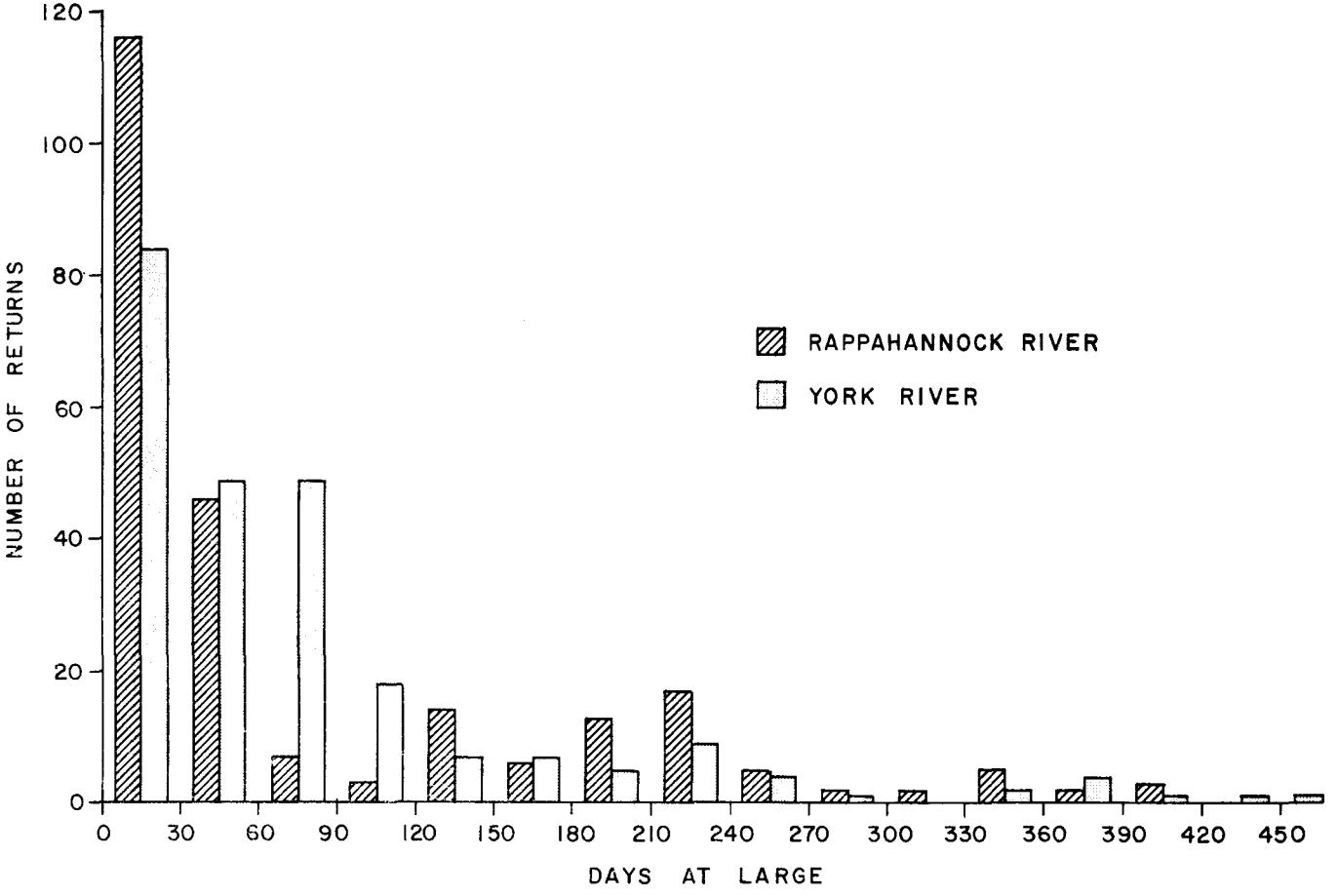

FIGURE 2. Number of returns within successive 30-day intervals from date of individual tag release. Winter 1968 tags.