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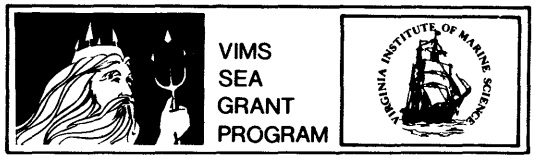

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INTRODUCTION

This report has been prepared at the request of a majority of the oyster growers in the Virginia tributaries of the lower Potomac River and in the upper Rappahannock River. These two areas produce about one-fourth of all oysters grown on leased bottoms in Virginia. Growers in these two areas began experiencing excessive losses during the 1977-78 and 1978-79 growing seasons; losses during the winter and spring of 1980 were especially severe. We believe these losses, which are reported to be as high as 100% on some beds, are related to low salinity conditions brought about by excessive flow of fresh waters into the Potomac and Rappahannock rivers.

Oyster Biology

The American oyster is a mesohaline mollusk that inhabits the estuarine areas of the east and Gulf coasts of the U. S. Its range within these areas is dictated primarily by the physical-chemical parameters of the local body of water. The Rappahannock River and the tributaries of the Potomac River generally provide the oyster with optimum conditions for growth and survival. As a result, these areas contain some of the best oyster growing grounds on the East coast, and have historically produced large quantities of this epicurean delight. Occasionally, however, the conditions in these areas change, due to extreme environmental fluctuations. While the oyster has developed mechanisms to sustain itself through these periods of stress, its survival is determined by the extent and duration

of such stress. It is believed the mortalities and absence of growth reported by the oyster growers and described herein were the result of prolonged exposure to low salinities. Salinity data, available for the period 1970 through 1980 demonstrates the persistence of salinities at levels which would inhibit growth and feeding and which could cause excessive mortalities. To further document this period as an unusual environmental event, fresh water discharge information for the Rappahannock River, supplied by the U. S. Geological Survey has been included. Since the salinity in the upper reaches of our estuaries is largely determined by the volume of freshwater entering the system, river discharge and salinity are inversely proportional to each other in these areas.

Locations Involved

The areas impacted most severely as reported by growers are as follows: 1) The Virginia tributaries of the Potomac River from Colonial Beach to just below Ragged Point. 2) In the Rappahannock, most losses are reported from about one mile above Bowlers Rock Light to Jones Point.

Extent of Losses - Rappahannock River

In the spring of 1980 VIMS made two studies of oyster leases in the upper Rappahannock at the request of oyster growers.

On 1 April 1980 oysters from 12 beds were examined in an area extending from just above Bowlers Rock to Jones Point. In this area we observed a recent mortality (in the last month or two) ranging from 0-27%. Mortalities were highest upriver. Many of the recently dead oysters had

decaying meats still inside the shell. This indicated deaths were occurring at the time of our observation. Beds in this area at this time of year normally show a recent mortality of from 0 to 5%.

A second examination of leases in the same area was made by VIMS on 16 May 1980. Recent mortalities ranged from 14 to 44%. No further field studies were made in 1980 in this system. Reports from oyster growers, however, indicated that mortalities continued into early June.

It is emphasized the mortalities observed in April and May 1980 were abnormally high and represented deaths which occurred within the last month or two. The growers report their cumulative mortalities on some of their leases since 1977 in both estuaries has reached 90 to 100%.

Losses in the Potomac River Tributaries

On 25 April 1980 about 15 leased oyster bottoms were examined in Lower Machodoc Creek. Recent deaths ranged from 15 to 20%. Growers in this area report cumulative mortalities over the past two years of as much as 90 to 100%. Observations indicated that oysters in the creek showed little growth over the past two years. This condition may be associated with low salinity conditions.

On 5 April 1980 oysters in Nomini Creek were examined by VIMS. Mortalities (recent) ranged from 10 to 38%. The cumulative mortalities on some of these planted beds are reported to have reached 90 to 100%.

Summary of Mortalities

Growers in the upper Rappahannock and lower Potomac have experienced serious losses of their planted oysters since the 1977-78 season. As will be

shown below these losses are associated with low salinities due to excessive flows of fresh water. This condition is discussed below for the Rappahannock. A similar situation may have occurred in the Potomac.

Salinity Data

Salinities were severely depressed in the oyster growing area of the upper Rappahannock River during most of 1978 and 1979. This condition persisted through March of 1980. These abnormally low salinities are to a large degree the result of excessive flows of freshwater into the Rappahannock which will be covered later in this report.

The Response of Oysters to Low Salinity

Salinities below about 5.00 parts per thousand (ppt) have a major impact on oyster activity. Below this level they remain closed for long periods and they do not feed or grow. Between about 5 and 6.5 ppt there is a transition period where growth, feeding and other physiological processes are greatly reduced. The meats of oysters exposed to these levels may become poor and yields (pints of meats per bushel) are often low. Mortalities will result when salinities range from 0.0 to 5.0 ppt for extended periods. During the colder water months oysters can tolerate salinity associated stress for extended periods. However, at the same salinity levels at warmer water temperatures they are quickly killed.

Salinities in the Upper Rappahannock, 1970-1980

Salinity data for this report was obtained from the Institute's files.[1] In all cases the data show salinities at 9 ft. Surface salinities might average about 0.5 ppt less.

Monthly values for each year (when available) were averaged into three periods: 1) January, February, March and April; 2) May, June, July and August; 3) September, October, November and December. These data were compiled for two regions: 1) Mile 31.5 just below Accaceek Point which is near the upper limit of oyster culture in the Rappahannock River (Figure 1); and 2) Mile 27 which is just above Jones Point (Figure 2). These locations border the area of reported losses in the Rappahannock River. Figure 1 shows salinities were at or below the level of activity (5.0 ppt) during most of 1978 and 1979. Figure 2 (area above Jones Point) shows salinities at or below 6.5 ppt during 1979 and January through April of 1980.

DISCUSSION

Figure 1 and 2 show that in 1978, 1979 and for part of 1980 conditions existed in the oyster growing area of the upper Rappahannock which were not favorable for feeding, growth and survival. Moreover, salinities were low for long periods in warm weather when growth and feeding normally occurs.

Extensive salinity data is not available for the Virginia tributaries

[1]Department of Oceanography and Department of Fisheries.

Figure 1

SEASONAL CHANGES IN SALINITY AT MILE 31.5 IN THE RAPPAHANNOCK RIVER
1970 - 1980

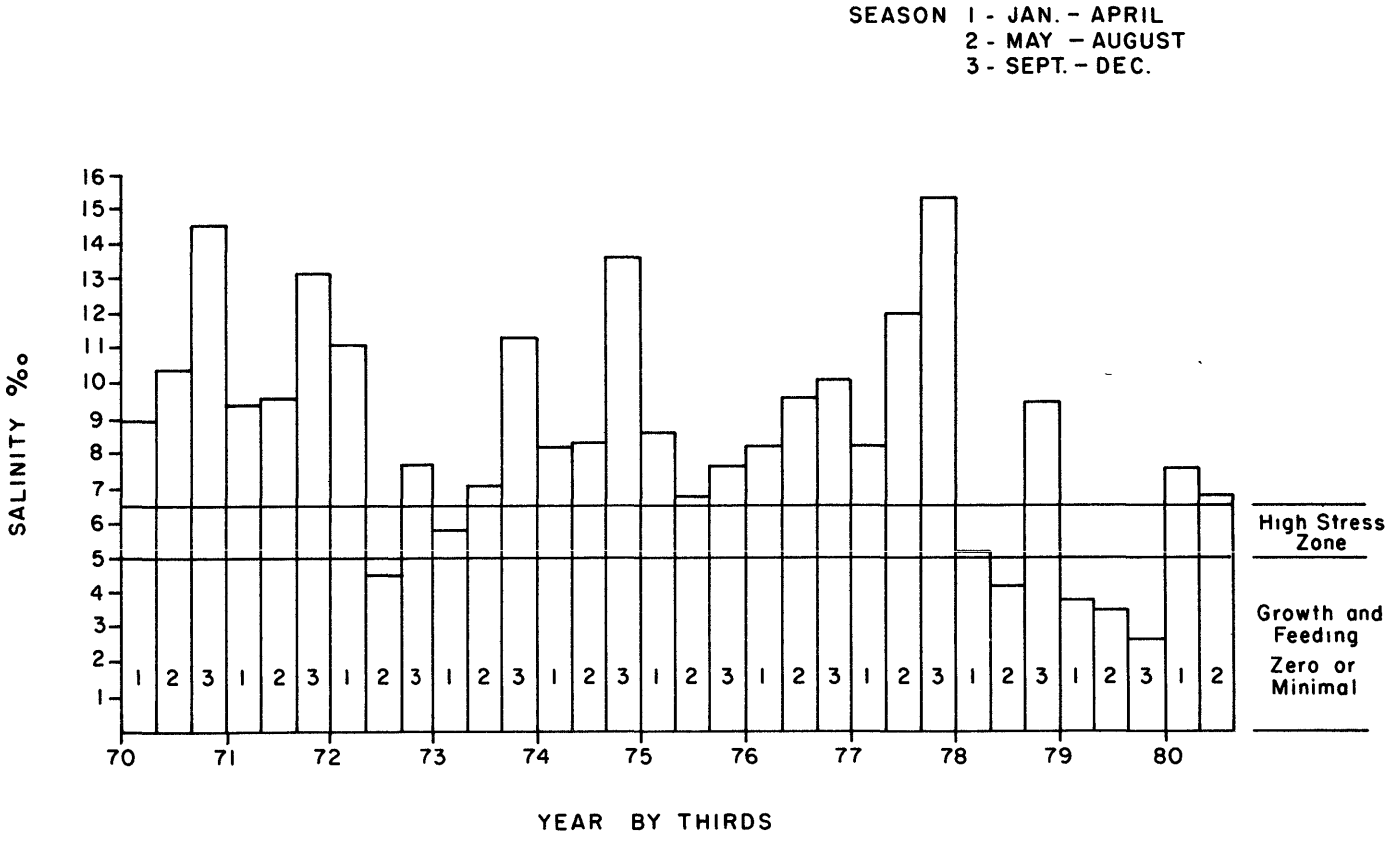
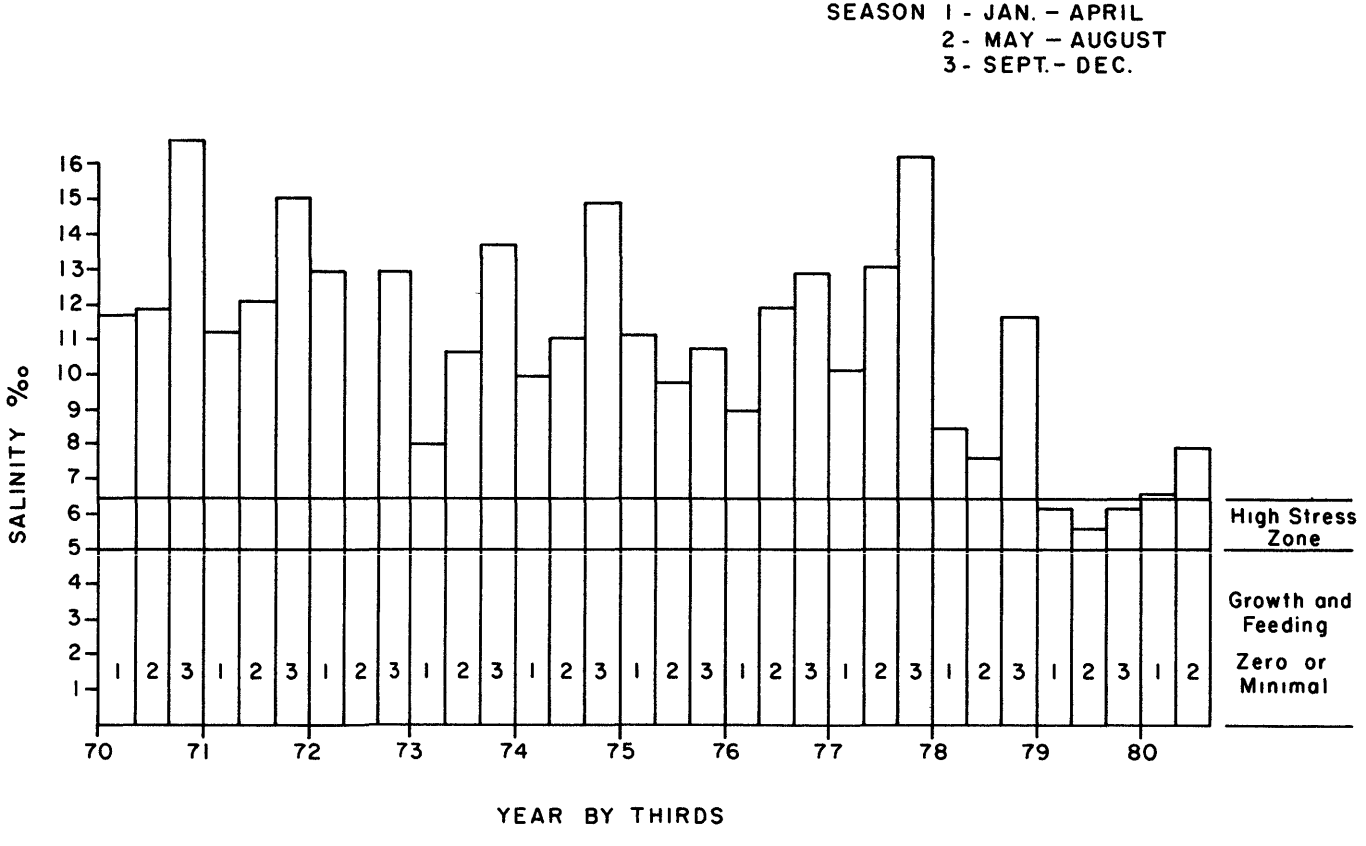


Figure 2

SEASONAL CHANGES IN SALINITY AT MILE 27 IN THE RAPPAHANNOCK RIVER
1970 - 1980



of the lower Potomac. However, occasional measurements for that area indicate that oysters were in a similar state of stress.

Fresh Water Flows

The river discharge information presented in Figures 3 and 4 represent 70 years of data. These figures support the salinity information presented earlier and further substantiate the recent past as a period of unusual freshwater discharge.

Figure 3 depicts the annual mean river discharge for the Rappahannock River at the gaging station near Fredricksburg. This figure graphically demonstrates that the volume of freshwater entering the Rappahannock during 1979 was greater than any year previously recorded, doubling the 69 year average. Figure 4 shows the seasonal discharge for the same period, and illustrates the fact that river discharge during 1979 was above the 69 year average for each season. More importantly, it shows that excessive discharge (i.e. twice the 69 year seasonal average) persisted through three of the four seasons. This unusually high rate of discharge is responsible for the low salinities addressed earlier and no doubt for the heavy oyster mortalities reported by the growers in these areas. While this same information has not been accumulated for the Potomac River tributaries, it is likely that the areas delineated earlier experienced similarly anomalous conditions during the same period.

In conclusion, it is apparent that oyster beds in the upper Rappahannock River have been subject to unusual and stressful conditions associated with low salinities. It is probable that oysters in the Potomac River tributaries have been subject to similar conditions.

Figure 3

MEAN ANNUAL DISCHARGE, RAPPAHANNOCK RIVER NEAR FREDERICKSBURG
1911 - 1979

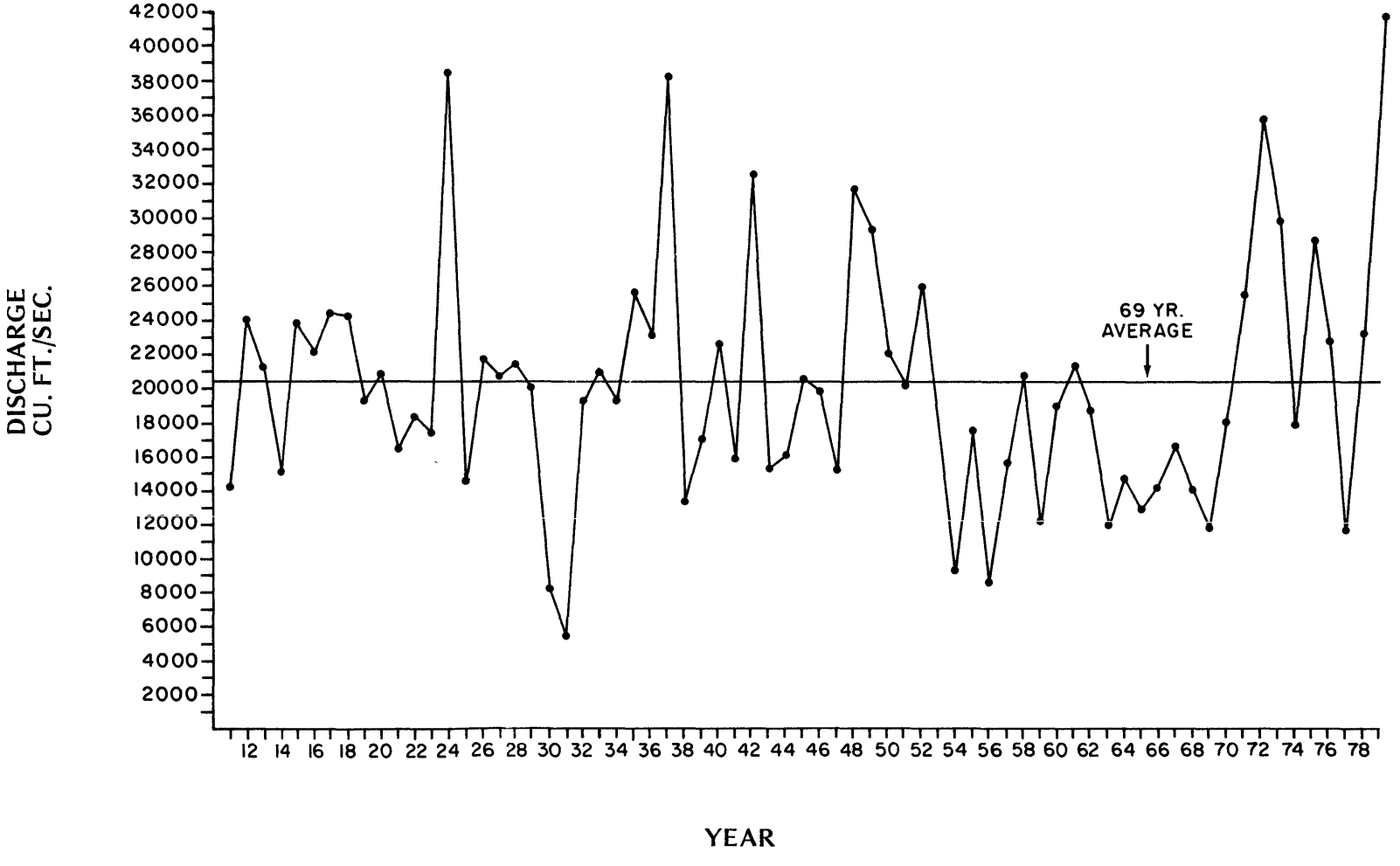
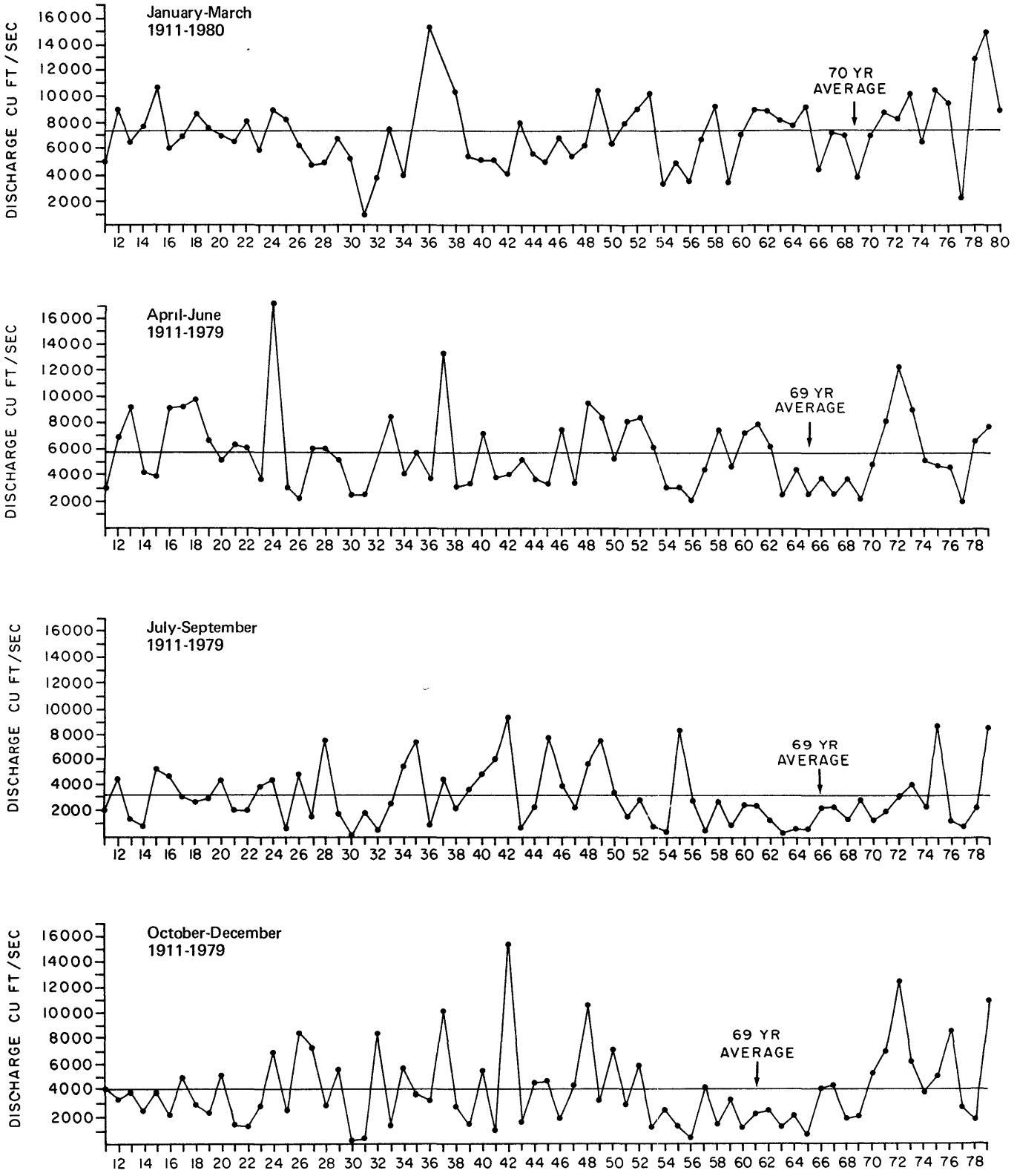
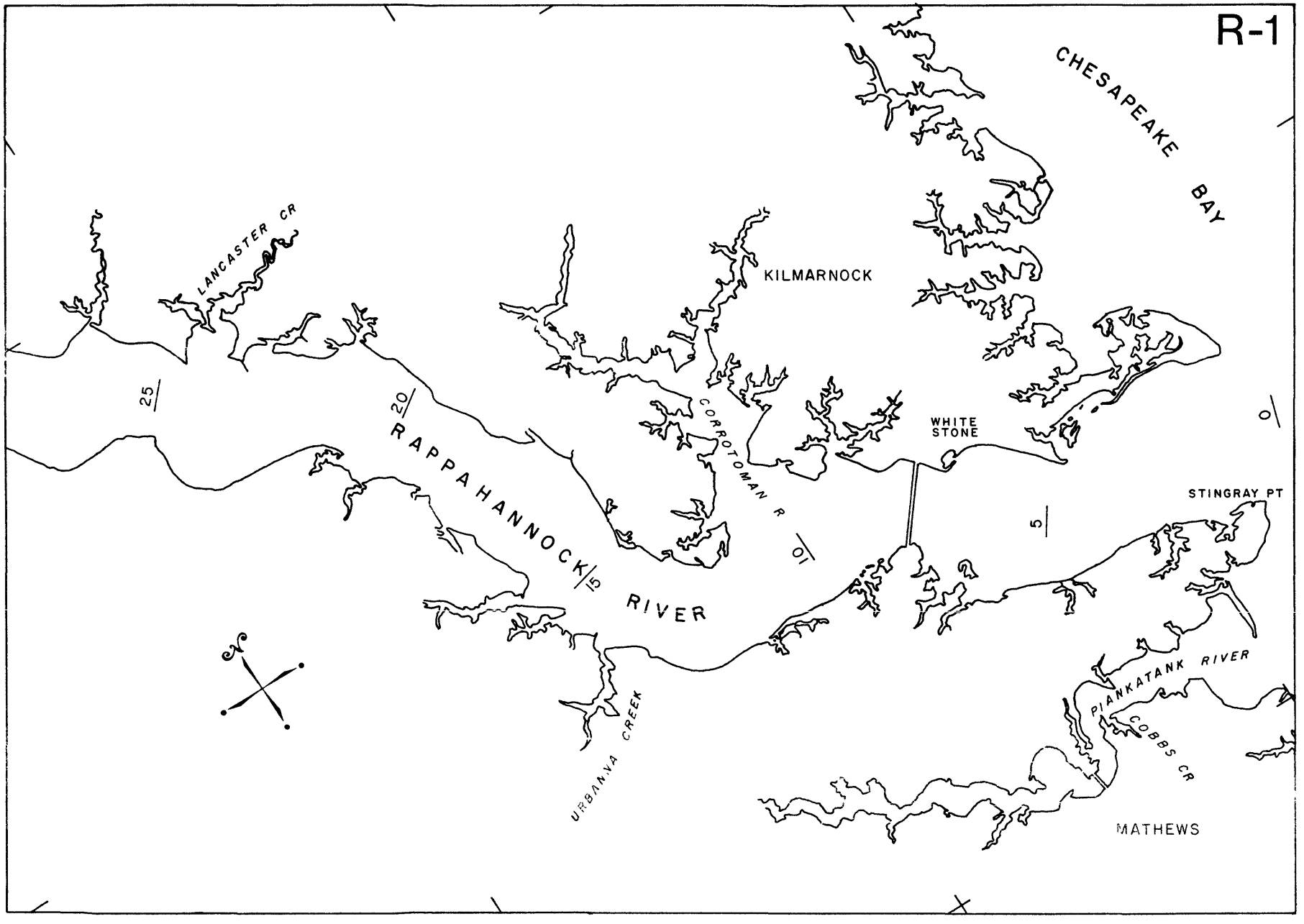
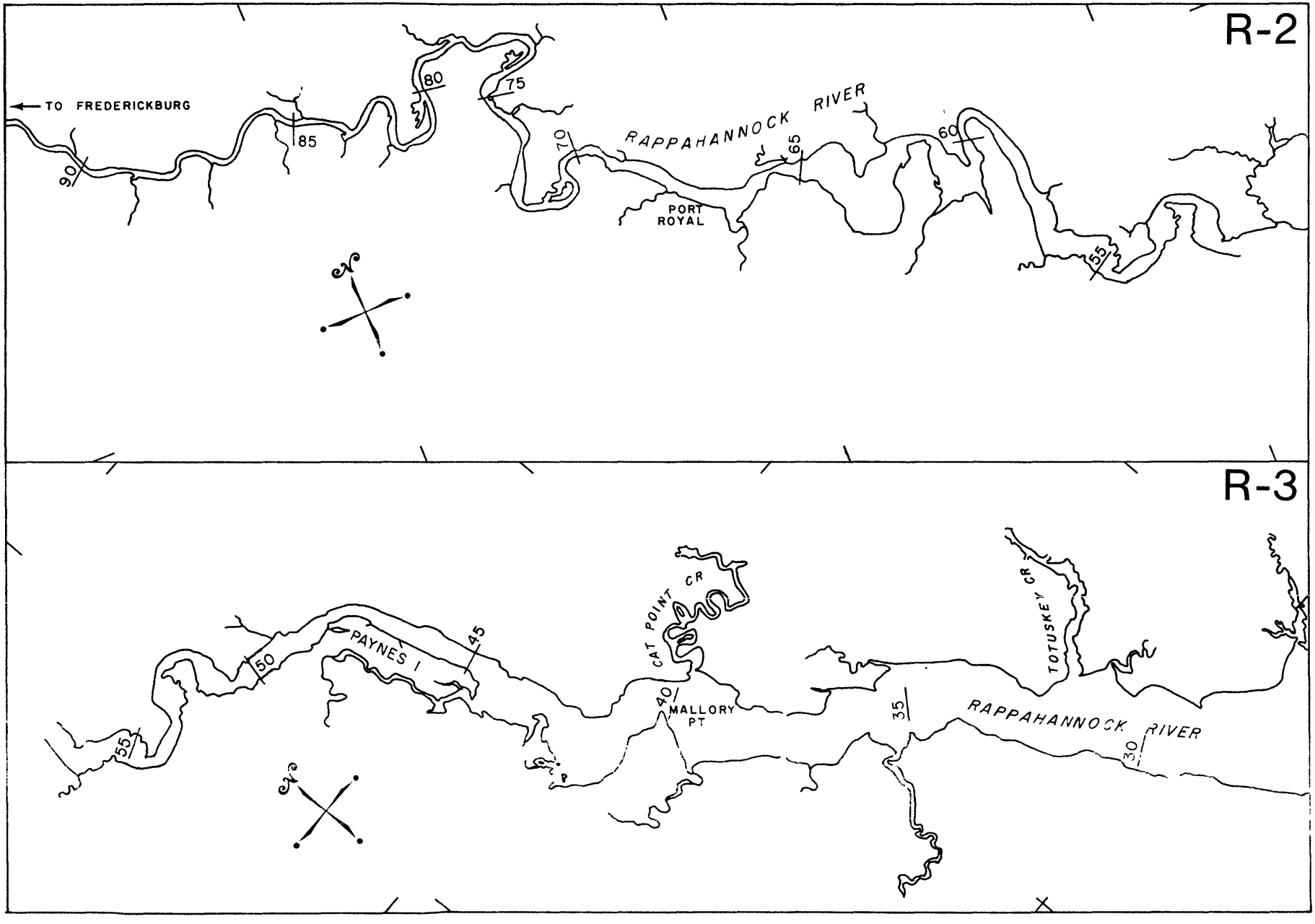


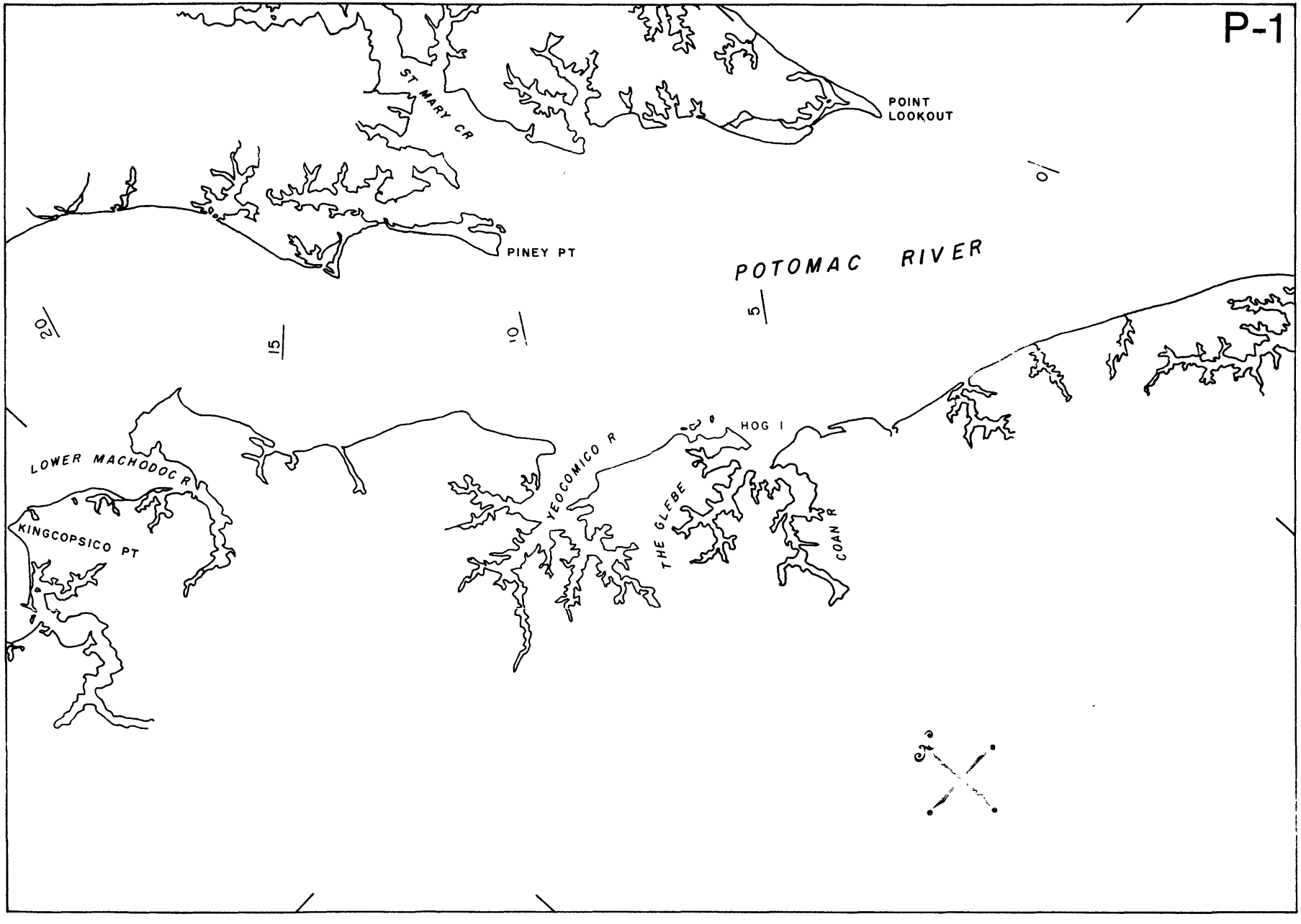
Figure 4

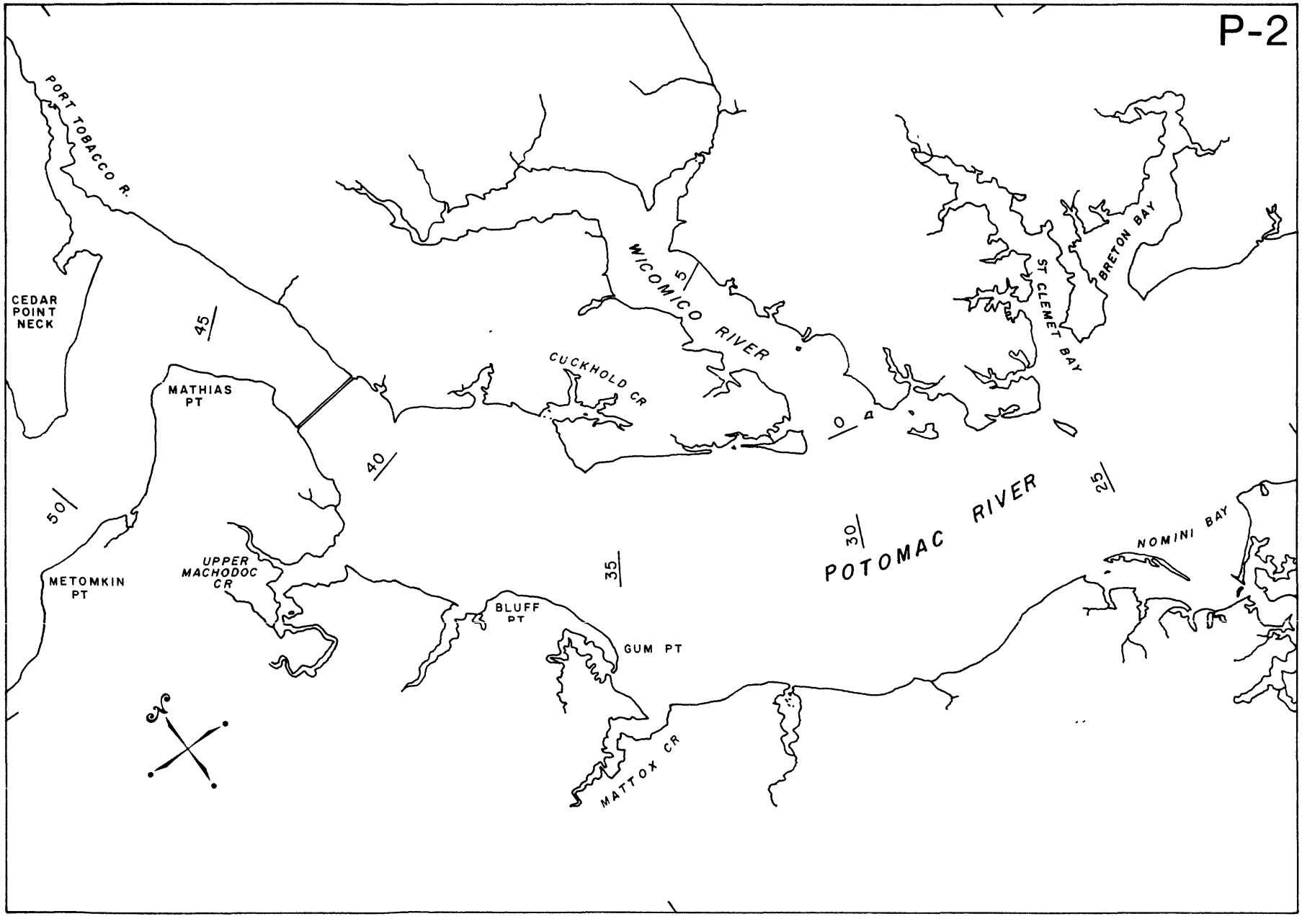
RAPPAHANNOCK RIVER FRESHWATER DISCHARGE
1911-1980




R-1
CHESAPEAKE BAY
LANCASTER CR
KILMARNOCK
25
20
RAPPAHANNOCK
15
RIVER
CORROTOMAN R
01
WHITE
STONE
0
STINGRAY PT
5
PIANKATANK RIVER
COBBS CR
URBANNA CREEK
MATHEWS


R-2
TO FREDERICKBURG
90
85
80
75
70
RAPPAHANNOCK RIVER
65
60
55
PORT ROYAL
R-3
55
50
PAYNES I
45
CAT POINT CR
40
MALLORY PT
35
TOTUSKEY CR
RAPPAHANNOCK RIVER
30


P-1
ST MARY CR
POINT LOOKOUT
PINEY PT
POTOMAC RIVER
20
15
10
5
0
LOWER MACHODOC R
KINGCOPSICO PT
YEOCOMICO R
HOG I
THE GLEBE
COAN R


P-2
PORT TOBACCO R.
CEDAR POINT NECK
MATHIAS PT
45
40
50
CUCKHOLD CR
WICOMICO RIVER
ST CLEMET BAY
BRETON BAY
0
25
30
35
POTOMAC RIVER
NOMINI BAY
METOMKIN PT
UPPER MACHODOC CR
BLUFF PT
GUM PT
MATTOX CR

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