SURVEY OF ANADROMOUS FISH SPAWNING AREAS

Completion Report, Project AFC-8
July 1970 — January 1975

For

Potomac River Drainage
Upper Chesapeake Bay Drainage

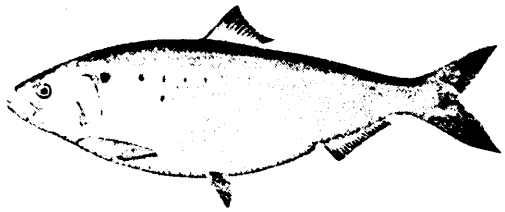
By
Jay O'Dell, *Project Leader/*
John Gabor, *Biologist*
Ray Dintaman, *Biologist*

Maryland Department of Natural Resources
Fisheries Administration
Anadromous Fish Stream Survey Program
In Cooperation With
National Marine Fisheries Service

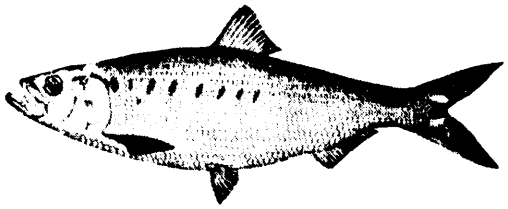
August 1975

ANADROMOUS FISH SPECIES *

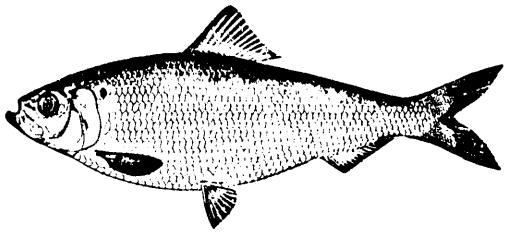
American shad
(*White shad*)
Alosa sapidissima



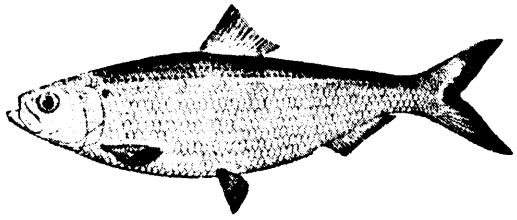
Hickory shad
(*Hickory jack*)
Alosa mediocris



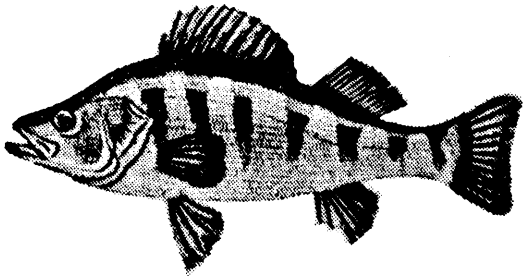
Alewife
(*Branch herring*)
Alosa pseudoharengus



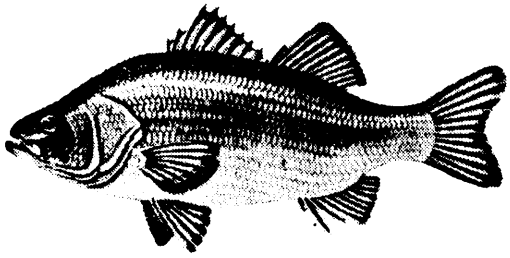
Blueback herring
(*Glut herring*)
Alosa aestivalis



Yellow perch
Perca flavescens



White perch
Morone americana



Striped bass
(*Rockfish*)
Morone saxatilis

* The yellow perch and white perch, while not oceanic in migration patterns, are defined as anadromous for stream study purposes.

SURVEY OF ANADROMOUS FISH SPAWNING AREAS*

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Ray Dintaman, Biologist

For

MARYLAND DEPARTMENT OF NATURAL RESOURCES
Fisheries Administration
580 Taylor Avenue
Annapolis, Maryland 21401

In Cooperation With

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
State Fish Pier
Gloucester, Massachusetts 01930

August 1975

*This study (Project AFC-8) was conducted under the Federal Anadromous Fish Act of 1965, Public Law 89-304, by the Maryland Anadromous Fish Stream Survey Project.

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ABSTRACT

This report summarizes Project AFC-8 ("Survey of Anadromous Fish Spawning Areas") stream investigation and improvement activities for the entire study period of July 1970 to January 1975. In the Potomac River drainage (segments 1, 2, and 5) the study area extended from the river mouth at Chesapeake Bay to Little Falls Dam, at river mile 117.4, in the Washington, D. C. area. The river and more than 100 streams in the Maryland portion (eastern side) of the river drainage located in Washington, D. C. and the Maryland counties of St. Mary's, Charles, and Prince George's were surveyed. The area of investigation also included both eastern and western shores of the Upper Chesapeake Bay drainage (segments 3, 4, and 5) from the Chesapeake Bay Bridge (mouth of Magothy River) north to the Pennsylvania boundary, east to the Delaware boundary, and west to the headwaters of Maryland river systems in this sector of the Bay drainage. Approximately 200 streams in twelve of the thirteen area river drainages (Chester River drainage excluded) located in Baltimore City and the Maryland counties of Anne Arundel, Baltimore, Howard, Harford, Cecil, and Kent, were investigated.

The four and one-half year study included four inter-related jobs or types of stream investigation: Literature and Data Review, Fishery Investigation, Stream Investigation, Data Summarization and Storage/Preparation of Report.

Literature and data reviews (Job I) were conducted for study area streams to aid in planning field investigations and as a supplement to field inventories for documentation of the known pollution sources, habitat, barriers and other stream conditions.

Fishery investigation (Job II) consisted of biological sampling in watercourses to determine the presence of anadromous fish species, spawning locations, and nursery (young-of-year) area streams.

Biological sampling on 310 streams and rivers compiled over 7,000 combined trap and plankton samples which documented 198 anadromous fish spawning streams for one or more species. Haul seining in estuarine study area streams recorded young-of-year nursery areas for anadromous species following their spawning cycle, as well as resident fish species. Biological sampling for anadromous species resulted in a survey and publication on the American eel (Anguilla rostrata), a predatory fish species, together with the occurrence and abundance of other fish species in anadromous study area freshwater streams.

Stream investigation (Job III) was conducted on study area streams to inventory conditions for anadromous fish passage and spawning potential, including barriers, pollution, habitat, water quality, and watercourse alterations. Each stream was walked to the headwaters (source) or major barrier which comprised a survey of anadromous fish passage, and an inventory of Maryland stream conditions.

Stream improvements were effected on some watercourses by referral of recorded problem situations to responsible local and

state enforcement agencies for corrective action. Development of the Maryland Save Our Streams (SOS) programs and continued technical assistance to participating citizen groups provided improvements in some stream problem situations and the basis for a national SOS program. In addition, four relatively small fishways were constructed in the Anacostia River drainage through project cooperative assistance provided to participating governmental agencies.

A computer system (Job IV) with query capability was developed for storing, retrieving, and displaying biological study data. All biological study data including anadromous fish trapping, plankton sampling and seining were computerized. Data on stream usage by anadromous species and stream conditions were provided to consultant and environmental review agencies for the protection and management of the anadromous fish resource.

Various brochures, news releases, published articles, and talks were developed for purposes of anadromous fish education and conservation awareness.

Stream study information and resulting dissemination of findings has been useful for referencing anadromous fish spawning streams and nursery areas, recording stream barriers, future additional improvements in stream conditions, and assessment of watershed developmental-type projects which cause stream alterations associated with residential and commercial expansion.

Sub-Project Accomplishments

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PREFACE

Anadromous fish included in the study are defined as species which ascend streams and rivers from the ocean or other saline stream areas to spawn. Species included in this study are: alewife or branch herring (Alosa pseudoharengus), blueback herring (A. aestivalis), American shad or white shad (A. sapidissima), and hickory shad (A. mediocris). In addition to these four species of the herring (Clupeidae) family; striped bass or rockfish (Morone saxatilis), and white perch (M. americana), members of the temperate bass (Percichthyidae) family, were included. Yellow perch (Perca flavescens), a species of the perch (Percidae) family, was likewise included in investigations. The latter two species migrations are generally confined to the Chesapeake Bay drainage system. While not oceanic in nature, annual spawning migrations from tidal to freshwater streams exceeds the upstream extent of some anadromous species spawning runs. The two perch species are defined as estuarine.

All seven species are sought for both commercial and sport catches. The commercial dockside catch value in Maryland waters of anadromous species is approximately 1.4 million dollars annually. The monetary impact of sport catches, while not measured, probably exceeds that of commercial landings. Of the annual anadromous commercial catches, striped bass landings comprise nearly one million dollars and the other combined anadromous species one-half million dollars. Commercial and sport catches of anadromous species, therefore, generate a multi-million dollar annual enterprise in Maryland alone, as well as constituting an important natural Atlantic Coastal resource.

Biological sampling to document the occurrence, spawning streams, and nursery areas of the seven anadromous species in Maryland waters and related watercourse surveys to inventory and improve stream conditions were conducted for over 300 watercourses in seventeen river drainages. The principal spawning areas of anadromous species, other than striped bass, were not documented prior to the present study. Documentation of spawning and nursery areas has, therefore, provided a basis for protection and management of the Maryland anadromous fishery resource.

This report is intended to serve as a management guide or index to Anadromous Fish Spawning and Nursery Streams. Species abundance data is contained in computer print-outs of biological data, not included herein.

This study summarizes anadromous fish spawning and nursery area streams for all principal watercourses in the Potomac River and upper Chesapeake Bay drainages, except for the Chester River drainage which is currently being inventoried (1975-76).

The study does not present abundance of spawning or nursery (young-of-year) species. Abundance (numbers) of eggs, larvae, and young of year fish were inventoried, however, the extensive amount of data prohibits the inclusion of species abundance in this report.

All 310 watercourses that were surveyed for anadromous spawning are listed by sub-basin drainages in Tables I to IX (List of Tables, page V). Anadromous species are indicated for each watercourse where they were present, based on the collection of eggs, larvae, or fish in spawning condition.

The distribution of each spawning species is also mapped (List of Maps, page VII) for streams in each sub-basin drainage, together with dams and other stream structures.

A listing of all spawning streams for each anadromous species in the Potomac River and Upper Chesapeake Bay drainages is contained in Appendix A.

Streams containing young-of-year nursery areas are mapped for each species in the Potomac River and Upper Chesapeake Bay drainages (Maps LII to LXVI). All young-of-year nursery streams are also listed in Appendix B, with species occurrence.

Appendix A provides a rapid index to spawning streams, while Appendix B references nursery streams.

Data in this report should answer numerous inquiries, relative to anadromous spawning/nursery streams, that I have received from resource managers in various State and Federal agencies, consulting firms and other groups. This report should be useful in environmental review of various stream and watershed construction projects, such as highways, dams, channelization, and other watercourse alterations where anadromous fish are usually considered in the planning-construction process.

Jay O'Dell, Natural
Resources Manager I

August 12, 1975

FORWARD

A prior study, Project AFC-3, ("Stream Improvement Program for Anadromous Fish Management"), comprised the first study phase of the Anadromous Fish Stream Survey Program activities in Maryland. During the study, investigations were conducted on selected streams located in forty-three river systems on both shores of the Chesapeake Bay and for additional watercourses draining directly into the Atlantic Ocean. Lack of sufficient study time prohibited both intensive stream site sampling and a comprehensive inventory of all streams and rivers in the seventeen Maryland tidewater counties having anadromous spawning potential. With the exception of striped bass investigations, no previous comprehensive stream studies had been conducted for watercourses in Maryland to ascertain spawning areas for other anadromous fish species.

Field investigations during the first phase of Project AFC-3 study were conducted during the period of June, 1967, to September, 1970. Project activities included anadromous fish investigations, survey of stream conditions, stream improvement, water quality surveys, and inventory of stream barriers. Study findings were presented in two annual progress reports for Project AFC 3-1 and Project AFC 3-2 respectively. A completion report for the entire study period of June 1, 1967 to August 31, 1970, with stream study findings was also compiled. A supplemental data report, "Streams Having Seasonal Populations of Adult Anadromous and Semi-Anadromous Fish", was completed to record documented spawning streams.

Anadromous fish investigations were continued and extended to specific areas of the State in a similar study, Project AFC-8, "Survey of Anadromous Fish Spawning Areas". Project AFC-8 started September 1, 1970, at the termination of Project AFC-3. Stream investigations started, however, during July, 1970, while awaiting formal federal project approval for continuation of studies. The techniques and methodology developed during former Project AFC-3 study segments became the basic guidelines for Project AFC-8 investigations. Project AFC-8 studies, unlike Project AFC-3, concentrated study efforts on comprehensive anadromous fish inventories of all streams in designated river drainages.

The five study segments of Project AFC-8 spanned a period of four and one-half years, from July, 1970 to January, 1975. All principal streams and rivers on the Maryland side of the Potomac River below Washington, D. C. and in upper Chesapeake Bay area located north of the Bay Bridge crossing, with the exception of the Chester River drainage, were surveyed for anadromous species and stream conditions.

Anadromous fish investigations are continuing for other areas of Maryland. Project AFC-9, "Survey and Inventory of Anadromous Fish Spawning Areas, started in January 1975 at the conclusion of Project AFC-8. The three segments will include in sequence, the Chester River drainage (two years), lower western shore drainages of Chesapeake Bay (one year) and the Patuxent River drainage (two years), during the period of 1975 to 1980.

After completion of Project AFC-9, all potential anadromous fish spawning streams in Maryland will be inventoried, except for the lower eastern shore drainages of Chesapeake Bay (south of the Bay Bridge) and the Atlantic Coast drainage streams.

ACKNOWLEDGEMENTS

The study was conducted in cooperation with the Federal National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce. Work was performed under the Anadromous Fish Act of 1965, Public Law 89-304, as amended. The Maryland sponsoring agency was the Department of Natural Resources, Fisheries Administration (formerly Fish and Wildlife Administration). Fifty per cent funding by each agency was provided for all phases of study activities.

During the five segments of Project AFC-8, George J. Murphy served as Federal Aid Coordinator for the Department of Natural Resources. Assistance was provided by him in Federal-State project document renewals and obtaining federal funding.

Personnel of the Chesapeake Field Station of the Federal Environmental Protection Agency contributed assistance in water quality sampling on the Potomac River during the first segment. Laboratory analyses were also provided by the agency's laboratory personnel at Annapolis.

The joint sampling program of water quality and plankton (eggs and larvae) in the Potomac River was assisted by Joseph Boone, Maryland Department of Natural Resources and Dr. Donald Lear, Environmental Protection Agency.

Boats, for biological sampling, were at times provided by Commander Roy Rafter of the Natural Resources Police (Marine Police), Maryland Department of Natural Resources.

During the four and one-half years of study several staff persons participated in field surveys, laboratory analysis of biological collections, data processing, and other project activities. The normal project staff included eight persons with additional secretarial and summer assistants. Following is a listing of individuals and their periods of service during the study. Staff assistance of some personnel was commenced during Project AFC-3, as indicated by employment prior to July 1970.

STAFF

C. Jay O'Dell, Natural Resources Manager, (Biologist)	3-20-68 - Present
John P. Gabor, Biologist, (Water Quality Technician)	6-19-68 - Present
Ray C. Dintaman, Biologist	3-14-73 - Present
James P. Mowrer, Conservation Associate, (Water Quality Technician)	3-4-70 - Present
Anthony A. Jarzynski, Conservation Associate	3-13-74 - Present
Donald T. Cosden, Conservation Aide	6-20-73 - Present
Howard J. King, Biologist	5-19-69 - 3-13-73
Kyle W. Tutwiler, Water Quality Technician	3-4-70 - 8-10-71
Maureen G. Shannon, Water Quality Technician	11-17-71 - 4-18-72
David J. Pushkar, Conservation Associate, (Water Quality Technician)	11-10-71 - 3-5-74
Newton H. Kershner, Conservation Associate, (Water Quality Technician)	7-5-72 - 10-30-74
Richard D. Klein, Conservation Associate, (Conservation Aide)	9-15-69 - 10-7-73
Frank L. Ryan, Sr., Conservation Aide	9-15-69 - 5-11-71
David M. Hughes, Conservation Aide	1-9-73 - 3-27-73
Charles A. Shenk, Conservation Aide	6-23-71 - 12-19-72

SEASONAL ASSISTANTS

1970

Philip W. Briddell
John-Walter S. Foster III

1971

Charles P. Wilkerson
Frank R. Weidmann

1972

Laurence D. Chitlik
David C. Rodeheaver
Glenn E. Johnson

1973

John W. Shank
Susan H. Wolverton
David J. Wolfkill

1974

James A. Wintrode

SECRETARIAL

Frances Sherbert	1968 to 1970
June W. Morris	1970 to 1972
Joyce A. Campbell	1972 to 1975

INTRODUCTION

Seventeen Maryland counties have streams and rivers with open access to the Chesapeake Bay or Atlantic Ocean. Some of the streams in the seventeen tidewater counties, therefore, have the potential for ocean runs of fish. (Map I). (Lower Montgomery County, accessible only to Little Falls Dam, is not included).

Inventories of anadromous fish spawning and nursery area streams and related watercourse surveys to document and improve stream conditions for fish propagation were completed for the principal tidal and freshwater stream-courses in two major areas of Maryland, the Potomac River Drainage and the Upper Chesapeake Bay Drainage.

In the Lower Chesapeake Bay Drainage, the Potomac River Drainage Study comprised four sub-river systems. Surveys on the Maryland side of the river included streams in St. Mary's, Charles, and Prince George's counties (Map II). Watercourses within Washington, D. C., located in the Rock Creek and Anacostia River drainages and Potomac River proper in lower Montgomery County were also surveyed. A total of 116 streams were inventoried in the five river drainages of the Potomac Watershed below Little Falls Dam, at river mile 117.4, for spawning.

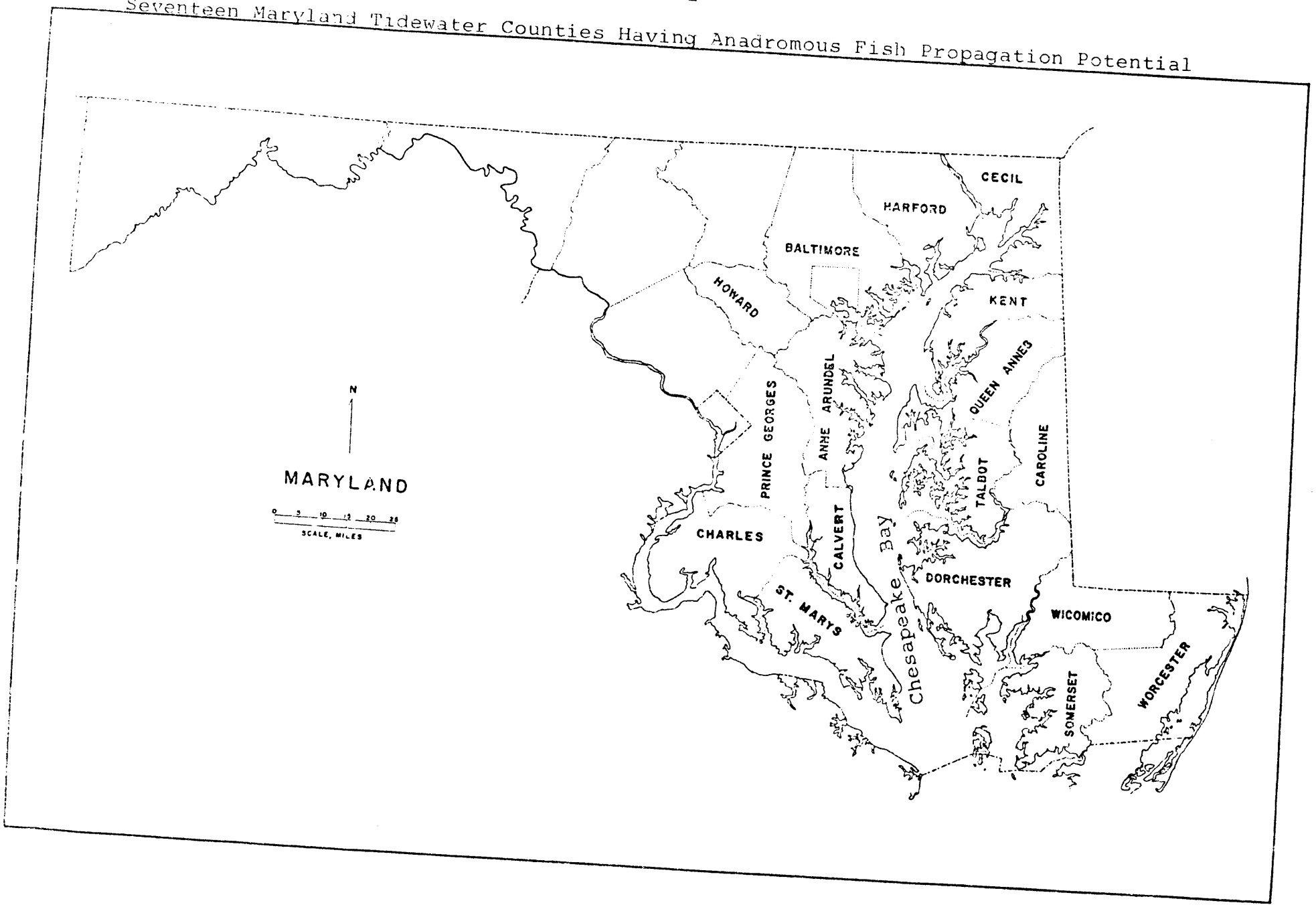
The Upper Chesapeake Bay Drainage Study included twelve rivers and their drainage systems, located in Anne Arundel, Baltimore, Howard, Harford, Cecil, and Kent counties (Map III). Additional watercourses draining directly into Chesapeake Bay, including their tributaries, within study area counties were also surveyed. A total of 194 streams in the twelve river drainages located on both shores of the Bay were surveyed for anadromous species. All river systems of the State north of the Chesapeake Bay Bridge to Pennsylvania and Delaware boundaries were included, except for the Chester River Watershed.

Investigations were conducted for all streams, generally a mile or greater in length, within the two major study areas of the upper and lower Chesapeake Bay drainage. Surveys to document barriers and other stream conditions generally extended to the headwaters of inventoried streams and rivers. In a relatively few instances, surveys were terminated at sites of major impoundments and at the Pennsylvania and Delaware boundaries. Surveys commenced at the mouth of tidal watercourses and extended to the limit of tidal influence. Freshwater watercourses, were also surveyed from mouths to headwaters, by walking each stream course.

Biological sampling for spawning documentation was established generally at one to three mile intervals in both tidal and freshwater streams, depending on stream accessibility and the location of barriers. Sampling to ascertain nursery areas was conducted in tidal streams, based on one to five sites per stream.

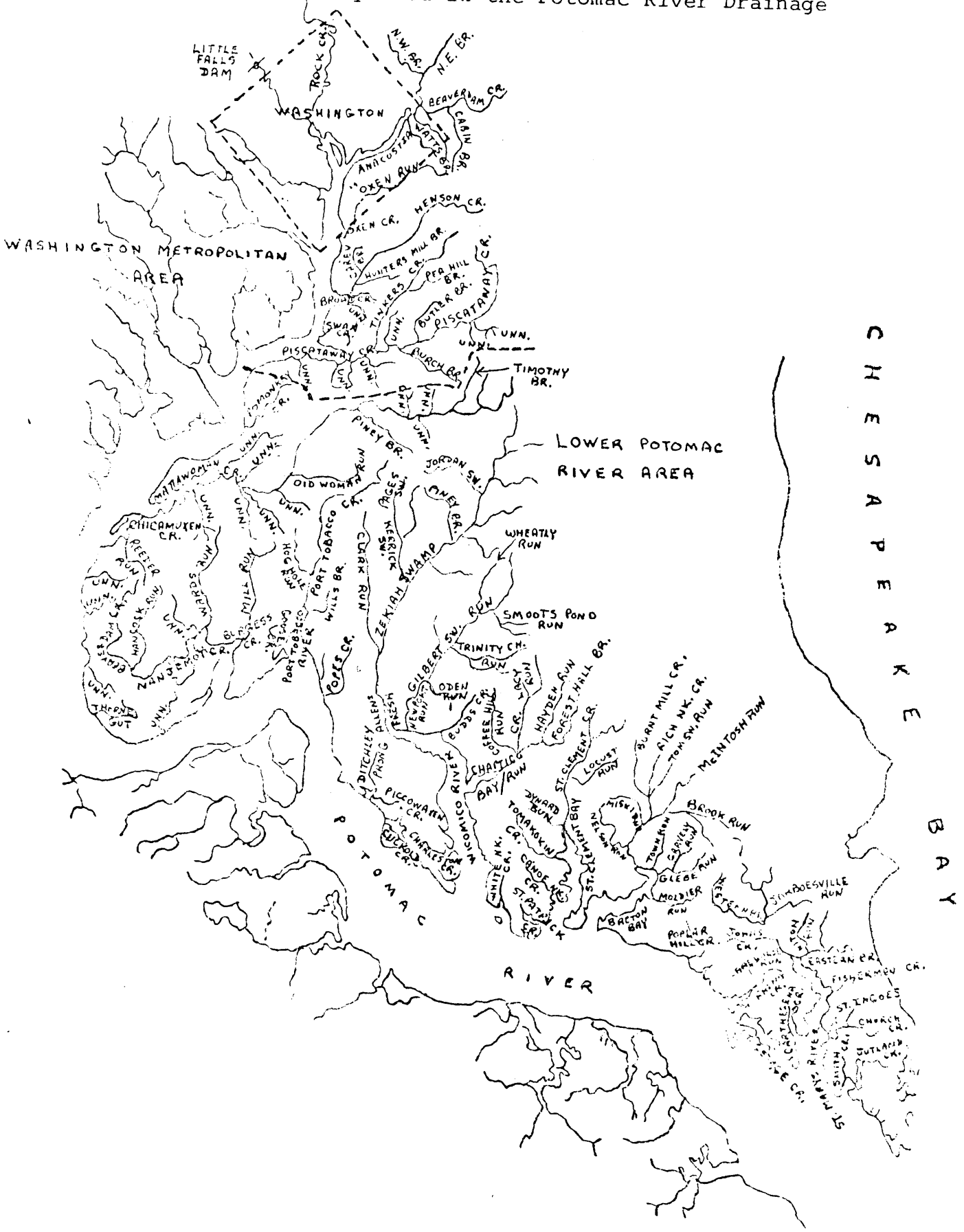
MAP I

Seventeen Maryland Tidewater Counties Having Anadromous Fish Propagation Potential



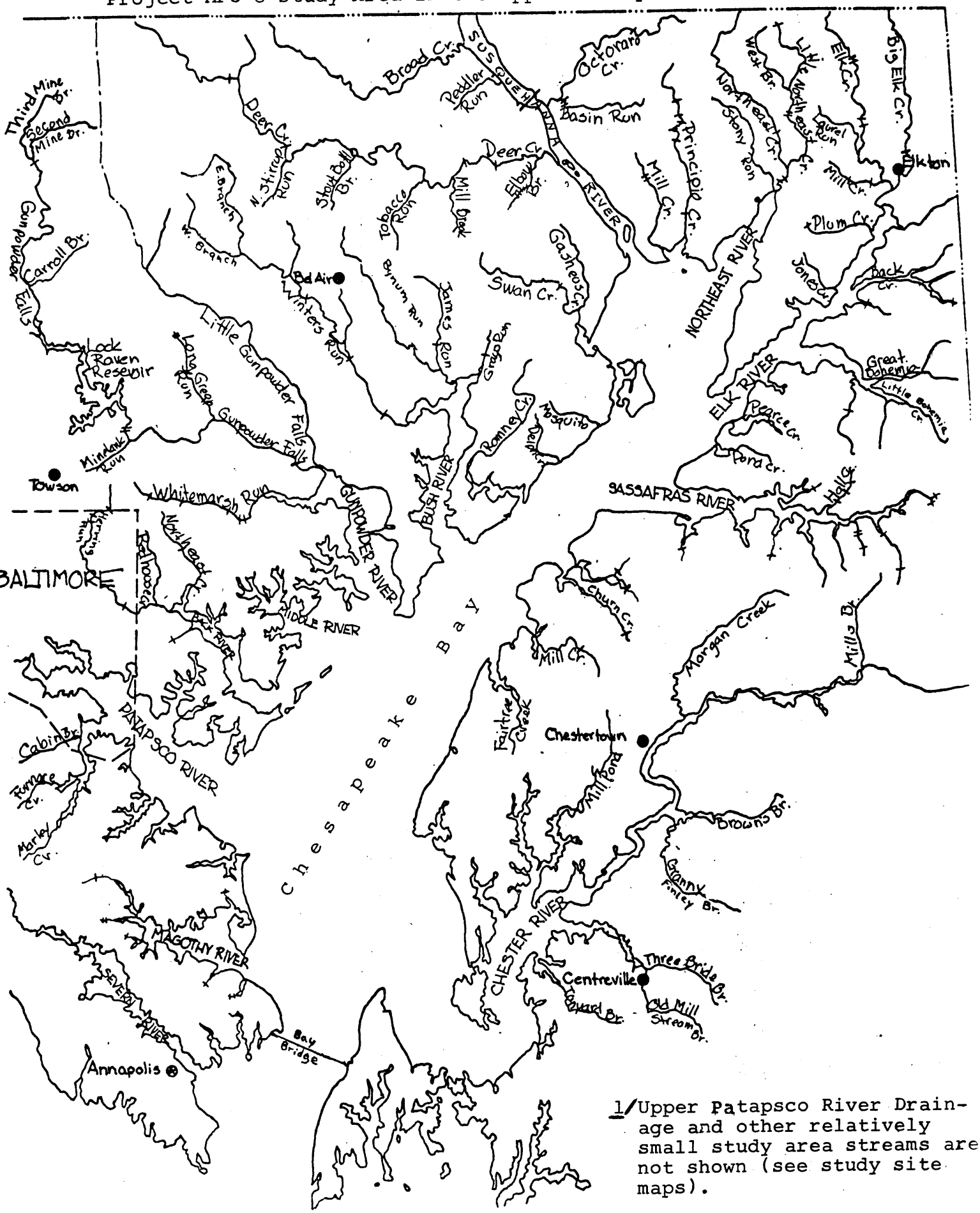
MAP II

Project AFC-8 Study Area in the Potomac River Drainage



MAP III

Project AFC-8 Study Area in the Upper Chesapeake Bay Drainage 1/



1/ Upper Patapsco River Drainage and other relatively small study area streams are not shown (see study site maps).

For purposes of this study a stream or watercourse is hereafter defined as any course of water having banks and flowing water, either tidal or fresh. The term stream or watercourse refers to bodies of water commonly referred to as rivers, creeks, branches, coves and inlets. A stream or section of watercourse having tidal influence is referred to as an estuary. The terms estuarine and tidal are used synonymously in this report, as are stream and watercourse. The term freshwater stream denotes an absence of tidal influence, including tidal-fresh water, and is indicative of flowing water from inland areas.

Stream data was collected for a total of eight sub-basins (watersheds) in the main Chesapeake Bay Drainage Basin (Map IV). The sub-basin watershed designations and delineations were developed jointly by the Anadromous Fish Program and Maryland Water Resources Administration. A common hydrological basis for collecting, storing, and retrieving, computerized stream data was essential to studies of both groups, as well as other state agencies. Anadromous Fish Study data is, therefore, presented separately for each sub-basin in the two major study areas. A listing and physical description of each watershed sub-basin and their major watercourses (sub-sub basins) are included with Job II, "Fishery Investigation".

Project AFC-8 study activities were comprised of four inter-related jobs, all of which were completed during the four and one-half years of study. This report includes a life history summary of anadromous species, followed by a summation of study activities and findings by job for the five combined study segments as follows:

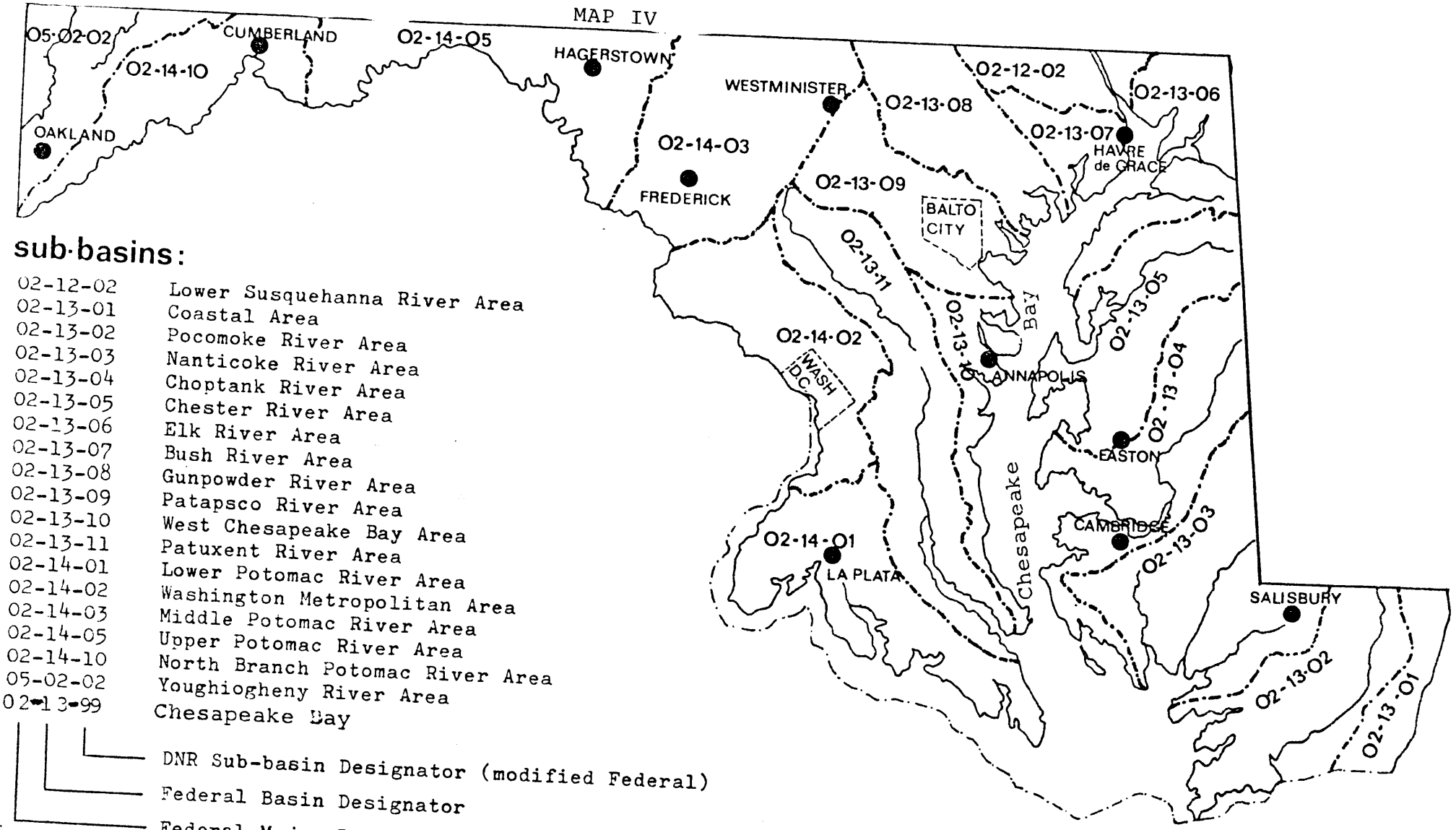
Job I. Literature and Data Review

Job II. Fishery Investigation

Job III. Stream Investigation

Job IV. Data Summarization and Storage, Preparation of Report

Maryland Watershed Designations



sub-basins:

*	02-12-02	Lower Susquehanna River Area
	02-13-01	Coastal Area
	02-13-02	Pocomoke River Area
	02-13-03	Nanticoke River Area
	02-13-04	Choptank River Area
	02-13-05	Chester River Area
*	02-13-06	Elk River Area
*	02-13-07	Bush River Area
*	02-13-08	Gunpowder River Area
*	02-13-09	Patapsco River Area
*	02-13-10	West Chesapeake Bay Area
*	02-13-11	Patuxent River Area
	02-14-01	Lower Potomac River Area
*	02-14-02	Washington Metropolitan Area
	02-14-03	Middle Potomac River Area
	02-14-05	Upper Potomac River Area
	02-14-10	North Branch Potomac River Area
	05-02-02	Youghiogheny River Area
*	02-13-99	Chesapeake Bay

02-13-99
- 99 — DNR Sub-basin Designator (modified Federal)
- 13 — Federal Basin Designator
- 02 — Federal Major Basin Designator

*Project AFC-8 studies were conducted within these sub-basins.

GENERAL LIFE HISTORY OF ANADROMOUS FISH SPECIES IN MARYLAND

Anadromous fish are defined as fish species which live their adult lives in ocean waters, but return to freshwater rivers and streams to spawn. Anadromous fish species that spawn in Maryland include: American shad, hickory shad, alewife, blueback herring, and striped bass.

Estuarine species spend their adult years in bays and rivers where the salt content is less than ocean waters, and ascend freshwater streams to spawn. Estuarine fish species in Maryland include white perch and yellow perch.

STRIPED BASS (Morone saxatilis)

The striped bass or rockfish is the official State fish of Maryland. It is Maryland's most valuable and prized species, both to the sport and commercial fisherman. It is an anadromous species that inhabits the entire Chesapeake Bay proper, including some tidal-fresh streams.

Striped bass spawn between April and June in tidal-fresh or slightly brackish water. They require large rivers with a strong flow for spawning. The striped bass eggs are semi-buoyant and require flowing waters to keep them afloat. The homing instinct is strong in striped bass, for they return to the same rivers to spawn in successive years.

After hatching, the young larvae move into low-salinity waters of river nursery areas. As they mature, young striped bass move downstream, concentrating along the shoal areas of the Chesapeake Bay and tributary streams to feed during their first summer. With the approach of winter, they move to deeper off-shore estuarine waters.

WHITE PERCH (Morone americana)

Like the striped bass, the white perch is sought by commercial and sport fishermen for its fine flavor. This species is also preyed upon by larger predators.

White perch are estuarine, migrating from tidal waters to freshwater streams of the Chesapeake Bay drainage for spawning. Although the white perch inhabits the entire Bay in both brackish and tidal freshwater, there are separate white perch populations which apparently remain within specific tributaries, such as the Potomac and Magothy rivers.

Ripe white perch can be found as early as March moving upstream to fresh water to spawn. Adult white perch remain on the spawning grounds until early June. White perch eggs are slightly heavier than water and adhesive. They attach underwater to tree limbs and debris or on firm sandy bottoms.

After hatching, the larvae move downstream to nursery areas. As they grow, they move further downstream into shallow beach areas to feed. With the approach of winter, both adults and juveniles move to deeper water (generally greater than 40 feet) where it is warmer.

YELLOW PERCH (Perca flavescens)

The yellow perch is another estuarine fish that inhabits the Chesapeake Bay in all major tributaries and streams. They are primarily a freshwater fish, but have adapted to the estuarine conditions of the Chesapeake Bay. They prefer low salinity portions of the Bay except during the spawning season.

Yellow perch are generally the first anadromous fish species to migrate upstream to freshwater in the spring. They usually appear in freshwater in late February and are gone by mid-March. The upstream spawning migration usually marks the upper limit of the yellow perch distribution in streams of the Bay drainage.

The yellow perch eggs are easily recognized as long, yellow, gelatinous strands of eggs which adhere to limbs and other debris in streams.

Spent fish move downstream after spawning. They remain within their particular river system throughout the summer and winter, rarely moving out into the Chesapeake Bay proper.

AMERICAN SHAD (Alosa sapidissima)

The American shad has long been considered a delicacy by many. Shad roe (eggs) are especially prized. Although numbers of this species have declined dramatically in this country, they are still fished commercially. Anglers look forward to the spring shad arrival in various rivers of Maryland where the shad provides a rather intense sport fishery.

Spawning occurs during April and early May in tidal-fresh water. Adults return to the ocean after spawning, while the juveniles remain in the Bay and its tributaries until fall or even for their first year. They then migrate to ocean water where they reach maturity. Tagging studies show that shad can return to the site where they were spawned with much accuracy.

HICKORY SHAD (Alosa mediocris)

The hickory shad is regarded as a unique sportfish. It moves into larger streams and can be caught on light tackle during the spring and in ocean inlets during the summer months.

Hickory shad populations have suffered historical declines in Maryland and currently appear to be in a population low.

Adult hickory shad are oceanic and estuarine fish whose movements are unknown. It is generally believed that they stay fairly close to the mainland as well as in the estuaries. Adults enter tidal freshwater in late April to spawn and are usually gone by mid-June.

Juveniles leave the nursery areas in early summer to return to sea. Some specimens, less than one year old, however, have been found in the Bay and its tributaries throughout most of the year.

ALEWIFE (Alosa pseudoharengus) and BLUEBACK HERRING (Alosa aestivalis)

The alewife and blueback herring are the most numerous of the oceanic anadromous fish species in the Chesapeake Bay drainage. They are harvested for reduction to nutritional organic supplements, or for processing as canned fish products.

The two herring species enter their spawning streams slightly earlier than the shad. Spawning occurs in small freshwater streams, often less than ten feet in width. The alewife spawning runs usually occur from late March through April, while the blueback herring runs begin the last half of April and continues through the first half of May. After spawning, the adults move downriver to lower estuaries and Chesapeake Bay. As winter approaches, they move to deeper Bay water and then to the sea. The young-of-year fish follow this same general migration pattern.

JOB I. LITERATURE AND DATA REVIEW

Literature and data reviews were conducted to provide information on previous stream studies and inventories in order to document known stream conditions. Relevant data was incorporated into each segment of this study, following field inspection and verification.

A. Data Review

Prior to establishing study stations for each segment of this study, all preceding study segments were reviewed. Shore habitat, watershed conditions and types of improvements that were made in stream conditions during Project AFC-3 (Stream Improvement Program For Anadromous Fish Management) to promote fish passage were taken into consideration in determining the location of study stations for each study segment.

Stream barriers to anadromous fish, documented for some streams in previous AFC-3 study segments, were reviewed each year. Knowledge of the location of stream barriers, which often prohibit fish passage, was essential in the selection of biological sample sites. Previously documented stream barriers were incorporated with those documented in Project AFC-8 stream surveys. Data from past and current surveys established potential limits of anadromous spawning migrations for inventoried watercourses.

B. Literature Review

Prior to and in the course of each study segment, literature that was pertinent to the study area was reviewed. The Maryland wetland inventory conducted by the State Department of Game and Inland Fish in 1968 was reviewed for stream habitat assessment. One limitation of this reference was the fact that no wetland areas of less than five acres were included in the inventory. Referral was made to topographic (county and 7½ minute series) and wetland maps. Wetland maps were used in recording some of the previously documented habitats along streams. Topographic maps were used in locating sample sites and referencing documented stream conditions. The Maryland State Health Department listing of sewage plant outfalls and status of treatment was used to document and record this type of stream pollution. Significant Sources of Wastewater Discharges in Maryland was used to document discharges of industrial and municipal operations. This same source was also used in giving a brief description of each basin and sub-basin, which is found later in this text under Trap and Plankton Net Findings. The Water Resources Law of Maryland was used as a guide in determining whether certain stream conditions should be referred for corrective action.

The striped bass spawning areas were delineated in Striped Bass in Maryland Tidewater, and confirmed by project sampling. Life history studies of other anadromous species were reviewed. Other watershed literature and management agencies were consulted at intervals for information useful in survey activities.

Limitations of previous studies for use in this study included the fact that there were no previous documentations of anadromous spawning areas, except for the striped bass. Also, no prior inventory existed for dams and other stream blockages.

The data and literature review provided essential information for planning this study and referencing of some stream conditions for later field investigation.

A complete listing of all references used in this study appear on pages 183 and 184.

C. Literature Development

During the course of the study, literature was developed by project personnel for purposes of promoting anadromous fish education and conservation.

A slide talk on the "Anadromous Fish Stream Survey" (Project AFC-8) activities was developed and presented at various conservation group meetings. Another slide talk was developed for the Save Our Streams (S. O. S.) programs in order to promote stream surveillance and improvement practices.

Statewide news releases were issued to newspapers, radio stations and television stations each year on anadromous spawning and nursery area surveys and other phases of investigation activities.

Various articles on project activities and findings were written and published in several state conservation magazines each year.

A brochure on anadromous fish species and survey activities was developed. Copies of this publication were distributed statewide at natural resource conferences and to various state and federal management agencies.

A brochure was written for the Maryland Save Our Streams program which outlined procedures for surveying and improving watercourses to improve fish propagation.

Information on anadromous spawning streams and other information on watercourses was provided to local, state and federal natural resource management agencies. Stream data was used in environmental review of proposed watershed development projects.

A listing of anadromous spawning streams and dams was compiled and distributed to state natural resource agencies which was also useful in environmental review.

JOB II. FISHERY INVESTIGATION

Introduction:

Objectives of this job were to determine streams supporting spawning runs of anadromous fish, document species and spawning areas for various streams, and ascertain nursery areas for these species in the Potomac River drainage system (Maryland portion) and the upper Chesapeake Bay drainage system.

Fishery investigation included three different phases: trap net survey (adult fish trapping), both inland and estuarine plankton survey (fish eggs and larvae sampling), and seining survey (young-of-year sampling). Unless otherwise stated, the total number of streams investigated for each study segment mentioned below includes sub-totals for all three phases of biological survey.

There were three study segments conducted in the Potomac River drainage system during this study (segments 1, 2, and 5). The first two study segments, Projects AFC-8-1 and AFC-8-2, were conducted from September 1, 1970 to December 31, 1971. The study area, on the Maryland portion of the river drainage, extended from the mouth of the river to Little Falls Dam and Fishway, located 117.4 river miles above Chesapeake Bay (Map II). Maryland counties within this study area included St. Mary's, Charles, and Prince George's. Streams in Washington, D. C. below Little Falls Dam were also included in the study.

The fifth study segment, Project AFC-8-5, covered the period from January 1, 1974 to December 31, 1974. The study area was the same as for segments one and two. During this segment, streams having anadromous fish propagation potential, but not previously investigated in earlier study segments, were sampled. A total of 32 streams within the Potomac River drainage were investigated during the fifth study segment. The stream total includes sub-totals from the trap net and plankton surveys only. Seining was not conducted during this study segment because of prior coverage.

A total of 135 streams in the Potomac River drainage were investigated during the three study segments.

The upper Chesapeake Bay drainage system, for purposes of this study, included the Chesapeake Bay proper and all its tributaries north of the Bay Bridge, except the Chester River drainage (Map III). The upper Bay drainage system was divided into three study segments (Segments 3, 4, and 5).

Study segment 3, Project AFC-8-3, was conducted in the area bounded by the Gunpowder River on the Bay's western shore and Fairlee Creek on the eastern shore (Map III). Maryland counties within this study area included Baltimore, Harford, Cecil and Kent. Major river drainages included the Bird River, Gunpowder River, Bush River, Susquehanna River, Northeast River, Elk River, Bohemia River, and the Sassafras River. Several smaller watercourses emptying directly into the Bay within the study area were also investigated during the fourteen month study (January 1, 1972 to February 28, 1973).

Study segment 4, Project AFC-8-4, was conducted during the period of March 1, 1973 to December 31, 1973. The area of investigation extended from the Chesapeake Bay Bridge north along the western shore of the Bay to the Gunpowder River, which included streams in Anne Arundel, Baltimore and Howard counties and Baltimore City (Map III). Four river drainage systems (Magothy, Patapsco, Back and Middle rivers) were inventoried, plus two streams in the lower Gunpowder River not previously surveyed. In addition, several watercourses emptying directly into Chesapeake Bay and their tributaries were also investigated. Originally, the Chester River drainage was to be included in this study segment, however, to accommodate the lower federal funding available to Maryland and the lack of sufficient time for coverage, the drainage was deferred to a future year.

During study segment 5 (mentioned earlier), streams having the potential to support anadromous fish runs, but not investigated to date, were inventoried. The study area was bounded by the lower Gunpowder River drainage on the western shore of the Bay and the Sassafras River drainage on the eastern shore (Map III). Previously non-inventoried streams on both shores of the Bay were surveyed for anadromous species.

During study segments 3, 4, and 5, a total of 223 streams were investigated in the upper Chesapeake Bay drainage system.

In determining streams which support runs of anadromous fish, both trap net and plankton sampling must be considered. Trap net data documents the presence of captured adult anadromous species, however, at times species present in the stream may be missed entirely. Plankton samples document actual spawning activity of species captured. Again, however, eggs and larvae of anadromous species present in the stream may be missed completely. Trap nets and plankton samples together, are reliable for documenting the presence of anadromous fish species, and indicate spawning streams. If certain anadromous fish species are not documented in either trap net or plankton survey data for a particular stream or site, this indicates that the species does not occur in that stream.

Part I. Inventory of Anadromous Fish Spawning Areas

A. Objectives

The objective of the trap net survey was to determine streams supporting runs of anadromous fish. No attempt was made to estimate populations of species. Trap nets were used to document only the presence of fish.

A plankton sampling survey was conducted to determine actual spawning activity in inland and estuarine streams. Through this method, it was possible to determine species spawning areas for various streams.

B. Methods and Procedures

1. Trap Net Survey

Potential spawning streams were selected from county topographical maps on the basis of stream length greater than one mile, salinity less than 3.5 parts per thousand, and absence of stream barriers. Where stream barriers were encountered, sites were established on the downstream side of the barrier.

Stations were selected at road crossings or other access points near stream mouths. Successive upstream stations were established at approximately one mile intervals or below barrier sites.

Inland freshwater streams and upper portions of estuarine streams were sampled generally from mid-March to mid-June each year. The sampling period covered the normal spawning period for all anadromous fish species in Maryland.

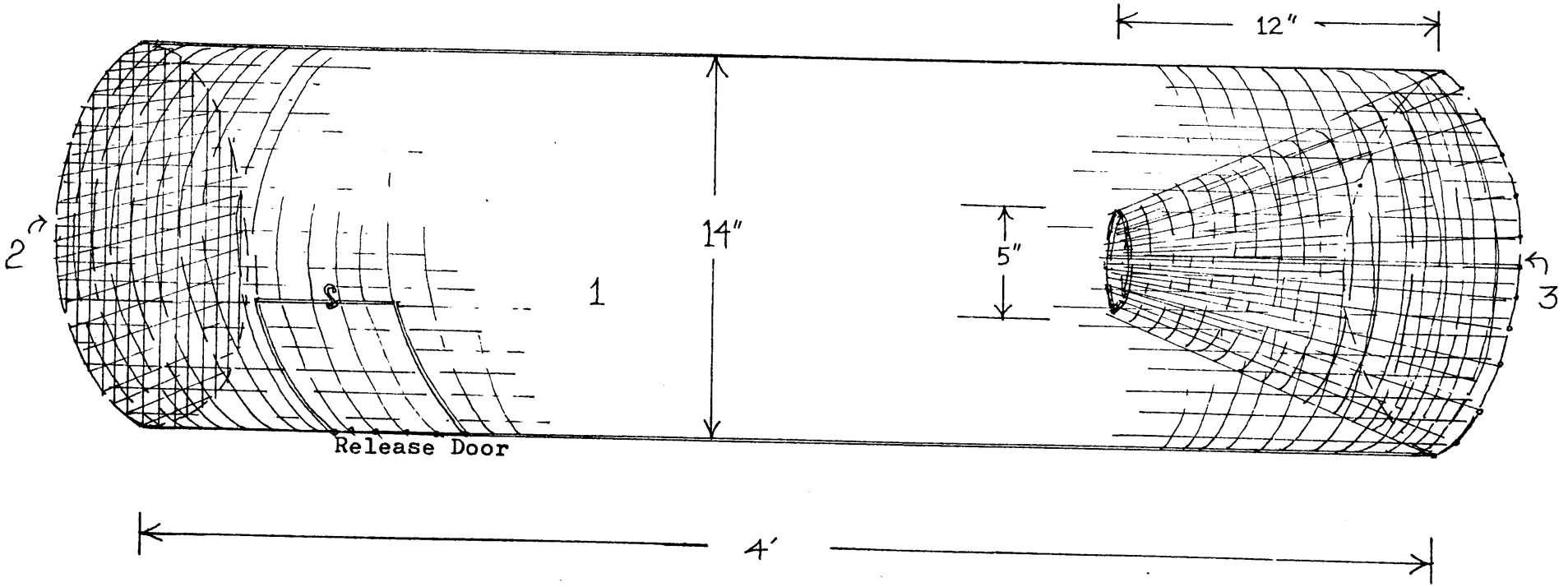
Biological sampling was accomplished by using a 14-inch diameter wire trap net having a one-inch mesh (Figure I). The four foot long traps had wire funnels one foot in length tapering to a five-inch rear opening. Traps were placed in the streams so that they could rest on the stream bottom. The funnel end of the trap was always placed facing downstream to capture fish which may have been migrating in an upstream direction. Attachment lines from the traps were anchored to the stream bank to prohibit them from being carried downstream by the current. The traps were set on an established sampling day and retrieved approximately 24 hours later (Photo I). Each stream site was sampled once a week throughout the sampling period each year.

Trap design permitted sampling all streams regardless of size or shoreline habitat, especially where other gear was impractical. Trap versatility also allowed sampling under varied conditions during which spawners were migrating upstream; whether day or night, various water temperatures, currents, weather conditions, and tidal cycles.

One limitation of this trap was selectivity for fish species. During this study, no shad were collected in the traps, even though their presence was documented by plankton samples and visual observation. Striped bass were never captured in the traps, however, this was due to the fact that the traps were never set in areas where striped bass spawn (tidal-fresh water of major river mouths). Occasionally, adult spawners of other anadromous species were missed even though they could be seen in the stream near the trap. In some cases, the fish were migrating upstream on the opposite side of the stream from the trap. In other cases, the spawning run was of such low volume that the fish could actively avoid the trap. Reliability

FIGURE I

Fish Trap Net:

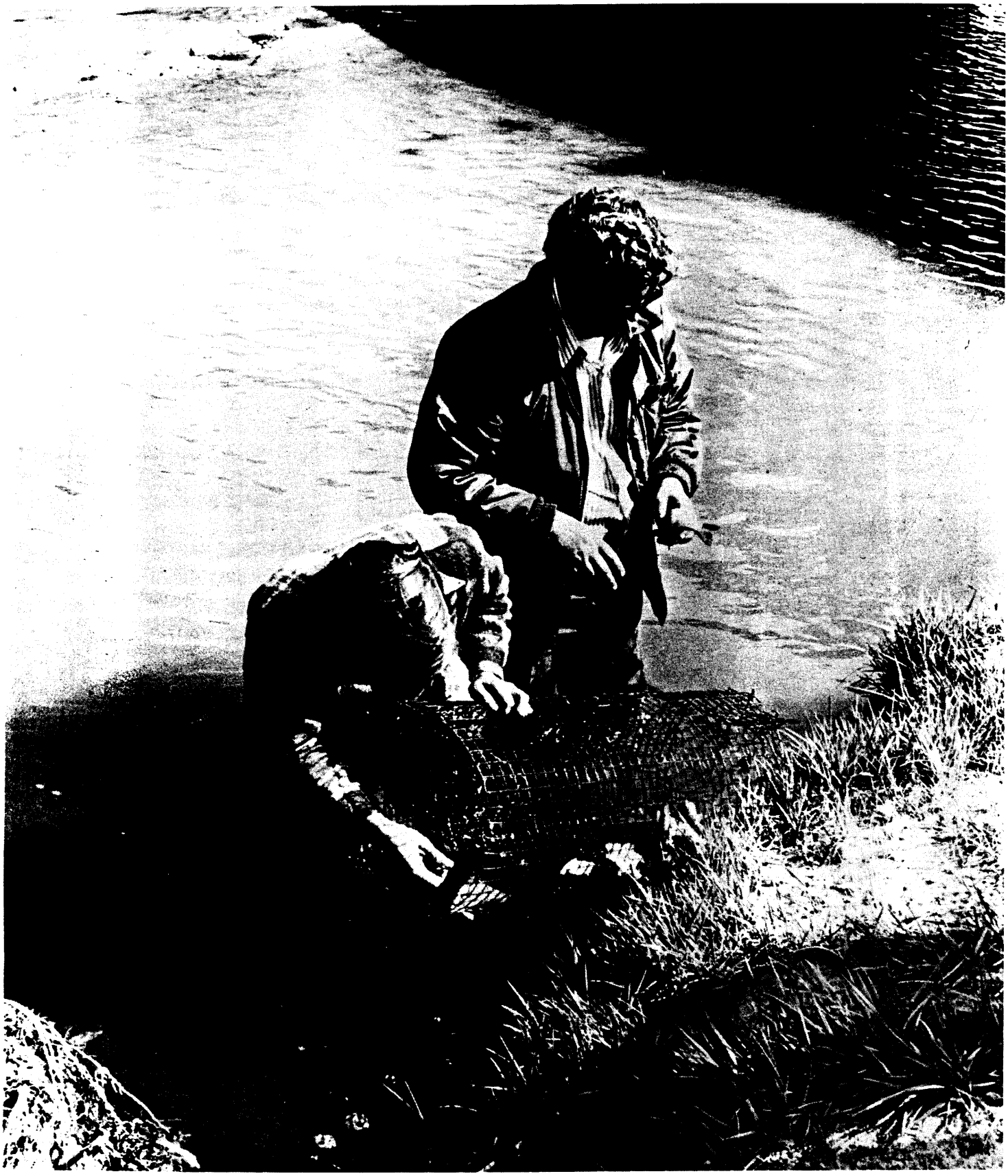


1 MAIN BODY MADE FROM 1" MESH HARDWARE FABRIC OR 1" POULTRY WIRE

2 REAR PANEL MADE FROM 1" MESH HARDWARE FABRIC OR 1" POULTRY WIRE

3 FUNNEL (THROAT) MADE FROM 1"MESH HARDWARE FABRIC OR 1" POULTRY WIRE

Photo I
Fish Trapping on Inland Streams



Project Staff Examine Spawning Condition of Fish Collected Overnight in Wire Trap

was obtained by combining the trap net survey with the plankton survey, supplemented by visual observation recordings. If adults were missed in the traps, the eggs or larvae of these adults were captured in the plankton samples. Sampling continued for twelve weeks during each study segment with two biological samples taken each week (one trap and one plankton sample). Each stream studied had an average of twenty-four biological samples taken from it. The probability of documenting some life stage of all anadromous fish species present was nearly 100%.

All fish were removed from the trap through a release flap. Anadromous species caught were identified and sexed. Spawning conditions were recorded as immature (non-spawner), ripe (spawner), or undetermined (either unripe or previously spawned). After identification, anadromous species were released into the stream. Non-anadromous species were identified, measured for size, and then released into the stream. If field identification was impossible, the fish were labelled with collecting data and preserved with 10% formalin for later laboratory identification.

Additional data recorded on the computerized Trap Net Survey Form (Figure II) included sample date and time, stream type (intermittent, perennial, freshwater, freshwater impoundment, or tidal stream), weather, tide stage, water temperature, conductivity, and salinity. Temperature, conductivity and salinity readings were recorded weekly for estuarine (tidal) trapping sites. Conductivity and salinity for inland freshwater stations were recorded once at the beginning of the survey, since readings were relatively constant.

2. Plankton Survey

Two different methods and gear were used for the plankton sampling. A square stream drift net was used to sample relatively shallow inland streams and a circular half-meter net for estuarine sampling. Data parameters recorded for both methods were the same. Data was recorded on the computerized Plankton Survey Form (Figure III).

Field recording consisted of station descriptive information, including: sample date and time, water type, stream depth, weather, tide state, water temperature, conductivity, salinity and gear code. Biological data was recorded later in the laboratory following identification of collected specimens.

DNR-FA 36A

PROCEDURE NO.
A23050 FM

03/06/73
FORM AFTRAP

FIGURE II

DEPARTMENT OF NATURAL RESOURCES
FISHERIES ADMINISTRATION
ANADROMOUS FISH/STREAM SURVEY PROGRAM
TRAP NET SURVEY FORM

DRAINAGE SYSTEM _____

STREAM _____

TRIBUTARY OF _____

COUNTY _____

LOCATION _____

SURVEY SEQUENCE NO. ____

FISH COLLECTION NO. ____

WATER SAMPLE NO. ____

(principal signature) _____ (date)

STREAM OR GRID CODE	RIVER MILE OR GRID NO.	SAMPLE DATE YR	MO	DA	SAMPLE TIME (MILITARY)	TRAP NET	BASIN CODE MAJOR	MINOR	SUB	SUB-SUB	COUNTY CODE	AGENCY SUBMITTER	STUDY NUMBER	INVESTIGATOR CODES #1	#2	#3	#4
1 2 3	4 5 6 7	8 9	10 11	12 13	14 15 16 17	18	21 22	23 24	25 26	27 28	29 30	34 35	36	37	38	39	40
						1						1 5					

WATER TYPE	WEATHER	TIDE	WATER TEMP. C	G/L	CONDUCTIVITY UMHOS/CM	G/L	SALINITY °/oo	G/L	CARD 1
41	47	48	53 54 55	56	57 58 59 60 61	62	63 64 65 66	67	80
			•				•		1

SAMPLE GEAR CODE	ANADROMOUS FISH INDICATOR	TOTAL NUMBER OF ALL FISH OF ALL SPECIES (FROM FISH SAMPLE TOTAL BELOW)	LAB TECH. INITIALS
21 22 23	42 43	44 45 46 47 48	63 64 65

LAB DATE YR	MO	DA	CARD 2
66 67	68 69	70 71	80
			2

SPECIES SEQUENCE	SPECIES CODE FAMILY	GENUS	SPECIES	NUMBER OF FISH SUBSAMPLED FOR EACH SPECIES	TOTAL NUMBER OF FISH FOR EACH SPECIES	SMALLEST FISH SIZE IN INCHES	LARGEST FISH SIZE IN INCHES	NUMBER OF IMMATURE FISH	NUMBER OF RIPE MALES	NUMBER OF RIPE FEMALES	NUMBER OF UNDETERMINED SEX OR CONDITION	CARD 3
19 20	21 22	23	24	25 26 27 28 29	30 31 32 33 34	35 36 37 38	39 40 41 42	43 44 45 46	47 48 49	50 51 52	53 54 55 56	80
						•	•					3
						•	•					3
						•	•					3
						•	•					3
						•	•					3
						•	•					3
						•	•					3
						•	•					3
						•	•					3
						•	•					3
						•	•					3
SAMPLE TOTAL												

SPECIAL REMARKS

SCIENTIFIC NAMES OF SPECIES

1 _____ 1
2 _____ 2
3 _____ 3
4 _____ 4
5 _____ 5
6 _____ 6
7 _____ 7
8 _____ 8
9 _____ 9
10 _____ 10
11 _____ 11

species data cont'd, p. 2 ___ ck.

PS-529

DNR-FA 36

PROCEDURE NO.
A23050 FW

FIGURE III

DEPARTMENT OF NATURAL RESOURCES
FISHERIES ADMINISTRATION
ANADROMOUS FISH/STREAM SURVEY PROGRAM
PLANKTON SURVEY FORM

PS-020

03/06/73
FORM AFPLANK

SURVEY SEQUENCE NO. ____

DRAINAGE SYSTEM: _____ STREAM _____

TRIBUTARY OF _____ COUNTY _____

LOCATION _____

PLANKTON COLLECTION NO. ____ WATER SAMPLE NO. ____

STREAM OR GRID CODE	RIVER MILE OR GRID NO.	SAMPLE DATE YR	SAMPLE DATE MO	SAMPLE DATE DA	SAMPLE TIME (MILITARY)	PLANKTON	BASIN CODE MAJOR	BASIN CODE MINOR	BASIN CODE SUB	BASIN CODE SUB-SUB	COUNTY CODE	AGENCY SUBMITTER	STUDY NUMBER	INVESTIGATOR CODES #1	#2	#3	#4
1 2 3	4 5 6 7	8 9	10 11	12 13	14 15 16 17	18	21 22 23	24	25	26 27 28	29 30	34 35	36	37 38	39	40	
						2						1 5					

WATER TYPE	STREAM DEPTH (FT.)	G/L	WEATHER	TIDE	WATER TEMP. C	G/L	CONDUCTIVITY UMHOS/CM	G/L	SALINITY o/oo	G/L	CARD 1
41	42 43 44 45	46	47	48	53 54 55	56	57 58 59 60 61	62	63 64 65	66 67	80
	•				•				•		1

SAMPLE GEAR CODE	SURFACE/BOTTOM	ANADROMOUS FISH PLANKTON INDICATOR	TOTAL NUMBER OF ALL EGGS THIS SAMPLE (FROM EGG SAMPLE TOTAL BELOW)
21 22 23	41	42 43	49 50 51 52 53

TOTAL NUMBER OF ALL LARVAE THIS SAMPLE (FROM LARVAE SAMPLE TOTAL BELOW)	LAB TECH. INITIALS	LAB DATE YR	LAB DATE MO	LAB DATE DA	CARD 2
54 55 56 57 58	63 64 65	66 67	68 69	70 71	80
					2

SPECIAL REMARKS

_____

_____

_____

_____

(principal signature) (date)

SPECIES SEQUENCE NO.	SPECIES CODE FAMILY	SPECIES CODE GENUS	SPECIES CODE SPECIES	NUMBER OF EGGS SUBSAMPLED FOR EACH SPECIES	TOTAL NUMBER OF EGGS FOR EACH SPECIES	TOTAL NUMBER OF LARVAE FOR EACH SPECIES	CARD 4
19 20	21 22	23	24	25 26 27 28 29	30 31 32 33 34	35 36 37 38 39	80
							4
							4
							4
							4
							4
							4
							4
							4
							4
							4
							4
SAMPLE TOTALS							

SCIENTIFIC NAMES OF SPECIES

1 _____ 1
2 _____ 2
3 _____ 3
4 _____ 4
5 _____ 5
6 _____ 6
7 _____ 7
8 _____ 8
9 _____ 9
10 _____ 10
11 _____ 11

species data cont'd ___ ck, see page 2

a. Inland Plankton Sampling

Inland plankton sampling was conducted in conjunction with adult fish trapping. Inland stream sites were chosen at the same locations as for those in the trapping survey. The plankton sample was taken on the days the traps were retrieved. A five minute sample was taken using a 15-inch square framed net (Figure IV).

The tapered net was four feet long, including a quart mason jar at the end, and had 28 x 50 meshes per square inch. Because of its design, the net permitted sampling of shallow streams, and also allowed the collection of demersal type eggs, characteristic of the herrings, white perch, and the two species of shad (Photo II). For streams less than 15 inches deep, the surface water as well as the stream bottom was sampled. Placing the plankton net on the stream bottom permitted suspended and floating material to flow into the net and funnel down into the collection jar. The contents of the jar were preserved in 10% formalin for later laboratory identification.

b. Estuarine Plankton Sampling

Weekly estuarine plankton sampling was conducted from project boats and also with the assistance of boats operated by Natural Resources Police, Marine Division.

A 0.5 meter diameter circular hoop with a 28 x 50 mesh per square inch nylon plankton net was towed by a boat against the tide at the water surface for five minutes (Photo III). Organisms were collected in the net and funneled down into a quart mason jar. The sample was preserved in 10% formalin and retained for later identification.

3. Laboratory Activities and Methods

Laboratory identification usually began in late June each year and terminated when all samples were identified. All anadromous eggs and larvae were identified to species with a few exceptions.

Because of the similar characteristics of A. pseudoharengus and A. aestivalis eggs and larvae, their presence was recorded as herring species. Documentation of spawning streams for both species is based on trapping data, whereas plankton data indicates either or both species. In a few instances, hickory shad eggs could not be distinguished from those of the two herring species, whereby an indeterminate identification of the three species was made.

Larvae of the striped bass and white perch could not be identified to species at the 8 to 20 millimeter

FIGURE IV

Stream Drift Net
anadromous fish plankton sampler

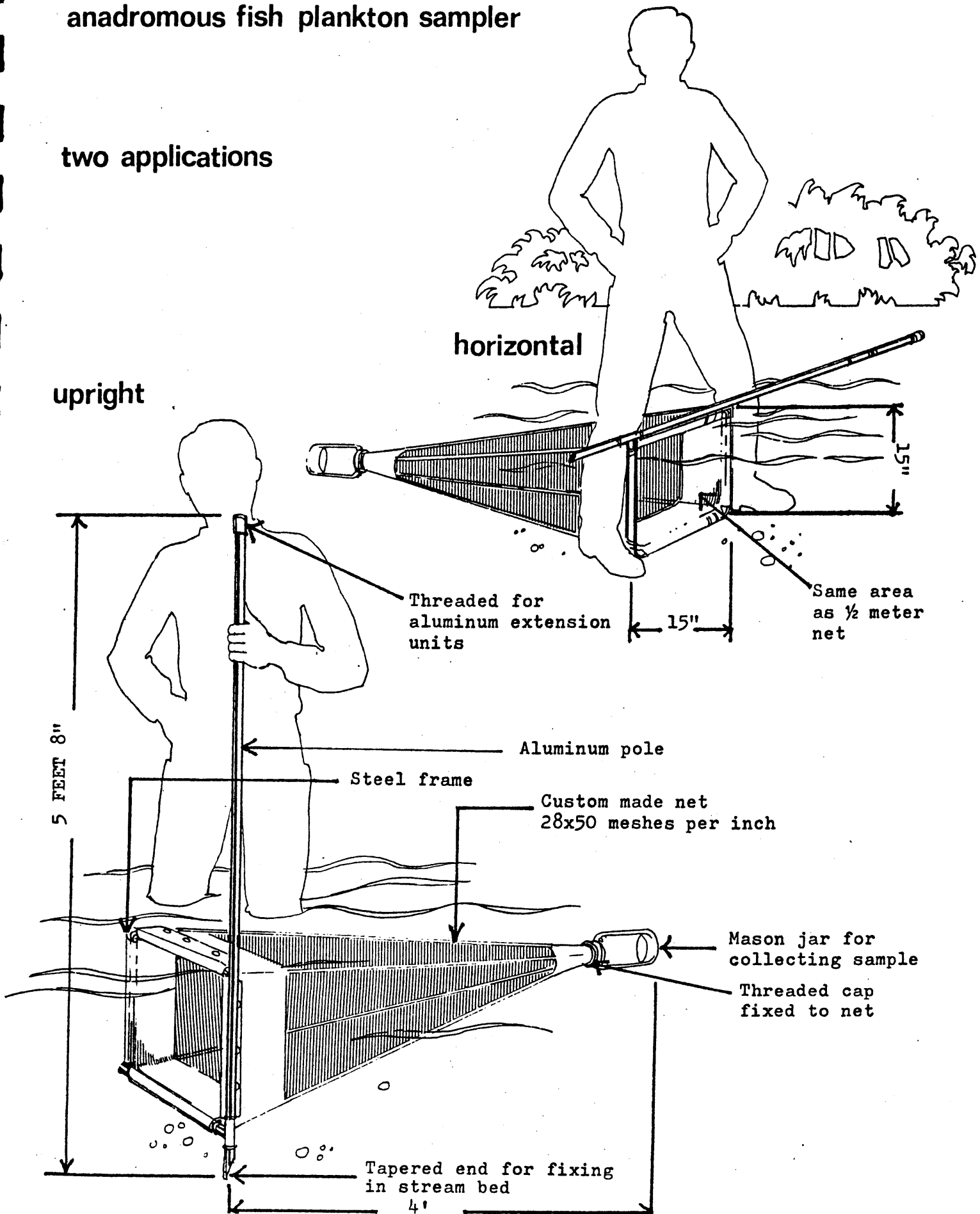
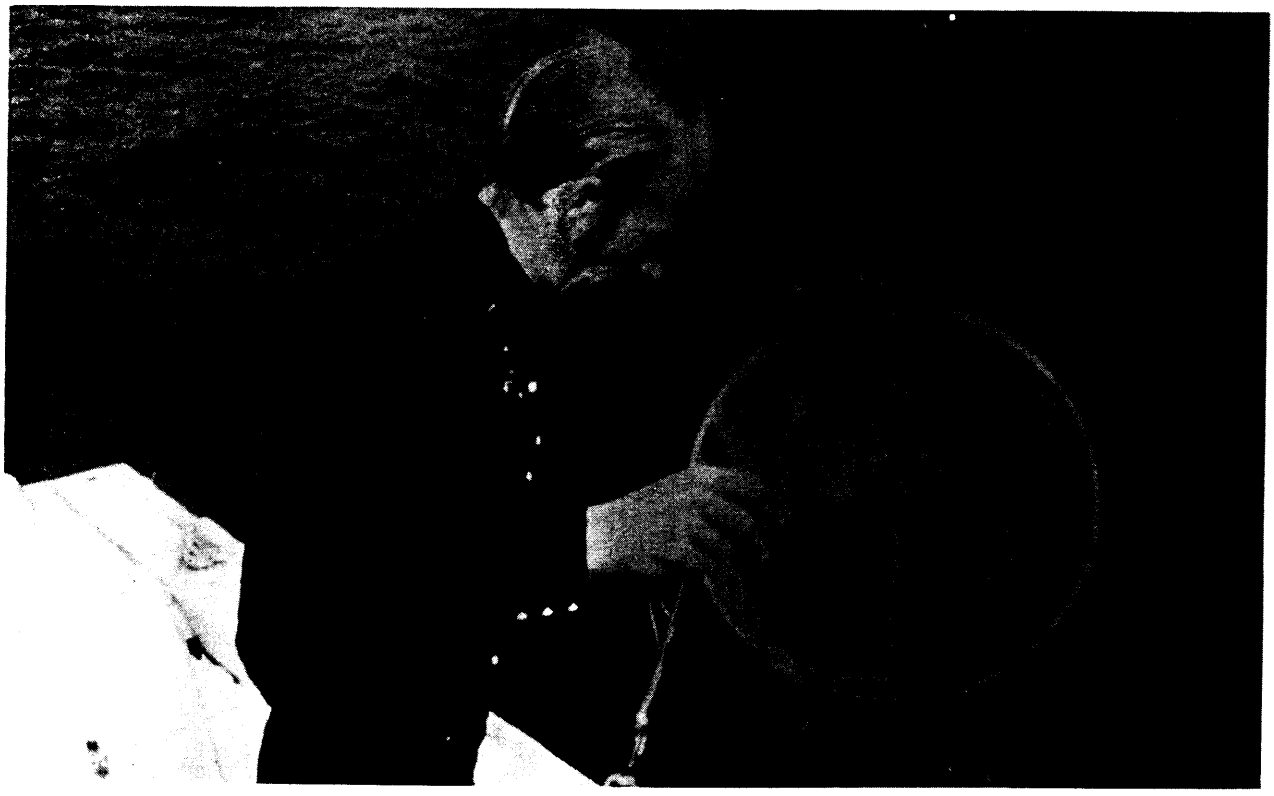


Photo II
Inland Plankton Sampling

Spawned Eggs and Hatched Larvae are Strained from the Flowing Stream

Photo III
Estuarine Plankton Sampling



Tidal Water is Sampled by Plankton Net Towed from Boat

size range and were, therefore, identified as Morone species. In some collections, menhaden larvae were found with larvae of one or more of the four Alosa species. When species identification was uncertain, a Clupeidae (herring) family grouping and identification was assigned to the collection.

Biological data recorded in addition to species, were total number of eggs and larvae collected for each species, indicating general abundance.

4. Additional Biological Sampling

During 1974, a study was conducted on seven streams in Maryland to determine the American eel (Anguilla rostrata) population and the occurrence of elver migrations.

The survey was conducted in the Potomac River and upper Chesapeake Bay drainages, corresponding to areas of anadromous fish investigation.

The study was conducted primarily to provide data on the occurrence and abundance of the American eel, a predatory fish species. The American eel, while catadromous in migration patterns, may have possible significance by affecting the anadromous fishery, through its predatory behavior and is likewise a commercial species. In addition to eels, the occurrence, relative populations, and poundage of other fish species were documented.

The frequency of sampling precluded the documentation of anadromous spawning runs and collection of anadromous species, therefore, survey data is not presented in this report. A separate publication, A Preliminary Study of the Occurrence of the American Eel and Other Finfish Species in Maryland was compiled which presented study findings.

C. Findings

Section I: Findings for the Potomac River Drainage Spawning Survey

There were two major watersheds (sub-basins) studied within the Potomac River drainage system, the Washington Metropolitan Area and the Lower Potomac River Area. The findings for each of these sub-basins are discussed below:

1. Washington Metropolitan Area

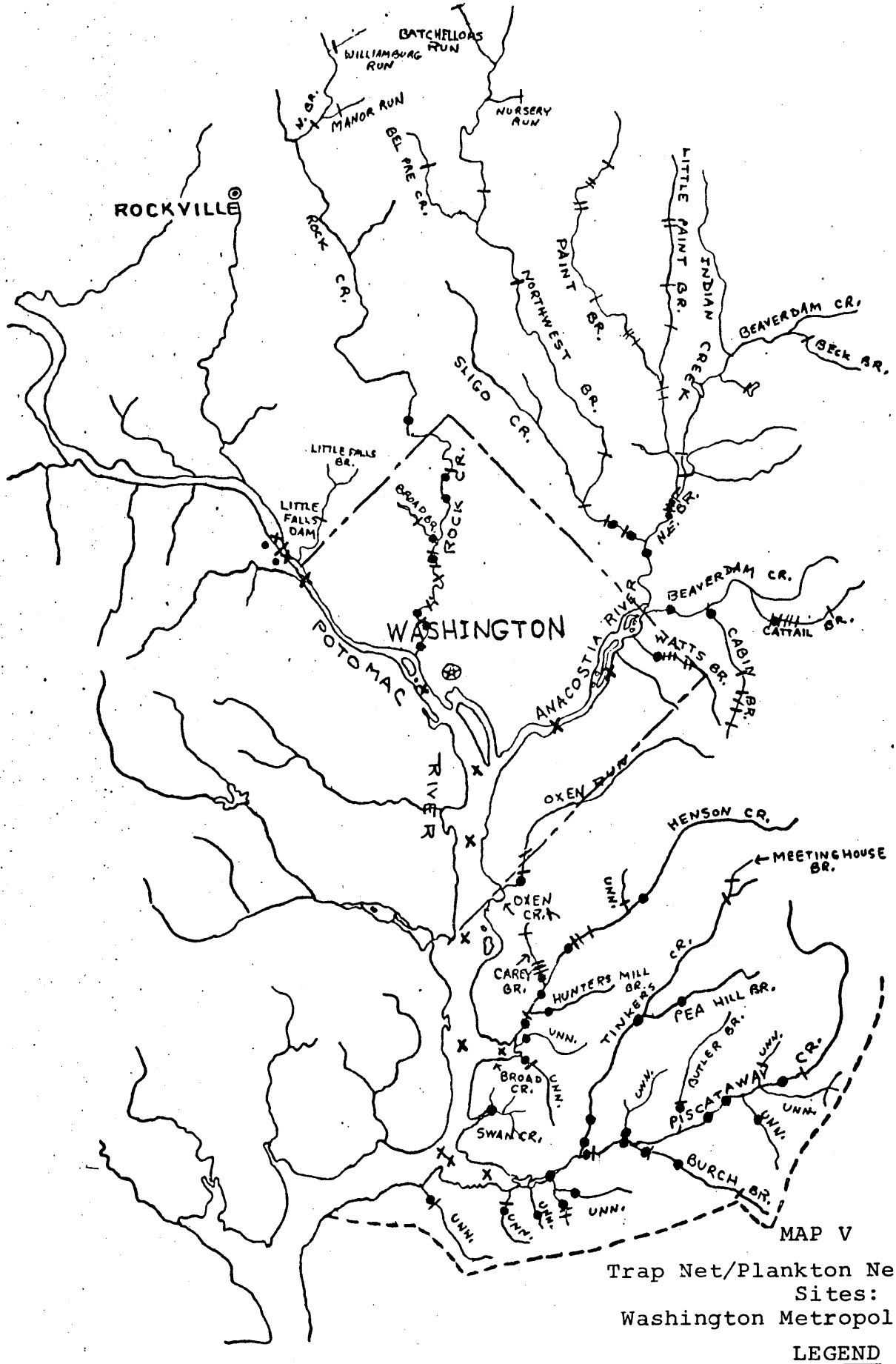
The Washington Metropolitan Area sub-basin includes streams and bodies of water in Montgomery County, the western half of Prince George's County, and a small corner of northwestern Charles County. The northeastern portions of these areas are part of the Patuxent River watershed.

The sub-basin watershed includes the stretch of the Potomac River from Dickerson at the Montgomery-Frederick county boundary to below the mouth of Piscataway Creek, near Marshall Hall. Streams tributary to this section of the Potomac River include Seneca Creek, Cabin John Creek, Little Falls Branch, Broad Creek and Piscataway Creek. The upper sections of Rock Creek, Anacostia River, and Oxon Run drainages are Maryland waters, while the lower sections of these streams flow through the District of Columbia before entering the Potomac. The southern, and larger, portion of this watershed lies within the Coastal Plain, while the northwest corner is part of the Piedmont Plateau.

Within the Washington Metropolitan Area, a total of sixty-two sites on thirty watercourses were investigated in the southern sector of the sub-basin below Little Falls Dam. Map V shows the locations of the biological sampling sites within this area. A summary table lists all the streams, by name, that were investigated during this study.

Yellow perch were documented at only two biological sampling sites. One site was on the Potomac River mainstem at river mile 111.0 (Memorial Bridge) and the other site was in Piscataway Creek at stream mile 0.9. Map VI shows the location of these documentations.

Alewife and/or blueback herring were documented in sixteen different streams or rivers. This represents 53.3% of the streams investigated. Herring were documented throughout this drainage, from the Piscataway Creek area and in every major tributary upriver to river mile 115.9 (Chain Bridge). The Chain Bridge site was also the only site where the blueback herring was positively documented. Alewife herring were positively identified in thirteen different streams. Map VII shows the locations of herring documentations.



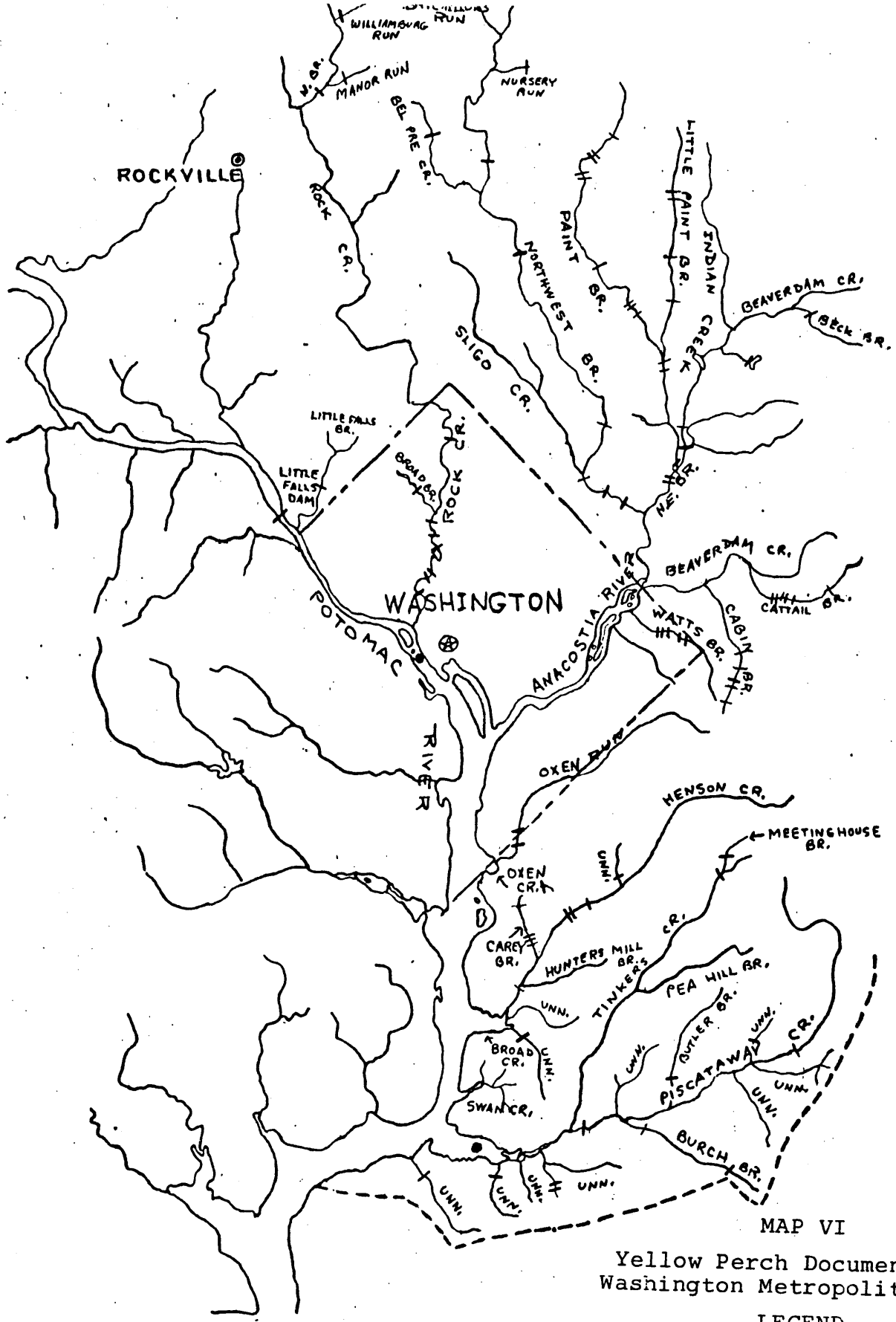
MAP V

Trap Net/Plankton Net Sampling Sites:
Washington Metropolitan Area

LEGEND

—— - Dam or stream structure
● - Inland sampling site
x - Estuarine sampling site
--- - Sub-basin division

SCALE 0 2 4 miles



MAP VI

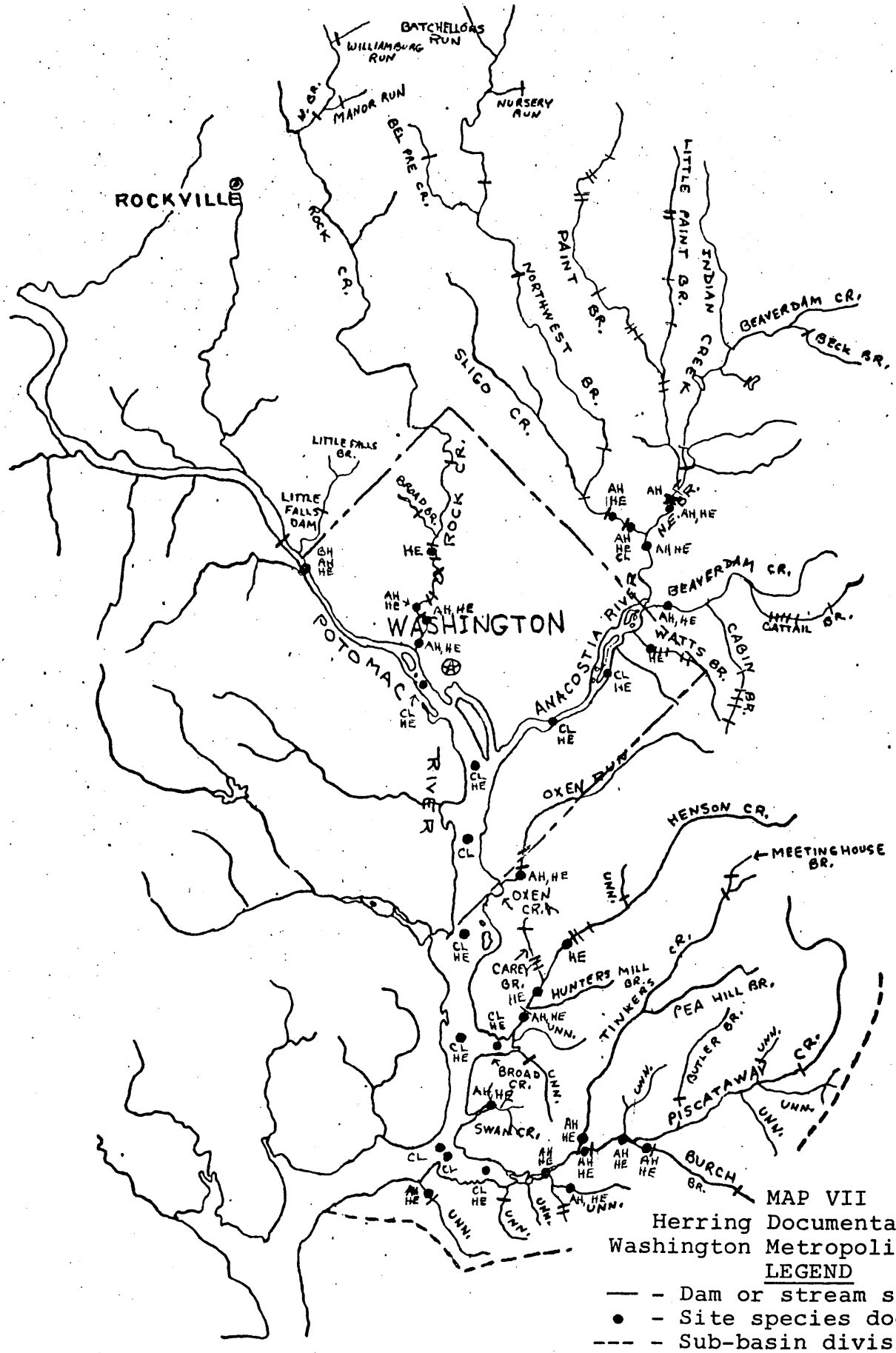
Yellow Perch Documentations:
Washington Metropolitan Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles



MAP VII
Herring Documentations:
Washington Metropolitan Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
AH - Alewife Herring
BH - Blueback Herring
HE - Alewife or Blueback Herring
CL - Clupeidae species

SCALE 0 2 4 miles

Herring migrated farther upstream than any other anadromous species in several streams. In the Piscataway Creek drainage, herring were documented as far upstream as 0.2 miles into Burch Branch, a total migration distance of 7.0 miles from the mouth of Piscataway Creek. The herring migration was 2.2 miles farther upstream than white perch documentation.

In the Broad Creek drainage, herring were documented 1.4 miles upstream in Henson Creek at a barrier. This documentation was a total migration distance of 4.6 miles upstream from the mouth of Broad Creek.

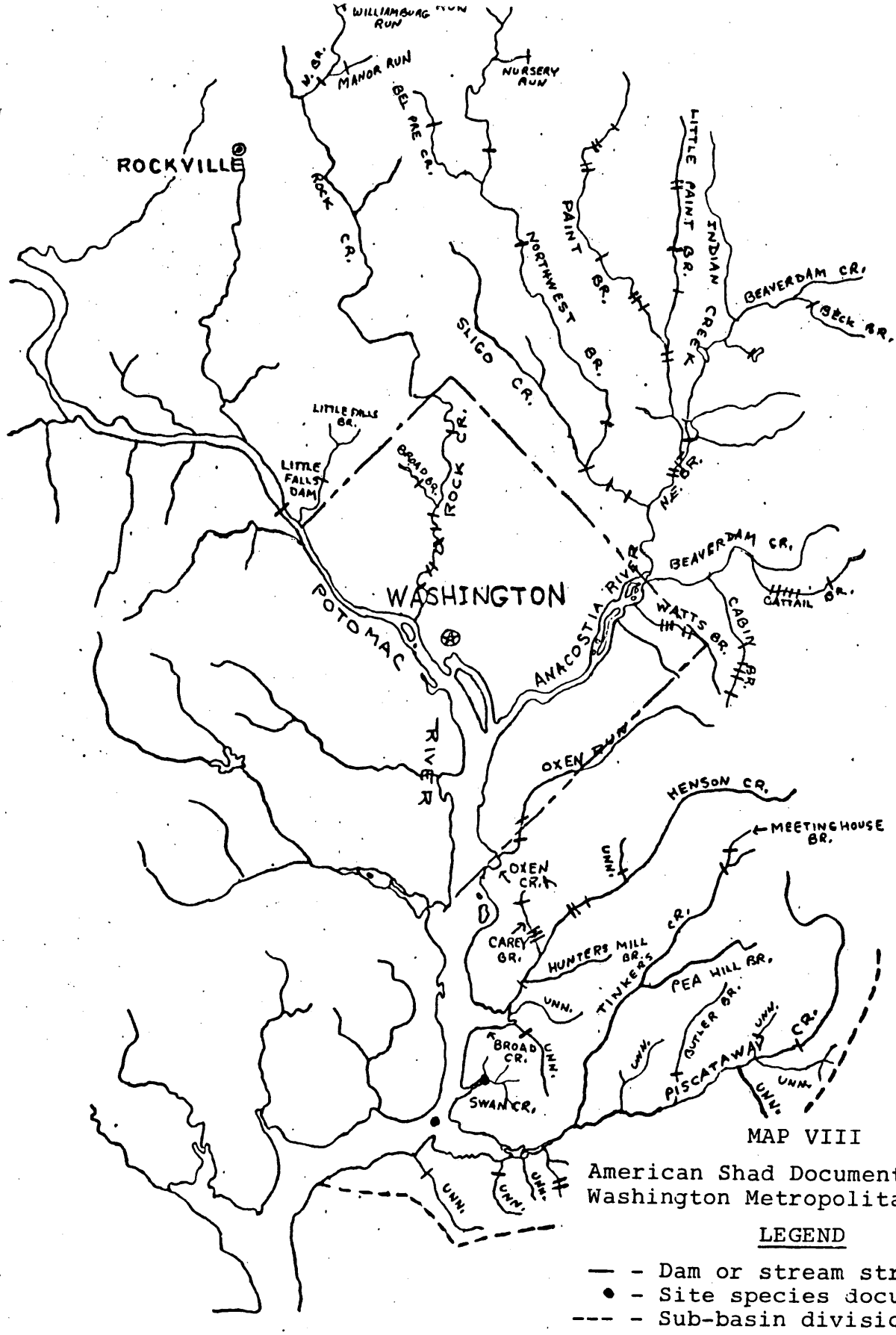
Herring were also found to be the anadromous species migrating farthest up the Anacostia River drainage into Northwest Branch. They were documented in the stream at mile 1.8. This species had negotiated a barrier at stream mile 1.0, with a fish passage opening that apparently stopped white perch. Herring were also documented upstream in Northeast Branch to an impassable barrier at stream mile 1.8 which has subsequently been opened to fish passage. Both these documentations (Northwest Branch and Northeast Branch) represent a total upstream migration distance of 10.4 miles from the mouth of the Anacostia River.

Herring were documented upstream in Rock Creek to stream mile 4.4 where there was an impassable barrier (Pierce Mill Dam). The fish negotiated five barriers in Washington, D. C., located downstream from the dam site.

The American shad was documented at only two biological sampling sites. One site was on the Potomac River mainstem off the mouth of Piscataway Creek and the other site was located in Swan Creek (Map VIII). Limited spawning, based on sport catches, extended upriver to Chain Bridge in Washington.

Map IX shows the distribution for white perch. This species was found in a total of ten different streams, representing 33.3% of those streams sampled. Like herring, white perch were documented throughout this drainage, from the Piscataway Creek area in every major tributary upriver to river mile 115.9 (Chain Bridge). White perch were second to herring as the most frequently documented anadromous fish species in this sub-basin area.

Striped bass and hickory shad were documented in single samples from the Potomac River mainstem at river mile 97.2 (off Piscataway Creek) and 106.1 (off Oxon Creek), respectively. No map or table coverage is given to these two species since spawning activities were found to be insignificant.



MAP VIII

American Shad Documentations:*
Washington Metropolitan Area

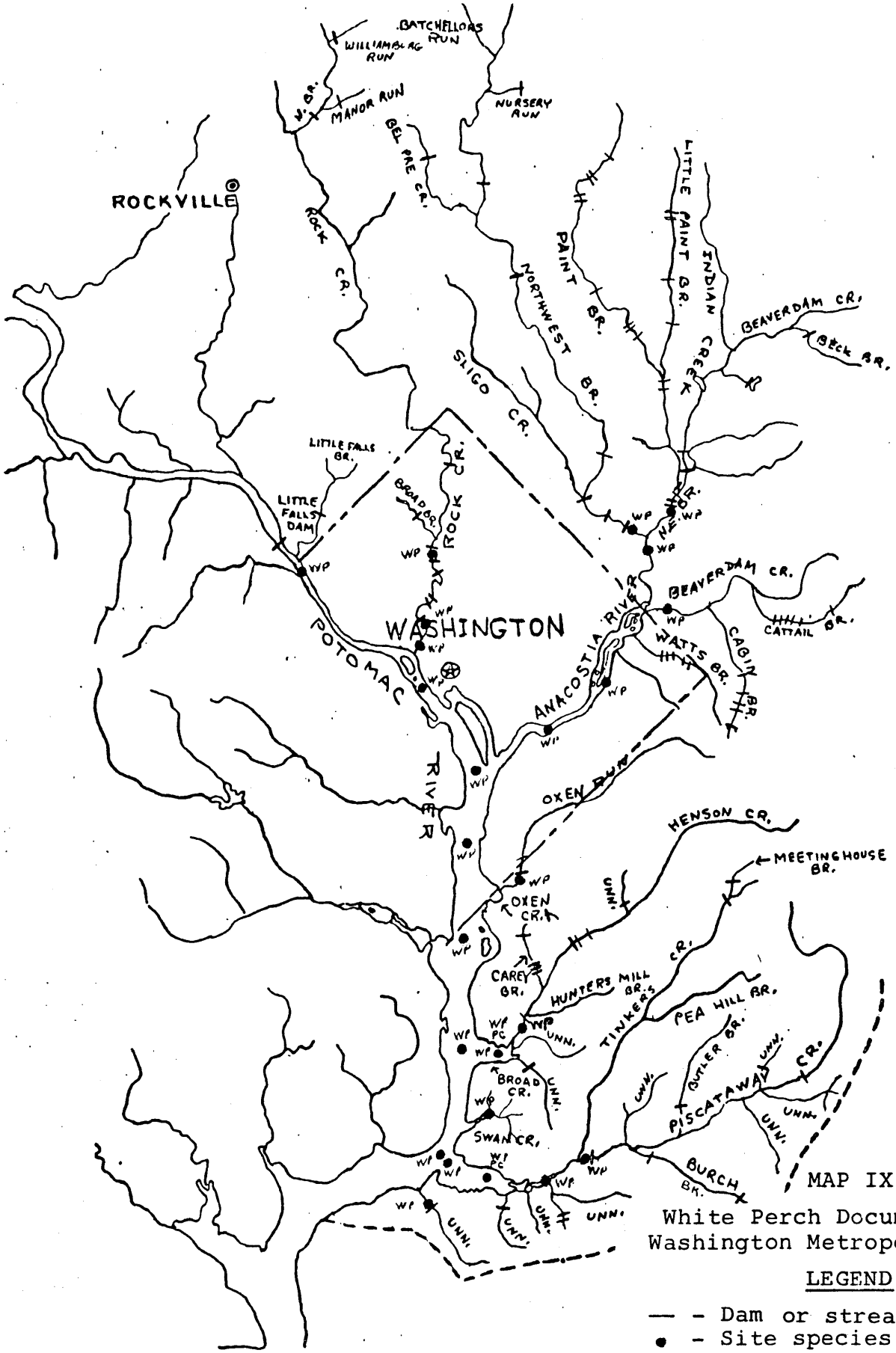
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Spawning, based on sport catches, extended up the Potomac River to Chain Bridge in northwest Washington



MAP IX

White Perch Documentations:
Washington Metropolitan Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
WP - White Perch
PC - White Perch or Striped Bass (uncertain)

SCALE

0 2 4
miles

Table I lists the streams investigated and indicates which anadromous fish species were found in each watercourse. Within the Washington Metropolitan Area, sixteen (53.3%) of the thirty streams investigated had anadromous fish spawning activity.

TABLE I.

ANADROMOUS FISH SPAWNING STREAMS IN THE WASHINGTON METROPOLITAN AREA

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS 4/	HS 5/	CL	WP	SB 6/	PC
Potomac River Mainstem	x	x	x	x	x		x	x		
Piscataway Creek	x	x		x			x	x		x
Burch Branch		x		x						
Butler Branch										
Pea Hill Branch										
Tinkers Creek		x		x						
Unnamed (841,400E-326,400N)										
Unnamed (801,800E-310,400N)										
Unnamed (817,500E-320,000N)										
Unnamed (806,400E-313,100N)		x		x						
Unnamed (797,300E-310,700N)										
Unnamed (804,200E-310,700N)										
Anacostia River		x		x			x	x		
Beaverdam Creek		x		x				x		
Cattail Creek										
Cabin Branch										
Northeast Branch		x		x				x		
Northwest Branch		x		x			x			
Watts Branch				x						
Rock Creek		x		x				x		
Broad Branch										
Byran Point Area										
Unnamed (785,200E-311,700N)		x		x				x		
Washington D. C. South Area										
Broad Creek		x		x			x	x		x
Carey Branch										
Henson Creek				x						
Hunters Mill Branch										
Oxon Run		x		x				x		

1/ Streams arranged according to sub-sub basins.
2/ Maryland coordinates given to identify sample sites of unnamed streams.
3/ Species recordings based on egg, larvae or adult fish life stages collected.
4/ Swan Creek documentation probably due to tidal drift of eggs/larvae.
5/ One probable documentation in the Potomac River off Oxon Creek.
6/ One documentation in the Potomac River off Piscataway Creek.

YP - Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

TABLE I. (continued)

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS 4/	HS 5/	CL	WP	SB 6/	PC
Swan Creek				x	x			x		
Unnamed (797,600E-334,700N)										
Unnamed (800,000E-330,800N)										
Total Spawning Streams by Species:	2	13	1	16	2	0	5	10	0	2
Total Sampled Streams:	30									
Total Spawning Streams (all species):	16									

2. Lower Potomac River Area

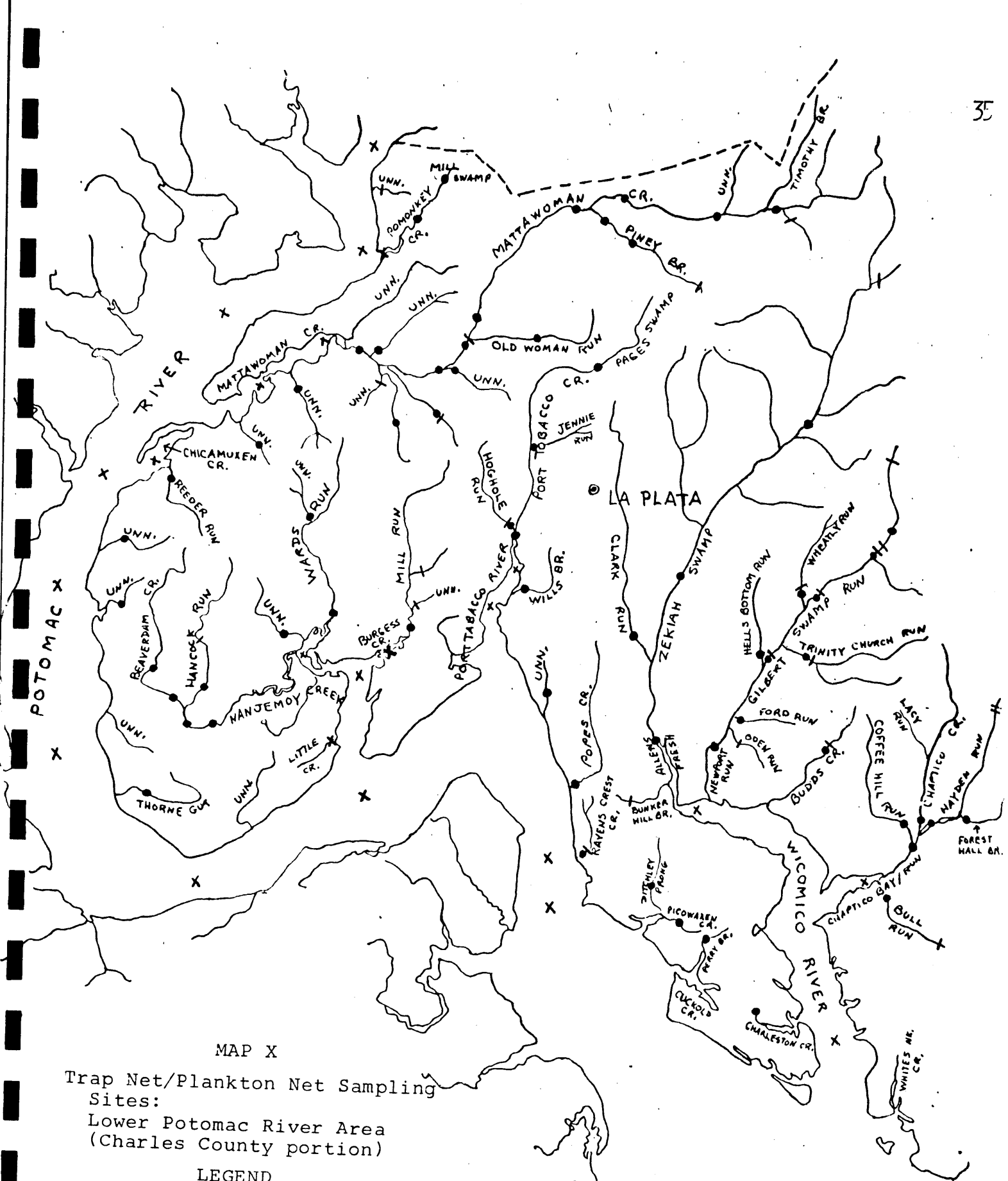
The Lower Potomac River Area sub-basin includes streams and bodies of water in a small portion of southern Prince George's County and most of Charles County, with the exception of a small segment near Marshall Hall and the eastern portion of Charles County. This watershed also includes the southern and southwestern portions of St. Mary's County. Major Maryland tributaries are the St. Mary's River, Wicomico River, Port Tobacco River, Mattawoman Creek, Nanjemoy Creek, Breton Bay and St. Clement Bay. The entire sub-basin area lies within the Coastal Plain, and is characterized by flat to gently rolling terrain.

Within the lower Potomac River area sub-basin, a total of 129 sites on eighty seven watercourses were investigated. Maps X and XI show the locations of biological sampling sites within this area.

Yellow perch documentations are shown on Map XII. No yellow perch documentations were made in the Lower Potomac River Area below the junction of the Wicomico River with the Potomac River. This species was documented in a total of fourteen streams, including the river, or 16.0% of the streams investigated. This species was found in the Wicomico River drainage upstream into Allens Fresh at stream mile 2.4 and in Newport Run at stream mile 2.6. Migration distance was 15.1 miles and 15.3 miles, respectively, from the mouth of the Wicomico River. Yellow perch migrated up the Port Tobacco River, a total distance of 4.8 miles to near the mouth of Hoghole Run. In Nanjemoy Creek, this species was documented at the Route 6 crossing, located 9.3 miles upstream. In Mattawoman Creek, yellow perch were documented as far upstream as 7.7 miles at the first barrier. This barrier cannot be considered totally impassable since both white perch and herring negotiated it.

Alewife or blueback herring were documented in sixteen watercourses. Herring documentation represents 18.4% of the streams investigated. Map XIII shows the documentations of herring. No herring documentations were made downriver from the mouth of the Wicomico River.

The farthest upstream migration in the Lower Potomac River sub-basin occurred in Mattawoman Creek. Herring were documented in this stream at river mile 13.6.



MAP X

Trap Net/Plankton Net Sampling Sites:
Lower Potomac River Area
(Charles County portion)

LEGEND

— - Dam or stream structure
• - Inland sampling site
x - Estuarine sampling site
--- - Sub-basin division

SCALE 0 2 4
miles
1" = 4 miles

MAP XI

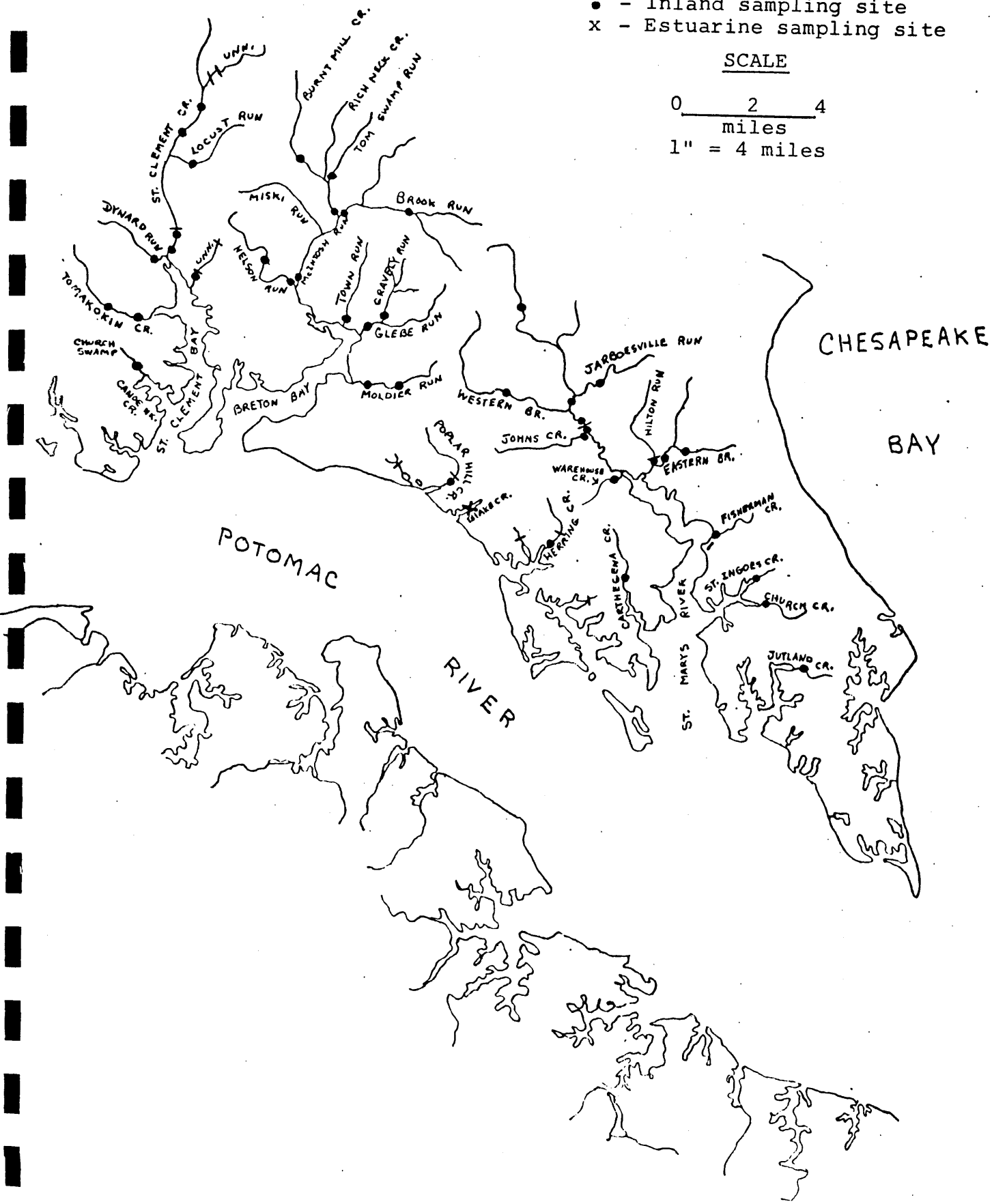
Trap Net/Plankton Net Sampling Sites:
Lower Potomac River Area
(St. Marys County Portion)

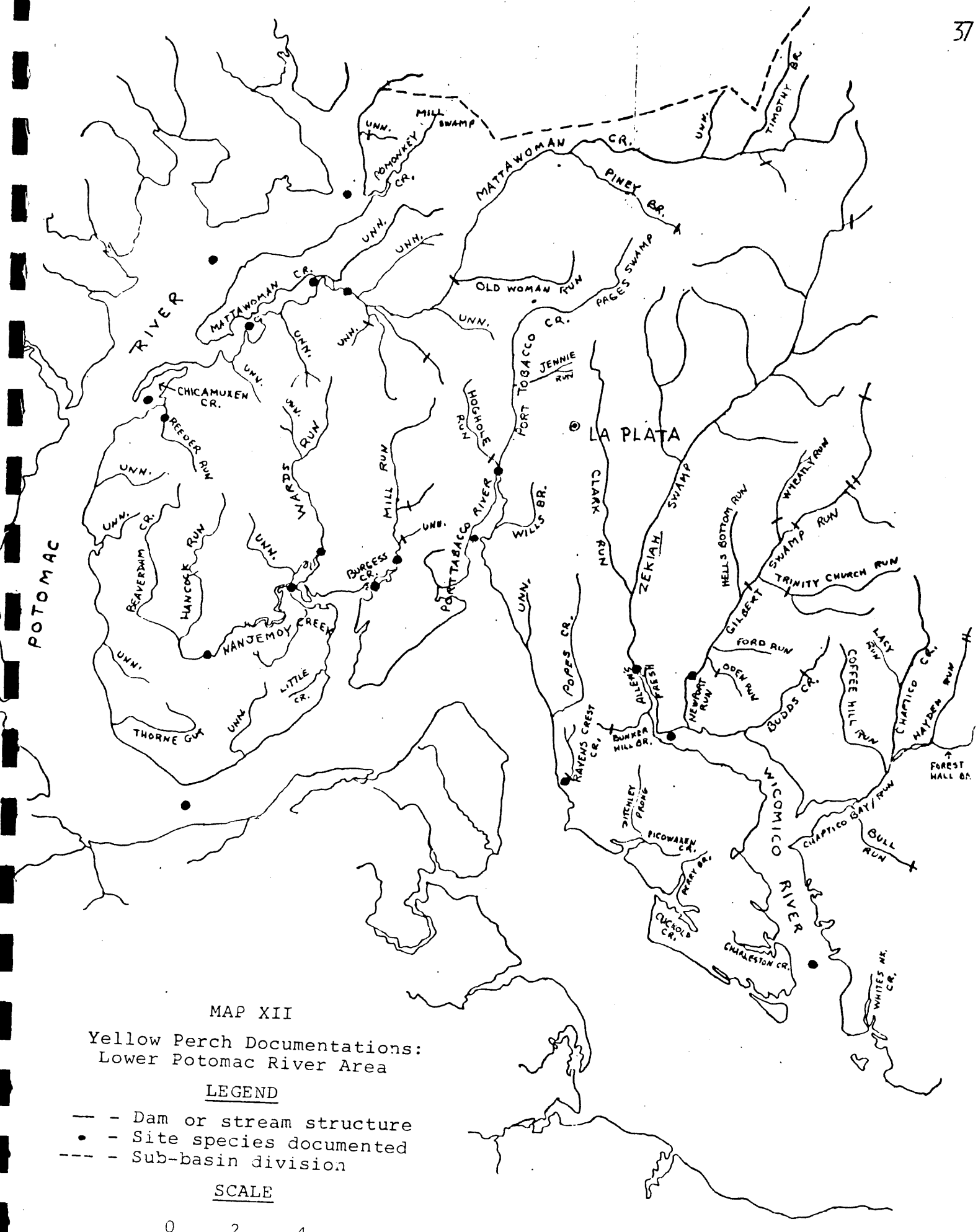
LEGEND

— - Dam or stream structure
• - Inland sampling site
x - Estuarine sampling site

SCALE

0 2 4
miles
1" = 4 miles





MAP XII

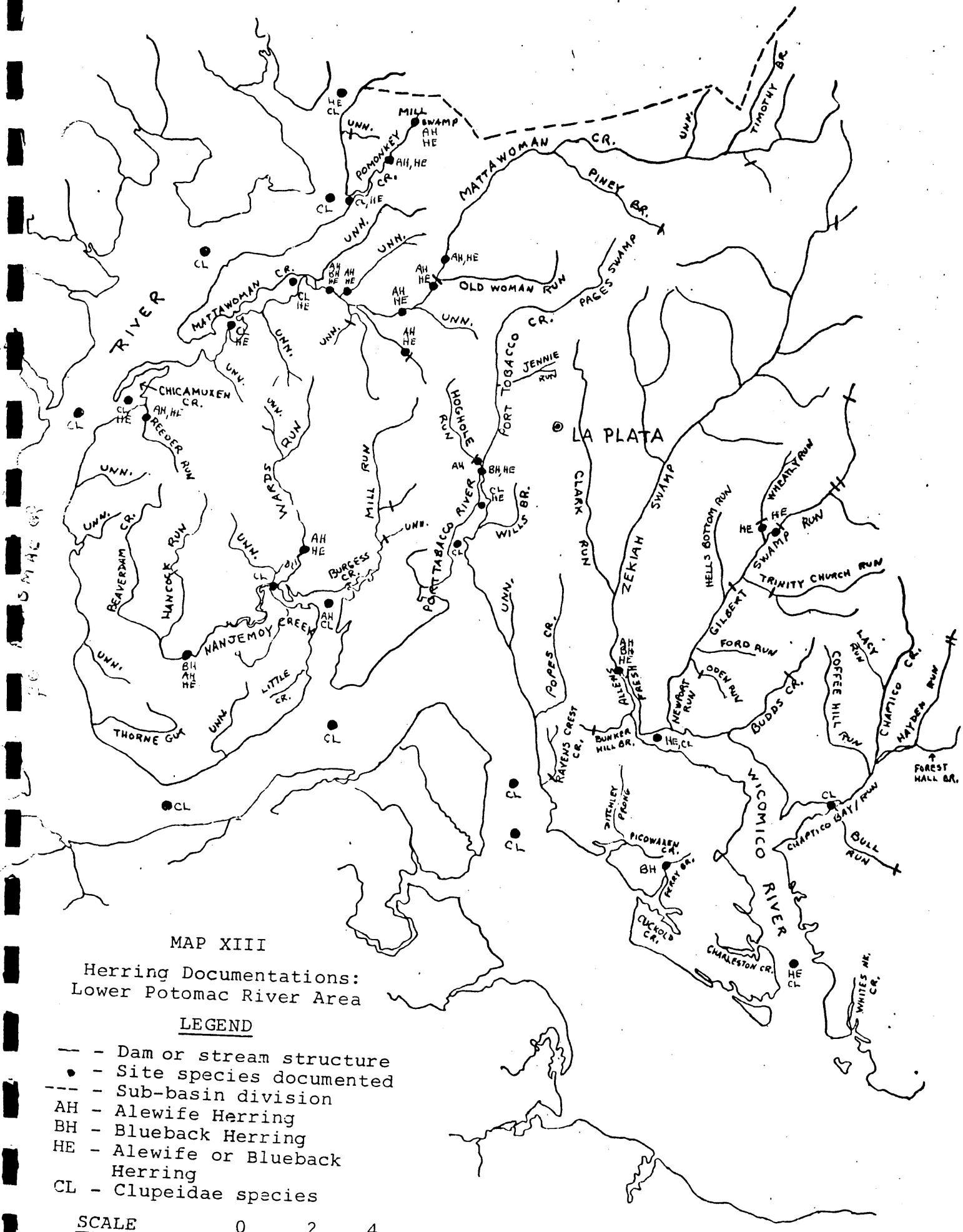
Yellow Perch Documentations:
Lower Potomac River Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles



MAP XIII

Herring Documentations:
Lower Potomac River Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
AH - Alewife Herring
BH - Blueback Herring
HE - Alewife or Blueback Herring
CL - Clupeidae species

SCALE 0 2 4 miles

1" = 4 miles

Blueback herring were positively identified in five streams. These streams were Allens Fresh Run, Port Tobacco Creek, Nanjemoy Creek, Mattawoman Creek, and Perry Branch. Alewife herring were positively identified in ten streams (Table II).

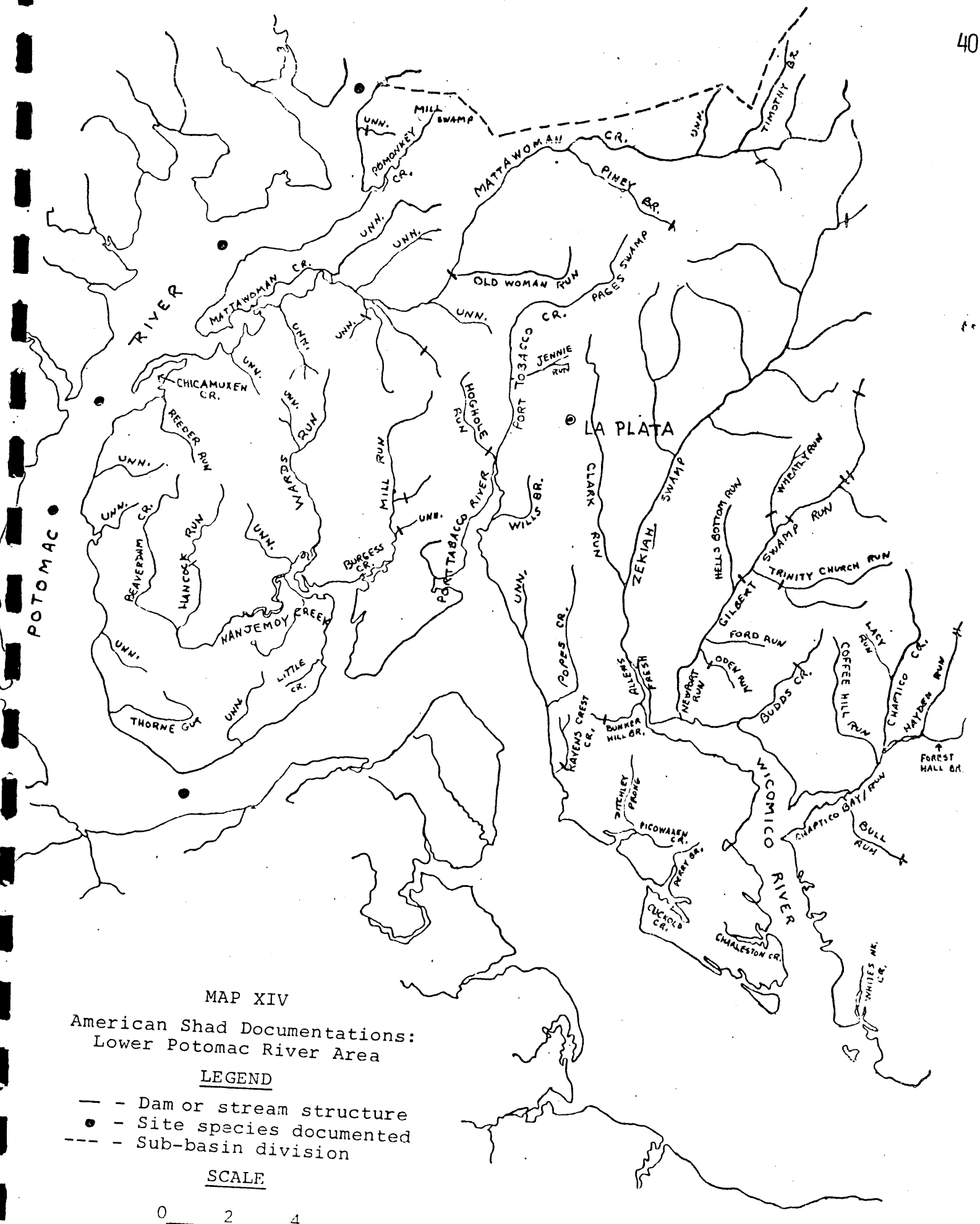
American shad were documented in the Potomac River mainstem at five different biological sampling sites. Eggs and/or larvae were found from river mile 64.4 (Maryland Point) to Marshall Hall at river mile 93.5 (Map XIV), representing the upper limit of sampling in the sub-basin. No spawning activities of the American shad were found in any of the tributaries to the Potomac River in this sub-basin. The upper limit of spawning, at Chain Bridge, is summarized with the Washington Metropolitan Area sub-basin.

Using number of streams in which spawning activities occurred as the criteria, white perch were the dominate species in this sub-basin. They were documented in twenty-one different rivers or streams, representing 22.9% of the streams investigated. Maps XV and XVI show the locations of white perch documentations. As in the Washington Metropolitan Area, the spawning ranges of white perch and herring were also very similar in this sub-basin area.

Striped bass were documented at nine different biological sampling sites on the Potomac River mainstem. Eggs and/or larvae ranged from the lower sample station at river mile 46.9 (lower Cedar Point) to the upper station at river mile 93.5 (Marshall Hall). One site collection was made off Piscataway Creek at river mile 97.2 in the Washington Metropolitan Area. There were also documentations made in Nanjemoy Creek at stream mile 2.7 and in Mattawoman Creek at stream mile 3.0 (Map XVII), which were probably carried out of the spawning area by tidal movements.

Hickory shad were documented in a single sample from Nanjemoy Creek at the confluence with Burgess Creek. No map or table coverage is given this species.

Table II gives a brief summary of the streams investigated in this area and the anadromous fish species that were documented in each watercourse. Of the eighty-seven streams investigated, twenty-eight (32.2%) were found to have spawning activities of at least one anadromous fish species.



MAP XIV

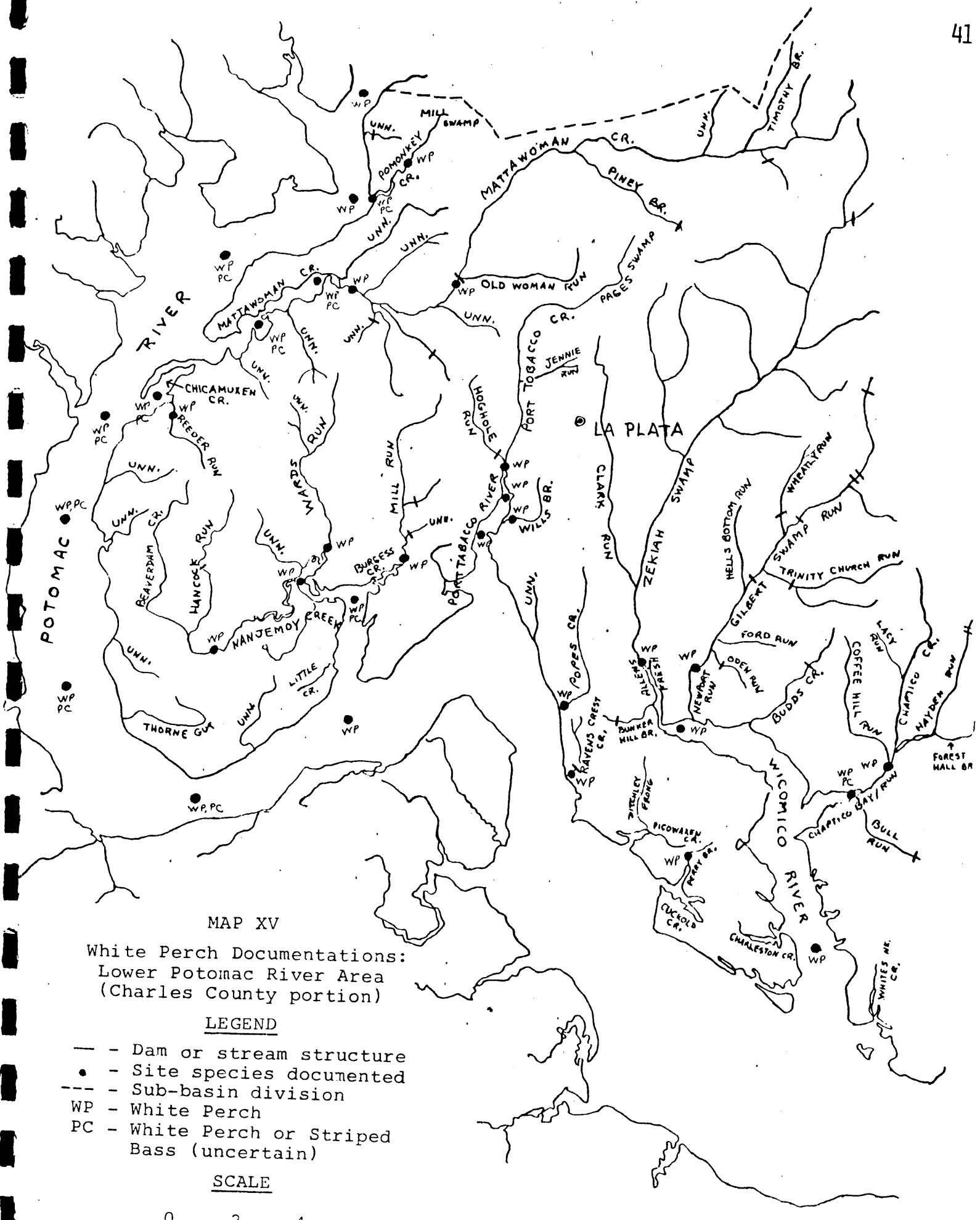
American Shad Documentations:
Lower Potomac River Area

LEGEND

— - Dam or stream structure
● - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles



MAP XV

White Perch Documentations:
Lower Potomac River Area
(Charles County portion)

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
WP - White Perch
PC - White Perch or Striped Bass (uncertain)

SCALE

0 2 4
miles

MAP XVI

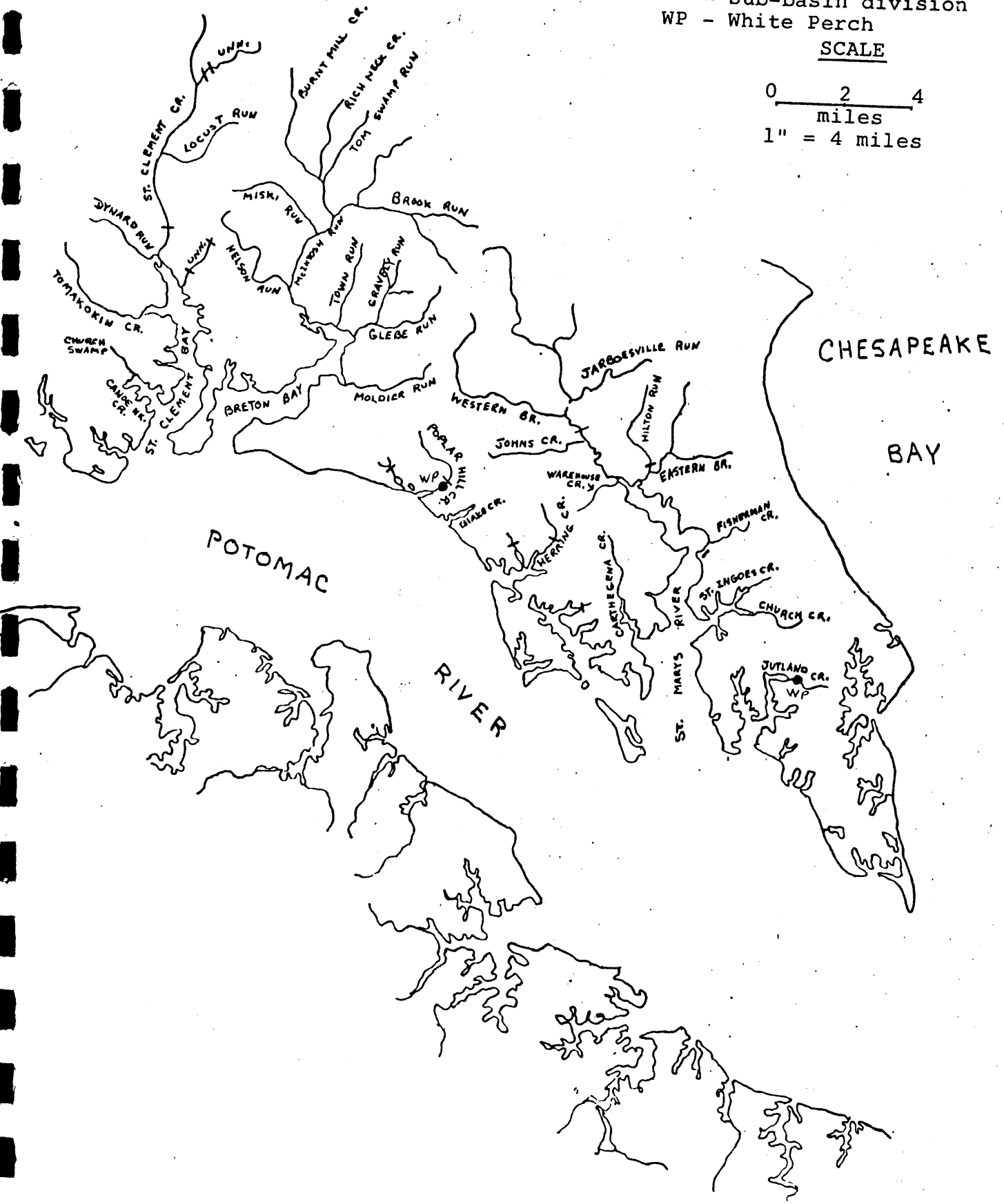
White Perch Documentations:
Lower Potomac River Area
(St. Marys County portion)

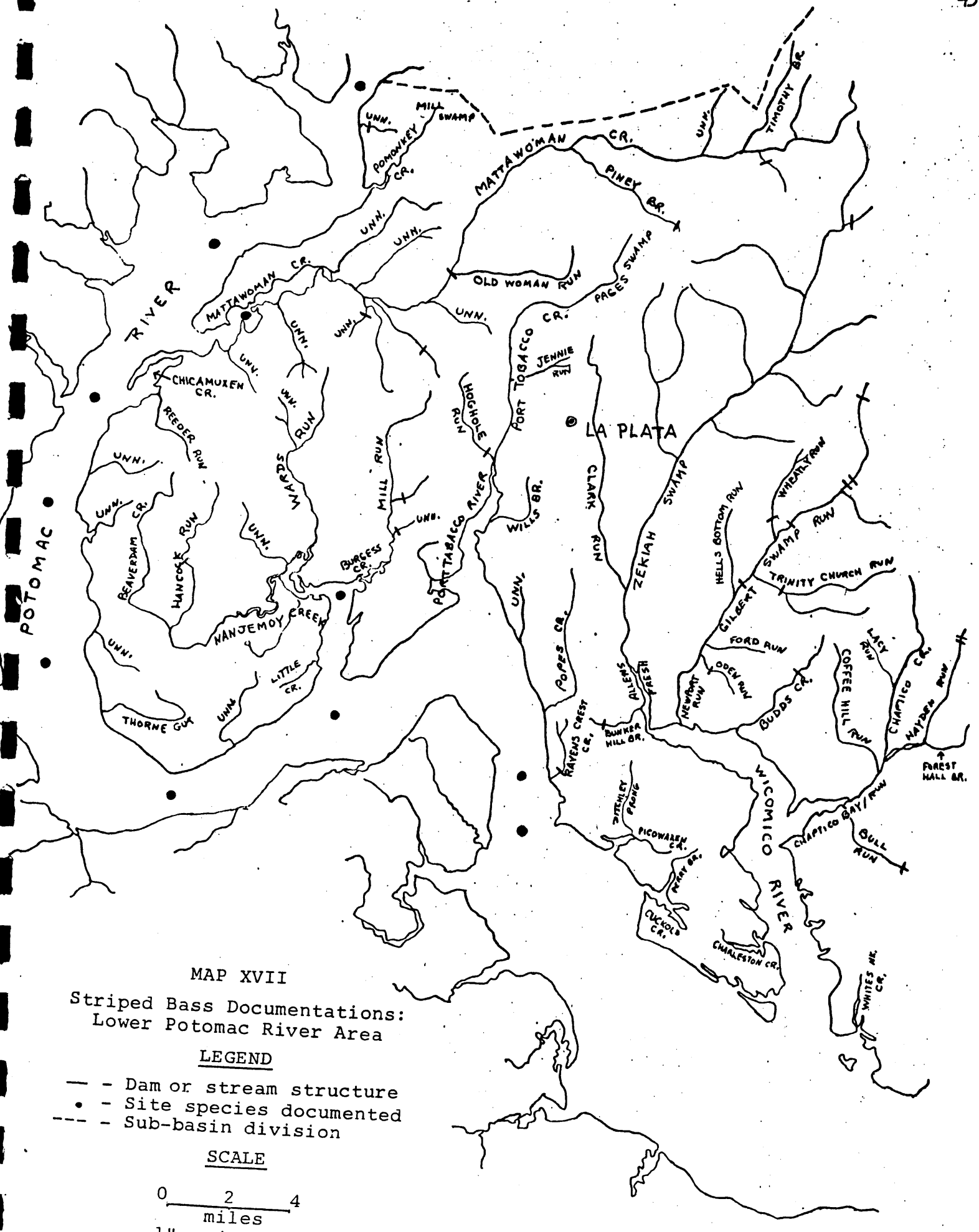
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
WP - White Perch

SCALE

0 2 4
miles
1" = 4 miles





MAP XVII

Striped Bass Documentations:
Lower Potomac River Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

TABLE II.

ANADROMOUS FISH SPAWNING STREAMS IN THE LOWER POTOMAC RIVER AREA

Streams Investigated 1/ 2/ — Sub-sub basin name / Stream name	Anadromous Species Recorded 3/									
	YP	AH	BH	HE	AS	HS 4/	CL	WP	SB 5/	PC
Potomac River Mainstem	x			x	x		x	x	x	x
Saint Marys River										
Carthegena Creek										
Church Creek										
Eastern Branch										
Fisherman Creek										
Hillton Run										
Jarboesville Run										
Johns Creek										
St. Inigoes Creek										
Warehouse Run										
Western Branch										
Breton Bay Drainage										
Brooks Run										
Burnt Mill Creek										
Glebe Run										
Gravely Run										
McIntosh Run										
Moldier Run										
Nelson Run										
Tom Swamp Run										
Town Run										
St. Clement Bay Drainage										
Church Swamp										
Dynard Run										
Locust Run										
St. Clement Creek										
Tomakokin Creek										
Unnamed (882,500E-173,300N)										

1/ Streams arranged according to sub-sub basins.
2/ Maryland coordinates given to identify sample sites of unnamed streams.
3/ Species recordings based on egg, larvae or adult fish life stages collected.
4/ One probable documentation in a single sample from Nanjemoy Creek.
5/ Two stream documentations may be due to tidal drift of larvae.

YP - Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

TABLE II. (Continued)

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS	HS 4/	CL	WP	SB 5/	PC
Wicomico River	x			x			x	x		
Allens Fresh Run	x	x	x	x				x		
Budds Creek										
Bull Run										
Chaptico Bay							x	x		x
Chaptico Creek								x		
Coffee Hill Run										
Charleston Creek										
Forest Hill Branch										
Hayden Run										
Gilbert Swamp Drainage										
Ford Run										
Gilbert Creek				x						
Hells Bottom Run										
Newport Run	x							x		
Trinity Church Run										
Wheatley Run				x						
Zekiah Swamp										
Clark Run										
Port Tobacco River	x			x			x	x		
Hoghole Run		x								
Jennie Run										
Pages Swamp										
Port Tobacco Creek	x		x	x				x		
Wills Branch								x		
Nanjemoy Creek	x	x	x	x			x	x	x	x
Burgess Creek	x									
Beaverdam Creek										
Hancock Run										
Little Creek										
Mill Run	x							x		
Unnamed (757,800E-247,500N)										
Unnamed (753,300E-230,500N)										
Wards Run	x	x		x				x		
Mattawoman Creek	x	x	x	x			x	x	x	x
Old Womans Run										
Piney Branch										
Unnamed (779,100E-271,200N)										
Unnamed (747,100E-258,000N)										
Unnamed (768,800E-276,200N)		x		x						
Unnamed (771,800E-266,300N)										
Unnamed (756,900E-270,400N)										
Unnamed (779,000E-265,000N)		x		x						
Potomac River Mouth										
Jutland Creek										
Higgins Pt.-Straight Point Area							x			
Blake Creek										

TABLE II. (Continued)

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS	HS 4/	CL	WP	SB 5/	PC
Herring Creek										
Poplar Hill Creek								x		
Whites Neck Pt.-Colton Pt. Area										
Whites Neck Creek										
Morgantown Area										
Ditchley Prong								x		
Piccowaxen Creek			x					x		
Popes Creek	x							x		
Perry Branch										
Ravens Crest Creek										
Unnamed (799,100E-219,700N)										
Chicamuxen Cr. to Riverside										
Chicamuxen Creek	x			x			x	x		x
Reeder Run	x	x		x				x		
Thorne Gut										
Unnamed (729,600E-247,000N)										
Unnamed (727,400E-232,900N)										
Potomac Heights Area										
Mill Swamp		x		x						
Pomonkey Creek		x		x			x	x		x
Total Spawning Streams by Species:	14	10	5	16	1	0	8	21	3	6
Total Sampled Streams:	87									
Total Spawning Streams (all species):	28									

Summary and Conclusions for the Potomac River Drainage Spawning Survey

There were a total of one hundred and sixteen rivers or streams investigated in two sub-basins within the Potomac River drainage. Biological sampling sites were established in 115 Potomac River tributaries from Jutland Creek, a tributary to Smith Creek (at river mile 9.9), in lower St. Mary's County upriver to and including Rock Creek in Washington. The Potomac River mainstem was sampled at 19 sites from Lower Cedar Point (river mile 46.9) to Little Falls Dam, below and above the fishway (river mile 117.4).

Of the one hundred and sixteen rivers or streams investigated in the Potomac River drainage, forty-three (37.0%) supported spawning activities of one or more anadromous fish species.

Significant spawning activities of yellow perch, white perch, herring (alewife and blueback herring), American shad and striped bass were found in both sub-basins above the confluence of the Wicomico River with the Potomac River mainstem. Downriver from this point, only white perch were found to spawn and this spawning activity was very limited. White perch were found only in Poplar Hill Creek and Jutland Creek, tributaries to the Potomac River in St. Mary's County. The lack of anadromous fish spawning activity below the Wicomico River may be attributed to the relatively high salinity (12 to 16 ppt) of the river in this area, although fresh water tributaries are present. Anadromous fish species pass the lower river area, and migrate into the fresher waters of the upper river drainage for spawning.

Herring species and white perch were documented in about equal frequency within the Potomac River drainage. Herring were found in thirty-two streams, while white perch were found in thirty-one streams. The ranges and distribution for herring (Maps VII and XIII) and white perch (Maps IX, XV, XVI) were very similar in the Potomac River drainage.

Yellow perch were found to spawn in a total of sixteen (13.6%) of the streams investigated. Spawning streams of this species were found to be of greater occurrence within the Lower Potomac River Area (Table II) than the Washington Metropolitan Area (Table I).

Documentations of American shad spawning area occurred mainly on the Potomac River mainstem from river mile 64.4 (Maryland Point) to 97.2 (mouth of Piscataway Creek). There was also a documentation in Swan Creek, a tributary to the Potomac River at river mile 98.3 (Maps VIII and XIV), probably due to tidal drift of eggs/larvae. Non-recorded evidence of shad spawning was also found further up the Potomac River, extending to Chain Bridge in Washington.

Striped bass spawning area documentations also occurred mainly in the river mainstem from river mile 46.9 (Lower Cedar Point) upriver to river mile 97.2 at the mouth of Piscataway Creek (Map XVII), in the Marshall Hall area.

Hickory shad spawning was of uncertain occurrence because of eggs or larvae collected only in single instances in the Potomac River off Oxon Creek and in Nanjemoy Creek.

C. Findings (continued)

Section II: Findings for the Upper Chesapeake Bay Drainage Spawning Survey

Within the upper Chesapeake Bay drainage system, there were six sub-basins, plus the Chesapeake Bay Basin proper, included in this study. The findings for this drainage system are presented below by sub-basin, preceded by a general description of each of these sub-basins.

1. Elk River Area

The Elk River Area includes streams and bodies of water in Cecil County, with the exception of a northwestern segment (which drains to the Lower Susquehanna) and a small northeastern segment (which drains to the Christiana River, into the state of Delaware). It also includes the northern half of Kent County in Maryland.

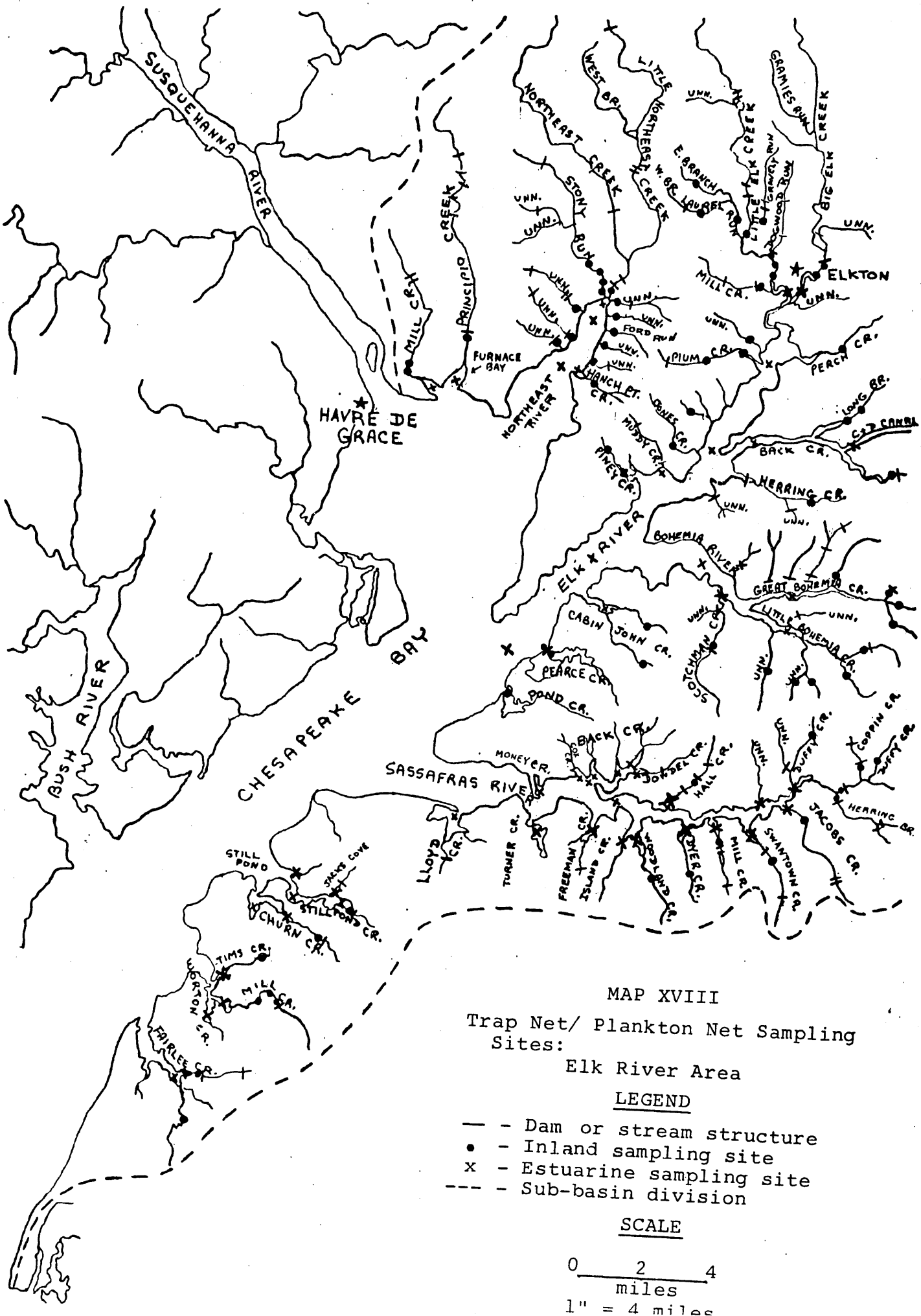
Gently rolling hills characterize the northern portion of this watershed near the Delaware and Pennsylvania state lines. In the southern sector, the topography is Coastal Plain. The Northeast River, Little Elk Creek, the Bohemia River and the Sassafras River are part of the Elk River sub-basin.

Within the Elk River sub-basin a total of one hundred and twenty-seven sites on eighty-three streams, including the Elk River mainstem, were investigated. Map XVIII shows the locations of the biological sampling sites for this sub-basin.

Yellow perch were documented in a total of forty-nine streams, representing 59.0% of the streams sampled. Map XIX show the stream documentations of this species.

Within the Sassafras River drainage this species was found in every major tributary and in the river proper upstream as far as a dam located at river mile 15.4. The dam is considered impassable to anadromous fish species since none were documented upstream from the structure. There were a total of twenty biological sites in this river drainage where yellow perch were documented.

Within the Elk River drainage, yellow perch were documented from near the mouth, in Pond Creek and Pearce Creek, upriver into Big Elk Creek to a dam located at stream mile 4.5. Species documentation was approximately nineteen miles upriver from the mouth of Elk River. This species was also documented in Little Elk Creek upstream at 1.2 miles.



MAP XVIII

Trap Net/ Plankton Net Sampling Sites:

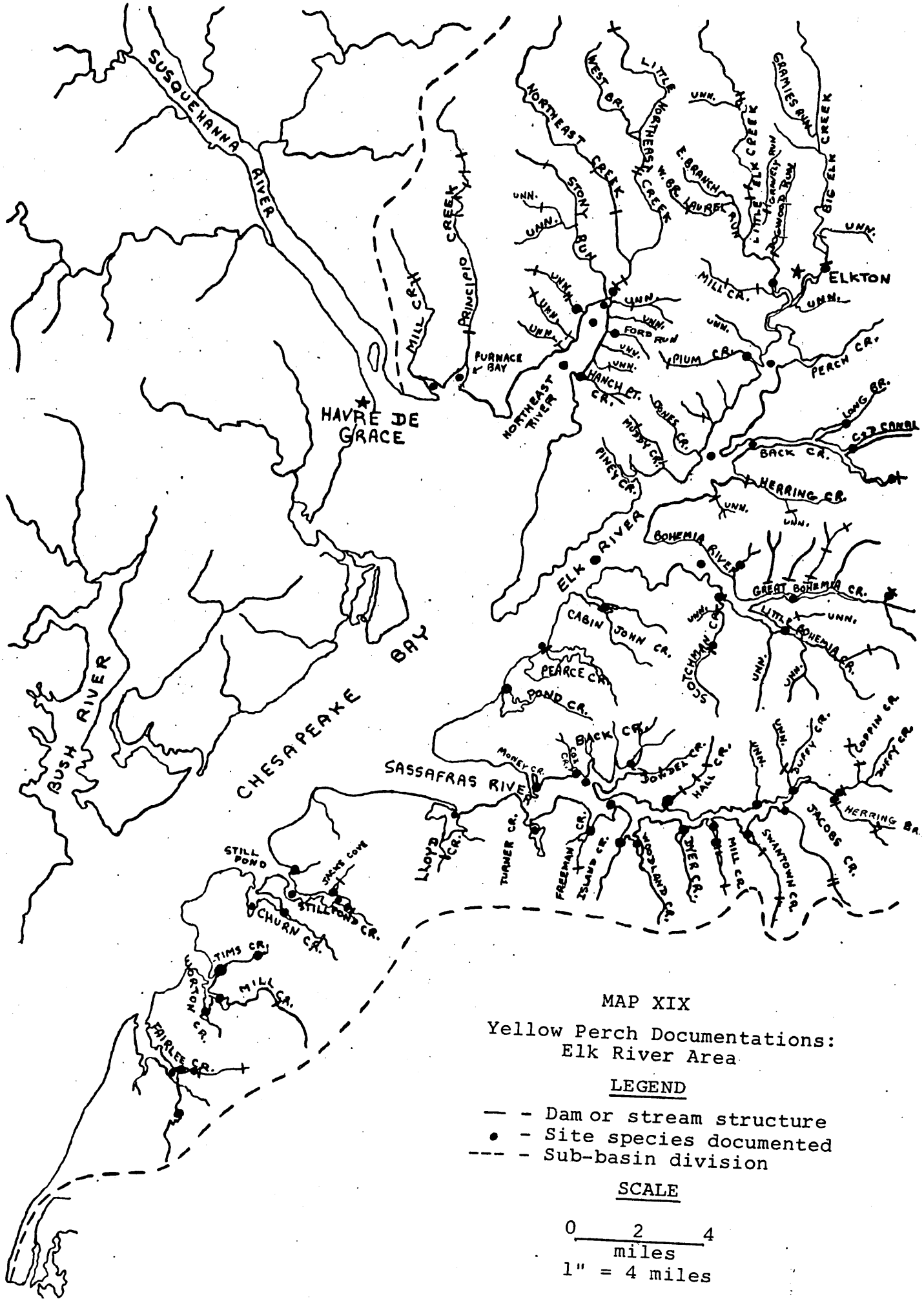
Elk River Area

LEGEND

— - Dam or stream structure
• - Inland sampling site
x - Estuarine sampling site
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles



MAP XIX

Yellow Perch Documentations:
Elk River Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

Back Creek, and C and D Canal, and the Bohemia River had yellow perch spawning activity. This species was found in Back Creek upstream to an impassable dam located at stream mile 6.0, and in Great Bohemia Creek upstream to an impassable dam located at stream mile 5.0.

Yellow perch were documented in the Northeast River from Hance Point, upriver to an impassable dam on Northeast Creek located at stream mile 1.0. Species documentation was a distance of approximately six miles from the mouth of Northeast River. A total of four tributaries, including Northeast Creek, were found to support yellow perch spawning.

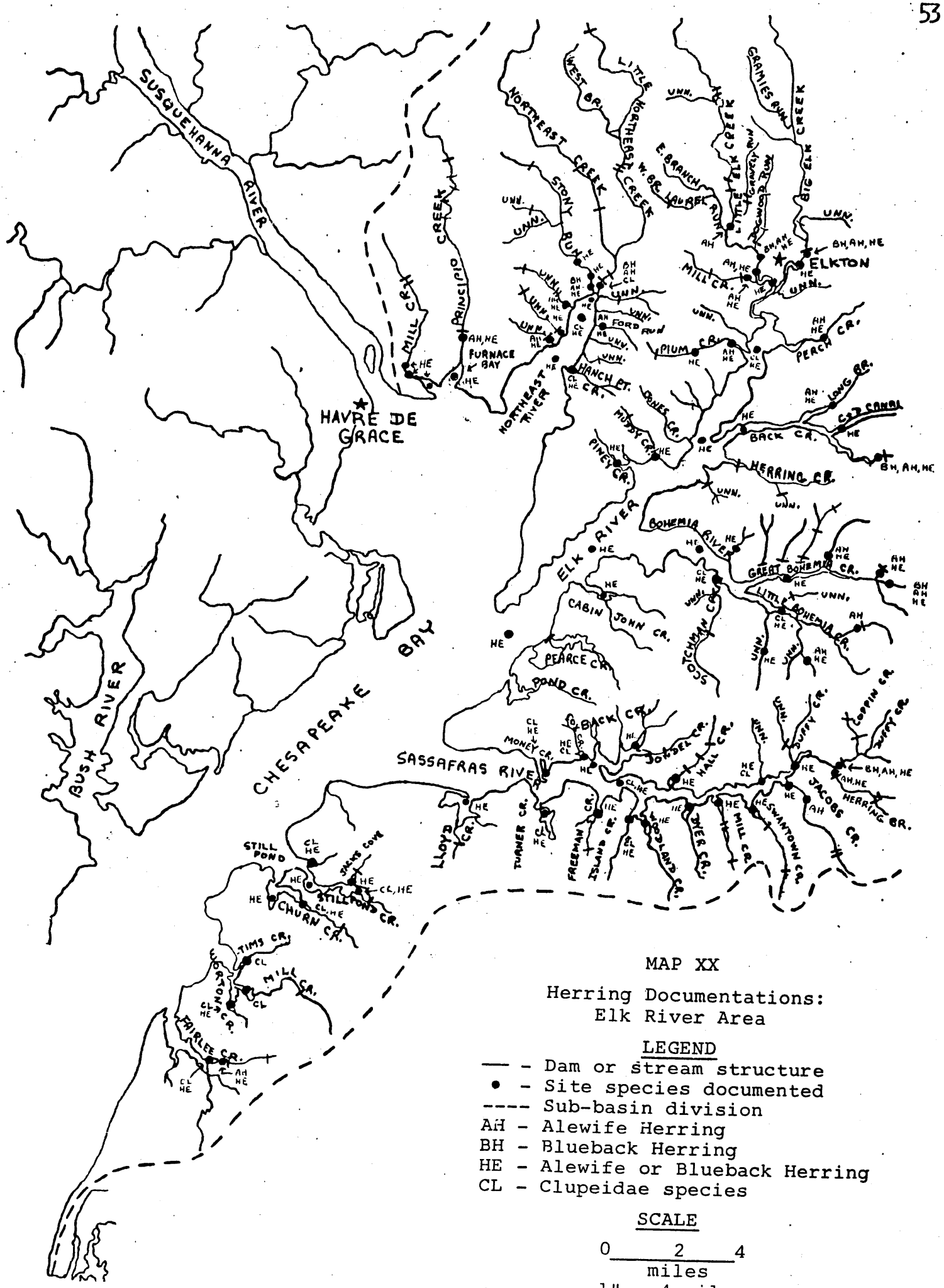
Alewife or blueback herring were documented in a total of fifty-five streams, comprising 66.3% of the total streams sampled. Map XX shows the documentations for herring species. Also included on this map are species which could be identified only to the Clupeidae (herring) Family. All these cases were due to difficulty in identifying the eggs and larvae of herring and shad species.

Herring spawning was documented in the lowermost sampled stream (Fairlee Creek) and throughout all other principal Bay tributaries in the Elk River sub-basin.

As with the yellow perch, herring were found in every major tributary to the Sassafras River. The upstream migration limit was the dam located at river mile 15.4. At this dam, alewife and blueback herring were positively identified to species. This was the only site within the Sassafras River drainage where blueback herring were positively documented. Alewife were positively identified in both the Sassafras River and Jacobs Creek (Map XX), also in Herring Branch.

Within the Elk River drainage herring ranged from the river mouth, upstream into Little Elk Creek for a distance of 4.4 miles. The total migration distance of 20.4 miles from the mouth of Elk River represented the farthest upstream migration of any anadromous species documented within the Elk River sub-basin. The herring species documented at this point was the alewife (Map XX).

Of the eleven investigated tributaries to the Northeast River, only four did not have spawning activity of herring. These four relatively small tributaries were all unnamed streams located on the east side of the river (Map XX). No other anadromous fish were documented in these four unnamed tributaries during this study.



MAP XX

Herring Documentations:
Elk River Area

LEGEND

— - Dam or stream structure
• - Site species documented
---- Sub-basin division
AH - Alewife Herring
BH - Blueback Herring
HE - Alewife or Blueback Herring
CL - Clupeidae species

SCALE

0 2 4
miles

Herring were documented along Northeast River into Northeast Creek as far as the first dam located at stream mile 1.0. Migration distance was six miles from the river mouth. Alewife and blueback herring were documented in Stony Run at the lower biological sampling site. The Northeast Creek and Stony Run recordings were the only two positive documentations of blueback herring in the Northeast River drainage. Alewife herring were documented in five tributaries (Map XX). The farthest upstream penetration of herring in this river drainage occurred in Stony Run at stream mile 4.4.

Herring were the only anadromous species found to migrate upstream into Mill Creek farther than one-half mile. Herring were documented in this stream at stream mile 1.6.

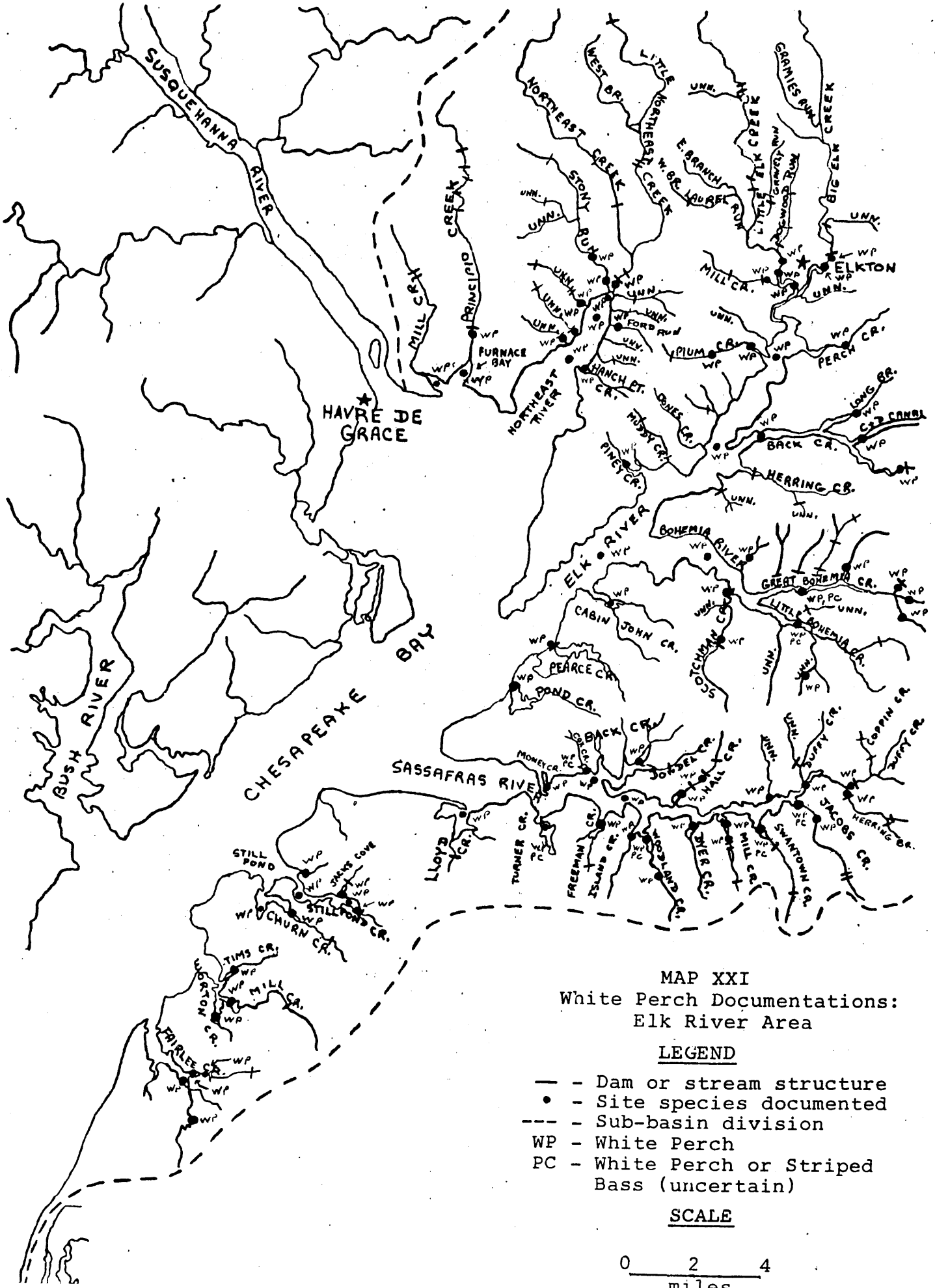
Map XXI shows the biological sites where white perch were documented. Indeterminate white perch/striped bass larvae recordings are also included on this map. White perch were documented in fifty-nine (71.1%) of the streams investigated in the Elk River Area.

The distribution of white perch within the Sassafras River drainage was the same as that for herring, with the exception of a documentation in Hall Creek below the second existing dam (stream mile 1.7). Since the first dam on Hall Creek is impassable to anadromous fish, the documentation above this dam was probably due to a resident white perch population.

Within the Elk River drainage, white perch were documented from near the mouth, in Pond Creek and Pearce Creek, upriver into Big Elk Creek to the dam at stream mile 4.5. They were also upstream in Little Elk Creek to the biological site located at stream mile 2.2. Evidence of white perch spawning was documented in both Back Creek and the Bohemia River from near the mouths to the headwaters. Dams on both these tributaries are apparently the upstream limit of anadromous fish spawning activities.

The occurrence of white perch in the Northeast River drainage was the same as that for herring. Documented upstream migration limits were identical for herring and white perch in this river drainage.

Striped bass documentations in the Elk River Area were made in the Still Pond drainage, Sassafras River drainage, and Elk River drainage. No documentations were made in the Northeast River or Furnace Bay drainages. Map XXII shows these documentations.



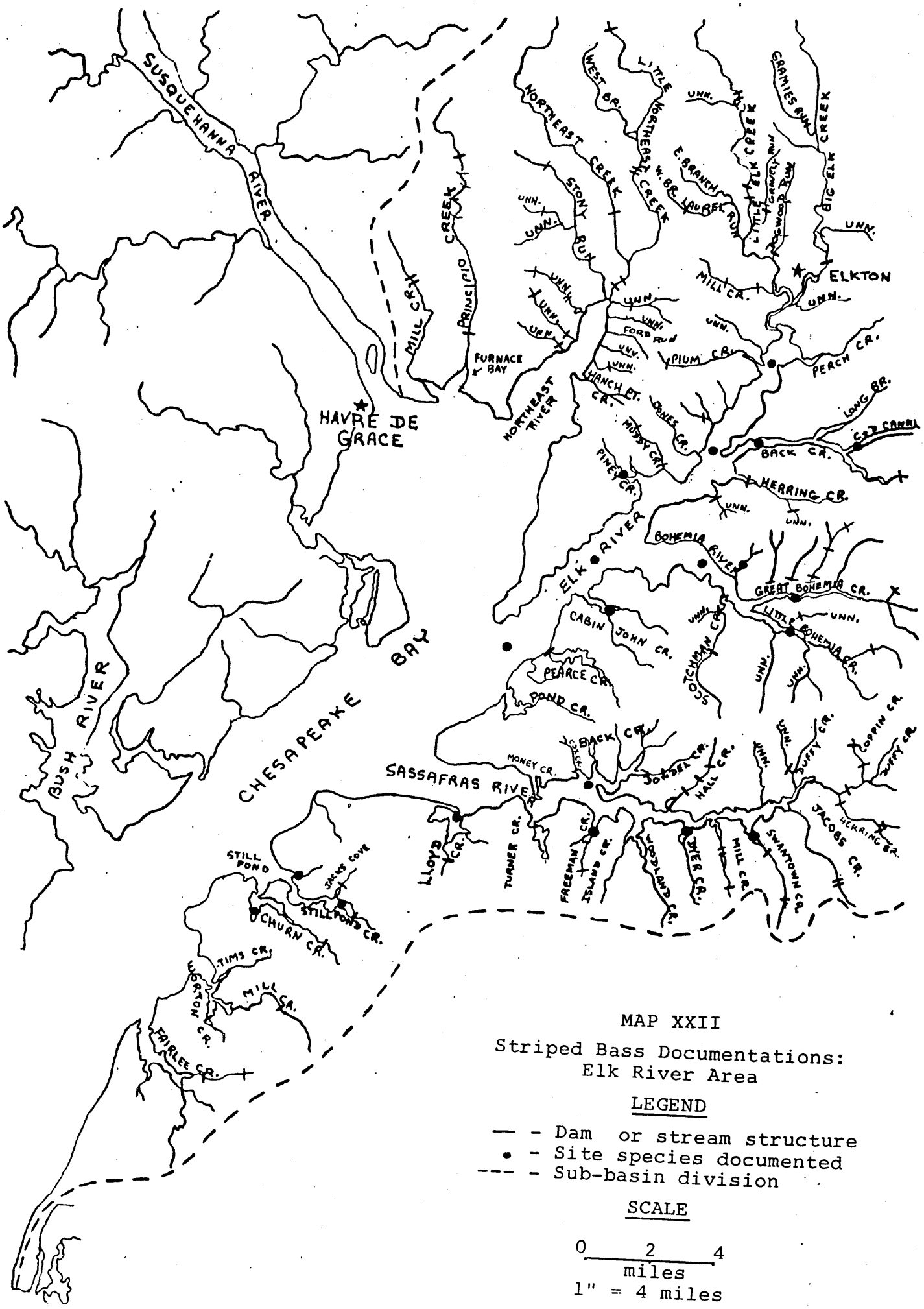
MAP XXI
White Perch Documentations:
Elk River Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
WP - White Perch
PC - White Perch or Striped Bass (uncertain)

SCALE

0 2 4
miles



MAP XXII

Striped Bass Documentations:
Elk River Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

Within the Still Pond drainage there were three sites where striped bass were documented (Map XXII). The farthest upstream documentation was at stream mile 2.6 in Still Pond Creek.

There were five striped bass documentations made within the Sassafras River drainage. These occurred in Lloyd Creek, Back Creek, Freeman Creek, Dyer Creek, and Swantown Creek. Swantown Creek was the farthest upriver documentation. The mouth of Swantown Creek is at river mile 11.7 on the Sassafras River.

Within the Elk River drainage there were twelve striped bass documentations. Four of these documentations were on the Elk River mainstem from the river mouth to river mile 13.1. There was one documentation each in Cabin John Creek, Piney Creek, Back Creek, and the C&D Canal. Within the Bohemia River drainage, striped bass were found in both Great Bohemia Creek and Little Bohemia Creek. There was one documentation made on the Bohemia River mainstem and one in Manor Creek, a tributary to the Bohemia River.

The American shad was documented in the Elk River drainage in only one sample. This occurred at the sampling site located at river mile 13.1.

The hickory shad was documented in Northeast Creek below the first dam on three different sampling dates. All these documentations were of adult species. Since no significant spawning activity of these two shad species were documented, no map coverage is given.

Table III lists all the streams in the Elk River Area that were investigated. The table further shows which anadromous fish species were documented in each stream. Of the eighty-three streams investigated, sixty-two (74.7%) were found to support spawning activities of one or more anadromous fish species.

TABLE III.

ANADROMOUS FISH SPAWNING STREAMS IN THE ELK RIVER AREA

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS	HS	CL	WP	SB 4/	PC
Sassafras River	x	x	x	x			x	x		
Back Creek	x			x				x	x	
Coppin Creek										
Cox Creek	x			x			x	x		x
Duffy Creek										
Dowdel Creek										
Dyer Creek	x			x				x	x	
Foreman Creek										
Freeman Creek	x			x				x	x	
Herring Branch	x	x		x				x		
Hall Creek	x			x				x		
Island Creek	x			x			x	x		
Jacobs Creek	x	x		x				x		x
Lloyd Creek	x			x				x	x	
McGill Creek										
Mill Creek	x			x				x		
Money Creek	x			x			x	x		
Swantown Creek	x			x				x	x	x
Turner Creek	x			x			x	x		x
Unnamed (1,125,300E-561,700N)	x			x			x	x		
Unnamed (1,144,800E-569,200N)										
Woodland Creek	x			x				x		x
Elk River Mainstem	x			x	x		x	x	x	
Bohemia River	x			x				x	x	
Great Bohemia Creek	x	x		x				x	x	x
Little Bohemia Creek	x	x		x			x	x	x	x
Manor Creek	x			x				x	x	
Sandy Branch		x	x	x				x		
Scotchman Creek	x			x			x	x		
Unnamed (1,132,000E-583,300N)								x		
Unnamed (1,145,500E-589,800N)				x						
Unnamed (1,125,400E-584,800N)										

1/ Streams arranged according to sub-sub basins.
2/ Maryland coordinates given to identify sample sites of unnamed streams.
3/ Species recordings based on egg, larvae or adult fish life stages collected.
4/ Stream documentations may be due to tidal drift of eggs/larvae.

YP - Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

TABLE III. (Continued)

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS	HS	CL	WP	SB	PC
Unnamed (1,139,800E-596,700N)		x		x				x		
Unnamed (1,137,100E-585,400N)		x		x						
Unnamed (1,130,200E-583,600N)								x		
Back Creek	x	x	x	x				x	x	
C & D Canal	x			x				x	x	
Long Branch	x	x		x				x		
Northeast River	x			x			x	x		
Ford Run	x	x		x				x		
Hance Point Creek	x			x			x	x		
Northeast Creek	x	x	x	x		x		x		
Stony Run		x	x	x				x		
Unnamed (1,095,800E-635,100N)										
Unnamed (1,098,000E-639,800N)										
Unnamed (1,094,900E-630,900N)										
Unnamed (1,098,300E-643,000N)	x	x		x				x		
Unnamed (1,091,900E-640,000N)				x				x		
Unnamed (1,089,250E-636,700N)		x		x				x		
Unnamed (1,087,600E-635,000N)	x			x				x		
Furnace Bay	x			x				x		
Mill Creek		x		x				x		
Principio Creek										
Stillpond-Fairlee Area	x			x			x	x	x	
Codjus Cove	x			x			x	x		
Churn Creek	x							x		
Fairlee Creek	x			x				x		
Jacks Cove	x						x	x		
Mill Creek	x			x				x		
Stillpond Creek	x						x	x		
Tims Creek	x			x			x	x	x	
Unnamed (1,041,900E-541,500N)	x						x	x		
Unnamed (1,030,200E-515,100N)	x			x				x	x	
Worton Creek	x	x		x			x	x		
Crystal Beach Area	x			x			x	x		
Cabin John Creek	x									
Pearce Creek	x			x				x	x	
Pond Creek	x							x		
Unnamed (1,103,500E-593,000N)								x		
Elk Neck Area										
Jones Creek										
Muddy Creek										
Plum Creek				x						
Piney Creek	x	x		x				x		
Unnamed (1,120,300E-636,100N)	x			x						
Unnamed (1,112,500E-624,500E)							x	x		

TABLE III. (Continued)

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS	HS	CL	WP	SB	PC
Port Herman Area Drainage										
Herring Creek										
Elk River Headwaters										
Big Elk Creek	x	x	x	x				x		
Dogwood Run										
East Branch										
Gravelly Run										
Little Elk Creek	x	x	x	x				x		
Laurel Run										
Mill Creek		x		x				x		
Perch Creek		x		x				x		
West Branch										
Total Spawning Streams by Species:	49	22	7	55	1	1	18	59	17	7
Total Sampled Streams:	83									
Total Spawning Streams (all species):	62									

2. Lower Susquehanna River Area

The Lower Susquehanna River Area includes streams and bodies of water in the northeastern corner of Baltimore County, the northern half of Harford County, and the northwestern segment of Cecil County. The Susquehanna is the largest freshwater river in the eastern United States. After crossing the Maryland State line, it flows southeasterly entering the Chesapeake Bay at Havre de Grace, a distance of only 16 miles.

The drainage basin of the entire river covers approximately 27,500 square miles in the states of New York, Pennsylvania and Maryland. Only 280 square miles lie in Maryland, mostly in Harford and Cecil counties. Cecil County, lying to the east, and Harford County, to the west, are separated by the river which forms their common boundary from the Pennsylvania-Maryland line to the Chesapeake Bay.

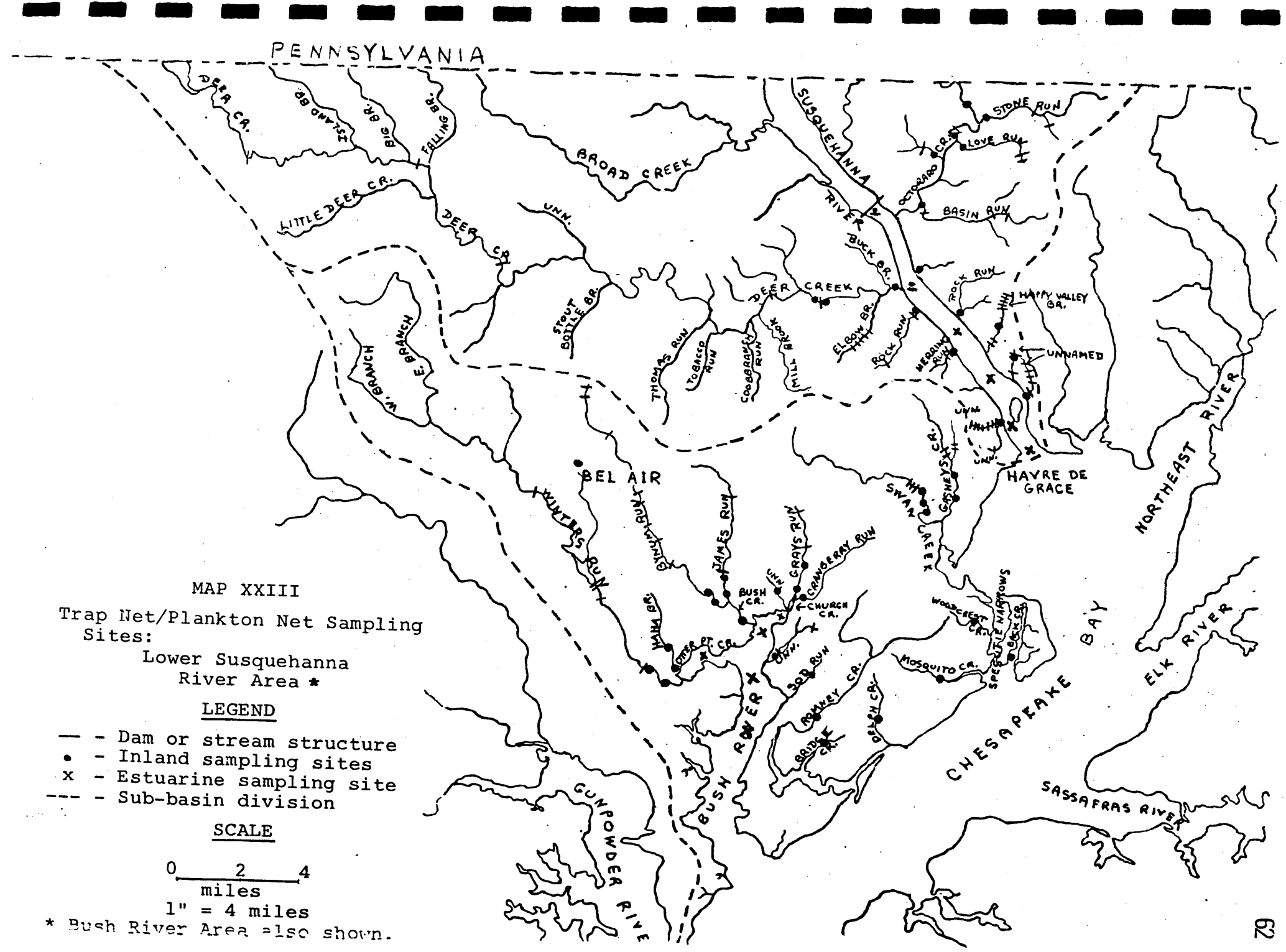
Four major streams in Maryland which discharge into the Susquehanna are Broad, Conowingo, Octoraro and Deer creeks.

The Maryland portion of the Susquehanna River watershed lies mostly in the Piedmont Plateau, but a small area lies in the Coastal Plain. The "Fall Line", which separates the two geologic provinces, crosses the river a short distance upstream from Havre de Grace.

Within the Lower Susquehanna River Area a total of fifteen streams, including the river, were investigated. Map XXIII shows where all the biological sampling sites were located, including both estuarine and freshwater inland sites. A total of twenty-three sites were sampled for anadromous species.

Investigations documented the occurrence of yellow perch spawning in seven of the fifteen streams sampled (46.6%). Map XXIV shows the locations of these documentations. Yellow perch were found to migrate up the Susquehanna River to the Conowingo Dam. They were also documented in Octoraro Creek at 6.4 miles upstream from its mouth, at Newbridge Road, above two dams.

Alewife or blueback herring were documented in eleven streams, representing 73.3% of the streams sampled. Map XXV shows the locations of the two herring species documentations. Blueback herring were positively identified in only two streams (Rock Run and Deer Creek). Alewife herring were positively identified in five streams (Susquehanna River, Herring Run, Deer Creek, Octoraro Creek and Basin Run). Within the river area, herring ranged from the mouth of the Susquehanna River upstream ten



MAP XXIII

Trap Net/Plankton Net Sampling Sites:

Lower Susquehanna River Area *

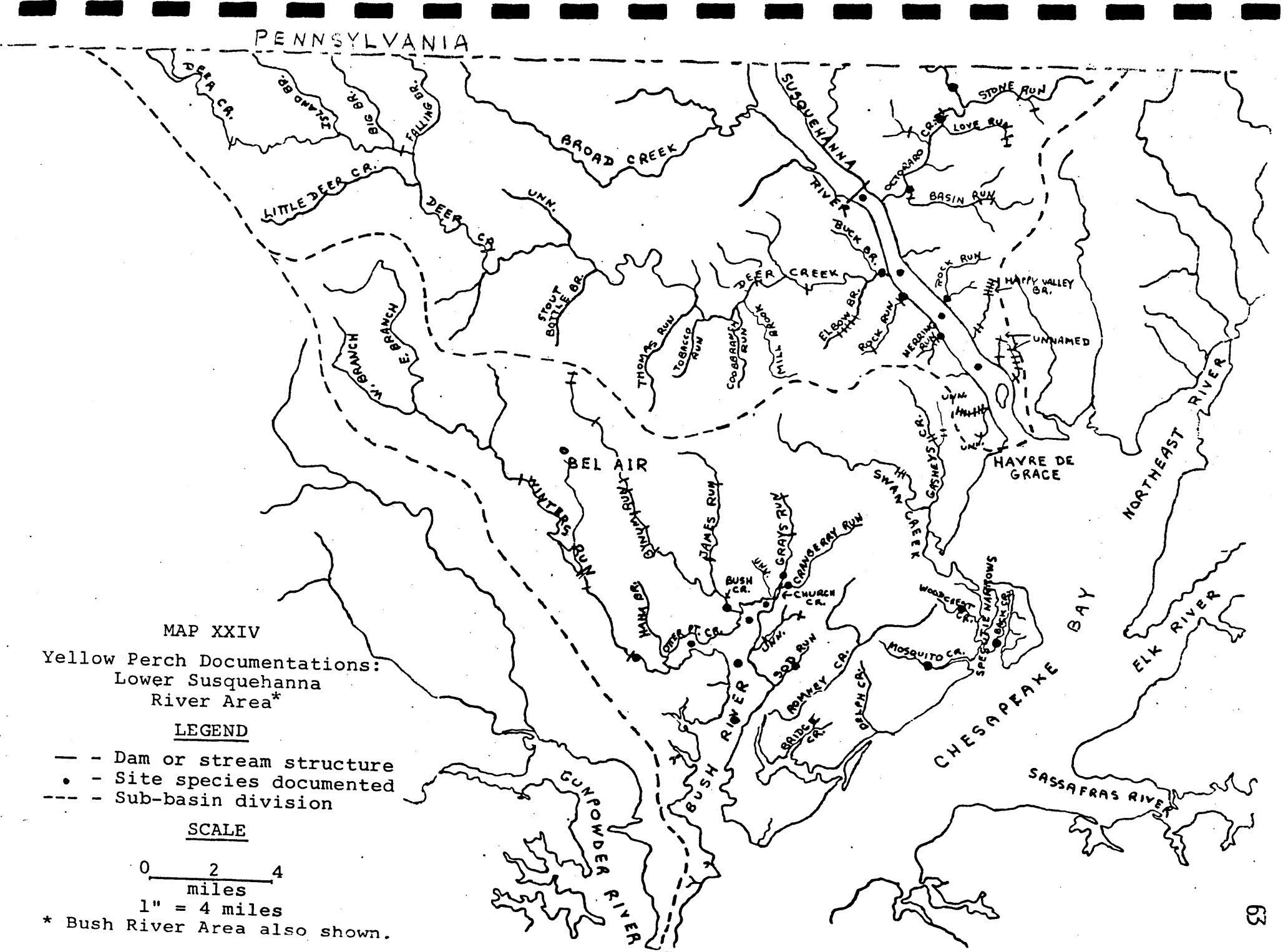
LEGEND

— - Dam or stream structure
• - Inland sampling sites
x - Estuarine sampling site
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Bush River Area also shown.



MAP XXIV

Yellow Perch Documentations:
Lower Susquehanna
River Area*

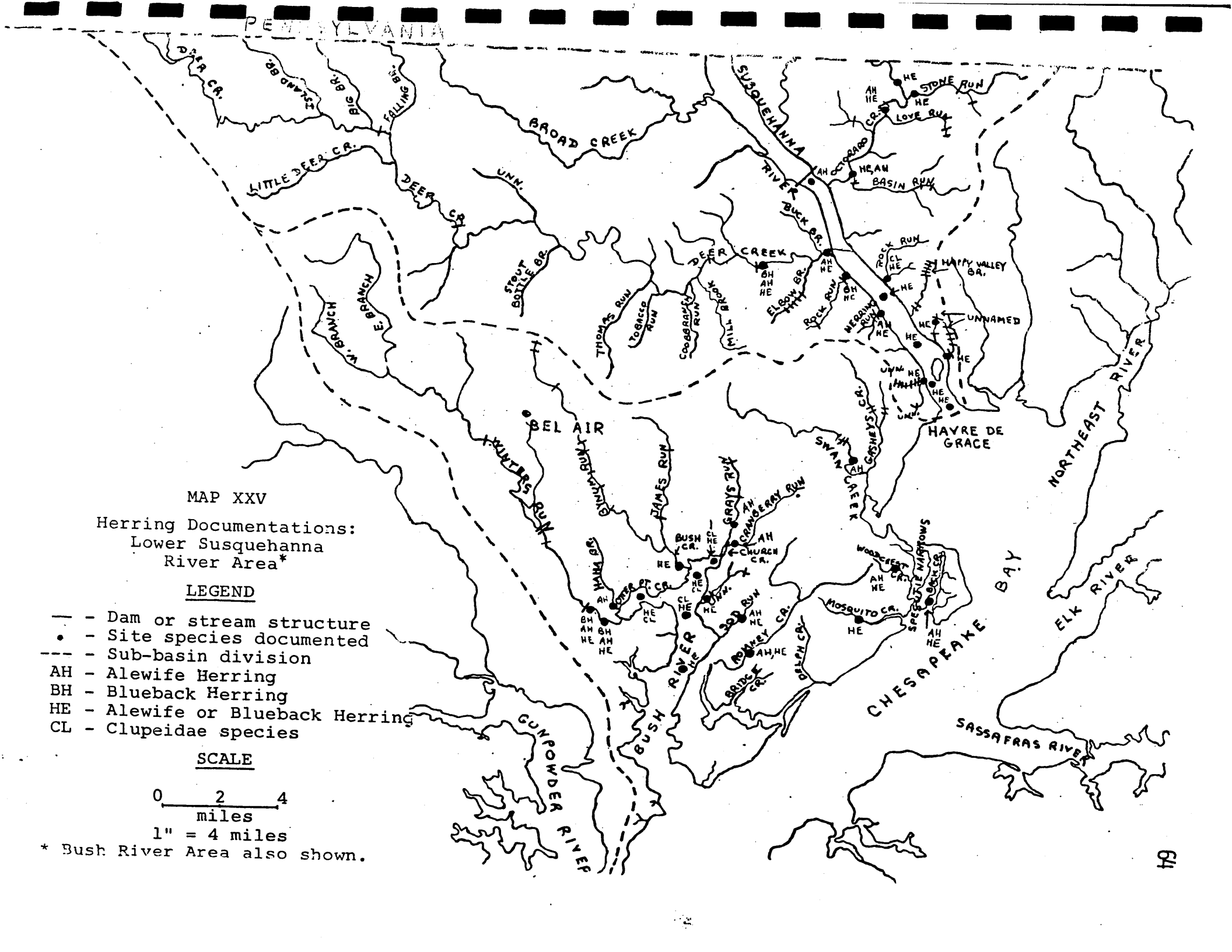
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Bush River Area also shown.



MAP XXV

Herring Documentations:
Lower Susquehanna
River Area*

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
AH - Alewife Herring
BH - Blueback Herring
HE - Alewife or Blueback Herring
CL - Clupeidae species

SCALE

0 2 4
miles
1" = 4 miles

* Bush River Area also shown.

miles to the Conowingo Dam. Herring migrations were documented in Octoraro Creek upstream for 6.4 miles to the sample station at Newbridge Road. In Deer Creek, herring spawned upstream for 4.3 miles to an impassable dam and fishway near Darlington.

American shad were documented only in the Susquehanna River. They ranged from the river mouth upstream to the Conowingo Dam (Map XXVI).

Hickory shad were documented at the Conowingo Dam and in Deer Creek upstream 4.3 miles to the previously mentioned dam (Map XXVII). Spawning probably occurred in lower Octoraro Creek, based on sport catch information.

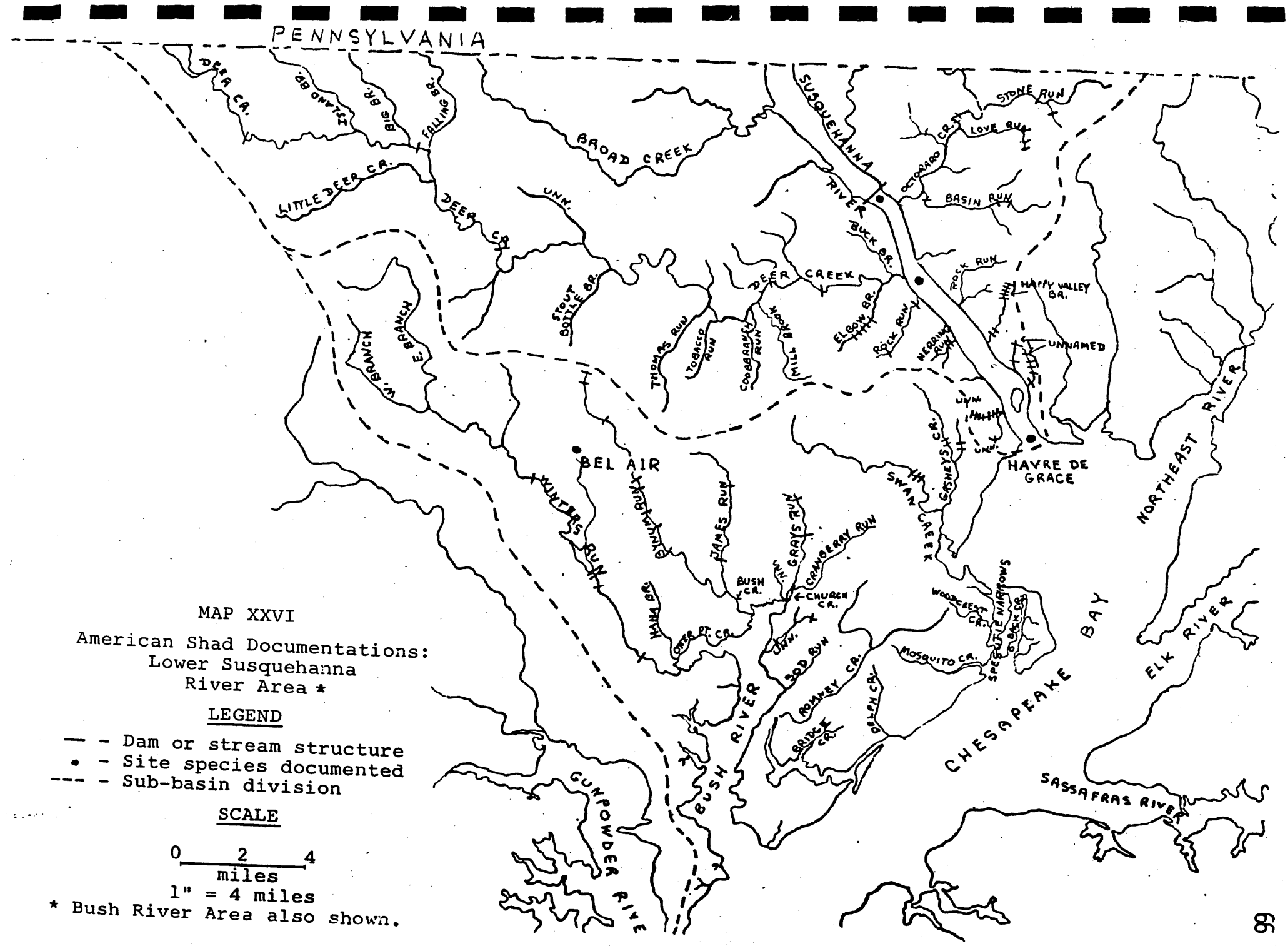
Shad spawning stream documentations confirm findings from Project AFSC-1[1/] in that American shad utilize only the Susquehanna River for spawning whereas hickory shad spawn in the river and additionally in Deer and Octoraro creeks.

White perch spawning was recorded in five streams (33.3%). Map XXVIII shows the distribution of white perch documentations. They were found at every site on the Susquehanna River, however, they were not documented as far upstream in tributaries as the herring or yellow perch. The farthest up a tributary that white perch were documented was at the mouth of Basin Run, which is only one mile up Octoraro Creek from its junction with the Susquehanna River.

Striped bass were documented in the Susquehanna River upstream to 6.3 miles which is off the mouth of Deer Creek. Map XXIX shows each striped bass documentation in the river. The species may have ranged to Conowingo Dam where plankton sampling was not conducted.

Table IV lists all the streams in the Lower Susquehanna River Area that were investigated. It shows which anadromous fish species were present in each of these streams. Herring were the most frequently occurring anadromous species found. Every stream listed as an anadromous spawning stream had herring present. Eleven (73.3%) of fifteen sampled streams had spawning of one or more anadromous species.

1/ Ecological Study of the Susquehanna River and Tributaries below Conowingo Dam



MAP XXVI

American Shad Documentations:
Lower Susquehanna
River Area *

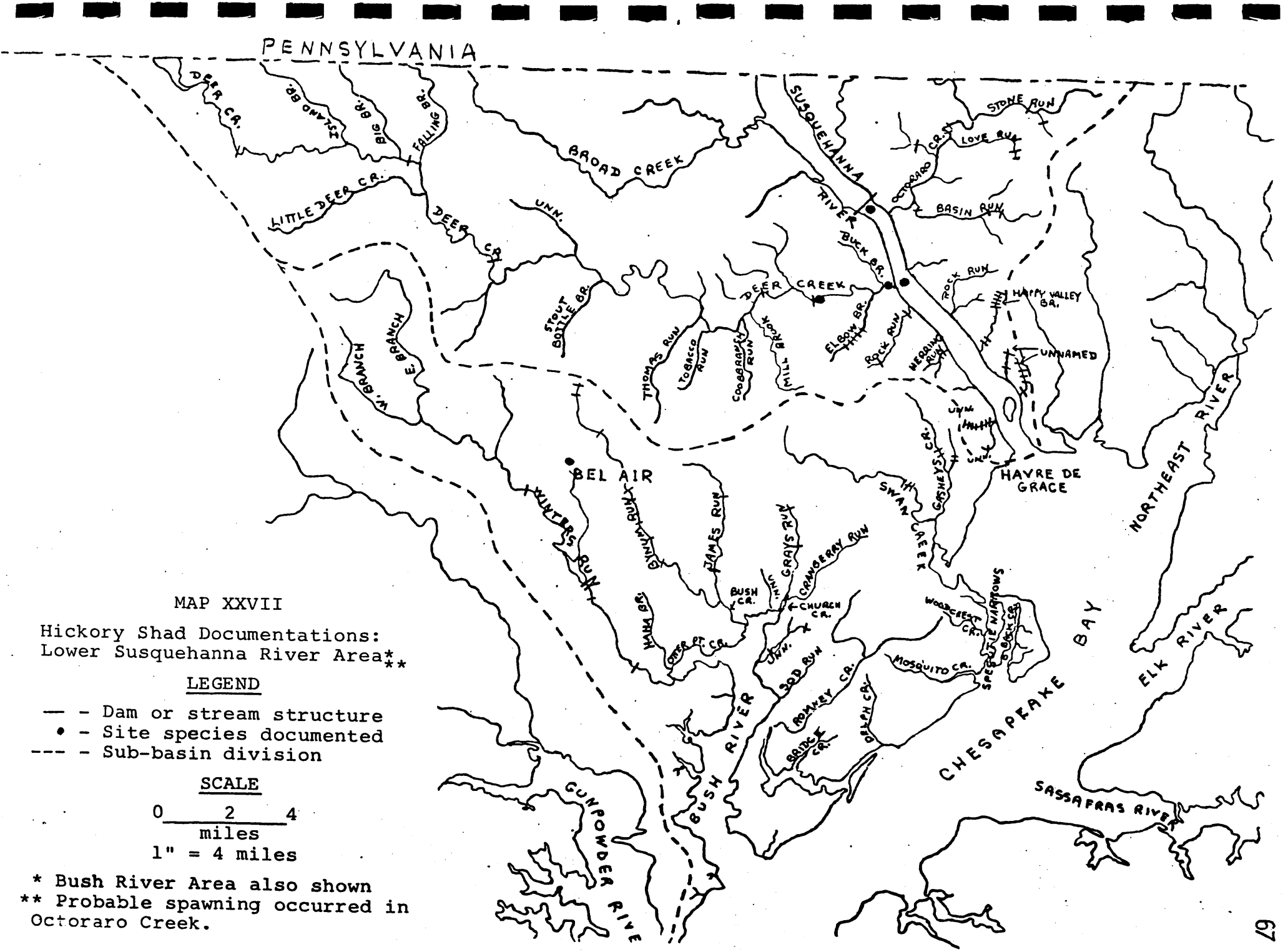
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Bush River Area also shown.



MAP XXVII

Hickory Shad Documentations:
Lower Susquehanna River Area*,**

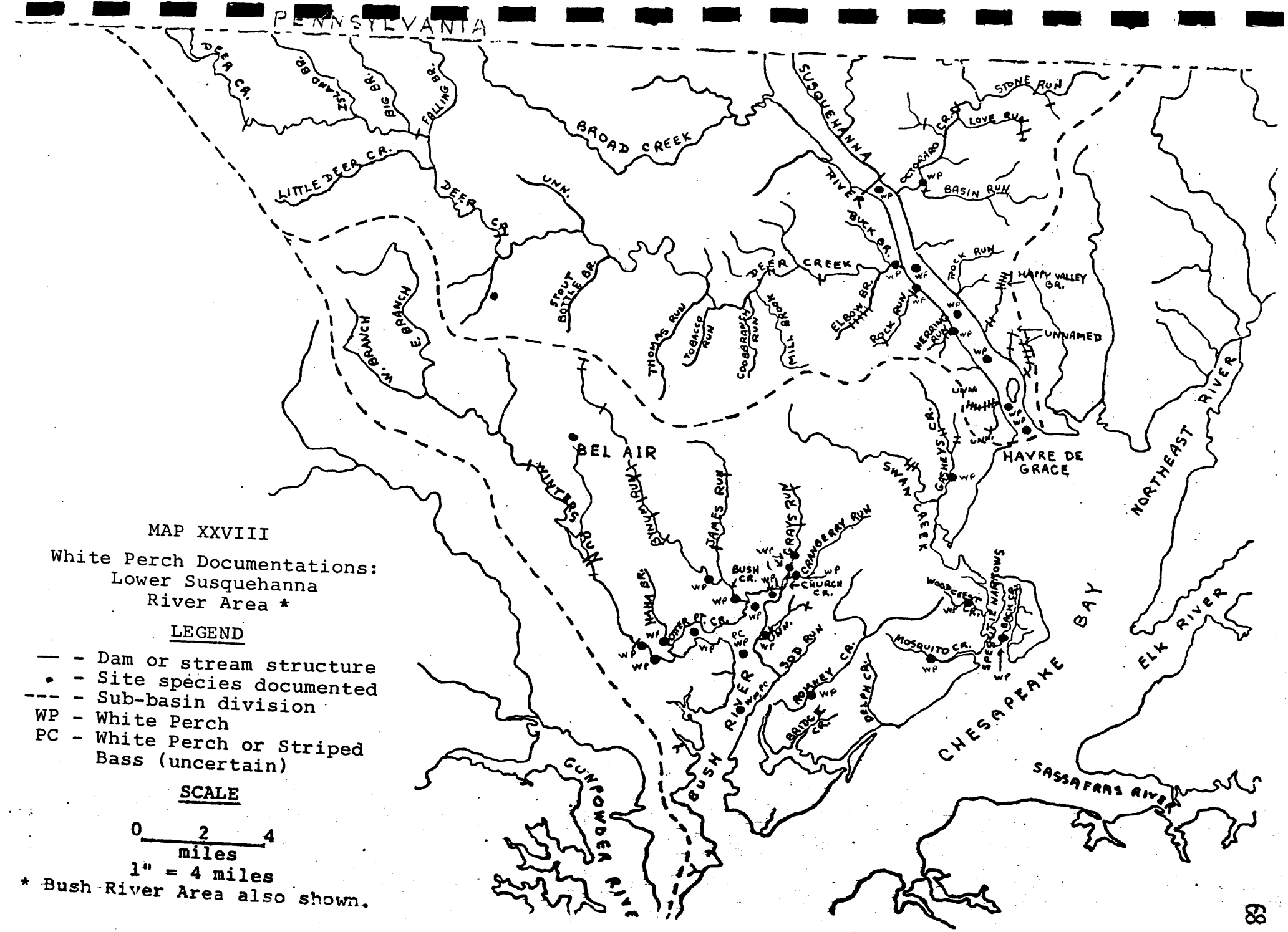
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Bush River Area also shown
** Probable spawning occurred in Octoraro Creek.



MAP XXVIII

White Perch Documentations:
Lower Susquehanna
River Area *

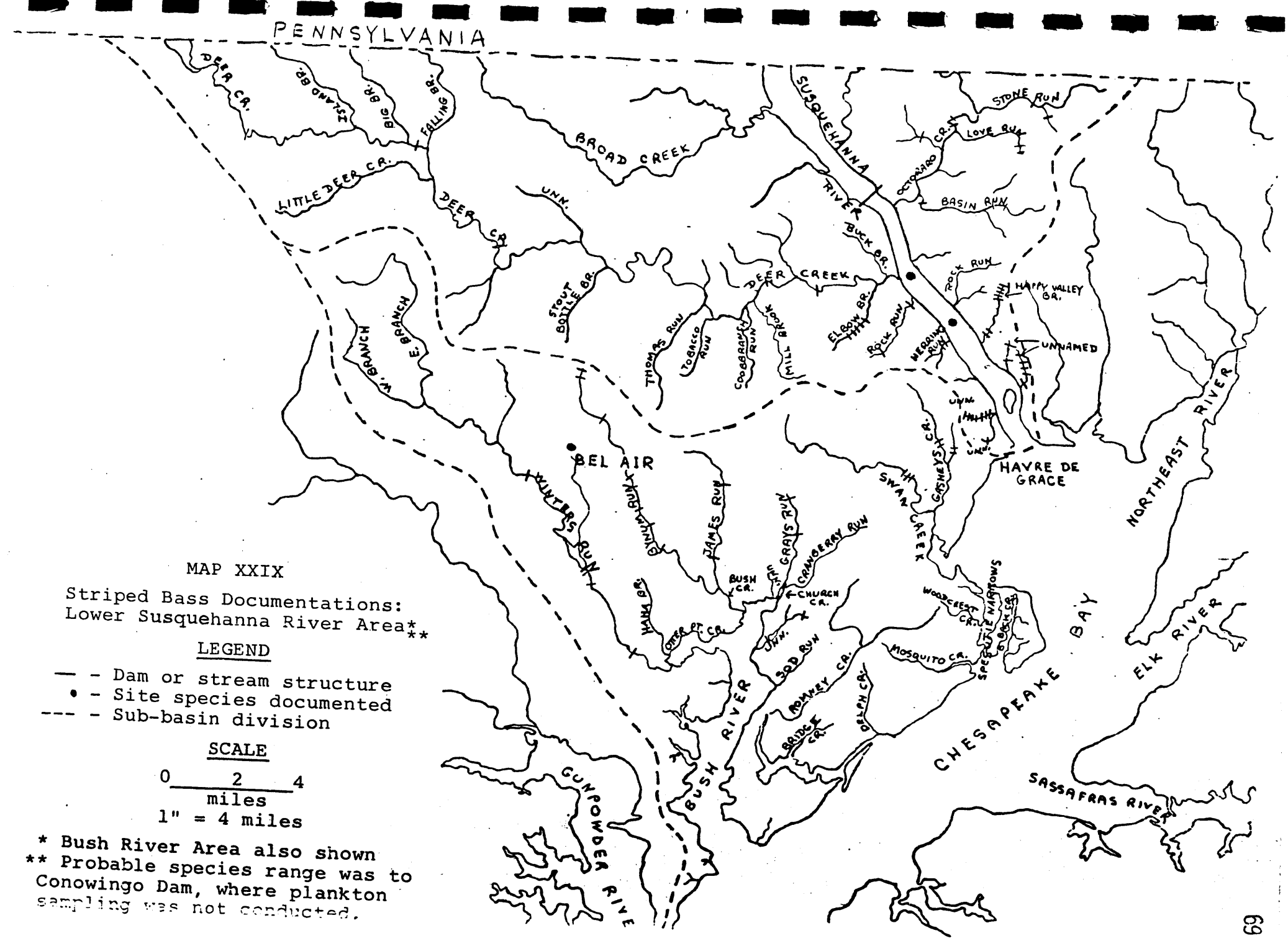
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
WP - White Perch
PC - White Perch or Striped Bass (uncertain)

SCALE

0 2 4
miles
1" = 4 miles

* Bush River Area also shown.



MAP XXIX

Striped Bass Documentations:
Lower Susquehanna River Area*,**

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Bush River Area also shown
** Probable species range was to Conowingo Dam, where plankton sampling was not conducted.

TABLE IV.

ANADROMOUS FISH SPAWNING STREAMS IN THE LOWER SUSQUEHANNA RIVER AREA

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS	HS 4/	CL	WP	SB	PC
Susquehanna River	x	x		x	x	x		x	x	
Deer Creek	x	x	x	x		x		x		
Octoraro Creek	x	x		x						
Basin Run	x	x		x				x		
Love Run										
Stone Run				x						
Unnamed (1,042,500E-675,900N)										
Havre de Grace Area										
Herring Run	x	x		x				x		
Rock Run (Harford County)	x		x	x				x		
Unnamed (1,054,500E-628,900N)				x						
Bainbridge Area										
Happy Valley Branch										
Rock Run (Cecil County)	x			x			x			
Unnamed (1,059,200E-635,200N)				x						
Unnamed (1,039,200E-660,100N)										
Unnamed (1,058,500E-641,500N)				x						
Total Spawning Streams by Species:	7	5	2	11	1	2	1	5	1	0
Total Sampled Streams:	15									
Total Spawning Streams (all species):	11									

1/ Streams arranged according to sub-sub basins.
2/ Maryland coordinates given to identify sample sites of unnamed streams.
3/ Species recordings based on egg, larvae or adult fish life stages collected.
4/ Hickory Shad probably spawned in Octoraro Creek based on sport catch information.

YP - Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

3. Bush River Area

The Bush River Area lies entirely within Harford County and includes an estuary fed by small streams with a total drainage area of approximately 140 square miles. Major waters are the Bush River, Swan Creek, Winters Run and Bynum Run. Major communities include Bel Air, the county seat of Harford County, Aberdeen and Edgewood.

The watershed contains rolling hills changing to the flatter coastal plain topography along the western Chesapeake Bay shore.

Bush River is bordered by Aberdeen Proving Ground on the east end and Edgewood Arsenal on the west. Entrance into the waters surrounding these Federal installations is restricted at times because of various explosive testing programs carried out at the two military posts.

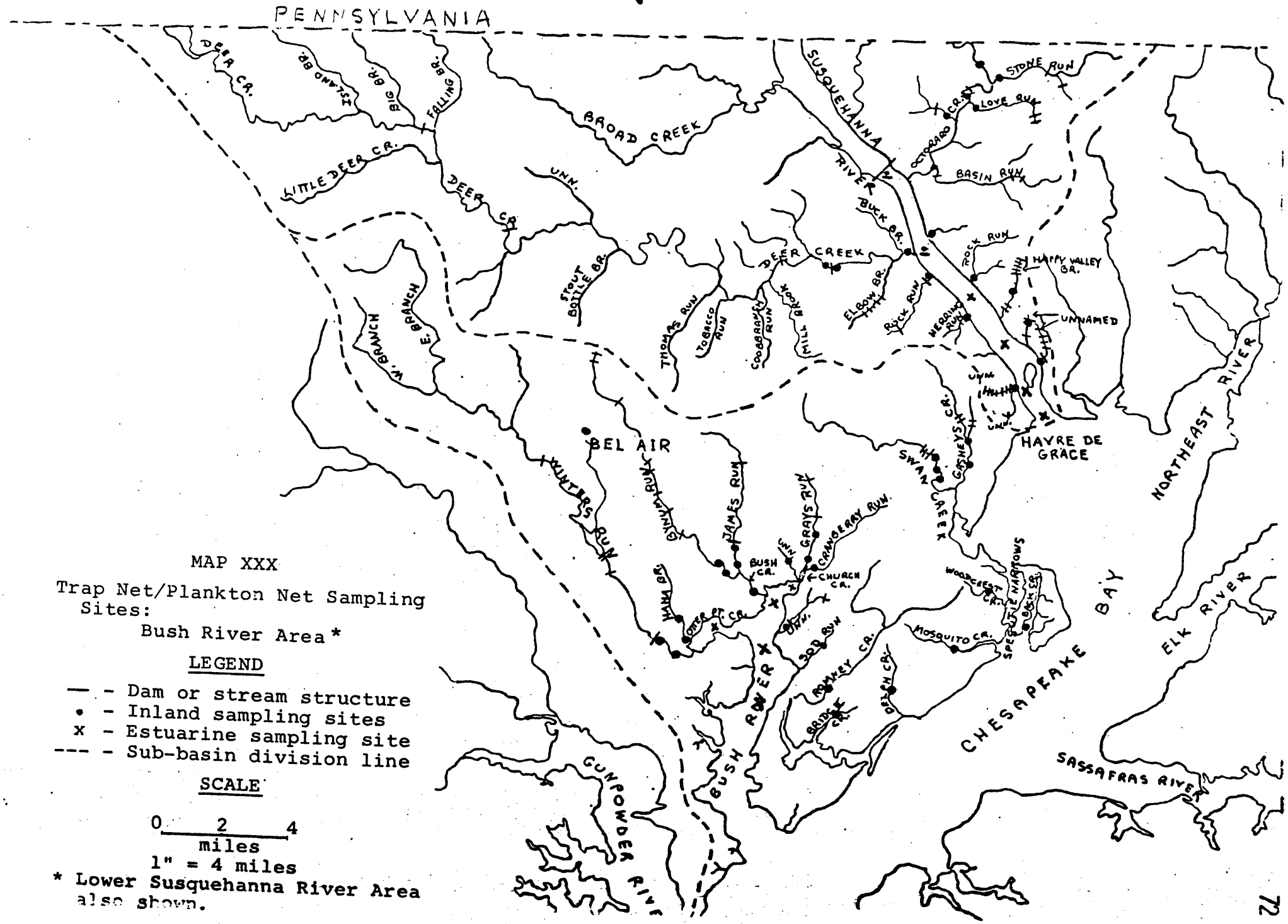
There were a total of twenty-one streams investigated within the Bush River Area, including the river proper. Map XXX shows the distribution of these sites. There were a total of thirty-one biological sites sampled.

Spawning activities of yellow perch were documented in a total of eleven streams, representing 52.4% of the streams investigated. Map XXXI shows the sites where yellow perch occurred. This species was found to migrate up the Bush River to its headwaters and then into several fresh water tributaries. The farthest upstream yellow perch migration was documented at 2.5 miles upstream in Winters Run at an impassable dam. The recording was a total distance of approximately 12.3 miles from the mouth of the Bush River. It is interesting to note that no yellow perch were found in the Swan Creek drainage.

Alewife or blueback herring were documented in fifteen (71.4%) of the streams investigated. Map XXXII shows the sites where they were documented. As with yellow perch, the farthest upstream herring migration occurred in Winters Run. Both herring species migrated approximately 12.3 miles upstream from the mouth of Bush River to the dam on Winters Run. The upstream migration in Grays Run may also have been limited by the presence of a dam located 0.8 miles upstream from the stream mouth. Blueback herring were positively documented in only one stream, Winters Run. Alewife herring were positively documented in nine streams (Table V).

No American shad or hickory shad were documented in this sub-basin.

Striped bass were found on one occasion in Bush Creek in a trap net sample. This documentation was not given map or table coverage since it was an isolated instance of a specimen in non-spawning condition.



MAP XXX

Trap Net/Plankton Net Sampling Sites:

Bush River Area*

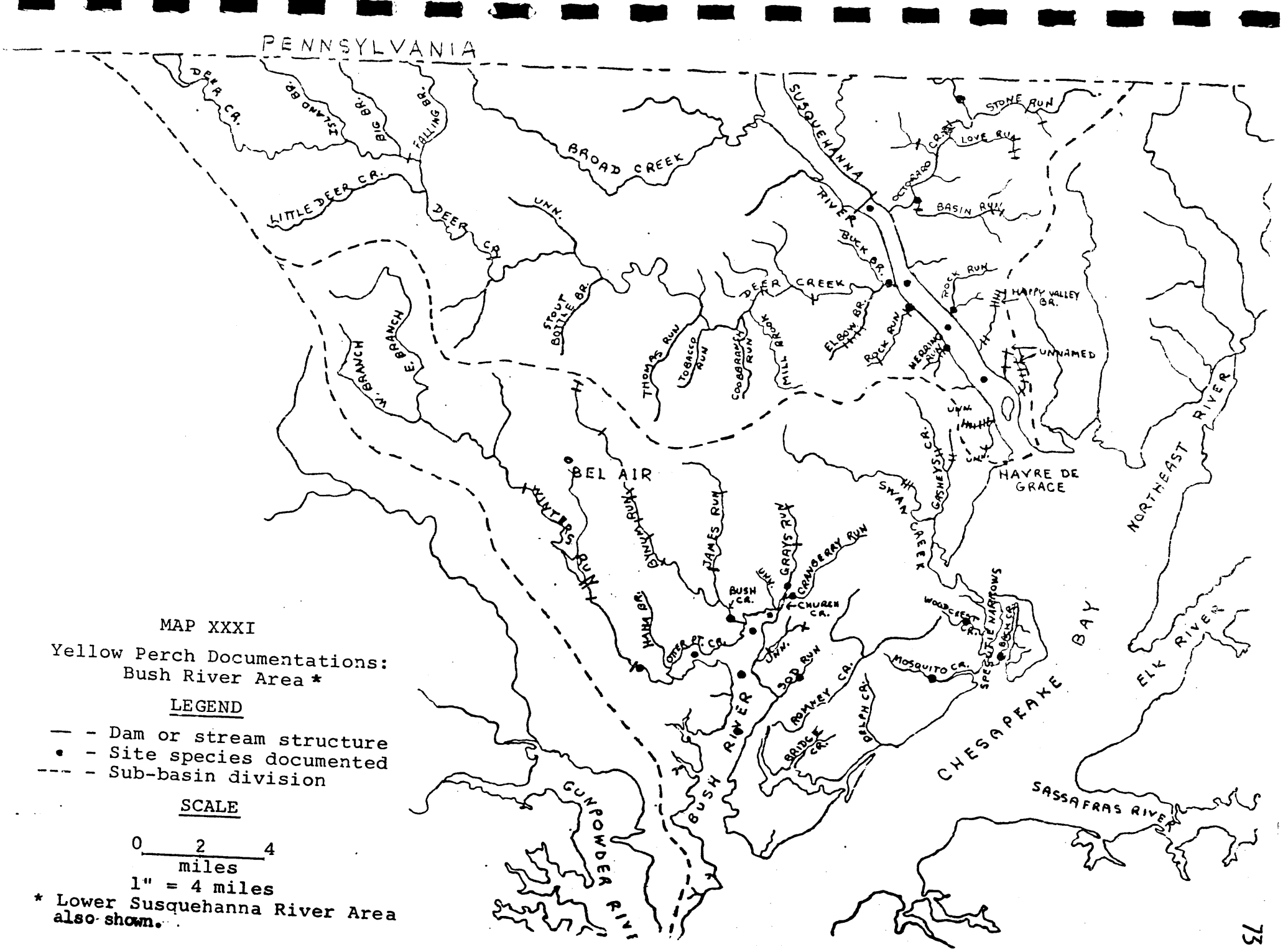
LEGEND

— - Dam or stream structure
• - Inland sampling sites
x - Estuarine sampling site
--- - Sub-basin division line

SCALE

0 2 4
miles
1" = 4 miles

* Lower Susquehanna River Area also shown.



MAP XXXI

Yellow Perch Documentations:
Bush River Area *

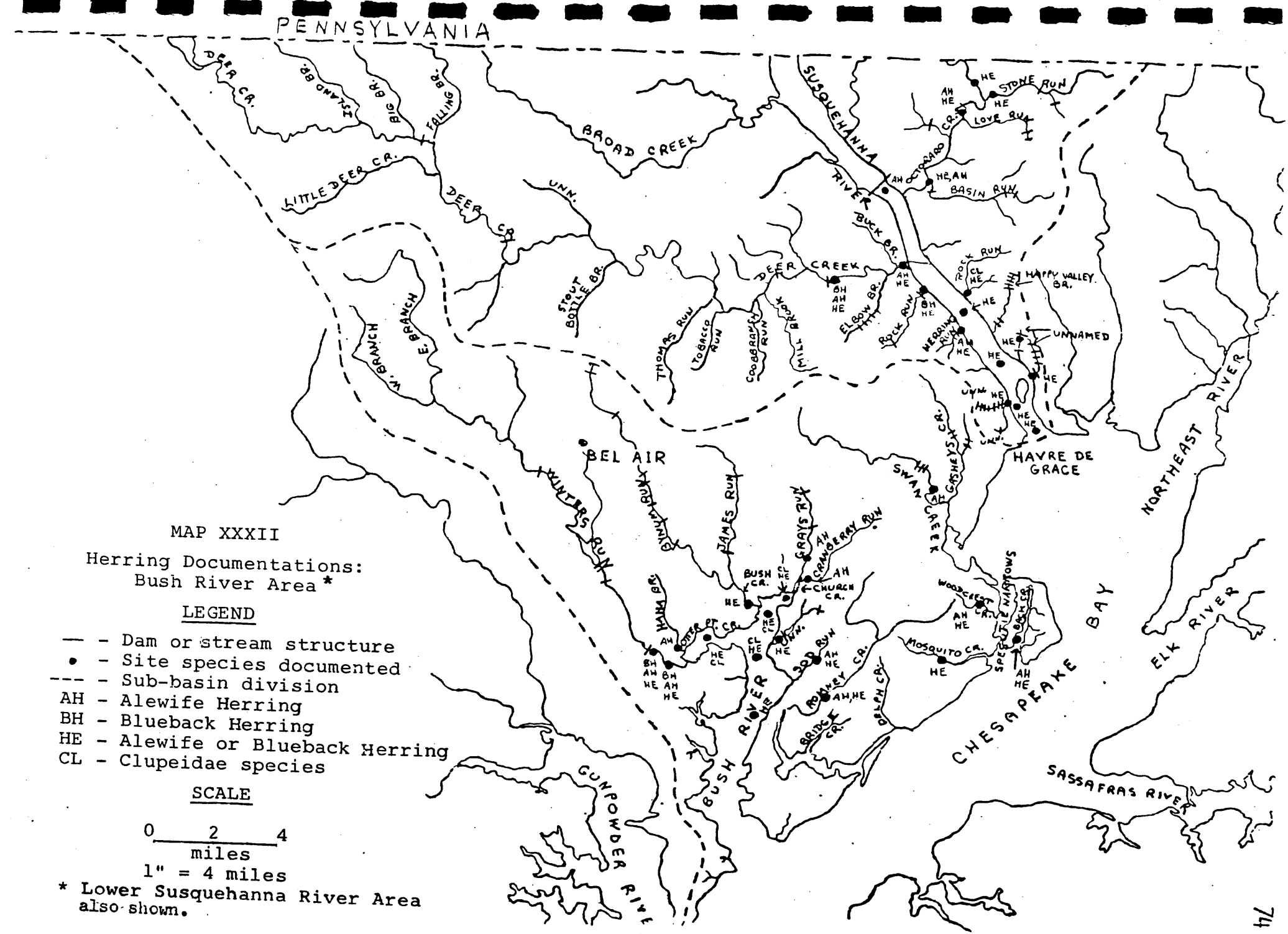
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Lower Susquehanna River Area also shown.



MAP XXXII

Herring Documentations:
Bush River Area*

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
AH - Alewife Herring
BH - Blueback Herring
HE - Alewife or Blueback Herring
CL - Clupeidae species

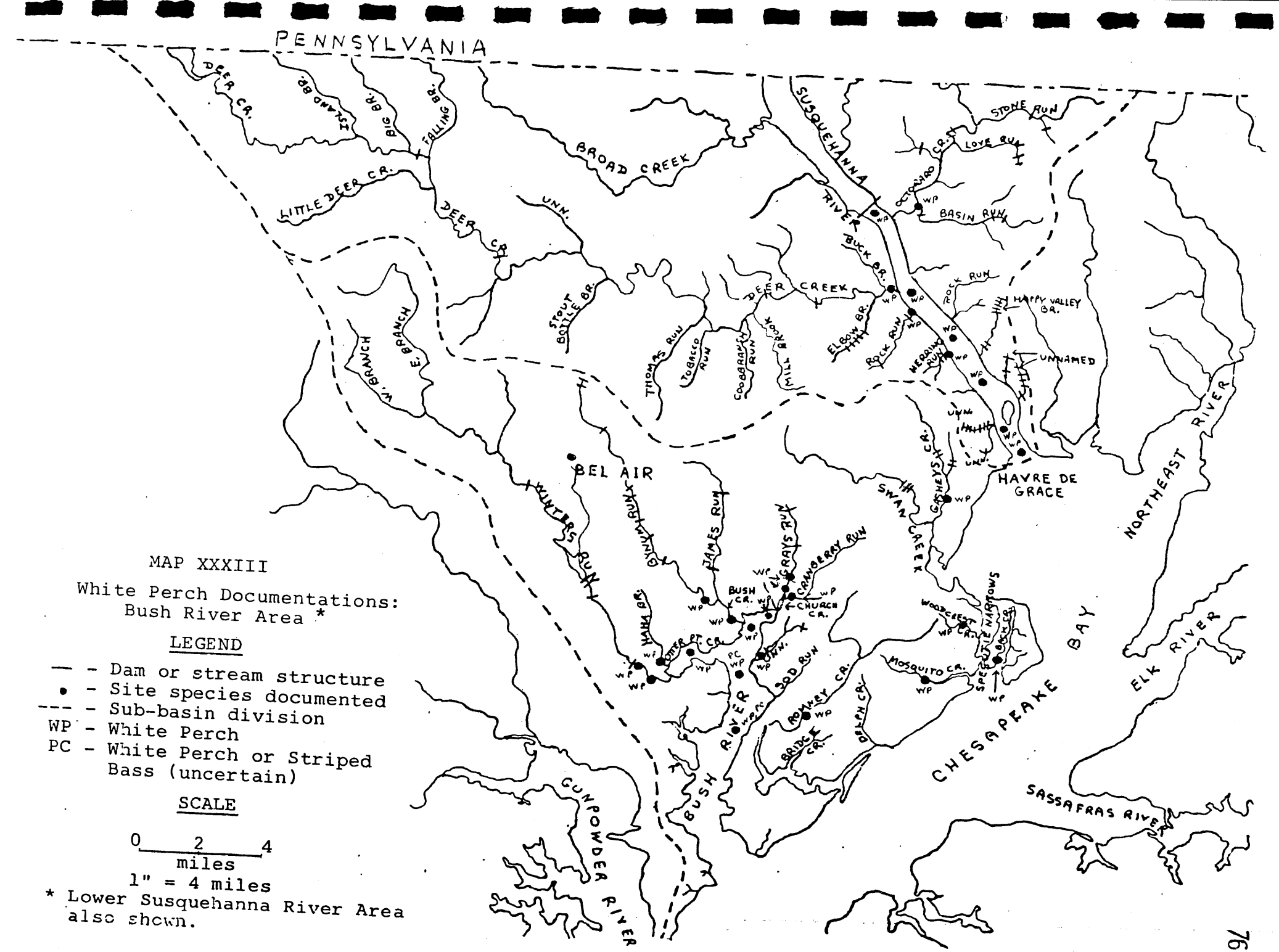
SCALE

0 2 4
miles
1" = 4 miles

* Lower Susquehanna River Area also shown.

White perch were documented in fifteen streams (71.4%) as shown on Map XXXIII. White perch were found as far upstream as the dam on Winters Run, the dam on Grays Run, and 0.7 miles upstream into Bynum Run. White perch were the only anadromous species to be documented in Gasheys Creek and Bynum Run.

Table V lists the twenty-one streams in the Bush River Area that were investigated. This table further shows where anadromous species were documented and the species found in each of the seventeen spawning streams. White perch and herring, both recorded in fifteen watercourses, were the most frequently documented species in streams of the subbasin drainage system.



MAP XXXIII

White Perch Documentations:
Bush River Area *

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
WP - White Perch
PC - White Perch or Striped Bass (uncertain)

SCALE

0 2 4
miles
1" = 4 miles

* Lower Susquehanna River Area also shown.

TABLE V.

ANADROMOUS FISH SPAWNING STREAMS IN THE BUSH RIVER AREA

Streams Investigated 1/ 2/ — Sub-sub basin name / Stream name	Anadromous Species Recorded 3/ YP	AH	BH	HE	AS	HS	CL	WP	SB	PC
Swan Creek		x								
Gasheys Creek								x		
Bush River	x			x			x	x		x
Bush Creek	x			x				x		
Church Creek	x			x			x	x		
Cranberry Run	x	x						x		
Grays Run	x	x						x		
Ha Ha Branch		x						x		
James Run										
Otter Point Creek	x			x			x	x		
Sod Run	x	x		x						
Unnamed (1,017,500E-588,200N)				x				x		
Unnamed (1,016,900E-597,700N)										
Bynum Run								x		
Winters Run	x	x	x	x				x		
Aberdeen Proving Ground Area										
Back Creek	x	x		x				x		
Bridge Creek										
Delph Creek										
Mosquito Creek	x			x				x		
Romney Creek		x		x				x		
Woodcrest Creek	x	x		x				x		
Total Spawning Streams by Species:	11	9	1	11	0	0	3	15	0	1
Total Sampled Streams:	21									
Total Spawning Streams (all species):	17									

1/ Streams arranged according to sub-sub basins.
2/ Maryland coordinates given to identify sample sites of unnamed streams.
3/ Species recordings based on egg, larvae or adult fish life stages collected.

YP - Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

4. Gunpowder River Area

The Gunpowder River Area includes the northern portion of Baltimore County, the southwestern portion of Harford County and a small part of the northwestern section of Carroll County.

The major waterways consist of Prettyboy and Loch Raven reservoirs, Gunpowder and Middle rivers, and other water bodies such as Gunpowder Falls and Little Gunpowder Falls.

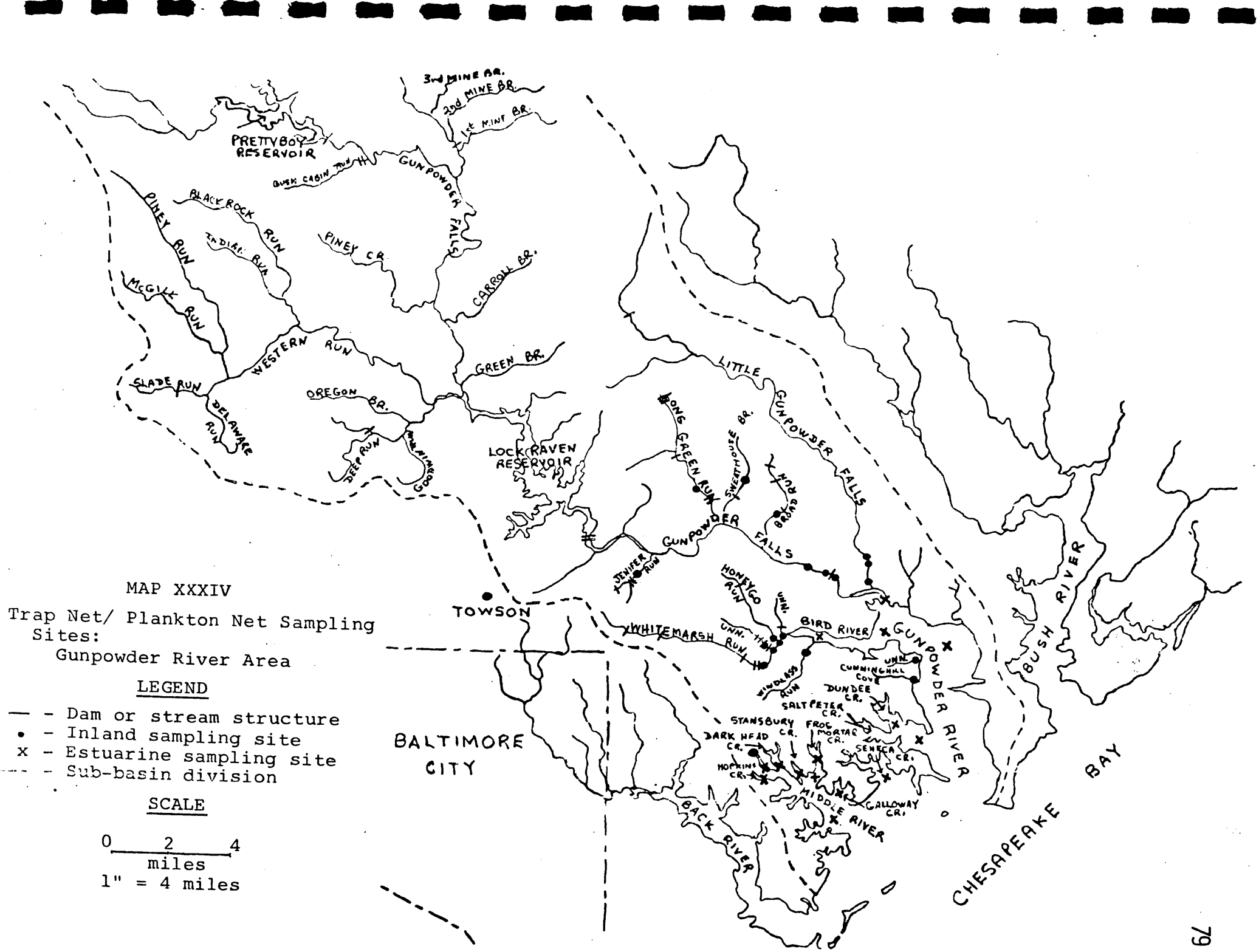
The northwest section contains rolling hills with some sharp inclines which is characteristic of the eastern portion of the Piedmont Province. The Piedmont characteristic changes towards the southeast where there are coastal plains bordering the western Chesapeake Bay.

Within the Gunpowder River Area a total of twenty-three streams, including the Gunpowder River, were investigated. Map XXXIV shows where each of the thirty-five biological sampling sites were located. Of the twenty-three streams investigated, anadromous fish were documented in seventeen of them (73.9%).

Yellow perch were documented in eleven (47.8%) of the streams investigated (Map XXXV). They were found from near the mouth of the Gunpowder River (in Saltpeter Creek), upstream in Gunpowder Falls for a distance of 0.3 miles. This represents a total migration distance of 11.8 and 12.2 miles respectively from the mouth of the Gunpowder River. The first barrier located upstream on Gunpowder Falls is a partially washed-out dam, passable for anadromous fish. Yellow perch were also found at the mouth of Seneca Creek and in Middle River, from the mouth upstream for a distance of 4.8 miles.

Herring were documented in a total of seven (30.4%) of the streams investigated (Map XXXVI). They had the farthest upstream migration of any anadromous fish found in the area. They were found to have migrated up the Gunpowder River, into Gunpowder Falls, and then upstream into Broad Run for a distance of 1.1 miles to an impassable dam. The total migration distance was 15 miles from the mouth of the Gunpowder River. Herring were also found upstream in Whitemarsh Run for a distance of 1.7 miles to an impassable dam. Herring were documented in only one stream in the Middle River drainage, Frog Mortar Creek. Blueback herring were positively identified in Gunpowder Falls and Whitemarsh Run. Alewife herring were also positively identified in these same two streams.

White perch documentation is shown on Map XXXVII. This species was found in a total of fourteen (60.9%) of the streams investigated. White perch was the only anadromous species found to penetrate upstream into Little Gunpowder Falls, a tributary to Gunpowder



MAP XXXIV

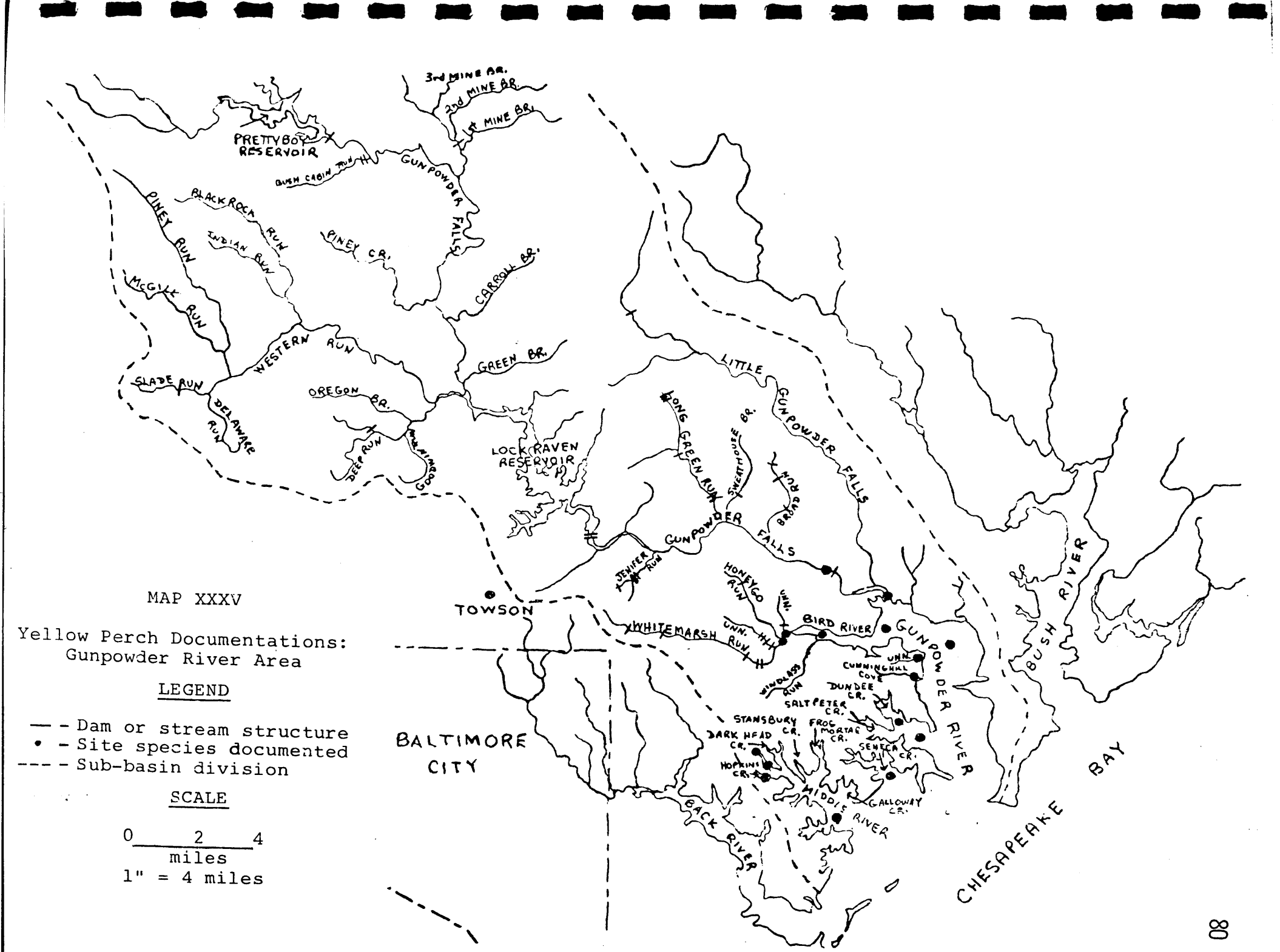
Trap Net/ Plankton Net Sampling Sites:
Gunpowder River Area

LEGEND

— - Dam or stream structure
• - Inland sampling site
x - Estuarine sampling site
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles



MAP XXXV

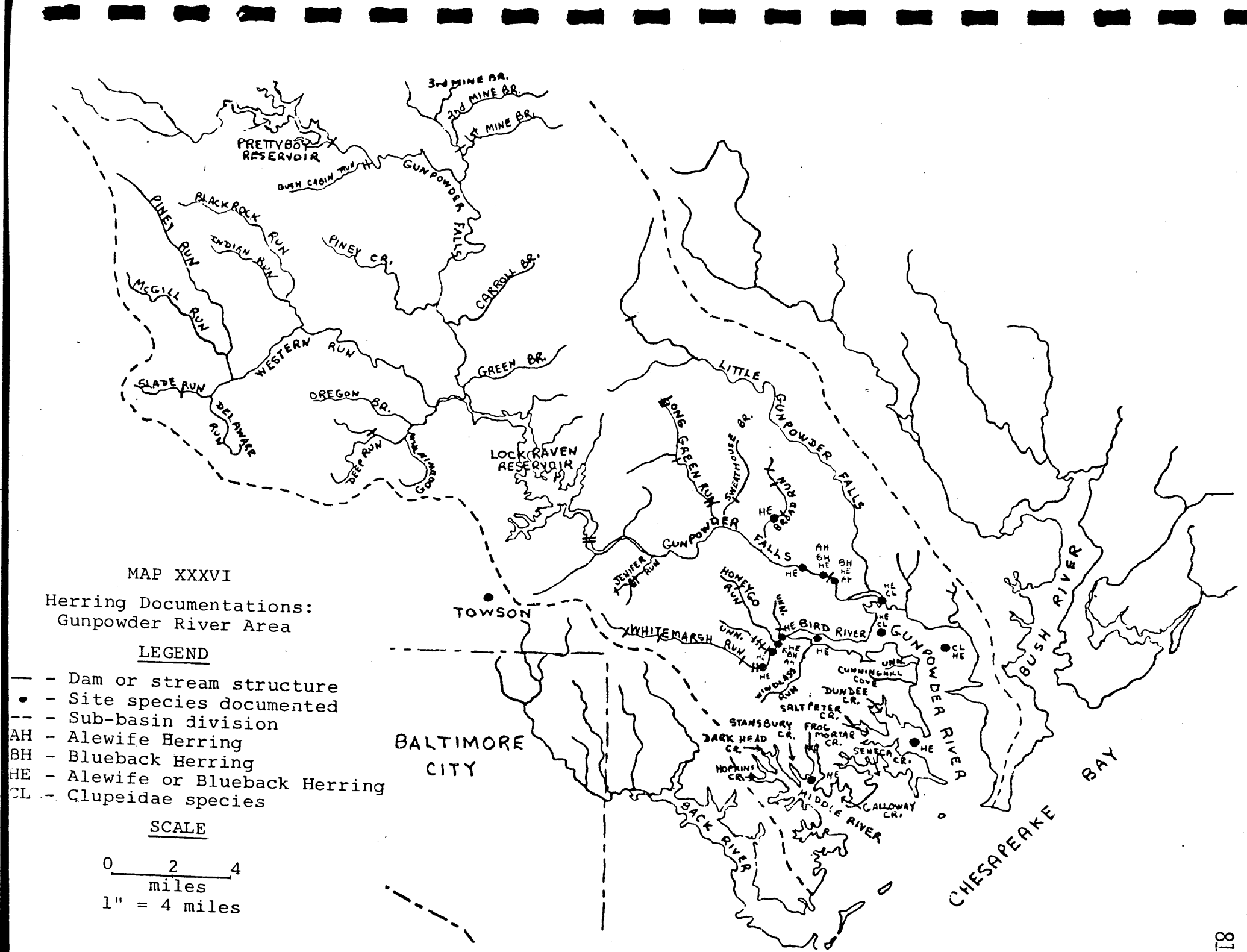
Yellow Perch Documentations:
Gunpowder River Area

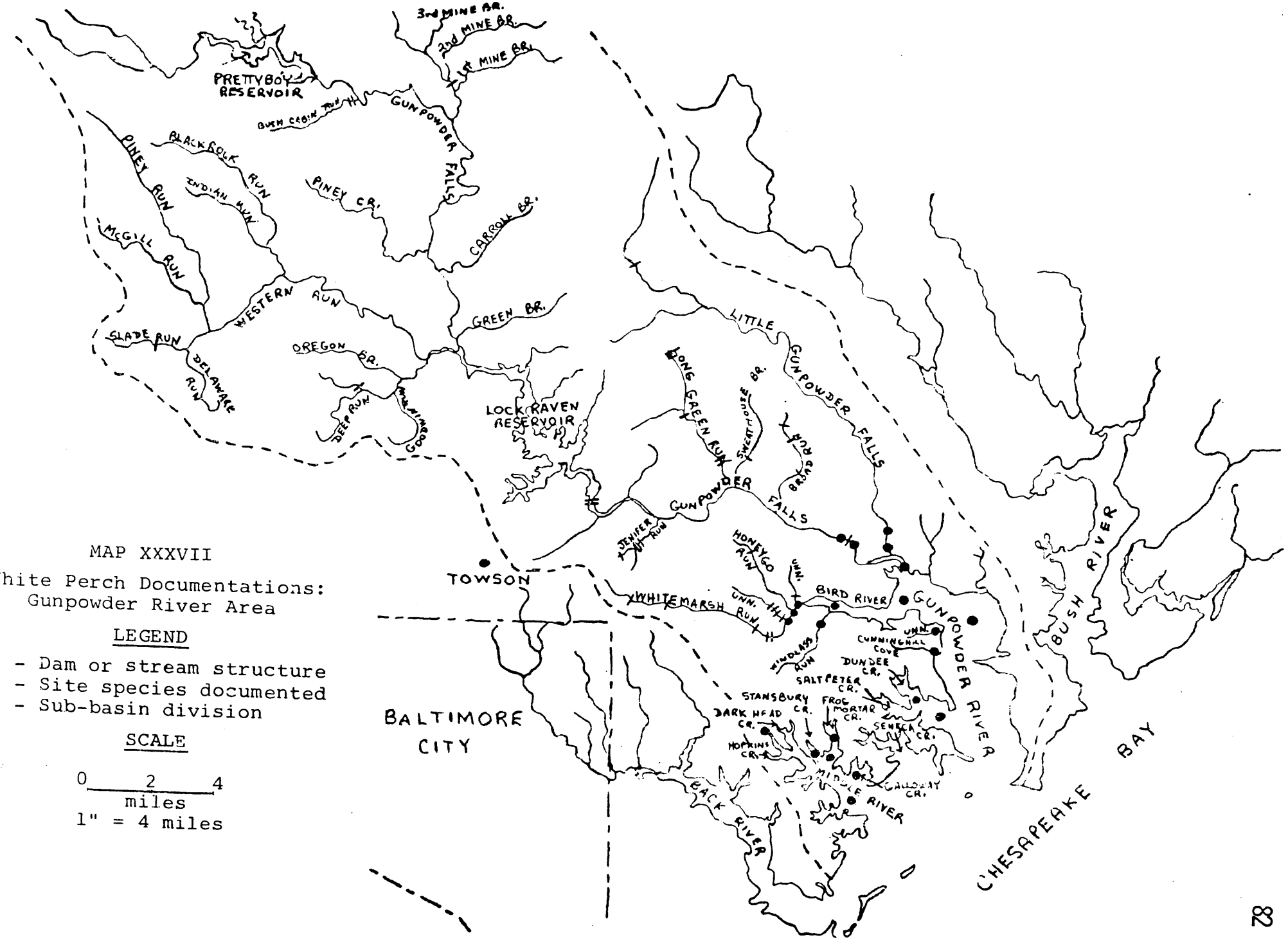
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles


MAP XXXVI
Herring Documentations:
Gunpowder River Area
LEGEND
— - Dam or stream structure
• - Site species documented
-- - Sub-basin division
AH - Alewife Herring
BH - Blueback Herring
HE - Alewife or Blueback Herring
CL - Clupeidae species
SCALE
0 2 4
miles
1" = 4 miles
PRETTYBOY RESERVOIR
3rd MINE BR.
2nd MINE BR.
1st MINE BR.
GUNPOWDER FALLS
BUSH CABIN RUN
BLACKROCK RUN
PINEY RUN
INDIAN RUN
PINEY CR.
CARROLL BR.
McGILL RUN
WESTERN RUN
GREEN BR.
SLADE RUN
DELAWARE RUN
OREGON BR.
DEER RUN
HAMPROD
LOCK RAVEN RESERVOIR
LONG GREEN RUN
SWEATHOUSE BR.
LITTLE GUNPOWDER FALLS
BROAD RUN
GUNPOWDER FALLS
JENIFER RUN
HONEYGO RUN
UNN.
TOWSON
WHITEMARSH RUN
THE BIRD RIVER
GUNPOWDER RIVER
BUSH RIVER
CUNNINGHILL COVE
DUNDEE CR.
SALTPETER CR.
STANSBURY CR.
FROG MORTAR CR.
DARK HEAD CR.
SENECA CR.
HOPKINS CR.
MIDDLE RIVER
GALLOWAY CR.
BACK RIVER
BALTIMORE CITY
CHESAPEAKE BAY



MAP XXXVII

White Perch Documentations:
Gunpowder River Area

LEGEND

— - Dam or stream structure
• - Site species documented
-- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

Falls, where they were documented 2.2 miles upstream. White perch were also the only anadromous species documented in Windlass Run (tributary to Bird River), Stansbury Creek, and Galloway Creek (tributaries to Middle River).

No significant spawning activities of striped bass, hickory shad, or American shad were documented in the Gunpowder River Area. American shad eggs were identified in a single sample from Bird River in 1972 and in a single sample from Saltpeter Creek in 1973. Hickory shad eggs were identified in a single sample from Dundee Creek in 1973. Hickory shad and American shad recordings are not considered significant enough to warrant mapping or tabular summary, since spawning does not occur to any great extent.

Table VI lists the twenty-three streams investigated within the Gunpowder River Area and indicates the seventeen watercourses that support fish migrations.

TABLE VI.

ANADROMOUS FISH SPAWNING STREAMS IN THE GUNPOWDER RIVER AREA

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name / Stream name	YP	AH	BH	HE	AS 4/	HS 5/	CL	WP	SB	PC
Gunpowder River	x			x			x	x		
Cunninghill Cove	x							x		
Dundee Creek	x							x		
Saltpeter Creek	x			x				x		
Unnamed (986,300E-559,500N)	x							x		
Gunpowder Falls	x	x	x	x				x		
Broad Run				x						
Jenifer Run										
Long Green Creek										
Sweathouse Branch										
Little Gunpowder Falls								x		
Bird River	x			x			x	x		
Honeygo Run										
Unnamed (959,800E-560,700N)										
Whitemarsh Run	x	x	x	x				x		
Windlass Run								x		
Middle River	x							x		
Dark Head Creek										
Frog Mortar Creek				x				x		
Galloway Creek								x		
Hopkins Creek	x									
Stansbury Creek								x		
Seneca Creek	x									
Total Spawning Streams by Species:	11	2	2	7	0	0	2	14	0	0
Total Sampled Streams:	23									
Total Spawning Streams(all species):	17									

1/ Streams arranged according to sub-sub basins.
2/ Maryland coordinates given to identify sample sites of unnamed streams.
3/ Species recordings based on egg, larvae or adult fish life stages collected.
4/ Single egg samples collected in Bird River and Saltpeter Creek.
5/ Single egg sample collected in Dundee Creek.

YP - Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

5. Patapsco River Area

The Patapsco River Area includes the southern portions of Baltimore County, the southeastern portion of Carroll County, and the northern portion of both Howard and Anne Arundel counties. Of major importance within the watershed is Baltimore City and its suburban areas which exert influences on water quality common to all highly urbanized areas.

The principal streams or rivers are Back River and the Patapsco River, including Baltimore Harbor. The Harbor is a unique body of water in that it has been modified by man to support a variety of industrial and shipping enterprises, and consequently presents a special problem in water quality enforcement in that it receives much of the total accumulated wastes from the Baltimore Metropolitan area.

The watershed, physically, is typified by rolling hills over much of its area; characteristic of the Eastern Division of the Piedmont Province. To the southeast, this watershed lies in the coastal plain bordering the western side of Chesapeake Bay.

Within the Patapsco River Area, a total of thirty-five streams, including the river, were investigated. Map XXXVIII shows where each of the biological sampling sites were located. There were a total of fifty-four sites sampled. Of these fifty-four sites, twenty-eight were inland sites.

Investigations documented the occurrence of yellow perch spawning in thirteen streams. This represents 37.1% of the total streams sampled. Map XXXIX shows the distribution of yellow perch documentations. No yellow perch were documented within the Back River drainage.

Within the Patapsco River drainage, yellow perch spawning activity was found from just outside the mouth of the Patapsco River, in Bodkin Creek, upstream to a site located just below the second dam. The first dam was partially washed out during flooding associated with Hurricane Agnes. The second dam is located 21.1 miles upstream from the mouth of the Patapsco River at 1.8 miles above the first dam. Yellow perch migration represents the farthest upstream migration in the Patapsco River of any anadromous fish species documented.

Herring (blueback or alewife) were documented in eighteen streams (Map XL). One or both species were represented in 51.4% of the streams investigated. Alewife herring were positively identified in six different streams sampled (Patapsco River, Deep Creek, Rockburn Branch, Stony Run, Marley Creek and Sawmill Creek).

Within the Patapsco River drainage, herring were documented from near the mouth of the river, in Rock Creek and Jones Creek, upstream to the first dam located at river mile 19.3. This dam was passable to anadromous fish at the time of sampling.

MAP XXXVIII

Trap Net/Plankton Net Sampling Sites:
Patapsco River Area *

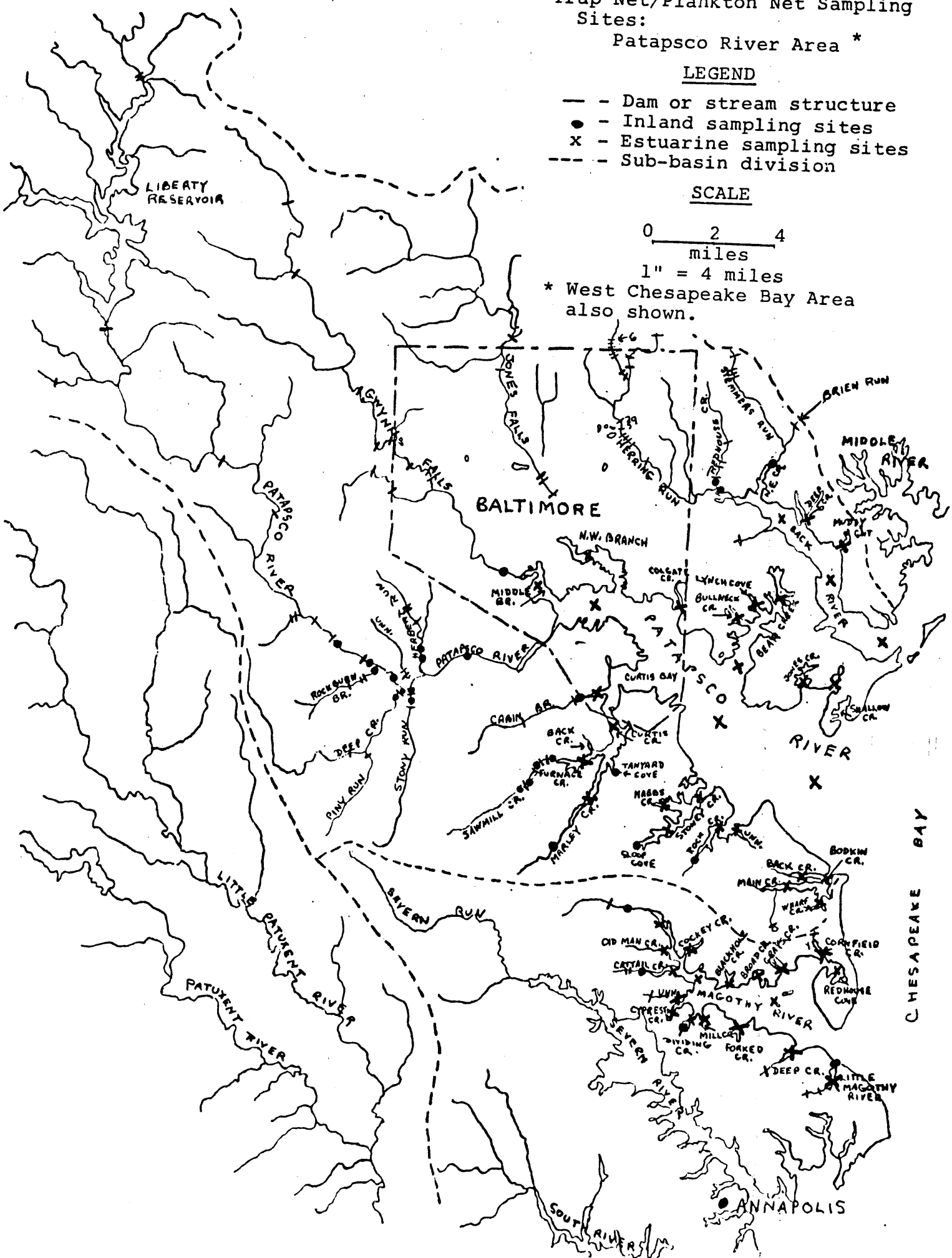
LEGEND

— - Dam or stream structure
● - Inland sampling sites
x - Estuarine sampling sites
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* West Chesapeake Bay Area also shown.



MAP XXXIX

Yellow Perch Documentations:
Patapsco River Area *

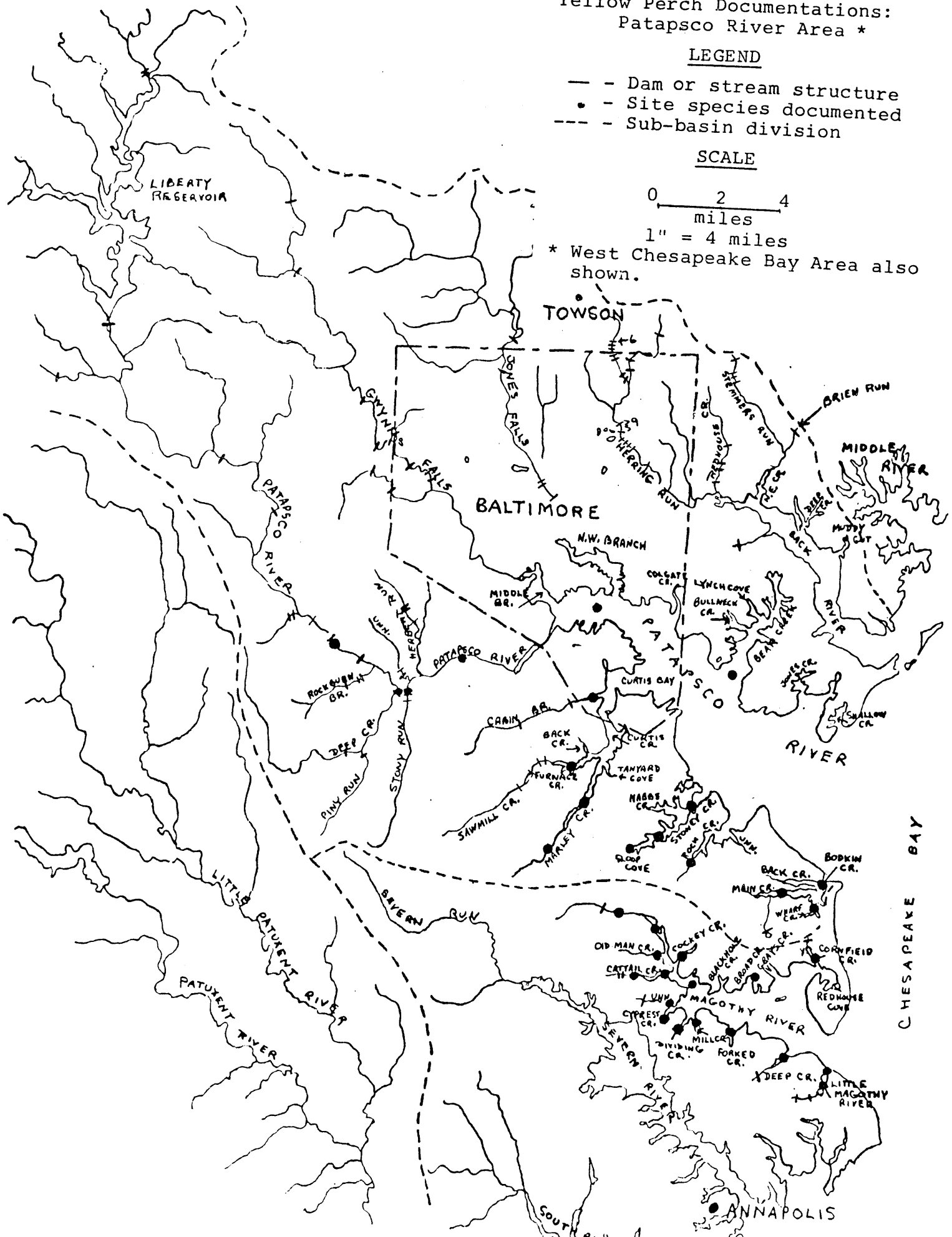
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* West Chesapeake Bay Area also shown.



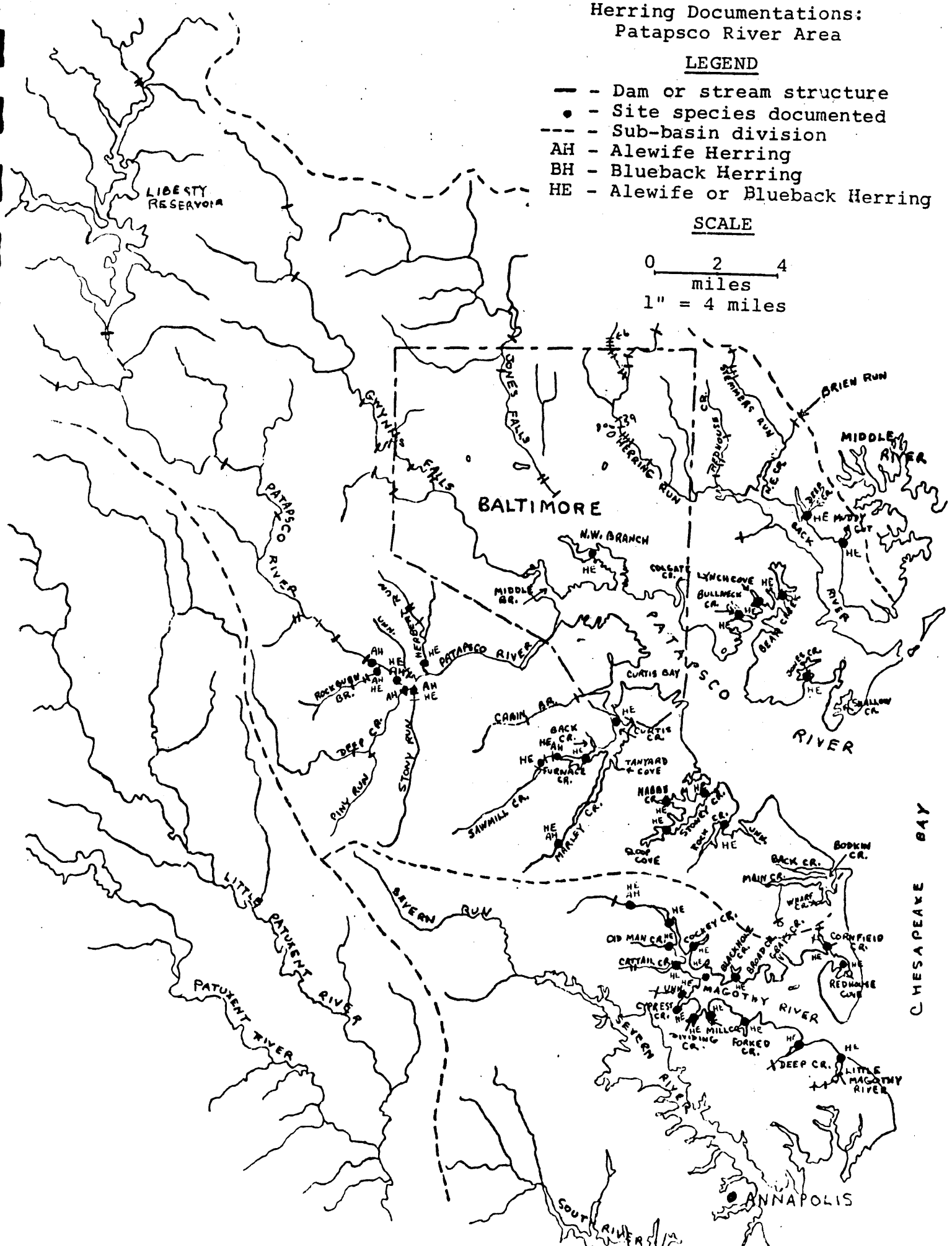
Herring Documentations: Patapsco River Area

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
AH - Alewife Herring
BH - Blueback Herring
HE - Alewife or Blueback Herring

SCALE

0 2 4
miles
1" = 4 miles



Herring were the only anadromous fish species found in Rockburn Branch, Northwest Branch and Curtis Creek.

White perch were documented in twenty-five streams. This represents 71.4% of the streams investigated. Map XLI shows their distribution. They were the dominate species documented in the Back River drainage. They were found in six different streams in this drainage (Back River, Muddy Gut, Deep Creek, Northeast Creek, Herring Run, and Redhouse Creek).

Within the Patapsco River drainage, they ranged from near the river mouth, in Rock Creek and Jones Creek, upstream for a distance of 19.3 miles to the first dam.

White perch were the only anadromous species documented in Back River, Herring Run, Northeast Creek, Redhouse Creek, Colgate Creek, Tanyard Cove, and Back Creek.

There was one isolated instance of a striped bass documentation in Marley Creek. The American shad was documented in one instance in Cabin Branch. The hickory shad was documented once in Bear Creek. These instances are not considered significant enough to warrant mapping or tabular coverage. It is general knowledge that spawning of these species does not occur to any great extent in these areas.

Table VII lists all the streams within the Patapsco River Area that were investigated. Anadromous fish occurring in each of these streams are shown. Thirty-one of thirty-five sampled streams had spawning of one or more anadromous species. White perch were the predominate species documented in streams of the sub-basin area.

MAP XLI

White Perch Documentations:
Patapsco River Area *

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* West Chesapeake Bay Area also shown.

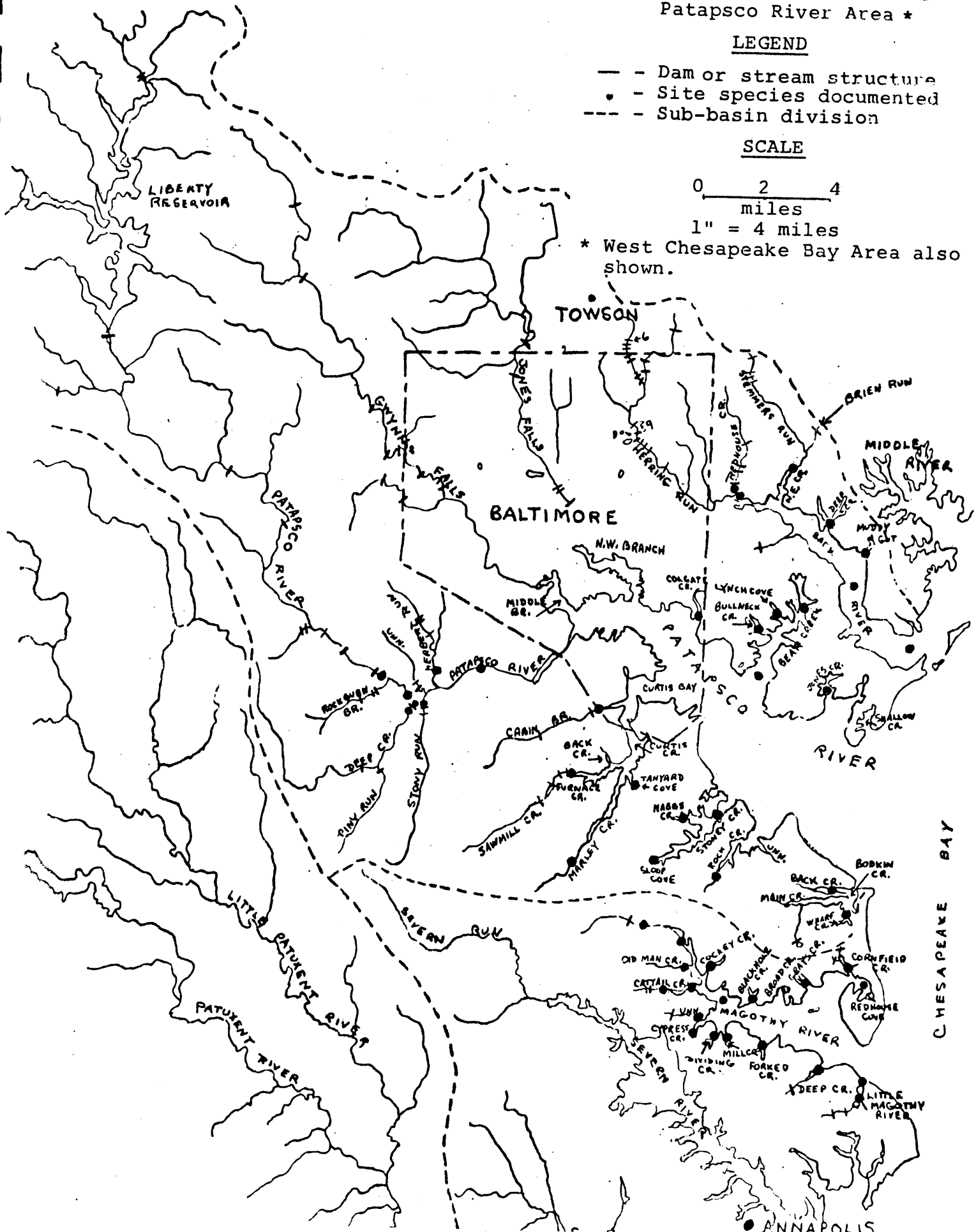


TABLE VII.

ANADROMOUS FISH SPAWNING STREAMS IN THE PATAPSCO RIVER AREA

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS 4/	HS 5/	CL	WP	SB 6/	PC
Back River										
Deep Creek								x		
Herring Run				x				x		
Muddy Gut								x		
Northeast Creek				x				x		
Redhouse Creek								x		
Patapsco River								x		
Deep Creek	x	x		x				x		
Herbert Run	x	x						x		
Rockburn Branch				x				x		
Stony Run		x		x						
Inner Baltimore Harbor	x	x		x				x		
Middle Branch										
Northwest Branch										
N. Drainage to Inner Baltimore Harbor				x						
Colgate Creek										
Gwynn Falls								x		
Outer Baltimore Harbor										
Bear Creek										
Bullneck Creek	x			x				x		
Jones Creek				x				x		
Lynch Creek				x				x		
Nabbs Creek				x				x		
Rock Creek				x				x		
	x			x				x		

1/ Streams arranged according to sub-sub basins.
2/ Maryland coordinates given to identify sample sites of unnamed streams.
3/ Species recordings based on egg, larvae or adult fish life stages collected.
4/ One larvae collected in Cabin Branch.
5/ Two larvae collected in Bear Creek.
6/ One adult fish in non-spawning condition collected (Marley Creek).

YP -Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

TABLE VII. (Continued)

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS	HS	CL	WP	SB	PC
Sloop Cove	x							x		
Stony Creek	x			x				x		
Unnamed (958,300E-505,400N)										
Unnamed (943,000E-480,000N)										
S. Drainage to Inner Baltimore Harbor										
Cabin Branch	x							x		
Curtis Creek				x						
Furnace Creek	x			x						
Marley Creek	x	x		x				x		
Sawmill Creek		x		x				x		
Tanyard Cove								x		
Bodkin Creek	x									
Back Creek								x		
Main Creek	x									
Wharf Creek	x							x		
Total Spawning Streams by Species:	13	6	0	18	0	0	0	25	0	0
Total Sampled Streams:	35									
Total Spawning Streams (all species):	31									

6. West Chesapeake Bay Area

The West Chesapeake Bay Area includes streams and bodies of water in eastern portions of Anne Arundel and Calvert counties. To the west lies the Patuxent River watershed. The west Chesapeake Bay drainage includes the Magothy River drainage in Anne Arundel County and extends south to Cove Point, Calvert County. The largest rivers in this drainage are the Magothy, Severn and South. The entire watershed lies within the coastal plain.

Within the West Chesapeake Bay Area, the only river investigated during this study was the Magothy. Within the Magothy River drainage a total of sixteen streams, including the river itself, were investigated. Map XLII shows the location of each of these streams and the biological sites sampled. There were a total of twenty-two sites sampled. Of these twenty-two sites, all but four were estuarine sites.

Yellow perch were documented in a total of thirteen streams. This represents 81.3% of the streams investigated. The only streams sampled where yellow perch did not occur were Blackhole Creek, Grays Creek and Redhouse Cove. Map XLIII shows the distribution of this species. Yellow perch were documented within the Magothy River from near the mouth, in Little Magothy River, upstream to river mile 8.4 at Catherine Avenue. Their range extended to Lake Waterford Dam, at river mile 9.1.

Herring (alewife or blueback) were documented in fourteen (87.5%) of the streams sampled. Map XLIV shows their distribution. Blueback herring were not positively identified in any of the streams sampled. Alewife herring were positively identified in only one instance (the Magothy River). The range of herring in the Magothy River was the same as yellow perch. They were found from near the river mouth, upstream for 8.4 miles and probably ranged to Lake Waterford Dam, where sampling was not conducted.

White perch were documented in every stream sampled. Map XLV shows their distribution. They ranged from the river mouth upstream for 8.4 miles, as did herring and yellow perch. Grays Creek was the only stream where white perch were the only anadromous species documented.

There was one isolated instance of an American shad documentation in the Magothy River. This documentation was not given table or map coverage since it occurred only once and it is general knowledge that no significant shad spawning occurs in this area.

Yellow perch, white perch and herring were documented in this drainage with about equal frequency, however, white perch were the most predominate species.

MAP XLII

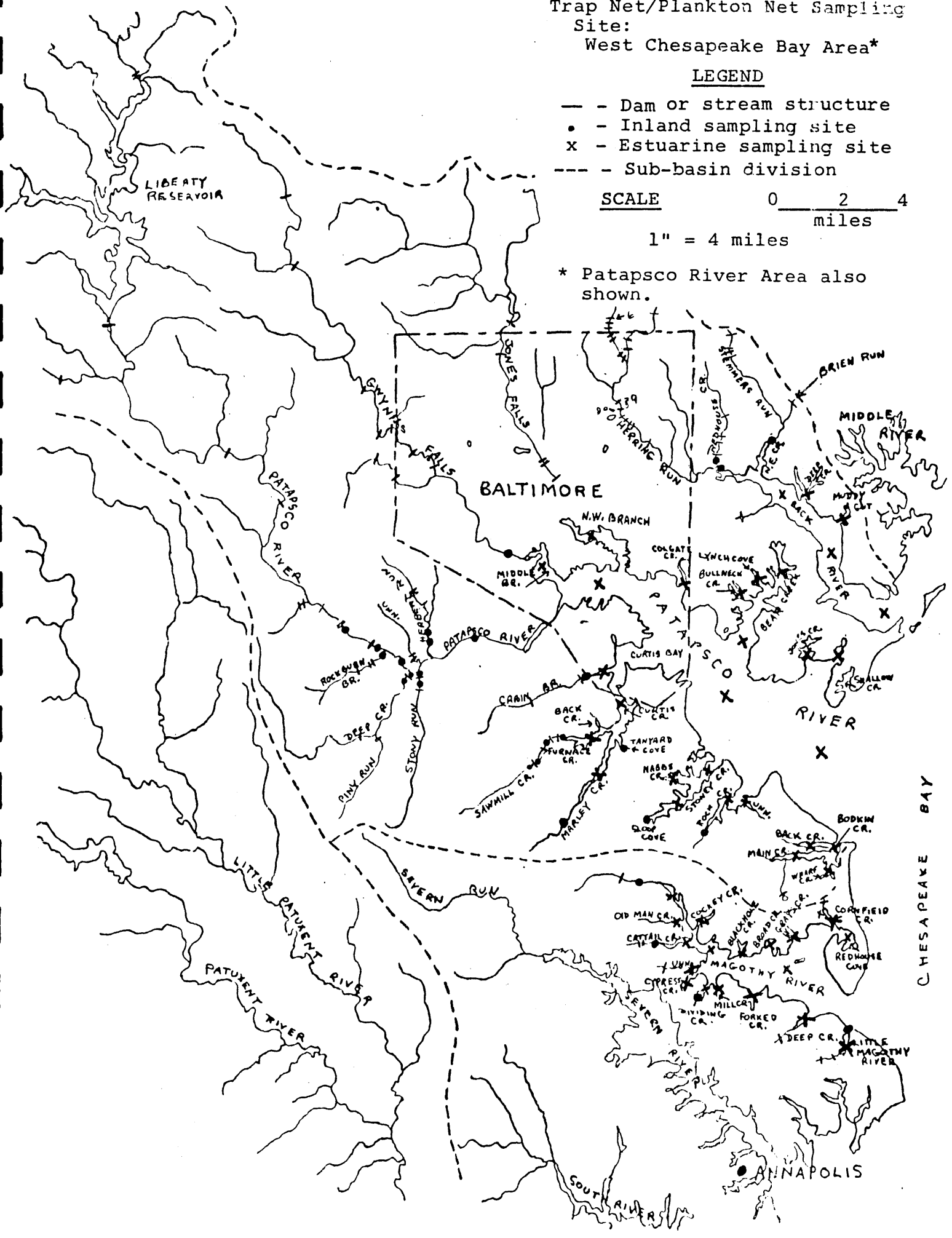
Trap Net/Plankton Net Sampling Site:
West Chesapeake Bay Area*

LEGEND

— - Dam or stream structure
• - Inland sampling site
x - Estuarine sampling site
--- - Sub-basin division

SCALE 0 2 4 miles
1" = 4 miles

* Patapsco River Area also shown.



MAP XLIII

Yellow Perch Documentations:
West Chesapeake Bay Area*

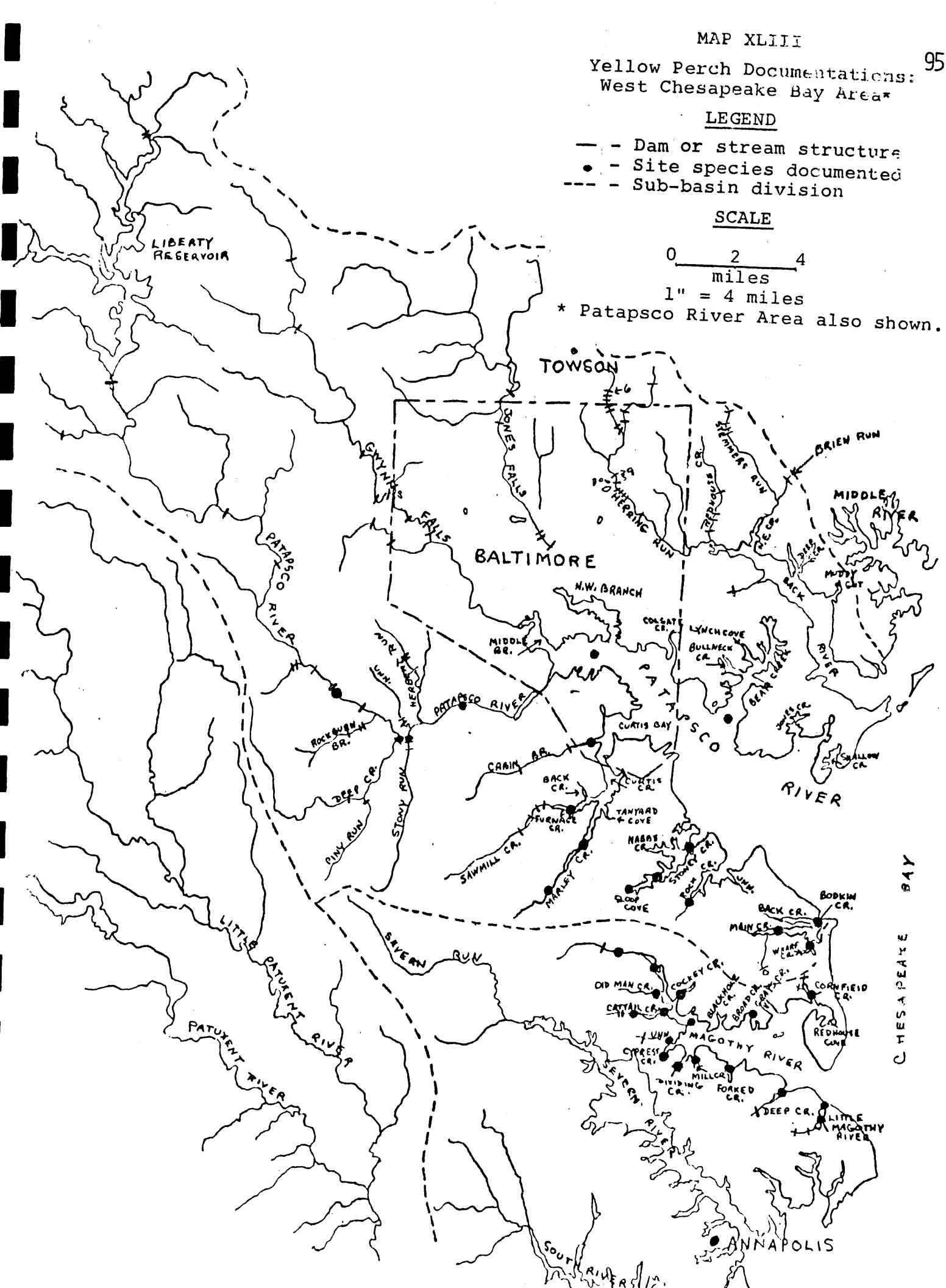
LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Patapsco River Area also shown.



MAP XLIV

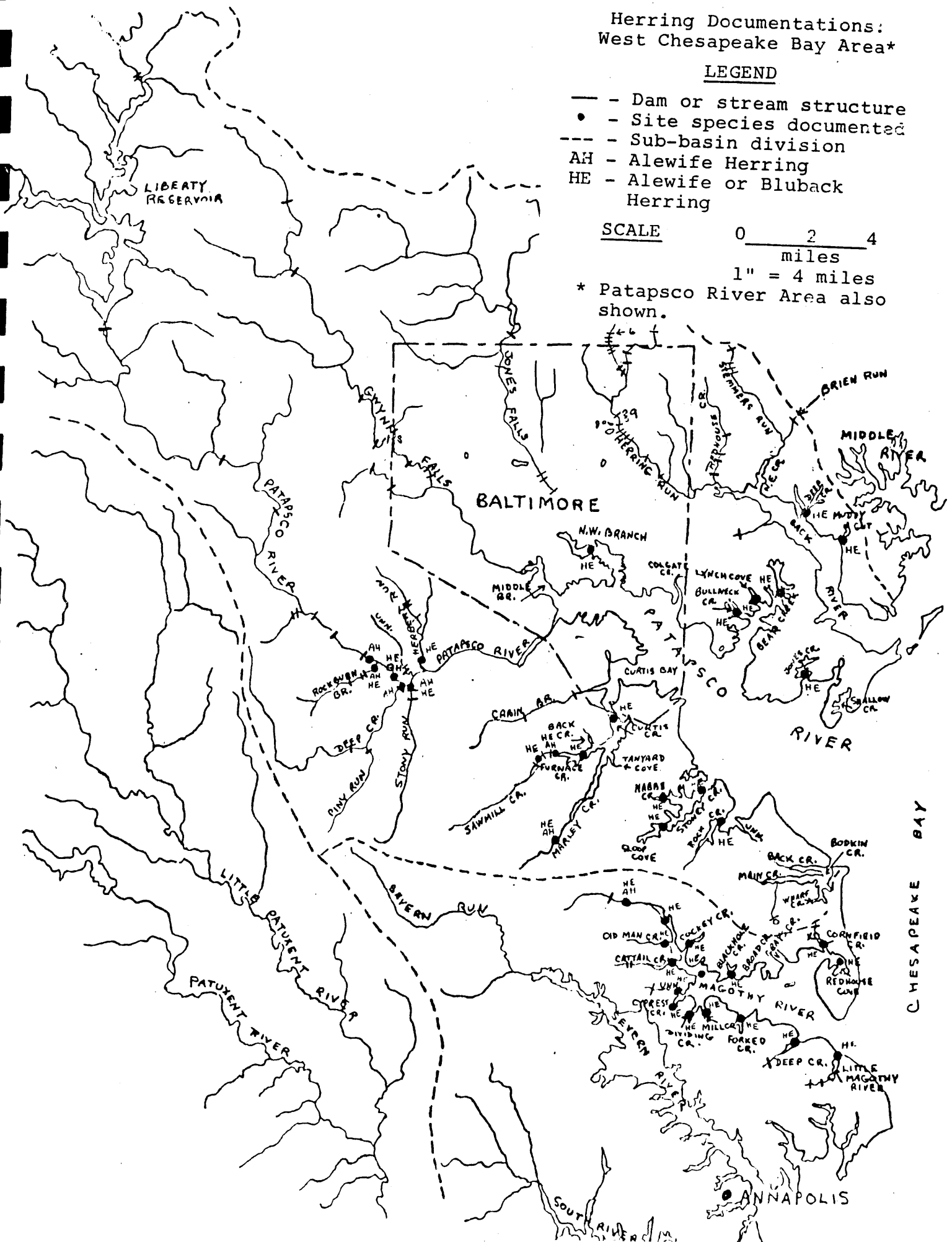
Herring Documentations:
West Chesapeake Bay Area*

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division
AH - Alewife Herring
HE - Alewife or Bluback Herring

SCALE 0 2 4 miles
1" = 4 miles

* Patapsco River Area also shown.



MAP XLV

White Perch Documentations:
West Chesapeake Bay Area*

LEGEND

— - Dam or stream structure
• - Site species documented
--- - Sub-basin division

SCALE

0 2 4
miles
1" = 4 miles

* Patapsco River Area also shown.

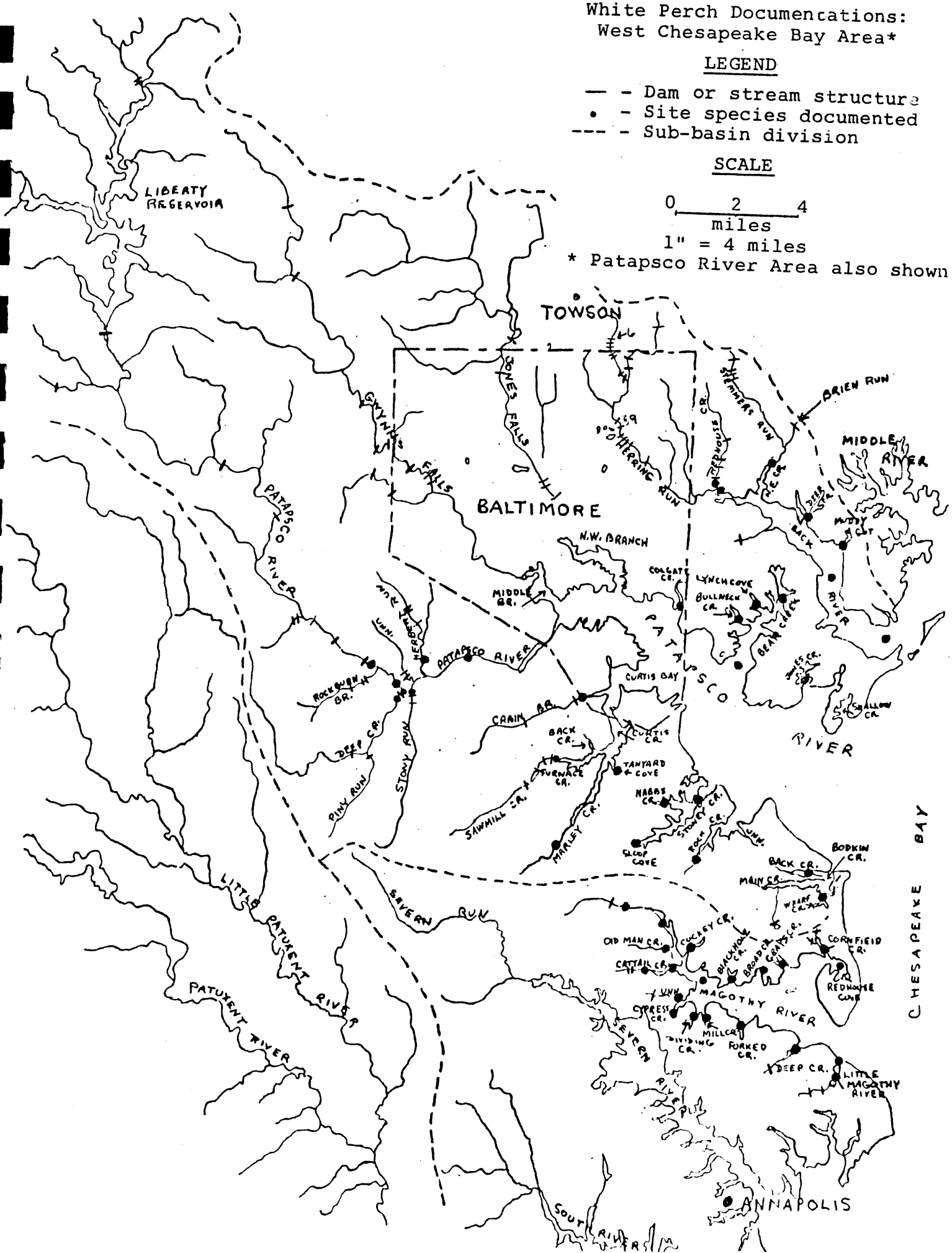


Table VIII lists all the streams sampled within the West Chesapeake Bay Area and anadromous fish species that were documented.

TABLE VIII.

ANADROMOUS FISH SPAWNING STREAMS IN THE WEST CHESAPEAKE BAY AREA

Streams Investigated 1/ 2/	Anadromous Species Recorded 3/									
Sub-sub basin name Stream name	YP	AH	BH	HE	AS 4/	HS	CL	WP	SB	PC
Magothy River	x	x		x				x		
Blackhole Creek				x				x		
Broad Creek	x							x		
Cockey Creek	x			x				x		
Cornfield Creek	x			x				x		
Cattail Creek	x			x				x		
Cypress Creek	x			x				x		
Deep Creek	x			x				x		
Dividing Creek	x			x				x		
Forked Creek	x			x				x		
Grays Creek								x		
Mill Creek	x			x				x		
Old Man Creek	x			x				x		
Redhouse Cove				x				x		
Unnamed (933,200E-452,600N)	x			x				x		
Broadneck Area										
Little Magothy River	x			x				x		
Total Spawning Streams by Species:	13	1	0	14	0	0	0	16	0	0
Total Sampled Streams:	16									
Total Spawning Streams (all species):	16									

1/ Streams arranged according to sub-sub basins.
2/ Maryland coordinates given to identify sample sites of unnamed streams.
3/ Species recordings based on egg, larvae or adult fish life stages collected.
4/ Single larvae collected in the Magothy River.

YP - Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

7. Chesapeake Bay Proper

The upper Chesapeake Bay area includes all of the Chesapeake Bay proper above the north side of the original Bay Bridge. The entire watershed lies within the Coastal Plain.

Major rivers which discharge into the upper Chesapeake Bay basin are the Magothy, Patapsco, Back, Middle, Gunpowder, Bush, Susquehanna, Northeast, Elk, Sassafras and Chester.

There were a total of thirteen estuarine plankton net sampling sites on the Chesapeake Bay. The southernmost site was located in the eastern channel at the Bay Bridge. The sites extended up the Chesapeake Bay to near the mouth of the Susquehanna River. The frequency of the sites was approximately every two to four nautical miles. Map XLVI shows the distribution of the biological sampling sites. Anadromous species documentation, as with other estuarine streams, is based on eggs and larvae collected.

Yellow perch were documented at eleven of the biological sampling sites. Map XLVII shows the distribution of these documentations. They ranged from near the mouth of the Magothy River (site 2) up the Bay to near the mouth of Swan Creek (site 12).

Herring (alewife or blueback) were documented at ten of the sample sites. Map XLVIII shows species distribution. Herring were taken from near the mouth of the Patapsco River (site 4) up the Bay to near the mouth of the Susquehanna River (site 13).

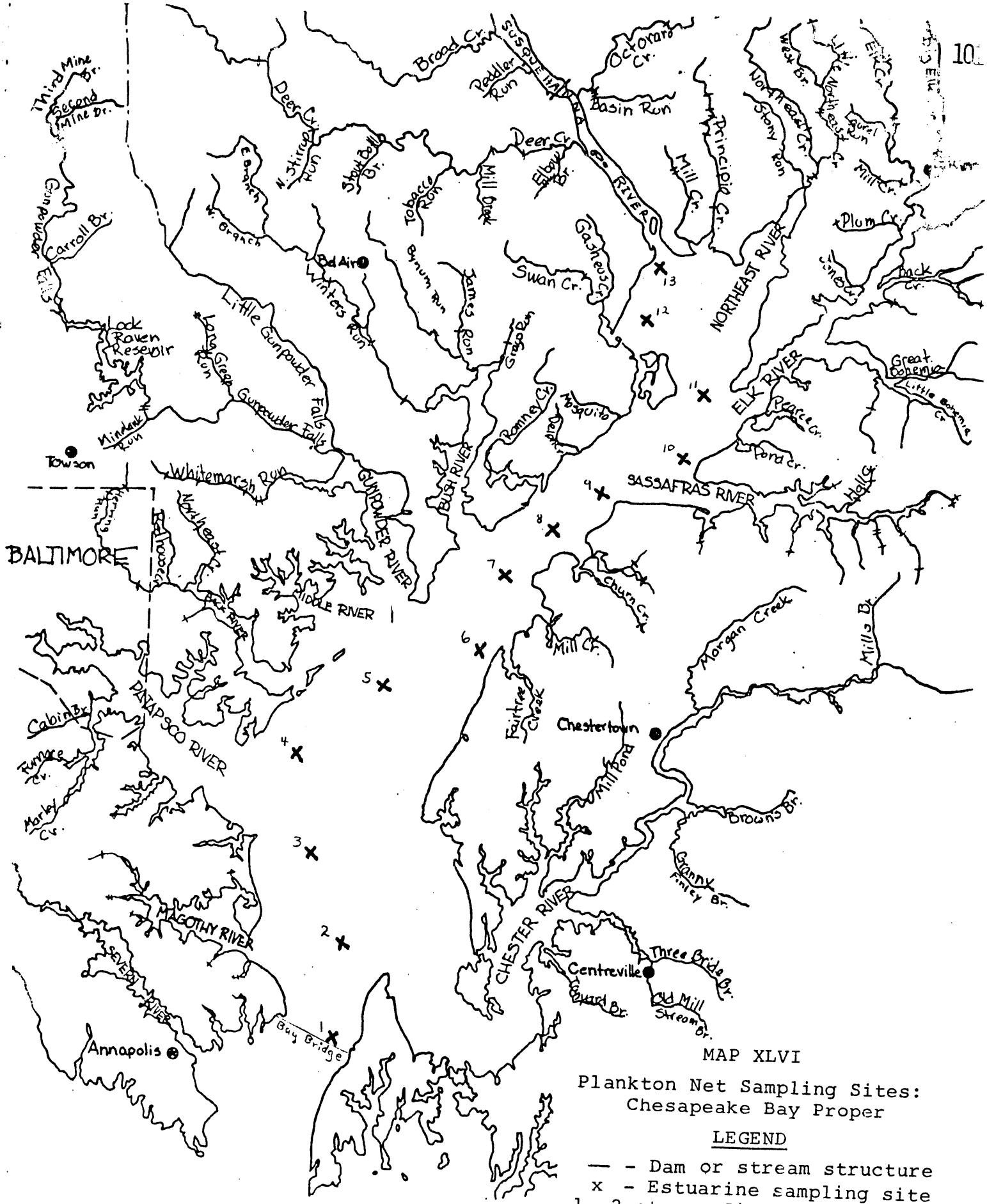
Hickory shad were documented at only one site, near the mouth of the Patapsco River. Map XLIX shows species documentation.

White perch documentation is shown on Map L. This species occurred at eight different sites, ranging from near the mouth of Fairlee Creek (site 6) up the Bay to near the mouth of the Susquehanna River (site 13).

Striped bass were documented at two sites near the mouth of the Sassafras River. Map LI shows the location of these two sites (sites 9 and 10). Findings confirm the previously documented spawning area of striped bass in the Upper Bay Area.

Table IX lists each sampling site on the Chesapeake Bay proper and shows anadromous fish species that were collected at each site. A total of five anadromous fish species were collected. Of these five species, yellow perch were documented the most often, at eleven different sites. Herring were the second most frequently documented species, followed closely by white perch. No American shad eggs or larvae were collected.

The only site on the Bay proper where no anadromous species were collected was site 1, located at the Bay Bridge. Sampling in the eastern channel may have been out of the mid-Bay spawning area.



MAP XLVI

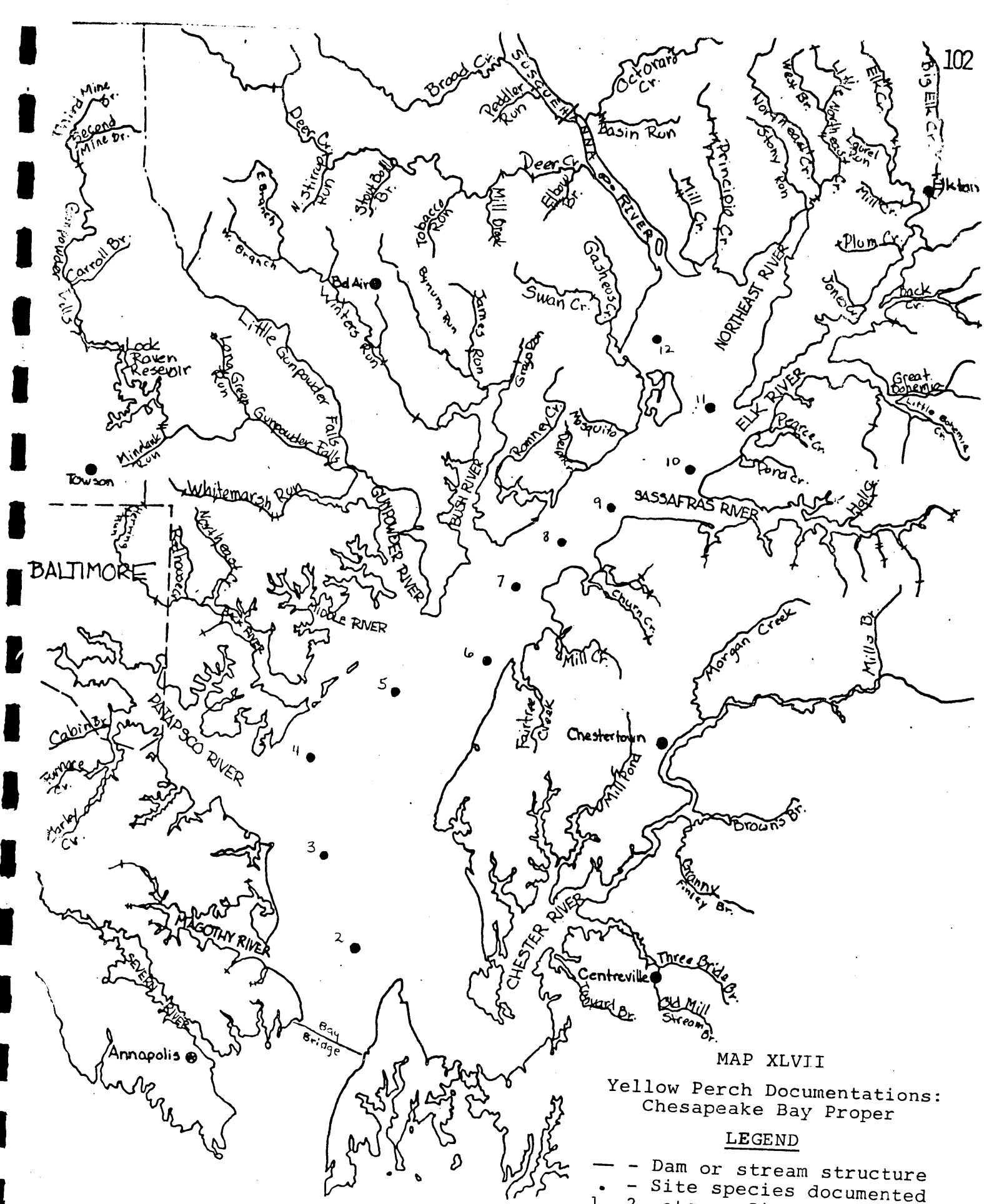
Plankton Net Sampling Sites:
Chesapeake Bay Proper

LEGEND

— - Dam or stream structure
x - Estuarine sampling site
1, 2 etc. - Site numbers

SCALE

0 2 4
miles
1" = 4 miles



MAP XLVII

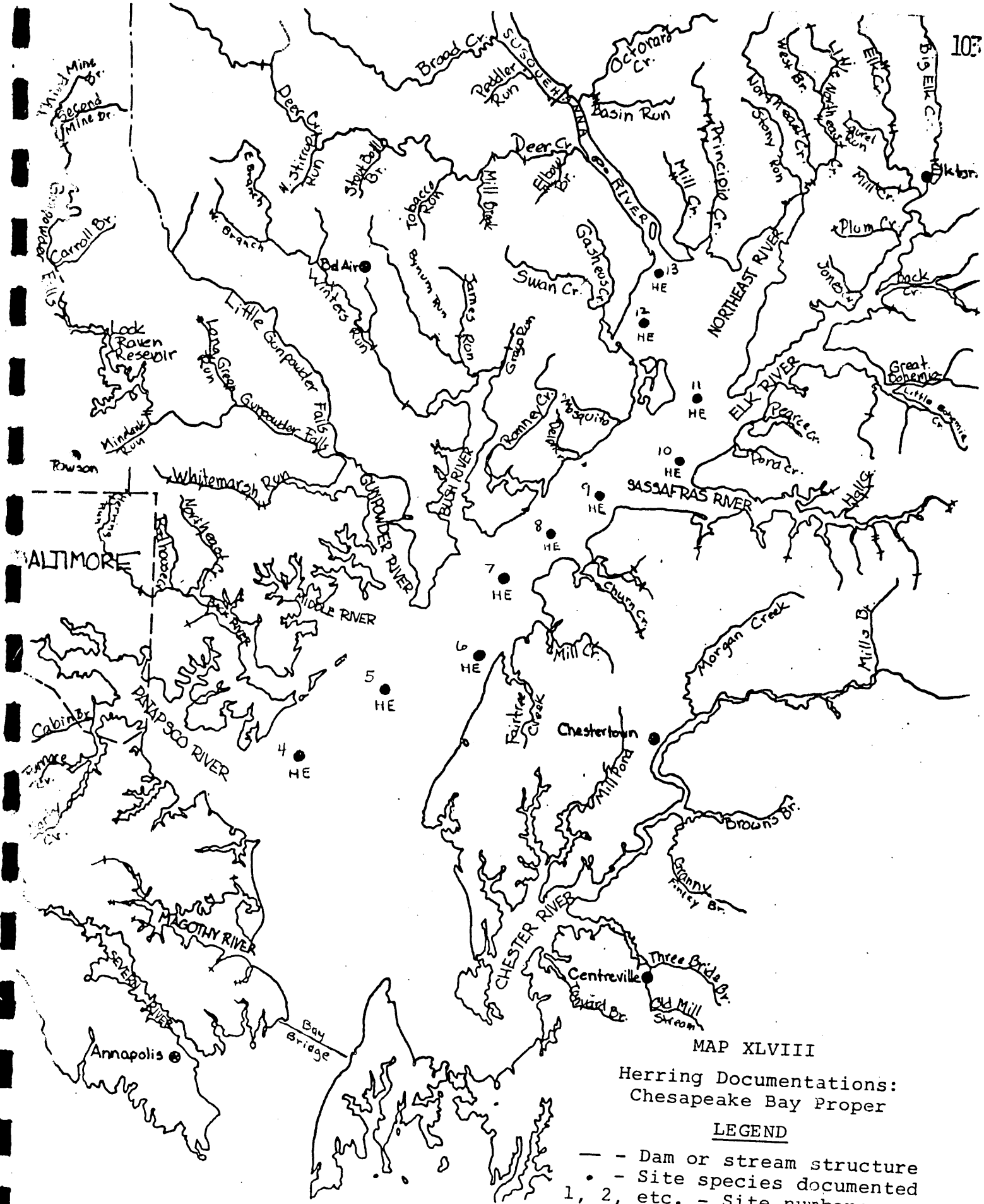
Yellow Perch Documentations:
Chesapeake Bay Proper

LEGEND

— - Dam or stream structure
• - Site species documented
1, 2, etc. - Site numbers

SCALE

0 2 4
miles



MAP XLVIII

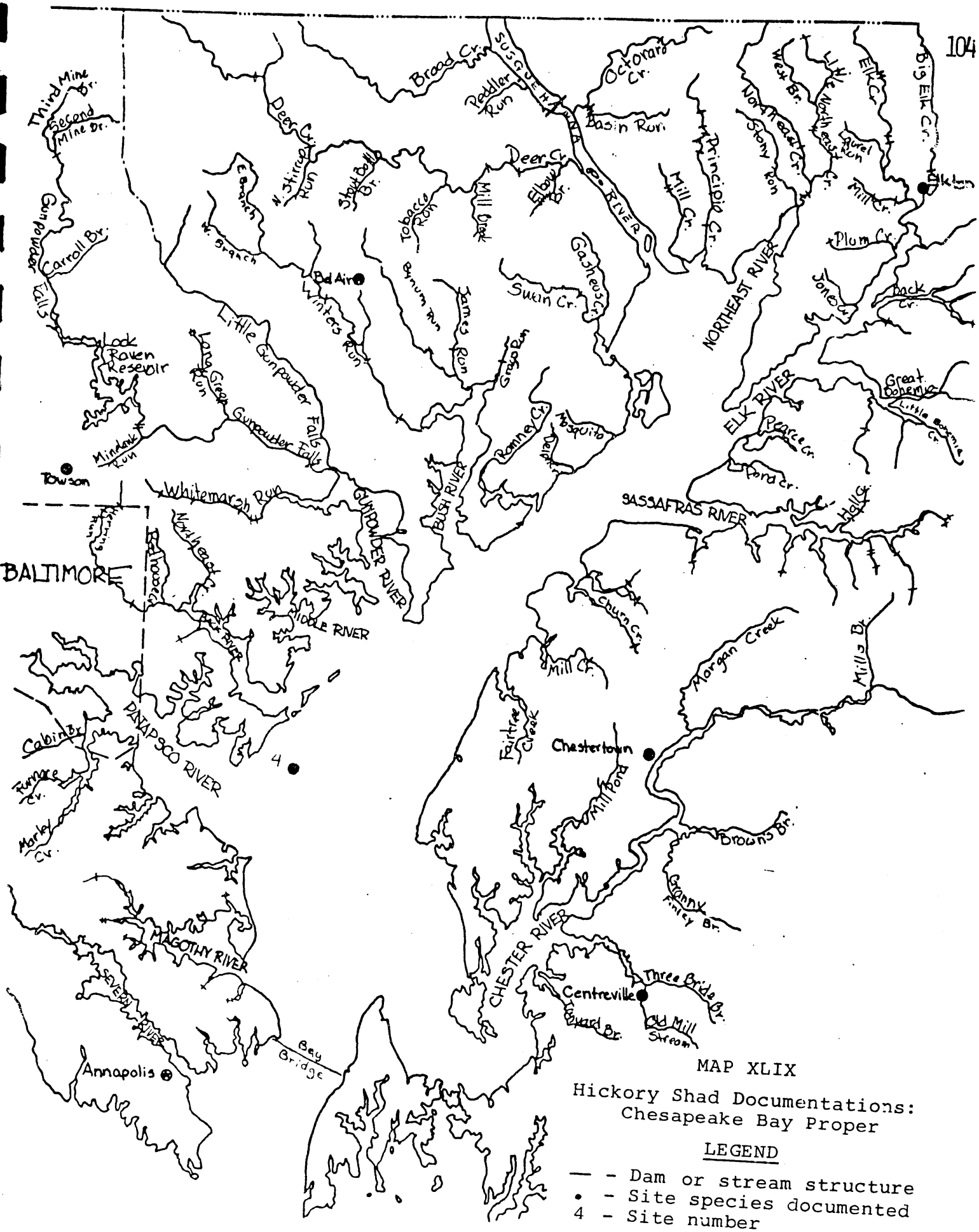
Herring Documentations:
Chesapeake Bay Proper

LEGEND

— - Dam or stream structure
• - Site species documented
1, 2, etc. - Site numbers
HE - Alewife or Blueback Herrin

SCALE

0 2 4
miles



MAP XLIX

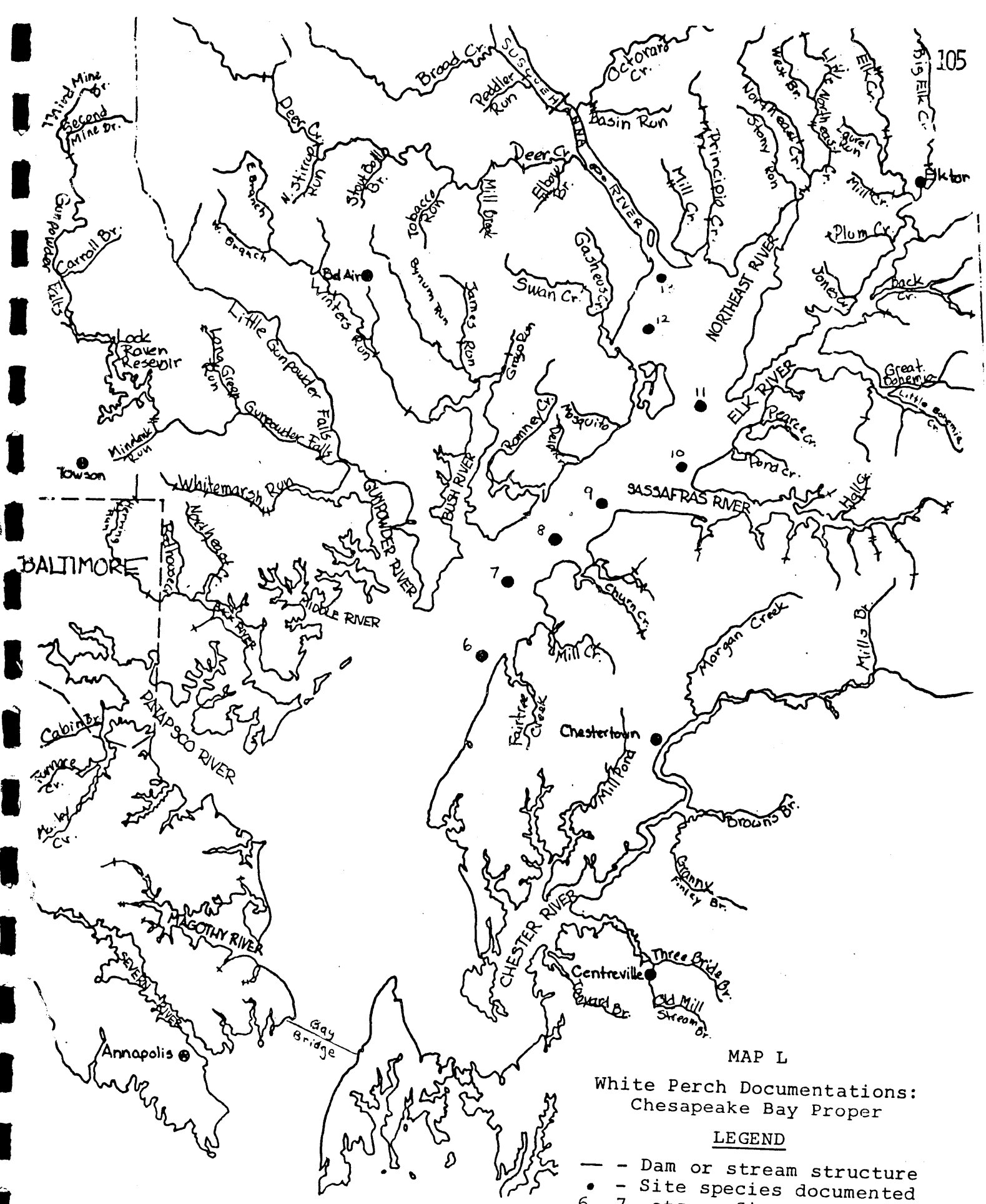
Hickory Shad Documentations:
Chesapeake Bay Proper

LEGEND

— - Dam or stream structure
• - Site species documented
4 - Site number

SCALE

0 2 4
miles



MAP L

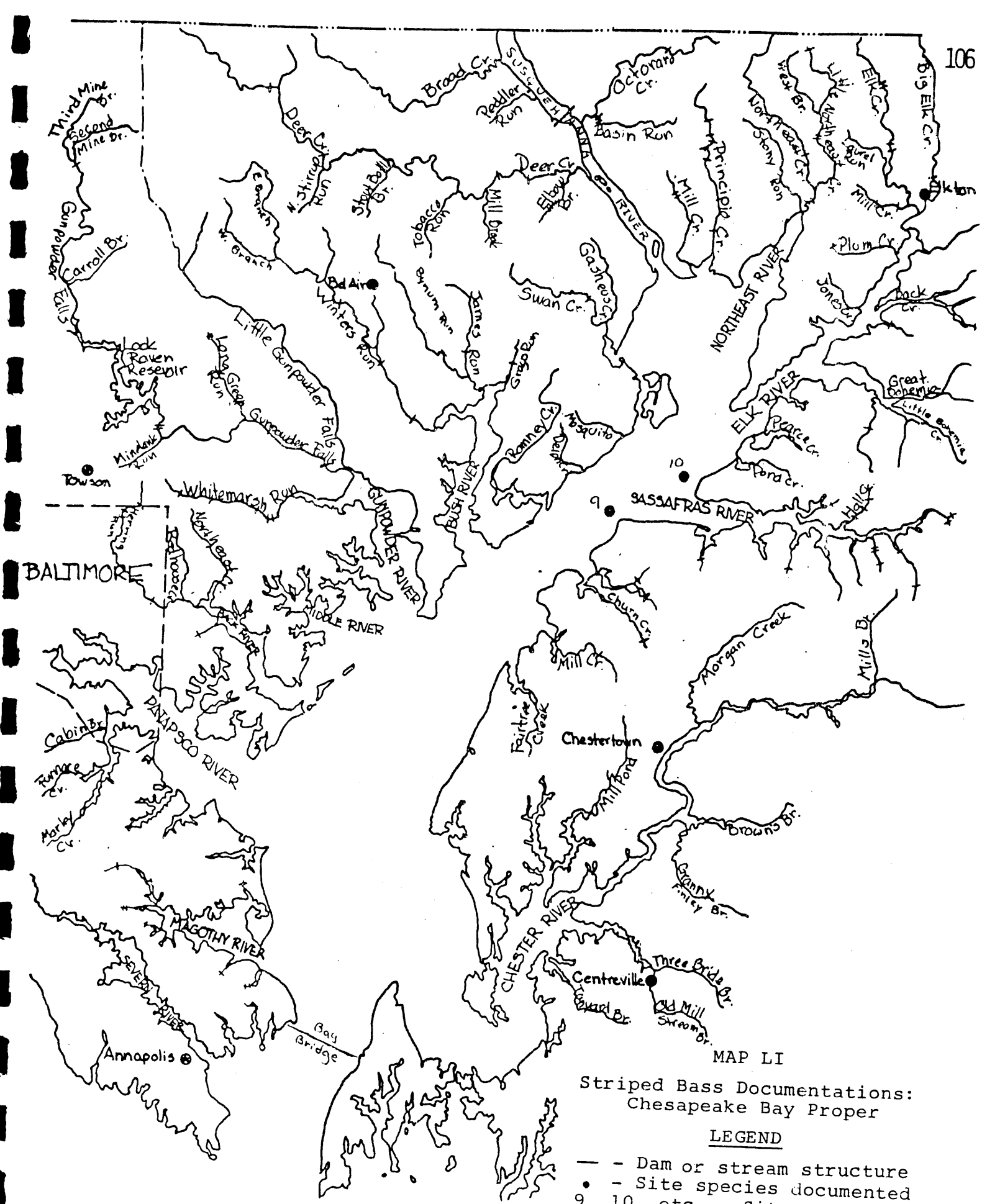
White Perch Documentations:
Chesapeake Bay Proper

LEGEND

— - Dam or stream structure
• - Site species documented
6, 7, etc. - Site numbers

SCALE

0 2 4
miles



MAP LI

Striped Bass Documentations:
Chesapeake Bay Proper

LEGEND

— - Dam or stream structure
• - Site species documented
9, 10, etc. - Site numbers

SCALE

0 2 4
miles

TABLE IX.

ANADROMOUS FISH SPAWNING AREAS IN THE CHESAPEAKE BAY PROPER

Sample Site 1/	YP	AH	BH	HE	AS	HS	CL	WP	SB	PC
1										
2										
3	x									
4	x									
5	x			x		x				
6	x			x						
7	x			x				x		
8	x			x				x		
9	x			x				x		
10	x			x				x	x	
11	x			x				x	x	
12	x			x				x		
13	x			x				x		
Total Sites, by Species, Where Collections Were Made:	11	0	0	10	0	1	0	8	2	0

Total Sampled Sites: 13
Total Spawning Sites: 12

1/ Refer to Map XLVI for site locations.

YP - Yellow Perch (Perca flavescens)
AH - Alewife (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
HE - Herring (A. pseudoharengus or A. aestivalis)
HS - Hickory Shad (A. mediocris)
AS - American Shad (A. sapidissima)
CL - Clupeidae Family (Herring, Menhaden, or Shad) Species
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)
PC - Perichthyidae Family (M. americana or M. saxatilis)

Summary and Conclusions for the Upper Chesapeake Bay Drainage Spawning Survey

Within the Upper Chesapeake Bay drainage, a total of one hundred and ninety-four streams and/or rivers, including the Chesapeake Bay mainstem, were investigated. Of this total, spawning activity of one or more anadromous fish species was documented in a total of one hundred and fifty-five streams and/or rivers. This total is 79.9% of all the streams investigated.

Yellow perch spawning activity was documented in every sub-basin investigated in the Upper Chesapeake Bay. This species was documented in a total of one hundred and five different streams or rivers (54.1%). Investigations indicate that yellow perch spawning activity is relatively evenly distributed throughout all the sub-basins studied in the Upper Chesapeake Bay. The minimum number of streams and/or rivers in any one sub-basin where this species was documented was seven (Lower Susquehanna River Area). In the Chesapeake Bay proper, the species was documented at eleven of thirteen sampling sites.

Herring (alewife and blueback) were documented in one hundred and seventeen streams and/or rivers and were present in every sub-basin investigated. This total represents 60.3% of all the streams investigated. As with the yellow perch, this species was relatively evenly distributed throughout all the sub-basins studied. Alewife were positively identified in a total of forty-five streams. Twenty-two of these streams were within the Elk River Area. Blueback herring were positively identified in a total of twelve streams in four different sub-basins. No documentations were made in the Patapsco River Area, West Chesapeake Bay Area and the Chesapeake Bay proper.

American shad were positively documented in only two streams. They were found in the Elk River mainstem and the Susquehanna River mainstem. Single egg samples were collected in Bird River and Saltpeter Creek in the Gunpowder River Area. Single larvae samples were collected in Cabin Branch and the Magothy River. Egg and larvae documentations were probably due to tidal drift, rather than active spawning in these streams.

Hickory shad were documented in four streams located in three sub-basins. They were found within the Chesapeake Bay proper off the mouth of the Patapsco River, within the Elk River Area sub-basin in Northeast Creek (Northeast River drainage), and within the Lower Susquehanna River Area sub-basin in the river mainstem and Deer Creek. Spawning, based on limited information, also occurred in Octoraro Creek. A single egg sample was collected in Dundee Creek. Two larvae were collected in Bear Creek. Egg and larvae recordings were probably due to tidal drift from other areas.

Considering the total number of streams and/or rivers used for spawning as the criteria, white perch were the dominate anadromous fish species in the Upper Chesapeake Bay Area. They were documented in a total of one hundred and thirty-five streams or rivers. They were found in every sub-basin with a relatively even distribution. Within each sub-basin (excluding Chesapeake

Bay proper), this species used more streams for spawning than any other anadromous fish species with the single exception of the Lower Susquehanna River Area, where both yellow perch and herring used more streams for spawning.

Striped bass were documented in three sub-basins. Spawning was documented in the Chesapeake Bay proper at two sites and in the Lower Susquehanna River. The Elk River Area sub-basin appeared to be the principal spawning area for this species within the Upper Chesapeake Bay drainage. There were a total of seventeen different streams or rivers used by striped bass in this sub-basin.

Part II. Inventory of Anadromous Fish Nursery Areas

A. Objective

The seining survey was conducted to determine anadromous species nursery (young-of-year) areas in rivers and streams.

B. Methods and Procedures

Seining investigations were conducted each year during months corresponding to anadromous species young-of-year presence (generally from July through October).

Within the Potomac River and upper Chesapeake Bay drainage systems, sites were selected to sample tidal tributaries from their mouths to headwaters or upper limits of tidal influence. Freshwater tributaries to tidal streams were not sampled, due to the lack of gear suitability. The number of sites varied for different estuarine tributaries, depending on stream length and suitability for seining. In general, sites were spaced at intervals of one to two miles along each watercourse from stream mouths to the approximate upper limit of tidal influence. At least one site was selected on the Potomac River or Chesapeake Bay between each principal tributary.

Within the Potomac River drainage system, a total of 122 sites in two sub-basins were sampled. (Map LII). In the upper Chesapeake Bay drainage system, a total of 264 sites in seven sub-basins were sampled. (Map LIX).

During study segment five, no seining survey was conducted. This was due mainly to a lack of available time and the fact that seining coverage had been established for rivers and principal estuarine tributaries in both the Potomac River and upper Chesapeake Bay drainages during previous study segments.

At each sampling site two hauls were conducted using nylon seines of one-fourth inch mesh and four feet depth. Seine lengths varied according to the available sweep area. The following seines were principally employed in the sampling: 100 feet, 50 feet, 20 feet, and other less frequent lengths. In the smaller streams, 20-foot seines were used in the upper reaches, while in the lower portions of these streams, 50-foot seines were utilized as consistently as possible. At the river and Bay seining locations, 100-foot seines were generally used. (Photo IV).

Two seining methods were utilized during this study, quadrant and rectangular. In the quadrant seine technique, the seine was extended to its full length perpendicular to the shoreline. The offshore end was pulled in the direction of the tidal movement in a sweeping 90^{o} arc to the shore. The rectangular technique was employed less

Photo IV
Haul Seining for Anadromous Species

Small Mesh Haul Seines Capture Young-of-Year Fish

frequently, where offshore water depth was too great to permit quadrant seining. The seine was extended to its full length parallel to the shoreline. The distance from the shore varied depending on water depth which determined the suitability of the site for this technique. After the seine was completely extended and parallel to the shoreline, it was pulled to shore, sweeping 180 degrees.

Anadromous species were collected, counted, identified and recorded on a Seine Survey Form (Figure V). Non-anadromous species were collected and preserved for later laboratory identification. Fish were measured for size range, total counts made by species, and data recorded.

During study sequence three, seining was impossible in the lower Susquehanna River due to the lack of suitable shoreline conditions; and in waters located within Aberdeen and Edgewood Proving Grounds where explosive testing occurred along the shoreline. In these cases, special traps (6' length, 2' radius) were made to sample these areas at offshore sites. A total of twenty-nine stream trappings were made.

Physical field data recorded at the time of biological sampling included: sample date and time, water type, weather code, tide stage, water temperature, conductivity and salinity, depth range, and bottom types.

Biological station data recorded on the seining form included: the number of fish collected for each species, collective number of all species, and age-group category: age-group zero (young-of-year), older than age-group zero, and entirely undetermined for age-group.

FIGURE V

PROCEDURE NO.
A23030 FM

03/06/73
FORM AFSEINE

DEPARTMENT OF NATURAL RESOURCES
FISHERIES ADMINISTRATION
ANADROMOUS FISH/STREAM SURVEY PROGRAM
SEINE SURVEY FORM

DRAINAGE SYSTEM ____________________

STREAM ____________________

TRIBUTARY OF ____________________

COUNTY ____________________

LOCATION ____________________

____

SURVEY SEQUENCE NO. ____ FISH COLLECTION NO. ____ WATER SAMPLE NO. ____

____________________ (principal signature) ____________________ (date)

STREAM OR GRID CODE			RIVER MILE OR GRID NO.				SAMPLE DATE YR		MO		DA		SAMPLE TIME (MILITARY)				SEINE	BASIN CODE MAJOR		MINOR		SUB		SUB-SUB		COUNTY CODE		FISHERIES ZONE NUMBER			AGENCY SUBMITTER		STUDY NUMBER	INVESTIGATOR CODES #1	#2	#3	#4	WATER TYPE	WEATHER CODE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	47
																	3														1	5							

TIDE STAGE CODE	WATER TEMP. C			Q/L	CONDUCTIVITY UMHOS/CM					Q/L	SALINITY o/oo				Q/L	CARD 1
48	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	80
																1

SAMPLE GEAR CODE			HAUL NUMBER	SEINE LENGTH FT.				DEPTH RANGE CODE	SEINE DISTANCE OFFSHORE FT.				SEINE SWEEP TYPE	PRINCIPAL SHORE HABITAT		BOTTOM TYPES #1		#2		ANADROMOUS FISH INDICATOR	
21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	42	43

TOTAL NUMBER OF ALL FISH OF ALL SPECIES (FROM FISH SAMPLE TOTAL BELOW)					LAB TECH. INITIALS			LAB DATE YR		MO		DA		CARD 2
44	45	46	47	48	63	64	65	66	67	68	69	70	71	80
														2

SPECIAL REMARKS

____

SPECIES SEQUENCE		SPECIES CODE FAMILY		GENUS	SPECIES	NUMBER OF FISH SUBSAMPLED FOR EACH SPECIES					TOTAL NUMBER OF FISH FOR EACH SPECIES					SMALLEST FISH SIZE IN INCHES				LARGEST FISH SIZE IN INCHES				NUMBER OF AGE-GROUP ZERO FISH				NUMBER OF FISH OLDER THAN AGE-GROUP ZERO				NUMBER OF FISH ENTIRELY UNDETERMINED FOR AGE-GROUP				CARD 3
19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	57	58	59	60	61	62	63	64	65	66	67	68	80
																																				3
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																																				3
																																				3
																																				3
																																				3
																																				3
SAMPLE TOTAL																																				

SCIENTIFIC NAMES OF SPECIES

1 ____________________ 1
2 ____________________ 2
3 ____________________ 3
4 ____________________ 4
5 ____________________ 5
6 ____________________ 6
7 ____________________ 7
8 ____________________ 8
9 ____________________ 9
10 ____________________ 10
11 ____________________ 11

species data cont [illegible]

C. Findings

Section I: Findings for the Potomac River Drainage Nursery Area Survey

Within the Potomac River drainage, seining sites were established on the Potomac River mainstem and in all major Maryland tributaries. Sampling sites on the river ranged from river mile 6.3 to river mile 102.4 in the Oxon Creek area near Washington. River tributaries were sampled from Smith Creek at river mile 9.9 to Oxon Creek at river mile 104.6. Map LII shows the locations of the sampling sites in the river and its tributaries. This map covers both the Washington Metropolitan Area sub-basin and the Lower Potomac River Area sub-basin. In addition to the Potomac River mainstem, a total of forty-five streams within these two sub-basins were seined. Within these two sub-basins a total of one hundred and twenty-two sites were seined.

The number of streams and river sites from which each anadromous species was collected and percent occurrence in relation to sampled watercourses or river sites are contained in the following summary. Catch data is based on young-of-year fish seined for all anadromous species. It includes catches of later life stages for white perch, yellow perch and blueback herring, which were the only post young-of-year anadromous species collected. Catch data was as follows:

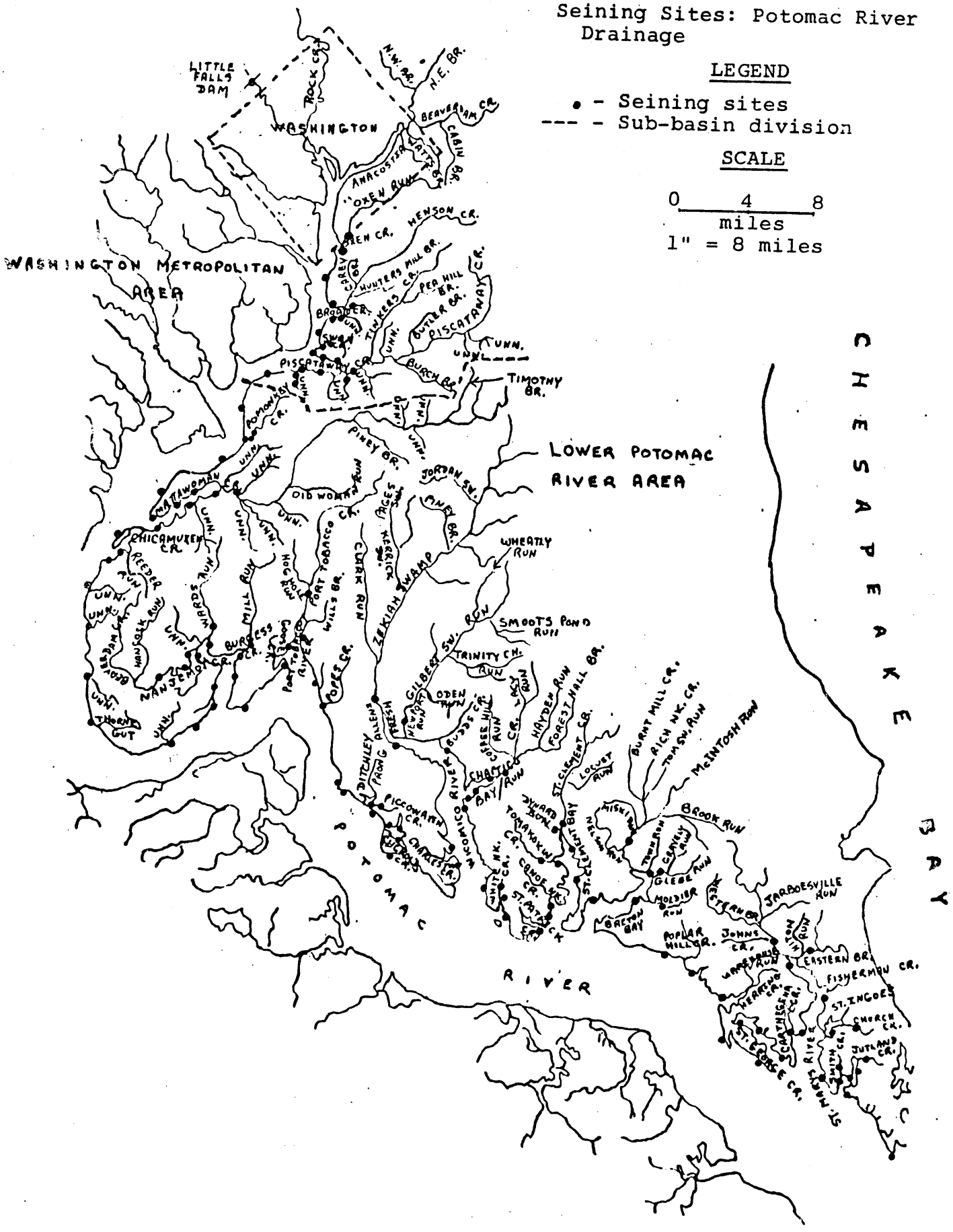
Anadromous Species Seined

Species	No. Streams Collected	% of 45 Sampled Streams	No. River Sites Collected	% of 26 Sampled River Sites
White perch	35	78	22	85
Yellow perch	16	36	3	12
Alewife	15	33	8	30
Blueback herring	10	22	7	27
Striped bass	17	38	16	62
American shad	8	18	7	27
Hickory shad	0	0	0	0

Anadromous species were collected in the Potomac River mainstem from the lower most sampled site at river mile 6.3 to the upper most site at river mile 102.4. Within the tributaries, anadromous species were collected from Smith Creek (lower most sampled stream) to Oxon Creek (upper most sampled stream). White perch were the only anadromous species collected in the St. Mary's River drainage. No anadromous species were documented in the St. Mary's River drainage during trap and plankton net surveys. This finding supports Project AFC-3 investigative data and indicates that with the possible exception of white perch, no anadromous spawning occurs in this large estuarine-freshwater drainage system. Anadromous species apparently by-pass the drainage system in preference of spawning sites farther up the Potomac River drainage.

MAP LII

Seining Sites: Potomac River Drainage



White perch were the most abundant young-of-year anadromous species in both the Potomac River and its tributaries. This species was collected at 85% of the river sample sites and in 78% of the sampled tributaries (Map LIII). They were present from the lowermost study site in Smith Creek, to the uppermost site on Oxon Creek. They were present in all major estuarine drainages, being recorded on 35 of 45 sampled streams. The estuarine drainage system that comprised the minimum number of stream recordings for white perch was the St. Mary's River, followed by Breton Bay, both of which are lower river drainages.

Striped bass were documented on the river mainstem from Herring Creek, in the lower river drainage, to the sample site just below Oxon Creek (river mile 102.4). Within the river tributaries, this species was collected from Jutland Creek, a lower river tributary, to and including Broad Creek drainage (Map LIV). The majority of striped bass were concentrated in the Wicomico River-Broad Creek segment of the river (river mile 35.0-100.4). No documentation of species presence was made in the large lower river tributaries of St. Mary's River, Breton Bay and St. Clement Bay. Young-of-year striped bass were documented in all large estuarine drainages from the Wicomico River to Broad Creek. The nursery area streams coincides with the river segment used for spawning (Wicomico River to Pomonkey Creek area) determined by plankton collections.

Alewife herring were collected from the lowermost site on the river mainstem at river mile 6.3 to the uppermost river site located at river mile 102.4. Between river mile 6.3 and 67.8, no documentations were made on the river mainstem. Alewife were recorded at most river investigation sites from river mile 67.8 (Thorne Gut) upriver to the Oxon Creek area. Within the river tributaries, alewife were collected in a total of fifteen streams. Most documentations occurred from the Chicamuxen Creek area upriver to the Broad Creek area. Map LV shows the locations of alewife documentations.

Blueback herring documentations were randomly scattered from river mile 6.3 to 102.4 on the river mainstem. Within the river tributaries, this species lacked documentation in both the Port Tobacco River and Nanjemoy Creek drainages. Both herring species were present in all other major estuarine systems from the lower river area through Broad Creek drainage. The smaller Swan Creek and Oxon Creek had alewife present, but the blueback herring was not documented. Blueback herring were documented in a total of ten streams and at seven river sites. Map LVI shows the locations of these documentations.

The American shad was documented between Nanjemoy Creek and Broad Creek on the river mainstem (Map LVII). This species was documented in the Wicomico River drainage at one site. The American shad was not documented in five river tributaries of relatively large size extending from the St. Mary's River to Nanjemoy Creek. No trap or plankton net documentations were made in the Potomac River tributaries, with the exception of Swan Creek. Additional sites of young-of-year collections were Mallows Bay, Chicamuxen Creek, Mattawoman Creek, Pomonkey Creek, and Piscataway Creek.

MAP LIII

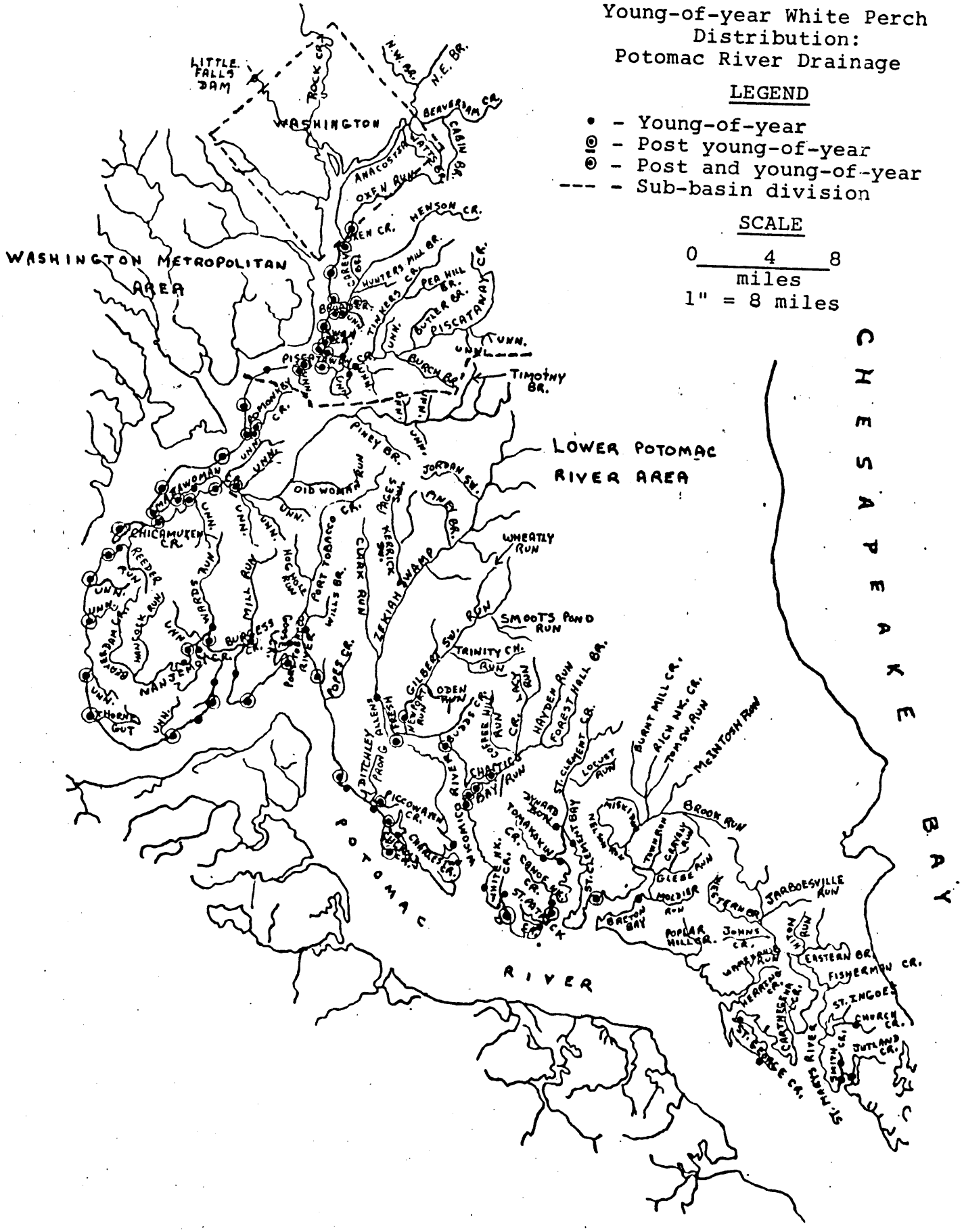
Young-of-year White Perch
Distribution:
Potomac River Drainage

LEGEND

- • - Young-of-year
- ⊙ - Post young-of-year
- ◉ - Post and young-of-year
- --- - Sub-basin division

SCALE

0 4 8
miles
1" = 8 miles



MAP LIV

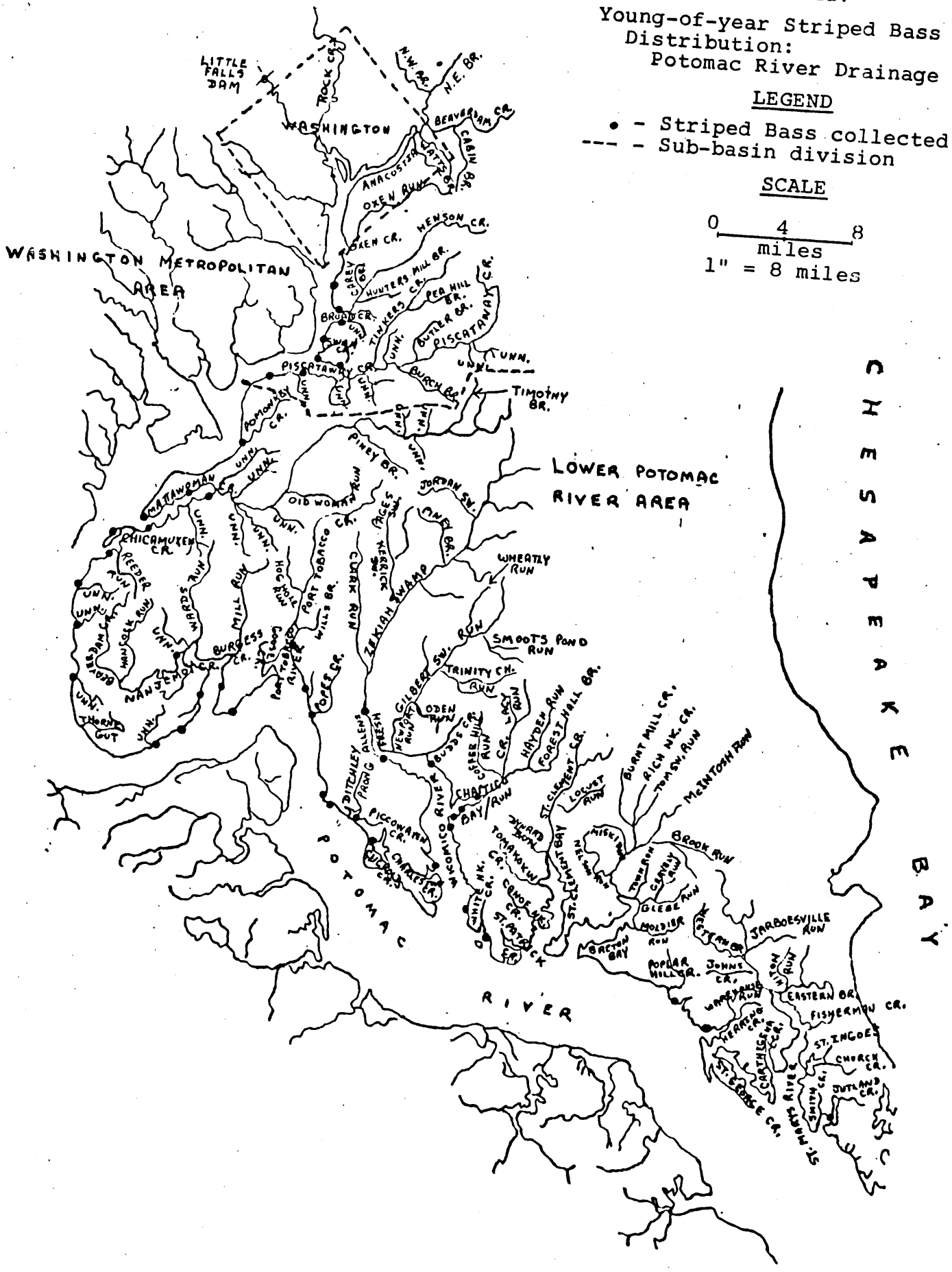
Young-of-year Striped Bass Distribution:
Potomac River Drainage

LEGEND

• - Striped Bass collected
--- - Sub-basin division

SCALE

0 4 8
miles
1" = 8 miles



MAP LV

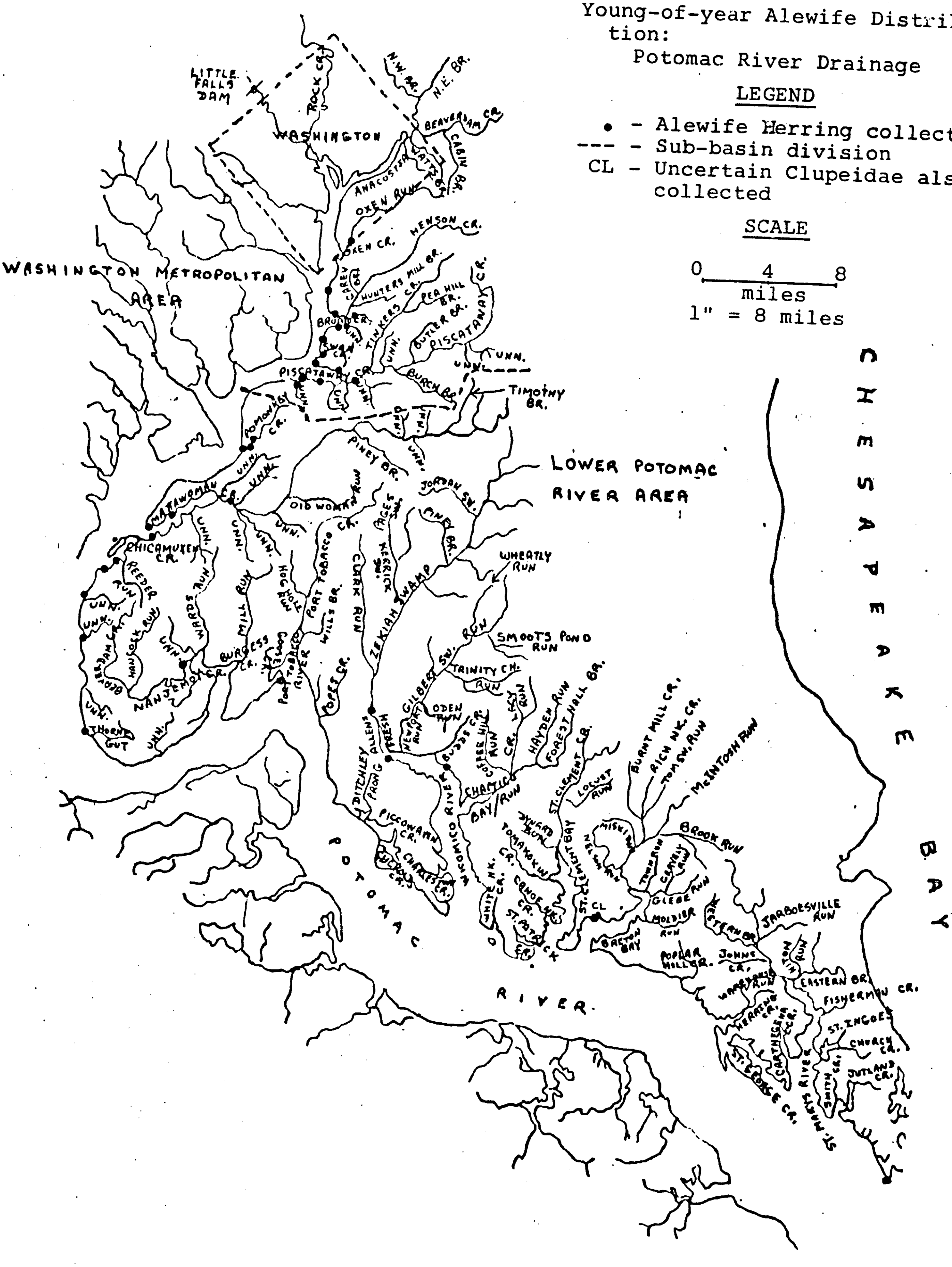
Young-of-year Alewife Distribution:
Potomac River Drainage

LEGEND

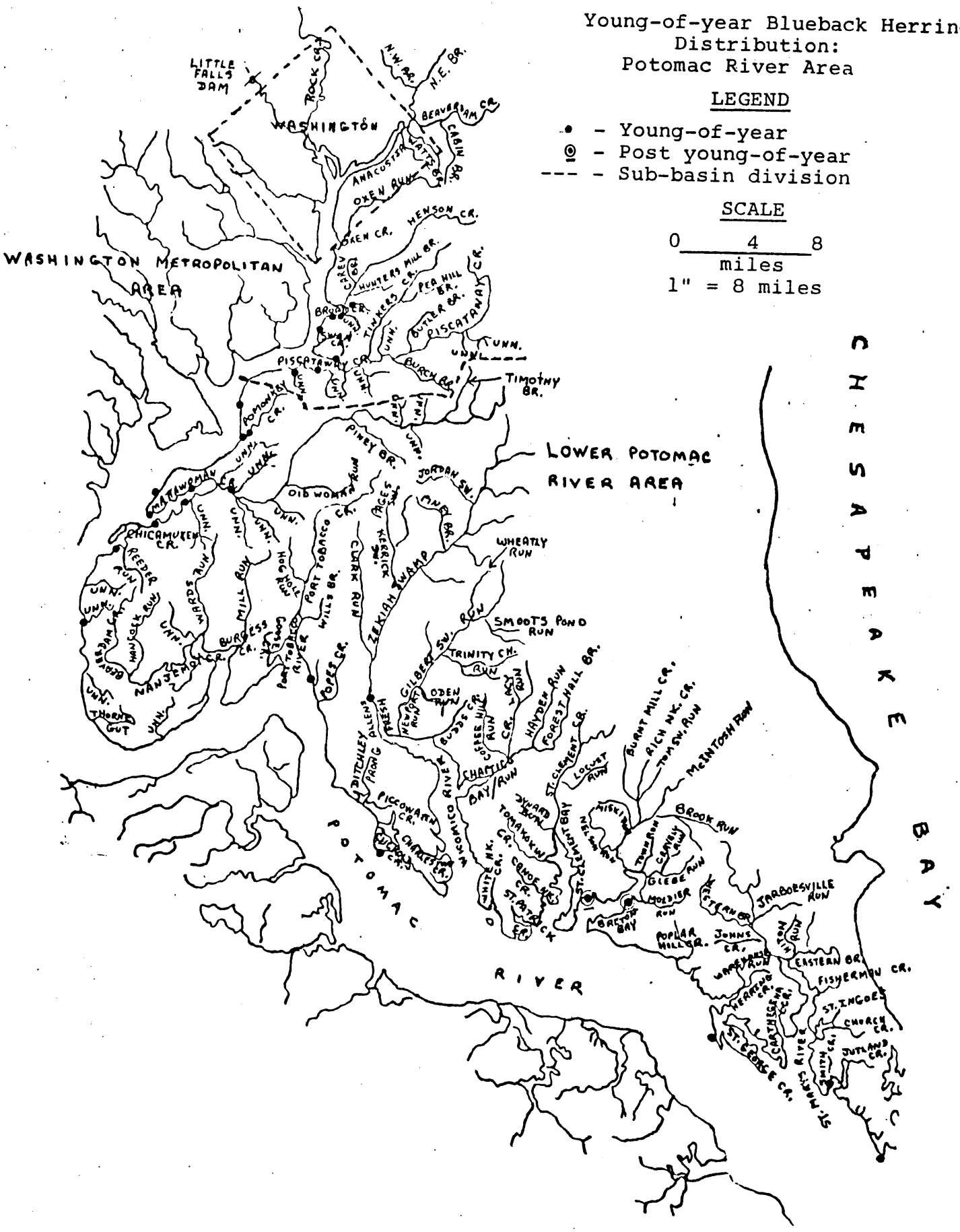
• - Alewife Herring collected
--- - Sub-basin division
CL - Uncertain Clupeidae also collected

SCALE

0 4 8
miles
1" = 8 miles



Young-of-year Blueback Herring Distribution: Potomac River Area



MAP LVII

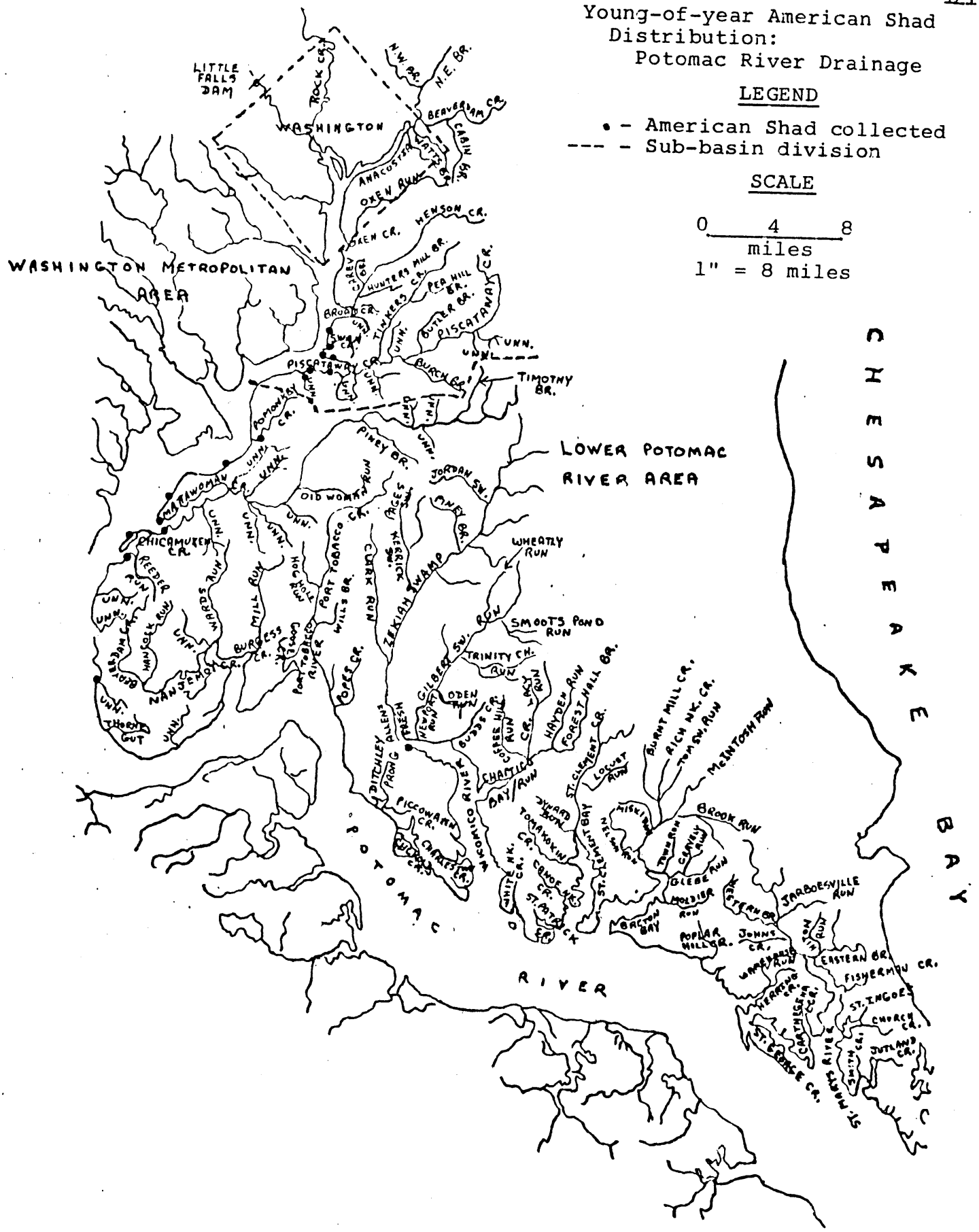
Young-of-year American Shad Distribution:
Potomac River Drainage

LEGEND

• - American Shad collected
--- - Sub-basin division

SCALE

0 4 8
miles
1" = 8 miles



Hickory shad were not recorded in tributaries of the river or in the river mainstem. A single spawning documentation in Nanjemoy Creek explains the absence of young-of-year for the species.

Yellow perch were collected on the river mainstem from near the mouth of Nanjemoy Creek to Indian Head, above Mattawaman Creek. In the tributaries, this species ranged from the Breton Bay drainage to Oxon Creek in a total of sixteen streams. The only major drainage in this range which lacked species documentation was Pomonkey Creek. Map LVIII shows the locations of these documentations.

Collection data indicates that following spawning in freshwater tributaries, adult yellow perch and their young-of-year migrate downstream into these same drainages and probably remain there until the next annual spawning period. The few collection sites of adult yellow perch in tidal fresh river areas and the abundance of young-of-year and other life stages in river tributaries supports prior findings of Project AFC-3.

MAP LVIII

Young-of-year Yellow Perch Distribution: Potomac River Drainage

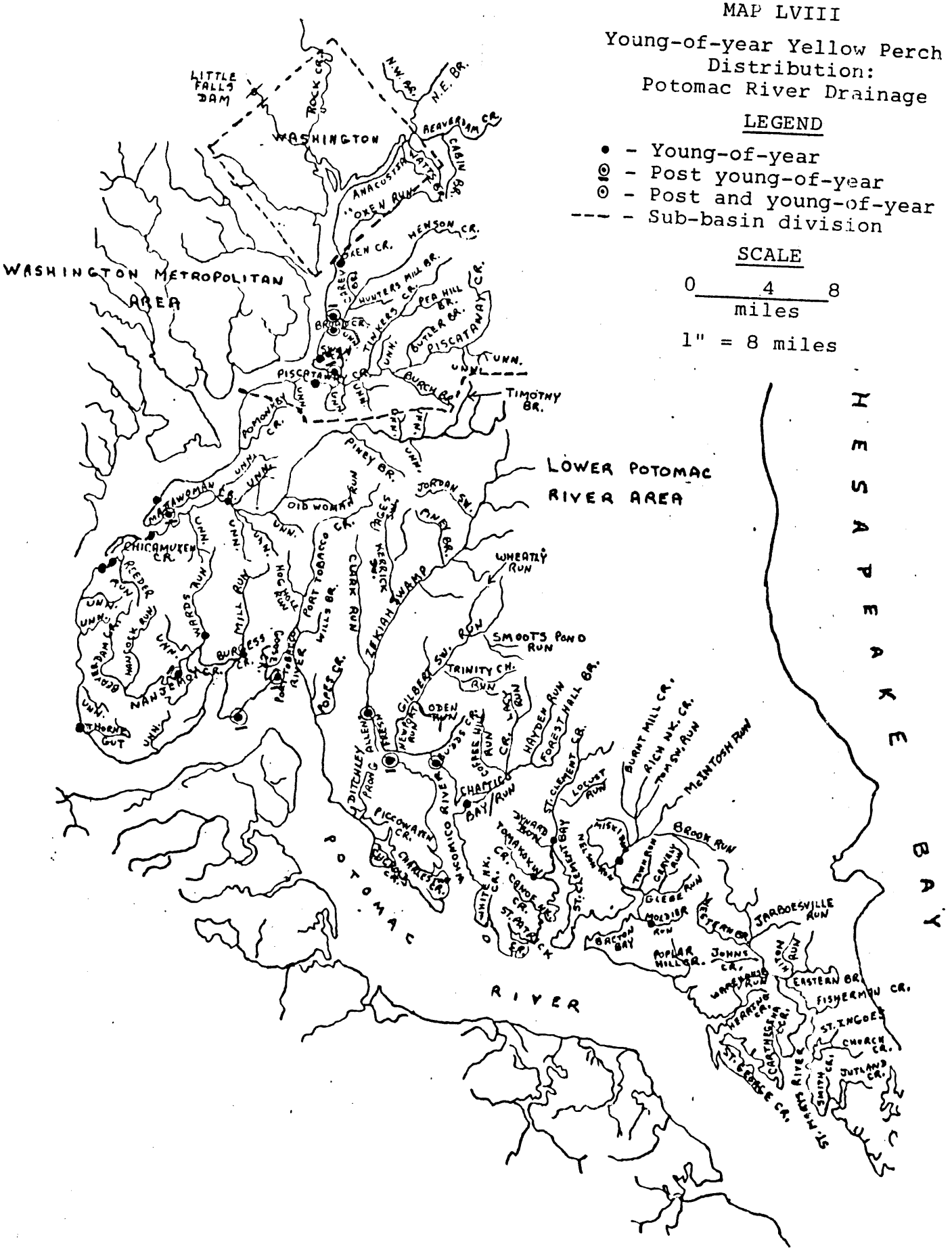
LEGEND

- • - Young-of-year
- ⊙ - Post young-of-year
- ⊙ - Post and young-of-year
- --- - Sub-basin division

SCALE

0 4 8 miles

1" = 8 miles



Summary and Conclusions For the Potomac River Drainage Nursery Area Survey

Seining collections delineated nursery areas for six of seven defined anadromous species. Catch data established that the Potomac River and most of its tributaries on the Maryland shore south of the Anacostia River serve as anadromous nursery areas. One or more anadromous species were recorded in 40 of 45 sampled streams and at 25 of 26 river sites. No young-of-year hickory shad were recorded on the river mainstem. The latter species was not collected at any sampled sites. White perch, collected at 85% of the river sites, followed by striped bass at 62%, were the most frequently occurring anadromous species in the mainstem.

In the Potomac River tributaries, white perch were collected at 78% of the sampled sites, yellow perch at 36%, striped bass at 38% and alewife at 33%, which represented the most frequently caught species. The majority of all anadromous species were collected in the river and tributaries from the Wicomico River to Broad Creek, which represents the moderately saline and tidal fresh areas of the Potomac River drainage system. The large estuarine-freshwater drainage systems of the St. Mary's River, Breton Bay, and St. Clement Bay, located below the Wicomico River, do not appear to be as productive for spawning-nursery areas as upper river drainage systems. (Appendix B-1).

C. Findings

Section II: Findings for the Upper Chesapeake Bay Drainage Nursery Area Survey

Within the Upper Chesapeake Bay drainage, seining sites were established in every sub-basin (except the Chester River) and on the Chesapeake Bay proper. Map LIX shows the locations of these seining sites. Estuarine trap sites are also included on this map. Data from estuarine trap sites is treated the same as normal seining data. The sampling site map includes all seven of the sub-basins studied within the Upper Chesapeake Bay.

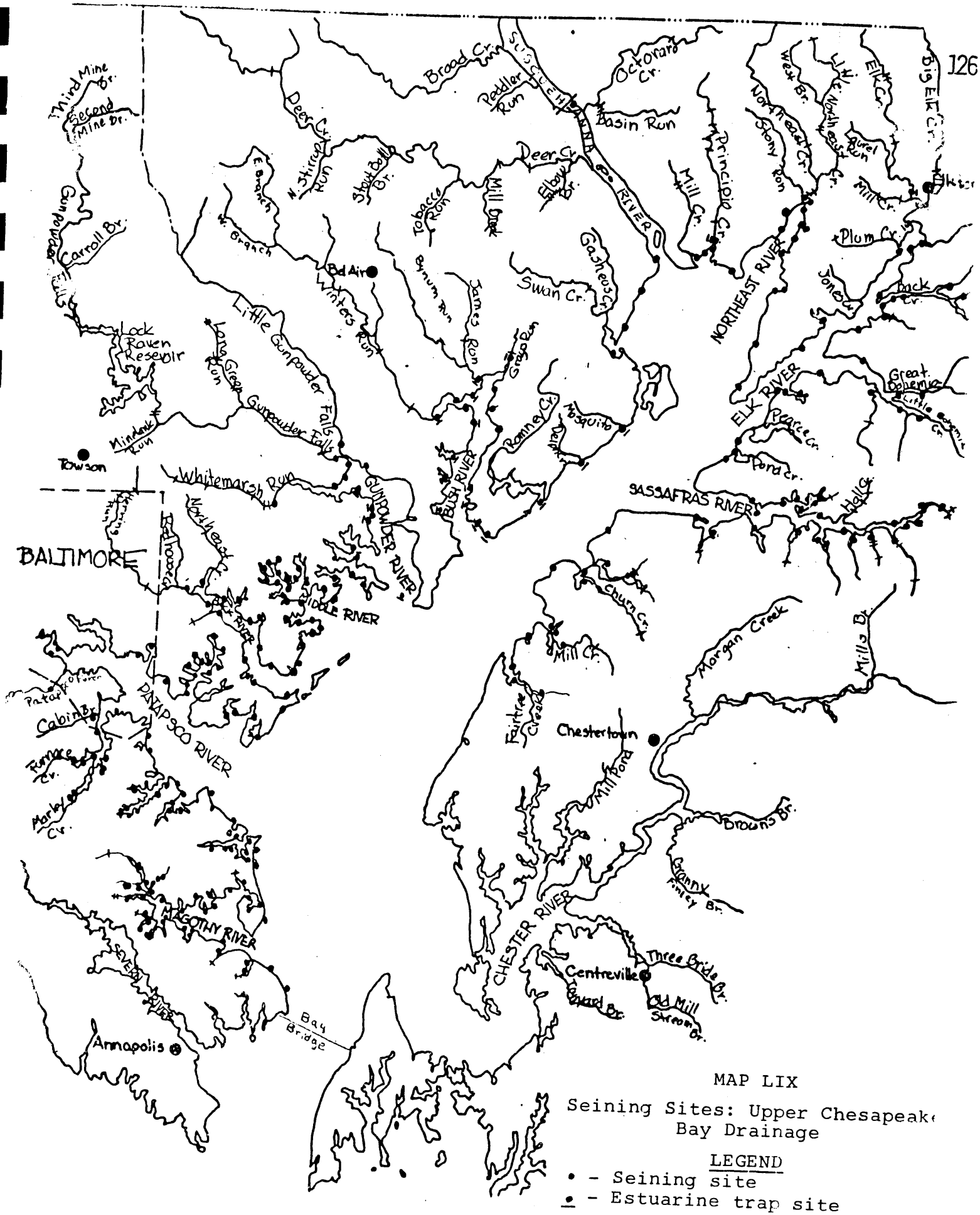
There were a total of two hundred and sixty-four seining sites established in the one hundred and fifty watercourses sampled. A listing of the number of watercourses and seining sites within each sub-basin follows:

Sub-Basin	No. Watercourses Sampled	No. Seining Sites
Lower Susquehanna River	1	2 (1 estuarine trap sample)
Elk River	51	79 (5 estuarine trap samples)
Bush River	19	21 (17 estuarine trap samples)
Gunpowder River	24	37 (6 estuarine trap samples)
Patapsco River	35	70
West Chesapeake Bay	19	34
Chesapeake Bay Proper	1	21
TOTAL	150 streams	264 sites

The number of samples from which each anadromous species was collected and percent occurrence in relation to sampled watercourses is contained in the following summary. Catch data is based on young-of-year fish seined for all anadromous species. It includes catches of later life stages for striped bass, alewife, blueback herring, white perch, and yellow perch, which were the only post young-of-year anadromous species collected. Catch data was as follows:

Anadromous Species Seined

Species	No. Watercourses Collected	% of 150 Sampled Watercourses
White perch	130	87
Yellow perch	75	50
Alewife	26	17
Blueback herring	20	13
Striped bass	47	31
American shad	4	3
Hickory shad	2	1



MAP LIX

Seining Sites: Upper Chesapeake Bay Drainage

LEGEND

• - Seining site

• - Estuarine trap site

SCALE

0 3 6

miles

Anadromous species were collected in the Upper Chesapeake Bay drainage from the lowermost sampled site located off the mouth of Magothy River to the uppermost site located at the Conowingo Dam Fish Elevator.

White perch were the most abundant young-of-year anadromous species collected in the Upper Chesapeake Bay drainage. This species was collected in 87% of the sampled watercourses. Map LX shows the locations of these collections. They were present from the lowermost study site off the mouth of the Magothy River, up the Bay and into Northeast Creek at stream mile 0.5. They were present in all sub-basins, being recorded on 130 of 150 sampled watercourses.

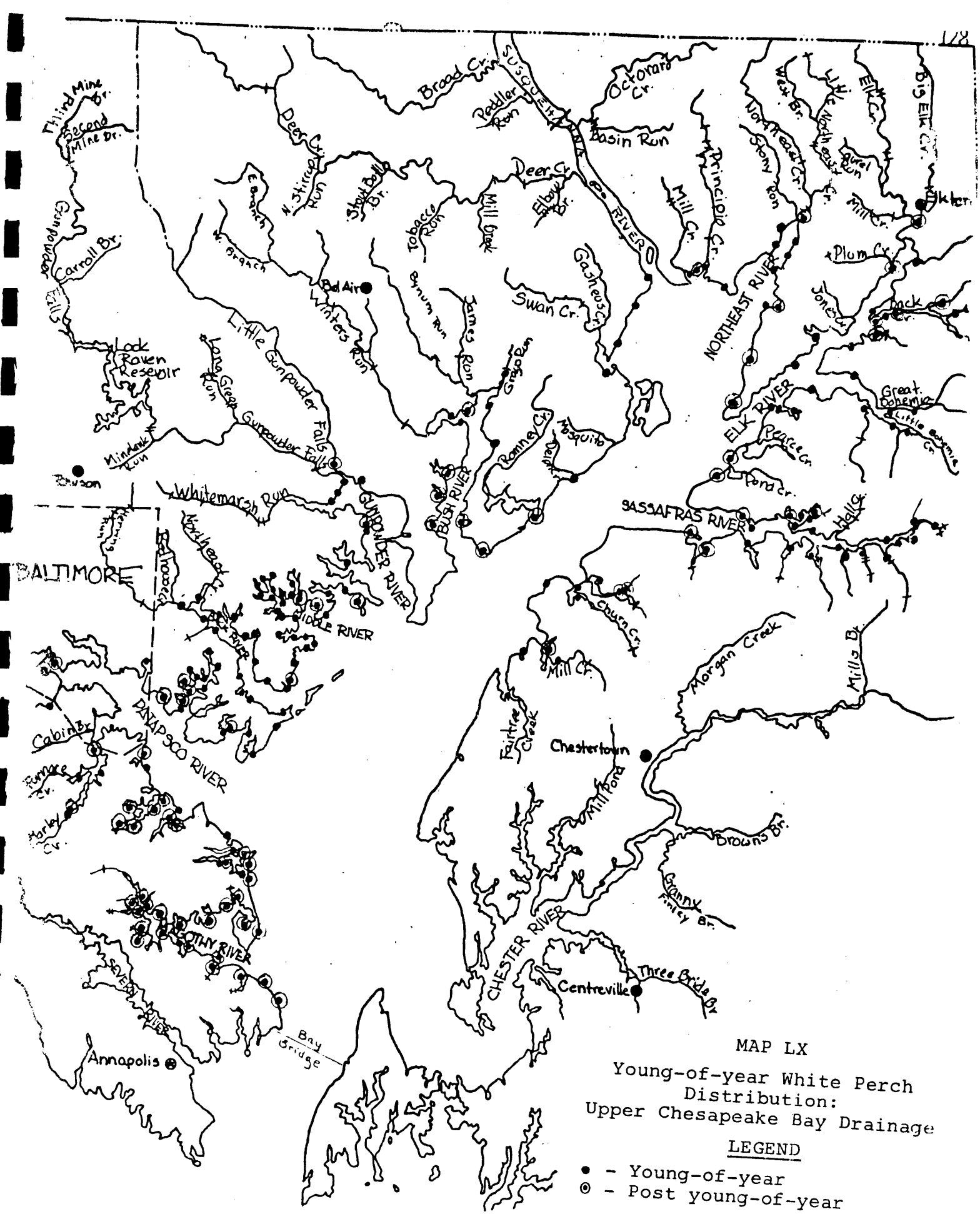
Striped bass were documented in 31% of the watercourses sampled. This species was present in six of the seven sub-basins studied in the Upper Chesapeake Bay. The Lower Susquehanna River Area was the only sub-basin where striped bass were not documented. Limited sampling at two sites may have precluded species documentation. The largest concentration of young-of-year striped bass was in the Magothy River, Patapsco River, and Gunpowder River areas. Map LXI shows the locations of these documentations. Nursery areas do not coincide with the striped bass spawning areas as documented by trap and plankton samples. Little or no spawning activity of striped bass was documented in the Magothy, Patapsco, and Gunpowder drainage areas. The young-of-year apparently migrated into these areas from spawning grounds located in other areas of the Bay drainage such as the Elk and lower Susquehanna rivers.

Alewife herring were documented in twenty- six different watercourses, or 17% of those sampled. They were documented from the lowermost sampled site off the mouth of the Magothy River up the Bay into Northeast River as far as Hance Point. Map LXII shows the locations of these documentations. There were documentations made in every sub-basin with the exception of the Lower Susquehanna River Area. The largest concentration of alewife was apparently in the Elk River Area.

Blueback herring were documented in twenty different watercourses, or 13% of the watercourses sampled. The largest concentration of young-of-year occurred in the Elk River Area. Documentations were made as far up the Bay as Hance Point on the Northeast River, near the mouth of Mill Creek, and near the mouth of the Susquehanna River. This species was documented as far south in the Bay drainage as the Patapsco River on the western shore and Fairlee Creek on the eastern shore. There were only single documentations in the latter two watercourses. Map LXIII shows the range of the blueback herring documentations.

American shad were documented at only five seining sites and only in four different watercourses. Map LXIV shows the locations of these documentations. The only documentation outside of the Elk River Area sub-basin was in the Gunpowder River Area at 1.4 miles up Gunpowder Falls.

Hickory shad were documented at only two seining sites in the Upper Chesapeake Bay. One site was located in the Chesapeake Bay Proper and the other site was in the Northeast River. Map LXV shows these two locations.



MAP LX

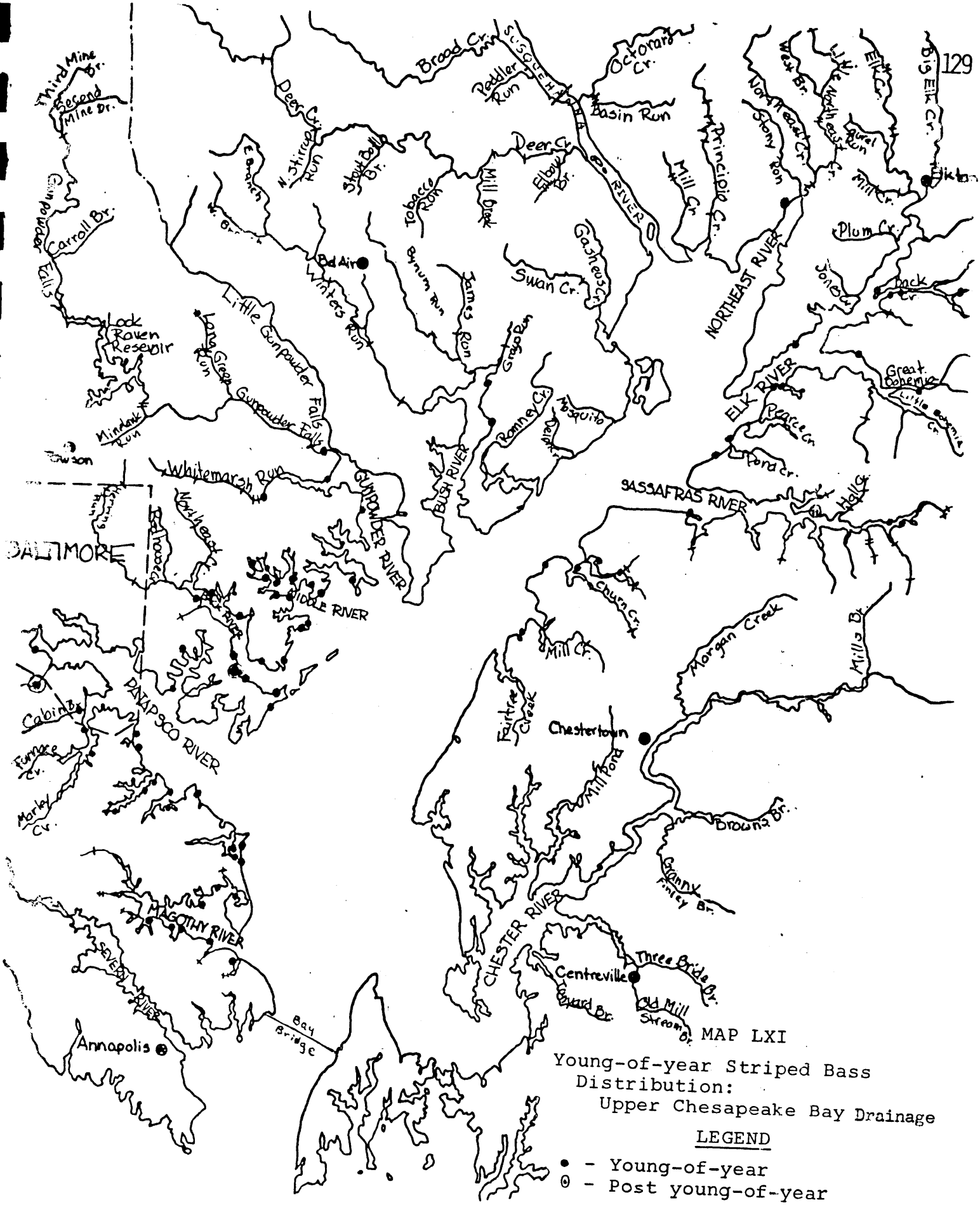
Young-of-year White Perch Distribution: Upper Chesapeake Bay Drainage

LEGEND

• - Young-of-year
◉ - Post young-of-year

SCALE

0 — 3 — 6
miles
1" = 6 miles



MAP LXI

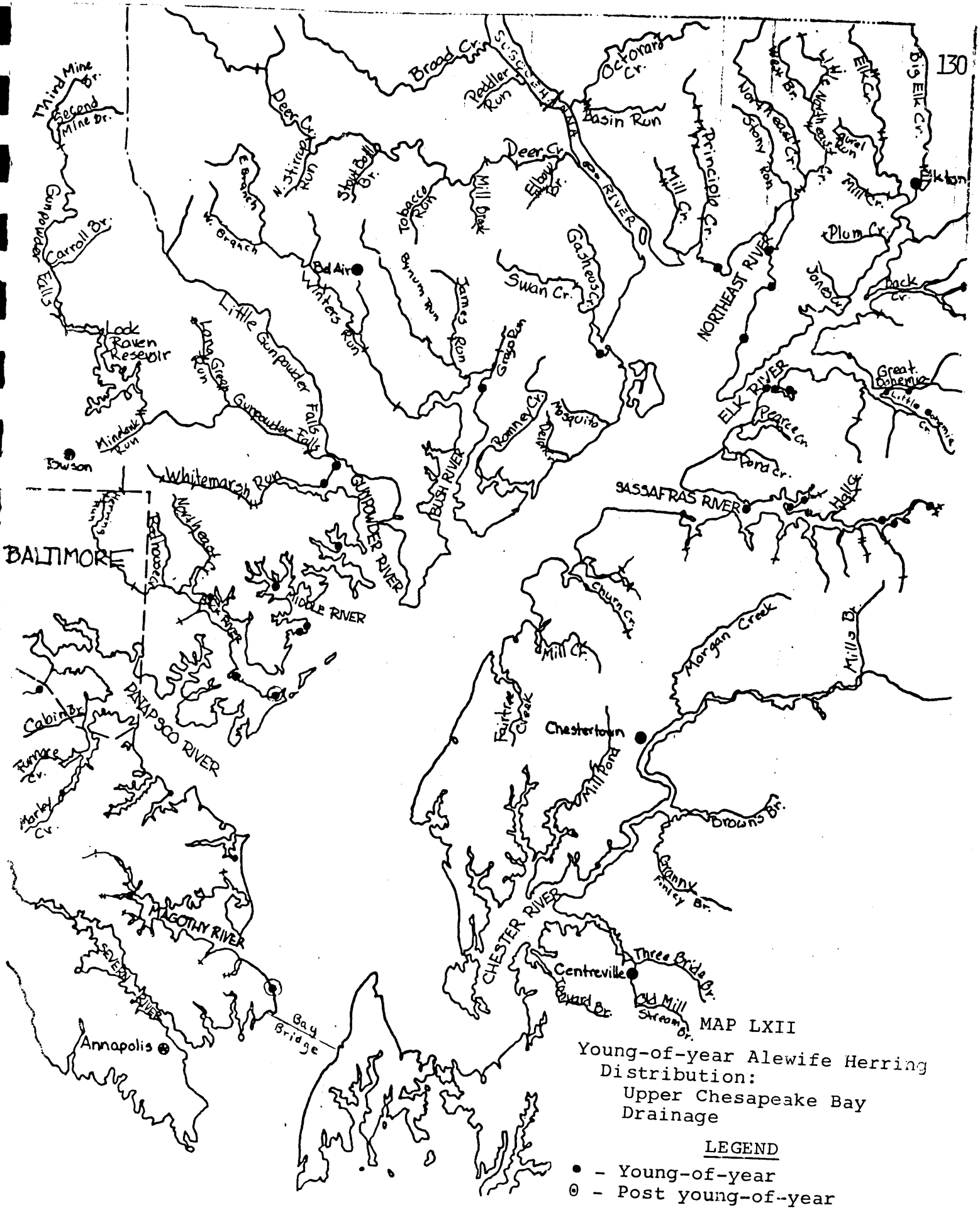
Young-of-year Striped Bass
Distribution:
Upper Chesapeake Bay Drainage

LEGEND

- ● - Young-of-year
- ⊙ - Post young-of-year

SCALE

0 3 6
miles
1" = 6 miles



MAP LXII

Young-of-year Alewife Herring Distribution: Upper Chesapeake Bay Drainage

LEGEND

• - Young-of-year

⊙ - Post young-of-year

SCALE

0 3 6

miles

Sub-Project Accomplishments

TABLE OF CONTENTS

MAP LXIII

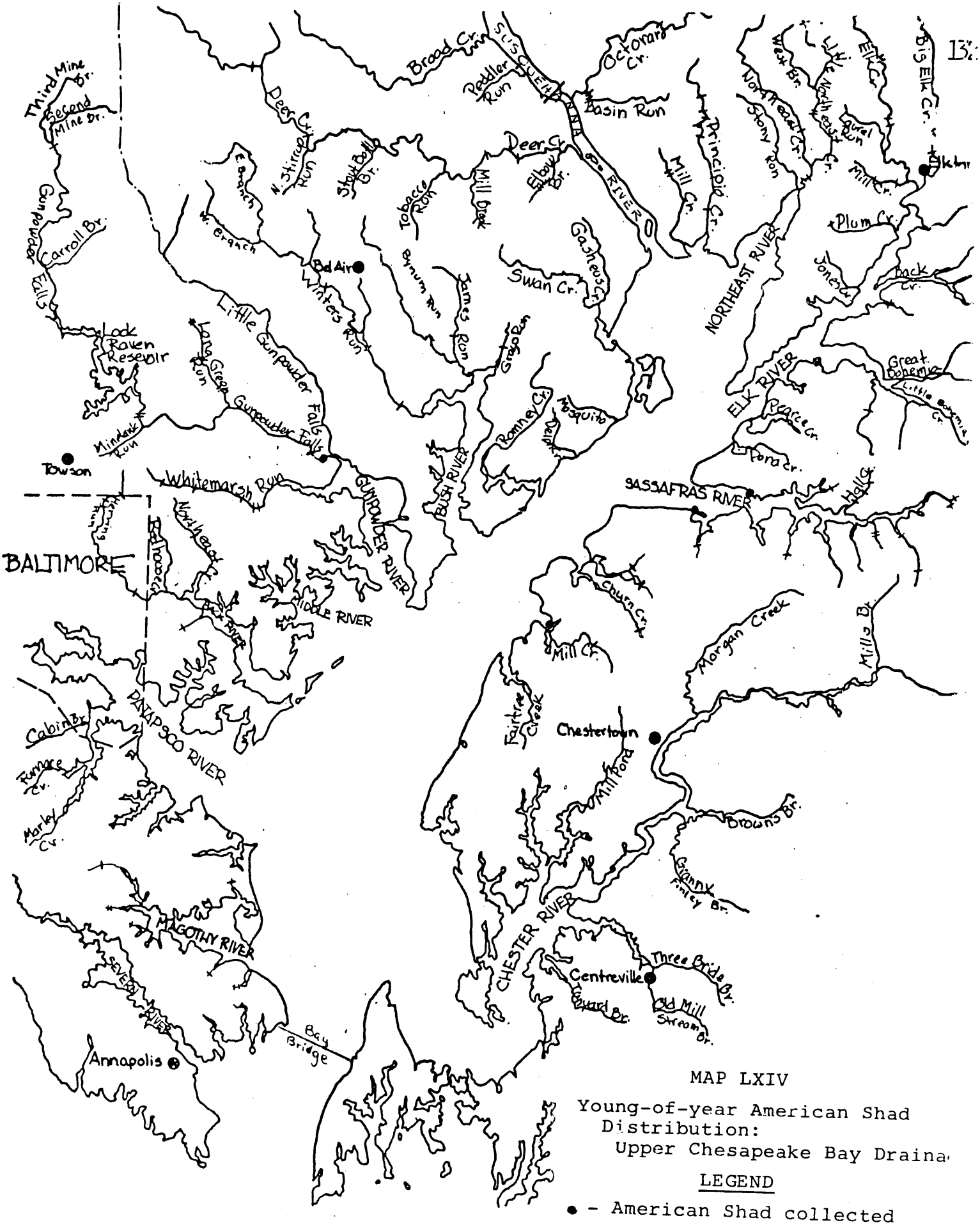
Year Blueback Herring Distribution:
Upper Chesapeake Bay Drainag

LEGEND

- Blueback collected

SCALE

0 3 6
miles



MAP LXIV

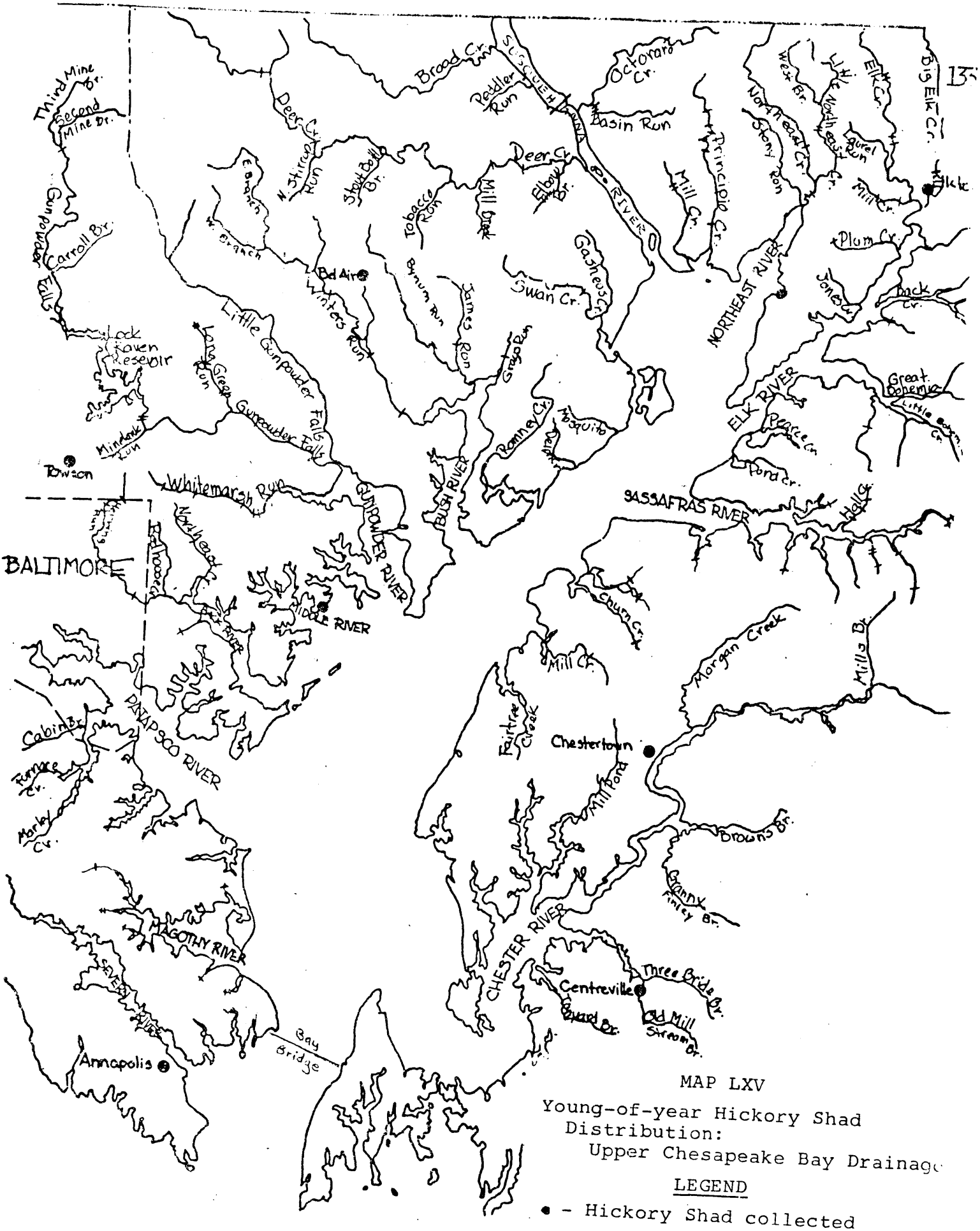
Young-of-year American Shad Distribution:
Upper Chesapeake Bay Drainage

LEGEND

● - American Shad collected

SCALE

0 3 6
miles
1" = 6 miles



MAP LXV

Young-of-year Hickory Shad Distribution:
Upper Chesapeake Bay Drainage

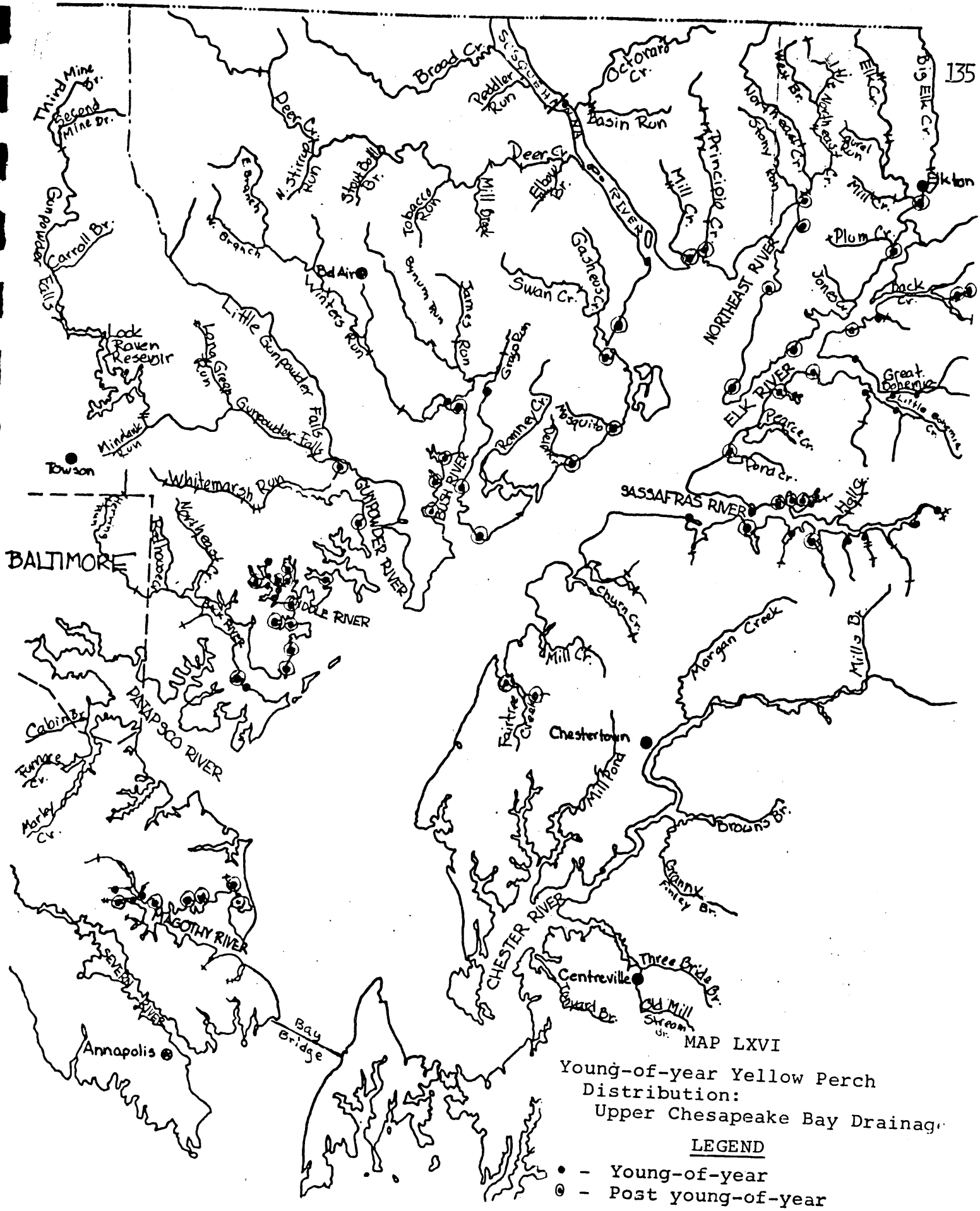
LEGEND

• - Hickory Shad collected

SCALE

0 3 6
miles

Yellow perch were documented in seventy-five different watercourses, or 50% of the sampled watercourses. Next to white perch, yellow perch was the most abundant species documented. Map LXVI shows the locations of these documentations. The lowermost documentations of yellow perch were in the Magothy River drainage. The uppermost documentation was at the fish elevator at Conowingo Dam in the Lower Susquehanna River Area. Yellow perch were documented in all seven sub-basins studied. Documentations were fairly evenly distributed over the entire upper Chesapeake Bay drainage with the obvious exception of the Patapsco River. There were no documentations of this species made in the Patapsco River drainage. Trap and plankton samples documented spawning activity at fourteen different sites within this river drainage.



MAP LXVI

Young-of-year Yellow Perch Distribution: Upper Chesapeake Bay Drainage

LEGEND

- • - Young-of-year
- ◎ - Post young-of-year

SCALE

0 3 6
miles

Summary and Conclusions for the Upper Chesapeake Bay Drainage Nursery Area Survey

Seining collections in the Upper Chesapeake Bay drainage delineated nursery areas for the seven defined anadromous species. Catch data established that the Upper Chesapeake Bay and most of its tributaries serve as anadromous nursery areas. One or more anadromous species were recorded in one hundred (young-of-year) of one hundred and fifty sampled watercourses. White perch, collected at 87% of the sampled watercourses, followed by yellow perch at 50%, were the most frequently occurring anadromous species in the Upper Bay drainage (includes both young-of-year and post young-of-year catches).

White perch were present in all sub-basins of the Upper Chesapeake Bay drainage and were documented in 130 of 150 sampled watercourses. Striped bass were documented in six different sub-basins with a relatively large number of documentations of young-of-year, compared to number of seine hauls, being in the Magothy, Patapsco, and Gunpowder River Areas. Alewife herring were documented in all sampled sub-basins with the largest number of documentations being in the Elk River Area. Blueback herring, like alewife, were more frequently documented in the Elk River Area. With the exception of a single documentation in the Gunpowder River Area, all American shad young-of-year were collected from the Elk River Area. Hickory shad were found at only two sampling sites, one in the Chesapeake Bay Proper and one in Northeast River. Yellow perch were found in all seven sub-basins and were second only to white perch in frequency of occurrence.

The abundant, random, relatively even distribution of anadromous fish documentations would indicate that the entire Upper Chesapeake Bay drainage is productive for spawning/nursery areas (Appendix B-2).

JOB III. STREAM INVESTIGATION

Objective:

Stream Investigation was conducted to determine stream potential for anadromous fish propagation by identifying problem areas along watercourses affecting fish passage and reproduction. A second objective was to implement measures to correct or mitigate stream problem areas affecting anadromous fish propagation.

Introduction:

Stream investigation included both Water Quality Survey and Stream Condition Inventory. Stream Improvement was also conducted following stream investigation. Each of these three activities are summarized separately in Parts I, II, and III of this job.

The study area comprised the same regions as surveyed in Fishery Investigation (Job II), for both the Potomac River and Upper Chesapeake Bay drainages. In the Potomac River drainage, surveys included the river shoreline and principal tributaries on the Maryland shore from the river mouth at Chesapeake Bay to Little Falls Dam (river mile 117.4). In the Upper Chesapeake Bay drainage, surveys included all principal tributaries and the Bay shoreline, except for the Chester River drainage. Watercourses on both shores of the Bay drainage, from the Bay Bridge to Pennsylvania and Delaware boundaries, were inventoried.

In general, all study area watercourses over one mile in length were surveyed. Annual surveys from 1970 through 1974 were conducted during the summer months on tidal streams and in the fall and winter on freshwater streams. Watercourses over one mile in length were divided into sections (stream segments) and investigated separately.

Part I. Inventory of Stream Conditions

Introduction

Stream survey was conducted to inventory stream conditions (discussed below) in order to meet the general objectives of Stream Investigation. Surveys were made on all streams that contained biological sampling sites (streams having anadromous fish potential) and for additional study area watercourses. In general, the streams that contained biological sampling sites were surveyed to the headwaters. Upper survey limits of other small watercourses depended on available time.

Usually, watercourses over one mile in length were surveyed in sections (segments). Sections in estuarine areas were determined by appropriate shoreline landmarks at one to two mile intervals. Sections in inland areas were determined by road crossings and impoundments at varying intervals. Shoreline surveys in the estuaries were conducted by boat, while walking was generally employed for the non-navigable inland streams. Two categories of stream data were inventoried for each surveyed watercourse: Section

Data and Station Data.

Inventoried stream Section Data included watercourse conditions plus conditions in the lateral drainage of the stream section. Stream Station Data was taken at the beginning of each stream section survey. Impoundments were special cases of shoreline survey where only section data was taken. Station and Section Data were recorded on the "Stream Investigation and Water Quality Data Sheet" (Figure VI).

A. Methods and Procedures

1. Station Data

Station Data included survey date and time, tide state (where applicable), weather code, water temperature, conductivity, and salinity. Conductivity and salinity served as indices for stream spawning potential by indicating fresh water stream areas. The conductivities were taken with either a Beckman Model RB3-338 or a RB3-349 conductivity meter. Salinities were obtained either by making standard conductivity conversions or, as in the case of more saline waters, by using a Beckman Model RS5-3 salinometer. Stream dimensions, consisting of average stream width and average mid-stream depth, were also taken as station data. Stream measurements were taken either at the station or at a point near the station where the stream size appeared to become typical for the section survey. If the section survey contained the stream mouth, the stream dimensions, along with the other station data, were taken at the stream mouth. Where practicality did not permit measuring stream width in the field (generally when the width exceeded 100 feet), stream widths were obtained by quadrangle map measurements.

2. Section Data

Stream Section Data described either potential problem situations or habitat. Number counts or presence codes were used for documenting Stream Section Data paramaters on the "Stream Investigation and Water Quality Data Sheet". Ten categories of data were inventoried for surveyed watercourses:

a. Stream Blockages

Stream Blockages included man-made, cross-sectional stream structures, such as dams, and various other conditions having the potential to block the upstream migration of anadromous fish. The man-made, cross-sectional structures were recorded numerically on the "Stream Investigation and Water Quality Data Sheet" as either barriers or non-barriers. Barriers and non-barriers were distinguished by using Project-developed criteria, based on the height and slope of each structure. Additional information for the stream structure, such as the structure's

FORM NO. AFSSP

FIGURE VI

DEPARTMENT OF NATURAL RESOURCES
STREAM INVESTIGATION & WATER QUALITY DATA SHEET

SEQUENCE NUMBER (PUNCH IN 76-79 ALL CARDS)

DRAINAGE SYSTEM _____

STREAM _____

SECTION: FROM _____

TO _____

TRIBUTARY OF _____

BOTTLE NUMBERS

D.O. ____ NITRATE NITROGEN ____

B.O.D. ____ RESIDUAL CHLORINE ____

SUB-SAMPLE ____ BACTERI-OLOGICAL ____

OIL/GREASE ____

A

STREAM CODE | DOWNSTREAM RIVER MILE | DATE: Year, Month, Day | TIME OF SAMPLE | SAMPLE DEPTH FT. | SUBMITTER CODE | DATA CATEGORY CODE | TIDE STATE | WEATHER CODE | SAMPLE TYPE | TROUT STANDARD | WATER TYPE GROUP | ZONE NO. (ITEM NO.) | COUNTY CODE

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 | 27 28 29 30 31 32 | 34 35 36 37 38

REG. 4.03 USE CLASS 1-4

B

WATER USES (CLASS): 1 2 3 4 5 6 | FLOW: VALUE, BASIS, EXP., +/- | TEMPERATURE °C: AIR, NEG., WATER | FIELD pH G/L | LAB pH G/L | DO mg/l G/L | SPECIFIC CONDUCTANCE micromhos/cm @ 25°C G/L | CARD NO.

39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 | 80 = 1

C

BACTERIOLOGICAL: HEALTH DEPT. ☐ WRA ☐ ICED: YES NO

COLIFORMS MPN/100 ml G/L | FECAL COLIFORMS MPN/100 ml G/L | SALINITY 0/00 G/L | SUSPENDED SOLIDS mg/l G/L | DISSOLVED SOLIDS mg/l G/L

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37

D

TURBIDITY JTU G/L | NITRATE - N mg/l N G/L | TOTAL PO4 mg/l P G/L | 5 DAY B O D mg/l G/L | CARD NO.

38 39 40 41 42 43 | 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 | 80 = 2

COLOR UNITS G/L | GREASE & OIL mg/l (hexane soluble) G/L

49 50 51 52 53 54 55 56 57 58 59

E

OIL & GREASE mg/l (pet. ether soluble) G/L | RESIDUAL CHLORINE mg/l Cl G/L | CARD NO.

60 61 62 63 64 65 66 67 68 69 | 80 = 4

21 22 23 = 0 3 2

BASIN CODES: MAJOR, MINOR, SUB, SUB-SUB | CARD NO.

25 26 27 28 29 30 31 32 | 80 = 5

21 22 23 = 2 0 4

STREAM DIMENSIONS (DOWNSTREAM AREA): AVG. STREAM WIDTH FT. | AVG. MID STREAM DEPTH FT. | CARD NO.

25 26 27 28 29 30 31 32 33 | 80 = 5

F

21 22 23 = 0 2 7

UPSTREAM RIVER MILE

NATURAL BARRIERS: NON-BARRIER STRUCTURES, BARRIER STRUCTURES, LOG/DEBRIS, BEAVER DAMS, WATERFALLS

STREAM ALTERATIONS: DREDGING -D, BULKHEADING -B, SEAWALLS -S, CHANNELIZATION -C | CODE

SHORE/FLOOD PLAIN ACTIVITIES: AGRICULTURAL, MUNICIPAL, INDUSTRIAL, OTHER

WATER REMOVALS: PRESENCE AT, OTHER PRESENCE

STORM DRAINS: SEW. OVERFLOW OUTLET

SEWAGE OUTFALLS: UNTREATED, PRIMARY, SECONDARY, A.W.T.

25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51

G

RESIDENTIAL WASTE CONDITIONS: N. S. E.

IDENTIFIED, UNIDENTIFIED | PIPES: DISCHARGE UNDETECTED | OTHER STREAM ALT. | REFUSE PRESENCE CODE | TRAILER PARK - T | LIVESTOCK PRESENCE CODE | SEDIMENT PROBLEM - S

INDUSTRIAL/GOVERNMENTAL WASTE CONDITIONS (NON-SEWAGE)

EFFLUENT DOCUMENTED AND/OR IDENTIFIED: # DISCHARGES NOT DOCUMENTED & UNIDENTIFIED | DISCHARGE UNDETECTED & UNDOCUMENTED | # PIPES | CARD NO.

INDUSTRIAL CODE

32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 | 80 = 5

21 22 23 = 2 1 0

STREAM CLASSIFICATION CODES: VALUE 1, VALUE 2, VALUE 3 | CARD NO.

25 26 27 28 29 30 31 32 | 80 = 5

H

21 22 23 = 0 1 2

WETLAND TYPE/OTHER HABITAT CODES: VALUE 1, VALUE 2, VALUE 3, VALUE 4, VALUE 5 | CARD NO.

25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 | 80 = 5

21 22 23 = 2 0 8

ENVIRONS CODES: RECREATIONAL, AGRICULTURAL, RESIDENTIAL, COMMERCIAL/GOV., INDUSTRIAL | CARD NO.

25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 | 80 = 5

21 22 23 = 2 1 4

OTHER ENVIRONS. CODES: ACCESSIBILITY, FRESH WATER | ANAD. FISH STR. RATING | CARD NO.

25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 | 80 = 5

type, purpose, and ownership, was recorded on the "Stream Structure Inventory Form" (Figure VII). A barrier structure, typical of those inventoried, is shown in Photo V. Natural conditions; namely, log obstruction, beaver dams, and waterfalls, were recorded only on the "Stream Investigation and Water Quality Data Sheet" and only for those situations meeting barrier criteria.

b. Stream, Shore, and Floodplain Alterations

Stream, Shore, and Floodplain Alterations were recorded for presence and included conditions altering the habitat such as dredging, bulkheading, channelization, clearing, and grading. The severity of habitat alteration varied, in some cases resulting in a stream being completely destroyed for use by anadromous and other species of fish. The destruction of stream channelization to spawning habitat is illustrated in Photo VI.

c. Water Removals

Water Removals from streams were recorded as the number of agricultural, municipal, and industrial occurrences.

d. Point Discharges

Point Discharges were documented in an effort to determine deterrent effects on anadromous fish migration. Point Discharges included sewage outfalls, storm drains, residential waste conditions, and industrial waste conditions. Sewage outfalls and residential waste conditions were recorded as the number of occurrences. Storm drains were recorded for presence. Industrial waste conditions were recorded for presence and/or number of occurrences, depending on the type of discharge. The effects of discharge wastes vary from the typical dissolved oxygen sag associated with sewage to directly toxic conditions associated with certain industrial wastes.

Any point discharge situations that were not previously documented by controlling governmental agencies were referred to the responsible agency for corrective action. Residential wastes were referred to county units of the Maryland Department of Health and Mental Hygiene. Non-documented industrial wastes were referred to the Maryland Water Resources Administration.

FIGURE VII

Structure ID (1 – 7)

(This number to be punched in columns 1 thru 7 on all cards)

STATE OF MARYLAND
DEPARTMENT OF NATURAL RESOURCES
STREAM STRUCTURE INVENTORY FORM

Form No. AFSSI

Ø= ALPHA, I = ALPHA, 1= NUMERIC

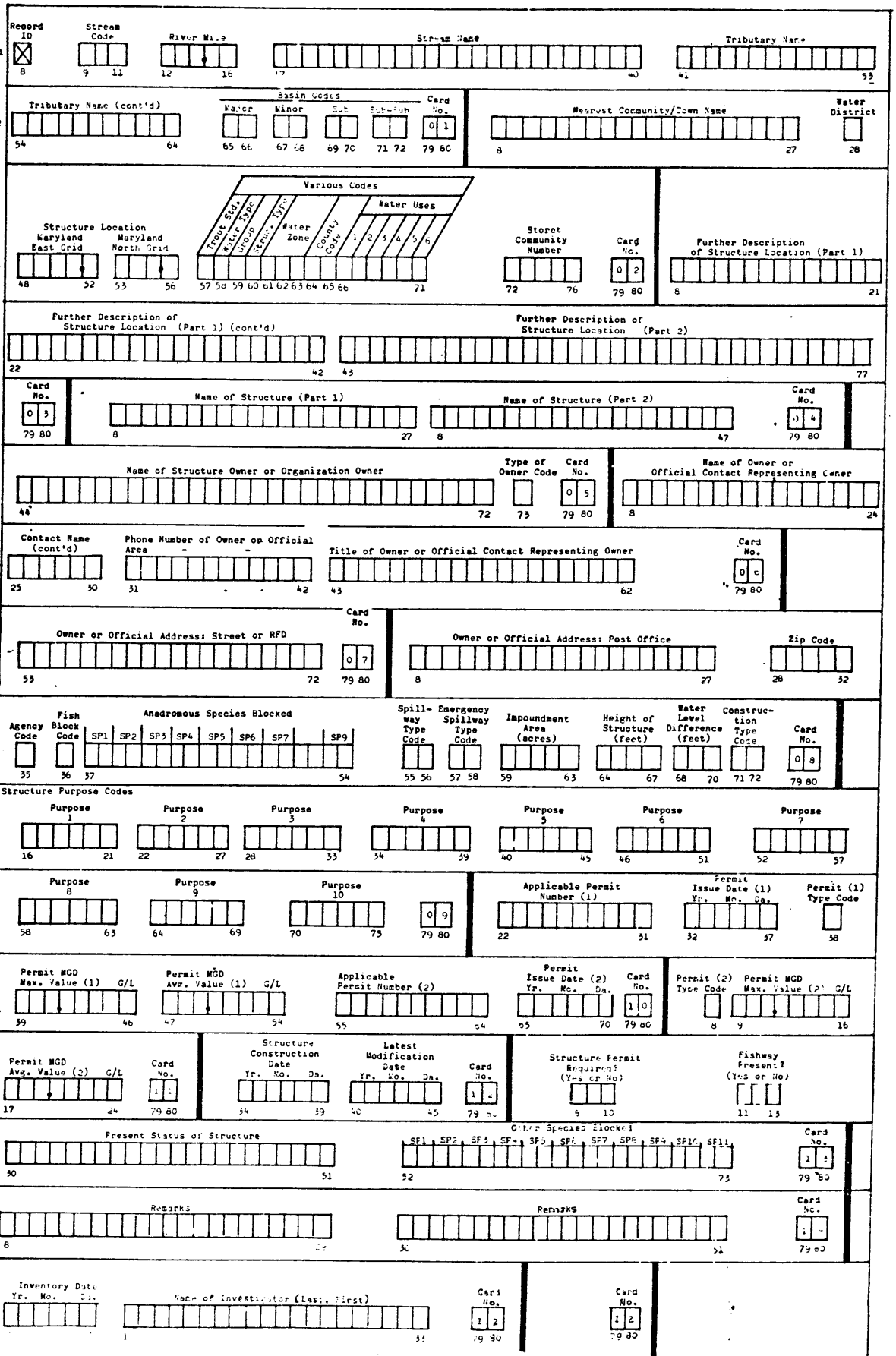
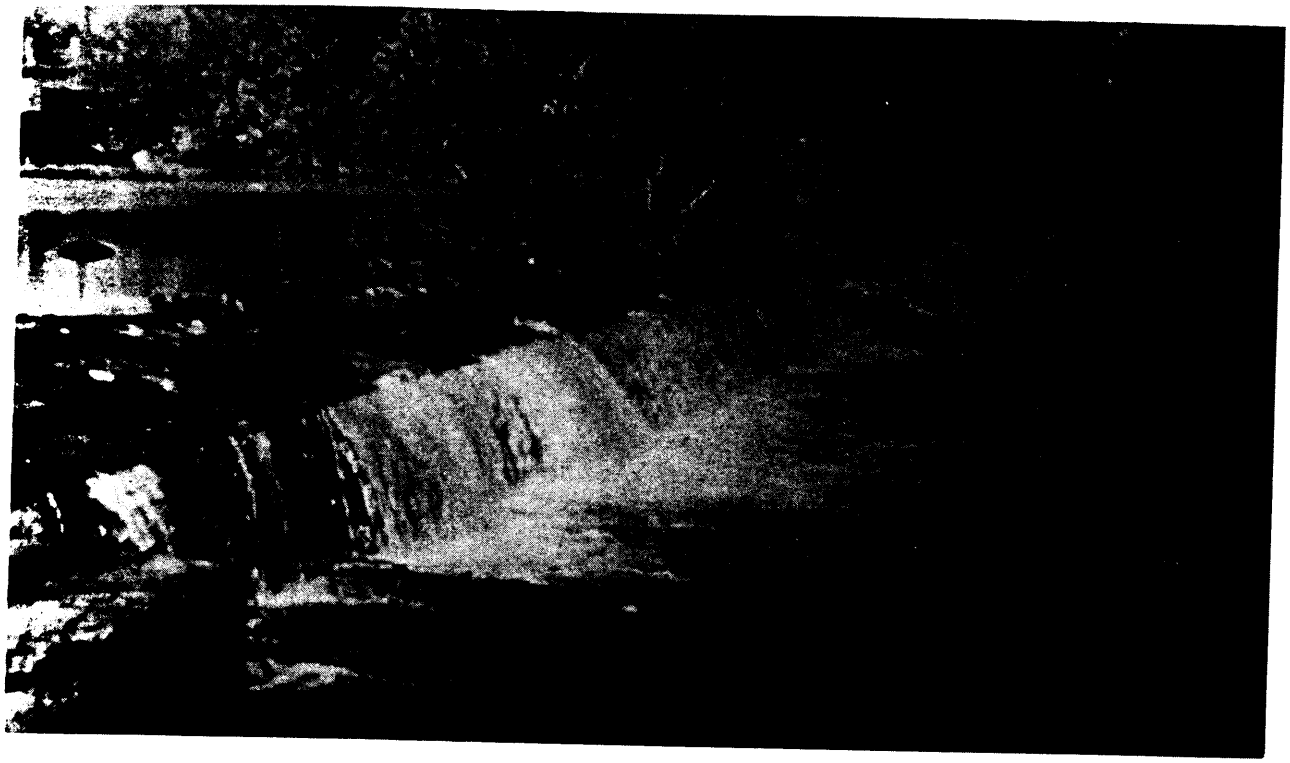


Photo V
Stream Survey Documents Problem Conditions



Dams Block Spawning Migrations of Anadromous Fish

Photo VI
Stream Alterations Are Inventoried

Stream Channelization Destroys Spawning Habitat

e. Watershed Related Problems

Watershed Related Problems were conditions in the watershed potentially or actually detrimental to the stream. Conditions were recorded for presence and included refuse, livestock, and sediment. The effects of Watershed Related Problems are general lowering of water quality and destruction of habitat.

f. Stream Classification

Streams were classified on the basis of width, depth, bottom type, and characteristic fauna. The Project-developed system for classifying streams contains 17 classes and incorporates R. D. Van Deusen's Maryland Stream Classification (12 classes), presented January 1953 in "The Progressive Fish Culturist". One to three stream classes were recorded for each inventoried stream section. More than three stream classes necessitated beginning a new survey section of the watercourse.

g. Wetland Type/Other Habitats

Habitat was recorded for the floodplain in fluvial (fresh) waters or as seen from the boat in tidal waters. The Habitat Classification included 26 types, incorporating the 20 nationally recognized wetland types[1]. The other habitats included wooded, agricultural, successional, and non-natural conditions. One to five habitat types were recorded for each stream section.

h. Environs

Environs were recorded for the lateral drainage of stream sections. There were five main categories of Environs, namely, agricultural, residential, commercial/governmental, and industrial. Each main category of development consisted of more specifically defined situations describing the status of the watershed.

i. Other Environs

Other Environs recorded were junkyards, municipal facilities, and transportation facilities. Each of these categories, consisting of more specifically defined situations, were inventoried when they occurred in the vicinity of watercourses.

---

[1] Shaw, Samuel P., and G. C. Fredine, Wetlands of the United States

j. Anadromous Fish Stream Rating

Stream sections were rated for anadromous fish propagation potential on the basis of accessibility and salinity. The accessibility rating was determined by the absence of barriers, or their presence and locations along watercourses. Salinities obtained from Station Data were used to identify streams with spawning potential (salinity less than 3.5 ppt) and streams that did not have spawning potential (salinity greater than 3.5 ppt). The presence or absence of stream barriers and salinities provided the basis for identifying stream areas potentially suitable for anadromous fish propagation.

B. Findings

At present, stream survey data that was taken prior to AFC-8-4 is being transcribed onto computerized data sheets. All stream survey data is scheduled for machine storage during Project AFC-9. The data that was inventoried for over 300 surveyed watercourses is too extensive for summarizing in this report. Findings, based on computer output, will be presented as special data reports. Dams and other stream blockages, mapped in this report, will also be further described in a separate report.

Part II. Water Quality Survey

Introduction:

Water Quality Survey was conducted during Project AFC-8 in segments one, three and five. Water quality was not sampled for the Potomac River drainage in segment two because of stream coverage during segment one. Segment four included streams in the Baltimore Harbor area which had intensive prior monitoring by State agencies. Water quality study areas corresponded to segments one, three, and five fishery study sites for each respective segment.

Water quality sampling sites were established at biological (trap and/or plankton) sampling sites. Each trap/plankton site was sampled for water quality once during the study segment during the anadromous spawning season. The purpose of the sampling was to determine water quality suitability for anadromous fish spawning. During study segment one, in addition to water quality sampling at inland fishery investigation sites, project personnel assisted the Federal Environmental Protection Agency in water quality surveillance at biological investigation sites on the Potomac River.

A. Methods and Procedures

1. Segment One: Potomac River Drainage

a. Sampling by Project Personnel

Water quality sampling was conducted in the Potomac River drainage from May 3 to May 27, 1971. Three sampling sites were located on the river: at Chain Bridge, below Little Falls Dam, and above Little Falls Dam. Lower river areas were jointly sampled by Project and EPA personnel. A total of 133 sampling sites were located on 85 tributaries within the drainage.

Two surface water samples were taken at each site and the surface water temperature recorded. One sample was fixed for dissolved oxygen, using the Azide Modification of the Winkler Method, and the other sample was collected for pH, conductivity, salinity, suspended solids, and turbidity. Samples were submitted to the Maryland Water Resources Administration laboratory in Annapolis for analyses.

b. Sampling by Environmental Protection Agency Personnel Assisted by Maryland Fisheries Administration Personnel

The Federal Environmental Protection Agency, with the assistance of the Maryland Fisheries Administration, including Project AFC-8 personnel, conducted water quality surveillance on the Potomac River from January 25 to June 30, 1971. The sampling area extended from the river mouth at Point Lookout to

Washington, D.C. at Key Bridge. A total of 27 river sites were investigated.

Both surface and sub-surface water samples were taken at each site and the surface and sub-surface water temperatures recorded. Secchi disk readings and sub-surface sample depths were also recorded. The samples were analyzed by the EPA laboratory in Annapolis. Parameters for both surface and sub-surface samples consisted of dissolved oxygen, total phosphates, inorganic phosphates, total Kjeldahl nitrogen, nitrite-nitrates, ammonia, and total organic carbon. Chlorophyll-a was an additional, exclusively surface sample parameter.

2. Segment Three: Upper Chesapeake Bay Drainage

Water quality sampling was conducted in the Upper Chesapeake Bay drainage study area from May 2 to June 8, 1972. Eight sampling sites were located on the Chesapeake Bay, and 156 sampling sites were established on various level tributaries throughout the study area. The Chesapeake Bay sites, located along the mid-channel of the Bay, extended from Pooles Island to Concord Point at the mouth of the Susquehanna River. Other estuarine tributary waters were also sampled along their mid-channels.

Three surface water samples were taken at each sampling site and the surface water temperature recorded. One sample was fixed for dissolved oxygen (using the Azide Modification of the Winkler Method), a second sample was refrigerated for biochemical oxygen demand, and the third sample was collected for pH, conductivity, salinity, suspended solids, turbidity, and total alkalinity. Samples were submitted to the Maryland Water Resources Administration laboratory for analyses.

3. Segment Five: Additional Potomac River and Upper Chesapeake Bay Tributaries

Potomac River and Upper Chesapeake Bay streams having anadromous fish potential but not previously investigated in study segments 1,2,3, or 4, were investigated in study segment five. Also investigated in study segment five were some special cases of previously investigated Potomac River and Upper Bay streams.

In the Potomac River drainage from May 30 to June 6, 1974, water quality samples were taken at 44 sites on 32 streams. In the Upper Bay study area from June 4 to June 8, 1974, water quality samples were taken at 33 sites on 33 streams. Three trap/plankton sites on three Upper Bay drainage streams were not sampled for water quality due to stream inaccessibility at the time of sampling.

Upper Bay study area parameters were the same as for segment three. Sampled parameters included temperature, dissolved oxygen, biochemical oxygen demand (BOD), pH, conductivity, salinity, suspended solids, dissolved solids, turbidity, and total alkalinity. Potomac River study area parameters were the same as those taken in segment one, which included all the Upper Bay area parameters except for BOD, dissolved solids, and total alkalinity. Water samples were submitted to the Maryland Water Resources Administration laboratory for analyses.

B. Findings

1. Potomac River Main Stem

Water quality parameter ranges for each sampled station, both surface and sub-surface, are presented in Table X. The date and station having the minimum and maximum recording for each sampled parameter is summarized in Table XI.

a. Surface Water Quality

Temperature

As could be expected, water temperatures increased with rising average air temperature during the sampling period. Minimum and maximum water temperatures were recorded on the earliest and latest sampling dates respectively.

A low of 2.5°C was recorded at station 22 (Woodrow Wilson Bridge) on January 25, 1971, and a high of 29.0°C was taken at the same site on June 30, 1971.

Chlorophyll-a

Chlorophyll-a levels were at a minimum on the earliest sampling dates. Maximum levels for upper stations usually occurred during the latter part of April, then decreased drastically during May and increased again almost to peak recordings by the end of June (termination of sampling). At station 9 (Lower Cedar Point) a steady growth of Chlorophyll-a was experienced throughout the sample period, reaching a maximum at the end of June. The area below station 9 peaked the latter part of May and usually decreased to very low levels by the end of June.

A minimum level of 2.3 ug/l was recorded on March 29, at stations 27 (Key Bridge) and 25 (14th street bridge). The maximum recording for the river was 356.3 ug/l and occurred at station 2 (Piney Point) on May 27. Other sites with levels over 80.0 ug/l were as follows: station 1 (Point Lookout) - 291.8 ug/l; station 3 (Herring Creek) - 172.5; station 5 (St. Clement Bay) - 128.3; station 9 (Lower Cedar Point) - 80.3; station 10 (Rt. 301 Bridge) - 123.0; station 17 (Indianhead) - 104.3; station 18 (Pomonkey Creek) - 102.8; and station 27 (Key Bridge) - 83.3.

TABLE X. WATER QUALITY PARAMETER RANGES FOR THE POTOMAC RIVER: 1971

Station	Location	River Mile	Dates (1971)	Depths (ft.)	Temperature (°C)	Chlorophyll a µg/l	Salinity (ppt)	Secchi Disc Inches	Total Phosphate mg/l PO_4	Inorganic Phosphate mg/l PO_4	Total Kjeldahl Nitrogen mg/l N	Nitrite + Nitrate mg/l NO_3-N	Ammonia Nitrogen mg/l N	Dissolved Oxygen mg/l	Total Organic Carbon mg/l C
1	Point Lookout	00.0	(3)3/31-6/28 2/	S 1/ 35-40	7.9-27.4 9.3-22.1	12.8-271.8	6.53- 9.64 10.25-14.15	24-80	0.092-0.412 0.113-0.681	0.040-0.051 0.042-0.156	0.345-2.467 0.425-2.572	0.001-0.348 0.023-1.500	0.009-0.134 0.110-0.519	7.5-11.7 5.5-11.8	3.65-11.25 2.80- 5.13
2	Piney Point"30" 1/	14.8	(3)3/31-6/25	S 35-40	9.0-27.9 7.7-21.6	12.0-356.3	6.35- 9.15 9.80-12.56	24-45	0.121-0.419 0.113-0.[illegible]	0.045-0.071 0.035-0.048	0.576-2.746 0.539-2.109	0.011-0.503 0.042-0.485	0.00 0.169 0.053-[illegible]	7.4-11.2 1.0-11.2	3.23- 9.21 2.29- 3.37
3	Herring Cr."31"	20.4	(3)3/31-6/25	S 30-35	7.[illegible]-28.1 7.9-21.1	4.3-172.9	3.70- 7.39 9.40-12.0[illegible]	30-36	0.174-0.276 0.149-0.430	0.055-0.179 0.049-0.252	0.480-1.612 0.626-1.120	0.[illegible]-0.626 0.[illegible]-0.572	0.011-0.283 0.134-0.[illegible]	10.4-12.7 3.4-10.6	3.43- 5.78 3.64- 3.24
4	St. Clement Bay"2"	29.3	(3)3/14-6/28	S 15-20	15.2-27.3 15.7-24.8	35.0- 38.3	4.70- 7.10 6.00- 8.34	26-44	0.142-0.201 0.091-0.247	0.045-0.073 0.044-0.034	0.65 -1.052 0.519-0.704	0.014-0.200 0.017-0.042	0.040-0.274 0.037-0.241	7.8- 9.1 0.7- 7.3	3.82 2.29
5	St. Clement Bay"32"	25.5	(2)3/31-5/27	S 20	7.4-20.0 7.5-18.1	10.5-128.3	6.76- 7.50 9.03- 9.50	24-26	0.157-0.201 0.082-0.175	0.054-0.179 0.044-0.175	0.577-1.483 0.5[illegible]-0.5[illegible]	0.001-0.516 0.033-0.521	0.007-0.257 0.042-0.252	10.9-12.4 9.8-10.5	4.44- 4.76 2.43- 3.31
6	Wicomico River "Bluff Point"	33.1 0.8	(2)3/27-5/25	S 10	20.6-28.1 19.2-24.5	17.3- 21.8	5.85- 6.71 7.63- 7.64	24-36	0.142-0.315 0.203-0.254	0.062-0.059 0.040-0.064	0.521-0.840 0.404-0.984	0.011-0.097 0.012-0.127	0.044 0.020-0.042	4.1-13.1 2.8- 5.3	3.17 3.09
7	Wicomico River"14"	35.1	(3)3/31-6/25	S 15-20	7.5-27.9 7.4-24.3	7.9- 66.8	5.43- 7.30 7.57- 8.34	30-36	0.159-0.285 0.123-0.313	0.041-0.193 0.059-0.401	0.613-1.205 0.477-0.559	0.001-1.210 0.001-0.639	0.015-0.245 0.012-0.262	10.0-12.8	3.54- 4.12
8	Neale Sound"N"	39.0	(4)3/30-6/28	S 15-20	6.9-27.2 7.3-23.2	7.9- 23.3	4.31- 5.90 5.75- 8.44	30-60	0.147-0.2[illegible] 0.139-0.22	0.034-0.247 0.057-0.435	0.132-0.893 0.288-0.765	0.120-0.757 0.001-0.393	0.055-0.102 0.039-0.128	1.8-10.7 6.4-10.4	3.17- 6.09 4.01- 5.[illegible]
9	Lower Cedar Pt."30"	47.0	(5)3/30-6/25	S 30-40	6.8-27.8 6.8-23.7	3.8- 80.3	3.06- 4.49 4.07- 5.66	12-24	0.275-0.395 0.252-0.335	0.156-0.304 0.138-0.305	0.639-0.963 0.465-0.984	0.181-1.000 0.056-0.254	0.037-0.356 0.032-0.325	5.8-12.7 9.4-10.4	3.72- 4.56 2.58- 5.43
10	Rt. 301 Bridge"X"	48.8	(9)3/30-6/29	S 20-38	7.0-25.3 7.1-24.7	6.8-129.0	1.20- 1.70 2.60- 5.33	12-19	0.316-0.456 0.551-0.215	0.157-0.414 0.154-0.428	0.354-1.069 0.333-1.150	0.211-1.150 0.149-1.013	0.047-0.405 0.092-0.518	8.3-10.5 2.3-10.5	3.02- 6.71 3.15- 6.43
11	Port Tobacco River "6"	55.5	(3)4/27-6/29	S 30-40	15.0-25.7 14.5-25.4	9.0- 27.0	0.80- 3.35 1.03- 5.22	8-24	0.349-0.614 0.420-1.252	0.255-0.430 0.223-0.412	0.255-0.643 0.455-1.203	0.460-1.071 0.233-1.068	0.041-0.363 0.225-0.405	4.4- 5.8 2.2- 8.3	3.64- 5.95 3.18- 6.11
12	Nanjemoy Creek"13"	57.0	(9)3/30-6/29	S 15-27	7.3-25.0 7.2-25.1	9.0- 43.0	0.23- 2.35 0.24- 3.60	8-23	0.499-0.549 0.545-1.476	0.329-0.433 0.264-0.464	0.461-0.908 0.406-1.135	0.570-2.220 0.255-2.250	0.029-0.568 0.140-0.575	5.4-10.7 2.6-10.7	3.22- 6.29 3.05- 6.75
13	Maryland Point	63.8	(10)3/30-6/29	S 20-45	7.6-27.4 7.6-27.1	9.0- 35.3	0.07- 1.49 0.10- 2.32	6-20	0.453-0.504 0.694-1.002	0.324-0.453 0.331-0.469	0.354-0.992 0.515-1.271	0.723-1.000 0.543-1.023	0.025-0.653 0.223-0.602	4.4-10.9 3.3-10.9	3.64- 6.13 3.92-10.47
14	Smith Point	70.5	(9)3/30-6/29	S 20-30	7.6-27.8 7.4-27.7	10.5- 35.3	0.10- 0.53 0.20- 0.70	20-19	0.467-0.757 0.600-1.035	0.365-0.467 0.337-0.453	0.353-0.926 0.400-1.243	0.835-1.170 0.356-1.233	0.031-0.607 0.027-0.542	4.2-10.7 3.9-10.6	3.19- 7.55 2.63- 8.57
15	Sandy Point	75.6	(10)3/30-6/29	S 25-35	7.4-27.5 7.3-27.6	7.9- 42.0	0.10- 0.50 0.10- 0.50	12-26	0.354-0.705 0.650-1.176	0.325-0.455 0.345-0.427	0.462-0.882 0.412-1.400	0.773-1.149 0.315-1.140	0.015-0.622 0.016-0.595	5.7-10.5 5.0-10.7	3.15- 6.19 3.15- 6.29
16	Chicamuxen Creek"44"	79.1	(10)3/30-6/29	S 20-32	7.9-28.2 9.0-27.9	21.0- 59.0	0.00- 0.40 0.00- 0.53	12-24	0.410-0.925 0.563-0.734	0.287-0.448 0.371-0.4[illegible]	0.497-1.126 0.527-1.203	0.578-1.150 0.552-1.950	0.032-0.665 0.036-0.720	4.6-10.6 5.5-10.8	2.35- 6.71 4.20- 5.90
17	Indian Head"64"	85.1	(10)3/30-6/29	S 35-50	7.9-25.9 8.4-22.2	15.0-104.3	0.04- 0.35 0.20- 0.45	14-24	0.472-0.827 0.654-0.991	0.324-0.483 0.344-0.524	0.851-1.225 0.73[illegible]-1.225	0.424-1.470 0.[illegible]-1.070	0.039-0.733 0.281-0.722	5.3-10.4 4.3-10.2	1.29- 6.10 2.25- 6.54
18	Mattawoman Creek"62"	89.2	(10)3/30-6/29	S 20-40	7.9-25.9 7.7-25.9	21.0-107.8	0.20- 0.45 0.10- 0.35	24-17	0.493-0.673 0.647-0.849	0.344-0.490 0.352-0.491	0.940-1.279 0.633-1.559	0.590-1.070 0.547-1.220	0.263-0.517 0.223-0.793	5.2-10.4 4.4-10.3	2.24- 6.52 2.10- 8.64
19	Marshall Hall"58"	93.5	(10)3/30-6/29	S 20-40	8.5-28.5 8.5-22.4	16.5- 65.3	0.00- 0.17 0.00- 0.50	8-18	0.551-0.831 0.522-0.885	0.355-0.529 0.322-0.515	1.189-1.652 1.032-1.576	0.457-0.905 0.404-0.975	0.577-1.120 0.544-1.260	6.2-10.4 5.3-10.3	3.57- 6.91 2.42- 6.08
20	Piscataway Creek "77"	97.2	(10)3/29-6/30	S 25-60	8.0-28.0 8.0-28.0	8.5- 47.3	0.00-0.30 0.00-0.30	14-23	0.587-1.122 0.615-1.435	0.510-0.945 0.501-0.405	0.872-2.209 1.093-1.953	0.241-1.220 0.251-1.240	0.457-1.570 0.440-1.621	2.7-10.2 5.7-10.1	2.10- 6.53 4.03-10.24
21	Broad Creek"85"	100.4	(11)1/25-6/30	S 25-40	2.5-28.5 3.5-28.0	8.5- 42.0	0.00-0.30 0.00-0.30	13-24	0.[illegible]-2.1[illegible] 0.[illegible]-2.076	0.555-1.170 0.571-1.200	2.155-2.461 2.17[illegible]-2.436	0.229-1.270 0.227-1.240	0.562-1.086 0.455-1.[illegible]	1.8-13.2 3.4-12.7	2.74-10.48 3.10-10.61
22	Woodrow Wilson Br.	103.6	(12)1/25-6/30	S 25-35	3.5-29.0 3.0-28.5	7.0- 33.8	0.00-0.33	12-30	0.363-2.115 0.329-2.225	0.353-1.330 0.354-1.330	0.431-3.523 0.234-3.203	0.223-1.360 0.225-1.325	0.130-2.052 0.221-2.141	2.7-13.9 2.3-13.3	2.30- 8.59 1.37- 8.63
23	Bellevue"8" (Coon Cr.)	105.0	(11)1/25-6/30	S 20-30	3.0-29.0 3.5-28.0	5.5- 41.3	0.00-0.30 0.00-0.30	18-36	0.270-1.722 0.523-1.467	0.235-1.250 0.244-1.965	0.212-1.210 0.635-1.793	0.241-1.350 0.238-1.320	0.347-1.163 0.153-1.084	5.7-14.0 5.3-13.2	2.75- 8.84 1.32- 9.75
24	Anacostia River (Poison Pt.)	107.8	(10)3/29-6/30	S 10-34	8.0-28.0 9.0-28.0	5.5- 59.3	0.00-0.30 0.00-0.30	8-27	0.270-0.451 0.146-0.938	0.052-0.206 0.040-0.166	0.127-0.900 0.424-1.192	0.284-1.110 0.240-1.020	0.110-0.231 0.[illegible]-0.733	4.4-11.8 4.5-11.9	1.10- 7.92 3.15- 7.12
25	14th Street Br.	109.9	(4)3/29-6/30	S 10-15	8.0-23.0 27.0	2.3- 63.3		8-30	0.152-0.440 0.243-0.377	0.027-0.197 0.032-0.313	0.267-0.673 0.537-0.770	0.242-1.070 0.232-1.320	0.045-0.110 0.0[illegible]-0.142	6.2-11.7 4.9-11.9	1.47- 7.80 1.15- 8.27
26	Memorial Bridge	111.0	(8)3/29-6/10	S 10-25	8.5-24.4 24.5	5.8- 64.5		8-48	0.111-0.209 0.120-0.552	0.037-0.076 0.044-0.313	0.233-0.711 1.052	0.267-[illegible] 0.211-1.250	0.[illegible]-0.079 0.0[illegible]-0.128	[illegible] 6.7-11.6	1.[illegible]- 6.97 1.05-11.32
27	Key Bridge	112.6	(5)3/29-6/30	S 15-20	9.0-28.0 9.0-23.0	4.3- 83.3		22-42	0.103-0.473 0.121-0.647	0.044-0.271 0.044-0.272	0.159-0.895 0.133-0.749	0.188-1.040 0.245-1.150	0.072-1.073 0.039-0.080	5.0-11.5 5.4-11.6	2.41- 8.34 1.91-11.20
Ranges	Surface	00.0 112.6	(5-12) 1/25-6/30	S	2.5-29.0	2.3-356.3	0.00-9.66	6-80	0.072-2.156	0.027-1.370	0.041-2.527	0.001-2.220	0.007-2.050	1.8-14.0	1.18-11.28
	Subsurface			10-60	3.5-23.9		0.00-14.15		0.082-2.123	0.037-1.850	0.133-2.350	0.001-1.950	0.016-2.141	3.2-13.5	1.05-11.32

1/ " " Designates [illegible] buoy numbers or letters.
2/ ( ) Designates number of dates sampled.
3/ [illegible]

TABLE XI.

MINIMUM-MAXIMUM RECORDINGS FOR POTOMAC RIVER WATER QUALITY PARAMETERS: 1971

	Surface H_2O Quality [1]		Subsurface H_2O Quality [1]			
	Minimum	Maximum	Minimum	Depth[2] (ft.)	Maximum	Depth[2] (ft.)
Temperature (°C)	2.5 1/25/72 Sta. 22	29.0 6/30/72 Sta. 22	3.0 1/25/72 Sta. 22	25	28.5 6/30/72 Sta. 22	20
Chlorophyll a as µg/l	2.3 3/29/72 Sta. 27	356.3 5/27/72 Sta. 2				
Salinity (ppt)	0.00 4/22/72 Sta. 15,16, 19-23	9.64 5/27/72 Sta. 1	0.00 4/22/72 Sta. 16,19-24	NA	14.15 6/28/72 Sta. 1	40
Secchi disc (inches)	6 4/27/72 Sta. 13	80 3/31/72 Sta. 1				
Total phosphates as mg/l PO_4	0.092 3/31/72 Sta. 1	2.156 4/26/72 Sta. 22	0.082 5/27/72 Sta. 5	20	2.120 6/30/72 Sta. 22	20
Inorganic phosphates as mg/l PO_4	0.037 4/26/72 Sta. 25,26	1.370 6/30/72 Sta. 21	0.032 4/26/72 Sta. 25	15	1.830 6/30/72 Sta. 22	20
Total kjeldahl nitrogen as mg/l N	0.098 5/24/72 Sta. 25	2.807 4/26/72 Sta. 22	0.133 3/29/72 Sta. 27	20	2.800 6/30/72 Sta. 22	20
Nitrite - Nitrate as mg/l NO_3 - N	0.001 5/72 & 6/72 Sta, 1,3,5,7	2.220 3/30/72 Sta. 12	0.001 6/28/72 Sta. 7,8	15 20	3.960 3/30/72 Sta. 16	20
Ammonia as mg/l N	0.007 5/27/72 Sta. 5	2.050 4/26/72 Sta. 22	0.016 6/29/72 Sta. 15	25	2.141 6/30/72 Sta. 22	20
Dissolved Oxygen as mg/l	1.8 6/30/72 Sta. 21	14.0 1/25/72 Sta. 23	0.2 6/28/72 Sta. 3	30	13.6 1/25/72 Sta. 22	25
Total organic carbon as mg/l	1.18 3/29/72 Sta. 24	11.28 5/27/72 Sta. 1	1.05 3/29/72 Sta. 26	10	11.32 5/24/72 Sta. 26	15

1/ Stations and dates given for minimum and maximum recordings

2/ Water depth given for minimum and maximum recordings

Salinity

Waters with salinities of less than 0.5 (ppt) have been considered as fresh in some literature. Using this criteria, all Potomac River waters (surface and subsurface to a depth of 50 feet on May 14, and 33 feet on June 10) north of station 17 (Indianhead) were fresh for the duration of the sampling period (January through June).

Minimum salinities of 0.00 (ppt) were recorded in a long reach from station 24 (Anacostia River mouth) downriver to station 19 (Marshall Hall) and again at sta- 16 (Chicamuxen Creek) and 15 (Sandy Point) on April 22. The maximum surface salinity was 9.64 (ppt), recorded at station 1 (Point Lookout) on May 27.

Secchi Disc

Secchi disc readings were 24 inches or more throughout the sample period from station 1 upriver through station 8 (river mile 39.0). Readings of 24 inches or less, indicating more turbid conditions, were in evidence during the sample period from stations 9 to 27, excepting station 15 where a 26 inch maximum was noted.

The maximum secchi disc observation for the entire river was 80 inches at station 1 on March 31. The minimum depth (read) was 6 inches at station 13 (Maryland Point) on April 27.

Total Phosphates

In general, average phosphate levels were highest in the area of stations 21 (Broad Creek) and 22 (Woodrow Wilson Bridge). These sites are immediately below the Blue Plains sewage treatment plant that serves the Washington, D.C. metropolitan area. Surface phosphates were relatively low both upriver from station 26 (Memorial Bridge) and from stations 1 through 8 (Neale Sound).

A surface maximum of 2.156 mg/l PO_4 was taken at station 22 on April 26. A minimum of 0.092 mg/l PO_4 was recorded at station 1 on March 31.

Inorganic Phosphates

Inorganic phosphates reached the highest levels from station 20 (Piscataway Creek) to station 23 (Bellvue). This area is in the immediate vicinity of Blue Plains sewage treatment plant. Low average surface

quantities were analyzed in samples taken from stations 1 through 7 and in the river north of station 24 (Anacostia River mouth).

The lowest level was 0.037 mg/l PO_4 sampled from station 26 on April 26. The highest inorganic phosphate content was 1.370 mg/l PO_4 at station 21 on June 30.

Total Kjeldahl Nitrogen

Total kjeldahl nitrogen readings were highest in a reach from stations 19 to 23. Recordings decreased from station 19 downriver to station 10. Levels then increased from station 10 to near maximums at station 1. Lowest levels were contained in the areas upriver from station 23.

Minimum TKN content was 0.098 mg/l N registered from the station 25 sample on May 24. The maximum reading was recorded not far downriver, at station 22 immediately below Blue Plains. The April 26 sample taken at that station yielded 2.807 mg/l N.

Nitrite-Nitrate

Nitrite-nitrate levels were lowest at downriver stations 1 through 5 and in the Wicomico River at station 6.

The maximum reading of 2.220 mg/l NO_3-N at station 12 (Nanjemoy Creek) on March 30 was more than double the highest level obtained at stations 11 or 13. Minimum analyses of 0.001 mg/l NO_3-N were recorded at four surface stations during the latter part of May and June. These stations were: 1; 3 (Herring Creek); 5 (St. Clement Bay); and 7 (Cobb Island Light-Wicomico River).

Ammonia

The highest ammonia nitrogen levels were centered in the reach from stations 19 to 23. Overall values were consistently low in the upper portion of the tested area above station 24. Additionally, the values for surface samples decreased dramatically as the distance increased downriver from station 22 (vicinity of Blue Plains sewage treatment plant).

The maximum level recorded was 2.050 mg/l N sampled at station 22 on April 26, while the minimum was 0.007 mg/l N recorded at station 5 on May 27.

Dissolved Oxygen

Dissolved oxygen recordings were rounded off to the nearest tenth of one per cent. Surface dissolved oxygen below 5.0 mg/l were reported at stations 6, 11, 13, 14, 16, 20, 21, 22, and 24. Dissolved oxygen levels below 3.0 mg/l were reported at stations 20, 21, and 22, with the minimum for the entire river of 1.8 mg/l recorded at station 21 on June 30. Blue Plains sewage treatment plant is immediately upstream from station 22 which probably influences oxygen levels. The maximum surface dissolved oxygen was 14.0 mg/l taken at station 23 on January 25. This is slightly over 100 per cent saturation at the 3.0°C temperature reported for the sample time.

Total Organic Carbon

Station 22 has the highest organic carbon level in its vicinity. The maximum recording, however, is from station 1. Station 1 had 11.28 mg/l C reported on May 27, the last time TOC was analyzed at this site. The high carbon level coincides with the highest chlorophyll-a reading for that station on the same date. The minimum TOC level was 1.18 mg/l C recorded at station 24 on March 29.

b. Subsurface Water Quality

The subsurface water quality characteristics followed the same general trends as the surface layer (Table X). All subsurface samples were not collected from the same depth. In addition, the following general differences in surface and subsurface water quality should be noted. Below station 14 (Smith Point) stratification due to salinity is apparent with most of the subsurface minimum-maximum recordings exceeding surface readings for the same stations.

At stations 1 through 3 subsurface ammonia maximums were more than double the surface levels. Subsurface dissolved oxygen minimums were severely depressed also indicating stratification. Sites with minimum recorded dissolved oxygen less than 3.0 mg/l were: 1, 2, 3, 4, 6, 8, 9, 10, 11, 12, and 22. Dissolved oxygen of 1.0 mg/l or less was noted at stations 1, 2, 3, 4, 8, and 9.

Total organic carbon analyses show maximum readings for the subsurface samples at stations 1 through 3 to be significantly less than sur-

face samples. At station 1 subsurface carbon levels were 45 percent of the surface reading, while stations 2 and 3 were 35 percent and 66 percent, respectively of surface recordings. Recordings may be accounted for by the elevated surface chlorophyll-a that was found at stations 1 through 3.

c. Fisheries Significance of Water Quality

Information indicates the primary spawning area in the river for striped bass and American shad is determined by salinity gradients. These species selected the area immediately upriver of the freshwater-saline interface, here considered as 0.5 (ppt). This places the majority of all river spawning of anadromous species in the area north of Nanjemoy Creek during this study. The principal spawning species include the white perch and the clupeids, which also spawn extensively in small freshwater streams.

The great majority of striped bass spawning, based on plankton analysis, extended upriver to station 18 (plankton station) with only a mid-June confirmation at stations 21 and 22 (plankton stations 12 and 13) recorded beyond this point. American shad were documented primarily upriver to station 20 (plankton station 11). These upstream limits of two commercially important species may be produced by the area of undesirable water quality below the Washington, D.C. metropolitan area and the Blue Plains sewage treatment plant discharging in the vicinity of stations 21 and 22.

The chemical factors most affecting fish propagation are probably combinations of pH (not analyzed), ammonia nitrogen, and dissolved oxygen. High nutrient levels (salts) are contributed primarily by the Blue Plains plant. The possibility also exists of heavy metals contamination of water discharged in this area.

Even the species which may migrate beyond the affected area to spawn, such as the white perch and clupeid herrings, subject their eggs and larvae to the stress that can be created by poor water quality conditions.

B. Findings cont'd

2. Potomac River Drainage Tributaries

a. Surface Water Quality

Results for the water quality analyses of the Potomac River drainage tributaries are summarized in Table XII. The ranges for the 175 sampled stream sites are as follows:

pH	5.1-7.8
Water Temperature (^{o}C)	9.4-26.1
Conductivity (umhos/cm)	40-20,000
Salinity (ppt)	<0.1-12.0
Dissolved Oxygen (ppm)	1.4-13.4
Turbidity (JTU or ppm)	1-700
Suspended Solids (ppm)	1-520

pH

The 5.1 minimum pH recording was taken on Western Branch in the St. Mary's River drainage. The 7.8 maximum pH recording was taken on Fisherman Creek also in the St. Mary's River drainage. The majority of pH readings of 6.0 and less were taken on streams located in the Lower Potomac River Area Sub-basin. Low pH recordings were probably attributable to drainage from wooded swamp habitat in this area.

Water Temperature

The lowest water temperature recording was 9.4^{o}C, taken on Church Creek in the St. Mary's River drainage on May 3, 1971. The generally lower water temperatures in the St. Mary's River drainage can be attributed to the fact that sampling was conducted earliest in the season in the St. Mary's River drainage. The maximum water temperature recording was 26.1^{o}C, taken on Oxon Run in the Washington D.C. South Area Drainage on May 19, 1971.

Conductivity

Minimum and maximum conductivities were recorded in the St. Mary's River drainage. The minimum conductivity reading of 40 umhos/cm (<0.1 ppt salinity) was recorded on Western Branch. The maximum conductivity

TABLE XII

WATER QUALITY PARAMETER RANGES FOR POTOMAC RIVER DRAINAGE TRIBUTARIES

DRAINAGE	NO. STREAMS INVESTIGATED	NO. SITES IN DRAINAGE	SAMPLE DATES	pH	WATER TEMPERATURE (°C)	CONDUCTIVITY µMHOS/CM	SALINITY (PPT)	DISSOLVED OXYGEN (PPM)	TURB. (PPM)	SUSP. SOLIDS (PPM)
02-14-01: LOWER POTOMAC RIVER AREA SUB-BASIN										
SUB-SUB BASINS:										
03: St. Mary's River Dr.	11	15	5-03-71, 6-03-74	5.1-7.8	9.4-17.0	40-20,000	<0.1-12.0	6.8-13.4	2-14	4-17
05: Breton Bay Dr.	9	13	5-04-71, 6-03-74	5.8-7.2	10.6-17.0	60-220	<0.1-0.1	7.9-12.7	2-22	1-15
06: St. Clement Bay Dr.	6	11	5-05-71, 6-03-74	5.6-7.5	13.9-18.0	70-200	<0.1-0.1	7.9-12.8	1-32	1-38
07: Wicomico River Dr.	15	18	5-6,12,13,14,26-71 6-03-74, 6-04-74	5.2-7.3	13.9-24.7	60-7,900	<0.1-4.5	1.4-11.4	2-23	2-166
08: Gilbert Swamp Dr.	3	3	5-14-71, 6-05-74	5.6-6.7	16.0-16.1	60-140	<0.1	8.9-9.1	5-220	26-296
09: Zekiah Swamp Dr.	2	2	5-12-71	6.5	15.0	60-180	<0.1	7.8-8.7	6	8-27
10: Port Tobacco River Dr.	6	7	5-13-71, 5-26-71 6-04-74	6.0-7.4	16.1-25.2	50-3,800	<0.1-2.0	7.7-9.3	2-12	7-37
11: Nanjemoy Creek Dr.	9	13	5-10,13,26,30-71 6-06-74	6.0-7.5	16.1-23.8	47-1,750	<0.1-1.0	7.2-9.4	3-11	2-40
12: Mattawoman Creek Dr.	8	18	5-10,12,14,27-71 5-30-74	5.4-7.5	14.4-22.1	50-200	<0.1-0.1	7.0-11.2	3-16	2-36
13: Potomac River Mouth Area Dr.	1	1	6-03-74	6.0	17.0	100	<0.1	7.5	12	40
14: Huggins Point-Strait Point Area Dr.	3	3	6-03-74, 6-06-74	6.0-6.6	18.0-21.0	55-12,500	<0.1-8.2	6.5-7.8	4-11	12-78
15: White Neck Point-Colton Point Area Dr.	1	1	6-03-74	5.7	18.0	160	<0.1	9.3	8	20

TABLE XII

DRAINAGE	NO. STREAMS INVESTIGATED	NO. SITES IN DRAINAGE	SAMPLE DATES	pH	WATER TEMPERATURE (°C)	CONDUCTIVITY µMHOS/CM	SALINITY 'PPT)	DISSOLVED OXYGEN (PPM)	TURB. (PPM)	SUSP. SOLIDS (PPM)
16: Morgantown Area Dr.	6	6	5-12-71, 6-04-74 6-05-75	6.0-6.7	15.0-20.0	60-8,000	<0.1-4.5	8.2-10.7	4-13	2-42
18: Chicamuxen Creek to Riverside Area Dr.	6	6	5-10-71, 5-27-71	6.5-7.5	14.4-21.9	60-190	<0.1	2.8-11.7	4-12	2-21
19: Potomac Heights Area Dr.	2	3	5-10-71, 5-27-71 5-30-74	5.4-7.6	15.0-21.9	59-210	<0.1-0.1	8.1-9.7	14-17	16-32
02-14-02: WASHINGTON METROPOLITAN AREA SUB-BASIN										
SUB-SUB BASINS:										
01: Potomac River Mainstem[1]		Summarized separately at bottom of page								
02: Piscataway Creek Dr.	12	22	5-20-71, 5-21-71 5-27-71	5.9-7.5	11.7-22.9	60-220	<0.1-0.1	7.6-10.4	2-700	4-376
03: Anacostia River Dr.	7	14	5-18-71, 5-27-71 5-30-74	6.7-7.4	13.9-22.8	155-374	<0.1-0.2	3.6-9.3	3-500	3-520
04: Rock Creek Dr.	2	8	5-18-71, 5-30-71	6.7-7.2	17.8-19.5	167-741	<0.1-0.4	6.9-9.1	3-70	2-158
07: Washington D.C. South Area Dr.	8	11	5-19-71, 5-27-71	6.5-7.6	15.6-26.1	140-260	<0.1-0.1	5.4-9.8	1-500	2-252
TOTALS:	117	175								
RANGES:			5-03-71-6-06-74	5.1-7.8	9.4-26.1	40-20,000	<0.1-12.0	1.4-13.4	1-700	1-520
101: Potomac River Mainstem at Little Falls (below and above fishway)	1	2	5-18-71	7.6-7.9	17.5	229-234	0.1	9.4-10.2	9-16	36-92

reading of 20,000 umhos/cm (12 ppt salinity) was recorded on Fisherman Creek.

Salinity

Salinities on the majority of streams investigated were less than 0.1 ppt. The maximum salinity of 12 ppt was recorded on Fisherman Creek. As would be expected, the higher salinity recordings were taken in the lower river drainage. Beginning with the Nanjemoy Creek drainage, all upriver drainages had salinity recordings of 0.1 ppt and less, with the exception of Watts Branch in the Anacostia River drainage and Broad Branch in the Rock Creek drainage. Salinities on these two streams were 0.2 ppt and 0.4 ppt, respectively. Industrial pollutants or chlorinated sewage may have produced these two relatively high salinities.

Dissolved Oxygen

The minimum dissolved oxygen recording of 1.4 ppm was taken on Charleston Creek in the Wicomico River drainage. The low reading can be attributed to low flow conditions and the June 4, 1974 sample date. Other dissolved oxygen values of less than 6.0 ppm were recorded on an unnamed tributary to the Potomac River in the Chicamuxen Creek to Riverside Area drainage (2.8 ppm), on Swan Creek in the Washington D.C. South Area drainage (5.4 ppm), and at two Anacostia River sites (3.6 ppm and 3.8 ppm). The low dissolved oxygen recording on Swan Creek was probably due to storm drain discharge from a marina and residential development in the area. The low dissolved oxygen recordings on the Anacostia River were mid-morning readings typical of the nocturnal dissolved oxygen sag on the urbanized river. The maximum dissolved oxygen recording of 13.4 ppm was taken on the upper reach of the St. Mary's River at St. Andrews Church Road. The generally higher dissolved oxygen values in the lower Potomac River drainage can be attributed to the fact that sampling was conducted earlier in the season in the lower river drainage when water temperatures were lower (oxygen solubility and water temperature are inversely related).

Turbidity

Minimum turbidities of one (1) Jackson Turbidity Unit (JTU or ppm) were recorded on Tomakokin Creek in the St. Clement Bay drainage and Broad Creek in the Washington D.C. South Area drainage. The majority of streams investigated had turbidities of less than 50 JTU, which indicated relatively clear water. The maximum turbidity recording of 700 JTU was taken on an unnamed tributary in the Piscataway Creek drainage and was probably the result of urban development along the watercourse. Other high turbidities were recorded on Gilbert Creek in the Gilbert Swamp drainage (220 JTU), on Carey Branch in the Washington D.C. South Area drainage (500 JTU), and on Northwest Branch in the Anacostia River drainage (500 JTU). The high turbidity on Gilbert Creek reflected recent stream channelization by the Federal Soil Conservation Service. The high turbidity on Carey Branch was probably attributable to residential development in the area. The high turbidity on the Northwest Branch was probably due to the sewage treatment discharge on Rt. 208 in Hyattsville.

Suspended Solids

Minimum recordings for suspended solids of 1 ppm were recorded on Burnt Mill Creek, McIntosh Run, Moldier Run, Nelson Run, and Tom Swamp Run in the Breton Bay drainage. Suspended solids of 1 ppm were also recorded on Locust Run and St. Clement Creek in the St. Clements Bay drainage. The majority of streams investigated had suspended solids readings of less than 50 ppm. The maximum recording for suspended solids of 520 ppm was on the Northwest Branch. Other high recordings for suspended solids were on Gilbert Creek (296 ppm), on an unnamed tributary to Piscataway Creek (376 ppm), and on Carey Branch (252 ppm). High recordings for suspended solids corresponded with high turbidity readings.

General Appearance

General water appearance in the river and in the drainage deteriorated above Piscataway Creek. Often, the water had a disagreeable odor. Probable reasons for the deterioration were sediment discharges, sewage outfalls, and other conditions associated with urban development.

b. Fisheries Significance of Water Quality

In an effort to determine if there is a correlation between water quality and anadromous fish spawning, each water quality parameter is presented below with low and high values (excepting water temperature) and associated anadromous fish presence or absence.

pH

Anadromous fish were not present in the Western Branch which had the 5.1 minimum pH value. Anadromous fish were present, however, in Pomonkey Creek at stream mile 2.1 and also in an unnamed tributary to Mattawoman Creek, both with a pH of 5.4. Mature alewife and white perch and herring eggs and larvae were collected on Pomonkey Creek. Mature alewife and their eggs were collected on the unnamed tributary to Mattawoman Creek.

Anadromous fish were not present in Fisherman Creek which had a 7.8 maximum pH value. Anadromous fish were present, however, in Pomonkey Creek at the mouth where the pH was 7.6. Alewife and white perch adults, eggs, and larvae were collected.

There was no correlation between recorded pH values and anadromous fish spawning.

Water Temperature

After the initial spawning run for a species, the data discounted water temperature as having any prohibitive effect on successive spawning runs. Temperatures were variable but suitable for spawning of all anadromous species during each respective spawning season.

Conductivity/Salinity

Anadromous species spawn the majority of times in waters having a salinity of less than 0.1 ppt. Nevertheless, herring and white perch larvae were collected in Chaptico Bay, having a salinity of 4.4 ppt. Actual spawning, however, may have occurred upstream in Chaptico Creek where the salinity was recorded as less than 0.1 ppt.

Dissolved Oxygen

Anadromous fish were not present in Charleston Creek which had the minimum dissolved oxygen value of 1.4 ppm, nor were they present in Thorne Gut which had a low dissolved oxygen value of 2.8 ppm. Both

streams were relatively small in size. Two other small tributaries in the same river area as Thorne Gut had oxygen values in excess of 9.0 ppm, but also lacked anadromous species documentation.

Other dissolved oxygen values of less than 5.0 ppm were recorded for two sites on the Anacostia River where alewife and white perch spawning was documented. Low flow velocity is probably a greater deterrent to anadromous fish spawning than low dissolved oxygen. Nevertheless, low dissolved oxygen may have adverse effects on egg development and later life stages of anadromous species.

Turbidity and Suspended Solids

Northwest Branch had the highest value for suspended solids (520 ppm) and also a very high turbidity (500 JTU). Alewife and white perch adults and eggs were collected. Turbidity and solids apparently do not prevent spawning of anadromous species. Egg and larval development, however, could be subject to adverse effects from turbidity.

3. Upper Chesapeake Bay Drainage

a. Surface Water Quality

Results for the water quality analyses of the Upper Chesapeake Bay drainage are summarized in Table XIII. The ranges for the 197 stream and Bay sites are as follows:

pH	4.7-8.3
Water Temperature (^{o}C)	4.4-26.7
Conductivity (umhos/cm)	22-4828
Salinity (ppt)	<0.1-2.5
Dissolved Oxygen (ppm)	1.4-14.8
Turbidity (JTU or ppm)	1-3000
Suspended Solids (ppm)	1-32,680

pH

The 4.7 minimum pH recording was taken on an unnamed tributary to Northeast River. Maximum pH recordings of 8.3 were taken on Back Creek and Mill Creek, both in the Sassafras River drainage.

TABLE XIII

WATER QUALITY PARAMETER RANGES FOR THE UPPER CHESAPEAKE BAY DRAINAGE

DRAINAGE	NO. STREAMS INVESTIGATED	NO. SITES IN DRAINAGE	SAMPLE DATE	pH	WATER TEMPERATURE (°C)	CONDUCTIVITY µMHOS/CM	SALINITY (PPT)	DISSOLVED OXYGEN (PPM)	TURB. (PPM)	SUSP. SOLIDS (PPM)
02-12-02: LOWER SUSQUEHANNA RIVER AREA SUB-BASIN										
SUB-SUB BASINS:										
01: Susquehanna River (Below Conowingo Dam)	1	4	5-02-72	7.6-7.7	13.3-13.9	160-170	< 0.1	9.5-9.9	8-20	10-24
02: Deer Creek Dr.	1	2	5-03-72	7.4-7.5	5.5	100	< 0.1	9.5-11.0	10-700	29-9800
03: Octoraro Creek Dr.	5	6	5-03-72, 6-06-74	7.1-7.4	5.5-22.0	130-155	< 0.1	9.6-11.8	1-95	11-146
10: Havre De Grace Area Dr.	3	3	5-03-72, 6-06-74	7.3-7.4	4.4-20.0	75-175	< 0.1	7.9-9.2	700-3000	2-32680
11: Bainbridge Area Dr.	4	4	5-03-72, 6-06-74	6.8-7.2	15.6-18.0	80-240	< 0.1-0.1	7.7-10.1	1-10	10-144
02-13-06: ELK RIVER AREA SUB-BASIN										
SUB-SUB BASINS:										
01: Sassafras River Dr.	19	27	5-24-72, 6-01-72 6-08-72, 6-04-74	5.9-8.3	13.9-26.7	95-369	< 0.1-0.2	8.3-14.8	10-28	3-27
02: Elk River Mainstem	1	3	5-23-72	7.1	19.4-20.0	149-436	< 0.1-0.2	8.0-11.0	42-70	36-112
03: Bohemia River Dr.	12	15	5-23-72, 5-31-72 6-06-72	6.6-7.3	15.6-22.8	84-400	< 0.1-0.2	6.1-10.3	20-62	3-68
04: Back Creek Dr.	3	5	5-27-72, 6-06-72	6.7-7.2	17.8-22.8	119-582	< 0.1-0.3	6.5-8.4	20-30	8-46
06: Northeast River Dr.	11	16	5-02-72, 5-03-72 6-06-74	4.7-7.9	13.9-22.0	25-170	< 0.1	8.6-11.3	1-22	3-412

TABLE XIII

DRAINAGE	NO. STREAMS INVESTIGATED	NO. SITES IN DRAINAGE	SAMPLE DATE	pH	WATER TEMPERATURE (°C)	CONDUCTIVITY µMHOS/CM	SALINITY (PPT)	DISSOLVED OXYGEN (PPM)	TURB. (PPM)	SUSP. SOLIDS (PPM)
07: Furnace Bay Area Dr.	3	5	5-03-72	6.9-7.3	15.0-15.6	85-200	<0.1-0.1	9.1-11.1	5-10	1-2
08: Stillpond-Fairlee Area Dr.	10	19	5-24-72, 5-25-72. 5-26-72, 6-02-72	6.6-7.5	15.0-22.8	74-4828	<0.1-2.5	1.4-12.5	11-32	3-36
10: Crystal Beach Area Dr.	4	5	5-23-72, 5-31-72	5.4-7.4	18.3-22.2	111-1392	<0.1-0.7	8.2-12.3	6-28	12-42
11: Elk Neck (Elk River) Area Dr.	5	7	5-02-72, 5-23-72 6-06-74	4.8-7.1	15.2-20.6	22-388	<0.1-0.2	8.1-10.4	1-40	6-124
12: Port Herman Area Dr.	1	1	6-06-72	7.0	18.3	117	<0.1	7.6	20	9
13: Elk River Headwaters Area Dr.	9	15	5-02-72, 5-23-72 6-06-72	6.9-7.7	15.2-19.4	35-141	<0.1	8.7-12.5	9-15	6-114
02-13-07: BUSH RIVER AREA SUB-BASIN										
SUB-SUB BASINS:										
01: Swan Creek Dr.	2	5	5-04-72	7.2-7.3	14.4-15.0	127-147	<0.1	8.7-9.4	11-15	18-50
02: Bush River Dr.	11	16	5-04-72, 5-05-72 5-06-72, 6-04-74	6.6-7.2	12.2-18.0	76-941	<0.1-0.5	7.1-12.9	8-89	4-390
03: Bynum Run Dr.	1	2	5-04-72	7.0-7.1	15.0-16.1	126-130	<0.1	8.3-9.8	50-70	168-986
04: Winters Run Dr.	1	2	5-05-72	6.4-7.0	14.4-15.0	124-135	<0.1	7.8-10.2	9-15	36-66
05: Aberdeen Proving Ground Area Dr.	4	4	6-08-74	5.9-6.9	16.0-17.0	55-340	<0.1-0.2	7.2-7.8	7-18	12-52

TABLE XIII

DRAINAGE	NO. STREAMS INVESTIGATED	NO. SITES IN DRAINAGE	SAMPLE DATE	pH	WATER TEMPERATURE (°C)	CONDUCTIVITY µMHOS/CM	SALINITY (PPT)	DISSOLVED OXYGEN (PPM)	TURB. (PPM)	SUSP. SOLIDS (PPM)
02-13-08: GUNPOWDER RIVER AREA SUB-BASIN										
SUB-SUB BASINS:										
01: Gunpowder River Dr.	3	4	5-08-72, 6-04-74	6.7-7.2	18.3-19.5	180-480	<0.1-0.2	6.7-8.6	6-56	8-98
02: Gunpowder Falls Dr.	5	7	5-05-72, 6-04-74	6.7-8.4	15.6-21.0	124-247	<0.1-0.1	9.2-11.3	4-20	2-56
03: Little Gunpowder Falls Dr.	1	3	5-05-72	7.1-7.2	12.8-13.9	120-128	<0.1	11.4-16.0	10-25	26-80
04: Bird River Dr.	5	9	5-05-72, 5-08-72 6-04-74	5.7-7.4	13.9-20.1	124-306	<0.1-0.2	6.6-9.3	7-150	4-132
02-13-99: CHESAPEAKE BAY PROPER SUB-BASIN										
SUB-SUB BASIN:										
99: Upper Chesapeake Bay (Above Old Bay Bridge)	1	8	5-02-72, 5-05-72 5-09-72	7.0-7.4	13.9-16.7	160-245	<0.1-0.1	7.2-11.5	10-20	1-33
TOTALS:	126	197								
RANGES: [1]			5-02-72, 6-06-74	4.7-8.3	4.4-26.7	22-4828	<0.1-2.5	1.4-14.8	1-3000	1-32680

[1] B.O.D. range for the 197 sampled stream sites was 0.4-28.0 ppm

Water Temperature

Minimum water temperature recordings of 4.4°C were taken on Herring Run and Rock Creek in the Havre de Grace Area drainage on May 3, 1972. These were the only two streams sampled in the Havre de Grace Area on May 3, 1972. Rock Run, in the Bainbridge Area drainage, was sampled May 3, 1972 and had a reading of 15.6°C. The maximum water temperature recording of 26.7°C was taken on Island Creek in the Sassafras River drainage on May 24, 1972.

Conductivity/Salinity

The majority of streams investigated had salinities of less than 0.1 ppt. Only seven of the 126 streams sampled had salinities greater than 0.5 ppt. These seven streams were located in the Stillpond-Fairlee Area drainage and the Crystal Beach Area drainage. These streams are in the lower portion of the Upper Chesapeake Bay drainage where higher salinities would be expected. Tims Creek, in the Stillpond-Fairlee Area drainage, had the maximum recorded salinity value of 2.5 ppt.

Dissolved Oxygen

The minimum dissolved oxygen recording of 1.4 ppm was taken on Codjus Cove in the Stillpond-Fairlee Area drainage. All other dissolved oxygen recordings were over 6 ppm. The maximum value for dissolved oxygen of 14.8 ppm was taken on the Sassafras River.

Turbidity

Minimum turbidities of one (1) JTU were recorded on Love Run and an unnamed tributary to Octoraro Creek in the Octoraro Creek drainage, on Happy Valley Branch and an unnamed tributary to the Susquehanna River in the Bainbridge Area drainage, on an unnamed tributary to the Northeast River in the Northeast River drainage, and on an unnamed tributary to the Gunpowder River in the Elk Neck Area drainage. The majority of streams investigated had turbidities of less than 50 JTU, which indicated relatively clear water. The maximum turbidity recording of 3000 JTU was taken on Rock Creek in the Havre de Grace Area drainage. Other high turbidities were recorded on Herring Run (700 JTU) in the Havre de Grace Area drainage and on Deer Creek (700 JTU) in the Deer Creek drainage.

Suspended Solids

Minimum recordings for suspended solids of one (1) ppm were recorded on Furnace Bay, Mill Creek, and Principio Creek in the Furnace Bay Area drainage. Suspended solids of one ppm were recorded on the Chesapeake Bay at Worton Point. The maximum recording for suspended solids of 32,680 ppm was taken on Rock Creek in the Havre de Grace Area drainage. Other high values for suspended solids were recorded on Herring Run (7320 ppm) in the Havre de Grace Area drainage, on Deer Creek (9800 ppm) in the Deer Creek drainage, and on Bynum Run (986 ppm) in the Bynum Run drainage.

b. Fisheries Significance of Water Quality

Water quality parameters, except for water temperature, are presented below with low and high values and associated anadromous fish presence or absence.

pH

Anadromous fish were not present at the sampling site having the 4.7 minimum pH value, located on an unnamed tributary to the Northeast River. Anadromous fish were present, however, in Plum Creek at stream mile 2.0 where the pH was 4.8. Herring and white perch eggs were collected at the Plum Creek site.

Anadromous fish were present at both sampling sites having the 8.3 maximum pH value, located on Back Creek at the mouth and Mill Creek at stream mile 0.9. Herring and white perch were collected at the Back Creek site. White perch adults and eggs and yellow perch adults were collected at the Mill Creek site.

There was no correlation between recorded pH values and anadromous fish spawning.

Conductivity/Salinity

From the standpoint of salinity, the entire Upper Chesapeake Bay drainage has spawning potential. Eggs of anadromous species are usually found in waters having a salinity of less than 0.5 ppt. Anadromous fish larvae were found in all seven of the streams that had sampling sites where the salinity was greater than 0.5 ppt. Clupeid, white perch, and yellow perch larvae were collected at the sampling site having the 2.5 maximum salinity, located on Tims Creek. Actual spawning on the seven

streams may have occurred in upstream areas of lower salinity.

Dissolved Oxygen

Anadromous fish were present at the sampling site having the minimum dissolved oxygen value of 1.4 ppm, located on Codjus Cove. Clupeid, white perch, striped bass and yellow perch larvae were collected at the site. It is very unlikely that the 1.4 ppm was the mean seasonal value for dissolved oxygen.

Turbidity and Suspended Solids

Rock Creek had the highest value for both turbidity and suspended solids--3,000 JTU and 32,680 ppm, respectively. White perch, yellow perch and blueback herring adults along with herring eggs were collected at the site. Adverse effects to egg and larval development can be speculated.

Part III. Stream Improvement

Introduction:

Stream Improvement for anadromous fish propagation was implemented during Project AFC-8 through Project-initiated Stream Problem Referrals, a citizen-oriented Save Our Streams Program, and a Project-coordinated Blockage Removal/Fishway Construction Program.

A. Stream Problem Referrals

Conditions encountered during the Stream and Water Quality Surveys that appeared to constitute violations of state laws were referred to the appropriate state, county, or local regulatory agency for corrective action. A "Stream Problem Referral Report" was developed to facilitate documenting and referring problem situations (Figure VIII).

The majority of stream problem conditions were referred to either the Maryland Water Resources Administration or the Maryland Department of Health and Mental Hygiene. Tables XIV and XV summarize Stream Problem Referrals for the Upper Chesapeake Bay and Potomac River study areas.

B. Save Our Streams Program

The Anadromous Fish Project is the state sponsor for the Save Our Streams Program. The concept of Save Our Streams (SOS) is to enable private citizens and groups to actively participate in the restoration, conservation, and protection of Maryland waterways. Individuals and/or groups "adopt" streams or stream sections for surveillance and management. Project AFC-8 provides special SOS "Stream Survey Forms" (Figure IX) and the "Stream Problem Referral Reports", along with SOS brochures, to the individuals and organizations adopting streams.

Stream sponsors are encouraged to institute approved measures to correct stream problem situations. Corrective measures include soil stabilization in the watershed, storm water retention, litter removal, and streambank protection. Problem conditions constituting violations of state laws are forwarded through the Anadromous Fish Project to the appropriate regulatory agency for corrective action.

C. Blockage Removal/Fishway Construction Program

During Project AFC-8, the Anadromous Fish Project coordinated a blockage removal and fishway construction program for anadromous fish passage. Agencies involved in the program were the Washington Suburban Sanitary Commission, the Maryland National Capital Park and Planning Commission, and the U.S. Army Corps of Engineers. Five blockage removal/fishway construction projects were completed.

1. Anacostia River Drainage Projects

There were four blockage removal/fishway construction projects in the Anacostia River drainage. The projects were located on the Northwest Branch near 38th Avenue in Hyattsville, on the Northeast Branch near Route 412 in Riverdale, and on Indian Creek and

FIGURE VIII

STATE OF MARYLAND

Form No. AFC-8-SR-8/72

DEPARTMENT OF NATURAL RESOURCES

STATE OFFICE BUILDING
ANNAPOLIS, MD. 21401

BASIN NUMBER: (DNR Use Only) [ ]

REFERRAL NUMBER: (DNR Use Only)

Stream Code			Survey Beginning River Mile				SURVEY Date						Time			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

STREAM PROBLEM REFERRAL REPORT

PROBLEM REFERRED TO: (Name, Title and Address of Responsible Agency Official)

Name and Title_____
Agency_____
Address_____
City *State* *Zip Code*

DNR Use Only

[ ] [ ] [ ] Agency/County SOS Number
21 22 23

[ ] Referral Status

[9] Referral Sent [6]
25 80

PROBLEM LOCATION:

Drainage System_____ Map Attached (Check)_____
Tributary to_____ Stream Name_____
Location_____ County_____
DNR Stream Mile_____

PROBLEM SOURCE: (Name and Address if Applicable)

Name of Individual or_____
Organization:_____
Address_____
City *State* *Zip Code*

PROBLEM DESCRIPTION: (Check Category of Problem)

Constructed Barrier_____ Natural Barrier_____ Stream Alteration_____ Shore/
Floodplain Activities_____ Water Removal_____ Storm Drain_____ Sewage Outfall_____
Residential Waste Condition_____ Refuse Dump_____ Sanitary Landfill Violation_____
Problem: Oil Presence_____ Livestock Presence_____ Sediment_____
Industrial/Governmental Waste Condition (non-Sewage)_____
Water Quality Standards Violation_____ Lab Analysis Attached (Check)_____
Sampled: Date_____ Time_____ Effluent_____ In-stream_____
Other Problem (Specify):_____
Statement of Findings (State Possible Effects if Applicable):_____

PROBLEM INVESTIGATION SOURCE:

DNR Agency_____ Agency Unit_____
Investigator_____ Title_____
Referred by_____ Telephone No._____ Date_____

CORRECTIVE ACTION TAKEN: (Check Appropriate Action)

No Action Necessary_____ [1] Corrective Action Underway_____ [2]
Remarks_____

DNR - 139 *Signature of Agency Official* *Title* *Date* *Telephone No.*

TABLE XIV

STREAM PROBLEM REFERRALS FOR THE POTOMAC RIVER DRAINAGE

Problem Condition	Number Referrals	No Action Necessary	Corrective Action Underway	Condition Under Surveillance	No Reply To Date
Refuse	1				1
Livestock (Referrable)	2				2
Sediment	1		1		
Floodplain Activities	2				2
TOTALS	6		1		5

TABLE XV

STREAM PROBLEM REFERRALS FOR THE UPPER CHESAPEAKE BAY DRAINAGE

Problem Condition	Number Referrals	No Action Necessary	Corrective Action Underway	Condition Under Surveillance	No Reply To Date
Industrial/Governmental Waste Conditions	7	1	1		5
Sewage	11	1	5		5
Storm Drain Discharge Violations	1	1			
Residential Waste Conditions (Non-Sewage)	3		1		2
Refuse	10		2		8
Sanitary Landfill Violations	1			1	
Livestock (Referrable)	1				1
Stream Alterations	2	1	1		
Sediment	7		3		4
Floodplain Activities	2		2		
TOTALS	45	4	15	1	25

FIGURE IX

STREAM SURVEY FORM

SAVE OUR STREAMS

Stream Name_____ Tributary of_____

River Drainage_____ County_____

Survey No._____ Surveyed By: Individual_____ Sponsoring Organization_____

Survey Date_____ (*month*) _____ (*day*) _____ (*year*) Tidal_____ Freshwater_____ Stream Area

Stream Section Surveyed:

From:_____ (*downstream location*) To:_____ (*upstream location*)

Stream Size (ft.): Width

0-5_____ 5-10_____ 10-15_____ 15-20_____ 20-25_____ 25-30_____ 30-35_____

35-40_____ 40-45_____ 45-50_____ 50-60_____ 60-70_____ 70—and over_____

Depth

0-1_____ 1-2_____ 2-3_____ 3-4_____ 4-5_____ 5-6_____ 6-7_____

7-and over_____

Streambank Habitat (check all that are present along stream section)

_____Woodland_____Wooded Swamp_____Marsh_____Pasture_____Developed_____Cropland/Fields

Watershed Environs (Check all that occur laterally to stream section within watershed)

_____Residential_____Commercial_____Industrial_____Agricultural_____Recreational

ENTER NO. OF EACH CONDITION IN SPACES; IF NOT PRESENT ENTER 0:

I. CONSTRUCTED BARRIERS:
(above stream surface level)
_____Dams
_____Culverts
_____Other man-made structures

II. NATURAL BARRIERS:
_____Beaverdams
_____Waterfalls (2' or greater))
_____Logs/debris (50% or more of stream cross-section)

III. STREAM ALTERATIONS: (Excluding highway crossings)
_____Channelization (Ditching)
_____Dredging (ongoing)
_____Seawalls (No. areas)
_____Bulkheaded areas
_____Channel Liners (No. areas)

IV. SEWAGE OUTFALLS:
_____Untreated (septic tanks, etc.)
_____Treated (plant discharges)

V. RESIDENTIAL WASTE OUTFALLS: (Non-sewage)
_____Discharge detected
_____Discharge undetected

VI. INDUSTRIAL/GOVERNMENTAL NON-SEWAGE OUTFALLS:
_____Discharge detected
_____Discharge undetected

VII. STORM DRAIN OUTFALLS:
_____Excluding highways and bulkheads

VIII. WATER REMOVALS:
_____Agricultural
_____Municipal
_____Industrial
_____Other

IX. INSTREAM/FLOODPLAIN SITUATIONS:
_____Refuse Dumps
_____Litter Present (check)
_____Sanitary Landfills
_____Livestock Areas
_____Oil Presence (check)
Sediment Sources:
_____Points of Discharge
_____Watershed Oriented (check)
Construction Activities in Progress:
_____Logging
_____Grading/Filling
_____Construction

X. OTHER ADVERSE SITUATIONS:
_____Problem:_____
_____Problem:_____

Survey Remarks:_____

INDICATE PROBLEM CATEGORY NUMBER, ALSO NAME AND ADDRESS OF PROBLEM SOURCE OR OWNERSHIP IF DETERMINED:

Category No.	Name of Individual or Organization	RFD, Street or Box No.	City or Town

Retain one copy of survey and send others to your local (or State) SOS sponsoring group.
Submit any suggested improvement projects with stream survey forms.

SOS Action Taken: (Check)

_____Present stream conditions referred for corrective action (write referral)

_____No present referral action necessary, based on this survey

_____Suggested attached improvements approved

_____Improvement projects suggested by SOS

Paint Branch in College Park. Fish passage was provided on each of the four streams by construction of a notch in a drop structure (dam) on each watercourse.

The stream drop structure consists of steel sheet piling driven vertically into the stream bed. The sheet piling spans the cross section of the stream at a height of from one and one-half to three feet above the stream bed. A notch two to eight feet wide is located in the center of the sheet piling structure. A fishway basically consists of a concrete ramp approximately 35 feet long and graded at a fifteen to one slope. A pilot chute located on the upstream side of the drop structure and consisting of an inclined trough with sloped sides and a rock bottom, reduces the water velocity prior to discharge over the drop structure. A pool located downstream from the ramp provides a resting place for the fish prior to swimming up the ramp and through the notch in the drop structure.

a. Northwest Branch Project

On the Northwest Branch a stream drop structure dam was modified for fish passage. The drop structure had originally been constructed in the 1950's by the Army Corps of Engineers as part of a stream channelization program for flood control in the urbanized Anacostia drainage. The stream drop structure served to reduce stream velocity and bank erosion on the channelized stream.

The drop structure was known to have blocked the upstream migration of alewife and other resident fish species. Mitigating the structure with an opening for fish passage provided the Northwest Branch with several additional stream miles of potential spawning area.

b. Northeast Branch Project

On the Northeast Branch an obsolete U.S. Geological Survey, stream flow gaging station weir was removed. A fishway was constructed over the foundation of the gaging station weir (Photo VII). The weir was known to have blocked the upstream migration of alewife and other fish species.

c. Indian Creek Project, Paint Branch Project

Approximately two miles upstream from the Northeast Branch gaging station site, the stream diverges to form Indian Creek and Paint Branch. The Army Corps of Engineers recently instituted flood control measures on both tributaries. Fishways were included in the drop structures that were constructed on the two tributaries near their mouths.

Photo VII
Stream Improvement Projects Are Conducted

One of Four Fishways Constructed in 1974, Anacostia River Drainage, For Alewife Passage

2. North River Project

A fifth project on the North River was completed where an obsolete U.S. Geological Survey, stream flow gaging station weir was removed. The gaging station weir was known to have blocked the upstream migration of alewife and yellow perch.

JOB IV. DATA SUMMARIZATION AND STORAGE, PREPARATION OF REPORT

Introduction

The objectives of Job IV were to facilitate the storage, retrieval, and analysis of Project AFC-8 data and to provide data information to responsible management agencies.

Part I. Data Summarization and Storage

A. Feasibility Study

A feasibility study was conducted during segment AFC-8-2, in 1971, to determine the practicality of developing a computer system to process the Anadromous Fish Study data. It was concluded from the study that the nature and volume of the data warranted computerization. The data system would be designed and programmed cooperatively by project personnel and the Data Coordinator for the Department of Natural Resources. Computer hardware and key punching would be provided by the Annapolis Data Center of the Maryland Treasury Department, through cost reimbursement from the Anadromous Fish Project.

B. System Design

System design was accomplished during segment AFC-8-3 in 1972. Data banks for the system were developed to correspond with project activities. The data banks:are Stream Investigation File, Stream Structure File, Stream Problem Referral File, and Biological File. At present, the Stream Structure File and the Stream Problem Referral File are being handled manually due to low volume data in these two areas.

C. System Development

System development was initiated during segment AFC-8-3 and involved designing computerized data sheets and programming the computer facility. The computerized data sheets are used for recording field data which is subsequently keypunched from the same data sheets. Data sheets, previously depicted with appropriate jobs, are as follows:

1. Stream Investigation and Water Quality Data Sheet
2. Stream Structure Inventory Form
3. Stream Problem Referral Report
4. Biological Data Sheets
    a. Trap Net Survey Form
    b. Plankton Survey Form
    c. Seine Survey Form

Programming was accomplished for the Biological File during segment AFC-8-4 in 1973.

D. Transcribing and Data Entry

Biological Data (trap, plankton, and seine data) taken prior to segment AFC-8-4 (1973) had been recorded on non-computerized field sheets. During the AFC-8-4 and AFC-8-5 studies the previously recorded biological data, including segments one, two, and three, was transcribed onto the computerized data sheets and machine-stored. All biological data taken during segments four and five was field recorded directly onto computerized data sheets and machine-stored.

Stream Investigation data (water quality and stream section survey data) taken prior to AFC-8-4 had been recorded either on non-computerized field sheets or on computerized field sheets that were later modified. To date not all stream investigation data has been transcribed onto current, computerized data sheets. All stream investigation data taken during segments four and five (1973 and 1974) was field recorded on current, computerized data sheets. To date all of the water quality data has been machine-stored. The stream section data will be machine-stored during Project AFC-9.

Part II. Preparation of Report

The final data reports are based on computer output. The three basic formats used in the data reports are data dumps, data summaries, and special data parameters.

The types of data reports are Biological Investigations and Stream Investigations. Biological Investigation reports consist of trap net survey, plankton survey, and seine survey data. The computerized portion of Stream Investigation reports presently consist of only water quality data. Non-computerized Stream Investigation survey reports also contain blockages, pollution, habitat, and alterations which will be presented at a later date either as appendices to this report or as separate data reports. Currently, a publication is being prepared on inventoried stream blockages ("Inventory of Dams, Other Stream Blockages, and Fishways in the Seventeen Tidewater Counties of Maryland") which comprises the first inventory and publication of dams and other stream barriers in Maryland.

SUMMARY AND CONCLUSIONS FOR THE STUDY

During the four and one-half years of Project AFC-8 Studies, a total of 310 streams were surveyed for anadromous fish spawning. In the Potomac River drainage, 43 of the 116 surveyed streams had spawning of one or more anadromous species. The river proper and all principal tributaries along the Maryland shoreline from the Wicomico River to Washington, D.C. had anadromous spawning activity of one or more species. The lower river and its tributaries lacked anadromous spawning runs, except for white perch.

In the Upper Chesapeake Bay drainage 155 of 194 surveyed streams, including the Chesapeake Bay, had anadromous spawning activity. All principal tributaries on both shores of the Bay drainage had spawning of one or more anadromous species.

A total of 198 spawning streams were documented in the Potomac River and Upper Chesapeake Bay drainages.

Haul seining on the Potomac River at 26 sites and in 45 principal estuarine tributaries documented young-of-year nursery areas. Anadromous species were recorded throughout the river drainage at 25 river sites and in 40 tributaries. Anadromous young-of-year species were recorded primarily upriver from the Wicomico River confluence which coincided with the principal spawning area.

In the Upper Chesapeake Bay drainage, anadromous young-of-year species were recorded in 100 of 150 sampled estuarine watercourses. Species were distributed throughout the Bay drainage, indicating that the entire drainage is a nursery area for one or more anadromous species.

Each of the 310 watercourses that were surveyed for anadromous species, plus additional streams, were walked to inventory dams, habitat, pollution discharges, stream alterations, and other problem conditions having the potential to affect fish passage and spawning.

Four fishways were constructed as a cooperative project and another blockage removed. Fifty-one written stream problem referrals were made to responsible management agencies, following stream survey. Corrective improvement action was made in some conditions, while others are under current surveillance or pending action.

A state citizen program (Save Our Streams) was developed to survey and improve watercourses, thereby aiding fish propagation.

All streams under biological investigation, with the exception of the Baltimore area of West Chesapeake Bay drainage, were surveyed for water quality during the anadromous spawning season.

A computer system for storing and retrieving biological data was developed and inventoried biological data was machine stored and retrieved.

Literature relating to anadromous species was reviewed and developed, including brochures, published articles, and slide talks.

The present study provides the first and only comprehensive survey of anadromous spawning streams, except for prior identification of striped bass spawning rivers. Walking each stream course also provided the first state inventory of dams and other stream blockages.

Survey data is useful in referencing, managing, and preserving anadromous fish spawning streams and in environmental review of proposed watershed-development projects.

RECOMMENDATIONS

Biological sampling to document watercourses utilized by anadromous species and stream surveys to inventory watercourse conditions for spawning were conducted under Project AFC-8 and its predecessor, Project AFC-3.

Some of the streams located in 17 Maryland counties having anadromous fish spawning potential were investigated in the two studies. Based upon extensive stream study data on over 300 streams during Project AFC-8, the following measures are recommended to promote and improve anadromous fish (and other species) conservation in the Chesapeake Bay drainage system.

1. Several natural resources management agencies of Maryland, federal and interstate agencies or commissions and others are involved in fisheries management and/or environmental review of proposed watershed development projects. These agencies should give priority planning consideration to projects affecting fish propagation potential on identified spawning streams in the Potomac River drainage and other river systems of Maryland.

2. Future studies, similar to the present one, should be conducted for other drainage systems of Maryland to ascertain additional streams utilized by anadromous fish species, and conditions along watercourses affecting fish passage and spawning success. High priority for initial stream investigation should be given to watercourses in areas of expanding domestic populations and watershed developments where stream pollution and alterations are likely to occur.

3. On anadromous spawning streams, future study-projects are recommended to assess populations of fish species blocked by stream barriers. These obstacles should be removed or mitigated to allow anadromous and other species of fish full access to spawning streams.

4. Improvement in water quality and habitat on streams utilized by anadromous species should be conducted by responsible agencies to improve fish propagation potential and other desired uses of watercourses.

5. Planting anadromous fish stocks (of eggs and/or fish) in watercourses devoid of anadromous spawners or not having present populations of all anadromous species, may be a feasible means of establishing and improving fish propagation potential of streams.

6. A program of public education is needed to emphasize the importance of anadromous species in the Chesapeake Bay drainage ecosystem, and offshore fisheries. The importance of anadromous species in the food-chain, as well as their esthetic, commercial and sport-catch values to Maryland and other states should be emphasized.

7. Stream inventory data should be collected on a systematic stream and river drainage basis, using defined methods and procedures. Collected information on anadromous fish spawning species, stream barriers and other data collected in the Anadromous Fish Stream Survey Program should be computerized and disseminated to management agencies at all levels of government.

8. Many problem situations that are documented along watercourses, including pollution discharges and stream alterations, are unknown to responsible management agencies. A systematic written referral of stream problem conditions in violation of Maryland's natural resources laws should be implemented to bring about improvements in conditions for aquatic life.

9. Legislation should be developed and implemented to prohibit or mitigate the construction of dams, culverts and other stream barriers on major anadromous spawning streams.

During Project AFC-8, all nine recommendations were implemented for some watercourses or to some degree. Project AFC-8 has been extended to other areas of Maryland (as Project AFC-9), therefore, these recommendations will continue to be promoted and utilized for past and future study streams.

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APPENDIX A - 1

Yellow Perch Spawning Streams 1/ 2/

Part I

Potomac River Drainage

Lower Potomac River Area 3/
- Potomac River Mainstem 4/
  - Potomac River
- Wicomico River Area
  - Wicomico River
  - Allens Fresh Run
- Gilbert Swamp Drainage
  - Newport Run
- Port Tobacco River Drainage
  - Port Tobacco River
  - Port Tobacco Creek
- Nanjemoy Creek Drainage
  - Nanjemoy Creek
  - Burgess Creek
  - Mill Run
  - Wards Run
- Mattawoman Creek Drainage
  - Mattawoman Creek
- Morgantown Area
  - Ravens Crest Creek
- Chicamuxen Creek to Riverside Area
  - Chicamuxen Creek
  - Reeder Run

Washington Metropolitan Area
- Piscataway Creek Drainage
  - Piscataway Creek

Total Spawning Streams - 15 (14 streams, plus Potomac River)

Total Streams Investigated - 116 (115 streams, plus Potomac River)

Part II

Upper Chesapeake Bay Drainage

Lower Susquehanna River Area
- Susquehanna River Drainage
  - Susquehanna River
- Deer Creek Drainage
  - Deer Creek
- Octoraro Creek Drainage
  - Octoraro Creek
  - Basin Run

Havre de Grace Area
- Herring Run
- Rock Run

Bainbridge Area
- Rock Run (Cecil County)

Elk River Area
- Sassafras River Drainage
  - Sassafras River
  - Back Creek
  - Cox Creek
  - Dyer Creek
  - Freeman Creek

1/ Streams arranged according to sub-basins and sub-sub basins.
2/ Maryland coordinates given to identify unnamed streams.
3/ Sub-basin name.
4/ Sub-sub basin name.

APPENDIX A - 1 (continued)

Herring Branch
Hall Creek
Island Creek
Jacobs Creek
Lloyd Creek
Mill Creek
Money Creek
Swantown Creek
Turner Creek
Unnamed (1,125,300E-561,700N)
Woodland Creek

Elk River Mainstem
Elk River

Bohemia River Drainage
Bohemia River
Great Bohemia Creek
Little Bohemia Creek
Manor Creek
Scotchman Creek

Back Creek Drainage
Back Creek
C & D Canal
Long Branch

Northeast River Drainage
Northeast River
Ford Run
Hance Point Creek
Northeast Creek
Unnamed (1,091,900E-640,000N)

Furnace Bay Drainage
Furnace Bay
Mill Creek

Stillpond-Fairlee Area
Codjus Cove
Churn Creek
Fairlee Creek
Jacks Cove
Mill Creek
Stillpond Creek
Tims Creek
Unnamed (1,041,900E-541,500N)
Unnamed (1,030,200E-515,100N)
Worton Creek

Crystal Beach Area
Cabin John Creek
Pearce Creek
Pond Creek

Elk Neck Area
Plum Creek
Piney Creek

Elk River Headwaters Area
Big Elk Creek
Little Elk Creek

Bush River Area

Bush River Drainage
Bush River
Bush Creek
Church Creek
Cranberry Run
Grays Run
Otter Point Creek
Sod Run

Winters Run Drainage
Winters Run

Aberdeen Proving Ground Area
Back Creek
Mosquito Creek
Woodcrest Creek

Gunpowder River Area

Gunpowder River Drainage
Gunpowder River
Cunninghill Cove
Dundee Creek
Saltpeter Creek
Unnamed (986,300E-559,500N)

Gunpowder Falls Drainage
Gunpowder Falls

Bird River Drainage
Bird River
Whitemarsh Run

Middle River Drainage
Middle River
Hopkins Creek

Seneca Creek Drainage
Seneca Creek

Patapsco River Area

Patapsco River Drainage
Patapsco River
Deep Creek
Stony Run

Outer Baltimore Harbor Drainage
Bear Creek
Rock Creek
Sloop Cove
Stony Creek

APPENDIX A - 1 (continued)

South Drainage to Inner Baltimore Harbor
- Cabin Branch
- Furnace Creek
- Marley Creek

Bodkin Creek Drainage
- Bodkin Creek
- Main Creek
- Wharf Creek

West Chesapeake Bay Area

Magothy River Drainage
- Magothy River
- Broad Creek
- Cockey Creek
- Cornfield Creek
- Cattail Creek
- Cypress Creek
- Deep Creek
- Dividing Creek
- Forked Creek
- Mill Creek
- Old Man Creek
- Unnamed (933,200E-452,600N)

Broadneck Area
- Little Magothy River

Chesapeake Bay Proper
- Chesapeake Bay

Total Spawning Streams - 105 (Chesapeake Bay counted as one stream)

Total Streams Investigated - 194 (193 streams, plus Chesapeake Bay)

APPENDIX A - 2

Herring Spawning Streams 1/ 2/

Part I

Potomac River Drainage

	Positive Identification	
	Alewife Herring	Blueback Herring
Lower Potomac River Area 3/		
Potomac River Mainstem 4/		
Potomac River		
Wicomico River Drainage		
Wicomico River		
Allens Fresh Run		
Chaptico Bay 5/	x	x
Gilbert Swamp Drainage		
Gilbert Creek		
Wheatley Run		
Port Tobacco River Drainage		
Port Tobacco River		
Hoghole Run		
Port Tobacco Creek	x	
Nanjemoy Creek Drainage		x
Nanjemoy Creek		
Wards Run	x	x
Mattawoman Creek Drainage	x	
Mattawoman Creek		
Unnamed (768,800E-276,200N)	x	x
Unnamed (779,000E-265,000N)	x	
Morgantown Area	x	
Perry Branch		
Chicamuxen Creek to Riverside Area		x
Chicamuxen Creek		
Reeder Run		
Potomac Heights Area	x	
Mill Swamp		
Pomonkey Creek	x	
Washington Metropolitan Area	x	
Potomac River Mainstem		
Potomac River		
Piscataway Creek Drainage	x	x
Piscataway Creek		
Burch Branch	x	
Tinkers Creek	x	
Unnamed (806,400E-313,100N)	x	
	x	

1/ Streams arranged according to sub-basins and sub-sub basins.
2/ Maryland coordinates given to identify unnamed streams.
3/ Sub-basin name.
4/ Sub-sub basin name.
5/ Unidentified Clupeidae collected.

APPENDIX A - 2 (continued)

	Positive Identification	
	Alewife Herring	Blueback Herring
Anacostia River Drainage		
Anacostia River	x	
Beaverdam Creek	x	
Northeast Branch	x	
Northwest Branch	x	
Watts Branch		
Rock Creek Drainage		
Rock Creek	x	
Bryan Point Area		
Unnamed (785,200E-311,700N)	x	
Washington D. C. South Area		
Broad Creek	x	
Henson Creek		
Oxon Run	x	
Swan Creek		

Total Spawning Streams - 34 *

Total Streams Investigated - 116 (115 streams, plus Potomac River)

Part II

Upper Chesapeake Bay Drainage

	Positive Identification	
	Alewife Herring	Blueback Herring
Lower Susquehanna River Area		
Susquehanna River Drainage		
Susquehanna River	x	
Deer Creek Drainage		
Deer Creek	x	x
Octoraro Creek Drainage		
Octoraro Creek	x	
Basin Run	x	
Stone Run		
Havre de Grace Area		
Herring Run	x	
Rock Run (Harford County)		x
Unnamed (1,054,500E-628,900N)		
Bainbridge Area		
Rock Run (Cecil County)		
Unnamed (1,059,200E-635,200N)		
Unnamed (1,058,500E-641,500N)		
Elk River Area		
Sassafras River Drainage		
Sassafras River	x	x
Back Creek		
Cox Creek		

* Potomac River (two areas) counted as one stream.

APPENDIX A - 2 (continued)

	Positive Identification	
	Alewife Herring	Blueback Herring
Dyer Creek		
Freeman Creek		
Herring Branch		
Hall Creek	x	
Island Creek		
Jacobs Creek		
Lloyd Creek	x	
Mill Creek		
Money Creek		
Swantown Creek		
Turner Creek		
Unnamed (1,125,300E-561,700N)		
Woodland Creek		
Elk River Mainstem		
Elk River		
Bohemia River Drainage		
Bohemia River		
Great Bohemia Creek		
Little Bohemia Creek	x	
Manor Creek	x	
Sandy Branch		
Scotchman Creek	x	x
Unnamed (1,125,400E-584,800N)		
Unnamed (1,139,800E-596,700N)	x	
Unnamed (1,137,100E-585,400N)	x	
Back Creek Drainage		
Back Creek		
C & D Canal	x	x
Long Branch		
Northeast River Drainage	x	
Northeast River		
Ford Run		
Hance Point Creek	x	
Northeast Creek		
Stony Run	x	x
Unnamed (1,091,900E-640,000N)	x	x
Unnamed (1,089,250E-636,700N)	x	
Unnamed (1,087,600E-635,000N)	x	
Furnace Bay Drainage		
Furnace Bay		
Mill Creek		
Principio Creek		
Stillpond-Fairlee Area	x	
Codjus Cove		
Churn Creek		
Jacks Cove		
Mill Creek 1/		

1/ Unidentified Clupeidae collected.

APPENDIX A - 2 (continued)

	Positive Identification	
	Alewife Herring	Blueback Herring
Stillpond Creek		
Tims Creek 1/		
Unnamed (1,041,900E-541,500N)		
Unnamed (1,030,200E-515,100N)	x	
Worton Creek		
Crystal Beach Area		
Cabin John Creek		
Elk Neck Area		
Muddy Creek		
Plum Creek		
Piney Creek	x	
Elk River Headwaters		
Big Elk Creek	x	x
Little Elk Creek	x	x
Mill Creek	x	
Perch Creek	x	
Bush River Area		
Swan Creek Drainage		
Swan Creek	x	
Bush River Drainage		
Bush River		
Bush Creek		
Church Creek		
Cranberry Run		
Grays Run	x	
Ha Ha Branch	x	
Otter Point Creek	x	
Sod Run		
Unnamed (1,017,500E-588,200N)	x	
Winters Run Drainage		
Winters Run	x	x
Aberdeen Proving Ground Area		
Back Creek		
Mosquito Creek	x	
Romney Creek		
Woodcrest Creek	x	
Gunpowder River Area	x	
Gunpowder River Drainage		
Gunpowder River		
Saltpeter Creek		
Gunpowder Falls Drainage		
Gunpowder Falls		
Broad Run	x	x
Bird River Drainage		
Bird River		
Whitemarsh Run		
Middle River Drainage	x	x
Frog Mortar Creek		

1/ Unidentified Clupeidae collected.

APPENDIX A - 2 (continued)

	Positive Identification	
	Alewife Herring	Blueback Herring
Back River Drainage		
Deep Creek		
Muddy Gut		
Patapsco River Drainage		
Patapsco River		
Deep Creek	x	
Herbert Run	x	
Rockburn Branch		
Stony Run	x	
Inner Baltimore Harbor	x	
Northwest Branch		
Outer Baltimore Harbor		
Bear Creek		
Bullneck Creek		
Jones Creek		
Lynch Creek		
Nabbs Creek		
Rock Creek		
Stony Creek		
South Drainage to Inner Baltimore Harbor		
Curtis Creek		
Furnace Creek		
Marley Creek		
Sawmill Creek	x	
West Chesapeake Bay Area	x	
Magothy River Drainage		
Magothy River		
Blackhole Creek	x	
Cockey Creek		
Cornfield Creek		
Cattail Creek		
Cypress Creek		
Deep Creek		
Dividing Creek		
Forked Creek		
Mill Creek		
Old Man Creek		
Redhouse Cove		
Unnamed (933,200E-452,600N)		
Broadneck Area		
Little Magothy River		
Chesapeake Bay Proper		
Chesapeake Bay		

Total Spawning Streams - 122 (Chesapeake Bay counted as one stream) (plus unidentified Clupeidae collected in two streams)

Total Streams Investigated - 194 (193 streams, plus Chesapeake Bay)

APPENDIX A - 3

Shad Spawning Streams 1/ 2/

Part I

Potomac River Drainage

	Positive Identification American Shad 3/	Hickory Shad 4/
Lower Potomac River Area 5/		
Potomac River Mainstem 6/		
Potomac River	x	
Wicomico River Drainage		
Chaptico Bay 7/		
Washington Metropolitan Area		
Potomac River Mainstem		
Potomac River	x	
Washington D. C. South Area		
Swan Creek	x	

Total Spawning Streams - 3* * Potomac River (two areas) counted as one stream.
Total Streams Investigated - 116 (115 streams, plus Potomac River)

Part II

Upper Chesapeake Bay Drainage

	Positive Identification American Shad 8/	Hickory Shad 9/
Lower Susquehanna River Area		
Susquehanna River Drainage		
Susquehanna River	x	x
Deer Creek Drainage		
Deer Creek		x
Elk River Area		
Elk River Mainstem		
Elk River	x	
Northeast River Drainage		
Northeast River		x
Stillpond-Fairlee Area		
Mill Creek 7/		
Tims Creek 7/		
Chesapeake Bay Proper		
Chesapeake Bay		x

Total Spawning Streams - 5 (Chesapeake Bay counted as one stream)
Total Streams Investigated - 194 (plus unidentified Clupeidae collected in two streams)
(193 streams, plus Chesapeake Bay)

1/ Streams arranged according to sub-basins and sub-sub basins.
2/ Maryland coordinates given to identify unnamed streams.
3/ Swan Creek documentation probably due to tidal drift of eggs/larvae.
4/ One probable documentation in a single sample from Nanjemoy Creek.
5/ Sub-basin name.
6/ Sub-sub basin name.
7/ Unidentified Clupeidae collected.
8/ Single egg samples were collected in Bird River and Saltpeter Creek. One larvae was collected in Cabin Branch, tributary to the Patapsco River, and in the Magothy River.
9/ Hickory Shad probably spawned in Octoraro Creek based on sport catch information. A single egg sample was collected in Dundee Creek, tributary to Gunpowder River. Two larvae were collected in Bear Creek, tributary to Patapsco River.

APPENDIX A - 4

White Perch Spawning Streams 1/ 2/

Part I

Potomac River Drainage

Lower Potomac River Area 3/
- Potomac River Mainstem 4/
  - Potomac River
- Wicomico River Drainage
  - Wicomico River
  - Allens Fresh Run
  - Chaptico Bay
  - Chaptico Creek
- Gilbert Swamp Drainage
  - Newport Run
- Port Tobacco River Drainage
  - Port Tobacco River
  - Port Tobacco Creek
  - Wills Branch
- Nanjemoy Creek Drainage
  - Nanjemoy Creek
  - Mill Run
  - Wards Run
- Mattawoman Creek Drainage
  - Mattawoman Creek
- Potomac River Mouth Area
  - Jutland Creek
- Higgins Point - Straight Point Area
  - Poplar Hill Creek
- Morgantown Area
  - Popes Creek
  - Perry Branch
  - Ravens Crest Creek
- Chicamuxen Creek to Riverside Area
  - Chicamuxen Creek
  - Reeder Run
- Potomac Heights Area
  - Pomonkey Creek

Washington Metropolitan Area
- Potomac River Mainstem
  - Potomac River
- Piscataway Creek Drainage
  - Piscataway Creek
- Anacostia River Drainage
  - Anacostia River
  - Beaverdam Creek
  - Northeast Branch
- Rock Creek Drainage
  - Rock Creek
- Bryan Point Area
  - Unnamed (785,200E-311,700N)
- Washington D. C. South Area
  - Broad Creek
  - Oxon Run
  - Swan Creek

Total Spawning Streams - 30*

Total Streams Investigated - 116 (115 streams, plus Potomac River)

1/ Streams arranged according to sub-basins and sub-sub basins.
2/ Maryland coordinates given to identify unnamed streams.
3/ Sub-basin name.
4/ Sub-sub basin name.

* Potomac River (two areas) counted as one stream.

APPENDIX A - 4 (continued)

Part II

Upper Chesapeake Bay Drainage

Lower Susquehanna River Area
- Susquehanna River Drainage
  - Susquehanna River
- Deer Creek Drainage
  - Deer Creek
- Octoraro Creek Drainage
  - Basin Run
- Havre de Grace Area
  - Herring Run
  - Rock Run (Harford County)

Elk River Area
- Sassafras River Drainage
  - Sassafras River
  - Back Creek
  - Cox Creek
  - Dyer Creek
  - Freeman Creek
  - Herring Branch
  - Hall Creek
  - Island Creek
  - Jacobs Creek
  - Lloyd Creek
  - Mill Creek
  - Money Creek
  - Swantown Creek
  - Turner Creek
  - Unnamed (1,125,300E-561,700N)
  - Woodland Creek
- Elk River Mainstem
  - Elk River
- Bohemia River Drainage
  - Bohemia River
  - Great Bohemia Creek
  - Little Bohemia Creek
  - Manor Creek
  - Sandy Branch
  - Scotchman Creek
  - Unnamed (1,145,500E-589,800N)
  - Unnamed (1,139,800E-596,700N)
  - Unnamed (1,130,200E-583,600N)
- Back Creek Drainage
  - Back Creek
  - C & D Canal
  - Long Branch
- Northeast River Drainage
  - Northeast River
  - Ford Run
  - Hance Point Creek
  - Northeast Creek
  - Stony Run
  - Unnamed (1,091,900E-640,000N)
  - Unnamed (1,089,250E-636,700N)
  - Unnamed (1,087,600E-635,000N)
- Furnace Bay Drainage
  - Furnace Bay
  - Mill Creek
  - Principio Creek
- Stillpond-Fairlee Area
  - Codjus Cove
  - Churn Creek
  - Fairlee Creek
  - Jacks Cove
  - Mill Creek
  - Stillpond Creek
  - Tims Creek
  - Unnamed (1,041,900E-541,500N)
  - Unnamed (1,030,200E-515,100N)
  - Worton Creek
- Crystal Beach Area
  - Cabin John Creek
  - Pearce Creek
  - Pond Creek
- Elk Neck Area
  - Plum Creek
  - Piney Creek
- Elk River Headwaters
  - Big Elk Creek
  - Little Elk Creek
  - Mill Creek
  - Perch Creek

Bush River Area
- Swan Creek Drainage
  - Gasheys Creek
- Bush River Drainage
  - Bush River
  - Bush Creek
  - Church Creek
  - Cranberry Run

APPENDIX A - 4 (continued)

Grays Run
Ha Ha Branch
Otter Point Creek
Unnamed (1,017,500E-588,200N)

Bynum Run Drainage
Bynum Run

Winters Run Drainage
Winters Run

Aberdeen Proving Ground Area
Back Creek
Mosquito Creek
Romney Creek
Woodcrest Creek

Gunpowder River Area

Gunpowder River Drainage
Gunpowder River
Cunninghill Cove
Dundee Creek
Saltpeter Creek
Unnamed (986,300E-559,500N)

Gunpowder Falls Drainage
Gunpowder Falls

Little Gunpowder Falls Drainage
Little Gunpowder Falls

Bird River Drainage
Bird River
Whitemarsh Run
Windlass Run

Middle River Drainage
Middle River
Frog Mortar Creek
Galloway Creek
Stansbury Creek

Patapsco River Area

Back River Drainage
Back River
Deep Creek
Herring Run
Muddy Gut
Northeast Creek
Redhouse Creek

Patapsco River Drainage
Patapsco River
Deep Creek
Herbert Run
Stony Run

North Drainage to Inner Baltimore Harbor
Colgate Creek

Outer Baltimore Harbor
Bear Creek
Bullneck Creek
Jones Creek
Lynch Creek
Nabbs Creek
Rock Creek
Sloop Cove
Stony Creek

South Drainage to Inner Baltimore Harbor
Cabin Branch
Marley Creek
Sawmill Creek
Tanyard Cove

Bodkin Creek Drainage
Back Creek
Wharf Creek

West Chesapeake Bay Area

Magothy River Drainage
Magothy River
Blackhole Creek
Broad Creek
Cockey Creek
Cornfield Creek
Cattail Creek
Cypress Creek
Deep Creek
Dividing Creek
Forked Creek
Grays Creek
Mill Creek
Old Man Creek
Redhouse Cove
Unnamed (933,200E-452,600N)

Broadneck Area
Little Magothy River

Chesapeake Bay Proper
Chesapeake Bay

Total Spawning Streams - 135 (Chesapeake Bay counted as one stream)

Total Streams Investigated - 194 (193 streams, plus Chesapeake Bay)

APPENDIX A - 5

Striped Bass Spawning Streams 1/ 2/ 3/ 4/

Part I

Potomac River Drainage

Lower Potomac River Area 5/
- Potomac River Mainstem 6/
  - Potomac River
- Nanjemoy Creek Drainage
  - Nanjemoy Creek
- Mattawoman Creek Drainage
  - Mattawoman Creek

Total Spawning Streams - 3

Total Streams Investigated - 116 (115 streams, plus Potomac River)

Part II

Upper Chesapeake Bay Drainage 7/

Lower Susquehanna River Area
- Susquehanna River Drainage
  - Susquehanna River

Elk River Area
- Sassafras River Drainage
  - Back Creek
  - Dyer Creek
  - Freeman Creek
  - Lloyd Creek
  - Swantown Creek
- Elk River Mainstem
  - Elk River
- Bohemia River Drainage
  - Bohemia River
  - Great Bohemia Creek
  - Little Bohemia Creek
  - Manor Creek
- Back Creek Drainage
  - Back Creek
  - C & D Canal
- Stillpond-Fairlee Area
  - Codjus Cove
  - Stillpond Creek
  - Unnamed (1,041,900E-541,500N)
- Crystal Beach Area
  - Cabin John Creek
- Elk Neck Area
  - Piney Creek

Chesapeake Bay Proper
- Chesapeake Bay

Total Spawning Streams - 19 (Chesapeake Bay counted as one stream)

Total Streams Investigated - 194 (193 streams, plus Chesapeake Bay)

1/ Streams arranged according to sub-basins and sub-sub basins.
2/ Maryland coordinates given to identify unnamed streams.
3/ Sub-basin name.
4/ Sub-sub basin name.
5/ Two stream documentations may be due to tidal drift of larvae.
6/ One documentation in the Potomac River off Piscataway Creek.
7/ One adult fish in non-spawning condition collected in the Patapsco River Area.

APPENDIX B - 1

Anadromous Fish Nursery Areas In The Potomac River Drainage

Nursery Streams 1/2/	No. of* Sites	Seine Length (ft)	Species Collected 3/ AH	BH	AS	HS	YP	WP	SB
Lower Potomac River Area									
Potomac River	21	100	x	x	x		x	x	x
		50							
St. Catherine Sound	1	100						x	x
Church Creek	1	20						x	
St. George Creek	3	100						x	
Breton Bay	3	100	x					x	
McIntosh Run	1	20					x		
Moldier Run	1	15					x		
Canoe Neck Creek	1	50						x	
Dynard Run	1	20						x	
St. Clement Creek	1	30					x		
St. Clement Bay	3	100						x	
		50							
St. Patrick Creek	1	50						x	
Tomakokin Creek	2	50					x	x	
		20							
Chaptico Bay	3	100					x	x	x
		50							
Wicomico River	5	100	x		x		x	x	x
Newport Run	1	20						x	
Allens Fresh Run	1	50	x	x			x	x	x
Port Tobacco River	4	50	x					x	x
		30							
Burgess Creek	2	20					x	x	
Hilltop Fork	1	20						x	
Nanjemoy Creek	7	50	x				x	x	x
		30							
Wards Run	1	20					x	x	
Mattawoman Creek	7	50	x	x	x		x	x	x
		30							
		20							
Jutland Creek	3	50						x	x
		30							

1/ Streams arranged according to sub-basins.
2/ Maryland coordinates given to identify unnamed streams.
3/ Species recordings based on young-of-year fish collected. (Post young-of-year collected at additional sites).

AH - Alewife Herring (Alosa pseudoharengus)
BH - Blueback Herring (A. aestivalis)
AS - American Shad (A. sapidissima)
HS - Hickory Shad (A. mediocris)
YP - Yellow Perch (Perca flavescens)
WP - White Perch (Morone americana)
SB - Striped Bass (M. saxatilis)

* Sites where young-of-year fish were collected.

APPENDIX B - 1 (continued)

Nursery Streams	No. of Sites	Seine Length (ft)	Species Collected AH	BH	AS	HS	YP	WP	SB
Smith Creek	3	100		x				x	
Herring Creek	1	50							x
Unnamed (861,900E-152,000N)	1	30						x	
Cuckold Creek	3	50						x	x
Piccawaxen Creek	2	20							
		50						x	x
Popes Creek	1	20							
Chicamuxen Creek	2	50							x
Mallows Bay	1	50	x	x	x		x	x	x
Pomonkey Creek	3	50	x	x	x			x	x
			x	x	x			x	x
Washington Metropolitan Area									
Potomac River	5	50	x	x	x			x	x
Piscataway Creek	4	50	x	x	x		x	x	x
		20							
Unnamed (802,100E-314,100N)	1	20						x	
Unnamed (784,300E-313,100N)	1	20	x	x	x			x	
Broad Creek	3	50	x	x			x	x	x
Oxon Creek	1	50					x	x	
Oxon Run	1	50	x					x	
Swan Creek	2	50	x		x		x	x	
Unnamed (798,500E-332,200N)	1	30	x	x				x	
Total Nursery Streams by Species:			16	11	9	0	17	36	18

Total Nursery Streams - 41* (40 streams, plus river)

Total Streams Investigated - 46 (45 streams, plus river)

* Potomac River (two areas) counted as one stream.

APPENDIX B - 2

Anadromous Fish Nursery Areas In The Upper Chesapeake Bay Drainage

Nursery Streams 1/ 2/	No. of* Sites	Seine Length (ft)	Species Collected 3/ AH	BH	AS	HS	YP	WP	SB
Lower Susquehanna River Area									
Susquehanna River	2	100		x			x	x	
		trap**							
Elk River Area									
Back Creek	2	100	x	x			x	x	
Cox Creek	1	50					x		
Duffy Creek	1	50					x		
Dowdel Creek	1	50					x	x	
Dyer Creek	1	100					x	x	
Freeman Creek	1	100					x	x	
Island Creek	1	50					x	x	
Jacobs Creek	1	100						x	
McGill Creek	1	50					x	x	
Mill Creek (tributary to Sassafras River)	1	100						x	
Money Creek	1	100	x	x			x	x	
Sassafras River	7	100	x	x	x		x	x	x
Swantown Creek	1	50						x	
Turner Creek	1	100						x	
Woodland Creek	1	100						x	
Elk River	5	100	x	x				x	x
		50							
Bohemia River	2	100	x	x	x		x	x	x
Great Bohemia Creek	2	100	x				x	x	x
Little Bohemia Creek	2	100					x	x	
Scotchman Creek	1	100					x	x	
Back Creek	3	100		x				x	x
C & D Canal	2	100	x			x		x	x
Cara Cove	1	100	x						
Ford Run	2	20						x	
Northeast River	4	100	x	x				x	
		50							

1/ Streams arranged according to sub-basins.
2/ Maryland coordinates given to identify unnamed streams.
3/ Species recordings based on young-of-year fish collected. (Post young-of-year collected at additional sites).

AH - Alewife Herring (*Alosa pseudo-harengus*)
BH - Blueback Herring (*A. aestivalis*)
AS - American Shad (*A. sapidissima*)
HS - Hickory Shad (*A. mediocris*)
YP - Yellow Perch (*Perca flavescens*)
WP - White Perch (*Morone americana*)
SB - Striped Bass (*M. saxatilis*)

* Sites where young-of-year fish were collected.
** Estuarine trap used in place of seine.

APPENDIX B - 2 (continued)

Nursery Streams	No. of Sites	Seine Length (ft)	Species Collected AH	BH	AS	HS	YP	WP	SB
Unnamed (1,090,300E-635,900N)	1	20						x	
Furnace Bay	2	50						x	
Mill Creek (tributary to Furnace Bay)	1	100		x				x	
Chesapeake Bay	1	100						x	x
Codjus Cove	1	100						x	x
Churn Creek	1	100						x	
Fairlee Creek	2	100		x				x	
Mill Creek (tributary to Worton Creek)	1	50						x	
Stillpond Creek	1	50							x
Worton Creek	1	100			x				
Cabin John Creek	2	100	x	x			x	x	x
Piney Creek	1	50		x				x	
Herring Creek	1	100		x			x		
Perch Creek	1	100						x	
Bush River Area									
Swan Creek	1	100	x					x	
Bush River	2	100 trap	x				x	x	x
Otter Point Creek	2	100 50					x	x	
Sod Run	1	50	x					x	x
Delph Creek	1	trap						x	
Gunpowder River Area									
Dundee Creek	1	100	x	x				x	
Foster Branch	1	100						x	
Gunpowder River	3	100 trap		x				x	x
Big Gunpowder Falls	1	100			x				x
Bird River	2	50	x	x				x	x
Days Cove	1	50	x					x	
Whitemarsh Run	1	50						x	
Cow Pen Creek	1	50							x
Dark Head Creek	2	100 50				x		x	x
Frog Mortar Creek	3	100 50						x	x
Galloway Creek	1	50							x
Hog Pen Creek	1	50						x	x
Hopkins Creek	1	50						x	
Middle River	5	100 50	x	x		x		x	x
Norman Creek	1	50				x		x	
Stansbury Creek	1	50						x	
Sue Creek	2	50		x				x	

APPENDIX B - 2 (continued)

Nursery Streams	No. of Sites	Seine Length (ft)	Species Collected AH	BH	AS	HS	YP	WP	SB
Browns Creek	2	50	x					x	x
Hawthorn Cove	1	100							x
Seneca Creek	2	50						x	
Patapsco River Area									
Back River	10	100	x				x	x	x
		50							
Deep Creek	1	50						x	
Greenhill Cove	1	50	x					x	
Muddy Gut	1	50						x	
Northeast Creek	1	50						x	
Unnamed (968,700E-516,000N)	1	50						x	
Patapsco River	2	100	x	x				x	x
		20							
Middle Branch	3	50						x	x
Colgate Creek	1	50						x	
Bear Creek	5	50						x	x
Lynch Cove	2	50						x	x
Old Road Bay	1	100						x	
Rock Creek	3	100	x					x	x
		50							
Sloop Cove	2	50							x
Stony Creek	3	100							x
		50							
Unnamed (958,500E-505,900N)	1	50						x	
Unnamed (941,900E-480,500N)	1	50							x
Cabin Branch	1	50							x
Curtis Creek	2	50						x	x
Furnace Creek	2	50						x	
Marley Creek	2	50	x					x	
Back Creek	2	100						x	
		50							
Bodkin Creek	2	50							x
Main Creek	2	50						x	
Wharf Creek	1	50	x					x	x
Shallow Creek	1	50						x	
West Chesapeake Bay Area									
Cockeys Creek	3	50				x			
Cattail Creek	2	50	x			x			
Forked Creek	2	100						x	x
		50							
Magothy River	6	100							x
		50							
Magothy Narrows	1	50							x
Mill Creek	1	50							x

APPENDIX B - 2 (continued)

Nursery Streams	No. of Sites	Seine Length (ft)	Species Collected AH	BH	AS	HS	YP	WP	SB
Old Man Creek	2	50					x		
Sillery Bay	2	100							x
Little Magothy River	2	50							x
Chesapeake Bay Proper									
Chesapeake Bay (West Shore)	13	100 50	x	x		x		x	x
Chesapeake Bay (East Shore)	8	100	x	x				x	x
Total Nursery Streams by Species:			26*	20*	4	2	26	77**	42**

Total Nursery Streams - 100 (Chesapeake Bay and eastern/western shores counted as one stream)

Total Streams Investigated - 150 (149 streams, plus Chesapeake Bay)

* Two shores of Chesapeake Bay counted as one stream.

** Two shores of Chesapeake Bay, plus Bay proper, counted as one stream.