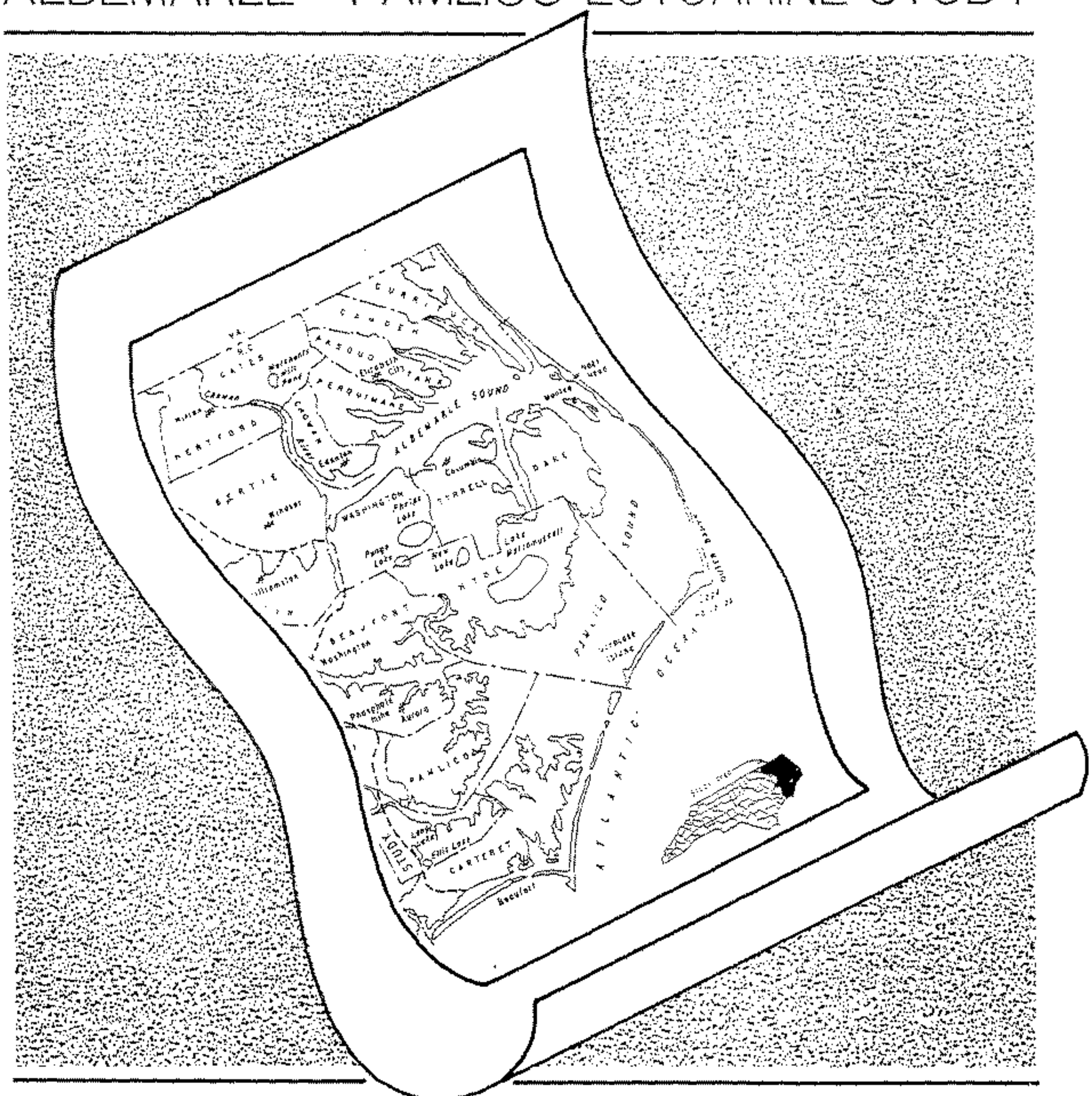
December 1989

Project No. 88-12

OBSTRUCTIONS TO ANADROMOUS FISH MIGRATION

ALBEMARLE - PAMLICO ESTUARINE STUDY



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OBSTRUCTIONS TO

ANADROMOUS FISH MIGRATION

By

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ABSTRACT

Present and historical usage of rivers and streams within the Albemarle-Pamlico Estuarine Study (A/P Study) area by anadromous fish (striped bass, American shad, hickory shad, alewife, blueback herring, Atlantic sturgeon, and shortnose sturgeon) were determined by reviewing literature and consulting with resource managers and scientists. Physical barriers to anadromous fish migrations in these tributaries were identified through literature review, consultation with resource managers and scientists, examination of maps, aerial survey, and ground investigation.

There is a lack of knowledge regarding historical and present migrations of Atlantic and shortnose sturgeon in the A/P Study area. Shortnose sturgeon are believed to be extirpated, and Atlantic sturgeon are so uncommon that attempts to document spawning grounds in the A/P Study area have been unsuccessful.

The limited data we found regarding historical range of anadromous fish was restricted to striped bass and the shad species in the larger rivers including the Neuse, Roanoke, Meherrin, Nottoway, and Blackwater Rivers. Present usage of tributaries within the A/P Study area is relatively well documented, especially for the large and medium-sized streams.

Twenty-seven obstructions known to impede anadromous fish were identified within the A/P Study area; 18 of these are dams, 4 are storm gates on canals, 2 are highway culverts, 2 are vegetational blockages, and 1 is a navigation lock on a canal. An additional 30 impediments were identified on stream reaches where anadromous fish usage is suspected but has not yet been confirmed. Of these, 21 are highway culverts, 8 are dams, and 1 is a beaver dam.

Dams, the most common obstruction, have affected all anadromous species, preventing fish from accessing large areas of historical spawning habitat, especially in the Roanoke River Basin. Requiring future dams to install fish passage structures would help prevent the type of habitat losses that have occurred in the past. Restoration of spawning runs by fish passageway construction at existing dams may be applicable in the A/P Study area, provided there is significant spawning habitat upstream of the impoundments.

Highway culverts, the second most common blockage, are low cost alternatives to bridges when roads must cross small streams, and impact primarily alewife and blueback herring. Current trends in highway maintenance favor replacement of small bridges with culverts. This may result in significant adverse cumulative impacts in the future unless appropriate culvert designs for anadromous fish passage are employed.

The products of this investigation include this report and maps depicting the known historic and present anadromous fish utilization of streams in the A/P Study area and impediments to anadromous fish migrations.

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SUMMARY AND CONCLUSIONS

1. Reduced access to historical spawning areas is believed to be one of the causes for the decline in anadromous fish in the Albemarle-Pamlico Estuarine Study (A/P Study) area. Physical impediments to anadromous fish migrations in the A/P Study area were identified.

2. Dams are the most common impediment in the A/P Study area and have blocked large areas of former spawning habitat for all anadromous species, especially in the Roanoke River Basin. Highway culverts are the second most common blockage, affecting primarily alewife and blueback herring migrations on smaller streams. The trend in highway maintenance to replace old bridges on small streams with new culverts has the potential to significantly impact alewife and blueback herring migrations.

3. Restoration of anadromous fish runs to historical spawning areas above existing impediments may yield significant benefits to the fishery resource, as observed in New England. The first step in restoration is to prioritize the sites where fish passage facilities should be installed based upon the expected benefits to the fishery resource.

RECOMMENDATIONS

1. State-of-the-art guidelines for culvert installation to provide for anadromous fish passage should be reviewed and evaluated. Recommendations resulting from this evaluation should be used in developing guidelines for highway culvert installation on anadromous fish spawning streams in North Carolina.

2. Until culvert designs conducive to anadromous fish passage are utilized in North Carolina, any road crossing of a stream supporting anadromous fish migrations should be accomplished by bridging.

3. Any new dams constructed in the A/P Study area should include anadromous fish passage facilities, as needed.

4. The feasibility of restoring anadromous fish migrations to historical spawning areas presently blocked by dams should be investigated. Relevant factors to be considered should include the types and costs of fish passage devices that could be utilized, quantity and quality of spawning habitat above the obstructions, impacts to existing resources upstream of the dams, and expected benefits to the anadromous fishery resource.

INTRODUCTION

Anadromous fish have been important to human existence since pre-colonial times. In the Albemarle-Pamlico Estuarine Study (A/P Study) area, anadromous fish include Atlantic sturgeon (Acipenser oxyrhynchus), shortnose sturgeon (Acipenser brevirostrum), American shad (Alosa sapidissima), hickory shad (Alosa mediocris), alewife (Alosa psuedoharengus), blueback herring (Alosa aestivalis), and striped bass (Morone saxatilis). Anadromous fish have been a mainstay of the North Carolina commercial fishery, as well as a significant resource for sport fishermen, particularly in Albemarle Sound where over 90 percent of North Carolina's anadromous fish landings occur (Winslow et al. 1985). However, there has been an unprecedented decline in harvest of anadromous fish in North Carolina to record low levels (Street 1980) prompting concern for these species. The reasons for this decline are not apparent, but probable causes include water quality degradation, water flow manipulation, overfishing, habitat destruction caused by channelization projects and wetland filling, siltation of spawning areas, and reduced access to historical spawning grounds.

The purpose of this study is to document the occurrence and significance of physical obstructions to anadromous fish spawning migrations in the A/P Study area. Specifically, the objectives are to: 1) determine the known historic and present ranges of anadromous fishes in rivers and streams of the A/P Study area, and 2) identify existing physical barriers to anadromous fish migrations in these streams.

METHODS

Present and historic usage of streams within the A/P Study area by anadromous fishes was determined by literature review and consultation with recognized professionals and interested individuals concerned with the resource (Table 1). Identification of physical obstructions to anadromous fish migrations was accomplished by literature review, consultation with the aforementioned individuals, examination of U.S. Geological Survey topographic maps, aerial survey of most of the A/P Study area, and ground investigation. Obstructions were recorded photographically and are on file at the Raleigh Fish and Wildlife Enhancement Field Office, U.S. Fish and Wildlife Service, Raleigh, North Carolina.

RESULTS

Historic usage of streams in the A/P Study area by anadromous fishes is poorly documented. Odom et al. (1986) provided an overview of anadromous fish migrations in Virginia's mainstream rivers of the Chowan River drainage, including known historical upstream limits. The only historical

Table 1. Professionals consulted in the course of investigation.

NAME	AFFILIATION
W. Donald Baker	N.C. Wildlife Resources Commission
Alvin Braswell	N.C. Museum of Natural Sciences
Jess Hawkins	N.C. Division of Marine Fisheries
Robert E. Jenkins	Roanoke College, Salem, Virginia
Harrel Johnson	N.C. Division of Marine Fisheries
Gregory Judy	N.C. Division of Marine Fisheries
James W. Kornegay	N.C. Wildlife Resources Commission
Albert Little	N.C. Wildlife Resources Commission
Charles S. Manooch	National Marine Fisheries Service
Edward Menhinick	University of North Carolina, Charlotte
Anthony Mullis	N.C. Wildlife Resources Commission
Franklin T. McBride	N.C. Wildlife Resources Commission
William M. Palmer	N.C. Museum of Natural Science
Roger A. Rulifson	East Carolina University
William B. Smith	N.C. Wildlife Resources Commission
Sara E. Winslow	N.C. Division of Marine Fisheries

data that they could find pertained to American shad (Figure 1). In the Roanoke River, American shad are reported to have ascended upstream as far as the vicinity of Salem, Virginia (37° 16' 19" N, 80° 01' 47" W) (Virginia Fish Commission 1878). In 1790, striped bass were observed in the Roanoke River as far upstream as Clarksville, Virginia (Virginia Fish Commission 1877). However, newspaper accounts claim that a large striped bass was taken from the Roanoke River near Salem, Virginia, 275 km upstream of Clarksville (Robert E. Jenkins, Roanoke College, personal communication). Within North Carolina, Jordan (1889) reported the presence of American shad at Milburnie Dam on the Neuse River in Wake County east of Raleigh (Figure 2).

Present ranges of anadromous fishes in the streams of the A/P Study area were identified from the following publications: Pate (1975), Street et al. (1975), Marshall (1976), Johnson et al. (1977), Marshall (1977), Hawkins (1980), Johnson et al. (1981), Rulifson et al. (1982), Winslow et al. (1983), Winslow et al. (1985), and Odom et al. (1986). Additional information regarding present ranges of anadromous fishes was obtained by consultation with the individuals listed in Table 1, and the compiled data was transferred to a map format (Figures 3-9). Except where upstream limits correspond with permanent obstructions, the range of anadromous fish migrations may vary from year to year due to a variety of probable factors including fluctuations in stream discharge, water quality, and water

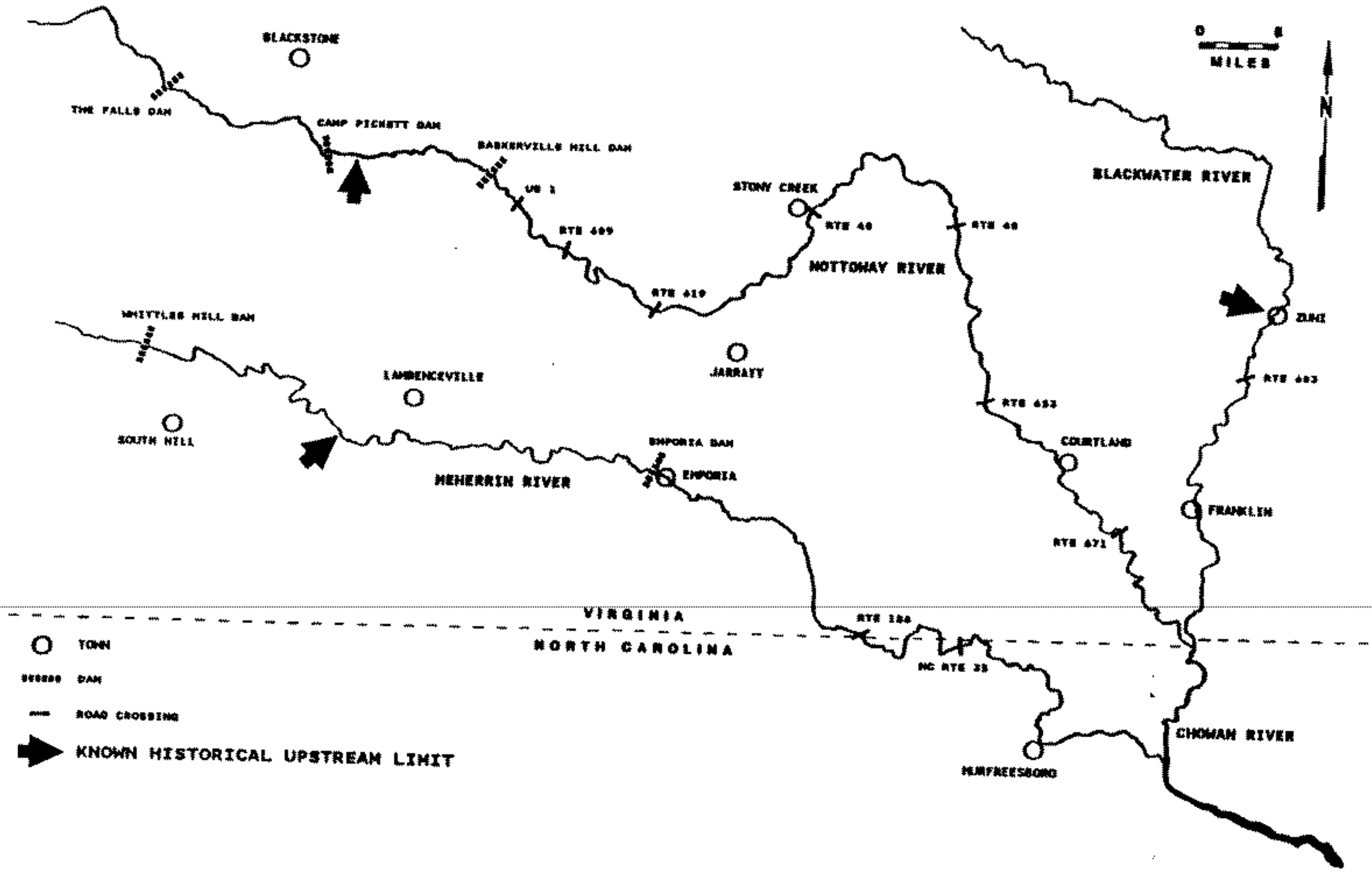


Figure 1. Known historical upstream limits of American shad spawning runs in the Blackwater, Nottoway, and Meherrin Rivers. From Odom et al. (1986).

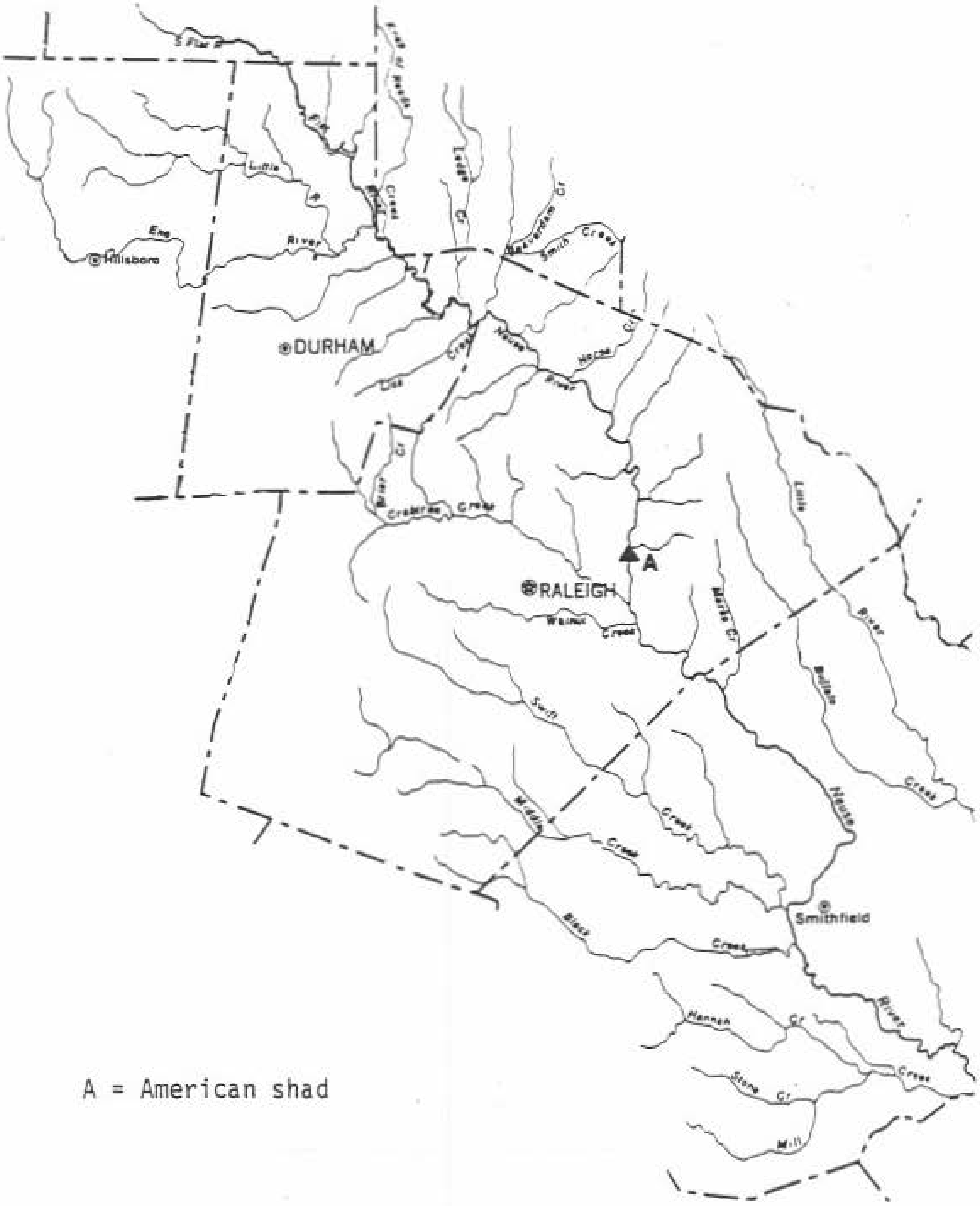


Figure 2. Historic captures of American shad in the Neuse River drainage, as reported by Jordan (1889).

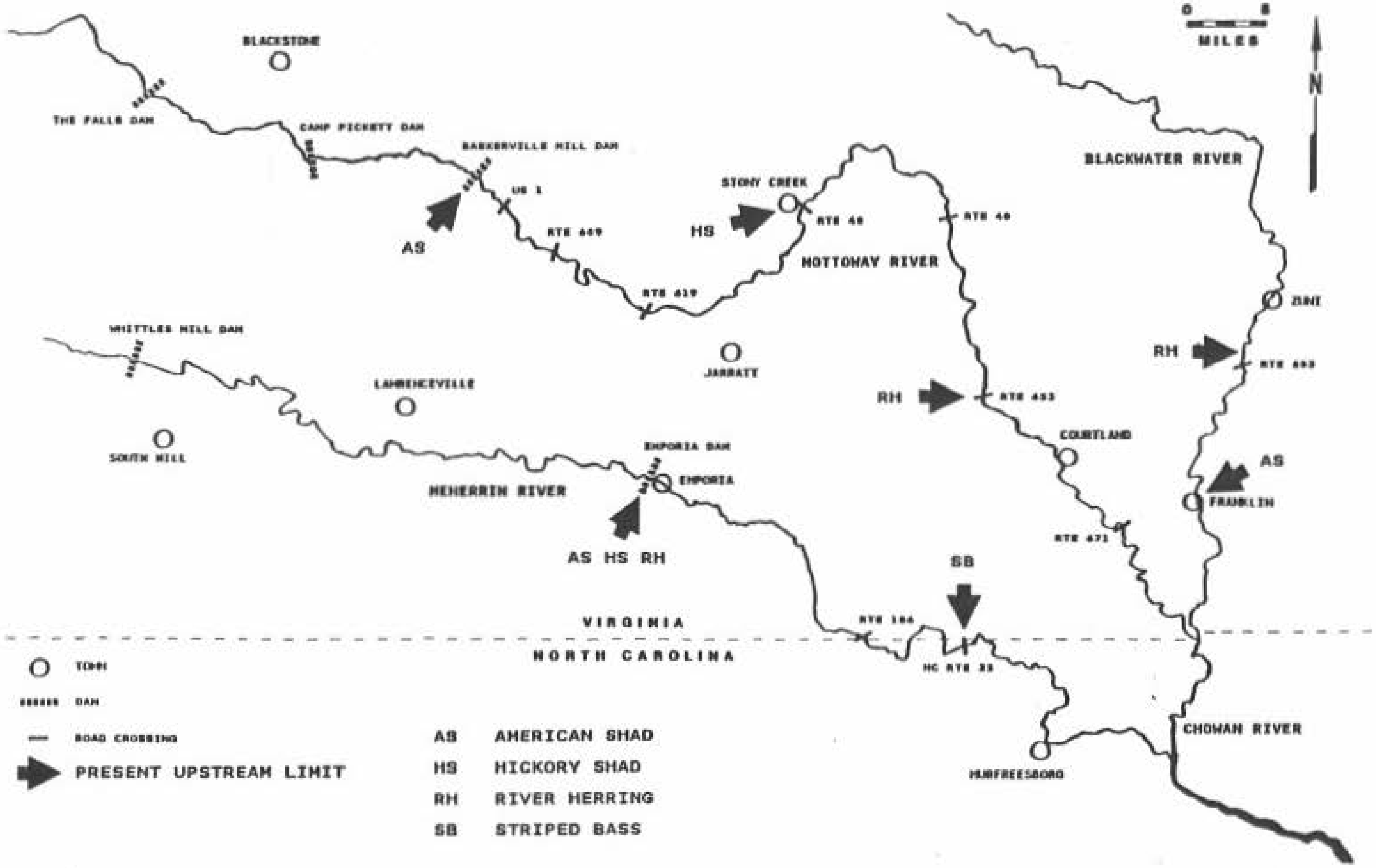
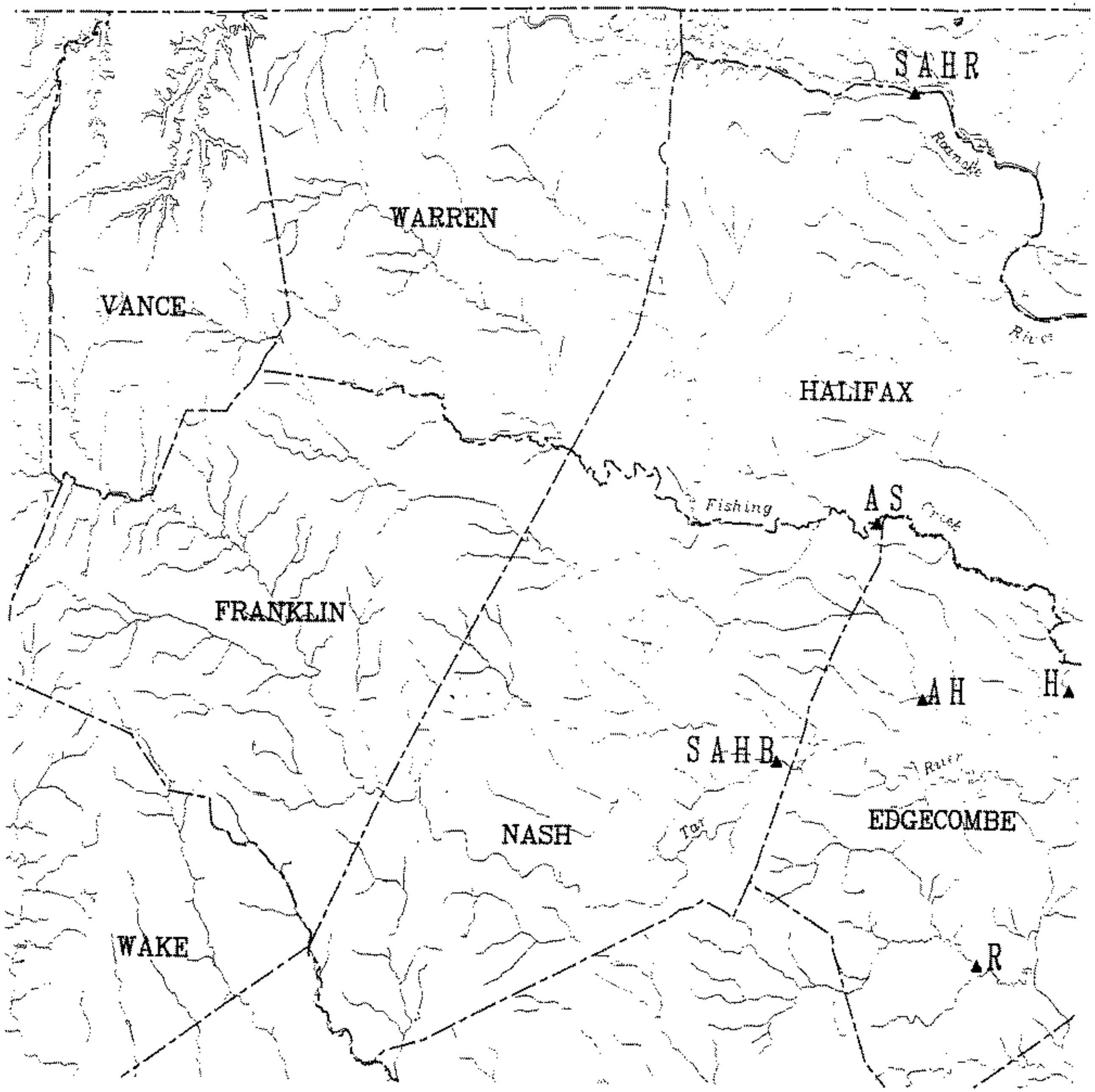


Figure 3. Presently known upstream limits of anadromous fish spawning runs in the Blackwater, Nottoway, and Meherrin Rivers. Striped bass are suspected of spawning in the lower Nottoway River, but conclusive evidence is lacking. From Odom et al. (1986).

Figure 4. Presently known upstream limits of anadromous fish spawning runs in the A/P Study area - northwest quadrangle.



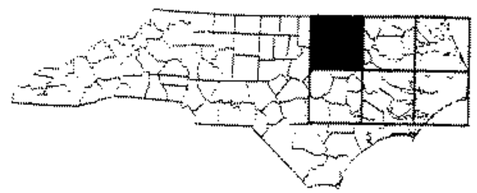
LEGEND

— Hydrography

-- County Boundary

▲ Upstream Limit

A = American Shad
B = Blueback Herring
H = Hickory Shad
R = River Herring
S = Striped Bass
W = Alewife



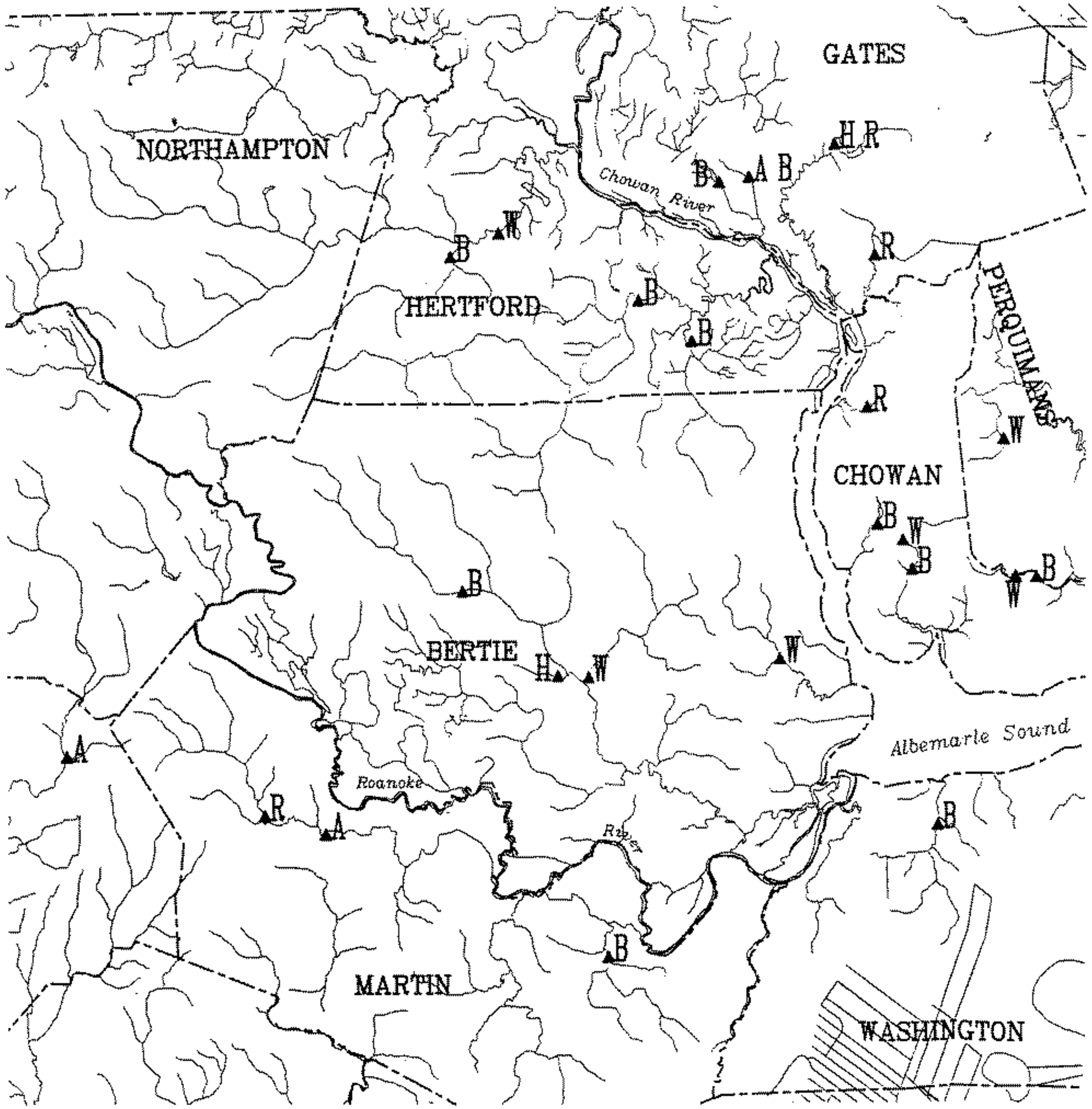
SOURCE of POINT DATA U.S. Fish & Wildlife Service

SCALE 1:432,000

December, 1989

Prepared by:
Center for Geographic Information and Analysis
N.C Dept. of Environment, Health, & Natural Resources

Figure 5. Presently known upstream limits of anadromous fish spawning runs in the A/P Study area - north-central quadrangle.



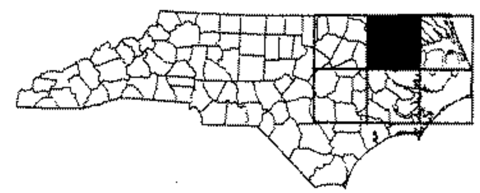
LEGEND

Hydrography

County Boundary

▲ Upstream Limit

A = American Shad
B = Blueback Herring
H = Hickory Shad
R = River Herring
S = Striped Bass
W = Alewife



SOURCE of POINT DATA: U.S. Fish & Wildlife Service

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0 10 20 30 MILES

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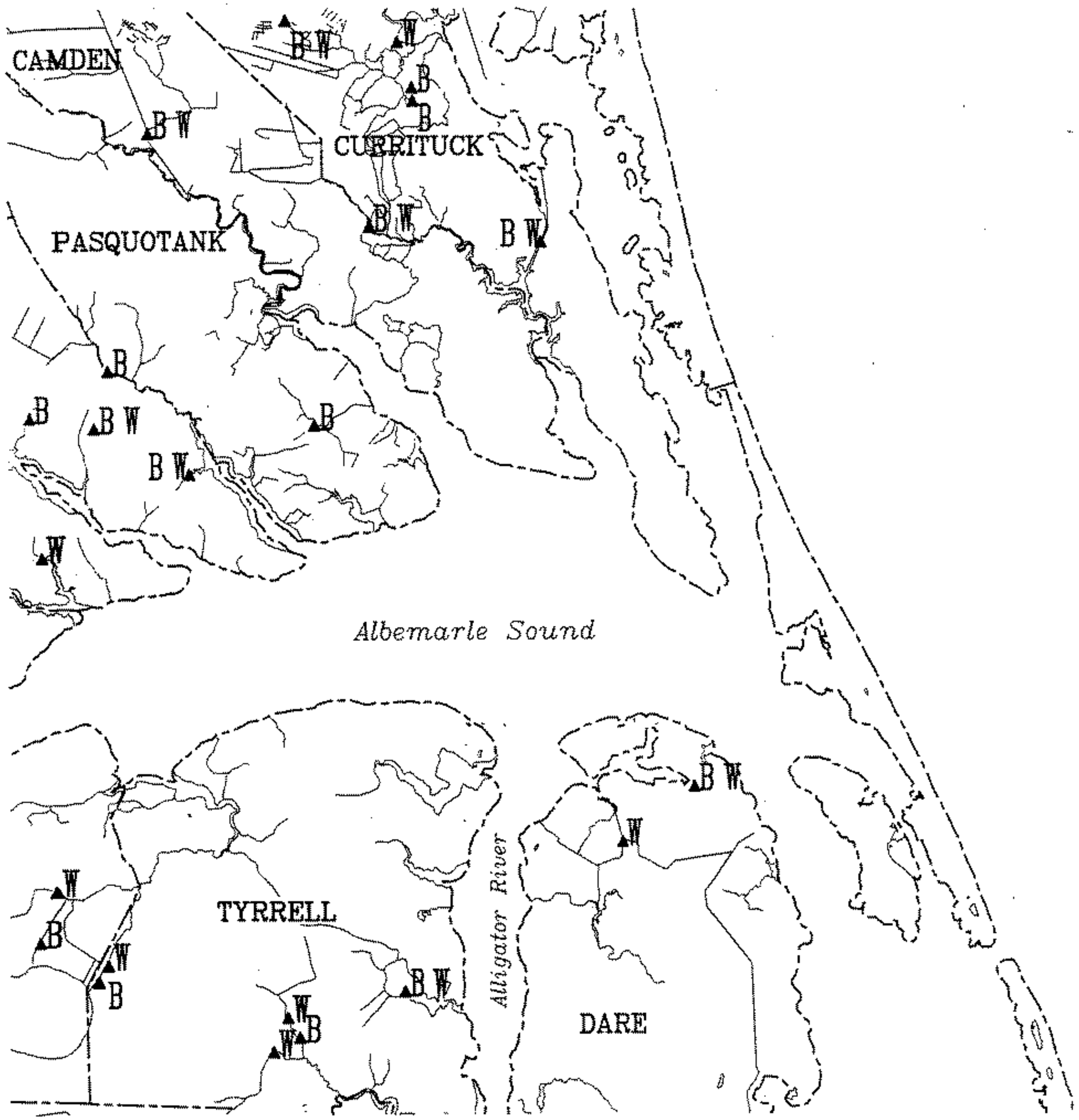
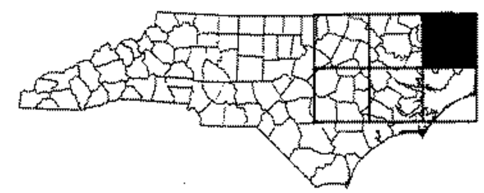


Figure 6. Presently known upstream limits of anadromous fish spawning runs in the A/P Study area - northeast quadrangle.

LEGEND

- —— Hydrography
- — - County Boundary
- ▲ Upstream Limit

A = American Shad
B = Blueback Herring
H = Hickory Shad
R = River Herring
S = Striped Bass
W = Alewife



SOURCE of POINT DATA: U.S. Fish & Wildlife Service

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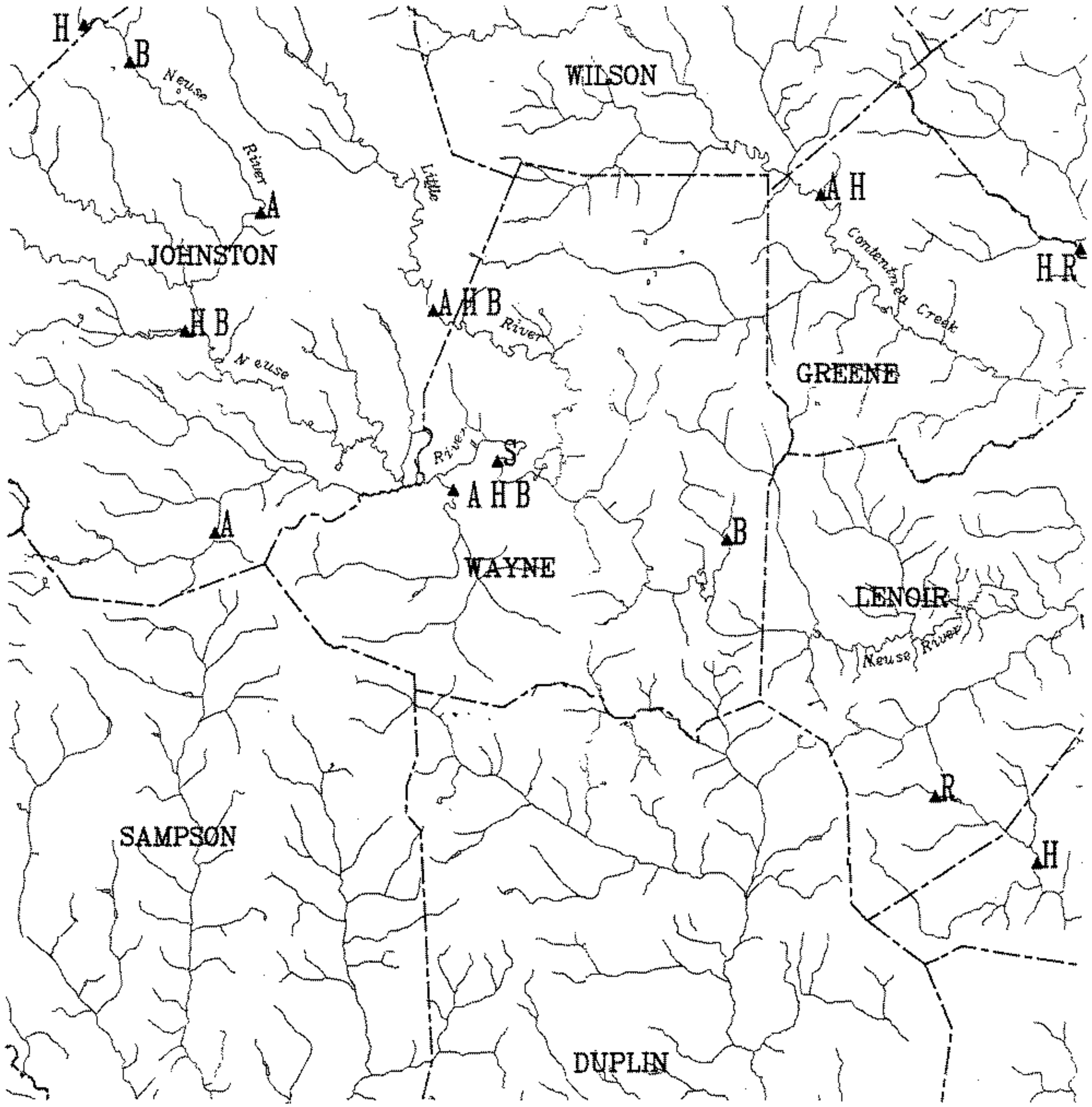
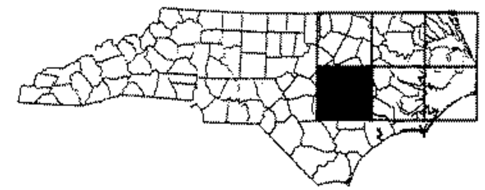


Figure 7. Presently known upstream limits of anadromous fish spawning runs in the A/P Study area - southwest quadrangle.

LEGEND

— Hydrography
-·- County Boundary
▲ Upstream Limit

A = American Shad
B = Blueback Herring
H = Hickory Shad
R = River Herring
S = Striped Bass
W = Alewife



SOURCE of POINT DATA: U.S. Fish & Wildlife Service

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December, 1989

Prepared by:
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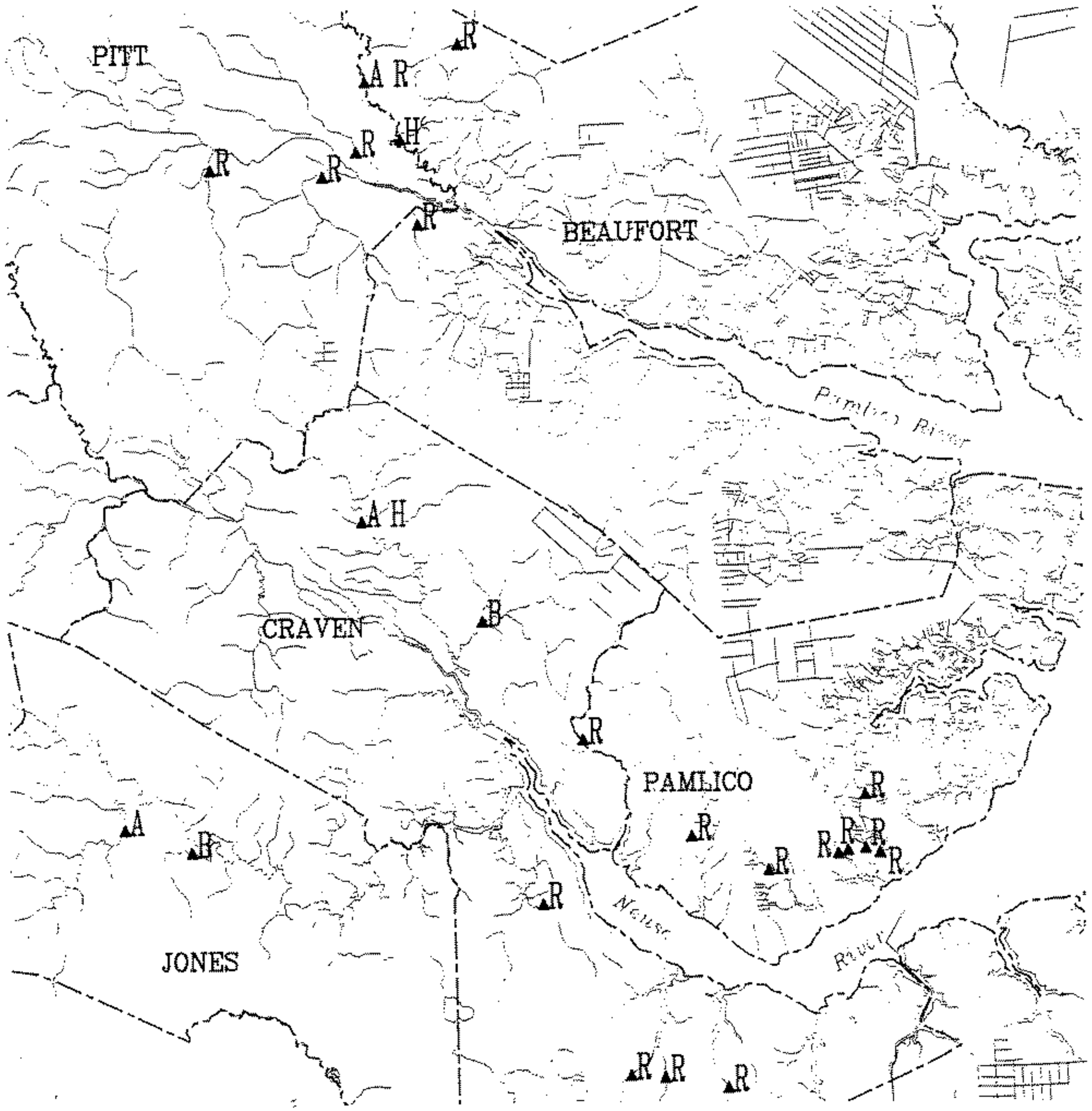
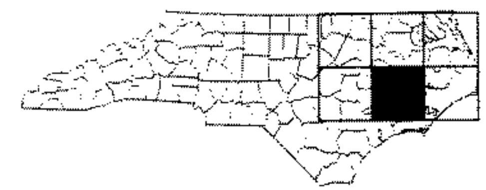


Figure 8. Presently known upstream limits of anadromous fish spawning runs in the A/P Study area - south-central quadrangle.

LEGEND

— Hydrography
— - County Boundary
▲ Upstream Limit

A = American Shad
B = Blueback Herring
H = Hickory Shad
R = River Herring
S = Striped Bass
W = Alewife



SOURCE of POINT DATA: U.S. Fish & Wildlife Service

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0 10 20 30 MILES

December, 1989

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Center for Geographic Information and Analysis
N.C Dept. of Environment, Health, & Natural Resources

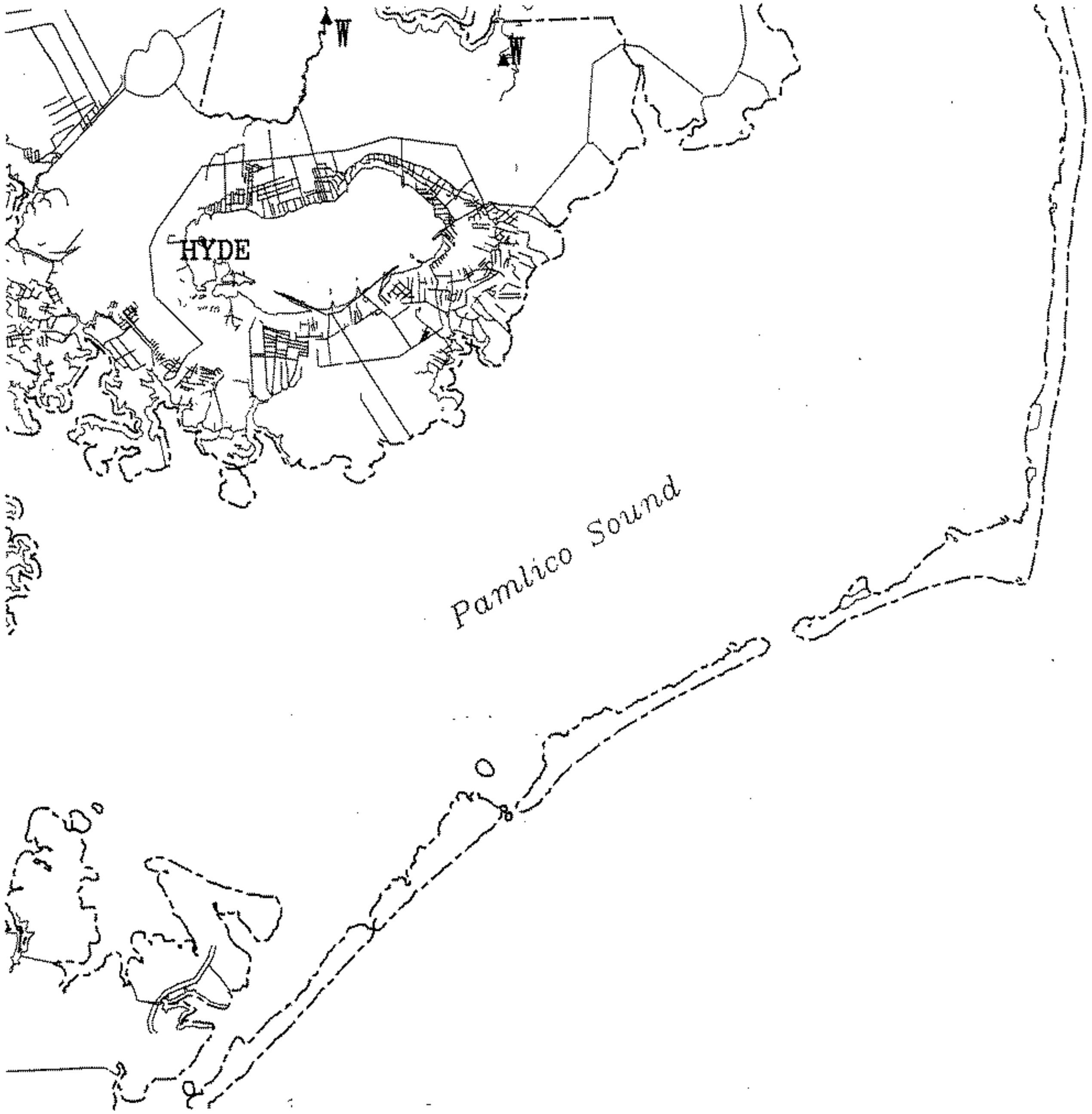


Figure 9. Presently known upstream limits of anadromous fish spawning runs in the A/P Study area - southeast quadrangle.

LEGEND

— Hydrography

--- County Boundary

▲ Upstream Limit

A = American Shad   R = River Herring
B = Blueback Herring   S = Striped Bass
H = Hickory Shad   W = Alewife

SOURCE of POINT DATA: U.S. Fish & Wildlife Service

SCALE 1:432,000

0   10   20   30 MILES

December, 1989

Prepared by:
Center for Geographic Information and Analysis*
N.C. Dept. of Environment, Health, & Natural Resources

temperature. "River herring", as used in Figures 3-9, is a collective term for alewife and blueback herring.

There is a lack of knowledge regarding historical and present spawning migrations of Atlantic sturgeon and shortnose sturgeon in the A/P Study area. The shortnose sturgeon was never common is North Carolina and is now believed to be extirpated in the A/P Study area (Rulifson et al. 1982). Atlantic sturgeon exist within the A/P Study area but in such low numbers that attempts to document spawning grounds have been unsuccessful.

Twenty-seven obstructions known to impede anadromous fish migrations within the A/P Study area were identified (Table 2). These include 18 dams (3 of which are passable to all or some anadromous fish during certain flows), 4 storm gates on canals, 2 highway culverts, 2 dense aquatic vegetation blockages, and 1 navigation lock on a canal. An additional 30 impediments were identified on stream reaches where anadromous fish usage is suspected but has not yet been confirmed (Table 3). These are comprised of 21 highway culverts, 8 dams, and 1 beaver dam. Figures 10-14 are maps showing the location of each of the aforementioned impediments. Each obstruction is identified by number on Figure 10-14; these numbers correspond to those listed in Tables 2-3.

DISCUSSION

Readily available information regarding the historic range of anadromous fish migrations in the A/P Study area is scarce, and what little we found pertained only to the larger tributaries. A thorough review of archive resources may have yielded additional historical information contained in personal letters, diaries, and newspaper accounts, but such an undertaking was beyond the scope of this study. Information on the present range of anadromous fish in the A/P Study area is more complete, especially for the large and medium-sized tributaries. Current usage of the numerous small streams, principally by alewife and blueback herring, is not thoroughly documented and remains a weakness in the existing data base.

Dams, the most common obstruction in the A/P Study area, prevent anadromous fish from accessing large areas of former spawning habitat. The greatest loss of habitat has occurred in the Roanoke River drainage. American shad, one of the few species for which we have historical data, no longer have access to over 350 km of former habitat in the mainstem Roanoke River not to mention the additional habitat they probably utilized on large tributaries such as the Dan River. Because dams are constructed on all sizes of streams, they have directly affected all anadromous species.

On the other hand, highway culverts, the second most common impediment in the A/P Study area, affect primarily river herring (a collective term for alewife and blueback herring). Culverts are low-cost alternatives to

Table 2. Confirmed impediments to upstream movement of anadromous fishes in the A/P Study area.

OBSTRUCTION NUMBER	DESCRIPTION	LATITUDE	LONGITUDE
1	Dam on Little River at SR 1002, Johnston Co.	35° 28' 55" N	78° 08' 39" W
2	Dam on Little River near US 70, Wayne Co. Passable at some flows.	35° 24' 14" N	78° 00' 41" W
3	Dam on Little River at NC 581, Wayne Co. Passable at some flows.	35° 23' 38" N	78° 01' 35" W
4	Dam on Tar River at NC 43, Nash Co.	35° 57' 38" N	77° 48' 12" W
5	Dam on Fishing Creek near SR 1518, Halifax and Nash Cos.	36° 09' 13" N	77° 44' 35" W
6	Dam on Neuse River, 0.9 km upstream of US 64, Wake Co. Anadromous fish have not been observed as far up as this dam in recent years, but historically they were.	35° 48' 00" N	78° 32' 22" W
7	Dam on Neuse River near SR 1223, Wayne Co. Passable at some flows.	35° 22' 00" N	78° 05' 00" W
8	Dam on Roanoke River, 2.7 km upstream of NC 48, Halifax and Northampton Cos.	36° 28' 45" N	77° 40' 21" W
9	Dam on Indian Creek at SR 1226, Chowan Co.	36° 13' 44" N	76° 40' 24" W
10	Dam on Rockyhock Creek at SR 1222, Chowan Co.	36° 08' 21" N	76° 39' 53" W
11	Dam on Falling Creek at SR 1008, Wayne Co.	35° 20' 33" N	78° 07' 31" W

Table 2. (Continued)

OBSTRUCTION NUMBER	DESCRIPTION	LATITUDE	LONGITUDE
12	Dam on Crooked Run Creek at NC 58, Jones Co.	35° 03' 32" N	77° 21' 21" W
13	Dam on Walnut Creek, 2.9 km upstream of SR 1730, Wayne Co.	35° 18' 12" N	77° 51' 55" W
14	Dam on Black Creek at NC 96, Johnston Co.	35° 27' 59" N	78° 23' 27" W
15	Lock on Dismal Swamp Canal, Camden Co.	36° 26' 12" N	76° 19' 30" W
16	Vegetation block on Suttons Creek at SR 1304, Perquimans Co.	36° 12' 45" N	76° 23' 06" W
17	Vegetation block on Pollock Swamp Creek at NC 32, Chowan Co.	36° 06' 13" N	76° 38' 30" W
18	Dam on Hoggards Mill Creek near SR 1300, Bertie Co.	36° 01' 33" N	76° 56' 58" W
19	Dam on Bennetts Creek at SR 1400, Gates Co.	36° 25' 56" N	76° 42' 00" W
20	Culvert in Yeopim Creek at SR 1347, Perquimans Co.	36° 07' 24" N	76° 26' 30" W
21	Culvert on Burnt Mill Creek at NC 37, Perquimans Co.	36° 05' 47" N	76° 32' 03" W
22	Storm gate on Western Canal at Phelps Lake, Washington Co.	35° 48' 17" N	76° 26' 44" W
23	Storm gate on Thirtyfoot Canal at Phelps Lake, Washington Co.	35° 47' 29" N	76° 24' 38" W
24	Storm gate on Old Canal at Phelps Lake, Washington and Tyrrell Cos.	35° 47' 12" N	76° 24' 20" W

Table 2. (Continued)

OBSTRUCTION NUMBER	DESCRIPTION	LATITUDE	LONGITUDE
25	Storm gate on Bonarva Canal at Phelps Lake, Tyrrell Co.	35° 47' 00" N	76° 24' 10" W
26	Dam on Nottoway River, Dinwiddie and Brunswick Cos., Virginia	37° 58' 30" N	77° 46' 06" W
27	Dam on Meherrin River, Greenville Co., Virginia	36° 42' 20" N	77° 35' 00" W

Table 3. Structures suspected of impeding upstream movement of anadromous fishes in the A/P Study area. These structures occur on stream reaches where anadromous fish spawning runs are likely but evidence of such usage is presently lacking.

OBSTRUCTION NUMBER	DESCRIPTION	LATITUDE	LONGITUDE
28	Dam on Moccasin Creek at SR 2530, Johnston Co.	35° 27' 49" N	78° 11' 08" W
29	Dam on Contentnea Creek at US 301, Wilson Co.	35° 41' 17" N	77° 56' 55" W
30	Dam on Toisnot Creek near NC 42, Wilson Co.	35° 44' 37" N	77° 54' 13" W
31	Beaver dam on Eastmost Swamp at NC 45, Bertie Co.	36° 05' 00" N	76° 46' 35" W
32	Dam on Meeting House Branch, 0.1 km upstream of SR 1807, Pitt Co.	35° 35' 19" N	77° 19' 46" W
33	Dam on Southwest Creek at US 70, Lenoir Co.	35° 13' 42" N	77° 32' 39" W
34	Dam on Trotters Creek at NC 55, Lenoir Co. Dam breached but a beaver dam exists immediately upstream.	35° 11' 43" N	77° 47' 04" W
35	Dam on Dalys Creek at SR 1302, Lenoir Co.	35° 12' 41" N	77° 47' 04" W
36	Dam on Sleepy Creek, 0.5 km upstream of SR 1915, Wayne Co.	35° 15' 07" N	77° 57' 33" W
37	Culvert on Tankard Creek at SR 1607, Beaufort Co.	35° 32' 04" N	76° 49' 58" W
38	Culvert on Pungo Swamp at SR 1528, Beaufort Co.	35° 34' 14" N	76° 50' 56" W
39	Culvert on unnamed tributary to Little River at SR 1100, Pasquotank Co.	36° 11' 42" N	76° 15' 19" W

Table 3. (Continued)

OBSTRUCTION NUMBER	DESCRIPTION	LATITUDE	LONGITUDE
40	Culvert on Symonds Creek at SR 1182, Pasquotank Co.	36° 11' 32" N	76° 13' 54" W
41	Culvert on Mathews Creek (tributary to Symonds Creek) at SR 1118, Pasquotank Co.	36° 11' 21" N	76° 12' 28" W
42	Culvert on unnamed tributary to Chapel Creek (tributary to Big Flatty Creek) at SR 1116, Pasquotank Co.	36° 09' 36" N	76° 10' 29" W
43	Culvert on unnamed tributary to unnamed tributary to Newbegun Creek at SR 1103, Pasquotank Co.	36° 12' 02" N	76° 09' 35" W
44	Culvert on unnamed tributary to unnamed tributary to Newbegun Creek at SR 1103, Pasquotank Co.	36° 12' 13" N	76° 09' 42" W
45	Culvert on unnamed tributary to Newbegun Creek at NC 34, Pasquotank Co.	36° 12' 23" N	76° 09' 57" W
46	Culvert on unnamed tributary to Newbegun Creek at NC 34, Pasquotank Co.	36° 12' 17" N	76° 10' 25" W
47	Culvert on unnamed tributary to Newbegun Creek at SR 1101, Pasquotank Co.	36° 12' 49" N	76° 11' 18" W
48	Culvert on unnamed tributary to Newbegun Creek at SR 1132, Pasquotank Co.	36° 13' 46" N	76° 11' 09" W
49	Culvert on Newbegun Creek at SR 1132, Pasquotank Co.	36° 13' 47" N	76° 11' 07" W

Table 3. (Continued)

OBSTRUCTION NUMBER	DESCRIPTION	LATITUDE	LONGITUDE
50	Culvert on unnamed tributary to Newbegun Creek at SR 1124, Pasquotank Co.	36° 13' 33" N	76° 10' 14" W
51	Culvert on unnamed tributary to Racoon Creek at US 17, Perquimans Co.	36° 10' 09" N	76° 28' 15" W
52	Culvert on Racoon Creek at US 17, Perquimans Co.	36° 10' 01" N	76° 28' 27" W
53	Culvert on Bethel Creek at US 17, Perquimans Co.	36° 07' 39" N	76° 30' 00" W
54	Culvert on Trotman Creek at SR 1415, Gates Co.	36° 21' 41" N	76° 36' 25" W
55	Culvert on unnamed tributary to Deep Creek at SR 1308, Washington Co.	35° 55' 22" N	76° 24' 20" W
56	Culvert on Joshua Branch at SR 1150, Jones Co.	35° 01' 48" N	77° 37' 21" W
57	Culvert on Quankey Creek at US 301, Halifax Co.	36° 19' 06" N	77° 35' 42" W

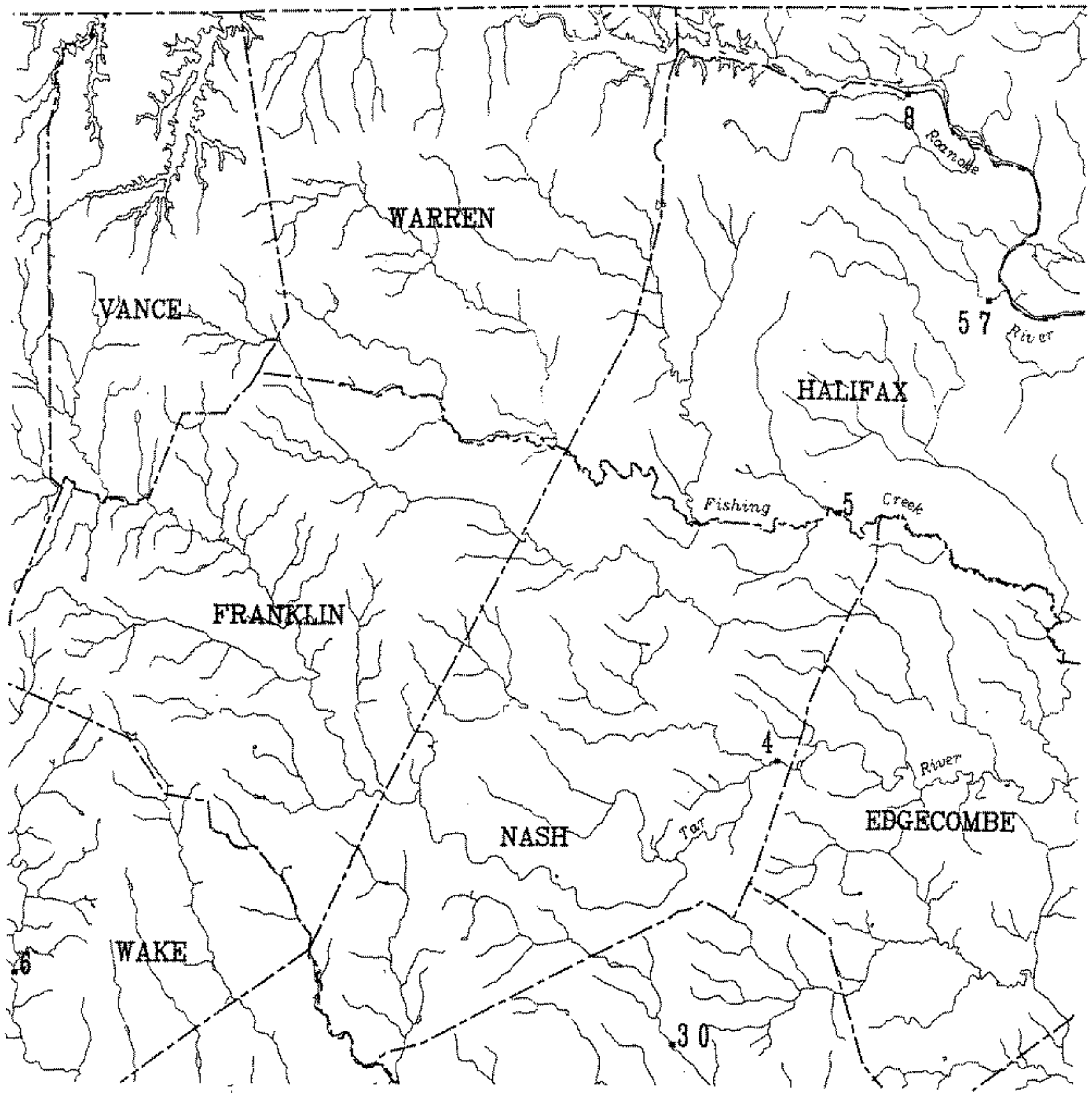
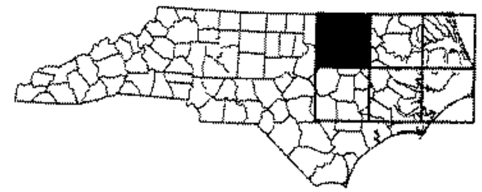


Figure 10. Obstructions to anadromous fish spawning migrations in the A/P Study area - northwest quadrangle.

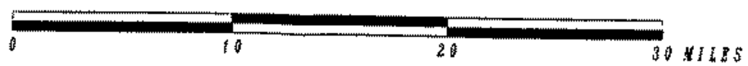
LEGEND

— Hydrography
-- County Boundary
▪ Obstruction



SOURCE of POINT DATA: U.S. Fish & Wildlife Service

SCALE 1:432,000



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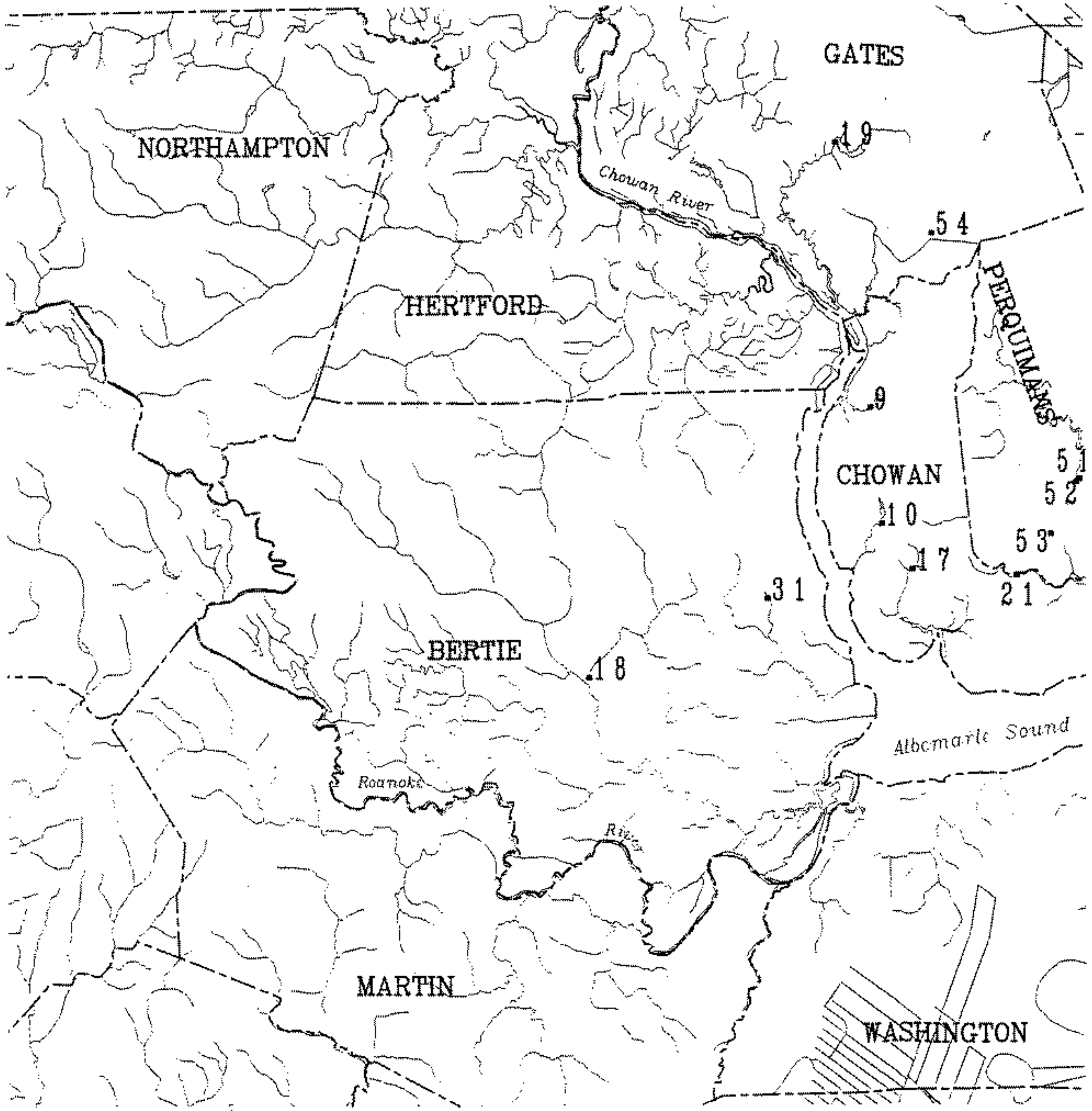
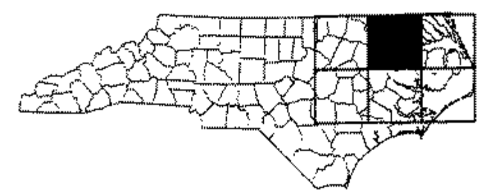


Figure 11. Obstructions to anadromous fish spawning migrations in the A/P Study area - north-central quadrangle.

LEGEND

- Hydrography
- County Boundary
- Obstruction



SOURCE of POINT DATA: U.S. Fish & Wildlife Service

SCALE 1:432,000

0 10 20 30 MILES

December, 1989

Prepared by:
Center for Geographic Information and Analysis
N.C. Dept. of Environment, Health, & Natural Resources

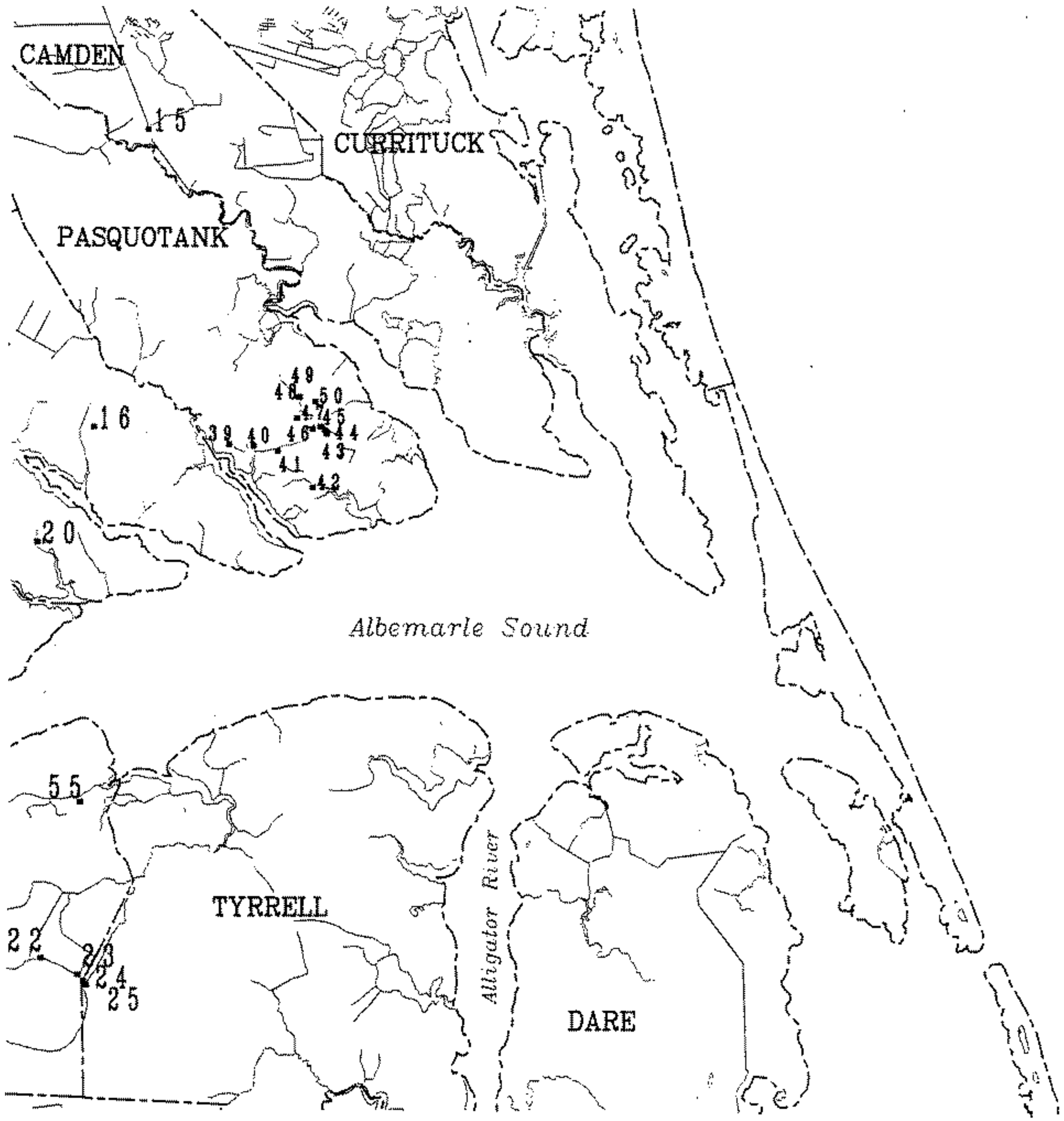
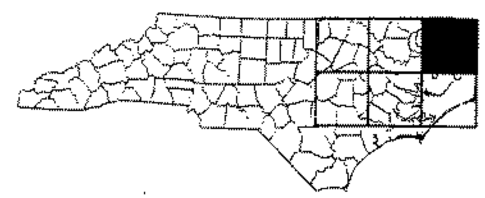


Figure 12. Obstructions to anadromous fish spawning migrations in the A/P Study area - northeast quadrangle.

LEGEND

— Hydrography
--- County Boundary
▪ Obstruction



SOURCE of POINT DATA: U.S. Fish & Wildlife Service

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0 10 20 30 MILES

December, 1989

Prepared by:
Center for Geographic Information and Analysis
N.C. Dept. of Environment, Health, & Natural Resources

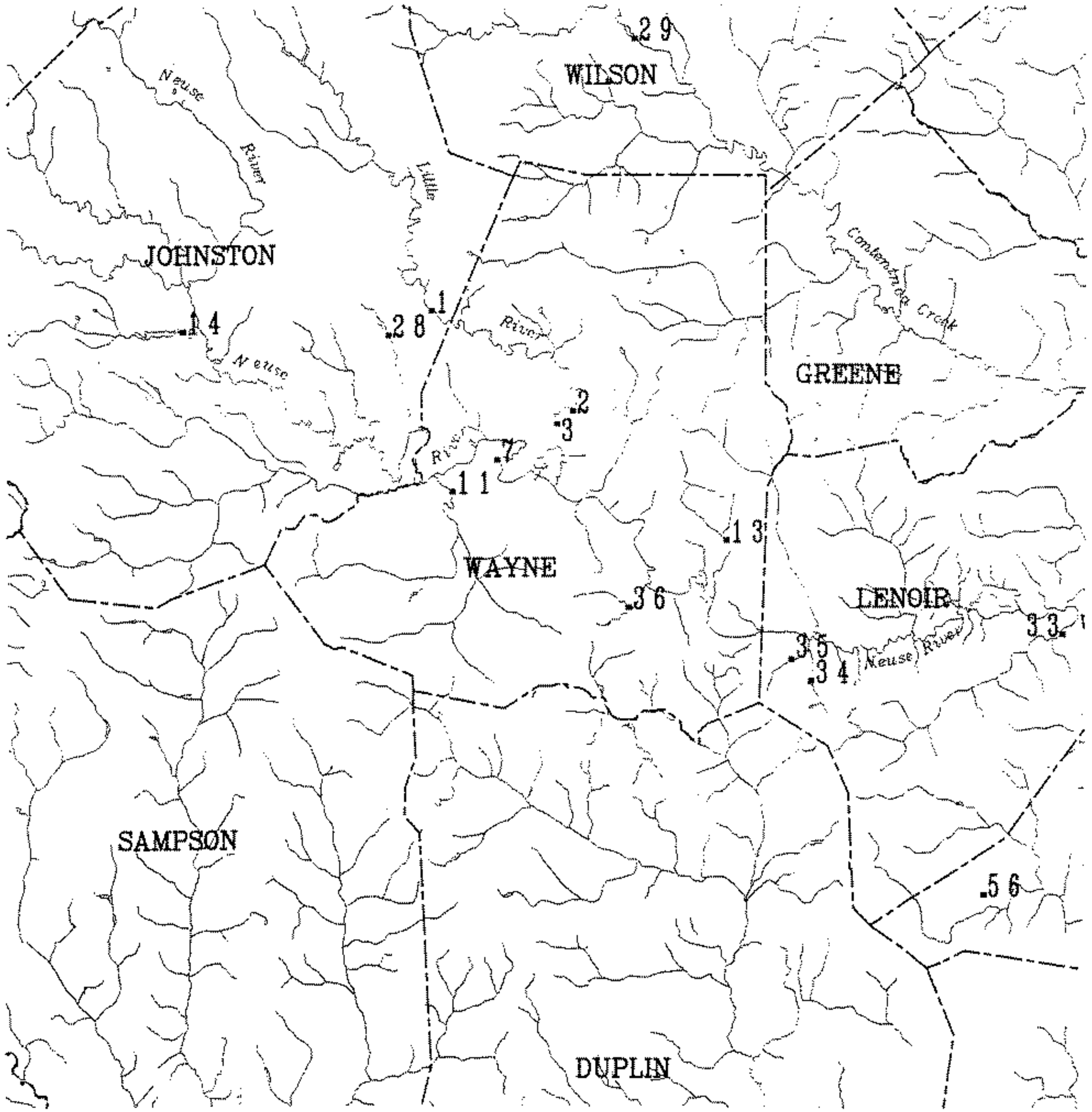
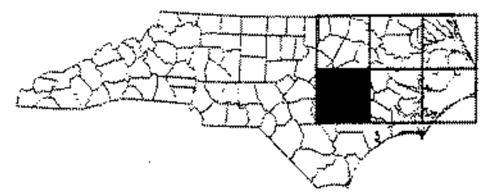


Figure 13. Obstructions to anadromous fish spawning migrations in the A/P Study area - southwest quadrangle.

LEGEND

- Hydrography
- County Boundary
- Obstruction



SOURCE of POINT DATA: U.S. Fish & Wildlife Service

SCALE 1:432,000

0 10 20 30 MILES

December, 1989

Prepared by:
Center for Geographic Information and Analysis
N.C. Dept. of Environment, Health, & Natural Resources

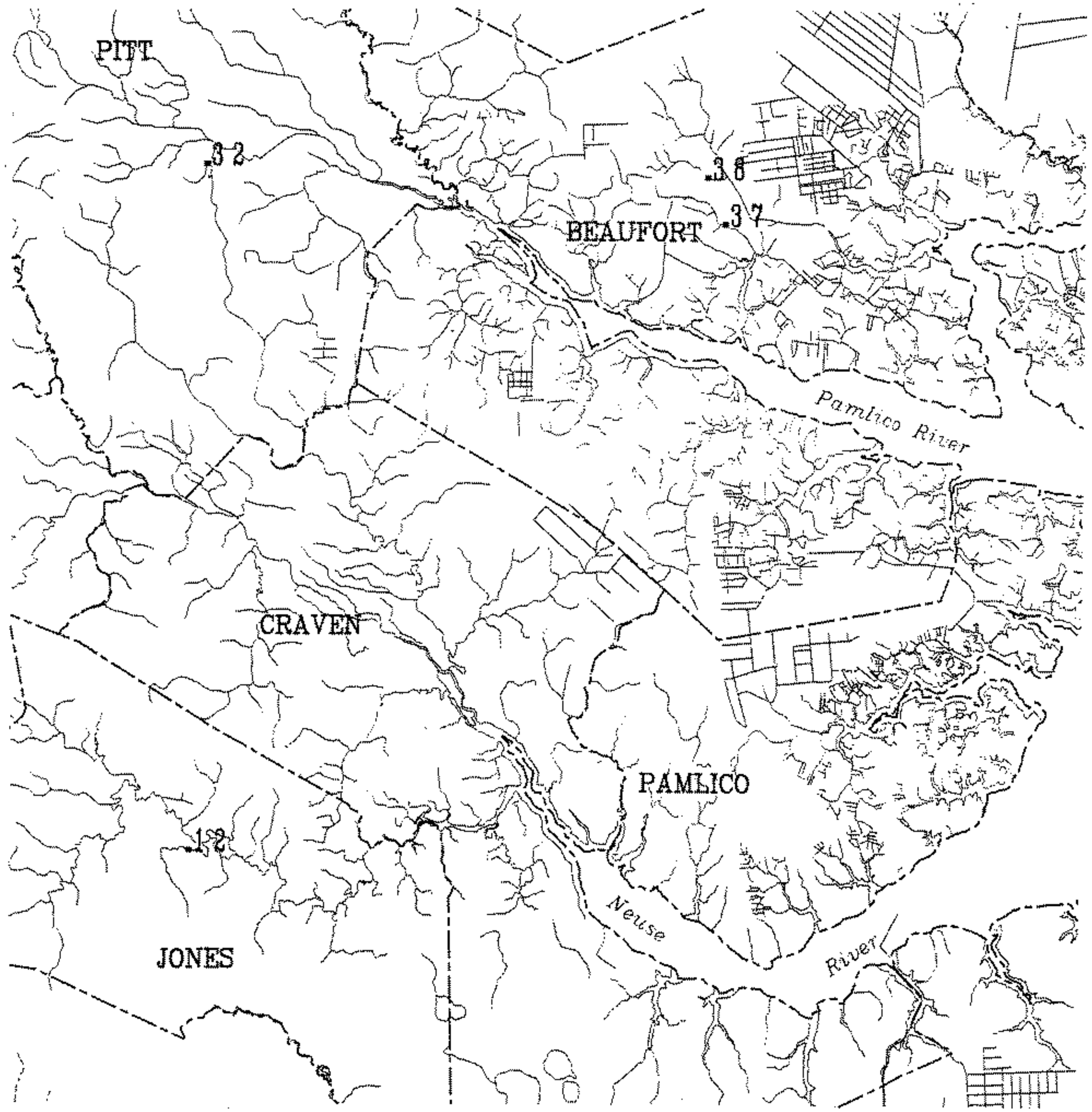


Figure 14. Obstructions to anadromous fish spawning migrations in the A/P Study area - south-central quadrangle.

LEGEND

— Hydrography
—- County Boundary
▪ Obstruction

SOURCE of POINT DATA: U.S. Fish & Wildlife Service

SCALE 1:432,000

0 10 20 30 MILES

December, 1989

Prepared by:
Center for Geographic Information and Analysis
N.C. Dept. of Environment, Health, & Natural Resources

bridges when roads must cross small streams, and river herring are the principal anadromous species to utilize small tributaries. While habitat losses associated with an individual impassable culvert may not appear significant, cumulative impacts within a watershed could be substantial. As the current trend in highway maintenance is to replace small bridges with culverts, the potential to adversely affect river herring spawning migrations will increase unless mitigative measures are adopted to insure anadromous fish passage.

Mudre et al.(1985) provided a brief overview of anadromous fish passage through culverts. Much of the following information was gleaned from their report, and it was supplemented with information obtained by consulting with resource managers and scientists. As it is unlikely that striped bass and the sturgeon species would use tributaries small enough to install culverts on, the following narrative applies primarily to alosids (a collective term for all Alosa species). For successful fish passage, the flow characteristics within the culvert must be within the biological limitations of the fish. Relevant factors for our anadromous species include water depth, water velocity, turbulence, culvert length, height of freeboard (i.e, air space in the culvert), and the presence of any vertical drops, as may form at culvert outlets. Unlike salmon, our anadromous species do not jump, so vertical drops should be avoided. Turbulence should be minimized as it tends to confuse the fish, making it difficult for them to orient into the current. The minimum water depth required for river herring is 20 cm, while the larger alosids need at least 30 cm.

Water velocity, culvert length, and height of freeboard are factors that may interact to determine alosid passage. Since many culverts lack resting locations within, water velocities must be slow enough for fish to traverse the entire length of the culvert without exhaustion. A long culvert with moderate velocities could be more of a barrier than a short culvert with high velocities. Observations of alosids indicate that they may be reluctant to enter dark orifices unless light is visible on the other side, especially on bright days with high contrast. Available light within a culvert declines with increasing culvert length and decreasing freeboard. Some fishery biologists have suggested that this avoidance behavior may explain why river herring have failed to ascend certain dark culverts with little freeboard where conditions otherwise appeared passable (e.g., adequate depth and suitable velocities). However, the existence of documented river herring migrations through long pipes of relatively small diameter in New England appears to conflict with the "dark culvert" hypothesis (J.J. Ney, Virginia Polytechnic Institute and State University, personal communication). Consequently, the issue of light in culverts remains a moot topic.

Due to inadequate understanding of the factors involved, specific guidelines for culvert installation to insure passage of alosids remain to be developed and tested. Mudre et al. (1985) provided some general guidelines which the Virginia Department of Transportation adopted for their use, but the effectiveness of these measures has not been evaluated. The Maryland State Highway Administration (MDSHA) is funding an evaluation of the effectiveness of their current fish passage guidelines for culvert construction. Current MDSHA guidelines call for installing culverts with the culvert bottom placed one-foot below the existing stream grade. In addition, MDSHA has tried several alternative culvert designs including bottomless box culverts, flow diversion weirs to concentrate low flows through one cell of multiple-cell box culverts, and internal baffles to reduce culvert velocities and provide adequate depth for fish passage. The final report on this evaluation should be available in January 1991.

Beaver dams and vegetation blockages are barriers that occur almost exclusively on small streams, with resultant impacts to primarily river herring. A rigorous ongoing aquatic weed control program conducted by the State of North Carolina has eliminated several potential blockages in the A/P Study area. We anticipate that continuation of that program and fluctuations in natural conditions affecting plant growth will preclude appreciable incidence of vegetation barriers in the future. The incidence of beaver dams as impediments to anadromous fish in the A/P Study area is not likely to increase substantially over time, as the beaver populations in this area are well established (P. Sumner, North Carolina Wildlife Resources Commission, personal communication).

Mitigation of anthropogenic barriers to anadromous fish migrations should encompass both present and potential impediments. Future dam construction should include effective fish passage facilities, as needed, to avoid additional impacts to the anadromous fish resource. Similarly, the design of new road crossing structures over streams should incorporate provisions for anadromous fish passage, as needed. Bridges are the preferred alternative with respect to fish passage, but culverts installed using state-of-the-art guidelines for anadromous fish passage may be an acceptable compromise. Retrofitting existing impassable culverts for anadromous fish passage may be technically feasible (Mudre et al. 1985) but difficult to justify fiscally unless it provides access to significant upstream spawning habitat.

The installation of effective fish passage structures at dams in New England have realized significant benefits to anadromous fish resources there. Similar restoration efforts may be possible in the A/P Study area, provided that quality spawning habitat still exists upstream of the dams. Our anadromous species require some water movement for spawning, so impoundments are not considered good spawning areas. Run-of-the-river dams are relatively low in height and impound little water. Consequently, fish passage facilities at such dams are relatively inexpensive to construct and, in general, the historical upstream spawning areas have not been affected much by the impoundment. High dams require more costly fish passage devices, and their associated impoundments may inundate substantial amounts of historical spawning habitat. The three large dams in sequence on the Roanoke River (Roanoke Rapids Dam, Gaston Dam, and John H. Kerr Dam) not only provide three formidable obstacles for anadromous fish, but their associated reservoirs have inundated miles of former spawning habitat. The first step towards restoring anadromous fish runs above existing dams should be to assess the quantity and quality of the spawning habitat above each impediment to help prioritize where restoration efforts would yield the greatest benefits.

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Appendix A. Inaccessible obstructions within the known or suspected historical range of anadromous fish in the A/P Study area. Downstream impediments currently prevent anadromous fish from ascending up to the obstructions listed below. This is not a complete inventory of inaccessible obstructions in the A/P Study area, but merely a listing of those that were identified during the course of this study.

DESCRIPTION	LATITUDE	LONGITUDE
Gaston Dam on Roanoke River, Northampton and Halifax Cos.	36° 30' 00" N	77° 48' 42" W
Dam on Neuse River at SR 2000, Wake Co.	35° 56' 28" N	78° 34' 50" W
Dam on Little River at NC 42, Johnston Co.	35° 40' 04" N	78° 15' 37" W
Dam on Cattail Creek at NC 96, Johnston Co.	35° 40' 39" N	78° 16' 28" W
Dam on Buffalo Creek at SR 1716, Johnston Co.	35° 43' 35" N	78° 21' 39" W
Dam on Contentnea Creek near NC 581, Wilson Co.	35° 41' 28" N	78° 07' 14" W
Dam on Contentnea Creek at NC 42, Wilson Co. (significantly breached).	35° 41' 52" N	78° 03' 39" W
Dam on Toisnot Creek near SR 1332, Wilson Co.	35° 47' 20" N	77° 55' 14" W
Dam on Toisnot Creek at NC 58, Wilson Co.	35° 48' 08" N	77° 56' 59" W
Dam on Tar River near SR 1746, Nash Co.	35° 53' 56" N	77° 53' 06" W
Dam on Tar River near SR 1544, Nash Co. (partially breached).	35° 54' 15" N	77° 52' 05" W
Dam on Rocky Swamp Creek at SR 1226, Halifax Co.	36° 09' 27" N	77° 45' 12" W
Dam on Buffalo Creek at SR 2324, Wake Co.	35° 49' 03" N	78° 24' 48" W
Culvert on unnamed tributary to Newbegun Creek at SR 1132, Pasquotank Co.	36° 13' 22" N	76° 11' 55" W
Culvert on unnamed tributary to Burnt Mill Creek at US 17, Perquimans Co.	36° 05' 52" N	76° 32' 21" W