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Final Report

FISHERY INVENTORY AND BASELINE WATER QUALITY OF THE
BACK RIVER SYSTEM, JAMESTOWN ISLAND
COLONIAL NATIONAL HISTORICAL PARK, VIRGINIA

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NPS Agreement Number 4000-1-0007

Period Covered: May-October 1991



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ABSTRACT

Baseline information on seasonal variation of fish species utilization and water quality parameters of the Back River system, Jamestown Island, Colonial National Historical Park, Virginia, was collected in May and October, 1991. Fish specimens were collected from 10 locations and water quality parameters were collected from 18 locations. Composition and life stage occurrence in fish species that were collected indicate that the Back River system is utilized as a nursery area for both recreationally and commercially important species. Water quality parameters collected were within acceptable ranges to promote completion of all life stages of the fish species collected. No federal or state listed threatened, rare, or endangered species were collected.

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INTRODUCTION

The Colonial National Historical Park (CNHP) entered into Interagency Agreement Number 4000-1-0007 dated May 22, 1991 with the U.S. Fish and Wildlife Service (Service), and requested therein that the Service collect baseline water quality data and compile a listing of non-migratory (resident) and migratory fish species utilizing the tidal waters (Back River System) on and around Jamestown Island.

The natural resources data base for the CNHP does not contain baseline water quality data or a current species list of fishes utilizing the tidal waters of the park. Such information is essential to enable CNHP to evaluate and monitor its natural resources program and to evaluate impacts to its aquatic resources due to pollution and off-site changes in land use practices. The Service designed a study to determine if the area was being utilized for spawning and/or nursery habitat for the fish species collected.

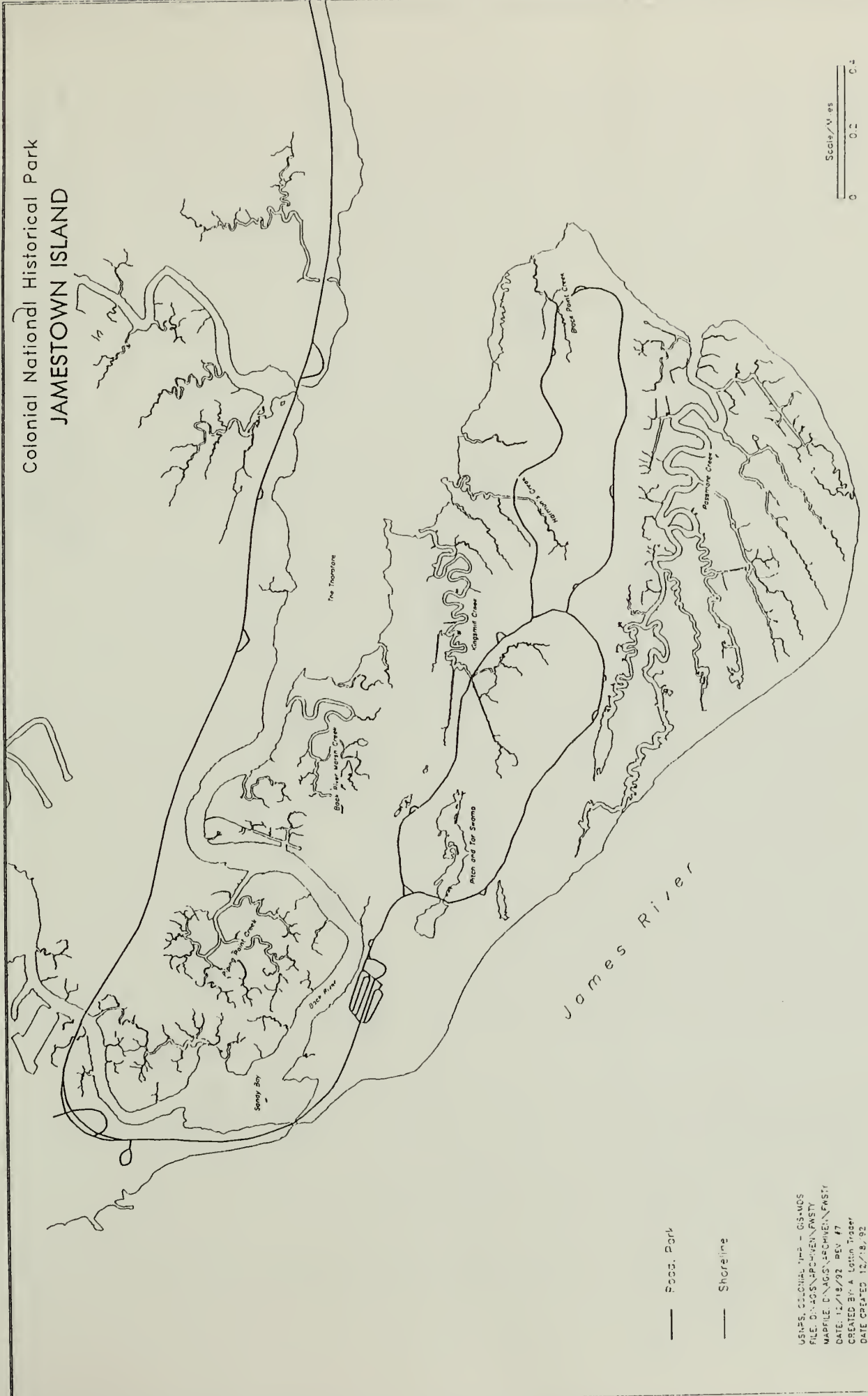
No previous investigations have been conducted within the study area. Historical data on fishes known to Colonial Virginians which occurred in rivers, 1607-1705, are presented in Appendix A. Fish data collected in beach seine surveys conducted by the Virginia Institute of Marine Science in July and September 1969-1973 and 1980-1989, are presented in Appendix B. Appendix C presents historical data compiled in the Biota of Virginia (BOVA) data base from fishery surveys on the James River in the vicinity of Jamestown Island and Powhatan Creek from 1942 through 1978.

STUDY AREA

The Back River system, for the purpose of this study, includes Sandy Bay, Back River, The Thorofare, Piping Point Creek, Back River Marsh Creek, Kingsmill Creek, Harman's Creek, Black Point Creek and Passmore Creek (Map 1.) Please note that the names for Piping Point Creek, Back River Marsh Creek, Harman's Creek and Black Point Creek do not appear on the Geological Survey map for CNHP. The names were given for these locations by the Service as reference points. All sampling stations within the system experienced tidal fluctuation of approximately two feet. The substrate at all sampling sites is comprised of muck, hard clay, and sand. The upper reaches of all tidal creeks contained the most muck due to less flushing action by tidal currents.

Ten fish sampling sites were established in the Back River System (Map 2). These sites were sampled by using two electrofishing boats, a 3.3 meter shrimp trawl, and minnow traps. Electrofishing methods were used during the spring (May) sampling period. Each electrofishing boat was 16 feet long, constructed of aluminum, and powered by a 30 HP outboard engine. Each boat was equipped with a Homelite Model 180RIE62, 6200 watt generator and a Smith-Root Type VI-A electrofisher unit. Each boat contained a live well and aeration equipment to keep the fish specimens alive. The sampling crew on each boat consisted of a boat operator and one or two people on the bow platform collecting fish. The fish surveys were accomplished by sampling all accessible habitat within the sample site. On Sandy Bay this involved covering all accessible waters greater than .5 meters deep. Much of the shoreline of Sandy Bay was inaccessible due to shallow water. Sampling on the tidal stream of Piping Point, Back River Marsh, Kingsmill, Harman's, Black Point, and Passmore was begun at the mouth of the creeks and electrofished to the head of the stream or until upstream progress was halted due to low water or obstructions. All habitat on the Back River from Sandy Bay to the Thorofare was accessible to electrofishing.

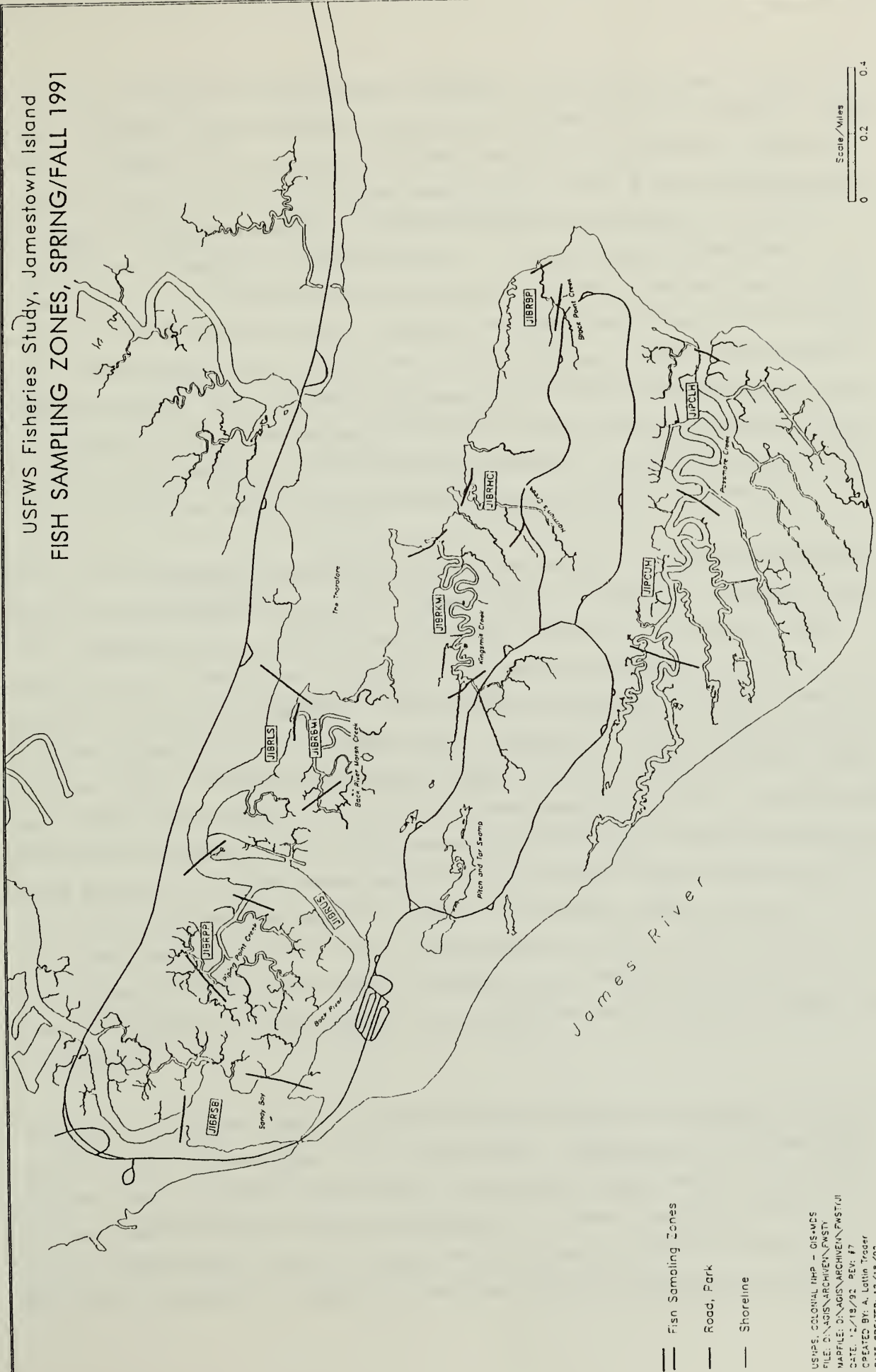
Colonial National Historical Park
JAMESTOWN ISLAND



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Map 1. Back River System, Jamestown Island, Colonial National Historical Park

USFWS Fisheries Study, Jamestown Island
 FISH SAMPLING ZONES, SPRING/FALL 1991



- Fish Sampling Zones
- Road, Park
- Shoreline

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Map 2. Fish sample areas, Back River System, Jamestown Island, Colonial National Historical Park

The electrofishing technique required establishing an electrical field between the positive electrode (anode) which extends eight feet in front of the boat, and the negative electrode (cathode) which is the hull of the aluminum boat. This field encompasses an area of approximately 20 feet in diameter around the anode and extends to a depth of about 10 feet. All fish within the electrical field may not be collected. Some fish may be at the edge of the field and their reflex to the electrical current may force them out of the field and they escape. Other fish may be immobilized by the electricity but are swept downstream by the water current and are able to regain their mobility before they float to the surface and can be collected. In murky water the fish may not be seen by the netters and are not collected.

The electrofishing procedures required using two electrofishing boats at the same time on the same stream. On the narrow creeks i.e. Piping Point, Back River Marsh, Kingsmill, Harman's and Black Point, the total surface area of the creeks could be sampled by this procedure. One boat would sample along one side of the creek while the other boat was sampling the opposite side of the creek. Both boats would start at the mouth of the creek and sample upstream to the end of the sampling area. On the Back River and Passmore Creek the same procedure was used but because both areas were much more extensive in size it was not possible to cover 100% of the surface area. Instead, sampling was concentrated along the creek banks where logs, brush, deep holes and undercut banks provided the best fish attracting habitat. Electrofishing in Sandy Bay was concentrated on areas deeper than .5 meters.

In most instances when electrofishing, the boats were in motion at all times traveling at a slow idle. However, when sampling around logs, brush, deep holes, undercut banks and other fish attracting habitat it was necessary to remain stationary for short durations to allow the fish to float to the surface. As the fish floated to the surface they were collected with dip nets

by the netters standing on the bow of the boats. The fish were then placed in the live well on the boat and held there until they were identified, measured, weighed and then released. The length of time the fish were held in the live well before they were released depended on how many fish were being collected over time. Generally the operation would cease after a half hour of operation for recordation of data. The sampling would then resume until the site was thoroughly sampled.

The electrofishing boats used were not effective in high salinity water (greater than 1 part per thousand (ppt)). During the May sampling period water quality was favorable for electrofishing. Fresh water flow throughout the Back River system in May kept the salinity level below 1 ppt. Because of reduced fresh water flow during the October sampling, the salinity level in the Back River system rose to levels too high to use the electrofishing equipment.

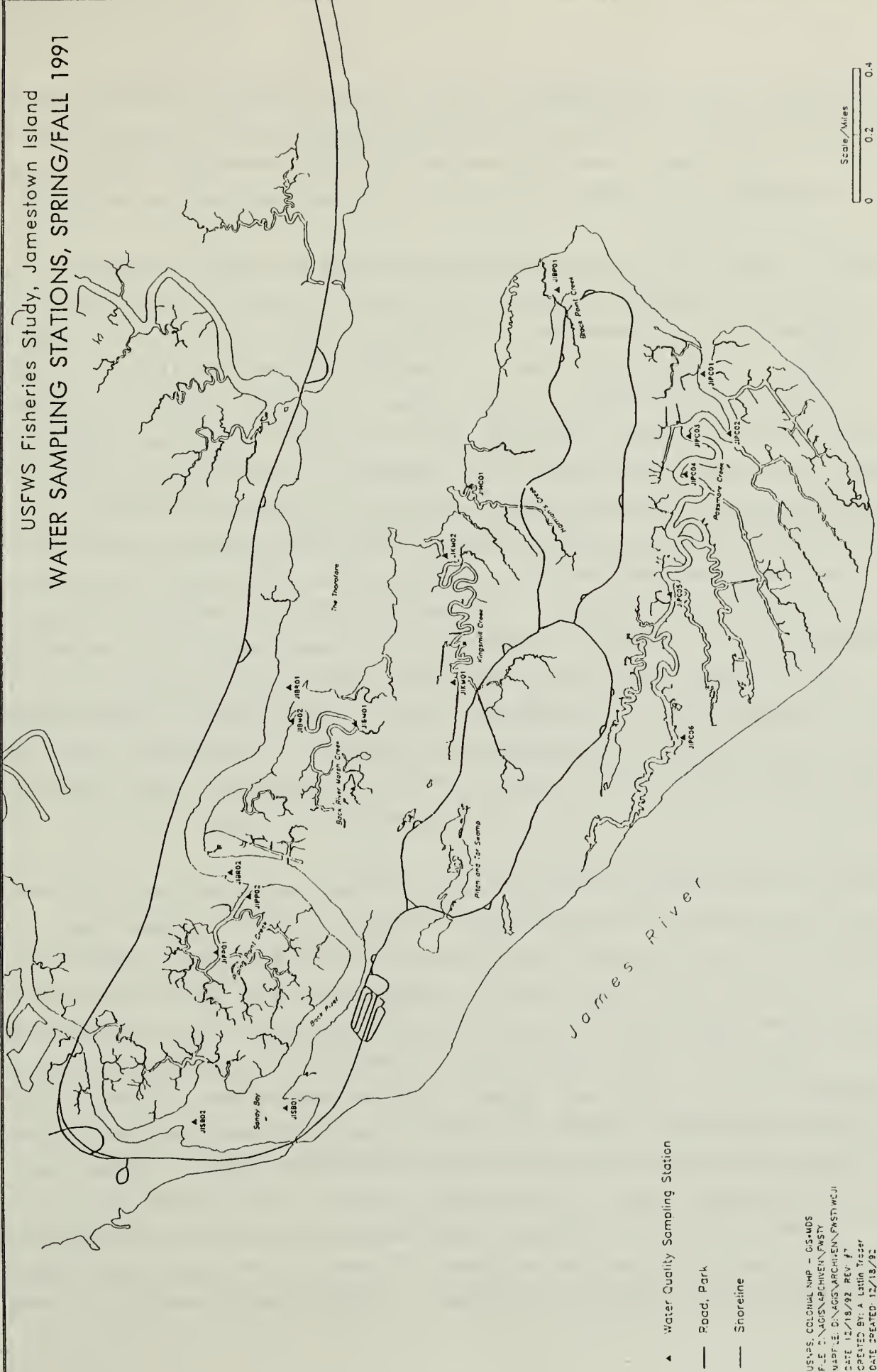
Trawl surveys were used in place of electrofishing gear during the October sampling because high salinity waters rendered the electrofishing gear ineffective in collecting fish samples. The trawl is an elongated bag net designed to be pulled behind a boat. As fish enter the net they are forced into the closed end of the net (cod end) which is restricted in size. At the end of a sampling run (net tow) the trawl is pulled into the boat, the cod end is opened and the fish are placed in the live well. The trawl used for the surveys is referred to as a "bottom trawl" meaning the trawl is designed to slide along the bottom and capture bottom dwelling fish. The particular trawl used was a 3.3 meter (size of the mouth opening of the net) shrimp trawl constructed from nylon netting material with a 33 millimeter stretch mesh size. Inside the bag of the net was a bag liner made from 3 millimeter stretch mesh size. The liner was used to prevent small fish from passing through the net. On each side of the mouth opening of the trawl are positioned trawl boards (61 X 31 cm). When the trawl is pulled the trawl boards will plane in

opposite directions to keep the mouth of the trawl open. The trawl was attached to the boat with a tow line and was approximately 30 feet behind the boat. Setting the trawl in preparation for a net tow required two people in the boat--one to put the trawl overboard while the other ran the boat to keep the net out of the prop on the outboard motor. Once the trawl was set the boat maintained a speed of 2-3 miles per hour while pulling the net. If it was possible to sample the entire creek without stopping, then the creek could be sampled on one net tow. Often the net tow had to be stopped because the net snagged on bottom debris or sharp bends in the creek channel prevented pulling the trawl around the bends. When the tow stopped the trawl was pulled into the boat and the fish were put into the live well. The tow would start again once the obstructions were cleared. The trawl would effectively sample a zone along the bottom approximately 8 feet wide and extending from the bottom to approximately 3 feet above the bottom.

Minnow traps were used to sample areas that could not be sampled by electrofishing or by the trawl. On October 23 plastic minnow traps, (43 X 22 cm) with 3 cm throat opening, were fished over night in Harman's Creek and Black Point Creek. Two traps at each location were tied to the bridge pilings where the loop road crossed the creeks. The traps were baited with dry dog food which dissolved and produced a chum line to attract the fish to the traps.

Water sampling sites were established at 18 locations in the Back River system (Map 3). These sites were located generally at the mouth of the creek and at a point farther upstream to detect any change in water quality. The water quality parameters for temperature, dissolved oxygen, salinity, conductivity, pH, and oxidation-reduction potential (redox) were measured from the surface to the bottom at one-half meter intervals with a Hydrolab® Surveyor II water quality meter. Total Dissolved Solids (TDS) were measured at the surface with a Hach® Model

USFWS Fisheries Study, Jamestown Island
 WATER SAMPLING STATIONS, SPRING/FALL 1991



- ▲ Water Quality Sampling Station
- Road, Park
- Shoreline

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Map 3. Water quality sampling stations, Back River System, Jamestown Island, Colonial National Historical Park

44600 Conductivity/TDS meter. Water transparency was measured with a 20 cm diameter secchi disk with alternate black and white quadrants. All water quality values for each creek were collected on the same day that the fish surveys were conducted.

All sites were sampled by electrofishing during the weeks of May 7-10 and May 21-24 and by trawl the week of October 21-25. A total of 2,276 fish were collected and measured in millimeters (mm) to total length (TL) (Table 1). Data is provided on total number of fish collected at each site for each sampling period and also the total number for each species (Table 2). The fishes collected represented 36 species in 18 families (Table 3). These data illustrate that the May survey using electrofishing methods were more successful than the October survey using the trawl in collecting fishes due to the ability of the electrofisher to sample a greater diversity of habitat. Table 4 illustrates the probable life stage uses of the fishes in the Back River system. This information is derived from the survey data based on TL measurement of fish captured and the results of life history studies conducted by fisheries researchers over many years (Johnson 1978; Jones et. al. 1978; Hardy 1978a; Hardy 1978b; Lee et. al. 1980; Martin and Drewry 1978).

Results from the water quality monitoring are presented in Table 5. The change in water quality values observed between the May and October sampling period for salinity, conductivity and total dissolved solids are significant. These three water quality parameters are co-dependent due to the dissolved salts associated with the estuarine environment of the study area. A change in the value for one parameter will change the value for the others. During the May sampling period the Back River system had mostly fresh water flowing through it due to spring precipitation and the fresh water flow from the James River. These conditions resulted in low values for salinity, conductivity and total dissolved solids which made it feasible to use the electrofishing gear to collect fish samples. During the October sampling period

the system had become a brackish environment due to reduced flow of fresh water. The brackish conditions resulted in high values for salinity, conductivity and total dissolved solids which made the electrofishing gear ineffective for collecting fish samples and therefore required the use of the trawl. Although seasonal changes in water quality were quite pronounced, all parameters measured were within acceptable ranges for all fish species present.

Table 1: Fish species distribution by station, month, number captured, and size range (mm in parenthesis), Back River System, Jamestown Island, CNHP, VA. (May and October, 1991)

Species	Sandy Bay		Back River (upper)		Piping Point		Back River (lower)		Back River Marsh	
	JIBRSB		JIBRUS		JIBRPP		JIBRLS		JIBRBM	
	May	October	May	October	May	October	May	October	May	October
Anchovy, Bay	9 (48-58)	7 (45-57)	17 (42-73)	127 (29-74)	4 (48-67)	-	3 (46-57)	82 (29-88)	2 (55-63)	-
Bass, Largemouth	18 (152-374)	-	32 (145-485)	-	13 (211-410)	-	3 (237-285)	-	7 (297-407)	-
Bass, Striped	5 (83-139)	2 (85-104)	8 (95-195)	-	-	-	1 (120)	-	-	-
Bluegill	4 (55-125)	-	26 (50-195)	-	8 (75-175)	-	1 (149)	-	3 (67-157)	-
Bowfin	-	-	-	-	8 (420-615)	-	-	-	2 (585-660)	-
Bullhead, Brown	3 (222)	-	6 (190-272)	-	4 (184-220)	-	7 (140-205)	-	1 (205)	-
Bullhead, Yellow	1 (267-267)	-	1 (197)	-	-	-	-	-	-	-
Carp	-	-	13 (480-540)	-	3 (35-420)	-	1 (507)	-	3 (210-548)	1 (547)
Catfish, Blue *	-	-	-	-	-	-	-	-	-	-
Catfish, Channel	21 (180-610)	-	68 (142-685)	-	2 (410-482)	-	3 (337-472)	-	2 (425-450)	-
Catfish, White	-	-	-	-	2 (235-240)	-	-	-	1 (257)	-
Chubsucker, Creek	-	-	-	-	-	1 (150)	-	-	-	-
Croaker, Atlantic	5 (76-88)	43 (16-80)	1 (44)	-	2 (95-109)	-	16 (46-85)	2 (21-40)	1 (42)	-
Darter, Tesselated	1 (74)	-	-	-	-	-	-	-	-	-
Eel, American	**	-	**	-	**	-	**	-	**	-
Flounder, Summer	-	-	1 (70)	-	-	2 (47-60)	-	-	-	-
Goby, Naked	-	-	-	-	-	-	-	-	-	-
Hogchoker	9 (34-105)	36 (25-80)	4 (40-77)	1 (40)	10 (49-80)	5 (45-91)	-	-	-	4 (32-90)
Killifish, Banded	18 (42-70)	-	27 (40-82)	-	16 (42-82)	-	-	-	-	-
Menhaden, Atlantic	24 (35-157)	-	6 (45-132)	-	-	-	-	-	6 (37-140)	-
Mullet, Striped	1 (250)	-	5 (92-312)	-	1 (252)	-	-	-	-	-
Mullet, White	5 (243-286)	-	6 (72-340)	-	-	-	1 (254)	-	3 (257-287)	-
Mummichog	4 (52-92)	-	62 (42-92)	-	26 (33-82)	-	-	-	18 (40-67)	-
Perch, White	51 (65-178)	4 (87-214)	72 (43-234)	-	58 (85-245)	6 (66-82)	12 (87-193)	-	38 (42-247)	-
Perch, Yellow	-	-	4 (236-288)	-	3 (222-291)	-	2 (33-270)	-	3 (245-265)	-
Pipefish	-	1 (106)	-	-	-	-	-	-	-	-
Shad, Gizzard	57 (95-155)	-	17 (120-305)	-	56 (132-336)	-	-	-	27 (140-369)	-
Shad, Threadfin	2 (100-104)	-	5 (90-132)	-	-	-	-	-	-	-
Shiner, Golden	-	-	16 (82-149)	-	10 (78-147)	-	2 (263-292)	-	2 (140-172)	-
Shiner, Spottail	4 (75-89)	-	-	-	-	-	-	-	-	-
Silverside, Tidewater	8 (57-105)	-	31 (50-71)	-	1 (60)	-	1 (59)	-	6 (55-78)	-
Spot	-	19 (97-121)	2 (52-133)	2 (120-120)	47 (43-105)	5 (102-122)	21 (20-52)	-	-	7 (95-127)
Sunfish, Pumpkinseed	31 (80-147)	-	45 (67-149)	-	35 (57-165)	-	9 (83-168)	-	12 (110-147)	-
Sunfish, Redbreasted	3 (125-182)	-	-	-	-	-	-	-	-	-
Sunfish, Redear	-	-	4 (110-151)	-	-	-	-	-	2 (150-165)	-
Warmouth	-	-	1 (72)	-	-	-	-	-	-	-

* = One juvenile observed in possession of a fisherman: none collected
 ** = American Eels, 50mm and larger were prevalent at each station; none collected
 *** = Collected in minnow trap
 NS = Not Sampled: inadvertently omitted

Table 1: Fish species distribution by station, month, number captured, and size range (mm in parenthesis), Back River System, Jamestown Island, CNHP, VA. (May and October, 1991)

Species	Kingsmill		Harman's		Black Point		Passmore (upper)		Passmore (lower)	
	JIBRKM	October	JIBRHC	October	JIBRBP	October	JIPCLH	October	JPCUH	October
Anchovy, Bay	-	-	-	-	NS	-	3 (57-70)	25 (25-64)	-	3 (56-75)
Bass, Largemouth	5 (280-326)	-	-	-	NS	-	-	-	1 (300)	-
Bass, Striped	2 (125-147)	-	-	-	NS	-	-	-	-	-
Bluegill	3 (51-160)	-	-	-	NS	-	-	-	-	-
Bowfin	1 (407)	-	-	-	NS	-	-	-	-	-
Bullhead, Brown	2 (220-245)	-	-	-	NS	-	2 (147-185)	-	-	-
Bullhead, Yellow	-	-	-	-	NS	-	-	-	-	-
Carp	6 (475-517)	3 (480-504)	4 (370-535)	-	NS	-	2 (475-516)	-	3 (450-592)	1 (618)
Catfish, Blue *	-	-	-	-	NS	-	-	-	-	-
Catfish, Chennel	6 (303-485)	-	-	-	NS	-	9 (420-740)	-	3 (432-507)	-
Catfish, White	-	-	-	-	NS	-	5 (105-325)	-	2 (235-272)	1 (175)
Chubsucker, Creek	-	-	-	-	NS	-	-	-	-	-
Croaker, Atlantic	2 (95-109)	-	-	-	NS	-	5 (83-103)	7 (25-64)	-	13 (22-87)
Darter, Tessellated	-	-	-	-	NS	-	-	-	-	-
Eel, American	**	-	**	-	NS	-	**	-	**	-
Flounder, Summer	-	-	-	-	NS	-	-	-	-	-
Goby, Naked	-	-	-	1 *** (43)	NS	4 *** (35-52)	-	-	-	-
Hogchoker	-	10 (38-96)	-	-	NS	-	10 (40-67)	4 (36-72)	-	29 (30-85)
Killifish, Banded	9 (41-73)	-	-	-	NS	1 (72)	9 (43-90)	-	16 (41-95)	-
Menhaden, Atlantic	1 (172)	-	1 (165)	-	NS	-	1 (138)	-	-	-
Mullet, Striped	6 (202-285)	-	4 (232-252)	-	NS	-	6 (250-295)	-	5 (266-405)	-
Mullet, White	2 (211-265)	-	-	-	NS	-	-	-	-	-
Mummichog	7 (60-87)	-	-	12 (56-92)	NS	4 (55-77)	26 (36-105)	-	6 (37-87)	-
Perch, White	24 (74-172)	13 (45-160)	13 (85-231)	-	NS	-	45 (31-210)	3 (120-132)	28 (107-235)	20 (56-163)
Perch, Yellow	1 (255)	-	-	-	NS	-	1 (300)	-	-	-
Pipefish	-	-	-	-	NS	-	-	-	-	-
Shad, Gizzard	2 (289-365)	-	10 (135-282)	-	NS	-	8 (142-308)	-	10 (30-320)	-
Shad, Threadfin	-	-	-	-	NS	-	-	-	-	-
Shiner, Golden	4 (90-172)	-	1 (124)	-	NS	-	-	-	-	-
Shiner, Spottail	-	-	-	-	NS	-	-	-	-	-
Silverside, Tidewater	2 (57-67)	-	-	-	NS	-	-	-	1 (68)	-
Spot	2 (27-41)	17 (104-138)	1 (73)	-	NS	-	69 (32-110)	4 (87-125)	-	20 (96-141)
Sunfish, Pumpkinseed	12 (72-140)	-	3 (105-122)	-	NS	-	3 (112-115)	-	1 (135)	-
Sunfish, Redbreasted	1 (110)	-	-	-	NS	-	-	-	-	-
Sunfish, Redear	2 (124-145)	-	-	-	NS	-	-	-	-	-
Warmouth	-	-	-	-	NS	-	-	-	-	-

* = One juvenile observed in possession of a fisherman; none collected
 ** = American Eels, 50mm and larger were prevalent at each station; none collected
 *** = Collected in minnow trap
 NS = Not Sampled: inadvertently omitted

Table 2: Total number of fish collected per sampling period and total number per species (May and October, 1991)

Species	JIBRSB		JIBRUS		JIBRPP		JIBRLS		JIBRBM		JIBRKM		JIBRHC		JIBRBP		JIPCLH		JIPCOH		Total # of fish for each species
	May	Oct	May	Oct	May	Oct	May	Oct	May	Oct	May	Oct	May	Oct	May	Oct	May	Oct	May	Oct	
Anchovy, Bay	9	7	17	127	4		3	82	2									3			282
Bass, Largemouth	18		32		13		3		2										1		79
Bass, Striped	5	2	6				1		2		5										18
Bluegill	4		26		3		1				2										45
Bowfin					3		1		3		6										11
Bullhead, Brown	3		6		4		2		1		2										25
Bullhead, Yellow	1		1																		2
Carp			13		3		1		3		6		13								50
Catfish, Blue														4							0
Catfish, Channel	21		68		2		3		2		6										114
Catfish, White					2				1												11
Chubstucker, Creek																					1
Croaker, Atlantic	5	43	1		2		16	2	1		2										97
Darter, Tessellated	1																				1
Eel, American																					1
Flounder, Summer																					0
Goby, Naked																					0
Hogchoker	9	36	4	1	10	5			4												3
Killifish, Banded	18		27		16								19								5
Menhaden, Atlantic	24		6								6										122
Mullet, Striped	1		5		1				6		1										96
Mullet, White	5		6				1				6										39
Mummichog	4		62		26				3		2										28
Perch, White	51	4	72		58	6	12		16		2										17
Perch, Yellow			4		3		2		38		24		19								165
Pipefish	1								3		1										387
Shad, Gizzard	57		12		50																14
Shad, Threadfin	2		5						27		2										1
Shiner, Golden			16		10				2		4										187
Shiner, Spottail	4								2												7
Silverside, Tidewater	8		31		1																35
Spot			2	2	47	5	1		6		2										4
Sunfish, Pumpkinse	31		45		35		21		7		2		17								50
Sunfish, Redbreaste	3						3		12		12										216
Sunfish, Redear			4								1										151
Warmouth			1						2		2										4
Total # of fish at each site:	284	112	480	130	309	19	83	84	139	12	102	53	37	19	9	204	43	76	87	Total = 2276	

* = One juvenile observed in possession of a fisherman; none collected
 ** = American Eels, 50mm and larger were prevalent at each station; none collected
 *** = Collected in minnow trap
 NS = Not Sampled; inadvertently omitted

Table 3: Fish species collected from the Back River system, Jamestown Island, Colonial National Historical Park, Virginia (May and October, 1991).

Family:	Genus / Specie:	Common Name:
Amiidae	<i>Amia calva</i>	Bowfin
Anguillidae	<i>Anguilla rostrata</i>	American Eel
Atherinidae	<i>Menidia beryllina</i>	Tidewater Silverside
Bothidae	<i>Paralichthys dentatus</i>	Summer Flounder
Catostomidae	<i>Erimyzon oblongus</i>	Creek Chubsucker
Centrarchidae	<i>Lepomis auritus</i>	Redbreasted Sunfish
	<i>Lepomis gibbosus</i>	Pumpkinseed Sunfish
	<i>Lepomis gulosus</i>	Warmouth
	<i>Lepomis macrochirus</i>	Bluegill
	<i>Lepomis microlophus</i>	Redear Sunfish
Clupeidae	<i>Micropterus salmoides</i>	Largemouth Bass
	<i>Brevoortia tyrannus</i>	Atlantic Menhaden
	<i>Dorosoma cepedianum</i>	Gizzard Shad
Cyprinidae	<i>Dorosoma petenensis</i>	Threadfin Shad
	<i>Cyprinus carpio</i>	Carp
	<i>Notemigonus crysoleucas</i>	Golden Shiner
Cyprinodontidae	<i>Notropis hudsonius</i>	Spottail Shiner
	<i>Fundulus diaphanus</i>	Banded Killifish
Engraulidae	<i>Fundulus heteroclitus</i>	Mummichog
	<i>Anchoa mitchilli</i>	Bay Anchovy
Gobiidae	<i>Gobiosoma bosci</i>	Naked Goby
Ictaluridae	<i>Ameiurus natalis</i>	Yellow Bullhead
	<i>Ameiurus nebulosus</i>	Brown Bullhead
	<i>Ictalurus catus</i>	White Catfish
	<i>Ictalurus furcatus</i>	Blue Catfish
	<i>Ictalurus punctatus</i>	Channel Catfish
Mugilidae	<i>Mugil cephalus</i>	Striped Mullet
	<i>Mugil curema</i>	White Mullet
Percichthyidae	<i>Morone americana</i>	White Perch
	<i>Morone saxatilis</i>	Striped Bass
Percidae	<i>Etheostoma olmstedi</i>	Tessellated Darter
	<i>Perca flavescens</i>	Yellow Perch
Sciaenidae	<i>Leiostomus xanthurus</i>	Spot
	<i>Micropogonias undulatus</i>	Atlantic Croaker
Soleidae	<i>Trinectes maculatus</i>	Hogchoker
Syngnathidae	<i>Syngnathus fuscus</i>	Pipefish

Table 4: Life stage uses of non-migratory and migratory fish of the Back River system, Jamestown Island, Colonial National Historical Park, Virginia.

Species	Non-Migratory	Migratory	Life Stage Uses		
			Spawning	Nursery	Resident
Anchovy, Bay <i>Anchoa mitchilli</i>	X		X	X	X
Bass, Largemouth <i>Micropterus salmoides</i>	X		? (5)	X	X
Bass, Striped <i>Morone saxatilis</i>		X (1)		X	
Bluegill <i>Lepomis macrochirus</i>	X		? (5)	X	X
Bowfin <i>Amia calva</i>	X		? (5)	X	X
Bullhead, Brown <i>Ameiurus nebulosus</i>	X		? (5)	X	X
Bullhead, Yellow <i>Ameiurus natalis</i>	X		? (5)	X	X
Carp <i>Cyprinus carpio</i>	X		? (5)	X	X
Catfish, Blue <i>Ictalurus furcatus</i>	X		? (5)	X	X
Catfish, Channel <i>Ictalurus punctatus</i>	X		? (5)	X	X
Catfish, White <i>Ictalurus catus</i>	X		? (5)	X	X
Chubsucker, Creek <i>Erimyzon oblongus</i>	X		? (5)	X	X
Croaker, Atlantic <i>Micropogonias undulatus</i>	X	X (2)		X	
Darter, Tessellated <i>Etheostoma olmstedii</i>	X		? (5)	X	X
Eel, American <i>Anguilla rostrata</i>		X (3)		X	X
Flounder, Summer <i>Paralichthys dentatus</i>		X (2)		X	
Goby, Naked <i>Gobiosoma boscii</i>	X		X	X	X
Hogchoker <i>Trinectes maculatus</i>	X		X	X	X

(1) Anadromous to semi-anadromous specie

(2) Spawn in open marine areas, eggs and larvae move by currents back into estuarine areas

(3) Adults migrate from freshwater to spawn and die in open marine area (Sargasso Sea). Elvers (young eels) migrate back into freshwater to mature into adults (only Catadromous specie in the Chesapeake Bay).

(4) Adults spawn in open deeper areas in the bay and lower tidal areas. The young move up and into estuarine shallow areas to mature. At maturity they move back into the bay and lower tidal areas (deeper water).

(5) May inhabit brackish waters, but they require low to no salinity for reproduction. This requirement dictates if any spawning may occur in the waters of Jamestown Island, CNHP, Va.

Current data indicates that the salinity levels are low enough to support spawning activities as long as the system receives normal rainfall to flush the backwater areas.

(6) Require some sort of substrate (i.e., submerged and inundated vegetation, roots, brush, gravel, rocks, boulders, or sometimes sand) for spawning. The Back River most likely contains suitable habitat for spawning, but it is very doubtful that the remaining creeks have suitable spawning habitat.

Table 4: Life stage uses of non-migratory and migratory fish of the Back River system, Jamestown Island, Colonial National Historical Park, Virginia.

Species	Life Stage Uses				
	Non-Migratory	Migratory	Spawning	Nursery	Resident
Killifish, Banded <i>Fundulus diaphanus</i>	X		X	X	X
Menhaden, Atlantic <i>Brevoortia tyrannus</i>		X (2)		X	
Mullet, Striped <i>Mugil cephalus</i>		x (2)		X	
Mullet, White <i>Mugil curema</i>		X (2)		X	
Mummichog <i>Fundulus heteroclitus</i>	X		X	X	X
Perch, White <i>Morone americana</i>		X (4)		X	X
Perch, Yellow <i>Perca flavescens</i>	X		X (5)	X	X
Pipefish <i>Syngnathus fuscus</i>	X		X	X	X
Shad, Gizzard <i>Dorosoma cepedianum</i>	X		? (5)(6)	X	X
Shad, Threadfin <i>Dorosoma petenense</i>	X		? (5)(6)	X	X
Shiner, Golden <i>Notemigonus crysoleucas</i>	X		? (5)	X	X
Shiner, Spottail <i>Notropis hudsonius</i>	X		? (5)	X	X
Silverside, Tidewater <i>Menidia beryllina</i>	X		X	X	X
Spot <i>Leiostomus xanthurus</i>		X (1)		X	
Sunfish, Pumpkinseed <i>Lepomis gibbosus</i>	X		? (5)	X	X
Sunfish, Redbreasted <i>Lepomis auritus</i>	X		? (5)	X	X
Sunfish, Redear <i>Lepomis microlophus</i>	X		? (5)	X	X
Warmouth <i>Lepomis gulosus</i>	X		? (5)	X	X

- (1) Anadromous to semi-anadromous specie
- (2) Spawn in open marine areas, eggs and larvae move by currents back into estuarine areas
- (3) Adults migrate from freshwater to spawn and die in open marine area (Sargasso Sea). Elvers (young eels) migrate back into freshwater to mature into adults (only Catadromous specie in the Chesapeake Bay).
- (4) Adults spawn in open deeper areas in the bay and lower tidal areas. The young move up and into estuarine shallow areas to mature. At maturity they move back into the bay and lower tidal areas (deeper water).
- (5) May inhabit brackish waters, but they require low to no salinity for reproduction. This requirement dictates if any spawning may occur in the waters of Jamestown Island, CNHP, Va.
Current data indicates that the salinity levels are low enough to support spawning activities as long as the system receives normal rainfall to flush the backwater areas.
- (6) Require some sort of substrate (i.e., submerged and inundated vegetation, roots, brush, gravel, rocks, boulders, or sometimes sand) for spawning. The Back River most likely contains suitable habitat for spawning, but it is very doubtful that the remaining creeks have suitable spawning habitat.

Table 5: Water quality data from the Back River system, Jamastown Island, Colonial National Historical Park (May and October 1991)

Area	Station	Date	Depth (m)	Temp (C)	pH	D.O. (ppm)	Cond (mmhos/cm)	ORP (V)	Sal (ppt)	TDS (ppm)	Air Temp (C)	Time	Tide Stage*	Secchi Disk (m)
NPS Back River Marsh Creek (upper)	JIBM01	05/23/91	Surface	25.00	6.84	11.40	0.356	0.126	0.0	0.49	26.40	1115	5	0.27
		05/23/91	0.5	24.50	6.95	9.10	1.061	0.144	0.0					
		05/23/91	1.0	24.40	6.83	8.40	1.052	0.146	0.0					
		10/23/91	Surface	16.61	7.49	9.15	9.740	0.105	5.1	4.92	17.88	1025	2	0.55
		10/23/91	0.5	16.55	7.47	9.13	9.770	0.106	5.2					
		10/23/91	1.0	16.56	7.45	9.17	9.810	0.107	5.2					
		10/23/91	1.5	16.55	7.44	9.13	9.850	0.108	5.2					
		10/23/91	1.9	16.55	7.43	9.13	9.860	0.109	5.2					
NPS Back River Marsh Creek (lower)	JIBM02	05/23/91	Surface	25.56	7.00	9.10	0.202	0.103	0.0	0.38	-	1140	5	0.46
		05/23/91	0.5	24.62	7.14	8.01	0.585	0.110	0.0					
		05/23/91	1.0	24.10	7.13	7.47	0.592	0.112	0.0					
		10/22/91	Surface	17.35	7.48	10.10	8.980	0.100	4.7	4.42	16.42	1430	5	0.55
		10/22/91	0.5	17.26	7.43	10.07	9.020	0.101	4.7					
		10/22/91	1.0	17.25	7.42	10.00	9.040	0.103	4.7					
NPS Black Point Creek	JIBPO1	10/23/91	Surface	18.17	7.50	9.16	11.720	0.117	6.4	5.70	19.20	1400	5	0.31
		10/23/91	0.5	18.14	7.49	9.23	11.720	0.117	6.4					
		10/23/91	1.0	18.07	7.48	9.26	11.700	0.116	6.4					
		10/23/91	1.3	18.06	7.47	9.24	11.730	0.116	6.4					
NPS Back River (lower)	JIBRO1	05/09/91	Surface	21.94	8.34	9.18	0.248	0.139	0.0	-	19.55	1230	6	0.58
		05/09/91	0.5	21.98	8.25	9.15	0.246	0.140	0.0					
		05/09/91	1.0	21.98	8.24	9.18	0.244	0.140	0.0					
		05/10/91	1.5	21.97	8.22	9.16	0.243	0.140	0.0					
		10/22/92	Surface	16.64	7.58	9.65	10.390	0.104	5.5	5.16	16.42	1400	5	0.58
		10/22/92	0.5	16.55	7.62	9.71	10.420	0.104	5.5					
		10/22/92	1.0	16.46	7.62	9.62	10.530	0.106	5.6					
		10/22/92	1.5	16.46	7.61	9.50	10.660	0.107	5.7					
		10/22/92	2.0	16.28	7.60	9.46	10.730	0.109	5.8					
		10/22/92	2.5	16.30	7.59	9.40	10.810	0.112	5.8					
		10/22/92	3.0	16.24	7.58	9.40	10.830	0.112	5.8					
NPS Back River (upper)	JIBRO2	05/09/91	Surface	21.73	8.66	9.90	0.196	0.100	0.0	-	18.91	1400	7	0.58
		05/09/91	0.5	21.79	8.62	9.85	0.195	0.101	0.0					
		05/09/91	1.0	21.78	8.60	9.91	0.195	0.102	0.0					
		05/09/91	1.3	21.78	8.59	9.90	0.196	0.102	0.0					
		10/22/91	Surface	16.68	7.60	9.77	10.290	0.122	5.5	5.15	15.57	1245	5	0.58
		10/22/91	0.5	16.58	7.65	9.55	10.360	0.112	5.5					
		10/22/91	1.0	15.88	7.61	9.43	10.670	0.115	5.7					
		10/22/91	1.5	15.83	7.60	9.35	10.850	0.116	5.8					
		10/22/91	2.0	15.87	7.57	9.22	10.920	0.118	5.9					
		10/22/91	2.5	15.85	7.55	9.09	11.060	0.120	5.9					
		10/22/91	3.0	15.83	7.53	9.03	11.010	0.121	6.0					
		10/22/91	3.5	15.84	7.51	8.90	11.230	0.123	6.0					
		10/22/91	3.7	15.83	7.51	8.91	11.250	0.123	6.1					
NPS Harman's Creek	JIHCO1	05/24/91	Surface	23.10	6.64	6.64	0.590	0.146	0.0	0.81	22.40	1000	4	0.55
		05/24/91	0.6	24.60	6.64	6.04	1.700	0.153	0.4					
		10/23/91	Surface	19.08	7.52	9.29	3.650	0.113	1.5	5.35	-	1245	4	0.55
		10/23/91	0.4	17.31	7.64	9.97	11.160	0.108	6.0					
NPS Kingsmill (upper)	JIKMO1	05/10/91	Surface	20.09	7.34	4.12	1.215	0.144	0.1	-	20.90	1111	5	0.58
		05/10/91	0.5	20.08	7.20	3.93	1.222	0.141	0.1					
		05/10/91	1.0	20.06	7.17	3.71	1.229	0.142	0.1					
		10/23/91	Surface	16.15	7.31	8.29	9.200	0.129	4.9	4.73	18.00	1130	5	0.58
		10/23/91	0.5	16.23	7.15	8.40	9.470	0.129	4.9					
	10/23/91	0.7	16.20	7.14	8.44	9.530	0.128	5.0						

KEY: (C) Celsius * Tide stage: 4 High ebb High Tide ± 15 mins
 Cond Conductivity 3 Late flood 1 hr 59 mins before high tide to immediately before High
 D.O. Dissolved Oxygen 2 Mex flood 3hrs 59 mins to 2hrs before high
 (m) Meters 1 Early flood Immediately after Low slack to 4hrs before high
 (mmhos/cm) Micro-mhos per centimeter 8 Low ebb Low tide ± 15 mins
 ORP Oxygen Reduction Potential 7 Late ebb 1 hr 59 mins before high tide to immediately before Low
 (ppm) Parts per million 6 Mex ebb 3hrs 59 mins to 2hrs before Low
 (ppt) Parts per thousand 5 Early ebb Immediately after High slack to 4hrs before Low
 Sal Salinity
 TDS Total Dissolved Solids
 (V) Volts

Table 5: Water quality data from the Back River system, Jamestown Island, Colonial National Historical Park (May and October 1991)

Area	Station	Date	Depth (m)	Temp (C)	pH	D.O. (ppm)	Cond (mmhos/cm)	ORP (V)	Sel (ppt)	TDS (ppm)	Air Temp (C)	Time	Tide Stage*	Secchi Disk (m)
NPS Kingsmill (lower)	JIKM02	05/10/91	Surface	21.41	7.65	7.27	0.699	0.132	0.0	-	-	-	6	-
		05/10/91	0.5	21.26	7.57	7.26	0.696	0.133	0.0					
		05/10/91	1.0	21.31	7.52	7.21	0.700	0.133	0.0					
		10/23/91	Surface	17.43	7.62	9.52	11.220	0.109	6.1	5.46	19.80	1200	3	0.56
		10/23/91	0.5	17.29	7.66	9.49	11.320	0.110	6.1					
		10/23/91	1.0	17.29	7.66	9.47	11.350	0.111	6.1					
		10/23/91	1.5	17.29	7.66	9.47	11.350	0.112	6.1					
		10/23/91	2.0	17.26	7.65	9.44	11.390	0.113	6.2					
		10/23/91	2.4	17.26	7.64	9.39	11.410	0.115	6.2					
		10/23/91	2.4	17.26	7.64	9.39	11.410	0.115	6.2					
NPS Passmore (lower)	JIPC01	05/21/91	Surface	20.60	6.47	5.00	0.777	0.143	0.0	-	21.50	1100	6	-
		05/21/91	0.5	20.20	6.57	5.15	2.330	0.145	0.7					
		10/24/91	Surface	17.60	7.62	9.02	11.990	0.133	6.6	5.93	17.32	1115	3	0.71
		10/24/91	0.50	17.78	7.61	9.00	12.060	0.133	6.6					
		10/24/91	1.00	17.75	7.61	9.00	12.100	0.134	6.6					
		10/24/91	1.50	17.77	7.61	8.99	12.140	0.134	6.6					
		10/24/91	2.00	17.61	7.60	8.96	12.470	0.135	6.7					
		10/24/91	2.50	17.87	7.59	8.87	12.460	0.138	6.6					
		10/24/91	3.00	17.90	7.61	8.85	12.600	0.120	6.8					
		10/24/91	3.30	17.68	7.61	8.84	12.650	0.122	7.0					
NPS Passmore	JIPC02	05/21/91	Surface	20.90	6.39	6.00	0.805	0.162	0.0	-	-	1200	7	0.46
		05/21/91	0.5	20.79	6.69	5.56	2.360	0.164	0.6					
		05/21/91	1.0	20.91	6.56	5.69	2.430	0.167	0.8					
		05/21/91	1.5	20.84	6.55	5.66	2.430	0.166	0.8					
		05/21/91	1.6	20.89	6.53	5.64	2.430	0.168	0.6					
		10/24/91	Surface	17.96	7.65	9.00	12.270	0.125	6.7	6.11	16.75	1200	3	0.62
		10/24/91	0.5	17.92	7.64	8.98	12.300	0.126	6.7					
		10/24/91	1.0	17.93	7.64	8.98	12.310	0.126	6.7					
		10/24/91	1.5	17.92	7.63	8.95	12.330	0.126	6.7					
		10/24/91	2.0	17.93	7.63	9.01	12.350	0.127	6.8					
NPS Passmore	JIPC03	05/24/91	Surface	24.20	7.10	7.34	1.670	0.116	0.4	-	31.10	1200	5	0.30
		05/24/91	0.5	24.10	7.14	7.34	1.670	0.119	0.4					
		05/24/91	1.0	24.00	7.14	7.29	1.660	0.122	0.4					
		05/24/91	1.5	24.00	7.14	7.27	1.660	0.124	0.4					
		05/24/91	2.0	24.00	7.15	7.27	1.660	0.124	0.4					
		05/24/91	2.5	24.00	7.16	7.32	1.670	0.127	0.4					
		05/24/91	3.0	24.00	7.16	7.32	1.660	0.129	0.4					
		05/24/91	3.5	24.00	7.16	7.34	1.670	0.131	0.4					
		05/24/91	3.7	24.00	7.16	7.34	1.660	0.133	0.4					
		10/24/91	Surface	17.97	7.63	8.96	12.240	0.115	6.7	6.05	18.70	1215	3	0.58
		10/24/91	0.5	17.95	7.64	8.96	12.270	0.115	6.7					
		10/24/91	1.0	17.94	7.63	8.96	12.270	0.117	6.7					
		10/24/91	1.5	17.94	7.63	8.97	12.280	0.117	6.7					
		10/24/91	2.0	17.94	7.63	8.97	12.290	0.116	6.7					
		10/24/91	2.5	17.95	7.63	8.97	12.310	0.118	6.7					
		10/24/91	3.0	17.94	7.63	8.97	12.310	0.119	6.7					
10/24/91	3.5	17.94	7.63	8.94	12.350	0.119	6.6							
10/24/91	3.6	17.94	7.63	8.94	12.340	0.120	6.6							
NPS Passmore	JIPC04	05/23/91	Surface	26.80	6.80	8.17	2.290	0.139	0.7	1.12	-	1400	3	0.46
		05/23/91	0.5	26.50	6.90	6.03	2.300	0.144	0.7					
		05/23/91	1.0	25.90	6.91	7.66	2.300	0.146	0.7					
		05/23/91	1.5	25.70	6.87	7.11	2.300	0.150	0.7					
		05/23/91	2.0	25.50	6.83	7.06	2.300	1.520	0.7					
		05/23/91	2.3	25.50	6.80	6.95	2.300	0.150	0.7					
		10/24/91	Surface	18.07	7.57	8.96	11.990	0.100	6.5	6.03	21.60	1230	3	0.56
		10/24/91	0.5	18.06	7.63	6.99	11.990	0.100	6.6					
		10/24/91	1.0	18.06	7.63	8.99	12.070	0.101	6.6					
		10/24/91	1.5	17.96	7.62	8.99	12.060	0.102	6.6					
10/24/91	1.7	17.97	7.62	9.00	12.050	0.103	6.6							

KEY: (C) Celsius * Tide stage: 4 High slack High Tide ± 15 mins
 Cond Conductivity 3 Late flood 1 hr 59 mins before high tide to immediately before High
 D.O. Dissolved Oxygen 2 Max flood 3hrs 59 mins to 2hrs before high
 (m) Meters 1 Early flood Immediately after Low slack to 4hrs before high
 (mmhos/cm) Micro-mhos per centimeter 8 Low slack Low tide ± 15 mins
 ORP Oxygen Reduction Potential 7 Late ebb 1 hr 59 mins before high tide to immediately before Low
 (ppm) Parts per million 6 Max ebb 3hrs 59 mins to 2hrs before Low
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 (V) Volts

Table 5: Water quality data from the Back River system, Jamestown Island, Colonial National Historical Park (May and October 1991)

Area	Station	Date	Depth (m)	Temp (C)	pH	D.O. (ppm)	Cond (mmhos/cm)	ORP (V)	Sel (ppt)	TDS (ppm)	Air Temp (C)	Time	Tide Stage*	Secchi Disk (m)
NPS Passmore	JIPC05	05/23/91	Surface	26.40	6.87	7.97	2.130	0.127	0.0	1.06	-	1420	3	0.46
		05/23/91	0.5	28.00	6.95	7.70	2.210	0.136	0.7					
		05/23/91	1.0	25.40	6.91	7.16	2.210	0.141	0.7					
		05/23/91	1.5	24.90	6.89	7.05	2.210	0.145	0.7					
		05/23/91	2.0	24.70	6.86	6.81	2.200	0.148	0.7					
		05/23/91	2.5	24.70	6.83	6.73	2.200	0.149	0.7					
		05/23/91	2.9	24.70	6.83	6.70	2.210	0.151	0.7					
		10/24/91	Surface	18.12	7.65	8.92	11.970	0.126	6.5	8.87	19.75	1330	5	0.58
		10/24/91	0.5	18.11	7.65	8.99	11.950	0.125	6.5					
		10/24/91	1.0	18.11	7.64	9.00	11.950	0.125	6.5					
		10/24/91	1.5	18.14	7.64	9.00	11.970	0.125	6.5					
		10/24/91	2.0	18.11	7.62	8.96	11.990	0.125	6.5					
NPS Passmore	JIPC06	10/24/91	Surface	18.22	7.58	8.69	11.980	0.116	6.5	5.95	21.13	1315	3	0.58
		10/24/91	0.5	18.13	7.56	8.72	12.010	0.117	6.5					
		10/24/91	1.0	18.10	7.54	8.70	12.030	0.118	6.6					
		10/24/91	1.3	18.07	7.52	8.67	12.030	0.120	6.6					
NPS Piping Point (upper)	JIPPO1	05/22/91	Surface	24.40	7.95	16.15	0.949	0.083	0.0	0.44	24.87	1232	7	0.20
		05/22/91	0.5	12.10	7.32	11.80	0.956	0.117	0.0					
		05/22/91	1.0	22.23	6.99	7.74	0.954	0.147	0.0					
		05/22/91	1.2	21.92	6.76	7.33	0.953	0.150	0.0					
		10/23/91	Surface	16.47	7.52	9.07	8.640	0.098	4.5	4.35	15.20	949	2	0.64
		10/23/91	0.5	16.55	7.50	9.02	8.640	0.099	4.5					
		10/23/91	1.0	16.55	7.49	9.02	8.640	0.101	4.5					
		10/23/91	1.4	16.59	7.48	8.99	8.650	0.102	4.5					
NPS Piping Point (lower)	JIPPO2	05/22/91	Surface	23.35	7.50	13.85	0.911	0.123	0.0	-	-	1400	7	-
		05/22/91	0.5	24.75	7.51	11.31	0.854	0.141	0.0					
		05/22/91	1.0	22.56	7.10	6.99	0.832	0.155	0.0					
		10/22/91	Surface	16.35	7.56	9.64	9.390	0.118	4.9	4.69	16.90	1315	5	0.55
		10/22/91	0.5	16.40	7.54	9.70	9.410	0.119	4.9					
		10/22/91	1.0	16.37	7.53	9.69	9.400	0.119	4.9					
		10/22/91	1.5	16.41	7.52	9.67	9.380	0.120	4.9					
		10/22/91	2.0	16.47	7.51	9.64	9.410	0.122	4.9					
		10/22/91	2.3	16.52	7.50	9.69	9.340	0.124	4.9					
		NPS Sandy Bay (lower)	JISB01	05/07/91	Surface	22.26	9.08	11.20	0.208	0.090	0.0	-	18.98	1228
05/07/91	0.5			22.32	9.03	11.25	0.206	0.100	0.0					
05/07/91	0.8			22.35	9.03	11.34	0.208	0.106	0.0					
10/21/91	Surface			16.61	7.81	9.69	8.900	0.112	4.6	4.40	18.00	1340	5	0.64
10/21/91	0.5			16.54	7.82	9.54	8.950	0.112	4.7					
10/21/91	0.8			16.53	7.81	9.55	8.960	0.113	4.7					
NPS Sandy Bay (upper)	JISB02	05/07/91	Surface	24.33	8.32	10.35	0.289	0.103	0.0	-	-	1350	1	0.34
		05/07/91	0.5	23.77	8.33	10.43	0.287	0.108	0.0					
		05/07/91	0.8	23.52	8.33	10.30	0.285	0.114	0.0					
		10/21/92	Surface	16.12	7.63	9.85	7.930	0.123	4.0	3.97	18.00	1300	5	0.58
		10/21/92	0.5	16.12	7.61	9.73	8.000	0.124	4.1					
		10/21/92	1.0	16.08	7.60	9.64	8.010	0.124	4.1					
		10/21/92	1.5	16.07	7.60	9.64	8.000	0.125	4.1					
		10/21/92	1.7	16.03	7.59	9.53	7.980	0.125	4.1					

KEY:	(C)	Celsius	* Tide stage:	4 High slack	High Tide ± 15 mins
	Cond	Conductivity		3 Late flood	1 hr 59 mins before high tide to immediately before High
	D.O.	Dissolved Oxygen		2 Mex flood	3hrs 59 mins to 2hrs before high
	(m)	Meters		1 Early flood	Immediately after Low slack to 4hrs before high
	(mmhos/cm)	Micro-mhos per centimeter		8 Low slack	Low tide ± 15 mins
	ORP	Oxygen Reduction Potential		7 Late ebb	1 hr 59 mins before high tide to immediately before Low
	(ppm)	Parts per million		6 Mex ebb	3hrs 59 mins to 2hrs before Low
	(ppt)	Parts per thousand		5 Early ebb	Immediately after High slack to 4hrs before Low
	Sel	Selinity			
	TDS	Total Dissolved Solids			
	(V)	Volts			

CONCLUSION

The Back River system appears to be an important nursery area for striped bass, Atlantic croaker, American eel, summer flounder, white perch and spot. These six migratory species represent significantly important recreational and commercial species. The remaining migratory species play an equally important role by becoming the forage base. The system also provides the life support for numerous fresh water species that are sought for their recreational qualities, i.e. largemouth bass, catfish, yellow perch and sunfish.

The value of the system as spawning habitat for fresh water fish species is questionable. The eggs of most fresh water species are drastically affected when salinity levels are above 4.5 ppt. Salinity levels in the spring of 1991 were low enough not to interfere with hatching of the eggs. If the system were to experience a spring of low precipitation, salinity levels would rise and reproduction for fresh water species would decrease or cease.

Water quality of the entire Back River system is influenced by the James River. Due to the location of Jamestown Island, many water quality parameters will change in response to tides and/or freshwater inflow. Therefore, the results from this study only reflect the water quality at the time the measurements were taken.

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APPENDICES

Appendix A. Fishes known to Colonial Virginians which occurred in rivers, 1607-1705 (Pearson 1942, 1943).

Common name Given by Colonists	Possible Species*	Family*	General information*
* Sturgeon; Sturgeon	Acipenser oxyrhynchus Acipenser brevirostrum	Acipenseridae	"In somer no place affordeth more plentie of Sturgeon" - Capt. John Smith (1612)
* Rock-fish; Rockfish	Morone saxatilis	Percichthyidae	Striped bass
* Mulletts	Mugil spp.	Mugilidae	White and striped mullets
* Herings; Herrings; Oldwife	Alosa spp.	Clupeidae	River herring, i.e. blueback herring, alewife
* Lampreyes; Lampreys	Petromyzon spp.	Petromyzontidae	Lamprey
* Eeles; Ele	Anguilla rostrata	Anguillidae	American eel
* Catfish	Ictalurus spp.	Ictaluridae	Channel catfish; white catfish; brown bullhead
* Shades; Shads	Alosa spp.	Clupeidae	American shad; hickory shad; gizzard shad
* Pike; Jack	Esox spp	Esocidae	Chain pickerel; redbfin pickerel
* Perches; Pearches	Bairdiella chrysoura Morone Americana Perca flavescens Lepomis; Micropterus	Sciaenidae Percichthyidae Percidae Centrarchidae	Observed 3 to 6 kinds; Silver perch; White perch; Yellow perch Sunfish (Sunperch?); black bass
* Crokers	Micropogon undulatus	Atlantic croaker	Croaker
* Taylors	Pomatomus saltatrix	Pomatomidae	Bluefish
Drums; Drummers	Pogonias cromis	Sciaenidae	Black drum

* Fish which probably occurred at Jamestown - based on an intuitive interpretation, by the authors, of present and historical data

Appendix A, Continued. Fishes known to Colonial Virginians which occurred in rivers, 1607-1705 (Pearson 1942, 1943).

Common name Given by Colonists	Possible Species	Family	General information
* Trout; Trowts	Cynoscion regalis	Sciaenidae	Gray trout; weakfish
Base	Sciaenops ocellatus	Sciaenidae	Red drum; channel bass
* Carpes; Carp	Catostomus spp.	Catostomidae	Suckers
* Flat-fish	Paralichthys lethostigma	Bothidae	Summer flounder
* Sun-fish; Brema	Lepomis spp.	Centrarchidae	Sunfish, e.g. bluegill, pumpkinseed, etc.
* Bass	Micropterus spp.	Centrarchidae	Largemouth and smallmouth bass
* Fatbacks	Brevoortia tyrannus	Clupeidae	Atlantic menhaden
Conyfish;	Archosargus probatocephalus	Sparidae	Sheepshead

* Fish which probably occurred at Jamestown - based on on intuitive interpretation, by the authors, of present and historical data

Appendix B. Fish species captured from James River (River 30-35) in vicinity of Jamestown Island, July and September (Virginia Institute of Marine Science Juvenile Striped Bass Surveys, 1969-1973, 1980-1989).

Family	Species	Common name
Anguillidae	<i>Anguilla rostrata</i>	Eel, American
Atherinidae	<i>Membras martinica</i>	Silverside, rough
Atherinidae	<i>Menidia menidia</i>	Silverside, Atlantic
Atherinidae	<i>Menidia peninsulae</i>	Silverside, tidewater
Belonidae	<i>Strongylura marina</i>	Needlefish, Atlantic
Bothidae	<i>Paralichthys dentatus</i>	Flounder, summer
Carangidae	<i>Caranx hippos</i>	Jack, crevalle
Catostomidae	<i>Moxostoma macrolepidotum</i>	Redhorse, shorthead
Centrarchidae	<i>Lepomis gibbosus</i>	Pumpkinseed
Centrarchidae	<i>Lepomis macrochirus</i>	Bluegill
Centrarchidae	<i>Micropterus dolomieu</i>	Bass, smallmouth
Centrarchidae	<i>Micropterus salmoides</i>	Bass, largemouth
Clupeidae	<i>Alosa aestivalis</i>	Herring, blueback
Clupeidae	<i>Alosa pseudoharengus</i>	Alewife
Clupeidae	<i>Alosa sapidissima</i>	Shad, American
Clupeidae	<i>Brevoortia tyrannus</i>	Menhaden, Atlantic
Clupeidae	<i>Dorosoma cepedianum</i>	Shad, gizzard
Clupeidae	<i>Dorosoma petenense</i>	Shad, threadfin
Cyprinidae	<i>Cyprinus carpio</i>	Carp, common
Cyprinidae	<i>Hybognathus regius</i>	Minnow, eastern silvery
Cyprinidae	<i>Notemigonus crysoleucas</i>	Shiner, golden
Cyprinidae	<i>Notropis bifrenatus</i>	Shiner, bridle
Cyprinidae	<i>Notropis hudsonius</i>	Shiner, spottail
Cyprinodontidae	<i>Fundulus diaphanus</i>	Killifish, banded
Cyprinodontidae	<i>Fundulus heteroclitus</i>	Mummichog
Cyprinodontidae	<i>Fundulus majalis</i>	Killifish, striped
Engraulidae	<i>Anchoa hepsetus</i>	Anchovy, striped
Engraulidae	<i>Anchoa mitchilli</i>	Anchovy, bay
Ictaluridae	<i>Ictalurus catus</i>	Catfish, white
Ictaluridae	<i>Ictalurus nebulosus</i>	Bullhead, brown
Ictaluridae	<i>Ictalurus punctatus</i>	Catfish, channel
Ictaluridae	<i>Noturus insignis</i>	Madtom, margined
Mugilidae	<i>Mugil cephalus</i>	Mullet, striped
Mugilidae	<i>Mugil curema</i>	Mullet, white
Percichthyidae	<i>Morone americana</i>	Perch, white
Percichthyidae	<i>Morone saxatilis</i>	Bass, striped
Percidae	<i>Etheostoma olmstedii</i>	Darter, tessellated
Percidae	<i>Perca flavescens</i>	Perch, yellow
Pomatomidae	<i>Pomatomus saltatrix</i>	Bluefish
Sciaenidae	<i>Bairdiella chrysoura</i>	Perch, silver
Sciaenidae	<i>Leiostomus xanthurus</i>	Spot
Sciaenidae	<i>Menticirrhus saxatilis</i>	Kingfish, northern
Sciaenidae	<i>Micropogonias undulatus</i>	Croaker, Atlantic
Scrombridae	<i>Scomberomorus maculatus</i>	Mackerel, Spanish
Soleidae	<i>Trinectes maculatus</i>	Hogchoker
Sparidae	<i>Lagodon rhomboides</i>	Pinfish
Sparidae	<i>Stenotomus chrysops</i>	Scup
Syngnathidae	<i>Syngnathus</i> sp.	Pipefish

Appendix C. Fishes captured from the James River (River mile 30-35) in the vicinity of Jamestown Island, and from Powhatan Creek from 1942 through 1978 (BOVA 1991).

Species	Common name	1942	1949	1951	1953	1954	1955	1958	1964	1965	1967	1970	1975	1978
Sturgeon Family - Acipenseridae														
Acipenser oxyrhynchus	Sturgeon, Atlantic	-	-	-	-	-	-	-	-	-	-	X	-	-
Bowfin Family - Amiidae														
Amia calva	Bowfin	-	-	-	-	-	-	-	-	-	-	X	-	-
Freshwater Eel Family - Anguillidae														
Anguilla rostrata	Eel, American	-	-	-	-	X	-	-	-	-	X	X	X	X
Silverside Family - Atherinidae														
Menidia beryllina	Silverside, inland	-	X	-	-	-	-	-	-	-	-	-	-	-
Needlefish Family - Belonidae														
Strongylura marina	Needlefish, Atlantic	-	X	-	-	-	-	-	-	-	-	-	-	-
Sucker Family - Catostomidae														
Moxostoma macrolepidotum	Redhorse, shorthead	-	-	-	-	-	-	-	-	-	-	X	-	-
Sunfish Family - Centrarchidae														
Centrarchus macropterus	Flier	-	-	-	-	-	-	-	-	-	-	-	-	-
Enneacanthus gloriosus	Sunfish, bluespotted	-	-	-	-	-	-	-	-	-	X	X	-	-
Lepomis auritus	Sunfish, redbreast	-	-	-	-	-	-	-	-	-	-	X	-	-
Lepomis gibbosus	Pumpkinseed	-	-	-	-	X	-	-	-	-	-	X	-	-
Lepomis macrochirus	Bluegill	-	-	-	-	-	-	-	-	-	-	X	-	-
Micropterus dolomieu	Bass, smallmouth	-	-	-	-	-	-	-	-	-	-	X	-	-
Micropterus salmoides	Bass, largemouth	-	-	-	-	-	-	-	-	-	-	X	-	-
Pomoxis nigromaculatus	Crappie, black	-	-	-	-	-	-	-	-	-	-	-	X	-

X = Captured
 - = Not Captured

Appendix C, Continued. Fishes captured from the James River (River mile 30-35) in the vicinity of Jamestown Island, and from Powhatan Creek from 1942 through 1978 (BOVA 1991).

Species	Common name	1942	1949	1951	1953	1954	1955	1958	1964	1965	1967	1970	1975	1978
Herring Family - Clupeidae														
<i>Alosa aestivalis</i>	Herring, blueback	-	-	-	-	-	-	-	-	-	-	X	-	X
<i>Alosa mediocris</i>	Shad, hickory	-	-	-	-	-	-	-	-	-	-	X	-	X
<i>Alosa pseudoharengus</i>	Alewife	-	-	-	-	-	-	-	-	-	-	X	-	X
<i>Alosa sapidissima</i>	Shad, american	-	-	-	-	-	-	-	-	-	-	X	-	X
<i>Brevoortia tyrannus</i>	Menhaden, atlantic	-	-	-	-	-	-	-	-	-	-	X	-	X
<i>Dorosoma cepedianum</i>	Shad, gizzard	-	-	-	-	-	X	-	-	-	-	X	-	X
<i>Dorosoma petenense</i>	Shad, threadfin	-	-	-	-	-	-	-	-	-	-	X	-	X
Minnow and Carp Family - Cyprinidae														
<i>Cyprinus carpio</i>	Carp, common	-	-	-	-	-	-	-	-	X	-	X	-	-
<i>Hybognathus regius</i>	Minnow, eastern silvery	-	-	-	-	X	-	-	-	X	-	X	-	X
<i>Notemigonus crysoleucas</i>	Shiner, golden	-	-	-	X	X	-	-	-	X	-	X	-	-
<i>Notropis analostanus</i>	Shiner, satinfin	-	-	-	-	-	-	-	-	X	-	X	-	-
<i>Notropis bifrenatus</i>	Shiner, bridle	-	-	-	-	-	-	-	-	X	-	X	-	-
<i>Notropis cornutus</i>	Shiner, common	-	-	-	-	-	-	-	-	X	-	X	-	-
<i>Notropis hudsonius</i>	Shiner, spottail	-	-	-	-	X	X	-	-	X	-	X	-	X
<i>Notropis procne</i>	Shiner, swallowtail	-	-	-	-	-	-	-	X	-	-	X	-	-
<i>Semotilus atromaculatus</i>	Chub, creek	-	-	-	-	-	-	-	-	-	-	X	-	-
Killifish Family - Cyprinodontidae														
<i>Fundulus confluentus</i>	Killifish, marsh	-	-	-	-	-	-	-	-	-	-	X	-	-
<i>Fundulus diaphanus</i>	Killifish, banded	-	-	-	-	-	-	-	-	-	X	X	-	-
<i>Fundulus heteroclitus</i>	Mummichog	-	X	-	-	-	-	-	-	-	X	X	-	-
Anchovy Family - Engraulidae														
<i>Anchoa mitchilli</i>	Anchovy, bay	-	-	-	-	-	-	-	-	-	-	-	-	X
Pike Family - Esocidae														
<i>Esox americanus</i>	Pickereel, redfin	-	-	-	-	-	-	-	-	-	-	-	-	X
<i>Esox niger</i>	Pickereel, chain	-	-	-	-	-	-	-	-	-	-	-	-	X

X = Captured
- = Not Captured

Appendix C, Continued. Fishes captured from the James River (River mile 30-35) in the vicinity of Jamestown Island, and from Powhatan Creek from 1942 through 1978 (BOVA 1991).

Species	Common name	1942	1949	1951	1953	1954	1955	1958	1964	1965	1967	1970	1975	1978
Stickleback Family - Gasterosteidae														
Gasterosteus aculeatus	Stickleback, threespine	-	-	-	-	-	-	-	-	-	-	X	-	-
Catfish Family - Ictaluridae														
Ictalurus catus	Catfish, white	X	-	-	-	-	-	-	-	-	X	X	-	X
Ictalurus nebulosus	Bullhead, brown	X	X	-	-	-	-	-	-	-	X	X	-	-
Ictalurus punctatus	Catfish, channel	X	-	-	-	-	X	-	-	-	X	X	-	X
Gar Family - Lepisosteidae														
Lepisosteus osseus	Gar, longnose	-	-	-	-	-	-	-	-	-	-	X	-	-
Temperate Bass Family - Percichthyidae														
Morone americana	Perch, white	X	-	X	X	X	X	-	-	-	X	X	-	X
Morone saxatilis	Bass, striped	X	-	X	X	X	X	-	-	-	X	X	-	X
Perch Family - Percidae														
Etheostoma olmstedi	Darter, tessellated	X	-	-	-	-	X	-	-	-	X	X	-	X
Perca flavescens	Perch, yellow	-	-	-	-	-	-	-	-	-	X	X	-	X
Lamprey Family - Petromyzontidae														
Lampetra aepyptera	Lamprey, least brook	-	-	X	-	-	-	X	-	-	-	-	-	-
Petromyzon marinus	Lamprey, sea	-	-	-	-	-	-	-	-	-	-	X	-	-
Livebearer Family - Poeciliidae														
Gambusia affinis	Mosquitofish	-	-	-	-	-	-	-	-	-	-	X	-	-
Mudminnow Family - Umbridae														
Umbra pygmaea	Mudminnow, eastern	-	-	-	-	-	-	-	-	-	-	X	-	-

X = Captured
 - = Not Captured

