

Summary
of
Murderkill River Fish Sampling

Nutrient and DO Subcommittee
Murderkill River Working Group



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January, 2013

Introduction

In 2001, the Delaware Department of Natural Resources and Environmental Control (DNREC) established Total Maximum Daily Load (TMDL) criteria to address nonpoint nutrient loading and low dissolved oxygen (D.O.) levels. The Murderkill River Study Group was formed in 2007 by DNREC and Kent County to plan and implement a comprehensive monitoring effort on the tidal portion of the Murderkill River (Rogers, et al, 2011). The Study Group worked to develop and calibrate a scientific model that could be used to aid in developing site-specific nutrient and D.O. criteria for the Murderkill River.

In early 2012, a Nutrient and D.O. Subcommittee was created to investigate developing new criteria. To determine the possible effects on fish assemblages of proposed changes to the nutrient and D.O. criteria for the Murderkill River, a survey was conducted during July through September 2012 to determine the presence of different fish species within the river.

Methods and Materials

The Murderkill River watershed consists of 68,000 acres in the southeastern portion of Kent County. It is bordered to the north by the St. Jones River watershed and to the west and south by the Marshyhope Creek and Mispillion River watersheds respectively (Figure 1). The river, with its headwaters west of Felton, is 20.5 miles long, the lower 10.5 miles of which being tidal, emptying into the Delaware Bay at Bowers. The majority of the watershed (55%) is classified as agricultural and is relatively level to gently sloping (USEPA, 2005).

The Murderkill River was sampled to determine if the distribution of fish species was affected by poor water quality associated with the Kent County Wastewater Treatment Plant. The St. Jones River, which does not receive wastewater treatment plant effluent, was sampled as a control due to its proximity and similar hydrologic characteristics to the Murderkill River. Sampling locations were selected to correspond with previous surveys that had been conducted on the rivers (Figure 2a and 2b). In addition, sampling locations on the Murderkill River were selected to have a site above and below the effluent input from the treatment facility.

Fish were sampled with a 10-ft. (3-m) semi-balloon trawl with two 16-inch (0.4-m) long by 10.5-inch (0.27-m) wide trawl doors. The trawl had a 1.5-inch (38.1-mm) stretch mesh body and a 1.25-inch (31.8-mm) stretch mesh cod-end lined with 0.375-inch (9.5-mm) stretch mesh knotless netting. The trawl was towed in the direction of the prevailing tide by a 21-ft long fiberglass catamaran powered by a 150-hp outboard motor running at 1100 RPM. The average towing speed was 3 miles (4.8-km) per hour. In addition, a fyke net was deployed in the Murderkill River to sample for fish along the shoreline and in smaller tidal guts.

Three trawl samples were taken per river on each sampling day. The trawl was towed for ten minutes unless the net became hung on a bottom snag. The trawl was hauled over the side and the catch was emptied into a fish tote upon completion of each tow. Finfish species were sorted by species and enumerated. A representative subsample of 20 specimens per species was measured for fork length to the nearest half centimeter. Hogchokers and bay anchovy were not measured. Surface and bottom temperature (°C), salinity (ppt), dissolved oxygen (ppm) were recorded at completion of each tow. Tidal stage, weather conditions, water depth, engine speed were also recorded at the beginning of each tow.

The trawl was restricted to sampling the channel, so a fyke net was used to sample the nearshore Murderkill River. This net was deployed along the shoreline and near smaller tidal guts in an effort to catch nearshore fish species. Strong tidal currents caused the net to collapse during several sets. The fyke was initially set overnight and fished for 19 hours. All subsequent sets were made at the start of the sampling day and retrieved once all trawl samples were completed. Soak time was generally 3-4 hours.

Water quality was summarized by site and sample. The catch was summarized by month and in total. Each summary included a listing of species collected, total number of each species taken by river and sampling site

Results and Discussion

Water Quality

Surface temperatures ranged from 20.3 °C in early October to 28.3 °C in late July. Bottom temperatures ranged from 20.2 °C in early October to 28.0 °C in July (Table 1). There was little difference between the two rivers in water temperatures (Figure 3). Surface and bottom salinities followed the typical estuarine river pattern with the higher salinity waters closest to the mouth of the river. However, salinity readings were quite possibly influenced by lower than average rainfall during the summer months in 2012 (Table 2 and Figure 4). Dissolved oxygen levels were not considered limiting to normal species distributions (Table 3 and Figure 5).

Table 1. Surface and bottom temperature (°C) readings measured in the Murderkill (M1-M3) and St. Jones (S1-S3) Rivers, by station and sample date.

Date	Temperature											
	M1		M2		M3		S1		S2		S3	
	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT
7/12/2012	27.7	27.9	27.7	27.7	28.0	28.0	28.1	28.0	27.8	27.6	28.1	27.7
7/31/2012	28.3	28.0	28.0	27.9	27.2	27.2	27.5	27.5	27.3	27.2	27.3	27.2
8/17/2012	27.1	26.6	27.0	26.9	26.8	26.6	26.5	26.5	26.6	26.6	26.8	26.7
8/30/2012	26.4	25.7	26.2	25.9	25.6	25.3	25.4	25.4	25.4	25.3	25.7	25.3
9/14/2012	23.2	23.1	23.3	23.1	22.9	22.9	22.9	22.9	23.7	23.1	23.3	23.1
10/2/2012	20.8	20.8	20.6	20.6	20.7	20.7	20.3	20.2	20.5	20.5	20.6	20.6

Table 2. Surface and bottom salinity (ppt) readings measured in the Murderkill (M1-M3) and St. Jones (S1-S3) Rivers, by station and sample date.

Date	Salinity											
	M1		M2		M3		S1		S2		S3	
	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT
7/12/2012	13	13	15	15	21	21	16	16	21	21	22	23
7/31/2012	19	22	24	24	28	28	24	25	27	27	28	28
8/17/2012	14	15	20	21	28	28	22	22	25	25	28	28
8/30/2012	19	21	24	25	29	30	24	24	28	28	29	29
9/14/2012	6	6	11	11	28	28	21	22	27	27	27	28
10/2/2012	18	19	26	25	30	30	20	20	28	28	29	29

Table 3. Surface and bottom dissolved oxygen (ppm) readings measured in the Murderkill (M1-M3) and St. Jones (S1-S3) Rivers, by station and sample date.

Date	Dissolved Oxygen											
	M1		M2		M3		S1		S2		S3	
	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT	SUR	BOT
7/12/2012	3.1	2.7	2.9	2.7	3.7	3.6	3.1	2.7	3.2	2.7	4.6	3.5
7/31/2012	4.2	3	3.6	3.4	5	4.8	2.9	2.7	4.5	3.9	5.4	4.9
8/17/2012	3.5	2.7	3.6	3.6	6.3	5.9	2.5	2.3	4.4	4.3	6.4	6.3
8/30/2012	3.4	3.2	4.4	4.3	5.7	5.9	3.3	3.1	4.9	4.7	6.4	5.9
9/14/2012	3.9	3.4	4.3	3.7	7.2	7.3	4.4	4.3	7.3	7.3	7.4	7.7
10/2/2012	4.1	4.3	4.8	4.8	6.2	6.2	3.6	3.7	5.9	5.9	6.9	6.4

Catch Composition

A total of sixteen (16) species of finfish and three (3) species of invertebrates were recorded between the two river systems (Table 4). Finfish species diversity was slightly higher in the Murderkill River (16 species) (Table 5) than in the St. Jones River (12 species) (Table 6). Species which were caught in solely in the Murderkill River were Atlantic menhaden, northern kingfish, channel catfish and white catfish. Five species constituted over 74% of the total finfish catch for their respective rivers: Atlantic croaker, hogchoker, white perch, spot and weakfish (Tables 7 and 8). Although the species encountered are not uncommon in these rivers, the higher abundance of more marine oriented fish could have been influenced by increased salinities resulting from lower than average rainfall during the summer months in 2012. Table 4. Combined catch statistics from bottom trawl sampling for the Murderkill and St. Jones River systems.

Species	Total	% Total
Hogchoker	412	30.3%
White perch	239	17.6%
Atlantic croaker	152	11.2%
Spot	145	10.7%
Blue crab	129	9.5%
Weakfish	74	5.4%
Striped bass	33	2.4%
White catfish	31	2.3%
Bay anchovy	29	2.1%
Penaeid shrimp	27	2.0%
Oyster toadfish	22	1.6%
Black sea bass	16	1.2%
Black drum	15	1.1%
Silver perch	14	1.0%
American eel	7	0.5%
Channel catfish	6	0.4%
Horseshoe crab	4	0.3%
Northern kingfish	2	0.1%
Atlantic menhaden	1	0.1%

Table 5. Catch statistics from bottom trawl sampling in the Murderkill River by station.

Species	Totals			Total	% Total
	M1	M2	M3		
Hogchoker	232	71	42	345	45.3
Atlantic croaker	18	70	10	98	12.9
White perch	17	14	20	51	6.7
Spot	17	24	7	48	6.3
Weakfish	18	8	13	39	5.1
Blue crab	9	13	15	37	4.9
White catfish	14	17	-	31	4.1
Penaeid shrimp	23	2	-	25	3.3
Striped bass	-	19	-	19	2.5
Bay anchovy	1	13	3	17	2.2
Oyster toadfish	-	-	11	11	1.4
Silver perch	7	3	-	10	1.3
Black sea bass	-	-	9	9	1.2
Black drum	4	1	2	7	0.9
Channel catfish	5	1	-	6	0.8
American eel	-	4	1	5	0.7
Northern kingfish	-	-	2	2	0.3
Atlantic menhaden	1	-	-	1	0.1
Horseshoe crab	-	-	1	1	0.1

Table 6. Catch statistics from bottom trawl sampling in the St. Jones River by station.

Species	Totals			Total	% Total
	S1	S2	S3		
White perch	138	39	11	188	31.5
Spot	79	13	5	97	16.3
Blue crab	61	19	12	92	15.4
Hogchoker	36	5	26	67	11.2
Atlantic croaker	18	15	21	54	9.1
Weakfish	5	24	6	35	5.9
Striped bass	14	-	-	14	2.3
Bay anchovy	-	4	8	12	2.0
Oyster toadfish	1	9	1	11	1.8
Black drum	2	2	4	8	1.3
Black sea bass	1	2	4	7	1.2
Silver perch	-	1	3	4	0.7
Horseshoe crab	-	-	3	3	0.5
Penaeid shrimp	2	-	-	2	0.3
American eel	2	-	-	2	0.3

Sample collections were similar to previous surveys conducted by the Division (Shirey 1987). The top five species from each survey are shown in tables 7 and 8. It should be noted that the 1986 survey data is for combined trawl and seine samples and includes freshwater sampling not conducted in this survey.

Table 7. Catch comparison of top five caught in the Murderkill River surveys in 1986 and 2012.

Murderkill River - 2012	Murderkill River - 1986
762 Specimens (19 species)	1246 Specimens (27 species)
Hogchoker (45%)	White perch (49%)
Atlantic croaker (13%)	Hogchoker (11%)
White perch (7%)	White catfish (11%)
Spot (6%)	Mummichog (6%)
Weakfish (5%)	Atlantic menhaden (4%)

Table 8. Catch comparison of top five caught in the St. Jones River surveys in 1986 and 2012.

St. Jones River - 2012	St. Jones River - 1986
596 Specimens (15 Species)	1470 Specimens (24 species)
White perch (32%)	Atlantic silverside (50%)
Spot (16%)	White perch (14%)
Hogchoker (11%)	Spot (10%)
Atlantic croaker (9%)	Hogchoker (7%)
Weakfish (6%)	Striped cusk eel (5%)

A literature review of prior studies and surveys showed that most species managed under fishery management plans inhabit tidal tributaries, (Clark 2000). Tidal tributaries are an important nursery for these species, with nursery being defined as the presence in the habitat of one or more of the species immature life stages (Clark 2000). Size distribution data collected indicated the presence of young of the year and juveniles for several managed species in both rivers sampled (Table 9). The fish community of the trawl site nearest to the wastewater plant effluent outfall was similar in species composition and numbers to the other trawl sites in the Murderkill and the St. Jones, which suggested the effluent was not impairing its nursery habitat quality.

Table 9. Size distribution data of select species caught in the Murderkill and St. Jones Rivers surveys in 2012. Species of which young of the year specimens were collected are indicated by an asterisk.

Murderkill River	St. Jones River
American eel 200-475mm	American eel 240-250mm
Black sea bass 105-160mm*	Black sea bass 115-160mm*
White perch 55-250mm*	White perch 120-240mm
Striped bass 155-245mm	Striped bass 140-205mm
Silver perch 30-160mm*	Silver perch 165-175mm
Weakfish 25-105mm*	Weakfish 20-140mm*
Spot 105-205mm*	Spot 100-180mm*
Atlantic croaker 20-170mm*	Atlantic croaker 20-220mm*

A fyke net was set in the Murderkill River in an area of the river that was closest to the Kent County Wastewater Treatment facility (Figure 2a). Catch data for the fyke net is shown in Table 10. Fyke net catches were dominated by white catfish, most of which were caught in one 3-hour set. Species that were only caught in the fyke net were bullheads (brown and yellow), bluegill, mummichog and bluefish.

Table 10. Catch statistics from fyke net sampling in the Murderkill River.

	Total	% Total
White catfish	251	72.8
White perch	31	9.0
Spot	18	5.2
Channel catfish	11	3.2
Atlantic croaker	8	2.3
Blue crab	8	2.3
Atlantic menhaden	5	1.4
Bluefish	4	1.2
Brown bullhead	2	0.6
Weakfish	1	0.3
Striped bass	1	0.3
Black drum	1	0.3
American eel	1	0.3
Bluegill	1	0.3
Yellow bullhead	1	0.3
Mummichog	1	0.3

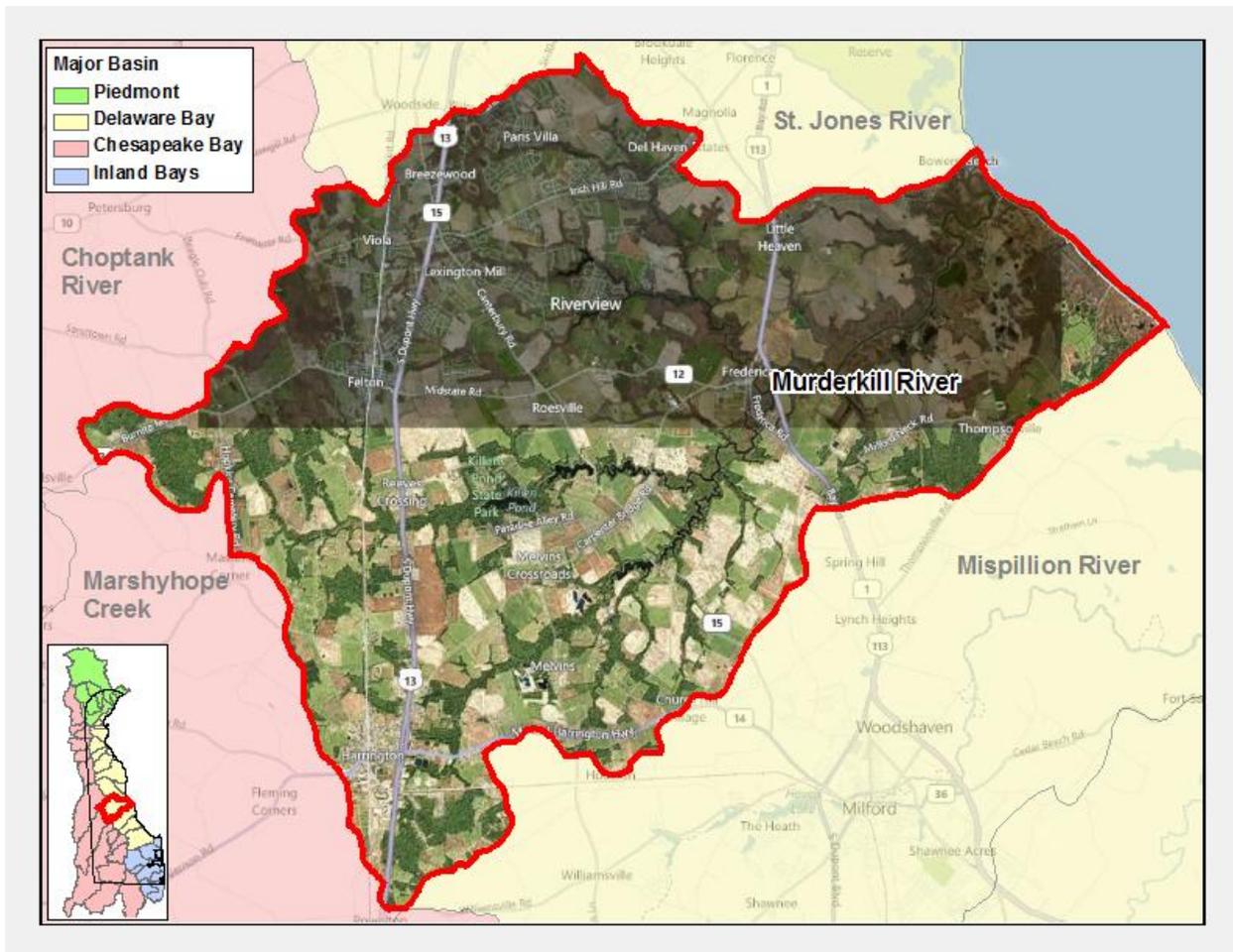


Figure 1. Murderkill River watershed and surrounding watersheds. (Image courtesy DelawareWatersheds.org).

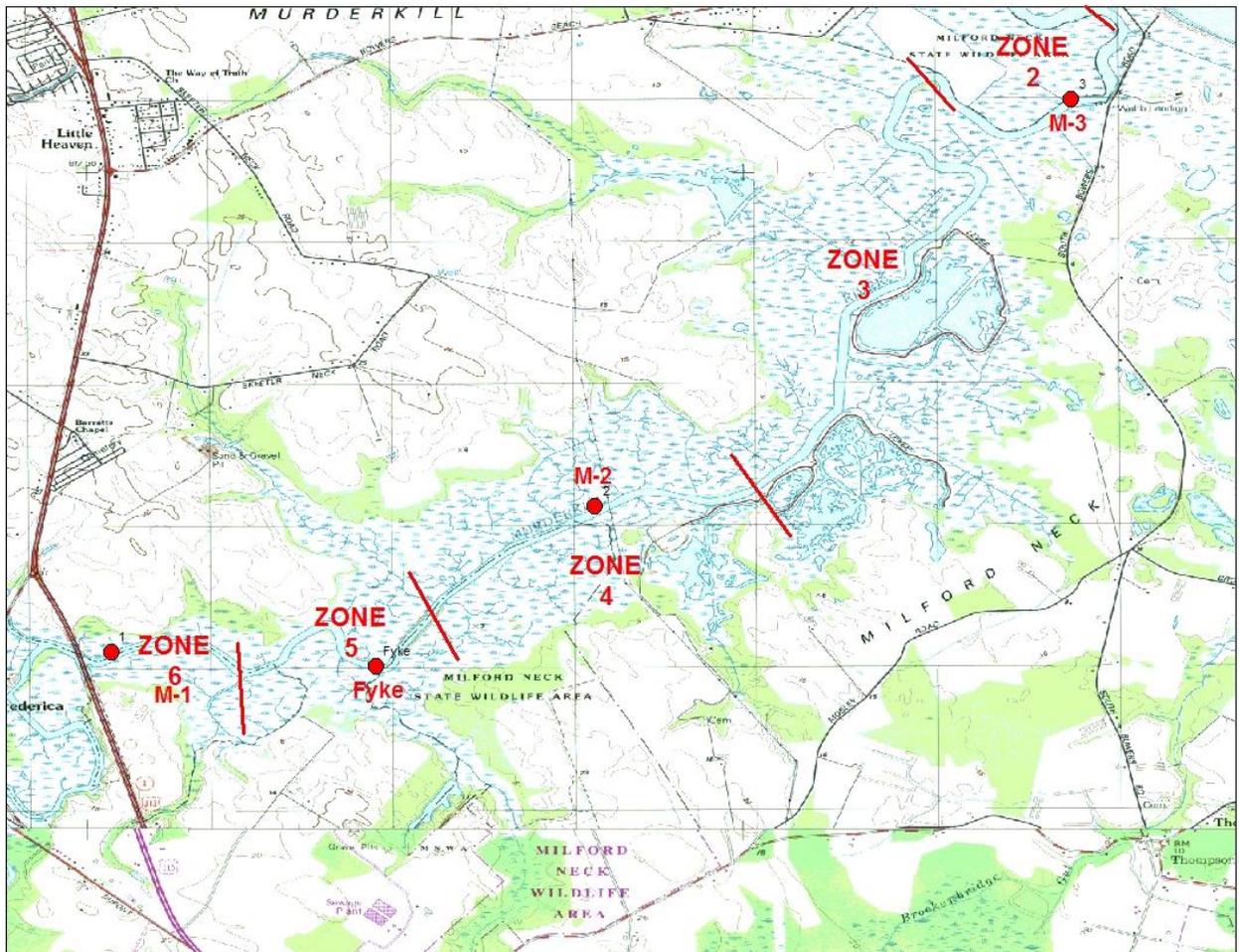


Figure 2a. Stations sampled with 10-foot otter trawl in the Murderkill River. Zones indicated are associated with the zones used in the water quality models.

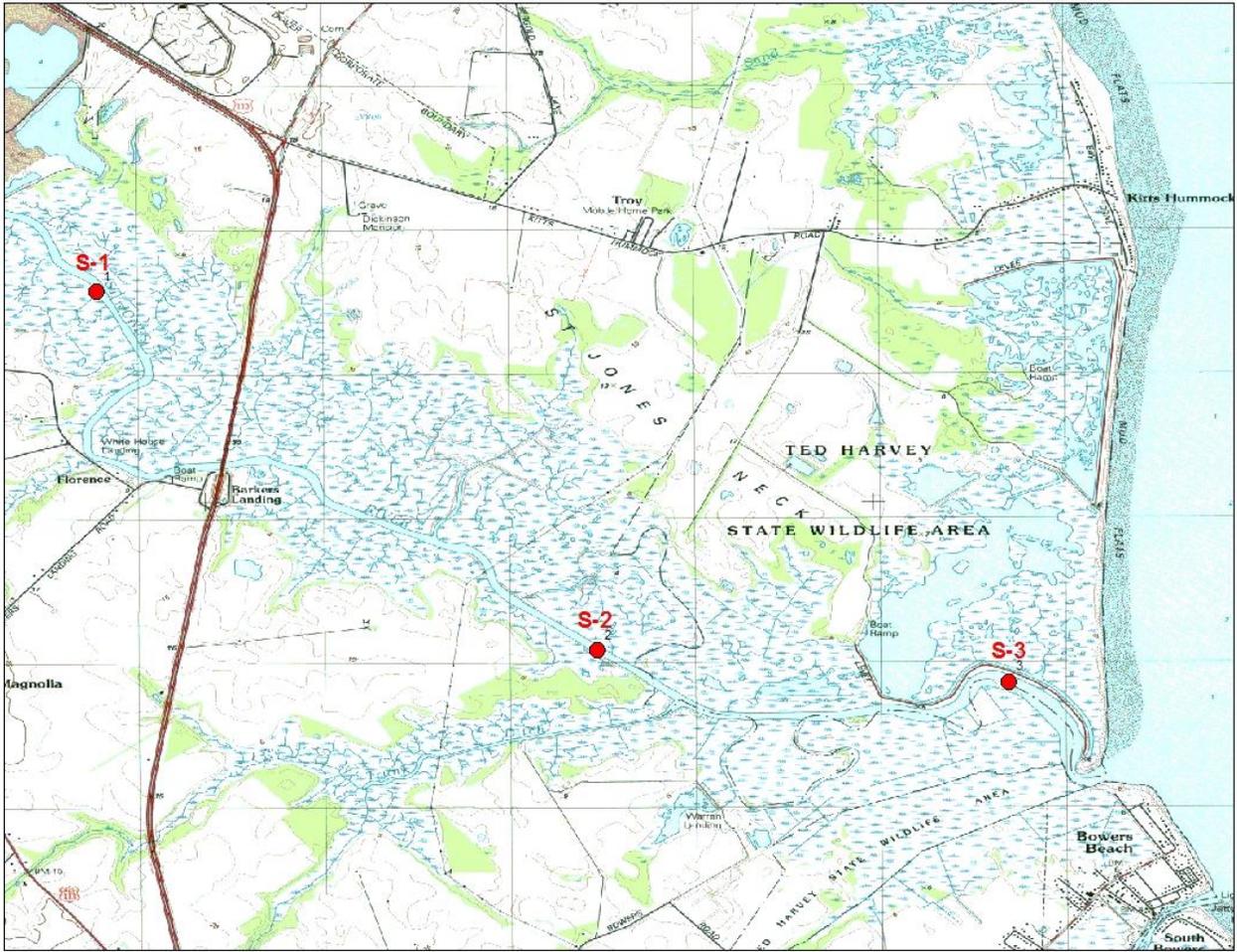


Figure 2b. Stations sampled with 10-foot otter trawl in the St. Jones River.

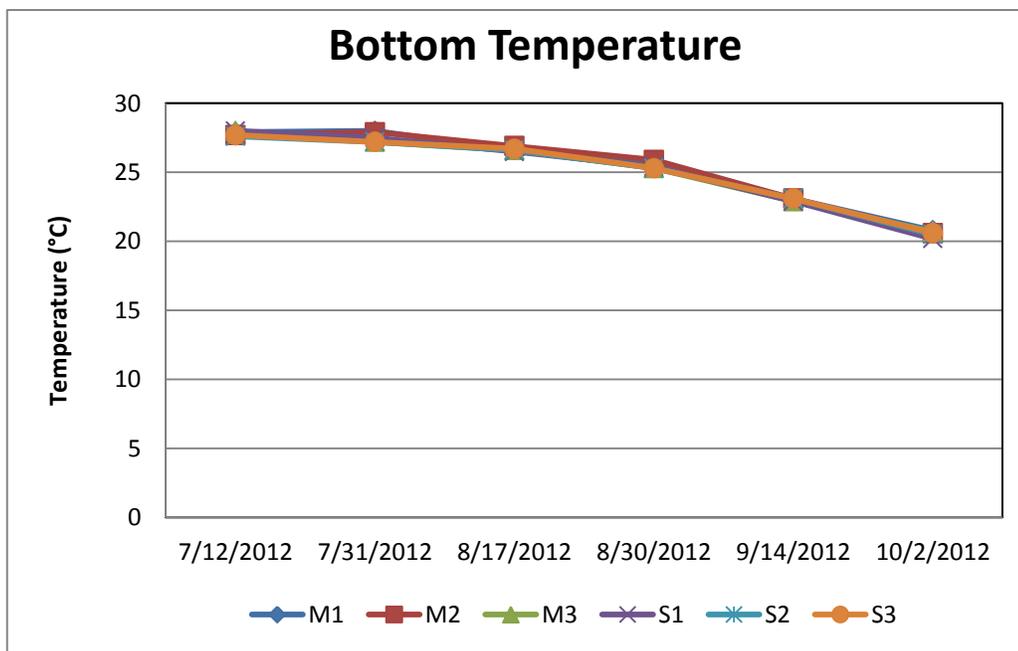
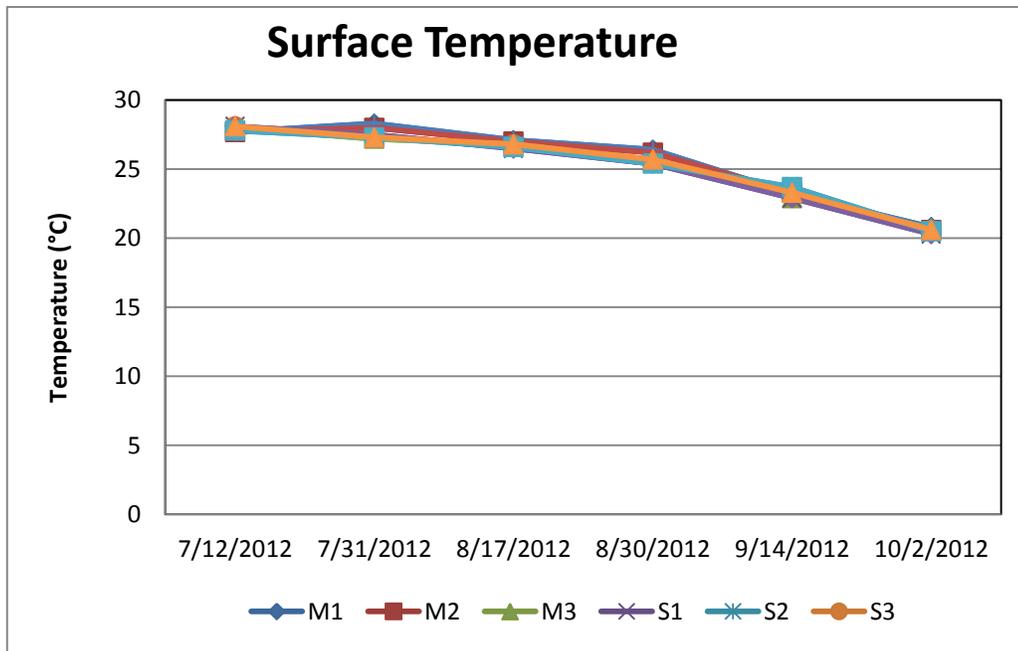


Figure 3. Surface and bottom temperature ($^{\circ}\text{C}$) readings measured in the Murderkill and St. Jones Rivers, by station and sample date.

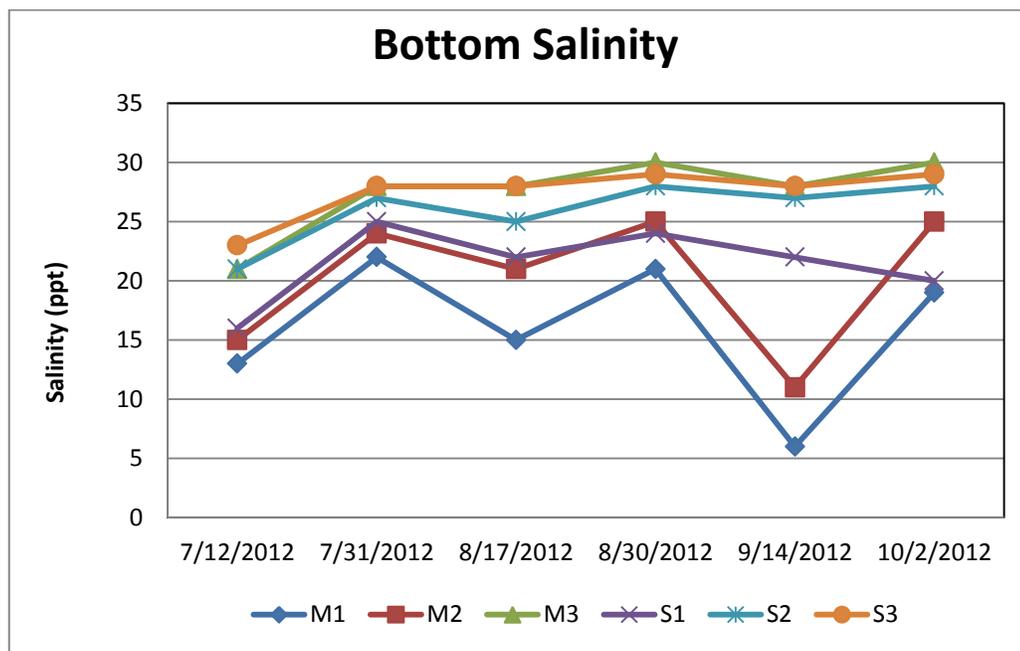
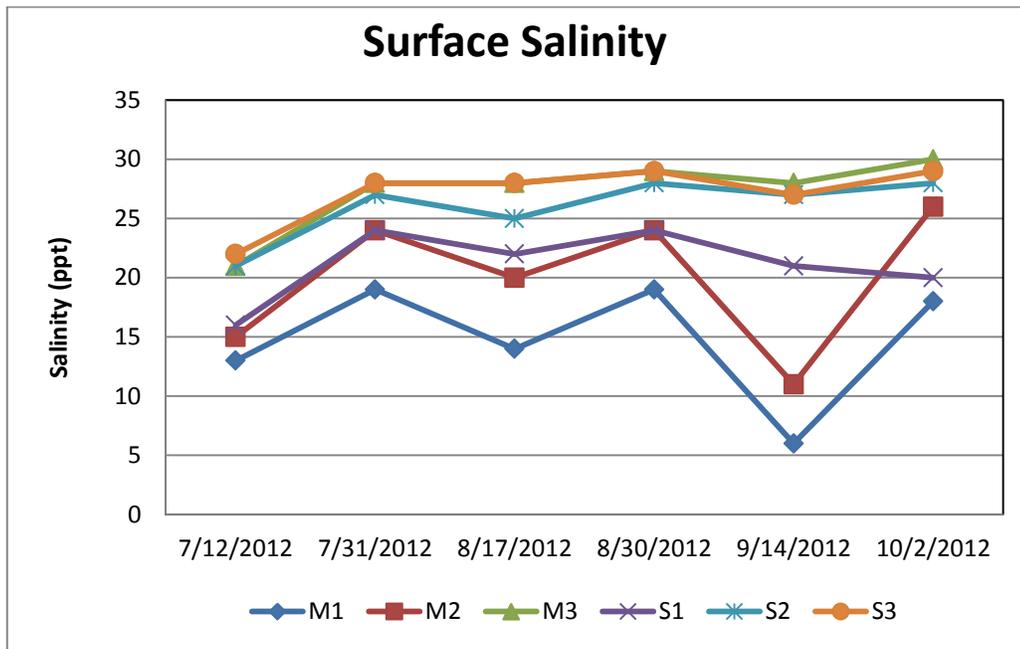


Figure 4. Surface and bottom salinity (ppt) readings measured in the Murderkill and St. Jones Rivers, by station and sample date.

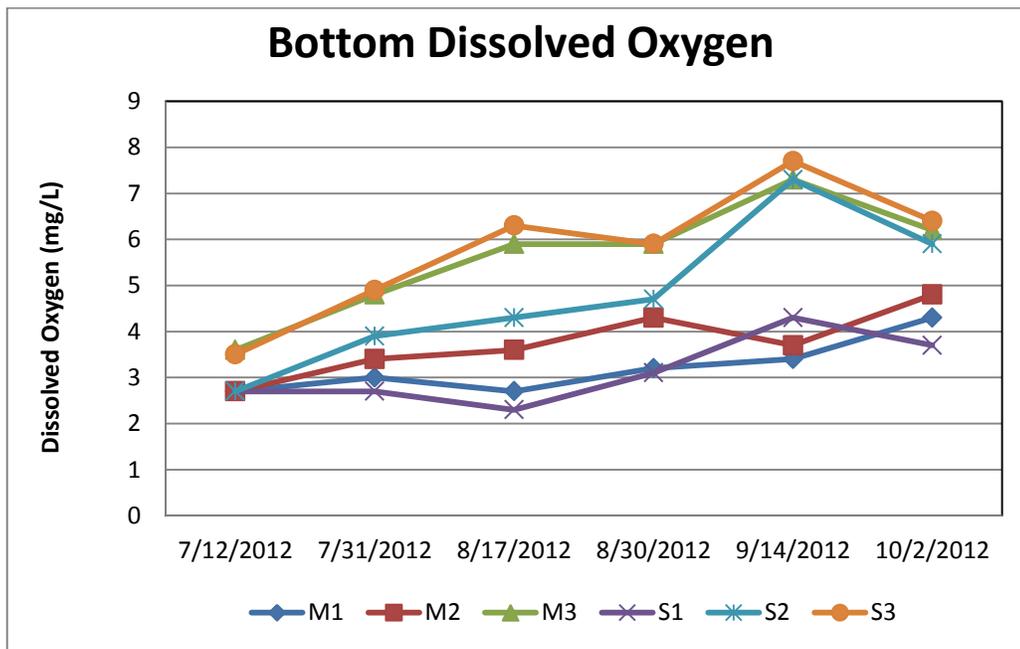
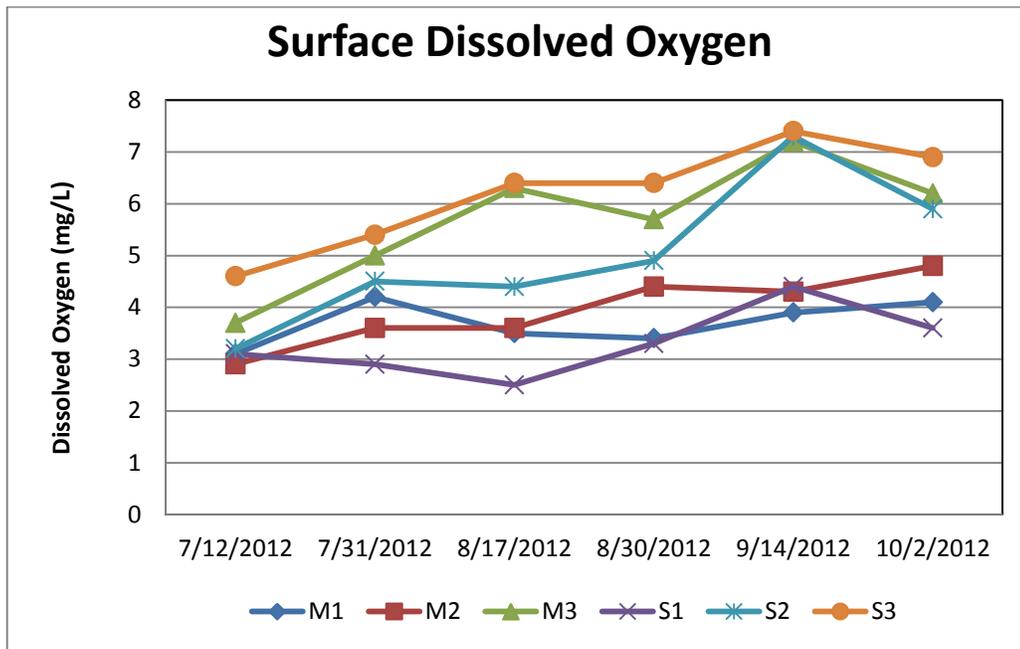


Figure 5. Surface and bottom salinity (ppt) readings measured in the Murderkill and St. Jones Rivers, by station and sample date.

Literature Cited

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