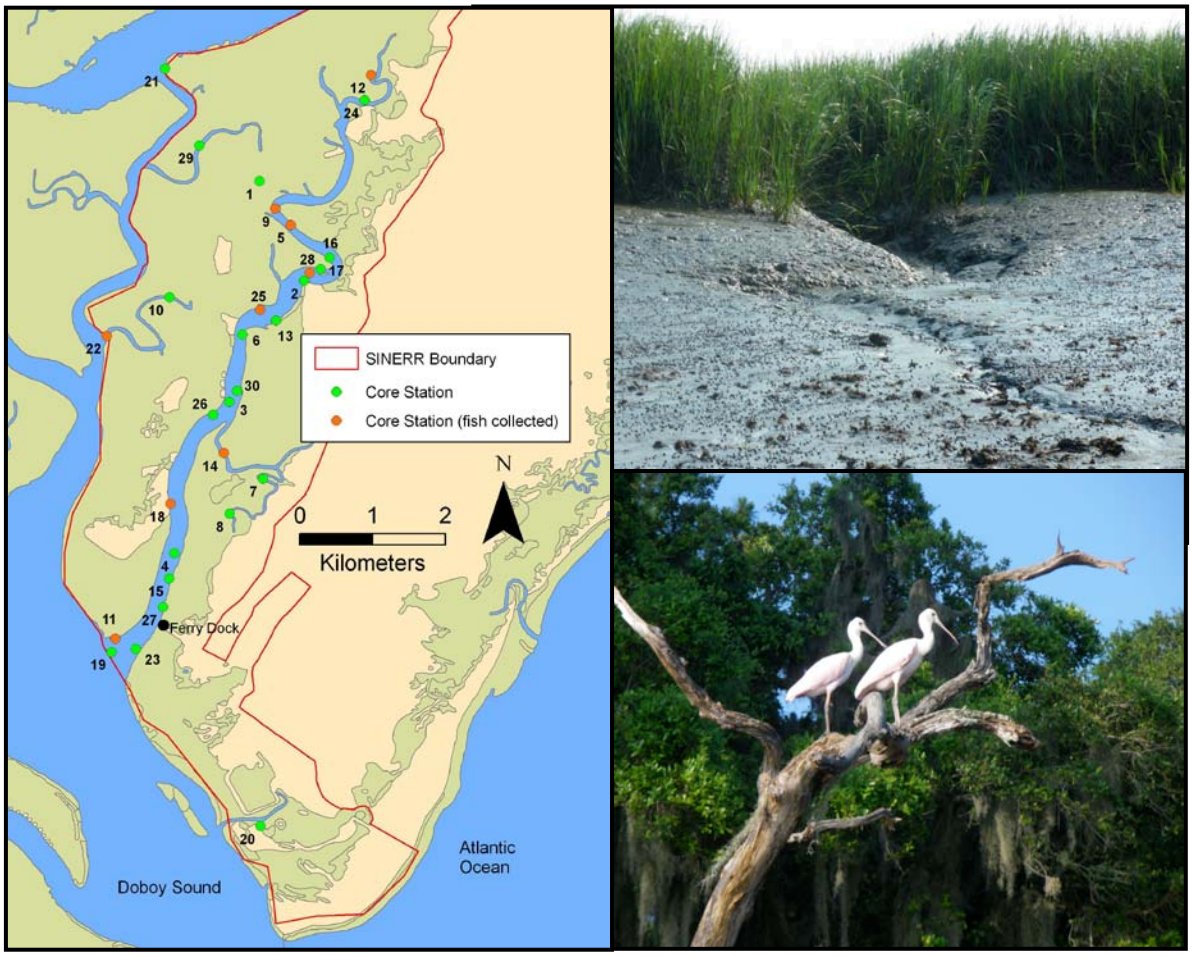
Cruise Report: Summer 2009 Sapelo Island National Estuarine Research Reserve Ecological Characterization

(June 7 - June 13, 2009)



NOAA Technical Memorandum NOS NCCOS 101

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(June 7 - June 13, 2009)

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Summary

This cruise report is a summary of a field survey conducted within the Sapelo Island National Estuarine Research Reserve (SINERR), located on the Georgia coastline, June 7 – June 13, 2009. Multiple indicators of ecological condition and human dimensions were sampled synoptically at each of 30 stations throughout SINERR using a random probabilistic sampling design. Samples were collected for the analysis of benthic community structure and composition; concentrations of chemical contaminants (metals, pesticides, PAHs, PCBs, PBDEs) in sediments and target demersal biota; nutrient and chlorophyll levels in the water column; bacterial contaminants in the water column; and other basic habitat characteristics such as depth, salinity, temperature, dissolved oxygen, turbidity, total suspended solids, pH, sediment grain size, and organic carbon content. In addition to the fish samples that were collected for analysis of chemical contaminants relative to human-health consumption limits, other human-dimension indicators were sampled as well including presence or absence of fishing gear, vessels, surface trash, and noxious sediment odors. The overall purpose of the survey was to collect data to assess the status of ecosystem condition and potential stressor impacts throughout SINERR, based on these various indicators and corresponding management thresholds, and to provide this information as a baseline for determining how such conditions may be changing with time. While sample analysis is still ongoing a few preliminary results and observations are reported here. A final report will be completed once all data have been processed. The results will provide a comprehensive weight-of-evidence basis for evaluating current condition (*aka* a "state-of-the-SINEER environmental report") and serve as a quantitative benchmark for tracking any future changes due to either natural or human disturbances. Another goal of the study is to demonstrate its utility as a possible model for assessing the status of condition at other NEERS sites using similar and consistent methods to promote system-wide regional and national comparisons.

This was a multi-disciplinary partnership effort made possible by scientists from the following organizations:

- NOAA, National Ocean Service (NOS), National Centers for Coastal Ocean Science (NCCOS), Center for Coastal Environmental Health and Biomolecular Research (CCEHBR), Charleston, SC.
    - Protected Area and Resources Branch
    - Estuaries and Land Use Branch
- NOAA, NOS, Office of Coastal Resource Management, Estuarine Reserves Division, Silver Spring, MD.
- Sapelo Island National Estuarine Research Reserve, Sapelo Island, GA.

Additional copies of this cruise report can be obtained by contacting:
NOAA, Center for Coastal Environmental Health and Biomolecular Research, 219 Fort Johnson Road, Charleston, South Carolina, 29412, Telephone: 843/762-8511. Attention: Cynthia Cooksey.

1.0 Introduction

This survey is being conducted as part of a Long Term Agreement between NOAA's Office of Ocean and Coastal Resource Management's (OCRM) Estuarine Reserve Division (ERD) and NOAA's National Centers for Coastal Ocean Science (NCCOS), signed in April 2008, with the purpose of formally establishing a partnership between the National Estuarine Research Reserve System (NERRS) and NCCOS to address common research and management goals. The primary objective for the present work is to assess the status of ecological condition of the Sapelo Island NERR (SINERR) using a probabilistic sampling framework to support unbiased statistical estimates of the spatial extent of condition relative to various measured ecological indicators and associated management thresholds. This information will provide a comprehensive weight-of-evidence basis for evaluating current condition (*aka* a "state-of-the-SINEER environmental report") and serve as a quantitative benchmark for tracking any future changes due to either natural or human disturbances. Another goal of the study is to demonstrate its utility as a possible model for assessing the status of condition at other NEERS sites using similar and consistent methods to promote system-wide regional and national comparisons.

The present survey was conducted within the SINERR which encompasses 6,110 acres of productive habitats, consisting of 2,110 acres of upland maritime forest and hammock land, and 4,000 acres of salt marsh and tidal creeks including the Duplin River (Figure 1). SINERR is a protected area which contains important regional ecological and cultural resources (SINERR 2008). Synoptic sampling of multiple ecological and human-dimension indicators was conducted at each of 30 random stations throughout the submerged aquatic habitats of SINERR (i.e., Duplin River and nearby tidal creeks). The consistent and synoptic sampling of the different biological and environmental variables across these stations will provide an opportunity for learning more about the spatial patterns of these resources and processes controlling their distributions. As mentioned above, by incorporating a random probabilistic sampling design, the resulting data also can be used to make unbiased statistical estimates of the spatial extent of the sanctuary's health with respect to the various measured indicators and corresponding management thresholds, and to provide this information as a baseline for determining how environmental conditions may be changing in the future. Results from this survey will also be used to help support the needs of a companion study of bottle-nose dolphin health in relation to contaminant exposure from possible prey food sources in the surrounding watershed (Lori Schwacke, Hollings Marine Lab, Charleston, SC). The following report provides a brief summary of the scope and preliminary results of the supporting sampling conducted June 7 – June 13, 2009.

2.0 Scientific Approach

Samples were collected from small, trailerable boats, at 30 random stations within the Sapelo Island National Estuarine Research Reserve (Figure 1, Table 1). At each station, samples were obtained for characterization of the following core indicators (Table 2): (1) community structure and composition of benthic macroinfauna (> 0.5 mm); (2) concentrations of chemical contaminants in sediments (metals, pesticides, PCBs, PAHs, PBDEs); (3) sediment toxicity (Microtox assay); (4) microbial contamination of the water column; and (5) general habitat conditions (water depth, dissolved oxygen, salinity, temperature, chlorophyll a, total suspended

solids, water-column nutrients, turbidity, % silt-clay versus sand content of sediment, organic-carbon content of sediment). Where possible, samples of demersal fish species were collected by hook and line and/or cast net for analysis of chemical contaminant body burdens and visual evidence of pathological disorders. Once available, the fish contaminant data will be compared to human-health consumption limits as a measure of potential human-health risks. Additional human-dimension indicators were sampled as well including presence or absence of fishing gear, vessels, surface trash and oil, and noxious sediment odors.

Sediment sampling was conducted using a 0.04 m^2 Young-modified Van Veen grab. Samples for benthic macro-infaunal analysis were collected in duplicate, live-sieved through a 0.5 mm screen, and preserved separately in 10% buffered formalin with Rose Bengal stain. Samples for the analysis of sediment toxicity, sediment contaminants, % silt-clay, % water, and % TOC were sub-sampled from composited surface sediment (upper 3-5 cm) taken from additional grabs (typically two) independent of the macro-infaunal grabs. A YSI 6-series multiparameter sonde was used to acquire profiles of salinity, temperature, pH, dissolved oxygen, turbidity, and depth through the water column. A discrete water sample was collected near-surface for analysis of nutrients, total suspended solids, turbidity (NTU), chlorophyll, and microbial contamination.

Additional fish sampling, hook and line and cast net, was conducted in the Brunswick area (Figure 2) in support of a companion study of bottle-nose dolphin health in relation to contaminant exposure from possible prey food sources.

3.0 Preliminary Results

A total of 30 stations were sampled for all indicators throughout the study region (Figure 1, Table 1). An additional four stations were sampled in the Brunswick, GA area for demersal fish species on June 28-30, 2009 (Figure 2). Presented here are preliminary results and observations from the research cruise. A final report will be completed once all data have been processed.

Water depths (raw data, not corrected for tides) at the 33 stations averaged 4.0 m and ranged from 1.0 – 9.7 m (Table 1). Bottom-water salinity levels across the reserve were in the polyhaline range, 18.7 to 28.2 ppt, averaging 21.4 ppt (Table 2). Bottom-water dissolved oxygen was consistently low across SINERR, ranging from 2.3 mg/L to 5.1 mg/L and averaging 3.7 mg/L. Lowest DO measurements occurred furthest upstream within the Duplin River or its tributary Post Office Creek (Figure 3). These values are above the range (< 2 mg/L) typically associated with benthic impacts (Diaz and Rosenberg 1995, USEPA 2000), though all but one station had values below the range (> 5 mg/L) considered good in EPA national coastal assessments (USEPA 2004). The measured DO values are in good agreement with daily bottom DO measured at the Sapelo Island Ferry Dock SINERR water monitoring station (Figure 4). Surface and bottom water-quality measurements for temperature, salinity, pH, DO and turbidity at each station are presented in Table 3.

Both turbidity (NTU) and secchi depth (m) were measured at each of the 30 stations as indicators of water clarity (Table 1 and 3). Turbidity was consistently higher in bottom water then surface water. Turbidity in bottom water ranged from 8.7 to 48.5 NTU and averaged 20.9 NTU while

surface turbidity ranged from 4.0 to 19.9 NTU and averaged 9.0 NTU across SINERR. Secchi depths had a narrow range of 0.5 to 1.5 m, and averaged 0.7 m. The State of Georgia does not have specific water quality thresholds for turbidity, instead a narrative standard based on natural conditions has been adopted. However, for comparison purposes, South Carolina has a not-to-exceed turbidity threshold of 25 NTU for saltwater. Bottom turbidity was generally highest (> 25 NTU) in the lower portion of the Duplin and other small creeks on the western edge of SINERR (Figure 5). The turbidity values measured throughout SINERR were generally higher than the turbidity observed during the same, June 7-13, sampling period at the Sapelo Island Ferry Dock SINERR water monitoring station (Figure 6). However, these values are within a general range that can be observed at the Ferry Dock over a broader sampling interval (e.g., January – July 2009, Figure 6).

Observations of several human-dimension indicators (e.g., presence or absence of fishing gear, vessels, surface trash and oil, and noxious sediment odors) also were made at each station (Table 4). At nearly two-thirds (60 %) of the SINERR stations at least one indicator of human use (presence of fishing gear or vessels) was observed. All observed fishing gear consisted of crab pot buoys and were distributed throughout the SINERR (Figure 7). Vessel activities were observed primarily in the lower portion of the Duplin River (Figure 8).

A total of 29 fish were collected from 9 stations within SINERR for tissue contaminant analysis (Table 5, Figure 1). Fish species collected included striped mullet (*Mugil cephalus*), Atlantic croaker (*Micropogonias undulatus*), spotted seatrout (*Cynoscion nebulosus*), red drum (*Scianenops ocellatus*), southern flounder (*Paralichthys lethostigma*), whiting (*Menticirrhus* spp.), and silver perch (*Bairdiella chrysoura*). An additional 21 fish where collected from four stations in the Brunswick area, south of SINERR (Figure 2). Fish collected in Brunswick included striped mullet, Atlantic croaker, whiting, and silver perch (Table 5).

Data for other biological and abiotic environmental variables listed in Table 2 will be available once the processing of these samples has been completed.

4.0 Acknowledgements

Funding for this project was provided by NOAA/NOS/NCCOS/CCEHBR. Logistical support provided by Sapelo Island National Estuarine Research Reserve. All members of the field crew (Table 6) are commended for their hard work, technical expertise, teamwork and dedication.

5.0 References

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Table 1. Coordinates, date sampled, station depth, and secchi depth for 30 stations sampled within SINERR, June 2009.

Station	Date Sampled	Latitude (DD)	Longitude (DD)	Station Depth (m)	Secchi Depth (m)
SI09001	6/10/2009	31.47230	-81.28348	1.7	0.6
SI09002	6/8/2009	31.46001	-81.27798	8.4	0.7
SI09003	6/11/2009	31.44505	-81.28719	5.3	1.0
SI09004	6/11/2009	31.42636	-81.29398	5.1	0.7
SI09005	6/9/2009	31.46691	-81.27962	5.1	0.7
SI09006	6/12/2009	31.45338	-81.28561	6.8	1.0
SI09007	6/11/2009	31.43559	-81.28304	2.8	0.7
SI09008	6/11/2009	31.43123	-81.28718	4.4	0.8
SI09009	6/9/2009	31.46893	-81.28152	9.7	1.0
SI09010	6/10/2009	31.45799	-81.29460	2.2	0.7
SI09011	6/9/2009	31.41582	-81.30126	1.0	0.6
SI09012	6/9/2009	31.48542	-81.26971	2.2	1.0
SI09013	6/12/2009	31.45511	-81.28146	1.2	1.0
SI09014	6/11/2009	31.43875	-81.28790	4.4	0.7
SI09015	6/9/2009	31.42325	-81.29463	5.7	0.7
SI09016	6/8/2009	31.46286	-81.27483	3.7	0.7
SI09017	6/8/2009	31.46102	-81.27729	3.4	0.7
SI09018	6/12/2009	31.43246	-81.29445	7.1	1.0
SI09019	6/10/2009	31.41419	-81.30173	2.4	0.6
SI09020	6/8/2009	31.39268	-81.28336	3.5	1.5
SI09021	6/10/2009	31.48623	-81.29512	1.4	0.7
SI09022	6/10/2009	31.45321	-81.30234	4.3	0.6
SI09023	6/8/2009	31.41455	-81.29872	4.0	0.7
SI09024	6/9/2009	31.48230	-81.27052	2.4	1.0
SI09025	6/9/2009	31.45643	-81.28340	2.5	0.7
SI09026	6/11/2009	31.44346	-81.28921	3.3	0.7
SI09027	6/10/2009	31.41972	-81.29540	4.2	0.6
SI09028	6/8/2009	31.46148	-81.27592	4.4	0.7
SI09029	6/10/2009	31.47673	-81.29091	2.8	0.5
SI09030	6/11/2009	31.44643	-81.28625	3.4	1.0
			Mean	4.0	0.7

Table 2. Summary of field samples collected at each 2009 SINERR station.

Parameters	# of Replicates	Container	Sample Size	Preservation
Infauna	2	1000 ml Polypropylene jar	All material retained on 0.5mm sieve	10% Buffered Formalin in the field
Metal Contaminants	1 (composited sediment)	250 ml (8 oz) polypropylene jar	2/3 full	frozen
Organic Contaminants	1 (composited sediment)	250 ml (8 oz) glass jar	2/3 full	frozen
TOC	1 (composited sediment)	125 ml (4 oz) Polypropylene jar	2/3 full	frozen
% Silt/Clay & % Moisture	1 (composited sediment)	500 ml (16 oz) HDPE jar	2/3 full	frozen
Microtox	1 (composited sediment)	125 ml (4 oz) Glass jar	2/3 Full	Refrigerate
Water Column (Temp., D.O., pH, Sal., NTU)	1	N/A	Profile	N/A
Turbidity (NTU)	1 (water column - surface)	N/A	Hach Turbidimeter	N/A
Total Suspended Solids	1 (water column - surface)	47 mm preweighed filter pads	TSS retained on filter pad	frozen
Nutrients	1 (water column - surface)	60 ml HDPE containers	2/3 full	frozen
Chlorophyll a	1 (water column - surface)	25 mm filter pads	cells retained on pad	frozen
Microbial Contaminants	1 (water column - surface)	500 ml (16 oz) HDPE jar	full	Refrigerate
Fish Tissue	--	ziplock bag	Multiple specimens	frozen

Table 3. Summary by station of water column characteristics at 30 stations sampled within SINERR, June 2009.

	Surface Water					Bottom Water				
Station	Temp. (C)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Temp. (C)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)
1	27.2	19.9	3.3	7.1	12.2	27.1	20.1	3.4	7.2	22.4
2	26.9	19.3	3.6	7.2	7.7	26.6	19.4	3.5	7.2	16.5
3	27.5	20.4	4.1	7.3	5.4	27.5	20.7	3.7	7.3	17.3
4	28.3	21.1	4.5	7.4	6.9	27.7	21.9	4.1	7.4	25.9
5	27.5	19.3	3.3	7.2	10.2	27.2	19.3	3.1	7.1	28.5
6	28.2	20.1	4.9	7.4	5.2	27.9	20.8	4.0	7.3	13.2
7	28.0	20.6	3.8	7.2	5.3	27.8	20.6	3.6	7.2	10.8
8	28.2	19.6	2.3	7.1	6.2	28.0	19.7	2.3	7.1	8.7
9	27.1	19.3	3.1	7.2	8.2	27.0	19.6	3.1	7.2	10.2
10	27.4	20.5	3.7	7.2	7.7	27.2	20.5	3.5	7.2	10.5
11*	27.8	22.1	4.9	7.5	17.5	27.8	22.1	4.9	7.5	17.5
12	27.2	18.7	2.5	7.1	7.3	27.2	18.7	2.4	7.1	12.2
13	28.3	20.1	3.4	7.3	6.3	28.2	20.2	3.4	7.2	23.5
14	28.6	21.1	5.2	7.4	4.1	27.2	23.3	4.2	7.4	13.2
15	28.1	20.1	4.5	7.4	6.9	26.6	23.6	4.0	7.5	14.0
16	28.1	18.8	3.8	7.2	9.9	27.1	18.9	3.2	7.2	9.2
17	27.2	19.0	3.4	7.2	16.4	27.0	19.1	3.4	7.2	18.5
18	28.6	22.3	5.6	7.6	4.9	27.4	25.0	4.5	7.6	38.2
19	29.2	21.8	6.0	7.6	4.0	26.8	25.6	5.1	7.6	34.3
20	25.9	22.0	4.8	7.1	11.0	25.9	26.0	3.8	7.2	22.6
21	27.1	20.3	3.9	7.2	9.1	27.0	20.3	3.6	7.2	13.5
22	27.8	19.7	5.3	7.4	4.8	26.7	23.6	4.3	7.4	41.6
23	26.2	21.5	5.3	7.1	9.2	26.0	28.2	4.8	7.4	48.5
24	27.1	18.7	2.4	7.0	7.8	27.1	18.7	2.4	7.1	15.3
25	28.0	19.7	4.0	7.2	10.2	27.4	20.0	3.8	7.2	14.4
26	28.3	21.2	4.4	7.3	13.2	27.3	22.8	4.0	7.3	21.9
27	27.8	21.6	5.0	7.4	19.9	26.8	23.9	4.5	7.5	40.5
28	27.7	19.1	3.8	7.2	12.0	27.1	19.2	3.6	7.2	9.7
29	27.2	20.4	3.7	7.2	14.9	27.1	20.4	3.5	7.2	35.4
30	27.6	19.7	3.3	7.2	7.0	27.7	19.9	3.2	7.3	17.7
Mean	*27.7*	*20.3*	*4.1*	*7.3*	*9.0*	*27.2*	*21.4*	*3.7*	*7.3*	*20.9*

* - Station depth 1.0 m, surface and bottom water column characteristics the same.

Table 4. Summary by station of human-dimension indicators at 30 stations sampled within SINERR, June 2009.

Station	Surface Trash Present (Y/N)	Trash Description	Surface Oil Present (Y/N)	Other Vessels Present (Y/N)	Fishing Gear Present (Y/N)
1	N		N	N	Y
2	N		N	N	N
3	N		N	N	Y
4	N		N	N	N
5	N		N	N	Y
6	N		N	N	Y
7	N		N	N	N
8	N		N	N	N
9	N		N	N	Y
10	N		N	N	N
11	N		N	Y	Y
12	N		N	N	N
13	N		N	N	Y
14	N		N	Y	N
15	N		N	N	N
16	N		N	N	Y
17	N		N	N	Y
18	N		N	N	N
19	N		N	Y	N
20	N		N	N	N
21	N		N	N	Y
22	N		N	N	Y
23	N		N	N	N
24	N		N	Y	Y
25	N		N	N	Y
26	N		N	N	N
27	N		N	N	N
28	N		N	N	Y
29	N		N	Y	Y
30	N		N	N	Y

Table 5. Summary by station of fish collected at 30 stations sampled within SINERR, plus 4 supplementary stations in the Brunswick area, June 2009.

Station	Species	Number
SI09005	*Mugil cephalus*	2
SI09009	*M. cephalus*	1
SI09011	*Micropogonias undulatus*	1
	Cynoscion nebulosus	1
SI09012	*Paralichthys lethostigma*	1
SI09014	*C. nebulosus*	1
	Scianenops ocellatus	1
SI09017	*M. cephalus*	5
	C. nebulosus	1
	M. undulatus	1
SI09018	*Menticirrhus* spp.	1
SI09022	*M. undulatus*	1
SI09025	*M. cephalus*	3
	Bairdiella chrysoura	8
	S. ocellatus	1
BR09001	*M. undulatus*	1
	Menticirrihus spp.	1
	M. cephalus	7
BR09002	*M. cephalus*	8
BR09003	*M. cephalus*	1
BR09004	*M. cephalus*	2
	B. chrysoura	1

Table 6. SINERR June 2009 cruise participants.

Name	Affiliation
Cynthia Cooksey	NOAA/NOS/CCEHBR
JD Dubick	NOAA/NOS/CCEHBR
Mike Fulton	NOAA/NOS/CCEHBR
Jeff Hyland	NOAA/NOS/CCEHBR
Travis Washburn	NOAA/NOS/CCEHBR
Blaine West	NOAA/NOS/CCEHBR

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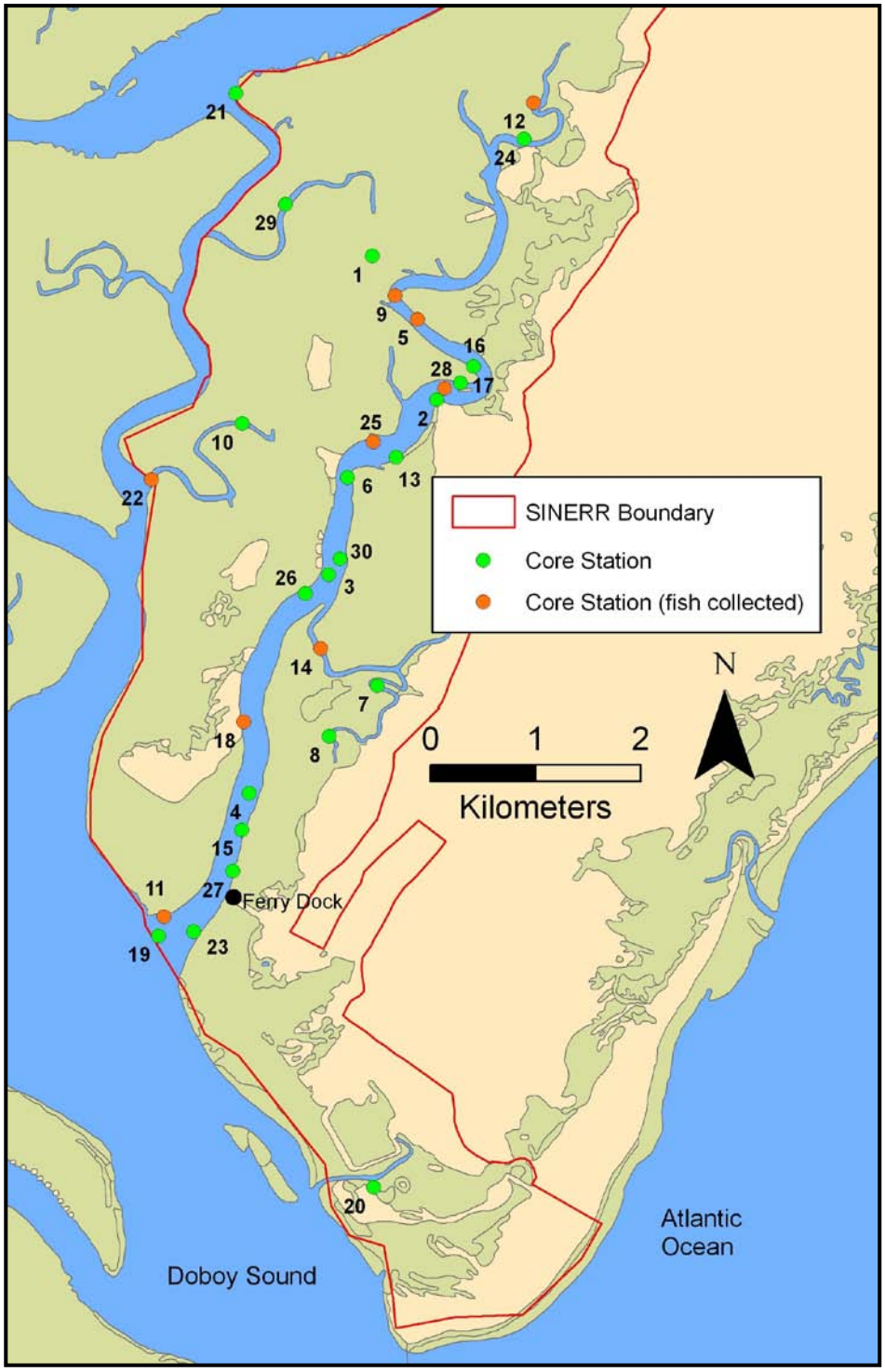
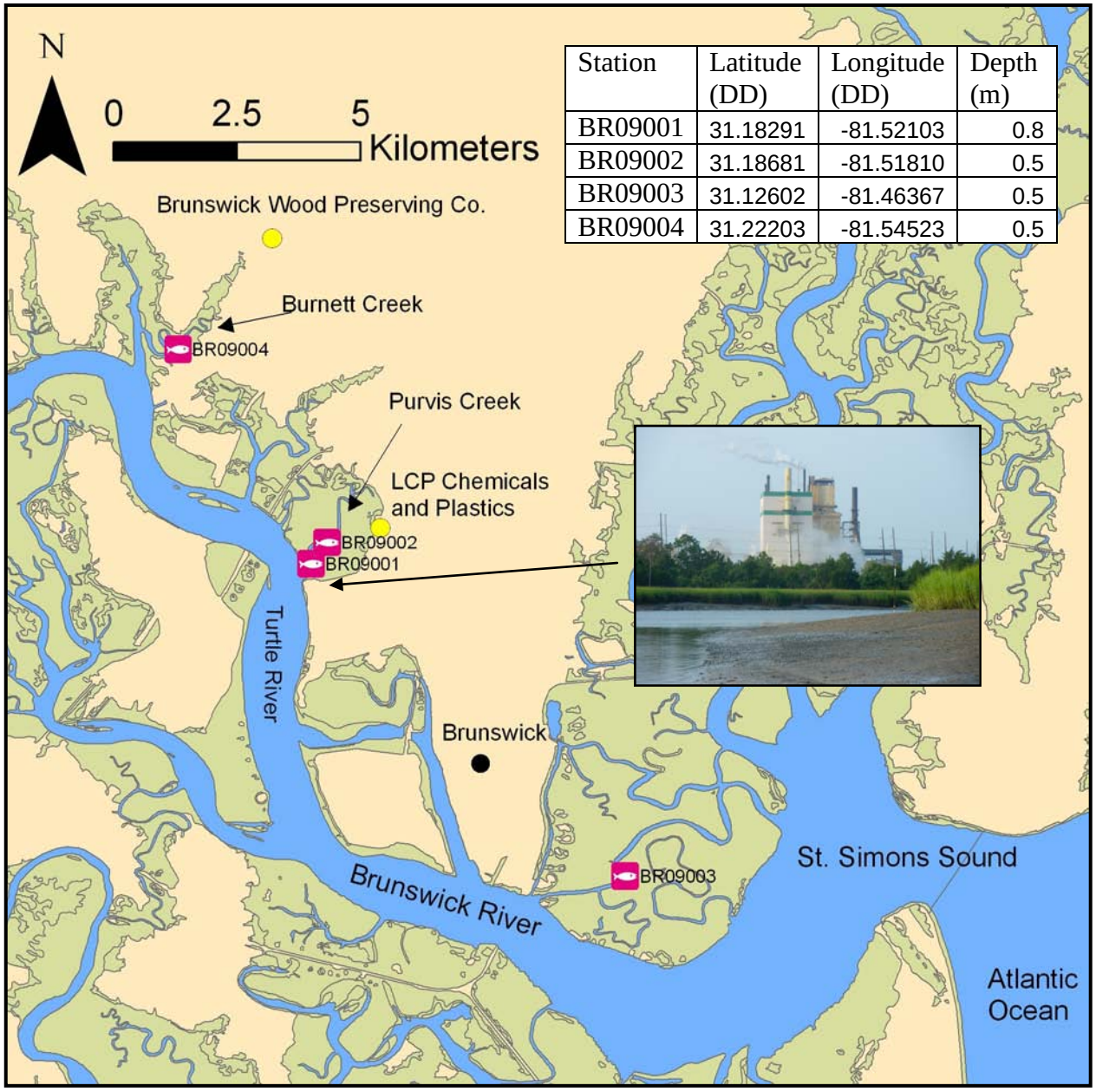


Figure 1. Study area and sampling sites for summer 2009 Sapelo Island National Estuarine Research Reserve Ecological Characterization. Green circles indicate stations where all indicators were sampled. Red circles indicate stations where all indicators were sampled and fish were collected. Fish collections were attempted at all stations.



Station	Latitude (DD)	Longitude (DD)	Depth (m)
BR09001	31.18291	-81.52103	0.8
BR09002	31.18681	-81.51810	0.5
BR09003	31.12602	-81.46367	0.5
BR09004	31.22203	-81.54523	0.5

Figure 2. Sampling area and collection sites for summer 2009 supplemental fish collections in the Brunswick area. Pink squares with fish symbols indicate stations where fish were collected. Fish collections were attempted throughout the Turtle River, Brunswick River, and St. Simons Sound areas June 28 - 30, 2009. Photo inset shows view from station BR09001.

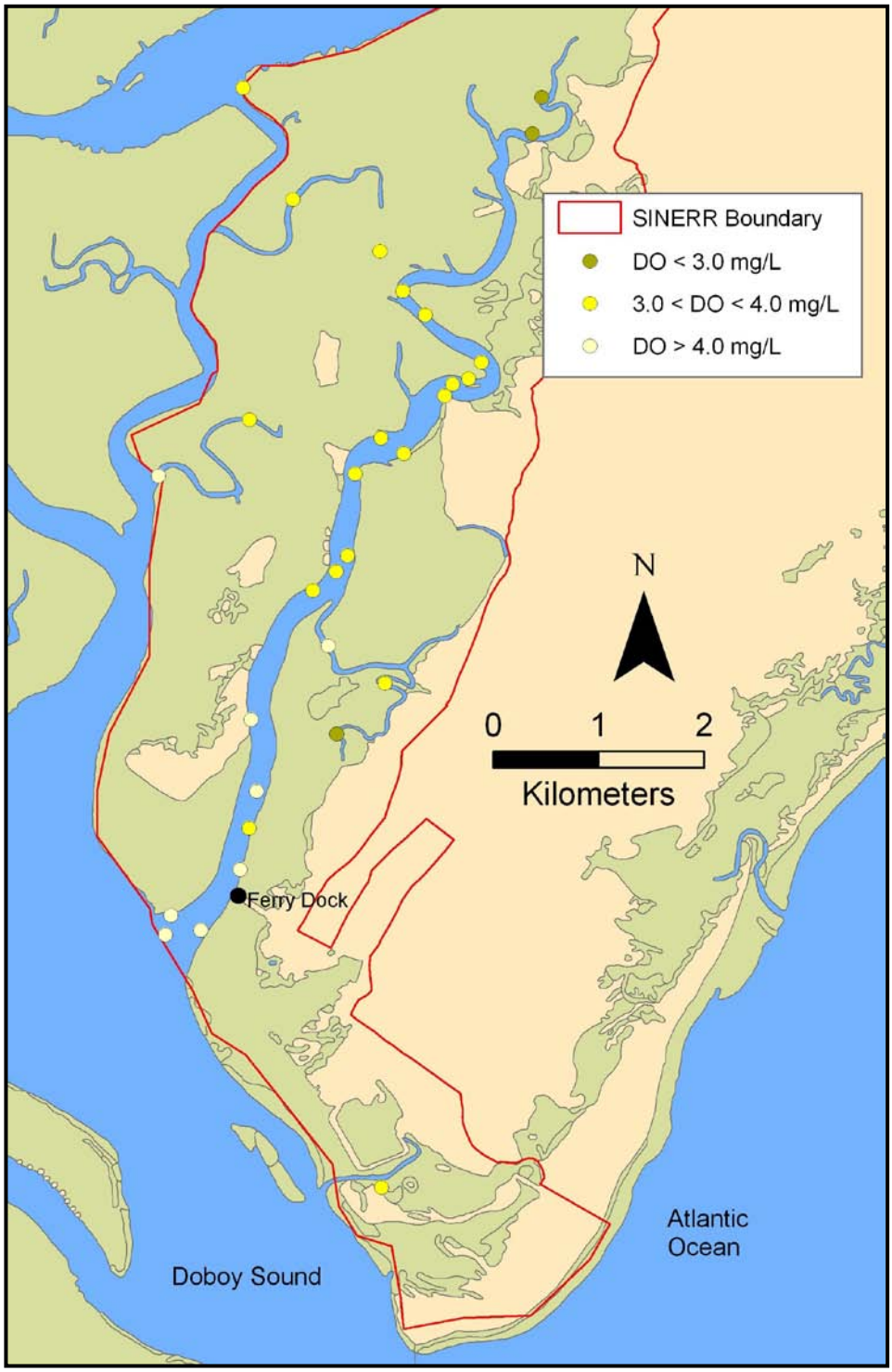


Figure 3. Distribution of bottom dissolved oxygen (mg/L) concentrations throughout the SINERR.

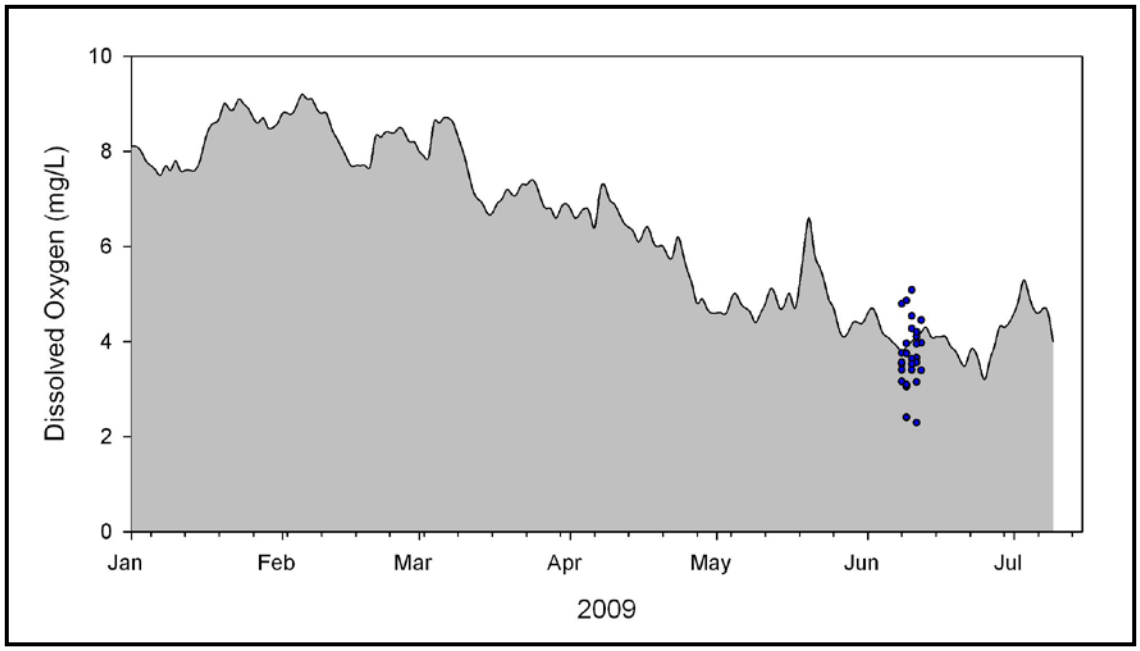


Figure 4. Comparison of bottom dissolved oxygen (mg/L) concentrations throughout the SINERR (blue circles) with daily bottom dissolved oxygen concentrations (gray area) measured at the Sapelo Island Ferry Dock SINERR water quality monitoring station in the lower Duplin River.

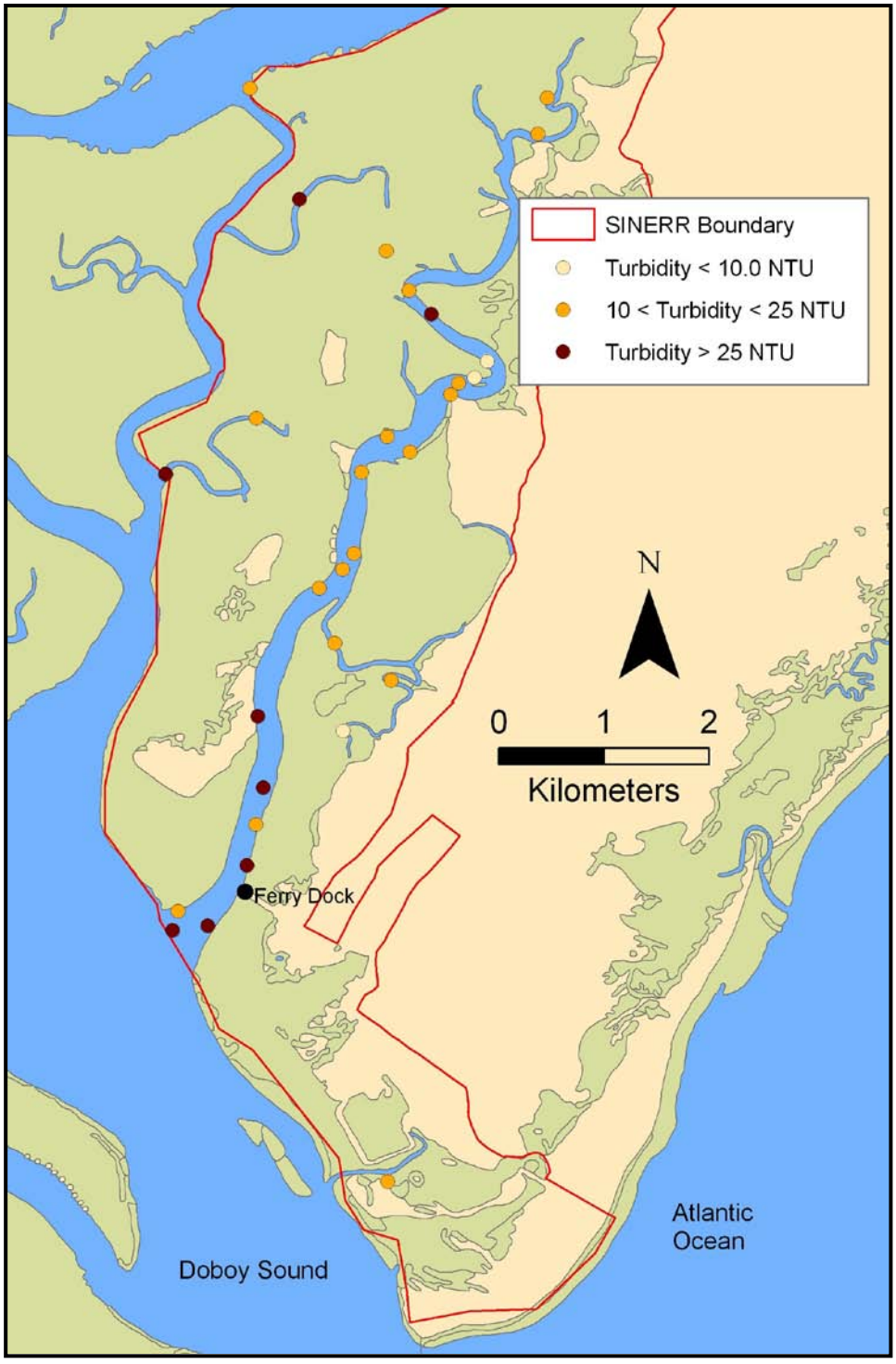


Figure 5. Distribution of bottom turbidity (NTU) concentrations throughout the SINERR.

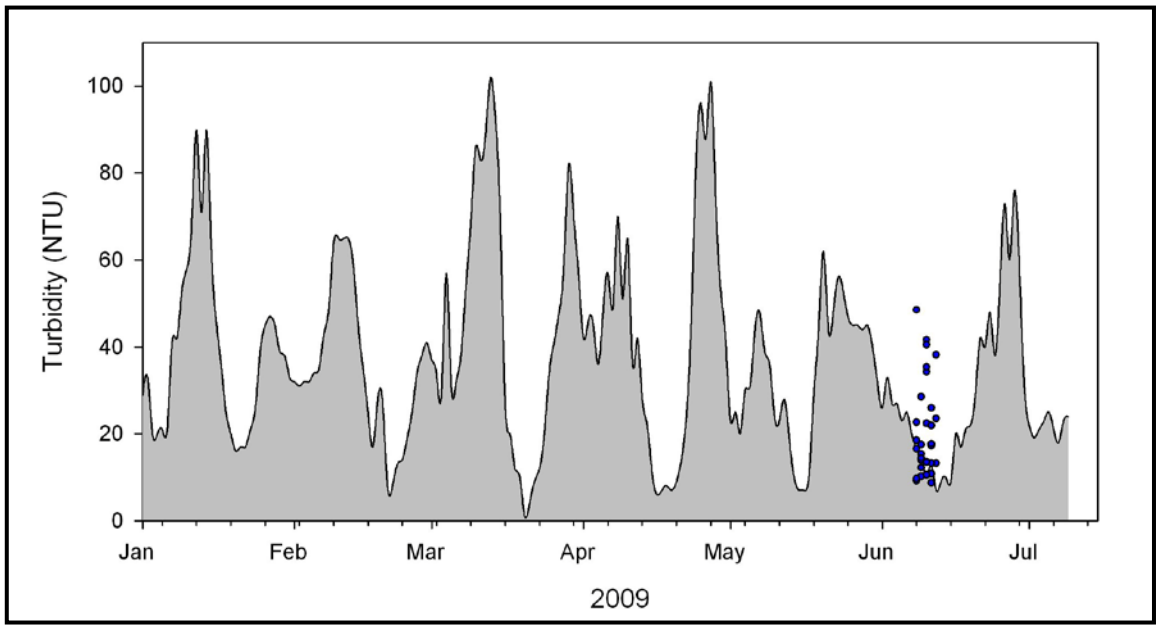


Figure 6. Comparison of bottom turbidity (NTU) concentrations throughout the SINERR (blue circles) with daily bottom turbidity concentrations (gray area) measured at the Sapelo Island Ferry Dock SINERR water quality monitoring station in the lower Duplin River.

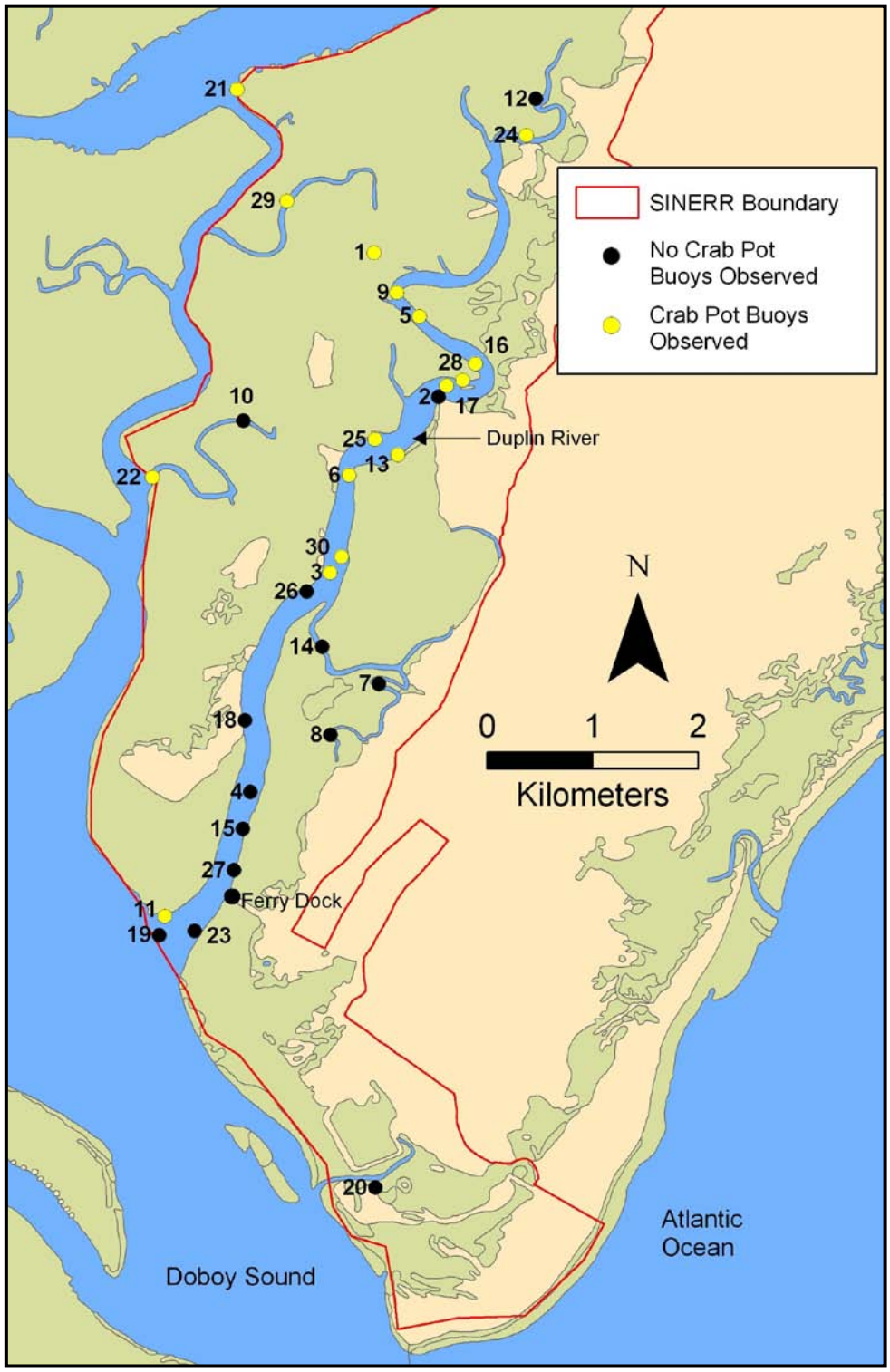


Figure 7. Station locations where crab pot buoys were observed (yellow circles) or not observed (black circles) during summer 2009 SINERR Ecological Characterization.

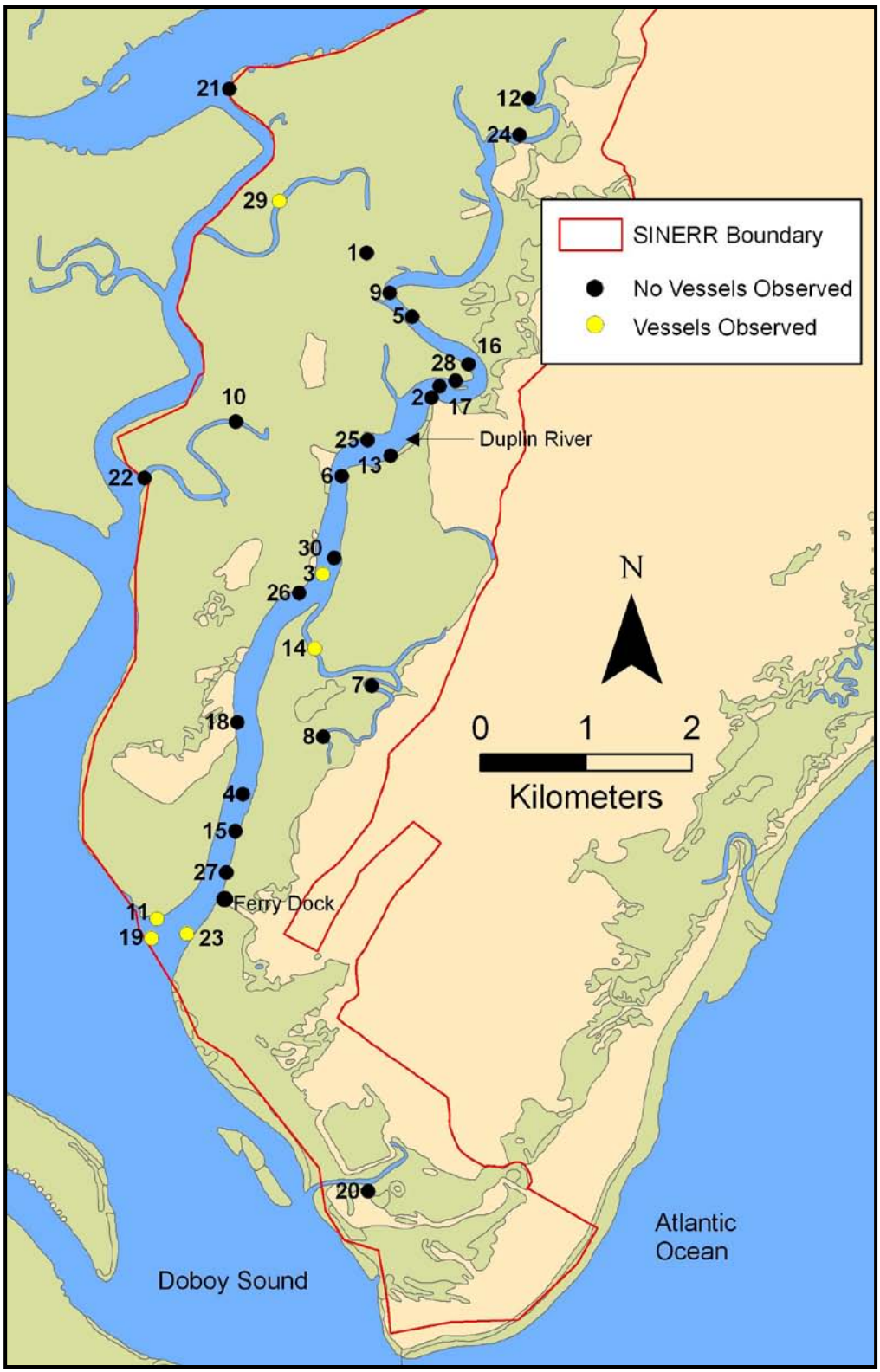


Figure 8. Station locations where vessels were observed (yellow circles) or not observed (black circles) during summer 2009 SINERR Ecological Characterization.

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