SHORELINE CHANGES IN THE NORTH CHANDELEUR ISLAND BARRIER ARC- 1887 TO 1996 ST BERNARD PARISH, LOUISIANA

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INTRODUCTION

The U.S. Geological Survey (USGS), in cooperation with the Coastal Research Laboratory in the Department of Geology and Geophysics at the University of New Orleans (UNO) and the Center for Coastal Energy and Environmental Resources at Louisiana State University (LSU), is investigating the processes of coastal erosion and wetland loss in Louisiana (Sallenger and others, 1987; Sallenger and Williams 1989; Penland and others, 1992). Building on the USGS Louisiana Barrier Island Study (Williams and others, 1992), this USGS Open-File Report depicts shoreline changes between 1855 and 1996, which provides an 7.9 year update of McBride and others (1992). In order to quantify shoreline changes since 1989, new vertical aerial mapping photography was acquired on December 9, 1996. The methods and transects used by McBride and others (1992) were used to insure data compatibility of the new measurements and analysis. Tables 1 and 2 presents the transect measurements of shoreline change for the North Chandeleur Islands. For gulfside change measurements, a negative (-) sign signifies landward movement or erosion and a positive (+) sign signifies a seaward movement or progradation. For bayside change measurements, a negative (-) sign signifies a seaward movement or erosion and a positive (+) sign signifies a landward movement or accretion.

The northern Chandeleur Island arc is located approximately 120km east of New Orleans (Figure 1). This barrier island shoreline is nearly 40km long and represents a flanking barrier island system developed from the reworking and erosion of an abandoned distributary of the St, Bernard delta complex within the Mississippi River delta plain. This large, arcuate shaped barrier island possesses a smooth gulf shoreline, while the bay shoreline is crenulate and dominated by washover fans and ebb-tidal deltas. At the northern end lies Hewes Point, a large recurved spit complex, and the terminus of longshore sediment transport for the northern half of the barrier island arc (McBride and others, 1992). Redfish Point and Monkey Bayou, along the bay shoreline, are possibly relic distributary systems of the St. Bernard delta. The northern Chandeleur Islands' evolution is predominately driven by longshore sediment transport and storm overwash, causing the island arc to slowly migrate to the west while gradually losing total area. In 1855, North Chandeleur Island was generally continuous except for breaches along the north-central section of the gulf shoreline. By the 1950's, most of the island's breaches healed and the total area was slowly increasing (McBride and others, 1992). In August of 1969, the Chandeleur Islands were devastated by Hurricane Camille; a category 5

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hurricane which produced wind speeds of 190-200 mph and a storm surge exceeding 20 feet. This extreme natural disaster caused extensive erosion and extreme morphologic changes in the Chandeleur Islands, making the arc more susceptible to subsequent storm events. By 1978, the breaches caused by Camille had healed. With the exception of indirect impacts of Hurricane Frederic (1979) and Hurricanes Elena and Juan (1985), the North Chandeleur Islands were spared any major weather events allowing the island arc to enter a period of reduced transgression and area loss.

SHORELINE MOVEMENT

The magnitude and rate of change for the North Chandeleur Islands were derived from 172 shore-normal transects along the gulf and bay shorelines (Transect Map, Tables 1&2). Comparisons of shoreline positions are made for the periods 1855 vs. 1989, 1989 vs. 1996, and 1855 vs. 1996. The overlay maps illustrate land loss and quantitative changes for the northern Chandeleur Islands.

GULFSIDE SHORELINE CHANGES

For the 141 year period between 1855 and 1996, long-term gulf shoreline transects for the Northern Chandeleur Islands measured between –36m and –2486m (Table 1, 1885-1996). The average shoreline change was determined to be –910.3m, which equals a rate of –6.5m/yr. (Table 3). Separating the Northern Chandeleur arc at its most stable point (Table 1, 1855-1996, transect 53-86) (Latitude 29:55:15), dramatically different erosion rates can be observed between the northern and southern areas. The southern region's gulf shoreline is eroding 2.7 times faster than the gulf shoreline of the northern region. The long-term shoreline movement rate for the southern area is –8.6m/yr (Table 1, 1855-1996, transects 1- 52). This demonstrates a –5.4m/yr. change over the northern area's shoreline movement rate of –3.2m/yr (Table 1, 1855-1996, transects 53-86) (Table 3). The long-term average rate variation between the northern and southern portions is a result the longshore sediment transport acting primarily on the northern third of the barrier island arc.

In terms of the short-term shoreline change history for the 7.9 year period between 1989 and 1996, the 4 northern Chandeleur Islands' barrier arc transects measured between 108m and –317m (Table 1, 1989- 1996). Overall, the islands experienced an average short-term gulfside shoreline movement of –48.0m at a rate of –6.1m/yr. (Table 3). Comparing the yearly shoreline movement rates of the northern and southern regions of the north Chandeleur Islands, the southern region's shoreline is eroding over five times faster than its northern shoreline. Between the years 1989 and 1996, the southern shoreline (Table 1, 1989-1996, transects 1-52) (Table 3) experienced a –8.9m/yr. rate of movement compared to a –1.7m/yr. rate of the northern shoreline (Table 1, 1989-1996, transects 53-86) (Table 3).

Previous work by McBride and others (1992) documented long-term shoreline change between years 1855 and 1989 (134 years) and short-term shoreline change between years 1978 and 1989 (11 years). This earlier analysis reported a long-term gulf shoreline change rate of –6.6m/yr., and a short-term change rate of –12.2m/yr. (Table 3). A

comparison between the new long-term shoreline change rate and the McBride and others (1992) long-term change rate show no variation; remaining at –6.5m/yr. (Table 3). A short-term rate comparison between this study and the previous analysis exhibits much different results. Between 1989 and 1996, a short-term rate was calculated to be –6.1m/yr, (Table 3). McBride and others (1992) calculated a short-term rate of –12.2m/yr. (Table 3) between 1978 and 1989. The short-term rate of the previous study was twice that of the current study possibly due to the impact of Hurricane Frederic in 1979 and Hurricanes Elena and Juan in 1985.

BAYSIDE SHORELINE CHANGES

Like the gulf shoreline, the bay shoreline of the North Chandeleur Islands is migrating landward. This 5 migration landward is primarily in response to washover deposition associated with extratropical and tropical storms (McBride and others, 1992). The long-term bay shoreline change history for the 141 year period between 1855 and 1996 measured migration between 1846m and –208m (Table 2, 1855-1996). The average change for the North Chandeleur Islands' bay shoreline was 414.7m at an average landward rate of +2.9m/yr. (Table 4). The years between 1989 and 1996 saw a relatively calm period of meteorological events over the North Chandeleur Barrier Island arc. For the 7.9 years of the short-term analysis, the bay shoreline experienced landward movement between 363m and – 109m (Table 2, 1989-1996). The average rate of 17.4m yielded a bay shoreline rate of 2.2m/yr. (Table 4).

McBride and others (1992) studied long-term change rates between 1855 and 1989 (134 years) and shortterm rates between 1978 and 1989 (11 years). In the earlier study, long-term bay shoreline change rate for North Chandeleur was determined to be 2.9m/yr., and short-term change rate was found to be 5.3m/yr. A comparison between the new long-term shoreline change rate, and the McBride and others (1992) longterm change rate exhibits no variation. In both studies, the rate was 2.9m/yr. The short-term rate comparison between the two studies reveals a 3.1m/yr. difference. Increased hurricane activity between 1978 and 1989 caused a landward migration of the bay shoreline at a rate of 5.3m/yr. (Table 4). In contrast, a decrease in storm activity between 1989 and 1996 reduced shoreline migration to a rate of 2.2m/yr. (Table 4).

AREA CHANGES

The North Chandeleur Island's area is decreasing at a slower rate compared to other barrier islands along the Louisiana coast (McBride and others, 1992). Chandeleur Island is a trasgressive barrier arc which is slowly migrating to the west as a result of storm overwash. However, the gulf shoreline is migrating landward at a rate nearly twice that of its bay shoreline resulting in an overall loss of island area. In terms of the long-term area change between 1855 and 1996, Chandeleur Island lost 37% of its area when it shrank from 6828 acres to 4333 acres (Table 5). This equals an area change rate of –17.7 acres/yr. resulting in a calculated disappearance date of 2241 (Table 6). McBride and others (1992) assessed a long-term area change rate of –18.7 acres/yr. and forecasted a disappearance date of 2220 (Table 6). The seemingly minor decline in area loss, (1.0

acres/yr.) between the two studies, extends the life of Chandeleur Island by 21 years.

For the 7.9 year period between 1989 and 1996, Chandeleur Island increased in area 0.2%, from 4322 acres to 4333 acres (Table 5). This statistically negligible increase of 1.4 acres/yr. (Table 6) indicates the island was experiencing a period of equilibrium between 1989 and 1996 possibly due to the lack of major storm activity. This is in stark comparison to the earlier study (McBride and others, 1992) in which a shortterm loss rate of –10.5 acres/yr. was documented for the years between 1978 and 1989 (Table 6). Acting on the area of Chandeleur Island in 1989, McBride and others (1992) predicted a disappearance date of 2401 (Table 6). These calculations, however, are most likely exaggerated by the impact of Hurricane Frederic in 1979 and Hurricanes Elena and Juan in 1985.

ACKNOWLEDGEMENTS

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DISCLAIMER

This poster is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards (and stratigraphic nomenclature). Any use of trade names is for descriptive purposes only and does not imply endorsement by the USGS.

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FIGURES

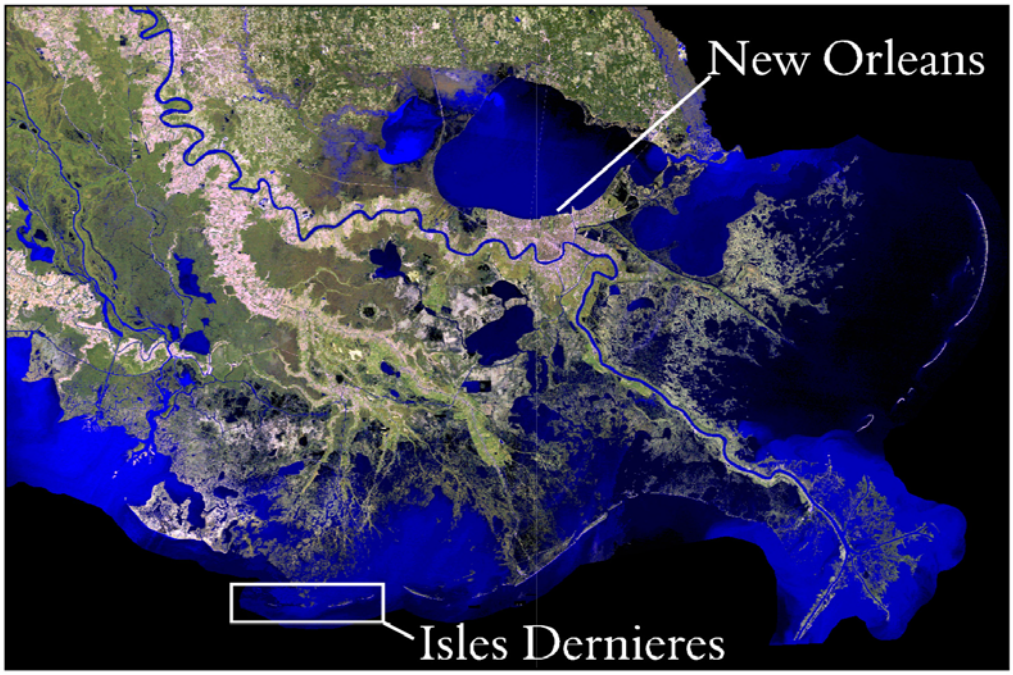
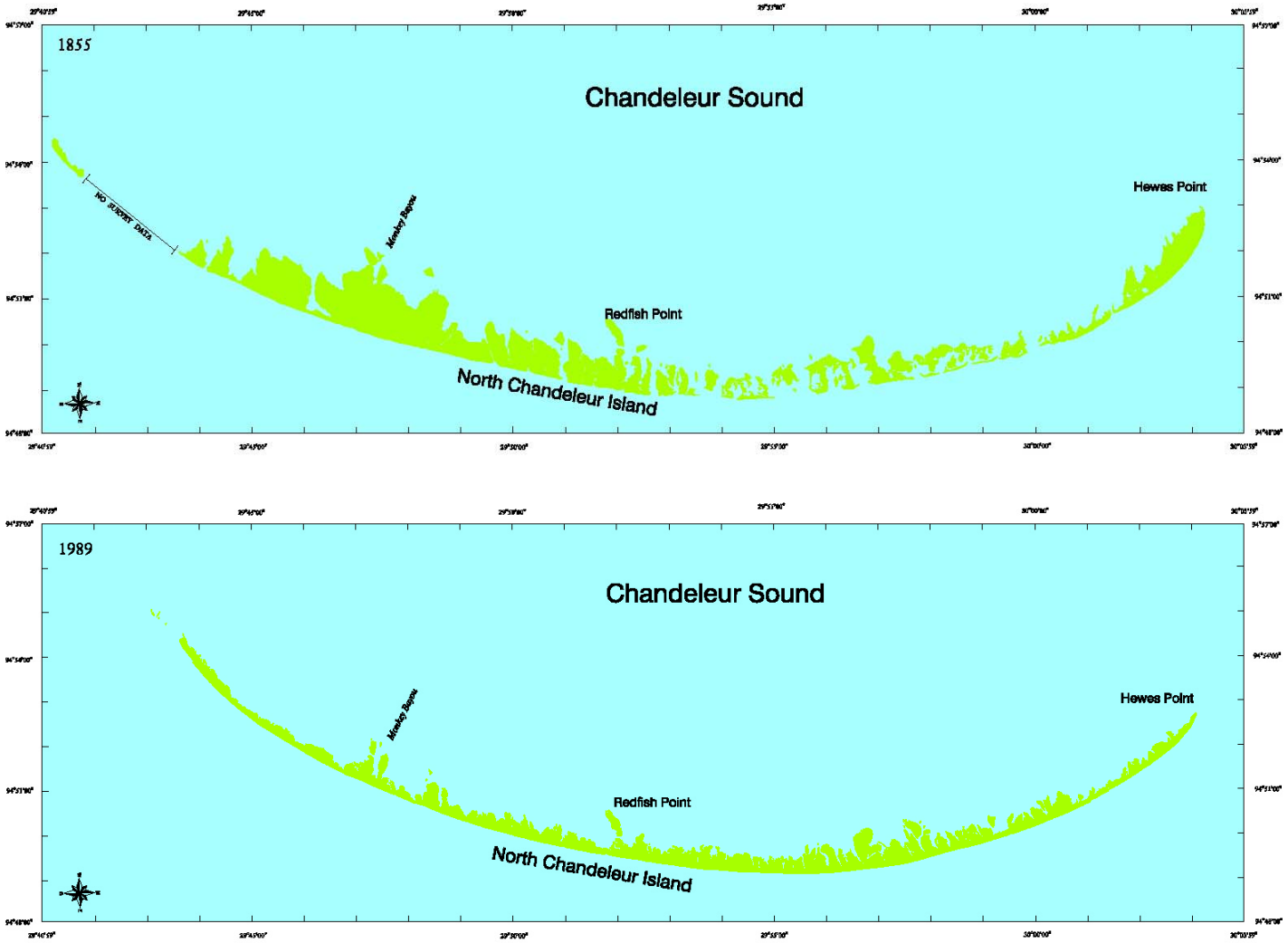
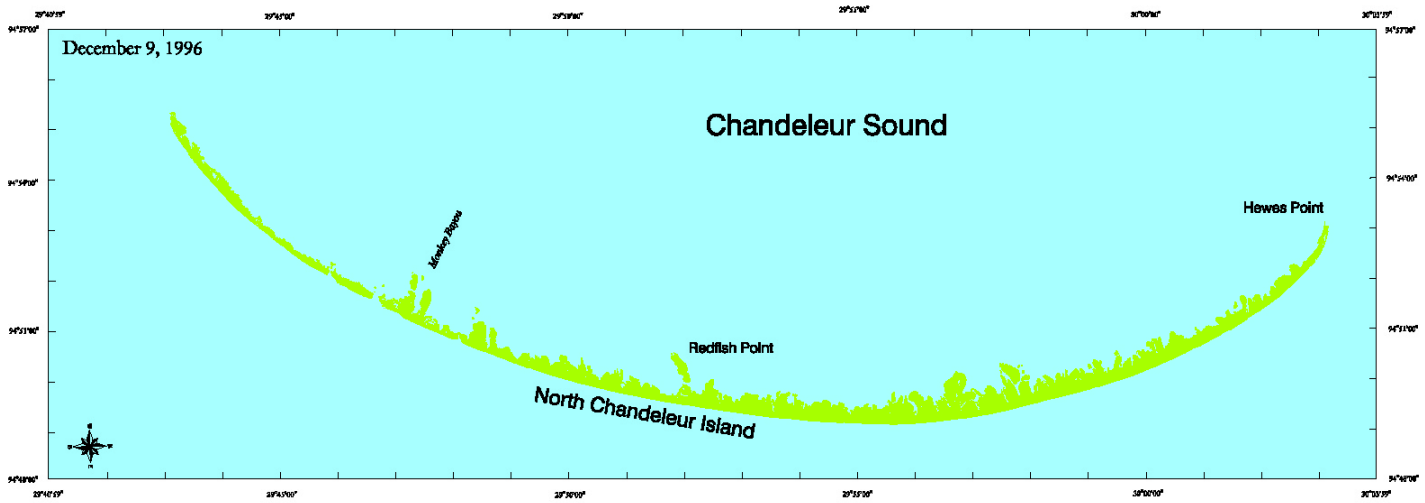
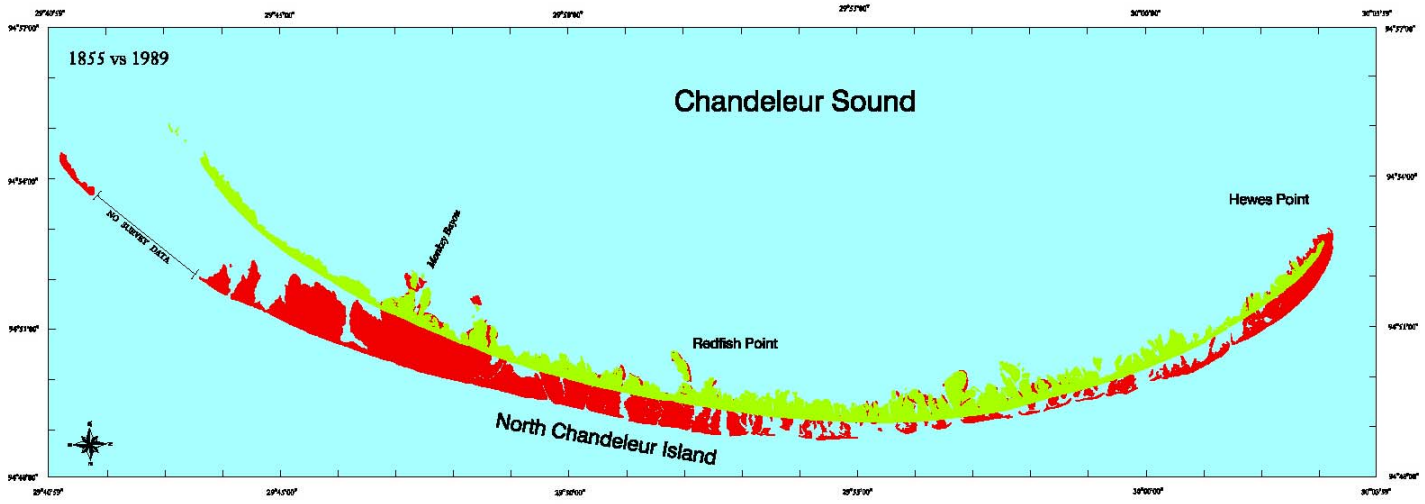


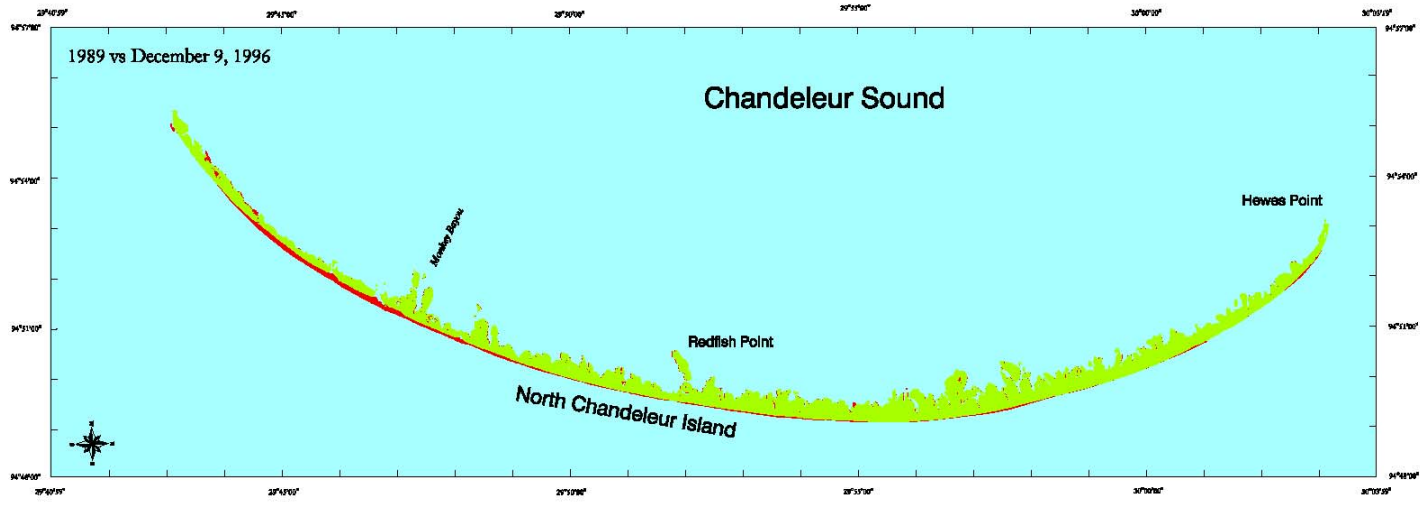
Figure 1.
The Isles Dernieres barrier island arc located 120 km southwest of New Orleans.

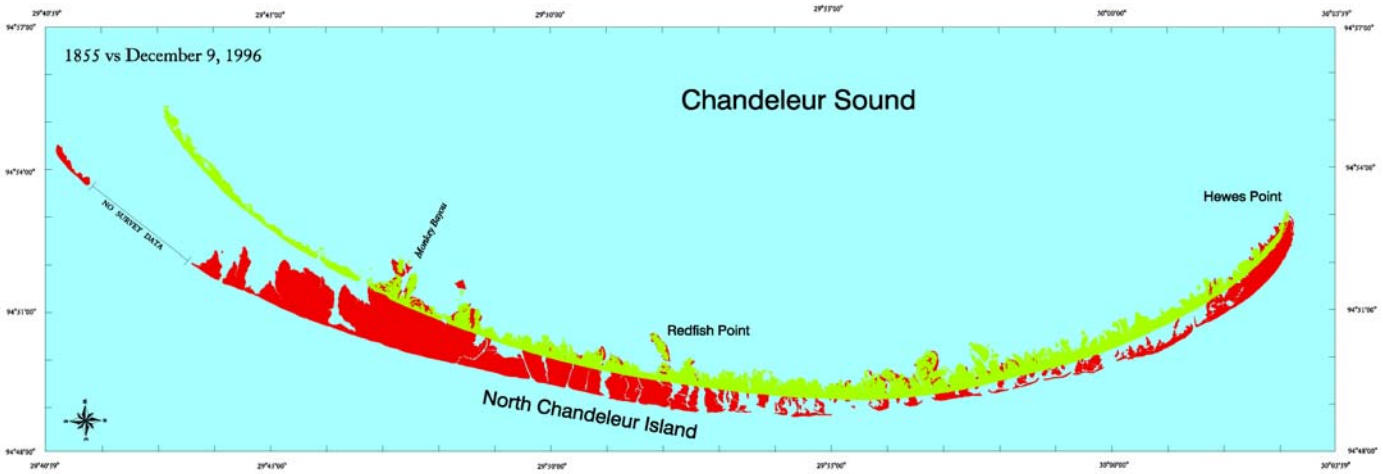
MAPS

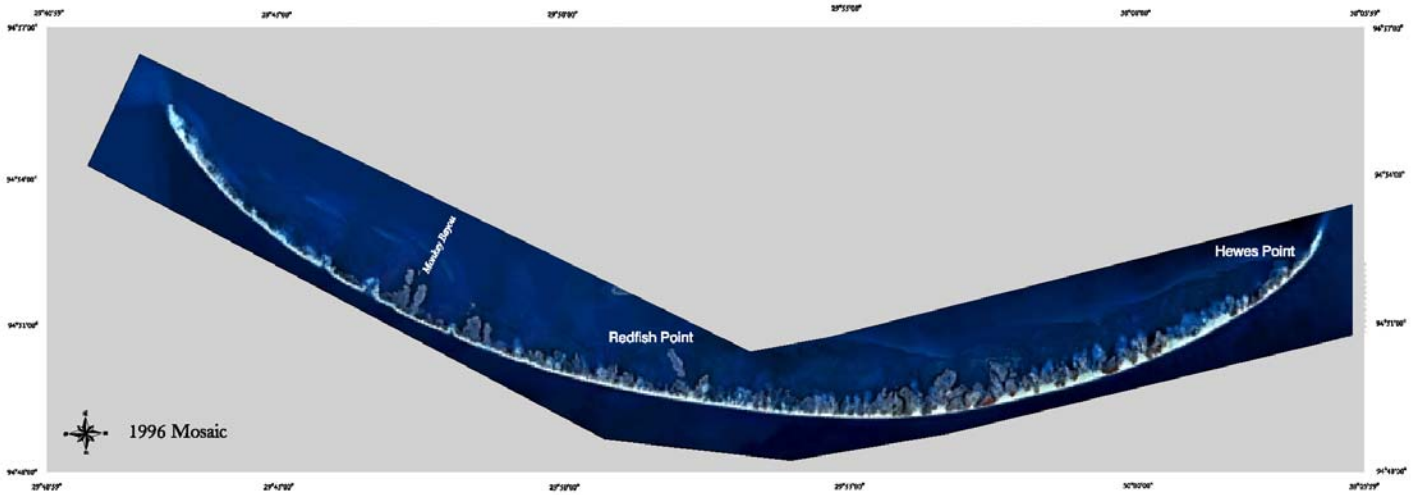

1855
Chandeleur Sound
NO SURVEY DATA
Monkey Bayou
Hewes Point
Redfish Point
North Chandeleur Island
1989
Chandeleur Sound
Monkey Bayou
Hewes Point
Redfish Point
North Chandeleur Island

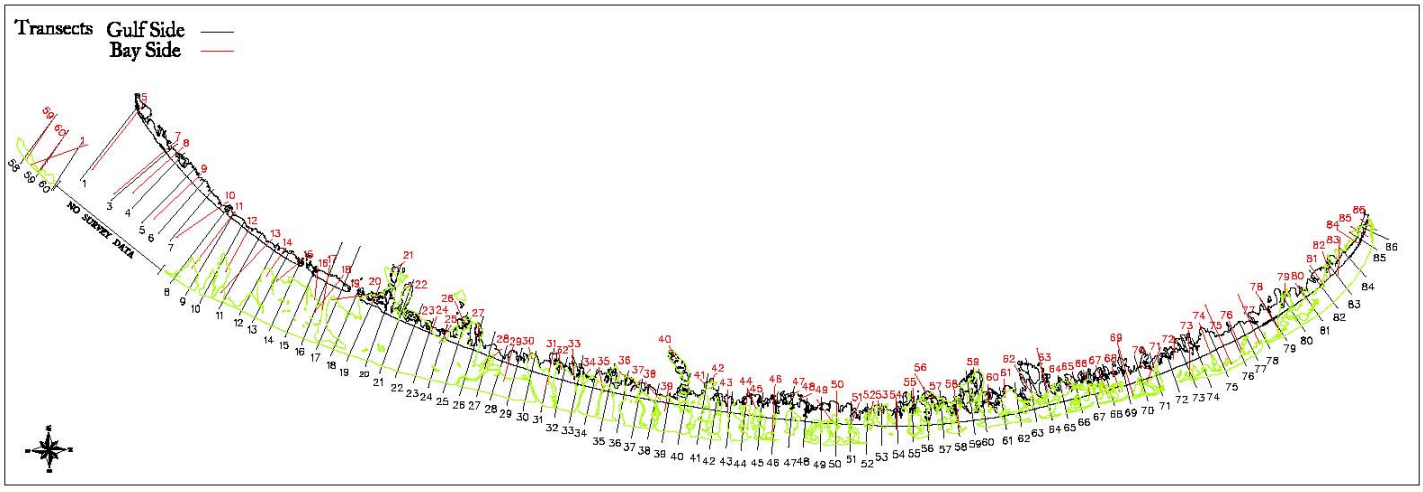

December 9, 1996
Chandeleur Sound
Hewes Point
Monkey Bayou
Redfish Point
North Chandeleur Island


1855 vs 1989
Chandeleur Sound
NO SURVEY DATA
Hewes Point
Monkey Bayou
Redfish Point
North Chandeleur Island


1989 vs December 9, 1996
Chandeleur Sound
Hewes Point
Monkey Bayou
Redfish Point
North Chandeleur Island


1855 vs December 9, 1996
Chandeleur Sound
NO SURVEY DATA
Mosley Bayou
Redfish Point
North Chandeleur Island
Hewes Point


Mosley Bayou
Redfish Point
Hewes Point
1996 Mosaic


Transects
Gulf Side
Bay Side
NO SURVEY DATA

TABLES

Table 1

North Chandeleur Islands gulfside magnitude of change (meters)					
1855 - 1989		1989 - 1996		1855 - 1996	
1	n.a.	1	-127	1	n.a.
2	n.a.	2	n.a.	2	n.a.
3	n.a.	3	108	3	n.a.
4	n.a.	4	56	4	n.a.
5	n.a.	5	-23	5	n.a.
6	n.a.	6	-42	6	n.a.
7	n.a.	7	-62	7	n.a.
8	-2368	8	-118	8	-2486
9	-2319	9	-132	9	-2454
10	-2229	10	-148	10	-2375
11	-1999	11	-158	11	-2154
12	-1924	12	-125	12	-2050
13	-1888	13	-124	13	-2010
14	-1841	14	-165	14	-2003
15	-1785	15	-112	15	-1896
16	-1684	16	-140	16	-1825
17	-1596	17	-168	17	-1760
18	-1534	18	-317	18	-1851
19	-1486	19	-159	19	-1644
20	-1433	20	-78	20	-1511
21	-1397	21	-82	21	-1478
22	-1362	22	-78	22	-1441
23	-1277	23	-80	23	-1356
24	-1207	24	-189	24	-1394
25	-1164	25	-87	25	-1213
26	-1070	26	-87	26	-1158
27	-1013	27	-75	27	-1088
28	-971	28	-58	28	-1030
29	-958	29	-53	29	-1010
30	-880	30	-49	30	-929
31	-848	31	-25	31	-872
32	-835	32	-32	32	-866
33	-820	33	-36	33	-855
34	-803	34	-32	34	-833
35	-811	35	-23	35	-834
36	-517	36	-30	36	-545
37	-852	37	-34	37	-884
38	-831	38	-30	38	-858
39	-859	39	9	39	-852
40	-805	40	-40	40	-844

Table 2

North Chandeleur Islands bayside magnitude of change (meters)					
1855 - 1989		1989 - 1996		1855 - 1996	
1	n.a.	1	n.a.	1	n.a.
2	n.a.	2	n.a.	2	n.a.
3	n.a.	3	n.a.	3	n.a.
4	n.a.	4	n.a.	4	n.a.
5	n.a.	5	363	5	n.a.
6	n.a.	6	n.a.	6	n.a.
7	n.a.	7	-109	7	n.a.
8	n.a.	8	9	8	n.a.
9	n.a.	9	-27	9	n.a.
10	n.a.	10	-100	10	n.a.
11	1861	11	51	11	1670
12	1282	12	34	12	1316
13	2008	13	-16	13	1846
14	775	14	3	14	551
15	850	15	59	15	717
16	809	16	0	16	613
17	1174	17	-12	17	933
18	903	18	-7	18	652
19	545	19	n.a.	19	884
20	61	20	-7	20	54
21	198	21	1	21	200
22	173	22	14	22	185
23	-38	23	7	23	-33
24	74	24	6	24	79
25	295	25	10	25	307
26	93	26	9	26	101
27	13	27	0	27	-13
28	232	28	-2	28	229
29	815	29	6	29	821
30	36	30	-2	30	35
31	558	31	11	31	573
32	91	32	15	32	106
33	608	33	3	33	606
34	-9	34	9	34	-1
35	365	35	0	35	366
36	4	36	-8	36	-4
37	-102	37	6	37	-97
38	512	38	4	38	518
39	2	39	14	39	17
40	26	40	0	40	26

41	-831	41	-24	41	-854		41	39	41	-16	41	23
42	-831	42	-37	42	-868		42	110	42	18	42	126
43	-525	43	-47	43	-572		43	440	43	-9	43	431
44	-734	44	-37	44	-769		44	400	44	-26	44	377
45	-615	45	-40	45	-654		45	492	45	-29	45	463
46	-618	46	-47	46	-662		46	900	46	0	46	1030
47	-372	47	-46	47	-417		47	n.a.	47	33	47	n.a.
48	n.a.	48	-35	48	n.a.		48	n.a.	48	2	48	n.a.
49	n.a.	49	-30	49	-198		49	637	49	-4	49	633
50	-593	50	-29	50	-622		50	404	50	31	50	433
51	-546	51	-31	51	-577		51	411	51	-14	51	334
52	-520	52	-33	52	-552		52	68	52	-17	52	51
53	-22	53	-14	53	-36		53	36	53	-3	53	33
54	n.a.	54	-10	54	n.a.		54	524	54	-3	54	n.a.
55	-303	55	-4	55	-306		55	193	55	6	55	200
56	-287	56	-11	56	-299		56	116	56	-2	56	115
57	n.a.	57	-13	57	n.a.		57	-86	57	18	57	n.a.
58	-300	58	-13	58	-314		58	n.a.	58	-7	58	720
59	n.a.	59	-16	59	n.a.		59	31	59	4	59	38
60	-224	60	-25	60	-249		60	464	60	10	60	526
61	-196	61	-40	61	-238		61	222	61	-4	61	219
62	-215	62	-52	62	-266		62	721	62	-1	62	719
63		63	-51	63			63	509	63	-4	63	646
64	-326	64	-38	64	-363		64	-117	64	-11	64	-127
65	-347	65	-24	65	-372		65	-147	65	40	65	145
66	-353	66	-10	66	-365		66	148	66	-2	66	144
67	n.a.	67	-13	67	n.a.		67	418	67	8	67	425
68	-355	68	-16	68	-371		68	354	68	8	68	359
69	-328	69	6	69	-321		69	568	69	-12	69	1180
70	-477	70	9	70	-464		70	436	70	47	70	483
71	-517	71	5	71	-511		71	869	71	15	71	855
72	n.a.	72	-8	72	n.a.		72	n.a.	72	-13	72	n.a.
73	-539	73	2	73	-536		73	1309	73	-5	73	1301
74	-615	74	-13	74	-630		74	899	74	1	74	900
75	-688	75	-23	75	-711		75	644	75	201	75	845
76	-647	76	-33	76	-680		76	457	76	264	76	721
77	-666	77	-7	77	-672		77	612	77	115	77	727
78	-545	78	-3	78	-551		78	551	78	125	78	677
79	-622	79	32	79	-591		79	41	79	0	79	41
80	-630	80	3	80	-628		80	144	80	9	80	153
81	-655	81	13	81	-641		81	389	81	2	81	391
82	-621	82	-14	82	-633		82	-71	82	-5	82	-76
83	-555	83	-42	83	-597		83	-264	83	56	83	-208
84	-472	84	-43	84	-516		84	-104	84	58	84	-47
85	-367	85	12	85	-355		85	-158	85	149	85	-9
86	n.a.	86	n.a.	86	-223		86	n.a.	86	n.a.	86	191

Table 3: Average Gulfside Erosion Rates for the North Chandeleur Islands: 1855 – 1996

Years	Average Gulfside Erosion Rates (m/yr)		North Chandeleur Island Arc
	Northern Region	Southern Region	
Previous Analysis[1] 1978 - 1989 (short-term)	0	0	0
1855 - 1988 (long-term)	-8.6	-3.3	-6.5
New Analysis[2] 1989 - 1996 (short-term)	-8.9	-1.7	-6.1
1855 - 1996 (long-term)	-8.6	-3.2	-6.5

[1] McBride and others (1992)
[2] This USGS Open-File Report

Table 4: Average Bayside Erosion Rates for the North Chandeleur Islands: 1855 – 1996

Years	Average Bayside Erosion Rates (m/yr)
	North Chandeleur Island Arc
Previous Analysis[1] 1978 - 1989 (short-term)	5.3
1855 - 1988 (long-term)	2.9
New Analysis[2] 1989 - 1996 (short-term)	2.2
1855 - 1996 (long-term)	2.9

[1] McBride and others (1992)
[2] This USGS Open-File Report

Table 5: North Chandeleur Islands Area Mesaurements (acres)

	Previous[1]			Update[2]
	1855	1978	1989	Dec 1996
North Chandeleur Islands	6828	4438	4322	4333

[1] McBride and others (1992)
[2] This USGS Open-File Report