

HURRICANE ANDREW IMPACT ON THE ISLES DERNIERES BARRIER ISLAND ARC TERREBONNE PARISH, LOUISIANA

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INTRODUCTION

The U.S. Geological Survey (USGS), in cooperation with 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). In 1992 Hurricane Andrew struck coastal Louisiana causing extensive barrier island erosion and wetland loss (Stone and Finkl, 1995). Building on the USGS Louisiana Barrier Island Study (Williams and others, 1992), this USGS Open-File Report depicts the Hurricane Andrew damages to the Isles Dernieres in Terrebonne Parish, Louisiana (figure 1). The objective is to compare and contrast the impact of Hurricane Andrew with previously published data on the long-term (1887-1988) and short-term (1978-1988) erosion of the Isles Dernieres (McBride and others, 1989 and 1992).

The Isles Dernieres are located about 120 km southwest of New Orleans (Figure 2). This barrier island shoreline is 32 km long and extends from Caillou Bay east to Wine Island Pass. The Isles Dernieres represent a barrier island arc developed from the reworking and erosion of an abandoned distributary of the Lafourche delta complex within the Mississippi River delta plain (Penland and others, 1988). Previous work by McBride and others (1992) documented a longterm (1887-1988) gulfside erosion rate of -11.1 m/yr and a short-term (1978-1988) gulfside side erosion rate of -19.2 m/yr. The long-term bayside (1906-1988) erosion rate was measured at -0.6 m/yr and the shore-term (1978-1988) bayside erosion rate was measure at -5.2 m/yr. In terms of area loss, the Isles Dernieres decreased in area at a rate of -28.2 ha/yr between 1887 and 1988 suggesting the long-term date of disappearance would be 2015. The rate of area loss between 1978 and 1988 was measured at -47.2 ha/yr suggesting a short-term disappearance date of 2004. In this Hurricane Andrew impact assessment, the authors used the methods and transects used by McBride and others (1992) to insure data compatibility of the new measurements and analysis. Table 1 presents the transect measurements of shoreline change for the Isles Dernieres. A gulfside measurement followed by a w indicates that the width of the island was destroyed by erosion and the measurement is of the width lost. A gulfside measurement followed by an s indicates that the shoreline is still in existence but has change position and the measurement is of this change. For gulfside change measurements, a negative (-) sign signifies landward movement or erosion and a positive (+) sign signifies a seaward movement or accretion. For bayside change measurements, a

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HURRICANE ANDREW

Hurricane Andrew developed from an easterly wave which moved off the west coast of Africa into the Atlantic Ocean on August 14, 1992 (Rappaport, 1994). It developed into a tropical storm on August 17, 1992 approximately 1500 miles east of the Lesser Antilles and moved westnorthwest for four days with little change in intensity. It gradually strengthened to be classed a Saffir/Simpson Category One hurricane (minimal strength) on August 22, becoming a Category Five hurricane by the afternoon of August 23 with sustained winds of 67 m/s, gusts to 82 m/s. Hurricane Andrew made its first U.S. landfall in southern Dade County, Florida at approximately 5:30 a.m. EDT on August 24 with sustained winds of 63 m/s, gusts to 73 m/s. The eye of the hurricane was over southern Florida for only 4 hours. Hurricane Andrew then entered the Gulf of Mexico on August 24, and regained its intensity to a Category Four hurricane. The eye of Hurricane Andrew passed just west of the Isles Dernieres around 9:00 pm on August 25, 1992, Point au Fer Island near midnight, and made official landfall in Louisiana as a Category Three hurricane at 03:30 CST on the morning of August 26, 20 miles west-southwest of Morgan City (Figure 1). It then turned more northward around Morgan City to pass through Baton Rouge as a Category One hurricane around mid-day and to continue on through Mississippi and north Alabama as a tropical storm.

Hurricane Andrew was the strongest storm to impact this area since the Cheniere Caminada hurricane of 1893. Wind speeds exceeded 60 m/s with gusts over 70 m/s, and offshore wave heights were reported exceeding 14 m. The storm surge was measured at 2-4 m and inundated St. Mary, Terrebonne, Lafourche, Jefferson, and Plaquemines parishes for more than 40 kilometers inland. The northeastern quadrant of Hurricane Andrew passed directly over the Isles Dernieres and Timbalier Islands and cut a 45-kilometer swath of destruction from Fourchon, through Cocodrie and Morgan City to Baton Rouge. The wetlands and barrier islands suffered severe damage. The Isles Dernieres had all of its sand substrate removed, taking with it the beach and dune habitats so important to nesting marine birds including the endangered brown pelican. The marshes were stripped of exposed vegetation and the substrate was scoured, and in some areas the marsh was peeled up in strips and formed into "balls" that were deposited some distance away. Surveys of the surge inundation area revealed a distinct seaward zonation of storm effects: maximum surge line, mud deposition line, thatch wrack line, and marsh-ball line. Within the area inundated, a blanket of mud up to 0.5 meters thick was deposited over tens of thousands of acres of marsh and shallow bays. One quarter of the trees within the swamps and forests along the path of Hurricane Andrew were broken and relieved of their foliage. A 2-3 m storm surge forced saltwater into the freshwater marshes, and turbulent, oxygen-depleted water caused a die-off of millions of fresh and marine fish.

SHORELINE CHANGE

The strength of Hurricane Andrew inundated the Isles Dernieres with severe overwash conditions which produced dramatic shoreline erosion, barrier island breaching, and sand dune destruction. At Raccoon Island the recurved spit on the western end was completely destroyed and the entire dune system leveled (Figure 3a and b). At Trinity Island in the eastern half of the Isles Dernieres, pre- and post-storm aerial photography recorded dramatic damage to the only structures on the island as well as severe shoreline erosion and dune destruction (Figure 4a and b).

To quantify the shoreline changes associated with the Hurricane Andrew impact, vertical aerial photography was used. The baseline photography is dated January 24, 1992. An aerial photographic mission was flown on October 12, 1992 to document the impact of hurricane Andrew. An additional aerial photographic mission was flown on January 16, 1993 to record a year of shoreline changes since the January 24, 1992 baseline conditions.

Along the gulfside shoreline of the Isles Dernieres, the greatest areas of erosion were concentrated on Trinity Island, followed by East Island, Whiskey Island and Raccoon Island (Table 1). At Trinity Island the erosion was measured to range between -272m and -219.7m. The greatest erosion was found at the margins of the Coupe Juan tidal inlet that separates Trinity Island and East Island. The high wave energy and storm surge conditions widened Coupe Juan and completely eroded many sections of shoreline. Three small areas of accretion were documented on Trinity Island. On the west end of Trinity Island at Whiskey Pass a small recurved spit was undergoing post-storm recovery and had built out 15m. The other two areas of accretion were associated with the infilling of breaches resulting in the shoreline building out +18.1m to +27.2m. On East Island the amount of erosion ranged between -24.8 m and -111.5m. The greatest areas of erosion on East Island were associated with the eastern margin of Coupe Juan. The lowest rates are associated with the Terrebonne Parish barrier island restoration project adjacent to Wine Island Pass. On Whiskey Island the amount of erosion ranged between -20.6m and -92.0m. Shoreline erosion was relatively evenly distributed throughout Whiskey Island. Erosion measured at Raccoon Island increased from east to west ranging between -22.5m and -61.7m toward the recurved spit that was destroyed.

For the post-storm period between October 12, 1992 and January 16, 1993 the amount of erosion was significantly reduced (Table 1). Several erosion hot spots are apparent as breaches through the islands and on the margins of tidal inlets. The beaches on Raccoon Island continued to experience erosion, particularly at the breach through the western portion of the island. The breaches through Whiskey Island continued to widen and erosion occurred along the adjacent shorelines. The spit extending into the western margin of Whiskey Pass experienced further erosion after the initial impact of Hurricane Andrew. A similar pattern of breach widening and adjacent beach erosion was observed at Trinity Island. Both ends of East Island also experienced continued erosion following the Hurricane Andrew impact, however, the central beaches experienced a net accretion. The high wave energy and storm surge conditions widened Coupe Juan and completely eroded many sections of shoreline. Three small areas of accretion were documented on Trinity Island. On the west end of Trinity Island at Whiskey Pass a small recurved spit

was undergoing post-storm recovery and had built out 15m. The other two areas of accretion were associated with the infilling of breaches resulting in the shoreline building out +18.1m to +27.2m. The average amount of Hurricane Andrew erosion between January 24, 1992 and October 12, 1992 was measured at -55.32m for the Isles Dernieres (Table 1). For the individual islands, the average amount of erosion was -43.59m for Raccoon Island, -43.61m for Whiskey Island, -68.07m for Trinity Island, and -66.26m for East Island.

In contrast to the erosion, seaward areas of significant deposition were observed indicating that the post-storm recovery of the Isles Dernieres was underway. Beaches directly in front of the Terrebonne Parish Barrier Island Project showed signs of accretion due to westward sediment bypassing at Wine Island Pass. Several of the smaller hurricane breaches began to infill and close producing localized areas of shoreline progradation. The average amount of post-Hurricane Andrew erosion between October 12, 1992 and January 16, 1993 was -2.47m for the Isles Dernieres. For the individual islands, the average amount of post-hurricane erosion was -13.85 m for Raccoon Island - 8.58 m for Whiskey Island, and -5.56 m for Trinity Island. At East Island, the post-Hurricane measurements indicated that the shoreline had, on average, actually accreted +18.1 m.

Hurricane Andrew also had an impact on the bayside shoreline of the Isles Dernieres, and a majority of the bayside transects experienced erosion between January 24, 1992 and October 12, 1992, especially where the islands were narrow (Table 1). The amount of bayside erosion ranged between -0.8 m and -98.9 m. Bayside erosion was primarily a function of hydraulic scour produced by hurricane overwash and offshore-directed wave energy. The few areas where the bayside built out were zones of overwash deposition and subsequent flood tidal delta development. The amount of bayside accretion ranged between +1.3 m and +24.6 m.

Between October 12, 1992 and January 16, 1993, the bayside shoreline experienced zones of erosion and deposition. Erosion amounts ranged from -0.8 m and -31.5 m. Most of the erosion was associated with the margins of tidal inlets and hurricane breaches. Deposition and shoreline progradation was associated with the development of flood tidal deltas at the locations of hurricane breaches. The amount of progradation ranged between +0.4 m and +133.4 m for the period of October 12, 1992 and January 16, 1993. This greater amount of progradation was related to post-storm recovery processes infilling hurricane breaches and the development of flood tidal deltas. The amount of storm impact bayside erosion measured -13.02 m. Post-storm bayside average erosion measured -6.88 m. The average amount of bayside storm impact progradation was +6.65 m. In contrast the average amount of post-storm progradation was + 16.36 m.

The area of the Isles Dernieres was significantly reduced by the impact of Hurricane Andrew (Table 2). On January 24, 1992 prior to the landfall of Hurricane Andrew, the area of the Isles Dernieres was measured at 682 ha. On October 12, 1992 after the landfall of Hurricane Andrew, the area of the Isles Dernieres was measured at 550 ha which represents a loss of 132 ha or a 19.3 percent decrease in area. Between October 12,

1992 and January 16, 1993, the area of the Isles Dernieres continued to decrease further to 526 ha which represents a loss of 24 ha or -4.5 percent in area.

During the 1992 Hurricane Andrew impact year, the net amount of gulfside shoreline changes ranged from +48.2 m to -219.7 m between January 24, 1992 and January 16, 1993 (Table 1). The average amount of gulfside shoreline change for this period was -59.37 m. For the same time period, the net bayside shoreline changes ranged between +143.5 m to -108.4 m. The average amount of bayside shoreline change for this period was -10.8 m. The net area reduction for the Isles Dernieres was -151.93 ha or 23 percent for this same time period.

SUMMARY

The impact of Hurricane Andrew produced profound changes in the Isles Dernieres barrier island arc. McBride and others (1992) documented the long-term (1887-1988) and short-term (1978- 1988) gulfside side average erosion rates at -11.1 m/yr and -19.2 my⁻¹, respectively. The impact of Hurricane Andrew increased the average rate of gulfside erosion to -59.37 m/yr. McBride and others (1992) documented the long-term (1906-1988) and short-term (1978-1988) bayside average erosion rate at -0.5 m/yr and -5.2 m/yr, respectively. The impact of Hurricane Andrew increased the average rate of bayside erosion to -10.8 m/yr. In terms of area changes, the Isles Dernieres rate of area change accelerated to -155.71 ha/yr during the 1992 hurricane season. The long-term (1887-1988) area loss rate is -28.2 ha/yr and the short-term (1978-1988) area loss rate is -47.2 ha/yr. Hurricane Andrew accelerated the long-term loss rate to -28.5 ha/yr and the short-term loss rate to -49.54 ha/yr. The Hurricane Andrew impact on the Isles Dernieres produced 3-5 years of erosion in a matter of days. After the Hurricane Andrew impact, the projected long-term disappearance date of the Isles Dernieres altered from 2015 to 2012 and the short-term disappearance shifted from 2004 to 2003.

ACKNOWLEDGEMENTS

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DISCLAIMER

This map 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

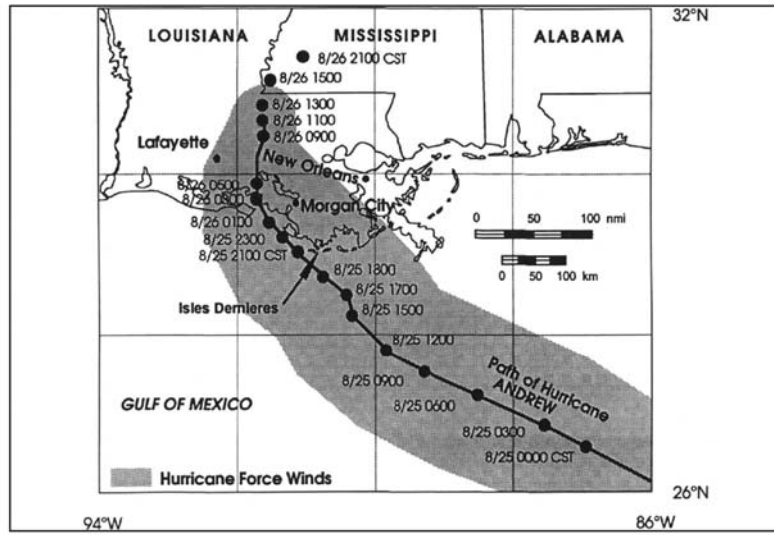


Figure 1. The track of Hurricane Andrew in the Gulf of Mexico.

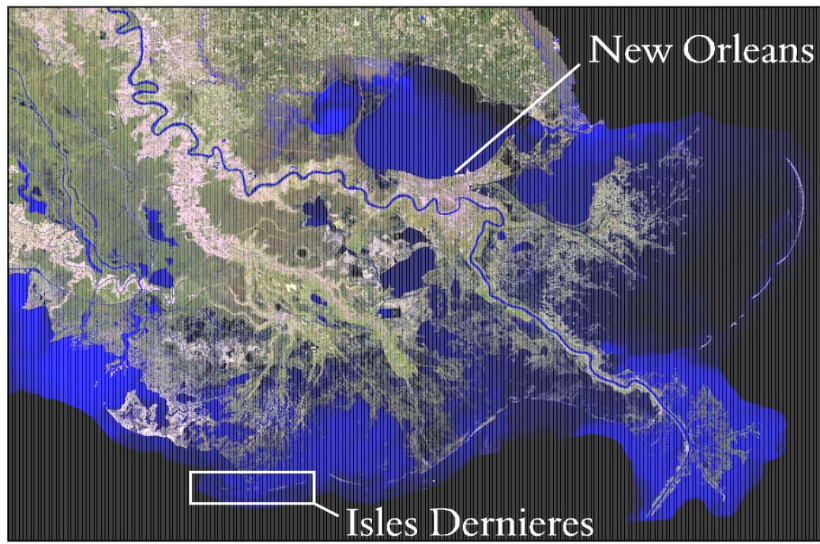


Figure 2. The Isles Dernieres barrier island arc located 120 km southwest of New Orleans.



Figure 3a. An oblique aerial photograph of Raccoon Point prior to the landfall of Hurricane Andrew on July 9, 1992.



Figure 3b. An oblique aerial photograph of Raccoon Point after the landfall of Hurricane Andrew on August 30, 1992.

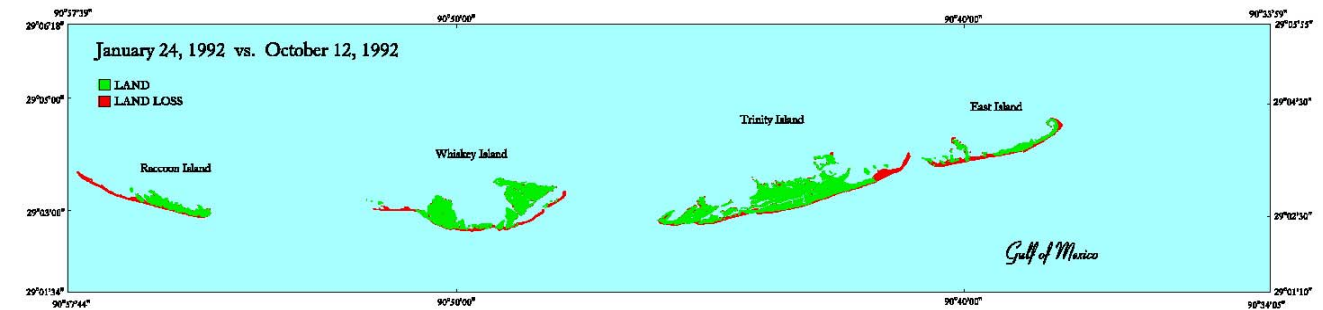
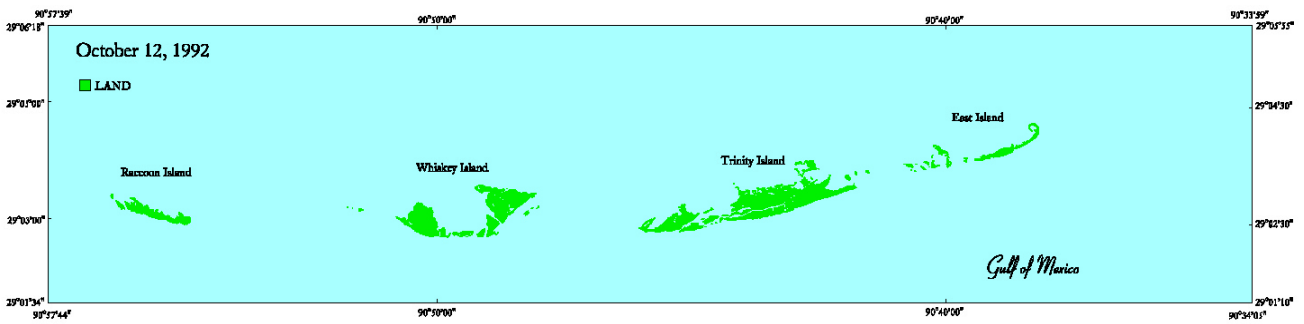
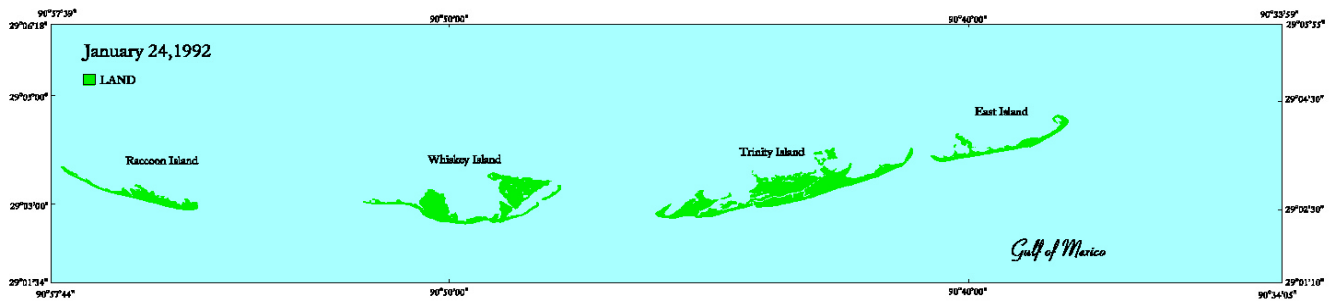


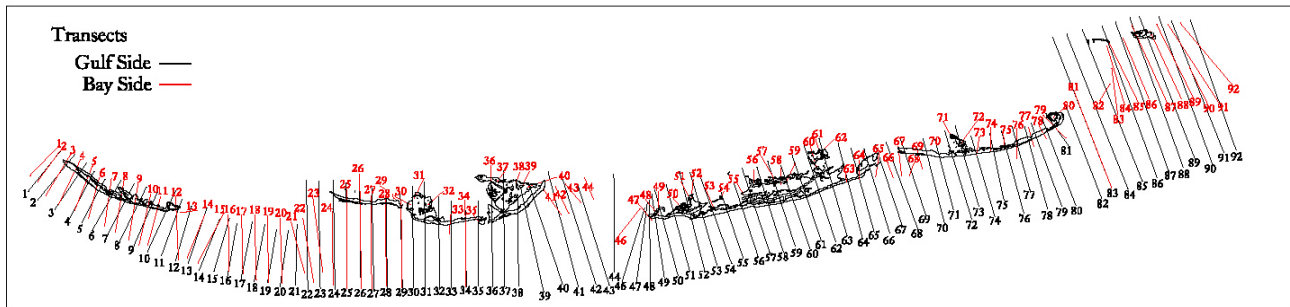
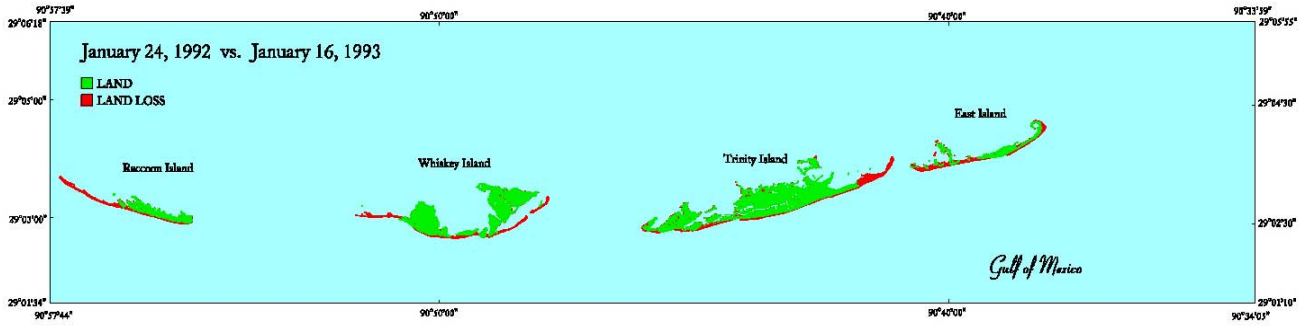
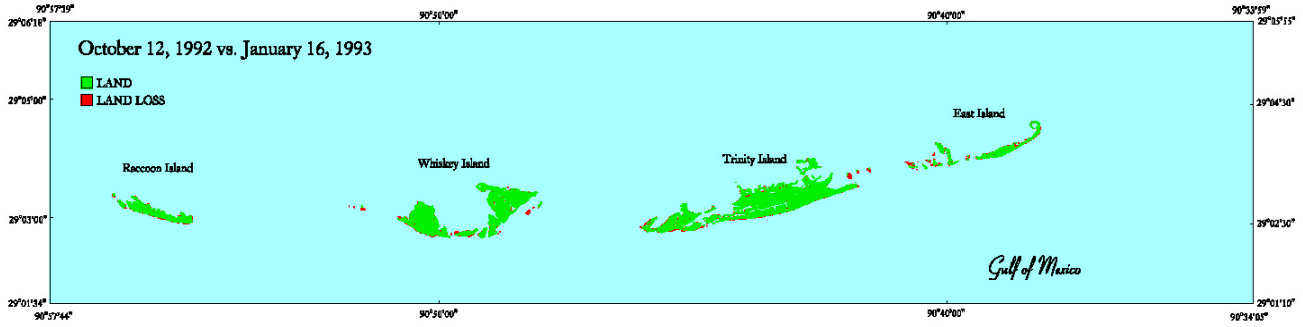
Figure 4a. An oblique aerial photograph of Trinity Island prior to the landfall of Hurricane Andrew on July 9, 1992.



Figure 4b. An oblique aerial photograph of Trinity Island after the landfall of Hurricane Andrew on August 30, 1992.

MAPS





TABLES

Table 1

Isles Dernieres gulfside magnitude of change (meters)					Isles Dernieres bayside magnitude of change (meters)								
Jan 92 - Oct 92		Oct 1992 - 1993			Jan 92 - Jan 93		Jan 92 - Oct 92		Oct 1992 - 1993			Jan 92 - Jan 93	
1	-61.6	1	na	1	-61.6	1	na	1	na	1	na		
2	-54.9	2	na	2	-54.9	2	na	2	na	2	na		
3	-60.8	3	na	3	-60.8	3	na	3	na	3	na		
4	-45.5	4	na	4	-45.5	4	na	4	na	4	na		
5	-61.7	5	na	5	-61.7	5	na	5	na	5	na		
6	-37.9	6	-50.2	6	-99.8	6	na	6	na	6	na		
7	-30.02	7	-7.1	7	-37.12	7	-8.9	7	-2	7	-10.9		
8	-32	8	-12.4	8	-44.4	8	-2.1	8	-2.4	8	-4.5		
9	-36.5	9	-13.8	9	-50.3	9	1.3	9	-1.2	9	0.1		
10	-22.5	10	-21.3	10	-43.8	10	3.7	10	-0.8	10	2.9		
11	-36.1	11	-21.7	11	-14.4	11	-0.8	11	7.5	11	6.7		
12	na	12	na	12	na	12	-3.2	12	-6.4	12	-9.6		
13	na	13	na	13	na	13	na	13	na	13	na		
14	na	14	na	14	na	14	na	14	na	14	na		
15	na	15	na	15	na	15	na	15	na	15	na		
16	na	16	na	16	na	16	na	16	na	16	na		
17	na	17	na	17	na	17	na	17	na	17	na		
18	na	18	na	18	na	18	na	18	na	18	na		
19	na	19	na	19	na	19	na	19	na	19	na		
20	na	20	na	20	na	20	na	20	na	20	na		
21	na	21	na	21	na	21	na	21	na	21	na		
22	na	22	na	22	na	22	na	22	na	22	na		
23	na	23	na	23	na	23	na	23	na	23	na		
24	na	24	na	24	na	24	na	24	na	24	na		
25	na	25	na	25	na	25	na	25	na	25	na		
26	-21.1	26	na	26	-21.1	26	na	26	na	26	na		
27	-45.6	27	na	27	-45.6	27	na	27	na	27	na		
28	-92	28	na	28	-92	28	na	28	na	28	na		
29	35	29	13.2	29	48.2	29	-23.4	29	-7	29	16.4		
30	-20.6	30	-16.5	30	-37.1	30	1.3	30	-4.3	30	-3		
31	-25.3	31	-13.7	31	-39	31	2.1	31	1.1	31	-3.2		
32	-66.5	32	na	32	-66.5	32	-1.7	32	0	32	-1.7		
33	-71.6	33	na	33	-71.6	33	na	33	na	33	na		
34	-66.1	34	22	34	-44.1	34	-13.4	34	-5.6	34	7.8		
35	2.2	35	-44.6	35	-42.4	35	-10.1	35	133.4	35	143.5		
36	-43.3	36	-11.9	36	-55.2	36	-1.1	36	0.9	36	-0.2		
37	-59	37	na	37	-59	37	10.3	37	-7.3	37	3		
38	-50.7	38	na	38	-50.7	38	-3.9	38	5.5	38	1.6		
39	-69.4	39	na	39	-69.4	39	9.7	39	-6.8	39	-16.5		
40	-60.1	40	na	40	-60.1	40	-12.4	40	8.1	40	-5.2		

41	na	41	na	41	na	41	na	41	na		
42	na	42	na	42	na	42	na	42	na		
43	na	43	na	43	na	43	na	43	na		
44	na	44	na	44	na	44	na	44	na		
45	na	45	na	45	na	45	na	45	na		
46	na	46	na	46	na	46	na	46	na		
47	15	47	-15	47	0	47	-18.5	47	-7	47	-25.5
48	-41.1	48	-11.7	48	-52.8	48	24.6	48	-31.5	48	-6.9
49	-36.6	49	-0.1	49	-36.7	49	13	49	-7.2	49	5.8
50	-41.1	50	-6.5	50	-47.6	50	-60.2	50	32	50	-28.2
51	27.2	51	-21.4	51	5.8	51	-6.2	51	-5.2	51	-11.4
52	-45	52	-2.1	52	-47.1	52	-6.1	52	13.3	52	7.2
53	-50.8	53	-7.4	53	-58.2	53	-1.8	53	51.3	53	1.6
54	-39.6	54	-7.2	54	-50.3	54	-8.9	54	1	54	-7.9
55	-181.3	55	-9.6	55	-190.9	55	-1.9	55	-2.3	55	-4.2
56	18.1	56	-14	56	4.1	56	4.4	56	-7.5	56	-3.1
57	-44.2	57	-4.1	57	-48.3	57	-1	57	-6	57	-7
58	-53.7	58	1.6	58	-52.1	58	9	58	-11.5	58	-2.5
59	-56.9	59	-4.1	59	-61	59	3	59	0.9	59	3.9
60	-40.6	60	8.6	60	-32	60	-0.1	60	5.2	60	5.1
61	-64.9	61	50.3	61	-14.6	61	-0.4	61	-5.3	61	-5.7
62	-37.1	62	-5.3	62	-42.4	62	-98.9	62	-9.5	62	-108.4
63	-27.2	63	-4.5	63	-28.8	63	-1.4	63	4	63	2.6
64	-38.8	64	0.6	64	-38.2	64	-4.5	64	8.1	64	3.6
65	-34.7	65	-12.1	65	-46.8	65	na	65	na	65	na
66	-218.8	66	na	66	-2118.8	66	na	66	na	66	na
67	-219.7	67	na	67	-219.7	67	na	67	na	67	na
68	-94.8	68	na	68	-94.8	68	na	68	na	68	na
69	-153	69	na	69	-153	69	na	69	na	69	na
70	-91.1	70	-47.2	70	-43.4	70	0.7	70	-3.9	70	-3.2
71	-99.9	71	39	71	-60.9	71	-21.6	71	0.8	71	-20.8
72	-77.9	72	-50.8	72	-128.7	72	-1.4	72	-0.8	72	-2.2
73	-111.5	73	na	73	-111.5	73	na	73	na	73	na
74	-97.5	74	na	74	-97.5	74	na	74	na	74	na
75	-93.4	75	na	75	-93.4	75	10.8	75	-13.5	75	-2.7
76	-45.6	76	35.9	76	-9.7	76	0	76	0.4	76	0.4
77	-24.8	77	44.5	77	19.7	77	-7.9	77	-4.7	77	-12.6
78	-53.6	78	2.1	78	-51.5	78	-7	78	-2.3	78	-9.3
79	-67.5	79	21.1	79	-46.4	79	-1.4	79	5.7	79	4.3
80	-27.5	80	-17.4	80	-44.9	80	-39.7	80	-16.9	80	-56.6
81	-29.6	81	-12.1	81	-41.7	81	na	81	na	81	na
82	na	82	na	82	na	82	na	82	na	82	na
83	na	83	na	83	na	83	na	83	na	83	na
84	na	84	na	84	na	84	na	84	na	84	na
85	na	85	na	85	na	85	na	85	na	85	na
86	na	86	na	86	na	86	na	86	na	86	na
87	na	87	na	87	na	87	na	87	na	87	na
88	na	88	na	88	na	88	na	88	na	88	na

89 na	89 na	89 na		89 na	89 na	89 na
90 na	90 na	90 na		90 na	90 na	90 na
91 na	91 na	91 na		91 na	91 na	91 na
92 na	92 na	92 na		92 na	92 na	92 na

Table 2: Isles Dernieres Area Measurements by Island (in hectares)

Isles Dernieres	1-24-92	10-12-92	1-16-92
Raccoon Island	67.90	45.61	40.40
Whiskey Island	204.62	178.37	173.34
Trinity Island	322.33	274.58	263.61
East Island	70.16	37.93	35.81
Total	665.01	536.48	513.15