SHORELINE CHANGES IN THE ISLES DERNIERES BARRIER ISLAND ARC: 1887 - 1996
Terrebonne 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) and the USGS Hurricane Andrew impact assessment (Penland and others, 1998), this USGS Open-File Report depicts shoreline changes between 1887 and 1996, which provides an 8 year update of McBride and others (1992).

The Isles Dernieres are located about 120 km southwest of New Orleans (Figure 1). This barrier island shoreline is 32 km long and extends from Caillou Bayou 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 long-term (1887-1988) gulfside erosion rate of -11.1 my-1 and a short-term (1978-1988) gulfside erosion rate of -19.2 my-1. The long-term bayside (1906-1988) erosion rate was measured at -0.6 my-1 and the short-term (1978-1988) bayside erosion rate was measured at -2.2 my-1. The Isles Dernieres decreased in area at a rate of -28.2 ha/y-1 between 1887 and 1988, suggesting the long-term date of disappearance would be 2019. The rate of area loss between 1974 and 1988 was measured at -42.7 ha/y-1 suggesting a short-term disappearance date of 2004. In the 1992 Hurricane Andrew impact assessment by Penland and others (1998), the Isles Dernieres experienced a brief and intense period of increased erosion. The average gulfside erosion rate accelerated to -19.37 my-1 and the average bayside erosion rate accelerated to -43.5 my-1 during the year of the 1992 Hurricane Andrew impact. The Isles Dernieres rate of area change accelerated to -155.7 ha/y-1 during the 1992 hurricane season. Hurricane Andrew accelerated the long-term area loss rate to -28.5 ha/y-1 and the short-term area loss rate to -49.54 ha/y-1.

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 was reduced from 2015 to 2012 and the short-term disappearance date was reduced from 2004 to 2003.

The objective of this USGS Open-File Report is to up-date the shoreline change analysis by McBride and others (1992) and Penland and others (1998) for the Isles Dernieres to 1996. In this shoreline change update, 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. 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.

To update the Louisiana Barrier Island Erosion Study Atlas, new vertical aerial mapping photography was acquired on December 9, 1996 in order to quantify shoreline changes since January 21, 1988. The focus of this USGS Open-File report is to update the results presented by McBride and others (1992). The Hurricane Andrew impact on the Isles Dernieres is recorded in the December 9, 1996 morphology of this barrier island arc and is analyzed separately in USGS Open-File Report 98-XXX (Penland and others, 1998).

GULFSIDE SHORELINE CHANGES

In terms of long-term shoreline change history between 1887 and 1996, the highest rates of change occurred along the gulfside of the Isles Dernieres where erosion is dominant (Table 1). The highest rates of shoreline erosion are found at Wine Island where total erosion amounts measured between -2412.1 m (transect #88) and -2429.2 m (transect #86) for this 109 year period. This amount of erosion translates to an average annual rate of -22.2 my-1.

In general, the Isles Dernieres experiences high rates of coastal erosion in the center of the island arc which increases east and west away from Whiskey Island. The greatest amount of long-term erosion found on Whiskey Island is at Whiskey Pass (transect #44) and Coupe Colin (transect #24) where -2453.6 m and -2268.7 m of erosion were measured respectively. At these locations, very dynamic sandy recurved spits respond rapidly to changes in wave and tidal energy. On the central portion of Whiskey Pass (transect #33) where a resistant marsh platform is exposed, erosion was measured at -1493.7 m. The average long-term (1887-1996) erosion rate for Whiskey Island is -17.0 my-1.

East and west of Whiskey Island the long-term erosion rates gradually decrease to the flanks of the Isles Dernieres barrier island arc. The exception is at the flank of Coupe Juan where this tidal inlet is rapidly eroding its channel margins. In general, erosion at Trinity Island measured -1838.6 m at the west end (transect #48) and decreased to -1092.2 m at the east end (transect #67). Adjacent to Coupe Juan on Trinity Island, the long-term erosion increased to a maximum of -1669.9 m (transect #66). The average long-term rate of erosion for Trinity Island is measured at -11.5 my-1.

Further to the east lies East Island, which is the site of a barrier island restoration project by the Terrebonne Parish Consolidation Government. On the west end of East Island, at the margin of Coupe Juan (transect #67), the long-term erosion was measured at -1407.2 m and decreased and reversed to +186.9 m on the western margin of Wine Island Pass (transect #81) at the east end of East Island. The average long-term erosion rate documented for East Island is -5.1 my-1.

West of Whiskey Island lies Raccoon Island which is experiencing a similar pattern of erosion that decreases from the central barrier island arc to its margins. The long-term erosion measurements ranged from -1196.4 m at the east end of Raccoon Island (transect #11) to -778.0 m at the west end (transect #2). The average long-term rate of erosion is measured at -8.4 my-1.

Between 1887 and 1996, the overall average erosion rate for the Isles Dernieres was measured at -11.8 my-1 (Table 2). The previous analysis by McBride and others (1992) documented the long-term erosion rate between 1887 and 1988 as -11.1 my-1. Our new analysis indicates the long-term rate of erosion has accelerated by -0.7 my-1 since 1988.

The short-term shoreline changes in the Isles Dernieres between 1988 and 1996 show greater variability than the long-term shoreline changes between 1887 and 1996 (Table 1). The highest erosion rates are found at tidal inlet margins and at breaches through individual islands. The average short-term erosion rate at Whiskey Island is -25.6 my-1. The short-term erosion rate here is a third more than the long-term erosion rate of -17.0 my-1 (Table 2). At Trinity Island, the average short-term erosion rate is -25.0 my-1 which is more than double the long-term erosion rate of -11.5 my-1. The short-term erosion at East Island is -12.8 my-1 which is double the long-term erosion rate of -5.1 my-1. The westernmost island in this barrier island arc is Raccoon Island where the short-term erosion rate is 25.3 my-1 which is triple the long-term erosion rate of -8.4 my-1. At Wine Island the short-term erosion rate is -14.5 my-1 which is less than its long-term erosion rate of -22.2 my-1. The overall short-term gulfside erosion rate of the Isles Dernieres is -21.8 my-1 which is a -2.6 my-1 increase over the 1978-1988 short-term rate of -19.2 my-1.

BAYSIDE SHORELINE CHANGES

For the bayside of the Isles Dernieres, the period of record for analysis is 1906-1996. In the original 1887 survey of the Isles Dernieres, only the gulfside shoreline was mapped. It was not until 1906 that a suitable bayside shoreline was mapped accurately to provide a long-term baseline for change analysis. Two distinct patterns of shoreline change are apparent. The first pattern of change is one of erosion associated with marsh platforms located at the wide parts of the individual barrier islands. The erosion of these features have been persistent since 1906 and will be discussed at that time scale. The second pattern is one of landward progradation associated with sandy tidal inlets and barrier shoreline features such as recurved spits and baymouth bars. Patterns of change associated with these sandy geomorphic features are episodic and most are less than a decade old. Therefore, the shoreline changes associated with these dynamic, ephemeral, and young sandy shoreline features will be discussed at the time scales suitable to accurately describe their development and rate of change.

The erosion of the marsh platform on the bayside of the Isles Dernieres has been persistent since 1906 (Table 1). The highest measurements of bayside erosion are found on Trinity Island where erosion measurements range between -80.2 m (transect #62) and -423.6 m (transect #62) with an average rate of -2.5 my-1. At East Island the bayside erosion amounts range between -60.3 m (transect #70) and -398.1 m (transect #79) with an average rate of -2.6 my-1. The bayside erosion amounts at Whiskey Island are measured between -153.2 m (transect #29) and -239.1 m (transect #42) with an average rate of -2.1 my-1. Further to the west at transects #11 and #10 on Raccoon Island the bayside erosion amounts range between -97.8 m and -245.5 m. The average bayside erosion rate here is -2.0 my-1. The overall annual erosion rate along the bayside marsh platform shoreline of the Isles Dernieres is -2.5 my-1 for the period of 1906 - 1996. In comparison, the rate of bayside erosion between 1906 and 1988 is -1.6 my-1. This bayside shoreline change rate indicates the erosion of the marsh platform has accelerated. The short-term rate of bayside marsh platform shoreline change is__my-1. This is an increase of -__my-1 over the previous long-term bayside marsh platform erosion rate of -1.6 my-1.

At Wine Island, the amount of landward bayside progradation for the period 1906 to 1996 ranges between +1856.8 m and +2638.3 m at transects #88 & 92. This amount of progradation is related to island migration by overwash and tidal inlet processes. The average rate of landward progradation is +23.9 my-1. Similar patterns of progradation are found at Coupe Juan separating East Island and Trinity Island. The original single island composed of Whiskey, Trinity, and East Islands was breached by Hurricane Carmen in 1974 to form a tidal inlet. Subsequently in 1985 Hurricane Juan significantly modified and enlarged this tidal inlet which was renamed Coupe Juan. The morphology of the Coupe Juan tidal inlet is wave dominated with a pair of landward flaring recurved spits and a flood tidal delta. These sandy recurved spits have prograded landward between +216.8 m and +766.7 m at an average long-term rate of +21.8 my-1 since Hurricane Carmen breached the tidal inlet in 1974. At Whiskey Island where the sandy baymouth bar connects the two island halves, the amount of landward progradation was measured between +69.7 m and +416.9 m since forming in 1978. The average rate of landward baymouth bar progradation is +11.1 my-1. On the western side of Whiskey Island there has been a landward prograding recurved spit in existence since 1934. The amount of long-term progradation was measured between +1706.5 m and +1941.9 m at an average rate of +29.8 my-1. Further west, the recurved spit on the west end of Raccoon Island has shown significant progradation since 1988. Prior to this time the west end of Raccoon Island was more or less eroding in place from both the gulf and bay sides. Since 1988, the Raccoon Island recurved spit has prograded between +102.8 m and +600.1 m at an average rate of +42.6 my-1.

SHORELINE AREA CHANGES

The area changes of the Isles Dernieres have been dramatic since 1887. Between 1887 and 1996, the Isles Dernieres have decreased from 3533.0 ha to 616.7 ha at a rate of -26.8 ha/y-1 (Table 3). This long-term rate of area loss forecasts a disappearance date of 2019. The previous long-term disappearance date was forecasted at 2015 using an area loss rate of -27.2 ha/y-1 (McBride and others, 1992). All of the individual islands show a remarkable improvement over the predictions made by McBride and others (1991; 1992). At Raccoon Island, the shift in the short-term disappearance date from 2001 to 2013 is due to the beach nourishment project that repaired much of the Hurricane Andrew damages to this important shore bird nesting colony. The shift of the disappearance date of Whiskey Island from 2016 to 2039 demonstrates the importance of barrier island recovery processes following a major hurricane impact. Since the impact of Hurricane Andrew in 1992, two major flanking recurved spits have formed at Whiskey Island by the sediment bypassing Whiskey Pass and nourishing these recurved spits and the baymouth bar in the central part of the island. A similar pattern of post-storm recovery processes have nourished Trinity Island, shifting its disappearance date from 2011 to 2017. A combination of natural storm recovery processes combined with two barrier island restoration projects significantly improved East Island and shifted its disappearance date from 2003 to 2110.

SUMMARY

The highest and most persistent erosion continues to occur along the gulfside shoreline of the Isles Dernieres. The average gulfside shoreline erosion has increased from -11.1 my-1 for 1887 - 1988 to -11.8 my-1 for 1887-1996. The highest erosion rates are found along tidal inlet margins and the lowest rates are found where salt marsh platforms are exposed on the gulfside shoreline.

The bayside shoreline of the Isles Dernieres exhibits two very distinct patterns of shoreline change. Bayside shorelines which are composed of an eroded salt marsh platform have displayed a steady rate of erosion between -1.6 and -2.5 my-1. The other distinct style of bayside shoreline change is associated with tidal inlet and recurved spit development during this century. At these locations significant volumes of sand accumulate to prograde tidal inlet systems landward. Coupe Juan has prograded +21.8 my-1 since 1974. The sandy baymouth bar in the central portion of Whiskey Island has prograded landward at a rate of -11.1 my-1 since 1978. The recurved spit in the Coupe Colin tidal inlet system has prograded landward at a rate of +29.8 my-1 over the last 62 years. The recurved spit on the west end of Raccoon Island has prograded landward at a rate of +43.7 my-1 since it became active in 1988. Wine Island has rapidly migrated landward by gulfside erosion and bayside progradation at a rate of +23.9 my-1.

The most remarkable discovery made by this shoreline change analysis update is that the life expectancy of the Isles Dernieres has greatly improved due to the combination of post-storm barrier island recovery processes and several restoration projects. The projected long-term disappearance date has shifted from 2015 to 2019. The projected short-term disappearance date has shifted from 2004 to 2029.

The conclusion of this Isles Dernieres coastal erosion update is that the combination of post-storm recovery processes, combined with the natural sediment dispersal pattern and barrier island restoration projects is helping to stabilize these islands and sustain them for future generations.

Map Source

Additional copies of this USGS open-file report can be obtained from the Coastal Research Laboratory (CRL) within the Department of Geology and Geophysics at the University of New Orleans. CRL's telephone number is 504-280-3232. The fax number is 504-280-7396, and the world wide web site is xxxxxxxxxx.

Table 1

Transect	Isles Dernieres gulfside magnitude of change (meters): 1887 - Jan 88	Jan 88 - Dec 96	1887 - Dec 96	Isles Dernieres bayside magnitude of change (meters): 1906 - Jan 88	Jan 88 - Dec 96	1906 - Dec 96
1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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Table 2
Average Gulfside Erosion Rates
for the Isles Dernieres: 1887 - 1996

YEARS	AVERAGE EROSION RATE
Previous Analysis[1]	
1887 - 1934	-11.7 my-1
1934 - 1956	-2.6 my-1
1956 - 1978	-3.9 my-1
1978 - 1988	-15.2 my-1
1887 - 1988	-11.1 my-1
New Analysis[2]	
1988 - 1996	-21.8 my-1
1887 - 1996	-11.8 my-1

[1] McBride and others (1992)
[2] this USGS open-file report

Table 3
Isles Dernieres Area Change: 1887 - 1996[1]

Isles Dernieres	1887	1988	1996	NLTACR[2]	NSTACR[3]	NLTDR[4]	NSTDR[5]	PSTDD[6]	PLTDD[7]
Raccoon Island	433.1	91.0	56.1	-7.2	-2.4	2004	2012	2001	NA[8]
Whiskey Island		238.3	209.6	-18.3	-2.5	2039	2039	2016	NA[8]
Trinity Island	2943.4	362.0	261.1	-19.3	-12.6	2019	2017	2011	NA[8]
East Island		85.8	78.5	-18.2	-0.7	2030	2110	2003	NA[8]
Wine Island	185.5	1.6	11.0	-1.4	+0.7	2005	NA[8]	NA[8]	NA[8]
Total	3533.8	769.9	616.7	-26.8	-17.7	2019	2029	2004	2015

[1] area in hectares (ha)
[2] New long-term area change rate
[3] New short-term area change rate
[4] New long-term disappearance rate
[5] New short-term disappearance rate
[6] Previous short-term disappearance date (McBride and others, 1992)
[7] Previous long-term disappearance date (McBride and others, 1992)
[8] Not Applicable

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

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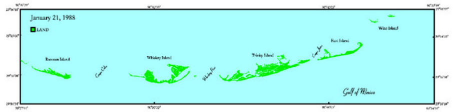

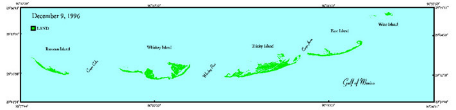

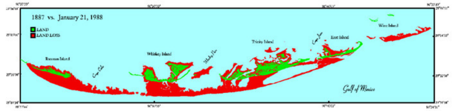

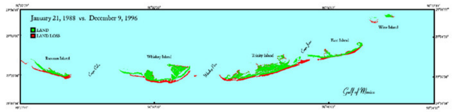

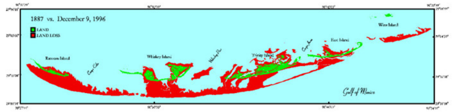

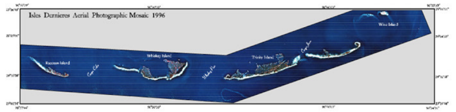

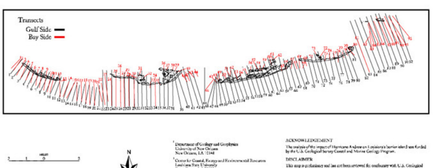

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ACKNOWLEDGEMENT

The analysis of the impact of Hurricane Andrew on Louisiana's barrier island was funded by the U.S. Geological Survey Coastal and Marine Geology Program.

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MAP SOURCE

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