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John A. Barras, Pierre E. Bourgeois, and Lawrence R. Handley

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Introduction

Louisiana's coastal wetlands, a national resource supporting 30% of the nation's fisheries and most of the wintering ducks in the Mississippi Flyway, are at risk from the annual conversion of an estimated 35-45 mi^2 of wetlands to open water. Louisiana's wetland loss rate is the highest of any state in the nation. The processes causing wetland loss in coastal Louisiana are complex and varied.

The National Wetlands Research Center (NWRC) has been researching land loss in coastal Louisiana since the late 1970's. An initial land loss study completed in 1981 indicated that coastwide land loss rates within the time frame 1956-78 were approaching 44 mi^2/yr. In late 1987, Congress provided funds to identify areas of continuing loss. Additionally, the joint State and Federal Task Force created by Section 303 of the Coastal Wetlands Planning, Protection, and Restoration Act (CWPPRA) of 1990 provided funds for data analysis and map preparation. This report presents the findings of the study which showed that land loss rates although decreasing, remain high at 34.9 mi^2/yr for the 1978-90 time period.

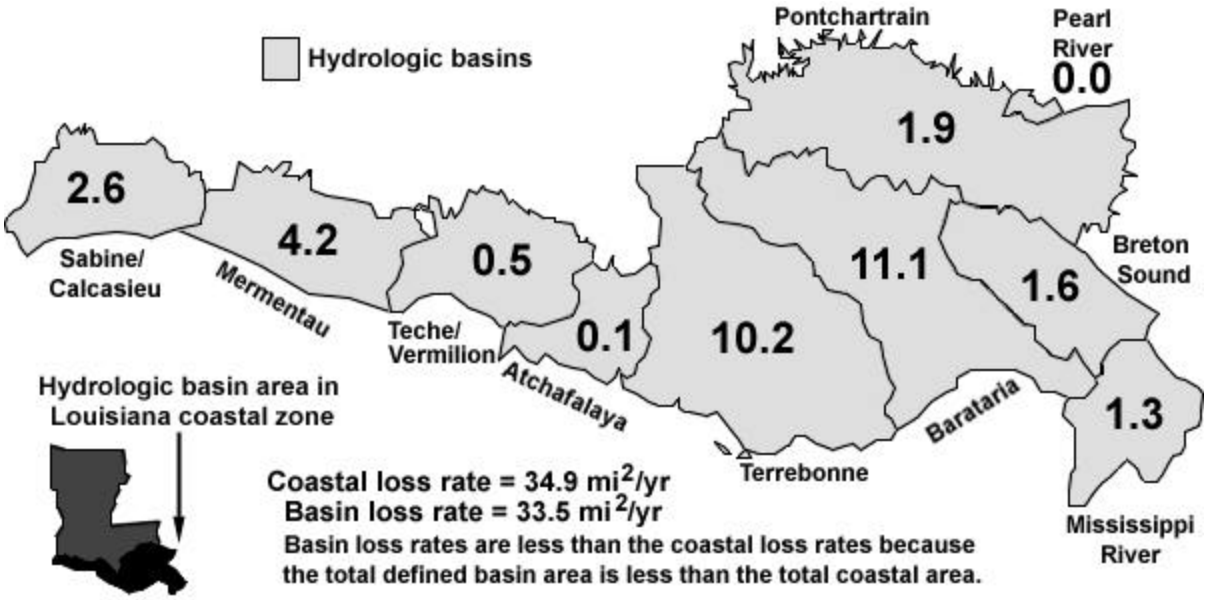
Methodology

Color infrared (CIR) aerial photography taken in late 1988 and early 1989 was photointerpreted and transferred to U.S. Geological Survey 1:24,000 base maps by the U.S. Fish and Wildlife Service's National Wetlands Inventory (NWI). These maps were then converted to a digital format by NWRC and NWI to create a land cover/use data set for coastal Louisiana. Traditional photointerpretation techniques, used to develop the 1988 data set, allow for accurate delineation of land cover/use classes but can become prohibitively expensive to produce, depending upon the desired minimum resolution of the interpreted data. Louisiana's coastal wetlands contain many complex areas of "broken marsh" consisting of innumerable small ponds and islands that are 1 acre or less in size and are cost prohibitive to interpret and map. Current NWI mapping conventions and classification methodologies tend to minimize areas of "broken" marsh. Therefore, wetland trends derived from comparison of the 1988 land cover data to earlier data sets such as the 1978 and 1956 NWI land cover data sets, which were developed using a different classification methodology, show decreased wetland loss rates, or in some cases, gains in areas that are clearly losing wetlands.

Landsat thematic mapper (TM) digital satellite imagery can accurately identify "broken marsh" in a cost effective manner using image processing techniques that NWRC personnel developed. The NWRC decided to incorporate available 1990 classified Landsat TM water data, developed jointly with the Louisiana Department of Natural Resources (LDNR), with the 1988 land cover data to provide the most current and accurate estimate of land loss possible. The 1990 TM water class was merged with the 1988 habitat data utilizing geographic information system (GIS) technology to create a 1990 landcover/use data set for coastal Louisiana (Barras et al. 1994). The 1990 data set was then compared to the existing 1978 data set by using

the GIS to develop a 1978-90 land loss data set for coastal Louisiana. Land loss is defined as the net conversion of land to water and does not reflect conversion of lands to agriculture, urbanization, or other development. Land loss for 1978-90 was then calculated for the entire coastal zone and for the 10 major hydrologic basins making up coastal Louisiana

(Figure 1).



The boundaries used for the basins were defined by CWPPRA Task Force and include the following basins: Sabine-Calcasieu, Mermentau, Teche-Vermilion, Atchafalaya, Terrebonne, Barataria, Breton Sound, Mississippi River, Pontchartrain, and Pearl River. Land loss statistics for the Pearl River Basin were included in the report but a color plate was not included because of the small size of this basin.

Data Analysis

The analysis of the 1978-90 land loss required several steps to complete. First, the area covered by the 1990 land cover data was clipped to match the extent of the 1978 land cover data so that land losses between 1978 and 1990 could be calculated. The 1978 data boundary was based on the legislatively defined 1978 Coastal Zone Boundary, which is smaller than the total area covered by the 1990 data and does not include data coverage of the northern Terrebonne and Barataria Basins and northeastern Pontchartrain Basin.

Once the data sets were matched, area tables were developed for the 1978 and 1990 land cover classes by using GIS software. The landcover data were then aggregated to land and water classes from which land loss rates were calculated for coastal Louisiana utilizing land cover class area totals to minimize misregistration error inherent within the 1978 data set. The 1978 data set was developed without using proper photo-rectification techniques because of high costs. Comparison of the 1978 data set with data sets developed using correct rectification techniques for creating loss maps will generate areas of false land loss and gain caused by misregistration between the data sets. The 1978 landcover data were then compared to the 1990 land cover data utilizing ERDAS GIS software to create a digital map depicting areas of land loss and gain that occurred between 1978 and 1990. The land loss data were then filtered to depict areas of loss and gain > 10 acres in size (hot spots) to eliminate areas of false loss and gain caused by misregistration between the 1978 and 1988 data sets. The filtered land loss data were then merged with a winter 1993 Landsat TM

satellite image backdrop (bands 7, 5, and 3) to create a coastwide 1978-90 land loss map. Individual basin loss maps were then extracted from the coastwide data set. Statistics for the individual basin land losses were calculated by using the same methodology. Please note that the overall coastal land loss rate between 1978 and 1990 is slightly higher than the sum of the individual basin loss rates because the basins as defined by the CWPPRA Task Force cover less total area than the 1978 data set. The land loss maps are intended for use as visual references to identify the spatial location of large areas or hot spots of loss or gain. Quantitative measures should not be made from these maps but rather from the 1978 and 1990 land cover/use area tables for the specified area of interest (Barras et al. 1994).

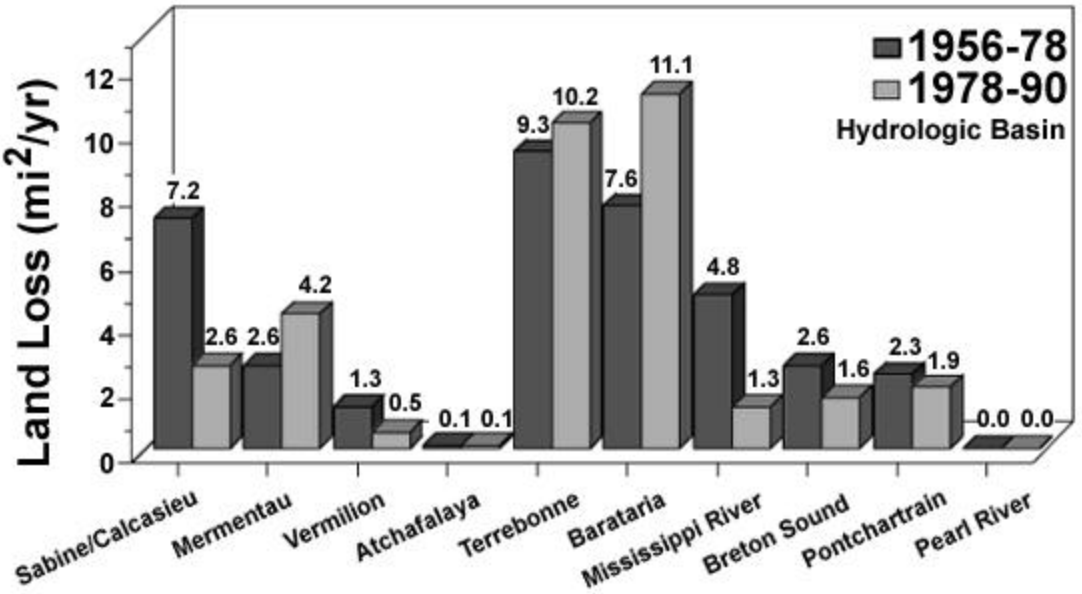
Discussion

Coastwide

Net land loss for coastal Louisiana for the time period 1978-90 was 418.8 mi^2, which equals a loss rate of 34.9 mi^2/yr for the 12-year period. Net land loss for the time period 1956-78 was 862.4 mi^2 which equals a loss rate of 39.4 mi^2/yr for the 22-year period. Land loss patterns have shifted between the 1956-78 and 1978-90 periods (Plate 1). Overall, the land loss rate has decreased from a high of 39.4 mi^2/yr between 1956 and 1978 and is concentrated in the southern deltaic plain. Land loss patterns have shifted from loss of primarily large areas of interior lands in the 1956-78 time period to also include loss of fringing marshes within the Terrebonne and Barataria Basins. The Chenier Plain of Louisiana has also suffered continued loss, although many of the larger areas of loss seem to be related to impounded areas where managed water levels may be affecting loss patterns by either increasing or decreasing areas of loss depending on management practices.

Basin Level

On the basin level, the Barataria and Terrebonne Basins continue to suffer the highest loss rates of 11.1 mi^2/yr and 10.2 mi^2/yr, accounting for 61% of all land loss in the 1978-90 time frame (Figure 2). Loss patterns within the Terrebonne and Barataria Basins are dominated by continued interior land loss, although loss of nonfresh, bay-fringing lands seems to have increased (Plates 6 and 7). Both basins also show some sign of land gain within interior lands, particularly within areas defined as floating marshes. Areas of greatest loss are concentrated east of the Bayou Dularge ridge within the Terrebonne Basin and along the entire south-central and southeastern portions of the Barataria Basin. The Mermentau and Sabine-Calcasieu Basins have the next highest with respective loss rates of 4.2 and 2.6 mi^2/yr (Plates 3 and 2).



Most losses within these basins are confined to large areas of internal loss within the northern and central portions except for shoreline erosion along the Mermentau Basin coastline. Loss rates within the Vermilion, Atchafalaya, Mississippi, Breton Sound, Pontchartrain, and Pearl River Basins are all less than 2 mi^2/yr, which seems to indicate more stable environments (Plates 4, 5, 9, 8, and 10). Examination of 1956-78 basin loss rates indicates that although the Barataria and Terrebonne Basins were undergoing loss rates of 7.6 mi^2/yr and 9.3 mi^2/yr, they accounted for only 43% of total land loss.
Significant loss rates were also occurring within the Sabine-Calcasieu (7.2 mi^2/yr) and the Mississippi River (4.8 mi^2/yr) Basins, both of which have current loss rates below 3 mi^2/yr.

Examination of land loss as a percentage of the total land area of each basin for each time period reveals that although current land loss rates within the Terrebonne and Barataria Basins are higher than the 1956-78 losses, the percentage of total land area loss was greater within the 1956-78 time frame than within the 1978-90 period (Figure 3). The total area of land loss is decreasing as remaining land area within each basin decreases. The Sabine-Calcasieu and Mississippi River Basins exhibited the highest percentage of total within-basin land area lost in the 1956-78 period but exhibited marked decreases in percentage of total land area loss in the 1978-90 time period, which may indicate a stabilization of loss rates within these basins.

All basins showed decreases in the total amount of land loss within each basin for the 1978-90 time period except for the Mermentau Basin, which actually showed a net increase in total land area lost. Examination of the land loss map for the Mermentau Basin indicates that some of this loss is due to flooded conditions occurring within impounded areas that were dry at the time the 1978 land cover data were acquired although large areas of loss located in the northwestern portion of the basin did not seem to be related to flooded impoundments (Plate 3).

The 1956-78 and 1978-90 land loss data are reliable indicators of land loss trends within coastal Louisiana but will contain some probable error because of a combination of environmental and technique-related factors. In most cases the error is minimal and will not significantly affect estimates of land loss. Examples of environmental factors include seasonal variation in spectral

response of vegetation and the raising or lowering of water levels caused by general climate conditions prevailing at the time the photography or satellite imagery was acquired. High water conditions will effectively decrease land area, thereby increasing land loss estimates, whereas low water conditions will have the opposite effect. Technique-related factors include false land loss or gain caused either by misclassification of water and land or by positional misregistration of land and water between land cover data sets used to create the land loss data sets. In any case, potential users should be aware that some error is inherent in land loss data.

Conclusions

Land loss rates within coastal Louisiana, although decreasing, remain high at 34.9 mi^2/yr for the 1978-90 time period. The Deltaic Plain accounts for 80.7% of total coastwide land loss, while the Chenier Plain accounts for the remaining 19.3% land loss for this time period. Loss rates are almost a magnitude higher within the Terrebonne and Barataria Basins than within all of the remaining basins and account for 61% of coastwide land loss between 1978 and 1990. Much of the large areas of land loss occurring within the Chenier Plain appears to be related to impounded areas and therefore may be an artifact of managed water levels. The land loss figures developed from this data can be used as an indicator of current land loss with the understanding that some error is inherent within the data because of procedural and environmental factors. The NWRC is planning to provide future land loss updates of coastal Louisiana utilizing Landsat TM satellite imagery on a 3-year basis to supplement the CWPPRA planning process. This information will provide a clearer understanding of land losses within coastal Louisiana.

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Literature Cited

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