

THE EFFECT OF HURRICANE BOB
(JULY 11, 1979) ON THE ST. LOUIS BAY
TIDAL MARSHES: TRANSPORT AND
RELOCATION OF DEBRIS

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Abstract

The effect of a low level hurricane (Bob) on the transport and relocation of marsh debris (dead plant material) was evaluated. Aerial photographs and ground truth data indicated that debris (wrack) was distributed on the marsh along areas of higher vegetation. The mean density of the resultant wrack was 2.19 kg/m^2 . Approximately $226 \times 10^3 \text{ kg}$ of unattached dead plant material was removed from the marsh and 7.7×10^3 redeposited as wrack. Little or no standing dead plant material was removed. Thus, $218 \times 10^3 \text{ kg}$ of dead plant material was removed from the 96 ha study area and transported from the marsh system.

Introduction

Hurricane Bob was a minor storm compared to other hurricanes which have ravaged the coasts of Mississippi and Louisiana. On 11 July 1979 this storm struck the eastern coast of Louisiana and the western coast of Mississippi with 38 knot sustained winds from the southeast (130°). Storm tides from one to one and a half meters above normal were reported from the Gulf Coast Research Lab located about 48 km east of the entrance to St. Louis Bay and east of the eye of the hurricane. A similar tidal surge appears to have occurred in St. Louis Bay, Mississippi based upon the location of tidal wrack following the storm.

Numerous reports on hurricane produced alterations of sand bars, deltas, and channels are available in the literature (Morgan 1959; Behrens 1969; Andrews 1970; McGowen et al 1970; Davis et al 1973). The effects of hurricanes on tidal marsh vegetation have also been examined (Ensminger and Nichols 1957; Harris and Chabreck 1958; Chamberlain 1959; Craighead and Gilbert 1962; Chabreck and Palmisano 1973). A question that has not been addressed in the literature is the effect of hurricanes on detrital flux. Although numerous authors have addressed the subject of detrital transport (de la Cruz 1965; Axelrad 1974; Day et al. 1973; Hackney and de la Cruz In Press; Heald 1969; Heinle and Flemer 1976; Moore 1974; Nadeau 1972; Nixon and Oviatt 1973; Settlemyre and Gardner 1977; Shisler 1975; Woodwell et al 1977), none of these authors provide any insight into the transport of detrital material during storm surges. One storm surge could potentially transport as much organic material as is produced in an estuary during an entire year.

The purpose of this study was to examine the effect of the storm surge from Hurricane Bob on the debris within St. Louis Bay. Through analysis of the changes in standing dead biomass and detached dead plant material we hoped to obtain information on the transport of debris during a storm event.

Materials and Methods

On 15 July 1979 aerial photos of the St. Louis Bay marshes were taken from approximately 325 m with infrared and standard color film. Later that day five quarter m² (0.5 m x 0.5 m) quadrats were collected from a Juncus roemerianus marsh and a Spartina cynosuroides marsh (Figure 1). All dead material still attached at the time of collection (dead standing) and dead material unattached to the marsh surface (debris) were placed in plastic bags and returned to the laboratory. Each sample was sorted into the proper category and dried at 103°C to a constant weight. These samples were collected adjacent to an area where similar samples were collected on 30 June 1979 (de la Cruz and Hackney, unpublished).

Using the aerial photographs, a detailed map of wrack (dense mats of dead plant material) was constructed for the Jourdan River marsh study area (Figure 2). With this as a guide, five areas of wrack were selected representing all parts of this area of marsh. Twelve samples were collected from five of these areas. Each sample consisted of all dead, unattached, plant matter under a 0.5 m x 0.5 m square. The wrack was generally suspended on top of dense vegetation (Figure 3). The area of wrack was estimated in each of the five study areas. These measurements of wrack size were used to estimate the total area of wrack based on the aerial photographs. All material not originating from the marsh was removed from each sample (i.e. plastic cups, logs etc.). Each sample was dried at 103°C to a constant weight.

Results and Discussion

Wrack was distributed on the marsh in the form of wind rows (Figure 2), the width of which varied from 1 to 15.7 meters. The location of the wind rows was generally associated with areas of higher plant growth in the S. cynosuroides marsh and areas of more vigorous plant growth in the J. roemerianus marsh. Because of the parallel distribution of these plant communities with the creeks and bayous, wrack was generally oriented in a similar fashion (Figure 2). The density of the wrack varied from 5.07 to 0.4 kg/m², with a mean of 2.19 kg/m² (Standard Error = 458.8 g/m²). Based upon ground truth data and aerial photographs we estimate that there were 7,075 kg of wrack on the 96 ha study area (Figure 2).

There was no statistically significant change in the amount of dead standing plant matter in either marsh type. In the Juncus marsh there were 802 g/m² of dead standing material before the storm surge and 812 g/m² after. There was a decline in the amount of dead standing plant material (1,208 to 809 g/m²) in the Spartina marsh following the storm. The difference was not statistically significant at $\alpha=0.05$. This area (Figure 1) borders the bay and wave action was probably greater here than in the Juncus marsh. The area of the marsh where the quadrats were collected was not unique. We observed differences on other areas of the marsh similar to those found near the quadrat collections.

The material in the wrack apparently did not come from the dead standing material, instead it was derived from the debris. There was a statistically significant drop ($\alpha = 0.05$) in the amount of debris present in both marsh types subsequent to the storm surge (542 to 290 g/m², $F_{1 \times 9} = 8.189$, for Juncus and 292 to 171 g/m², $F_{1 \times 9} = 6.340$ for Spartina).

The area of marsh encompassed in our study area (Figure 2) was composed of approximately 12% Spartina marsh and 88% Juncus marsh. Assuming that the loss of debris was constant throughout each marsh type then 252 g of debris was transported from each square meter of Juncus marsh and 121 g from each square meter of Spartina marsh. Thus, for the entire marsh approximately 226.8×10^3 kg of debris was removed from the marsh. This is considerably more than the 7,705 kg we found in the wrack following the storm. Certainly an argument could be developed around the fact that our sampling was limited. Thus, we would be reluctant to consider any differences within an order of magnitude as being a real difference. The 218,000 kg of debris that we could not account for on the marsh was too much to explain by sample error. Almost no wrack was present on the marsh before the storm, based upon our observations during the last year. Since we were working with just a small area of marsh, one could also argue that this material was displaced to other marshes and not really lost to the estuary. Although we cannot totally discount this argument, we did note that the area of wrack located on other marshes within the St. Louis Bay estuary was no larger than the area of wrack cover of our study area. Much of the debris found in the study area in the marsh was nearly saturated with water. We believe that this material becomes suspended in the water column and so is not deposited as wrack. Instead this debris material either settles in the submerged portions of the estuary or is washed from the estuary by the receding storm tide. The 218,000 kg of debris apparently lost from the 96 ha of marsh during the storm is many times greater than the net annual export of 3.1 kg of debris transported from 5.8 ha (Hackney 1977) of this same marsh.

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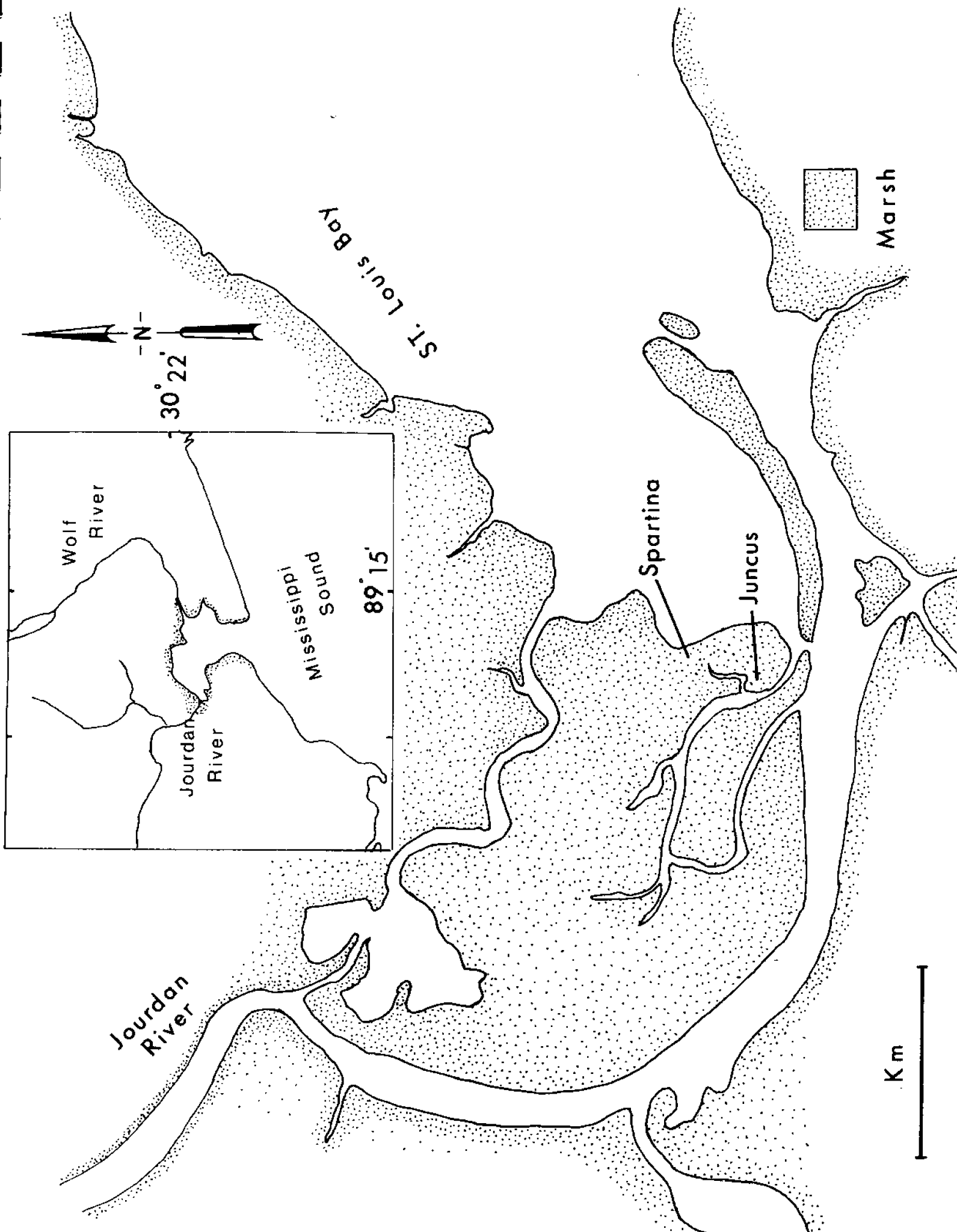
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Figure 1. The St. Louis Bay, Mississippi estuary and the Jourdan River marshes. The Spartina and Juncus areas denote collection sites for standing dead plant and litter collections.

Figure 2. Location of wrack deposited on the 96 ha study area. The line denotes the boundary of the study area. Areas of wrack have been slightly exaggerated to show the relative shape and location of wrack.

Figure 3. Characteristic location of wrack on top of dense vegetation.



St. Louis Bay

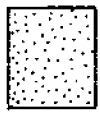
Wolf River
Jordan River
Mississippi Sound

$30^{\circ} 22'$

$89^{\circ} 15'$

Spartina

Juncus



Marsh

Jordan River

Km

