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CHANGES IN VEGETATIVE TYPES IN LOUISIANA COASTAL MARSHES OVER A 10-YEAR PERIOD

Robert H. Chabreck
School of Forestry and Wildlife Management
Louisiana State University
Baron Rouge, LA 70803

and

R. G. Linscombe
Louisiana Department of Wildlife and Fisheries
New Iberia, LA 70560

The total area of marshland and associated water bodies of the Louisiana coastal region encompassed 6,581 square miles ($mi^2$) in 1968 (1). That marshland borders the entire coastline of the state and extends inland 15 to 50 miles. Penfound and Hathaway (2) studied marsh plant communities of southeastern Louisiana and identified four vegetative types: saline, brackish, slightly fresh (intermediate) and fresh; they described the plant species composition of each type. The vegetative types occur in bands generally parallel to the shoreline of the Gulf of Mexico (1).

The saline vegetative type lies adjacent to the Gulf, major bays and sounds and is subjected to drastic tidal fluctuations and highly saline water (water salinity: $\bar{x}=18.1$ ppt). The brackish type is more inland than saline marsh and has slightly lower water salinity ($\bar{x}=8.2$ ppt) and less tidal fluctuation. The fresh type lies farthest inland than all other marsh types and is in areas relatively free of salt water and tidal action. The intermediate vegetative type is located between brackish and fresh types and is slightly brackish ($\bar{x}=3.3$ ppt). Intermediate type is comprised of certain plants that also commonly occur in the fresh type and others that commonly occur in the brackish type (1).

Marsh plants become established and grow within a specific range of water salinities (2). Species occupying a particular area will usually persist as long as water salinities remain within the desired range. Whenever water salinities in an area change, plant species in the area unable to tolerate the newly established condition will die. Other plant species, tolerant to the newly established condition, will then persist and/or invade the area.

Each vegetative type is comprised of species having similar water salinity requirements (2). Therefore, a long-term change in water salinity within a particular marsh area is usually followed by a change from one vegetative type to another within the area.

In 1968, a vegetative type map (3) of the Louisiana coastal marshes was prepared showing the boundary of each type. Plant species and associations described by Penfound and Hathaway (2) were used to identify vegetative types. In order to determine changes in vegetative types in the Louisiana coastal marshes over a 10-year period, the vegetative types were again
mapped in 1978 (4) and were compared with the 1968 survey by using a map overlay process. The size of the vegetative types and areas where vegetation types had changed to less saline or more saline conditions was computed using a planimeter.

The comparison of vegetative types disclosed that 1,440 mi² (21.9%) of the coastal marshland had changed in the 10-year period. This included a 13.7% change to more saline vegetative types and an 8.2% change to less saline types for a net increase to more saline conditions on 5.6% of the total marsh area or 367 mi². The greatest net change in area was in the fresh vegetative type, which decreased 139 mi² (6.8%) in size (Table 1). In contrast, the saline vegetative type increased 130 mi² (8.9%) in size, and the brackish type increased 37 mi² (1.8%). The intermediate type decreased 28 mi² (2.6%) in size. In 1968, the fresh vegetative type contained 2,031 mi² and was the largest type. The brackish vegetative type was only slightly smaller and contained 2,023 mi². However, in 1978 the brackish vegetative type contained 2,060 mi² and the fresh type occupied 1,892 mi².

The brackish and intermediate vegetative types are actually transitional zones between the saline and fresh vegetative types. As salt water moved farther inland during the 10-year interval, the saline type expanded in size and caused the transitional zones (brackish and intermediate types) to move farther inland with very little alteration in size. Consequently, the inland advancement of the saline vegetative type was done mostly at the expense of the fresh vegetative type.

The coastal region of Louisiana was previously subdivided into 9 hydrologic units for descriptive purposes with each unit generally encompassing a major drainage basin (5; Fig. 1).

Only a small net change in vegetative types was noted in marshes east of the Mississippi River (Hydrologic Units I and II; Table 2). Although the total change in Unit I was 113.9 mi² and in Unit II was 71.6 mi², the net change in area in each unit accounted for only 1.2% of the total marsh. Both hydrologic units combined moved toward less saline conditions on 102.1 mi² over the 10-year period. A major factor in reducing water salinities was the opening of the Bonnet Carree Spillway in 1973, which moved vast quantities of the Mississippi River flood waters through the area. Neverthe-
less, vegetative types reflected increased water salinities on 83.4 mi². Increased water salinity was mostly associated with the Mississippi River Gulf Outlet and other canals in the area which permitted salt water to move farther inland.

Hydrologic Unit III (the Mississippi River Delta area) generally changed to more saline conditions. Vegetative types reflecting increased salinities made up 48.2 mi² and types reflecting fresher conditions occupied 40.5 mi². The net area of change was 7.7 mi² and made up only 2.4% of the total hydrologic unit. The marshes with increasing salinities were actually north of the active delta in areas separated from Mississippi River waters by flood control levees. Canal dredging and subsidence were mainly responsible for increasing water salinities.

The greatest changes in vegetative types during the 10-year period were noted in the Barataria Basin (Hydrologic Unit IV; Table 2). More saline types increased on 258.8 mi² and less saline types increased on 51.7 mi² for a net change to more saline conditions on 207.1 mi² (17.2%) of the total marsh areas of the hydrologic unit. Highly saline waters from the Gulf of Mexico entered Barataria Bay and reached much of the area in the lower portion of the basin. Canal dredging and stream channelization provided a means for salt water to move farther inland. This basin lacks the large inflow of freshwater necessary to dilute salt water and maintain the vegetative types in their historical positions.

An overall change to more saline conditions was also noted in Hydrologic Unit V, which includes the marshes between Bayou Lafourche and the
Atchafalaya Basin. A change to vegetative types with higher salinities was noted on 210.3 mi² and lower salinities occurred on 80.9 mi². The net change was to more saline types on 129.4 mi² (10.1%) of the hydrologic unit. The greatest move to more saline conditions was in the central and eastern portions of Unit V, and the situation there was similar to that of Unit IV. Particularly noticeable were changes associated with the Houma Navigation Canal. In the western portion of Unit V, however, the trend was to fresher conditions. The low salinities resulted from the increased discharge of Atchafalaya River flood waters through the area during the early 1970’s.

No change in vegetative types was noted in Hydrologic Unit VI, the Atchafalaya Basin. The vast amounts of freshwater moving through the basin maintained the marshes as a fresh vegetative type.

Hydrologic Unit VII, which includes the marshes surrounding East and West Cote Blanche bays and Vermilion Bay, changed to slightly fresher conditions during the 10-year interval. More saline vegetative types were noted on 63.4 mi², but less saline types were produced on 103.9 mi² for a net change to less saline conditions on 40.5 mi² (8.2%) of the area. The situation in Unit VII was similar to that in Unit V with the portion of the unit nearer the Atchafalaya Basin changing to less saline conditions (the east portion of Unit VII). The western portion of Unit VII showed some change to more saline types. The Freshwater Bayou Navigation Canal appeared to be partially responsible for increasing salinities, although navigation locks near the Gulf of Mexico functioned as a partial barrier to salt water intrusion through the canal.

Hydrologic Units VIII and IX, which comprise the Chenier Plain of southwestern Louisiana, reflected a change to slightly saltier conditions from 1968 to 1978. The net change to more saline vegetative types occurred on 53.6 mi² (5.6%) in Hydrologic Unit VIII and 28.0 mi² (4.2%) in Hydrologic Unit IX. Salt water intrusion through canals dredged for navigational
purposes was responsible for much of the change. Particularly noticeable were more saline conditions associated with the Freshwater Bayou Navigation Canal, Mermentau River Navigation Canal, and Calcasieu Ship Channel. Levee systems constructed as salt water barriers served to reduce salinities in several areas.

In conclusion, the Louisiana coastal marshes changed to more saline vegetative types on 367 mi² during the 10-year interval. Areas in the coastal region where vegetative types showed little change or shifted to less saline types were those subjected to freshwater discharge from the Mississippi and Atchafalaya rivers. A change to more saline vegetative types was most evident in marshes transected by large canals connecting with the Gulf of Mexico.

References