Major Ecological Factors Controlling Plant Communities in Louisiana Marshes

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Approximately four and one-half million acres of marshlands are located in the southern part of Louisiana adjacent to the Gulf of Mexico. Almost two million acres of this area are suitable for use by range cattle. Although soil type influences range vegetation to a degree, water level and salinity of the free soil water are the key factors that determine plant communities in these marshlands (Penfound and Hathaway, 1938; Penfound, 1952). Where the quantity and quality of water can be manipulated important changes in vegetation may result in a relatively short time (Miller, 1956).

Marsh Plant Communities

The impact of water level and salinity on vegetation composition can be readily seen by examining the major plant communities and their optimum ranges in water level and salinity.

Starting at the Gulf's edge and moving inland across the marsh complex, several distinct plant communities occur (Penfound and Hathaway, 1938; Penfound, 1952; Soil Conservation Service, 1957). These communities are usually characterized by one dominant species which makes up 50 percent or more of the plant composition by weight (Figure 1). These include:

1. Smooth cordgrass *(Spartina alterniflora)* grows at the edge of seawater or in saline water trapped from high tides in depressions inland from the coast. It prefers a water level that fluctuates from 0 to 12 inches above ground level. Salinity requirements are from 1.2 to 5.0 percent in the free soil water. Smooth cordgrass normally grows in almost pure stands.
2. Seashore saltgrass *(Distichlis spicata)* occupies flats a few inches higher in elevation and inland from areas occupied by smooth cordgrass. Water level averages from six inches below ground level to two inches above. Salinity of soil water is between 0.5 and 5.0 percent. Associated sub-dominants are marshhay cordgrass *(Spartina patens)* and saltmarsh bulrush *(Scripus robustus)*.
3. Marshhay cordgrass occupies the greatest area of the salt marsh community (Figure 2). Its optimum fluctuating water level is −4 to +2 inches. Water salinity ranges from 0 to 2.5 percent. Associated species are seashore saltgrass, seashore paspalum *(Paspalum vaginatum)* and Olney bulrush *(Scripus olneyi)*.
4. Big cordgrass *(Spartina cynosuroides)* often occurs in nearly pure stands or in a co-dominant role with common reed *(Pharagmites*

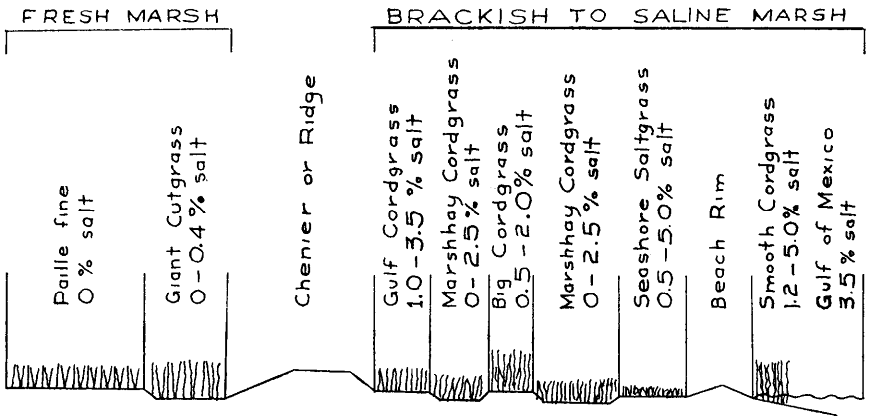

FIGURE 1. Plant communities of Louisiana marshes as influenced by water depth and salinity of the free soil water.

communis) on ground of slightly higher elevation within the other plant communities (Figure 2). The water level preferred is between −4 and +2 inches. Salinity requirements vary from 0.5 to 2.0 percent. The principal associated species is marshhay cordgrass.

5. Gulf cordgrass *(Spartina spartinae)* grows at intermediate elevations between the true marsh and the highland or ridges (Figure 2). Water levels range between −12 inches and ground level. Salinity range is normally from 1.0 to 3.5 percent. When salinity of this area falls below one percent the community is usually dominated by common reed.
6. Giant-cutgrass *(Zizaniopsis miliacea)* is the first dominant species encountered on fresh water marshes. It may occur in almost pure stands or in codominance with paille fine *(Panicum hemitomon)*. Giant-cutgrass prefers water levels of 0 to + 12 inches and will not grow where salinity exceeds 0.43 percent. It normally occurs on firm mineral soils. Associated species are California bulrush *(Scripus californicus)* and cattail *(Typha* spp.). Longtom *(Paspalum lividum)* may occur in small amount on higher areas.
7. Paille fine occurs in pure stands or with giant-cutgrass as a co-dominant. Water levels preferred are from −4 to +2 inches. It will tolerate practically no salt and grows on soil conditions that vary from mineral clay to "floating" peat.
8. Other fresh water communities in the slightly brackish and fresh marsh areas include cattail-bulrush *(Typha* spp.-*Scripus* spp.) and Jamacia sawgrass *(Cladium jamaicense)*. These normally require higher water levels and grow on soft marsh that has practically no value for range forage production.

All the plant communities discussed except the last are suitable for use as rangeland if the soil is firm enough to support cattle. Salt marshes are best grazed during the winter months. Insects especially mosquitoes and flies, limit their use during the rest of the year. Fresh water marshes normally provide the best grazing during early spring and summer. One exception to this is pure stands of giant-cutgrass which provides good winter grazing and can be used year-long better than any other community discussed.

Change in Plant Communities

How water level and salinity can be manipulated to influence plant composition is illustrated in an actual example on the Severin Miller Ranch at Grand Chenier, Louisiana. Miller was able to improve a 200-acre marsh to better suit his ranching enterprise despite a catastrophic storm which interrupted his plans and resulted in changes he did not expect.

The area affected was originally a fresh water marsh dominated by giant-cutgrass, California bulrush and rattlebox *(Daubentonia drummondi)*. Some longtom was present along

FIGURE 2. Three marsh plant communities; gulf cordgrass is in the light colored foreground, marshhay cordgrass in the background and big cordgrass in the upper right.

FIGURE 3. Miller's pasture five months after Hurricane Audrey. The vegetation is practically all seashore paspalum.

the edge of the marsh (Miller, 1956). Water levels were quite high and as Miller describes it "It would bog a horse most of the time". Livestock production was very low on the marsh since it could be safely used only during dry spells. The dense, heavy soil was identified as Harris clay. The vegetation indicated that the salinity was 0.40 percent or less.

In 1951 the area was leveed and a pump was installed to control water level and prevent intrusion of salt water. Miller's objective was to convert to a more productive and reliable permanent summer pasture and hay meadow. More summer grazing was needed to balance his cattle operation.

Weeds became a problem initially. These were controlled by mowing and aerial spraying. Close mowing also helped in eliminating the giant-cutgrass. By 1954, the area had become practically a pure stand of longtom which is an excellent summer grazing and hay plant. Longtom, a subdominant species on both fresh and slightly salty marshes, increased when competition from giant-cutgrass was removed (Soil Conservation Service, 1959; Williams, 1952). Williams (1952) describes longtom as growing on ridge flanks in fresh and slightly salty areas and growing in association with marshhay cordgrass on brackish marsh.

The area was used for grazing and hay production after the longtom became well established. The pasture was never dried completely by pumping except just prior to haying (Miller, 1956).

On June 27, 1957 a saline tidal wave from Hurricane Audrey struck Miller's ranch. Levees and pumps were destroyed and the entire area inundated with water containing an estimated 3.5 percent salt. Water stayed on the land for almost six months and practically all vegetation was killed.

The Soil Conservation Service initiated a study following Hurricane Audrey to determine the reaction of vegetation to the storm (Soil Conservation Service, 1960). Soil and water were analyzed periodically and vegetation observed each time samples were taken.

First samples were taken in November, 1957 five months after the hurricane. At this time water was an inch deep, salinity of the surface water was 0.11 percent and that of the upper four inches of soil 0.15 percent (Table 1). About 50 percent of the ground was covered with seashore paspalum (Figure 3).

By January 1958, salinity had increased to 0.36 percent, and seashore paspalum comprised 95 percent of the ground cover. This preponderance of seashore paspalum was unexpected. Little is known about the role of this grass in secondary succession on fresh water marshes. Penfound and Hathaway (1938) recorded its presence where salinity of free soil water was 1.1 percent,

Table 1. Soil and water salinity and vegetative composition of Severin Miller pasture[1]

Date	Salinity of Soil Water	Salinity of Soil 0-4″	Salinity of Soil 4-10″	Ground Cover Long-tom	Ground Cover Seashore Paspalum	Ground Cover Others
	(Percent)					
Prior to September 27, 1957 (Estimated)	0.40	0.30	0.15	95	0	5
November, 1957	0.11	0.15	0.14	0	50	0
January, 1958	0.36	0.15	0.15	0	95	5
June, 1958	0.40	0.22	0.12	0	90	10
February, 1959	0.40	0.10	0.12	0	90	10
July, 1959	0.43	0.30	0.15	5	90	5
June, 1960	[2]			30	65	5
September, 1960				50	45	5
September, 1961				85	5	10

[1] Soil and water samples analyzed as to the electrical conductivity of the soil saturation extract mmhos/cm, converted here to approximate percentage by weight.

[2] Water and soil analysis were discontinued after July, 1959.

but Miller's pasture was far below that level. Seashore paspalum is recognized as a subdominant species in the marshhay cordgrass community (Soil Conservation Service, 1959). Since none was present in the pasture before the storm, it is assumed that seashore paspalum seeds from the marshhay cordgrass community were in the mud deposited by the tidal wave.

By June 1958, the ground cover was 90 percent seashore paspalum and ten percent miscellaneous species. No longtom was present. By this time the levees had been restored and a new pump installed. The free soil water contained 0.40 percent salt and the soil 0.20 percent. By October, soil salinity was down to 0.10 percent in the top four inches. Plant composition was the same and water management was similar to that prior to the storm.

In July 1959, the first longtom was observed. It comprised five percent of he ground cover. Seashore paspalum still occupied 90 percent of the total area. Miscellaneous species made up the remaining five percent. Salinity of the free soil water had increased little from the February 1959 level, but that of the top four inches of soil had risen sharply to 0.30 percent due apparently to capillary action. In the four to ten inch soil depth salinity was 0.15 percent. These salinity conditions were estimated to be very close to those which existed before the storm.

Soil and water analyses were discontinued after July 1959, but vegetational observations were continued through 1961. By June 1960, longtom covered an estimated 30 percent of the area, seashore paspalum 65 percent and miscellaneous species the remaining five percent. Three months later longtom occupied some 50 percent. Hay was cut from selected areas for the first time since the hurricane in 1957.

FIGURE 4. In September 1961 the pasture was 85 percent covered by longtom. Seashore paspalum is practically gone.

In September 1961, longtom again fully dominated this area (Figure 4) covering 85 percent of the ground. Seashore paspalum covering only five percent, was confined to the wettest areas. Its vigor was generally low. Bermuda grass *(Cynodon dactylon)* made up the bulk of the remaining ten percent. This intrusion apparently resulted from keeping the water level low. Bermuda grass is as salt tolerant as longtom but not as water tolerant.

In just over four years Miller's pasture had returned to near the pre-storm vegetational composition. According to Miller, productivity has not reached the level experienced before the storm.

In mid-September, 1961 nature took another swing at Miller's ranch. Hurricane Carla missed the area but created storm tides which inundated the pasture with salt water and did some damage to the levee system. The standing hay crop was damaged by the deep saline water. Apparently residual salt from the storm stunted the 1962 growth but had not material effect on plant composition.

Conclusion

Water depth and salinity exert major influences on plant composition of marshland ranges. Manipulation of these factors by use of pumps and levees can be used to change the plant composition to better fit the livestock enterprise. The giant-cutgrass community can be converted to longtom by lowering water level, preventing salt water intrusion, and mowing.

Seashore paspalum may become dominant when the longtom is killed by deep saline water such as that received from storm tides. Rapid removal of storm tide water is necessary if longtom stands are to be maintained. Seashore paspalum withstands more salt than longtom, tolerating up to 1.1 percent in the free soil water. The upper limit for longtom is 0.5 percent. Longtom requires a wet soil but will not tolerate more than four inches of water above the soil surface for extended periods of time. Seashore paspalum apparently requires some water above the surface to compete with other species and will stand a higher level of flooding than longtom.

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