USDA Natural Resources Conservation Service

Ecological site R150BY550TX
Northern Salt Marsh

Last updated: 9/22/2023
Accessed: 05/11/2025

General information

Provisional. A provisional ecological site description has undergone quality control and quality assurance review. It contains a working state and transition model and enough information to identify the ecological site.

Figure 1. Mapped extent

Areas shown in blue indicate the maximum mapped extent of this ecological site. Other ecological sites likely occur within the highlighted areas. It is also possible for this ecological site to occur outside of highlighted areas if detailed soil survey has not been completed or recently updated.

MLRA notes

Major Land Resource Area (MLRA): 150B–Gulf Coast Saline Prairies

MLRA 150B is in the West Gulf Coastal Plain Section of the Coastal Plain Province of the Atlantic Plain and entirely in Texas. It makes up about 3,420 square miles. It is characterized by nearly level to gently sloping coastal lowland plains dissected by rivers and streams that flow toward the Gulf of Mexico. Barrier islands and coastal beaches are included. The lowest parts of the area are covered by high tides, and the rest are periodically covered by storm tides. Parts of the area have been worked by wind, and the sandy areas have gently undulating to irregular topography because of low mounds or dunes. Broad, shallow flood plains are along streams flowing into the bays. Elevation generally ranges from sea level to about 10 feet, but it is as much as 25 feet on some of the dunes. Local relief is mainly less than 3 feet. The towns of Groves, Texas City, Galveston, Lake Jackson, and Freeport are in the northern half of this area. The towns of South Padre Island, Loyola Beach, Corpus Christi, and Port Lavaca are in the southern half. Interstate 37 terminates in Corpus Christi, and Interstate 45 terminates in Galveston.

Classification relationships

USDA-Natural Resources Conservation Service, 2006.
-Major Land Resource Area (MLRA) 150B

Ecological site concept

Salt Marshes are closed depressions of the inland Coastal Plains exhibiting salt-tolerant vegetation.

Associated sites

R150BY551TX	**Salty Prairie** This site is on a higher landform and not as wet.
R150BY552TX	**Tidal Flat** This site is on a lower landform and is subject to daily tides.
R150BY530TX	**Northern Coastal Sand** This site is in a higher site and are sandy throughout.

Similar sites

R150BY652TX	**Southern Salt Marsh** This site is in a drier precipitation regime.

Table 1. Dominant plant species

Tree	Not specified
Shrub	Not specified
Herbaceous	(1) *Spartina patens* (2) *Spartina spartinae*

Physiographic features

The Salt Marsh formed in flood plains and flats on the barrier islands and coastal plains adjacent to the Gulf of Mexico. They are on broad tidal areas in coastal marshes. The landscape is typically very flat and interspersed with small drainages, small depressional areas, and variable sized open water bays. Streams or rivers that flow may cross towards the ocean. The marshlands may extend a few hundred yards or up to several miles from the coast depending on the slope gradient. Due to their location between the ocean and inland, the marshes are influenced by tides, saline substrates, and freshwater inflows. This site was formed in saline clayey coastal sediments. The slope is nearly level with elevation ranging from 0 to 10 feet.

Table 2. Representative physiographic features

Landforms	(1) Delta plain > Flood plain (2) Coastal plain > Marsh
Runoff class	Negligible to high
Flooding duration	Long (7 to 30 days)
Flooding frequency	Occasional to frequent
Ponding duration	Very brief (4 to 48 hours) to very long (more than 30 days)
Ponding frequency	None to occasional
Elevation	0–10 ft
Slope	0–1%
Water table depth	0–30 in
Aspect	Aspect is not a significant factor

Climatic features

The climate is predominately maritime, controlled by the warm and very moist air masses from the Gulf of Mexico. The climate along the upper coast of the barrier islands is subtropical subhumid and the climate on the lower coast

of Padre Island is subtropical semiarid (due to high evaporation rates that exceed precipitation). Almost constant sea breezes moderate the summer heat along the coast. Winters are generally warm and are occasionally interrupted by incursions of cool air from the north. Spring is mild and damaging wind and rain may occur during spring and summer months. Tropical cyclones or hurricanes can occur with wind speeds of greater than 74 mph and have the potential to cause flooding from torrential rainstorms. Despite the threat of tropical storms, the storms are rare. Throughout the year, the prevailing winds are from the southeast to south-southeast.

The average annual precipitation is 45 to 57 inches in the northeastern half of this area, 26 inches at the extreme southern tip of the area, and 30 to 45 inches in the rest of the area. Precipitation is abundant in spring and fall in the southwestern part of the area and is evenly distributed throughout the year in the northeastern part. Rainfall typically occurs as moderate-intensity, tropical storms that produce large amounts of rain during the winter. The average annual temperature is 68 to 74 degrees F. The freeze-free period averages 340 days and ranges from 315 to 365 days.

Table 3. Representative climatic features

Frost-free period (characteristic range)	261-365 days
Freeze-free period (characteristic range)	365 days
Precipitation total (characteristic range)	41-49 in
Frost-free period (actual range)	247-365 days
Freeze-free period (actual range)	365 days
Precipitation total (actual range)	37-50 in
Frost-free period (average)	318 days
Freeze-free period (average)	365 days
Precipitation total (average)	44 in

Climate stations used

- (1) ARANSAS WR [USC00410305], Tivoli, TX
- (2) PORT O'CONNOR [USC00417186], Port O Connor, TX
- (3) PALACIOS MUNI AP [USW00012935], Palacios, TX
- (4) MATAGORDA NO 2 [USC00415659], Matagorda, TX
- (5) FREEPORT 2 NW [USC00413340], Freeport, TX
- (6) GALVESTON SCHOLES FLD [USW00012923], Galveston, TX
- (7) GALVESTON [USW00012944], Galveston, TX

Influencing water features

This site has an Aquic soil moisture regime. Gulf storms and high tides flood most areas occasionally or frequently for long periods. Ponding occurs on some areas for very long periods. A permanent water table can be found within 30 inches of the surface during most of the year. Runoff is negligible on depressed sites and high on others due to the high water table. These are hydric soils.

Wetland description

These areas have hydric soils. Onsite investigation needed to determine local conditions.

Soil features

The site consists of very deep, saline, very poorly drained, very slowly permeable soils. Tidal influence and salty substrates produce saline to brackish conditions. However, at any given location, the degree of salinity is a result of the local interaction of tidal influence, freshwater inflows, and substrate salt content. This site has an Aquic soil moisture regime with gleyed colors throughout the profile. Other features include moderate to strong sodicity and neutral to strong alkalinity. Soil correlated to this site include: Placedo, Swan, Velasco, and Veston.

Table 4. Representative soil features

Parent material	(1) Alluvium–igneous, metamorphic and sedimentary rock
Surface texture	(1) Clay (2) Silty clay
Family particle size	(1) Clayey (2) Fine-silty
Drainage class	Poorly drained to very poorly drained
Permeability class	Very slow
Soil depth	80 in
Surface fragment cover <=3"	0%
Surface fragment cover >3"	0%
Available water capacity (0-60in)	3–7 in
Calcium carbonate equivalent (0-60in)	0–8%
Electrical conductivity (0-60in)	8–24 mmhos/cm
Sodium adsorption ratio (0-60in)	13–65
Soil reaction (1:1 water) (0-60in)	7.9–9
Subsurface fragment volume <=3" (25-60in)	0–1%

Ecological dynamics

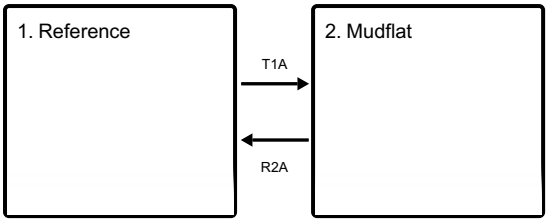
The environment is largely controlled by the Salt Marshes position between the ocean and inland upland sites. The generally flat, featureless plain is influenced by flooding of ocean tides, which vary seasonally and from year-to-year in their extent, duration, depth, and degree of salinity. In opposition to these ocean influences are freshwater inflows which move into the marsh as sheet flow from adjacent areas following precipitation events or result from flood overflow of streams that cross through the marsh from inland areas. Throughout the marsh, slight variations of a few inches in relief can produce noticeable changes in the plant community since minor variations in elevation can locally alter the salinity and water regime.

Within the marsh, many features add heterogeneity to the landscape and increase vegetation variability. Included are many small streams to large rivers that cross the marsh with their associated levees, oxbows, tidal guts, or drains that carry tidal waters inland. Depressional wetlands and small-to-large ridges that resulted from historic differential deposition and erosion within this geomorphologically recent and active surface are present. Interspersed within the vegetated marsh may be open water bays and mudflats that vary in size, depth, and duration of standing water. The interaction of the tidal influence and the freshwater inflows are temporally and spatially variable which contribute to vegetative variation. This results from the local internal variation in elevation, as well as the rise in elevation from the coast inland, which may be subtle and gradual over long distances or can be abrupt and rapid over short distances.

All the variables contribute influences on the degree and rate of change of water and salinity regime moving inland. This correspondingly controls change in plant composition, which may be gradual and continuous when there is a minor elevation gradient or more zonal where it is more abrupt. The variation in salinity fluctuates as the site is further away from the ocean. Typically, saline water (greater than 10 parts per thousand of salt) is found closest to the ocean. Located further inland, they become brackish (3.5 to 10 parts per thousand), then intermediate (0.5 to 3.5 parts per thousand). Eventually, they arrive on the inland border as fresh marsh with less than 0.5 parts per thousand of salt.

State and transition model

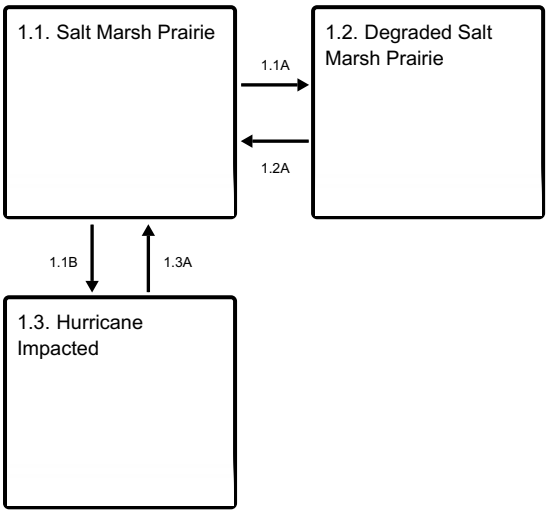
Ecosystem states



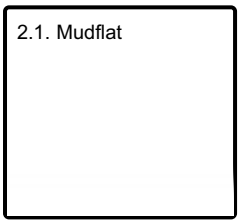
T1A - Extreme disturbance event coupled with excessive grazing pressure

R2A - Absence of disturbance, reintroduction of native species and natural regeneration over time

State 1 submodel, plant communities



State 2 submodel, plant communities



State 1
Reference

The Reference state is considered to be representative of pre-Euro settlement conditions. Historically the marsh was highly variable in both microtopography and vegetation. Community phase changes are primarily driven by flooding of ocean tides, which vary seasonally and from year-to-year in their extent, duration, depth, and degree of salinity. As well as freshwater inflows which move into the marsh as sheet flow from adjacent areas following precipitation events or result from flood overflow of streams that cross through the marsh from inland areas.

Dominant plant species

- saltmeadow cordgrass (*Spartina patens*), grass
- common reed (*Phragmites australis*), grass

Community 1.1
Salt Marsh Prairie

The reference community is a mixture of mid and tallgrasses making up greater than 80 percent of the biomass. Dominant grasses include marshhay cordgrass (*Spartina patens*), common reed (*Phragmites australis*), and seashore dropseed (*Sporobolus virginicus*). Interstitial graminoids include shoregrass (*Monanthochloe littoralis*), seashore paspalum (*Paspalum vaginatum*), and bulrushes (Scirpus spp.). Forbs include dwarf glasswort (Salicornia

virginica), sea lavender (*Limonium carolinianum*), and seacoast sumpweed (*Iva annua*). Shrubs and half-shrubs are generally sparse in this community, but if present may include sea oxeye (*Borrichia frutescens*) and wolfberry (*Lycium carolinianum*). Smooth cordgrass (*Spartina alterniflora*), seashore saltgrass (*Distichlis spicata*), and saltmarsh bulrush (*Bolboschoenus robustus*) occur on the more saline areas. Fresher parts of the site are indicated by the presence of Common reed, big cordgrass (*Spartina cynosuroides*), and seashore paspalum. Shifts in composition may occur due to changes in the water and/or salinity regimes or in response to grazing impacts. Any of these sets of factors may produce similar vegetation responses and thus careful assessment must be made to determine the cause of observed changes. Many of the graminoids become coarse and unpalatable at maturity and fire can be used to stimulate new, more palatable growth and increase production. Improper grazing can cause a decrease in cordgrass, seashore dropseed, and common reed. When they are grazed frequently, they will be eliminated from the site because their root system is unable to recover. When the desirable plants have decreased, less desirable plants such as inland saltgrass and smooth cordgrass start to increase. Cordgrasses and other plants within this community primary reproduce vegetatively by rhizomes, which makes this site very resilient to disturbance. However, once they are eliminated they are hard to reestablish. Reseeding is not an option for this site because most of the seeds from these species are sterile. To reestablish these species transplanting or bringing in rhizomes are possible options for reestablishment. Unwanted species are limited due to the high salinity in the soil. Plants that are intolerant of salt are controlled with a tidal surge or hurricanes.

Table 5. Annual production by plant type

Plant Type	Low (Lb/Acre)	Representative Value (Lb/Acre)	High (Lb/Acre)
Grass/Grasslike	6300	9000	11700
Shrub/Vine	350	500	650
Forb	350	500	650
Tree	0	0	0
Total	**7000**	**10000**	**13000**

Figure 9. Plant community growth curve (percent production by month). TX7751, Midgrass Prairie Community. Open grassland plain composed of mid-grasses with seacoast bluestem and gulfdune paspalum dominate the site..

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0	0	5	15	20	15	10	10	15	6	4	0

Community 1.2
Degraded Salt Marsh Prairie

Changes in the plant community are characterized by a decrease in common reed, seashore dropseed, and marshhay cordgrass. Other plants such as inland saltgrass, smooth cordgrass, gulf cordgrass, sea ox-eye, devil weed (Leucosyris spinosa), and sesbania increase. Plants within this community have high salt tolerance. Plants found in this community can tolerate grazing because of their growth forms. Rhizomes are present on most of the species, which allow this community to withstand extended intense grazing because they are not dependent on producing seeds. Gulf cordgrass has leaves with a sharp point and high lignin content, both of which reduce desirability to cattle. Inland saltgrass is a course-growing plant, which makes it unpalatable to cattle. Ground surface changes occur within this community. Bare ground is increased because of improper grazing. Litter on this site is reduced because the plants are heavily grazed and above ground biomass is removed. Fire is used to maintain this community to make the gulf cordgrass more palatable. With proper grazing management and fire, restoring this community back to the Salt Marsh Prairie Community is possible. However, restoring this community will require time. If too much vegetation is lost, reseeding is not an option for this site because most of the native species found on this site produce sterile seeds. To reestablish these species transplanting or sprigging are options. If grazing pressure is not reduced or a hurricane occurs, this community will transition to a Mudflat Community (2.1).

Community 1.3
Hurricane Impacted

The Hurricane Impacted Community (1.3) is characterized by vegetation that has been burned due to high salinity content carried by storm-driven flooding and by high winds laden with coastal water. Vegetation may be buried under thick sediment deposits left by storm surges. Some areas are scoured and devoid of vegetation and may temporarily suffer complete vegetative loss. Vegetation production will vary greatly in this community depending on the amount of plant survival and depth of sediment burial. Bare ground is abundant within this community because of the sediment deposit caused by a hurricane. The amount of sediment deposited on this site will determine how long it takes the site to return to the reference community. However, it is estimated that it will take 1 to 5 years to recover, depending on which community was impacted. More than likely, the reference community will recover naturally, whereas the Degraded Salt Marsh (1.2) will more easily transition to the Mudflat State (2). Areas that have a higher number of plant species that can tolerate salinity will recover quicker than areas that have plants with a lower tolerance to salinity. Salt-tolerant species may have a noticeable die-off following a hurricane depending on the amount of soil removed from around the roots. If the roots are exposed to sunlight and air, it causes mortality in the plants. This delays the recovery rate back to the reference community. Hurricanes are a natural deterrent to invasive plants because they are not adapted to high levels of salinity that is often associated with a hurricane. Invasive plants are usually eliminated from the community after the passing of a hurricane and its associated storm surges. Grazing pressure should be reduced post-hurricane. Without rest, this community will take longer to reach the reference community. Plant revegetation can be slow, but to hasten restoration revegetating is an option to assist in recovery.

Pathway 1.1A
Community 1.1 to 1.2

Heavy grazing will impact the site negatively and cause a transition to Community 1.2.

Pathway 1.1B
Community 1.1 to 1.3

Hurricanes and storm surges denude vegetation and cause the transition to Community 1.3.

Pathway 1.2A
Community 1.2 to 1.1

Prescribed grazing, specifically deferment, will allow the vegetation to transition back to reference conditions.

Pathway 1.3A
Community 1.3 to 1.1

Natural or land manager-induced revegetation will restore the reference community.

State 2
Mudflat

This state is the result of severe disturbance and is characterized by sparse vegetation and extensive bare ground.

Community 2.1
Mudflat

The Mudflat Community (2.1) represents extreme disturbance for this site. This community is typified by sparse vegetation. The site may have large areas devoid of plants. However, some remnants of plants may exist depending on the extent of the damage from grazing or a hurricane. A hurricane or destructive grazing by snow geese and/or livestock are drivers for this community transition. Returning to the Salt Marsh Prairie (1) requires extensive restoration. Plants such as marshhay cordgrass, common reed, and seashore dropseed reproduce primarily vegetatively, which makes it hard for them to reestablish. If plants remain on site, it will take to self-propagate because the seeds they produce are not viable. However, to reestablish them on a site, vegetative stem propagation or transplanting are options. Grazing should not be allowed on this site due to the limited amount of forage.

Transition T1A
State 1 to 2

Heavy overgrazing or a hurricane can cause the transition to State 2. The Degraded Salt Marsh Community (1.2) is at risk to transition, as is the Hurricane Impacted Community (1.3) if the site is not allowed to revegetate.

Restoration pathway R2A
State 2 to 1

Revegetation of the natural plant system is necessary to restore the Salt Marsh Prairie State (1). Revegetating can be difficult because it requires sprigging as seed sources are usually not viable.

Additional community tables

Table 6. Community 1.1 plant community composition

Group	Common Name	Symbol	Scientific Name	Annual Production (Lb/Acre)	Foliar Cover (%)
Grass/Grasslike					
1	**Tall/midgrasses**			5600–10400	
	common reed	PHAU7	*Phragmites australis*	5600–10000	–
	saltmeadow cordgrass	SPPA	*Spartina patens*	5600–10000	–
	seashore dropseed	SPVI3	*Sporobolus virginicus*	5600–10000	–
2	**Tall/midgrasses**			350–650	
	smooth cordgrass	SPAL	*Spartina alterniflora*	350–600	–
	saltgrass	DISP	*Distichlis spicata*	200–400	–
	longtom	PADE24	*Paspalum denticulatum*	200–400	–
	seashore paspalum	PAVA	*Paspalum vaginatum*	200–400	–
	switchgrass	PAVI2	*Panicum virgatum*	200–400	–
	marsh bristlegrass	SEPA10	*Setaria parviflora*	200–400	–
	gulf cordgrass	SPSP	*Spartina spartinae*	0–200	–
3	**Rushes**			350–650	
	chairmaker's bulrush	SCAM6	*Schoenoplectus americanus*	350–650	–
Forb					
4	**Forbs**			350–650	
	annual marsh elder	IVAN2	*Iva annua*	300–600	–
	bushy seaside tansy	BOFR	*Borrichia frutescens*	300–600	–
	eastern annual saltmarsh aster	SYSU5	*Symphyotrichum subulatum*	300–600	–
	hairypod cowpea	VILU3	*Vigna luteola*	300–600	–
	salt heliotrope	HECU3	*Heliotropium curassavicum*	100–300	–
	sea lavender	LIMON	*Limonium*	100–300	–
	dwarf saltwort	SABI	*Salicornia bigelovii*	100–300	–
	Virginia glasswort	SADE10	*Salicornia depressa*	100–300	–
	turtleweed	BATIS	*Batis*	100–300	–
Shrub/Vine					
5	**Shrubs/Vines**			350–650	
	eastern baccharis	BAHA	*Baccharis halimifolia*	100–600	–
	Carolina desert-thorn	LYCA2	*Lycium carolinianum*	100–600	–
	bigpod sesbania	SEHE8	*Sesbania herbacea*	100–600	–

Animal community

The animal communities of the Coastal Prairie communities are influenced by fresh and salt water inundations. Cattle and many species of wildlife make extensive use of the site. White-tailed deer may be found scattered across the prairie and are found in heavier concentrations where woody cover exists. Feral hogs are present and at times become abundant. Coyotes are abundant and fill the mammalian predator niche. Rodent populations rise during drier periods and fall during periods of inundation. Alligators are locally abundant and make frequent use of the marshes depending on salt concentrations in the marshes.

The region is a major flyway for waterfowl and migrating birds. Hundreds of thousands of ducks, geese, and sandhill cranes abound during winter. Whooping cranes are an important endangered species that occur in the area, especially near Aransas National Wildlife Refuge. Northern harriers are common predatory birds seen patrolling marshes. Curlews, plovers, sandpipers, and willets are shorebirds that make use of the tidal areas. Seagulls and terns are plentiful throughout the year trolling the shores as well. Further inland, rails, gallinules, and moorhens make use of the brackish marshes.

Hydrological functions

In the Salt Marsh Prairie State (1) infiltration into marshy sandy soils is low because the water table is high. This site is a wetland and as such serves as a part of the wetland filtering system that is essential to the Gulf Coast. Because of landscape position, this site receives seepage water from adjacent sites and may be inundated following extensive rains from rainfall and seepage. Runoff and erosion from water are seldom a problem in the Cordgrass Plant State except for ship wake.

The hydrology of the Mudflat State (2) functions differently depending on the soil deposited following a hurricane. If it was a sandy textured soil infiltration will be high, however, if the soil had a clay type texture it is expected to have slower infiltration. As vegetation increases, infiltration will increase. The more slope on the site the high the runoff will be and the higher chance of erosion that is likely to occur because of the sand found in the soil.

Recreational uses

The beach area is a popular tourist designation throughout the year. Bird watching and saltwater fishing are other recreational uses.

Inventory data references

Information presented was derived from the Salty Marsh Range Site Description, NRCS clipping data, literature, field observations, and personal contacts with range-trained personnel.

Other references

Archer, S. 1994. Woody plant encroachment into southwestern grasslands and savannas: rates, patterns and proximate causes. Ecological implications of livestock herbivory in the West, 13-68.

Archer, S. and F. E. Smeins. 1991. Ecosystem-level processes. Grazing Management: An Ecological Perspective. Edited by R.K. Heischmidt and J.W. Stuth. Timber Press, Portland, OR.

Bailey, V. 1905. North American Fauna No. 25: Biological Survey of Texas. United States Department of Agriculture Biological Survey. Government Printing Office, Washington D. C.

Beasom, S. L, G. Proudfoot, and J. Mays. 1994. Characteristics of a live oak-dominated area on the eastern South Texas Sand Plain. In the Caesar Kleberg Wildlife Research Institute Annual Report, 1-2.

Bestelmeyer, B. T., J. R. Brown, K. M. Havstad, R. Alexander, G. Chavez, and J. E. Herrick. 2003. Development and use of state-and-transition models for rangelands. Journal of Range Management, 56(2):114-126.

Briske, B. B, B. T. Bestelmeyer, T. K. Stringham, and P. L. Shaver. 2008. Recommendations for development of

resilience-based State-and-Transition Models. Rangeland Ecology and Management, 61:359-367.

Brown, J. R. and S. Archer. 1999. Shrub invasion of grassland: recruitment is continuous and not regulated by herbaceous biomass or density. Ecology, 80(7):2385-2396.

Butzler, R. E. 2006. The Spatial and Temporal Patterns of *Lycium carolinianum* Walt. M. S. Thesis. Texas A&M, College Station, TX.

Chabreck, R. H. 1972. Vegetation, water and soil characteristics of the Louisiana coastal region. Louisiana State University Agriculture Experiment Station Bulletin, 664.

Davis, W. B. 1974. The Mammals of Texas. Texas Parks and Wildlife Department Bulletin, 41.

Drawe, D. L., A. D. Chamrad, and T. W. Box. 1978. Plant communities of the Welder Wildlife Refuge. The Welder Wildlife Refuge, Sinton, TX.

Drawe, D. L., K. R. Kattner, W. H. McFarland, and D. D. Neher. 1981. Vegetation and soil properties of five habitat types on north Padre Island. Texas Journal of Science, 33:145-157.

Everitt, J. H., D. L. Drawe, and R. I. Leonard. 2002. Trees, Shrubs, and Cacti of South Texas. Texas Tech University Press, Lubbock, TX.

Foster, J. H. 1917. Pre-settlement fire frequency regions of the United States: A first approximation. Tall Timbers Fire Ecology Conference Proceedings, 20.

Frost, C. C. 1995. Presettlement fire regimes in southeastern marshes, peatlands, and swamps. Tall Timbers Fire Ecology Conference Proceedings, 19:39-60.

Fulbright, T. E., D. D. Diamond, J. Rappole, and J. Norwine. 1990. The Coastal Sand Plain of Southern Texas. Rangelands, 12:337-340.

Fulbright, T. E., J. A. Ortega-Santos, A. Lozano-Cavazos, and L. E. Ramirez-Yanez. 2006. Establishing vegetation on migrating inland sand dunes in Texas. Rangeland Ecology and Management, 59:549-556.

Gosselink, J.D., C.L. Cordes, and J.W. Parsons. 1979. An. Ecological characterization study of the Chenier Plain Coastal Ecosystem of Louisiana and Texas. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Gould, F. W. 1975. The Grasses of Texas. Texas A&M University Press, College Station, TX.

Gould, F. W. and T. W. Box. 1965. Grasses of the Texas Coastal Bend. Texas A&M University Press, College Station, TX.

Grace, J. B., L. K. Allain, H. Q. Baldwin, A. G. Billock, W. R. Eddleman, A. M. Given, C. W. Jeske, and R. Moss. 2005. Effects of prescribed fire in the coastal prairies of Texas. USGS Open File Report, 2005-1287.

Hamilton, W. and D. Ueckert. 2005. Rangeland woody plant control: Past, present, and future. Brush management: Past, present, and future, 3-16.

Harcombe, P. A. and J. E. Neaville. 1997. Vegetation types of Chambers County, Texas. The Texas Journal of Science, 29:209-234.

Hatch, S. L., J. L. Schuster, and D. L. Drawe. 1999. Grasses of the Texas Gulf Prairies and Marshes. Texas A&M University Press, College Station, TX.

Johnson, M. C. 1963. Past and present grasslands of southern Texas and northeastern Mexico. Ecology 44(3):456-466.

Lehman, V. W. 1965. Fire in the range of Attwater's prairie chicken. Tall Timbers Fire Ecology Conference Proceedings, 4:127-143.

Mann, C. 2004. 1491: New Revelations of the Americas before Columbus. Vintage Books, New York City, NY.

Mapston, M. E. 2007. Feral Hogs in Texas. Texas Agrilife Extension Bulletin, B-6149

McAtee, J. W., C. J. Scifres, D. L. and Drawe. 1979. Digestible energy and protein content of gulf cordgrass following burning or shredding. Journal of Range Management, 376-378.

McGowen, J. H., L. F. Brown, T. J. Evans, W. L. Fisher, and C. G. Groat. 1976. Environmental geologic atlas of the Texas Coastal Zone-Bay City-Freeport area. The University of Texas at Austin, Bureau of Economic Geology, Austin, TX.

Miller, D. L., F. E Smeins, and J. W. Webb. 1998. Response of a Texas *Distichlis spicata* coastal marsh following Lesser Snow Goose herbivory. Aquatic Botany, 61:301-307.

Miller, D. L., F. E. Smeins, and J. W. Webb. 1996. Mid-Texas coastal marsh change (1939-1991) as influenced by Lesser Snow Goose herbivory. Journal of Coastal Research, 12:462-476.

Miller, D. L., F. E. Smeins, J. W. Webb, and M. T. Longnecker. 1997. Regeneration of Scirpus americanus in a Texas coastal marsh following Lesser Snow Goose herbivory. Wetlands, 17:31-42.

Oefinger, R. D. and C. J. Scifres. 1977. Gulf cordgrass production, utilization, and nutritional value following burning. Texas Agricultural Experiment Station Bulletin, B-1176.

Palmer, G. R., T. E. Fulbright, and G. McBryde. 1995. Inland sand dune reclamation on the Coastal Sand Plain of Southern Texas. Caesar Kleberg Wildlife Research Institute Annual Report, 1994-1995.

Prichard, D. 1998. Riparian area management: A user guide to assessing proper functioning condition and the supporting science for lotic areas. Bureau of Land Management, Denver, CO.

Rappole, J. H. and G. W. Blacklock. 1985. Birds of the Texas Coastal Bend: Abundance and distribution. Texas A&M University Press, College Station, TX.

Scifres, C. J. and W. T. Hamilton. 1993. Prescribed burning for brushland management: The South Texas example. Texas A&M Press, College Station, TX.

Scifres, C. J., J. W. McAtee, and D. L. Drawe 1980. Botanical, edaphic, and water relationships of gulf cordgrass (Spartina spartinae [Trin.] Hitchc.) and associated communities. The Southwestern Naturalist, 25(3):397-409.

Shiflet, T. N. 1963. Major ecological factors controlling plant communities in Louisiana marshes. Journal of Range Management, 16:231-235.

Singleton, J. R. 1951. Production and utilization of waterfowl food plants on the east Texas gulf coast. Journal of Wildlife Management, 15:46-56.

Smeins, F. E., D. D. Diamond, and W. Hanselka. 1991. Coastal prairie, 269-290. Ecosystems of the World: Natural Grasslands. Edited by R. T. Coupland. Elsevier Press, Amsterdam, Netherlands.

Smeins, F. E., S. Fuhlendorf, and C. Taylor, Jr. 1997. Environmental and land use changes: A long term perspective. Juniper Symposium, 1-21.

Snyder, R. A. and C. L. Boss. 2002. Recovery and stability in barrier island plant communities. Journal of Coastal Research, 18:530-536.

Stoddart, L. A., A. D. Smith, and T. W. Box. 1975. Range management. McGraw-Hill Book Co., New York, NY.

Stringham, T. K., W. C. Krueger, and P. L. Shaver. 2001. State and transition modeling: An ecological process approach. Journal of Range Management, 56(2):106-113.

Thornthwaite, C. W. 1948. An approach towards a rational classification of climate. Geographical Review, 38: 55-94.

Thurow, T. L. 1991. Hydrology and erosion. Grazing Management: An Ecological Perspective. Edited by R.K. Heitschmidt and J.W. Stuth. Timber Press, Portland, OR.

Urbatsch, L. 2000. Chinese tallow tree Triadica sebifera (L.) Small. USDA-NRCS, National Plant Center, Baton Rouge, LA.

Van't Hul, J. T., R. S. Lutz, and N. E. Mathews. 1997. Impact of prescribed burning on vegetation and bird abundance on Matagorda Island, Texas. Journal of Range Management, 50:346-360.

Vines, R. A. 1977. Trees of Eastern Texas. University of Texas Press, Austin, TX.

Vines, R. A. 1984. Trees of Central Texas. University of Texas Press, Austin, TX.

Wade, D. D., B. L. Brock, P. H. Brose, J. B. Grace, G. A. Hoch, and W. A. Patterson III. 2000. Fire in Eastern ecosystems. Wildland fire in ecosystems: effects of fire on flora. Edited by. J. K. Brown and J. Kaplers. United States Forest Service, Rocky Mountain Research Station, Ogden, UT.

Warren, W. S. 1998. The La Salle Expedition to Texas: The journal of Henry Joutel, 1684-1687. Edited by W. C. Foster. Texas State Historical Association, Austin, TX.

Weaver, J. E. and F. E. Clements. 1938. Plant ecology. McGraw-Hill, New York, NY.

Williams, A. M., R. A. Feagin, W.K. Smith, and N. L. Jackson. 2009. Ecosystem impacts of Hurricane Ike on Galveston Island and Bolivar Peninsula: Perspectives of the coastal barrier island network (CBIN). Shore and Beach, 7(2):1-5.

Williams, L. R. and G. N Cameron. 1985. Effects of removal of pocket gophers on a Texas coastal prairie. The American Midland Naturalist Journal, 115:216-224.

Wright, H.A. and A.W. Bailey. 1982. Fire Ecology: United States and Southern Canada. John Wiley & Sons, Inc., Hoboken, NJ.

Contributors

Jack Alexander, Synergy Resource Solutions, Inc., Belgrade, MT
Dr. Fred Smeins, Professor, Texas A&M University, College Station, TX

Approval

Bryan Christensen, 9/22/2023

Acknowledgments

Reviewers and Technical Contributors:
Justin Clary, RMS, NRCS, Temple, TX
Shanna Dunn, RSS, NRCS, Corpus Christi, TX
Mark Moseley, RMS, NRCS, Boerne, TX
Tim Reinke, RMS, NRCS, Victoria, TX
Mike Stellbauer, RMS, NRCS, Bryan, TX

Site Development and Testing Plan:

Future work, as described in a Project Plan, to validate the information in this Provisional Ecological Site Description is needed. This will include field activities to collect low, medium and high-intensity sampling, soil correlations, and analysis of that data. Annual field reviews should be done by soil scientists and vegetation specialists. A final field review, peer review, quality control, and quality assurance reviews of the ESD will be needed to produce the final document. Annual reviews of the Project Plan are to be conducted by the Ecological Site Technical Team.

Rangeland health reference sheet

Interpreting Indicators of Rangeland Health is a qualitative assessment protocol used to determine ecosystem condition based on benchmark characteristics described in the Reference Sheet. A suite of 17 (or more) indicators are typically considered in an assessment. The ecological site(s) representative of an assessment location must be known prior to applying the protocol and must be verified based on soils and climate. Current plant community cannot be used to identify the ecological site.

Author(s)/participant(s)	Mike Stellbauer, Zone RMS, NRCS, Bryan, TX
Contact for lead author	
Date	06/08/2004
Approved by	Bryan Christensen
Approval date	
Composition (Indicators 10 and 12) based on	Annual Production

Indicators

1. **Number and extent of rills:** None.

2. **Presence of water flow patterns:** At large scales, some drainage do occur.

3. **Number and height of erosional pedestals or terracettes:** None.

4. **Bare ground from Ecological Site Description or other studies (rock, litter, lichen, moss, plant canopy are not bare ground):** Less than 5 percent bare ground randomly distributed throughout.

5. **Number of gullies and erosion associated with gullies:** None.

6. **Extent of wind scoured, blowouts and/or depositional areas:** None.

7. **Amount of litter movement (describe size and distance expected to travel):** Small to medium-sized litter can be expected to move short to long distances depending on the degree and extent of flooding.

8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil surface is resistant to erosion. Stability class ranges from 4 to 5 on the surface.

9. **Soil surface structure and SOM content (include type of structure and A-horizon color and thickness):** Soil surface structure is 60 inches thick of dark gray to very dark gray clay or silty clay of moderate fine subangular blocky structure. SOM is 1 to 2 percent.

10. **Effect of community phase composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** This tallgrass marsh site along with adequate litter and little bare ground provides for maximum infiltration and little runoff under normal rainfall events.

11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** None.

12. **Functional/Structural Groups (list in order of descending dominance by above-ground annual-production or live foliar cover using symbols: >>, >, = to indicate much greater than, greater than, and equal to):**

    Dominant: Warm-season tallgrasses/grass-likes

    Sub-dominant: Forbs

    Other: Warm-season midgrasses Shrubs Warm-season annual grasses Warm-season annual forbs

    Additional:

13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Grasses due to their growth habit will exhibit some mortality and decadence, though very slight.

14. **Average percent litter cover (%) and depth (in):** Litter is primarily herbaceous.

15. **Expected annual annual-production (this is TOTAL above-ground annual-production, not just forage annual-production):** 7,000 pounds per acre for below average moisture years to 13,000 pounds per acre for above average moisture years.

16. **Potential invasive (including noxious) species (native and non-native). List species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicators, we are describing what is NOT expected in the reference state for the ecological site:** Chinese tallow and salt cedar.

17. **Perennial plant reproductive capability:** Perennial plants should be capable of reproduction, except for periods of prolonged drought conditions, heavy natural herbivory, hurricanes, and intense wildfires.