U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation and collaboration with U.S. Fish and Wildlife Service via Gulf Coast Joint Venture, Texas A&M University-Kingsville, University of Louisiana-Lafayette, and Ducks Unlimited, Inc.

Scientific Investigations Report 2014–5110
Delineation of Marsh Types of the Texas Coast from Corpus Christi Bay to the Sabine River in 2010—PLATE 1

Overview

Detailed information on the extent and distribution of marsh vegetation zones throughout the Texas coast has been historically unavailable. Most existing large-scale land cover classifications for coastal Texas identified emergent marsh as either palustrine (less than [<] 0.5 parts per thousand [ppt] salinity) or estuarine (≥0.5 ppt salinity) (National Oceanic and Atmospheric Administration [NOAA] Coastal Change Analysis Program [C-CAP] and National Wetlands Inventory [NWI]) or used the combined categories of fresh-intermediate and brackish-saline to identify marsh types (Texas Ecological Classification Systems [TECS] developed by the Texas Parks and Wildlife Department [TPWD] and Missouri Resource Assessment Partnership). To help meet these needs, the U.S. Geological Survey, in cooperation and collaboration with the U.S. Fish and Wildlife Service via the Gulf Coast Joint Venture, Texas A&M University-Kingsville, the University of Louisiana-Lafayette, and Ducks Unlimited, Inc., has produced a seamless and standardized classification of marsh vegetation types indicative of salinity zones (fresh, intermediate, brackish, and saline zones as discussed by Nyman and Chabreck, 2012) for the middle and upper Texas coast from Corpus Christi Bay to the Sabine River (Texas/Louisiana border).

Salinity and vegetation community relationships in Texas coastal marsh were assumed to be similar to those found in Louisiana; therefore, fresh marsh salinity ranged from 0.1 to 3.4 ppt with an average of 1.0 ppt and was commonly dominated by maidencane (*Panicum hemitomon*), spikerushes (*Eleocharis* spp.), and alligator weed (*Alternanthera philoxeroides*) (O'Neil, 1949; Chabreck, 1972). Intermediate marsh salinity ranged from 0.5 to 8.3 ppt with an average of 3.3 ppt and was commonly dominated by gulf cordgrass (*Spartina spartinae*), marshhay cordgrass (*Spartina patens*), bulltongue (*Sagittaria lancifolia*), and coastal waterhyssop (*Bacopa monnieri*) (Chabreck, 1972; Nyman and Chabreck, 2012). Brackish marsh salinity ranged from 1.0 to 18.4 ppt with an average of 8.2 ppt and was typically dominated by marshhay cordgrass (*Spartina patens*) and seashore saltgrass (*Distichlis spicata*) (Chabreck, 1972; Nyman and Chabreck, 2012). Saline marsh salinity ranged from 8.1 to 29.4 ppt with an average of 18.0 ppt and was typically dominated by smooth cordgrass (*Spartina alterniflora*), seashore saltgrass (*Distichlis spicata*), and needlegrass rush (*Juncus roemerianus*) (Chabreck, 1972; Nyman and Chabreck, 2012).

The inland extent of the study area covers approximately 21,853 square kilometers (km^2) and was defined by the 10-meter (m) elevation contour line, which was created from the U.S. Geological Survey National Elevation Dataset (NED) 1/3 arc-second (10-m) elevation data, referenced to the North American Vertical Datum of 1988 (NAVD 88), accessed in July 2012. Building upon earlier efforts of Mitchell and others (in press), this study incorporates approximately 1,000 ground reference locations collected via helicopter surveys in coastal marsh areas and about 2,000 supplemental locations from fresh marsh, water, and "other" (nonmarsh) areas. About two-thirds of these data were used for training, and about one-third were used for assessing accuracy. Decision-tree analyses using Rulequest See5 were used to classify emergent marsh vegetation types by using these data, multitemporal satellite-based multispectral imagery from 2009 to 2011, a bare-earth digital elevation model (DEM) based on airborne light detection and ranging (lidar), alternative contemporary land cover classifications, and other spatially explicit variables believed to be important for delineating the extent and distribution of marsh vegetation communities. Image objects were generated from segmentation of high resolution airborne imagery acquired in 2010 and were used to refine the classification. The classification is dated 2010 because the year is both the midpoint of the multitemporal satellite-based imagery (2009–11) classified and the date of the high resolution airborne imagery that was used to develop image objects.

Over 3,041 km^2 of marsh were classified in this study (table 1). Overall accuracy corrected for bias (accuracy estimate incorporates true marginal proportions; Congalton and Green, 2009) was 91 percent (confidence interval [CI]: 89.2–92.8), with a kappa statistic of 0.79 (95 percent CI: 0.77–0.81) (table 1). The classification performed best for saline marsh (user's accuracy was 81.5 percent; producer's accuracy corrected for bias was 62.9 percent) but showed a lesser ability to discriminate intermediate marsh (user's accuracy was 47.7 percent; producer's accuracy corrected for bias was 49.5 percent) (table 1). For all marsh types combined, mean user's accuracy was 65.4 percent, and mean producer's accuracy corrected for bias was 56.7 percent. Because of confusion in intermediate and brackish marsh classes, an alternative classification containing only three marsh types was created in which intermediate and brackish marshes were combined into a single class. Image objects were reattributed by using this alternative three-marsh-type classification. The overall accuracy corrected for bias for the alternative three-marsh-type classification was 92.4 percent (95 percent CI: 90.7–94.2), and the kappa statistic was 0.83 (95 percent CI: 0.81–0.85) (table 1). The combined intermediate/brackish marsh class had a user's accuracy of 74.2 percent (95 percent CI: 71.1–77.3) and a producer's accuracy corrected for bias of 68.2 percent (95 percent CI: 64.4–72) (table 1). For all marsh vegetation classes in the three-marsh-type classification, mean user's accuracy was 75.6 percent, and mean producer's accuracy corrected for bias was 65.1 percent.

This study provides a more objective and repeatable method for classifying marsh types of the middle and upper Texas coast at an extent and greater level of detail than previously available for the study area. The seamless classification produced through this work is now available to help State agencies (such as the Texas Parks and Wildlife Department) and landscape-scale conservation partnerships (such as the Gulf Coast Prairie Landscape Conservation Cooperative and the Gulf Coast Joint Venture) to develop and (or) refine conservation plans targeting priority natural resources. Moreover, these data may improve projections of landscape change and serve as a baseline for monitoring future changes resulting from chronic and episodic stressors (Sasser and others, 2008, 2014).

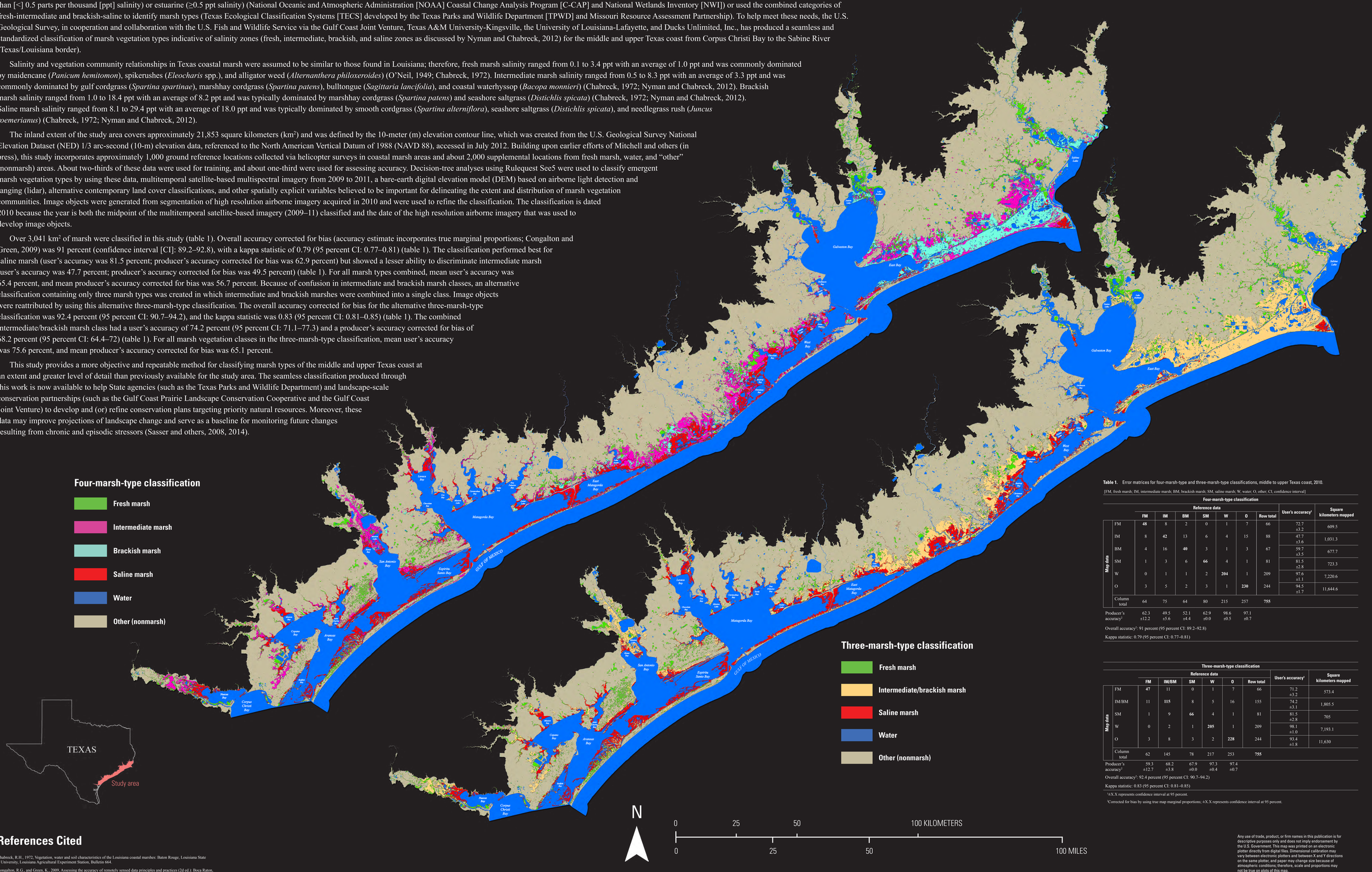

Table 1. Error matrices for four-marsh-type and three-marsh-type classifications, middle to upper Texas coast, 2010.

[FM, fresh marsh; IM, intermediate marsh; BM, brackish marsh; SM, saline marsh; W, water; O, other; CI, confidence interval]

Four-marsh-type classification

		Reference data							User's accuracy[1]	Square kilometers mapped
		FM	IM	BM	SM	W	O	Row total		
Map data	FM	**48**	8	2	0	1	7	66	72.7 ±3.2	609.5
	IM	8	**42**	13	6	4	15	88	47.7 ±3.6	1,031.3
	BM	4	16	**40**	3	1	3	67	59.7 ±3.5	677.7
	SM	1	3	6	**66**	4	1	81	81.5 ±2.8	723.3
	W	0	1	1	2	**204**	1	209	97.6 ±1.1	7,220.6
	O	3	5	2	3	1	**230**	244	94.5 ±1.7	11,644.6
	Column total	64	75	64	80	215	257	**755**		
Producer's accuracy[2]		62.3 ±12.2	49.5 ±5.6	52.1 ±4.4	62.9 ±0.0	98.6 ±0.5	97.1 ±0.7			

Overall accuracy[2]: 91 percent (95 percent CI: 89.2–92.8)

Kappa statistic: 0.79 (95 percent CI: 0.77–0.81)

Three-marsh-type classification

		Reference data						User's accuracy[1]	Square kilometers mapped
		FM	IM/BM	SM	W	O	Row total		
Map data	FM	**47**	11	0	1	7	66	71.2 ±3.2	573.4
	IM/BM	11	**115**	8	5	16	155	74.2 ±3.1	1,805.5
	SM	1	9	**66**	4	1	81	81.5 ±2.8	705
	W	0	2	1	**205**	1	209	98.1 ±1.0	7,193.1
	O	3	8	3	2	**228**	244	93.4 ±1.8	11,630
	Column total	62	145	78	217	253	**755**		
Producer's accuracy[2]		59.3 ±12.7	68.2 ±3.8	67.9 ±0.0	97.3 ±0.4	97.4 ±0.7			

Overall accuracy[2]: 92.4 percent (95 percent CI: 90.7–94.2)

Kappa statistic: 0.83 (95 percent CI: 0.81–0.85)

[1]±X.X represents confidence interval at 95 percent.

[2]Corrected for bias by using true map marginal proportions; ±X.X represents confidence interval at 95 percent.

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by

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2014

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Enwright, N.M., Hartley, S.B., Brasher, M.G., Visser, J.M., Mitchell, M.K., Ballard, B.M., Parr, M.W., Couvillion, B.R., and Wilson, B.C., 2014, Delineation of marsh types of the Texas coast from Corpus Christi Bay to the Sabine River in 2010: U.S. Geological Survey Scientific Investigations Report 2014–5110, 18 p., 1 pl., scale 1:400,000, http://dx.doi.org/10.3133/sir20145110.

Publishing support provided by Lafayette Publishing Service Center

ISSN 2328-0328 (online)
http://dx.doi.org/10.3133/sir20145110