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ARTICLE

Loss of Playa Wetlands Caused by Reclassification and Remapping of Hydric Soils on the Southern High Plains

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Abstract Historically, playas in the Southern High Plains (SHP) were identified by the presence of hydric soils. The United States Department of Agriculture (USDA) has begun a reclassification and remapping of upland and depressional soils for the playa region of Texas. For eight counties in Texas, we compared the occurrence of playas, as indicated by soils designated as hydric in original soil surveys, to designations in remapped soil surveys. We estimate a 65% decrease in playa numbers and 50% decrease in area as defined by the presence of hydric soil. Anthropogenic impacts, resulting in an altered hydrology and masking of hydric soil are proposed as primary factors responsible for reduction in playa numbers. Other potential factors include current USDA methodology and correction of historical survey errors. Playas on the SHP being considered for inclusion under USDA conservation programs must be individually and independently assessed on-site for wetland criteria, rather than reliance on revised USDA-NRCS Soil Survey maps. During on-site evaluations, effects of anthropogenic alterations on the playa soil to develop and maintain hydric characteristics must be considered. Until completion of the remapping effort, confusion will ensue with the use of the online USDA-NRCS Soil Survey maps during interpretation by those unfamiliar with the status of soil survey reports for the Texas SHP.

Keywords Depressional soils · Playa conservation · Playa management · Revised soil survey · Texas · USDA

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Introduction

Playas comprise the primary wetland system in the High Plains portion of the Great Plains. The distribution of Great Plains playas extends from western Nebraska and eastern Wyoming southward into eastern New Mexico and northwest Texas, with the greatest density occurring in the Southern High Plains (SHP) of Texas and New Mexico (Guthery and Bryant 1981; Osterkamp and Wood 1987; Smith 2003; Fig. 1). Historically, 21,800 playas were identified within the SHP, with 19,340 occurring in Texas covering 121,842 ha, based on the presence of hydric soils designated in soil surveys completed prior to the 1970s (Guthery and Bryant 1981; Haukos and Smith 1994; Fish et al. 1999). The average playa size in Texas, based on area of hydric soil, is estimated at 6.3 ha (Guthery and Bryant 1982). Total playa numbers and area, as estimated from hydric soil designation on original soil surveys, are widely used by private and public organizations to assess, quantify, and extrapolate delivery of ecological functions and services. These estimations are then utilized to evaluate conservation efforts, identify existing resources such as available wetland habitat, and estimate numbers of migrating and wintering birds supported in the SHP (Smith 2003).

When functional, these hydrologically isolated wetlands go through frequent, naturally occurring but unpredictable, wet-dry fluctuations (Haukos and Smith 1994). Duration

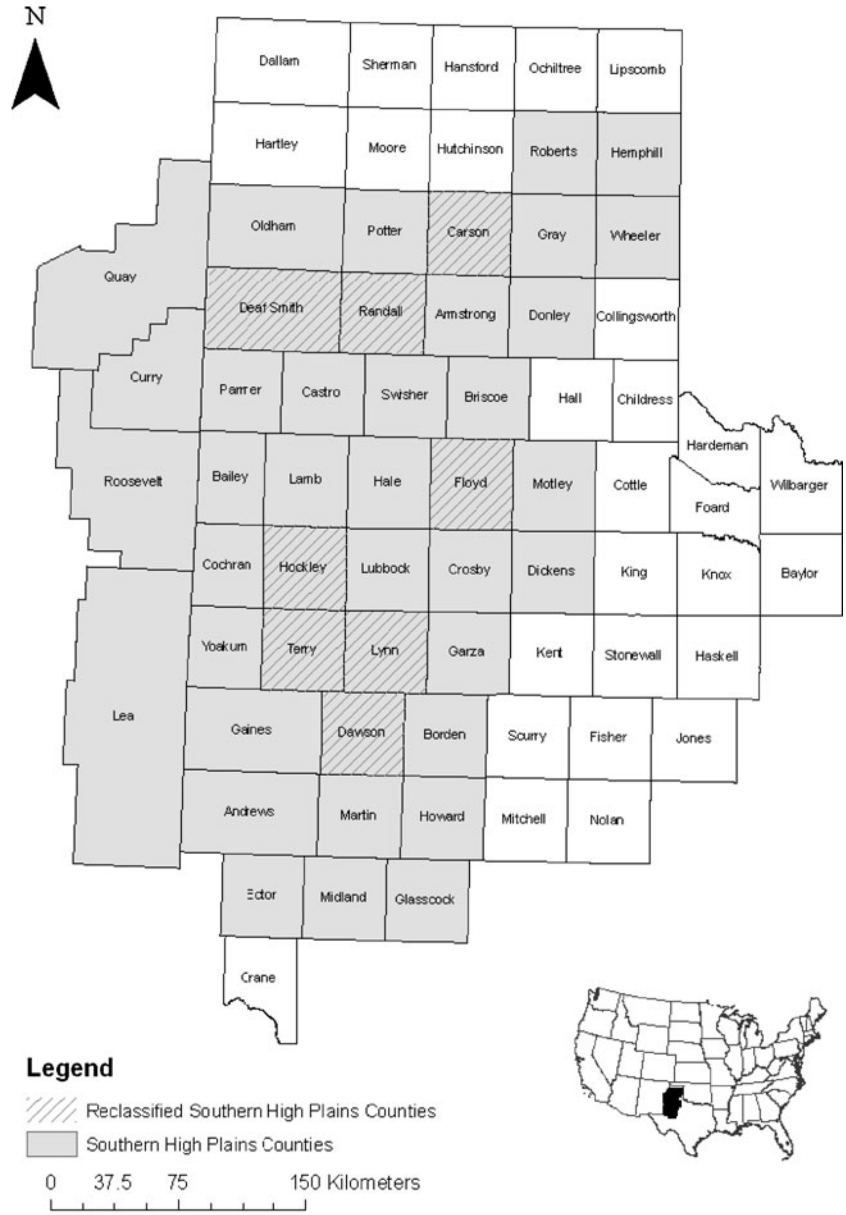

Fig. 1 Counties of the Southern High Plains of Texas and New Mexico along with the eight Texas counties where soils of playa wetlands have been completely remapped

and timing of these fluctuations is the driving force behind their ecology and delivery of ecosystem functions. As the keystone ecosystem of the SHP, playas provide numerous ecological functions and services by interacting with all other ecosystems in the region. Collectively, these wetlands are the primary sites for floodwater catchment, biodiversity, islands of refugia for native plant species, and focused recharge points to the underlying aquifer of the SHP. They also are important sites for biomass production, water quality improvement, livestock water and forage, irrigation water, and recreation. In addition, playas are the primary wetland habitat for numerous wetland-dependent species that breed, migrate through, and winter in the High Plains (Haukos and Smith 1994; Smith 2003).

The SHP is perhaps the most agriculturally impacted region in North America (Bolen et al. 1989), with prominent landscape uses including cultivation and grazing (Luo et al. 1997). Numerous anthropogenic alterations such as concentration of water through excavated pits, cultivation within the playa, inadequately managed grazing, urbanization, and increased sedimentation due to watershed erosion are negatively affecting playas. Accelerated sedimentation and its associated disturbances are the primary threats to playas because of active filling in of the wetland, leading to altered hydrology, altered biota, and complete loss (e.g., Luo et al. 1997; Smith and Haukos 2002; Gray et al. 2004; Tsai et al. 2007).

Declaration of federal jurisdictional status provides a legal foundation for protection and conservation of wetlands through U.S. Army Corps of Engineers (USACE) regulations under Section 404 of the Clean Water Act. This regulation combined with wetland determinations under U.S. Department of Agriculture (USDA) conservation programs and incentive provisions contained within various Farm Bills since 1985 previously provided the regulatory foundation for conservation of playas and other isolated wetlands. In January 2001, the U.S. Supreme Court ruled on *Solid Waste Agency of Northern Cook County (SWANCC) v. United States Army of Corps of Engineers*, which virtually eliminated the provisions of the Clean Water Act (CWA) available for the protection of playas and other isolated wetlands (Haukos and Smith 2003). The 1985 Food Security Act enacted the Federal "Swampbuster" provision for conservation of wetlands, which has been maintained in subsequent Farm Bills. Swampbuster is an incentive-based program under which wetlands are provided protection on agricultural lands by the reduction or elimination of Federal Farm Bill subsidies to landowners who alter the hydrology of a wetland to grow a commodity crop. Equivalent to the jurisdictional determinant to verify if a wetland meets the necessary criteria for protection under the CWA, a wetland must be certified to receive protection under Swampbuster. In addition, it must be enrolled in other USDA programs (http://www.nrcs.usda.gov/programs/compliance/WCindex.html).

For a playa to be determined as a wetland under Swampbuster, there must be a prevalence of hydric soil, inundation or saturation by ground or surface water for a minimum of 7 days, or saturation by surface or ground water for at least 14 consecutive days within the growing season capable of supporting hydrophytic vegetation (USDA, NRCS 1996). By 2002, an estimated 16,367 (80%) playas in Texas had been certified and subject to Swampbuster provisions based on historical soil surveys (Haukos and Smith 2003).

Historically, playas in the SHP were located and characterized by hydric soils principally in the Randall Series, with smaller numbers characterized by soils in the Lipan, Ness, and Roscoe Series (Allen et al. 1972). These hydric soils were used not only to characterize and define playa locations, but also as a necessary criterion for determination of wetland status. However, since 1994, soils of the SHP associated with depressions, including playas, have been subject to reclassification and subsequent remapping by the USDA. This effort was initiated to update soil types occurring on the SHP, and improve the accuracy of the USDA soil survey information, and was conducted using standard USDA-NRCS soil survey protocols. The reclassification of historical soil series resulted in the development of 11 series and four ecosites to characterize depressional soils on the SHP (Table 1). Soil series are determined by soil properties exclusively, whereas ecosites are defined by climate, landscape, vegetation similarities, and soil properties. Four of the 11 series retained the hydric designation, and seven were classified as non-hydric. In addition, three of the seven non-hydric series retained the ecosite designation of playa. Therefore, the remapping effort has the potential to categorize playas as a depression containing either a hydric or non-hydric soil. Our objectives were to (1) estimate the potential change in area and number of hydric locations (i.e., historical playas) as a result of the USDA soil reclassification and subsequent remapping of upland and depressional soils in the SHP of Texas, (2) evaluate implications of this remapping for natural resource managers and other scientists involved in conservation of playas, and (3) relate potential factors resulting in the remapping of soils associated with playa wetlands.

Table 1 Soil series and associated ecosites resulting from the post-1994 reclassification of the Randall Soil Series into 11 different hydric and non-hydric series as part of the USDA-NRCS soil remapping of playa/depressional soils in the Southern High Plains (MLRA-77C) (http://soildatamart.nrcs.usda.gov) and historical and post-1994 representation in number of playas (#) and area (ha) in the eight Texas counties of the SHP that have been completely remapped

		Historical		Post-1994	
Series	Ecosite	#	Area	#	Area
Hydric					
Randall	Playa	6122	45931	1416	18390
Ranco	Playa	0	0	598	3207
Lamesa	Playa	0	0	121	1263
Cedarlake	Wet saline	0	0	22	605
Non-hydric					
[a]McLean	Playa				
[a]Sparenberg	Playa				
[a]Chapel	Playa				
Lazbuddie	Deep hardland				
Lockney	Deep hardland				
Lofton	Deep hardland				
Seagraves	Sandy loam				

[a] This map unit may contain hydric soil inclusions

Methods

Pre-1970s historical soil survey information for playas of the SHP was provided by *Playa Lakes Digital Database for the Texas Portion of the Playa Lakes Joint Venture Region* (PLDD) (Fish et al. 1999). This is a Geographic Information System (GIS) that contains a digitized location database of historical playas based on the presence of hydric soils (i.e., Randall, Lipan, Ness, and Roscoe series) as formerly designated on USDA soil survey maps (Guthery et al. 1981). Along with other descriptive information, each playa was attributed with coordinates at the polygon center, area of the mapped unit, soil series, and county (Fish et al. 1999).

At the time of this analysis, eight Texas counties were completely remapped (Fig. 1) through on-the-ground soil investigations using standard soil survey methodology (USDA-NRCS personal communication). The data utilized for the analysis were publicly available though the USDA-NRCS Soil Data Mart (http://soildatamart.nrcs.usda.gov) and included Carson, Dawson, Deaf Smith, Floyd, Hockley, Lynn, Randall, and Terry counties. These eight counties were located throughout the SHP, included a range of playa densities, and historically contained only hydric soils designated in the Randall series. The spatial layer for each remapped county was merged into a single, new output layer using the Data Management Merge Tool in ArcMap. Within the USDA-NRCS Soil Survey Geographic (SSURGO) Database, polygons were used to spatially indicate depressions occupied by different soil series. Area of polygons, computed with ArcMap, was used to evaluate the changes in mapped hydric soil and potential certified playas based on USDA soil remappings by county and playa size. All layer attributes were exported to a spreadsheet for summaries and tabulations. Hydric and non-hydric soil abbreviations were obtained for each county via the USDA-NRCS Soil Data Mart. The Cedarlake series occurred in Terry, Lynn, and Dawson counties but was excluded from analyses because it represents saline lakes and does not include freshwater playas. The calculation of number, total area, and mean area for playas within remapped counties was done by filtering on depression soils in combination with a custom sort by county. In addition, to investigate the influence of playa area on frequency of soil remapping, we evaluated the percent of playas remapped within size categories of 0–<5, 5–<10, 10–<20, 20–<30, and ≥30 ha. To make this comparison, we utilized data contained within the previously mentioned spreadsheet and soil abbreviations coupled with historical size data.

The influence of surrounding land use on remapping of historical hydric soils was addressed by combining the PLDD layer with a landcover layer developed by Great Plains GIS Partnership (G^2P^2; U.S. Fish and Wildlife Service, Playa Lakes Joint Venture, and Rainwater Basin Joint Venture), Grand Island, Nebraska, USA. The watershed of each historical playa location was represented by a 100-m buffer in which landcover was determined through unioning the USDA Farm Service Agency (FSA) Common Land Unit (CLU) and the historical playa location information for the SHP. Playas were identified by their occurrence in the PLDD playa layer, while the land class code was defined by the Common Land Unit Classification Code in the CLU. We used a shared coordinate system of NAD 83 State Plane for layers of interest (i.e., G^2P^2 land cover, SSURGO, and historical soil survey data). Based on the relative location of the polygons, G^2P^2 landcover and SSURGO attributes were appended to the historical soil survey data via the spatial join analysis with a one-to-one join. Analyses were restricted to hydric locations having one of three surrounding land cover types: cropland, Conservation Reserve Program (CRP), or grassland. Since the CRP was not initiated until 1986 and prior to enrollment was cropland, we combined cropland and CRP land cover types. The resulting layer's attributes were exported to a spreadsheet and sorted by land cover, soil series, and hydric location size to estimate mean hydric area remapped within a given land cover type.

Results

Following remapping, the number of depressions with hydric soils in the eight counties declined from 6,122 to 2,135 (65.1% decline). Combined hydric and non-hydric playa ecosites following remapping numbered 4,572, which was still 1,550 less than the historical 6,122 (Tables 2 and 3; Figs. 2 and 3a). Under the assumption that changes seen here are representative of future remapping efforts, this represents a potential 25% decrease in the number of depressions classified as playa in the SHP.

A similar pattern was found when evaluating the influence of soil reclassification and remapping on area of depressions with hydric soils. The area of hydric locations declined from 45,931.3 to 22,859.4 ha (50.2% decline). The total area of combined hydric and non-hydric playa ecosites after remapping was 41,635.3 ha, a 9% decrease in area of depressions classified as playa. After remapping, mean playa ecosite area increased from the historical 7.5 to 10.7 ha in remapped counties, because of the loss of small playas (Tables 2 and 3; Fig. 3b).

Size of depression area and surrounding landcover influenced remapping of previously identified hydric soils. Changes from a historically mapped hydric soil to a non-hydric soil series occurred most often for small depressions, with remapping of 80% of the depressions originally mapped as ≤5 ha. The percent of hydric soil remapped as non-hydric decreased as size increased to 20 ha, at which point percent remapped playas started to increase. Fifty-six percent of depressions ≥30 ha originally mapped as hydric were remapped into a nonhydric series (Fig. 4). Although both cropland and grassland playas were remapped, the size varied between the two land uses based on historical area data. For playas assigned a landcover, the mean size (±SE) for remapped grassland playas was 7±0.40 ha, which

Table 2 Historical (pre-1970) estimated number of depressions (i.e., playas) and area (ha) mapped as a hydric soil (Randall Series), estimated number and area (ha) of depressional soils defined for non-hydric (McLean, Sparenberg, and Chapel Series) playa ecosites following remapping of soils, and current estimated number of depressions (i.e., playas) and area (ha) mapped as a hydric soil (Randall, Ranco, and Lamesa Series) for the eight Texas counties of the Southern High Plains that have been completely remapped

	Historical depressions			Following remapping					
	Classified as hydric soil			Depressions classified as non-hydric soil			Depressions classified as hydric		
County	#	Area	$\bar{x}$ Area	#	Area	$\bar{x}$ Area	#	Area	$\bar{x}$ Area
Carson	544	7393.0	13.6	174	2040.5	11.7	176	4688.3	26.6
Dawson	691	3010.2	4.4	201	1501.9	7.5	145	1352.4	9.3
Deaf Smith	452	5760.9	12.7	200	2267.4	11.3	242	2568.2	10.6
Floyd	1721	14398.4	8.4	616	4019.2	6.5	820	9028.2	11.0
Hockley	1055	3864.6	3.7	297	1504.0	5.1	372	1722.0	4.6
Lynn	801	3868.3	4.8	519	3378.5	6.5	147	1013.7	6.9
Randall	561	6795.8	12.1	349	3684.7	10.6	178	2105.3	11.8
Terry	297	840.1	2.8	81	379.8	4.7	55	380.7	6.9
Total	6122	45931.3	7.5	2437	18775.9	7.7	2135	22859.4	10.7

increased the mean size of grassland playas mapped by a hydric soil from 8.64±0.28 to 11.97±0.72 ha. The mean size of remapped playas in cropland was 3±0.06 ha, which increased the overall mean size mapped as a hydric soil from 3.5±0.07 to 5.27±0.37 ha.

Discussion

The inability to accurately locate and enumerate playa wetlands on the High Plains continues to be an obstacle in the conservation, management, and assessment of provision of ecological services provided by playas. Our results indicate that the current approach to soil reclassification and subsequent remapping of depressions on the SHP has the potential of contributing to the uncertainty of the location and number of playas on the SHP. Although unlikely providing a complete count of playas on the SHP, use of hydric soil designations on historical soil surveys provided the foundation for conservation and management of playas in this region. Conservation plans, monitoring and survey protocols, and research investigations of ecological condition and provision of ecological services have all relied on these locations for extrapolation and inference of results. Continued remapping of playa and other depressional soils in the SHP will result in approximately 65% of historical playa numbers and 51% of historical playa area being no longer classified as containing a hydric soil. Assuming the eight remapped counties are representative of the remaining 18 counties scheduled for remapping in the SHP of Texas, approximately 14,170 playas and 62,139 ha of total historically-defined playa area will be remapped to non-hydric. In addition, of the depressions mapped in historical soil surveys as containing hydric soil and identified as playas, 25% are not accounted for in the combined hydric and non-hydric playa ecosite totals following remapping and thus, are absent from future playa location determinations using soils or ecosite as the primary criteria.

Possible causes for historical hydric soils of depressions on the SHP being remapped into non-hydric with either a

Table 3 Estimated percent loss (%) of the number and area (ha) of potentially certified playa wetlands due to remapping of previously identified hydric soils (i.e., Randall Series) into 11 potential hydric (Randall, Ranco, and Lamesa Series) and non-hydric series for depressional areas in the eight Texas counties of the Southern High Plains that have been completely remapped

County	Number lost	% Number lost	Area lost	% Area lost
Carson	368	67.7	2704.7	36.6
Dawson	546	79.0	1657.8	55.1
Deaf Smith	210	46.5	3192.7	55.4
Floyd	901	52.4	5370.2	37.3
Hockley	683	64.7	2141.6	55.4
Lynn	654	81.7	2854.6	72.2
Randall	383	68.3	4690.5	69.0
Terry	242	81.5	459.4	54.7
Total	3987	65.1	23071.5	50.2

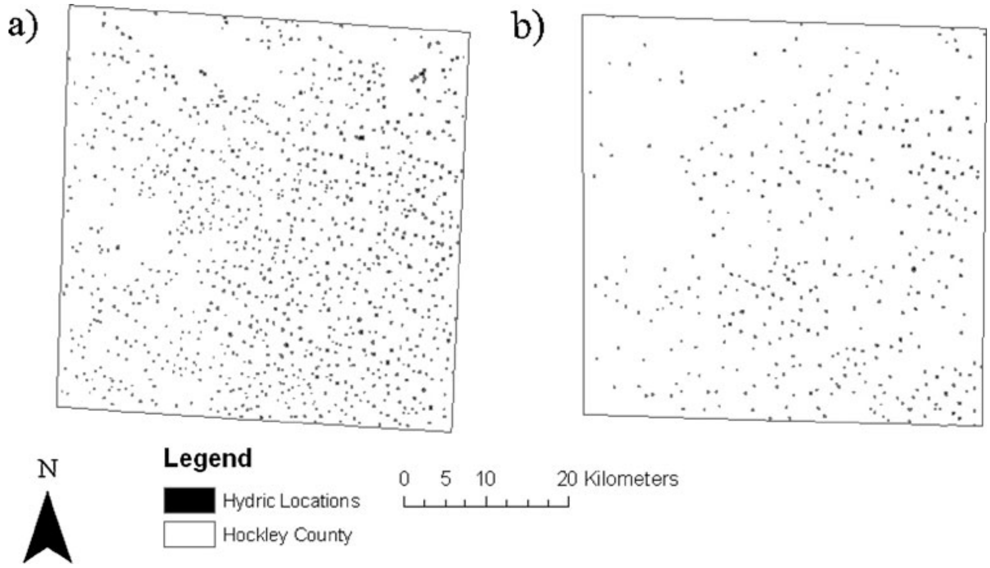

Fig. 2 **a** Hydric soil locations in historical (pre-1970) SSURGO data in Hockley County, Texas. **b** Hydric soil locations after the USDA soil remapping in Hockley County, Texas

playa or non-playa ecosite designation are likely principally related to anthropogenic impacts to the watershed and/or playa and, perhaps, correction of historical soil mapping errors. Anthropogenic impacts leading to the remapping of a previously existing depression or apparent hydric soil are intentional filling, excavation, or leveling of the historical depression, complete or partial loss of hydric-soil defined volume by accumulation of sediment, cultivation of the wetland that resulted in destruction of the defined playa location or the masking of these wetlands through their use as waste sites. Established mapping methodology does not consider changes in soil characteristics or depth due to anthropogenic impacts. This can lead to individual historical hydric locations being remapped to non-hydric and groups of playas being remapped through the merging of swaths of land into one soil series and ecosite. Historical surveys may contain inappropriate hydric locations that are being corrected in the remapping effort due to improved technology or mapping methodology. However, it is exceedingly rare for a playa identified in historical surveys as containing a hydric soil not to contain a soil representative of a playa in the absence of anthropogenic impacts.

Impacts from sediment accumulation are prominent in the SHP where sediment depth ranges from 3.60 to102.2 cm with a mean (±SE) of 43.04±6.33 and annual sedimentation rates in wetlands on farmed landscapes average 4.8 and 9.7 mm/year in medium and fine-texture soil zones, respectively (Luo et al. 1997). Playas with cultivated watersheds contain 172% more sediment than playas with grassland watersheds (Venne 2006) and many have their hydric-soil defined volume completely filled with sediment (Luo 1994; Luo et al. 1997), reducing the appearance of the depression and burying historical hydric soils. The reduced or lost playa volume results in a decreased hydroperiod due to increased water surface area subject to evaporation and infiltration rates as floodwaters are held on more permeable soils (Tsai et al. 2007). In addition, 69% of playas larger than 4 ha in this region contained excavated pits and >46% of playas were cultivated in the early 1980s (Guthery and Bryant 1982). Further, during cultivation of the playa, the characteristic clay layer is often punctured or mixed with accumulated sediment. Altered hydroperiods due to sediment accumulation, pitting, and cultivation can lessen the occurrence of hydric field indicators by reducing the ability of the soil to form hydric inclusions in both the newly deposited sediment and the underlying clay soil. Although soil remapping may appear to be appropriate if the sediment has eliminated the depression entirely, the anthropogenic cause for accumulation of sediment should be considered during on-site wetland determinations because many of these sites likely continue to support hydrophytic vegetation, pond water and may be candidates for restoration but are mapped as non-hydric (Haukos and Smith 2004; Tsai et al. 2007).

Grassland playas are not subject to the same level of excess sediment loading as cropland playas, with sediment depths averages ranged from 0.00–11.90 cm with a mean (±SE) of 4.63±0.92 (Luo et al. 1997); however, the majority of remapped playas >30 ha had grassland watersheds. This remapping may be partially explained by reduced frequency of inundation in large grassland playas, relative to small grassland playas or cropland playas (Cariveau and Pavlacky 2009). This reduced inundation limits the occurrence of hydric features in the playa soil and weakens those that do occur, rendering them unidentifiable during field visits (Allen et al. 1972; Mitsch and Gosselink 2000). This abridged inundation may be attributable to the increase in water volume required to flood large grassland playas and a reduced ability to receive historical volumes of run-off due to

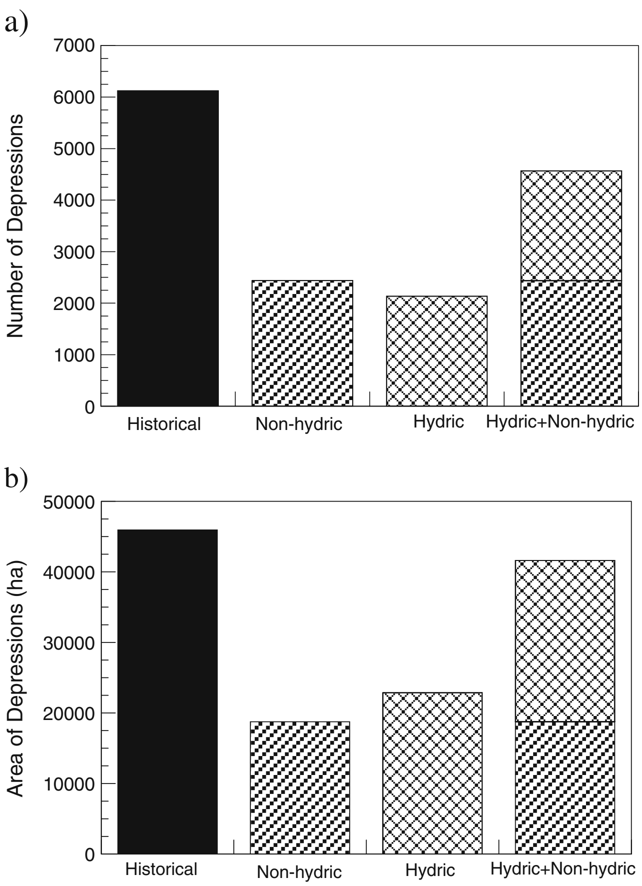

Fig. 3 **a** Historical (pre-1970) estimated number of depressions (i.e., playas) mapped as a hydric soil (i.e., Randall Series), estimated number of depressional soils defined for playa ecosites (non-hydric, hydric, and hydric and non-hydric combined; six potential Soil Series) following remapping of soils for the eight Texas counties of the Southern High Plains that have been completely remapped. After remapping, hydric soil included the Randall, Ranco, and Lamesa Series. **b** Historical (pre-1970) estimated area (ha) of depressions (i.e., playas) mapped as a hydric soil (i.e., Randall Series) and area (ha) of depressional soils defined for playa ecosites (non-hydric, hydric, and hydric and non-hydric combined; six potential Soil Series) following remapping of soils for the eight Texas counties of the Southern High Plains that have been completely remapped. After remapping, hydric soil included the Randall, Ranco, and Lamesa Series

anthropogenic impacts to the watershed (e.g., roads reducing flow). The increased water volume requirement is a result of absorption of water in the larger, more vegetated watershed (Cariveau and Pavlacky 2009). Watersheds in grassland have a higher infiltration rate relative to cultivated areas (van der Kamp et al. 2003) due to increased vegetation slowing water flow rates. In addition, both an increase in the density of macropores occurring as a result of root channels (Mapa and Gunasena 1995) and soil fauna increase hydraulic conductivity (Lepilin 1989; Bodhinayake and Si 2004). Moreover, organic content is typically greater in grasslands, leading to higher aggregate stability, primarily after decomposition is initiated and by products of microorganisms and mycelia

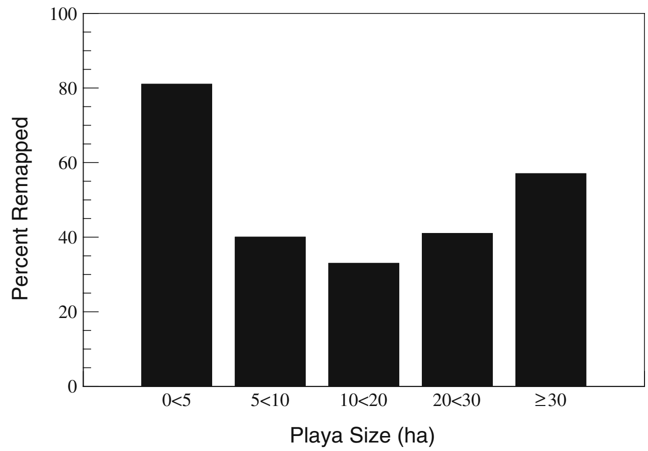

Fig. 4 Percent remapped playas by size due to remapping of previously identified hydric soils (i.e., Randall Series) into 11 potential hydric (Randall, Ranco, and Lamesa Series) and non-hydric for depressional areas in the eight Texas counties of the Southern High Plains that have been completely remapped

have formed (Mapa and Gunasena 1995). This drier grassland playa soil may promote the remapping of grassland playas from hydric to non-hydric under current USDA methodology.

The three necessary jurisdictional or determination characteristics of wetlands are the presence of hydrophytic vegetation, wetland hydrology and hydric soils (Cowardin et al. 1979; U.S. Army Corp of Engineers 1987; USDA NRCS 1996). Hydric soils are specifically defined as soils that develop in conditions of saturation, flooding, or ponding for a long enough period during the growing season to develop anaerobic conditions in the upper part (Federal Register 1994). Ecologically, hydric soils are a substrate in which saturated conditions create a reducing environment in soil pores as a consequence of hypoxia or anoxia (Cronk and Fennessy 2001) resulting in reduced forms of elements characteristic of hydric soils (Gambrell and Patrick 1978). These unique soil properties were used to develop criteria or field indicators for hydric soils. Since their development in the 1980s, field indicators have been used for determination of hydric soils and vary widely throughout the United States (USDA NRCS 2006).

Historical soil surveys were completed prior to the current understanding and definition of hydric soils in wetlands. The current classification of hydric soils involves exposing and describing a soil profile to a minimum depth of 50 cm (less than the depth of sediment in many playas in the SHP) and comparing this description to a set of field indicators for the appropriate region (USDA NRCS 2006). Although it is recommended that excavation continue to the required depth for a full characterization of the redoximorphic process, in practice it is unlikely that the soil profile is commonly described beyond 50 cm and USDA protocol requires the inspection of only the top 15 cm for hydric soil field indicators. For playas in the SHP, the upper 15 cm is evaluated for ≥5% prominent or distinct redox concentrations occurring as soft masses or pore linings and in a layer ≥5 cm thick (USDA NRCS 2006). Given that sediment depth in many playas in the SHP exceeds 50 cm combined with standard USDA protocols for detection of field indicators in redox depressions (e.g., playas) (USDA NRCS 2006), original hydric soil indicators will be obscured by accumulated sediment under current soil survey methodolgy.

The current remapping of depressional soils categorizes playa ecosites as potentially containing hydric and non-hydric soils. This categorization of approximately 40% of depressions containing hydric soil as a playa with a non-hydric soil further complicates efforts to conserve playas as wetlands. Criteria used to reclassify hydric soils into non-hydric soil series include soil texture, slope of the landscape and ponding frequency of the area. Using these characteristics, 80% of playas originally mapped as 0–5 ha in size were remapped and the majority of them were contained within cropland watersheds. The high percentage of small, cropland playas being remapped may be because small playas are more susceptible to filling by sedimentation and repeated cultivation, which can render playa soils indistinguishable from surrounding upland soils, especially at shallow depths.

Field indicators and methodology currently used to describe hydric soils in the SHP may not fully account for the influence of anthropogenic factors and naturally occurring wet-dry fluctuations of playas. Inclusion of these factors in the development of hydric field indicators and protocols is necessary to accurately describe playa soils. Therefore, the dynamics of playa wetland hydric soil indicators and current determination protocols should be investigated and revised. However, the results of the reclassification of playa soils on the SHP do provide indication of the extent of potential playa loss in the region. If the historical and revised soil surveys accurately depict the presence of hydric soils, then >50% of the historical playas have been lost since approximately 1970. Such a rate of loss should renew emphasis for the conservation of playas.

Completion of the remapping effort in the SHP may result in several negative impacts to conservation and ecological understanding of playa systems. Historically identified depressions containing playas that have accumulated sediment are likely to be classified as containing nonhydric soils in a playa ecosite or no longer classified as a playa. Ecological condition of these playas will range from completely filled in and nonfunctional, to minimally filled in (but sufficient to result in soil remapping) but partially to mostly functional. The loss of Swampbuster protection due to loss of hydric soil designation will result in the more functional playas being further degraded and eventually lost to the playa system. The loss of Swampbuster designation and any potential future jurisdictional status will eliminate identification of candidate playas for restoration. Finally, in the interim period before remapping is completed for the entire SHP, there is potential for confusion in conservation and restoration efforts because of the availability of two different mapping efforts representing different time periods, ecological conditions, and mapping criteria/techniques.

Management Implications

Any decrease in playa numbers or area is of concern, regardless of whether it is the result of change in resource function or differences between USDA methodology in historical and current mapping approaches. Reclassification and subsequent remapping of depressional soils will reduce the potential protection and conservation of playa wetlands, the keystone ecosystem of the SHP. The presence of a hydric soil is a necessary criterion for a playa to be declared a certified wetland for USDA programs including Swampbuster, which is the only remaining potential federal protection afforded playas following the loss of protection under CWA in 2001 (Haukos and Smith 2003). If protections previously provided by Section 404 of the CWA are restored, then the impact of the loss of hydric soil designations from this soil reclassification and remapping will be amplified. This is particularly true if the changes seen here are due to methodological differences. In addition, if loss of hydric locations is the result of reduced function, from a conservation perspective, ongoing physical and functional loss of playas will be compounded by remapped playas no longer qualifying for USDA restoration programs and incentives. Therefore, it is critical that any playa on the SHP being considered for inclusion under Swampbuster or any other USDA conservation program be individually assessed for wetland criteria, including hydric soils, on-site, rather than reliance on information from revised soil maps. Further, during on-site evaluations, the effects of anthropogenic alterations that lead to masking and reduced development and maintenance of hydric characteristics must be considered.

If remapping of hydric locations to non-hydric is not a correction of historical soil surveys, major implications will likely ensue from the combining of hydric and non-hydric depressions within the ecosite of playa not equaling the number of hydric depressions in historical surveys, because accurate data on the location and number of playas on the landscape are vital for conservation and management of playas and playa-dependent species. The ability to manage, conserve, and monitor playas and playa loss along with changes in functional connectivity of the landscape, supported by the network of playas, is reduced by removal of hydric soil locations that represent functional or restorable playas. Since the 1950s, values of wetlands to a healthy functioning environment and human society have been increasingly recognized by scientists, conservationists, and the general public. This understanding has led recent U.S. presidential administrations to promote a policy goal of "no net loss" of wetlands (Smith 2003). However, without proper location information it is unlikely these losses will be accounted for when evaluating the effectiveness of this federal policy goal for wetlands, and, although conceivably remaining on the landscape, many of the remapped playas are no longer identifiable for inclusion in current or future resource estimates and extrapolations. Accurate estimates and extrapolation of playa numbers are vital given their use for conservation planning, habitat availability, estimation of flora and fauna population size, water storage capacity, and aquifer recharge estimates. Inaccuracies in these estimations due to artificially reduced numbers and area of playas and in the ecosystem services and functions they provide create an underestimate of ecosystem value. These issues will be confounded until the remapping is completed, by soils maps of SHP counties being publically available under two different sets of soil classification efforts and associated ecosites.

Despite numerous efforts, physical and functional loss of playa wetlands continues at an alarming rate (Smith et al. 2011). These losses may be responsible for the remapping of hydric locations to non-hydric and can be attributed to today's highly modified landscape, social choices, and political influences. Given these pressures, playas will be better protected when they are considered wetlands for Swampbuster and more effective conservation programs are implemented. The conservation of playas will be enhanced by the utilization, creation and enforcement of associated biologically relevant tools and laws, such as the USDA's Wetland Reserve Program or the creation of one or more Playa Wetland Management Districts where land is protected through easements or purchase and become part of the National Wildlife Refuge System (Haukos and Smith 2003). Conservation and protection of playas would be further enhanced through the restoration of previous protections provided to isolated wetlands by the Clean Water Act.

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