14820

Great Plains Prairie Pothole

BpS Model/Description Version: Aug. 2020

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| **Modelers** |  | **Reviewers** |  |
| Peter Lesica | peter.lesica@mso.umt.edu | Kathy Roche | kroche@fs.fed.us |
| Elena Contreras | econtreras@tnc.org | None | None |
| None | None | None | None |

Vegetation Type

Mixed Upland and Wetland

Map Zones

30

Geographic Range

This type is found primarily in the glaciated northern Great Plains of the US and Canada. This system can be found throughout the Northern Great Plains ranging from central IA northeast to southern Saskatchewan and Alberta, and extending west into north-central MT. It encompasses approximately 870,000 square km with approximately 80% of its range in southern Canada. It is also prevalent in ND, SD and northern Minnesota.

It occurs in section 331E in MZ30; also occurs in MZ20. It does not occur in MZ29.

Biophysical Site Description

BpS is dominated by depressional wetlands formed by glaciers scraping the landscape during the Pleistocene era. This system is typified by several classes of wetlands distinguished by changes in topography, soils and hydrology. Many of the basins within this system are closed basins and receive irregular inputs of water from their surroundings (groundwater and precipitation), and export water as groundwater. Hydrology of the potholes is complex. Precipitation and runoff from snowmelt are often the principal water sources, with groundwater inflow secondary. Evapotranspiration is the major water loss, with seepage loss secondary. Most of the wetlands and lakes contain water that is alkaline (pH >7.4). The concentration of dissolved solids results in water that ranges from fresh to extremely saline. The flora and vegetation of this system are a function of the topography, water regime and salinity. In addition, because of periodic droughts and wet periods, many wetlands within this system may undergo vegetation cycles. This system includes elements of emergent marshes and wet, sedge meadows that develop into a pattern of concentric rings.

This system is dominated by closed basins, potholes, that receive irregular inputs of water from the surroundings and export water as groundwater. The climate for the range of this system is characterized by mid-continental temperature and precipitation extremes. Snowmelt in the spring typically fills many of the potholes in examples of this system. The region in the range of this system is distinguished by a thin mantle of glacial drift with overlying stratified sedimentary rocks of the Mesozoic and Cenozoic ages; these form a glacial landscape of end moraines, stagnation moraines, outwash plains and lakeplains. The glacial drift ranges 30-120m thick and forms steep to slight local relief with fine-grained, silty to clayey soils. Limestone, sandstone and shales predominant, and highly mineralized water can discharge from these rocks. The hydrology of this system is complex with salinity ranging from fresh to saline, and chemical characteristics varying seasonally and annually. Precipitation and snowmelt are the primary water sources with evapotranspiration being the source of major water loss.

Many or most of the potholes are depressions where glaciers deposited big chunks of ice in the ground. The ice melted leaving a depression that became ponds. Hydrologic regime and water quality (pH and conductivity) determine vegetation.

Vegetation Description

Dominant species are Carex lanuginosa (woolly sedge) or Carex lasiocarpa and C. atherodes. C. lasiocarpa is found in fens while C. lanuginosa occurs in mineral soil of wetlands such as wet meadows and marshes.

Associations are:

Carex lasiocarpa or lanuginosa-Carex oligosperma/Sphagnum spp.;

Schoenoplectus acutus (=Scirpus acutus) - (Schoenoplectus fluviatilis);

Schoenoplectus maritimus (=Scirpus maritimus) - Schoenoplectus acutus (=Scirpus acutus) - (Triglochin maritima);

Carex oligosperma (in the east - not west of Minnesota) - Carex lanuginosa; Schoenoplectus acutus - (Schoenoplectus tabernaemontani) semipermanently;

and Schoenoplectus maritimus.

In the drawdown zone, species are Eleocharis acicularis, Rumex maritimus and Hordeum jubatum.

In the wet meadow zone- Hordeum jubatum, Juncus balticus and Spartina pectinata.

In the shallow marsh zone- Carex atherodes, Glyceria grandis, Eleocharis palustris Scirpus americanus and Scirpus maritimus.

In the deep marsh zone- Typha latifolia, Scirpus acutus.

Western wheatgrass and Eleocharis spp are typical of the drier zones in MT.

The context in which these potholes exist is not always grassland or xeric shrubland but can include aspen or mixed aspen/conifer communities as well.

Saline playa vegetation is the same as drawdown zone and shallow marsh zone vegetation for prairie potholes. Saline playas don’t have deep marsh (cattail-bulrush) or open water vegetation like the deeper prairie potholes do.

BpS Dominant and Indicator Species

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** |
| CAPE42 | *Carex pellita* | Woolly sedge |
| CAAT2 | *Carex atherodes* | Wheat sedge |
| SPAN | *Sparganium androcladum* | Branched bur-reed |
| SCAC3 | *Schoenoplectus acutus* | Hardstem bulrush |
| SCMA8 | *Schoenoplectus maritimus* | Cosmopolitan bulrush |
| ELEOC | *Eleocharis* | Spikerush |
| PASM | *Pascopyrum smithii* | Western wheatgrass |
| CALA11 | *Carex lasiocarpa* | Woollyfruit sedge |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

Disturbance Description

Flooding is the primary natural dynamic influencing this system. Snowmelt in the spring often floods this system and can cause the prominent potholes within the system to overflow. Greater than normal precipitation can flood out emergent vegetation and/or increase herbivory by animal species such as muskrats. This system can undergo periodic wet and droughty periods that can

cause shifts in the vegetation. Vegetation zones are evident around the wet potholes throughout this system, and each zone responds to changing environmental conditions. Draining and conversion to agriculture can also significantly impact this system. Much of the original extent of this system has been converted to cropland, and many remaining examples are under pressure to be drained.

Drought-flood cycling is the main disturbance and primary driver of successional change. Drought causes deep marsh to become shallow marsh, shallow marsh to become wet meadow etc.

Fire frequency would probably be much less than that in adjacent mid-grass prairie because these systems stay pretty wet in at least 50% of years. However, it is probably less wet and in fewer years in the southern end of the MZ. Fire would have little effect on these systems because nearly all the dominant plants are rhizomatous perennials that would not be damaged.

Fire is most likely in a year with a wet spring and high grass productivity. However, a wet spring will usually mean the wetlands are wet, so fire will have minimal effect if the wetlands even burn. Brief spring rains followed by dry period will result in greatest fire potential in southern end of MZ.

Most of the wetlands in the North Dakota Arrowwood NWR Complex contain heavy fuel loadings of emergent vegetation including bulrush, cattail and other vegetation that when cured, will support a fire even over the top of the water. During dry years, many of these areas will completely dry up, burning with moderate to high fire behavior characteristics (Arrowwood NWR Complex Fire Management Plan, 2001).

There can be little doubt that the activities of the wild bison, which was extirpated from the Prairie Pothole Region of the Dakotas in the 19th century, had a major biotic influence on prairie wetlands in pristine times. Unfortunately, there is no documentation of how wetlands were impacted by the feeding, drinking, dusting or other activities of millions of these huge, shaggy beasts as they roamed the prairies. Other grassland mammals extirpated from the region are the grizzly bear (Ursus arctos), kit fox (Vulpes velox) and plains wolf (Canis lupus). These carnivores probably made only minor use of prairie wetlands (Kantrud et al. 1989).

Uncounted numbers of wapiti (Cervus elephus) and pronghorn (Antilocapra americana) and smaller numbers of mule deer (Odocoileus hemionus), the only other large herbivores of open grasslands, once inhabited the region and undoubtedly used the wetlands, at least for drinking. These three species are still found in small numbers in the region. Also, nearly extirpated from the prairie region are the river otter (Lutra canadensis), mountain lion (Felis concolor), lynx (F. lynx) and bobcat (F. rufus). Although once distributed throughout the region, it is unlikely that any of these species were strongly associated with the wetlands dealt with in this report (Kantrud et al. 1989).

Potholes are a sort of subclass within depressional wetlands; therefore, the model from the Depressional Wetland system (Western Great Plains Depressional Wetland Systems, 14950) is used for this BpS.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 49 | 100 | 10 | 100 |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 49 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

Scale Description

Prairie wetlands can vary in size from a couple acres to hundreds of acres.

Potholes are typically connected to each other in a broad spatial/temporal fashion.

Adjacency or Identification Concerns

Many wetlands today have been drained and cropped; federal policy has slowed this process.

In MZ30 these wetlands are surrounded by mixed-grass prairie or cropland. In MZ20, they can be surrounded by aspen or fescue (foothills) prairie.

The context in which these potholes exist is not always a grassland or xeric shrubland but can include aspen or mixed aspen/conifer communities as well.

This system could be confused with Western Great Plains Depressional Wetland System, and indeed, some shallow, saline prairie potholes have nearly identical vegetation. It may also even be said that potholes are a sort of subclass within depressional wetlands, they just have a unique origin, occurring within glaciated terrain where ice-blocks have melted leaving kettle holes (depressions) of various dimensions. (Saline playa vegetation is the same as drawdown zone and shallow marsh zone vegetation for prairie potholes. Saline playas don’t have deep marsh (cattail-bulrush) or open water vegetation like the deeper prairie potholes do.) However, the potholes are also different from wetlands in that potholes are typically connected to each other in a broad spatial/temporal fashion. In wet years and wet seasons, and in individual basins, they often have both surface and groundwater connections.

Poa pratensis, Poa palustris and Kochia scoparia are common exotics.

In prairie wetlands, disruption of natural processes such as fire has led to domination by robust, emergent plants, particularly in the prairie pothole region. Cattail, once rare on the Great Plains, has spread across thousands of prairie wetlands, as has purple loosestrife, a species native to Europe which is now threatening waterways across the United States (US Congress, Office of Technology Assessment 1993, Malecki and Blossey 1994). In the past, climate, fire and grazing controlled the diversity and abundance of vegetation in northern prairie wetlands (http://www.npwrc.usgs.gov/resource/habitat/grlands/landmgt.htm).

More is known about the effects of grazing than fire. Nodal rooting, or underground branching, and unpalatability are evident evolutionary responses of wetland plants to grazing. Under certain conditions grazing can increase species diversity and the development of intricate patterns and sharp boundaries among prairie wetland plant communities (Bakker and Ruyter 1981).

About half of the original potholes in the Dakotas have been destroyed (60% in ND and 40% in SD; Tiner 1984). Over half were altered by agriculture, irrigation and flood control projects (http://www.fws.gov/nwi/Pubs\_Reports/isolated/report\_files/2\_section/overview.htm).

Issues or Problems

Native Uncharacteristic Conditions

Vegetation may be more productive in wetlands polluted by agricultural fertilizers.

Comments

Succession Classes

**Mapping Rules**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** | | | | | | | | | |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | B | B | B | B | B | B | B |
| Herb | 0.5-1.0 | A | A | A | B | B | B | B | B | B | B |
| Herb | >1.0 | A | A | A | B | B | B | B | B | B | B |
| Shrub | 0-0.5 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | >3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 0-5 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 5-10 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 10-25 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 25-50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | >50 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

Class A 33 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CALA11 | Carex lasiocarpa | Woollyfruit sedge | None |
| CAAT2 | Carex atherodes | Wheat sedge | None |
| ELEOC | Eleocharis | Spikerush | None |
| PASM | Pascopyrum smithii | Western wheatgrass | None |

Description

Dominated by resprouts and seedlings of grasses and post-fire associated forbs. Low to medium height with variable canopy cover.

Persists for 20yrs and then succeeds to mid-development closed stage.

Fire would cause little change in species composition except possible a temporary decline in Puccinellia and Hordeum (bunch grasses). However, the 20yr interval was retained for feedback from original modelers.

Also - the periodic wet and dry periods are the reason for the long time in class A and the slow recovery of cover. Perhaps as you go further south and more outside the glaciation effects, the recovery of the system is slower (Kathy Roche, USFS, pers comm). In the southern end of the Map Zone, the dry periods are longer and slow the vegetation recovery.

*Maximum Tree Size Class*  
None

Class B 67 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CALA11 | Carex lasiocarpa | Woollyfruit sedge | None |
| CAAT2 | Carex atherodes | Wheat sedge | None |
| ELEOC | Eleocharis | Spikerush | None |
| PASM | Pascopyrum smithii | Western wheatgrass | None |

Description

Greater than 30% herb and shrub cover combined.

Upper Layer Lifeform is not the dominant lifeform. Scattered shrubs may be present.

*Maximum Tree Size Class*  
None

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:CLS | 20 |
| Mid1:CLS | 21 | Mid1:CLS | 999 |

Probabilistic Transitions

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Native Grazing | Early1:ALL | Early1:ALL | 0.1 | 10 | No | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Native Grazing | Mid1:CLS | Mid1:CLS | 0.2 | 5 | No | 0 |

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