14820

Great Plains Prairie Pothole

BpS Model/Description Version: Aug. 2020

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| --- | --- | --- | --- |
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|  |  |  |  |

Vegetation Type

Mixed Upland and Wetland

Map Zones

39, 40

Model Splits or Lumps

This BpS is lumped with: 1493

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 northwest and 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 and western MN.

For MZs 39 and 40, it did occur prevalently throughout the zones in the eastern portions but not west of the Missouri River. The exception is in MT. It occurred from ECOMAP subsection (Cleland et al. 2007) 222Na down south through 251Bd and Bf and into IA; it is also in 331Ea south and east – so throughout the mapzones. However, it is not in eastern NE.

Prairie potholes do not exist in western SD, they do to an extent in western ND. Prairie potholes only exist in areas of the prairie that were affect by glaciation.

Biophysical Site Description

This 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 result in water that ranges from fresh to extremely saline. There are more freshwater wetlands in a gradient going east through the Dakotas. The evapo-precipitation ratio affects the salinity, where it is more alkaline going west. 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 and 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

This system is comprised of different water permanence classes. Deep potholes are permanent. Some have seasonal water. Some have temporary flooded basins. Each has different set of associated vegetation. Deep marshes have cattails and bulrush. Shallow marshes in big basins, depending on salinity have sedges, prairie bulrush. There are also wet meadows and low prairies.

Some of the 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 MN) - *Carex lanuginosa*; *Schoenoplectus acutus* - (*Schoenoplectus tabernaemontani*) Semipermanently; *Schoenoplectus maritimus*.

In big basins:

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

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

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

Fire frequency would probably be much less than that in adjacent midgrass prairie because these systems stay fairly wet in at least 50% of years. However, it is probably less wet and in fewer years in the southern end of the MZ20. Fire would have little effect on the vegetation composition because nearly all the dominant plants are rhizomatous perennials that would not be damaged. 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. Fire probably occurs in drought years that have less relative humidity.

However, 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).

Activities of the wild bison (*Bison 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 is used as a starting point for this BpS.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 50 | 100 | 10 | 100 |
| Moderate (Mixed) |  |  |  |  |
| Low (Surface) |  |  |  |  |
| All Fires | 50 | 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 of acres to hundreds of acres.

Potholes are generally not connected with each other.

Adjacency or Identification Concerns

This system is within the tallgrass prairie matrix. Mixed-grass prairie can also be adjacent.

Much of the original extent of this system has been converted to agriculture, and only approximately 40-50% of the system remains undrained (NatureServe 2007). Many wetlands today have been drained and cropped; federal policy has slowed this process.

Estimates of wetlands lost in North and South Dakota are 49% and 35% respectively (Dahl 1990). Remaining wetlands are often highly degraded (i.e., sediment-filled, invaded by non-native plants, poor water quality due to agricultural runoff).

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).

Also, because of hydrological manipulations of water systems including potholes and riparian systems, the water movement on the landscape occurs in a modified manner than in pristine times. Wetlands are often dominated by monotypic stands of reed canary grass or narrow-leaf and/or hybrid cattail.

In terms of differences today versus the historic system – exotic cattails and hybrids of have created monotypic stands in the semi-permanent basins, instead of being interspersed within. There would have been less continuous vegetation and therefore fire historically versus now. There were patches, but now there are exotic cattails forming uniform monocultures throughout the deep marsh or open water zone, and so there is more fire today (Dave Ode, pers. comm.). If there is more open water, it is thought that that might cause more of a move to solid cattails.

A large proportion of temporary wetlands are cropped. They’re shallow, just wet spots. Drainage and filling is occurring. The deep ones get drained. South and North Dakota do still have many potholes, however.

Today there are also small wetlands that are more integrated now because of drainage. Smaller potholes are being drained into the nearest big wetland or lake. This increases the flood frequency in larger basins. Drainage has altered the hydrology of drained and receiving basins.

In MZ30 these wetlands are surrounded by mixed-grass prairie or cropland. In MZ20, they can be surrounded by aspen or fescue (foothills) prairie. In MZs 39 and 40, this BpS is surrounded by tallgrass prairie in the eastern Dakotas and mixed-grass prairie in the central Dakotas and west. 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. Also though the 1495 wetlands systems could probably be just a subsection of the prairie potholes 1482. It might even be that the variability of the prairie potholes encompasses the wetland system 1495. The 1495 wetlands systems would be the unglaciated semi-arid system versus potholes which would be glacial sub-humid.

(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.

It is also unclear as to where one would draw the line between a lake and a pothole when describing deep potholes. These systems are very variable. There are huge basins such as in Preston and Whitewood, where there were huge cattail marshes flooded in the 80’s and are now lakes; they got into the wet cycle and became lakes and still have not returned.

There was also some debate in MZs 39 and 40 as to whether or not potholes should be lumped into the tallgrass systems. It was decided that they would be split out. When there is water, it is a system. Drought converts the aquatic system to terrestrial. The system goes in and out of existence based on weather patterns. There is also a temporal shift where potholes might go out of existence. Permanent wetlands are further east, but further northwest through to western Dakota, they go in and out of this pothole state.

*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 (U.S. 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).

Also - herbaceous wetlands BpS 1493 are being combined into this system. 1493 is probably wetter than 1482 potholes, but they'd intergrade within each other. Prairie potholes are driven by drought and have frequent drawdowns and go totally dry with regularity, whereas 1493 would always be wet. BpS 1493 probably occurs from ECOMAP subsections 251Ba, 251Bb - 97 latitude east. However, there would be a combination of potholes versus 1493; therefore, we are lumping this into the potholes system.

Issues or Problems

Potholes are a sort of subclass within depressional wetlands; therefore, the model from the Depressional Wetland system is used for this BpS.

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 40 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CALA11 | Carex lasiocarpa | Woollyfruit sedge | Upper |
| CAAT2 | Carex atherodes | Wheat sedge | Upper |
| ELEOC | Eleocharis | Spikerush | Upper |
| PASM | Pascopyrum smithii | Western wheatgrass | Upper |

Description

This class is dominated by resprouts and seedlings of grasses and post-fire associated forbs with low to medium height with variable canopy cover. In the deep marsh, it is 50% vegetated and 50% open water. For previous mapzones such as MZ30 or MZ20, previous modelers might have been thinking that the low vegetative cover should be modeled because part was open water. However, for MZs 39 and 40, there is a different view as to how this should be modeled. In shallow potholes, there is high vegetative cover. If there is deep water, there would actually be a zone of cattails surrounding. If the basin is flooded, this drowns out all vegetation. When it drops down, it will go without vegetation until the appropriate environment starts, and then vegetation will generate (although currently cattail will regenerate creating a monoculture – which is a different endpoint than that which would have happened historically). The flood event kills deep marsh vegetation, then the water recedes and almost has to go down to nothing for the vegetation to become re-established. With seedling established on wet areas and not standing water in the basin, emergent plants will grow. Water will then return, and then the pothole will be an interspersed emergent vegetation and open water mosaic. Over time, it will become denser with vegetation.

The smaller the basin, probably the quicker the cycling might occur.

Drought will affect large amounts of the area.

Fire would cause little change in species composition except possible a temporary decline in *Puccinellia* and *Hordeum* (bunch grasses).

Native grazing and herbivory could be heavy.

Since this is a wetland community, it is thought that fire would impact the landscape much less frequently. The fire frequency would vary dependent on type of pothole. Temporary wetlands/potholes burned more frequently – probably as often as a grassland since they only had water for a short period and then they dry up. The larger ones probably have water most of the time and would not burn because they would be full of water. Also, after a flood, the flood might have killed the vegetation and then the fire frequency wouldn’t be high, because there would be no vegetation for fuels. (For example, around Miller, South Dakota, big basins flooded, and now they are dry because no more vegetation is there – Dave Ode, pers. comm.). There would only be a few phases where the potholes would be susceptible to fire – for instance, when there is vegetation and when it is dry and during drought.

*Maximum Tree Size Class*  
None

Class B 60 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| CALA11 | Carex lasiocarpa | Woollyfruit sedge | Upper |
| CAAT2 | Carex atherodes | Wheat sedge | Upper |
| ELEOC | Eleocharis | Spikerush | Upper |
| PASM | Pascopyrum smithii | Western wheatgrass | Upper |

Description

This class has greater than 30% herb and shrub cover combined. Scattered shrubs may be present.

Native grazing and herbivory could be heavy.

Since this is a wetland community, it is thought that fire would impact the landscape much less frequently. The fire frequency would vary dependent on type of pothole. Temporary wetlands/potholes burned more frequently – probably as often as a grassland since they only had water for a short period and then they dry up. The larger ones probably have water most of the time and would not burn because they would be full of water. Also, after a flood, the flood might have killed the vegetation and then the fire frequency wouldn’t be high, because there would be no vegetation for fuels. (For example, around Miller, South Dakota, big basins flooded, and now they are dry because no more vegetation is there – Dave Ode, pers. comm.). There would only be a few phases where the potholes would be susceptible to fire – for instance, when there is vegetation and when it is dry and during drought.

*Maximum Tree Size Class*  
None

Model Parameters

Deterministic Transitions

|  |  |  |  |
| --- | --- | --- | --- |
| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| Early1:ALL | 0 | Mid1:CLS | 10 |
| Mid1:CLS | 11 | 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** |
| Optional 1 | Early1:ALL | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Wind or Weather or Stress | Early1:ALL | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Optional 2 | Early1:ALL | Early1:ALL | 0.02 | 50 | No | 0 |
| Native Grazing | Early1:ALL | Early1:ALL | 0.1 | 10 | No | 0 |
| Optional 1 | Mid1:CLS | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Optional 2 | Mid1:CLS | Mid1:CLS | 0.02 | 50 | No | 0 |
| Wind or Weather or Stress | Mid1:CLS | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.02 | 50 | Yes | 0 |
| Native Grazing | Mid1:CLS | Mid1:CLS | 0.2 | 5 | No | 0 |

Optional Disturbances

Optional 1: major flooding

Optional 2: regular flooding

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