14690

Eastern Great Plains Floodplain Systems

BpS Model/Description Version: Aug. 2020

Update: 3/18

Vegetation Type

Mixed Upland and Wetland

Map Zones

38, 42, 49

Model Splits or Lumps

This BpS is lumped with: 1162

Geographic Range

This system is found along rivers across the glaciated Midwest. This system is found along medium and large river floodplains throughout the prairie-dominated part of the glaciated Midwest ranging from eastern Kansas and eastern Nebraska to central Illinois and north along the Red River basin in Minnesota.

It's difficult to determine geographically where the Western model ends and the Eastern model starts, but probably around Yankton, South Dakota or perhaps up to Fort Randall Dam might be a good dividing line for Eastern vs. Western on the Missouri.

Biophysical Site Description

Alluvial surfaces, usually bare, within broad floodplains are present as low elevation shorelines and barforms. The slightly higher fluvial landform adjacent to the channel forms the first terrace for fluvial dependent species. Over time, laterally migrating point bars form bench platforms that may become late seral stage floodplain forests.

Great Plains riparian and floodplain systems will be lower elevations in the plains matrix.

Dominant communities within this system range from floodplain forests to wet meadows to gravel/sand flats; however, they are linked by underlying soils and the flooding regime.

Vegetation Description

It is this variety of substrates and flooding that creates the mix of vegetation that includes *Acer saccharinum, Populus deltoides*, willows, especially *Salix amygdaloides* and *Salix nigra* in the wettest areas, and *Fraxinus pennsylvanica, Ulmus americana*, and *Quercus macrocarpa* in more well-drained areas. Within this system are oxbows that may support *Nelumbo lutea, Numphaea odorata,* and *Typha latifolia*. Understory species are mixed, but include shrubs, such as *Cornus* *drummondii* and *Asimina triloba* (in Kansas), sedges and grasses, which sometimes help form savanna vegetation.

The variety of soil properties associated with this system can create a mixture of vegetation. *Acer saccharinum* occurs on the wetter soils of floodplains in the eastern portion of this system, with *Populus deltoides* and willows, especially *Salix nigra* and *S. amygdaloides*, occurring more in the western range of this system. *Fraxinus pennsylvanica, Ulmus americana,* and *Quercus macrocarpa* occur in more well-drained areas. Understory species can vary across the range of this system but can include shrubs such as *Cornus drummondii* and *Asimina triloba,* and sedge and grass species. Oxbows within this system may have species such as *Nelumbo lutea* and *Typha latifolia*.

Associations:

•*Acer saccharinum - Celtis laevigata - Carya illinoinensis* Forest (CEGL002431, G3G4)

•*Acer saccharinum - Ulmus americana* Forest (CEGL002586, G4?)

•*Acer saccharum - Carya cordiformis / Asimina triloba* Floodplain Forest (CEGL005035, G2)

•*Betula nigra - Platanus occidentalis* Forest (CEGL002086, G5)

•*Brasenia schreberi* Herbaceous Vegetation (CEGL004527, G4?)

•*Calamagrostis canadensis - Juncus* spp. - *Carex* spp. Sandhills Herbaceous Vegetation (CEGL002028, G3G4)

*•Calamagrostis stricta - Carex sartwellii - Carex praegracilis - Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)

•*Carex pellita - Carex* spp. - *Schoenoplectus tabernaemontani* Fen Herbaceous Vegetation (CEGL002041, G1)

Alliances:

•*Acer saccharinum* Temporarily Flooded Forest Alliance (A.279)

•*Acer saccharum - Carya cordiformis* Temporarily Flooded Forest Alliance (A.302)

•*Andropogon gerardii - (Sorghastrum nutans*) Temporarily Flooded Herbaceous Alliance (A.1337)

*•Betula nigra - (Platanus occidentalis*) Temporarily Flooded Forest Alliance (A.280)

•*Brasenia schreberi* Permanently Flooded Herbaceous Alliance (A.1742)

•*Carex (rostrata, utriculata*) Seasonally Flooded Herbaceous Alliance (A.1403)

BpS Dominant and Indicator Species

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

Disturbance Description

Flooding is the primary dynamic process, but drought, grazing, and fire have all had historical influence on this system.

This system is primarily controlled by moderate to frequent flooding. Grazing can also impact this system and can lead to decreased cover of many graminoid species in some areas. Grazing was not modeled due to lack of data.

Beaver influence was modeled.

Fire Frequency

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

This Biophysical Setting (BpS) occurred in a linear dimension, with smaller areas covered in tributary rivers and streams. Wetland complexes include oxbow lakes, slough, and marshes.

Adjacency or Identification Concerns

Reservoirs have had a serious and negative effect on this system, along with agriculture that has converted much of this system to drained agricultural land.

This system is distinguished from floodplain systems northeastward, Laurentian-Acadian Floodplain Forest (CES201.587), and eastward, Central Appalachian Floodplain (CES202.608). *Celtis* and *Populus deltoides* are absent (or essentially so) from the Laurentian-Acadian type.

This system is easily identified by using flood plain which is covered by a 10yr event. Surrounding vegetation could vary from forested to grass prairie transition or bare rock or rock outcrops for instance in the Badlands, White River in South Dakota, and on the Cheyenne. It is adjacent to grassland with some woody draws in the river breaks.

This system might be very difficult to distinguish from 1162 Western Great Plains Floodplain Systems. There is actually only a Midwestern Floodplain and a Great Plains Floodplain, not an Eastern and Western Great Plains Floodplain. This 1162 Western Great Plains Floodplain is akin to Great Plains Floodplain, whereas 1469 Eastern Great Plains Floodplain is akin to Midwestern Floodplain. It's difficult to determine geographically where the Western model ends and the Eastern model starts, but probably around Yankton, South Dakota or perhaps up to Fort Randall Dam might be a good dividing line for Eastern vs. Western on the Missouri.

Russian olive and tamarisk may be invaders. Tamarisk comes in with cottonwood and willow in earliest post-disturbance stage, although tamarisk is an invader more in the Great Plains region. Russian olive might affect later successional stages, after 10yrs, usually at about the time that green ash comes in.

Eastern redcedar is invasive in the floodplain forest along the Missouri at Yankton and below, and on reaches farther upstream. Indications are that eastern redcedar would have been less prevalent historically than today due to fires and less grazing pressure. Eastern redcedar has increased on floodplains especially due to fire suppression. Also, flood control and channel degradation have been a dominant influence favoring historic redcedar increases on the Missouri River floodplain, at least below Yankton. Many of redcedar trees on river below Yankton appear to be 30-40yrs old, tying in well with the period that the dams have been in place. Frequent flooding likely kept redcedar scarce on lower floodplain surfaces in the pre-dam era. How far north and west eastern redcedar would have occurred along our rivers originally is questionable (Gary Larson, personal communication).

Leafy spruce, Smooth brome, Russian knapweed and Canada thistle might invade also, especially along lower reaches.

The natural flooding frequencies have been changed by the modern water control structures, e.g., dam and irrigation projects. Flooding intensity has been altered by construction of small impoundments on tributaries as well as larger impoundments on the main-stem rivers. Decreased flood frequency along the Little Missouri River has decreased cottonwood abundance.

Agricultural activities have change seral development and introduced invasive plant species to the BpS.

Woodcutters along the system operated from the earliest days (1860s) to supply wood to the paddle wheelers plying the river. They cut many of the early stands along the river.

There are thousands of smaller dams on watersheds in addition to the large control structures that are altering hydrology today.

American elms are less dominant today than historically, and they are smaller than historically, due to Dutch Elm Disease, but they are still numerically abundant.

Livestock grazing is now different vs. historically, as are the effects of cattle vs. bison grazing.

Currently, unpalatable sagebrush cover might be higher today (although not as much in the Midwest), but chokecherry and associates might be getting wiped out. Bison would have grazed on top, not in the floodplain, whereas cattle are there regularly. Cows graze all tree and shrub seedlings, and the seedling re-establishment is episodic, and now re-establishment is stretched out further due to the livestock. They are removing much of the woody vegetation, and are hammering the grassland more intensely (Dave Ode, personal communication.).

Johnson (1992), in a study of Missouri River floodplain forests in central North Dakota, determined that the pre-settlement forest was, in fact, dominated by early successional stages. He reports that young pioneer stands (<40yrs. old) comprised 47% of the forest, while older pioneer stands (40-80yrs. old) comprised 25% of the forest; that transitional forest (80-150yrs old) comprised 21% of the forested acreage and that equilibrium stands (dominated by green ash, elm, oak, etc.) (>150yrs old) comprised only seven percent of the forested acreage. Johnson (1992) also demonstrated that with construction of Garrison Dam and subsequent cessation of flooding, there is a continuing shift to older forest stages and very little recruitment of new, early successional forest; the very types that once dominated the Missouri River floodplain and provided habitat for its varied native wildlife. (From Ode 2004).

Over the past 37yrs much has changed in the cottonwood forest of LaFramboise Island in South Dakota. As the density of cottonwoods has declined (at a rate of about two per acre per year), the number of junipers and, to some extent, green ash have dramatically increased. In cottonwood forests throughout much of the upper Missouri River Valley, green ash is one of the most important tree species to colonize cottonwood forests and, over time, becomes the dominant forest tree (Ode 2004). Whatever the dominance of green ash may be in the future forest, it will likely be overwhelmed if not over-shadowed by the massive number of junipers which are now developing in the LaFramboise Island forest understory (Ode 2004). Cottonwood is declining.

Junipers are notoriously vulnerable to fire. On the presettlement landscape of the northern plains, where prairie fires were frequent events, juniper woodlands were restricted to fire-protected environments like river breaks, badland escarpments, buttes, and islands (Ode 2004).

There might be some difficulty distinguishing the Floodplain systems from the Riparian from the Wooded Draw/Ravines, and where to assign smaller, second- and third-order prairie streams. The second and third order prairie streams can sometimes have cottonwood and be like small rivers (Riparian, Floodplain); sometimes they are dominated by other woodies such as water birch, boxelder, green ash (Wooded Draw/Ravine) and willows, depending on how far east you go; sometimes they have very few woody plants other than silver sagebrush. Streams in the eastern half of Montana (east of the Big Snowies) could probably be modeled as either a cottonwood successional sequence or a woody draw successional sequence, depending on the size of the drainage basin. If the basin is big enough there will eventually be a flood big enough to result in cottonwood regeneration. This is especially true now with all the impoundments in the headwaters of these prairie streams. Drainages that don't have the area to get a good flood would probably have been some sort of woody draw, dominated by green ash in the eastern third of the state or other woodies like hawthorn or chokecherry in the more western part of the Great Plains. Assigning the drainage to one or the other type of system would depend on basin size.

Rivers and streams that have had impoundments (current conditions) for 50yrs or more probably have more Class D than presettlement but less Class A and B. Class A and B currently have tamarisk. Class C and D have Russian olive currently. Several exotics, such as Canada thistle, Kentucky bluegrass and quackgrass are ubiquitous in classes B through E currently.

Issues or Problems

Native Uncharacteristic Conditions

Comments

For map zone (MZ) 42: the model developed for MZs39 and 40 (created by Dave Ode and Elena Contreras) was modified by making minor text changes and changing some species more common in MZ42 (Susanne Hickey). This BpS for MZs 39 and 40 was created from the NatureServe description as well as adaptations from BpS 1162 from MZs 39 and 40 created by Dave Ode and modeled by Elena Contreras and reviewed by Gary Larson, Mark Dixon, John Ortmann. Changes were made to better fit the eastern vegetative and functional components. Model for 1469 similar to 1162, except that class E is removed for 1469, as it is not present for the East. Evolution of 1162 can be found in BpS 1162 Comments description.

Succession Classes

**Mapping Rules**

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 14 Early Development 1 - All Structures

Indicator Species

Description

This class is created by deposition, stream meander changes, point bar formation, and scouring.

The upper layer lifeform is comprised of a seedling and sapling shrub, e.g., willows, and tree component and dominated by a young canopy of tree saplings and shrubs after a few years. Trees might be more abundant and frequent.

Sandbar willow, *Salix interior* is invariably the first which makes its appearance on the newly made lands on the borders of the Mississippi and Missouri, and seems to contribute much towards facilitating the operation of raising this ground still higher; they grow remarkably close and in some instances so much so that they form a thicket almost impenetrable (from Meriwether Lewis during the Lewis & Clark expedition in 1804 to 1806). (From Ode 2004).

Pioneer tree and shrub species of cottonwoods and willows. The understory is highly variable and consists of bare sand, annuals, or perennial hydrophytes. Species would include various grass, sedges, and rushes. Annuals become less and less common as the rhizomatous perennials take hold. Herbaceous understory of sedges (bulrushes) and native annuals in wet areas. In the early few years of this stage, most of the area is bare sand. *Acer saccharinum* and *Salix nigra* are also indicators.

Most of area is seasonally flooded. Much bare, wet-alluvium habitat for cottonwood establishment is created each year during spring floods; however, most will be swept away by the following year's flood in the early part of this class. Flooding occurs up high enough on point bars and low terraces to establish cottonwoods, and then allows them to escape flooding until they are large enough to persist, in the early part of this class.

During the second part of this class, minor flooding occurs advancing this stage to the next; deposition causes the terrace to build and become higher and drier. This was modeled as alternate succession. Lack of flooding actually maintains the stage.

Major flooding occurs bringing it back to the beginning of this stage. This was modeled as wind/weather stress.

Beaver disturbance occurs in this class. The closer to the river, the more likely it is. It was modeled as "Optional 1". Beavers, however, do not have as much of an impact in stands less than 10yrs old unless there is nothing else in the area. Beaver activity is quite variable. It was modeled as occurring on 1% of this class on the landscape each year, maintaining this class.

This class succeeds to the mid-development closed stage.

Johnson (1992) states that young pioneer stands (<40yrs old) comprised 47% of the forest historically.

*Maximum Tree Size Class*  
Sapling >4.5ft; <5"DBH

Class B 29 Mid Development 1 - Closed

Indicator Species

Description

This stage develops as the stand starts to mature. This community tends to be partially opened, with scattered cottonwoods and willows. Stands of cottonwoods 20-50yrs old can be fairly dense, although there are usually some openings. The shrub layer is highly variable and may include species such as rose, snowberry, chokecherry, dogwood.

Green ash begins to establish in cottonwood stands when they are approximately 20yrs old (Lesica and Miles 1999). Silver maple can also be an indicator.

The understory vegetation is highly variable, succeeding to Class C, a late closed stage.

Willows slow current and create deposition on top. The vegetation helps anchor and causes deposition which decreases flood frequency. Flooding leading to deposition occurs every 50yrs, promoting succession to the next stage by raising the level of the terrace (modeled as alternate succession). Major flooding also occurs bringing this class back to the early Class A stage (modeled as wind/weather stress).

Replacement fires were modeled. It would probably only burn in drought, as fires would be very rare. It has been suggested that stand-replacing fires might not occur in this class because it might be too wet for fire. However, due to lack of data, replacement fires were kept in the model. It is questionable whether replacement fire would set this stage back to the beginning of Class A, as the terrace would be too high and dry to provide conditions for successful establishment of cottonwood and willow from seed. If the cottonwoods resprouted, it would be more like the middle of Class A because the understory would be more mature than the beginning of Class A; if the cottonwoods didn't resprout, it would probably just be a willow stand. Replacement fire was modeled as taking this class to Class A, however.

Low severity and mixed fire also occur, and would not cause transition to another stage.

Beaver disturbance occurs in this class. The closer to the river, the more likely it is. Activity was modeled as "optional 1". Beaver activity is quite variable, and was modeled as occurring on 1% of this class on the landscape each year, thus maintaining this class.

It has been suggested that Native Americans likely burned low severity fires in these areas. However, another reviewer questioned that and stated that they probably didn’t burn these areas but rather the surrounding area, since this area would be too difficult to burn due to too much shade and humidity. Also, some sites were likely heavily grazed by bison (low severity fire sites) and horses near camps. However, the model was retained as is, as no confirming feedback was received.

*Maximum Tree Size Class*  
Medium 9-21"DBH

Class C 42 Late Development 1 - Closed

Indicator Species

Description

This class is a mature, late seral closed canopy cottonwood floodplain forest. Overstory is dominated by cottonwood and green ash. Box elder is a frequent component of this class for MZs 39 and 40 but is not as common as green ash. (Some modelers/reviewers thought that the system is becoming drier in this class and allowing western wheatgrass to come in; however, others questioned that.) Tree height maximum probably rises to ̴ 30-35 meters; western portions will be shorter.

At least four studies along the Missouri River in southeastern South Dakota have described aspects of a successional sequence that begins with colonization by cattails or sandbar willow, develops through transitional phases to a plains cottonwood dominated forest, and finally, in the absence of stand replacing floods, develops into a mixed deciduous forest that may contain the following tree species in addition to aging cottonwoods: green ash, American elm, boxelder, bur oak, slippery elm, hackberry, American basswood, black walnut, and eastern redcedar (Johnson 1950, Heckel 1963, Wilson 1970). Ecological studies along the Missouri River in central North Dakota have documented a similar successional pattern ultimately resulting in a forest dominated by green ash, boxelder, American elm, and bur oak (Johnson et al. 1976). (from Ode 2004). This was therefore modeled as a successional pathway to Class D. Others have enough green ash that the next class, in this case Class D, is dominated by green ash and Symphoricarpos occidentalis.

This class can succeed to Class D.

Minor flooding raises the level of the terrace. Because this is the last stage in this cottonwood portion of the system, minor flooding was modeled as wind/weather stress, causing no transition. Major flooding bringing this class back to Class A. This was modeled as wind/weather stress.

Low severity fire was also modeled as it was in Class B, causing no transition. Mixed severity fire was also included with the same probability.

Optional 2 in this class represents erosional processes of river meandering that would bring this class eventually back to Class A. The class/system will first be part of the river, but then will succeed to class A or a point bar state. This occurs with a frequency of several hundred years.

River meanders begin to cut away at the banks where a mature or old-growth stand of POPDEL exists; the living trees slowly are undercut and ultimately fall into the stream.

Beaver disturbance occurs in this class; the closer to the river, the more likely. It was modeled as "optional 1". Beaver activity is quite variable, and was modeled as occurring on 1% of this class on the landscape each year, maintaining this class.

Johnson (1992) states that older pioneer stands (40-80yrs. old) comprised 25% of the forest; that transitional forest (80-150yrs old) comprised 21% of the forested acreage and that equilibrium stands (dominated by green ash, elm, oak, etc.) (>150yrs.old) comprised only 7% of the forested acreage historically.

*Maximum Tree Size Class*  
Very Large >33"DBH

Class D 15 Late Development 2 - Closed

Indicator Species

Description

The trees are actually shorter as one moves west. Green ash and cottonwood in the central and western Dakotas are almost half the size of those in the Midwest.

This class was based on R4NOFP class E. Found along the upper terrace that has been protected from most flood events, except for rare high intensity flooding. Species composition increases towards south and east within the region. Overstory species include hackberry, green ash, sycamore, black walnut, and elm. Understory species include vines and poison ivy. *Ulmus Americana* is another indicator.

In the absence of stand replacing floods, a mixed deciduous forest has developed that may contain the following tree species in addition to aging cottonwoods: green ash, American elm, boxelder, bur oak, slippery elm, hackberry, American basswood, black walnut, and eastern redcedar (Johnson 1950, Heckel 1963, Wilson 1965 & 1970, Lawry 1973), which is more prominent in the East but still present in the Dakotas. Ecological studies along the Missouri River in central North Dakota have documented a similar successional pattern ultimately resulting in a forest dominated by green ash, boxelder, bur oak, and American elm (Johnson, et al. 1976). (from Ode 2004).

Class D hackberry, slippery elm, basswood, bur oak and black walnut are present downstream from Yankton in the Dakotas. These species occur in central to eastern North Dakota. In western North Dakota (and probably much of western South Dakota, too) species are green ash, American elm, boxelder and eastern redcedar and *Juniperus scopulorum*.

Hansen et al. (1984) state that other dominants are *Toxicodendron rydbergii* and *Elymus canadensis.*

The FRPE/SYOC association is an edaphic climax on the floodplain adjacent to the Little Missouri River and its major tributaries. PODE currently dominates many stands but is no longer reproducing. It will be replaced by FRPE. The larger trees, some 6-7dm DBH are PODE, but the young trees establishing in the stands are FRPE. JUSC is tallied with the tree species, although it's an understory species in the closed forest. Its current abundance is attributed to adequate light penetrating to the shrub and herb layers of the community as a result of wide spacing of the old *Populus*. Along the Missouri River, in central North Dakota, southeast South Dakota, and near Omaha, Nebraska, PODE is a pioneer species and is successionally replaced by various combos of *Fraxinus, Ulmus, Acer,* and *Celtis*. Among the grasses, CALO, ELCA, MURA are important (Hansen et al. 1984).

The disturbances are those from R4NOFP: Major flooding events can bring this class back to A (.004 probability - every 250yrs), modeled as wind/weather stress. Flooding events can also cause a transition back to C (.005 probability - every 200yrs), modeled as wind/weather stress.

Mixed fire causes no transition.

Dominants of the green ash/western snowberry stands can resprout after fire. However, a very hot fire can kill the green ash (Lesica 2003), in which case it would probably become a stand of western snowberry-silver sagebrush-western wheatgrass (not modeled here).

*Maximum Tree Size Class*  
Large 21-33"DBH

Model Parameters

Deterministic Transitions

Probabilistic Transitions

Optional Disturbances

Optional 1: beaver

Optional 2: erosional processes of river meandering

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