

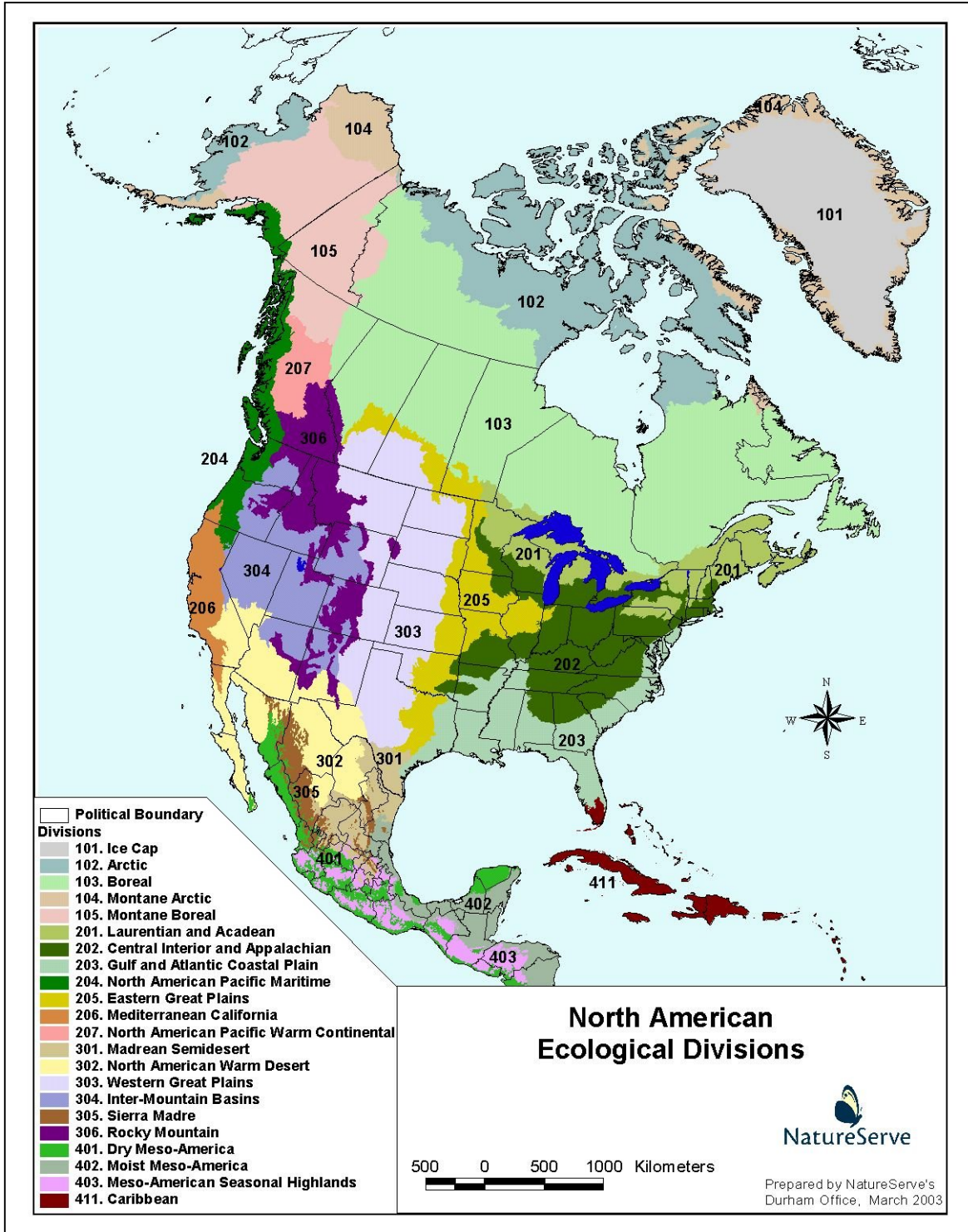
Appendix III: Wetland Ecological System Descriptions

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Ecological Divisions of North America for NatureServe Ecological Systems.



CES103.581 BOREAL-LAURENTIAN BOG

Primary Division: Boreal (103)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Organic Peat (>40 cm); Dwarf-Shrub; Graminoid; Oligotrophic Water

Concept Summary: These peatlands are found at the higher temperate and near-boreal latitudes of the northeastern and north-central United States and adjacent Canada, where climate allows the rate of peat accumulation to exceed its decomposition, resulting in acidic peatlands. Most are ombrotrophic, at least over part of their area, though some examples may be weakly minerotrophic (poor fen), especially around the margins. The surface morphology of the bog may be more-or-less level, domed, or eccentric, but typically is over the water table. The vegetation is either semi-treed and dominated by low ericaceous shrubs (including *Kalmia angustifolia*, *Kalmia polifolia*, *Ledum groenlandicum*, and *Chamaedaphne calyculata*), with patches of conifers, graminoids and bryophyte lawns, or more open forest, where trees form a partial to moderate cover over parts of the peatland. In the latter situation, stunted *Picea mariana* and *Larix laricina* are the dominant trees, and dwarf-shrubs (*Chamaedaphne calyculata*, *Ledum groenlandicum*) and sedges are common in the understory.

Secondary bog pools (schlenke) may be present. While the raised portion defines these bogs, fen vegetation is often present along the perimeter.

This broadly defined peatland system can be subdivided based on the geomorphology of the peatland. A variety of approaches have been taken - in Maine, see Davis and Anderson (2001); in Canada, see National Wetlands Working Group (1988), and in Minnesota see Glaser (1992). In Canada, bog and fen peatlands each have their own set of forms. In Minnesota, Glaser treats bogs and fens together as part of larger patterned peatland complexes (mire complexes).

Comments: This system corresponds to Glaser and Janssens' (1986) forested and "semi-forested continental bogs," but this system is somewhat broader in scope as it includes both the raised bogs and the flat bogs in the system type. Thus it extends further southward into the central Great Lakes and northeastern United States. Eastward, it extends roughly to the Acadian region, where it is replaced by Acadian Maritime Bog (CES201.580). Northwestward in northern Ontario, continental non-forested bogs are common (Glaser and Janssens 1986, fig. 2).

These bogs may overlap in common terminology with that of "muskeg," a flat bog peatland with scattered trees and a fairly dense shrub layer on hummocky peat. But muskeg could include poor fens and acid swamps as well as bogs.

DISTRIBUTION

Range: Central and eastern Canada, extending into northern New England and the Great Lakes region, particularly in northern Minnesota. Very few examples occur south of the Laurentian-Acadian Division.

Divisions: 103:C, 201:C, 202:C

TNC Ecoregions: 47:C, 48:C, 61:C, 63:C

Subnations: MB, ME, MI, MN, NB, NH, NS, NY, ON, PE?, QC, VT, WI

Associations:

- *Alnus incana* ssp. *rugosa* - *Nemopanthus mucronatus* / *Sphagnum* spp. Shrubland (CEGL006158, G5)
 - *Carex (oligosperma, exilis)* - *Chamaedaphne calyculata* Shrub Herbaceous Vegetation (CEGL006524, GNR)
 - *Carex lasiocarpa* - *Rhynchospora alba* - *Scheuchzeria palustris* Herbaceous Vegetation (CEGL002501, G2?)
 - *Carex oligosperma* - *Carex pauciflora* - *Eriophorum vaginatum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL005256, G4G5)
 - *Chamaedaphne calyculata* - *Ledum groenlandicum* - *Kalmia polifolia* Bog Dwarf-shrubland (CEGL005278, G5)
 - *Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
 - *Kalmia angustifolia* - *Chamaedaphne calyculata* - (*Picea mariana*) / *Cladina* spp. Dwarf-shrubland (CEGL006225, G5)
 - *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest (CEGL005271, G5)
 - *Picea mariana* / (*Vaccinium corymbosum*, *Gaylussacia baccata*) / *Sphagnum* sp. Woodland (CEGL006098, G3G5)
 - *Picea mariana* / *Chamaedaphne calyculata* / *Sphagnum* spp. Dwarf-shrubland (CEGL005218, G4G5)
 - *Picea mariana* / *Ledum groenlandicum* / *Carex trisperma* / *Sphagnum* spp. Forest (CEGL002485, G5)
- High-ranked species:** *Callophrys lanoraieensis* (G3G4), *Carex heleonastes* ssp. *heleonastes* (G4T3T4)

SOURCES

References: Comer et al. 2003, Damman and French 1987, Davis and Anderson 2001, Glaser 1992a, Glaser and Janssens 1986, Harris et al. 1996, National Wetlands Working Group 1988

Version: 04 Mar 2004

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler and D. Faber-Langendoen

LeadResp: East

CES103.724 BOREAL-LAURENTIAN CONIFER ACID SWAMP

Primary Division: Boreal (103)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This is a forested peatland where the trees form a partial to full cover over most or all of the peatland. Stunted to well-developed *Picea mariana* and *Larix laricina* are the dominant trees. The system is primarily weakly to moderately minerotrophic (poor fen), though some stands may approach ombrotrophic (bog) conditions. Heaths and sedges are common in the understory, but the dwarf-shrub layer is less well-developed than in open acidic peatlands, though it may be prominent in more open parts of the system. *Chamaedaphne calyculata* and *Ledum groenlandicum* are the dominant dwarf-shrubs.

Comments: This forested system is most common in poorly drained basins, with some minerotrophic influence. It is sometimes referred to as "muskeg," a flat bog peatland with scattered trees and a fairly dense shrub layer on mounded or hummocky peat, though this system is not, technically, an ombrotrophic bog [see Boreal-Laurentian Bog (CES103.581)]. Muskeg is probably a complex of bogs and acid swamps. There appears to be no need for a true Boreal alkaline swamp system (sub-boreal-Laurentian acid swamps are described in Laurentian-Acadian Conifer-Hardwood Acid Swamp (CES201.574)), but further review is needed. In Acadia and the Northern Appalachian region, this system is replaced by Laurentian-Acadian Conifer-Hardwood Acid Swamp (CES201.574).

DISTRIBUTION

Range: Central and eastern Canada, extending into northern New England and the Great Lakes region, particularly in northern Minnesota.

Divisions: 103:C, 201:C

TNC Ecoregions: 47:C, 48:C, 63:C

Subnations: MB, ME, MI, MN, NB, NH?, NS, NY, ON, PE?, WI

Associations:

- *Carex lasiocarpa* - *Carex oligosperma* / *Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
- *Larix laricina* / *Chamaedaphne calyculata* / *Carex lasiocarpa* Shrubland (CEGL005226, G4G5)
- *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest (CEGL005271, G5)
- *Picea mariana* / *Alnus incana* / *Sphagnum* spp. Forest (CEGL002452, G5)
- *Pinus banksiana* - (*Picea mariana*) - Mixed Hardwoods / *Sphagnum* spp. Forest (CEGL005166, GNRQ)

High-ranked species: *Callophrys lanoraieensis* (G3G4)

SOURCES

References: Comer et al. 2003, Glaser and Janssens 1986, Harris et al. 1996

Version: 04 Mar 2004

Stakeholders: Canada, East, Midwest

Concept Author: D. Faber-Langendoen

LeadResp: Midwest

CES103.871 BOREAL DEPRESSIONAL BOG

Primary Division: Boreal (103)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Shrubland (Shrub-dominated); Depressional [Lakeshore, Sinkhole]; Organic Peat (>40 cm); *Sphagnum* spp.

Concept Summary: These wetlands are found at higher temperate and boreal latitudes of Canada, extending south into the Pacific Maritime and Rocky Mountain Divisions. They form where the rate of sphagnum peat accumulation exceeds its decomposition, resulting in ombrotrophic and acidic peatlands in which the bog surface is raised above the water table. These peatlands are typically formed as lake-filled basins or depressions. The surface morphology of the peatland may be more-or-less level, domed, or eccentric. The vegetation is dominated by low ericaceous shrubs (including *Kalmia polifolia*, *Ledum groenlandicum*, *Betula nana* (= *Betula glandulosa*), *Myrica gale*, *Empetrum nigrum*, and *Chamaedaphne calyculata*), and with patches of graminoids and bryophyte lawns. *Sphagnum* species, including *Sphagnum magellanicum*, *Sphagnum fuscum*, and *Sphagnum cuspidatum* may be characteristic. Conifer trees sometimes codominate, especially late in succession. Secondary bog pools may be present. While the raised portion defines these bogs, boreal fen systems may occupy some portion of the same basin, due to localized groundwater input. Soils are saturated throughout the growing season from groundwater upwelling.

DISTRIBUTION

Range: Found at higher temperate and boreal latitudes of Canada, extending south into the Pacific Maritime and Rocky Mountain divisions, but not west of the coastal mountain ranges of Alaska, British Columbia and Washington.

Divisions: 103:C, 104:C, 105:C, 204:P

TNC Ecoregions: 71:C, 72:C, 74:C

Subnations: AK, BC, ID, MT?, OR, WA

Associations:

- *Carex exsiccata* Herbaceous Vegetation [Provisional] (CEGL003312, G2G3)
- *Dulichium arundinaceum* Seasonally Flooded Herbaceous Vegetation (CEGL001831, G3)
- *Eriophorum chamissonis* / *Sphagnum* spp. Herbaceous Vegetation (CEGL003333, G4)
- *Kalmia microphylla* - *Ledum groenlandicum* / *Xerophyllum tenax* Shrubland (CEGL003359, G1)
- *Ledum groenlandicum* - *Kalmia microphylla* / *Sphagnum* spp. Shrubland (CEGL003414, G4)
- *Ledum groenlandicum* - *Myrica gale* / *Sphagnum* spp. Shrubland (CEGL003335, G2)
- *Malus fusca* Shrubland (CEGL003385, G3)
- *Pinus contorta* - (*Chamaecyparis nootkatensis*) / *Gaultheria shallon* Woodland (CEGL003205, G4G5)
- *Pinus contorta* / *Carex aquatilis* var. *dives* Woodland (CEGL003203, G3)
- *Pinus contorta* / *Empetrum nigrum* Woodland (CEGL003202, G5)
- *Pinus contorta* / *Trichophorum caespitosum* Woodland (CEGL003204, G4G5)
- *Pinus contorta* / *Vaccinium ovalifolium* Woodland (CEGL003206, G3)
- *Pinus contorta* var. *contorta* / *Ledum groenlandicum* / *Sphagnum* spp. Woodland (CEGL003337, G3)
- *Pinus monticola* / *Ledum groenlandicum* / *Sphagnum* spp. Woodland (CEGL003360, G1)
- *Rhynchospora alba* - (*Vaccinium oxycoccos*) / *Sphagnum tenellum* Herbaceous Vegetation [Provisional] (CEGL003338, G3)
- *Spiraea douglasii* / *Sphagnum* spp. Shrubland (CEGL003416, G3)
- *Tsuga heterophylla* - (*Thuja plicata*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest (CEGL003339, G3)
- *Tsuga heterophylla* - (*Thuja plicata*) / *Sphagnum* spp. Forest (CEGL003417, G1)

High-ranked species: *Parnassia californica* (G3G4), *Phalacroseris bolanderi* (G3G4), *Phalacroseris bolanderi* var. *bolanderi* (G3G4T3?), *Phalacroseris bolanderi* var. *coronata* (G3G4T2T3), *Rana cascadae* (G3G4)

SOURCES

References: Banner et al. 1993, Bursik and Moseley 1995, Comer et al. 2003, Green and Klinka 1994, Viereck et al. 1992

Version: 21 Nov 2003

Stakeholders: Canada, West

Concept Author: G. Kittel and P. Comer

LeadResp: West

CES201.576 ACADIAN-APPALACHIAN CONIFER SEEPAGE FOREST

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Seepage-Fed Sloping; *Picea* (*glauca*, *mariana*, *rubens*) - *Abies*; *Thuja occidentalis* - *Fraxinus nigra*; Mesotrophic Water

Concept Summary: These forests occur as large-patch landscape features near the southern periphery of the boreal forest in the northeastern U.S. and adjacent Canada. They are found on gentle to moderate slopes in the colder regions of the northern

Appalachians, often adjacent to (but above) drainage channels, in settings where groundwater seepage provides constant moisture. *Thuja occidentalis* and *Picea rubens* are the typical dominants; some areas may have a prominent deciduous component. The herbaceous and bryophyte flora is typically extensive. Because of their setting, these are often not mapped as wetlands.

Comments: This system may have application in other parts of the Laurentian-Acadian Division, depending on how the break is made between "wet-mesic" lowland white-cedar forests (with subsurface gleyed soils) and the white-cedar seepage forests described here.

DISTRIBUTION

Range: Northernmost parts of New England, north and east into Canada.

Divisions: 201:C

TNC Ecoregions: 63:C

Subnations: ME, NB, NH, NY, QC, VT

Associations:

- *Thuja occidentalis* - (*Picea rubens*) / *Tiarella cordifolia* Forest (CEGL006175, GNR)

SOURCES

References: Comer et al. 2003

Version: 09 Jan 2003

Concept Author: S.C. Gawler

Stakeholders: Canada, East

LeadResp: East

CES201.583 BOREAL-LAURENTIAN-ACADIAN ACIDIC BASIN FEN

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional; Organic Peat (>40 cm); Broad-Leaved Shrub; Dwarf-Shrub; Graminoid; *Picea mariana* - *Larix laricina*; Acidic Water

Concept Summary: This peatland system ranges over a broad geographic area across the glaciated Northeast to the Great Lakes and upper Midwest. The fens have developed in open or closed, relatively shallow basins with nutrient-poor and acidic conditions. Many occur in association with larger lakes or streams. The substrate is *Sphagnum*, and vegetation typically includes areas of graminoid dominance and dwarf-shrub dominance. *Chamaedaphne calyculata* is usually present and often dominant. Scattered stunted trees may be present. These fens often develop adjacent to open water.

Particularly distinctive are the ribbed bogs or fens in which a pattern of narrow (2-3 m wide) low (less than 1 m deep) ridges are oriented at right angles to the direction of the drainage (National Wetlands Working Group 1988). Wet pools or depressions occur between the ridges. These patterned peatlands may include string bog, Atlantic ribbed fen, or northern ribbed fen (National Wetlands Working Group 1988). They develop almost entirely north of 46 degrees N latitude in east-central Canada and the adjacent U.S. They are minerotrophic peatlands in which the vegetation has developed into a pattern of strings (raised, usually linear features) and flarks (wet depressions separating the strings). The substrate chemistry is entirely acidic in some peatlands; in others, where bedrock or other substrate influence creates circumneutral to calcareous conditions, peatland chemistry may be entirely calcareous or vary from acidic to calcareous within the same peatland. In acidic portions, typical bog heaths predominate, mixed with sedges. *Dasiphora fruticosa ssp. floribunda* is diagnostic of circumneutral to calcareous conditions. These peatlands usually develop in open basins and flat plains, and the patterned portion may occupy only a fraction of the entire peatland. The edge of the basin may be shallow to deep peat over a sloping substrate, where seepage waters provide nutrients.

Comments: Need to clarify the conceptual boundaries between this and the boreal fens in central and eastern Canada.

DISTRIBUTION

Range: New England and adjacent Canada west to the Great Lakes and Minnesota, north of the glacial boundary.

Divisions: 103:C, 201:C, 202:C

TNC Ecoregions: 47:C, 48:P, 61:C, 63:C

Subnations: MA, ME, MI, MN, NB?, NH, NS?, NY, QC, VT, WI

Associations:

- *Betula pumila* - *Dasiphora fruticosa* ssp. *floribunda* / *Carex lasiocarpa* - *Trichophorum alpinum* Shrubland (CEGL002495, G3G5)
- *Betula pumila* / *Chamaedaphne calyculata* / *Carex lasiocarpa* Shrubland (CEGL002494, G4G5)
- *Carex (oligosperma, exilis)* - *Chamaedaphne calyculata* Shrub Herbaceous Vegetation (CEGL006524, GNR)
- *Carex lasiocarpa* - *Carex oligosperma* / *Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Chamaedaphne calyculata* / *Carex oligosperma* / *Sphagnum* spp. Poor Fen Dwarf-shrubland (CEGL005277, G5)
- *Larix laricina* / *Chamaedaphne calyculata* / *Carex lasiocarpa* Shrubland (CEGL005226, G4G5)
- *Myrica gale* - *Chamaedaphne calyculata* / *Carex (lasiocarpa, utriculata)* - *Utricularia* spp. Shrub Herbaceous Vegetation (CEGL006302, G4G5)
- *Myrica gale* - *Spiraea alba* - *Chamaedaphne calyculata* Shrubland (CEGL006512, GNR)
- *Thuja occidentalis* - *Abies balsamea* / *Ledum groenlandicum* / *Carex trisperma* Woodland (CEGL006507, GNR)
- *Vaccinium corymbosum* / *Sphagnum* spp. Shrubland (CEGL006190, G3G5)

High-ranked species: *Carex heleonastes* ssp. *heleonastes* (G4T3T4), *Carex wiegandii* (G3), *Lycopodiella margueritiae* (G2), *Lycopodiella subappressa* (G2)

SOURCES

References: Comer et al. 2003, Damman and French 1987

Version: 04 Mar 2004

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler

LeadResp: East

CES201.574 LAURENTIAN-ACADIAN CONIFER-HARDWOOD ACID SWAMP

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Extensive Wet Flat; *Picea (rubens, mariana)* - *Acer rubrum*; Acidic Water

Concept Summary: These forested wetlands are found in temperate northeastern and north-central U.S., primarily in glaciated regions in the eastern Laurentian-Acadian region. They occur on mineral soils that are nutrient-poor; there may be an organic epipedon, but the substrate is generally not deep peat. These basin wetlands remain saturated for all or nearly all of the growing season, and may have standing water seasonally. There may be some seepage influence, especially near the periphery. *Acer rubrum*, *Fraxinus* spp., *Picea rubens* (rarely *Picea mariana*), and *Abies balsamea* are the most typical trees. The herbaceous and shrub layers tend to be fairly species-poor. *Nemopanthus mucronatus* and *Osmunda* spp. are typical shrub and herb species.

Comments: Acadian Near-Boreal Spruce Flat (CES201.562) is related but is more northern and occurs on imperfectly drained but not persistently saturated soils. *Picea rubens* in the East versus *Picea mariana* in the West and North might be a split in future with more careful scrutiny, but that distinction may already be involved in distinguishing between this type and the more boreal acidic swamp, Boreal-Laurentian Conifer Acid Swamp (CES103.724). At this time, it is thought that this type is more common in the Acadian and Northern Appalachian region of the U.S. and Canada, whereas Boreal-Laurentian Conifer Acid Swamp is more common in the Upper Great Lakes region and into Canada. In the Upper Great Lakes region, the most likely association to fit this system is *Acer rubrum* - *Fraxinus* spp. - *Betula papyrifera* / *Cornus canadensis* Forest (CEGL002071), but it is treated as more typically part of Laurentian-Acadian Alkaline Conifer-Hardwood Swamp (CES201.575) (Eric Epstein pers. comm. 2004).

DISTRIBUTION

Range: New England and adjacent Canada west to the Great Lakes and northern Minnesota.

Divisions: 201:C

TNC Ecoregions: 47:P, 48:C, 60:P, 63:C

Subnations: ME, MI, MN, NB?, NH, NY, ON, VT, WI

Associations:

- *Acer rubrum* / *Carex stricta* - *Onoclea sensibilis* Woodland (CEGL006119, G3G5)
- *Acer rubrum* / *Nemopanthus mucronatus* - *Vaccinium corymbosum* Forest (CEGL006220, GNR)
- *Betula alleghaniensis* - *Acer rubrum* - (*Tsuga canadensis*, *Abies balsamea*) / *Osmunda cinnamomea* Forest (CEGL006380, G4?)

- *Picea mariana* - (*Larix laricina*) / *Ledum groenlandicum* / *Sphagnum* spp. Forest (CEGL005271, G5)
- *Picea mariana* / *Alnus incana* / *Sphagnum* spp. Forest (CEGL002452, G5)
- *Picea rubens* - *Abies balsamea* / *Gaultheria hispidula* / *Osmunda cinnamomea* / *Sphagnum* spp. Forest (CEGL006312, GNR)
- *Picea rubens* - *Acer rubrum* / *Nemopanthus mucronatus* Forest (CEGL006198, GNR)

High-ranked species: *Carex wiegandii* (G3), *Poa paludigena* (G3)

SOURCES

References: Comer and Albert 1997, Comer et al. 1995a, Comer et al. 1998, Comer et al. 2003, Epstein pers. comm.

Version: 04 Mar 2004

Stakeholders: Canada, East, Midwest

Concept Author: S.C. Gawler and D. Faber-Langendoen

LeadResp: East

CES201.034 NORTHERN GREAT LAKES INTERDUNAL WETLAND

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Mineral: W/ A-Horizon <10 cm; Intermittent Flooding; Coastal Dune Mosaic

Concept Summary: This system occurs in scattered location along the northern Great Lakes shoreline where coastal dunes are low and support swales close to lake water levels. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus*, *Juncus pelocarpus*, *Juncus nodosus*, *Eleocharis acicularis*, species of *Solidago* such as *Oligoneuron houghtonii* (= *Solidago houghtonii*), and *Schoenoplectus americanus* (= *Scirpus americanus*). Occasionally, such swales may contain lake-influenced, calcareous sands, and the shallow swale may contain moderately alkaline indicators, such as *Cladium mariscoides*, *Myrica gale*, *Dasiphora fruticosa* ssp. *floribunda* (= *Pentaphylloides floribunda*), and others.

Comments: While this type is most commonly described from the northern Great Lakes region, there are likely more occurrences across the southern half of the Great Lakes that may vary in floristic composition from the type described here.

DISTRIBUTION

Range: Occurs in scattered location along the northern Great Lakes shoreline.

Divisions: 201:C, 202:?

TNC Ecoregions: 48:C

Subnations: MI, MN, NY, ON, WI

Associations:

- *Dasiphora fruticosa* ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation (CEGL005105, G3?)

High-ranked species: *Oligoneuron houghtonii* (G3)

SPATIAL CHARACTERISTICS

Spatial Summary: small, sometimes linear patches

Size: <0.5 up to 10s of acres

Adjacent Ecological System Comments: Open dunes

SOURCES

References: Comer and Albert 1993, Comer and Albert 1997, Comer et al. 2003

Version: 26 Mar 2003

Stakeholders: Canada, East, Midwest

Concept Author: P. Comer

LeadResp: Midwest

CES201.562 ACADIAN NEAR-BOREAL SPRUCE FLAT

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland; Forest and Woodland (Treed); Toeslope/Valley Bottom; Glaciated; *Picea* (*glauca*, *mariana*, *rubens*) - *Abies*

Concept Summary: These spruce-fir forests are found in the colder regions of the northern Appalachians-Acadian region, in areas of imperfectly drained soils where they often form extensive flats along valley bottoms. The nutrient-poor acidic soils are typically saturated at snowmelt but are moderately well-drained for much of the growing season and may be reasonably dry at the soil surface. The mostly closed-canopy forests have *Picea rubens*, *Picea mariana*, and *Abies balsamea* as the dominant trees; other conifers are often present. Bryophytes are abundant in the ground layer; other layers are typically rather sparse. Many occurrences may be jurisdictional wetlands due to seasonal saturation, but the vegetation is primarily made up of upland or facultative species. The distribution in the Laurentian-Acadian Division is mostly Canadian.

Comments: This might be considered as a component of Acadian Low-Elevation Spruce-Fir-Hardwood Forest (CES201.565) but differs from that type *sensu stricto* in its hydrology (wetland vs. upland) and in that its range is somewhat more boreal. Alternatively, it shares some characteristics with Laurentian-Acadian Conifer-Hardwood Acid Swamp (CES201.574) but is more boreal in nature and appears to be typically not on consistently saturated soils. Information from Quebec and New Brunswick would be helpful in assessing its placement.

DISTRIBUTION

Range: This system is found in the northernmost parts of New England, north and east into Canada.

Divisions: 103:C, 201:C

TNC Ecoregions: 63:C

Subnations: ME, NB, NH, NY, QC, VT

Associations:

- *Picea mariana* - *Picea rubens* / *Pleurozium schreberi* Forest (CEGL006361, GNR)

SOURCES

References: Comer et al. 2003

Version: 05 Oct 2004

Concept Author: S.C. Gawler

Stakeholders: Canada, East

LeadResp: East

CES201.726 GREAT LAKES DUNE AND SWALE

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Dune (Substrate); Glaciated; Sand Soil Texture; 30-180-day hydroperiod; Coastal Dune Mosaic

Concept Summary: This system is found in nearly 100 occurrences throughout the Great Lakes shorelines of the United States and Canada. The system consists of a foredune, followed by a series of low to high dunes (uplands) and swales (wetlands). The system is often best developed where post-glacial streams entered an embayment and provide a dependable sand source. The combination of along-shore currents, waves, and winds form foredunes along the shoreline.

The foredunes of most dune-and-swale complexes are commonly 1-2 m high, with *Ammophila breviligulata*, *Calamovilfa longifolia*, *Salix serissima*, *Salix cordata*, and *Populus balsamifera* most common. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus*, *Juncus pelocarpus*, *Juncus nodosus*, *Eleocharis acicularis*, and *Schoenoplectus americanus* (= *Scirpus americanus*). Occasionally, such swales may contain lake-influenced, calcareous sands and may contain moderately alkaline indicators.

A low dune field with more advanced plant succession often follows the first open dunes and swales. *Pinus banksiana*, *Pinus strobus*, and *Pinus resinosa* often form a scattered overstory canopy, while *Juniperus communis*, *Juniperus horizontalis*, *Arctostaphylos uva-ursi*, and *Koeleria macrantha* form a scattered ground layer.

Following the dune-field zone, both dunes and swales are typically forested. Moist swales are often forested, and soil organic material has often begun to accumulate. *Thuja occidentalis*, *Alnus incana*, *Salix* spp., and *Acer rubrum* dominate the partial

overstory canopy and understory. In contrast to the dry or moist swales, wetter swales (where standing water is present through most of the year) may be dominated by Carices, such as *Carex aquatilis* and *Carex stricta*. Forested beach ridges, with soils of medium to coarse sand, tend to be dominated by species common to dry-mesic and mesic northern forest. Complexes located in embayments protected from prevailing winds tend to be formed entirely of low, water-lain beach ridges. As a result, even the beach ridges within these complexes support wetland vegetation.

Five major subtypes of Great Lakes Dune and Swale were described for Michigan, including the Lake Superior high dune type, the Lake Superior low dune type, the North Lake Michigan high dune type, Northern Lake Huron-Lake Michigan low dune type, and the Southern Lake Huron type. These subtypes represent patterns of floristic variation resulting from latitude and sand dune/beach ridge characteristics that constrain floristic and structural attributes. High dune types may support predominantly upland vegetation, while low dune types may support predominantly wetland vegetation

Comments: Five major subtypes of Great Lakes Dune and Swale were described for Michigan, including the Lake Superior high dune type, the Lake Superior low dune type, the North Lake Michigan high dune type, Northern Lake Huron-Lake Michigan low dune type, and the Southern Lake Huron type. These subtypes represent patterns of floristic variation resulting from latitude and sand dune/beach ridge characteristics that constrain floristic and structural attributes.

This system has rather strong variation between northern and southern Great Lakes examples (north and south of Bailey's 210-220 division line). Those occurring along the southern Lake Michigan shoreline of Indiana and Illinois have been altered significantly, but likely reflect a distinct ecological system type with oak woodland and savanna on beach ridges and wet prairie in swales. Additional classification and inventory of this system type on Lakes Erie and Ontario may suggest definition of another southern Great Lakes dune and swale system type.

DISTRIBUTION

Range: Throughout the Great Lakes shorelines of the United States and Canada.

Divisions: 201:C, 202:C

TNC Ecoregions: 48:C

Subnations: IL, IN, MI, MN, OH, ON, PA, WI

Associations:

- *Ammophila breviligulata* - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005098, G3G5)
- *Chamaedaphne calyculata* - *Myrica gale* / *Carex lasiocarpa* Dwarf-shrubland (CEGL005228, G4G5)
- *Dasiphora fruticosa* ssp. *floribunda* / *Cladium mariscoides* - *Juncus balticus* - (*Rhynchospora capillacea*) Herbaceous Vegetation (CEGL005105, G3?)
- *Juniperus horizontalis* - *Arctostaphylos uva-ursi* - *Juniperus communis* Dune Dwarf-shrubland (CEGL005064, G3G4)
- *Pinus banksiana* - (*Pinus resinosa*) - *Pinus strobus* / *Juniperus horizontalis* Wooded Herbaceous Vegetation (CEGL005125, G2)
- *Pinus banksiana* - *Pinus resinosa* - *Pinus strobus* Dune Forest (CEGL002589, G3Q)
- *Populus deltoides* - (*Juniperus virginiana*) Dune Woodland (CEGL005119, G1G2)
- *Prunus pumila* - (*Ptelea trifoliata*) Dune Shrubland (CEGL005075, G2Q)
- *Thuja occidentalis* - (*Picea mariana*, *Abies balsamea*) / *Alnus incana* Forest (CEGL002456, G4)
- *Thuja occidentalis* - *Fraxinus nigra* Forest (CEGL005165, GNR)

High-ranked species: *Iris lacustris* (G3), *Lycopodiella margueritiae* (G2), *Lycopodiella subappressa* (G2), *Oligoneuron houghtonii* (G3)

Environment: The system consists of a foredune, followed by a series of low to high dunes (uplands) and swales (wetlands). The system is often best developed where post-glacial streams entered an embayment and provide a dependable sand source. The combination of along-shore currents, waves, and winds form foredunes along the shoreline. With gradual long-term drops in water level, combined with post-glacial uplifting of the earth's crust, these low dunes gradually rise above the direct influence of the lakes, and new foredunes replace them. Over several thousand years, a series of ridges and swales is created. For most complexes, the flow of surface streams and groundwater maintain the wet conditions in the swales. With time, plant succession has proceeded to the point where the beach ridges are now forested while the wet swales are either forested or open wetlands. Along the Lake Superior shoreline, where post-glacial uplift is greatest, many of the complexes consist primarily of dry, forested swales. The dunes and swales differs depending on fetch and the amount of sediment available. The influence of Great Lakes water-level fluctuations is probably limited to the first few swales inland from the shoreline. For most of the complexes, the water occupying the swales comes from streams flowing from the adjacent uplands or from groundwater seepage.

Vegetation: The foredunes of most dune-and-swale complexes are commonly 1-2 m high, with *Ammophila breviligulata*, *Calamovilfa longifolia*, *Salix serissima*, *Salix cordata*, and *Populus balsamifera* most common. The swale immediately behind the foredune is influenced by short-term variation in lake levels and can be partially or occasionally completely filled by dune sands following major storm events. Species common to this first swale include *Juncus balticus*, *Juncus pelocarpus*, *Juncus nodosus*, *Eleocharis acicularis*, and *Schoenoplectus americanus* (= *Scirpus americanus*). Occasionally, such swales may contain lake-influenced, calcareous sands, and the shallow swale may contain moderately alkaline indicators, such as *Cladium mariscoides*, *Myrica gale*, *Dasiphora fruticosa ssp. floribunda* (= *Pentaphylloides floribunda*), and others.

A low dune field with more advanced plant succession often follows the first open dunes and swales. *Pinus banksiana*, *Pinus strobus*, and *Pinus resinosa* often form a scattered overstory canopy, while *Juniperus communis*, *Juniperus horizontalis*, *Arctostaphylos uva-ursi*, and *Koeleria macrantha* form a scattered ground layer.

Following the dune-field zone, both dunes and swales are typically forested. Moist swales are often forested, and soil organic material has often begun to accumulate. *Thuja occidentalis*, *Alnus incana*, *Salix* spp., and *Acer rubrum* dominate the partial overstory canopy and understory. In contrast to the dry or moist swales, wetter swales (where standing water is present through most of the year) may be dominated by Carices, such as *Carex aquatilis* and *Carex stricta*.

Forested beach ridges, with soils of medium to coarse sand, tend to be dominated by species common to dry-mesic and mesic northern forest. Soil moisture conditions appear to change dramatically with slight elevational changes and are reflected in the development of soil organic material and changing plant species. On higher, drier ridges, soils often have less than 3 cm of organic material. *Pinus resinosa*, *Pinus strobus*, and *Quercus rubra* are often codominant, while *Betula papyrifera*, *Populus grandidentata*, *Abies balsamea*, and *Acer rubrum* are subdominant or understory species. *Pteridium aquilinum*, *Gaylussacia baccata*, *Vaccinium myrtilloides*, *Cornus canadensis*, and *Gaultheria procumbens* occur in the shrub and ground layers.

Complexes located in embayments protected from prevailing winds tend to be formed entirely of low, water-lain beach ridges. As a result, even the beach ridges within these complexes support wetland vegetation.

Dynamics: Foredune and immediate back dune areas are influenced by active dune processes of wind-caused "blowouts" and subsequent restabilization. Forested beach ridges may support fire regimes characteristic of similar upland forest systems outside of these complexes. Due to lakeshore proximity, heavy winds and resultant windthrow are common in forested ridges. Great Lakes water-level fluctuations likely influence water levels in swales closest to the shoreline, if at all. The hydrology of interdunal swales is driven largely by lateral flow through the porous beach ridges. Older swales (farthest from current lakeshores) in larger complexes support peat-forming bogs.

SOURCES

References: Comer and Albert 1993, Comer et al. 2003, Lichter 1998, MNFI 1999

Version: 05 Mar 2003

Concept Author: P. Comer and D. Albert

Stakeholders: Canada, East, Midwest

LeadResp: Midwest

CES201.721 GREAT LAKES ALVAR

Primary Division: Laurentian-Acadian (201)

Land Cover Class: Barren

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland

Concept Summary: Alvars are natural systems of humid and subhumid climates, centered around areas of glaciated horizontal limestone/dolomite (dolostone) bedrock pavement with a discontinuous thin soil mantle. These communities are characterized by distinctive flora and fauna with less than 60% tree cover that is maintained by associated geologic, hydrologic, and other landscape processes. In particular, all forms of alvar tend to flood each spring, then experience moderate to severe drought in summer months. They include open pavement, grassland, and shrubland/woodland types. Alvar communities occur in an ecological matrix with similar bedrock and hydrologically influenced communities. Almost all of North America's alvars occur within the Great Lakes basin, primarily in an arc along the Niagaran Escarpment from northern Lake Michigan across northern Lake Huron and eastern Ontario and northwestern New York state.

DISTRIBUTION

Divisions: 201:C

TNC Ecoregions: 48:C

Subnations: MI, NY, OH, ON, WI

Associations:

- *Acer saccharum* - *Ostrya virginiana* - *Carya ovata* - *Quercus rubra* Limestone Woodland (CEGL005059, G3G4)
- *Carya ovata* / *Zanthoxylum americanum* / *Panicum philadelphicum* - *Carex pensylvanica* Wooded Herbaceous Vegetation (CEGL005230, GNR)
- *Danthonia spicata* - *Poa compressa* - (*Schizachyrium scoparium*) Herbaceous Vegetation (CEGL005100, G2?)
- *Deschampsia caespitosa* - (*Sporobolus heterolepis*, *Schizachyrium scoparium*) - *Carex crawei* - *Packera paupercula* Herbaceous Vegetation (CEGL005110, G2)
- *Juniperus communis* - (*Juniperus virginiana*) - *Rhus aromatica* - *Viburnum rafinesquianum* / *Oligoneuron album* Shrubland (CEGL005212, G3)
- *Juniperus horizontalis* - *Dasiphora fruticosa* ssp. *floribunda* / *Schizachyrium scoparium* - *Carex richardsonii* Dwarf-shrubland (CEGL005236, G2)
- *Juniperus virginiana* / *Ranunculus fascicularis* Woodland (CEGL005122, G3?)
- *Picea glauca* - *Thuja occidentalis* - *Juniperus communis* / *Iris lacustris* - *Carex eburnea* Shrubland (CEGL005211, G1G2)
- *Pinus banksiana* - *Thuja occidentalis* - *Picea glauca* / *Juniperus communis* Woodland (CEGL005126, G2?)
- *Sporobolus heterolepis* - *Schizachyrium scoparium* - (*Carex scirpoidea*) / (*Juniperus horizontalis*) Herbaceous Vegetation (CEGL005234, G2)
- *Sporobolus neglectus* - *Sporobolus vaginiflorus* - *Isanthus brachiatus* - *Panicum philadelphicum* - (*Poa compressa*) Herbaceous Vegetation (CEGL005235, G2)
- *Thuja occidentalis* - *Pinus banksiana* / *Dasiphora fruticosa* ssp. *floribunda* / *Clinopodium arkansanum* Wooded Herbaceous Vegetation (CEGL005132, G1G2)
- *Tortella tortuosa* - *Cladonia pocillum* - *Placynthium* spp. Sparse Vegetation (CEGL005192, G2)

High-ranked species: *Iris lacustris* (G3)

SOURCES

References: Albert 1990, Comer et al. 2003, Reschke et al. 1998

Version: 05 Mar 2003

Stakeholders: Canada, East, Midwest

Concept Author: C. Reschke

LeadResp: Midwest

CES202.018 CENTRAL INTERIOR HIGHLANDS AND APPALACHIAN SINKHOLE AND DEPRESSION POND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Lowland [Lowland]; Depressional [Pond, Sinkhole]; Muck; Mineral: W/ A-Horizon >10 cm

Concept Summary: This system of ponds and wetlands is found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions, ranging north from the southern and central Appalachians to the Northern Piedmont regions. Stands occur in basins of sinkholes or other isolated depressions on uplands. Soils are very poorly drained, and surface water may be present for extended periods of time, rarely becoming dry. Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer. Soils may be deep (100 cm or more), consisting of peat or muck, with parent material of peat, muck or alluvium. Ponds vary from open water to herb-, shrub-, or tree-dominated systems. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis*, *Fraxinus pennsylvanica*, *Acer saccharinum* or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.

Comments: Many of these ponds have their geologic origin as a more-or-less complete karst collapse feature. Some of them may display this geologic origin in a more explicit manner, with definite walls and exposed limestone or dolomite at the surface ("sinkholes"). Others are more subtle, and exist as more gentle depressions, with no exposed surface geology ("depression ponds").

This includes the "sagponds" of northwestern Georgia and adjacent Alabama. More information is available from Jon Ambrose. It also includes sinkhole ponds of northern New Jersey (K. Strakosch-Walz pers. comm.) and ponds of the Ridge and Valley in Pennsylvania. These are very similar to Shenandoah sinkhole ponds of Virginia and are in Maryland as well (L. Sneddon pers. comm.).

DISTRIBUTION

Range: This system is found in the Interior Highlands of the Ozark, Ouachita, and Interior Low Plateau regions, ranging north from the southern and central Appalachians to the northern Piedmont regions, and south to the Ridge and Valley of Georgia and Alabama.

Divisions: 202:C

TNC Ecoregions: 38:C, 39:C, 44:C, 50:C, 59:C, 61:C

Subnations: AL, AR, GA, IL, IN, KY, MD, MO, NC, NJ, PA, TN, VA, WV

Associations:

- *Brasenia schreberi* Herbaceous Vegetation (CEGL004527, G4?)
- *Carex aquatilis* - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL008542, G1?)
- *Carex barrattii* Herbaceous Vegetation (CEGL007857, G1)
- *Carex comosa* - *Carex decomposita* - *Dulichium arundinaceum* - *Lycopus rubellus* Herbaceous Vegetation (CEGL002413, G3G4)
- *Cephalanthus occidentalis* - (*Salix nigra*, *Quercus lyrata*) Karst Depression Shrubland (CEGL008439, G1Q)
- *Cephalanthus occidentalis* / *Dulichium arundinaceum* Shrubland (CEGL007854, G1)
- *Cephalanthus occidentalis* / *Hibiscus moscheutos* ssp. *moscheutos* Depression Pond Shrubland (CEGL004742, G3?)
- *Cephalanthus occidentalis* / *Torreyochloa pallida* Shrubland (CEGL007855, G1?)
- *Ceratophyllum demersum* Herbaceous Vegetation (CEGL004528, GNR)
- *Dasiphora fruticosa* ssp. *floribunda* / *Rhynchospora capillacea* - *Scleria verticillata* Shrub Herbaceous Vegetation (CEGL006356, G1)
- *Fraxinus pennsylvanica* - *Acer saccharinum* - *Quercus bicolor* / *Boehmeria cylindrica* Forest (CEGL006634, GNR)
- *Leersia oryzoides* - *Boehmeria cylindrica* - *Ranunculus flabellaris* Herbaceous Vegetation (CEGL006903, GNR)
- *Liquidambar styraciflua* - *Acer rubrum* / *Carex* spp. - *Sphagnum* spp. Forest (CEGL007388, G2Q)
- *Ludwigia peploides* Herbaceous Vegetation (CEGL007835, G4G5)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar lutea* ssp. *advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Nyssa aquatica* / *Cephalanthus occidentalis* Pond Forest (CEGL004712, G1?)
- *Nyssa biflora* / *Cephalanthus occidentalis* - *Lyonia lucida* Sagpond Forest (CEGL004116, G1G2)
- *Orontium aquaticum* - *Schoenoplectus subterminalis* - *Eriocaulon aquaticum* Herbaceous Vegetation (CEGL007859, G1)
- *Panicum hemitomon* - *Dulichium arundinaceum* Herbaceous Vegetation (CEGL004126, G1)
- *Phalaris arundinacea* Eastern Herbaceous Vegetation (CEGL006044, GNA)
- *Platanus occidentalis* - *Fraxinus pennsylvanica* - *Ulmus americana* / *Cornus sericea* Forest (CEGL006901, G2G3)
- *Pontederia cordata* - *Sagittaria graminea* - *Sagittaria latifolia* Semipermanently Flooded Herbaceous Vegetation (CEGL004986, G1G2Q)
- *Quercus alba* - *Nyssa sylvatica* Sandstone Ridgetop Depression Forest (CEGL008440, G2Q)
- *Quercus alba* - *Nyssa sylvatica* Seasonally Flooded Forest [Provisional] (CEGL008473, GNR)
- *Quercus bicolor* - *Fraxinus pennsylvanica* / *Carex* spp. Forest (CEGL004422, G1G2)
- *Quercus lyrata* - *Quercus (palustris, phellos)* - *Liquidambar styraciflua* - (*Populus heterophylla*) Forest (CEGL004421, G2G3)
- *Quercus lyrata* / *Betula nigra* / *Pleopeltis polypodioides* ssp. *michauxiana* Forest (CEGL004975, G1)
- *Quercus lyrata* Pond Forest (CEGL004642, G1G3)
- *Quercus palustris* - (*Quercus bicolor*) / *Carex crinita* / *Sphagnum* spp. Forest (CEGL002406, G3?)
- *Quercus palustris* / *Panicum rigidulum* var. *rigidulum* - *Panicum verrucosum* - *Eleocharis acicularis* Herbaceous Vegetation (CEGL007858, G1)
- *Quercus palustris* Pond Forest (CEGL007809, G2)
- *Quercus phellos* - *Liquidambar styraciflua* / *Chasmanthium laxum* Cumberland Plateau Forest (CEGL008441, G3)
- *Quercus phellos* Seasonally Flooded Ozark Pond Forest [Provisional] (CEGL007402, GNR)
- *Scirpus cyperinus* - *Dulichium arundinaceum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL004134, G1Q)
- *Scirpus cyperinus* - *Panicum rigidulum* - *Rhynchospora corniculata* - (*Dulichium arundinaceum*) Herbaceous Vegetation (CEGL004719, G2G3)
- *Sparganium americanum* - *Epilobium leptophyllum* Herbaceous Vegetation (CEGL004510, G2G3)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)
- *Vaccinium macrocarpon* / *Pogonia ophioglossoides* Dwarf-shrubland (CEGL007856, G1Q)

High-ranked species: *Boltonia* sp. 1 (G2?), *Carex decomposita* (G3), *Fimbristylis perpusilla* (G2), *Helenium virginicum* (G2), *Isoetes virginica* (G1), *Muhlenbergia torreyana* (G3), *Platanthera leucophaea* (G3), *Schoenoplectus hallii* (G2), *Scirpus ancistrochaetus* (G3)

Vegetation: Ponds vary from open water to herb-, shrub-, or tree-dominated systems. Tree-dominated examples typically contain *Quercus* species, *Platanus occidentalis*, *Fraxinus pennsylvanica*, *Acer saccharinum*, or *Nyssa* species, or a combination of these. In addition, *Liquidambar styraciflua* may be present in southern examples. *Cephalanthus occidentalis* is a typical shrub component. The herbaceous layer is widely variable depending on geography.

Dynamics: Water depth may vary greatly on a seasonal basis, and may be a meter deep or more in the winter. Some examples become dry in the summer.

SOURCES

References: Comer et al. 2003

Version: 18 Apr 2005

Concept Author: M. Pyne, S. Menard, D. Faber-Langendoen

Stakeholders: East, Midwest, Southeast

LeadResp: Midwest

CES202.702 NORTH-CENTRAL INTERIOR SHRUB-GRAMINOID ALKALINE FEN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This fen system is found in the glaciated portions of the Midwest and southern Canada. Examples of this system can be located on level to sloping seepage areas, in pitted outwash or in kettle lakes associated with kettle-kame-moraine topography. Groundwater flows through marls and shallow peat soils typically minerotrophic and slightly alkaline. Examples of this system contain a core fen area of graminoids surrounded by shrubs and tall-shrubs with a fairly continuous sphagnum moss. Herbaceous and shrub cover is variable with little to no tree cover. Characteristic species include prairie grasses such as *Andropogon gerardii* and *Spartina pectinata* with prairie forbs and sedges, *Carex* spp. Common shrub species include *Dasiphora fruticosa* ssp. *floribunda*, *Cornus* spp., and *Salix* spp. Alterations in wetland hydrology and agricultural development can threaten examples of this system.

DISTRIBUTION

Range: This system is found in the northern Midwest and southern Canada.

Divisions: 201:C, 202:C

TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:P

Subnations: IA, IL, IN, MI, MN, ND, OH, ON, SD, WI

Associations:

- *Carex lasiocarpa* - *Carex oligosperma* / *Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- *Cornus amomum* - *Salix* spp. - *Toxicodendron vernix* - *Rhamnus lanceolata* Fen Shrubland (CEGL005087, G2G3)
- *Cornus racemosa* / *Carex (sterilis, aquatilis, lacustris)* Shrub Herbaceous Vegetation (CEGL006123, G2G3)
- *Cornus* spp. - *Salix* spp. - *Vaccinium corymbosum* - *Rhamnus alnifolia* - *Toxicodendron vernix* Shrubland (CEGL005083, G4?)
- *Dasiphora fruticosa* ssp. *floribunda* / *Carex interior* - *Carex flava* - *Sarracenia purpurea* Shrub Herbaceous Vegetation (CEGL005140, G3)
- *Dasiphora fruticosa* ssp. *floribunda* / *Carex sterilis* - *Andropogon gerardii* - *Arnoglossum plantagineum* Shrub Herbaceous Vegetation (CEGL005139, G3G4)
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385, G4?)
- *Vaccinium corymbosum* - *Gaylussacia baccata* - *Photinia melanocarpa* / *Calla palustris* Shrubland (CEGL005085, G2G3)

High-ranked species: *Calephelis muticum* (G3), *Clonophis kirtlandii* (G2), *Hypericum adpressum* (G3), *Oecanthus laricis* (G1G2), *Poa paludigena* (G3), *Valeriana edulis* var. *ciliata* (G5T3)

SOURCES

References: Comer et al. 2003, MNNHP 1993

Version: 10 Mar 2003

Concept Author: S. Menard

Stakeholders: Canada, Midwest

LeadResp: Midwest

CES202.700 NORTH-CENTRAL INTERIOR WET FLATWOODS

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This small-patch system is found throughout the northern glaciated Midwest ranging east into Lower New England. It usually occurs on poorly drained uplands or in depressions associated with glacial features such as tillplains, lakeplains or outwash plains. Soils often have an impermeable or nearly impermeable clay layer that can create a shallow, perched water table. Saturation can vary, with ponding common during wetter seasons, and drought possible during the summer and autumn months. These fluctuating moisture levels can lead to complexes of forest upland and wetland species occurring within this system. *Quercus palustris* typically dominates and is often associated with *Quercus bicolor* and *Acer rubrum*. *Liquidambar styraciflua* and *Nyssa sylvatica* are also common associates. Some examples in Michigan, Indiana, Ohio, and southern Ontario are dominated by *Fagus grandifolia* associated with oak (*Quercus* spp.) and maple species (*Acer* spp.). Understory herbaceous and shrub species present in examples of this system can vary. Some common species include *Carex* spp., *Osmunda cinnamomea*, *Cephalanthus occidentalis*, *Alnus* spp., and *Ilex* spp. Flooding, drought and fire can influence this system.

Comments: These are mostly north of the glacial line, but one association is in the Interior Low Plateau and that placement may need to be reviewed.

DISTRIBUTION

Range: This system is found in the northern Midwest, southern Ontario, and southern portions of the northeastern U.S.

Divisions: 201:P, 202:C

TNC Ecoregions: 36:C, 44:C, 45:C, 47:?, 48:C, 49:P, 59:P, 60:P, 61:C

Subnations: CT, IN, MA, MI, MN, NY, OH, ON, PA, WI

Associations:

- *Cephalanthus occidentalis* / *Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Fagus grandifolia* - *Acer saccharum* - *Quercus bicolor* - *Acer rubrum* Flatwoods Forest (CEGL005173, G2G3)
- *Fagus grandifolia* - *Quercus alba* - (*Quercus michauxii*) - *Acer rubrum* Flatwoods Forest (CEGL005015, G3)
- *Quercus falcata* Flatwoods Forest (CEGL004412, G2?)
- *Quercus palustris* - (*Quercus bicolor*) - *Acer rubrum* / *Osmunda cinnamomea* Forest (CEGL006240, GNR)
- *Quercus palustris* - (*Quercus stellata*) - *Quercus pagoda* / *Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus palustris* - *Quercus bicolor* - (*Liquidambar styraciflua*) Mixed Hardwood Forest (CEGL002432, G3G4)
- *Quercus palustris* - *Quercus bicolor* - *Acer rubrum* Flatwoods Forest (CEGL005037, G2G3)
- *Quercus palustris* - *Quercus bicolor* - *Nyssa sylvatica* - *Acer rubrum* Sand Flatwoods Forest (CEGL002100, G2?)

High-ranked species: *Euphyes dukesi* (G3)

SOURCES

References: Comer et al. 2003

Version: 05 Mar 2003

Concept Author: S. Menard

Stakeholders: Canada, East, Midwest, Southeast

LeadResp: Midwest

CES202.701 NORTH-CENTRAL INTERIOR WET MEADOW-SHRUB SWAMP

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional [Lakeshore]; Broad-Leaved Shrub; Graminoid

Concept Summary: This system is found throughout the northern Midwest ranging into southern Canada. It is typically found on glacial potholes, river valleys, ponds, channels in glacial outwash and on lakeplains. This system contains a deep to shallow area of freshwater marsh dominated by emergent species surrounded by a zone of wet meadow. The emergent marsh zone within this system contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season. Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate the core of this system. Wet meadows can surround the emergent marsh core along wet mineral soils or shallow peat with the water table typically just below the surface for most of the growing season. The vegetation in this zone of the system is dominated by sedges

(*Carex* spp.) and grasses such as *Calamagrostis canadensis*. This system also can contain a zone of wet prairie species such as *Spartina pectinata*. Shrub swamps can also be associated with the wet meadows within this system. Typical shrub species include *Cornus* spp., *Salix* spp., and/or *Cephalanthus occidentalis*. Trees are generally absent and, if present, are scattered. Fire originating in adjacent uplands, as well as hydrology, can influence this system. In the absence of fire, drought and/or ditching can increase the proportion of shrubs compared to the wet meadow. In the absence of fire, drought and/or ditching can increase the proportion of shrubs compared to the wet meadow or prairie species.

Comments: If examples of these associations are found within an immediate medium to large floodplain, those should be considered part of North-Central Interior Floodplain (CES202.694). The freshwater marsh component was removed from this system to create a new system, North-Central Interior Freshwater Marsh (CES202.899).

DISTRIBUTION

Range: This system is found in the northern Midwest and southern Canada.

Divisions: 201:C, 202:C

TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:?

Subnations: IA, IL, IN, MI, MN, MO, ND, OH, ON, SD, WI

Associations:

- *Calamagrostis canadensis* - *Phalaris arundinacea* Herbaceous Vegetation (CEGL005174, G4G5)
- *Carex aquatilis* - *Carex* spp. Herbaceous Vegetation (CEGL002262, G4?)
- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Carex rostrata* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257, G4G5)
- *Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Cephalanthus occidentalis* / *Carex* spp. Northern Shrubland (CEGL002190, G4)
- *Cornus sericea* - *Salix* (*bebbiana*, *discolor*, *petiolaris*) / *Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Spartina pectinata* - *Calamagrostis stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002027, G3?)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* - *Lythrum alatum* - (*Oxypolis rigidior*) Herbaceous Vegetation (CEGL002224, G3?)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* Sand Herbaceous Vegetation (CEGL005178, G3?)
- *Spiraea tomentosa* - *Salix humilis* / *Andropogon gerardii* - *Panicum virgatum* Shrubland (CEGL005069, G1Q)

High-ranked species: *Calephelis muticum* (G3), *Clonophis kirtlandii* (G2), *Eleocharis nitida* (G3G4), *Eleocharis wolfii* (G3G4), *Platanthera leucophaea* (G3), *Schoenoplectus hallii* (G2), *Scirpus ancistrochaetus* (G3), *Valeriana edulis* var. *ciliata* (G5T3)

SOURCES

References: Comer and Albert 1997, Comer et al. 2003

Version: 16 Apr 2004

Concept Author: S. Menard

Stakeholders: Canada, Midwest

LeadResp: Midwest

CES202.606 NORTH-CENTRAL INTERIOR AND APPALACHIAN ACID PEATLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Shrubland (Shrub-dominated); Organic Peat (>40 cm); Acidic Water; >180-day hydroperiod

Concept Summary: These *Sphagnum* and shrub peatlands occur in basins south of the Laurentian-Acadian region down to near the glacial boundary in the northeastern and north-central U.S. They are found in colder regions of the division, mostly in areas where glacial stagnation left coarse deposits and glacial depressions (many are "kettleholes"). The basins are generally closed, i.e., without inlets or outlets of surface water. The nutrient-poor substrate and the reduced throughflow of water create oligotrophic conditions fostering the development of *Sphagnum* peat and the growth of peatland vegetation. In deeper basins, the vascular vegetation grows on a *Sphagnum* mat over water, with no mineral soil development. Ericaceous shrubs and dwarf-shrubs (e.g., *Chamaedaphne calyculata*) dominate, with patches of graminoid dominance. Some peatlands may have a sparse tree layer. Although these are often called bogs, in most cases they are technically fens (albeit nutrient-poor ones), as the vegetation remains in contact with the groundwater.

Comments: This system occurs south of the Laurentian-Acadian region, and these acidic peatlands are distinctive and discrete elements of the landscape. They are related to Laurentian-Acadian Conifer-Hardwood Acid Swamp (CES201.574). There are enough differences in landscape setting and more temperate floristic elements to distinguish them. They include treed, shrub, and graminoid associations. In the Midwest, it may be necessary to split off the shrub/graminoid acid peatland (poor fen) types.

DISTRIBUTION

Range: Central New England to the Great Lakes and south-central Minnesota southward, generally associated with the glacial terminus or stagnation zones.

Divisions: 202:C

TNC Ecoregions: 45:P, 46:P, 48:P, 49:P, 59:?, 60:P, 61:C, 62:C, 64:P

Subnations: CT, IL, IN, MA, ME, MI, MN, NH, NJ, NY, OH, ON, PA, RI, VT, WI

Associations:

- *Carex lasiocarpa* - *Carex oligosperma* - (*Lysimachia terrestris*) / *Sphagnum* spp. / *Spiraea tomentosa* Herbaceous Vegetation (CEGL005279, G3G4)
- *Carex oligosperma* - *Carex pauciflora* - *Eriophorum vaginatum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL005256, G4G5)
- *Chamaecyparis thyoides* / *Chamaedaphne calyculata* Woodland (CEGL006321, G3G4)
- *Chamaedaphne calyculata* - (*Gaylussacia dumosa*) - *Decodon verticillatus* / *Woodwardia virginica* Dwarf-shrubland (CEGL006008, G5)
- *Chamaedaphne calyculata* / *Carex oligosperma* - *Eriophorum virginicum* Dwarf-shrubland (CEGL005092, G3G4)
- *Larix laricina* / *Photinia melanocarpa* / *Sphagnum* spp. Forest (CEGL002472, G4?)
- *Myrica gale* - *Chamaedaphne calyculata* / *Carex (lasiocarpa, utriculata)* - *Utricularia* spp. Shrub Herbaceous Vegetation (CEGL006302, G4G5)
- *Myrica gale* - *Chamaedaphne calyculata* / *Carex exilis* Shrub Herbaceous Vegetation (CEGL006392, GNR)
- *Myrica gale* - *Dasiphora fruticosa* ssp. *floribunda* / *Carex lasiocarpa* - *Cladium mariscoides* Shrub Herbaceous Vegetation (CEGL006068, G2G3)
- *Picea mariana* / (*Vaccinium corymbosum*, *Gaylussacia baccata*) / *Sphagnum* sp. Woodland (CEGL006098, G3G5)
- *Pinus rigida* / *Chamaedaphne calyculata* / *Sphagnum* spp. Woodland (CEGL006194, G3G5)
- *Sphagnum (cuspidatum, torreyanum)* - *Vaccinium macrocarpon* Nonvascular Vegetation (CEGL006394, GNR)
- *Vaccinium corymbosum* - *Gaylussacia baccata* - *Photinia melanocarpa* / *Calla palustris* Shrubland (CEGL005085, G2G3)
- *Vaccinium corymbosum* / *Sphagnum* spp. Shrubland (CEGL006190, G3G5)

High-ranked species: *Caenestheriella gynecia* (G2G3), *Platanthera leucophaea* (G3)

SOURCES

References: Comer et al. 2003, Damman and French 1987

Version: 23 Mar 2003

Stakeholders: Canada, East, Midwest, Southeast

Concept Author: S.C. Gawler

LeadResp: East

CES202.336 SOUTHERN PIEDMONT / RIDGE AND VALLEY UPLAND DEPRESSION SWAMP

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional

Concept Summary: This system represents isolated wetlands primarily of the Piedmont in small, shallow basins in upland settings where water pools due to limited soil drainage. Also for now are related wetlands of the adjacent Ridge and Valley and Southern Blue Ridge (both extremely rare and small-patch examples). Most known examples occur on mafic rocks. The typical hydrology is seasonally flooded. Most examples consist of forests of wetland oaks, but a few are treeless or open-canopied ponds. Vegetation is zoned with an outer ring of trees, a more interior ring of shrubs, herbs and vines, and a central area with or without standing water year round depending on precipitation. A few examples occur in the adjacent Southern Blue Ridge and Ridge and Valley ecoregions. This system also includes the wet hardwood forests ("Iredell Flatwoods" or

"Gabbro Glades") which occur on gently sloping terrain or shallowly depressed upland flats over gabbro-derived clays in the Piedmont of Georgia and South Carolina.

Comments: This system is distinct from all other Piedmont systems in its ponded wetland hydrology in upland settings. The vegetation is generally also distinct from all other Piedmont systems. Though apparently quite different, Southern Piedmont Mafic Hardpan Woodland (CES202.268) is closely related by the importance of an impermeable clay hardpan, and some intermediate gradations occur. A few examples of Southern Piedmont / Ridge and Valley Upland Depression Swamp (CES202.336) appear to be closely related to Coastal Plain depressional wetlands, sharing some flora, but most are more distinct. The system has significant variation in vegetation and environment. The forested swamps and open pools represent well-marked subtypes. There is a more subtle distinction between the basic and acidic soil swamps. There is substantial variation among the pools, related to substrate, basin morphology, and geographic location. A few disjunct examples may occur in the Southern Blue Ridge because of similarity in topographic setting and general structure. They do, however, occur on different substrates (quartzite and sandstone) than any examples in the Piedmont. Their vegetation is different from other examples but not in having more montane flora. Their vegetation is no more different than most other pools are from each other.

DISTRIBUTION

Range: Ranges throughout the Piedmont, from Virginia to Alabama. A few examples attributable to this system are found in the Southern Blue Ridge and Ridge and Valley ecoregions.

Divisions: 202:C

TNC Ecoregions: 50:C, 51:C, 52:C, 59:?

Subnations: AL, GA, NC, SC, VA

Associations:

- *Cephalanthus occidentalis* - (*Leucothoe racemosa*) / *Carex jorii* Shrubland (CEGL004075, G1)
- *Leucothoe racemosa* - *Vaccinium fuscatum* - *Smilax walteri* Shrubland (CEGL004533, G1?)
- *Liquidambar styraciflua* - *Acer rubrum* / *Carex* spp. - *Sphagnum* spp. Forest (CEGL007388, G2Q)
- *Nyssa biflora* / *Cephalanthus occidentalis* - *Leucothoe racemosa* Forest (CEGL004550, G1)
- *Quercus* (*pagoda*, *phellos*, *shumardii*) - *Celtis laevigata* / *Cornus foemina* / *Podophyllum peltatum* - *Hymenocallis occidentalis* Flatwoods Forest (CEGL003880, G2?)
- *Quercus palustris* - *Quercus bicolor* / *Carex* spp. Forest (CEGL004643, G1G3)
- *Quercus phellos* - *Quercus* (*michauxii*, *shumardii*) - *Fraxinus americana* / (*Quercus oglethorpensis*) / *Zephyranthes atamasca* Gabbro Upland Depression Forest (CEGL008484, G2?)
- *Quercus phellos* / *Carex* (*albolutescens*, *intumescens*, *joorii*) - *Chasmanthium laxum* / *Sphagnum lescurii* Forest (CEGL007403, G2G3)
- *Scirpus cyperinus* - *Dulichium arundinaceum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL004134, G1Q)

High-ranked species: *Boltonia* sp. 1 (G2?), *Carex decomposita* (G3), *Isoetes piedmontana* (G3), *Isoetes virginica* (G1), *Trillium pusillum* var. *virginianum* (G3T2)

Environment: Occurs in small, shallow basins or gentle swales on flat to rolling upland sites, occasionally in depressions on narrow, steeper ridgetops. Soils have a dense clay hardpan or some other impermeable layer that limits internal drainage. Rainwater accumulates in the basins and persists through the wet season, occasionally persisting all year. Only a few kinds of rock are known to form these depressions. Most examples occur on mafic rocks such as gabbro or diabase, but a few occur on slates or on mafic to felsic tuffs where a dense clay hardpan has formed. A few occur over bedrock of other kinds. Rock chemistry affects soil chemistry and influences variation in vegetation, but hydroperiod is a more important influence. Rare examples in the Ridge and Valley of Georgia (Coosa Valley) are included here. These occur on limestones or dolomites of the Chickamauga group.

Vegetation: Vegetation consists either of swamps dominated by wetland oaks, or of more open-canopy pools with sparse trees and with substantial shrub or herbaceous vegetation. Swamps are most often dominated by *Quercus phellos*, with a substantial minority dominated by *Quercus lyrata* and a few having *Quercus bicolor*, *Quercus michauxii*, or other species. Examples that have been logged or cleared may be dominated by *Acer rubrum* or *Liquidambar styraciflua*. Lower strata are generally sparse in the swamps, often just a few shrubs such as *Vaccinium* spp., patches of *Smilax*, and a few wetland herbs. Open ponds may have the same canopy species on the edges, but a few have *Nyssa sylvatica* or other wetland species. The lower strata are better developed in the open pools, with *Cephalanthus occidentalis*, *Leucothoe racemosa*, *Vaccinium* spp., or other wetland species occurring as thickets along the edge or scattered in the interior. Large *Smilax* tangles sometimes occur. Herbs are usually still sparse or patchy, but may include dense beds of various graminoids or ferns, as well as scattered clumps. *Sphagnum* is sometimes extensive in parts of the pools. These isolated seasonal wetlands are often important breeding sites for amphibians.

Dynamics: The dynamics of water levels are the most important factor in these systems, differentiating them from the surrounding uplands and differentiating the various communities within the system. Most basins have almost no watershed, so water comes largely from rainfall. Variation in rainfall patterns will drive variation in duration of flooding, though most basins have an outlet that limits water depth. Fire is presumably naturally rare in these systems. Though they would naturally be exposed to fires in the surrounding uplands, standing water and lack of continuous fuel would limit fires to the edges, expect perhaps in early fall. Presumably important as a dynamic process is the migration of amphibians, which concentrate in these systems for breeding. Ecosystem dynamics may be strongly affected by the suitability of surrounding uplands for amphibian adult habitat.

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, occurring as isolated bodies surrounded by upland systems. Open pools are usually less than one acre, while swamps may be up to several acres in size.

Size: Occurs as small patches. Pools are usually less than one acre, and may be substantially smaller. Swamps range up to several acres, a few to ten or more acres. Most examples occur as isolated patches, but a few occur as small groups. Extensive mafic rock areas may support a number of swamps, but most are probably not close enough together to be treated as single occurrences. Most remaining examples are of natural size.

Heterogeneity: Most occurrences are single patches. Within the system, most examples will have only a single association. The open pools often have variation in vegetation physiognomy on a very fine scale, which is best treated within a single association.

Adjacent Ecological System Comments: Most examples are surrounded by Southern Piedmont Dry Oak-(Pine) Forest (CES202.339) or Southern Piedmont Mafic Hardpan Woodland (CES202.268).

SOURCES

References: Comer et al. 2003

Version: 12 Dec 2002

Concept Author: M. Schafale

Stakeholders: East, Southeast

LeadResp: Southeast

CES202.607 NORTH-CENTRAL APPALACHIAN SEEPAGE FEN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Herbaceous; Seepage-Fed Sloping; Organic Peat (>40 cm)

Concept Summary: This system is found in scattered locations in the central Appalachians and eastern Great Lakes regions. Mostly non-forested, these open fens develop on shallow to deep peat over a sloping substrate, where seepage waters provide nutrients. Conditions are often circumneutral to alkaline. Sedges are the major dominants. *Packera aurea*, *Symplocarpus foetidus*, and *Lobelia kalmii* are among the characteristic forbs. Some of these areas are kept open by grazing, and succession to shrublands may occur in the absence of disturbance.

DISTRIBUTION

Range: Scattered locations from central New England and New York west to Lake Erie and south to Virginia.

Divisions: 202:C

TNC Ecoregions: 45:P, 48:P, 49:C, 59:C, 60:P, 61:C

Subnations: CT, MA, MD, NJ, NY, PA, VA, VT, WV?

Associations:

- *Alnus serrulata* - *Lindera benzoin* / *Osmunda regalis* var. *spectabilis* - *Carex tetanica* Shrubland (CEGL008408, G1?)
- *Carex atlantica* - *Solidago patula* var. *patula* - *Lilium grayi* / *Sphagnum bartlettianum* Herbaceous Vegetation (CEGL004158, G1)
- *Cornus amomum* - *Salix candida* / *Dasiphora fruticosa* ssp. *floribunda* / *Carex stricta* Shrubland (CEGL006359, G3?)
- *Cornus racemosa* / *Carex (sterilis, aquatilis, lacustris)* Shrub Herbaceous Vegetation (CEGL006123, G2G3)
- *Dasiphora fruticosa* ssp. *floribunda* / *Carex (sterilis, hystericina, flava)* Shrub Herbaceous Vegetation (CEGL006326, G2)
- *Dasiphora fruticosa* ssp. *floribunda* / *Carex interior* - *Carex flava* - *Sarracenia purpurea* Shrub Herbaceous Vegetation (CEGL005140, G3)

- *Dasiphora fruticosa* ssp. *floribunda* / *Rhynchospora capillacea* - *Scleria verticillata* Shrub Herbaceous Vegetation (CEGL006356, G1)
- *Juniperus virginiana* / *Betula pumila* / *Carex sterilis* - *Oligoneuron rigidum* Shrub Herbaceous Vegetation (CEGL006367, G1Q)
- *Juniperus virginiana* / *Dasiphora fruticosa* ssp. *floribunda* / *Carex flava* - *Carex tetanica* Shrub Herbaceous Vegetation (CEGL006357, G1G2)
- *Morella pensylvanica* - *Dasiphora fruticosa* ssp. *floribunda* / *Carex sterilis* - *Carex flava* Shrub Herbaceous Vegetation (CEGL006103, G2)
- *Symplocarpus foetidus* Herbaceous Vegetation (CEGL002385, G4?)

High-ranked species: *Carex schweinitzii* (G3G4), *Carex* sp. 2 (G1), *Chelone cuthbertii* (G3), *Glyptemys muhlenbergii* (G3), *Neonympha mitchellii* (G1G2), *Parnassia grandifolia* (G3), *Poa paludigena* (G3)

SOURCES

References: Comer et al. 2003

Version: 09 Jan 2003

Concept Author: S.C. Gawler

Stakeholders: East, Midwest, Southeast

LeadResp: East

CES202.899 NORTH-CENTRAL INTERIOR FRESHWATER MARSH

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional [Lakeshore]; Graminoid; Shallow (<15 cm) Water; >180-day hydroperiod

Concept Summary: This system is found throughout the northern Midwest ranging into southern Canada. It is typically found on glacial potholes, along small streams, ponds, channels in glacial outwash and on lakeplains. This system contains a deep to shallow area of freshwater marsh dominated by emergent and submergent species. Stands may be open ponds with floating or rooted aquatics, or deep marsh with bulrush or cattails, and range from fairly small to several acres. It contains hydric soils flooded by water ranging from several centimeters to over 1 meter for most of the growing season. Emergent marsh species such as *Typha* spp. and *Schoenoplectus* spp. dominate this system with an occasional scattering of tall *Carex* spp. and forbs that can vary from dense to open cover. Trees are generally absent and, if present, are scattered. Submergent wetlands include a variety of macrophytes.

Comments: Some of the specific communities will also be found in the floodplain system and should not be considered a separate system in that case [see North-Central Interior Floodplain (CES202.694)]. Many of these marshes also may have a border of shrubby wet-meadow species similar to North-Central Interior Wet Meadow-Shrub Swamp (CES202.701), but only those areas with a relatively narrow border (<5-10 m) should included with this system.

DISTRIBUTION

Range: This system is found in the northern Midwest and southern Canada.

Divisions: 201:C, 202:C

TNC Ecoregions: 35:C, 36:C, 45:C, 46:C, 47:C, 48:C, 49:?

Subnations: IA, IL, IN, MI, MN, MO, ND, OH, ON?, SD, WI

Associations:

- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar lutea* ssp. *advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141, GNA)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430, G4G5)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Schoenoplectus acutus* - (*Schoenoplectus fluviatilis*) Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229, G4?)
- *Typha* spp. - *Schoenoplectus* spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228, G4G5)
- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233, G5)
- *Zizania (aquatica, palustris)* Herbaceous Vegetation (CEGL002382, G3G4)

SOURCES

References: Comer and Albert 1997, Midwestern Ecology Working Group n.d.

Version: 14 Dec 2004

Concept Author: S. Menard

Stakeholders: Canada, Midwest

LeadResp: Midwest

CES202.052 OZARK-OUACHITA FEN

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This fen system is found in the Ozarks region of the United States. Stands occur on the sideslopes of hills in narrow valleys, bases of bluffs, rock ledges, and terraces of streams and rivers, where the soil or substrate is saturated by calcareous groundwater seepage. Soils are moist to wet, mucky peat or mineral, with pH above 6.5, and vary from shallow (0-40 cm) to moderately deep (40-100 cm), depending on natural disturbance and slope. The parent material is a mixture of gravel and dolomite with fragments of deeply weathered bedrock present, or colluvium over bedrock. The bedrock strata are exposed, especially in hanging fens where the slope is greater than 35 degrees. Hydrophytic plants dominate the fen, which varies from mixed grass or sedge fen with complex zonation to more tallgrass prairie species mixed with calciphiles. Fires are possible in some of the larger prairie fens.

Comments: Some fens are typically associated with riparian vegetation. Seeps in the Ozarks are typically acidic to circumneutral and differ substantially in floristics and groundwater chemistry from these alkaline fens.

DISTRIBUTION

Range: This fen community type is found in the Ozarks region of the United States.

Divisions: 202:C

TNC Ecoregions: 38:C

Subnations: MO

Associations:

- (*Carex interior*, *Carex lurida*) - *Carex leptalea* - *Parnassia grandifolia* - *Rhynchospora capillacea* Herbaceous Vegetation (CEGL002404, G2G3)
- *Carex interior* - *Carex lurida* - *Andropogon gerardii* - *Parnassia grandifolia* Herbaceous Vegetation (CEGL002416, G1G2)

Vegetation: Stands of this small-scale system are typically dominated by primarily wetland obligate species of sedges (*Carex* spp.), ferns (*Osmunda* spp.), and other herbaceous species such as *Impatiens capensis* and *Parnassia grandifolia*.

SOURCES

References: Comer et al. 2003, Nelson 1985

Version: 14 Dec 2004

Concept Author: D. Faber-Langendoen

Stakeholders: Midwest, Southeast

LeadResp: Midwest

CES202.317 SOUTHERN APPALACHIAN SEEPAGE WETLAND

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Seepage-Fed Sloping

Concept Summary: This system consists of seepage-fed wetlands in the southern Appalachians on gentle slopes, with substantial seepage flow. Vegetation is variable, both within and among examples, but lacks vegetation characteristic of bogs or floodplains. This is a small-patch system occurring over a wide elevational range, nearly to the highest peaks, but is generally lacking from flat valley bottoms.

Comments: This system is fairly heterogeneous, covering a broad range of environments and vegetation, but without apparent breaks. At one extreme, the system contains rich, low-elevation, forb-dominated seeps closely related floristically to cove forests; at the other extreme, it contains acidic, sedge- and moss-dominated, bog-like, high-elevation seeps. This system

is distinguished from Southern and Central Appalachian Bog and Fen (CES202.300) by occurrence in sloping settings rather than flat valley bottoms, with more rapid flow of water, and by lack of dominance by the characteristic bog or fen flora (though some of it may be present). The only other systems with wetland systems within its range, floodplains and upland pools, are more distinct floristically as well as associated with very different landforms.

DISTRIBUTION

Range: Ranges throughout the Southern Appalachians, from northern Georgia and South Carolina north through Virginia, and westward into Tennessee, Kentucky?, and West Virginia.

Divisions: 202:C

TNC Ecoregions: 51:C, 59:?

Subnations: AL?, GA, KY?, NC, SC, TN, VA, WV?

Associations:

- *Alnus serrulata* - *Lindera benzoin* / *Scutellaria lateriflora* - *Thelypteris noveboracensis* Shrubland (CEGL003909, G2?)
- *Calamagrostis cainii* - *Carex ruthii* - *Parnassia asarifolia* / *Sphagnum* spp. Herbaceous Vegetation (CEGL007877, G1Q)
- *Carex gynandra* - *Platanthera clavellata* - *Drosera rotundifolia* - *Carex ruthii* - *Carex atlantica* / *Sphagnum* spp. Herbaceous Vegetation (CEGL007697, G2)
- *Diphylleia cymosa* - *Saxifraga micranthidifolia* - *Laportea canadensis* Herbaceous Vegetation (CEGL004296, G3)
- *Glyceria striata* - *Carex gynandra* - *Chelone glabra* - *Symphytotrichum puniceum* / *Sphagnum* spp. Herbaceous Vegetation (CEGL008438, G2G3)
- *Impatiens (capensis, pallida)* - *Monarda didyma* - *Rudbeckia laciniata* var. *humilis* Herbaceous Vegetation (CEGL004293, G3)
- *Schoenoplectus robustus* - *Juncus gerardii* - *Hordeum jubatum* - *Atriplex patula* Herbaceous Vegetation (CEGL006234, G1)

High-ranked species: *Cardamine clematitidis* (G2G3), *Carex mitchelliana* (G3G4), *Chelone cuthbertii* (G3), *Danthonia epilis* (G3G4), *Desmognathus aeneus* (G3G4), *Desmognathus imitator* (G3G4), *Desmognathus santeetlah* (G3G4Q), *Desmognathus wrightii* (G3G4), *Eurycea junaluska* (G3), *Glyceria nubigena* (G2), *Rhynchospora thornei* (G3), *Rudbeckia laciniata* var. *humilis* (G5T3?), *Sarracenia oreophila* (G2), *Saxifraga caroliniana* (G2), *Xyris tennesseensis* (G2)

Environment: Occurs in small patches where seepage creates saturated soil conditions permanently or seasonally. Wetness may vary substantially over short distances in response to amounts of seepage, flow, and pooling by topography or impermeable substrate. The system occurs over a wide elevational range, nearly to the highest peaks. Landforms are usually concave slopes, but may be on convex slopes or even in ridgetop gaps. This system is almost never on flat valley bottoms, though it may be on the edge of them. Soils may be muck or coarse boulders, but are usually saturated mineral soil. They may be residual or colluvial, and deep or shallow. The most extensive and wettest examples occur at elevations above 5000 feet, where cool temperatures and high rainfall make more water available.

Vegetation: Vegetation consists of a series of forested and open associations united by presence of wetland flora but lack of floodplain species and most bog species. Vegetation consists of a series of forested and open associations united by presence of wetland flora but lack of floodplain species and most bog species. Some tree cover by mesophytic species is usually present, but often only by trees rooted on the edge of adjacent systems. Shrubs may be sparse, or may form dense zones around the edge. Shrub species are mostly mesophytic rather than obligate wetland species. The herb layer is generally well-developed, and is usually dominated either by characteristic forbs such as *Impatiens capensis*, *Impatiens pallida*, *Monarda didyma*, *Chelone* spp., and *Rudbeckia triloba*, or by *Carex* spp. *Sphagnum* may occur in a minority of examples.

Dynamics: The presence of seepage is the primary determinant of this system. Long-term droughts that affect seepage flow presumably have an effect, but this has not been documented. Canopy dynamics are not well known and potentially may vary substantially over short distances in response to wetness. Wetness may limit recruitment of most tree and shrub seedlings to drier microsites, making canopy gaps persist longer than in adjacent forests and creating a more open canopy. Fire may penetrate from the adjacent forest systems, but only in the driest conditions are they likely to be intense enough to have much effect within this system. Seeps are fairly permanent features of the landscape, but may potentially be created, destroyed, or changed in extent because of changes in groundwater flow, stream entrenchment or headward erosion, mass movement on slopes, or long-term climatic cycles. Examples are often left undisturbed when surrounding forests are logged. Effects of logging on water infiltration or surface flow may have significant indirect effects.

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, from less than one to no more than several acres in size, potentially surrounded by a number of different systems.

Size: Occurs as small patches, most less than one acre in size. The largest patches at high elevations are several acres. Patches occasionally occur in complexes but more often occur singly.

Heterogeneity: Most patches are contiguous and contain only a single association. Vegetation is often very heterogeneous within single associations.

Adjacent Ecological System Comments: May be embedded in a variety of other systems. Most common are Southern Appalachian Northern Hardwood Forest (CES202.029) and Southern and Central Appalachian Cove Forest (CES202.373).

SOURCES

References: Comer et al. 2003

Version: 02 Feb 2005

Concept Author: M. Schafale and R. Evans

Stakeholders: East, Southeast

LeadResp: Southeast

CES202.027 GREAT LAKES WET-MESIC LAKEPLAIN PRAIRIE

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: This system is found on the lakeplain near the southern central Great Lakes of the United States and Canada. Stands occur on level, sandy glacial outwash, sandy glacial lakeplains, and deposits of dune sand in silty/clayey glacial lakeplains. The soils are sands and sandy loams, loams with poor to moderate water-retaining capacity, typically occurring over less permeable silty clays. There is often temporary inundations after heavy rains or in the spring, followed by dry conditions throughout much of the remaining growing season. The vegetation of this community is dominated by tallgrass species typically 1-2 m high. Trees and shrubs are very rare. There is very little bare ground. *Andropogon gerardii*, *Calamagrostis canadensis*, *Carex* spp. (*Carex aquatilis*, *Carex bicknellii*, *Carex buxbaumii*, *Carex pellita* (= *Carex lanuginosa*)), *Panicum virgatum*, *Spartina pectinata*, *Schizachyrium scoparium*, and *Sorghastrum nutans* are the most abundant graminoid species.

DISTRIBUTION

Range: This system is found near the southern central Great Lakes of the United States and Canada, from southeastern Wisconsin and northeastern Illinois to southern Michigan and southwestern Ontario.

Divisions: 202:C

TNC Ecoregions: 48:C

Subnations: IL, IN, MI, OH, ON, WI

Associations:

- *Andropogon gerardii* - *Calamagrostis canadensis* - *Pycnanthemum virginianum* - *Oligoneuron ohioense* Herbaceous Vegetation (CEGL005095, G2)
- *Andropogon gerardii* - *Sorghastrum nutans* - *Schizachyrium scoparium* - *Aletris farinosa* Herbaceous Vegetation (CEGL005096, G2)
- *Quercus alba* - *Quercus velutina* - *Quercus palustris* / *Carex pensylvanica* Woodland (CEGL005054, G2)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* Lakeplain Herbaceous Vegetation (CEGL005109, G2G3)

High-ranked species: *Clonophis kirtlandii* (G2), *Eleocharis wolfii* (G3G4), *Platanthera leucophaea* (G3)

SOURCES

References: Chapman 1984, Chapman 1986, Comer et al. 1995b, Comer et al. 2003, Faber-Langendoen and Maycock 1987, Faber-Langendoen and Maycock 1994

Version: 25 Mar 2003

Concept Author: K. Chapman, D. Faber-Langendoen, P. Comer

Stakeholders: Canada, Midwest

LeadResp: Midwest

CES202.329 SOUTHERN PIEDMONT GRANITE FLATROCK

Primary Division: Central Interior and Appalachian (202)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland

Diagnostic Classifiers: Rock Outcrops/Barrens/Glades

Concept Summary: This system consists of smooth, exfoliated outcrops of massive granite and related rocks in the eastern and central Piedmont of the southeastern United States, and rarely in the adjacent Atlantic Coastal Plain (confined to the Fall-Line where erosion has exposed underlying rocks). Examples occur from Virginia south to Alabama, but are found most abundantly in the upper Piedmont of Georgia. Depending upon the location, examples may rise above the surrounding landscape by as much as 200 m, or lie flush with the surrounding land surface. The vegetation is a complex of small-patch communities of different species and structure occupying different microhabitats present on the outcrops, ranging from moss and lichens to herbs to shrubs and trees. In some areas, these microhabitats include solution pits or depressions that retain water and form a distinctive wetland community. This outcrop system supports a relatively high degree of endemic plants.

Comments: Granitic domes are clearly related to other rock outcrop systems in the Piedmont but are distinct in their flora and vegetation mat succession. The smooth rock surface is crucial to their development. More fractured granitic rocks do not form this distinct system. In contrast, Southern Piedmont Cliff (CES202.386) have vertically oriented rock outcrops that tend to have fractures and ledges. Southern Piedmont Glade and Barrens (CES202.328) are similarly horizontally oriented, but have denser vegetation and rather different flora. Southern Appalachian Rocky Summit (CES202.327), which barely overlap the range of this system, has fractured rock and occurs in topographically high settings in rugged topography.

This system is closely related to Southern Appalachian Granitic Dome (CES202.297), with which it shares the distinctive structure and vegetation mat dynamics of exfoliated outcrops. The flat orientation of the flatrocks makes pools more important in them. Climatic and biogeographic differences lead to floristic differences between the two systems.

DISTRIBUTION

Range: This system is found scattered in the eastern and central Piedmont, from Alabama to Virginia. Rare examples occur in the upper Piedmont. A few, occurring surrounded by Tertiary sediments in the Fall Zone, may be considered to be in the Coastal Plain.

Divisions: 202:C

TNC Ecoregions: 52:C, 57:C

Subnations: AL, GA, NC, SC, VA

Associations:

- *Amphianthus pusillus* - *Isoetes melanospora* - *Isoetes tegetiformans* Herbaceous Vegetation (CEGL004342, G1)
- *Diamorpha smallii* - *Minuartia glabra* - *Minuartia uniflora* - *Cyperus granitophilus* Herbaceous Vegetation (CEGL004344, G3)
- *Packera tomentosa* - *Croton willdenowii* - *Schizachyrium scoparium* - (*Selaginella rupestris*) Herbaceous Vegetation (CEGL004298, G3)
- *Talinum teretifolium* - *Minuartia glabra* - *Diodia teres* - *Croton willdenowii* Herbaceous Vegetation (CEGL003857, G2G3)

High-ranked species: *Amphianthus pusillus* (G2), *Cyperus granitophilus* (G3Q), *Eriocaulon koernickianum* (G2), *Isoetes melanospora* (G1), *Isoetes piedmontana* (G3), *Isoetes tegetiformans* (G1), *Rhynchospora saxicola* (G3Q), *Sedum pusillum* (G3)

Environment: Occurs on exfoliated granitic outcrops; these are Precambrian metamorphic rocks generally found in the Piedmont Plateau (McVaugh 1943). Outcrops are level or gently sloped occurring as low domes up to 200 m above the surrounding landscape or as flat rocks varying considerably in size (Shure 1999). Smooth rock without crevices is the primary factor in the distinctive ecological character of this system. Granite, granitic gneiss, and related rocks without many internal joints tend to fracture in thin sheets parallel to the surface, forming outcrops with smooth surfaces largely lacking crevices. The outcrop surface is largely bare rock but has thin soil mats around the edge and in patches throughout. Mats vary in depth with age and level of development. Distinct microenvironments are created by small irregularities in the rock surface and by areas of seepage at the edge. Some examples (e.g., in central Georgia) may have prominent seepage-related features, where areas of perennial herbaceous vegetation are very wet in the winter and spring. In these cases, the only vegetated areas on the granite outcrop are seepage-related. One possible substrate is the Lilesville granite.

Vegetation: Most of the rock surface is bare or has only crustose or foliose lichen cover. Vegetation occurs as a series of small patches in the thin soil mats, or seasonal pools, with the community type dependent on the nature of the depression and depth of the soil mat (if any). Bare rock may have moss patches. The thinnest soils usually have a set of fine forbs, many of them annual. Slightly deeper soils often have grasses dominating. Deeper soils support shrubs or small trees. A distinctive woodland of pines or pines and oaks occurs on the continuous shallow soils surrounding the outcrop. The flora shares some species with other rock outcrops of the Piedmont, but has some distinctive species and different dominance of species.

Dynamics: Large numbers of soil island depression may be scattered across the surface of granite outcrops and occasional pools of shallow water may stand in certain depressions which trap rainfall (McVaugh 1943, Shure 1999). Where soil

accumulates in depressions formed by exfoliating surface rock, a distinctive and fairly predictable pattern of successional changes occurs [see references in Shure (1999)]. Soil mats appear and deepen over time in a process that links vegetational and soil development, but are eventually destroyed by wind throw, drought, other natural disturbances. The result is a mosaic with mats of different levels of development at any given time. Mat dynamics are different in different parts of the rock, with older mats and more permanent patterns near the edges and sparser and younger mats in the interior. The dynamics are further modified by microtopography and the presence of seepage. The larger vegetation patterns such the relative amount of different stages likely respond to climatic cycles and natural disturbance events. The thin soils make these communities sensitive to drought, especially the long-lived woody species. Fire is probably rare in the interior, given the sparse fuel, but may be important in determining the size of the open area and may affect the dynamics of the bordering woodlands.

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, most examples covering one to a relatively few acres.

Size: Most examples naturally cover one to a few acres, some less than one acre. A few examples exceed 10 acres. Most examples occur in a few clusters where geology is particularly suitable, such as central Georgia and northeastern North Carolina. A few examples are more isolated. Individual flatrocks may occur in complexes, separated by small patches of forest.

Heterogeneity: Examples may be a single patch or a complex embedded in upland forest. Within the system, vegetation is very heterogeneous on a fine scale. It is not yet definitively determined how much of this variation will be placed in separate associations.

Adjacent Ecological System Comments: Surrounded by forest systems on deeper soils less influenced by bedrock, most typically Southern Piedmont Dry Oak-(Pine) Forest (CES202.339).

SOURCES

References: Baker 1956, Coffey 1964, Comer et al. 2003, McVaugh 1943, Nelson 1986, Quarterman et al. 1993, Shure 1999

Version: 12 Dec 2002

Concept Author: M. Schafale and R. Evans

Stakeholders: East, Southeast

LeadResp: Southeast

CES203.245 ATLANTIC COASTAL PLAIN CLAY-BASED CAROLINA BAY WETLAND

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Forest and Woodland (Treed); Depressional; Graminoid

Concept Summary: This system consists of wetlands associated with ovoid, shallow depressions with nearly flat bottoms in parts of the Atlantic Coastal Plain. Often called Carolina bays, these areas are most numerous and extensive in South Carolina but are also present in the Inner Coastal Plain of North Carolina. The depressions have mineral soils with clay hardpans that trap and retain water from a combination of rainfall and exposure of a high regional water table. Some examples are essentially permanently flooded, while others support water levels that vary substantially from year to year and over longer climatic cycles. Vegetation includes a series of primarily herbaceous and woodland associations. The wettest sites have open water and floating-leaved aquatic vegetation, or marsh vegetation of tall graminoids. Drier sites often have an open canopy of *Taxodium ascendens*, with a dense, often fairly species-rich herbaceous layer beneath. A few occurrences are shrubby, but none contain the dense shrub layers of characteristic pocosin species that occur in the bays with organic soils. Vegetational composition often varies substantially from year to year, in response to differences in water levels and drawdown times. Variation in hydroperiod is the most important dynamic, causing rapid major changes in the herbaceous vegetation. Unlike the steeper-sided solution depressions, where many different hydroperiods are present within a short distance and vegetation zones simply shift, the flat-bottomed Carolina bays experience drastic yearly changes in hydroperiod over most of their extent. Fire periodically spreads into the bays from adjacent uplands when conditions are dry, helps prevent invasion by less water-tolerant trees during dry periods, and interacts with flooding to affect vegetational composition. Where fire is removed, *Pinus taeda* often invades the bays. Fire may also be important in preventing buildup of organic matter on the soil surface.

Comments: The distinction between the central concepts of this system and Atlantic Coastal Plain Southern Depression Pondshore (CES203.262) is well marked, with basin morphology, geographic range, and prevailing communities differing. However, there is a common set of plant species, including some rare ones, that occur in both systems. Thus, there may be difficulty in defining the local boundary, and some atypical depressions may have to be placed in one system or the other based on the preponderance of evidence. This system is related to Atlantic Coastal Plain Northern Pondshore (CES203.518)

which occurs farther north in the Coastal Plain and to some of the flat-bottomed basin wetlands of Florida which occur outside the range of this system to the south.

DISTRIBUTION

Range: Inner to Middle Coastal Plain, from southern North Carolina, through South Carolina, perhaps into Georgia. Most numerous and extensive in South Carolina.

Divisions: 203:C

TNC Ecoregions: 56:C, 57:C

Subnations: GA?, NC, SC

Associations:

- *Taxodium ascendens* / *Cyrilla racemiflora* - *Zenobia pulverulenta* Woodland (CEGL003734, G2)
- *Taxodium ascendens* / *Panicum hemitomon* - *Polygala cymosa* Woodland (CEGL003733, G2G3)

High-ranked species: *Andropogon gyrans* var. *stenophyllus* (G5T3T4), *Carex striata* var. *striata* (G4T3T4), *Carex verrucosa* (G3G4), *Echinodorus parvulus* (G3Q), *Euphyes dukesi* (G3), *Lindera melissifolia* (G2), *Litsea aestivalis* (G3), *Lobelia boykinii* (G2G3), *Ludwigia spathulata* (G2G3), *Myriophyllum laxum* (G3), *Oxypolis canbyi* (G2), *Panicum hirstii* (G1), *Polygonum hirsutum* (G3G4), *Rana capito* (G3), *Rhexia aristosa* (G3), *Rhynchospora inundata* (G3G4)

Environment: Occurs in Carolina bays with mineral soils and with seasonal to permanent standing water. Carolina bays are oriented, oval, shallow depressions with nearly flat bottoms, which range from North Carolina through South Carolina. Most Carolina bays in the Outer Coastal Plain occur in sandy sediments and are filled with peat, while most Carolina bays in the Inner Coastal Plain occur in loamy sediments and have mineral soils with clay hardpans. These depressions hold water, due to a combination of rainfall and exposure of a high regional water table. Some are essentially permanently flooded. Others contain water well into the growing season in most years, but water levels vary substantially from year to year and over longer climatic cycles. Fire is an important natural influence in dry times.

Vegetation: Vegetation includes a series of primarily herbaceous and woodland associations. The wettest sites have open water and floating-leaved aquatic vegetation, or marsh vegetation of tall graminoids. Drier sites often have an open canopy of *Taxodium ascendens*, with a dense, often fairly species-rich herbaceous layer beneath. A large number of annual species are present. Some sites have similar herbaceous vegetation without trees. A few occurrences are shrubby, but none contain the dense shrub layers of characteristic pocosin species that occur in the bays with organic soils. Vegetational composition often varies substantially from year to year, in response to differences in water levels and drawdown times. Seed banking plays an important role in component communities. The system is also important as amphibian breeding habitat and may support a distinctive aquatic invertebrate community.

Dynamics: Variation in hydroperiod is the most important dynamic, causing rapid major changes in the herbaceous vegetation. Unlike the steeper-sided solution depressions, where many different hydroperiods are present within a short distance and vegetation zones simply shift, the flat-bottomed Carolina bays experience drastic yearly changes in hydroperiod over most of their extent. Many plants persist in seed banks for periods of years when conditions are not suitable. Fire is also an important process, spreading into the bays from adjacent uplands when conditions are dry. Fire prevents invasion by less water-tolerant trees during dry periods, and interacts with flooding to affect vegetational composition. Where fire is removed, *Pinus taeda* often invades the bays. Fire may also be important in preventing buildup of organic matter on the soil surface.

SPATIAL CHARACTERISTICS

Spatial Summary: Small-patch system, occurring alone or in closely associated complexes.

Size: Most clay-based Carolina bays are ½ mile or less long. Some are isolated, while in places several bays may be close enough together to be considered part of the same occurrence.

Heterogeneity: This system is contiguous within individual Carolina bays. Complexes of several bays will be set in a matrix of upland systems. Within a bay, single associations usually cover a large area, and a given bay may contain one or a few associations. A complex of bays may have more different associations represented.

Adjacent Ecological System Comments: Most occurrences were naturally associated with or embedded within Atlantic Coastal Plain Northern Wet Longleaf Pine Savanna and Flatwoods (CES203.265) and Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281). Most are now surrounded by heavily altered systems.

SOURCES

References: Comer et al. 2003, Sharitz 2003

Version: 23 Sep 2002

Concept Author: M. Schafale and R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES203.522 ATLANTIC COASTAL PLAIN NORTHERN BASIN PEAT SWAMP

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system is comprised of acidic peat swamps formed in basins of various sizes, predominantly Atlantic white-cedar swamps, occurring on the northern portion of the Atlantic Coastal Plain from Massachusetts south to Virginia. The hydrology is saturated, as evidenced by *Sphagnum*-dominated hummock-and-hollow microtopography. *Chamaecyparis thyoides* is characteristic and often dominant. *Acer rubrum* may also be an important species, especially after logging.

DISTRIBUTION

Range: This system occurs on the northern portion of the Atlantic Coastal Plain from Massachusetts south to Virginia.

Divisions: 203:C

TNC Ecoregions: 58:C, 60:P, 62:?

Subnations: CT, DE, MA, MD, NJ, NY, VA

Associations:

- *Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* / *Viburnum nudum* var. *nudum* / *Osmunda cinnamomea* - *Woodwardia areolata* Forest (CEGL006238, G3?)
- *Acer rubrum* / *Rhododendron maximum* Forest (CEGL006396, GNR)
- *Chamaecyparis thyoides* - *Acer rubrum* - *Magnolia virginiana* Forest (CEGL006078, GNR)
- *Chamaecyparis thyoides* - *Acer rubrum* / *Lycopus* spp. Forest (CEGL006364, GNR)
- *Chamaecyparis thyoides* / *Alnus maritima* Woodland (CEGL006307, GNR)
- *Chamaecyparis thyoides* / *Ilex glabra* - *Rhododendron viscosum* Forest (CEGL006188, G3)
- *Chamaecyparis thyoides* / *Rhododendron maximum* Forest (CEGL006355, G2G3)
- *Vaccinium corymbosum* - *Rhododendron viscosum* - *Clethra alnifolia* Shrubland (CEGL006371, GNR)

High-ranked species: *Callophrys hesseli* (G3G4), *Gentiana autumnalis* (G3), *Helonias bullata* (G3), *Narthecium americanum* (G2), *Scirpus longii* (G2G3)

SOURCES

References: Comer et al. 2003

Version: 12 Oct 2004

Concept Author: R. Evans

Stakeholders: East, Southeast

LeadResp: East

CES203.520 ATLANTIC COASTAL PLAIN NORTHERN BASIN SWAMP AND WET HARDWOOD FOREST

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Forest and Woodland (Treed); Seepage-Fed Sloping; North Atlantic Coastal Plain

Concept Summary: This system is comprised of hardwood swamps of seasonally flooded habitats, including relatively shallow groundwater-influenced depressions, stream headwaters and other topographic depressions. It ranges from Long Island, New York, south to Virginia. Although supporting some seepage indicators, they are also affected by overland flow. The substrate is mineral soil overlain by a variable organic but non-peaty layer. Characteristic tree species include *Acer rubrum*, *Liquidambar styraciflua*, *Nyssa sylvatica*, *Quercus phellos*, and *Fraxinus pennsylvanica*. *Pinus taeda* is not uncommon south of Delaware Bay.

DISTRIBUTION

Range: It ranges from Long Island, New York, south to Virginia.

Divisions: 203:C

TNC Ecoregions: 58:C, 62:C

Subnations: DE, MD, NJ, NY, VA

Associations:

- *Acer rubrum* - *Fraxinus (pennsylvanica, americana)* / *Lindera benzoin* / *Symplocarpus foetidus* Forest (CEGL006406, G4G5)
- *Acer rubrum* - *Fraxinus pennsylvanica* / *Bidens laevis* - *Pilea fontana* Forest (CEGL006413, GNR)
- *Acer rubrum* - *Fraxinus pennsylvanica* / *Saururus cernuus* Forest (CEGL006606, GNR)
- *Acer rubrum* - *Nyssa sylvatica* - *Liquidambar styraciflua* - *Populus heterophylla* Forest (CEGL006013, G1)
- *Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* / *Viburnum nudum* var. *nudum* / *Osmunda cinnamomea* - *Woodwardia areolata* Forest (CEGL006238, G3?)
- *Liquidambar styraciflua* - *Acer rubrum* - *Nyssa biflora* / *Carex jorii* Forest (CEGL006223, G1G2)
- *Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* / *Leucothoe racemosa* Forest (CEGL006110, GNR)
- *Pinus taeda* / *Morella cerifera* / *Osmunda regalis* var. *spectabilis* Forest (CEGL006137, G3)

High-ranked species: *Carex schweinitzii* (G3G4), *Helonias bullata* (G3), *Hydrochus spangleri* (G1), *Juncus caesariensis* (G2), *Narthecium americanum* (G2), *Scirpus longii* (G2G3), *Trillium pusillum* var. *virginianum* (G3T2)

Vegetation: Characteristic tree species include *Acer rubrum*, *Liquidambar styraciflua*, *Nyssa sylvatica*, *Quercus phellos*, and *Fraxinus pennsylvanica*. *Pinus taeda* is not uncommon south of Delaware Bay.

SOURCES

References: Comer et al. 2003

Version: 12 Oct 2004

Concept Author: R. Evans

Stakeholders: East, Southeast

LeadResp: East

CES203.893 ATLANTIC COASTAL PLAIN NORTHERN BOG

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system is comprised of dwarf-shrub sphagnum bogs dominated by *Chamaedaphne calyculata* occurring on Cape Cod, Massachusetts; Long Island, New York; and the Coastal Plain of New Jersey. North of the glacial border, this system typically occurs in isolated glacial kettleholes and in New Jersey in similar isolated basins. This system occurs in regions of deep sands supporting a pine barrens landscape. The system is characterized by acidic, tannic water supporting a floating or grounded *Sphagnum* mat over which *Chamaedaphne calyculata*, *Gaylussacia dumosa*, and other dwarf-shrubs have rooted. Taller shrubs such as *Vaccinium corymbosum* may occur at the periphery of the bog, and *Decodon verticillatus* often forms a distinct zone adjacent to open water. Rooted hydromorphic plants such as *Nymphaea odorata* occur in open water.

DISTRIBUTION

Range: This system occurs on Cape Cod, Massachusetts; Long Island, New York; and the Coastal Plain of New Jersey.

Divisions: 203:C

TNC Ecoregions: 62:C

Subnations: MA, NJ, NY

Associations:

- *Chamaecyparis thyoides* / *Ilex glabra* - *Rhododendron viscosum* Forest (CEGL006188, G3)
- *Chamaedaphne calyculata* - (*Gaylussacia dumosa*) - *Decodon verticillatus* / *Woodwardia virginica* Dwarf-shrubland (CEGL006008, G5)
- *Chamaedaphne calyculata* / *Carex striata* Dwarf-shrubland (CEGL006208, GNR)
- *Nuphar lutea* ssp. *advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Pinus rigida* / *Chamaedaphne calyculata* / *Sphagnum* spp. Woodland (CEGL006194, G3G5)
- *Sphagnum cuspidatum* Nonvascular Vegetation (CEGL004384, G2?)

High-ranked species: *Eupatorium resinosum* (G3), *Papaipema sulphurata* (G2), *Scirpus longii* (G2G3)

SOURCES

References: Comer et al. 2003

Version: 09 Sep 2004

Stakeholders: East

CES203.262 ATLANTIC COASTAL PLAIN SOUTHERN DEPRESSION POND SHORE**Primary Division:** Gulf and Atlantic Coastal Plain (203)**Land Cover Class:** Woody Wetland**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.)**Diagnostic Classifiers:** Woody-Herbaceous; Coastal plain; Depressional [Pond]

Concept Summary: This system consists of wetlands in small basins formed in unconsolidated sediments of the Atlantic Coastal Plain, from southeastern Virginia to Florida. Most basins are formed by subsidence of surface sediments caused by solution in underlying limestone. Others may be formed as swales in mainland eolian sands, natural blockage of small drainages by sediment movement, and more obscure causes. Soils are generally sandy, with mucky surfaces in the wettest areas. Vegetation is often zonal in response to variation in duration of flooding in different parts of the depression pond. Vegetation usually ranges from open water or floating-leaved aquatics in the center of the deepest basins, to emergent marsh zones in semipermanent water, to drawdown zones with diverse small graminoid and forb vegetation, to dense shrub or woodland edges. A smaller number of basins may have emergent trees throughout their extent. Hydroperiod can vary substantially from year to year, and vegetation can similarly vary significantly in aspect and dominants. Besides flooding and its variation, fire is an important natural force in the outer drier portions.

Comments: The boundary of this system with adjacent upland or wetland systems occurs where vegetation begins to reflect the influence of regular flooding and basin hydrology. This system shares much of its character with Atlantic Coastal Plain Clay-Based Carolina Bay Wetland (CES203.245) but generally accommodates all "limesink depressions" as opposed to mineral soil Carolina bay wetlands. Other basins, especially broad, gently sloped basins on the Outer Coastal Plain and steep-sided depressions farther inland, will need to be placed based on the preponderance of evidence. The northern and southern range limits of this system are not well known. It is tentatively placed at the mouth of Chesapeake Bay and in south Georgia. Atlantic Coastal Plain Northern Pondshore (CES203.518) of Virginia and Maryland and the wet prairies of north-central Florida are closely related systems.

DISTRIBUTION

Range: This system is found from southeastern Virginia to Florida, primarily in the Outer Coastal Plain, but occasional depressions in the Inner Coastal Plain and Sandhills could be included.

Divisions: 203:C**TNC Ecoregions:** 56:C, 57:C**Subnations:** FL, GA, NC, SC, VA**Associations:**

- *Carex hyalinolepis* Seasonally Flooded Herbaceous Vegetation (CEGL004724, G1G3)
- *Carex striata* var. *striata* - *Xyris fimbriata* - *Lachnanthes carolina* Herbaceous Vegetation (CEGL007718, G2G3)
- *Cyrilla racemiflora* - *Lyonia lucida* Shrubland (CEGL003844, G3?)
- *Dichanthelium wrightianum* - *Dichanthelium erectifolium* Herbaceous Vegetation (CEGL004105, G2G3)
- *Nymphaea odorata* - *Nuphar lutea* ssp. *advena* - (*Nymphoides aquatica*, *Xyris smalliana*) Herbaceous Vegetation (CEGL004326, G3?)
- *Nyssa biflora* / *Itea virginica* - *Cephalanthus occidentalis* Depression Forest (CEGL007434, G3G4)
- *Nyssa ogeche* / *Ilex myrtifolia* / *Carex turgescens* - *Carex striata* Forest (CEGL004641, G2?)
- *Panicum hemitomon* - *Eleocharis equisetoides* - *Rhynchospora inundata* Herbaceous Vegetation (CEGL004127, G3)
- *Panicum virgatum* - *Andropogon (capillipes, glaucopsis)* - *Aristida palustris* Herbaceous Vegetation (CEGL004100, G2?)
- *Pinus serotina* / *Cyrilla racemiflora* - *Lyonia lucida* - *Vaccinium fuscatum* Woodland (CEGL004434, G2G3)
- *Quercus phellos* - *Nyssa biflora* / *Panicum hemitomon* - *Carex* spp. - *Woodwardia virginica* Forest [Provisional] (CEGL004104, G2G3)
- *Rhynchospora (careyana, inundata)* Seasonally Flooded Herbaceous Vegetation (CEGL004132, G3?)
- *Rhynchospora alba* Saturated Herbaceous Vegetation (CEGL004463, G1?)
- *Rhynchospora filifolia* - *Juncus abortivus* Herbaceous Vegetation (CEGL004131, G2?)
- *Saccharum baldwinii* - *Carex glaucescens* - *Rhynchospora corniculata* Herbaceous Vegetation (CEGL007745, G2G3)
- *Spartina bakeri* - *Woodwardia virginica* - *Saccharum giganteum* Herbaceous Vegetation (CEGL007713, G3?)
- *Sphagnum cuspidatum* Nonvascular Vegetation (CEGL004384, G2?)

- *Taxodium ascendens* / (*Nyssa biflora*) / *Leucothoe racemosa* - *Lyonia lucida* - *Morella cerifera* Depression Forest (CEGL007420, G3)
- *Taxodium ascendens* / *Cyrilla racemiflora* - *Zenobia pulverulenta* Woodland (CEGL003734, G2)
- *Taxodium ascendens* / *Ilex myrtifolia* Depression Forest (CEGL007418, G3?)
- *Vaccinium formosum* - *Vaccinium fuscatum* / *Sphagnum cuspidatum* Shrubland (CEGL003907, G3?)
- *Woodwardia virginica* / *Sphagnum cuspidatum* Herbaceous Vegetation (CEGL004475, G2?)

High-ranked species: *Amaranthus floridanus* (G3), *Ambystoma cingulatum* (G2G3), *Carex decomposita* (G3), *Carex striata* var. *striata* (G4T3T4), *Carex verrucosa* (G3G4), *Coreopsis rosea* (G3), *Fimbristylis perpusilla* (G2), *Hypericum adpressum* (G3), *Iris tridentata* (G3G4), *Lachnocaulon minus* (G3G4), *Lindera melissifolia* (G2), *Linum westii* (G2), *Litsea aestivalis* (G3), *Lobelia boykinii* (G2G3), *Ludwigia curtissii* (G3G4), *Ludwigia spathulata* (G2G3), *Lythrum flagellare* (G2), *Myriophyllum laxum* (G3), *Notophthalmus perstriatus* (G2G3), *Oxypolis canbyi* (G2), *Panicum hirstii* (G1), *Pieris phillyreifolia* (G3), *Polygonum hirsutum* (G3G4), *Rana capito* (G3), *Rhexia aristosa* (G3), *Rhynchospora globularis* var. *pinetorum* (G5?T3?), *Rhynchospora inundata* (G3G4), *Rhynchospora pleiantha* (G3), *Rhynchospora thornei* (G3), *Sabatia brevifolia* (G3G4), *Sagittaria graminea* var. *chapmanii* (G5T3?), *Xyris serotina* (G3G4), *Xyris stricta* (G3G4)

Environment: This system occurs in small basins, primarily in sandy terrain of the Atlantic Coastal Plain, from southeastern Virginia to Florida. Most basins are formed by subsidence of surface sediments caused by solution in underlying limestone. Others may be formed as dune swales in mainland eolian sands, natural blockage of small drainages by sediment movement, and more obscure causes. Basins often occur in complexes of a few to dozens, which vary in size, depth, and steepness of sides. Most or all of these basins are considered groundwater windows, with water levels matching the level of the local water table. Rainfall is probably also a substantial contributor. The water is acidic and is apparently not influenced by the underlying limestone or deeper groundwater. Hydroperiods vary substantially, with the deepest ponds having permanent water in the center, and the shallowest normally holding water only in the winter and spring. However, water levels can fluctuate substantially over the course of a year and from year to year in response to rainfall and longer term droughts. Soils have a mucky surface in the centers of basins that hold water most or all of the year and are generally sandy in smaller basins and in the outer drawdown zones that are exposed more of the time. Fire is potentially an important, if infrequent, influence in the system, penetrating the portions that are dry when adjacent communities burn. Its northern range limit is generally consistent with the northern limit of longleaf pine (*Pinus palustris*), although this species is not a component.

Vegetation: This system consists of wetland vegetation that is often strongly zoned within single basins and may vary substantially among basins even in close proximity. Most of the associations are herbaceous, but woody associations may be present. The center of the deepest basins generally is open water or floating-leaved aquatics. Semipermanently flooded zones may have marsh vegetation of medium to large emergents. Outer, mineral soil drawdown zones often have a species-rich flora of small to medium graminoids and forbs. These include a number of specialized species that are rare in states, some that are globally rare, and some that are widespread but nowhere common. The aspect of this vegetation may vary substantially from year to year depending on when water level drops. Some basins have a dense shrubby edge zone. Some trees or shrubs tolerant of standing water, especially bald-cypress (*Taxodium distichum*), pond-cypress (*Taxodium ascendens*) or swamp blackgum (*Nyssa biflora*), may grow within the basins, either as scattered individuals, as a distinct zone, or forming an open canopy over the whole basin. Because the basins are isolated from larger water bodies and most dry out at least occasionally, their aquatic fauna does not include fish unless fish have been artificially introduced. These systems are well known as important breeding sites for amphibians, and may support important aquatic invertebrate communities as well.

Dynamics: Flooding hydrology is the most important dynamic process. Standing water excludes plants not characteristic of the system. Variation in hydroperiod and drawdown drive vegetation changes from year to year. Because ponds are connected to the local water table, hydroperiods respond to seasonal and long-term cycles in rainfall as much as, perhaps more than, single rainfall events. They may also be affected by regional drainage that lowers the water table.

Fire is also an important dynamic process in the drier portions of this system. Fire may be important for preventing invasion of trees such as loblolly pine (*Pinus taeda*) during long-running droughts, as well as for driving variation in herbaceous species.

SPATIAL CHARACTERISTICS

Size: Depressions often occur in complexes, in a matrix of upland or saturated wetland systems. Individual depressions range from about 100 square meters to a hectare or two. Complexes may occupy several hectares within the space of several square kilometers.

Heterogeneity: This system occurs as small patches in a matrix of strongly contrasting upland or wetland systems. Often the small patches are clustered in complexes of a few to dozens. Individual basins often have two to four associations in them,

forming concentric zones, though some may have only one. Complexes may have more associations represented due to variation in depth and steepness of basins.

Adjacent Ecological System Comments: Most often associated with Atlantic Coastal Plain Upland Longleaf Pine Woodland (CES203.281), but any upland or saturated wetland system can potentially surround them.

SOURCES

References: Comer et al. 2003

Version: 26 Sep 2003

Concept Author: M. Schafale and R. Evans

Stakeholders: East, Midwest, Southeast

LeadResp: Southeast

CES203.557 EAST GULF COASTAL PLAIN SOUTHERN LOBLOLLY-HARDWOOD FLATWOODS

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Forest and Woodland (Treed); Extensive Wet Flat

Concept Summary: This forested system occurs on broad upland flats in the East Gulf Coastal Plain of Alabama and Mississippi, as well as western parts of the lower terraces of the East Gulf Coastal Plain ("Florida Parishes") of Louisiana, and likely occurs in other parts of the region as well. Known examples in the Alabama/Mississippi parts of the range include a mosaic of open forests dominated by *Pinus taeda* interspersed with patches of *Quercus phellos* and sometimes other tree species. The ground surface displays an evident microtopography of alternating mounds and swales occurring in a tight local mosaic. These mounds are most likely "gilgai" (R. Wieland pers. comm.) resulting from vertic or shrink-swell properties of the Luinn soil series. Known examples display a range of moisture conditions from dry to wet. The wettest examples trap significant moisture from local rainfall events. These areas have ponded water for a minimum of several days at an interval and potentially for long periods of the year, especially when evapotranspiration is lowest. The vegetation of this system supports a relatively low vascular plant diversity and thus may appear floristically similar to other pine-hardwood vegetation of the region. The dry portion of this vegetational mosaic is dominated by grassy ground cover (*Chasmanthium sessiliflorum*) with scattered emergent greenbriars (*Smilax* spp.) underneath a nearly pure *Pinus taeda* overstory. The historical composition of this type is unknown, but it seems likely that *Pinus taeda* was a natural and even dominant component of this system, as it is in related systems in the West Gulf Coastal Plain (R. Evans pers. obs., T. Foti pers. comm.). Wetter areas are dominated by an overstory of *Quercus phellos* with an abundance of *Sabal minor* in the understory. Although the specific role of fire in this system is unknown, low-intensity ground fires may have been ecologically important. Such fires could have originated in the surrounding East Gulf Coastal Plain Interior Shortleaf Pine-Oak Forest (CES203.506).

In the western parts of the lower terraces of the East Gulf Coastal Plain ("Florida Parishes") of Louisiana, the flatwoods vegetation tends to be dominated primarily by hardwoods in the most western portion, and a mixture of *Pinus glabra* and *Pinus taeda* in the intermediate portion to the east of this. In this "Louisiana Florida Parishes Spruce Pine Flatwoods Forest" some characteristic species include *Pinus glabra*, *Quercus laurifolia*, *Quercus michauxii*, *Quercus nigra*, *Quercus pagoda*, *Quercus virginiana*, *Pinus taeda*, and *Magnolia grandiflora*. Some important understory trees and shrubs include *Crataegus opaca*, *Sabal minor* (which may often be very abundant or dominant), and *Arundinaria gigantea* ssp. *tecta*.

Comments: The description of associations in the NVC for this system is undoubtedly incomplete. Classification work is in progress, but more information is needed.

DISTRIBUTION

Range: This forested system occurs on broad upland flats in the East Gulf Coastal Plain of Alabama and Mississippi, as well as western parts of the lower terraces of the East Gulf Coastal Plain ("Florida Parishes") in Louisiana, and likely occurs in other parts of the region as well. It is also found in the Mississippi River Alluvial Plain of Louisiana (P. Faulkner pers. comm.). The complete and detailed range of this system is being developed and is not completely understood.

Divisions: 203:C

TNC Ecoregions: 42:C, 43:C, 53:P

Subnations: AL, FL?, GA?, LA, MS

Associations:

- (*Quercus laurifolia*) / *Crataegus opaca* - *Crataegus viridis* Forest (CEGL007386, G1)
- *Pinus glabra* - *Quercus laurifolia* / *Crataegus opaca* / *Sabal minor* Forest (CEGL004534, G1G2)

- *Quercus michauxii* - *Quercus (nigra, pagoda)* - *Liquidambar styraciflua* - *Pinus taeda* Forest (CEGL007715, G2G3)

High-ranked species: *Polygala hookeri* (G3), *Spiranthes brevilabris* (G3G4), *Spiranthes brevilabris* var. *floridana* (G3G4T1), *Xyris scabrifolia* (G3), *Xyris stricta* (G3G4)

Environment: In the Alabama/Mississippi parts of this system's range, the ground surface displays an evident microtopography of alternating mounds and swales occurring in a tight local mosaic.

Vegetation: Known examples of this system in the Alabama/Mississippi parts of its range include a mosaic of open forests dominated by *Pinus taeda* interspersed with patches of *Quercus phellos* and sometimes other tree species. The vegetation of this system supports a relatively low vascular plant diversity and thus may appear floristically similar to other pine-hardwood vegetation of the region. The dry portion of this vegetational mosaic is dominated by grassy ground cover (e.g., *Chasmanthium sessiliflorum*) with scattered emergent greenbriars (*Smilax* spp.) underneath a nearly pure *Pinus taeda* overstory. The historical composition of this type is unknown, but it seems likely that *Pinus taeda* was a natural and even dominant component of this system, as it is in related systems in the West Gulf Coastal Plain (R. Evans pers. obs., T. Foti pers. comm.). Wetter areas are dominated by an overstory of *Quercus phellos* with an abundance of *Sabal minor* in the understory.

In the western parts of the lower terraces of the East Gulf Coastal Plain ("Florida Parishes") of Louisiana, the flatwoods vegetation tends to be dominated primarily by hardwoods in the most western portion, and a mixture of *Pinus glabra* and *Pinus taeda* in the intermediate portion to the east of this. In this "Louisiana Florida Parishes Spruce Pine Flatwoods Forest" stands contain *Pinus glabra*, *Quercus laurifolia*, *Quercus phellos*, *Quercus michauxii*, *Quercus nigra*, *Quercus pagoda*, *Quercus virginiana*, *Pinus taeda*, *Nyssa biflora*, *Nyssa sylvatica*, *Magnolia grandiflora*, *Salix nigra*, *Liquidambar styraciflua*, *Carya glabra*, *Acer rubrum*, and *Fraxinus pennsylvanica*. Understory trees and shrubs include *Crataegus opaca* and *Sabal minor* (which may often be very abundant or dominant), as well as *Arundinaria gigantea* ssp. *tecta*, *Cephalanthus occidentalis*, *Diospyros virginiana*, *Cornus foemina*, *Crataegus viridis*, *Ilex opaca* var. *opaca*, *Ilex decidua*, *Itea virginica*, *Morella cerifera* (= *Myrica cerifera*), *Sambucus canadensis*, *Styrax americanus*, and *Viburnum dentatum* (Smith 1996b).

SPATIAL CHARACTERISTICS

Other Comments: This should be the "Flatwoods" portion of the "Flatwoods/Blackland Prairie Margins" (Ecoregion 65b) of Omernik (EPA 2004).

SOURCES

References: Comer et al. 2003, Smith 1996b

Version: 14 Mar 2005

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES203.480 SOUTH-CENTRAL INTERIOR / UPPER COASTAL PLAIN WET FLATWOODS

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Extensive Wet Flat; Broad-Leaved Deciduous Tree

Concept Summary: This system represents predominately wet flatwoods of limited areas of the most inland portions of the East Gulf Coastal Plain in western Kentucky, as well as related broad, flat areas of the western Interior Low Plateau. This part of the Coastal Plain is referred to as the Jackson Purchase or "Jackson Plain." Flatwoods have long been recognized as a distinctive subdivision within this region (Davis 1923, Bryant and Martin 1988). Examples in the Pennyroyal Plain (of the western Interior Low Plateau) have been referred to as "pondywoods" or "crawfishy land" (Chester et al. 1995), and have been known for many years. They tend to be confined to relatively small areas near the eastern flank of the region where loess deposits thin out. Unlike South-Central Interior / Upper Coastal Plain Flatwoods (CES203.479) of the same general region (which are typified by complex microtopography), this system occupies broad flats underlain by fragipans. These fragipans impede the downward migration of water resulting in wet conditions for portions of the year. Fire was an important natural process in this system, probably maintaining relatively open-canopied stands (M. Evans pers. comm.). Stands are dominated by hardwood trees, including *Quercus* spp., *Liquidambar styraciflua*, *Carya* spp., and *Acer rubrum* (Chester et al. 1995).

Comments: The primary range of this system is limited areas of the "Jackson Purchase" or "Jackson Plain" of Kentucky and possibly related areas in adjacent western Tennessee, as well as related broad, flat areas of the western Interior Low Plateau. According to Bryant and Martin (1988) the "Flatwoods" portion of the Jackson Purchase (which is primarily where the "Wet

Flatwoods" are located in that area) occupies less than 2% of the total area, but localized occurrences could have been present in other parts of the region.

DISTRIBUTION

Range: The primary range of this system is limited areas of the "Jackson Purchase" or "Jackson Plain" of Kentucky and possibly related areas in adjacent western Tennessee, as well as related broad, flat areas of the western Interior Low Plateau.

Divisions: 203:C

TNC Ecoregions: 43:C, 44:C

Subnations: IL?, IN?, KY, TN

Associations:

- *Quercus falcata* Flatwoods Forest (CEGL004412, G2?)
- *Quercus palustris* - (*Quercus stellata*) - *Quercus pagoda* / *Isoetes* spp. Forest (CEGL002101, G2G3)
- *Quercus phellos* - (*Quercus lyrata*) / *Carex* spp. - *Leersia* spp. Forest (CEGL002102, G3G4Q)

Environment: These flatwoods have long been recognized as the primary vegetation type of a distinctive subdivision within the Upper East Gulf Coastal Plain region (Davis 1923, Bryant and Martin 1988), as well as related areas of the western Interior Low Plateau. Within the "Jackson Plain" portion of the Upper East Gulf Coastal Plain, these flatwoods tend to be confined to relatively small areas near the eastern flank of the "Jackson Plain" region where the loess deposits thin out. Unlike drier Post Oak Flatwoods of these areas (which are typified by microtopographic variation), this system occupies broad flats underlain by fragipans. These fragipans impede the downward migration of water resulting in wet conditions for portions of the year. Fire is probably relatively infrequent in this system (M. Evans pers. comm.). In the Pennyroyal Plain, this system occurs on upland flats and depressions with poor drainage, underlain by limestone; soils include Robertsville silt loam (Chester et al. 1995) and Henry silt loam (M. Evans pers. comm.).

Vegetation: Stands are typically dominated by *Quercus pagoda*, *Quercus palustris*, *Quercus michauxii*, *Quercus alba*, *Liquidambar styraciflua*, *Carya* spp., *Acer rubrum*, and *Nyssa sylvatica*. Most stands of this system have been severely altered or destroyed, and the characteristic herbs are poorly known. *Campsis radicans* may be found. *Quercus phellos* and/or *Quercus lyrata* may also be present in stands of this system (M. Evans pers. comm.).

Dynamics: Most historic occurrences have been cleared, drained and tiled, and remaining sites are small and degraded. Fire was an important natural process in this system probably maintaining relatively open-canopied stands (M. Evans pers. comm.).

SPATIAL CHARACTERISTICS

Heterogeneity: Stands of this system are more uniform than the related "regular" flatwoods type of the same general area (CES203.479)

Other Comments: Most stands of this system have been severely altered or destroyed.

SOURCES

References: Bryant and Martin 1988, Chester et al. 1995, Comer et al. 2003, Davis 1923, Evans 1991, Evans pers. comm., Hendricks et al. 1991, NatureServe Ecology - Southeastern U.S. unpubl. data

Version: 25 Aug 2003

Stakeholders: Midwest, Southeast

Concept Author: R. Evans and M. Evans, mod. M. Pyne

LeadResp: Southeast

CES203.384 SOUTHERN COASTAL PLAIN NONRIVERINE BASIN SWAMP

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Forest and Woodland (Treed); Depressional

Concept Summary: This system occupies large, seasonally inundated basins with peaty substrates in the southern and outermost portions of the Coastal Plain of the southeastern United States. These basins are nonriverine and do not receive overbank flooding. The southern range of this system extends into central Florida especially along the Atlantic Coast in Volusia and Brevard counties (A. Johnson pers. comm.). Examples are generally forested; the vegetation is characterized by *Taxodium distichum*, *Nyssa biflora*, evergreen "bay" shrubs and/or mixed hardwoods. Emergent *Pinus elliottii* may also be present. Some characteristic shrubs include *Cliftonia monophylla*, *Cyrilla racemiflora*, *Lyonia lucida*, and *Smilax laurifolia*.

Comments: Manifestations of this in the Atlantic and Gulf coastal plains are not differentiated at this time. There may be some minor floristic differences, particularly between the northernmost and southernmost examples, but these are not thought to warrant any subdivision of the type. Examples of this system differ from Southern Coastal Plain Hydric Hammock (CES203.501) by the absence of oaks (especially swamp laurel oak and live oak) and other less flood-tolerant species such as sweetgum (A. Johnson pers. comm.). In addition, this type is found in basins with peaty substrates as opposed to limestone-influenced substrates.

DISTRIBUTION

Range: East Gulf Coastal Plain.

Divisions: 203:C

TNC Ecoregions: 53:C, 55:C, 56:C, 57:C

Subnations: AL, FL, GA, LA?, MS, SC

Associations:

- *Cliftonia monophylla* / *Lyonia lucida* - *Smilax laurifolia* Forest (CEGL007042, G4)
- *Nyssa biflora* / *Ilex myrtifolia* / *Carex glaucescens* - *Eriocaulon compressum* Forest (CEGL004720, G2G3)
- *Pinus serotina* - *Pinus elliotii* var. *elliotii* / *Cliftonia monophylla* - *Cyrilla racemiflora* Woodland (CEGL003674, G3?Q)
- *Pinus serotina* / *Lyonia lucida* - *Ilex glabra* - (*Cyrilla racemiflora*) Shrubland (CEGL003846, G3)

High-ranked species: *Coreopsis nudata* (G3?), *Euphyes dukesi* (G3), *Hymenocallis henryae* (G2), *Kalmia cuneata* (G3), *Peltandra sagittifolia* (G3G4), *Pieris phillyreifolia* (G3), *Rhexia parviflora* (G2)

Environment: This system occupies large, seasonally inundated basins with peaty substrates. These basins are nonriverine and do not receive overbank flooding.

Vegetation: Examples are generally forested; the vegetation is characterized by *Taxodium distichum*, *Nyssa biflora*, evergreen "bay" shrubs and/or mixed hardwoods (FNAI 1997). Emergent *Pinus elliotii* may also be present. Some characteristic shrubs include *Cliftonia monophylla*, *Cyrilla racemiflora*, *Lyonia lucida*, and *Smilax laurifolia*.

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: Southern Coastal Plain Hydric Hammock (CES203.501) may occur upslope.

SOURCES

References: Comer et al. 2003, FNAI 1997

Version: 14 Mar 2005

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES203.251 SOUTHERN COASTAL PLAIN NONRIVERINE CYPRESS DOME

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Forest and Woodland (Treed); Depressional; Needle-Leaved Tree

Concept Summary: This system consists of small forested wetlands, typically dominated by *Taxodium ascendens*, with a characteristic and unique dome-shaped appearance in which trees in the center are higher than those around the sides (Monk and Brown 1965). Examples are known from the Southern Coastal Plain (Omernik Ecoregion 75) (EPA 2004) of Florida and Georgia. Examples occupy poorly drained depressions which are most often embedded in a matrix of pine flatwoods. The oldest and largest individual trees typically occupy the center of these domed wetlands, with smaller and younger individuals around the margins. Pools of stagnant, highly acidic water may stand in the center of these depressions ranging from 1-4 feet in depth, but becoming increasingly shallow along the margins. These sites are underlain by an impervious clay pan which impedes drainage and traps precipitation. Some examples may have thick (50-100 cm) organic layers. In addition to *Taxodium ascendens*, other woody species may include *Nyssa biflora*, *Cephalanthus occidentalis*, *Liquidambar styraciflua*, *Clethra alnifolia*, *Lyonia lucida*, and *Styrax americanus*.

Comments: The original range of this system was thought to include only the East Gulf Coastal Plain (TNC Ecoregion 53) and was named accordingly. Examples were later confirmed in central Florida (TNC Ecoregion 55) and the South Atlantic Coastal Plain portion of Florida (A. Johnson pers. comm.) (TNC Ecoregion 56), whereupon the name was broadened to Southern Coastal Plain Nonriverine Cypress Dome. Cypress "strangers" are included here as well; these are more-or-less

linear features that are parts of disconnected drainageways that arise in a pine flatwoods landscape (e.g., C EGL007419). The vegetation of the "stringers" is somewhat analogous to that of the edges of the true "dome swamps."

DISTRIBUTION

Range: This system is apparently restricted to Florida and adjacent areas of Georgia.

Divisions: 203:C

TNC Ecoregions: 53:C, 55:C, 56:C

Subnations: AL, FL, GA, MS

Associations:

- *Hypericum chapmanii* - *Ilex myrtifolia* - (*Nyssa ursina*) Shrubland (CEGL003867, G1)
- *Taxodium ascendens* / (*Nyssa biflora*) / *Leucothoe racemosa* - *Lyonia lucida* - *Morella cerifera* Depression Forest (CEGL007420, G3)
- *Taxodium ascendens* / *Ilex myrtifolia* / *Carex (striata, turgescens)* Stringer Forest (CEGL007419, G3?Q)
- *Taxodium ascendens* / *Ilex myrtifolia* / *Hypericum myrtifolium* / *Lobelia floridana* - *Polygala cymosa* Woodland (CEGL004959, G3)
- *Taxodium ascendens* / *Ilex myrtifolia* Depression Forest (CEGL007418, G3?)

High-ranked species: *Ambystoma cingulatum* (G2G3), *Carex striata* var. *striata* (G4T3T4), *Carex verrucosa* (G3G4), *Coreopsis nudata* (G3?), *Croton elliotii* (G2G3), *Euphyes dukesi* (G3), *Fuirena longa* (G3G4), *Lindera melissifolia* (G2), *Litsea aestivalis* (G3), *Pieris phillyreifolia* (G3), *Pinguicula planifolia* (G3?), *Polygonum hirsutum* (G3G4), *Rana capito* (G3), *Rhexia parviflora* (G2), *Rhynchospora inundata* (G3G4), *Sabatia brevifolia* (G3G4), *Schoenolirion albiflorum* (G3)

Environment: This system occurs in areas of low relief, occupying poorly drained to permanently wet depressions in uplands such as pine flatwoods. Pools of stagnant, highly acidic water may stand in the center of these depressions ranging from 1-4 feet in depth, but becoming increasingly shallow along the margins (Monk and Brown 1965). Some examples may have thick (50-100 cm) organic layers (Drew et al. 1998).

Vegetation: According to Drew et al. (1998) dominant plant taxa include *Taxodium ascendens*, *Nyssa biflora*, *Cephalanthus occidentalis*, *Liquidambar styraciflua*, *Clethra alnifolia*, *Lyonia lucida*, and *Styrax americanus*. A few less typical upland depression ponds in Florida dominated by *Nyssa sylvatica* are also accommodated in this system for now (A. Johnson pers. comm.).

SOURCES

References: Comer et al. 2003, Drew et al. 1998, EPA 2004, Johnson pers. comm., Monk and Brown 1965

Version: 23 Sep 2002

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES203.547 WEST GULF COASTAL PLAIN FLATWOODS POND

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional; Graminoid

Concept Summary: This system represents predominately graminoid-dominated flatwoods ponds of the West Gulf Coastal Plain of eastern Texas and western Louisiana. These ponds are generally circular or elliptical, flat-bottomed depressions on flat terraces in the Outer Coastal Plain. The slowly permeable soils trap local runoff and precipitation resulting in higher water tables than surrounding areas. Water depth may be 3-5 feet in the winter and even deeper toward the center of some examples (Bridges 1988, Bridges and Orzell 1989a). Examples range from shallow to several meters in depth; the large and deeper examples may exhibit distinct vegetation zonation. Most examples have a layer of tall wetland grasses and sedges above a layer of semi-aquatic herbs. Many lack a significant woody layer due in part to periodic fires originating in the pine savanna matrix. However, scattered, often stunted *Nyssa biflora* and stems of *Cephalanthus occidentalis* may be present. The following species are characteristic of this type: *Eriocaulon compressum*, *Xyris fimbriata*, *Eleocharis equisetoides*, *Eleocharis quadrangulata*, as well as two additional species, *Carex verrucosa* and *Rhynchospora cephalantha*, which are more frequent in other pond types. Some other species frequently found in this type include *Eriocaulon compressum*, *Rhynchospora corniculata*, *Panicum hemitomon*, *Ludwigia sphaerocarpa*, *Xyris laxifolia* var. *iridifolia* (= *Xyris iridifolia*), and *Sagittaria graminea*. Other herbaceous species may include *Gratiola brevifolia*, *Hydrolea ovata*, *Proserpinaca pectinata*, *Pluchea rosea*, *Ludwigia pilosa*, *Bacopa caroliniana*, *Xyris* sp., and *Rhynchospora capitellata*.

DISTRIBUTION

Range: West Gulf Coastal Plain of eastern Texas and western Louisiana.

Divisions: 203:C

TNC Ecoregions: 31:?, 40:C, 41:C

Subnations: LA, TX

Associations:

- *Aristida palustris* - *Panicum virgatum* - *Eriocaulon compressum* - *Eleocharis equisetoides* Herbaceous Vegetation (CEGL004577, G2G3)
- *Aristida palustris* - *Panicum virgatum* - *Eriocaulon decangulare* var. *decangulare* - *Rhynchospora elliottii* Herbaceous Vegetation (CEGL004576, G2G3)
- *Nymphoides aquatica* - *Nymphaea odorata* - *Gratiola brevifolia* Herbaceous Vegetation (CEGL004601, G3?)
- *Nyssa biflora* - *Crataegus opaca* - (*Fraxinus caroliniana*) / *Rhynchospora mixta* Woodland (CEGL007873, G2?)
- *Nyssa biflora* / *Panicum hemitomon* - *Woodwardia virginica* Woodland (CEGL004586, G3?)
- *Panicum hemitomon* - *Eriocaulon compressum* - *Rhynchospora corniculata* Herbaceous Vegetation (CEGL004578, G2)

High-ranked species: *Bufo houstonensis* (G1), *Carex decomposita* (G3), *Echinodorus parvulus* (G3Q), *Euphyes dukesi* (G3), *Fuirena longa* (G3G4)

Environment: This system tends to occur as inclusions within wetland pine savannas in depression ponds or ancient stream channels and sloughs. Local runoff and rainfall collect in these depressions with slowly permeable soils. Resulting water tables persist for long periods after rain, at higher levels than surrounding parts of the landscape. Water in this pond type is often 3-5 feet deep in winter, and even deeper areas (with floating aquatic vegetation) may occur in the center of some sites (Bridges 1988, Bridges and Orzell 1989a). They tend to occur as inclusions within wetland pine savannas, but may also be bordered by upland depression swamps.

Vegetation: Plant species dominance varies greatly depending upon water depth and the spread of colonial, rhizomatous species, and may also be related to geographic isolation of individual ponds and variations in local fire regimes. Most examples have a layer of tall wetland grasses and sedges above a layer of semi-aquatic herbs. Scattered woody plants, especially *Nyssa biflora*, may be present. In some instances woody stems may develop sufficient density to be classified as woodlands.

Dynamics: Water table fluctuations are probably the most important factor affecting examples of this system (Bridges and Orzell 1989a). Water collects in these depressions after rainfall events but generally not as a result of overbank flooding. Water tends to be deepest during the winter time when precipitation is concentrated (although other factors may also be important, such as the amount of evapotranspiration). Standing water may be evident from approximately November through May, and sporadically afterwards.

Most examples of this system were also likely affected by fires originating in the surrounding longleaf pine savanna vegetation. Given the moisture relationships generally outlined above, the primary season when fires could burn through these ponds occurs roughly between after May and before November when water levels typically rise. During season drought periods fires could burn across the entire surface of a given pond. In the absence of fire, hardwoods may become more abundant and dominant eventually altering both the hydrological regime and fire dynamics.

SPATIAL CHARACTERISTICS

Size: Most are quite small features; although specific data are not available, most are believed to be less than 1 acre in size.

SOURCES

References: Bridges 1988, Bridges and Orzell 1989a, Comer et al. 2003

Version: 19 May 2004

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES203.548 WEST GULF COASTAL PLAIN NONRIVERINE WET HARDWOOD FLATWOODS

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Forest and Woodland (Treed); Depressional

Concept Summary: This system represents predominately wet hardwood flatwoods of the West Gulf Coastal Plain of southern Arkansas, eastern Texas, and western Louisiana. Examples may be somewhat more common in the inland portions of the region but are also found in the Outer Coastal Plain as well. These areas are usually found on nonriverine, Pleistocene high terraces. Soils are fine-textured, and hardpans may be present in the subsurface. The limited permeability of these soils contributes to perched water tables during fairly substantial portions of the year (when precipitation is greatest and evapotranspiration is lowest). Saturation occurs not from overbank flooding but typically whenever precipitation events occur. The local landscape is often a complex of ridges and swales, usually occurring in close proximity. There is vegetation variability related to soil texture and moisture and disturbance history. Most examples support hardwood forests or swamps, which are often heavily oak-dominated. Important species are tolerant of inundation. They include *Quercus michauxii*, *Quercus phellos*, *Quercus laurifolia*, and *Liquidambar styraciflua*, with sparse coverage of wetland herbs such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp. Some examples can contain *Pinus taeda*.

Comments: This system may grade upslope into West Gulf Coastal Plain Pine-Hardwood Flatwoods (CES203.278) and West Gulf Coastal Plain Flatwoods Pond (CES203.547).

DISTRIBUTION

Range: This system is found in the West Gulf Coastal Plain, Upper West Gulf Coastal Plain, and Mississippi River Alluvial Plain (P. Faulkner pers. comm.).

Divisions: 203:C

TNC Ecoregions: 31:?, 40:C, 41:C, 42:C

Subnations: AR, LA, OK?, TX

Associations:

- (*Quercus laurifolia*) / *Crataegus opaca* - *Crataegus viridis* Forest (CEGL007386, G1)
- *Fraxinus caroliniana* Seasonally Flooded Forest (CEGL004753, G2G3)
- *Nyssa biflora* - *Quercus laurifolia* / *Sphagnum* spp. Depression Forest (CEGL007390, G3?)
- *Quercus laurifolia* - *Liquidambar styraciflua* - *Nyssa biflora* - *Acer rubrum* / *Sabal minor* Forest (CEGL007804, G3?)
- *Quercus laurifolia* - *Quercus phellos* - *Quercus nigra* / *Viburnum dentatum* - (*Sebastiania fruticosa*) / *Carex glaucescens* Upper West Gulf Flatwoods Forest (CEGL007961, G2G3)
- *Quercus lyrata* - *Quercus phellos* - *Ulmus americana* / *Rhynchospora* spp. Forest (CEGL007549, G2G3)
- *Quercus phellos* - *Quercus similis* / *Crataegus marshallii* - *Crataegus spathulata* / *Chasmanthium laxum* Forest (CEGL007363, G3?)
- *Quercus phellos* / *Chasmanthium laxum* - *Carex (flaccosperma, intumescens)* - *Hymenocallis liriosme* Flatwoods Forest (CEGL007371, G3G4)
- *Quercus phellos* / *Chasmanthium laxum* Forest (CEGL008576, G3?)
- *Taxodium distichum* - *Nyssa biflora* - *Magnolia virginiana* - *Acer rubrum* Forest (CEGL007902, G2?)

Environment: This system is found on the wettest inclusions of Pleistocene terraces in the West Gulf Coastal Plain of southern Arkansas, eastern Texas, and western Louisiana.

Vegetation: Stands are typically dominated by hardwoods, including *Quercus michauxii*. Important species are tolerant of inundation. They include *Quercus michauxii*, *Quercus phellos*, *Quercus laurifolia*, and *Liquidambar styraciflua*, with sparse coverage of wetland herbs such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp. Some examples can contain *Pinus taeda*.

Dynamics: The predominant ecological processes affecting this system are related to soil texture and moisture and disturbance history. These are wetlands that hold standing water for variable periods during the year after rainfall events. The wettest examples were likely not affected to a large degree by fires, however, they are often embedded in pyrogenic landscapes which did burn frequently (R. Evans pers. obs., T. Foti pers. comm.).

SOURCES

References: Comer et al. 2003, Evans pers. comm., Foti pers. comm., Marks and Harcombe 1981

Version: 31 Jan 2005

Stakeholders: Midwest, Southeast

Concept Author: R. Evans

LeadResp: Southeast

CES203.518 ATLANTIC COASTAL PLAIN NORTHERN PONDSHORE

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system includes vegetation of groundwater-flooded depressions characterized by a flora generally restricted to the Coastal Plain from the southern portion of the Delmarva peninsula to Cape Cod, Massachusetts. Ponds may contain permanent water, such as the deep glacial kettleholes of Cape Cod and Long Island, New York, or may be shallow basins where groundwater drops below the surface late in the growing season. This system occurs on sandy deposits such as outwash plains of the glaciated region (Long Island and Cape Cod), on the deep sands of the New Jersey Pine Barrens, or on finer sediments of the Coastal Plain of Cape May, New Jersey, the Delmarva peninsula, and the Chesapeake Bay region. The vegetation of steeper-sided basins (generally those containing permanent water) are characterized by strong zonation, with a border of tall shrubs, such as *Vaccinium corymbosum*, and several essentially concentric bands or zones dominated by different associations, depending on geography. Characteristic species in Massachusetts and Long Island include *Rhexia virginica*, *Cyperus dentatus*, *Gratiola aurea*, *Panicum verrucosum*, *Euthamia caroliniana* (= *Euthamia tenuifolia*), *Carex striata*, *Juncus pelocarpus*, *Rhynchospora capillacea*, *Rhynchospora macrostachya*, *Xyris difformis*, *Fimbristylis autumnalis*, *Scleria reticularis*, *Sabatia kennedyana*, *Drosera filiformis*, *Juncus militaris*, and many others.

Ponds of the New Jersey Pine Barrens share many of these species, with others including *Juncus repens*, *Muhlenbergia torreyi*, *Rhynchospora oligantha*, *Rhynchospora cephalantha*, *Rhynchospora chalarocephala*, and many others. In shallow basins, such strong zonation is generally lacking but still remains evident in some cases. On Cape Cod, Long Island, and New Jersey, this system most often occurs within the pitch pine barrens.

From Cape May and south, the system occurs within an upland matrix of mixed hardwood forests and generally supports a seasonally flooded swamp forest characterized by *Liquidambar styraciflua*, *Acer rubrum*, wetland oaks such as *Quercus phellos*, and in Virginia and scattered locations on the Inner Coastal Plain of Maryland *Nyssa biflora*. The vegetation is characterized by many of the species from New England, New York and New Jersey and also includes *Juncus repens*, *Boltonia asteroides*, *Fimbristylis perpusilla*, *Coelorachis rugosa*, *Dichanthelium spretum*, *Saccharum giganteum*, *Eleocharis quadrangulata*, and others. *Cephalanthus occidentalis* often occurs as scattered individuals or as a shrub swamp with less diversity and cover of Coastal Plain flora.

Comments: In some cases, these are locally known as "Delmarva bays."

DISTRIBUTION

Range: Ranges from the southern portion of the Delmarva peninsula to Cape Cod, Massachusetts, and also in limited, highly disjunct occurrences on sand lakeplain near southern Lake Michigan.

Divisions: 202:C, 203:C

TNC Ecoregions: 48:C, 58:C, 62:C

Subnations: DE, MA, MD, MI, NJ, NY, VA

Associations:

- *Calamagrostis canadensis* - *Dichanthelium meridionale* - (Mixed Shrub) Herbaceous Vegetation (CEGL006243, GNR)
- *Carex striata* var. *brevis* Herbaceous Vegetation (CEGL004120, GNR)
- *Cephalanthus occidentalis* / *Polygonum hydropiperoides* - *Panicum verrucosum* Shrubland (CEGL006242, G3?)
- *Ceratophyllum demersum* - *Utricularia macrorhiza* - *Nymphaea odorata* Herbaceous Vegetation (CEGL004661, G3?)
- *Cladium mariscoides* - *Coelorachis rugosa* Herbaceous Vegetation (CEGL006332, G1)
- *Cladium mariscoides* - *Eleocharis equisetoides* Herbaceous Vegetation (CEGL006016, GNR)
- *Decodon verticillatus* / *Triadenum virginicum* Shrubland (CEGL006087, GNR)
- *Dulichium arundinaceum* - *Juncus canadensis* - *Juncus pelocarpus* Herbaceous Vegetation (CEGL006415, GNR)
- *Eleocharis (obtusata, flavescens)* - *Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006261, G3G5)
- *Eleocharis flavescens* - *Xyris difformis* Herbaceous Vegetation (CEGL006400, GNR)
- *Eragrostis hypnoides* - *Ludwigia sphaerocarpa* - *Polygonum hydropiperoides* Herbaceous Vegetation (CEGL006608, GNR)
- *Eriocaulon aquaticum* - *Lobelia dortmanna* Herbaceous Vegetation (CEGL006346, GNR)
- *Juncus militaris* - *Eriocaulon aquaticum* Herbaceous Vegetation (CEGL006345, GNR)
- *Juncus repens* - *Boltonia asteroides* Herbaceous Vegetation (CEGL006610, GNR)
- *Leersia hexandra* - (*Panicum verrucosum*, *Scleria reticularis*) Herbaceous Vegetation [Provisional] (CEGL004047, G2G3)
- *Liquidambar styraciflua* - *Acer rubrum* - *Nyssa biflora* / *Carex jorii* Forest (CEGL006223, G1G2)
- *Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* / *Leucothoe racemosa* Forest (CEGL006110, GNR)

- *Lysimachia terrestris* - *Dulichium arundinaceum* - *Rhexia virginica* Herbaceous Vegetation (CEGL006035, G2G3)
- *Nuphar lutea* ssp. *sagittifolia* Herbaceous Vegetation (CEGL004328, G3?)
- *Nymphaea odorata* - *Eleocharis robbinsii* Herbaceous Vegetation (CEGL006086, G2)
- *Panicum hemitomon* - *Panicum verrucosum* Herbaceous Vegetation (CEGL006338, GNR)
- *Quercus phellos* / *Carex striata* var. *brevis* Forest (CEGL004644, G2?)
- *Rhexia virginica* - *Crotalaria sagittalis* Herbaceous Vegetation (CEGL006300, G2)
- *Rhexia virginica* - *Panicum verrucosum* Herbaceous Vegetation (CEGL006264, G2G3)
- *Rhynchospora capitellata* - *Cyperus dentatus* - *Rhexia virginica* - *Xyris difformis* Herbaceous Vegetation (CEGL006210, G2)
- *Rhynchospora capitellata* - *Rhexia virginica* - *Rhynchospora scirpoides* - *Schoenoplectus hallii* Herbaceous Vegetation (CEGL005108, G2?)
- *Saccharum giganteum* - (*Dichanthelium spretum*, *Panicum verrucosum*) Herbaceous Vegetation (CEGL006609, G1G2)
- *Spartina pectinata* North Atlantic Coast Herbaceous Vegetation (CEGL006095, GNR)
- *Taxodium distichum* - *Nyssa biflora* Chesapeake Bay Forest (CEGL006214, GNR)
- *Taxodium distichum* - *Taxodium ascendens* / *Panicum hemitomon* - *Sclerolepis uniflora* Woodland (CEGL004465, G1)
- *Taxodium distichum* - *Taxodium ascendens* / *Panicum hemitomon* Woodland (CEGL004466, G3?)
- *Vaccinium corymbosum* - *Rhododendron viscosum* - *Clethra alnifolia* Shrubland (CEGL006371, GNR)

High-ranked species: *Clonophis kirtlandii* (G2), *Coreopsis rosea* (G3), *Eulimnadia agassizii* (G1G2), *Eupatorium leucolepis* var. *novae-angliae* (G5T1), *Eupatorium resinosum* (G3), *Euthamia galetorum* (G3), *Fimbristylis perpusilla* (G2), *Helenium virginicum* (G2), *Hypericum adpressum* (G3), *Lobelia boykinii* (G2G3), *Lycopodiella margueritiae* (G2), *Lycopodiella subappressa* (G2), *Oxypolis canbyi* (G2), *Panicum hirstii* (G1), *Papaipema sulphurata* (G2), *Rhexia aristosa* (G3), *Rhynchospora inundata* (G3G4), *Sabatia kennedyana* (G3), *Sagittaria teres* (G3), *Schoenoplectus etuberculatus* (G3G4), *Scirpus ancistrochaetus* (G3)

SOURCES

References: Comer et al. 2003

Version: 01 Oct 2004

Concept Author: SC. Gawler, R. Evans, L. Sneddon, M. Pyne

Stakeholders: East, Midwest, Southeast

LeadResp: East

CES203.890 CENTRAL FLORIDA HERBACEOUS PONDSHORE

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Herbaceous; Depressional; Graminoid

Concept Summary: This system includes a variety of seasonal depression ponds in central Florida, especially along the Lake Wales Ridge. Examples are rounded or irregularly shaped, shallow depressions from tens to hundreds of meters in diameter (Abrahamson et al. 1984). Extensive variation is present based on the variety of soils and resultant hydroperiods. Most examples exhibit some zonation in vegetation and nearly all are ringed by *Serenoa repens*. Characteristic or dominant species associated with the interior of the ponds include *Panicum hemitomon*, *Panicum abscissum*, *Hypericum edisonianum*, and *Andropogon brachystachyus*.

Comments: Compare to East Gulf Coastal Plain Southern Depression Pondshore (CES203.504), found to the north.

DISTRIBUTION

Range: Endemic to central Florida.

Divisions: 203:C

TNC Ecoregions: 55:C

Subnations: FL

Associations:

- *Amphicarpum muehlenbergianum* - (*Panicum hemitomon*) Herbaceous Vegetation (CEGL008588, G2G3)
- *Andropogon (capillipes, glaucopsis)* - *Rhynchospora fascicularis* var. *fascicularis* - *Rhexia mariana* Herbaceous Vegetation (CEGL004460, G2?)
- *Hypericum brachyphyllum* Dwarf-shrubland (CEGL003955, G3?)
- *Panicum hemitomon* - *Pluchea (camphorata, rosea)* - *Ludwigia* spp. Herbaceous Vegetation (CEGL007792, G3)

- *Panicum hemitomon* - *Pontederia cordata* Herbaceous Vegetation (CEGL004461, G3G4)
- *Rhynchospora (careyana, inundata)* Seasonally Flooded Herbaceous Vegetation (CEGL004132, G3?)
- *Woodwardia virginica* / *Sphagnum cuspidatum* Herbaceous Vegetation (CEGL004475, G2?)

High-ranked species: *Amaranthus floridanus* (G3), *Campanula robinsiae* (G1), *Carex verrucosa* (G3G4), *Coelorachis tuberculosa* (G3), *Cucurbita okeechobeensis* (G1), *Echinochloa paludigena* (G3Q), *Echinodorus parvulus* (G3Q), *Hypericum edisonianum* (G2), *Litsea aestivalis* (G3), *Ludwigia curtissii* (G3G4), *Lythrum flagellare* (G2), *Najas filifolia* (G1), *Neofiber alleni* (G3), *Rana capito* (G3), *Rhynchospora fernaldii* (G3G4), *Zephyranthes simpsonii* (G2G3)

Environment: Most examples are known from the Lake Wales Ridge area of central Florida. These are shallow depressions found on a variety of different soils with different hydroperiods (Abrahamson et al. 1984).

Vegetation: Most depression ponds accommodated in this system display distinct vegetational zonation. At least four vegetational zones can be readily distinguished (Abrahamson et al. 1984); the community types need to be further reconciled into associations.

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: May grade into Central Florida Wet Prairie and Herbaceous Seep (CES203.491). Surrounding matrix vegetation can include Central Florida Pine Flatwoods (CES203.382) and Florida Dry Prairie (CES203.380).

SOURCES

References: Abrahamson et al. 1984, Comer et al. 2003

Version: 25 Mar 2004

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES203.558 EAST GULF COASTAL PLAIN NORTHERN DEPRESSION POND SHORE

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system consists of a variety of upland depression pondshores of the northern East Gulf Coastal Plain. Included here are shallow ponds of various geomorphic origin in a variety of substrates (e.g., limesinks, Grady Ponds) which are not separately distinguished as systems. These are generally in isolated upland situations, and are not part of a stream system, although they may serve as the origin of a stream system in a general way, releasing water gradually into the stream drainage system during periods of wet weather. In some examples, a distinct zonation of vegetation is present, in others the zones are not distinct or the differing associations are present in a complex mosaic. Most seasonal depression ponds are usually composed of mosaics of several plant associations. The vegetation includes various zones which become exposed as water levels decline, as well as emergent (rising out of the water) or submergent/floating plants. Some typical associations include ones dominated by species such as *Dichantherium wrightianum*, *Dichantherium erectifolium*, *Eleocharis equisetoides*, *Eleocharis microcarpa*, *Juncus effusus*, *Juncus repens*, *Rhynchospora corniculata*, *Rhynchospora inundata*, *Panicum hemitomon*, *Proserpinaca* spp., *Pluchea* spp., *Ludwigia* spp., *Saccharum* spp., *Panicum verrucosum*, *Rhexia* spp., and *Sabatia angularis*. In addition, associations dominated by *Polygonum* spp., *Leersia* spp., and *Typha* spp. may be present but are not characteristic.

DISTRIBUTION

Range: This system is found in the northern part of the East Gulf Coastal Plain, inland of the Gulf Coast Flatwoods (i.e., EPA Level III Ecoregion 65, not 75 (EPA 2004)).

Divisions: 203:C

TNC Ecoregions: 43:C, 53:C

Subnations: AL, GA, MS

Associations:

- *Alnus serrulata* Saturated Southern Shrubland (CEGL003912, G4)
- *Alnus serrulata* Southeastern Seasonally Flooded Shrubland (CEGL008474, G4)
- *Cephalanthus occidentalis* / *Hibiscus moscheutos* ssp. *moscheutos* Depression Pond Shrubland (CEGL004742, G3?)
- *Dichantherium wrightianum* - *Dichantherium erectifolium* Herbaceous Vegetation (CEGL004105, G2G3)

- *Eleocharis microcarpa* - *Juncus repens* - *Rhynchospora corniculata* - (*Mecardonia acuminata*, *Proserpinaca* spp.) Herbaceous Vegetation (CEGL004748, G2G3)
- *Juncus effusus* Seasonally Flooded Herbaceous Vegetation (CEGL004112, G5)
- *Nyssa biflora* / *Itea virginica* - *Cephalanthus occidentalis* Depression Forest (CEGL007434, G3G4)
- *Panicum hemitomon* - *Eleocharis equisetoides* - *Rhynchospora inundata* Herbaceous Vegetation (CEGL004127, G3)
- *Panicum hemitomon* - *Pluchea (camphorata, rosea)* - *Ludwigia* spp. Herbaceous Vegetation (CEGL007792, G3)
- *Polygonum (hydropiperoides, punctatum)* - *Leersia (lenticularis, virginica)* Herbaceous Vegetation (CEGL004290, G4?)
- *Polygonum amphibium* - (*Polygonum hydropiperoides*) Seasonally Flooded Herbaceous Vegetation (CEGL004699, G4G5)
- *Polygonum densiflorum* - (*Saccharum giganteum*) Herbaceous Vegetation (CEGL004966, G4G5)
- *Saccharum* spp. - *Panicum verrucosum* - (*Rhexia* spp., *Sabatia* spp.) Herbaceous Vegetation (CEGL004752, G2G3)
- *Salix nigra* / *Cephalanthus occidentalis* Forest (CEGL004773, G4)
- *Taxodium ascendens* / *Ilex myrtifolia* Depression Forest (CEGL007418, G3?)
- *Taxodium distichum* East Gulf Coastal Plain Pondshore Woodland (CEGL004046, G3)
- *Typha latifolia* Southern Herbaceous Vegetation (CEGL004150, G5)

High-ranked species: *Ambystoma cingulatum* (G2G3), *Carex decomposita* (G3), *Coelorachis tuberculosa* (G3), *Croton elliotii* (G2G3), *Echinodorus parvulus* (G3Q), *Hypericum adpressum* (G3), *Lindera melissifolia* (G2), *Litsea aestivalis* (G3), *Lobelia boykinii* (G2G3), *Ludwigia spathulata* (G2G3), *Myriophyllum laxum* (G3), *Notophthalmus perstriatus* (G2G3), *Oxypolis canbyi* (G2), *Polygonum hirsutum* (G3G4), *Rana capito* (G3), *Rhexia aristosa* (G3), *Rhexia parviflora* (G2), *Rhexia salicifolia* (G2), *Rhynchospora inundata* (G3G4), *Schoenoplectus hallii* (G2), *Xyris longispala* (G2)

Vegetation: Most seasonal depression ponds are usually composed of mosaics of several plant associations. The vegetation includes various zones which become exposed as water levels decline, as well as emergent (rising out of the water) or submergent/floating plants. Some typical dominant species in component associations include *Dichantherium wrightianum*, *Dichantherium erectifolium*, *Eleocharis microcarpa*, *Juncus repens*, *Rhynchospora corniculata*, *Proserpinaca* spp., *Juncus effusus*, *Panicum hemitomon*, *Eleocharis equisetoides*, *Rhynchospora inundata*, *Pluchea* spp., *Ludwigia* spp., *Saccharum* spp., *Panicum verrucosum*, *Rhexia* spp., and *Sabatia angularis*. In addition, associations dominated by *Polygonum* spp., *Leersia* spp., and *Typha* spp. may be present but are not characteristic. Other characteristic species include *Rhexia cubensis*, *Panicum rigidulum*, *Panicum verrucosum*, *Carex striata*, *Lachnanthes caroliana*, *Bartonia verna*, *Lachnocaulon minus*, and *Centella erecta*. Woody plants which may be present (particularly on margins) include *Cephalanthus occidentalis*, *Hibiscus* spp., and *Hypericum* spp.

Dynamics: The seasonal fluctuation in the water levels in these ponds controls both the overall vegetation composition as well as the composition of the zones of the vegetation, which may be quite distinct from one another. The evident species in a zone may fluctuate from year to year with differing length of hydroperiod.

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch

Heterogeneity: This system contains a wide variety of ecologically related associations which exhibit some physiognomic variation, being variously dominated by graminoids or by shrubs, (e.g., *Cephalanthus occidentalis*, *Hypericum* spp.).

Other Comments: Seasonal depression ponds are a small-patch system confined to specific environments (depressions) defined primarily by a seasonally flooded hydrology. Water levels may fluctuate 1 m or more over the course of the growing season. These communities typically occur in depressions in the landscape (limesink ponds). Soils have characteristics that result from long periods of anaerobic conditions (e.g., gleyed soils, high organic content, redoximorphic features). Seasonal depression ponds are typically characterized by zones or patches of herbaceous vegetation adapted to wetland soil conditions. Primary threats to this system include changes in water quality and quantity, diversions, mining, logging, and invasive species.

SOURCES

References: Comer et al. 2003, EPA 2004

Version: 26 Feb 2003

Concept Author: M. Pyne

Stakeholders: Southeast

LeadResp: Southeast

CES203.292 EAST GULF COASTAL PLAIN SANDHILL LAKESHORE DEPRESSION

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional [Vernal Pool]; Graminoid

Concept Summary: This small-patch wetland system occupies upland depressions on deep sandy soils in the southern portions of the East Gulf Coastal Plain of Florida and Alabama. These depressions are apparently of karstic origin but exhibit no evidence of calcareous conditions or evidence of limestone. Limestone is buried 50 or more feet below the surface under coarse sandy soils that cover the margins and, in some cases, the entire surface extent of these depressions (A. Johnson pers. comm.). The resulting appearance of these pondshores is that of large, inland white sand beach (at least in dry years). In the drier margins they even support some plant species found on coastal beaches of the region, such as *Lupinus westianus*, *Hypericum reductum*, and *Chrysoma pauciflosculosa*. The aspect of the vegetation ranges from shrublands to herbaceous-dominated with local variability. Several narrowly endemic plant species may be present such as *Hypericum lissophloeus*, *Rhexia salicifolia*, and *Xyris longisepala*. Examples may be periodically flooded to depths of as much as 1.5 m deep, but they dry down regularly. Some are fairly large, steep-sided depressions with as much as a 30-m elevation change from rim (sandhill) to center, while others form much more gradual depressions. Fire may be an important natural force in some examples.

Comments: This system has karstic origins in common with Southern Coastal Plain Sinkhole (CES203.495) but lacks exposed limestone and steep vertical, limestone walls. Other upland depressions of the East Gulf Coastal Plain (that may or may not have karstic origins) on less extreme sandy soils are accommodated by East Gulf Coastal Plain Southern Depression Pondshore (CES203.504).

This system was formerly covered by East Gulf Coastal Plain Southern Depression Pondshore, but this type was split out and recognized as distinct in February 2004.

DISTRIBUTION

Range: This system is found in the Florida panhandle and adjacent portions of Alabama (possibly confined to a single site) (A. Johnson pers. comm.).

Divisions: 203:C

TNC Ecoregions: 53:C

Subnations: AL, FL

Associations:

- *Hypericum lissophloeus* Shrubland (CEGL003870, G1)
- *Hypericum reductum* / *Syngonanthus flavidulus* - *Rhexia salicifolia* - (*Xyris longisepala*) Dwarf-shrubland (CEGL004998, G1G2)

High-ranked species: *Hypericum lissophloeus* (G2), *Paronychia chartacea* ssp. *minima* (G3T1), *Rhexia salicifolia* (G2), *Xyris isoetifolia* (G1)

Environment: Examples occur in the near-coastal flatlands (*sensu* Peet and Allard 1993) or the Gulf Coastal Plain Flatwoods region (*sensu* EPA 2004).

Vegetation: *Hypericum lissophloeus*, *Rhexia salicifolia*, and *Xyris longisepala* are some of the more unusual species associated with this system (A. Johnson pers comm.).

SOURCES

References: EPA 2004, Johnson pers. comm., Peet and Allard 1993, Southeastern Ecology Working Group n.d.

Version: 11 Mar 2004

Stakeholders: Southeast

Concept Author: R.E. Evans and A. Johnson

LeadResp: Southeast

CES203.504 EAST GULF COASTAL PLAIN SOUTHERN DEPRESSION PONDSHORE

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional [Vernal Pool]; Graminoid

Concept Summary: This small-patch wetland system occupies upland depressions in the southern portions of the East Gulf Coastal Plain. Most examples occur in the near-coastal flatlands (*sensu* Peet and Allard 1993) or the Gulf Coastal Plain Flatwoods region (Ecoregion 75a of EPA (2004)). Coastal dune lakes and related wetlands of barrier islands are covered by another system Southeastern Coastal Plain Interdunal Wetland (CES203.258). This system only includes ponds and pondshores in upland settings not those in riparian or floodplain environments. no explicit distinction is intended for wooded

versus herbaceous ponds. These tend to occupy basins that were formed by subsidence of surface sediments caused by solution in underlying limestone or as swales in eolian sand deposits. However, sinkholes with steep, vertical, exposed limestone walls are accommodated by another ecological system, as are sandhill ponds that develop on extreme sandy sites in the East Gulf Coastal Plain of Florida and adjacent Alabama. Examples of this system are relatively shallow depressions or basins with some surface soils present. Hydroperiod can vary substantially from year to year, and vegetation can similarly vary significantly in aspect and dominants. Fire is an important natural force in the outer, drier portions of many examples, and periodic fires may sweep through the interior of many examples during dry periods. Vegetation may exhibit distinct zonation in response to variation in duration of flooding. Communities can range from floating aquatic types (in the centers of the deepest basins) to emergent herbaceous zones (in semipermanent water drawdown zones) to sparse, yet diverse, small graminoid and forb herbaceous vegetation to bald-cypress woodland edges. Some examples may have emergent trees throughout their extent.

Comments: In Mississippi this system is apparently confined to the Pamlico Plain where it is very rare and small scale in occurrence (R. Wieland pers. comm.). It is unknown how distinct these depressions are from so-called Grady Ponds (e.g., Cottonmouth Savanna site). This system is closely related to Atlantic Coastal Plain Southern Depression Pondshore (CES203.262) of the Atlantic Coastal Plain and East Gulf Coastal Plain Northern Depression Pondshore (CES203.558) of more interior portions of the East Gulf Coastal Plain. This system also has karstic origins in common with Southern Coastal Plain Sinkhole (CES203.495) but occupies comparatively much shallower depressions and lacks exposed limestone. Compare to Central Florida Herbaceous Pondshore (CES203.890) to the south.

DISTRIBUTION

Range: This system is found in the southern portions of the East Gulf Coastal Plain and related parts of the Mississippi Valley Alluvial Plain, being restricted to the "Gulf Coast Flatwoods" (Ecoregion 75a of EPA (2004)).

Divisions: 203:C

TNC Ecoregions: 42:C, 53:C

Subnations: AL, FL, GA, LA?, MS

Associations:

- *Crataegus rufula* Forest (CEGL007783, G2G3)
- *Dichantherium wrightianum* - *Dichantherium erectifolium* Herbaceous Vegetation (CEGL004105, G2G3)
- *Eleocharis (elongata, equisetoides)* - *Rhynchospora tracyi* Semipermanently Flooded Herbaceous Vegetation (CEGL004960, G3?)
- *Fraxinus pennsylvanica* - *Populus heterophylla* - *Ulmus americana* - (*Quercus texana*) Forest (CEGL004694, G2?)
- *Fuirena scirpoidea* - *Rhynchospora tracyi* Herbaceous Vegetation (CEGL004123, G3G4)
- *Hypericum chapmanii* - *Ilex myrtifolia* - (*Nyssa ursina*) Shrubland (CEGL003867, G1)
- *Hypericum fasciculatum* / *Rhynchospora (chapmanii, harperi)* Shrubland (CEGL003869, G2G3)
- *Panicum virgatum* - *Andropogon (capillipes, glaucopsis)* - *Aristida palustris* Herbaceous Vegetation (CEGL004100, G2?)
- *Rhynchospora filifolia* - *Juncus abortivus* Herbaceous Vegetation (CEGL004131, G2?)
- *Taxodium distichum* East Gulf Coastal Plain Pondshore Woodland (CEGL004046, G3)

High-ranked species: *Ambystoma cingulatum* (G2G3), *Carex striata* var. *striata* (G4T3T4), *Carex verrucosa* (G3G4), *Coelorachis tuberculosa* (G3), *Coreopsis nudata* (G3?), *Croton elliotii* (G2G3), *Echinodorus parvulus* (G3Q), *Fuirena longa* (G3G4), *Hypericum chapmanii* (G3), *Lindera melissifolia* (G2), *Litsea aestivalis* (G3), *Lobelia boykinii* (G2G3), *Ludwigia spathulata* (G2G3), *Mirophyllum laxum* (G3), *Najas filifolia* (G1), *Notophthalmus perstriatus* (G2G3), *Parnassia grandifolia* (G3), *Pinckneya bracteata* (G3G4), *Pinguicula planifolia* (G3?), *Polygonum hirsutum* (G3G4), *Procamburus econfinae* (G1), *Rana capito* (G3), *Rana sevosia* (G1), *Rhexia parviflora* (G2), *Rhexia salicifolia* (G2), *Rhynchospora fernaldii* (G3G4), *Rhynchospora globularis* var. *pinetorum* (G5?T3?), *Rhynchospora inundata* (G3G4), *Rhynchospora macra* (G3), *Rhynchospora pleiantha* (G3), *Sabatia brevifolia* (G3G4), *Schwalbea americana* (G2), *Xyris longispala* (G2)

Vegetation: Many examples are herb-dominated, with a variety of zones and variants recognized as associations. Some characteristic species include *Dichantherium wrightianum*, *Dichantherium erectifolium*, *Eleocharis elongata*, *Eleocharis equisetoides*, *Rhynchospora tracyi*, *Fuirena scirpoidea*, *Rhynchospora tracyi*, *Aristida palustris*, *Rhynchospora chapmanii*, *Rhynchospora harperi*, *Rhynchospora filifolia*, and *Juncus abortivus*. Some stands with trees contain *Fraxinus pennsylvanica*, *Populus heterophylla*, *Ulmus americana*, and *Quercus texana*. Shrubs in stands may contain *Hypericum chapmanii*, *Hypericum fasciculatum*, *Hypericum reductum*, *Ilex myrtifolia*, and *Nyssa ursina*.

Dynamics: Hydroperiod can vary substantially from year to year, and vegetation can similarly vary significantly in aspect and dominants. Fire is an important natural force in the outer, drier portions of many examples, and periodic fires may sweep through the interior during dry periods.

SPATIAL CHARACTERISTICS

Other Comments: Upland depressions included in East Gulf Coastal Plain Sandhill Lakeshore Depression (CES203.292) were formerly accommodated here.

SOURCES

References: Comer et al. 2003, EPA 2004, Peet and Allard 1993

Version: 25 Mar 2004

Concept Author: R. Evans and M. Pyne

Stakeholders: Southeast

LeadResp: Southeast

CES203.077 FLORIDIAN HIGHLANDS FRESHWATER MARSH

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional [Sinkhole]; Graminoid

Concept Summary: This system represents non-tidal marsh vegetation in the peninsula of Florida. These highland marshes occupy different types of depressions such as former lake basins, shallow peat-filled valleys, and zones around existing natural lakes (Kushlan 1990). The marshes and the basins they occur within are unstable over time due to subsurface subsidence and drainage pattern changes. In some examples, surface waterflow is generally lacking due to the presence of limestone near the surface, but water levels have fluctuated greatly over time (Patton and Judd 1986). Soils range from mucky surfaces to sandy loams or sands, but slowly permeable subsoils contribute to the presence of standing water for much of the year. The vegetation mosaic includes a range of mostly herbaceous plant communities that may be referred to as marshes, meadows, and prairies, collectively comprising a relatively diverse number of associations. Permanent water bodies support a range of submerged and floating aquatic species. Areas with approximately a meter of standing water tend to support dense stands of emergent herbaceous perennials, often in monospecific stands; species include *Typha latifolia*, *Pontederia cordata*, *Nelumbo lutea*, and others. Where there is less water (usually present only during wet season), more graminoid vegetation is present, with species such as *Panicum hemitomon*, *Leersia hexandra*, and other species. With historic water level fluctuations, the vegetation mosaic has also changed, sometimes quite rapidly.

Comments: This system was originally intended to cover Paynes Prairie only, but the concept was greatly expanded to include other non-tidal marsh vegetation of Florida, including that around natural lakes, as well as the large Kissimmee and St. Johns River marshes. The Kissimmee and St. Johns River marshes occur within floodplains and are influenced by somewhat different processes than typical highland marshes. These are now considered a distinct ecological system, Florida Rivers Freshwater Marsh (CES203.198).

DISTRIBUTION

Range: Peninsula of Florida.

Divisions: 203:C

TNC Ecoregions: 55:C

Subnations: FL

Associations:

- *Cephalanthus occidentalis* / *Limnobium spongia* - *Salvinia minima* Shrubland (CEGL004457, G3?)
- *Nelumbo lutea* - *Pontederia cordata* - *Schoenoplectus tabernaemontani* Herbaceous Vegetation (CEGL004470, G2G3)
- *Osmunda regalis* var. *spectabilis* - *Peltandra virginica* - *Sagittaria lancifolia* Herbaceous Vegetation (CEGL004471, G2?)
- *Panicum hemitomon* - *Pontederia cordata* Herbaceous Vegetation (CEGL004461, G3G4)
- *Salix caroliniana* / *Decodon verticillatus* / *Typha latifolia* Forest (CEGL004423, G2G3)
- *Salix caroliniana* Temporarily Flooded Shrubland (CEGL003899, G4?)
- *Typha latifolia* - *Pontederia cordata* Herbaceous Vegetation (CEGL004462, G3?)

High-ranked species: *Neofiber alleni* (G3)

Vegetation: A relatively diverse assemblage of vegetation is present, ranging from open water communities to emergent and graminoid marshes, and scattered shrublands. Placing all component associations is difficult due to a number of factors; the current list (12-02) is incomplete.

SOURCES

References: Comer et al. 2003, Kushlan 1990, Patton and Judd 1986

CES203.258 SOUTHEASTERN COASTAL PLAIN INTERDUNAL WETLAND

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Coast; Depressional

Concept Summary: This system encompasses the wettest dune swales and basins on barrier islands and coastal areas, supporting pond or marsh-like vegetation, from the Coastal Plain of Texas to Virginia. Most examples are permanently or semipermanently flooded with freshwater but are affected by salt spray or overwash during periodic storm events. It is broadly defined in terms of floristic composition and is wide-ranging throughout the southeastern Coastal Plain of the United States.

Comments: This system is currently defined with a much broader geographic range than most other coastal systems in the Southeast. The extreme variability within even a limited geographic range limits the ability to find broader vegetational patterns. Examples may vary regionally with regard to the amount of wind or salt spray and the texture of the sand. The northern end of the range is not clearly defined.

DISTRIBUTION

Range: Ranges along the Atlantic and Gulf coasts, from southern Texas to central Virginia. It ranges into central and southern Florida as well.

Divisions: 203:C

TNC Ecoregions: 31:C, 53:C, 54:?, 55:?, 56:C, 57:C

Subnations: AL, FL, GA, LA, MS, NC, SC, TX, VA

Associations:

- (*Morella cerifera*) - *Panicum virgatum* - *Spartina patens* Herbaceous Vegetation (CEGL004129, GNR)
- (*Stillingia aquatica*) / *Panicum tenerum* - *Dichantherium erectifolium* Herbaceous Vegetation (CEGL004954, G2?)
- *Carex hyalinolepis* Seasonally Flooded Herbaceous Vegetation (CEGL004724, G1G3)
- *Cladium mariscus* ssp. *jamaicense* - *Woodwardia virginica* Herbaceous Vegetation (CEGL004949, G2?)
- *Decodon verticillatus* Semipermanently Flooded Shrubland (CEGL005089, GNR)
- *Eleocharis elongata* - *Panicum tenerum* - *Nymphaea odorata* Herbaceous Vegetation (CEGL004961, G2?)
- *Fimbristylis castanea* - *Paspalum distichum* Herbaceous Vegetation (CEGL004110, G3)
- *Fimbristylis castanea* - *Schoenoplectus pungens* Seasonally Flooded Herbaceous Vegetation (CEGL003790, GNR)
- *Fuirena scirpoidea* - *Fuirena longa* - *Rhynchospora microcarpa* - *Rhynchospora divergens* Herbaceous Vegetation (CEGL004952, G2)
- *Hypericum reductum* - *Licania michauxii* / *Andropogon capillipes* - *Polygonella gracilis* - *Xyris caroliniana* Dwarf-shrubland (CEGL003953, G2)
- *Morella cerifera* - *Vaccinium corymbosum* Shrubland (CEGL003906, GNR)
- *Panicum hemitomon* - (*Cladium mariscus* ssp. *jamaicense*, *Muhlenbergia filipes*) Herbaceous Vegetation (CEGL007716, G2G3)
- *Paspalum vaginatum* Herbaceous Vegetation (CEGL004114, G3G4)
- *Phragmites australis* Eastern North America Temperate Semi-natural Herbaceous Vegetation (CEGL004141, GNA)
- *Spartina bakeri* - *Muhlenbergia filipes* - *Andropogon glomeratus* - *Rhynchospora colorata* Herbaceous Vegetation (CEGL004511, G3?)
- *Spartina patens* - *Fimbristylis (caroliniana, castanea)* - (*Panicum virgatum*) Herbaceous Vegetation (CEGL007836, G2G3)
- *Typha domingensis* - *Setaria magna* Herbaceous Vegetation (CEGL004138, G2G3)
- *Typha domingensis* Seasonally Flooded Gulf Coastal Plain Herbaceous Vegetation (CEGL004137, G3?)

High-ranked species: *Eupatorium mikanioides* (G3?), *Fuirena longa* (G3G4), *Lachnocaulon engleri* (G3), *Lachnocaulon minus* (G3G4), *Ludwigia lanceolata* (G3)

Environment: Occurs on barrier islands and similar immediate coastal areas, in dune swales or other basins. The ponds have standing water well into the growing season, and most are permanently flooded. The water is from rainfall or the local

water table and is fresh, except perhaps during storm events that produce overwash. Soils are sand, sometimes with a thin layer of muck accumulated in the pond.

Vegetation: Vegetation is characterized by emergent or drawdown wetland plants, often tall graminoids. Vegetation varies substantially from one example to the next.

Dynamics: This system occurs in a geologically dynamic environment, where wind and waves may change landforms quickly. However, ponds usually occur in stable portions of islands, where they may last for decades. Salt spray, salt overwash, and heavy rainfall from storms may affect component communities, limiting vegetation to species that are somewhat salt-tolerant.

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch.

Size: Occurs as small patches, with most individual ponds an acre or less in size. Often ponds will occur in complexes of up to a dozen.

Heterogeneity: Occurrences may be either single patches or complexes with several patches set in a matrix of other systems. Most individual patches are homogeneous, consisting of a single association.

Adjacent Ecological System Comments: Surrounded by maritime forest or maritime grassland systems.

Other Comments: Given the variability of the vegetation in ponds, other associations probably need to be defined.

SOURCES

References: Comer et al. 2003

Version: 23 Sep 2002

Concept Author: M. Schafale and R. Evans

Stakeholders: East, Southeast

LeadResp: Southeast

CES203.541 TEXAS-LOUISIANA COASTAL PRAIRIE POND SHORE

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional; Graminoid

Concept Summary: This system includes small to moderately large ponds and swales in the coastal prairie of southeastern Texas and Louisiana. These wetlands contain surface water during much of the year, desiccating only in the driest summer months. They are often fed by water runoff but may result from percolation from adjacent sandy areas. Soils in the basins are finer-textured than surrounding areas and may be underlain by pans that enhance perched water tables in the winter. These wetlands occur within the coastal prairie matrix of southeastern Texas and Louisiana and are wetter than wet prairie dominated by *Tripsacum dactyloides* and *Panicum virgatum*. These wetlands may be dominated by *Eleocharis quadrangulata*. Other species that may be present include *Sagittaria papillosa*, *Sagittaria longiloba*, *Steinchisma hians*, *Panicum virgatum*, *Cyperus haspan*, *Cyperus virens*, *Ludwigia glandulosa*, *Ludwigia linearis*, *Fuirena squarrosa*, *Xyris jupicai*, *Leersia hexandra*, *Centella erecta* (= *Centella asiatica*), *Symphotrichum subulatum* (= *Aster subulatus*), *Sesbania* spp., and *Rhynchospora* spp. Open areas in the ponds may contain floating and submersed aquatic vegetation, including *Stuckenia pectinata*, *Ceratophyllum demersum*, *Brasenia schreberi*, *Nymphoides aquatica*, *Nuphar lutea*, and *Nelumbo lutea*.

DISTRIBUTION

Range: This system is restricted to the coastal prairie of southeastern Texas and Louisiana.

Divisions: 203:C

TNC Ecoregions: 31:C

Subnations: LA, TX

Associations:

- *Brasenia schreberi* Herbaceous Vegetation (CEGL004527, G4?)
- *Eleocharis quadrangulata* - *Sagittaria* spp. Herbaceous Vegetation (CEGL007929, G3?)
- *Nelumbo lutea* Herbaceous Vegetation (CEGL004323, G4?)
- *Nuphar lutea* ssp. *advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Potamogeton nodosus* Herbaceous Vegetation (CEGL004529, GNR)
- *Stuckenia pectinata* - *Ceratophyllum demersum* Herbaceous Vegetation (CEGL002281, GNR)

Environment: Examples of this system are often fed by water runoff but may result from percolation from adjacent sandy areas. Soils in the basins are finer-textured than surrounding areas and may be underlain by pans that enhance perched water tables in the winter.

Vegetation: Examples of this system are typically dominated by *Eleocharis quadrangulata*. Other species that may be present include *Sagittaria papillosa*, *Sagittaria longiloba*, *Steinchisma hians*, *Panicum virgatum*, *Cyperus haspan*, *Cyperus virens*, *Ludwigia glandulosa*, *Ludwigia linearis*, *Fuirena squarrosa*, *Xyris jupicai*, *Leersia hexandra*, *Centella erecta* (= *Centella asiatica*), *Symphotrichum subulatum* (= *Aster subulatus*), *Sesbania* spp., and *Rhynchospora* spp. Open areas in the ponds may contain floating and submersed aquatic vegetation, including *Stuckenia pectinata*, *Ceratophyllum demersum*, *Brasenia schreberi*, *Nymphoides aquatica*, *Nuphar lutea*, and *Nelumbo lutea*.

SOURCES

References: Comer et al. 2003

Version: 18 Apr 2005

Concept Author: J. Teague

Stakeholders: Southeast

LeadResp: Southeast

CES203.264 ATLANTIC COASTAL PLAIN NORTHERN DUNE AND MARITIME GRASSLAND

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Coast; Beach (Substrate); Graminoid; North Atlantic Coastal Plain

Concept Summary: This system consists of vegetation of barrier islands and other coastal areas, ranging from northern North Carolina northward to southern Maine, where extensive sandy coastlines are replaced by rocky coasts. A range of plant communities may be present, but natural vegetation is predominately herbaceous. Shrublands resulting from succession from grasslands may occur in limited areas, but they are generally not natural components of this system in the southern part of this system's range (M. Schafale pers. comm.). Both upland and non-flooded wetland vegetation are also included in this system. Small patches of natural woodland may also be present in limited areas, especially in the northern range of this system. Dominant ecological processes are those associated with the maritime environment, including frequent salt spray, saltwater overwash, and sand movement.

Comments: This system was separated from Atlantic Coastal Plain Southern Dune and Maritime Grassland (CES203.273) to parallel broad-scale biogeographic and climatic differences believed to be important in this environment. This system occupies the northern part of this broad transition which was labeled by Cowardin et al. (1979) as the Virginian Province, although the demarcated boundary differs somewhat from that used here. A useful vegetation indicator of this transition is the shift in herbaceous dominance on the dunes from *Uniola paniculata* in the south to *Ammophila breviligulata* in the north. Although the location of this shift itself is somewhat imprecise because of widespread planting of both species on artificially enhanced dunes, this boundary appears to be well approximated by Omernik Ecoregion 63g vs. 63d (EPA 2004). Along the northern boundary, there is extensive turnover of associations in TNC Ecoregion 58 with very little overlap southward.

This system is distinguished from Atlantic Coastal Plain Northern Maritime Forest (CES203.302) by the lack of dominant woody vegetation. This distinction becomes blurred where dunes have been artificially enhanced and an unnatural succession to woody vegetation is occurring. The boundary at the northern end is the end of extensive sandy coastlines and the beginning of rocky coasts.

Southeastern Coastal Plain Interdunal Wetland (CES203.258) is distinguished from this system by the presence of standing water for a significant part of the growing season. This corresponds to a break between open-water and tall-graminoid marsh vegetation in the ponds and low-graminoid- or forb-dominated vegetation in the grasslands.

DISTRIBUTION

Range: This system ranges from northern North Carolina (Omernik ecoregion 63d) and southeastern Virginia to southern Maine. The southern limit is a transition zone from around Kitty Hawk, North Carolina, to the Virginia-North Carolina border. The northern limit is Merrymeeting Bay, Maine.

Divisions: 203:C

TNC Ecoregions: 57:C, 62:C, 63:C

Subnations: CT, DE, MA, MD, ME, NC, NH, NJ, NY, RI, VA

Associations:

- (*Morella cerifera*) - *Panicum virgatum* - *Spartina patens* Herbaceous Vegetation (CEGL004129, GNR)
- *Ammophila breviligulata* - *Lathyrus japonicus* Herbaceous Vegetation (CEGL006274, G4?)
- *Ammophila breviligulata* - *Panicum amarum* var. *amarum* Herbaceous Vegetation (CEGL004043, G2)
- *Cladium mariscoides* / *Vaccinium macrocarpon* - *Morella pensylvanica* Dwarf-shrubland (CEGL006141, G2)
- *Hudsonia tomentosa* - *Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL006143, G2)
- *Hudsonia tomentosa* / *Panicum amarum* var. *amarulum* Dwarf-shrubland (CEGL003950, G2)
- *Juncus (dichotomus, scirpoides)* - *Drosera intermedia* Herbaceous Vegetation (CEGL004111, GNR)
- *Juniperus virginiana* var. *virginiana* / *Morella pensylvanica* Woodland (CEGL006212, G2)
- *Morella (pensylvanica, cerifera)* / *Schizachyrium littorale* - *Eupatorium hyssopifolium* Shrub Herbaceous Vegetation (CEGL004240, G2)
- *Morella cerifera* / *Hydrocotyle verticillata* Shrubland (CEGL003840, GNR)
- *Morella cerifera* / *Spartina patens* Shrubland (CEGL003839, G3G4)
- *Morella pensylvanica* - *Prunus maritima* Shrubland (CEGL006295, G4)
- *Morella pensylvanica* / *Diodia teres* Shrubland (CEGL003881, G2)
- *Morella pensylvanica* / *Schizachyrium littorale* - *Danthonia spicata* Shrub Herbaceous Vegetation (CEGL006067, G2)
- *Myrica gale* - *Morella pensylvanica* Saturated Shrubland (CEGL006339, GNR)
- *Pinus rigida* / *Hudsonia tomentosa* Woodland (CEGL006117, G2)
- *Pinus taeda* / *Hudsonia tomentosa* Woodland (CEGL006052, G1G2)
- *Prunus serotina* / *Morella cerifera* / *Smilax rotundifolia* Scrub Forest (CEGL006319, G1G2)
- *Quercus virginiana* - (*Ilex vomitoria*) Shrubland (CEGL003833, G3)
- *Schoenoplectus pungens* - *Fimbristylis (castanea, caroliniana)* Herbaceous Vegetation (CEGL004117, GNR)
- *Smilax glauca* - *Toxicodendron radicans* Vine-Shrubland (CEGL003886, GNR)
- *Spartina patens* - *Eleocharis parvula* Herbaceous Vegetation (CEGL006342, GNR)
- *Spartina patens* - *Schoenoplectus pungens* - *Solidago sempervirens* Herbaceous Vegetation (CEGL004097, G2G3)
- *Vaccinium corymbosum* - *Rhododendron viscosum* - *Clethra alnifolia* Shrubland (CEGL006371, GNR)
- *Vitis rotundifolia* / *Triplasis purpurea* - *Panicum amarum* - *Schizachyrium littorale* Mid-Atlantic Coastal Medaño Sparse Vegetation (CEGL004397, G1)

High-ranked species: *Schizaea pusilla* (G3G4)

Environment: Occurs on barrier islands and similar coastal strands, on sand dunes and sand flats. Strong salt spray is an important influence on vegetation in many parts. Overwash by sea water during storms is important on sand flats not protected by continuous dunes. On dunes, present or recent sand movement is an important factor. The combination of these factors prevents the dominance of woody vegetation. Sites may be either dry or saturated by freshwater from rainfall and local water table. Areas connected to tidal influence and areas with ponded freshwater are placed in other systems. Soils are sandy, with little organic matter and little or no horizon development. Soils may be excessively drained on the higher dunes. Soils are low in nutrient-holding capacity, but aerosol input of sea salt provides a continuous source of nutrients.

Vegetation: Vegetation consists of a set of grassland and herbaceous to shrubby associations. *Ammophila breviligulata* is the characteristic dominant on the youngest dunes and those most exposed to salt spray. These communities tend to be low in plant species richness, but have a characteristic set of forbs and occasional low shrubs associated with them. Wetter sand flats and dune swales may be dominated by a variety of herbs and sometimes have fairly high species richness.

Dynamics: The environment of this system is one of the most dynamic in existence for terrestrial vegetation. Reworking of sand by storms or by slower eolian processes may completely change the local environment in a short time, changing one association to another or changing this system into a different system. Many of these sites are fairly early in the process of primary succession on recent surfaces. Chronic salt spray is an ongoing stress. Overwash and extreme salt spray in storms are frequent disturbances. Vegetation interacts strongly with geologic processes; the presence of grass is an important factor in the development of new dunes. Alteration of dynamic processes, such as artificial enhancement of dunes by planting or sand fencing, can have drastic effects on this system, causing large areas to succeed to woody vegetation. Fire is probably not a major natural factor in this system, but may have been important locally. Most vegetation is too sparse to carry fire well.

SPATIAL CHARACTERISTICS

Spatial Summary: Occurs as a large-patch or local matrix system.

Size: Occurs in narrow to broad bands, up to several miles wide, extending along the length of barrier islands. Individual patches may cover a thousand or more acres. However, some of the best remnants are naturally small, occurring on smaller islands.

Heterogeneity: May occur as contiguous patches over large areas, or may be interspersed with maritime forests, salt and brackish tidal marshes, and interdune ponds.

SOURCES

References: Comer et al. 2003, Cowardin et al. 1979, EPA 2004, Schafale pers. comm.

Version: 26 Sep 2003

Concept Author: R. Evans

Stakeholders: East, Southeast

LeadResp: East

CES203.465 CENTRAL AND UPPER TEXAS COAST DUNE AND COASTAL GRASSLAND

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: This system consists of wetland and upland herbaceous and shrubland vegetation of barrier islands and near-coastal areas in the northern Gulf of Mexico along the upper Texas coast. Plant communities of primary and secondary dunes, interdunal swales and adjacent mainland are included. Salt spray, saltwater overwash, and sand movement are important ecological forces.

DISTRIBUTION

Range: Northern Gulf of Mexico along the upper Texas coast.

Divisions: 203:C

TNC Ecoregions: 31:C

Subnations: TX

Associations:

- *Eleocharis quadrangulata* - *Sagittaria* spp. Herbaceous Vegetation (CEGL007929, G3?)
- *Fuirena scirpoidea* - *Fuirena longa* - *Rhynchospora microcarpa* - *Rhynchospora divergens* Herbaceous Vegetation (CEGL004952, G2)
- *Panicum amarum* - *Paspalum monostachyum* Herbaceous Vegetation (CEGL004970, G3?)
- *Schizachyrium littorale* - *Paspalum monostachyum* Herbaceous Vegetation (CEGL002207, G3?)
- *Spartina patens* - *Panicum amarum* - *Hydrocotyle bonariensis* Herbaceous Vegetation (CEGL004971, G2?)
- *Uniola paniculata* - (*Panicum amarum*) - *Croton punctatus* Herbaceous Vegetation (CEGL002218, G3?)

SOURCES

References: Comer et al. 2003

Version: 13 Jan 2003

Concept Author: R. Evans and J. Teague

Stakeholders: Southeast

LeadResp: Southeast

CES203.500 EAST GULF COASTAL PLAIN DUNE AND COASTAL GRASSLAND

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: This system includes vegetation of coastal dunes along the northern Gulf of Mexico, including the northwestern panhandle of Florida, southern Alabama, and southeastern Mississippi. The vegetation consists largely of herbaceous and embedded shrublands on barrier islands and other near-coastal areas where salt spray, saltwater overwash, and sand movement are important ecological forces. This vegetation differs from that of other regions of the Gulf, and this region forms a natural unit with similar climate and substrate (Johnson 1997). There are a number of diagnostic and endemic plant species which characterize this system, including *Ceratiola ericoides*, *Chrysoma pauciflosculosa*, *Schizachyrium maritimum*, *Paronychia erecta*, and *Helianthemum arenicola* (Johnson and Barbour 1990).

DISTRIBUTION

Range: Coastal dunes along the northern Gulf of Mexico, including the northwestern panhandle of Florida, southern Alabama, and southeastern Mississippi.

Divisions: 203:C
TNC Ecoregions: 53:C
Subnations: AL, FL, MS

Associations:

- (*Iva imbricata*) / *Sporobolus virginicus* - *Spartina patens* - (*Paspalum distichum*, *Sesuvium portulacastrum*) Herbaceous Vegetation (CEGL007839, G3?)
- *Fuirena scirpoidea* - *Panicum tenerum* - *Dichantherium wrightianum* - *Andropogon capillipes* Herbaceous Vegetation (CEGL004953, G2?)
- *Schizachyrium maritimum* - (*Heterotheca subaxillaris*) Herbaceous Vegetation (CEGL004057, G2)
- *Spartina patens* - *Schizachyrium maritimum* - *Solidago sempervirens* Herbaceous Vegetation (CEGL008445, G3?)

High-ranked species: *Rhexia salicifolia* (G2)

SOURCES

References: Comer et al. 2003, Johnson 1997, Johnson and Barbour 1990

Version: 06 Feb 2003

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES203.550 TEXAS-LOUISIANA COASTAL PRAIRIE

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Herbaceous; Deep Soil; Graminoid

Concept Summary: This system encompasses non-saline tallgrass prairie vegetation ranging along the coast of Louisiana and Texas. This vegetation is found on Vertisols and Alfisols which developed over Pleistocene terraces flanking the Gulf Coast. It is often characterized by a ridge-and-swale or mound-and-intermound microtopography and encompasses both upland and wetland plant communities. Upland dominants include *Schizachyrium scoparium*, *Paspalum plicatulum*, *Sorghastrum nutans*, and *Andropogon gerardii*. Wetland dominants in undisturbed occurrences include *Panicum virgatum* and *Tripsacum dactyloides*; disturbed occurrences may be dominated by *Andropogon glomeratus*. Some estimates state that 99% of coastal prairie has been lost through conversion to other uses and environmental degradation due to the interruption of important ecological processes, such as fire, needed to maintain this system. In the absence of regular fire, this system will be invaded by woody shrubs and trees.

DISTRIBUTION

Range: Along the coast of Louisiana and Texas

Divisions: 203:C

TNC Ecoregions: 31:C

Subnations: LA, TX

Associations:

- *Andropogon gerardii* - *Panicum virgatum* - *Schizachyrium scoparium* - *Schizachyrium tenerum* - *Helianthus mollis* Herbaceous Vegetation (CEGL007938, G1)
- *Andropogon glomeratus* var. *pumilus* Herbaceous Vegetation (CEGL004099, GNA)
- *Andropogon virginicus* var. *virginicus* Herbaceous Vegetation (CEGL004044, GNA)
- *Baccharis halimifolia* Successional Shrubland (CEGL004657, GNA)
- *Euthamia leptcephala* - *Helianthus angustifolius* - *Boltonia asteroides* - *Spartina patens* Herbaceous Vegetation (CEGL007936, G1)
- *Panicum virgatum* - *Tripsacum dactyloides* - (*Panicum hemitomon*) Herbaceous Vegetation (CEGL007937, G1)
- *Schizachyrium scoparium* - *Paspalum plicatulum* - *Sorghastrum nutans* - *Dichantherium oligoanthos* - *Paspalum setaceum* - *Symphytotrichum pratense* Alfisol Herbaceous Vegetation (CEGL002208, G1)
- *Schizachyrium scoparium* - *Sorghastrum nutans* - *Paspalum plicatulum* - *Carex microdonta* - *Neptunia lutea* Vertisol Herbaceous Vegetation (CEGL004519, G1)

- *Schizachyrium scoparium* - *Triplasis purpurea* - *Eriogonum multiflorum* - *Liatris elegans* var. *carizzana* Herbaceous Vegetation (CEGL008483, G1)

High-ranked species: *Eleocharis wolfii* (G3G4)

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: In Louisiana, this system grades coastward into marshes of the chenier plain and inland into West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191). In Texas this system generally grades coastward into a saline prairie or salt marsh system and inland into West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods (CES203.191), or oak woodland vegetation. Degraded examples are often dominated by the invasive exotic *Triadica sebifera*. Relatively undisturbed natural depressions (potholes) occurring within the upland matrix units of this system are included in Texas-Louisiana Coastal Prairie Pondshore (CES203.541).

SOURCES

References: Comer et al. 2003

Version: 06 Feb 2003

Concept Author: J. Teague

Stakeholders: Southeast

LeadResp: Southeast

CES203.278 WEST GULF COASTAL PLAIN PINE-HARDWOOD FLATWOODS

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Pimple mounds; Extensive Wet Flat; Needle-Leaved Tree; Broad-Leaved Deciduous Tree

Concept Summary: This system represents predominately dry flatwoods of limited areas of inland portions of the West Gulf Coastal Plain. These areas are usually found on nonriverine, Pleistocene high terraces. Soils are fine-textured and hardpans may be present in the subsurface. The limited permeability of these soils contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to elsewhere as xerohydric. Saturation occurs not from overbank flooding but typically whenever precipitation events occur. Local topography is a complex of ridges and swales, often in close proximity to one another. Ridges tend to be much drier than swales, which may hold water for varying periods of time. Within both ridges and swales there is vegetation variability relating to soil texture and moisture and disturbance history. Driest ridges support *Pinus taeda* and *Quercus stellata*; more mesic ridges have *Pinus taeda* with *Quercus alba* and species such as *Symplocos tinctoria* and *Viburnum dentatum*. Fire may have been an important natural process in some examples of this system (T. Foti pers. comm.).

Comments: Embedded swales tend to support hardwood forests or swamps, often heavily oak-dominated with species tolerant of some inundation such as *Quercus phellos* and *Quercus laurifolia* with sparse coverage of wetland herbs such as *Carex glaucescens*. Some swales support unusual pockets of *Fraxinus caroliniana* and *Crataegus* spp.

DISTRIBUTION

Range: This system is found in the inland portions of the West Gulf Coastal Plain.

Divisions: 203:C

TNC Ecoregions: 40:C, 41:C

Subnations: AR, LA, OK?, TX

Associations:

- *Pinus taeda* - *Quercus alba* - (*Fagus grandifolia*) / *Ilex opaca* / *Smilax pumila* - *Mitchella repens* Forest (CEGL007525, G3G4)
- *Pinus taeda* - *Quercus stellata* / *Crataegus* spp. Woodland (CEGL002112, G2G3?)
- *Quercus alba* - *Carya alba* / *Symplocos tinctoria* / *Mitchella repens* Forest (CEGL007980, G3?)
- *Quercus stellata* - *Pinus taeda* Flatwoods Depression Forest (CEGL008587, G2G3)

High-ranked species: *Bufo houstonensis* (G1)

Environment: Areas occupied by this system are usually found on nonriverine, Pleistocene high terraces. Soils are fine-textured and hardpans may be present in the subsurface. The limited permeability of these soils contributes to shallowly perched water tables during portions of the year when precipitation is greatest and evapotranspiration is lowest. Soil moisture

fluctuates widely throughout the growing season, from saturated to very dry, a condition sometimes referred to elsewhere as xerohydric. Saturation occurs not from overbank flooding but typically whenever precipitation events occur. Local topography is a complex of ridges and swales, often in close proximity to one another. Ridges tend to be much drier than swales, which may hold water for varying periods of time.

SOURCES

References: Comer et al. 2003

Version: 31 Mar 2003

Concept Author: R. Evans

Stakeholders: Midwest, Southeast

LeadResp: Southeast

CES203.253 ATLANTIC COASTAL PLAIN SANDHILL SEEP

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.)

Diagnostic Classifiers: Seepage-Fed Sloping

Concept Summary: This sandhill seep system occurs in small patches on slopes in dissected terrain, where a clay lens or other impermeable layer forces groundwater to the surface as seepage. This type occurs largely in the Fall-line Sandhills region of the Carolinas and Georgia but also rarely in other parts of the Atlantic Coastal Plain. Soils are seasonally to permanently saturated by seepage and range from sandy or clayey to mucky. Vegetation is variable and complex in composition and structure, consisting of a mixture of plants of pine savannas and streamhead pocosins, but contrasting with both in structure and proportions. The tree canopy may be open or absent, and patches of dense shrubs, dense grass, ferns, and various mixtures may be present. Fire is a crucial determinant of structure and composition; it tends to occur in a variable and patchy pattern that is driven by both the fire regime of the surrounding system and the wetness of the seep vegetation at the time.

Comments: This system is distinguished from Atlantic Coastal Plain Northern Wet Longleaf Pine Savanna and Flatwoods (CES203.265) by having wetland hydrology driven by seepage rather than seasonal high water table, and by vegetational and landscape differences. Occurs rarely in southeastern Georgia in escarpment areas which have greater topography than is locally typical, and perched water tables which flow to the surface in sloping areas.

DISTRIBUTION

Range: This system occurs from east-central North Carolina to central Georgia, primarily in the Fall-line Sandhills region but occasionally occurring in the Outer Coastal Plain. For example, this system occurs in limited parts of southeastern Georgia associated with the topography of old escarpments. It occurs primarily in the Atlantic drainage but is rarely represented in the Gulf drainage (such as at Fort Benning, Georgia).

Divisions: 203:C

TNC Ecoregions: 53:C, 56:C, 57:C

Subnations: GA, NC, SC

Associations:

- (*Pinus palustris*, *Pinus serotina*) / *Ctenium aromaticum* - *Muhlenbergia expansa* - *Calamovilfa brevipilis* Woodland (CEGL003659, G2)
- *Arundinaria gigantea* ssp. *tecta* Shrubland (CEGL003843, G1)
- *Clethra alnifolia* - *Toxicodendron vernix* / *Aristida stricta* - *Osmunda cinnamomea* - *Sarracenia* spp. Shrub Herbaceous Vegetation (CEGL004467, G2?)
- *Gaylussacia frondosa* - *Clethra alnifolia* - *Arundinaria gigantea* ssp. *tecta* / *Aristida stricta* - *Pteridium aquilinum* var. *pseudocaudatum* Herbaceous Vegetation (CEGL004468, G3?)
- *Ilex coriacea* - *Lyonia lucida* - *Smilax laurifolia* Shrubland (CEGL004666, G3G4)
- *Pinus palustris* - *Pinus serotina* / *Ilex glabra* - *Lyonia lucida* / *Ctenium aromaticum* Woodland (CEGL003860, G3)

High-ranked species: *Agalinis aphylla* (G3G4), *Balduina atropurpurea* (G2), *Chelone cuthbertii* (G3), *Cirsium lecontei* (G2G3), *Danthonia epilis* (G3G4), *Dionaea muscipula* (G3), *Eupatorium resinosum* (G3), *Fallicambarus danielae* (G2), *Hartwrightia floridana* (G2), *Helenium brevifolium* (G3G4), *Lachnocaulon beyrichianum* (G3), *Lilium iridollae* (G2), *Lysimachia asperulifolia* (G3), *Lysimachia loomisii* (G3), *Parnassia caroliniana* (G3), *Parnassia grandifolia* (G3), *Platanthera blephariglottis* var. *conspicua* (G4G5T3T4), *Platanthera integra* (G3G4), *Polygala hookeri* (G3), *Rhynchospora macra* (G3),

Rhynchospora pallida (G3), Sarracenia rubra ssp. rubra (G3T3), Solidago verna (G3), Tofieldia glabra (G3), Xyris scabrifolia (G3)

Environment: Occurs on gentle to steep slopes of dissected areas in interbedded sand and clay, largely in the Fall-line Sandhills region but rarely in other parts of the Atlantic Coastal Plain. Sites are seasonally to permanently saturated with seeping groundwater, forced to the surface by an impermeable layer such as a clay bed. Soils may be sandy, clayey, or in the wettest sites, mucky. The hydrological connection to adjacent Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254), whose well-drained sandy soils are the source of seepage water, is crucial. Fire is a crucial natural force, and is also dependent on the adjacent systems.

Vegetation: Vegetation is a potentially diverse mixture of plants of wet savannas and pocosins. Vegetation structure may vary widely, with dense shrubs, dense herbs, or mixtures of shrubs and herbs, and with an open tree canopy or absent tree canopy occurring in complexes or in different patches. *Pinus palustris*, *Pinus serotina*, or several hardwood species may dominate the canopy. Characteristic Streamhead Pocosin shrubs such as *Ilex glabra*, *Lyonia lucida*, *Clethra alnifolia*, *Toxicodendron vernix*, *Ilex coriacea*, and *Zenobia pulverulenta* may mix with flatwoods shrubs such as *Gaylussacia frondosa* and *Kalmia carolina*. The herbs are primarily species shared with wet savannas, such *Aristida stricta*, *Calamovilfa brevifolia*, *Ctenium aromaticum*, *Andropogon glomeratus*, and a variety of showy forbs and insectivorous plants, but often occur in very different proportions. Large wetland ferns such as *Osmunda cinnamomea*, *Osmunda regalis*, and *Pteridium aquilinum* also often dominate.

Dynamics: Fire is the predominant natural dynamic force in this system, and is critical in determining its structure and even its identity. Fire regime is dominated by the fire regime of the surrounding system, which naturally burned every few years, but is modified by the wetness and flammability of the seep vegetation. Some fires do not penetrate parts of the seeps, creating variable age and vegetation structure. Areas that seldom burn have dense shrubs, while areas that burn frequently are dominated by herbs. With long absence of fire, many seeps become indistinguishable from Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin, and Baygall (CES203.252). Canopy dynamics are probably driven mainly by fire, with hot fires killing the less fire-tolerant trees and creating a fine mosaic or zoned complex of older trees, younger regeneration, and treeless areas. Shrubs and herbs readily sprout after fires, but relative proportions are controlled by frequency of fire.

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch, with occurrences ranging from a fraction of an acre to several acres. Patches sometimes occur in complexes in close proximity, but as often are isolated. Some seeps are linear bodies stretching across slopes, some are linear running downslope, and some are small oval bodies.

Heterogeneity: Patches of this system are small and are usually homogeneous. Occasionally they will contain small patches of Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin, and Baygall (CES203.252) or Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254). Within the system, most occurrences will contain only one association and few will contain more than two.

Adjacent Ecological System Comments: Generally surrounded by Atlantic Coastal Plain Fall-line Sandhills Longleaf Pine Woodland (CES203.254). Sometimes interspersed or grading to Atlantic Coastal Plain Streamhead Seepage Swamp, Pocosin, and Baygall (CES203.252) on one side.

SOURCES

References: Comer et al. 2003

Version: 23 Sep 2002

Concept Author: M. Schafale and R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES203.495 SOUTHERN COASTAL PLAIN SINKHOLE

Primary Division: Gulf and Atlantic Coastal Plain (203)

Land Cover Class: Barren

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland

Diagnostic Classifiers: Rock Outcrops/Barrens/Glades

Concept Summary: This system consists of deep sinkhole depressions with steep vertical walls of exposed limestone in the Gulf Coastal Plain of Florida and Georgia (other depressions formed in karstic regions that are shallow and lacking in steep vertical walls with exposed rock are accommodated by other systems). These cylindrical- or conical-shaped depressions form in karstic environments where cavities have been eroded in underlying limestone. As cavities enlarge, cavern roofs eventually collapse forming these steep-sided depressions. Some examples drain readily and contain standing water for short periods of time, while others contain permanent lakes. The steep-sided limestone walls are typically sparsely vegetated with

mosses, liverworts, and ferns, with occasional herbs and shrubs in crevices where organic soils have developed (FNAI 1990). The steepness and depth of these depressions help create a generally moist microclimate which is often enhanced by seepage from surrounding uplands, and the presence of standing water.

Comments: Excluded from this system are sinkholes of extreme southern Florida and the Mid-Atlantic Coastal Plain of the Carolinas which do not develop such extreme depth and microclimatic features.

DISTRIBUTION

Range: Gulf Coastal Plain of Florida and Georgia.

Divisions: 203:C

TNC Ecoregions: 53:C, 55:C

Subnations: FL, GA

Associations:

- *Adiantum capillus-veneris* - *Thelypteris kunthii* / *Dumortiera hirsuta* Herbaceous Vegetation (CEGL004717, G3?)
- *Adiantum tenerum* - *Parietaria praetermissa* - *Arenaria lanuginosa* Herbaceous Vegetation (CEGL004469, G2?)

SOURCES

References: Comer et al. 2003, FNAI 1990

Version: 14 Dec 2004

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES411.365 SOUTH FLORIDA CYPRESS DOME

Primary Division: Caribbean (411)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional

Concept Summary: This system is found primarily in the Everglades and Big Cypress regions. This system consists of small forested wetlands in poorly drained depressions which are underlain by an impervious layer that impedes drainage and traps precipitation. They receive their common name from the unique dome-shaped appearance in which trees in the center are higher than those around the sides (Monk and Brown 1965). *Taxodium ascendens* is the dominant tree, with the oldest and largest individuals characteristically occupying the center, and smaller and younger individuals around the margins. Pools of stagnant, highly acid water may stand in the center of these depressions ranging from 1-4 feet in depth, but becoming increasingly shallow along the margins. The understory flora is typified by species with tropical affinities.

DISTRIBUTION

Range: Endemic to south Florida.

Divisions: 411:C

TNC Ecoregions: 54:C

Subnations: FL

Associations:

- *Taxodium ascendens* / *Annona glabra* / *Bacopa caroliniana* Forest (CEGL007414, G2?)
- *Taxodium ascendens* / *Chrysobalanus icaco* - *Ficus aurea* - *Persea palustris* Forest (CEGL007416, G2?)

High-ranked species: *Aeschynomene pratensis* (G1), *Encyclia cochleata* var. *triandra* (G4G5T2), *Lythrum flagellare* (G2), *Polyradicion lindenii* (G2G4)

Environment: This system occurs in areas of low relief, occupying poorly drained to permanently wet depressions. Pools of stagnant, highly acid water may stand in the center of these depressions ranging from 1-4 feet in depth, but becoming increasingly shallow along the margins.

SOURCES

References: Comer et al. 2003, Monk and Brown 1965

Version: 16 Dec 2002

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES411.054 SOUTH FLORIDA DEPRESSION POND SHORE

Primary Division: Caribbean (411)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system occupies shallow depressional wetlands in southern and south-central Florida. As currently defined, this system includes a variety of wetlands occupying somewhat different environments. Included for now in this concept are isolated drainages or seasonal ponds as well as solution holes (may have only subsurface or historic water presence), and possibly the shores of large natural lakes. Examples found in these different environments tend to have obviously different landscape contexts, and often different floristics. For instance, examples embedded in Florida Dry Prairie (CES203.380) and/or South Florida Pine Flatwoods (CES411.381) tend to display distinct vegetation zones (Winchester et al. 1985, Huffman and Judd 1988). In contrast, solution holes embedded in South Florida Pine Rockland (CES411.367) and/or South Florida Hardwood Hammock (CES411.287) are small (may be less than 1 to 15 m across and less than 1 to 3+ m deep) and therefore tend to lack zonal vegetation (M. Fellows pers. comm.). More detailed information is needed on the range of vegetation present across this system. Huffman and Judd (1988) provide information on some examples of this system in southwestern Florida.

Comments: Examples of South Florida Freshwater Slough and Gator Hole (CES411.485) are generally larger and deeper water wetlands, usually connected with distinct drainageways.

DISTRIBUTION

Range: Endemic to south Florida.

Divisions: 411:C

TNC Ecoregions: 54:C

Subnations: FL

Associations:

- *Eleocharis interstincta* - *Pontederia cordata* - *Crinum americanum* Herbaceous Vegetation (CEGL003975, G2G3)
- *Panicum hemitomon* Tropical Herbaceous Vegetation (CEGL003980, G3?)
- *Schoenoplectus tabernaemontani* Tropical Herbaceous Vegetation (CEGL003986, G3G5)
- *Typha domingensis* - *Pontederia cordata* Herbaceous Vegetation (CEGL003988, G3?)
- *Zizaniopsis miliacea* Subtropical Herbaceous Vegetation (CEGL003989, G2G4Q)

High-ranked species: *Echinochloa paludigena* (G3Q), *Ludwigia curtissii* (G3G4), *Neofiber alleni* (G3), *Selaginella eatonii* (G2G3), *Tectaria coriandrifolia* (G2G4)

Vegetation: According to Huffman and Judd (1998) some examples of this system tend to display distinct vegetation zones (see also Winchester et al. 1985). In these cases, *Aristida palustris* is characteristic and possibly *Hypericum fasciculatum* depending upon fire history. A large number of other wetland species may be present, such as *Xyris jupicai*, *Rhexia cubensis*, *Rhynchospora filifolia*, and others. Deeper zones dominated by *Pontederia cordata*; as well as "heads" of woody species (*Cephalanthus occidentalis*, *Salix caroliniana*, *Persea palustris*) also may be present. More floristic information is needed from examples of this system found in other parts of south Florida.

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: May be embedded in Florida Dry Prairie (CES203.380), South Florida Pine Flatwoods (CES411.381), South Florida Pine Rockland (CES411.367) and/or South Florida Hardwood Hammock (CES411.287).

SOURCES

References: Comer et al. 2003, Fellows pers. comm., Huffman and Judd 1998

Version: 25 Aug 2003

Concept Author: R. Evans

Stakeholders: Southeast

LeadResp: Southeast

CES205.687 EASTERN GREAT PLAINS WET MEADOW, PRAIRIE, AND MARSH

Primary Division: Eastern Great Plains (205)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system is found along creeks and streams from Nebraska and Iowa to Illinois, and from Minnesota to Texas. It is also found along lake borders, especially in the northern extension of its range into Minnesota. It is often adjacent to a floodplain system, but is devoid of trees and riparian vegetation. It is also distinct from upland prairie systems by having more hydrology, especially associated with silty, dense clay soils that are often hydric soils, classified as Vertic Haplaquolls. The landform is usually floodplain or poorly drained, relatively level land. The vegetation is dominated by *Spartina pectinata*, *Tripsacum dactyloides*, numerous large sedges, such as *Carex frankii* and *Carex hyalinolepis*, and in wetter areas, *Eleocharis* spp. Other emergent marsh species such as *Typha* spp. can be associated with this system. Forbs can include *Helianthus grosseserratus*, *Vernonia fasciculata*, and *Physostegia virginiana*. Fire has had the primary influence on keeping these wet areas free of trees. Other dynamic processes include grazing and flooding (often in the late spring). Many areas have been converted to agricultural, but this usually requires some sort of drainage.

DISTRIBUTION

Range: This system is found throughout the northeastern Great Plains ranging from eastern Kansas to western Illinois and north into Minnesota.

Divisions: 205:C

TNC Ecoregions: 35:C, 36:C, 45:P, 46:P

Subnations: IA, IL, KS, MN, MO, ND, NE, SD

Associations:

- *Calamagrostis canadensis* - *Phalaris arundinacea* Herbaceous Vegetation (CEGL005174, G4G5)
- *Calamagrostis stricta* - *Carex sartwellii* - *Carex praegracilis* - *Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Carex aquatilis* - *Carex* spp. Herbaceous Vegetation (CEGL002262, G4?)
- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Carex lacustris* Herbaceous Vegetation (CEGL002256, G4G5)
- *Carex pellita* - *Calamagrostis stricta* Herbaceous Vegetation (CEGL002254, G3G5)
- *Carex rostrata* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257, G4G5)
- *Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Ceratophyllum demersum* Herbaceous Vegetation (CEGL004528, GNR)
- *Cornus sericea* - *Salix* (*bebbiana*, *discolor*, *petiolaris*) / *Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Cornus sericea* - *Salix* spp. - (*Rosa palustris*) Shrubland (CEGL002186, G5)
- *Impatiens pallida* - *Cystopteris bulbifera* - *Adoxa moschatellina* - (*Chrysosplenium iowense*, *Aconitum noveboracense*) Herbaceous Vegetation (CEGL002387, G2)
- *Nuphar lutea* ssp. *advena* - *Nymphaea odorata* Herbaceous Vegetation (CEGL002386, G4G5)
- *Polygonum amphibium* - (*Polygonum hydropiperoides*) Seasonally Flooded Herbaceous Vegetation (CEGL004699, G4G5)
- *Polygonum* spp. - Mixed Forbs Herbaceous Vegetation (CEGL002430, G4G5)
- *Potamogeton nodosus* Herbaceous Vegetation (CEGL004529, GNR)
- *Potamogeton* spp. - *Ceratophyllum* spp. Midwest Herbaceous Vegetation (CEGL002282, G5)
- *Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation (CEGL005240, GNR)
- *Sagittaria latifolia* - *Sagittaria longiloba* Herbaceous Vegetation (CEGL004525, GNR)
- *Schoenoplectus acutus* - (*Schoenoplectus fluviatilis*) Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Schoenoplectus fluviatilis* - *Schoenoplectus* spp. Herbaceous Vegetation (CEGL002221, G3G4)
- *Schoenoplectus maritimus* - *Atriplex patula* - *Eleocharis parvula* Herbaceous Vegetation (CEGL005111, G1)
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Spartina pectinata* - *Calamagrostis stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002027, G3?)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* - *Lythrum alatum* - (*Oxypolis rigidior*) Herbaceous Vegetation (CEGL002224, G3?)
- *Spartina pectinata* - *Carex* spp. - *Calamagrostis canadensis* Sand Herbaceous Vegetation (CEGL005178, G3?)
- *Spiraea tomentosa* - *Salix humilis* / *Andropogon gerardii* - *Panicum virgatum* Shrubland (CEGL005069, G1Q)
- *Stuckenia pectinata* - *Ceratophyllum demersum* Herbaceous Vegetation (CEGL002281, GNR)
- *Typha* (*angustifolia*, *domingensis*, *latifolia*) - *Schoenoplectus americanus* Herbaceous Vegetation (CEGL002032, G3G4)
- *Typha latifolia* - *Thalia dealbata* Herbaceous Vegetation (CEGL004526, GNR)
- *Typha* spp. - *Schoenoplectus acutus* - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229, G4?)

- *Typha* spp. Midwest Herbaceous Vegetation (CEGL002233, G5)

High-ranked species: *Calephelis muticum* (G3), *Eleocharis wolfii* (G3G4), *Platanthera leucophaea* (G3), *Schoenoplectus hallii* (G2)

Environment: This system is found primarily on silty and/or dense clay, hydric soils, usually classified as Vertic Haplaquolls. It is often found within poorly drained, relatively level areas.

Vegetation: *Spartina pectinata*, *Tripsacum dactyloides*, numerous large sedges, such as *Carex frankii* and *Carex hyalinolepis* dominate this system. In wetter areas, *Eleocharis* spp. and *Typha* spp. may be significant. Forbs such as *Helianthus grosseserratus*, *Vernonia fasciculata*, and *Physostegia virginiana* also may be common. Shrub species can be present, especially in the northern range of this system, however, they are usually insignificant compared to the prairie and meadow species.

Dynamics: Fire is the major dynamic process that helps maintain the herbaceous nature of this system and prevents trees from establishing. Grazing and periodic flooding can also influence this system.

SOURCES

References: Comer et al. 2003, Lauver et al. 1999, Steinauer and Rolfsmeier 2000

Version: 05 Mar 2003

Concept Author: S. Menard and K. Kindscher

Stakeholders: Canada, Midwest

LeadResp: Midwest

CES301.460 SOUTH TEXAS DUNE AND COASTAL GRASSLAND

Primary Division: Madrean Semidesert (301)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: This system includes non-tidal maritime grasslands occurring on barrier islands and mainland areas near the coast of southern Texas. This includes grasslands of primary and secondary dunes, interdune swales, barrier flats, and the mainland. Some examples of this system naturally occurred as an open matrix of midgrass species within native mesquite - acacia shrublands dominated by *Prosopis glandulosa*, *Acacia farnesiana*, and *Acacia rigidula* but have become shrub-dominated due to the lack of fire. In many areas this system has been virtually eliminated due to conversion to tame pasture, cropland, or due to lack of burning.

DISTRIBUTION

Range: This system ranges from Matagorda Island south along the northern Gulf of Mexico.

Divisions: 301:C

TNC Ecoregions: 31:C

Subnations: TX

Associations:

- *Acacia rigidula* Shrubland (CEGL003874, G4G5)
- *Bothriochloa barbinodis* - *Chloris pluriflora* Herbaceous Vegetation (CEGL002236, G2?)
- *Paspalum vaginatum* Herbaceous Vegetation (CEGL004114, G3G4)
- *Pennisetum ciliare* Herbaceous Vegetation (CEGL004925, GNA)
- *Prosopis glandulosa* var. *glandulosa* - *Celtis pallida* / *Opuntia* spp. - *Xylothamia palmeri* Woodland (CEGL007787, G4G5)
- *Prosopis glandulosa* var. *glandulosa* / (*Celtis pallida*, *Phaulothamnus spinescens*, *Ziziphus obtusifolia* var. *obtusifolia*) Woodland (CEGL002132, G2?)
- *Prosopis glandulosa* var. *glandulosa* / *Celtis pallida* - *Opuntia* spp. Woodland (CEGL007756, GNA)
- *Spartina patens* - *Fimbristylis (caroliniana, castanea)* - (*Panicum virgatum*) Herbaceous Vegetation (CEGL007836, G2G3)
- *Uniola paniculata* - (*Panicum amarum*) - *Croton punctatus* Herbaceous Vegetation (CEGL002218, G3?)

SOURCES

References: Comer et al. 2003

Version: 13 Jan 2003

Concept Author: J. Teague

Stakeholders: Southeast

LeadResp: Southeast

CES303.657 EDWARDS PLATEAU GRANITIC FOREST, WOODLAND AND GLADE

Primary Division: Western Great Plains (303)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Isolated Wetland [Strictly Isolated]

Concept Summary: This upland matrix system occurs primarily on coarse soils derived from the weathering of underlying granites in the Llano Uplift region of Texas. The underlying granitic substrate determines the range of this system. It is comprised of a mosaic of vegetation types, including closed-canopy forests, open woodlands, savannas and sparsely vegetated rock outcrops. Common trees include *Quercus marilandica*, *Quercus fusiformis*, *Quercus stellata*, *Carya texana*, *Ulmus crassifolia*, and *Prosopis glandulosa*. Subcanopy species may include *Diospyros texana*, *Ungnadia speciosa*, *Ziziphus obtusifolia* var. *obtusifolia*, *Eysenhardtia texana*, *Aesculus glabra* var. *arguta*, *Opuntia engelmannii* var. *lindheimeri* (= *Opuntia lindheimeri*), *Yucca elata*, *Nolina texana*, and *Opuntia leptocaulis*. Grasslands may be dominated by *Schizachyrium scoparium*, *Sorghastrum nutans*, *Panicum virgatum*, *Bouteloua hirsuta*, *Bouteloua curtipendula*, *Nassella leucotricha*, *Campanula reverchonii*, and *Plantago wrightiana*. Granitic glades and barrens are sparsely vegetated by crustose and foliose lichens, several ferns and fern allies, and cacti. This system also includes small (up to 16 m in diameter) shallow depressions that hold rainwater and support wetland flora including the Texas endemic, *Isoetes lithophila*.

Comments: This ecological system is defined to include a diversity of vegetation occurring on granitic outcrops and on soils that have developed over these outcrops in central Texas. In comparison to other areas of the U.S. where sparsely vegetated glades and barrens may be defined separately from the woodland surrounding them and/or the woodland separately from the forest (e.g., Southern Piedmont Granite Flatrock (CES202.329) just includes the sparsely vegetated barrens), these different vegetation types are included together here because they occur as an ecological complex or mosaic and they share floristic and geologic affinities that set them apart from the surrounding landscape. In the central mineral region of central Texas, granite glades and barrens are surrounded by areas of deeper soils derived from granite that support denser herbaceous or woody vegetation that includes many species found sparsely on the glades. In the eastern U.S. xeric granite outcrops are generally separated from one another by large areas of mesic to dry-mesic forests, whereas the granitic outcrops in central Texas are separated from one another by areas of coarse soils derived from the underlying granite. In addition, the xeric nature of the granite outcrops in the eastern U.S. is a stark contrast to the other vegetation in this humid temperate environment. Whereas, west of the dry line, the moisture availability of the granite outcrops in central Texas is not as starkly contrasted with the surrounding landscape. This has been suggested as a reason why the granite glades of central Texas do not support the degree of endemism that is found on the granite outcrops of the eastern U.S. (Walters and Wyatt 1982). The relationship of this ecological system to the granite glades and woodlands occurring in Oklahoma (currently included in Crosstimbers Oak Forest and Woodland (CES205.682)) needs to be further explored.

DISTRIBUTION

Range: This system is restricted to the Llano Uplift region of Texas.

Divisions: 303:C

TNC Ecoregions: 29:C

Subnations: TX

Associations:

- *Hilaria belangeri* - *Bouteloua curtipendula* Herbaceous Vegetation (CEGL002238, G3?)
- *Quercus fusiformis* - (*Quercus stellata*) / *Schizachyrium scoparium* Granite Woodland (CEGL004937, G2?)
- *Quercus fusiformis* - *Celtis laevigata* var. *reticulata* Woodland (CEGL002153, G4?)
- *Quercus fusiformis* / *Schizachyrium scoparium* Woodland (CEGL002115, G2G4)
- *Sedum nuttallianum* - *Selaginella peruviana* Granitic Outcrop Sparse Vegetation (CEGL004396, G2)

High-ranked species: *Campanula reverchonii* (G2), *Isoetes lithophila* (G2)

Environment: This system is restricted to the Llano Uplift, also known as the central mineral region of Texas. Though named as an uplift because it is an intrusion of Precambrian metamorphic rocks and large granitic massifs, this area is generally lower in elevation than the surrounding Edwards Plateau (Walters and Wyatt 1982, Riskind and Diamond 1988). At a regional scale, it is a topographic bowl, though rock outcrops such as Enchanted Rock often produce dramatic increases in elevation at a local scale. Aside from these massif intrusions, topography is generally level to rolling. The substrate of granites, gneisses and schists determines the range of this system in central Texas. Elevation ranges from 251 to 686 m above sea level (825-2250 feet). Rainfall averages about 76 cm (30 inches), peaking in May or June and September. The central mineral region occupies approximately 1.5 million hectares in central Texas (Riskind and Diamond 1988). Mineralogy of the

granitic material varies, with hornblende schist, graphite schist, quartz-feldspar gneiss and quartz-plagioclase-microcline rock common (Riskind and Diamond 1988). Soils are predominantly acidic.

Vegetation: This system is typified by a mosaic of mixed oak forests and savannas over coarse soils and sparsely vegetated areas on rock outcrops. Species such as *Quercus marilandica*, *Quercus fusiformis*, *Quercus stellata*, *Carya texana*, *Ulmus crassifolia*, and *Prosopis glandulosa* may dominate the canopy of this system. Some areas are characterized by dense forest patches (mottes) of *Quercus fusiformis*, with various mixtures of other oaks and shrubs surrounded by open grasslands. Subcanopy species may include *Diospyros texana*, *Ungnadia speciosa*, *Ziziphus obtusifolia* var. *obtusifolia*, *Eysenhardtia texana*, *Aesculus glabra* var. *arguta*, *Opuntia lindheimeri*, *Yucca elata*, *Nolina texana*, and *Opuntia leptocaulis*. The ground flora may contain *Schizachyrium scoparium*, *Sorghastrum nutans*, *Panicum virgatum*, *Bouteloua hirsuta*, *Bouteloua curtipendula*, *Nassella leucotricha*, *Campanula reverchonii*, and *Plantago wrightiana*.

In addition to oak woodlands and grasslands, this system also includes granitic glades and barrens. These are sparsely vegetated areas characterized by crustose and foliose lichens, several ferns and fern allies, and cacti, including *Cheilanthes lindheimeri*, *Pellaea ternifolia*, *Selaginella arenicola* ssp. *riddellii*, *Selaginella peruviana*, *Selaginella wrightii*, *Echinocereus reichenbachii*, and *Echinocereus triglochidiatus* (= *Echinocereus coccineus*). Other species that may occur in cracks and crevices or slight depressions with shallow, gravelly soil include *Eriogonum tenellum*, *Lechea san-sabeana*, *Sedum nuttallianum*, *Tripogon spicatus*, *Plantago wrightiana*, *Talinum parviflorum*, *Helenium amarum*, *Campanula reverchonii*, *Aphanostephus skirrhobasis*, and *Hypericum gentianoides*. Small-scale shallow vernal pools formed within barrens by weathering of the granitic surface support *Crassula aquatica*, *Sedum nuttallianum*, *Talinum parviflorum*, *Eleocharis montevidensis*, *Elatine brachysperma*, *Juncus diffusissimus*, *Allium canadense*, *Nothoscordum bivalve*, *Cooperia drummondii*, *Lepuropetalon spathulatum*, *Isoetes melanopoda*, and the Texas endemic *Isoetes lithophila*. Larger pools often exhibit a pattern of zonation of the vegetation as soil accumulates in the center. Crevices in the rock outcrops tend to support scattered, stunted individuals of trees and shrubs found in the adjacent woodland. Endemics or near-endemics occurring within this ecological system include *Isoetes lithophila*, *Campanula reverchonii*, *Eriogonum tenellum* var. *ramosissimum*, *Elatine brachysperma*, and *Tripogon spicatus*.

Dynamics: This ecological system is a complex of vegetation types. The different physiognomies are maintained by an interaction between site conditions and disturbance dynamics. The forest patches, woodlands, savannas and grasslands are thought to have been maintained historically by various fire frequencies and intensities. In the absence of natural or prescribed fire, increased cover of woody vegetation has increased in some occurrences. Native grazing may have also played a role in preventing woody encroachment though the rough terrain of much of this system would have limited the extent of native grazers.

SPATIAL CHARACTERISTICS

Spatial Summary: This system is the matrix system of the Llano Uplift area (EPA ecoregion 30D) of central Texas.

Size: As a complex, this system covered large areas (>2000 ha), but occurrences of individual physiognomies (forests, woodlands, grasslands, barrens) may occur as large (50-2000 ha) or small (1-50 ha) patches.

Heterogeneity: This ecological system is a complex of vegetation types, including forests, woodlands, grasslands and barrens.

Adjacent Ecological System Comments: This system is adjacent to Edwards Plateau Limestone Forest, Woodland and Glade (CES303.660), Edwards Plateau Limestone Shrubland (CES303.041), and is dissected by Edwards Plateau Mesic Canyon (CES303.038) and Western Great Plains Floodplain (CES303.678). A common component of Edwards Plateau Limestone Forest, Woodland and Glade (CES303.660), *Quercus buckleyi*, is conspicuously absent from Edwards Plateau Granitic Forest, Woodland and Glade (CES303.657).

SOURCES

References: Riskind and Diamond 1988, Southeastern Ecology Working Group n.d., Walters and Wyatt 1982, Whitehouse 1933

Version: 21 Apr 2005

Concept Author: J. Teague and L. Elliott

Stakeholders: Southeast

LeadResp: Southeast

CES303.666 WESTERN GREAT PLAINS CLOSED DEPRESSION WETLAND

Primary Division: Western Great Plains (303)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: Communities associated with the playa lakes in the southern areas of this province and the rainwater basins in Nebraska characterize this system. They are primarily upland depressional basins. This hydric system is typified by the presence of an impermeable layer such as a dense clay, hydric soil and is usually recharged by rainwater and nearby runoff. They are rarely linked to outside groundwater sources and do not have an extensive watershed. Ponds and lakes associated with this system can experience periodic drawdowns during drier seasons and years, and are often replenished by spring rains. *Eleocharis* spp., *Hordeum jubatum*, along with common forbs such as *Coreopsis tinctoria*, *Symphyotrichum subulatum* (= *Aster subulatus*), and *Polygonum pensylvanicum* (= *Polygonum bicorne*) are common vegetation in the wetter and deeper depression, while *Pascopyrum smithii* and *Buchloe dactyloides* are more common in shallow depressions in rangeland. Species richness can vary considerably among individual examples of this system and is especially influenced by adjacent land use, which is often agriculture, and may provide nutrient and herbicide runoff. Dynamic processes that affect these depressions are hydrological changes, grazing, and conversion to agricultural use.

Comments: Open and emergent marshes may be a separate system from wet meadows and wet prairies.

DISTRIBUTION

Range: This system can be found throughout the eastern portion of the Western Great Plains Division, however, it is most prevalent in the central states of Nebraska, Kansas and Oklahoma.

Divisions: 205:P, 303:C

TNC Ecoregions: 27:C, 28:C, 32:P, 33:C

Subnations: CO, KS, NE, NM?, OK, TX

Associations:

- *Argentina anserina* Herbaceous Vegetation [Provisional] (CEGL005825, GNA)
- *Eleocharis palustris* - (*Eleocharis compressa*) - *Leptochloa fusca* ssp. *fascicularis* Herbaceous Vegetation (CEGL002259, GNR)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Heteranthera limosa* - *Bacopa rotundifolia* - *Sagittaria latifolia* Herbaceous Vegetation (CEGL002279, GNR)
- *Hordeum jubatum* Herbaceous Vegetation (CEGL001798, G4)
- *Panicum obtusum* - *Buchloe dactyloides* Herbaceous Vegetation (CEGL001573, GNRQ)
- *Panicum obtusum* - *Panicum hallii* Herbaceous Vegetation (CEGL001575, GNR)
- *Pascopyrum smithii* - (*Elymus trachycaulus*) Clay Pan Herbaceous Vegetation (CEGL002239, GNR)
- *Pascopyrum smithii* - *Buchloe dactyloides* - (*Phyla cuneifolia*, *Oenothera canescens*) Herbaceous Vegetation (CEGL002038, G2G3)
- *Pascopyrum smithii* - *Distichlis spicata* Herbaceous Vegetation (CEGL001580, G4)
- *Pascopyrum smithii* - *Eleocharis* spp. Herbaceous Vegetation (CEGL001581, G1)
- *Pascopyrum smithii* - *Hordeum jubatum* Herbaceous Vegetation (CEGL001582, G4)
- *Pleuraphis mutica* - *Panicum obtusum* Herbaceous Vegetation (CEGL001639, G3)
- *Polygonum* spp. - *Echinochloa* spp. - *Distichlis spicata* Playa Lake Herbaceous Vegetation (CEGL002039, G2G4)
- *Sarcobatus vermiculatus* / *Leymus cinereus* Shrubland (CEGL001366, G3)
- *Schoenoplectus americanus* - *Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Spartina pectinata* - *Eleocharis* spp. - *Carex* spp. Herbaceous Vegetation (CEGL002223, G2G4)

High-ranked species: *Ambrosia linearis* (G3), *Branchinecta potassa* (G3), *Eleocharis wolfii* (G3G4)

Environment: This system is typified by upland depressional basins with an impermeable layer such as dense clay, hydric soils. Rainwater and runoff primarily recharge this system and it is rarely linked to outside groundwater sources.

Vegetation: Species richness varies considerably among individual examples of this system. Commonly, *Eleocharis* spp., *Hordeum jubatum*, along with *Coreopsis tinctoria*, *Symphyotrichum subulatum* (= *Aster subulatus*), and *Polygonum pensylvanicum* (= *Polygonum bicorne*) are found in the wetter and deeper depression. Shallower depressions in rangelands commonly contain *Pascopyrum smithii* and *Buchloe dactyloides*.

Dynamics: Hydrological changes, grazing and conversion to agriculture are the primary processes influencing this system.

SOURCES

References: Comer et al. 2003, Hoagland 2000, Lauver et al. 1999

Version: 14 Dec 2004

Concept Author: S. Menard and K. Kindscher

Stakeholders: Midwest, Southeast, West

LeadResp: Midwest

CES303.675 WESTERN GREAT PLAINS OPEN FRESHWATER DEPRESSION WETLAND

Primary Division: Western Great Plains (303)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system is composed of lowland depressions and also occurs along lake borders that have more open basins and a permanent water source through most of the year except during exceptional drought years. These areas are distinct from Western Great Plains Closed Depression Wetland (CES303.666) by having a large watershed and/or significant connection to the groundwater table. Some of the specific communities will also be found in the floodplain system and should not be considered a separate system in that case. These types should also not be considered a separate system if they are occurring in lowland areas of the prairie matrix only because of an exceptional wet year. A variety of species are part of this system, including *Typha* spp. and *Schoenoplectus* spp. The system includes submergent and emergent marshes, and associated wet meadows and wet prairies. These types can also drift into stream margins that are more permanently wet and linked directly to basin via groundwater flow from/into the pond or lake.

Comments: This system occurs widely throughout the western Great Plains, but in the arid shortgrass region, it is replaced by North American Arid West Emergent Marsh (CES300.729). Open and emergent marshes may be a separate system from wet meadows and wet prairies.

DISTRIBUTION

Range: This system can occur throughout the northwestern Great Plains Division, but not in the arid shortgrass region.

Divisions: 205:P, 303:C

TNC Ecoregions: 26:C, 33:C, 34:C, 37:?, 66:P, 67:P

Subnations: KS, MT, ND, NE, OK, SD, WY

Associations:

- *Alnus incana* Swamp Shrubland (CEGL002381, G5?)
- *Betula occidentalis* - *Dasiphora fruticosa* ssp. *floribunda* Shrubland (CEGL001083, G2Q)
- *Calamagrostis canadensis* - *Juncus* spp. - *Carex* spp. Sandhills Herbaceous Vegetation (CEGL002028, G3G4)
- *Calamagrostis stricta* - *Carex sartwellii* - *Carex praeagrabilis* - *Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Carex aquatilis* - *Carex* spp. Herbaceous Vegetation (CEGL002262, G4?)
- *Carex aquatilis* Herbaceous Vegetation (CEGL001802, G5)
- *Carex atherodes* Herbaceous Vegetation (CEGL002220, G3G5)
- *Carex interior* - *Eleocharis elliptica* - *Thelypteris palustris* Herbaceous Vegetation (CEGL002390, G1G2)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex pellita* - *Calamagrostis stricta* Herbaceous Vegetation (CEGL002254, G3G5)
- *Carex prairea* - *Schoenoplectus pungens* - *Rhynchospora capillacea* Herbaceous Vegetation (CEGL002267, G2)
- *Carex rostrata* - *Carex lacustris* - (*Carex vesicaria*) Herbaceous Vegetation (CEGL002257, G4G5)
- *Carex* spp. - *Triglochin maritima* - *Eleocharis quinqueflora* Marl Fen Herbaceous Vegetation (CEGL002268, G1?)
- *Carex stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002258, G4?)
- *Ceratophyllum demersum* Herbaceous Vegetation (CEGL004528, GNR)
- *Cornus sericea* - *Salix* (*bebbiana*, *discolor*, *petiolaris*) / *Calamagrostis stricta* Shrubland (CEGL002187, G3G4)
- *Eleocharis palustris* - (*Eleocharis compressa*) - *Leptochloa fusca* ssp. *fascicularis* Herbaceous Vegetation (CEGL002259, GNR)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Glyceria borealis* Herbaceous Vegetation (CEGL001569, G4)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Panicum virgatum* - (*Pascopyrum smithii*) Herbaceous Vegetation (CEGL001484, G2Q)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474, G5)
- *Polygonum amphibium* Permanently Flooded Herbaceous Vegetation [Placeholder] (CEGL002002, G5)
- *Polygonum pensylvanicum* - *Polygonum lapathifolium* Herbaceous Vegetation (CEGL002277, G4?)
- *Polygonum* spp. - *Echinochloa* spp. - *Distichlis spicata* Playa Lake Herbaceous Vegetation (CEGL002039, G2G4)
- *Potamogeton richardsonii* - *Myriophyllum spicatum* Herbaceous Vegetation (CEGL002006, G2Q)
- *Potamogeton* spp. - *Ceratophyllum demersum* Great Plains Herbaceous Vegetation (CEGL002044, G4G5)
- *Sagittaria latifolia* - *Leersia oryzoides* Herbaceous Vegetation (CEGL005240, GNR)
- *Sagittaria latifolia* - *Sagittaria longiloba* Herbaceous Vegetation (CEGL004525, GNR)
- *Schoenoplectus acutus* - (*Schoenoplectus fluviatilis*) Freshwater Herbaceous Vegetation (CEGL002225, G4G5)

- *Schoenoplectus acutus* - *Typha latifolia* - (*Schoenoplectus tabernaemontani*) Sandhills Herbaceous Vegetation (CEGL002030, G4)
- *Schoenoplectus tabernaemontani* - *Typha* spp. - (*Sparganium* spp., *Juncus* spp.) Herbaceous Vegetation (CEGL002026, G4G5)
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation (CEGL002623, G5)
- *Scolochloa festucacea* Herbaceous Vegetation (CEGL002260, G4G5)
- *Spartina pectinata* - *Calamagrostis stricta* - *Carex* spp. Herbaceous Vegetation (CEGL002027, G3?)
- *Spartina pectinata* - *Carex* spp. Herbaceous Vegetation (CEGL001477, G3?)
- *Spartina pectinata* - *Eleocharis* spp. - *Carex* spp. Herbaceous Vegetation (CEGL002223, G2G4)
- *Spartina pectinata* - *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001478, G3?)
- *Stuckenia pectinata* - *Ceratophyllum demersum* Herbaceous Vegetation (CEGL002281, GNR)
- *Stuckenia pectinata* - *Myriophyllum (sibiricum, spicatum)* Herbaceous Vegetation (CEGL002003, G3G4)
- *Stuckenia pectinata* - *Zannichellia palustris* Herbaceous Vegetation (CEGL002005, G3G4)
- *Typha (angustifolia, domingensis, latifolia)* - *Schoenoplectus americanus* Herbaceous Vegetation (CEGL002032, G3G4)
- *Typha (latifolia, angustifolia)* Western Herbaceous Vegetation (CEGL002010, G5)
- *Typha latifolia* - *Equisetum hyemale* - *Carex (hystericina, pellita)* Seep Herbaceous Vegetation (CEGL002033, G3)
- *Typha* spp. - *Schoenoplectus* spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228, G4G5)
- *Typha* spp. Great Plains Herbaceous Vegetation (CEGL002389, G4G5)

High-ranked species: *Eleocharis wolfii* (G3G4), *Schoenoplectus hallii* (G2)

Environment: This system is found within lowland depressions and along lakes that have more permanent water sources throughout the year. These areas typically have a large watershed and are connected to the groundwater sources. Examples may also drift into stream margins that are more permanently wet and linked to a basin via groundwater flow from/into a pond or lake. Those areas that are found within larger prairie matrix that are only lowland or wet because of an exceptional wet year are not part of this system.

Vegetation: Many species can be associated with this system with *Typha* spp. and *Schoenoplectus* spp. being common.

Dynamics: Hydrology is the primary process influencing this system. Grazing and conversion to agriculture can significantly impact the hydrology and species composition of this system.

SOURCES

References: Comer et al. 2003, Hoagland 2000, Lauver et al. 1999, Steinauer and Rolfsmeier 2000

Version: 14 Dec 2004

Stakeholders: Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

CES303.669 WESTERN GREAT PLAINS SALINE DEPRESSION WETLAND

Primary Division: Western Great Plains (303)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This ecological system is very similar to Western Great Plains Open Freshwater Depression Wetland (CES303.675) and Western Great Plains Closed Depression Wetland (CES303.666). However, strongly saline soils cause both the shallow lakes and depressions and the surrounding areas to be more brackish. Salt encrustations can occur on the surface in some examples of this system, and the soils are severely affected and have poor structure. Species that typify this system are salt-tolerant and halophytic species such as *Distichlis spicata*, *Sporobolus airoides*, and *Hordeum jubatum*. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some examples of this system which may allow for less salt-tolerant species to occur. Communities found within this system may also occur in floodplains (i.e., more open depressions) but probably should not be considered a separate system unless they transition to areas outside the immediate floodplain.

Comments: Open and emergent saline marshes may be a separate system from saline wet meadows and prairies.

DISTRIBUTION

Range: This system can occur throughout the Western Great Plains, but is likely more prevalent in the south-central portions of the division.

Divisions: 303:C

TNC Ecoregions: 26:?, 27:C, 28:C, 33:C, 34:?

Subnations: CO, KS, MT, ND, NE, NM, OK, SD, WY

Associations:

- *Calamagrostis stricta* - *Carex sartwellii* - *Carex praeegracilis* - *Plantago eriopoda* Saline Herbaceous Vegetation (CEGL002255, G2G3)
- *Distichlis spicata* - (*Hordeum jubatum*, *Poa arida*, *Sporobolus airoides*) Herbaceous Vegetation (CEGL002042, G3)
- *Distichlis spicata* - *Hordeum jubatum* - (*Poa arida*, *Iva annua*) Herbaceous Vegetation (CEGL002031, G2G3)
- *Distichlis spicata* - *Hordeum jubatum* - *Puccinellia nuttalliana* - *Suaeda calceoliformis* Herbaceous Vegetation (CEGL002273, G2G3)
- *Distichlis spicata* - *Schoenoplectus maritimus* - *Salicornia rubra* Herbaceous Vegetation (CEGL002043, G1G2)
- *Distichlis spicata* - *Spartina* spp. Herbaceous Vegetation (CEGL002275, G4)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Hordeum jubatum* Herbaceous Vegetation (CEGL001798, G4)
- *Pascopyrum smithii* - *Distichlis spicata* Herbaceous Vegetation (CEGL001580, G4)
- *Pascopyrum smithii* - *Hordeum jubatum* Herbaceous Vegetation (CEGL001582, G4)
- *Puccinellia nuttalliana* Herbaceous Vegetation (CEGL001799, G3?)
- *Salicornia rubra* Herbaceous Vegetation (CEGL001999, G2G3)
- *Sarcobatus vermiculatus* / *Distichlis spicata* - (*Puccinellia nuttalliana*) Shrub Herbaceous Vegetation (CEGL002146, GNR)
- *Sarcobatus vermiculatus* / *Pascopyrum smithii* - (*Elymus lanceolatus*) Shrub Herbaceous Vegetation (CEGL001508, G4)
- *Schoenoplectus americanus* - *Carex* spp. Herbaceous Vegetation (CEGL004144, GNR)
- *Schoenoplectus americanus* Great Plains Herbaceous Vegetation (CEGL002226, GNR)
- *Schoenoplectus maritimus* - *Schoenoplectus acutus* - (*Triglochin maritima*) Herbaceous Vegetation (CEGL002227, G3G5)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus pungens* - *Suaeda calceoliformis* Alkaline Herbaceous Vegetation (CEGL002040, G3G4)
- *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001587, G3G4)
- *Scolochloa festucacea* Herbaceous Vegetation (CEGL002260, G4G5)
- *Spartina pectinata* - *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001478, G3?)
- *Sporobolus airoides* Monotype Herbaceous Vegetation (CEGL001688, GUQ)
- *Sporobolus airoides* Northern Plains Herbaceous Vegetation (CEGL002274, GNR)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Stuckenia pectinata* - *Ruppia maritima* Herbaceous Vegetation (CEGL002004, G2?)
- *Stuckenia pectinata* - *Zannichellia palustris* Herbaceous Vegetation (CEGL002005, G3G4)
- *Typha* spp. - *Schoenoplectus* spp. - Mixed Herbs Great Plains Herbaceous Vegetation (CEGL002228, G4G5)
- *Typha* spp. Great Plains Herbaceous Vegetation (CEGL002389, G4G5)

High-ranked species: *Eleocharis wolfii* (G3G4), *Schoenoplectus hallii* (G2)

Environment: This system is distinct from the freshwater depression systems by its brackish nature caused by strongly saline soils. Salt encrustations could occur near the surface in some examples of this system.

Vegetation: Salt-tolerant and halophytic species such as *Distichlis spicata*, *Sporobolus airoides*, and *Hordeum jubatum* typify the system.

Dynamics: Hydrology processes primarily drive this system. Increases in precipitation and/or runoff can dilute the salt concentration and allow for less salt tolerant species to occur. Conversion to agriculture and pastureland can also impact this system, especially when it alters the hydrology of the system.

SOURCES

References: Comer et al. 2003, Hoagland 2000, Lauver et al. 1999, Steinauer and Rolfsmeier 2000

Version: 14 Dec 2004

Stakeholders: Midwest, Southeast, West

Concept Author: S. Menard and K. Kindscher

LeadResp: Midwest

CES303.661 GREAT PLAINS PRAIRIE POTHOLE

Primary Division: Western Great Plains (303)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Concept Summary: The prairie pothole system is found primarily in glaciated northern Great Plains of the United States and Canada, and 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 in these waters ranges from fresh to extremely saline. The flora and vegetation of this system is 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 responsible for a significant percentage of the annual production of many economically important waterfowl in North America and houses more than 50% of North American's migratory waterfowl with several species reliant on this system for breeding and feeding. Much of the original extent of this system has been converted to agriculture and only approximately 40-50% of the system remains undrained.

Comments: More data from Canada is needed to really define this system completely.

DISTRIBUTION

Range: This system can be found throughout the northern Great Plains ranging from central Iowa northeast to southern Saskatchewan and Alberta. It encompasses approximately 870,000 km² with approximately 80% of its range in southern Canada. It is also prevalent in North Dakota, South Dakota, and northern Minnesota.

Divisions: 205:C, 303:C

TNC Ecoregions: 34:C, 35:C, 66:P, 67:P

Subnations: AB, IA?, MB, MN, ND, SD, SK

Associations:

- *Carex lasiocarpa* - *Carex oligosperma* / *Sphagnum* spp. Herbaceous Vegetation (CEGL002265, G3G4)
- Northern Prairie Pothole Wetland Complex (CECX005705, G3G5)
- *Schoenoplectus acutus* - (*Schoenoplectus fluviatilis*) Freshwater Herbaceous Vegetation (CEGL002225, G4G5)
- *Schoenoplectus maritimus* - *Schoenoplectus acutus* - (*Triglochin maritima*) Herbaceous Vegetation (CEGL002227, G3G5)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)

High-ranked species: *Eleocharis wolfii* (G3G4), *Platanthera leucophaea* (G3)

Environment: 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 to 120 m 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.

Vegetation: The vegetation within this system is highly influenced by hydrology, salinity and dynamics. Potholes found within this system can vary in depth and duration, which will determine the local gradient of species. Likewise, plant species found within individual potholes of this system will be strongly influenced by periodic drought and wet periods. Deeper potholes with standing water throughout most of the year have a central zone of submersed aquatic vegetation. Potholes that dry during droughty times can have central zones dominated by either tall emergents or mid-height emergents depending on the depth of the marsh. Wet meadow species such as grasses, forbs and sedges can be found in potholes that are only flooded briefly in the spring. All of these types of potholes can be found within an example of this system. Grazing, draining, and mowing of this system can influence the distribution of these types of potholes and plant species within this system.

Dynamics: 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.

SOURCES

References: Comer et al. 2003, Johnson et al. 1987, Kantrud et al. 1989

Version: 05 Mar 2003

Concept Author: S. Menard

Stakeholders: Canada, Midwest

LeadResp: Midwest

CES304.060 NORTHERN ROCKY MOUNTAIN WOODED VERNAL POOL

Primary Division: Inter-Mountain Basins (304)

Land Cover Class: Woody Wetland

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional; Isolated Wetland [Strictly Isolated]

Concept Summary: Northern Rocky Mountain Wooded Vernal Pools are small shallow circumneutral freshwater wetlands that partially or totally dry up as the growing season progresses. They are known primarily from the Swan Valley in western Montana and from the Snake River Plain in Idaho. These vernal ponds and wetlands are usually filled with water over the fall, winter, and early spring, but then at least partially dry up towards the end of the growing season. Depending on annual patterns of temperature and precipitation the drying of the pond may be complete or partial by the fall. These sites are usually shallow and less than one meter in depth. The pool substrate is a poorly drained often clayey layer with shallow organic sediments. They are surrounded by a variety of tree species; *Populus trichocarpa* is commonly associated and to a lesser extent, *Populus tremuloides* and *Betula papyrifera*. Inflated sedge (*Carex vesicaria*) and reed canary grass (*Phalaris arundinacea*) are common plant associates as are a variety of shrubs.

DISTRIBUTION

Subnations: ID, MT

Associations:

-

High-ranked species: *Howellia aquatilis* (G3)

SPATIAL CHARACTERISTICS

SOURCES

References: Western Ecology Working Group n.d.

Concept Author: Western Ecology Group

LeadResp: West

CES304.764 COLORADO PLATEAU HANGING GARDEN

Primary Division: Inter-Mountain Basins (304)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Montane [Montane, Lower Montane]; Cliff (Landform); Cliff (Substrate); Sedimentary Rock; Temperate [Temperate Xeric]; Seepage-Fed Sloping; Forb; Fern; Graminoid; Saturated Soil

Concept Summary: Hanging gardens in the Colorado Plateau region are surrounded by an arid environment and associated with canyon country. These highly localized environments include canyonlands with perennial water sources (seeps) forming pocketed wetlands and draping vegetation across wet cliff faces. Three main garden types exist: alcove, terrace, or windowblind. Each is determined by the nature of the geological formation and the presence or absence of joint systems. They tend to occur at all exposures of the canyon walls, but they are always shaded for much to most of each day. Temperature and humidity are relatively stable compared to the surrounding environment. Most hanging gardens are dominated by herbaceous plants, and a number of these are endemic to this region. Common species include *Adiantum capillus-veneris*, *Adiantum pedatum*, *Mimulus eastwoodiae*, *Mimulus guttatus*, *Sullivantia hapemanii*, *Cirsium rydbergii*, and several species of *Aquilegia*.

DISTRIBUTION

Range: Colorado Plateau.

Divisions: 304:C
TNC Ecoregions: 19:C
Subnations: AZ, CO, UT

Associations:

- *Aquilegia micrantha* - *Mimulus eastwoodiae* Herbaceous Vegetation (CEGL002729, G2G3)
- *Aquilegia micrantha* Herbaceous Vegetation [Provisional] (CEGL002762, GNR)
- *Calamagrostis scopulorum* Hanging Garden Herbaceous Vegetation (CEGL002751, GNR)

High-ranked species: *Carex specuicola* (G2), *Erigeron kachinensis* (G2), *Mimulus eastwoodiae* (G3), *Platanthera zothecina* (G2)

Environment: Hanging gardens in the Colorado Plateau ecoregion are surrounded by an arid environment and associated with canyon country. Annual precipitation is low and varies from 5 to 14 inches. While mean annual temperatures are high, extreme temperatures are probably more important than means to the survival of plants. Summer temperatures greater than 100 degrees F are common. Complexity of the plant community within a hanging garden is a function of the quantity and quality of water, developmental aspects, and accessibility of plant species to it. They tend to occur at all exposures of the canyon walls, but they are always shaded for much to most of each day. Temperature and humidity are relatively stable compared to the surrounding environment. They vary in size, aspect, exposure to the elements, water quantity and quality, number of bedding planes, and amount of light received. Water quality, in some degree, controls the kinds of plants in hanging gardens. Quality of water is dictated by the nature of the formations through which the water passes. Water is often drinkable quality, however, water may be saline or laden with calcium, which results in tufa deposits in the gardens. Generally, however, water from the gardens is potable.

In the Colorado Plateau region, three main garden types exist: alcove, terrace, or windowblind. Each is determined by the nature of the geological formation and the presence or absence of joint systems. In general, the hanging gardens are the result of the ancient swales or valleys in a sand dune-swale system that developed between the Cretaceous and Pennsylvanian periods (65-310 mya). Massive sandstones seem to be best suited for alcove development coincidental with garden formation, some better than others. The formations with greatest development are the Navajo and Entrada, both of them cross-bedded, massive formations composed of wind-blown sand and containing ancient pond bottoms that serve as impervious bedding planes. The Wingate Formation lacks significant hanging gardens. The sands of formations suitable for hanging garden development were deposited mainly on lands, as dunes with interdunal valleys. The interdunal valleys were often the sites of lakes, whose bottoms were made impervious by accumulations of dust and other fine particles. Turned to stone, the ancient lake and pond basins continue to exist within the strata. Water percolating through the porous rock encounters the ancient bedding planes, still impervious and capable of holding water. When filled to overflowing, these bedding planes carry the water downward to the next bedding plane beneath or to another impervious stratum at the base of the formation. Joint systems within the rock act as passageways for water. Where the joint systems are exposed along canyon walls the water flows over the moist surfaces.

In the Utah High Plateaus, the hanging garden ecological system is associated with springs, seeps and waterfalls. The waterfall vegetation grows in the cracks behind and beside the waterfall and is best described as hanging gardens. In the seeps adjacent to waterfalls and in the splash zones at the base of waterfalls, the substrate is saturated during most of the growing season. The vegetation is continually wet, at least near the bases of the plants, and water can very commonly be seen dripping from leaves, exposed roots and old stems. Suitable growing sites are limited on the steep rock walls such that each of the available ledges has an abundance of plants which grow on it. Most of the hanging gardens in the Utah High Plateaus are associated with calcareous shales of the Green River Formation. Although large occurrences of hanging gardens are primarily associated with waterfalls, smaller occurrences occur along cliff seeps above the streams, especially in the Roan Plateau area.

Vegetation: The vegetation of hanging gardens is often comprised of few species, although the diversity of vegetation is much greater in the gardens on the Colorado Plateau versus those of the Utah High Plateaus. The vegetation may overlap with the nearby riparian vegetation, but there are a series of species that are unique to hanging gardens (Welsh 1989). Several species of algae are restricted to these hanging gardens. The classic alcove type of hanging garden in the Canyonlands of southeastern Utah consists of an overhanging back wall, a vaulted face wall, a detrital slope, and a plunge basin. The back and face walls support clinging plants of *Adiantum capillus-veneris*, *Primula specuicola*, *Mimulus eastwoodiae*, *Petrophyton caespitosum*, and several other species. The wet, sandy detritus supports *Carex aurea*, *Aquilegia micrantha*, *Calamagrostis scopulorum*, *Epipactis gigantea*, *Perityle specuicola*, *Dichanthelium acuminatum* (= *Panicum acuminatum*), *Cirsium rydbergii*, and *Zigadenus vaginatus*. A fringing margin of *Cercis canadensis* var. *texensis* (= *Cercis occidentalis*), *Celtis laevigata* var. *reticulata* (= *Celtis reticulata*), and *Quercus gambelii* often occurs outward from the

footslope where the plants tend to conceal the alcove base. The outer and drier edges support grasses typical of the prairies and plains of the western U.S. In the Utah High Plateaus gardens, the dominants are usually *Sullivantia hapemanii* var. *purpusii* and *Aquilegia barnebyi* with *Mimulus guttatus* common.

Variation in hanging garden vegetation varies from canyon to canyon as well as separate alcoves within a canyon. The vegetation of hanging gardens generally has some common species that are found at most of the hanging gardens, e.g., *Maianthemum stellatum*, *Adiantum capillus-veneris*, *Adiantum pedatum*, and *Mimulus* spp. But numerous endemics occur of which some may be represented by just one or two sites. The following species are endemic to hanging gardens of the Colorado Plateau region: *Aquilegia micrantha*, *Carex curatorum*, *Cirsium rydbergii*, *Erigeron kachinensis* (one occurrence outside of hanging gardens in the Abajo Mountains), *Erigeron sionis*, *Erigeron zothecinus*, *Platanthera zothecina* (= *Habenaria zothecina*), *Mimulus eastwoodiae*, *Perityle specuicola*, and *Primula specuicola*.

SOURCES

References: Comer et al. 2003, Keammerer and Keammerer 1978, Malanson 1980, Malanson 1982, Malanson and Kay 1980, Romme et al. 1993, Tuhy et al. 2002, Welsh 1989, Welsh and Toft 1981

Version: 14 Dec 2004

Stakeholders: West

Concept Author: NatureServe Western Ecology Team; R. Rondeau

LeadResp: West

CES304.057 COLUMBIA PLATEAU VERNAL POOL

Primary Division: Inter-Mountain Basins (304)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional [Vernal Pool]; Impermeable Layer; 1-29-day hydroperiod; Vernal Pool Mosaic

Concept Summary: This system includes shallow ephemeral water bodies found in very small (3 square meters to 1 acre) to large depressions (1500 square meters to a square mile, average size of vernal pools are 1600 square meters, while average size on non-alkaline playa lakes are 5-10 acres) throughout the exposed volcanic scablands of the Columbia Plateau in Washington, Oregon, and northern Nevada. Most of these pools and lakes are located on massive basalt flows exposed by Pleistocene floods; southward they also occur on andesite or rhyodacite caprock. Inundation is highly irregular, sometimes not occurring for several years. Depressions usually (but not always) fill with water during winter and spring. They are generally dry again within 9 months, though in exceptional times they can remain inundated for two years in a row. Water is from rainfall and snowmelt in relatively small closed basins, on average probably no more than 5-15 times the area of the ponds themselves. Because these pools and playas are perched above the general surrounding landscape, they are not generally subject to runoff from major stream systems. They typically have silty clay soils, sometimes with sandy margins. Pools are often found within a mounded or biscuit-swale topography with *Artemisia* shrub-steppe or rarely *Pinus ponderosa* savanna. In the northern Columbia Plateau, characteristic species are predominantly annual and diverse. Floristically akin to California vernal pool flora (one-third), however, many of the most abundant species are not reported in Californian pools. Characteristic species include *Callitriche marginata*, *Camissonia tanacetifolia*, *Elatine* spp., *Epilobium densiflorum* (= *Boisduvalia densiflora*), *Eryngium vaseyi*, *Juncus uncialis*, *Myosurus X clavicaulis*, *Plagiobothrys* spp., *Polygonum polygaloides* ssp. *confertiflorum*, *Polygonum polygaloides* ssp. *polygaloides*, *Psilocarphus brevissimus*, *Psilocarphus elatior*, *Psilocarphus oregonus*, and *Trifolium cyathiferum*. *Artemisia ludoviciana* ssp. *ludoviciana* can occur on better developed soils. In northern Nevada, most of the species by biomass are perennials and include *Polygonum*, *Rumex*, *Juncus balticus*, *Eleocharis*, *Carex douglasii*, *Muhlenbergia richardsonis*, and *Polycytenium* species, in addition to *Camissonia tanacetifolia* and *Psilocarphus brevissimus*. Endemic plant species *Navarretia leucocephala* ssp. *diffusa* and *Polycytenium williamsiae* may occur.

Comments: This includes Bjork (1997) vernal pool annual-dominated, vernal pool perennial-dominated and rain pools.

DISTRIBUTION

Range: This system is restricted to the northern Columbia Plateau ecoregion commonly called the Columbia Basin and perhaps the Okanagan Valley in British Columbia, and to the western Great Basin.

Divisions: 304:C

TNC Ecoregions: 6:C, 68:P

Subnations: BC?, NV, OR, WA

Associations:

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High-ranked species: *Ivesia pityocharis* (G2), *Juncus uncialis* (G3G4), *Myosurus sessilis* (G2), *Polycytenium williamsiae* (G2Q), *Polygonum polygaloides* ssp. *confertiflorum* (G4G5T3T4)

Environment: Winters are colder (coldest average median temperature month in the high 20 degrees F) than California vernal pools and are climatically defined by wet winters (November through January, sporadically so southward) and severe summer drought (July-September), although May or June can be wet. The northernmost vernal pools are adapted to cold spring and long summer days (18 hours).

SPATIAL CHARACTERISTICS

Size: Depressions (3-4608 square meters to a square mile; average 1600 sq.m to 10 acres), mean depth 0.47 to 1.5 m.

Adjacent Ecological System Comments: Primarily Columbia Plateau Scabland Shrubland (CES304.770) or Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) (three-tip sagebrush) rarely into ponderosa pine savanna or pinyon-juniper.

SOURCES

References: Bjork 1997, Bjork and Dunwiddie n.d., Comer et al. 2003

Version: 27 Jun 2005

Concept Author: R. Crawford

Stakeholders: Canada, West

LeadResp: West

CES304.998 INTER-MOUNTAIN BASINS ALKALINE CLOSED DEPRESSION

Primary Division: Inter-Mountain Basins (304)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system is very similar to Western Great Plains Closed Depression Wetland (CES303.666). Sites are seasonally to semipermanently flooded, usually retaining water into the growing season and drying completely only in drought years. Many are associated with hot and cold springs, located in basins with internal drainage. Soils are alkaline to saline clays with hardpans. Seasonal drying exposes mudflats colonized by annual wetland vegetation. Salt encrustations can occur on the surface in some examples of this system, and the soils are severely affected and have poor structure. Species that typify this system are salt-tolerant and halophytic species such as *Distichlis spicata*, *Puccinellia lemmonii*, *Poa secunda*, *Muhlenbergia* spp., *Leymus triticoides* (= *Elymus triticoides*), *Schoenoplectus maritimus*, *Schoenoplectus americanus*, *Triglochin maritima*, and *Salicornia* spp. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some examples of this system which may allow for less salt-tolerant species to occur. Communities found within this system may also occur in floodplains (i.e., more open depressions), but probably should not be considered a separate system unless they transition to areas outside the immediate floodplain. Types often occur along the margins of perennial lakes, in alkaline closed basins, with extremely low-gradient shorelines.

DISTRIBUTION

Range: This system can occur throughout the Columbia Plateau and the northern Great Basin but is most common in eastern Oregon and northern Nevada.

Divisions: 304:C

TNC Ecoregions: 6:C

Subnations: CA, ID, NV, OR

Associations:

- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Eleocharis (montevidensis, palustris, quinqueflora)* Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003050, G5)
- *Eleocharis palustris* - *Distichlis spicata* Herbaceous Vegetation (CEGL001834, G2G4)
- *Eleocharis palustris* - *Juncus balticus* Herbaceous Vegetation (CEGL001835, G2G4)
- *Leymus triticoides* - *Carex* spp. Herbaceous Vegetation (CEGL001571, G4?)
- *Leymus triticoides* - *Poa secunda* Herbaceous Vegetation (CEGL001572, G2)
- *Poa secunda* - *Muhlenbergia richardsonis* Herbaceous Vegetation (CEGL002755, GNR)
- *Puccinellia lemmonii* - *Poa secunda* Seasonally Flooded Herbaceous Vegetation (CEGL001658, G1)
- *Schoenoplectus americanus* - *Eleocharis palustris* Herbaceous Vegetation (CEGL001585, G4)

High-ranked species: *Astragalus applegatei* (G1), *Astragalus diversifolius* (G2), *Astragalus lemmonii* (G3?), *Astragalus phoenix* (G2), *Astragalus pterocarpus* (G3), *Calochortus striatus* (G2), *Castilleja salsuginosa* (G1Q), *Centaurium namophilum* (G2Q), *Cirsium mohavense* (G2G3), *Cordylanthus tecopensis* (G2), *Downingia bicornuta* (G3G4), *Downingia bicornuta* var. *bicornuta* (G3G4T3T4), *Eriogonum ampullaceum* (G3), *Eriogonum argophyllum* (G1), *Goodmania luteola* (G3), *Grindelia fraxinopratisensis* (G2), *Ivesia kingii* (G3), *Ivesia kingii* var. *eremica* (G3T1T2Q), *Juncus kelloggii* (G3?), *Juncus uncialis* (G3G4), *Lepidium davisii* (G3), *Microtus californicus scirpensis* (G5T1), *Phacelia parishii* (G2G3), *Plagiobothrys salsus* (G2G3), *Plagiobothrys stipitatus* var. *micranthus* (G4T3T4), *Pogogyne floribunda* (G3), *Polygonum polygaloides* ssp. *confertiflorum* (G4G5T3T4), *Polygonum polygaloides* ssp. *esotericum* (G4G5T2), *Potentilla basaltica* (G1), *Potentilla newberryi* (G3G4), *Pseudocopaeodes eunus obscurus* (G3G4T1), *Sisyrinchium funereum* (G2G3), *Spiranthes infernalis* (G1), *Thelypodium brachycarpum* (G3), *Thelypodium howellii* ssp. *spectabilis* (G2T1)

Environment: This system is distinct from the freshwater depression systems by its brackish nature caused by strongly saline soils. Salt encrustations could occur near the surface in some examples of this system.

Vegetation: Salt-tolerant and halophytic species such as *Distichlis spicata* typify the system.

Dynamics: Hydrology processes primarily drive this system. Increases in precipitation and/or runoff can dilute the salt concentration and allow for less salt-tolerant species to occur. Conversion to agriculture and pastureland can also impact this system, especially when it alters the hydrology of the system.

SOURCES

References: Western Ecology Working Group n.d.

Version: 07 Jun 2004

Concept Author: J. Kagan

Stakeholders: West

LeadResp: West

CES304.059 INTER-MOUNTAIN BASINS INTERDUNAL SWALE WETLAND

Primary Division: Inter-Mountain Basins (304)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Dune (Landform); Dune field; Dune (Substrate); Temperate [Temperate Xeric]; Depressional; Isolated Wetland [Partially Isolated]; Sand Soil Texture; W-Landscape/High Intensity; Graminoid

Concept Summary: This ecological system occurs within dune fields in the intermountain western U.S. as small (usually less than 0.1 ha) interdunal wetlands that occur in wind deflation areas, where sands are scoured down to the water table. Small ponds may be associated. Water table may be perched over an impermeable layer of caliche or clay layer or, in the case of the Great Sand Dunes of Colorado, a geologic dike that creates a closed basin that traps water. These wetland areas are typically dominated by common emergent herbaceous vegetation such as species of *Eleocharis*, *Juncus*, and *Schoenoplectus*. Dune field ecological processes distinguish these emergent wetlands from similar non-dune wetlands.

Comments: This system was originally included within Inter-Mountain Basins Active and Stabilized Dune (CES304.775). These small-scale wetlands were pulled out into their own system because they are isolated wetlands and support completely different biota than the surrounding dry dunes. Many dune fields in the Great Basin are associated with playas and playa lakes such as Washoe Lake, Great Salt Lake, and Mono Lake. At Great Sand Dunes National Monument, Colorado, isolated interdunal swale wetlands occur where winds scour sand to expose wet sand at the water table, largely on the west side (windward) of the main dune field. The same groundwater source also feeds springs that form intermittent creeks that are not part of this interdunal swale system.

DISTRIBUTION

Range: The system occurs in some dune fields across the intermountain western U.S., including the Great Sand Dunes in southern Colorado and the Pink Coral Dunes in Utah. Interdunal wetlands may also occur in dune fields in northeastern Arizona and the Great Basin as well as in southwestern Wyoming and southern Idaho.

Divisions: 304:C, 306:C

TNC Ecoregions: 6:?, 10:?, 11:?, 19:?, 20:C

Subnations: AZ?, CO, ID?, NV?, UT?, WY?

Associations:

- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)
- *Juncus balticus* - *Carex rossii* Herbaceous Vegetation (CEGL001839, G2G4)

- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Salicornia rubra* Herbaceous Vegetation (CEGL001999, G2G3)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840, G5)
- *Schoenoplectus americanus* - *Carex* spp. Herbaceous Vegetation (CEGL004144, GNR)
- *Schoenoplectus americanus* - *Eleocharis palustris* Herbaceous Vegetation (CEGL001585, G4)
- *Schoenoplectus americanus* - *Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Schoenoplectus americanus* Western Herbaceous Vegetation (CEGL001841, G3Q)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus pungens* Herbaceous Vegetation (CEGL001587, G3G4)
- *Typha* (*latifolia*, *angustifolia*) Western Herbaceous Vegetation (CEGL002010, G5)
- *Typha domingensis* Western Herbaceous Vegetation (CEGL001845, G5?)

Environment: Occurs in wet interdunal swales.

Vegetation: A variety of emergent herbaceous vegetation may occur including, *Juncus balticus*, *Schoenoplectus pungens*, *Typha* spp., *Cyperus* spp., *Eleocharis* spp., and *Salix exigua*.

Dynamics: The dunes are shaped by the wind and continue to change. The size and exact location of the wet swales may change as the sand dunes shift, due to active dune migration. Dune "blowouts" and subsequent stabilization through succession are characteristic processes of the active dunes which surround the interdunal swales.

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch.

Adjacent Ecological System Comments: This wetland system occurs in wet swales within Inter-Mountain Basins Active and Stabilized Dune (CES304.775).

SOURCES

References: Bowers 1982, Bowers 1984, Bowers 1986, Brand and Sanderson 2002, Cooper and Severn 1992, Hammond 1998, Pineada et al. 1999, Pineda 2000, Rondeau 2001, Western Ecology Working Group n.d.

Version: 12 May 2005

Concept Author: Hammond (1998)

Stakeholders: West

LeadResp: West

CES304.058 NORTHERN COLUMBIA PLATEAU BASALT POTHOLE POND

Primary Division: Inter-Mountain Basins (304)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional; Impermeable Layer

Concept Summary: This system includes shallow freshwater water bodies found in small depressions gouged into basalt by Pleistocene floods. These are found throughout channeled scablands of the Columbia Plateau in Washington's eastern Columbia River Gorge. They typically occupy the bottom of a basalt cliff (1-20+ m tall) lined circular or linear depression. Characteristic shoreline vegetation lining the aquatic environment is an emergent marsh that includes species of *Scirpus* and/or *Schoenoplectus*, *Typha*, *Juncus*, *Potamogeton*, *Polygonum*, *Nuphar*, and *Phalaris*. This system may also include areas of relatively deep water with floating-leaved plants (*Lemna*, *Potamogeton*, and *Brasenia*). Woody plants, including *Populus tremuloides*, *Salix exigua*, *Crataegus douglasii*, or *Rosa woodsii*, are present adjacent to more northerly potholes. Ponds are within *Artemisia* shrub-steppe and *Pinus ponderosa* savanna or woodland. The wetland vegetation occupies a narrow zone (0.5-10 m) between open water and upland vegetation.

Comments: This may be a subset of North American Arid West Emergent Marsh (CES300.729), or it could be a freshwater aquatic system with primarily zoological species composition (amphibians and invertebrates).

DISTRIBUTION

Range: Restricted to the northern Columbia Plateau ecoregion commonly called the Columbia Basin.

Divisions: 304:C

TNC Ecoregions: 6:C, 68:P

Subnations: OR, WA

Associations:

- *Carex utriculata* Herbaceous Vegetation (CEGL001562, G5)

- *Carex vesicaria* Herbaceous Vegetation (CEGL002661, G4Q)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Lemna* spp. Permanently Flooded Herbaceous Vegetation (CEGL003059, G3?)
- *Nuphar lutea* ssp. *polysepala* Herbaceous Vegetation (CEGL002001, G5)
- *Phalaris arundinacea* Western Herbaceous Vegetation (CEGL001474, G5)
- *Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation (CEGL001475, G5)
- *Schoenoplectus acutus* Herbaceous Vegetation (CEGL001840, G5)
- *Schoenoplectus americanus* Western Herbaceous Vegetation (CEGL001841, G3Q)
- *Schoenoplectus maritimus* Herbaceous Vegetation (CEGL001843, G4)
- *Schoenoplectus tabernaemontani* Temperate Herbaceous Vegetation (CEGL002623, G5)
- *Typha* (*latifolia*, *angustifolia*) Western Herbaceous Vegetation (CEGL002010, G5)

High-ranked species: *Howellia aquatilis* (G3), *Ivesia aperta* var. *aperta* (G2T2)

SPATIAL CHARACTERISTICS

Size: Depressions (50-10,000 sq m)

Adjacent Ecological System Comments: Primarily Inter-Mountain Basins Big Sagebrush Steppe (CES304.778) and Columbia Plateau Scabland Shrubland (CES304.770).

SOURCES

References: Comer et al. 2003

Version: 21 Nov 2003

Concept Author: R. Crawford

Stakeholders: West

LeadResp: West

CES304.780 INTER-MOUNTAIN BASINS GREASEWOOD FLAT

Primary Division: Inter-Mountain Basins (304)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland [Lowland]; Shrubland (Shrub-dominated); Toeslope/Valley Bottom; Alkaline Soil; Deep Soil; Xeromorphic Shrub

Concept Summary: This ecological system occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains. It typically occurs near drainages on stream terraces and flats or may form rings around more sparsely vegetated playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. The water table remains high enough to maintain vegetation, despite salt accumulations. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominated or codominated by *Sarcobatus vermiculatus*, *Atriplex canescens*, *Atriplex confertifolia*, or *Krascheninnikovia lanata* may be present to codominant. Occurrences are often surrounded by mixed salt desert scrub. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of *Sporobolus airoides*, *Distichlis spicata* (where water remains ponded the longest), or *Eleocharis palustris* herbaceous types.

DISTRIBUTION

Range: Occurs throughout much of the western U.S. in Intermountain basins and extends onto the western Great Plains.

Divisions: 303:C, 304:C

TNC Ecoregions: 4:C, 6:C, 8:C, 9:C, 10:C, 11:C, 19:C, 20:C, 26:C

Subnations: AZ, CA, CO, ID, MT, NV, OR, UT, WA, WY

Associations:

- *Distichlis spicata* - (*Scirpus nevadensis*) Herbaceous Vegetation (CEGL001773, G4)
- *Distichlis spicata* - *Lepidium perfoliatum* Herbaceous Vegetation (CEGL001772, GNA)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Distichlis spicata* Mixed Herb Herbaceous Vegetation (CEGL001771, G3G5)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Ericameria nauseosa* / *Sporobolus airoides* Shrubland [Provisional] (CEGL002918, G3Q)
- *Leymus cinereus* - *Distichlis spicata* Herbaceous Vegetation (CEGL001481, G3)
- *Leymus cinereus* Bottomland Herbaceous Vegetation (CEGL001480, G1)

- *Leymus cinereus* Herbaceous Vegetation (CEGL001479, G2G3Q)
 - *Puccinellia nuttalliana* Herbaceous Vegetation (CEGL001799, G3?)
 - *Salicornia rubra* Herbaceous Vegetation (CEGL001999, G2G3)
 - *Sarcobatus vermiculatus* - *Atriplex parryi* / *Distichlis spicata* Shrubland (CEGL002764, GNR)
 - *Sarcobatus vermiculatus* - *Psoralea polydenius* Shrubland (CEGL002763, GNR)
 - *Sarcobatus vermiculatus* / *Achnatherum hymenoides* Shrubland (CEGL001373, G4)
 - *Sarcobatus vermiculatus* / *Artemisia tridentata* Shrubland (CEGL001359, G4)
 - *Sarcobatus vermiculatus* / *Atriplex confertifolia* - (*Picrothamnus desertorum*, *Suaeda moquinii*) Shrubland (CEGL001371, G5?)
 - *Sarcobatus vermiculatus* / *Atriplex gardneri* Shrubland (CEGL001360, G4?)
 - *Sarcobatus vermiculatus* / *Bouteloua gracilis* Shrubland (CEGL001361, G1Q)
 - *Sarcobatus vermiculatus* / *Distichlis spicata* Shrubland (CEGL001363, G4)
 - *Sarcobatus vermiculatus* / *Elymus elymoides* - *Pascopyrum smithii* Shrubland (CEGL001365, G2?)
 - *Sarcobatus vermiculatus* / *Elymus elymoides* Shrubland (CEGL001372, G4)
 - *Sarcobatus vermiculatus* / *Juncus balticus* Sparse Vegetation (CEGL002919, G3?)
 - *Sarcobatus vermiculatus* / *Leymus cinereus* Shrubland (CEGL001366, G3)
 - *Sarcobatus vermiculatus* / *Nitrophila occidentalis* - *Suaeda moquinii* Shrubland (CEGL001369, G5?)
 - *Sarcobatus vermiculatus* / *Pascopyrum smithii* - (*Elymus lanceolatus*) Shrub Herbaceous Vegetation (CEGL001508, G4)
 - *Sarcobatus vermiculatus* / *Pseudoroegneria spicata* Shrubland (CEGL001367, G3)
 - *Sarcobatus vermiculatus* / *Sporobolus airoides* Sparse Vegetation (CEGL001368, G3?)
 - *Sarcobatus vermiculatus* / *Suaeda moquinii* Shrubland (CEGL001370, GUQ)
 - *Sarcobatus vermiculatus* Shrubland (CEGL001357, G5)
 - *Sporobolus airoides* - *Distichlis spicata* Herbaceous Vegetation (CEGL001687, G4?)
 - *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- High-ranked species:** *Astragalus pterocarpus* (G3), *Atriplex bonnevillensis* (G2G3Q), *Phacelia parishii* (G2G3), *Pseudocopaeodes eunus* (G3G4), *Puccinellia simplex* (G3G4)

SOURCES

References: Comer et al. 2003, Knight 1994, West 1983b

Version: 20 Feb 2003

Concept Author: NatureServe Western Ecology Team

Stakeholders: Midwest, West

LeadResp: West

CES304.786 INTER-MOUNTAIN BASINS PLAYA

Primary Division: Inter-Mountain Basins (304)

Land Cover Class: Barren

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland [Lowland]; Playa; Temperate [Temperate Xeric]; Depressional; Alkaline Soil; Saline Substrate Chemistry; Aridic; Alkaline Water; Saline Water Chemistry; Caliche Layer; Impermeable Layer; Intermittent Flooding

Concept Summary: This ecological system is composed of barren and sparsely vegetated playas (generally <10% plant cover) found in the intermountain western U.S. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. These systems are intermittently flooded. The water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and greatly affects species composition. Characteristic species may include *Allenrolfea occidentalis*, *Sarcobatus vermiculatus*, *Grayia spinosa*, *Puccinellia lemmonii*, *Leymus cinereus*, *Distichlis spicata*, and/or *Atriplex* spp.

Comments: Bjork (1997) refers to these as vernal lakes in Washington; his one example was ditched and may be artificial. There might have been these in Grand Coulee prior to Columbia Basin irrigation project.

DISTRIBUTION

Range: This system occurs throughout the Intermountain western U.S., extending east into the southwestern Great Plains.

Divisions: 304:C

TNC Ecoregions: 6:C, 10:C, 11:C, 19:C

Subnations: CA, CO, ID, NV, OR, UT, WA?, WY

Associations:

- (*Sarcocornia utahensis*) - (*Arthrocnemum subterminale*) Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003120, GNR)
- *Allenrolfea occidentalis* / *Atriplex gardneri* Shrubland (CEGL000989, G4?)
- *Allenrolfea occidentalis* Shrubland (CEGL000988, G3)
- *Artemisia papposa* / *Danthonia californica* - *Festuca idahoensis* Shrubland (CEGL002991, GNR)
- *Atriplex spinifera* Shrubland [Placeholder] (CEGL003015, G3?)
- *Chrysothamnus albidus* / *Puccinellia nuttalliana* Shrubland (CEGL001328, G3)
- *Distichlis spicata* - (*Scirpus nevadensis*) Herbaceous Vegetation (CEGL001773, G4)
- *Distichlis spicata* - *Lepidium perfoliatum* Herbaceous Vegetation (CEGL001772, GNA)
- *Distichlis spicata* Herbaceous Vegetation (CEGL001770, G5)
- *Distichlis spicata* Mixed Herb Herbaceous Vegetation (CEGL001771, G3G5)
- *Hordeum jubatum* Herbaceous Vegetation (CEGL001798, G4)
- *Krascheninnikovia lanata* / *Poa secunda* Dwarf-shrubland (CEGL001326, G3)
- *Leymus cinereus* - *Distichlis spicata* Herbaceous Vegetation (CEGL001481, G3)
- *Leymus cinereus* - *Pascopyrum smithii* Herbaceous Vegetation (CEGL001483, G3Q)
- *Leymus cinereus* Bottomland Herbaceous Vegetation (CEGL001480, G1)
- *Leymus triticoides* - *Carex* spp. Herbaceous Vegetation (CEGL001571, G4?)
- *Leymus triticoides* - *Poa secunda* Herbaceous Vegetation (CEGL001572, G2)
- *Pluchea sericea* Seasonally Flooded Shrubland [Placeholder] (CEGL003080, G3?)
- *Poa secunda* - *Muhlenbergia richardsonis* Herbaceous Vegetation (CEGL002755, GNR)
- *Puccinellia lemmonii* - *Poa secunda* Seasonally Flooded Herbaceous Vegetation (CEGL001658, G1)
- *Sarcobatus vermiculatus* - *Atriplex parryi* / *Distichlis spicata* Shrubland (CEGL002764, GNR)
- *Sarcobatus vermiculatus* - *Psoralea polydenius* Shrubland (CEGL002763, GNR)
- *Sarcobatus vermiculatus* / *Achnatherum hymenoides* Shrubland (CEGL001373, G4)
- *Sarcobatus vermiculatus* / *Artemisia tridentata* Shrubland (CEGL001359, G4)
- *Sarcobatus vermiculatus* / *Atriplex confertifolia* - (*Picrothamnus desertorum*, *Suaeda moquinii*) Shrubland (CEGL001371, G5?)
- *Sarcobatus vermiculatus* / *Distichlis spicata* Shrubland (CEGL001363, G4)
- *Sarcobatus vermiculatus* / *Elymus elymoides* - *Pascopyrum smithii* Shrubland (CEGL001365, G2?)
- *Sarcobatus vermiculatus* / *Elymus elymoides* Shrubland (CEGL001372, G4)
- *Sarcobatus vermiculatus* / *Ericameria nauseosa* Shrubland (CEGL001362, G5)
- *Sarcobatus vermiculatus* / *Leymus cinereus* Shrubland (CEGL001366, G3)
- *Sarcobatus vermiculatus* / *Nitrophila occidentalis* - *Suaeda moquinii* Shrubland (CEGL001369, G5?)
- *Sarcobatus vermiculatus* / *Pascopyrum smithii* - (*Elymus lanceolatus*) Shrub Herbaceous Vegetation (CEGL001508, G4)
- *Sarcobatus vermiculatus* / *Sporobolus airoides* Sparse Vegetation (CEGL001368, G3?)
- *Sarcobatus vermiculatus* Shrubland (CEGL001357, G5)
- *Spartina gracilis* Herbaceous Vegetation (CEGL001588, GU)
- *Sporobolus airoides* - *Distichlis spicata* Herbaceous Vegetation (CEGL001687, G4?)
- *Suaeda moquinii* Shrubland (CEGL001991, G5)

High-ranked species: *Atriplex spinifera* (G3?), *Gratiola heterosepala* (G3), *Lepidium davisii* (G3), *Phacelia inundata* (G2), *Phacelia parishii* (G2G3), *Pseudocopaodes eunus* (G3G4), *Rorippa calycina* (G3), *Sidalcea covillei* (G2), *Sisyrinchium funereum* (G2G3)

SOURCES

References: Bjork 1997, Comer et al. 2003, Knight 1994, Nachlinger et al. 2001

Version: 14 Dec 2004

Concept Author: NatureServe Western Ecology Team

Stakeholders: West

LeadResp: West

CES302.039 NORTH AMERICAN WARM DESERT INTERDUNAL SWALE WETLAND

Primary Division: North American Warm Desert (302)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Dune (Landform); Dune field; Dune (Substrate); Temperate [Temperate Xeric]; Isolated Wetland [Partially Isolated]; Sand Soil Texture; W-Landscape/High Intensity; Graminoid

Concept Summary: This interdunal wetland ecological system occurs in dune fields in the Chihuahuan Desert and likely in the Sonoran and Mojave deserts. This isolated or partially isolated wetland system is an occasional component of the more extensive active and stabilized desert dune system. Stands are typically small (usually less than 0.1 ha) interdunal swales that occur in wind deflation areas, where sands are scoured down to the water table. Water table may be perched over an impermeable layer of caliche or clay layer. These wetland areas are typically dominated by common emergent herbaceous vegetation, such as species of *Eleocharis*, *Juncus*, and *Schoenoplectus*, but may include endemic plants or animals. Occasionally wetlands are dominated by trees and shrubs, such as *Populus fremontii* and *Baccharis salicifolia*, which survive both being buried as dunes advance and having their root system exposed when deflation of the dune occurs. The specific dune field ecological processes distinguish these wetlands from non-dune emergent wetlands with similar species composition.

Comments: Additional interdunal wetland surveys and classification work are needed at dune systems in the Chihuahuan Desert at Cuatro Ciénegas, Guadalupe Mountains, and Samalayuca dunes as well as dune systems in the Sonoran or Mojave deserts, such as Algodones, Death Valley, Eureka, Gran Desierto, Kelso, Mohawk, and Salton Sea dunes, to clarify the extent of this small-patch ecological system. It may be necessary to restrict the system to the Chihuahuan Desert if that is the extent. Gypsum dunes have species unique to that substrate and may need to be treated differently.

DISTRIBUTION

Range: This interdunal wetland ecological system occurs in some dune fields in the Chihuahuan Desert and likely occurs in dune fields of the Sonoran and Mojave deserts, but more research is needed to learn the exact extent.

Divisions: 302:C

TNC Ecoregions: 24:C

Subnations: NM, TX

Associations:

- *Eleocharis palustris* - *Carex praegracilis* - *Berula erecta* Herbaceous Vegetation (CEGL002634, G2)
- *Populus fremontii* / *Baccharis salicifolia* Woodland (CEGL000941, G2)
- *Schoenoplectus americanus* - *Eleocharis palustris* Herbaceous Vegetation (CEGL001585, G4)
- *Schoenoplectus americanus* - *Eleocharis* spp. Herbaceous Vegetation (CEGL001586, GNR)
- *Schoenoplectus americanus* - *Flaveria chlorifolia* - (*Helianthus paradoxus*) Herbaceous Vegetation (CEGL004592, G1)

High-ranked species: *Cyperus onerosus* (G2)

Environment: This interdunal wetland ecological system occurs in some dune fields in the Chihuahuan and likely the Sonoran and Mojave deserts. This isolated or partially isolated wetland system is an occasional component of the more extensive active and stabilized desert dune system. Stands are typically small (usually less than 0.1 ha) interdunal swales that occur in wind deflation areas, where sands are scoured down to the water table. Water table may be perched over an impermeable layer of caliche or clay layer. Dune sands may be quartz or gypsum. Gypsum dunes have species unique to that substrate and may need to be treated differently. The specific dune field ecological processes distinguish these wetlands from similar emergent wetlands.

In west Texas these wetlands occur in interdunal swales in Monahan and Kermit quartz sand dunes. These dunes occur northeast of the Pecos River where the prevailing winds from the southwest have blown the sands to the east where they are trapped by the escarpment of the High Plains (Southern Shortgrass Prairie Ecoregion). The ponds are on a perched water table underlain by impermeable caliche layers.

The White Sand Dunes of the Tulerosa Basin in southern New Mexico are a gypsum interdunal/dune system that is moving/semi-stable, and during the rainy season many of the interdunes become ephemeral lakes with wetland indicators.

Vegetation: These wetland areas are typically dominated by common emergent herbaceous vegetation, such as species of *Eleocharis*, *Juncus*, and *Schoenoplectus*, but may include endemic plants or animals, especially on gypsum dunes. Occasionally wetlands are dominated by trees and shrubs, such as *Populus fremontii*, *Baccharis salicifolia*, or *Salix* spp., which must survive both being buried as dunes advance and having their root system exposed when deflation of the dune occurs. On occasion, dunes move over a site, leaving only the tops of cottonwood trees as remnants of the buried community (Muldavin et al. 1994b). The specific dune field ecological processes distinguish these wetlands from non-dune emergent wetlands with similar species composition.

In west Texas, stands in the Monahan and Kermit sandsheets wet interdunal swales, ponds and fringing wetlands are vegetated by herbaceous graminoids (generally >10% plant cover) between active dunes in sandsheets derived from quartz sands. Common vegetation is characterized by herbaceous graminoids and *Salix* spp. These interdunal valleys over impermeable substrata (as with the Monahans Sandsheet) may contain seasonal swales or ephemeral ponds supporting *Achnatherum hymenoides* and other grasses, *Schoenoplectus tabernaemontani*, *Juncus* spp., *Cyperus* spp., *Baccharis* spp., *Prosopis glandulosa*, *Salix interior*, *Pluchea odorata* (= *Pluchea purpurascens*), *Xanthium strumarium*, and other weeds (TPWD 1989d). The fringing wetland plants of the more permanent ponds include *Salix* spp., *Scirpus* and/or *Schoenoplectus* spp., *Typha* spp., *Cyperus* spp., *Juncus* spp., *Eleocharis* spp., and others. *Cyperus onerosus* is a rare plant, endemic to this region, also associated with these unusual wetlands (El-Hage and Moulton 1998).

Dynamics: The dunes are shaped by the wind and continue to change. The size and exact location of the wet swales may change as the sand dunes shift, due to active dune migration. Dune "blowouts" and subsequent stabilization through succession are characteristic processes of the active dunes which surround this system.

SPATIAL CHARACTERISTICS

Spatial Summary: Small patch.

Adjacent Ecological System Comments: This wetland system occurs in wet swales in North American Warm Desert Active and Stabilized Dune (CES302.744).

SOURCES

References: Bezanson 2000, Bowers 1982, Bowers 1984, Bowers 1986, Brown 1982, Carr 1991, Carr 2004, El-Hage and Moulton 1998, Muldavin et al. 1994b, Muldavin et al. 2000a, Muldavin et al. 2000b, Southeastern Ecology Working Group n.d., TPWD 1989d

Version: 12 May 2005

Stakeholders: Southeast, West

Concept Author: El-Hage and Moulton (1998)

LeadResp: Southeast

CES302.746 CHIHUAHUAN-SONORAN DESERT BOTTOMLAND AND SWALE GRASSLAND

Primary Division: North American Warm Desert (302)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland [Lowland]; Herbaceous; Swale; Toeslope/Valley Bottom; Depressional

Concept Summary: This ecological system occurs throughout the northern Chihuahuan Desert and adjacent Sky Islands and Sonoran Desert, as well as limited areas of the southern Great Plains and Edwards Plateau in relatively small depressions on broad mesas, plains and valley bottoms that receive runoff from adjacent areas. Water generally infiltrates relatively quickly. These depressions have deep, fine-textured soils that are neutral to slightly saline/alkaline. Vegetation is typically dominated by *Pleuraphis mutica* (tobosa swales) or other mesic graminoids such as *Pascopyrum smithii*, *Panicum obtusum*, *Sporobolus airoides*, or *Sporobolus wrightii*. With tobosa swales, sand-adapted species such as *Yucca elata* may grow at the swale's edge in the deep sandy alluvium that is deposited there from upland slopes. *Sporobolus airoides* and *Sporobolus wrightii* are more common in alkaline soils.

DISTRIBUTION

Range: Northern Chihuahuan Desert and adjacent Sky Islands and Sonoran Desert, as well as limited areas of the southern Great Plains and Edwards Plateau.

Divisions: 302:C, 303:C

TNC Ecoregions: 22:C, 23:C, 24:C, 28:C, 29:C

Subnations: AZ, MXCH, MXSO, NM, TX

Associations:

- *Panicum obtusum* - *Helianthus ciliaris* Herbaceous Vegetation (CEGL001574, G1)
- *Panicum obtusum* - *Panicum hirsutum* Herbaceous Vegetation (CEGL001576, GNRQ)
- *Pleuraphis mutica* - *Bouteloua gracilis* Herbaceous Vegetation (CEGL001638, GNRQ)
- *Pleuraphis mutica* - *Buchloe dactyloides* Herbaceous Vegetation (CEGL002272, G4?)
- *Pleuraphis mutica* - *Panicum obtusum* Herbaceous Vegetation (CEGL001639, G3)
- *Pleuraphis mutica* - *Scleropogon brevifolius* Herbaceous Vegetation (CEGL001640, G5)
- *Pleuraphis mutica* Monotype Herbaceous Vegetation (CEGL001637, G5?)

- *Sporobolus airoides* - *Distichlis spicata* Herbaceous Vegetation (CEGL001687, G4?)
- *Sporobolus airoides* - *Scleropogon brevifolius* Herbaceous Vegetation (CEGL001692, G5)
- *Sporobolus airoides* Monotype Herbaceous Vegetation (CEGL001688, GUQ)
- *Sporobolus airoides* Sod Herbaceous Vegetation [Placeholder] (CEGL001791, GNR)
- *Sporobolus airoides* Southern Plains Herbaceous Vegetation (CEGL001685, G3Q)
- *Sporobolus wrightii* - *Panicum hallii* Herbaceous Vegetation (CEGL001485, GNRQ)
- *Sporobolus wrightii* - *Panicum obtusum* Herbaceous Vegetation (CEGL001486, G2)

SOURCES

References: Brown 1982, Comer et al. 2003, Dick-Peddie 1993, MacMahon and Wagner 1985, Muldavin et al. 2000b

Version: 14 Dec 2004

Stakeholders: Latin America, Southeast, West

Concept Author: NatureServe Western Ecology Team

LeadResp: West

CES302.759 SONORAN FAN PALM OASIS

Primary Division: North American Warm Desert (302)

Land Cover Class: Mixed Upland and Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland; Wetland

Diagnostic Classifiers: Forest and Woodland (Treed); Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Seepage-Fed Sloping; Palm or Sabal

Concept Summary: This ecological system occurs on highly localized, spring-fed depressions along canyon waterways and tectonic faultlines below 900 m in elevation in the Sonoran and Mojave deserts. Permanent subsurface water is required to maintain *Washingtonia filifera*, a relict species. Salinity is low in the root zone, but increases near the surface where evaporation leaves salt accumulations. These oases woodlands are distinctively dominated by *Washingtonia filifera* with variable understory conditions. Other trees that may be present include *Platanus racemosa*, *Quercus chrysolepis*, *Populus fremontii*, and *Fraxinus velutina*. A subcanopy of *Salix lasiolepis*, *Salix gooddingii*, *Salix exigua*, or *Prosopis glandulosa* is often present. Reproduction of *Washingtonia filifera* is limited by water supply, surface salinity, rainfall, and fire. Fan palms are fire-tolerant, while the understory species are not, and fires open up the understory allowing palm seedlings to establish. Removal of the understory also decreases competition for water. There are currently 24 known occurrences in Arizona, Nevada, and California.

DISTRIBUTION

Range: Below 900 m in elevation in the Sonoran and Mojave deserts.

Divisions: 302:C

TNC Ecoregions: 17:C, 23:C

Subnations: AZ, CA, MXBC, MXSO, NV

Associations:

- *Washingtonia filifera* Woodland (CEGL000001, G3?)

High-ranked species: *Batrachoseps major aridus* (G4T1)

SOURCES

References: Barbour and Major 1988, Brown 1982, Comer et al. 2003, Holland and Keil 1995, MacMahon 1988, Sawyer and Keeler-Wolf 1995, Szaro 1989, Thomas et al. 2004

Version: 20 Feb 2003

Stakeholders: Latin America, West

Concept Author: NatureServe Western Ecology Team

LeadResp: West

CES302.751 NORTH AMERICAN WARM DESERT PLAYA

Primary Division: North American Warm Desert (302)

Land Cover Class: Barren

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland; Wetland

Diagnostic Classifiers: Lowland [Lowland]; Playa; Tropical/Subtropical [Tropical Xeric]; Temperate [Temperate Xeric]; Depressional; Alkaline Soil; Aridic; Alkaline Water; Saline Water Chemistry; Caliche Layer; Impermeable Layer; Intermittent Flooding

Concept Summary: This ecological system is composed of barren and sparsely vegetated playas (generally <10% plant cover) found across the warm deserts of North America, extending into the extreme southern end of the San Joaquin Valley in California. Playas form with intermittent flooding, followed by evaporation, leaving behind a saline residue. Salt crusts are common throughout, with small saltgrass beds in depressions and sparse shrubs around the margins. Subsoils often include an impermeable layer of clay or caliche. Large desert playas tend to be defined by vegetation rings formed in response to salinity. Given their common location in windswept desert basins, dune fields often form downwind of large playas. In turn, playas associated with dunes often have a deeper water supply. Species may include *Allenrolfea occidentalis*, *Suaeda* spp., *Distichlis spicata*, *Eleocharis palustris*, *Oryzopsis* spp., *Sporobolus* spp., *Tiquilia* spp., or *Atriplex* spp. Ephemeral herbaceous species may have high cover periodically. Adjacent vegetation is typically Sonora-Mojave Mixed Salt Desert Scrub (CES302.749), Chihuahuan Mixed Salt Desert Scrub (CES302.017), Gulf of California Coastal Mixed Salt Desert Scrub (CES302.015), Baja California del Norte Gulf Coast Ocotillo-Limberbush-Creosotebush Desert Scrub (CES302.014), or Chihuahuan Creosotebush Xeric Basin Desert Scrub (CES302.731).

DISTRIBUTION

Range: Found across the warm deserts of North America, extending into the extreme southern end of the San Joaquin Valley in California.

Divisions: 302:C

TNC Ecoregions: 17:C, 22:C, 23:C, 24:C

Subnations: AZ, CA, MXBC, MXCH, MXSO, NM, NV, TX

Associations:

- (*Sarcocornia utahensis*) - (*Arthrocnemum subterminale*) Seasonally Flooded Herbaceous Vegetation [Placeholder] (CEGL003120, GNR)
- *Allenrolfea occidentalis* Shrubland (CEGL000988, G3)
- *Atriplex (lentiformis, polycarpa)* Shrubland [Placeholder] (CEGL003016, G3)
- *Atriplex polycarpa* / *Pleuraphis mutica* Shrubland (CEGL001319, GU)
- *Atriplex polycarpa* Shrubland (CEGL001318, G5)
- *Atriplex spinifera* Shrubland [Placeholder] (CEGL003015, G3?)
- *Bouteloua breviseta* Sparse Vegetation (CEGL004609, G3?)
- *Sesuvium verrucosum* Sparse Vegetation (CEGL004595, G3?)

High-ranked species: *Atriplex griffithsii* (G2G3), *Atriplex spinifera* (G3?), *Branchinella acaciodea* (G2G3), *Branchinella sublettei* (G3), *Goodmania luteola* (G3), *Iva hayesiana* (G3?), *Ivesia kingii* (G3), *Nitrophila mohavensis* (G1), *Phacelia parishii* (G2G3), *Pseudocopaodes eunus* (G3G4), *Puccinellia simplex* (G3G4), *Streptocephalus moorei* (G1G2)

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: Adjacent vegetation is typically Sonora-Mojave Mixed Salt Desert Scrub (CES302.749), Chihuahuan Mixed Salt Desert Scrub (CES302.017), Gulf of California Coastal Mixed Salt Desert Scrub (CES302.015), Baja California del Norte Gulf Coast Ocotillo-Limberbush-Creosotebush Desert Scrub (CES302.014), or Chihuahuan Creosotebush Xeric Basin Desert Scrub (CES302.731).

SOURCES

References: Barbour and Major 1988, Brown 1982, Comer et al. 2003, Dick-Peddie 1993, Holland and Keil 1995, Muldavin et al. 2000b, Thomas et al. 2004

Version: 14 Dec 2004

Stakeholders: Latin America, Southeast, West

Concept Author: NatureServe Western Ecology Team

LeadResp: West

CES206.954 CALIFORNIA CENTRAL VALLEY ALKALI SINK

Primary Division: Mediterranean California (206)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Lowland [Lowland]; Mediterranean [Mediterranean Xeric-Oceanic]; Depressional; Playa Mosaic

Concept Summary: These strongly saline/alkaline playa-like depressions are limited to the San Joaquin Valley and typically occur in a matrix of mixed salt desert scrub. These areas are seasonally to intermittently flooded. They are not flooded every year and respond to localized thunderstorms. Soils typically are fine-textured with an impermeable caliche

layer or clay pan. Salt encrustations are often deposited on the surface as the playa dries. Species are salt-tolerant and halophytic species such as *Allenrolfea occidentalis*, *Suaeda moquinii*, *Distichlis spicata*, and *Salicornia rubra*. During exceptionally wet years, an increase in precipitation can dilute the salt concentration in the soils of some of examples of this system which may allow for less salt-tolerant species to occur.

DISTRIBUTION

Range: Limited to the San Joaquin Valley.

Divisions: 206:C

TNC Ecoregions: 13:C

Subnations: CA

Associations:

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High-ranked species: *Astragalus tener* var. *ferrisiae* (G1T1), *Astragalus tener* var. *tener* (G1T1), *Atriplex cordulata* (G2?), *Atriplex coronata* var. *coronata* (G4T3), *Atriplex coronata* var. *notatior* (G4T1), *Atriplex joaquiniana* (G2), *Atriplex minuscula* (G1), *Atriplex spinifera* (G3?), *Atriplex tularensis* (G1Q), *Atriplex vallicola* (G1), *Cordylanthus mollis* ssp. *hispidus* (G2T2), *Cordylanthus palmatus* (G1), *Delphinium recurvatum* (G2), *Isocoma arguta* (G1), *Juncus bufonius* var. *congestus* (G5T2T4), *Lasthenia glabrata* ssp. *coulteri* (G4T3), *Layia munzii* (G1), *Leptochloa viscida* (G3G4), *Plagiobothrys glaber* (GH), *Puccinellia simplex* (G3G4)

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Version: 14 Dec 2004

Concept Author: P. Comer, T. Keeler-Wolf

Stakeholders: West

LeadResp: West

CES206.947 MEDITERRANEAN CALIFORNIA ALKALI MARSH

Primary Division: Mediterranean California (206)

Land Cover Class: Woody Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Mediterranean [Mediterranean Xeric-Oceanic]; Depressional; Alkaline Water; Saline Water Chemistry; Shallow (<15 cm) Water; Caliche Layer

Concept Summary: These highly variable systems occur in scattered locations throughout the California Central Valley and along California's south coast extending into Baja Norte, all at elevations below 300 m (1000 feet). They are found in old lake beds or in floodplains of major river systems where seasonal water inputs are limited, and often include some groundwater seepage. High rates of evaporation lead to alkaline water and soil conditions, with layers of salt encrusted soils often accumulating near seeps. These are highly variable in plant composition, but often include *Distichlis spicata*, *Juncus balticus*, *Anemopsis californica*, *Schoenoplectus americanus* (= *Scirpus americanus*), *Atriplex* spp., *Triglochin maritima*, and *Cirsium* spp. Endemic plant species include *Puccinellia howellii*.

DISTRIBUTION

Range: Scattered locations throughout the California Central Valley and along California's south coast extending into Baja Norte, all at elevations below 300 m (1000 feet).

Divisions: 206:C

TNC Ecoregions: 13:C, 16:C

Subnations: CA, MXBC

Associations:

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High-ranked species: *Frankenia salina* (G3G4), *Myosurus sessilis* (G2), *Puccinellia parishii* (G2), *Sorex ornatus relictus* (G5T1), *Spergularia macrotheca* var. *longistyla* (G5T3T4)

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Version: 17 Mar 2003

Stakeholders: Latin America, West

CES206.951 MEDITERRANEAN CALIFORNIA COASTAL INTERDUNAL WETLAND

Primary Division: Mediterranean California (206)**Land Cover Class:** Herbaceous Wetland**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.)**Diagnostic Classifiers:** Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Depressional [Pond]; Mineral: W/ A-Horizon <10 cm; Graminoid; Shallow (<15 cm) Water; Sand Subsoil Texture; Coastal Dune Mosaic

Concept Summary: Coastal interdunal wetlands are common components of larger active and stabilized coastal dune fields, ranging from Coos Bay, Oregon, south to San Luis Obispo County, California. They can be referred to as "slack dune ponds" when associated with larger and deeper water or "coastal dune swales" when water is shallow, and typically occur behind active foredunes, especially where the base of the dunes are at or near groundwater levels. They may result from active dune movement, sometimes when dunes interrupt surface waterflow, or where extensive dune "blowouts" remove sand down to the water table. Common plant species include *Argentina anserina* (= *Potentilla anserina*), *Hydrocotyle umbellata*, *Euthamia occidentalis*, *Juncus* spp., *Carex obnupta*, and *Sparganium* spp.

DISTRIBUTION**Range:** Coos Bay, Oregon, south to San Luis Obispo County, California.**Divisions:** 206:C**TNC Ecoregions:** 1:P, 14:C, 15:C, 16:P**Subnations:** CA, OR**Associations:**

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High-ranked species: *Astragalus pycnostachyus* (G2), *Astragalus pycnostachyus* var. *lanosissimus* (G2T1), *Astragalus pycnostachyus* var. *pycnostachyus* (G2T2), *Branchinecta longiantenna* (G1), *Branchinecta lynchi* (G3), *Cirsium loncholepis* (G2), *Cyzicus californicus* (G2G3), *Isocoma menziesii* var. *vernonioides* (G3G5T2T3)

SOURCES**References:** Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995**Version:** 17 Mar 2003**Stakeholders:** West**Concept Author:** P. Comer, T. Keeler-Wolf**LeadResp:** West

CES206.948 NORTHERN CALIFORNIA CLAYPAN VERNAL POOL

Primary Division: Mediterranean California (206)**Land Cover Class:** Herbaceous Wetland**Spatial Scale & Pattern:** Small patch**Required Classifiers:** Natural/Semi-natural; Vegetated (>10% vasc.)**Diagnostic Classifiers:** Depressional; Forb; Circumneutral Water; Saline Water Chemistry; Impermeable Layer; Vernal Pool Mosaic

Concept Summary: These systems are shallow ephemeral water bodies found in depressions (up to several hectares in size) among grasslands and open woodlands throughout the northern Central Valley of California. Northern claypan vernal pools include a clay hardpan that retains water inputs throughout some portion of the spring, but typically the depression dries down entirely into early summer months. They tend to be circumneutral to alkaline and slightly saline wetlands with characteristic plant species including *Downingia bella*, *Downingia insignis*, *Cressa truxillensis*, *Plagiobothrys leptocladus* (= *Allocarya leptoclada*), *Pogogyne douglasii*, *Eryngium aristulatum*, *Veronica peregrina*, *Lasthenia ferrisiae*, *Lasthenia glaberrima*, and *Spergularia salina* (= *Spergularia marina*). Due to draw-down characteristics, vernal pools typically form concentric rings of similar forb-rich vegetation. Given their relative isolation in upland-dominated landscapes, many endemic plant species are common in California vernal pools.

DISTRIBUTION**Range:** Found in depressions among grasslands and open woodlands throughout the northern Central Valley of California.**Divisions:** 206:C

TNC Ecoregions: 13:C
Subnations: CA

Associations:

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High-ranked species: *Agrostis hendersonii* (G1Q), *Ambystoma californiense* (G2G3), *Boisduvalia cleistogama* (G3G4), *Branchinecta conservatio* (G1), *Branchinecta longiantenna* (G1), *Branchinecta lynchi* (G3), *Branchinecta mesovallensis* (G2), *Callitriche longipedunculata* (G2G3), *Cyzicus californicus* (G2G3), *Cyzicus elongatus* (G2G3Q), *Downingia bella* (G2G3), *Downingia bicornuta* var. *bicornuta* (G3G4T3T4), *Downingia cuspidata* (G3?), *Downingia ornatissima* (G2G3), *Downingia ornatissima* var. *eximia* (G2G3T1T3), *Downingia ornatissima* var. *ornatissima* (G2G3T1T3), *Downingia pulchella* (G3?), *Downingia pusilla* (G3), *Elaphrus viridis* (G1), *Eryngium aristulatum* var. *hooveri* (G5T2), *Gratiola heterosepala* (G3), *Hesperevax caulescens* (G3), *Hordeum intercedens* (G3G4), *Isoetes orcuttii* (G2?), *Ivesia sericoleuca* (G2), *Juncus kelloggii* (G3?), *Juncus leiospermus* (G2), *Juncus leiospermus* var. *ahartii* (G2T1), *Juncus leiospermus* var. *leiospermus* (G2T2), *Lasthenia burkei* (G1), *Lasthenia chrysantha* (G3?), *Lasthenia conjugens* (G1), *Lasthenia ferrisiae* (G3), *Legenere limosa* (G2), *Limnanthes alba* ssp. *versicolor* (G4T3T4), *Limnanthes bakeri* (G1), *Limnanthes douglasii* ssp. *nivea* (G4T3T4), *Limnanthes douglasii* ssp. *rosea* (G4T3T4), *Limnanthes douglasii* ssp. *sulphurea* (G4T1), *Limnanthes floccosa* ssp. *bellingieriana* (G4T2), *Limnanthes floccosa* ssp. *grandiflora* (G4T1), *Limnanthes vinculans* (G2), *Linderiella occidentalis* (G3G4), *Lomatium cookii* (G1), *Myosurus sessilis* (G2), *Navarretia eriocephala* (G3), *Navarretia heterandra* (G3), *Navarretia myersii* (G1), *Navarretia myersii* ssp. *deminuta* (G1T1), *Orcuttia viscida* (G1), *Plagiobothrys hystriculus* (GH), *Plagiobothrys stipitatus* var. *micranthus* (G4T3T4), *Polygonum polygaloides* ssp. *confertiflorum* (G4G5T3T4), *Spea hammondii* (G3), *Tuctoria greenei* (G2), *Tuctoria mucronata* (G1)

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Version: 17 Mar 2003

Concept Author: P. Comer, T. Keeler-Wolf

Stakeholders: West

LeadResp: West

CES206.949 NORTHERN CALIFORNIA VOLCANIC VERNAL POOL

Primary Division: Mediterranean California (206)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Mediterranean [Mediterranean Xeric-Oceanic]; Depressional; Forb; Shallow (<15 cm) Water; Impermeable Layer; Intermittent Flooding; Vernal Pool Mosaic

Concept Summary: These systems are shallow ephemeral water bodies found in very small depressions (typically no larger than 50 square meters) throughout foothills of the southern Cascades and Sierra Nevada. They are often on solid volcanic bedrock, but also can be found on volcanic ash flows (lahars) over bedrock. Hydrologically, they vary from flashy to more persistent hydrological regimes, typically due to the amount and periodicity of precipitation received. Where hydrology is flashy, they fill and evaporate rapidly; several times during the wet season. Typically these vernal pools do not support species requiring long inundation periods. Those on volcanic ash flows are less flashy and have pools that are larger and deeper. Where short inundation periods are characteristic, *Lasthenia californica*, *Downingia bicornuta*, *Psathyrotes* spp., and *Sedella* spp. (= *Parvisedum* spp.) are often present. Where longer inundation periods are characteristic, *Eryngium constancei* and *Eleocharis acicularis* may be found.

DISTRIBUTION

Range: Throughout foothills of the southern Cascades and Sierra Nevada.

Divisions: 204:?, 206:C

TNC Ecoregions: 4:C, 5:P, 12:C

Subnations: CA, OR

Associations:

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High-ranked species: *Downingia bicornuta* (G3G4), *Downingia bicornuta* var. *bicornuta* (G3G4T3T4), *Eryngium castrense* (G1G2), *Eryngium constancei* (G1), *Eryngium mathiasiae* (G3), *Eryngium pinnatisectum* (G3), *Gratiola heterosepala* (G3),

Limnanthes floccosa ssp. californica (G4T1), Limnanthes floccosa ssp. pumila (G4T1), Limnanthes striata (G3?), Navarretia heterandra (G3), Navarretia leucocephala ssp. pauciflora (G4T1), Navarretia leucocephala ssp. pliantha (G4T1), Paronychia ahartii (G2), Sedella leiocarpa (G1)

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Version: 17 Mar 2003

Stakeholders: West

Concept Author: P. Comer, T. Keeler-Wolf

LeadResp: West

CES206.950 SOUTH COASTAL CALIFORNIA VERNAL POOL

Primary Division: Mediterranean California (206)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Herbaceous; Mediterranean [Mediterranean Xeric-Oceanic]; Forb; Impermeable Layer; 1-29-day hydroperiod; Vernal Pool Mosaic

Concept Summary: These systems are shallow ephemeral water bodies found in small depressions that range from Baja Norte, Mexico, north through Santa Barbara County, California. They are found from sea level to 2600 m (7800 feet), and concomitant temperature and moisture ranges, but floristically distinct from more northerly distributed vernal pool types. These vernal pool systems are found on flat-topped marine terraces with Si-Fe cemented hardpans, volcanic bedrock, and acidic intrusive rock underlying thin soils. Characteristic plant species include *Trichostema austromontanum*, *Pogogyne abramsii*, *Eryngium aristulatum*, *Orcuttia californica*, *Pogogyne nudiuscula*, *Navarretia fossalis*, *Hemizonia parryi* ssp. *australis*, and *Lasthenia glabrata* ssp. *coulteri*.

DISTRIBUTION

Range: Baja Norte, Mexico, north through Santa Barbara County, California.

Divisions: 206:C

TNC Ecoregions: 16:C

Subnations: CA, MXBC

Associations:

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High-ranked species: *Ambystoma californiense* (G2G3), *Atriplex parishii* (G1G2), *Branchinecta longiantenna* (G1), *Branchinecta lynchi* (G3), *Branchinecta sandiegonensis* (G1), *Brodiaea filifolia* (G2), *Brodiaea orcuttii* (G3), *Cyzicus californicus* (G2G3), *Downingia concolor* var. *brevior* (G4T1), *Eryngium aristulatum* var. *parishii* (G5T2), *Eryngium pendletonensis* (G1), *Isoetes orcuttii* (G2?), *Juncus luciensis* (G3?), *Juncus triformis* (G2G3), *Linderiella occidentalis* (G3G4), *Linderiella santarosae* (G1G2), *Muilla clevelandii* (G2), *Navarretia fossalis* (G2), *Orcuttia californica* (G2), *Pogogyne abramsii* (G2), *Pogogyne nudiuscula* (G1), *Spea hammondii* (G3), *Streptocephalus woottoni* (G2)

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Version: 17 Mar 2003

Stakeholders: Latin America, West

Concept Author: P. Comer, T. Keeler-Wolf

LeadResp: West

CES204.996 MODOC BASALT FLOW VERNAL POOL

Primary Division: North American Pacific Maritime (204)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional; Impermeable Layer; 1-29-day hydroperiod; Vernal Pool Mosaic

Concept Summary: This system includes shallow ephemeral water bodies found in very small depressions (typically no larger than 50 square meters) throughout the Lassen, Klamath, and upper Pit river drainages, as well as the Devils Garden area of northern California, and along the eastern flanks of the Columbia River Gorge along the Oregon-Washington border. These vernal pools are located on top of massive basalt flows where soils are very thin over solid bedrock. Where soils are

better developed, they trend towards Vertisols (freeze-thaw characteristics). Characteristic species include *Blennosperma nanum*, *Epilobium densiflorum* (= *Boisduvalia densiflora*), *Callitriche marginata*, *Cicendia quadrangularis*, *Eryngium vaseyi*, *Psilocarphus brevissimus*, and *Sedella pumila* (= *Parvisedum pumilum*). *Artemisia cana* ssp. *bolanderi* can occur on better developed soils. Endemic plant species *Eryngium mathiasiae*, as well as several species of *Mimulus* and *Pogogyne*, may occur.

DISTRIBUTION

Range: Throughout the Lassen, Klamath, and upper Pit river drainages, as well as the Devils Garden area of northern California, and along the eastern flanks of the Columbia River Gorge along the Oregon-Washington border.

Divisions: 204:C, 206:C

TNC Ecoregions: 4:C, 5:P

Subnations: CA, OR, WA

Associations:

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High-ranked species: *Downingia bicornuta* (G3G4), *Downingia bicornuta* var. *bicornuta* (G3G4T3T4), *Gratiola heterosepala* (G3), *Pogogyne floribunda* (G3), *Polygonum polygaloides* ssp. *esotericum* (G4G5T2)

SOURCES

References: Barbour and Major 1988, Bjork 1997, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995

Version: 21 Nov 2003

Concept Author: P. Comer, T. Keeler-Wolf

Stakeholders: West

LeadResp: West

CES204.062 NORTH PACIFIC COASTAL INTERDUNAL WETLAND

Primary Division: North American Pacific Maritime (204)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Herbaceous; Depressional [Pond]; Isolated Wetland [Partially Isolated]; Mineral: W/ A-Horizon <10 cm; Graminoid; Shallow (<15 cm) Water; Sand Subsoil Texture; Coastal Dune Mosaic

Concept Summary: Coastal interdunal wetlands are common components of larger active and stabilized coastal barrier islands, spits, and coastal dunes, ranging from southeastern Alaska through the Aleutian Islands. Distinct landform and vegetation patterns are common to these dune systems. Landforms on the ocean side include low-gradient beaches, sparse to unvegetated dunes, slacks dominated by low herbaceous vegetation and back dunes dominated by tall herbaceous, shrub, or forested communities.

The slacks between dunes are colonized by *Equisetum variegatum* (northern horsetail) and other herbaceous species. The sites are elevated by the deposition of wind-blown sand, tectonic uplift and isostatic rebound. This further removes the sites from tidal water and allows shrubs, such as *Salix commutata* (undergreen willow), *Salix sitchensis* (Sitka willow), and *Myrica gale* (sweet gale) to invade. Organic mats also develop. Some slacks may develop into forested sites or peatlands, whereas other slacks may not persist to late succession because of dune encroachment.

The higher portions of dunes are dry and nutritionally poor because of leaching, moving the moisture and nutrients into the dune bases and slacks.

DISTRIBUTION

Range: This system ranges from southeastern Alaska through the Aleutian Islands.

Divisions: 204:C

Subnations: AK

Associations:

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SOURCES

References: Western Ecology Working Group n.d.

Version: 26 May 2005

Concept Author: K. Boggs and G. Kittel

Stakeholders: West

LeadResp: West

CES204.859 NORTH PACIFIC HARDPAN VERNAL POOL

Primary Division: North American Pacific Maritime (204)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Herbaceous; Depressional [Vernal Pool]

Concept Summary: This system includes shallow ephemeral water bodies found in depressions (up to several hectares in size) among grasslands and open woodlands throughout intermountain valleys of California, Oregon and the Gulf and San Juan islands of Washington and British Columbia. Northern hardpan vernal pools include an indurated clay or cemented (Si or Fe) hardpan that retains water inputs throughout some portion of the spring, but typically the depression dries down entirely into early summer months. In the Sand Juan and Gulf islands, they are created in small depressions in bedrock. This system typically occurs with a hummocky micro-relief. They tend to be acidic wetlands with characteristic plant species including *Downingia elegans*, *Isoetes orcuttii*, *Pilularia americana*, *Triteleia hyacinthina*, *Eleocharis* spp., *Eryngium petiolatum*, *Plagiobothrys figuratus*, *Plagiobothrys scouleri*, *Grindelia nana*, *Veronica peregrina*, *Deschampsia danthonioides*, and *Callitriche* spp. Due to draw-down characteristics, vernal pools typically form concentric rings of similar vegetation. Given their relative isolation in upland-dominated landscapes, many endemic plant species are common in California vernal pools.

Comments: This system includes both duripan/hardpan and bedrock types, which are segregated in the California systems. Decided to lump them for this system because both occur intermixed in the geographic area defined.

DISTRIBUTION

Range: Found in depressions among grasslands and open woodlands throughout intermountain valleys of California, Oregon and the Gulf and San Juan islands of Washington.

Divisions: 204:C

TNC Ecoregions: 2:C

Subnations: BC, CA, OR, WA

Associations:

- *Eryngium petiolatum* - *Grindelia nana* Herbaceous Vegetation (CEGL003345, G1G2)
- *Eryngium petiolatum* - *Lasthenia glaberrima* Herbaceous Vegetation (CEGL003458, G1G2)
- *Plagiobothrys figuratus* Vernal Pool Herbaceous Vegetation (CEGL003346, G1G2)
- *Plagiobothrys scouleri* - *Plantago bigelovii* Herbaceous Vegetation (CEGL003459, G2)

High-ranked species: *Blennosperma bakeri* (G1), *Castilleja campestris* ssp. *succulenta* (G4?T2), *Chamaesyce hooveri* (G2), *Downingia concolor* var. *concolor* (G4T3T4), *Downingia concolor* var. *tricolor* (G4T1?), *Eryngium spinosepalum* (G2), *Juncus kelloggii* (G3?), *Mimulus angustatus* (G3G4), *Navarretia leucocephala* ssp. *bakeri* (G4T2), *Navarretia myersii* (G1), *Navarretia myersii* ssp. *myersii* (G1T1), *Navarretia prostrata* (G2?), *Neostapfia colusana* (G3), *Orcuttia inaequalis* (G2), *Orcuttia pilosa* (G2), *Orcuttia tenuis* (G3), *Plagiobothrys bracteatus* var. *aculeolatus* (G4?T1T3Q), *Plagiobothrys chorisianus* var. *hickmanii* (G3T3Q), *Plagiobothrys hirtus* (G1), *Plagiobothrys humistratus* (G2?), *Plagiobothrys strictus* (G1), *Plagiobothrys trachycarpus* (G3G4), *Poa napensis* (G1), *Pogogyne douglasii* ssp. *parviflora* (G4T3Q), *Polygonum polygaloides* ssp. *confertiflorum* (G4G5T3T4), *Psilocarphus brevissimus* var. *multiflorus* (G4T3), *Spergularia macrotheca* var. *leucantha* (G5T3T4), *Trichostema rubisepalum* (G3), *Trifolium jokerstii* (G1)

SOURCES

References: Chappell and Christy 2004, Comer et al. 2003, Holland and Keil 1995

Version: 21 Nov 2003

Concept Author: C. Chappell

Stakeholders: Canada, West

LeadResp: West

CES204.874 WILLAMETTE VALLEY WET PRAIRIE

Primary Division: North American Pacific Maritime (204)

Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Concept Summary: This system is largely restricted to the Willamette Valley of Oregon and adjacent Washington. It is nearly extirpated from the Puget Trough of Washington. These are high-nutrient wetlands that are temporarily to seasonally flooded. They are dominated primarily by graminoids, especially *Deschampsia caespitosa*, *Camassia quamash*, *Carex densa*, and *Carex unilateralis*, and to a lesser degree by forbs (e.g., *Isoetes nuttallii*) or shrubs (e.g., *Rosa nutkana*). Wet prairies historically covered large areas of the Willamette Valley where they were maintained by a combination of wetland soil hydrology and frequent burning. They have been reduced to tiny fragments of their former extent.

DISTRIBUTION

Range: Restricted to the Willamette Valley of Oregon and adjacent Washington.

Divisions: 204:C

TNC Ecoregions: 2:C

Subnations: OR, WA

Associations:

- *Camassia quamash* Wet Prairie Herbaceous Vegetation (CEGL003341, G3)
- *Carex aperta* Herbaceous Vegetation (CEGL001801, G1?)
- *Carex densa* - *Deschampsia caespitosa* Herbaceous Vegetation [Provisional] (CEGL003455, G2)
- *Carex densa* - *Eleocharis palustris* Herbaceous Vegetation [Provisional] (CEGL003456, G3)
- *Deschampsia caespitosa* - *Danthonia californica* Herbaceous Vegetation (CEGL001604, G2)
- *Eleocharis palustris* - *Carex unilateralis* Herbaceous Vegetation (CEGL003411, G2)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Isoetes nuttallii* Herbaceous Vegetation (CEGL003343, G3)
- *Rosa nutkana* / *Deschampsia caespitosa* Shrubland [Provisional] (CEGL003344, G2)
- *Rosa nutkana* / *Oenanthe sarmentosa* Shrubland [Provisional] (CEGL003457, G1)

High-ranked species: *Lomatium bradshawii* (G2), *Perideridia erythrorhiza* (G1), *Rana pretiosa* (G2)

SOURCES

References: Chappell and Christy 2004, Comer et al. 2003

Version: 21 Nov 2003

Concept Author: C. Chappell

Stakeholders: West

LeadResp: West

CES412.223 HAWAI'I 'IHI'IHILUAKEA VERNAL POOL

Primary Division: Northern Polynesia (412)

Land Cover Class: Herbaceous

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Depressional; Isolated Wetland [Partially Isolated]; Short (<5 yrs) Flooding Interval [Short interval, Winter Flooding]; Vernal Pool Mosaic

Concept Summary: This intermittently wet fern wetland develops in lowland vernal pools and areas that get flooded periodically. It occurs in shallow depressions in clay soil, cinder craters, or lithified sand dunes overlain with alluvial clay common in dry areas of most islands where winter rains create seasonal pools at elevations between 424 and 1032 m (1391-3385 feet). Now restricted to O'ahu and Molokai'i, the wetland is characterized by the dominance of the federally endangered endemic fern *Marsilea villosa*. On Molokai'i, it occurs in rocky areas that never hold standing water but get flushed out annually or less often. On the seasonal floodplain in Lualualei Valley, O'ahu, scattered depressions support *Marsilea* mats under scattered *Prosopis pallida* and among *Sida fallax*. At 'Ihi'ihiilauakea Crater, O'ahu, the crater floor is thickly covered with *Marsilea* when seasonal rains saturate the soil, sometimes submerging the habitat. During dry periods the fern becomes a dormant rhizomatous mat, and the area appears to be a weedy dryland of grasses and forbs, including *Amaranthus spinosus*, *Xanthium strumarium*, *Setaria verticillata*, *Cynodon dactylon*, *Chloris barbata*, and *Merremia aegyptia*. Sexual reproduction of *Marsilea* may occur as infrequently as once every ten or more years, due to the infrequency of sufficiently heavy rains in lowland areas. Historic populations on O'ahu were destroyed by drainage of ponding areas, habitat degradation, competition from alien plants, off-road vehicle use, and development.

DISTRIBUTION

Range: This system occurs at elevations between 424 and 1032 m (1391-3385 feet) on O'ahu and Moloka'i. Historically it also occurred on Ni'ihau.

Divisions: 412:C

TNC Ecoregions: 65:C

Subnations: HI

Associations:

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High-ranked species: *Marsilea villosa* (G1)

SOURCES

References: Palmer 2003, USFWS 1996, USFWS 2003, Wagner et al. 1999, Western Ecology Working Group n.d.

Version: 20 Apr 2005

Stakeholders: West

Concept Author: M. Castillo and G. Kittel

LeadResp: West

CES412.216 HAWAI'I MONTANE BOG

Primary Division: Northern Polynesia (412)

Land Cover Class: Herbaceous Wetland

Spatial Scale & Pattern: Small patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)

Diagnostic Classifiers: Peat and mud; Depressional; Isolated Wetland [Strictly Isolated]; Impermeable Layer; Saturated Soil

Concept Summary: Hawai'i Upland Bog occurs primarily between 1067 and 1670 m (3500-5500 feet) elevation as isolated small patches on flat or gently sloping topography in high rainfall areas in cloud forests and other wet forests on all of the high islands. They are also known to occur at a subalpine bog at 2270 m (7446 feet) elevation on Maui, and a low elevation bog at 646 m (2120 feet) on Kaua'i. Soils remain saturated on a shallow to deep layer of peat (0.01-5 m), underlain by an impervious basal clay layer that impedes drainage. A few bogs occur on steeper terrain where precipitation is extremely high, such as in North Bog in the Wai'ale'ale summit region of Kaua'i, where soils remain saturated despite adequate drainage. Two bogs are believed to have formed in former small lakes, one along the Wailuku River, Hawai'i (Treeless bog), the other the subalpine bog on East Maui (Flat Top bog). The low-elevation bog on Kaua'i occurs on shallow, poorly drained acidic peat. The vegetation is an uneven hummocky matrix of sedges and grasses, including *Rhynchospora rugosa* ssp. *lavarum* (= *Rhynchospora lavarum*), *Oreobolus furcatus*, *Dichantherium*, *Panicum*, and *Deschampsia*, imbedded in moss (*Racomitrium lanuginosum*, *Sphagnum* spp.). Dwarfed woody plants can occur as scattered individuals, in clumps, or as a continuous layer and include *Metrosideros polymorpha*, *Cheirodendron* spp., and *Vaccinium* spp. Associated ferns and herbs include *Sadleria* spp., *Polypodium* spp., *Hymenophyllum* spp., *Elaphoglossum* spp., *Athyrium* spp., *Schizaea robusta*, *Selaginella deflexa*, *Plantago* spp., *Astelia* spp., *Viola* spp., *Machaerina* spp., *Lysimachia* spp., and on Kaua'i, the boreal catchfly *Drosera anglica*.

DISTRIBUTION

Range: This system is found at 646 to 2270 m (2120-7446 feet) elevation on Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i.

Divisions: 412:C

TNC Ecoregions: 65:C

Subnations: HI

Associations:

- *Metrosideros polymorpha* / *Rhynchospora* spp. / *Dicranopteris linearis* Mixed Lowland Bog Dwarf-shrubland (CEGL008080, G1)
- *Metrosideros polymorpha* Mixed Montane Bog Dwarf-shrubland (CEGL008081, G2)

High-ranked species: *Acaena exigua* (G1), *Argyroxiphium caliginis* (G1), *Argyroxiphium grayanum* (G1), *Astelia waialealae* (G1), *Calamagrostis expansa* (G1), *Calamagrostis hillebrandii* (G1), *Carex montis-eeka* (G2), *Chamaesyce sparsiflora* (G1), *Coprosma elliptica* (G3), *Dichantherium cynodon* (G2G3), *Dichantherium hillebrandianum* (G2G3), *Dichantherium isachnoides* (G2G3), *Dubautia paleata* (G1G2), *Dubautia waialealae* (G1), *Geranium hanaense* (G1), *Geranium humile* (G1), *Geranium kauaiense* (G1), *Isoetes hawaiiensis* (G1), *Keysseria erici* (G1), *Labordia pumila* (G1),

Lagenifera helenae (G1), Lagenifera maviensis (G2), Lobelia gloria-montis (G1G2), Lobelia kauaensis (G2), Lobelia villosa (G1), Lysimachia daphnoides (G1), Melicope waialealae (G2), Myrsine denticulata (G1G2), Myrsine helleri (G1G2), Myrsine vaccinioides (G1), Panicum longivaginatum (G1), Sanicula purpurea (G1), Selaginella deflexa (G1G2), Viola kauaensis (G2), Viola maviensis (G2?)

Environment: Clay formation in Hawai'ian bogs is typically a result of basaltic weathering under cool, wet conditions that permits an accumulation of humus. On flat and gently sloping terrain, the clay formation impedes drainage resulting in perched water on top of the clay. In addition, it has now been established that eolian clay mineral deposits accumulated on broad summits and ridges within high rainfall and cloud areas over a 200,000- to 500,000-year time span have also contributed to the formation of clay substrates that support Hawai'ian bogs.

Dynamics: All bogs are threatened by feral pig rooting followed by invasion of exotic sedges (*Cyperus* spp.) and colonization by grasses (*Andropogon virginicus*, *Schizachyrium condensatum*). Fencing at a few bogs has been shown to arrest damage, by keeping pigs away.

SOURCES

References: Mueller-Dombois and Fosberg 1998, Wagner et al. 1999, Western Ecology Working Group n.d., Ziegler 2002

Version: 20 Apr 2005

Stakeholders: West

Concept Author: M. Castillo and G. Kittel

LeadResp: West