USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Conservation Effects Assessment Project

Conservation of Wetlands in Agricultural Landscapes of the United States: Summary of the CEAP-Wetlands Literature Synthesis

April 2011

Appalachian Highlands

California Central Valley

Glaciated Interior Plains

The High Plains

Mississippi Alluvial Valley

Piedmont-Coastal Plain

Prairie Pothole Region

CEAP-Wetlands National Assessment Component Regions

Photo Credits (Cover)

Appalachian Highlands – William R. Effland, NRCS, Beltsville MD
California Central Valley – Walter G. Duffy, Humboldt State University, Arcata, CA
Glaciated Interior Plain – M. Siobhan Fennessy, Kenyon College, Gambier, OH
The High Plains – Loren M. Smith, Oklahoma State University, Stillwater, OK
Mississippi Alluvial Valley – Stephen Faulkner, USGS-LSC, Kearneysville, WV
Piedmont-Coastal Plain – Diane De Steven, USFS, Stoneville, MS
Prairie Pothole Region – David Mushet, USGS-NPWRC, Jamestown, ND

United States Department of Agriculture
Natural Resources Conservation Service

April 2011

Ecosystem Services from Wetlands Conservation in the United States: Summary of the CEAP-Wetlands Literature Synthesis

The U.S. Department of Agriculture (USDA) Conservation Effects Assessment Project (CEAP) began in 2003 as a multi-agency effort to quantify the environmental benefits of conservation practices used by private landowners. The CEAP-Wetlands assessment, one of four CEAP national components, examines the environmental effects of conservation practices on agricultural wetlands enrolled in USDA conservation programs in different regions of the United States.

CEAP-Wetland studies are designed to quantify selected ecosystem services (e.g., water quality, flood control, or biodiversity) for major wetland types in each region. Studies describe the effects of conservation practices on ecosystem services and develop local and regional models to forecast changes in services resulting from program implementation and other environmental and economic factors.

This summary is a compilation of the literature syntheses on CEAP-Wetland studies for seven different U.S. regions. It reviews what is known in the scientific literature about local USDA conservation practices and helps identify gaps to focus future research and management. The seven regions are Appalachian Highlands, California Central Valley, Glaciated Interior Plains, The High Plains, Mississippi Alluvial Valley, Piedmont-Coastal Plain, and Prairie Pothole Region. The literature syntheses were published in the April 2011 supplemental issue of the journal *Ecological Applications* along with a cross-regional synthesis. This supplemental issue also describes a prototype of a landscape modeling and monitoring decisionmaking tool to inform USDA policy and management practices concerning wetland ecosystem services, particularly in response to climate change and water quality. See page 16 of this summary for the contents of the supplemental issue.

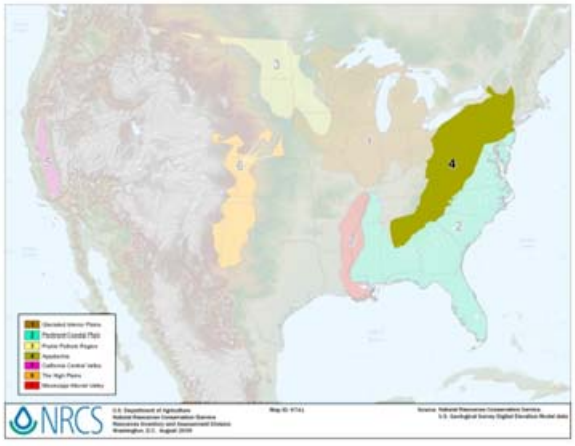
Each regional description outlines the region's wetland classes, ecosystem services provided by the wetlands, local conservation practices and their effects on the ecosystem services, and knowledge gaps that require further study. The most common conservation practices explored in these syntheses occur under the Wetlands Reserve Program (WRP) or Conservation Reserve Program (CRP). They include wetland enhancement and wetland wildlife habitat management practices that work to reduce pollution and enhance plant and animal diversity through establishment of riparian forest buffers, planting of trees and shrubs, pest management, and prescribed grazing.

It is envisioned that these regional evaluations will provide a scientific baseline to construct future research plans for sustainable management of agricultural wetlands.

Appalachian Highlands

Photo – Freshwater emergent wetlands, Maryland, William R. Effland, USDA-NRCS

The Appalachian Highlands regional topography ranges from steep and mountainous to relatively flat and fertile valleys. Agricultural lands, typically in small farms with row crops and livestock, occupy 23 percent of the total land cover. About 17 percent of the 4.2 million acres of wetlands in this region occur in agricultural settings.



Wetland Ecosystem Services

- Water and pollutant management
- Habitat support and biodiversity
- Greenhouse gas management

Regional Wetland Classes

- Riverine (supported by overbank flow on floodplains in valley bottoms)
- Slope (originate in steeper portions of watersheds as headwaters to streams that emerge in the valleys)
- Fringing (wetland areas along the margins of lakes and other water bodies)

Alterations Hindering Wetland Ecosystem Services

- Vegetation altered by agriculture and recent urbanization in valley bottoms
- Eutrophication
- Hydrologic alteration

Documented (D) or Potential (P) Conservation Practice Effects on Wetland Ecosystem Services

- Filter Strip and Prescribed Grazing: (P) Pollutant Management
- Riparian Forest Buffer, Riparian Herbaceous Cover: (P) Pollutant Management, Stormwater Runoff and Floodwater Management, Habitat and Biodiversity Support
- Wetland Restoration: (D) Habitat and Biodiversity Support; (P) Pollutant Management; (P) Support of Ecosystem Processes, (P) Stormwater and Floodwater Management

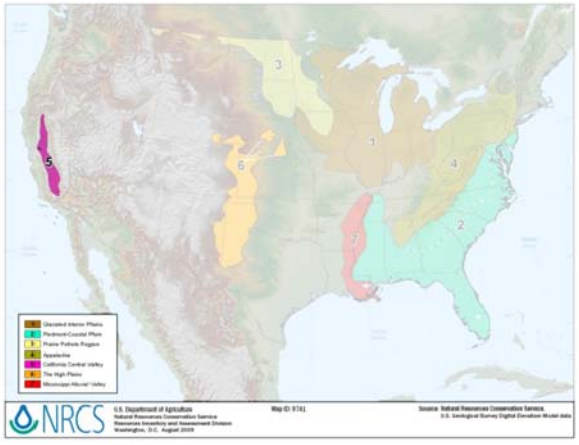
Emerging Issues Needing Further Investigation

- Effects of urban expansion on conservation practices implemented to provide wetland ecosystem services that benefit rural populations
- Effects of a targeted approach to conservation program and wetland practice implementation at the rural-urban interface.
- Wetland ecosystem services benefiting human well-being at the rural-urban interface at a finer spatial scale

California Central Valley

Photo – Sacramento Basin WRP in Central Valley, California, Walter G. Duffy, Humboldt State University

The California Central Valley is characterized by mild, wet winters and dry summers. The topography of the sedimentary basin is relatively flat, and it is bordered by savannas of grassland and oak and deserts to the south. The Valley was once covered by grasslands, extensive riparian forests, and freshwater marshes that today have been converted to primarily agriculture. Freshwater wetland area has increased from about 153,000 hectares in the 1980s to 198,000 hectares in 2006. Agricultural production of rice in the northern valley has also ameliorated some wetland loss.



Wetland Ecosystem Services
- Pollutant and water management
- Habitat and biodiversity support

Regional Wetland Classes
- Depressional (high elevation and small-scale diverse vernal pools)
- Remnant riparian (snowmelt riparian forests/ marsh altered by sedimentation from gold mine tailings and agriculture)

Alterations Hindering Wetland Ecosystem Services
- Altered hydrology from dams, levees, and other constructed infrastructure
- Competing water uses affecting water availability and management
- Eutrophication
- Deposition of atmospheric nitrogen
- Invasive exotics
- Landscape-scale conversion and fragmentation of native cover

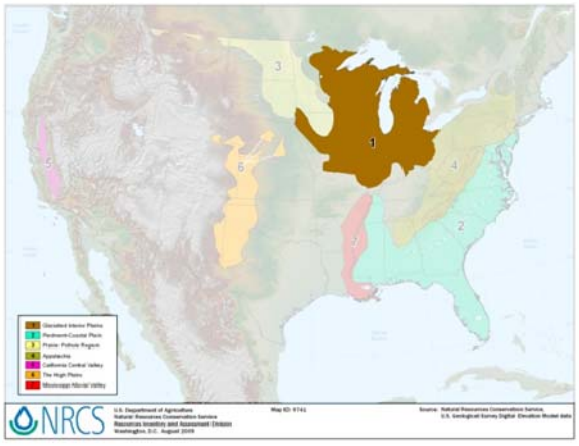
Documented (D) or Potential (P) Conservation Practice Effects on Wetland Ecosystem Services
- Wetland Restoration: (P) Nutrient Processing; (P) Climate Adaptation (N_2O emissions from excess N loadings), (P) Habitat and Biodiversity Support
- Wetland Wildlife Habitat Management, Wetland Enhancement: (P) Habitat and Biodiversity Support

Emerging Issues Needing Further Investigation
- The impact of availability and quality of source water entering WRP wetlands on ecosystem services, particularly biodiversity and habitat support and nutrient processing services
- Effects of managing plant communities in conservation wetlands and associated uplands on aquatic invertebrates, on vertebrate species dependent on invertebrates, and on native pollinators
- Degree of management intensity required on WRP lands to optimize ecosystem services
- Linkage between restored wetland age and provision of ecosystem services
- The effect of expansion of urban development and climate change on wetland structure, function, and services, particularly habitat and biodiversity support

Glaciated Interior Plains

Photo – Created wetland in Ohio, M. Siobhan Fennessy, Kenyon College

The Glaciated Interior Plains, also known as the Corn Belt, is the source of more than 50 percent of total U.S. corn production. The regional climate is temperate, continental with subhumid to humid summers and cold winters. Much of the regional topography was shaped during the most recent Wisconsin glaciation. About 18.6 million hectares of farmland were drained for agriculture.



Wetland Ecosystem Services

- Pollutant, water, and greenhouse gas management

Regional Wetland Classes

- Riverine (forested riparian wetlands are common along floodplains)
- Depressional (broad, upland flats in topographic low spots, e.g. vernal pools exist in the eastern portion of the Glaciated Interior Plains)
- Slope (wet meadows consisting of sedges, rushes and oak savannas are found in the central portion of the Glaciated Interior Plains)
- Organic soil flats (in the north, peat-accumulating wetlands such as forested fens and cedar swamps)

Alterations Hindering Wetland Ecosystem Services

- Cultivation in wetlands during dry years
- Drainage of individual wetlands
- Water table reduction
- Eutrophication

Documented (D) or Potential (P) Conservation Practice Effects on Wetland Ecosystem Services

- Riparian Buffers, Wetland Restoration, Wetland Creation: (D) Nutrient Processing, (D) Climate Adaptation (carbon sequestration, only for organic soil flats)
- Wetland Enhancement, Wetland Wildlife Habitat Management: (P) Habitat and biodiversity support

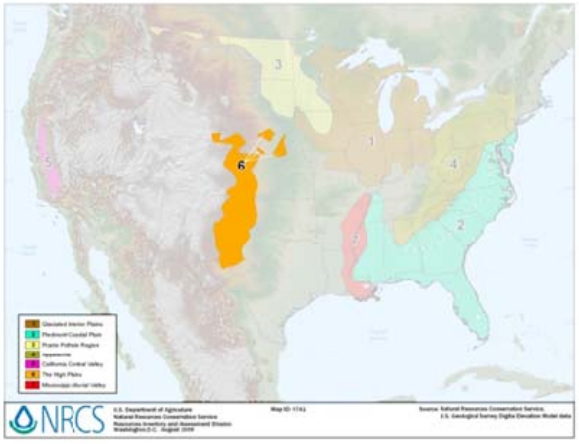
Emerging Issues Needing Further Investigation

- Potential of wetland and riparian buffer practices to reduce N and P inputs driving Gulf of Mexico hypoxia
- Tradeoffs among pollutant management, greenhouse gas emission management, and habitat support services

The High Plains

Photo – Playa wetlands on cropland in Texas, Loren M. Smith, Oklahoma State University

The High Plains are dominated by playas which are shallow depressional wetlands, each with its own watershed or catchment. This largely semi-arid region has extensive cultivation for crop production in conjunction with other agricultural activities (e.g., confined animal feeding operations, intensive livestock grazing). The native vegetation varies from shortgrass prairie to mixed grasses.



Wetland Ecosystem Services
- Biodiversity and habitat support
- Water and pollutant management

Regional Wetland Classes
- Depressional (freshwater playas are temporary, wet or dry depending on precipitation within that catchment)

Alterations Hindering Wetland Ecosystem Services
- Sediment deposition from local catchments
- Cultivation in wetlands

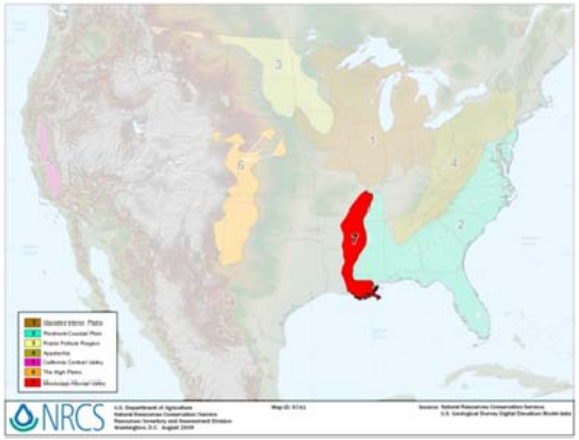
Documented (D) or Potential (P) Conservation Practice Effects on Wetland Ecosystem Services
- Conservation Crop Rotation, Irrigation Water Management, Residue Management, Use Exclusion, Range Planting, Cover Crop, Nutrient Management, Pest Management, Fence: (P) Processing Pollutants
- Range Planting, Upland Wildlife Habitat Management, Restoration and Management of Rare and Declining Habitats: (P) Wildlife Habitat and Biodiversity Support
- Wetland Restoration: (P) Managing Pollutants, (P) Managing Stormwater Runoff and Floodwater, (P) Support of Ecosystem Processes, (P) Habitat and Biodiversity Support, (P) Managing Water Quantity
- Wetland Wildlife Habitat Management, Wetland Enhancement: (P) Habitat and Biodiversity Support

Emerging Issues Needing Further Investigation
- Landscape-level effects of eliminating existing playas from the landscape due to sediment deposition from agriculture
- Recharge of Ogallala Aquifer through restoration of playa basins and catchments via USDA wetland conservation practices and Farm Bill conservation programs

Mississippi Alluvial Valley

Photo – WRP wetlands on cropland in the Mississippi Alluvial Valley, Stephen Faulkner, USGS

The Mississippi Alluvial Valley is the lowland valley of the Mississippi River that begins near the confluence of the Mississippi and Ohio Rivers in Illinois and extends 965 kilometers south to the Gulf of Mexico. The topography is dominated by Holocene-age swamps and meander belts of the Mississippi, Arkansas, and Red rivers with older upland ridges and alluvial terraces above the modern floodplain. The forested wetlands in this humid region host diverse wildlife, especially bird species.



Wetland Ecosystem Services
- Pollutant, water, and greenhouse gas management
- Habitat support

Regional Wetland Classes
- Depressional (contains runoff from precipitation; densely vegetated with baldcypress, water tupelo, and covercup oak)
- Riverine (flooded by overbank streamflows; overstory vegetation ranges from baldcypress/water tupelo to sweetgum/sugarberry)
- Fringe (along the edges of permanent water bodies with more than 2 meters of open water, dominated by baldcypress/ black willow)
- Mineral soil flats (retain the riverine vegetation, but are primarily precipitation driven)

Alterations Hindering Wetland Ecosystem Services
- Landscape-scale hydrologic alterations due to channelization and levees for drainage and flood control
- Sediment deposition

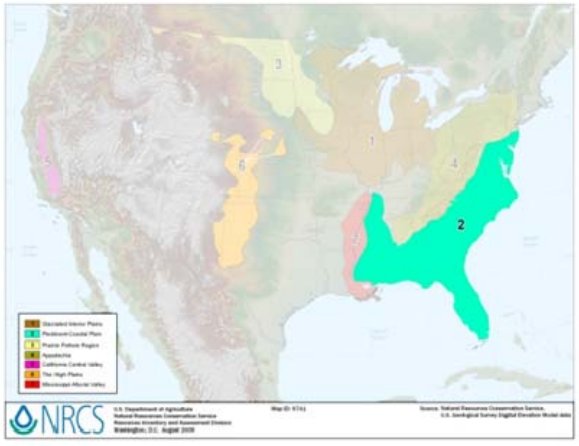
Documented (D) or Potential (P) Conservation Practice Effects on Wetland Ecosystem Services
- Conservation Crop Rotation, Residue Management, Prescribed Grazing, Use Exclusion, other upland practices: (D) Pollutant Management
- Wetland Restoration, Riparian Forest Buffer: (D) Biodiversity Support; (D) Pollutant Management; (D) Climate Adaptation (carbon sequestration); (D) Habitat and Biodiversity Support
- Wetland Wildlife Habitat Management Practice: (P) Habitat and Biodiversity Support

Emerging Issues Needing Further Investigation
- Effects of restored wetlands established through Farm Bill conservation programs on Gulf of Mexico hypoxia
- Landscape-level alterations that constrain effective restoration of wetland ecosystem services
- Extent of hydrologic reconnections and effects on ecosystem services at site- and landscape-scales
- Effects of variable implementation of wetland establishment and management practices on ecosystem services
- Contribution of anuran (amphibian) biodiversity to wetland ecosystem services
- Effectiveness of key upland and wetland conservation practices to mitigate or facilitate amphibian population recovery due to agricultural practices habitat modification

Piedmont Coastal Plain

Photo – Natural wetland in the Coastal Plain of South Carolina, Diane De Steven, USDA-FS

The Piedmont-Coastal Plain is an area of low topographic relief and a hot and humid climate. The region has approximately 50 percent of all freshwater wetlands and 95 percent of all estuarine wetlands (by area) in the conterminous United States. Food crop production and livestock grazing take up about 20 percent of the region, while 60 percent is covered by forests.



Wetland Ecosystem Services
- Habitat and biodiversity support
- Pollutant, greenhouse gas, and water management

Regional Wetland Classes
- Riverine (forested wetlands along streams and major rivers)
- Depressional (Carolina and Delmarva bays)
- Organic and mineral soil flats (pocosin peatlands, wet flatwoods)

Alterations Hindering Wetland Ecosystem Services
- Wetlands drainage, stream channelization
- Recent conversion from forest and cropland to urban areas causing habitat losses
- Nutrient pollution

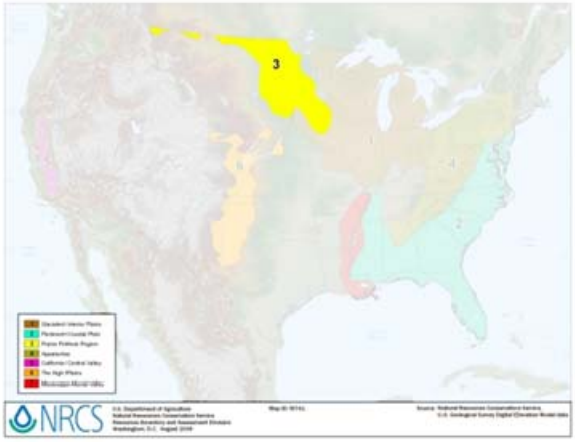
Documented (D) or Potential (P) Conservation Practice Effects on Wetland Ecosystem Services
- Filter Strip and Riparian Forest Buffer: (D) Pollutant Management; (D) Habitat Support
- Wetland Restoration and Creation: (P) Vegetation Biodiversity Support; (P) Nutrient Processing; (D) Habitat Support (in depressional wetlands)
- Wetland Wildlife Habitat Management, Wetland Enhancement, and Shallow Water Development and Management: (P) Habitat Support
- Drainage Water Management: (P) Water Management, (D) Nutrient Processing (in wet flats)
- Prescribed Grazing: (D) Habitat and Biodiversity Support (in wet flats)

Emerging Issues Needing Further Investigation
- Effectiveness of the Constructed Wetland practice on pollutant management from effluent associated with confined animal feeding operations
- Benefit of controlling excess phosphorus via implementation of a targeted suite of upland and wetland practices
- Identification of ecosystem services, by wetland type, provided from Wetland Restoration, Wetland Creation and Wildlife Habitat Management practices on the Coastal Plain
- Watershed- and landscape-scale targeting of practices and programs to facilitate broad spatial assessment of ecosystem services

Prairie Pothole Region

Photo – Prairie pothole wetland in North Dakota, David Mushet, USGS-NPWRC

The Prairie Pothole Region formed largely by glacial processes about 10,000 years ago with topography that ranges from rolling plains to hummocky areas of closely spaced hills pockmarked with tens of thousands of shallow depressional wetlands or potholes. It is one of the most productive agricultural regions in the world, accounting for one-third of the nation's annual production of wheat, corn, barley, and soybeans. Across the five states in the region (Iowa, Minnesota, Montana, North Dakota, and South Dakota), 27 to 89 percent of prairie wetlands have been drained to support agriculture.



Wetland Ecosystem Services

- Water, pollutant, and greenhouse gas management
- Biodiversity support

Regional Wetland Classes

- Depressional (small wetlands, typically less than 1 hectare—"potholes"—embedded in a landscape that was formerly prairie)

Alterations Hindering Wetland Ecosystem Services

- Drainage and sediment infilling
- Cultivation of wetlands

Documented (D) or Potential (P) Conservation Practice Effects on Wetland Ecosystem Services

- Filter Strip, Conservation Cover, Nutrient Management, Residue Management, Conservation Crop Rotation, Prescribed Grazing: (P) Pollutant Management
- Wetland Restoration: (D) Support of Ecosystem Processes; (D) Habitat and Biodiversity Support; (P) Floodwater Management; (D) Climate Adaptation; (D) Nutrient Processing and Sediment Management
- Wetland Wildlife Habitat Management: (D) Habitat and Biodiversity Support

Emerging Issues Needing Further Investigation

- Local and regional water table depletion affecting sustainability of prairie wetland processes and services
- Climate change effects due to conventional tillage and fertilizer use in temporary and seasonal depressional wetlands
- Effects of climate change on the capacity of prairie wetlands to provide ecosystem services and the extent to which conservation programs and practices can mitigate those effects
- Effectiveness of conservation practices on restoring wetland hydrologic processes

References

Following are the articles in the CEAP-Wetlands Literature Synthesis – April 2011 supplemental issue of *Ecological Applications*, "Conservation of Wetlands in Agricultural Landscapes." The supplemental issue is accessible on the CEAP Web site, http://www.nrcs.usda.gov/technical/nri/ceap/wetlands.html, and on the Ecological Society of America site, http://www.esajournals.org/toc/ecap/21/sp1.

Chapter 1. Linking science, policy, and management to conserve wetlands in agricultural landscapes by S.D. Eckles

Chapter 2. Agricultural conservation practices and wetland ecosystem services in the wetland-rich Piedmont–Coastal Plain region by D. De Steven and R. Lowrance

Chapter 3. Effects of conservation practices on wetlands in the Mississippi Alluvial Valley by S. Faulkner, W. Barrow, B. Keeland, S. Walls, and D. Telesco

Chapter 4. Ecosystem services provided by playas in the High Plains: Potential influences of USDA conservation programs by L.M. Smith, D. Haukos, S.T. McMurry, T. LaGrange, and D. Willis.

Chapter 5. USDA conservation program and practice effects on wetland ecosystem services in the Prairie Pothole Region by R.A. Gleason, N.H. Euliss, B. Tangen, M. Laubhan, and B. Browne

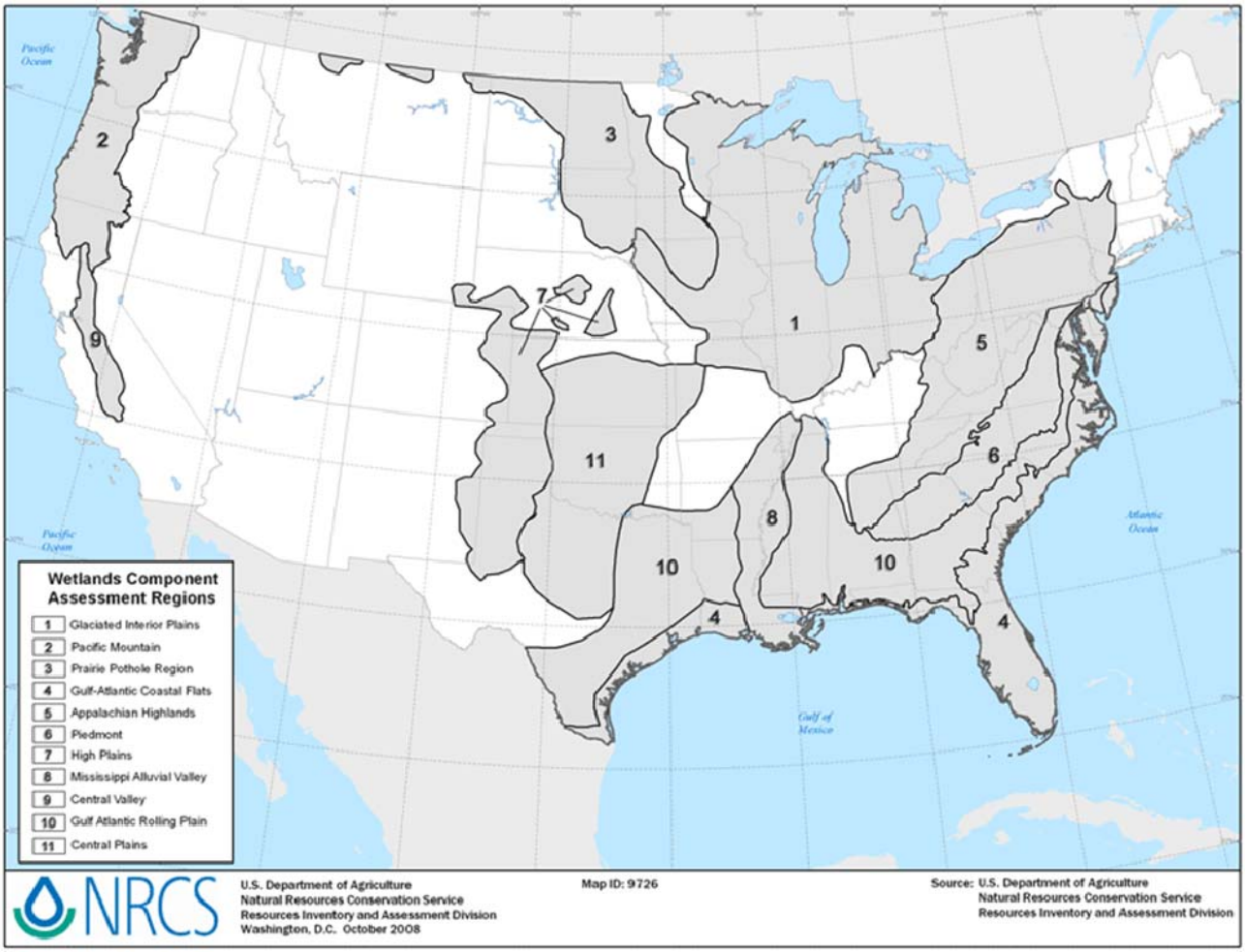
Chapter 6. Agricultural conservation practices increase wetland ecosystem services in the Glaciated Interior Plains by M.S. Fennessy and C. Craft

Chapter 7. Wetland ecosystem services in California's Central Valley and implications for the Wetland Reserve Program by W.G. Duffy and S.N. Kahara

Chapter 8. Wetland ecosystem services and coupled socioeconomic benefits through conservation practices in the Appalachian region by D.H. Wardrop, A.K. Glasmeier, J. Peterson-Smith, S.D. Eckles, H. Ingram, and R.P. Brooks

Chapter 9. U.S. Department of Agriculture conservation program and practice effects on wetland ecosystem services: a synthesis by M.M. Brinson and S.D. Eckles

Chapter 10. Integrating estimates of ecosystem services from conservation programs and practices into models for decision makers by N.H. Euliss, L.M. Smith, S. Liu, W.G. Duffy, S.P. Faulkner, R.A. Gleason, and S.D. Eckles


Pacific Ocean
Pacific Ocean
Atlantic Ocean
Gulf of Mexico
2
3
1
5
9
7
11
6
8
10
10
4
4
Wetlands Component Assessment Regions
1 Glaciated Interior Plains
2 Pacific Mountain
3 Prairie Pothole Region
4 Gulf-Atlantic Coastal Flats
5 Appalachian Highlands
6 Piedmont
7 High Plains
8 Mississippi Alluvial Valley
9 Central Valley
10 Gulf Atlantic Rolling Plain
11 Central Plains
NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service
Resources Inventory and Assessment Division
Washington, D.C. October 2008
Map ID: 9726
Source: U.S. Department of Agriculture
Natural Resources Conservation Service
Resources Inventory and Assessment Division

Conservation Effects Assessment Project