

Conservation, Protection and Utilization of Louisiana's Coastal Wetland Forests

Executive Summary of Final Report to the Governor of Louisiana from the

Coastal Wetland Forest Conservation and Use Science Working Group



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CONSERVATION, PROTECTION AND UTILIZATION OF LOUISIANA'S COASTAL WETLAND FORESTS

EXECUTIVE SUMMARY

Louisiana's coastal wetland forests are of tremendous economic, ecological, cultural, and recreational value to residents of Louisiana, the people of the United States, and the world. Although some two million acres of forested wetland occur throughout Louisiana, over half are in the coastal parishes. Large-scale and localized alterations of processes affecting coastal wetlands have caused the complete loss of some coastal wetland forests and reduced the productivity and vigor of remaining areas. This loss and degradation threatens ecosystem functions and the services they provide.

In response to the continuing loss and adverse impacts to Louisiana's coastal wetland forests, the Governor commissioned the formation of the Coastal Wetland Forest Conservation and Use Science Working Group (hereafter referred to as SWG). The mission of the SWG was to provide information and guidelines for the long-term utilization, conservation, and protection of Louisiana's coastal wetland forest ecosystem, from both environmental and economic perspectives. To accomplish this mission the following objectives were developed:

- 1) Gather and synthesize scientific information available on regeneration, growth, and potential harvesting effects on coastal wetland forests.
- 2) Gather and summarize field information on general characteristics of previously harvested baldcypress and tupelo forest stands to evaluate their potential to regenerate, become established, and remain vigorous.
- 3) Review existing laws, regulations, policy, and guidelines affecting coastal forestry activities (and current forest conditions).
- 4) Develop science-based, interim guidelines for the conservation and utilization of coastal wetland forests.
- 5) Identify critical areas of priority research needed to refine these interim guidelines.

The SWG developed this report to address these objectives. To emphasize the most important points of the report, the SWG developed a set of Findings and Recommendations. These are presented here with a summary of supporting information from the body of the report.

Findings

1) Louisiana's coastal wetland forests are of tremendous economic, ecological, cultural, and recreational value to residents of Louisiana and the people of the United States and the world; and include:

- wildlife habitat (including migratory songbirds/waterfowl, threatened and endangered species),
- flood protection, water quality improvement (including nitrate removal), and storm protection,
- carbon storage and soil stabilization,
- economic benefits of fishing, crawfishing, hunting, timber production, and ecotourism

The importance of these forests is derived in part from the unusual deltaic landscape they occupy. Most coastal wetland forests in Louisiana are a product of the Mississippi River and therefore experience natural development and degradation cycles as do most coastal marshes. The delta cycle can be seen as a balance between the forces that lead to formation and maintenance of wetlands (mainly riverine input) and the forces that lead to loss (subsidence and saltwater intrusion). This contributes to their global significance and adds to the impetus to develop appropriate management strategies.

Wetland functions are the physical, chemical, and biological processes that sustain the wetland ecosystem, irrespective of any interaction with humans, and can be broadly grouped into biotic, hydrologic, and biogeochemical functions. The most important functions of coastal wetland forests are biogeochemical nutrient transformations (wetlands are uniquely suited to mitigate the negative impacts of nonpoint source pollution), flood storage, and maintenance of characteristic plant communities for wildlife habitat and timber production. The important fish and wildlife habitat functions include habitat for threatened species (e.g., Louisiana black bear, bald eagle) and economically important species (e.g., crawfish and waterfowl). Millions of landbirds, including virtually all of the eastern neotropical migrant landbird species in the United States and numerous species from the western United States, migrate through the coastal forests of Louisiana during spring and fall migration. Dozens of wading bird rookeries and over one hundred bald eagle nests are located in Louisiana's coastal forests. In addition, two of three subpopulations of the Louisiana black bear use these forests. It is generally understood that the actual value of any particular tract is dependent upon the animal species of interest and numerous forest characteristics, including geographic location and size of the forest stand, connectivity to the adjacent forest stands and habitats, landscape composition, hydroperiod, vertical structure, tree sizes and species composition. Direct forest loss as a result of conversion of forest to open water or marsh would obviously be highly detrimental to species dependent upon coastal wetland forests. More subtle habitat changes, such as alterations in forest

structure and composition and increased flood depth and duration, are also significant threats to many wildlife species.

The landscape position and biogeochemical properties of coastal wetland forests give them both the opportunity and mechanisms to alter pollutant loadings to aquatic ecosystems. While nutrient loading can have detrimental effects on natural wetlands, Louisiana's coastal wetland forests are sediment and nutrient deprived as a result of the Mississippi River levee system and are experiencing significant habitat loss. Under these conditions, the addition of nutrients and sediments is the only way for these ecosystems to maintain their surface elevation relative to sea-level rise.

Ecosystem services are the benefits that humans and society derive from the functions of an ecosystem and the value of these services can be quantified. There are few data on the value of the specific ecosystem services provided by coastal wetland forests and it is beyond the scope of this effort to develop accurate estimates specifically for these wetlands. We can derive a rough estimate from the scientific literature of \$7,927 per acre per year for swamps and floodplains multiplied by the estimated 845,692 acre of swamp forest area for a total value of \$6.7 billion. Based on current stumpage volume and price, the value of the standing cypress-tupelo timber in the area delineated by the SWG has been estimated by the Louisiana Department of Agriculture and Forestry to be \$3.3 billion.

2) The functions and ecosystem services of Louisiana's coastal wetland forests are threatened by both large- and small-scale hydrologic and geomorphic alterations and by conversion of these forests to other uses.

- **Subsidence, sea-level rise, and levee construction are the large-scale hydrologic and geomorphic alterations responsible for the loss of Louisiana's coastal wetland ecosystems including coastal wetland forests. Since Louisiana's coastal wetland forests are nutrient deprived as a result of the Mississippi River levee system, addition of nutrients and sediments is the only way for these ecosystems to maintain their surface elevation relative to sea-level rise.**
- **The cumulative effects of small-scale or local factors can be of equal or greater importance in coastal wetland forest loss and degradation than large-scale alterations. These factors include increased depth and duration of flooding, saltwater intrusion, nutrient and sediment deprivation, herbivory, invasive species, and direct loss due to conversion. Causal agents include highways, railroads, channelization, navigation canals, oil and gas exploration canals, flood control structures, conversion of forests to urban and agricultural land, and non-sustainable forest practices.**
- **Under less severe impacts, many of the important functions and ecosystem services are lost or degraded even though the trees may be intact and the forest may appear unaffected.**

- **Without appropriate human intervention to alleviate the factors causing degradation, most of coastal Louisiana will inevitably experience the loss of coastal wetland forest functions and ecosystem services through conversion to open water, marsh, or other land uses.**

A number of factors have led to the massive loss of coastal wetlands in Louisiana. Foremost among these are flood-control levees along the Mississippi River that resulted in the elimination of riverine input to most of the delta and contributed to wetland loss. Hydrological disruption via control of rivers has reduced freshwater and sediment inputs, while canal construction has led to much greater saltwater intrusion into coastal wetlands. Increasing water levels resulting from eustatic sea-level rise and subsidence are also major degradation factors. Without the annual flood of new sediments, subsidence exceeds sedimentation in many areas, and most of coastal Louisiana is presently experiencing an apparent water level rise of about 3.3 feet per century. These detrimental, large-scale processes have been seriously increased by management practices and societal infrastructure that have also altered and degraded ecosystems.

As water levels continue to rise, the coastal forests will be subjected to more prolonged and deeper flood events. Even though many of the forest species growing in these areas are adapted to prolonged inundation, extended flooding during the growing season can cause mortality of these tree species. Already many of the trees in these areas are showing evidence of severe stress. Even baldcypress and water tupelo, two of the dominant species in Louisiana's coastal forests, slowly die when exposed to prolonged, deep flooding of longer than normal duration and regeneration of new trees cannot occur under flooded conditions. Together, these impacts are so substantial that total loss of wetland forests is nearly assured in most of coastal Louisiana without active measures to ameliorate problems.

The Barataria, Lake Verret, and Lake Pontchartrain basins, located in south central and southeastern Louisiana, contain extensive freshwater wetland forests. There are approximately 242,000 acres of seasonally (mostly permanently) flooded forests and wooded swamps in the Barataria Basin, 101,000 acres in the Verret Basin, and 213,000 acres in the Pontchartrain Basin. All of these watersheds were once overflow basins of the Mississippi or Atchafalaya rivers. With the construction of the flood protection levees along these rivers in the 1920-1940s, the only source of freshwater presently is rainfall or backwater flooding. When these areas received riverine input, sediment deposition served to offset apparent water level rise due to land subsidence. With the cessation of sediment input, regional subsidence is leading to increased flooding of these areas. Water levels in the Barataria, Lake Verret, and Pontchartrain basins historically followed a seasonal pattern of flooding and drying with the extent of flooding depending on the elevation of the site and seasonal water budget. Barataria and Verret basins have experienced significant

increases in the total number of days flooded per year. In Barataria Basin, the swamps have always been flooded to some extent, but forests are now flooded almost year round. Even during dry periods such as 1981 and 1985-1986, these forests were rarely free of standing water. Since the 1950s, flood water levels in the swamps of the Pontchartrain Basin have doubled. If water levels continue to rise, coastal forested areas will eventually be replaced by scrub-shrub stands, marsh, or open water.

3) Regeneration is a critical process of specific concern in maintaining coastal wetland forest resources. Successful natural regeneration of this resource in the 1920s was due to fortuitous conditions existing at that time. Currently, there is a lack of regeneration in coastal cypress-tupelo forests that is a direct result of factors identified above and their interactions with regeneration processes.

Baldcypress and water tupelo are the primary tree species in the coastal swamp forests of Louisiana. Consistent mast crops do not occur in either species until trees are about 30 years old. Baldcypress trees will generally produce seed every year, but larger seed crops occur every three to five years. However, baldcypress seeds cannot germinate in standing water, and seedlings must grow tall enough during short drawdown periods for their crowns to extend above the water surface to survive flooding during the growing season. Baldcypress seedlings can withstand complete inundation for up to 45 days, but long-term flooding above the foliage results in high mortality. Baldcypress is exacting in its needs, but regenerates well in swamps where there is ample sunlight and the seedbed is moist but not flooded during the time period of seed germination and seedling establishment.

Changes in hydrology have reduced regeneration in many stands even though overstory trees may still be thriving. Ultimately, the lack of regeneration will eliminate forest cover. When favorable conditions for germination and seedling growth do not immediately precede or follow a regeneration harvest, stand regeneration can only occur through artificial regeneration. In places where flooding is sufficiently persistent and deep, even artificial regeneration is not possible. For example, natural regeneration of baldcypress was poor to non-existent in south Louisiana swamps following logging operations in the 1980s, mainly because the land remained flooded for much of the year.

Herbivory is another problem that has long existed in Louisiana's swamps, and directly affects regeneration. One of the most important agents of this problem is the nutria, which has become firmly established throughout the coast since the 1950s. Nutria often clip or uproot newly planted baldcypress seedlings before the root systems are fully established, thus destroying the whole seedling. Several alternatives have been proposed to prevent nutria from eating newly planted baldcypress seedlings. Reducing nutria is one alternative to the problem, but this method is expensive.

The strict requirement for seedling establishment and pervasive seedling herbivory together dictate that management of coastal wetland forests hinges in large part on ensuring regeneration. Managing forested wetlands for timber production is generally difficult because of the periodic to continuously flooded nature of these sites. Although there is some knowledge regarding silvicultural practices for the drier end of the forested wetlands continuum (e.g., wet pine flats and moderately well drained to poorly drained bottomland hardwoods), there has been little research into optimum silvicultural practices for wet sites. It has been suggested that baldcypress and tupelo stands should be managed on an even-aged basis because of the characteristics of the species, the nature of the existing stands, and the sites they inhabit. The most common regeneration method used for this purpose with other species is clearcutting when stems reach the desired size. Residual stems should be removed or deadened to limit competition on natural or planted seedlings.

4) In those areas where flooding prevents or limits the natural regeneration of the cypress-tupelo forest, artificial regeneration through tree planting is the only currently viable mechanism to regenerate the forest. Some swamps are altered to such a significant extent that even artificial regeneration is not possible. Coppice or stump sprouting does not provide sufficient numbers of viable trees to reliably regenerate the forest, even under optimum conditions.

Because of the exacting requirements for germination and establishment and the variable success of stump sprouting, planting of baldcypress and water tupelo is likely necessary in many areas to ensure adequate stocking of future stands. Innovative planting methods are often required for forested wetland sites because of standing water, unconsolidated or organic substrates, and herbivory. Habitats planted have ranged from standing, stagnant water to flowing water in coastal to inland sites of Louisiana and South Carolina. Bareroot seedlings of baldcypress and water tupelo have been successfully planted under flooded conditions.

5) Conditions affecting the potential for forest regeneration and establishment are recognizable based upon existing biological and physical factors. The SWG has developed a set of condition classes for the dominant wetland forest type, in Louisiana's coastal cypress-tupelo forests. All references to flooding depths or durations assume average rainfall conditions, not extreme or unusual events. Sediment input is generally beneficial, but in localized situations, excessive levels can prevent or prohibit natural or artificial regeneration under SWG Condition Classes I and II. The SWG Cypress-Tupelo Coastal Wetland Forest Regeneration Condition Classes are:

SWG Condition Class I: Sites with Potential for Natural Regeneration

These sites are generally connected to a source of fresh surface or ground water and are flooded or ponded periodically on an annual basis (pulsing). They must have seasonal flooding and dry cycles (regular flushing with freshwater), usually have both sediment and nutrient inputs, and sites in the best condition are not subsiding. These sites have some level of positive tree growth, thereby providing increasing or stable biomass production, organic input, and experience re-charge of water table after drought periods. Sites in this category that are subject to increasing flood frequency, increased flood duration, or increasing flood water depths may eventually move into the next lower category unless action is taken to remedy these detrimental conditions.

SWG Condition Class II: Sites with Potential for Artificial Regeneration Only

These sites may have overstory trees with full crowns and few signs of canopy deterioration, but are either permanently flooded (which prevents seed germination and seedling establishment in the case of baldcypress and tupelo) or are flooded deeply enough that when natural regeneration does occur during low water, seedlings cannot grow tall enough between flood events for at least 50% of their crown to remain above the high water level during the growing season. These conditions require artificial regeneration, (i.e., planting of tree seedlings). Water depth for sites in this category is restricted to a maximum of two feet for practical reasons related to planting of tree seedlings. Planted seedlings should have at least 12 inches of crown (length of main stem with branches and foliage present) and must be tall enough for at least 50% of the crown to remain above the high water level during the growing season. Sites with a negative trajectory (increasing average annual water depth) may eventually move into SWG Condition Class III unless action is taken to remedy this detrimental condition.

SWG Condition Class III: Sites with No Potential for either Natural or Artificial Regeneration

These sites are either flooded for periods long enough to prevent natural regeneration and practical artificial regeneration, or are subject to saltwater intrusion with salinity levels that are toxic to cypress-tupelo forests. Two trajectories are possible for these two conditions: 1) freshwater forests transitioning to either floating marsh or open fresh water, or 2) forested areas with saltwater intrusion that are transitioning to open brackish or saltwater (marsh may be an intermediate condition). SWG Category III sites

are placed in specific subcategories relative to stress conditions as listed below. They may differ in the types of recommendations made or actions that should be taken relative to the particular stressing agent.

A. Forests with saltwater intrusion or high soil salinity:

1. Chronic (semi-permanent) saltwater intrusion (e.g., coastal areas with high rates of subsidence). These are sites where saltwater intrusion is of a long-term nature and requires correction.

a. For baldcypress, chronic levels of soil salinity of four ppt or greater increases mortality of seedlings and makes the likelihood of regeneration unreliable.

b. For tupelo, chronic levels of salinity greater than two ppt increases mortality.

2. Acute (temporary) flooding with saline waters such as from storm surges. These conditions are temporary and tolerance can be much higher.

B. Forests with water levels exceeding two feet at time of planting makes artificial regeneration impractical.

6) Physical and biological processes link coastal forests and coastal marshes. The current Louisiana Coastal Zone Boundary does not accurately reflect the full extent of Louisiana's coastal wetland forests. The lack of focus on large scale restoration and protection activities outside the Louisiana Coastal Zone Boundary makes them more vulnerable to loss and degradation from detrimental impacts.

Louisiana's coastal wetland forests have been shaped by the sediments, water, and energy of the Mississippi River as natural deltas have been formed and abandoned over the last 5,000 years. During the regressive or constructional phase of the delta cycle, the system is dominated by freshwater riverine inputs with the formation of corresponding freshwater marshes and swamps, which then deteriorate during the marine-dominated transgressive phase. The largest areas of Louisiana's coastal wetland forests are swamps in the deteriorating transgressive phase of the Deltaic Plain. Deterioration of the delta in areas currently occupied by forested wetlands will result in hydrological conditions unsuitable for forest cover and result in conversion to marsh or open water. As in coastal marshes, where local deterioration is accelerated by neighboring marsh conversion to open water, the condition of forested wetlands depends in part on neighboring forests and marshes. In particular, saltwater intrusion into forested wetlands is often increased when neighboring marshes deteriorate.

7) Spatially explicit data of coastal wetland forest conditions necessary to guide restoration, regulatory, and management efforts are scarce. USDA Forest Service Forest Inventory and Analysis (FIA) data are inadequate for these purposes.

The condition of coastal wetland forests and the stressing factors are known to vary across the coastal zone; however, existing data are insufficient to guide restoration, regulatory, and management efforts in most areas.

The most complete data available on the area of forest types in Louisiana come from FIA, currently collected by the Louisiana Department of Agriculture and Forestry in cooperation with the USDA Forest Service. Cypress-tupelo forests of the region in 1974 were dominated by relatively small trees, but 29 years of growth has seen the size structure change to be dominated by larger trees. However, FIA data and other scientific information suggest coastal cypress-tupelo forests are not currently growing vigorously, if at all, and suggest environmental stresses may be playing a part in stand development. Systematically collected field-based and remotely-sensed data are needed but are currently lacking.

Recommendations

Based on these findings, the SWG recommends that the Louisiana Governor's Office:

1. Adopt the following statement of mission and intent regarding coastal wetland forest ecosystem policy: The State of Louisiana will place priority on conserving, restoring, and managing coastal wetland forests, including collaborative efforts among public and private entities, to ensure that their functions and ecosystem services will be available to present and future citizens of Louisiana and the United States.
2. Recognize the regeneration condition classes (Finding 5) for cypress-tupelo forests developed by the Science Working Group (SWG) and use them to classify existing coastal forest site conditions for management, restoration, protection, and use purposes.
3. Place priority on maintaining hydrologic conditions on SWG Regeneration Condition Class I lands.
4. Delay timber harvesting on Condition Class III lands because these lands will not regenerate to forests. The goal is to allow time for hydrologic restoration and improvement of stand conditions to Class I or Class II lands. Place an interim moratorium on harvesting on state-owned Condition Class III lands. Develop mechanisms to delay timber harvesting on privately owned Condition Class III lands.

5. Before harvesting SWG Condition Class I and II sites, a written forest management plan with specific plans for regeneration must be reviewed by a state-approved entity so appropriate practices can be suggested based on local site conditions. The intent is to ensure that cypress-tupelo regeneration and long-term establishment take place and that species or wetland type conversion does not occur.
6. Develop spatially explicit data regarding SWG Condition Classes, existing hydrologic and geomorphic conditions, and current and future threats to coastal wetland forests. These data should be collected, evaluated, and updated by a consortium of state, local and federal agencies, universities and non-governmental organizations and made available to all entities. Adding remotely-sensed data to this data set should be aggressively pursued. Such data are critical to wisely manage and care for the coastal forest wetland ecosystem of Louisiana.
7. Establish and maintain a system of long-term monitoring of coastal wetland forest conditions, supplemental to FIA and Coastal Reference Monitoring System (CRMS) datasets, expanded to include the entire SWG coastal wetland forest area (see Figure 1). Additionally, monitoring of restoration should occur, and include measures to evaluate success. This may entail some long-term efforts because forests may take 25 years to establish functioning stands.
8. Coastal forests extend beyond the current Coastal Zone Boundary. Therefore, the target area for large scale restoration should be expanded to include coastal wetland forests as defined by the SWG (Figure 1), especially those in major river bottoms draining to the coast (e.g., Atchafalaya and Pearl River Basins) and those with extensive areas of coastal wetland forests (e.g., Lake Maurepas).
9. Direct all state and local agencies to review, evaluate and coordinate their activities in coastal wetland forests and develop guidelines and practices to prevent the loss and degradation of habitat, functions, and ecosystem services through official actions. The Governor should also officially request that federal agencies do the same.
10. Review and modify current accepted practices for mitigation of impacts on coastal wetland forests. Given the uniqueness of Louisiana's coastal wetland forests, all mitigation must be of the same forest type and occur within the same watershed where the impacts are located.

11. Encourage conservation and protection of coastal wetland forest areas by developing a Coastal Wetland Forest Reserve System.
12. Actively pursue restoration of degraded wetland forests, regardless of the SWG condition class. Encourage collaborative efforts between public and private entities including the development or modification of federal legislation to include degraded coastal wetland forests in landowner incentives programs.
13. Enhance wetland forest ecosystem functions and values as part of all hydrological management decisions, including management of point- and nonpoint-source inputs, floodways, creation of diversions, levee and highway construction, and coastal management.
14. Develop policies to ensure implementation of the above recommendations. Various incentive mechanisms should be explored as part of policy implementation.

Based on existing knowledge about coastal wetland forests and the compilation of new information from field surveys and federally-sponsored forest inventories, the SWG strongly recommends appropriate science-based management of Louisiana's coastal wetland forests based on the above findings and recommendations.