Swamp Restoration Suitability Assessment 2020-2021

Why We Do This

Swamp forests in Louisiana provide many important ecosystem services. Swamps improve water quality by assimilating nutrients and trapping sediment, store flood waters, provide habitat for wildlife, store carbon, provide opportunities for commercial and recreational fishing and hunting, provide recreation and tourism opportunities and are culturally important (Chambers et al. 2005). Additionally, swamp forests provide storm surge protection during hurricanes while sustaining low levels of wind damage in the hurricane, when compared to other forest types (Touliatos and Roth 1971, Doyle et al. 1995, Williams et al. 1999, Doyle et al. 2007, Shaffer et al. 2016). The Pontchartrain Conservancy (PC) has developed a robust swamp reforestation program and planted >92,000 wetland tree species across the basin (with partners), restoring approximately 410 acres of swamp habitat. To improve swamp reforestation outcomes PC periodically conducts Pontchartrain Basin-wide swamp restoration suitability assessments (SRSA). Previous assessments were conducted in 2014 - 2015 and in 2016 - 2017. This document describes the methods and outcomes of the 2020 - 2021 SRSA for the Pontchartrain Basin.

How We Do This

The purpose of the SRSA is to identify 1) areas currently suitable for swamp restoration, 2) areas that are likely to become suitable in the near feature and 3) areas that are not likely to be suitable. We conduct periodic updates because climate change, coastal development and hydrological restoration interact to impact environmental conditions across the basin, and in some areas, this interaction causes the environmental conditions (i.e. surface salinity, soil salinity, marsh inundation) to change, which in turn affects how an area is characterized in the SRSA and whether it is suitable for restoration.

Vegetation Data

In general, the SRSA is created by over laying vegetation, surface water salinity, and soil salinity data sets in ArcGIS software to generate the restoration suitability categories. First, we import the most recent land classification data. For the 2020 - 2021 SRSA we used a recoded vegetation raster dataset created from the Coastal Protection and Restoration Authority (CPRA) Coastal Master Plan 2017, which was obtained from DeWitt Braud at Louisiana State University (Baton Rouge, LA). Using ArcGIS, the raster was converted to polygons and re-classified as forested wetlands, floating marsh, water, bare ground, fresh marsh, intermediate marsh, brackish marsh, and salt marsh. The forested wetland areas were then removed from the assessment area and designated as 'Already Swamp,' because we do not need to assess the suitability for restoration areas that are already swamp habitat. The floating marsh was removed from the analysis, as it cannot support mature tree weight. The 2019 USA National Land Cover (NLCD) layer (ESRI 2021) was then used to identify developed areas, cropland, other forest and water, which were selected and removed from the preliminary assessment area. The remaining layer was clipped and constrained to the Pontchartrain Basin.

Surface Water Salinity Data

Next, we used continuous surface water salinity data from the United States Geologic Survey (USGS; https://waterdata.usgs.gov/nwis), the state of Louisiana's Coastwide Reference Monitoring Stations (CRMS; https://lacoast.gov/crms/), and the Consortium for Assimilative Data Modeling (http://HYCOM.org) to estimate annual average surface water salinity for 2020 and 2021 across the basin. We then created interpolated rasters of average annual surface water salinity for each year (2 raster files). The interpolated raster (2020, 2021) was then delineated into 3 categories (0 - 2 ppt, 2 - 3 ppt, > 3 ppt).

Soil Salinity Data

Monthly soil salinity data was obtained from the Louisiana Coastal Information Management System (CIMS; http://cims.coastal.louisiana.gov) for 2020 and 2021. We then created interpolated rastersof average annual soil salinity for each year (2 raster files). The interpolated rasters were spot checked against discreet soil salinity data collected in-house by PC staff for continuity. Each raster (2020, 2021) was then delineated into the same 3 categories (0 - 2 ppt, 2 - 3 ppt, > 3 ppt).

Spatial Analyses

The resulting 4 categorized raster files (2 surface salinity, 2 soil salinity) were overlaid to create common area polygons for the following categories: 1) consistently < 2 ppt., 2) mixed < 2 ppt. and 2ppt. – 3 ppt., 3) 2 ppt. – 3 ppt., 4) mixed 2 ppt. – 3 ppt. and > 3 ppt., and 5) > 3 ppt. **Only areas exclusively < 2 ppt. for both surface and soil salinity were considered "Restoration Ready"**. **Mixed category areas and consistently 2 ppt. – 3 ppt. areas were categorized as "Future Restorations Possible" and areas consistently > 3 ppt. were labeled "Restoration Not Recommended"** (Henkel et. al 2016)**.** Ten-year soil salinity trends were used to adjust the "Future Restoration Possible" category as follows: a declining salinity trend in the 2 ppt. - 3 ppt. range was considered suitable for "Future Restoration Possible", while fluctuating and increasing salinity trends in the 2 ppt. – 3 ppt. range were considered "Restoration Not Recommended." Ten-year soil salinity trends were also used to adjust the border between "Restoration Ready" and "Future Restoration Possible" areas. If sampling locations fell within the "Restoration Ready" category AND bordered the "Future Restoration Possible" category, BUT the ten-year soil salinity trend did not show a clear freshening trend, then the sampling location was moved from "Restoration Ready" to "Future Restoration Possible" category with a 1 km. radius (not crossing major landscape features). Categorizing the landscape in this manner and identifying areas by salinity is helpful in the context of swamp reforestation because 2 ppt. is a salinity threshold below which most wetland tree species can persist (bald cypress (*Taxodium distichum*), may persist when pulsed with higher salinity), however no wetland tree species will persist at consistently >3 ppt.

Refinement

Finally, with each SRSA update we strive to improve and refine our methodology so that our calculations are precise, yet conservative. For the 2020 - 2021 SRSA we excluded areas of the basin with an average subsidence rate ≥12mm/yr. to prevent planting in areas predicted to be submerged in the near future. We overlaid the basin-wide subsidence map (Fitzpatrick et al. 2021) onto the 2020 - 2021 SRSA and all areas coinciding with annual subsidence rate greater than 12 mm. were converted to "Restoration not Recommended" as they were deemed unsustainable.

Outcomes and Products

The 2020 - 2021 SRSA resulted in 345,961 acres designated as "Already Swamp," 157,130 acres as "Restoration Ready," 507,523 acres as "Future Restoration Possible," and 307,315 acres were labeled "Restoration not Recommended." The majority of wetlands categorized as "Restoration Ready" are located on the Maurepas Land Bridge, the LaBranche Wetlands, the northwestern shore of Lake Pontchartrain and south of the Caernarvon Freshwater Diversion along the Mississippi River. Considering only "Restoration Ready" areas, > 33,000,000 trees would need to be planted to fully restore swamp habitat; and with the addition of the "Future Restoration Possible" areas that number would increase to 132,000,000 trees! Should the currently planned freshwater and sediment diversions be constructed, they could potentially increase the magnitude of and conversion of areas that are currently designated as having potential future restoration capabilities to restoration ready status (CPRA 2017).

The SRSA is a tool. The map guides our swamp planting planning process, increases our efficiency and improves our planting outcomes. We no longer waste time, energy and resources scouting and planting in areas we know at a glance are not suitable. The assessments are one reason why the majority of our swamp reforestation plantings have been in the Caernarvon, Maurepas and LaBranche regions, and we are excited to be expanding into the north shore of Lake Pontchartrain. The SRSA also indicates the scale of the job in front of us.

References

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