# Species Richness of Cypress Dome Vegetation in West-Central Florida, USA

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## ABSTRACT

Cypress domes are relatively small forested depressional wetlands common in the southeastern United States. The vegetative species richness of cypress domes is quantified using 15 years of annual vegetation data for 41 relatively unimpacted cypress domes in west-central Florida. Wetland species richness was normally distributed, with a median of 73 species and standard deviation of 16 species. Across the sample, 396 species representing 204 genera and 92 families were observed, with the jackknife estimator predicting a species richness of 516, much higher than previous observed or predicted values for cypress domes. Using a bootstrapping technique, the effects of increasing the sampled number of years and wetlands on species richness estimates were assessed, with fewer years or wetlands resulting in considerably lower estimates of richness. The results demonstrate the major contribution of cypress domes to regional biodiversity and the value of long-term monitoring at multiple wetlands.

## INTRODUCTION

Cypress domes are forested depressional wetlands that occur within the Coastal Plains from southern Florida north to the Carolinas and west to Louisiana and are the most common stillwater swamp in Florida (Figure 1; Ewel 1990a; Ewel 1998; Schafale 2012; Costanza et al. 2014; NatureServe 2022). The canopy of a cypress dome is dominated by pond cypress trees (*Taxodium ascendens*), while understories are highly diverse (Ewel 1990a; USFWS 1999; Noble et al. 2004; FNAI 2010). Cypress domes vary in morphology but are usually relatively small (<150,000 m2), round, and shallow (Ewel 1998; Noble et al. 2004; Cameron et al. 2020). Cypress domes provide essential services, such as groundwater recharge, water table buffering, flood control, wildlife habitat, and water quality improvement, and like other Florida wetlands, they have seen extensive and ongoing loss and degradation (Ewel 1990a, b; USFWS 1999; McCauley et al. 2013; McLaughlin et al. 2014). While wetlands of all sorts are known to represent important stores of biodiversity (Flinn et al. 2008; Kingsford et al. 2016; Sutton-Grier and Sandifer 2019), the species richness of cypress dome vegetation is not well understood. Most existing studies were based on relatively few wetlands or sampled years and usually included impacted wetlands. Improved estimates of species richness can demonstrate the contribution of cypress domes to regional biodiversity and inform regulatory decision-making.


Figure 1. Photographs showing the (a) profile and (b) interior of a cypress dome. (Photos by C. Cameron)

Some of the earliest written descriptions of cypress dome plants and communities are available in Harper (1910, 1927) and Wright and Wright (1932). The latter reviewed 22 articles published between 1737 and 1860 to compile 97 species occurring in cypress domes, while Harper (1910) listed 76. More recent generalized descriptions include Lugo (1986), Ewel (1990a), USFWS (1999), Noble et al. (2004), and FNAI (2010). Cypress domes in certain regions are also known to host various rare species, such as the Henry's spider lily () and ghost orchid (*Dendrophylax lindenii*) (FNAI 2010; Mújica et al. 2021; Vogel 2022). Monk and Brown (1965) and Monk (1968) provide among the first quantitative studies of cypress dome diversity, collectively finding 19 tree species and 26 herb and shrub species at 15 cypress domes in north-central Florida during a short-term study period. Ewel (1986) examined four cypress domes in central Florida over a 4- to 6-year period, finding up to 66 species collectively observed in one year, including 8 trees, 17 shrubs, 6 vines, and 36 herbs and ferns. Huck (1999) identified 60 vascular flora species occurring in a central Florida cypress dome. In a short-term study in southern Florida, Park (2002) reported 8 canopy species, 7 subcanopy species, 17 shrub species, 46 herbaceous species, and 21 seedling species for reference cypress domes. In a study of 18 south Florida cypress domes, Muss (2001) observed 17 epiphyte species. In a short-term study of 30 domes in central Florida with varying degrees of impacts, Knickerbocker (2009) observed 188 plant species, with a range of 6 to 46 (mean: 21) species at each dome, estimating a total richness of 250 to 275 species. In an assessment of 19 west-central Florida cypress wetlands, each with varying hydrologic impacts and approximately 20 to 30 years of data, Thurman (2016) reported 103 vascular plant species. Photographs of selected cypress dome flora are shown in Figure 2.

The purpose of this study is to quantify the species richness of cypress dome vegetation while controlling for impacts and using a higher number of years and wetlands compared to existing works. In a previous study of cypress

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Figure 2. Photographs of selected species observed in cypress domes: (A) *Bidens mitis*, (B) *Iris savannarum*, (C) *Drosera capillaris*, and (D) *Sabatia grandiflora*. (Photos by T.J. Venning [A,C] and C. Cameron [B,D])

dome hydroperiods, Cameron et al. (2020) examined 41 cypress domes in Hillsborough, Lake, Pasco, Pinellas and Sumter counties in west-central Florida, selected based on data availability and quality, lack of substantial anthropogenic hydrologic impacts, location within similar hydrogeologic setting, and location within mesic soil physiographic regions. Since 2005, these wetlands have undergone an annual rooted vegetation survey, called the Wetland Assessment Procedure (WAP; SWFWMD and TBW 2005), and results from these surveys present an opportunity to characterize the vegetative species richness of relatively unimpacted cypress domes.

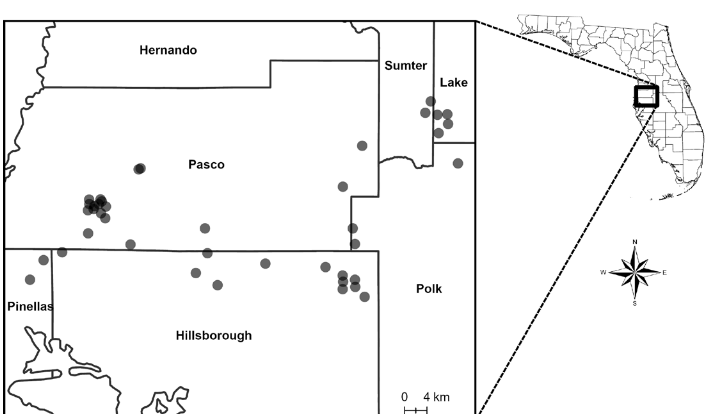


Figure 3. Locations of 41 west-central Florida cypress domes included in the study. (Reproduced from Cameron et al. 2020).

## STUDY AREA

The cypress domes studied are in west-central Florida (Figure 3). Descriptions of the cypress domes and study area can be found in Cameron et al. (2020).

## AVAILABLE DATA

Vegetation data were obtained for the 41 cypress domes over a 15-year period from 2005 through 2019. Data were not available for 17 wetlands for one year, and for two wetlands for two years, resulting in 594 wetland-years of data. WAP data may be unavailable for a particular year because of an inability to safely access the wetland (e.g., due to extremely high water).

The WAP methodology was developed by the Southwest Florida Water Management District (SWFWMD), a regional regulatory agency, in cooperation with Tampa Bay Water (TBW), a regional water utility, to monitor changes in vegetation resulting from changes in wetland hydrology, with an aim of identifying impacts caused by wellfield withdrawals. This methodology is described in detail in SWFWMD and TBW (2005) and summarized here.

## OVERVIEW OF WAP METHODOLOGY

It is a transect-based survey of vegetation species and vegetative strata conducted in the late spring and early summer (typically between April and June) by one or more assessors who receive annual training in plant identification and wetland assessment procedures. The WAP transect is a straight line from the historic wetland edge to the wetland interior (the deepest part of the wetland), intersecting a staff gage, selected to balance satisfactory assessment of the wetland with practical considerations. The transect width is 10 m, while transect length, which is divided into three elevation-based "zones" (transition, outer deep, and deep, although some wetlands do not have all three zones present), depends on the distance between the historic wetland edge and interior (Figure 4). The transect line is marked using poles and the staff gage, while transect width is tracked visually by assessors (calibration occurs during the annual training) supplemented with, as needed, a measuring tape and flagging. For the study cypress domes, using coarse geospatial data available for the sites, transect area ranged

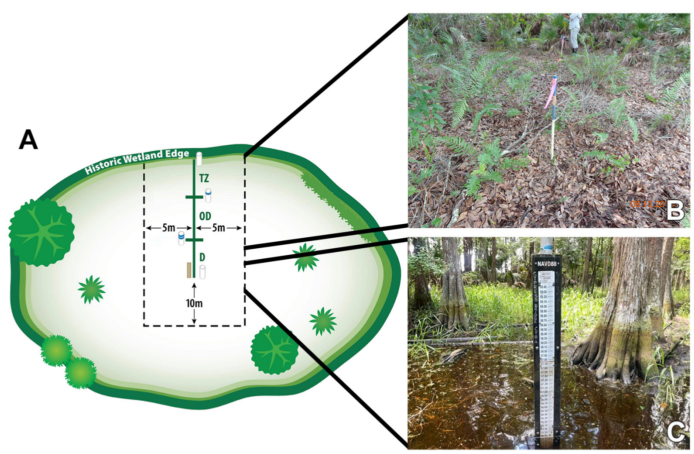


Figure 4. Schematic (A) of a representative WAP transect from historic wetland edge traversing through the "transition zone" (TZ), "outer deep zone" (OD), to 10 m beyond the staff gage in the wetland interior in the "deep zone" (D), with example photographs: (B) looking from just outside the OD toward historic wetland edge, with TZ and OD boundaries marked by poles, and (C) looking at a staff gage in the deep zone. See SWFWMD and TBW (2005) for a full description of the WAP methodology and transect development. (Source: Southwest Florida Water Management District [A,B] and M. Frazier [C])

from approximately 200 to 2,000 $m^2$ (mean: 450 $m^2$), while the wetlands range in size from approximately 3,000 to 134,000 $m^2$ (mean: 29,000 $m^2$).

For the WAP methodology, groundcover is defined as all woody species less than 1 m in height and all non-woody species (regardless of height) rooted in the ground. Shrubs and small trees (hereafter referred to simply as shrubs) are defined as woody plants greater than 1 m in height and less than 4 cm diameter at breast height (DBH). Trees are defined as woody plants that are greater than or equal to 1 m in height and greater than or equal to 4 cm DBH. For each of the nine zone-stratum combinations present at the wetland, percentage cover is recorded by species based on ocular estimate, with shrubs and trees additionally recorded as individual counts by species. Vegetation is excluded if it is dead, is rooted on hummocks, or cannot be identified beneath the surface of the water at the time of evaluation; the first two exclusions reflect the methodology's emphasis on hydrology, while the latter occurs for practical reasons. Additional information on the procedure is available in SWFWMD and TBW (2005).

## METHODS

Prior to analyses, recoding of certain taxa was performed, based on our experience and familiarity with WAP, fieldwork, and the study cypress domes. Due to difficulty in field differentiation and variations in assessors' reporting approaches, *Taxodium distichum, T. ascendens,* plus *Taxodium sp.* and *spp.* were recoded to represent the same species (*T. ascendens*), as were *Nyssa sylvatica*, *N. sylvatica* var. *biflora*, and *Nyssa sp*. (to *N. biflora* [syn. *N. sylvatica* var. *biflora*]). Additionally, 54 taxa identified only to the genus level were recoded to probable species in their respective genera, based on expert opinion on their likelihood to have been successfully identified to the species level in another wetland-year. The recoding produces conservative estimates of species richness. Finally, synonyms, such as *Tiedemannia filiformis* and *Oxypolis filiformis*, were reduced to the same species. For taxa identified to the species level, each species' status as native or non-native to Florida was obtained from Wunderlin et al. (2022).

A species was counted as present at the wetland if either percentage cover or individual count were non-zero along the transect in any year. Species richness was calculated at the stratum, wetland (all strata at the wetland), and sample/regional (all wetlands) levels. For sample species richness, to assess the influence of the number of years or wetlands on estimated species richness, bootstrapping (resampling with replacement) was performed varying the numbers of years and wetlands included, completing for each years-wetlands step 1,000 iterations varying the specific years and wetlands assessed. Additionally, the closed-solution jackknife estimator was applied to individual (varying years) and sample (varying wetlands) wetland species richness (Smith and Pontius 2005). Species richness distribution normality was assessed using the Shapiro-Wilk test at an alpha of 0.05.

## RESULTS

Species richness for the sample (all wetlands) exhibited the expected asymptote with increased collection or years and wetlands, with each additional year or wetland contributing an increasingly smaller number of species, although individual wetlands showed considerable variability (Figure 5). Over 90% of species richness was captured for 95% of wetlands after 12 years of data collection and for the entire

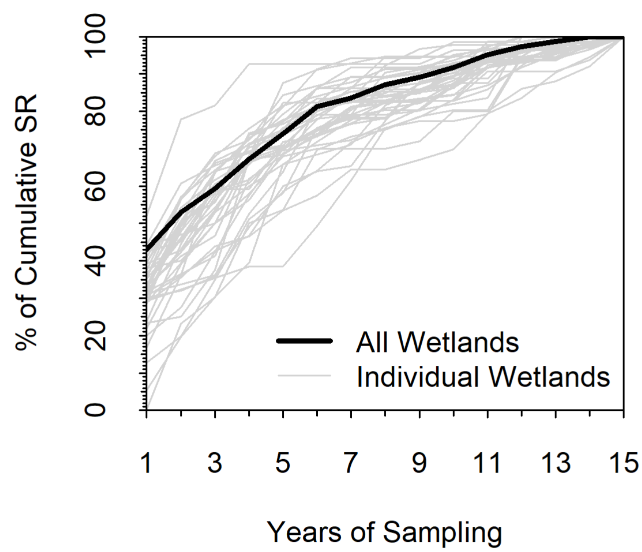


Figure 5. Species accumulation curves (using percentage of cumulative species richness, SR) for the sample (all 41 cypress domes). The curves show, for the sample (thick black line) and its individual wetlands (thin gray lines), the relative impact that adding an additional year of data collection has on the species richness estimate. As sampling periods become longer and most species have already been observed in the study in previous years, each additional year of data collection tends to result in the addition of fewer newly observed species, evidenced by flatter slopes.

sample after 10 years of data collection, with no new species added to the sample in the last year.

Based on bootstrapping results, the percentage of regional cypress dome species richness captured was relatively insensitive to the specific years and wetlands sampled; given the same number of years and wetlands, the interdecile range of resamples was <15 percentage points (Figure 6). Higher numbers of years and wetlands resulted in improved estimates (i.e., closer to 100%) of regional species richness. For example, given random samples of 1 wetland with 1 year of data, the median sample would be expected to capture 6% (interdecile range: 3% to 9%) of regional cypress dome species richness. A random sample similar in size to ours (i.e., 41 wetlands each having 15 years of data) would be expected to capture a median of 78% (interdecile range: 71% to 83%) of regional species richness. Wider contour spacing was noted at higher numbers of years and wetlands, indicating that each additional wetland or year of data has an increasingly small effect on the regional species richness estimate.

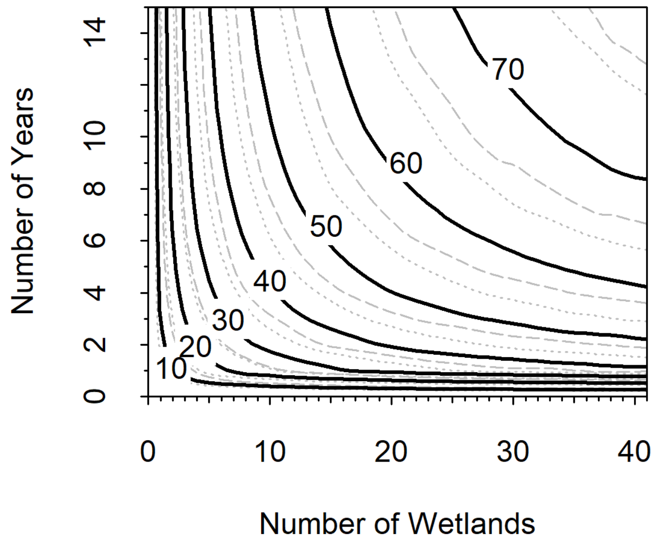


Figure 6. Estimated percentage of regional cypress dome species richness captured given a random sample of X number of wetlands each with Y number of years of data. Thick lines represent the median estimate from 100 resamples with replacement for each step of X and Y, varying the specific years and wetlands included, from a dataset of 41 cypress domes with 15 years of data. For each thick line, the dashed line to its lower left indicates the lower decile of resampling results, while the dotted line to its upper right indicates the upper decile of resampling results, together capturing 80% of the variability from resamples. For example, of random samples of 20 cypress domes each with 9 years of data, 90% of samples would be expected to capture ≥54% of regional species richness, 50% (i.e., the median) of samples would be expected to capture ≥60% of regional species richness, and 10% of samples would be expected to capture ≥66% of regional species richness.

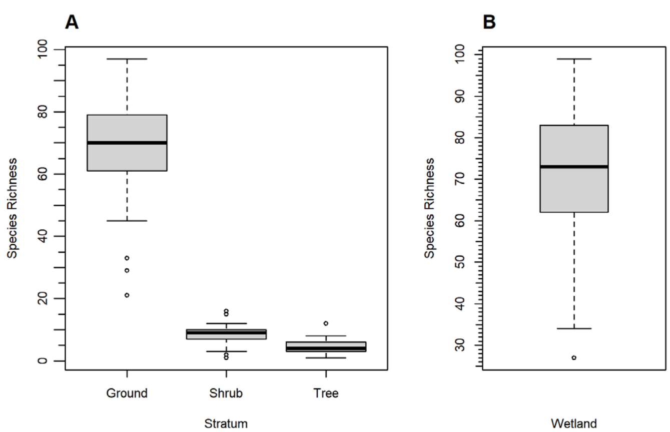


Figure 7. Boxplots showing the inter-wetland variability of species richness observed at 41 cypress domes by (A) individual strata and (B) all strata together ("wetland"). The thick central line represents the median, while the gray box encompasses the upper and lower quartiles. Dashed lines extending vertically from the box capture the range of values observed at the wetlands, excluding outliers, which are shown as circles. Outliers are defined as points located at least 1.5 times the interquartile range above or below, respectively, the upper and lower quartiles. Species richness observed at the individual cypress domes varied (A) between 21 and 97 for the groundcover stratum, between 1 and 16 for the shrub stratum, between 1 and 12 for the tree stratum, and (B) between 27 and 99 for all strata together ("wetland").

Across all wetlands, 396 species representing 204 genera and 92 families were observed, with 389 species observed in the groundcover stratum, 47 species in the shrub stratum, and 24 species in the tree stratum. No species were observed exclusively in the tree stratum, while 347 species were observed exclusively in the groundcover stratum and 4 in the shrub stratum.

Of the 396 observed taxa, 53 were not identified to the species level. Of the remaining 343 species, 88% (302) were classified in Wunderlin et al. (2022) as native. One hundred and twenty-three species were observed at only a single wetland (not always the same wetland) during the study period (i.e., the species was not seen in the other 40 wetlands).

At the individual cypress domes, species richness observed varied between 21 and 97 (median: 70) for the groundcover stratum, between 1 and 16 (median: 90) for the shrub stratum, between 1 and 12 (median: 4) for the tree stratum, and between 27 and 99 for all strata ("wetland") together (Figure 7). The distribution of wetland species richness was not significantly different from normal (p = 0.15), with a median of 73 species observed (standard deviation: 16 species).

Based on the jackknife technique, a median species richness of 93 species (range: 32 to 131 species) was estimated for individual cypress domes, with observed richness ranging between 68% and 85% (mean: 78%) of estimated richness. The jackknife technique estimated a species richness of 516 species for the sample; this suggests that our sample captured 77% of actual regional species richness, similar to bootstrapping results.

## DISCUSSION

The observations of 396 vegetation species and the 516 predicted species in a repeatedly assessed sample of 41 cypress domes are the highest values reported for this wetland type and demonstrate the major contribution of these wetlands to regional biodiversity. Given the conservative recoding approach applied in this paper and that the WAP methodology emphasizes live plants rooted in wetland sediments (although floating plants are often recorded) and does not include epiphytes, these richness values are underestimates.

Area is typically a strong predictor of species richness (Lomolino 2000). In this study, transect log area and species richness were significantly but weakly correlated (R2 = 0.14; p = 0.02), which could relate to low accuracy for current transect area estimates or the potential greater importance of other variables (such as fire frequency, hydrological factors, or transect morphology, that is, zone lengths), which will be explored in a future work. However, applying the area-richness relationship for Florida vegetation developed by Williams and Debelica (2008), the cypress domes, which have a combined area of approximately 1.56 km2, are estimated to have a species richness of 264. Thus, with 396 species observed, the cypress domes, relative to their area, exhibit a richness that is disproportionate for the state of Florida. The discrepancy could be associated with sampling differences, including differences in methods, ecosystems, regions, and years of study. Of note, Williams and Debelica (2008) reported that the counties within our study area exhibit documented taxa richness (inclusive of various ecosystems) considerably above predicted richness. However, other regional studies report lower tree species richness for cypress domes compared to upland forests and riverine cypress wetlands (Monk 1968; Ewel 1990a). Nonetheless, based on the statewide value reported in Wunderlin et al. (2022), the observed species richness for the study cypress domes captured approximately 8% of vegetation species richness for the state, which is surprising, considering their relatively small extent.

Our findings also demonstrate the value of long-term monitoring at multiple cypress domes for characterizing species richness. Compared to assessing one year of data, including multiple years increased the number of species ever observed from potentially as low as 120 in the least rich year (when unusually wet conditions precluded access to several transects and decreased visualization of groundcover) to 396 across all years. Compared to assessing one cypress dome, including multiple cypress domes increased the number of species observed from as low as 27 at the least rich dome to 396 across all domes. Even the richest cypress dome exhibited only a quarter of the observed sample species richness, and 123 species (31 percent of the total number of species) were observed only in a single wetland (not necessarily the same wetland). Sampling multiple wetlands is likely important due to the area-richness relationship that typifies species richness, while sampling over multiple years may be important because of species turnover (e.g., Lomolino 2000; Jove 2008). Fortunately, provided that a sufficient number of years and wetlands are sampled, the specific years or wetlands included appear to matter less. Generally, additional wetlands appear to contribute more than additional years in characterizing species richness. However, even with 41 wetlands and 15 years of data, jackknife estimators and bootstrapping results predict that only approximately 80% of species richness was captured for individual wetlands as well as the full sample.

The species accumulation and bootstrapping results may help provide insights on appropriate monitoring approaches (in terms of numbers of years and wetlands) for future efforts, depending on research goals. Using sampling methodologies similar to the WAP, it is expected that at least ~10 years of data collection are necessary to adequately characterize vegetation species richness at most individual cypress domes. At the regional level, monitoring programs could assess the proportion of species richness likely to be captured by existing or planned networks and, depending on the minimum targeted by the study, extend monitoring periods or incorporate additional wetlands. For example, using sampling methodologies similar to the WAP, a study utilizing 10 cypress domes with 10 years of data (100 wetland-years) would be expected to capture ~50% of species richness, while a study including 25 cypress domes with 4 years of data (100 wetland-years) would be expected to capture ≥50% of species richness. Additional work comparing WAP species accumulation curves to those from other sampling methodologies, as well as those for other wetland types and wetlands in other regions, would provide further insights into the wider applicability of the bootstrapping results.

## CONCLUSION

As regulatory debates continue about the level of protection appropriate for "isolated" and small wetlands, the paper documents the major contributions of cypress domes toward biodiversity. These small but mighty wetlands have been previously shown to disproportionately contribute to landscape groundwater buffering (McLaughlin et al. 2014) and now are shown to support vegetative communities far richer than expected given their relatively modest sizes. This paper also underscores the need to sample multiple wetlands for multiple years to characterize species richness, with fewer wetlands or years resulting in considerably lower estimates of richness.

Future work underway will assess for temporal trends in species richness and composition and explore factors that could explain inter-wetland variability in cypress dome species richness, such as transect area, wetland area, hydrologic variables, and wetland morphology (e.g., zone lengths). Additional work should assess the contributions toward species richness of taxa not captured by the WAP, such as epiphytes, and compare species richness and composition of healthy cypress domes to impacted cypress domes, other wetland types, and cypress domes in other regions. Overall, the WAP database is freely available from the SWFWMD on request, includes many more wetlands than those assessed in this work, and continues to be updated annually, and so represents a robust and extensive source of vegetation data for ecological research.

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## REFERENCES

Cameron, C.R., M.C. Hancock, D.W. Carr, M.K. Hurst, D.E. Campbell, T.J. Venning, P.D. Tara, and K. Rouse Holzwart. 2020. Hydroperiods of cypress domes in West-Central Florida, USA. *Wetlands* 40(6): 2225-2234. https://doi.org/10.1007/s13157-020-01329-x

Costanza, J., S. Beck, M. Pyne, A. Terando, M. Rubino, R. White, and J. Collazo. 2014 Assessing climate-sensitive ecosystems in the southeastern US (Open-File Report 2016-1073). US Geological Survey, Reston, VA. https://doi.org/10.3133/ofr20161073

Ewel, K.C. 1986. Effects of fire and wastewater on understory vegetation in cypress domes. In: K.C. Ewel and H.T. Odum (eds). *Cypress Swamps*. University of Florida, Gainesville, FL. pp. 119–126.

Ewel, K.C. 1990a. Swamps. In: R.L. Myers and J.J. Ewel (eds). *Ecosystems of Florida*. University of Central Florida Press, Orlando, FL. pp. 281–323

Ewel, K.C. 1990b. Multiple demands on wetlands. *BioScience* 40(9): 660-666. https://doi.org/10.2307/1311433

Ewel, K.C. 1998. Pondcypress swamps. In: M.G. Messina and W.H. Conner (eds). *Southern Forested Wetlands*. Routledge, London. pp. 405-420. https://doi.org/10.4324/9780429342653

Flinn, K.M., M.J. Lechowicz, and M.J. Waterway. 2008. Plant species diversity and composition of wetlands within an upland forest. *American Journal of Botany* 95(10): 1216-1224. https://doi.org/10.3732/ajb.0800098

Florida Natural Areas Inventory (FNAI). 2010 Guide to the Natural Communities of Florida: 2010 Edition. Florida Natural Areas Inventory, Tallahassee, FL.

Harper, R.M. 1910. Preliminary Report on the Florida Peat Deposits. In: E.H. Sellards, H. Gunter, and R.M. Harper (eds). Florida Geological Survey Third Annual Report, 1909-1910. Florida Geological Survey, Tallahassee, FL. pp. 197-375. https://doi.org/10.35256/AR03

Harper, R.M. 1927. Natural resources of southern Florida. In: H. Gunter and R.M. Harper (eds). Florida Geological Survey Eighteenth Annual Report, 1925-1926. Florida Geological Survey, Tallahassee, FL. pp. 27-192. https://doi.org/10.35256/AR18

Huck, R.B. 1999. Vegetation and flora of Bruner's Sink, a remnant bald cypress dome in Central Florida. *Florida Scientist* 62(3-4): 175-184.

Jove, R.T. 2008. Estimating landscape-scale species richness: reconciling frequency-and turnover-based approaches. *Ecology* 89(1): 174-182. https://doi.org/10.1890/06-1722.1

Kingsford, R.T., A. Basset and L. Jackson 2016. Wetlands: conservation's poor cousins. *Aquatic Conservation: Marine and Freshwater Ecosystems* 26(5): 892-916. https://doi.org/10.1002/aqc.2709

Knickerbocker, C.M. 2009. T*he effects of urbanization on the structure, quality, and diversity of cypress plant communities in central Florida.* Thesis. University of Central Florida, Orlando, FL.

Lomolino, M.V. 2000. Ecology's most general, yet protean pattern: the species-area relationship. *Journal of Biogeography* 27(1): 17-26. https://doi.org/10.1046/j.1365-2699.2000.00377.x

Lugo, A. 1986. A review of early literature on forested wetlands in the United States. In: K.C. Ewel and H.T. Odum (eds). *Cypress Swamps*. University of Florida, Gainesville, FL. pp. 7-15.

McCauley, L.A., D.G. Jenkins, and P.F. Quintana-Ascencio. 2013. Isolated wetland loss and degradation over two decades in an increasingly urbanized landscape. *Wetlands* 33(1): 117-127. https://doi.org/10.1007/s13157-012-0357-x

McLaughlin, D. L., D.A. Kaplan and M.J. Cohen. 2014. A significant nexus: geographically isolated wetlands influence landscape hydrology. *Water Resources Research* 50(9): 7153-7166. https://doi.org/10.1002/2013WR015002

Monk, C.D. and T.W. Brown, 1965. Ecological consideration of cypress heads in northcentral Florida. *American Midland Naturalist* 74(1): 126-140. https://doi.org/10.2307/2423126

Monk, C.D. 1967. Tree species diversity in the eastern deciduous forest with particular reference to north central Florida. *The American Naturalist* 101(918): 173-187. https://doi.org/10.1086/282482

Monk, C.D. 1968. Successional and environmental relationships of the forest vegetation of north central Florida. *American Midland Naturalist* 79(2): 441-457. https://doi.org/10.2307/2423190

Muss, J. 2001. *The effects of cypress dome size on epiphyte diversity in southern Florida.* Thesis. Florida Atlantic University, Boca Raton, FL.

Mújica, E.B., A.R. Herdman, M.W. Danaher, E.H. González, and L.W. Zettler. 2021. Projected status of the Ghost Orchid (*Dendrophylax lindenii*) in Florida during the next decade based on temporal dynamic studies spanning six years. *Plants* 10(8):1579. https://doi.org/10.3390/plants10081579

NatureServe. 2022. International Terrestrial Ecological System: Southern Coastal Plain Nonriverine Cypress Dome. NatureServe, Arlington, VA. https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.723234/Southern_Coastal_Plain_Nonriverine_Cypress_Dome. Accessed 5 Dec 2022

Noble, C.V., R. Evans, M. McGuire, K. Trott, K., M. Davis, and E.J. Clairain. 2004. A regional guidebook for applying the hydrogeomorphic approach to assessing wetland functions of depressional wetlands in peninsular Florida. U.S. Army Corps of Engineers, Vicksburg, MS.

Park, S.M.T. 2002. *Can rewatering reverse the effects of regional drainage on forest communities of the Big Cypress Swamp?* Thesis, Florida Atlantic University, Boca Raton, FL.

Thurman, P.E. 2016. *Vegetative responses to hydrology and ground water extraction in West-Central Florida cypress domes.* Thesis, University of South Florida, Tampa, FL.

Schafale, M.P. 2012. *Guide to the Natural Communities of North Carolina: Fourth Approximation.* North Carolina Natural Heritage Program, Raleigh, NC.

Smith, C.D. and J.S. Pontius. 2006. Jackknife estimator of species richness with S-PLUS. *Journal of Statistical Software* 15: 1-12. https://doi.org/10.18637/jss.v015.i03

Southwest Florida Water Management District (SWFWMD) and Tampa Bay Water (TBW). 2005. Wetlands Assessment Procedure (WAP) Instruction Manual for Isolated Wetlands. Southwest Florida Water Management District, Brooksville, FL.

Sutton-Grier, A.E. and P.A. Sandifer. 2019. Conservation of wetlands and other coastal ecosystems: a commentary on their value to protect biodiversity, reduce disaster impacts, and promote human health and well-being. *Wetlands* 39(6): 1295-1302. https://doi.org/10.1007/s13157-018-1039-0

U.S. Fish and Wildlife Service (USFWS). 1999. Pond Swamps. In: *South Florida Multi-species Recovery Plan.* U.S. Fish and Wildlife Service Southeast Region, Atlanta, GA.

Williams, J.K. and A. Deblica. 2008. Analysis of the completeness of vascular plant records in Florida. *Journal of Botanical Research Institute of Texas* 2(2): 1363-1371.

Wright, A.H. and A.A. Wright. 1932. The habitats and composition of the vegetation of Okefenokee Swamp, Georgia. *Ecological Monographs* 2(2): 109-232. https://doi.org/10.2307/1943105

Wunderlin, R.P., B.F. Hansen, A.R. Franck and F.B. Essig. 2022. *Atlas of Florida Plants.* Institute for Systematic Botany, University of South Florida, Tampa, FL. https://florida.plantatlas.usf.edu. Accessed 23 Nov 2022.