

April 19, 2004

TECHNICAL MEMORANDUM

TO: File

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SUBJECT: Comparison of Six Biologic Indicators of Hydrology in Isolated *Taxodium
ascendens* Domes

In order to conduct wetland health assessments, hydrology must be considered, especially the elevation of high water levels. This is done readily when long-term water level records exist. Unfortunately, sufficient hydrologic periods of record rarely exist. In the absence of these records, biological indicators are used to identify the elevation of historic high water levels. Little documentation is available on where these indicators occur vertically to the water level record and what, if any elevation differences there are between indicators. To gain understanding about these indicators, the elevations of six biotic indicators of hydrology were studied. The indicators were: the elevation of *Lyonia lucida* root crown bases (*Lyonia*), the lower elevation limit of epiphytic bryophytes (moss collars), the elevation of the *Hypericum fasciculatum* uppermost woody adventitious roots (*Hypericum*), the ground elevation at the landward-most *Taxodium ascendens* (outermost cypress), the inflection point elevation at the angular change of *Taxodium ascendens* buttress swellings (buttress swellings), and the ground elevation at the water-ward most *Serenoa repens* (Saw Palmetto).

Twelve healthy, cypress domes north and northwest of the Tampa Bay area were selected for study (Figure 1). The wetlands were shallow; mostly circular, depressional *T. ascendens* dominated domes that ranged in size from 0.4 to 6.4 hectares. The following selection criteria were used: 1) domes were palustrine cypress wetlands; 2) domes had a sufficient quantity of eligible indicators present (Table 1); 3) domes were rated healthy using the District's wetland assessment procedure; 4) Dome hydrology had not been significantly altered by surface water features; 5) Domes were greater than 0.2 hectares in size; and 6) water level records for each dome included at least the ten year period from May 1989 to April 1999.

Two environmental scientists marked indicators independently at each dome (February 2000 to April 2000 and December 2001 to February 2002). The elevations of all indicators marked were determined relative to the National Geodetic Vertical Datum (NGVD 29). The method of marking indicators was shown to be repeatable and significant (Kruskal-Wallis Test). Median indicator elevations from data marked by the two observers were less than 2 cm ($p < 0.6$) and ranged from 0 cm for buttress swelling ($p = 0.56$) to 2 cm for Saw Palmetto ($p = 0.09$) (Figure 2). The median differences between the other indicator elevations were: 0.5 cm for *Hypericum* ($p = 0.61$), 0.9cm for *Lyonia* and moss collars ($p = 0.35$ and 0.29 , respectively), and 1.5 cm for outermost cypress ($p = 0.30$). It was reasonable, therefore, to combine the data sets determined by the two observers into a single data set.

The differences between each of the 1864 indicator elevations and the 10-year median (P50) water level elevation for a given dome were determined. This data normalization facilitated comparisons among domes using a nonparametric one-way analysis of variance procedure (Kruskal-Wallis test).

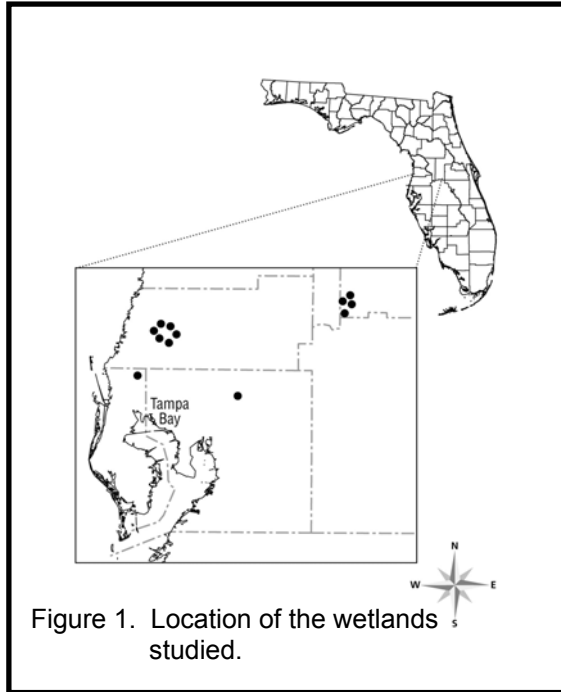
How do the indicators vertically compare to each other? Analyses performed on the combined data set included comparisons between all possible combinations of indicators individually and potentially equal populations or groups of populations based on closeness of their medians. The normalized median elevations of *Lyonia* (35.4 cm), Moss collars (33.2 cm), and buttress swelling (34.8 cm) did not differ significantly ($p = 0.29$) (Figure 3). Comparisons between the other median indicator elevations differed significantly ($p < 0.001$).

How variable were the indicators elevations? The variance of the indicators in all but a few domes was low (Figure 4); ninety percent of the variances of indicators in each dome were 2 cm. The least variable indicator was moss collars, with an average variance of 0.3 cm. The most variable indicator was outermost cypress with an average of 5.1 cm. The average variance of *Lyonia*, buttress swelling, *Hypericum*, and Saw Palmetto was between 0.8 cm and 1.3 cm.

Where do the indicators reside horizontally compared to historic water levels? Percentile ranks identified the distribution of each indicator median elevation along the ten-year water level record (Figure 5). All had a lower P value (higher in elevation) than the median water levels (P50). There are similarities in the elevations of indicators found primarily in the interior of the domes. *Lyonia*, moss collars, and buttress swellings were wet only during an occasional high water event at P2 to P3. Indicators near the dome edge were wet more often; Saw Palmetto were wet at the P14, *Hypericum* were wet at the P18, and outermost cypress were wet at the P29. Therefore, as water rises, the indicators become inundated in the following order: Outermost cypress < *Hypericum* < Saw Palmetto < *Lyonia*, moss collars, and buttress swelling.

The well-established and accepted biotic indicators of hydrology used locally by environmental scientists, include those found in the wetland interior (*Lyonia*, moss collars, and buttress swellings). Our data reveal that these established indicators are reliable and have little variability. In order to use indicators other than these interior ones requires individual offsets. For instance, for the elevations of outermost cypress to yield an elevation equivalent to the established indicators, an offset of 15.2 cm (0.5 ft) must be added. What's more, an offset of 6.1 cm (0.2 ft) must be added to Saw Palmetto elevations.

Questions remain regarding biotic indicators of hydrology and include: 1. How long and/or how often does an indicator have to be submerged, inundated or saturated to develop; 2. How old are *Lyonia* and outermost cypress tree specimens; 3. Are there other potential indicators such as *Spartina bakeri*. Further research is needed to address these questions.



Indicator definitions and the number of indicators (n) marked in each dome.	n
<i>Lyonia lucida</i> (<i>Lyonia</i>) The upper limit elevation of the main root crown base growing on tree tussocks (<i>Lyonia</i> main basal stem diameter >2.54 cm).	15
Moss collars (epiphytic bryophytes) The lower elevation limit of epiphytic bryophytes (moss collars) growing on the trunks of <i>T. ascendens</i> in the wetland interior.	6
<i>Taxodium ascendens</i> buttress swelling (buttress swelling) The inflection point elevation where the angle of buttress swelling changes to an angle of more rapid descent (near where the bole meets the buttress swelling).	10
<i>Hypericum fasciculatum</i> (<i>Hypericum</i>) The elevation of the uppermost woody adventitious root.	5
<i>Serenoa repens</i> (<i>Saw Palmetto</i>) The ground elevation at the water-ward most roots.	10
Landward-most <i>Taxodium ascendens</i> (outermost cypress) The ground elevation at the tree base of the landward-most <i>Taxodium ascendens</i> (4 cm < dbh > 10 cm). The logic behind tree size was to include individuals that were established approximately within the ten-year hydrologic record used in analysis (Mattoon, 1915; Burns and Honkala, 1990).	31

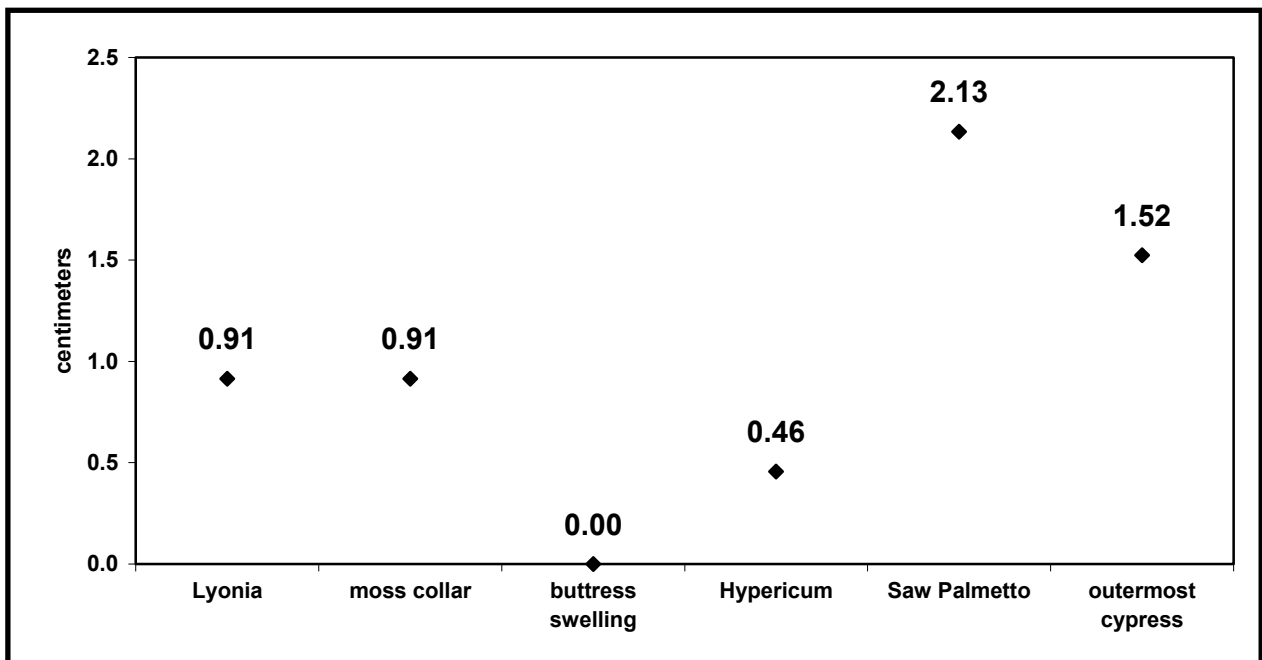


Figure 2. Differences between the median hydrologic indicator elevations identified by two independent observers.

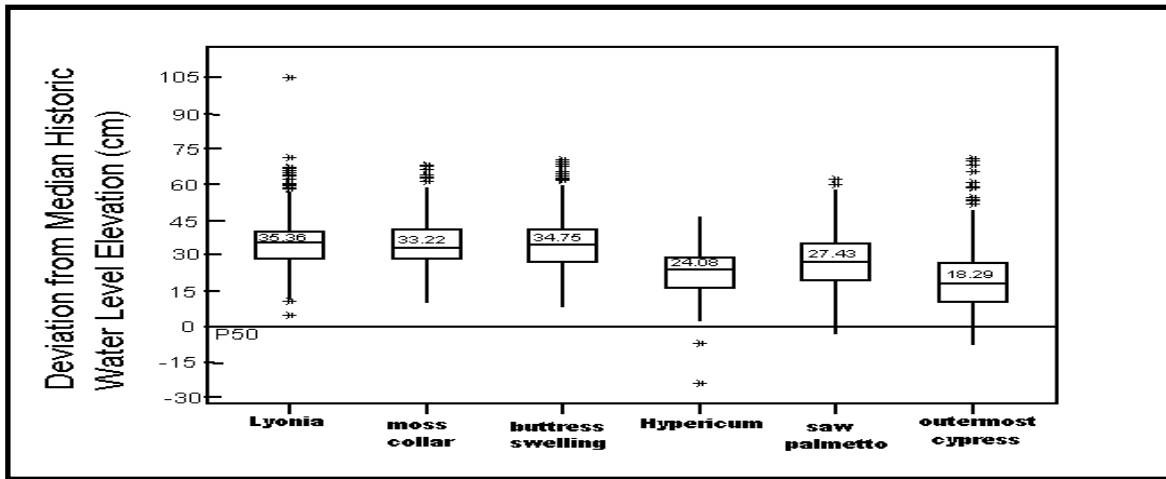


Figure 3. Median deviations of normalized indicator elevations from median historic water level elevations (P50).

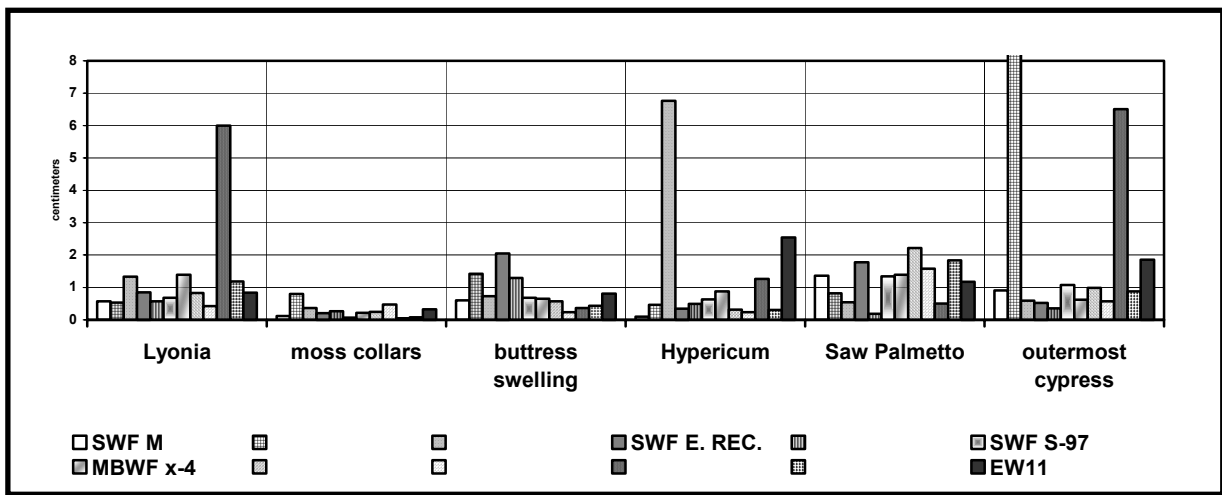


Figure 4. The results of an examination of data variability for each of the six indicators found in the domes.

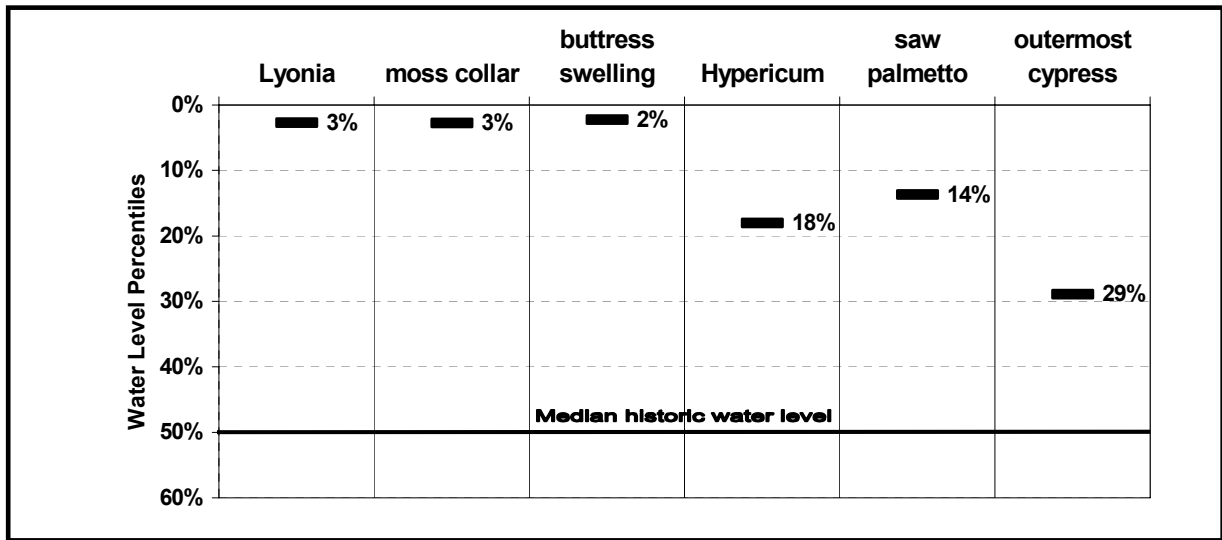


Figure 5. The percentile values for each indicator within the range of period of record water level in the domes.