



This LVI training presentation is from a webinar hosted June 6, 2019 by the Aquatic Ecology and Quality Assurance Section.

Please open the accompanying .mp4 file to view the videos and animations.



The Lake Vegetation Index (LVI) Sampling Method

June 6, 2019

Aquatic Ecology and Quality Assurance



LVI Introduction

- *Rapid field method*
 - *Assesses how similar a lake plant community is to a minimally disturbed one*
- *Must follow DEP SOP LVI 1000 and LVI Primer*
- *In chapters 62-302 (water quality standards) and 62-303 (IWR), F.A.C. as primary lake bioassessment tool*



LVI Thresholds

- 62-303.330 (IWR)

Planning list if 1 of 2 most recent LVI scores < 43 , or historic maximum score > 78 and recent score 20 points lower

- 62-303.430 (IWR)

Verified list if average of 2 most recent scores < 43 , or historic maximum score > 78 and average of 2 most recent scores is 20 points lower

- 62-302.800 (WQS-Site Specific Alternative Criteria)

If average LVI ≥ 43 , then LVI can be used to support lake SSAC



DEP SOP LVI 1000

Effective 4/16/2018; SOPs dated 1/2017

- LVI 1000
- LVI 1100 – Field Sampling method
 - LVI 1110 – Field documentation
- LVI 1200 – Proficiency criteria
- LVI 2000 – Lab
- LVI 2100 – Lab QC
- LVI 2200 - Index calculation
 - LVI 2210 – Calculation documentation
- Appendix –Table of Plant Attributes



LVI Method

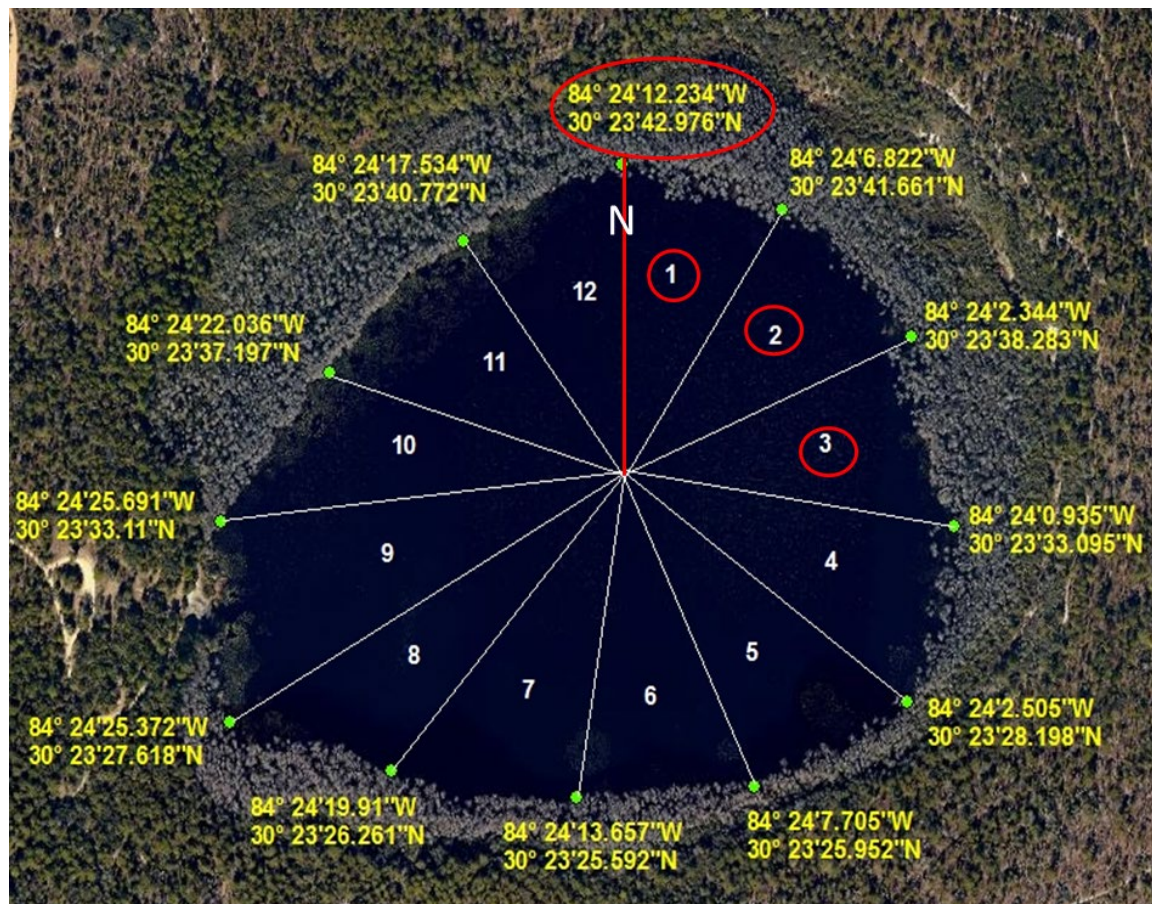
Overview of Steps

- 1. Sample 4 of 12 lake sections by visual “drive by” and 5 m belt transect, entering species in 4 separate columns on the data sheet**
- 2. Deploy frotus a minimum of 5 times during belt transect, and throughout section as needed**
- 3. Collect unknowns, place on ice, confirm in lab and consult reference herbarium and/or expert if needed**
- 4. Calculate metrics and index per DEP SOP LVI 2200**



Subdividing the Lake

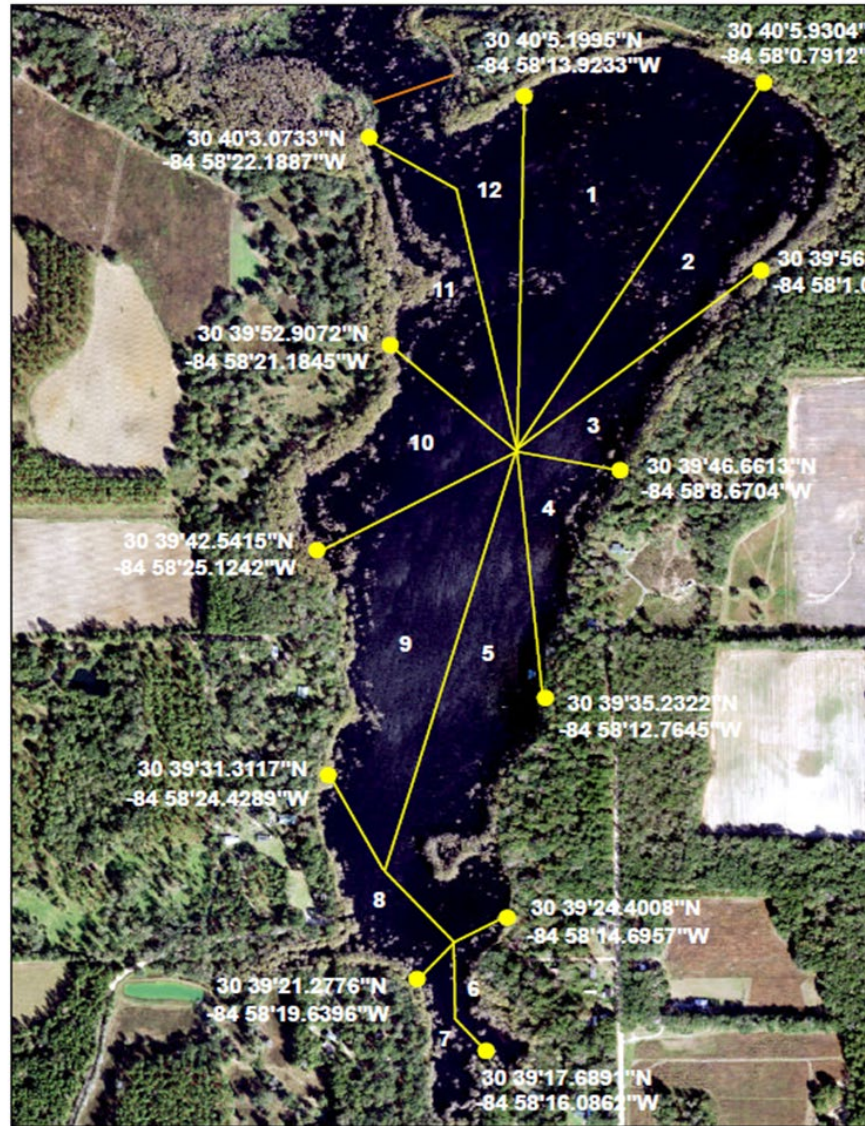
- 12 sections with ~ equal shoreline distance
- Must mark lat/longs of section divisions
- Section 1 starts east of the north line
- Randomly select 1, 2, or 3 as starting section
- Method the same for lakes of all sizes



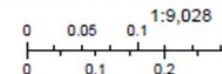


Subdividing the Lake (cont.)

- Some maps are simple, some are more complicated
- Strive for even shoreline

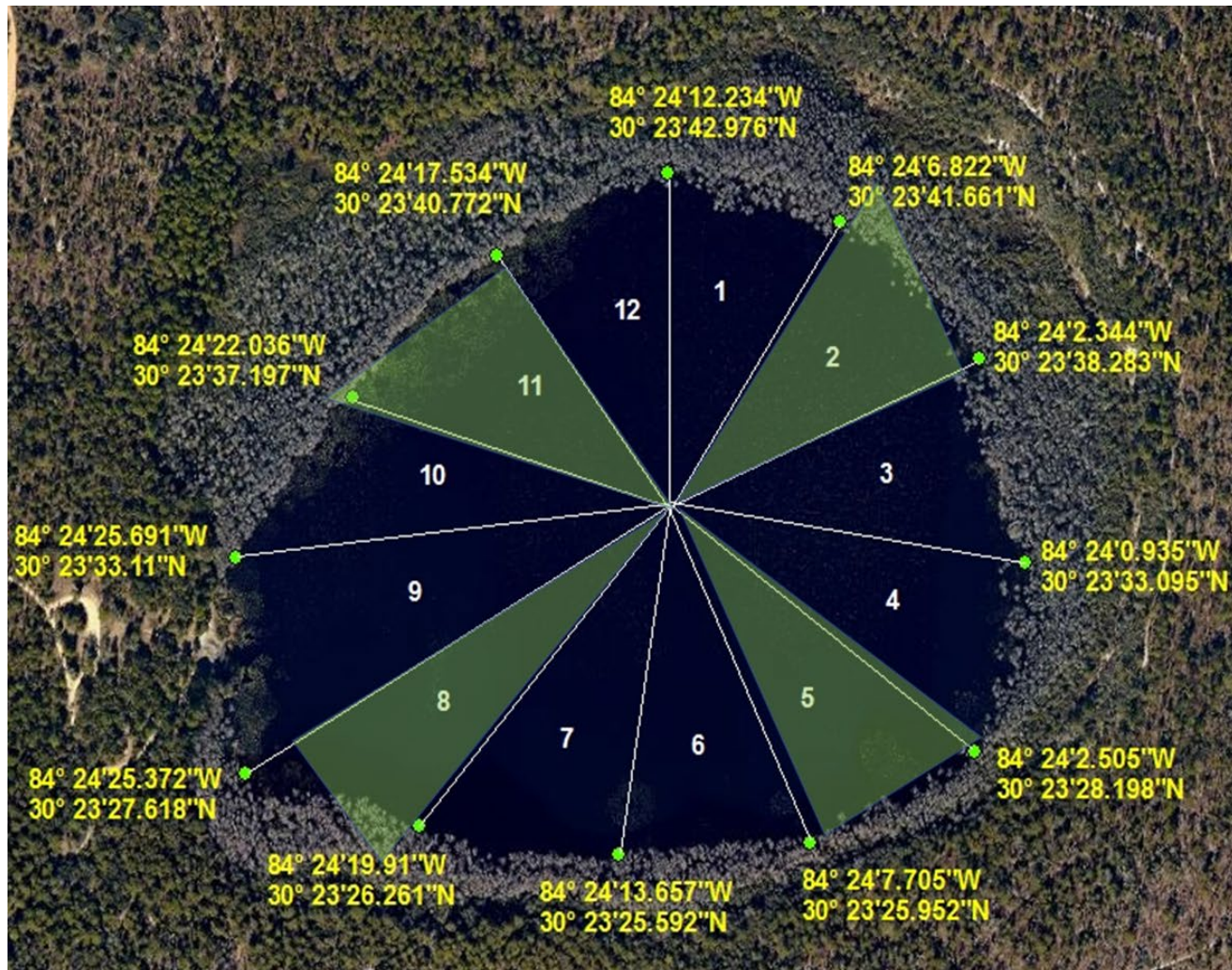


June 3, 2019





Selecting sampling sections



1,4,7,10

2,5,8,11

3,6,9,12

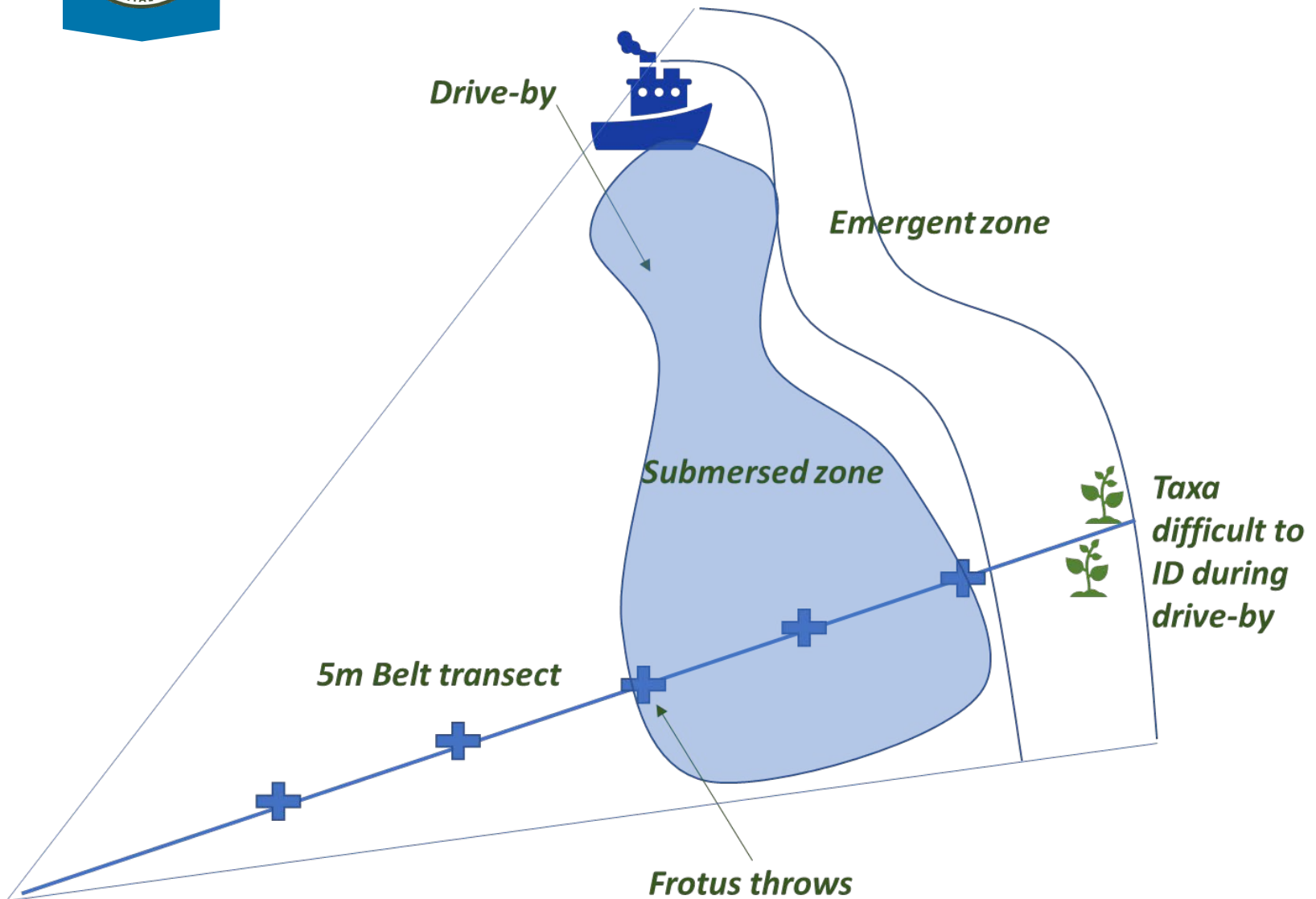


LVI Section Drive-by

[video placeholder – download .mp4 file to view]



Section Drive-by and Transect





LVI Transect

[video placeholder – download .mp4 file to view]



Deploying the Frotus

- Deploy the frotus 5 times along the transect from shore into open water
- Deploy additional times if submersed vegetation continues beyond 5 throws
- Deploy additional times to determine the extent of a submersed species that may be dominant or codominant

*[video placeholder –
download .mp4 file to view]*



LVI Datasheet

Current edition January 2017

DEP FORM FD 9000-27 LAKE VEGETATION INDEX FIELD SHEET

Waterbody:					County:					Date:				
Analyst:					Signature:					STORET:				
Except where noted as "sp." species level identification required. *Genera that may require lab verification* Plants in bold= FLEPPC invasive exotic. It is important to note dominant or co-dominant taxa (by areal extent) for each unit. Use "D" to denote dominant taxon, or "C" for the 2 co-dominant taxa.										Lake units sampled (circle one group): 1, 4, 7, 10 2, 5, 8, 11 3, 6, 9, 12				
SPECIES					Collected? (✓)	SPECIES					Collected? (✓)			
Acer rubrum						Habenaria repens								
Alternanthera philoxeroides						Hydrilla verticillata								
Andropogon sp.						Hydrocotyle sp.								
Azolla filiculoides (A. caroliniana)						Hygrophila polysperma								
Baccharis sp.						*Hypericum fasciculatum								
Bacopa caroliniana						*Hypericum hypericoides								
Bacopa monnieri						*Hypericum myrtifolium								
Bidens laevis						Ilex cassine								
Bidens mitis						Ipomoea aquatica								
Blechnum serrulatum						Ipomoea sagittata								
Boehmeria cylindrica						Itea virginica								
Brasenia schreberi						Juncus effusus								
Cabomba caroliniana						*Juncus marginatus								
Casuarina equisetifolia						*Juncus megacephalus								
Centella asiatica						Juncus repens								
Cephalanthus occidentalis						*Juncus scirpoides								
Ceratophyllum demersum						Lachnanthes caroliniana								
Chara sp.						Leersia hexandra								
Cladium jamaicense						Landoltia punctata (Spirodela punctata)								
Cliftonia monophylla						Lemna sp.								
Colocasia esculenta						Leucothoe racemosa (Eubotrys racemosa)								
*Commelina						Limnobia spongia								
Crinum americanum						Limnophila sessiliflora								
*Cyperus alternifolius (C. involucratus)						Liquidambar styraciflua								
Cyperus articulatus						*Ludwigia arcuata								
Cyperus haspan						*Ludwigia leptocarpa								
*Cyperus lecontei						*Ludwigia linearis								
*Cyperus polystachyos						*Ludwigia octovalvis								
*Cyperus odoratus						*Ludwigia peruviana								



Notations on LVI Field Sheet

- “Genus sp.” indicated for genera that can be left at genus level
- “*” next to species/genera for which you probably need to use a key and may need magnification for species level ID
- Invasive exotics are in **bold**

*Goal is
enhanced
plant ID QC*

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Analyst:						Signature:			STORET:		
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Boehmeria cylindrica						Itea virginica					
Brasenia schreberi						Juncus effusus					
Cabomba caroliniana						*Juncus marginatus					
Casuarina equisetifolia						*Juncus megacephalus					
Centella asiatica						Juncus repens					
Cephalanthus occidentalis						*Juncus scirpoides					



Lake Observation Form

FD 9000-31

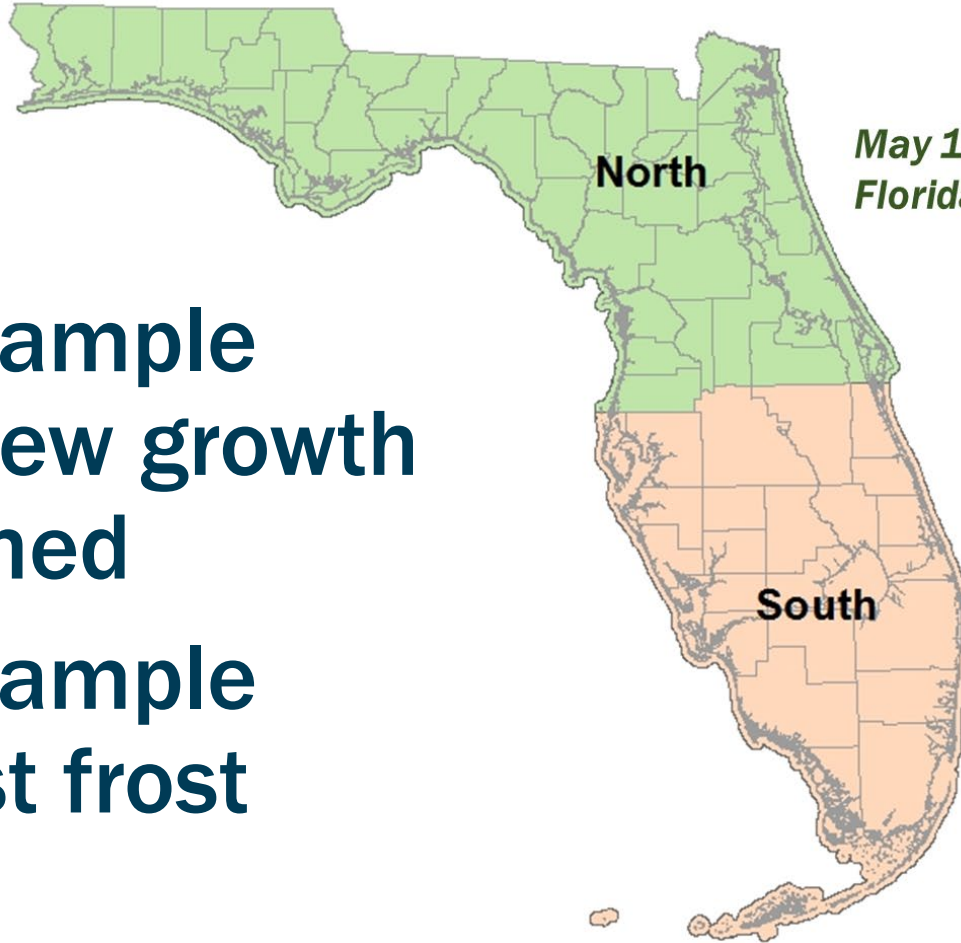
- Components of old lake HA independent of LVI and LDI
- Phys/Chem measurements and observations applicable to lake sampling and additional observations useful for interpreting WQ or LVI data

DEP FORM FD 9000-31: LAKE OBSERVATION FIELD SHEET											
SAMPLE ID: _____		MACROPHYTE ID: _____		LATITUDE: _____							
COUNTY: _____		STORET #: _____		LONGITUDE: _____							
DATE: _____		TIME: _____		SAMPLING AGENCY: _____							
SITE NAME: _____		WBID: _____		LAKE SIZE: _____ RQ: _____							
FIELD ID/NAME: _____											
WATERSHED / LAKE-SIDE FEATURES											
PREDOMINANT LAND-USE IN WATERSHED (specify relative percent in each category -- from GIS) : Forest/Natural ☐ Silviculture ☐ Field/Pasture ☐ Agricultural ☐ Residential ☐ Commercial ☐ Industrial ☐ Other (Specify) ☐										LANDSCAPE DEVELOPMENT INTENSITY (100 m buffer) LDI:	
Local Watershed Erosion (select one) : ☐ None ☐ Slight ☐ Moderate ☐ Heavy Local Watershed NPS Pollution : ☐ No evidence ☐ Slight ☐ Moderate ☐ Heavy										Artificially Impounded ☐ Yes ☐ No	
STORMWATER INPUTS Stormwater enters system via sheet flow over non-cultivated and/or natural vegetation										Some direct stormwater inputs (ditches, pipes, cultivated vegetation < 10%) but good BMPs in place	
Moderate direct inputs of stormwater (ditches, pipes, cultivated vegetation 11%-50%) but few BMPs in place										Much direct input of stormwater (ditches, pipes, cultivated vegetation > 51%) and no or ineffective BMPs in place	
LAKESIDE ALTERATIONS Very few man-made structures, roads, or other disturbance adjacent to lake (<10% lakeside affected)										Moderate disturbance visible - structures, roads or other (10%-49% lakeside affected)	
Many structures, roads or other human disturbance visible (50%-70% lakeside affected)										Highly developed or disturbed (>70% of lakeside affected)	
BUFFER ZONE Expected native vegetation between uplands and littoral zone, greater than 90% of shore with >18 m buffer										69%-51% of shoreline with >18m buffer or >75% with 10m to 18m buffer	
50%-30% of shoreline with >18m buffer or 50%-74% with 10m to 18m buffer										< 29% of shoreline with >18m buffer	
WATER / SUBSTRATE / BIOLOGICAL: SAMPLES AND OBSERVATIONS											
Water: Nutrient Sample Taken? ☐ Yes ☐ No Preserved? ☐ Yes ☐ No pH<2 ☐ No Color Sample Taken? ☐ Yes ☐ No Lot # _____ Exp. Date: _____ Alkalinity Sample Taken? ☐ Yes ☐ No Water Level ☐ Low ☐ Normal ☐ High						Water Odors: ☐ Normal ☐ Sewage ☐ Petroleum ☐ Other _____ Water Surface Oils: ☐ None ☐ Sheen/Slick ☐ Glob ☐ Other _____					
Meter Readings: Top: _____ Mid-Depth: _____ Bottom: _____						Clarity: ☐ Clear ☐ Opaque ☐ Turbid ☐ Slightly Turbid Color: ☐ Clear ☐ Tannic ☐ Green SECCHI (M) _____ Total Station Depth (M) _____ VOB ☐					
Sediment Type: (may check more than one) ☐ Sandy ☐ Organic fibrous (peaty, CPOM) ☐ Vegetated ☐ Sand/Silt ☐ Organic smooth (muck) ☐ Other (Specify): _____						Sediment Odors: ☐ Normal ☐ Other (Specify): _____ ☐ Anaerobic					
Biological Communities: LVI Conducted? ☐ Yes ☐ No Phytoplankton Sample Taken? ☐ Yes ☐ No Sample Preserved? ☐ Yes ☐ No Lot #: _____ Exp Date: _____ Algal Bloom/Algal ID Sample Taken? ☐ Yes ☐ No Active Vegetation Mgmt? ☐ Yes ☐ No ☐ Don't Know						Abundance: Periphyton ☐ Absent ☐ Rare ☐ Common ☐ Abundant Nuisance Plants ☐ Submersed Plants ☐ Exotic Apple Snails ☐					
Additional Notes:											
Weather Conditions :											
SAMPLING TEAM:						SIGNATURE:			DATE:		



Sampling Index Periods for LVI Regions

- Do not sample before new growth established
- Do not sample after first frost



May 1-October 31 for North Florida

April 1-November 30 for South Florida



Where is the LVI Sampling Boundary?

- Sample to Seasonal High Water - 62-340.200(15), F.A.C., “the elevation to which the groundwater and surface water can be expected to rise in a normal wet season...The presence of hydrologic indicators must be used with reasonable scientific judgment.”
- Only Include Plants with Wetland Status
 - OBL, FACW, FAC (except for vines and *Pinus elliottii*)
 - Use University of South FL Atlas of Vascular Plants





Where is the LVI Sampling Boundary? (cont.)



If a large wetland fringe is present, samplers should not assess it as part of the LVI.



Dominant Species Selection

- Assignment of dominant/codominant is very important!!
- Guidance straight from the SOP (LVI 1100):
 - 3.2.6.1. If a single taxon comprises a clear, overwhelming majority of the areal coverage of plants (e.g., if one taxon is twice as abundant as all others), record it as dominant.
 - 3.2.6.2. Assign two co-dominant taxa if there are two taxa that are abundant and one taxon is not twice as abundant as the other.
 - 3.2.7. If no one dominant or two co-dominant species are present, do not assign a dominance code for that sampling section and note that no dominant or co-dominant was assigned. (*3+ taxa are equally abundant, or nothing is abundant*)

When in doubt, choose codominance!



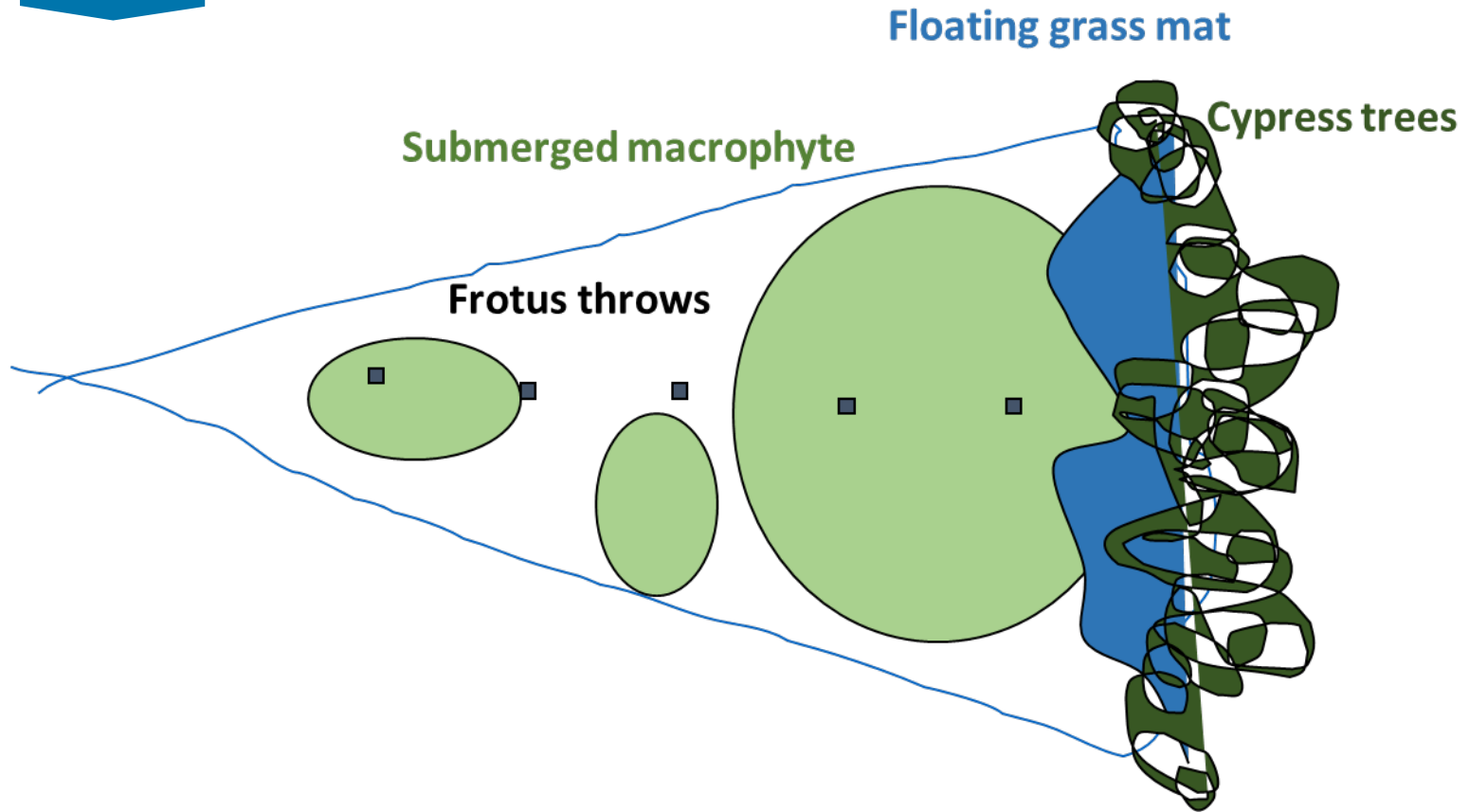
Dominant Species Selection

(cont.)

- How do I choose among submersed, emergent, floating, and trees/shrubs?
- Select dominance by areal extent in the water
 - LVI 1100 3.2.6.3. ...Dominance can be observed for woody, emergent, floating, or submersed species. For woody species, consider the canopy overhanging the lake in the determination of areal coverage. Deploy the frotus additional times if necessary to determine potential dominance of submersed taxa.
- Photograph or collect dominant taxa for verification by coworker or expert



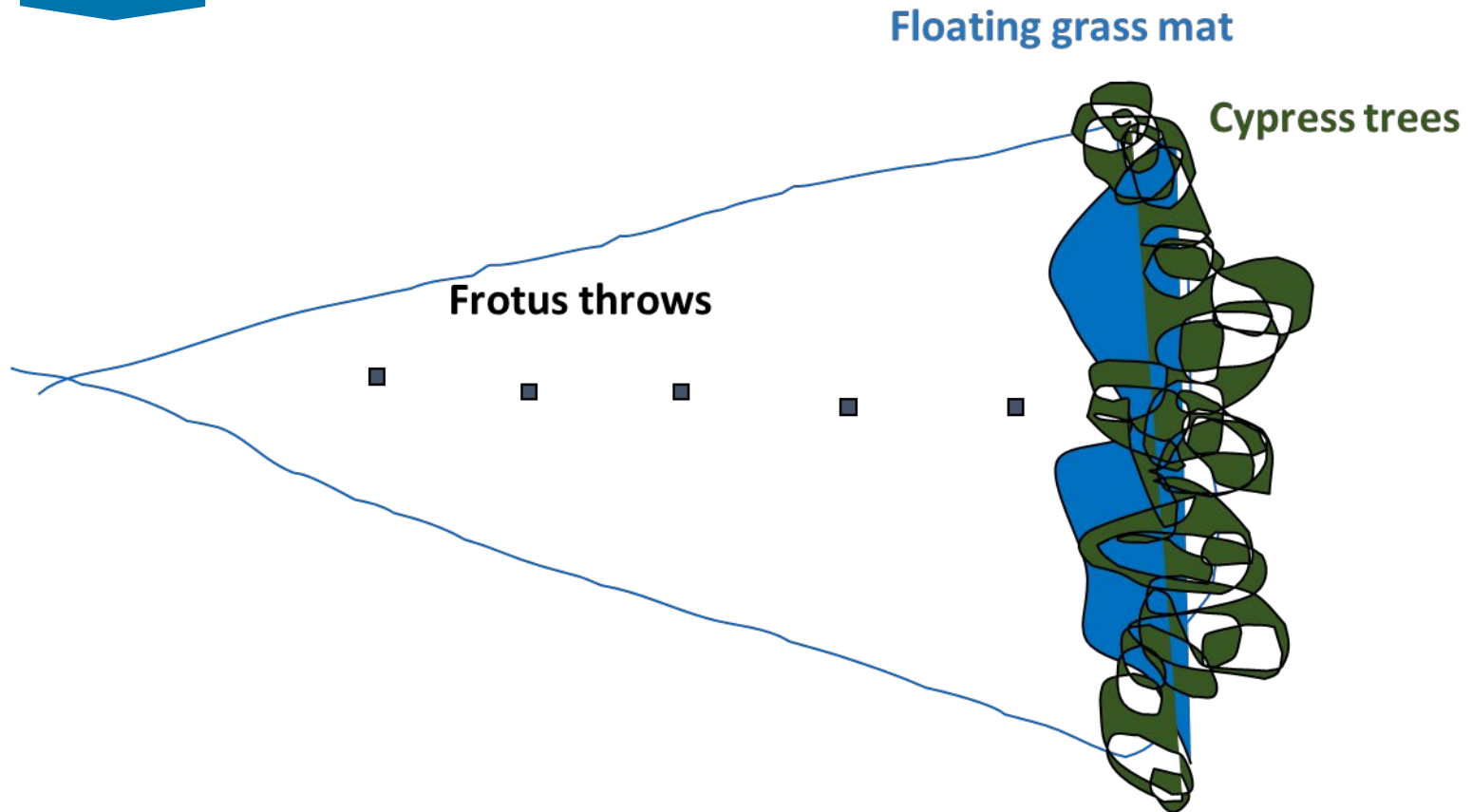
Assigning Dominance



The submerged macrophyte is dominant –
do additional frotus throws if needed.



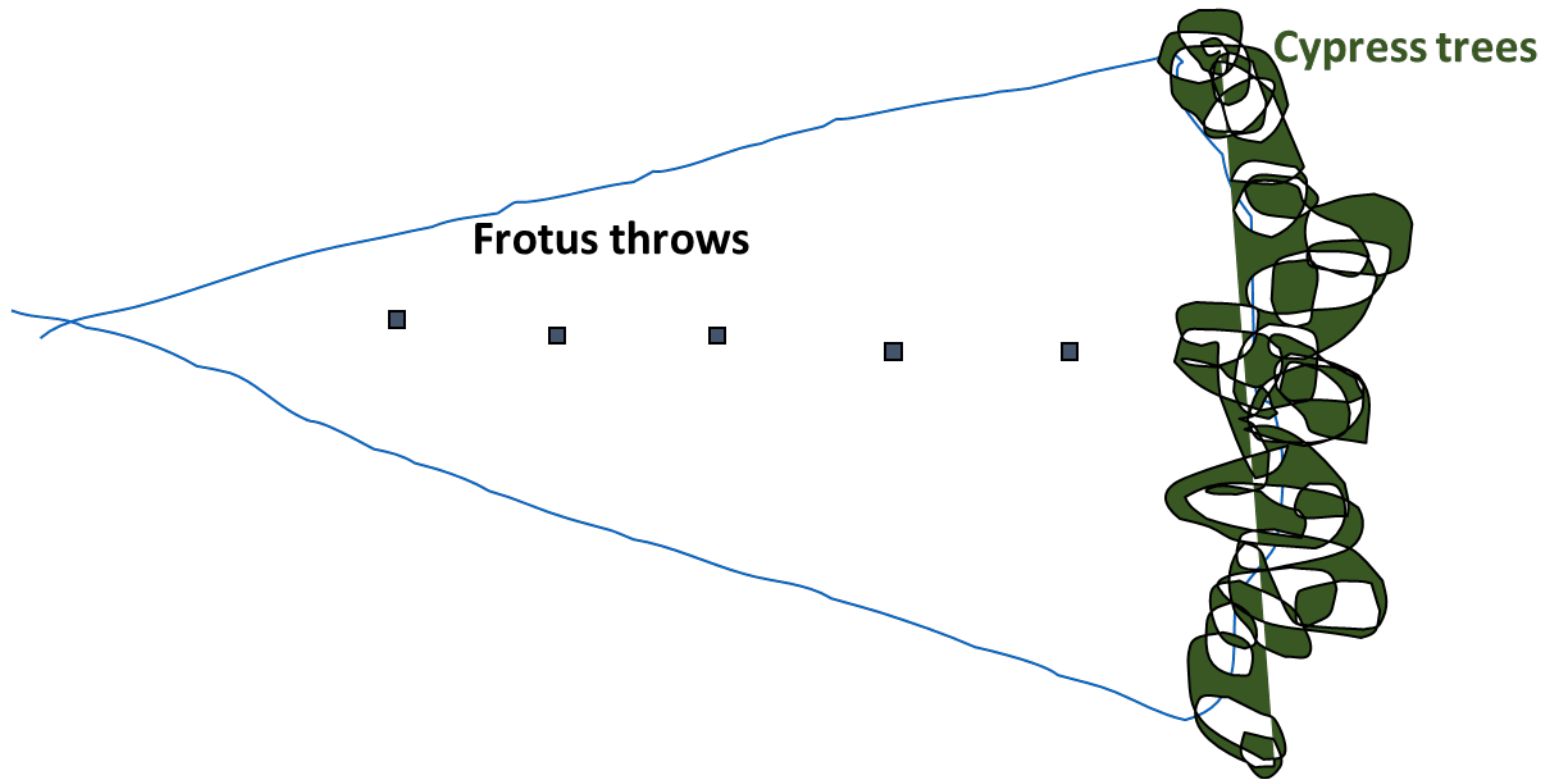
Assigning Dominance



The floating grass and cypress are codominant.



Assigning Dominance



The cypress trees are dominant.



Assigning Dominance

1. *Typha* dominant?
2. *Hydrocotyle* dominant?
3. *Typha* and *Hydrocotyle* codominant?





Assigning Dominance



1. *Taxodium* dominant?
2. *Sagittaria lancifolia* dominant?
3. *Taxodium* and *S. lancifolia* codominant?



Assigning Dominance

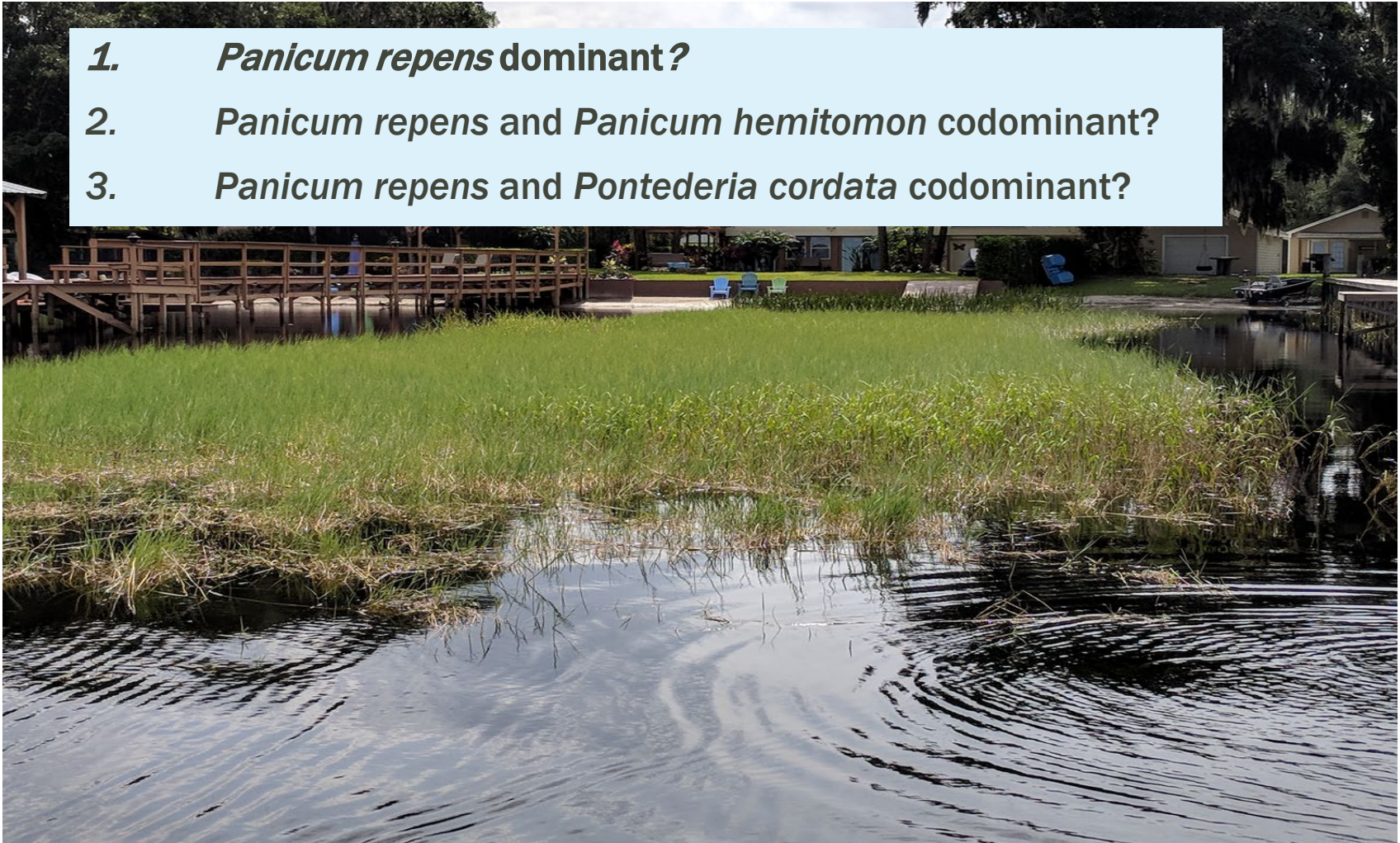
1. *Nymphaea odorata* dominant





Assigning Dominance

1. *Panicum repens* dominant?
2. *Panicum repens* and *Panicum hemitomon* codominant?
3. *Panicum repens* and *Pontederia cordata* codominant?





Don't forget the Submersed!





Assigning Dominance

1. *Utricularia floridana* dominant





Assigning Dominance

[video placeholder – download .mp4 file to view]



Collecting specimens

- Important QC step for the method
- Learn enough to know what you don't know!
- Collect sufficient material for ID (e.g. flowers, fruits, rhizomes)
- Keep plants in good shape
 - Fresh is best - Ziploc™ bags, drain the water! keep on ice
 - Alternative: Press in field or lab
- Take photos



Decodon verticillatus



Questions?



Nymphaea odorata at Lake Hall, Leon Co.



LVI Primer

- **Required companion to SOP**
- **Current version dated 10/24/11**
- **Purpose:** Provide LVI samplers and data users with additional guidance with which to make decisions about sampling with the LVI, and interpretation of LVI data

Sampling and Use of the LVI for Assessing Lake Plant Communities: A Primer



**Sampling and Use of the Lake Vegetation Index
(LVI) for Assessing Lake Plant Communities in
Florida:
A Primer**

Florida Department of Environmental Protection
Bureau of Assessment and Restoration Support
Standards and Assessment Section
DEP-SAS-002/11

October 24, 2011



2. LVI Intended Use

- Boatable waters only
- Regulatory application (via Ch. 62-302 and 62-303, F.A.C.) applies only to waters of the state
- “Lake” is a lentic fresh waterbody with a relatively long water residence time and an open water area that is free from emergent vegetation under typical hydrologic and climatic conditions. Aquatic or floating vegetation may be present in this open water.





3.6 Intentional Plantings

- **Include** wetland plants intentionally planted for aesthetics or restoration, if within the seasonal water level
- **Exclude** ornamental plants on lawns, above the seasonal water level





3.8 Very Large Lakes

- LVI can be done, but may take extra time, and may not be worth the effort or accomplish local goals
- Conduct drive-by at idle for ~1,000m and then speed up if no changes

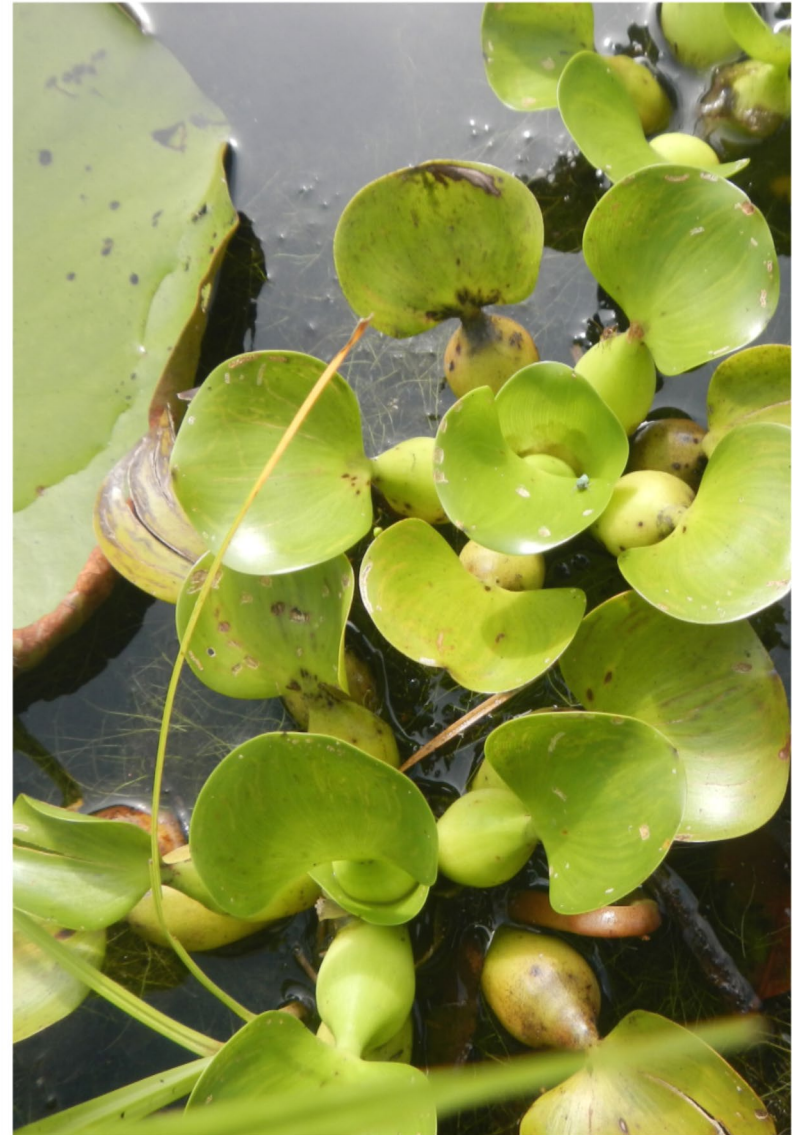
Lake Istokpoga





3.9 Aquatic Plant Control

- LVI can be used to evaluate effectiveness of plant management (before vs. after)
- Herbicide treatment effects differ in scale & duration, so no prescribed time to wait after treatment
- Consider study purpose
- Aim for representative conditions





4.2 Taxonomic Level

- Species-level ID is important
- Reasons for occasional genus level IDs
 - Lack of necessary plant parts (fruits, flowers)
 - Extraordinary effort (infrequent and hard to reach)
- Consequences of genus-level ID
 - % Native: entire genus native - included, otherwise not
 - % Sensitive: not included
 - % FLEPPC 1: entire genus native or non-FLEPPC, included, otherwise not
 - C of C Dominant: not included except limited list



Rhynchospora tracyi



4.2 Guidance Provided for Lowest Practical Taxonomic Levels

Four Categories:

1. ID ok at genus level (has genus-level C of C score)
2. ID ok at genus level (species ID impractical, taxa unlikely to be dom/codom)
3. Species level ID required, but can be done in field
4. Species level ID required, and usually required ID in the lab with scope



Our goal is to make IDs easier and more accurate in the field and lab without losing information for the LVI calculation



Genus Level ID OK (ID in field)

(Cat. 1) Genus-level C of C is assigned

- *Hydrocotyle*
- *Lemna**
- *Nuphar*
- *Peltandra*
- *Taxodium*
- *Typha*

(Cat. 2) Genus-level ok, because species ID impractical and taxa unlikely to be dom/codom

- *Andropogon*
- *Baccharis*
- *Persea*
- *Pluchea*
- *Solidago*
- *Xyris*

* Do not confuse *Lemna* with *Landoltia* or other “duckweeds”



Species Level ID Required

(Can be done in field)

(Cat. 3)

- *Bacopa*
- *Bidens*
- *Eleocharis* (large species)
- *Ludwigia* (select species)
- *Micranthemum*
- *Ilex*
- *Lyonia*
- *Triadenum*
- Select grasses, sedges, rushes, ferns



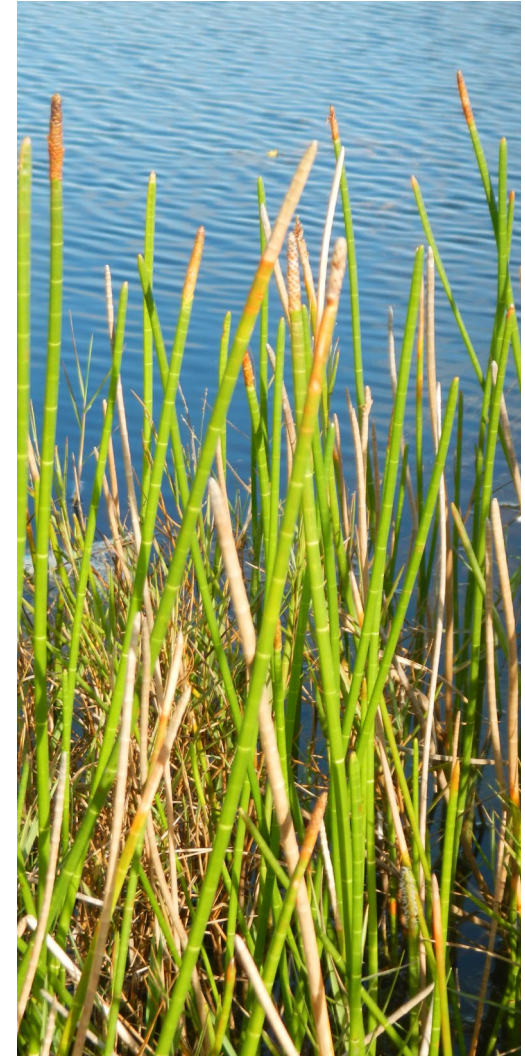


Genera to ID to species

Usually need lab

- **(Cat. 4)**

- *Aster*
- *Commelina*
- *Cyperus*
- *Echinochloa*
- *Eleocharis*
- *Eriocaulon*
- *Fuirena*
- *Hypericum* (with field obs)
- *Juncus*
- *Ludwigia*
- *Myriophyllum*
- *Najas*
- *Panicum*
- *Paspalum*
- *Persicaria*
- *Potamogeton*
- *Rhexia*
- *Rhynchospora*
- *Sagittaria*
- *Schoenoplectus*
- *Sesbania*
- *Utricularia*



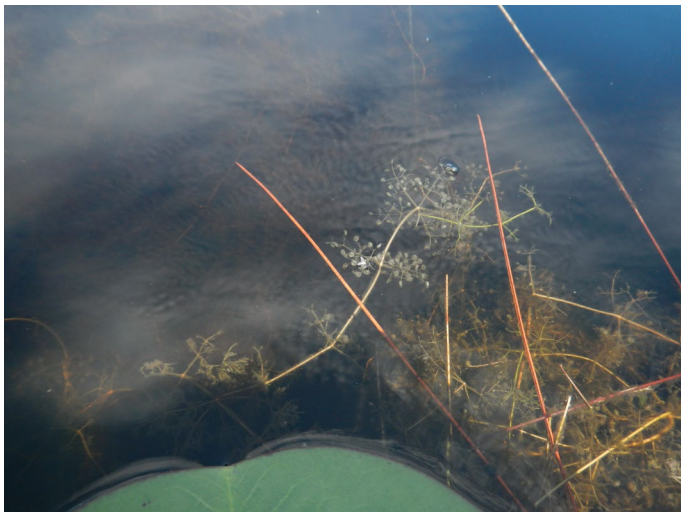
Eleocharis interstincta 43
Miami-Dade Co.



Genus/alternate level ID OK

ONLY if species level ID not possible

- Two groups that are commonly dom/codom and MAY be difficult to get to species level
- C of C scores assigned at genus/alternate level may be used, **ONLY if species ID not possible**
 - *Utricularia*, only if species level identification is not possible
 - Submersed viviparous *Eleocharis* species (includes *E. baldwinii*, *E. vivipara*, *E. acicularis*)





5. High & Low Water Considerations

- Guiding Principle: Conduct the LVI if expected plants are accessible and in good condition
- High water – do not sample if emergent or floating plants are submersed
- Low water – do not sample if littoral zone is dry and few taxa are in the water



Water Too High for LVI





Water Too Low for LVI





Other Considerations

- **5.3 Brackish Lakes**
 - Do not sample if marine plant species are present
- **5.4 Highly vegetated lakes**
 - Only do LVI if you can access/see shoreline and representative area of lake
 - Can use airboat
- **5.5-5.6 Impoundments and Artificial waters**
 - Ok to sample as long as there has been sufficient time for plant establishment
 - Consider program goals to determine usefulness



6. Data Usability

Things to consider when determining whether LVI data are usable for a particular purpose:

- **Project objectives (*what is the purpose of the sampling?*)**
- **Evaluate QA/QC**
 - Records may be audited, so keep good records
 - Need to demonstrate proficiency per SOP LVI 1200 to submit data to DEP
- **Method error**
- **Reasonable cause for failure (e.g. water quality, habitat, hydrology)**



LVI Field QC

(LVI 1200)

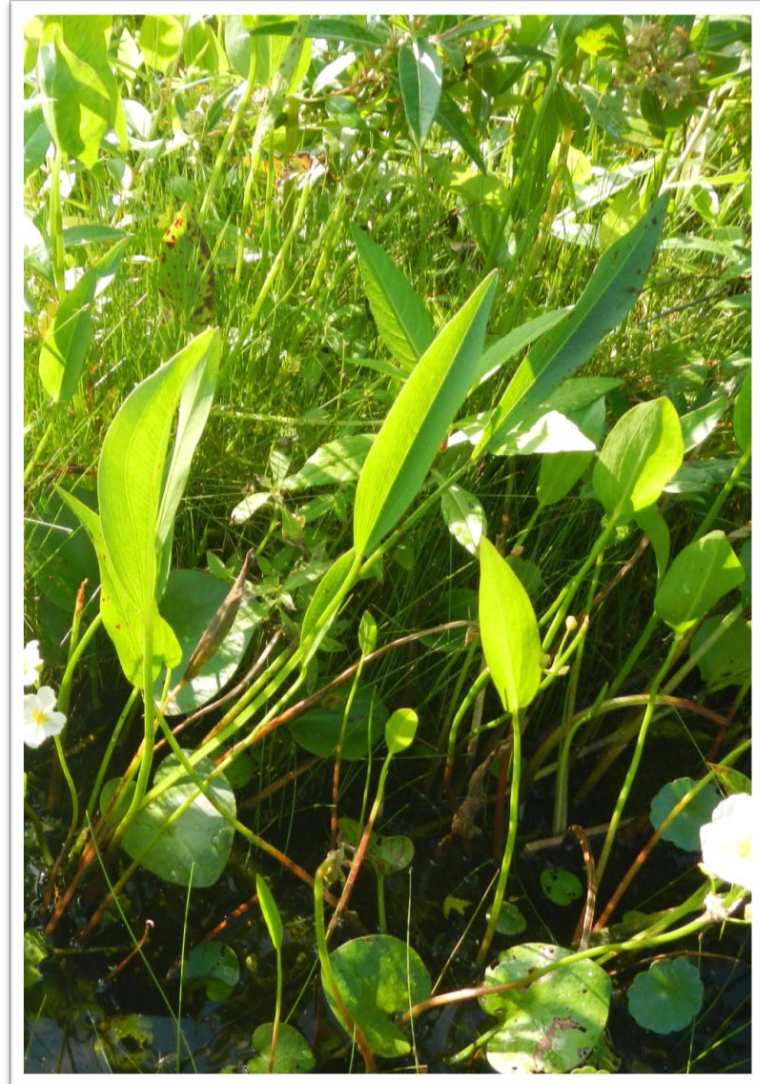
- **Plant ID test required annually. At least one member of LVI sampling team must pass**
 - Contact Ashley O'Neal to get link to online test
- **Team Proficiency Exercise required every 2 years**





Team Proficiency Criteria

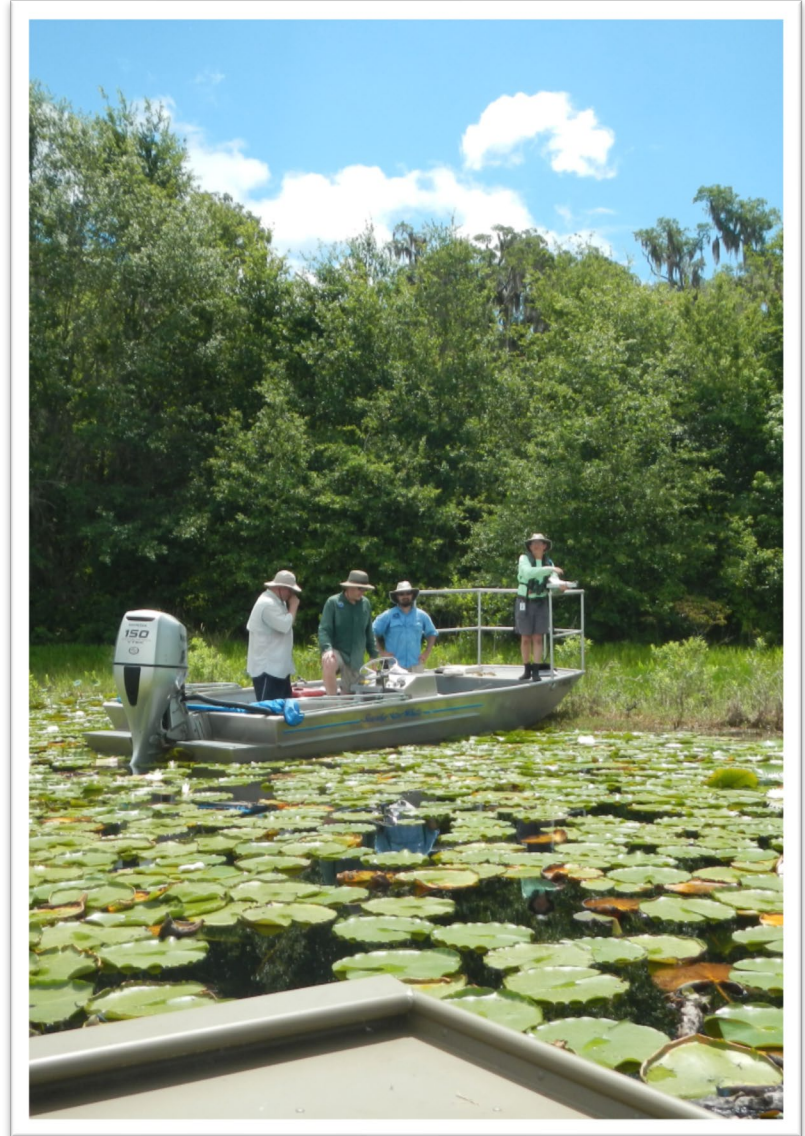
- Participate in and pass LVI Proficiency testing to ensure that DEP will use your data
- DEP sets up 3 geographically separate sites (Panhandle, N. Peninsula, S. Peninsula)
- Proficiency test announced 15 days prior to 30-day sampling window via Quality of Science Newsletter





Team Proficiency Criteria

- Conduct LVI at one lake within the 30 day window and score within +/- 12 points of expert median score
- A participating team will be part of the expert group if the team has obtained a passing score in the previous exercise (some changes in team personnel ok)
- Teams that do not pass can retrain and sample at an additional LVI benchmark lake, where they have not tested previously





LVI Lab QC

(LVI 2100)

- Retain experts to verify identifications (unknowns, disagreements between analysts)
- Establish and maintain a current plant reference specimen collection



Eleocharis equisetoides





LVI Calculation

(LVI 2200)

STEPS:

1. Calculate each metric for each sampling section
 - % Natives (can include genus-level, if genus is native)
 - % Sensitives (C of C ≥ 7)
 - % Invasive Exotics (FLEPPC Cat 1)
 - C of C of Dominant/Codominant Taxa
2. Average the metrics for section LVI score
3. Average the section LVI scores for final LVI score



Coefficient of Conservatism (C of C)

- The C of C is a score assigned to a plant species based on its fidelity to ecosystem conditions, using an expert panel.
 - 0 Alien and invasive native taxa
 - 1.0 – 3 Tolerant taxa
 - 3.1 – 6 Ubiquitous taxa
 - 6.1 - 9 Intolerant (sensitive) taxa
 - 9.1 – 10 Taxa that exhibit high degree of fidelity to a narrow set of ecological conditions.





LVI Calculation

(LVI 2200)

- Use appropriate calculations for each region
- Only include plants with wetland status: OBL, FACW, or FAC (except for *Pinus elliottii* and vines)
- Use taxon attributes in the table at the end of the LVI SOP: Appendix LVI 1000-1
- IF there is no C of C for a taxon in Appendix LVI 1000-1, THEN:
 - Nativity status CAN be used for % Native
 - FLEPPC status CAN be used for % FLEPPC
 - Taxon CAN NOT be included in % Sensitive
 - If taxon is dom/codom, no C of C metric calculated

Excel Calculator available on our website for external parties
DEP staff enter into SBI02



Useful Links to LVI Information

- DEP SOPs

<https://floridadep.gov/dear/quality-assurance/content/dep-sops>

- SOP forms (including LVI datasheet and Lake Obs form)

<https://floridadep.gov/dear/quality-assurance/content/sop-forms>

- Source for plant wetland status (and taxonomic info)

<http://www.florida.plantatlas.usf.edu/>

- Tips for creating herbarium specimens

<https://floridadep.gov/dear/bioassessment/content/plant-identification-resources>

- LVI Primer

[Sampling and Use of the Lake Vegetation Index \(LVI\) for Assessing Lake Plant Communities in Florida: A Primer](#)



Useful Links to LVI Information (continued)

- Team Proficiency Testing Information

<https://floridadep.gov/dear/bioassessment/content/bioassessment-training-evaluation-and-quality-assurance#lvi>

- LVI Calculator and Instructions for use

<https://floridadep.gov/dear/bioassessment/content/bioassessment-training-evaluation-and-quality-assurance#lvi>



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