Compensating for an endangered ecosystem:

Design and monitoring recommendations for Atlantic white cedar wetland compensation sites

Talk outline

- Purpose: Identify design considerations and success monitoring parameters for AWC compensation sites
- Site description
  - Location of 8 sites
  - Review of our functional analysis results
- Methods summary
- Results and Discussion
- History of work at GDSNWR
  - Sequence of events for AWC
  - Jeff's primary productivity study
  - Craig's GDSNWR refuge-wide AWC ring study
  - Deer browse study with undergrad class involvement
- Special recognition

Opportunities for AWC restoration

- National Wildlife Refuges and other federally-owned lands
- State Wildlife Refuges and other state-owned lands
- Municipally-owned lands
- Privately-owned lands
  - Funded through incentive programs, e.g. CREP
  - Funded through private sources as part of compliance with a regulatory program, i.e. Clean Water Act Section 404

Clean Water Act Section 404

- Permittees must replace lost wetland functions
- Typical monitoring programs only report structural parameters.
- For AWC, there are no generally-accepted monitoring parameters that connect to unique AWC forest functions.
- Requirements must encourage, not discourage, AWC restoration attempts!

Design: 8 sites including young (4), intermediate (2) and mature (2)

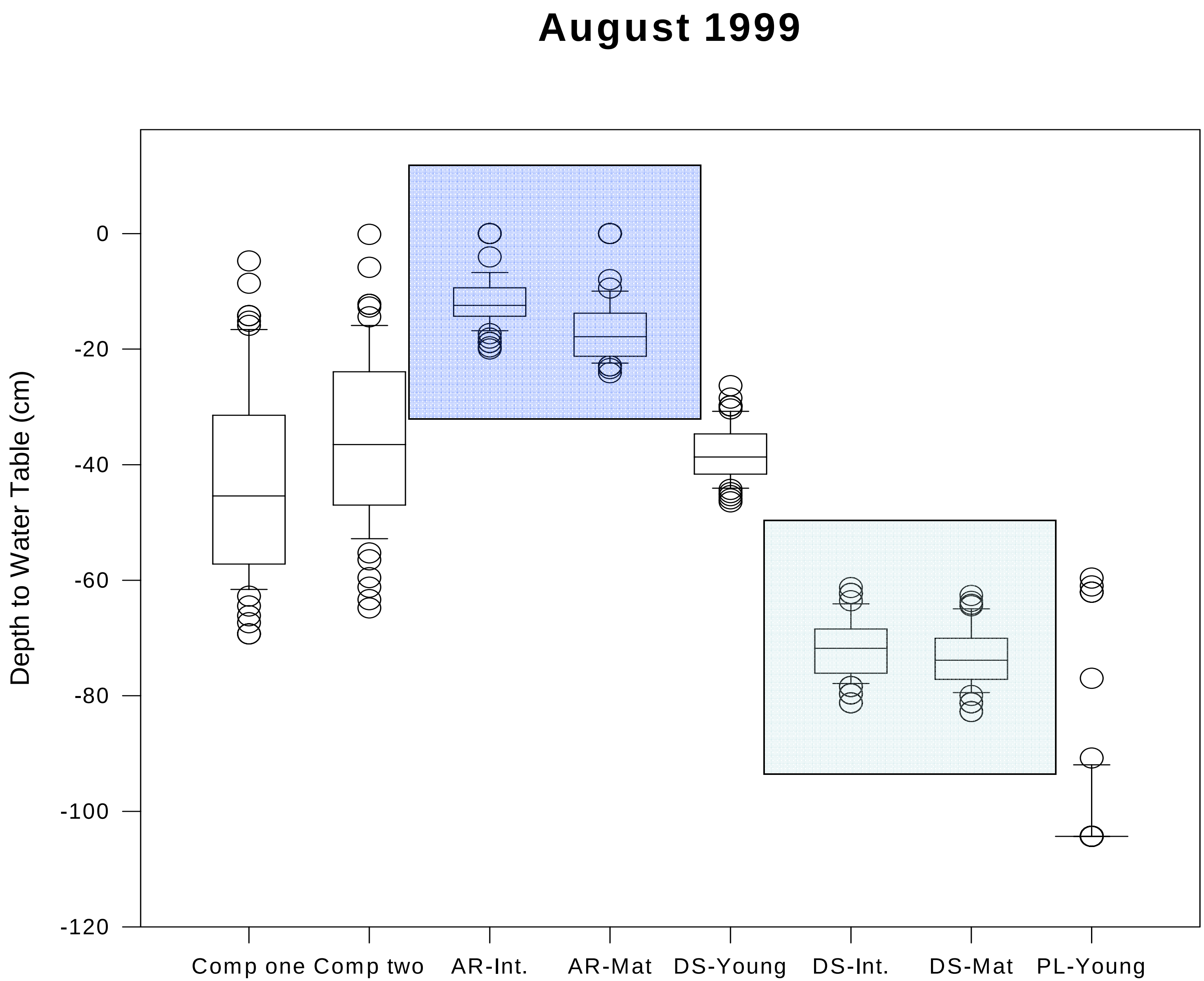
Great Dismal Swamp National Wildlife Refuge
3 sites:
Young-1
Intermediate-1
Mature-1

Wetland Compensation Bank
2 sites:
Young-2

Pocosin Lakes National Wildlife Refuge
1 site:
Young-1

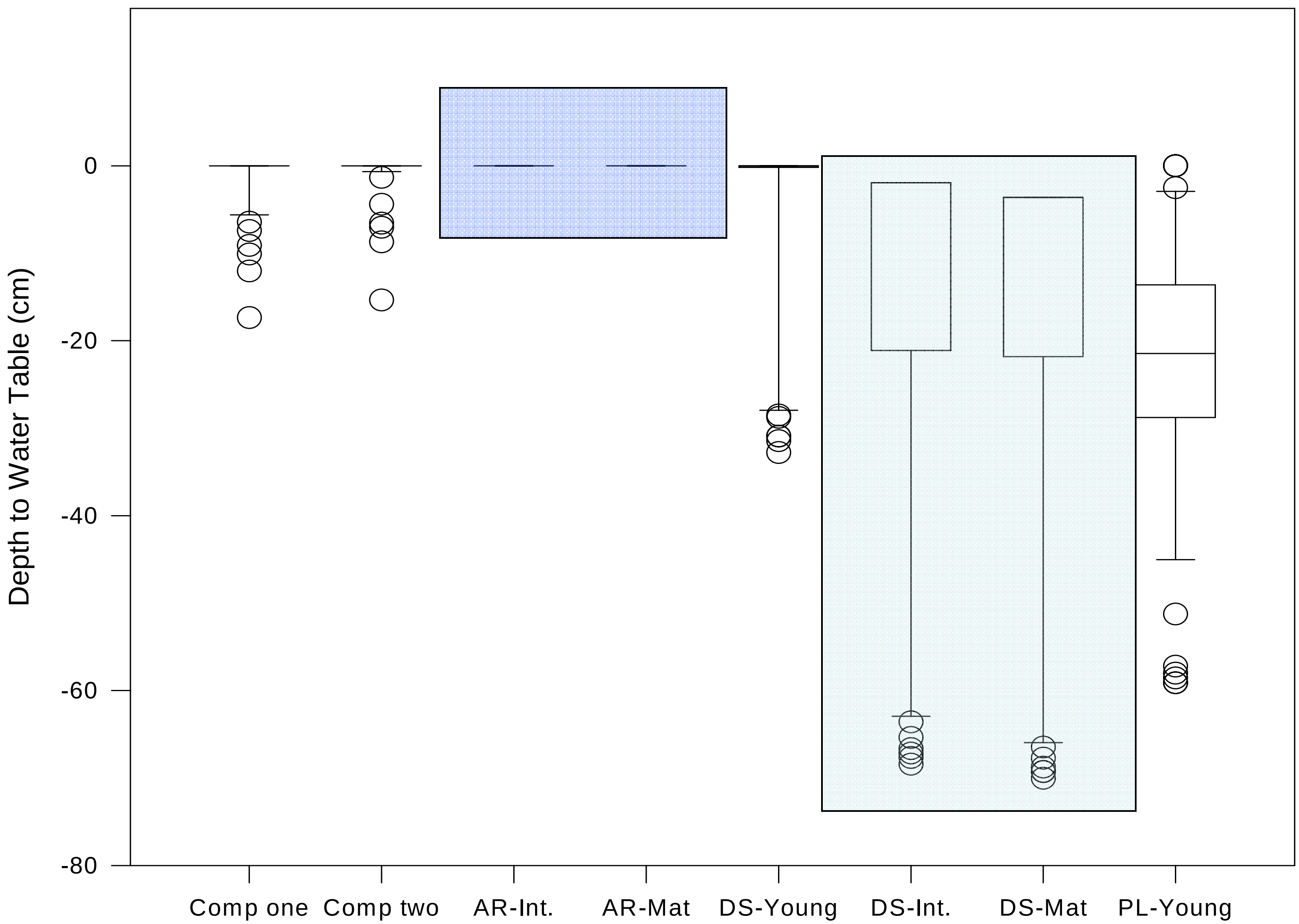
Alligator River National Wildlife Refuge
2 sites:
Intermediate-1
Mature-1


GDS
AR



August 1999
Depth to Water Table (cm)
0
-20
-40
-60
-80
-100
-120
Comp one
Comp two
AR-Int.
AR-Mat
DS-Young
DS-Int.
DS-Mat
PL-Young

September 1999

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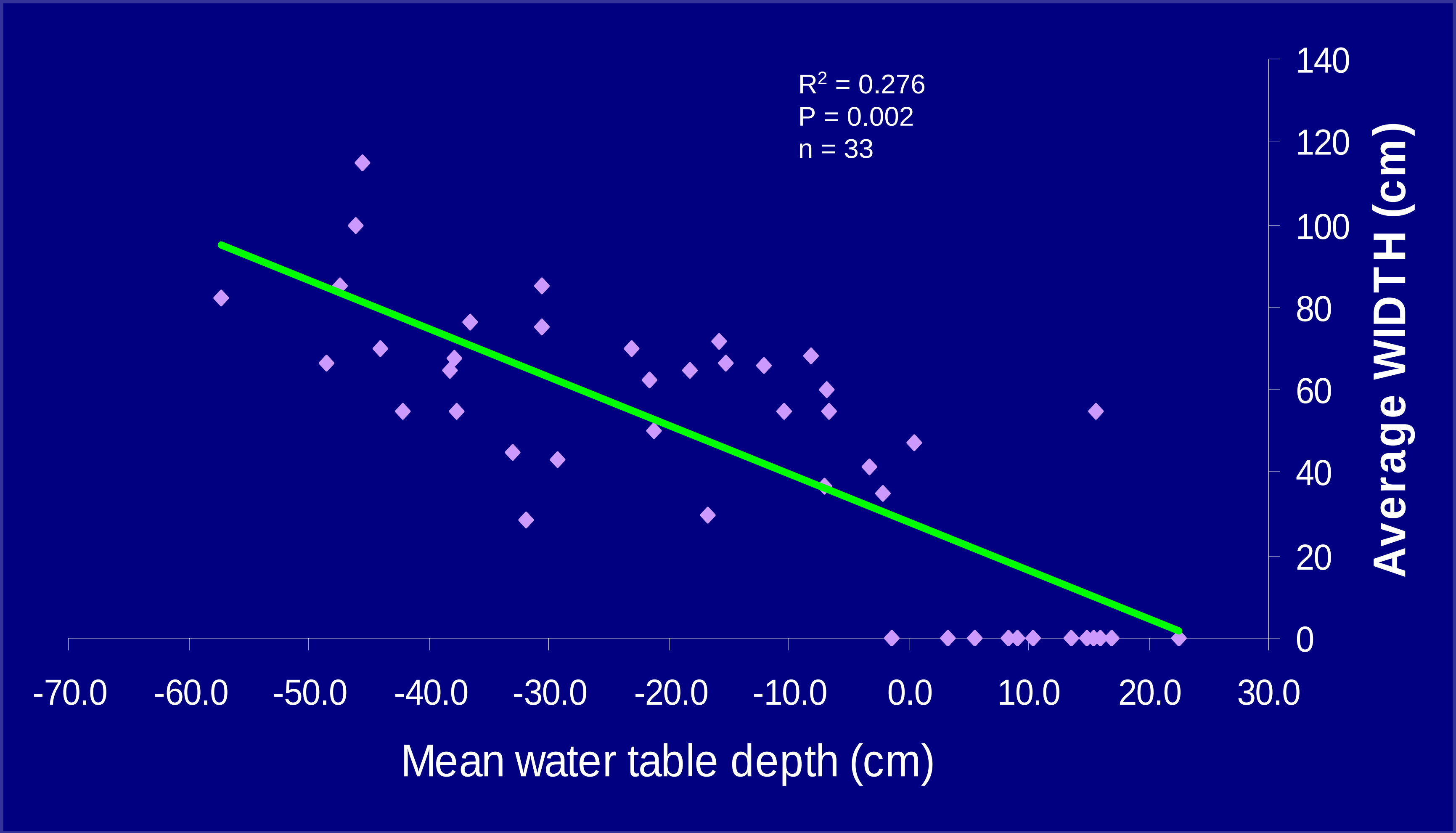
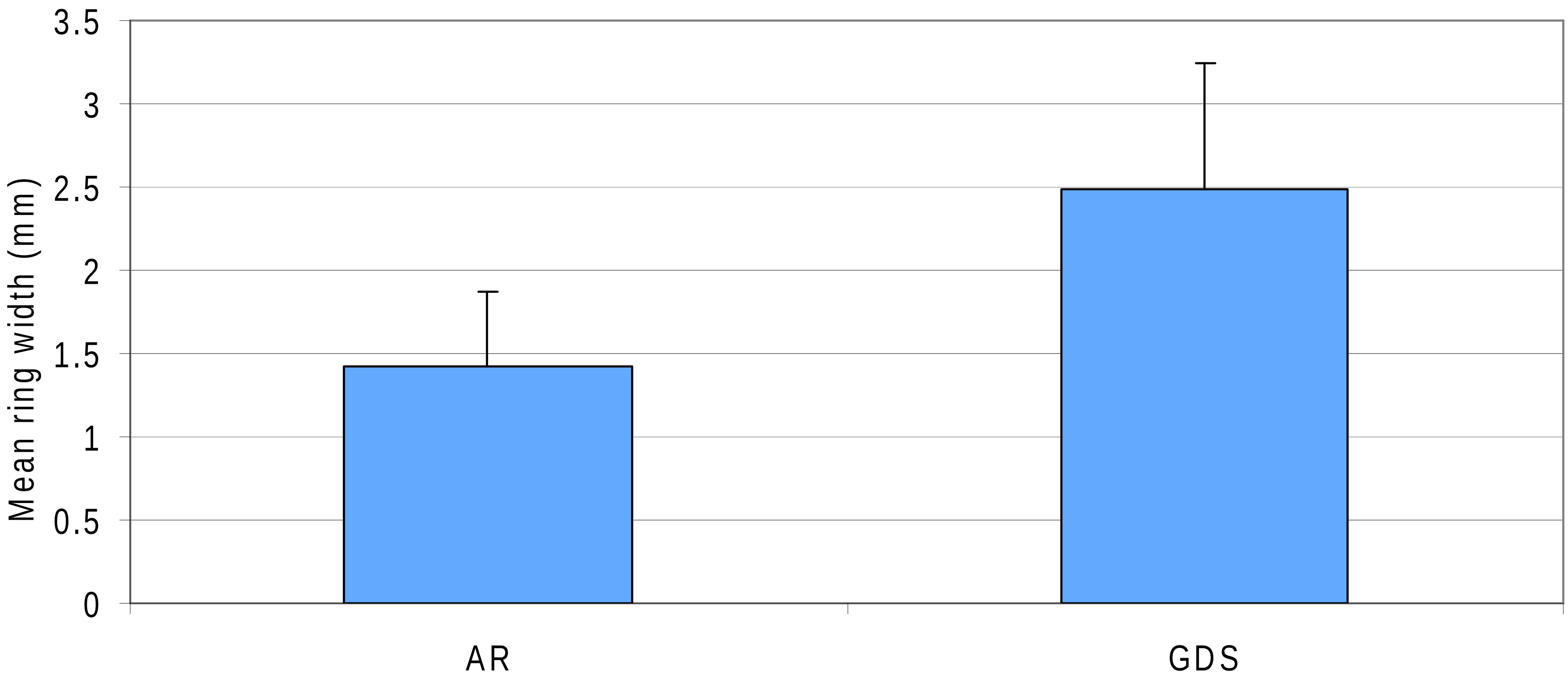
Response of cedar to water table depth:
Grows slower when wetter

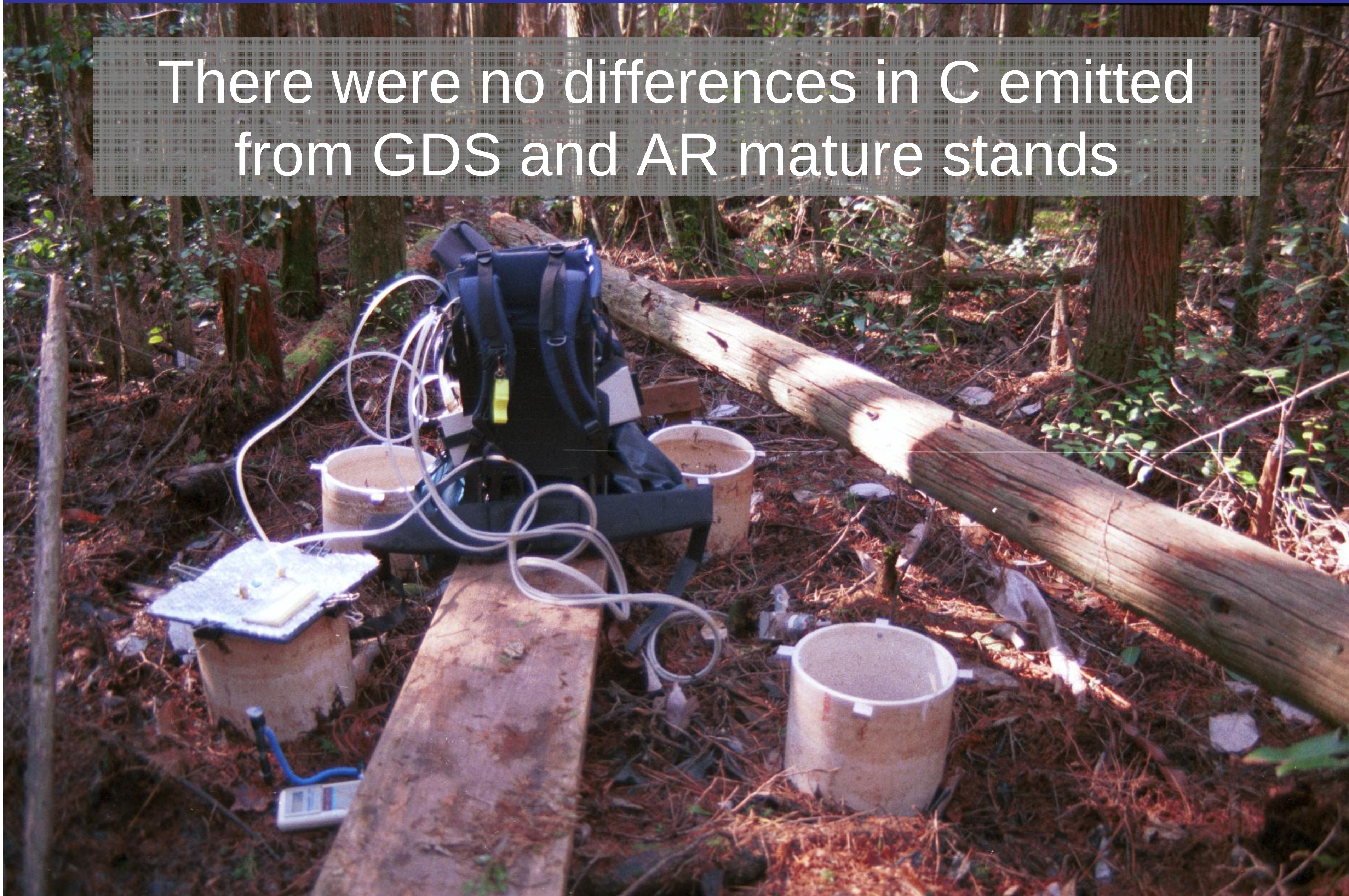


Mean ring width of cedar in Alligator River and Great Dismal Swamp ($P < 0.001$)

Recall that cedar stem density in AR is nearly twice that in GDS



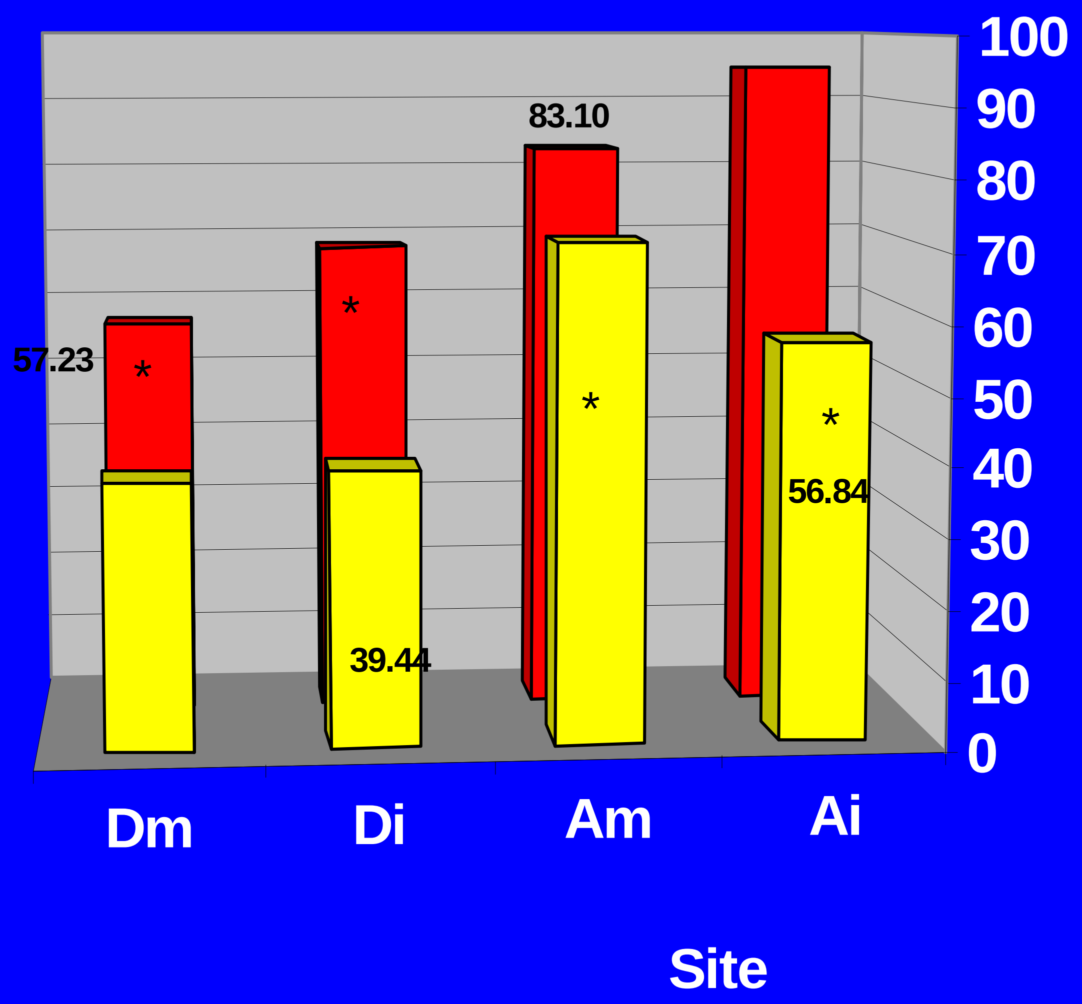
There were no differences in C emitted from GDS and AR mature stands



Carbon emitted from soil cores over a 42-day incubation period (g CO_2 m^{-2})

Red: drained cores

Yellow: inundated cores

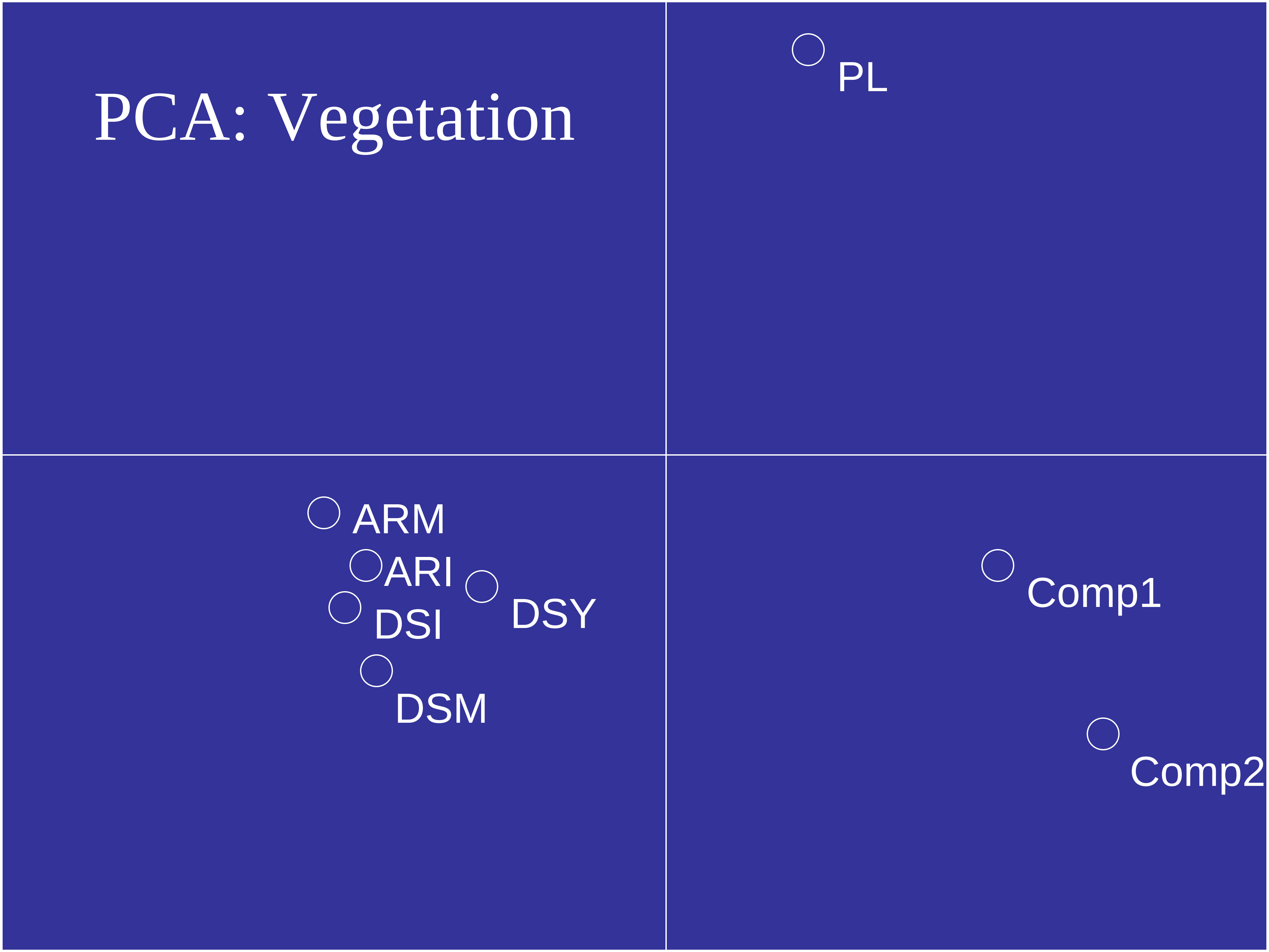


Conclusions for functional analyses

- AWC swamp functional response to fairly high water tables:
  - Similar primary productivity: Higher stem density offset by slower growth of individual trees
  - Soil respiration rate: high root respiration and low organic matter decomposition rate
  - Self-maintenance: Accumulates peat and provides seeds refugium in times of fire

Structural Investigation

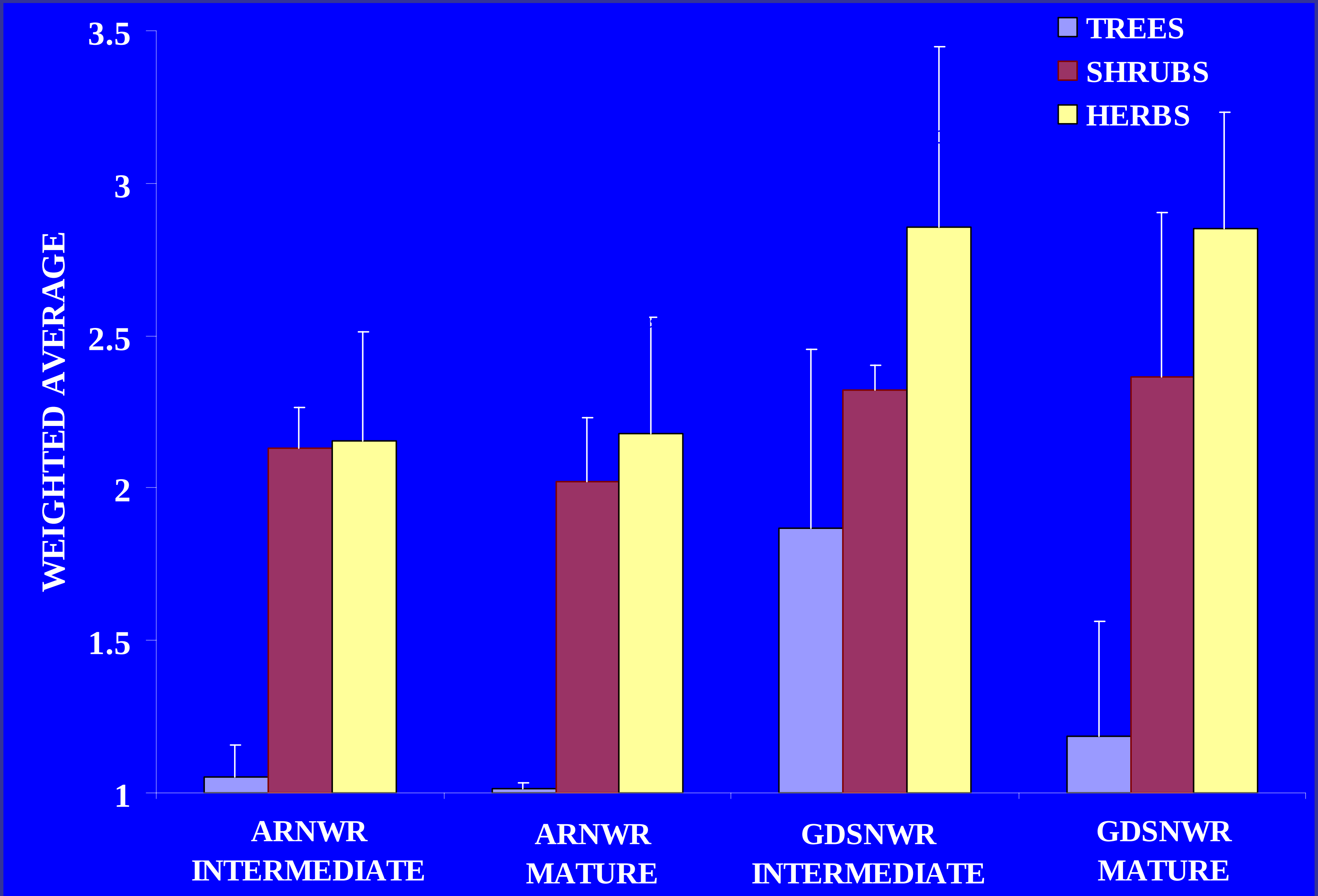
PCA: Vegetation



Red maple, *Acer rubrum* L.

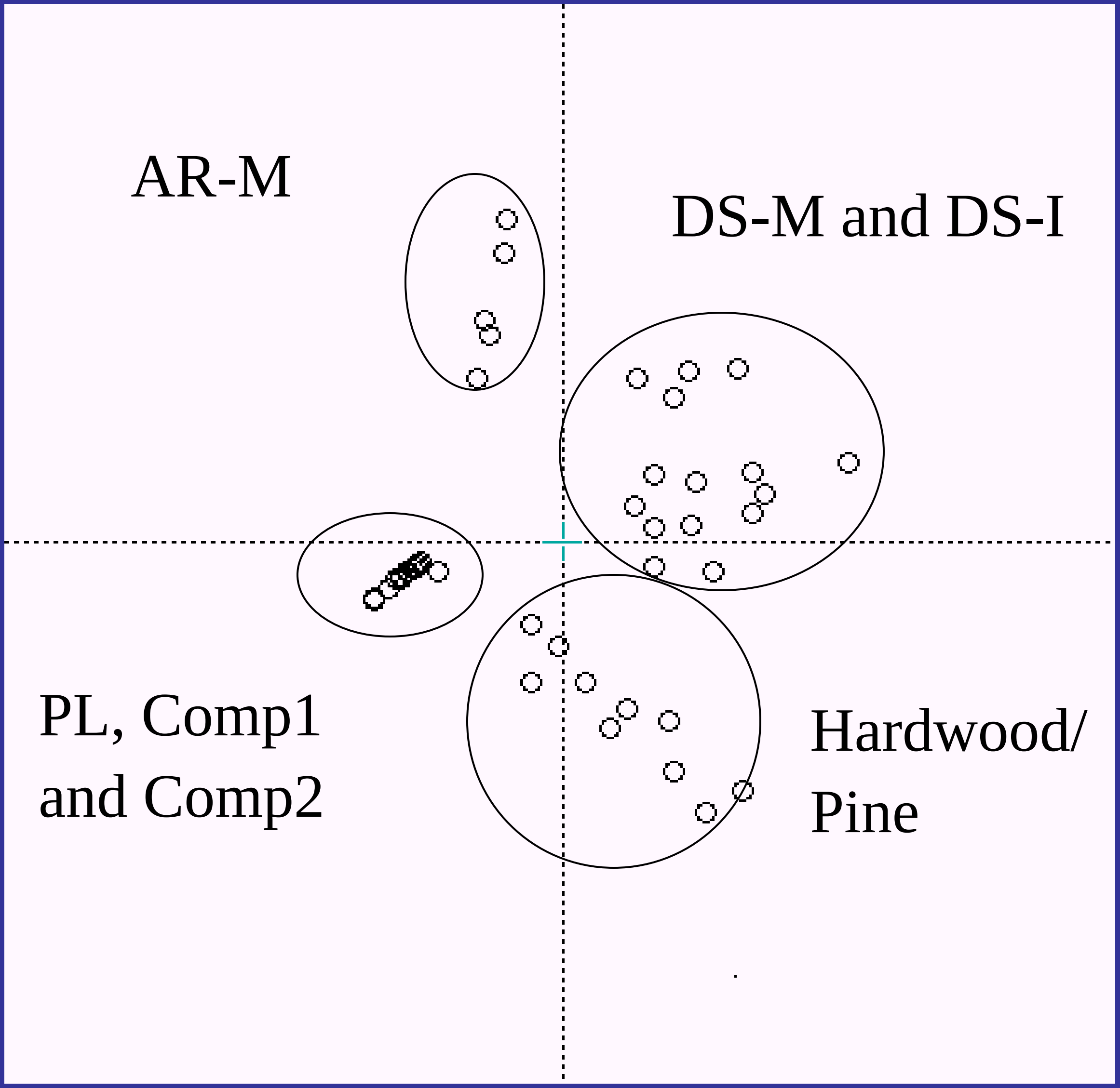
is a facultative hydrophyte (occurs in uplands and wetlands with equal frequency) (Reed, 1988) and is invading the Great Dismal Swamp.

Strata Weighted Averages for Forested Sites

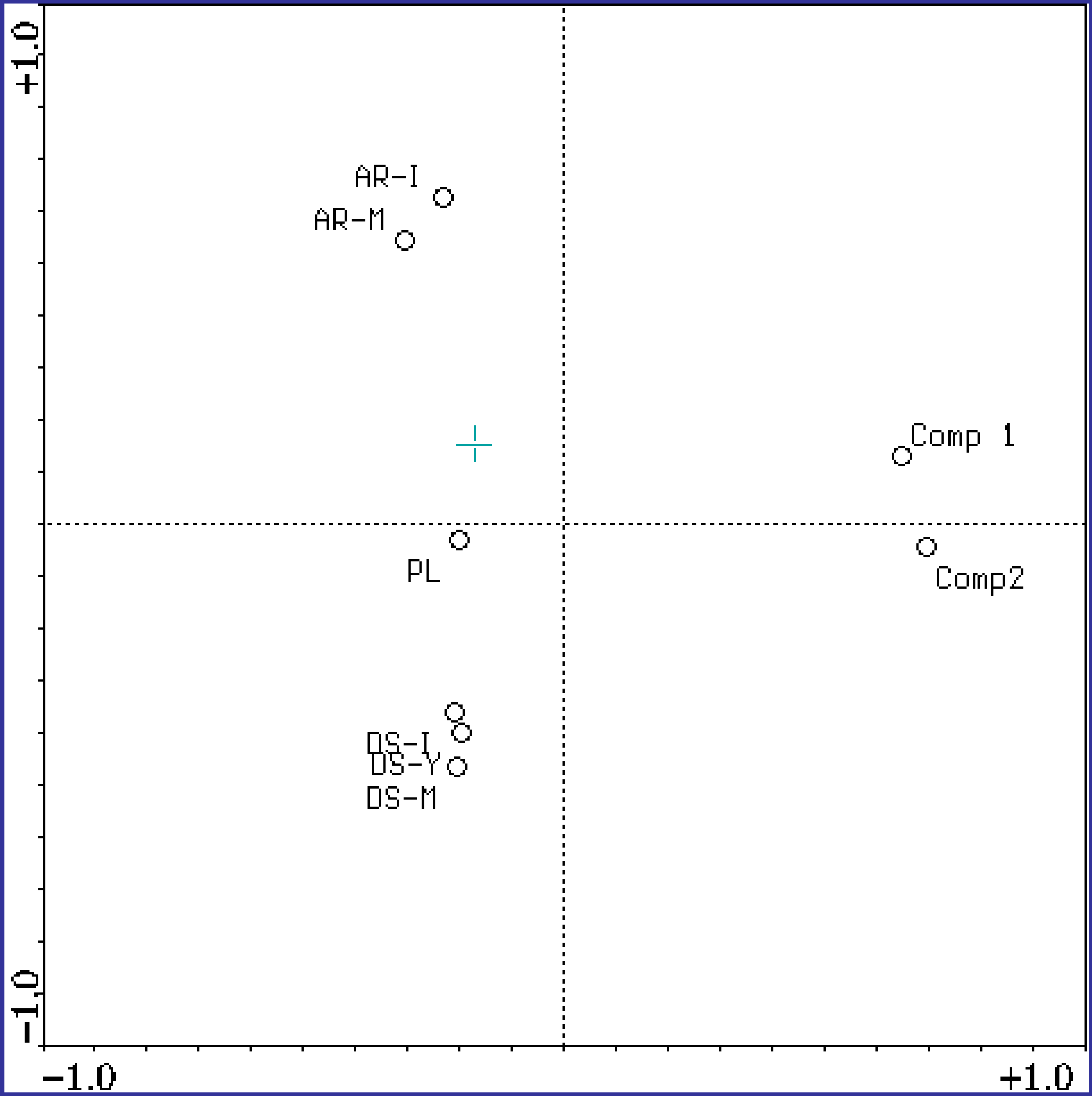


Faunal surveys

PCA: Birds



PCA: Amphibians, reptiles, & mammals



Design suggestions

- Site selection to include
  - Areas with organic accumulations: histic epipedon or deeper peats
  - Areas that permit high water tables
- “local” seed source
- Water levels
  - Could be moderate/low water table initially
  - Must me moderate to high operationally
  - Transition to no-maintenance control of water tables, e.g., ditch plugs

Monitoring criteria
Concept: ensure best chance for success but don’t penalize suboptimal performance

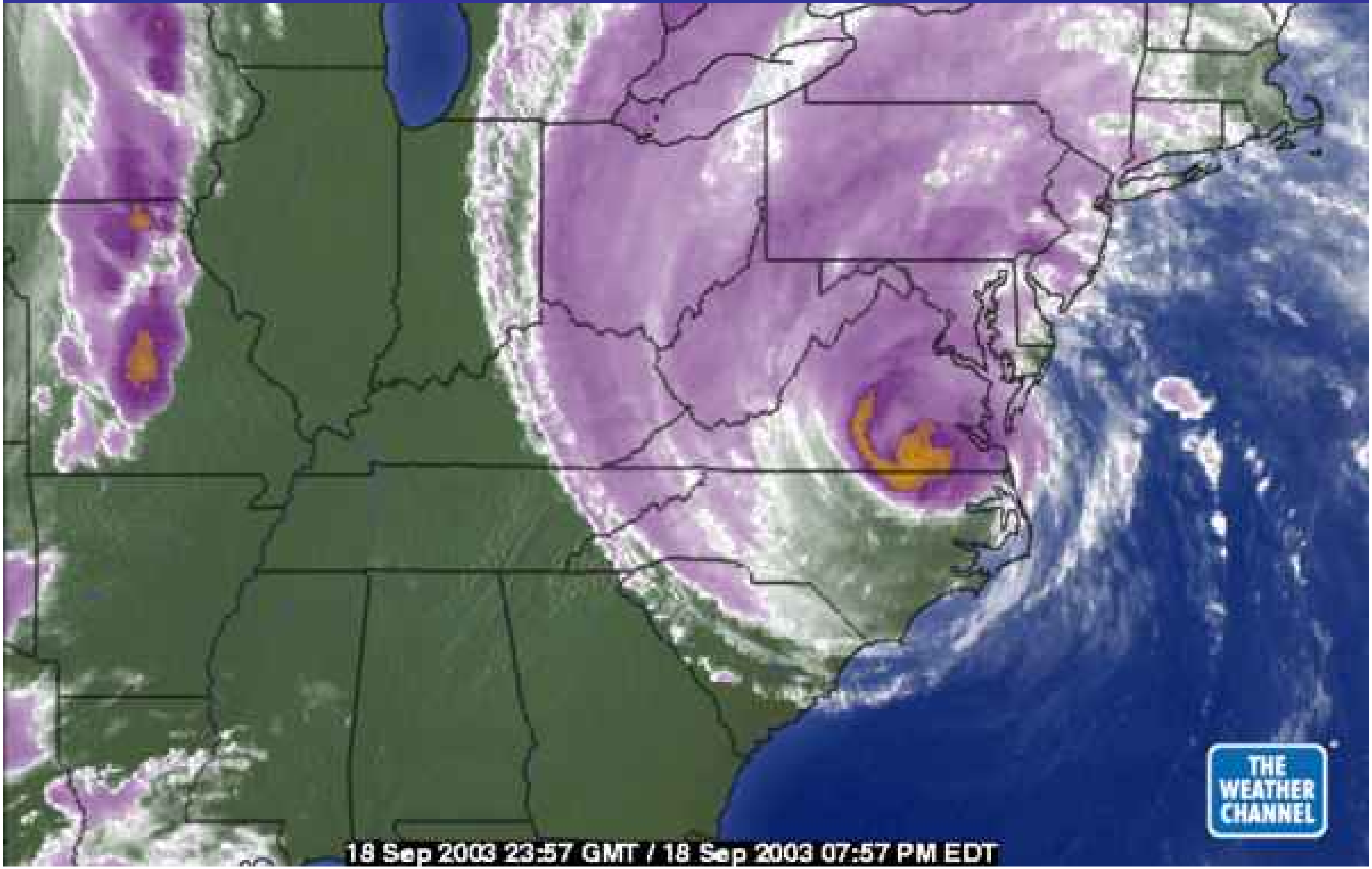
- Annual monitoring of water tables
- “normal” monitoring (yrs 1, 2, 3, 5, 7, and 10
  - Stem density
  - Growth
  - Dominance/weighted average of colonizing vegetation
- Adaptive management
  - May require herbicidal release
  - May require alternative restoration endpoint, e.g. other forested wetland type

Century-old image of Atlantic White Cedar in Great Dismal Swamp

View Showing the Fine Juniper (White Cedar) Timber on the Holdings of John L. Roper Lumber Co. in the Great Dismal Swamp of Virginia and North Carolina; About 60,000 Acres in This Body.

Atlantic White Cedar stand in Great Dismal Swamp (Pre-Isabel)

Hurricane Isabel 9/18/03

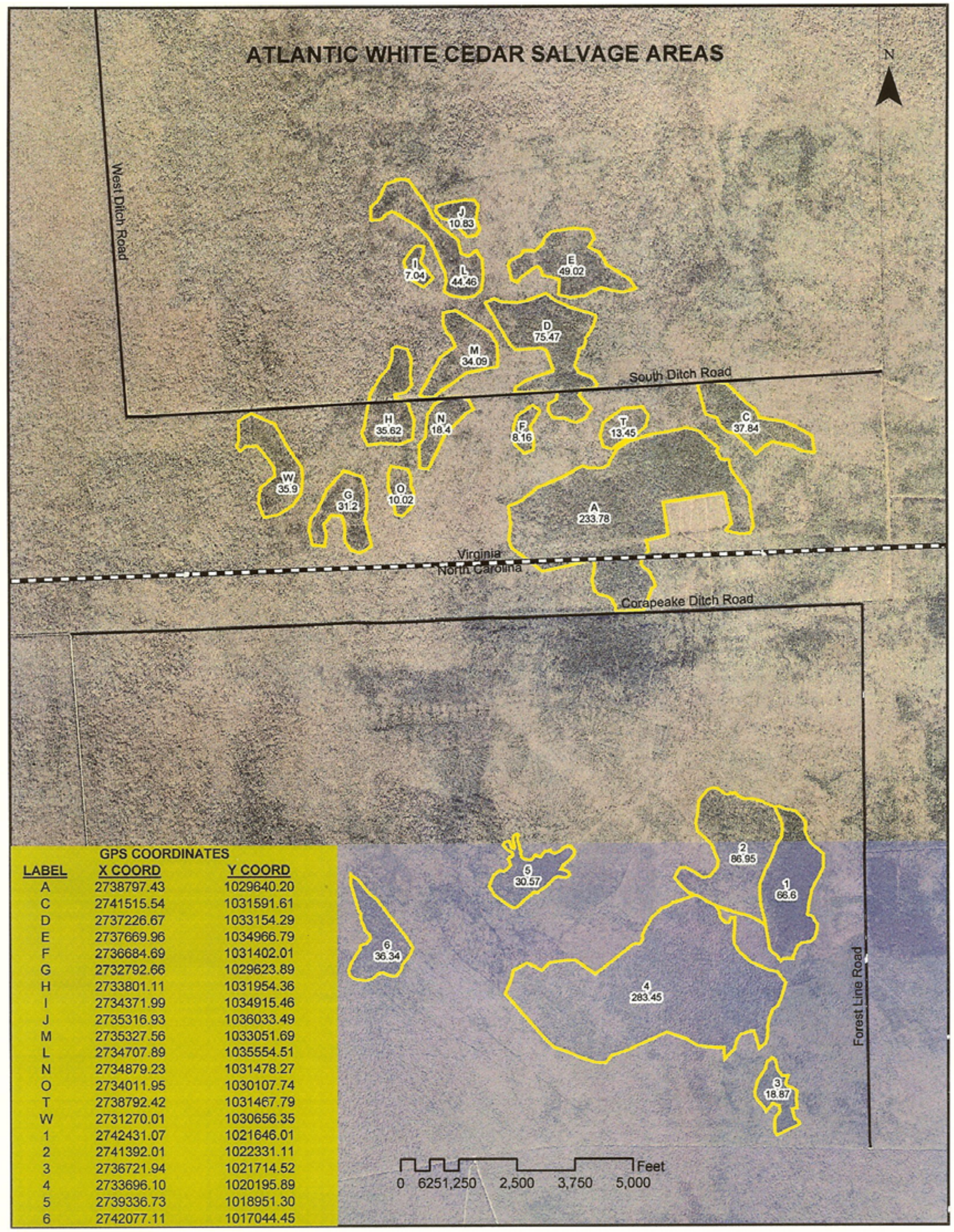


Damage from Hurricane Isabel

aerial photograph

Same site in GDS, timber harvested

Atlantic White Cedar salvage logging plan for GDS



GPS COORDINATES

LABEL	X COORD	Y COORD
A	2738797.43	1029640.20
C	2741515.54	1031591.61
D	2737226.67	1033154.29
E	2737669.96	1034966.79
F	2736684.69	1031402.01
G	2732792.66	1029623.89
H	2733801.11	1031954.36
I	2734371.99	1034915.46
J	2735316.93	1036033.49
M	2735327.56	1033051.69
L	2734707.89	1035554.51
N	2734879.23	1031478.27
O	2734011.95	1030107.74
T	2738792.42	1031467.79
W	2731270.01	1030656.35
1	2742431.07	1021646.01
2	2741392.01	1022331.11
3	2736721.94	1021714.52
4	2733696.10	1020195.89
5	2739336.73	1018951.30
6	2742077.11	1017044.45