ECOLOGICAL STUDIES OF WILLOW (*SALIX CAROLINIANA*): MONTHLY STATUS REPORT #19

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UCF undergraduate Sarah Green (left) and Dr. John Fauth recording demographic data.

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Ecological Studies of Willow (*Salix caroliniana*): Monthly Status Report #16

Covering the time period from August 1-31, 2010

This status report summarizes progress made on the Ecological Studies of Willow project through August 31, 2010, with reference to the tasks and timeline outlined in the Scope of Work and presented in Table 1 below.

Table 1. Timeline of tasks to be accomplished in Year 2. Tasks initiated and underway in this reporting month are highlighted in blue, completed tasks in red.

YEAR 2

Quarter	Months	Tasks accomplished
1st	Oct – Dec, 2009	Initiate Task 2.3 (*Fire response*) Continue Task 2.4 (*Life history*) Continue Task 2.5 (*Spatial analysis of willow distribution*)
2nd	Jan – Mar, 2010	Continue Task 2.3 (*Fire response*) Continue Task 2.4 (*Life history*) Continue Task 2.5 (*Spatial analysis of willow distribution*)
3rd	Apr – Jun, 2010	Initiate Task 2.2 (2nd iteration, *Willow transplantation*) Continue Task 2.3 (*Fire response*) Continue Task 2.4 (*Life history*) Continue Task 2.5 (*Spatial analysis of willow distribution*)
4th	Jul – Sep, 2010	Complete Task 2.2 (2nd iteration, *Willow transplantation*) Continue Task 2.3 (*Fire response*) Continue Task 2.4 (*Life history*) Continue Task 2.5 (*Spatial analysis of willow distribution*) Complete Task 3.2 (*Data analysis and final report, Year 2*)

Progress on Task 2.1 – Germination and Early Survival and Growth Experiments
This task was completed in April, 2010.

Progress on Task 2.2 – Willow Transplantation
A. Competition Experiment – We continued to maintain the flooding and competition experiments (Figs. 1-4). Based on results obtained in the September 10, 2010 census, we will continue the experiment until the willows drop leaves prior to flowering. This is a natural endpoint for this experiment. During this reporting period, we census willows and sawgrass on August 10, 2010.

Figure 1.Large and short cuttings are being prepared for transplantation

Figure 2. Cuttings and seedlings are transplanted in the experimental ponds

Figure 3. A group of seedlings in their final location; only the largest one was left after the next evaluation

Figure 4. Example of a high density saw grass with a short cutting after transplantation

We present initial results and a preliminary analysis of monthly height growth variation (log(final measurement/prior month measurement)) in response to the experimental treatments during the first (May-June; Table 2) and last (August-September; not final) evaluations. Considering only the plants without sawgrass (Table 2), during the period of acclimation in the first month after transplant and before we flooded the ponds, we found a significant interactions in the effect of stage and elevation (Figure 5) and block and stage on willow height growth (Figure 6).

Table 2. Results of an ANOVA of height growth during the first month after transplantation and block, stage (seedling, small, and large cutting), and elevation (0, 0.25, 0.38, 0.5 m from the bottom of the pond) for plants without sawgrass. Adjusted $r^2 = 0.92$.

Source of variation					
	Df	SS	MS	F	P
block	5	1.56	0.31	3.67	0.005
elevation	3	8.45	2.82	33.11	<0.001
stage	2	108.05	54.03	635.17	<0.001
block*elevation	15	1.30	0.09	1.02	0.45
block*stage	10	6.60	0.66	7.76	<0.001
elevation*stage	6	4.99	0.83	9.79	<0.001
block*elevation*stage	28	2.16	0.08	0.91	0.60
Residuals	68	5.78	0.08		

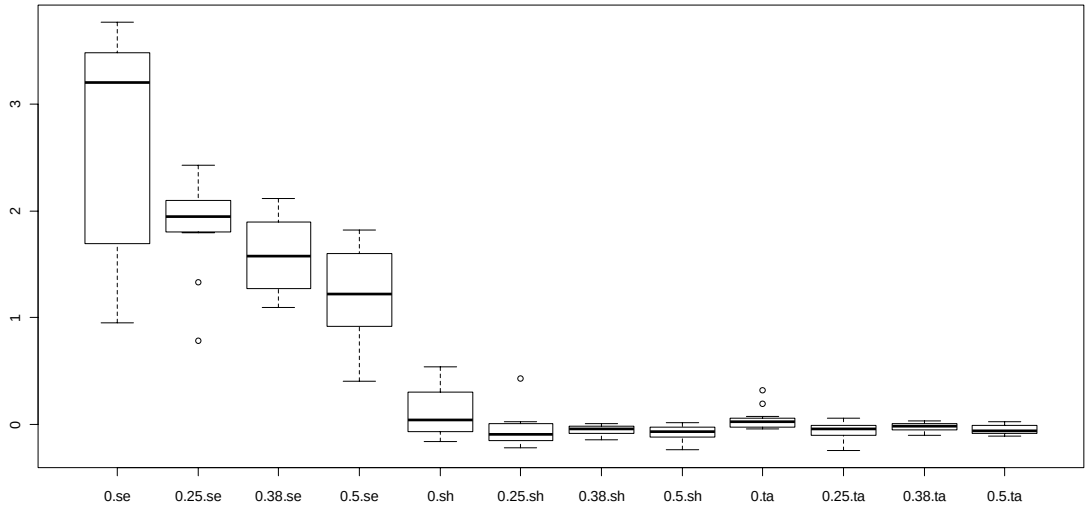

Figure 5. Before being flooded, seedlings (se) grew more the closer they were from the water table and more than the cuttings (sh; short, la: large).

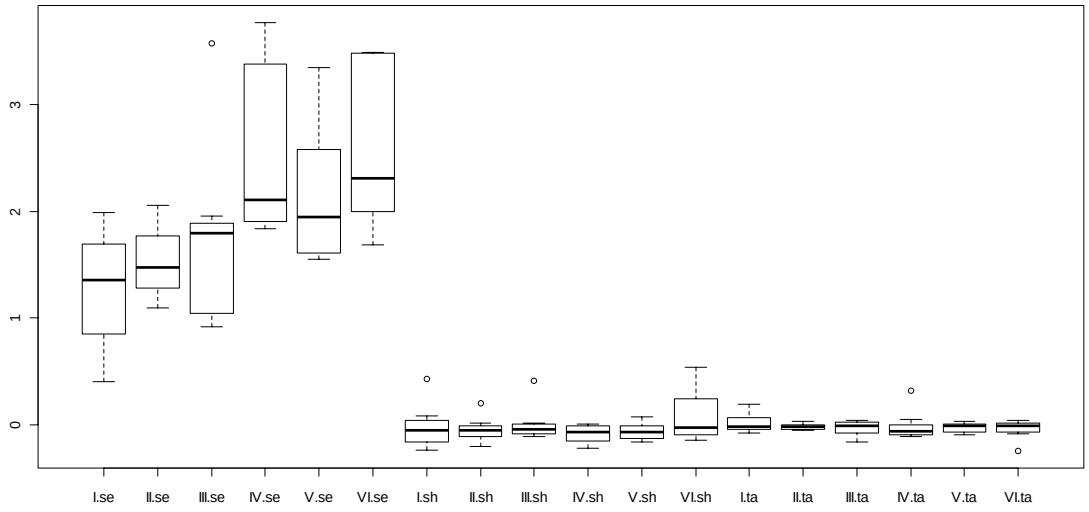

Figure 6. During the first month, seedling height growth was higher in the moister and less sandy blocks 4, 5, and 6. Cuttings were not affected by the blocks

Considering only the plants at the intermediate elevations (saw grass experiment, Table 3), during the period of acclimation in the first month after transplant and before we flooded the ponds, we found four way significant interactions in the effect of stage, grass, block and elevation on willow height growth (these results and presented in Figure 7 and 8).

Table 3. Results of an ANOVA of height growth and block, stage (seedling, small, and large cutting), saw grass (0, low:3 and high:6 tillers) and elevation (0.25, 0.38 m from the bottom of the pond) for plants in sawgrass experiment. Adjusted $r^2 = 0.93$.

Source of variation					
	Df	SS	MS	F	P
block	5	0.97	0.19	4.08	0.005
elevation	1	0.37	0.37	7.84	0.008
stage	2	88.86	44.43	936.40	<0.001
grass	2	0.31	0.15	3.22	0.052
block*elev	5	0.35	0.07	1.49	0.218
block*stage	10	2.21	0.22	4.66	<0.001
elev*stage	2	1.13	0.57	11.93	<0.001
block*grass	10	0.45	0.05	0.95	0.504
elev*grass	2	0.05	0.03	0.54	0.588
stage*grass	4	0.42	0.11	2.23	0.085
block*elev*stage	10	0.62	0.06	1.31	0.261
block*elev*grass	10	1.51	0.15	3.18	0.005
block*stage*grass	20	1.30	0.07	1.37	0.199
elev*stage*grass	4	0.26	0.06	1.34	0.273
block*elev*stage*grass	20	2.62	0.13	2.76	0.004
Residuals	36	1.71	0.05		

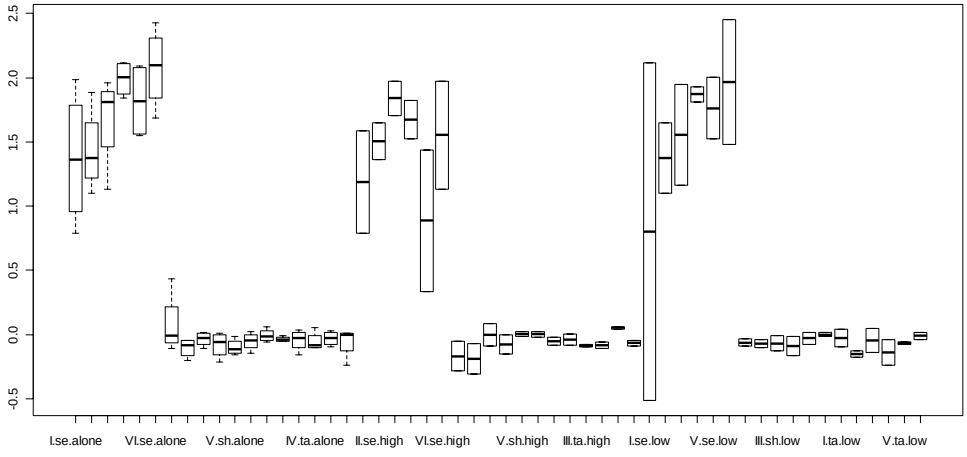

Figure 7. During the first month, seedlings grew more in height in the moister and less sandy blocks and with no (alone) or low grass competition. The cuttings did not respond to these variables.

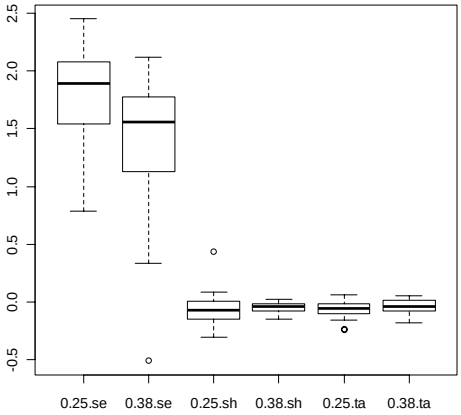

Figure 7. Before being flooded, seedlings (se) grew more the closer they were from the water table and more than the cuttings (sh; short, la: large) (experiment with sawgrass).

Considering only the plants without sawgrass (Table 4), and four months after transplant and three months after flooding the ponds, we found significant interactions in the effect of stage and elevation (Figure 9) and block and stage on willow height growth (Figure 10).

Table 4. Results of an ANOVA of height growth during the interval August-September and block, stage (seedling, small, and large cutting), and elevation (0, 0.25, 0.38, 0.5 m from the bottom of the pond) for plants without sawgrass. Adjusted $r^2 = 0.29$.

Source of variation	Df	SS	MS	F	P
block	5	0.137	0.027	0.692	0.632
elevation	3	0.874	0.291	7.342	<0.001
stage	2	0.066	0.033	0.829	0.442
block*elevation	15	0.559	0.037	0.939	0.530
block*stage	9	1.062	0.118	2.974	0.006
elevation*stage	5	0.899	0.180	4.529	0.002
block*elevation*stage	16	0.323	0.020	0.509	0.931
Residuals	51	2.024	0.040		

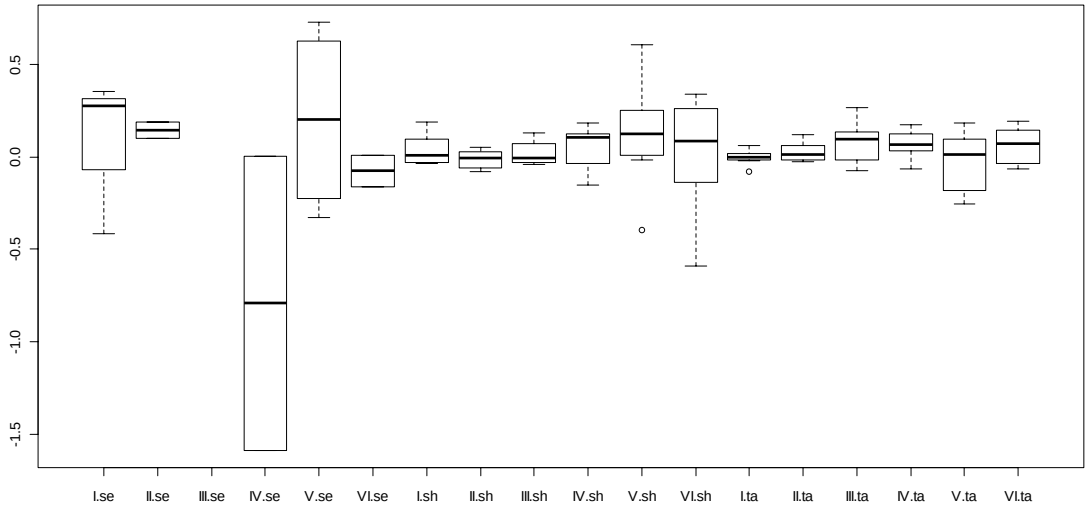

Figure 9. During the months of August and September, seedling height growth decreased compared to before flooding and was more idiosyncratic among blocks. Cuttings were not affected by the blocks.

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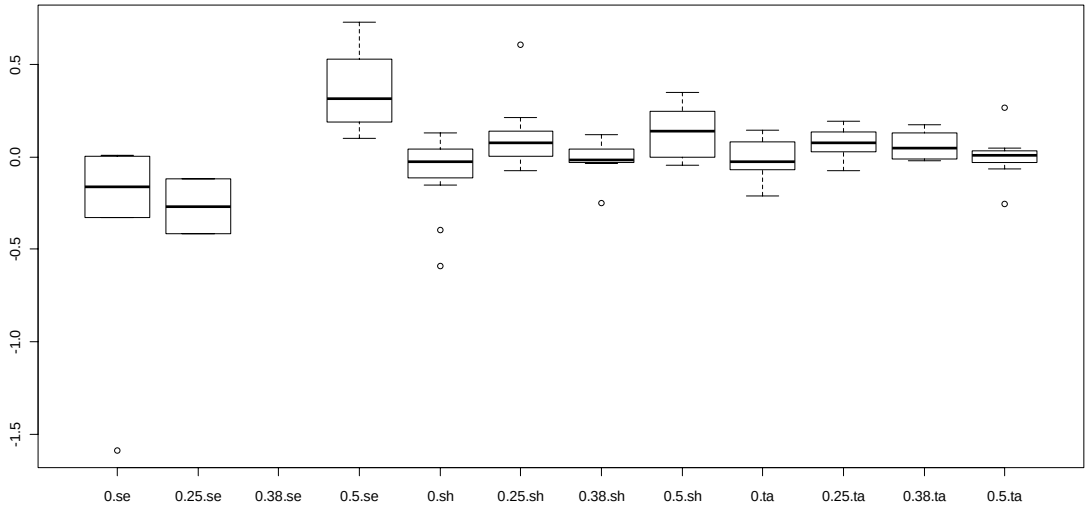

Figure 10. During the months of August and September, seedling height growth decreased compared to before flooding and was lower closer to the water table (more inundated). No seedlings survived in the 0.38 m distance (more wave action?). Cutting's height growth was not affected by the depth.

Considering only the plants at the intermediate elevations (saw grass experiment), and four months after transplant and three months after flooding the ponds, (Table 5), we found four way significant interactions in the effect of stage, grass, block and elevation on willow height growth (these results and presented in Figure 11 and 12).

Table 5. Results of an ANOVA of height growth and block, stage (seedling, small, and large cutting), saw grass (0, low:3 and high:6 tillers) and elevation (0.25, 0.38 m from the bottom of the pond) for plants with sawgrass. Adjusted r^2 =0.441. Interval August-September.

Source of variation	Df	SS	MS	F	P
block	5	0.218	0.044	3.958	0.010
elevation	1	0.017	0.017	1.532	0.228
stage	2	0.399	0.199	18.123	<0.001
grass	2	0.023	0.011	1.037	0.370
block*elev	5	0.021	0.004	0.380	0.857
block*stage	7	0.088	0.013	1.140	0.374
elev*stage	2	0.001	0.000	0.024	0.976
block*grass	10	0.101	0.010	0.915	0.536
elev*grass	2	0.009	0.004	0.403	0.673
stage*grass	3	0.026	0.009	0.775	0.520
block*elev*stage	5	0.023	0.005	0.409	0.838
block*elev*grass	10	0.150	0.015	1.363	0.258
block*stage*grass	11	0.263	0.024	2.174	0.056
elev*stage*grass	2	0.096	0.048	4.348	0.025
block*elev*stage*grass	10	0.283	0.028	2.575	0.029
Residuals	23	0.253	0.011		

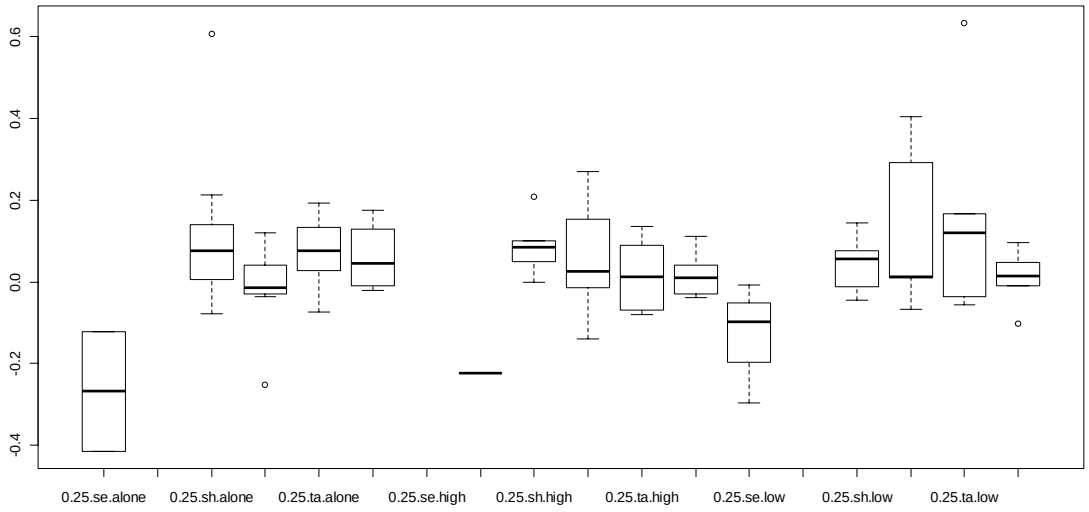

Figure 10. During the months of August and September, seedling height growth decreased compared to before flooding and was lower closer to the water table (more inundated). No seedlings survived in the 0.38 m distance. Cutting's height growth was not affected by the depth, and the effect of grass was reduced, but seedlings grew better in low grass than no or high (see next figure).

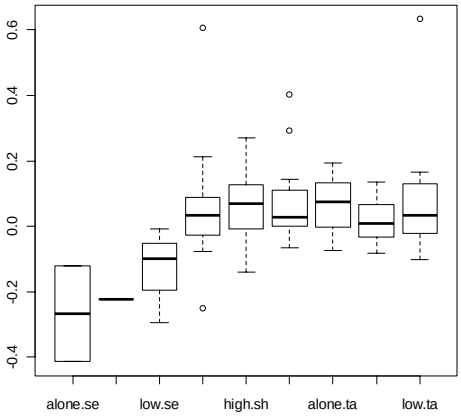

Figure 11. Between August and September seedlings (se) grew more under low density of grass than with no or high density of sawgrass. Cuttings were not affected by the sawgrass.

B. Hydrology Experiment – We completed analysis of this experiment and are continuing to prepare a manuscript for publication.

Progress on Task 2.3 - Fire response – We completed our efforts to conduct the burn experiment and reported on the results in our July report.

Progress on Task 2.4 - Life History

During this reporting period, we sampled willows in three more sites: open marsh and willow thickets within Blue Cypress Marsh Conservation Area (southern region), and open marsh within Seminole Ranch Conservation Area (northern region). Only one site remains for our life history sampling: open marsh within the central region. We expect to sample this habitat in September.

At each site, we record standard demographic data and take either a core or wedge from five willows, for dendrochronology. We have collected ~50 of such samples (Fig. 1), which currently are being sanded and stained for growth ring analysis.

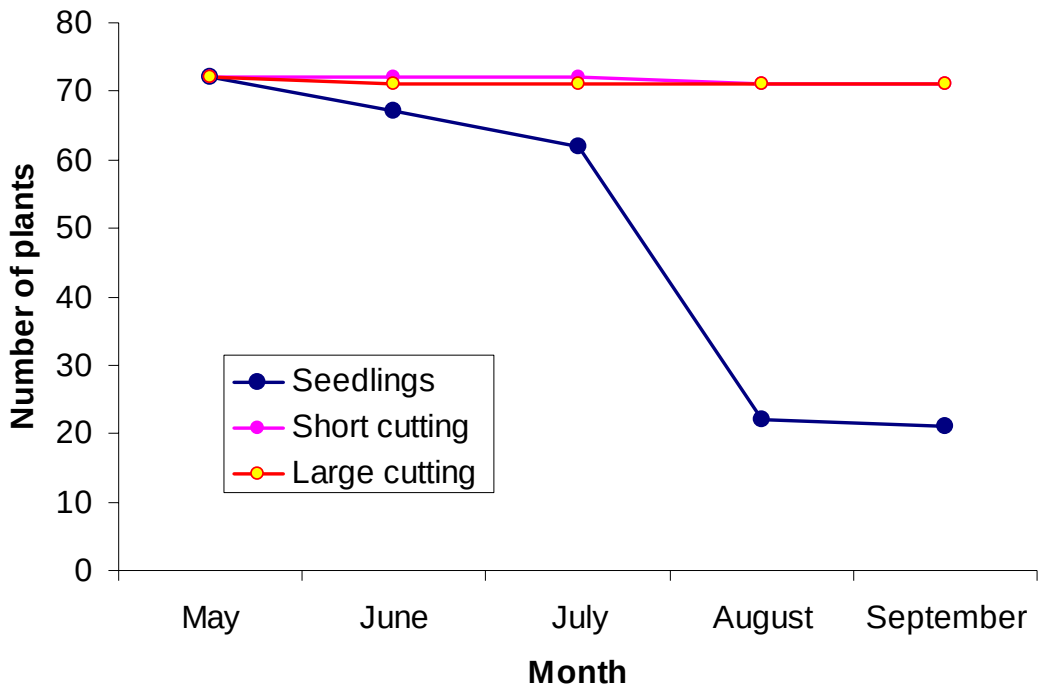

Figure 13. Survival of plants in the flooding experiment. The first monthly interval was for acclimation.

Figure 13. John Fauth (left) and Pedro Quintana-Ascencio (right) removing a willow disk for dendrochronology analysis.

Progress on Task 2.5 – Spatial Analysis of Willow Distribution.

We continued to modify our existing spatial model to incorporate vulnerability of adjacent communities to willow invasion. We also began repairing UCF boats & trailers so we can access sites along the river.

Summary of Activity

During this reporting period, the UCF team maintained the flooding and competition experiments for its 3rd month; sampled >3/4ths of the remaining life-history plots and continued modifying the GIS model.