

Laboratory vs. Field Comparison of Aquatic Vegetation Growth in the Comal River Ecosystem

HCP Science Committee Meeting

February 5, 2014



BAYLOR UNIVERSITY
Center for Reservoir and
Aquatic Systems Research

U.S. Fish & Wildlife Service

San Marcos Aquatic Resource Center



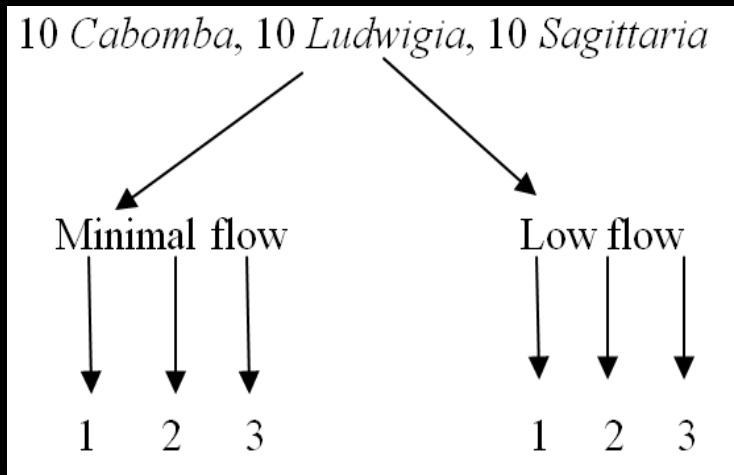
Applied Research

Lab vs. Field

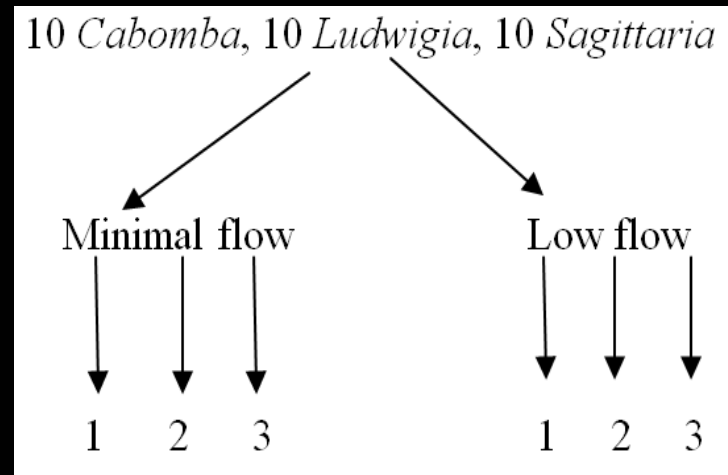
- **Objective:** compare growth of aquatic vegetation in field vs. lab.
- **Approach:** grow plants in field and lab under as close to the same environmental conditions as possible. Conditions include:
 - Flow velocity
 - Temperature
 - CO₂ & pH
 - Conductivity, light, depth

Experimental Design

Lab (ARC)



Old Channel







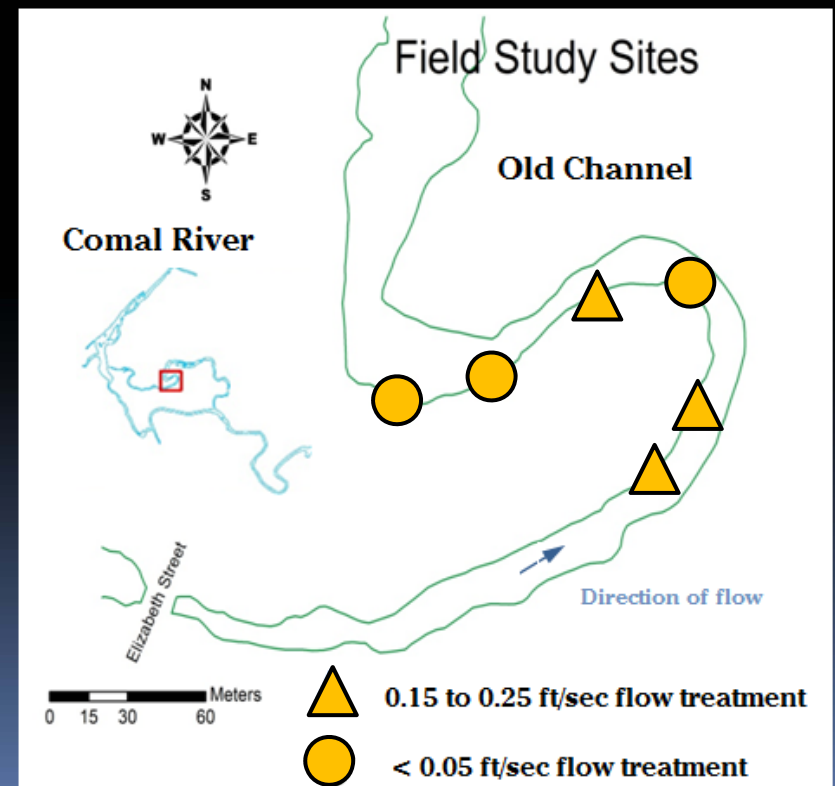
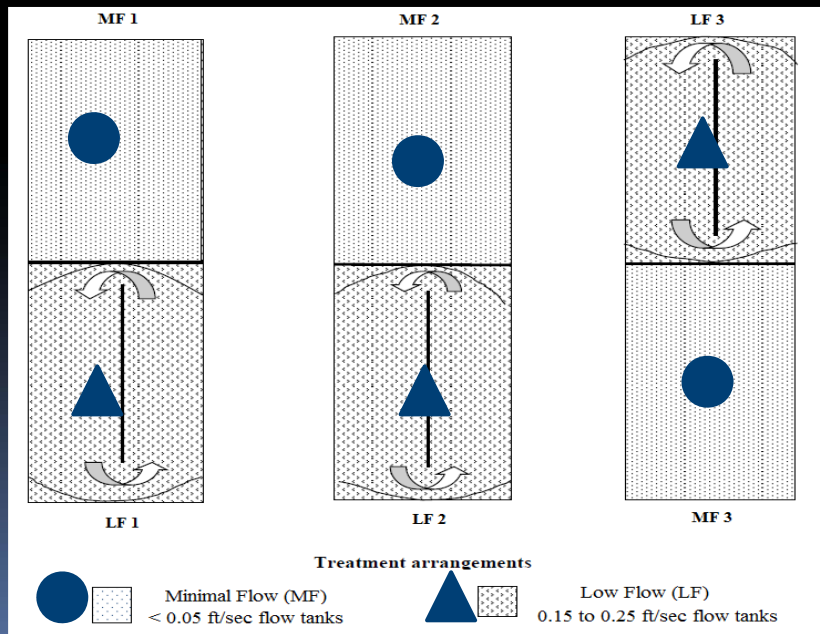
MAJOR FACTORS:

3 species X 2 locations (lab/field) X 2 conditions (min/low flow)

REPLICATION:

3 sites X 10 replicates

	Location	
	LAB	FIELD
Minimal Flow (<0.05 ft/s)	3 tanks 	3 MUPPT's 
Low Flow (0.15 - 0.25 ft/s)	3 tanks 	3 MUPPT's 



Methods

1. Grow plants from stock culture materials until well established



MUPPT

2. Transplant to field or lab
3. Monitor
survival, growth, WQ, velocity
4. Harvest





USFWS ARC Greenhouse



Extensive plumbing
and creativity

Lab vs Field Environmental Factors

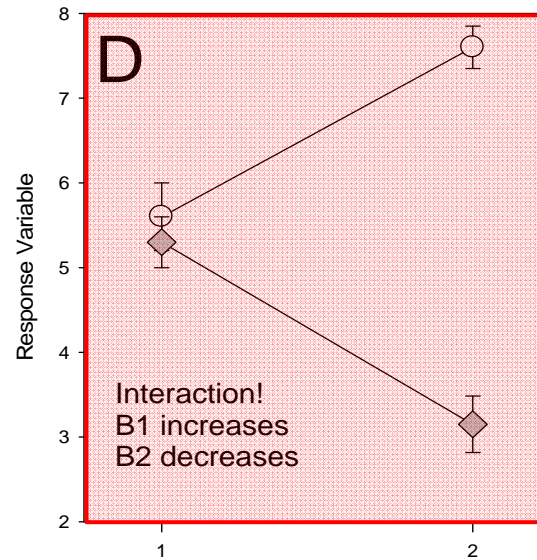
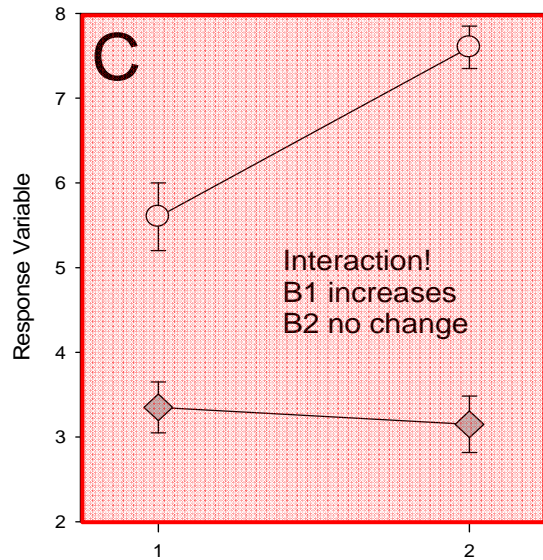
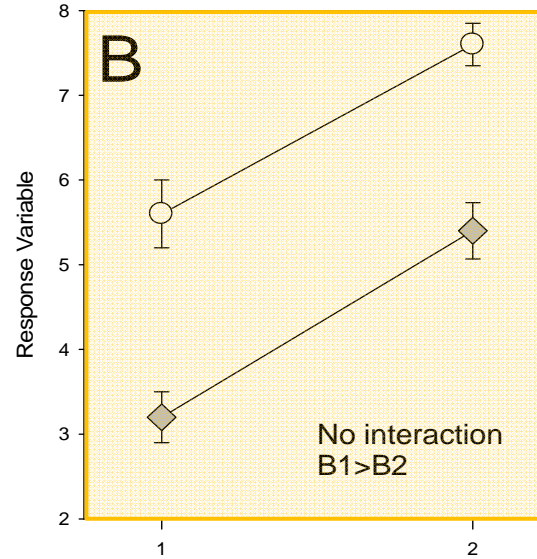
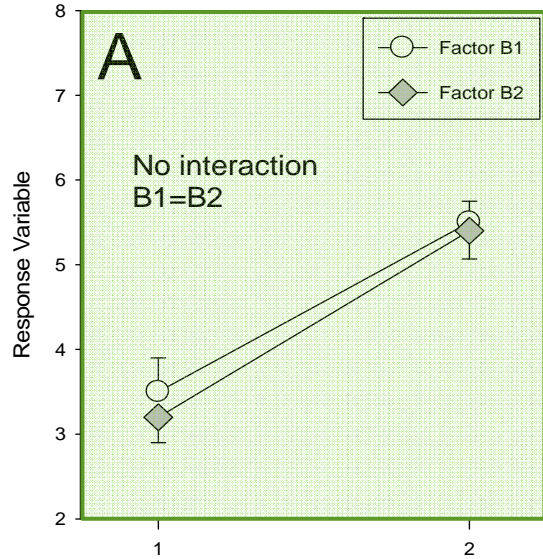
- Temp (Fig 10, mean temp <1 C difference)
- CO₂ (Fig 11, <0.5 mg/L difference)
- Flow (Fig 12 & Table 4, different, but within target ranges)
- Light (Fig 13, quite different)
 - Lab= lower maximum (but no shading)
 - Field= higher maximum (but periods in the shade)
- Overall- we feel very good about level of “replication” achieved.

Response Variables

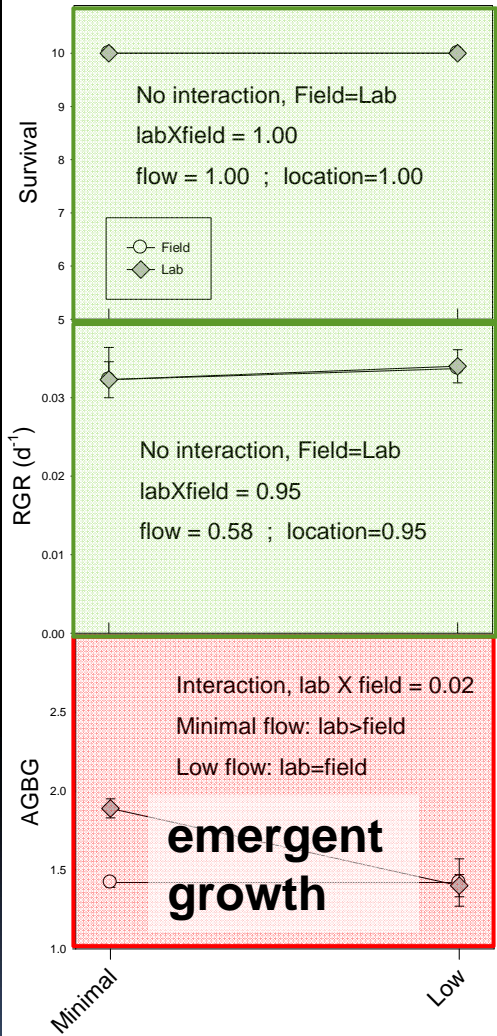
- **Survival**
- **Biomass**
 - Relative Growth Rate (change biomass/time)
 - AG:BG
- **Morphology**
 - Number of stems/leaves
 - Max stem/leaf length
 - Change in total stem/leaf length (cumulative)



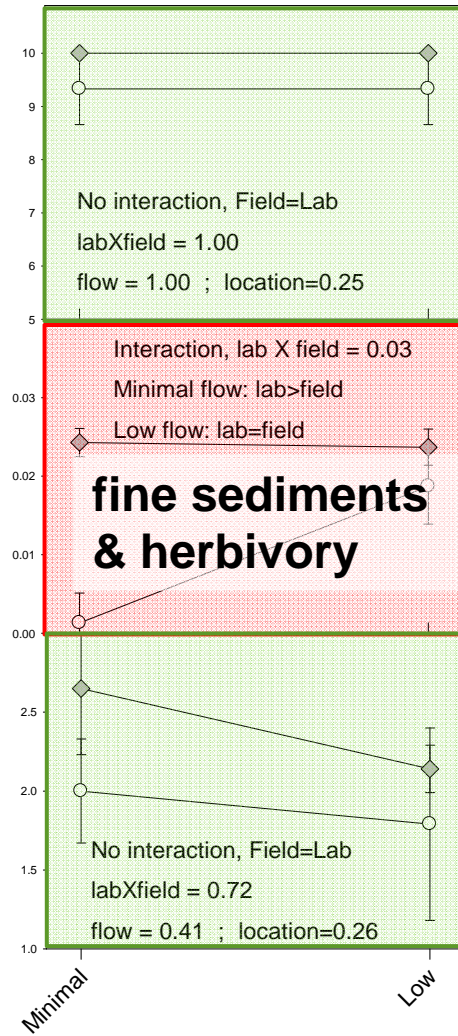
Factorial Analysis Primer



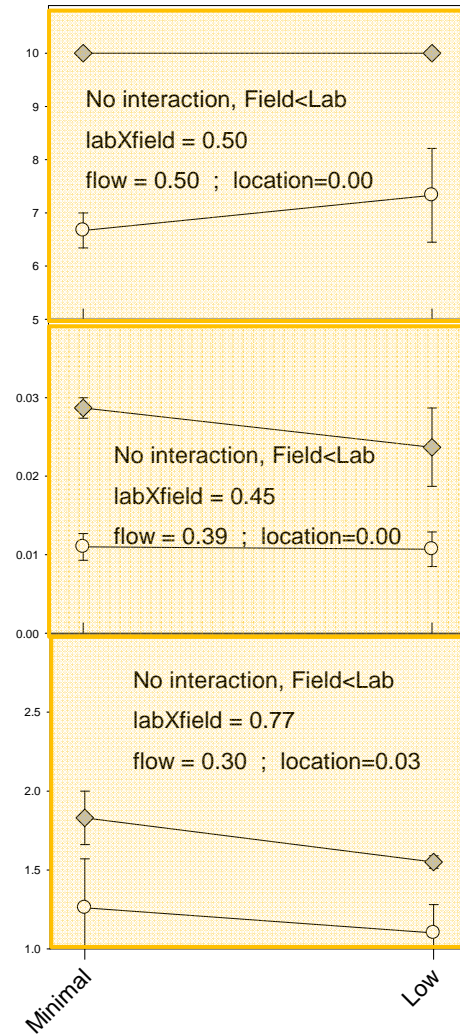
Sagittaria



Ludwigia

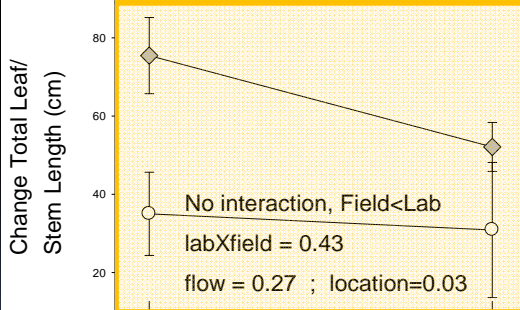
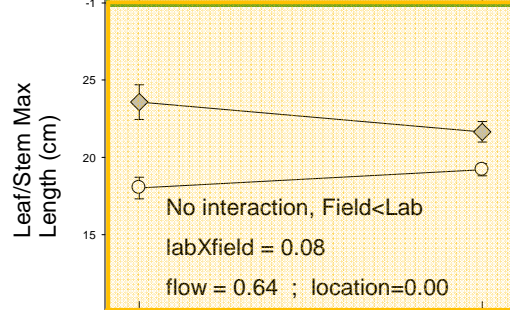
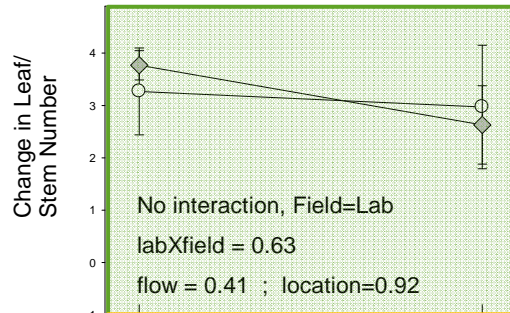


Cabomba



Flow Condition

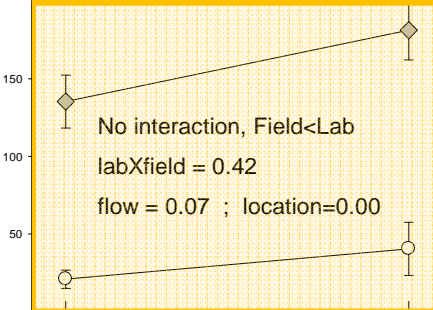
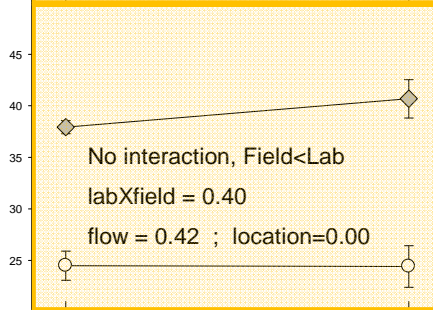
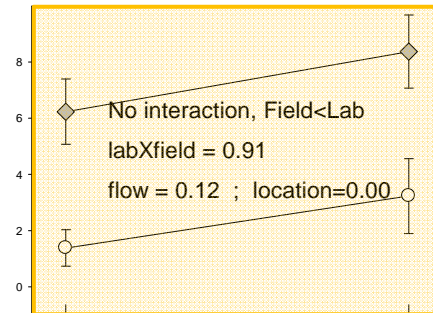
Sagittaria



Minimal

Low

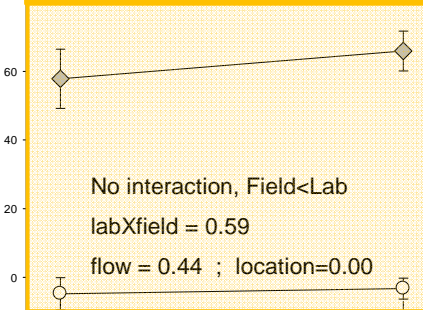
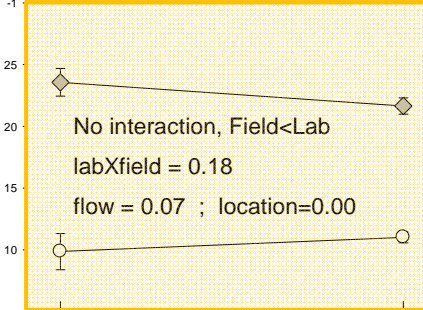
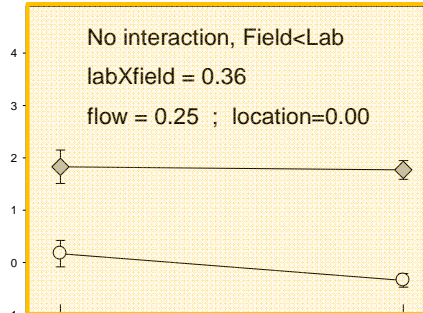
Ludwigia



Minimal

Low

Cabomba



Minimal

Low

Flow Conditions

Parameter Summary (Table 5)

SPECIES	PARAMETER	FIELD LOW-FLOW	FIELD MIN-FLOW	LAB LOW-FLOW	LAB MIN-FLOW	LOC X FLOW	FLOW	LOCATION
<i>Sagittaria</i>	Survival	10±0	10±0	10±0	10±0	1.00	1.00	1.00
	RGR ^a	0.0337±0.0003	0.0323±0.0041	0.0340±0.0021	0.0323±0.0023	0.95	0.58	0.95
	Change leaf #	2.97±1.18	3.27±0.83	2.63±0.75	3.77±0.28	0.63	0.41	0.92
	Leaf max length	19.20±0.39	18.02±0.70	21.65±0.66	23.57±1.12	0.08	0.64	0.00
	Change leaf total length	30.88±17.27	34.97±10.64	52.13±6.27	75.48±9.75	0.43	0.27	0.03
	AGBG ^b	1.42±0.15	1.42±0.03	1.40±0.07	1.89±0.06	0.02	Lab, * Field, ns	Low, * High, ns
<i>Ludwigia</i>	Survival	9.33±0.67	9.33±0.67	10.0±0	10.0±0	1.00	1.00	0.25
	RGR	0.0187±0.0048	0.0013±0.0038	0.0237±0.0023	0.0243±0.0018	0.03	Lab, ns Field, *	Low, * High, ns
	Change stem #	3.23±1.33	1.38±0.65	8.37±1.30	6.23±1.16	0.91	0.12	0.00
	Stem max length	24.40± 2.02	24.47±1.42	40.68±1.87	37.92±0.64	0.40	0.42	0.00
	Change stem total length	40.41±17.09	20.85±5.88	181.30±19.11	135.35±17.07	0.42	0.07	0.00
	AGBG	1.79±0.61	2.00±0.33	2.14±0.15	2.65±0.42	0.72	0.41	0.26
<i>Cabomba</i>	Survival	7.33±0.88	6.67±0.33	10±0	10±0	0.50	0.50	0.00
	RGR	0.0107±0.0022	0.0110±0.0017	0.0237±0.0050	0.0287±0.0013	0.45	0.39	0.00
	Change stem #	-0.34±0.13	0.17±0.25	1.77±0.18	1.83±0.32	0.36	0.25	0.00
	Stem max length	11.02±0.44	9.87±1.46	37.25±2.35	31.08±2.03	0.18	0.07	0.00
	Change stem total length	-3.30±3.06	-4.82±4.67	65.93±5.83	57.82±8.63	0.59	0.44	0.00
	AGBG	1.10±0.18	1.26±0.31	1.55±0.04	1.83±0.17	0.77	0.30	0.03

Laboratory vs. Field Conclusions

- Several key factors well controlled
 - Temp, CO₂, velocity
- Other field factors less well simulated
 - Light (intensity and diel shading)
 - Fine sediment deposition
(minimal flow, *Ludwigia*)
 - Herbivory & incidental damage

Lab vs. Field, Conclusions

- BAD NEWS....
 - Many (most factors) differed between lab and field (typically better growth in lab than in the field).
 - Lab vs. field difference highest for *Cabomba* (obligate submersed species)
- GOOD NEWS....
 - Few cases of interaction indicating that the pattern of the response between minimal and low flow treatments was the same in the lab as that in the field.

Lab vs. Field, Recommendations

- When available, field data provides best estimate of *in situ* responses
- If field data not available, lab data should provide sound estimate of direction of changes expected (=no interaction).
- However, when using lab data for HCP ecological models a range of responses be used rather than single response number.