

US EPA ARCHIVE DOCUMENT

Interactions among climate, humans, and playa wetlands on the Southern High Plains

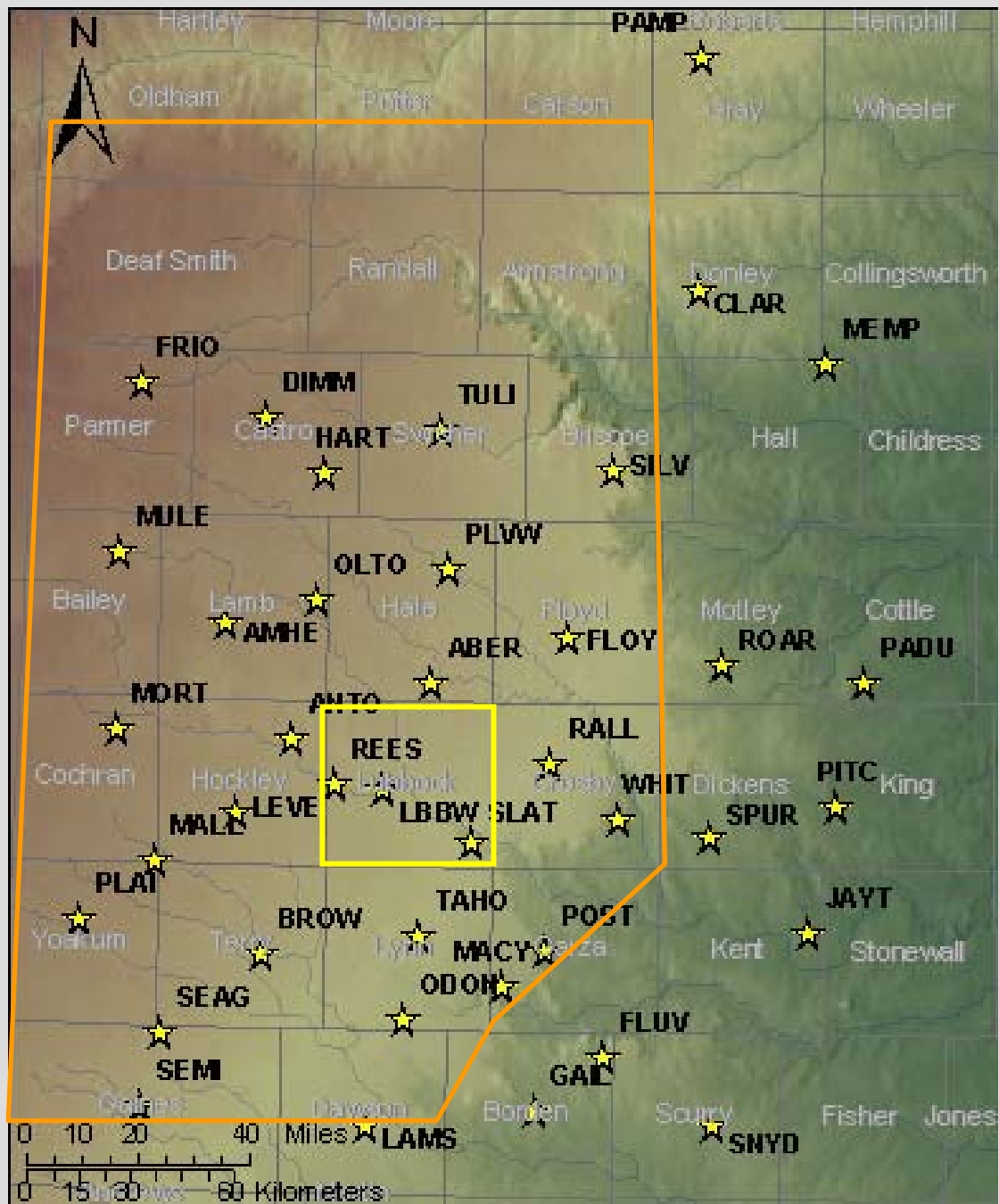
- S. McMurry, L. Smith, W. P. Dayawansa, D. Willis, C. Martin, K. Dixon, and C. Theodorakis
 - Texas Tech University
 - Lubbock, Texas

2003 8 14

Description of region



- Southern High Plains
- About 20,000 playas
- Each playa within its own watershed
- Heavy agriculture, mostly cotton and under irrigation from the Ogallala
- Significant wildlife use of playas

2003 8 14



Weather stations are scattered throughout the Southern High Plains.

Data from these stations are continuously updated and available online.

-  Lubbock County
-  Study site


40 miles

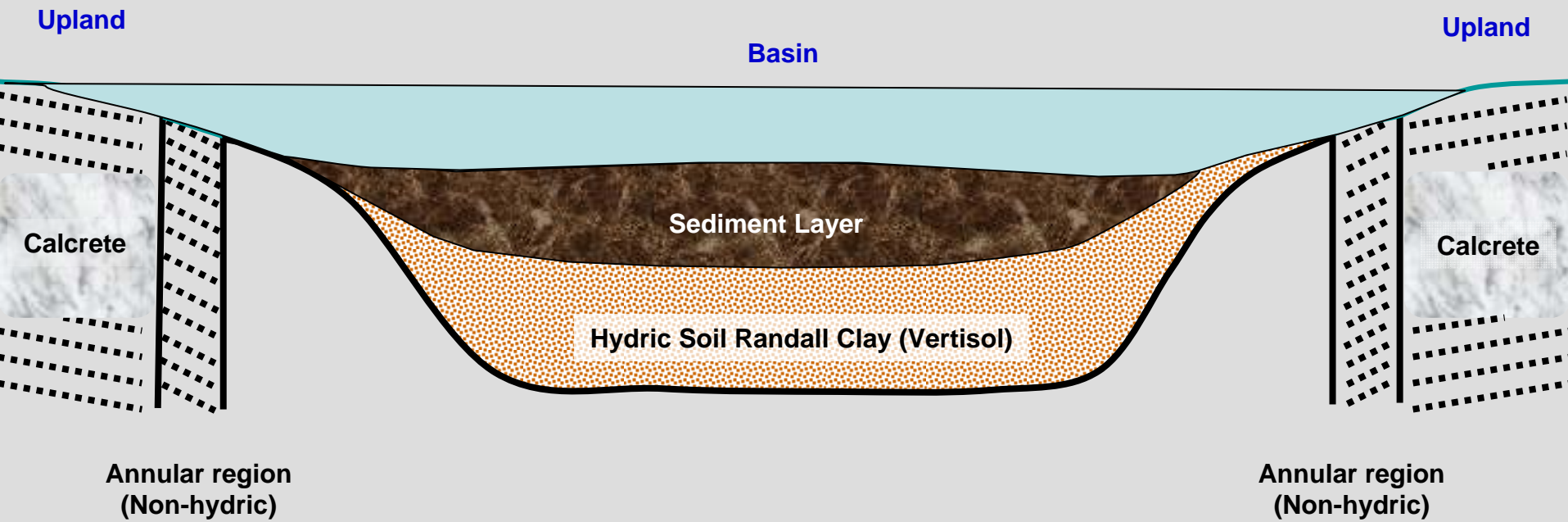
OGALLALA AQUIFER



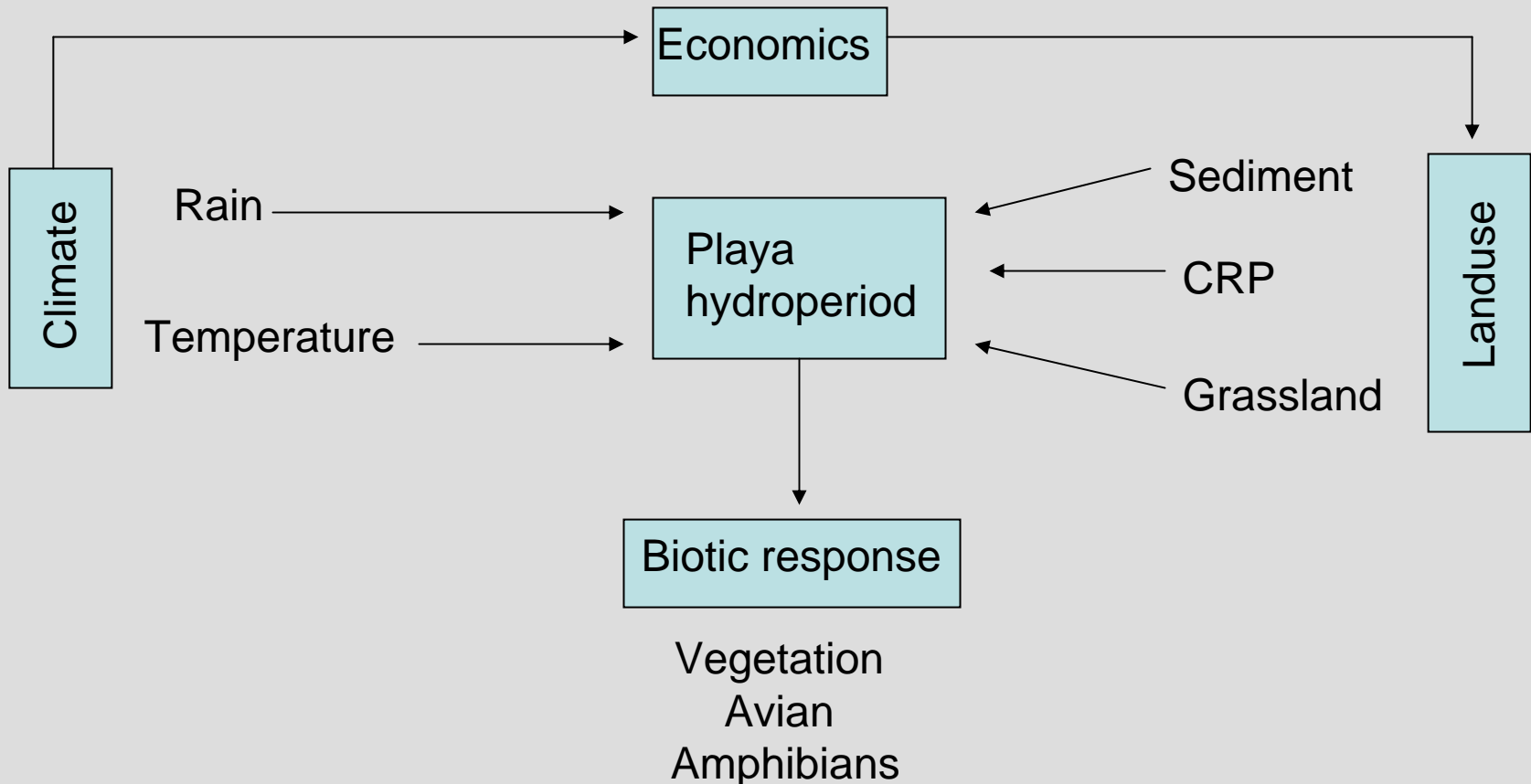




Playa Cross-section



- Hypothesis: Climatic variation and landuse practices dictate hydroperiod and spatial distribution of wet playas, influencing the ecological structure of vegetation and animal communities that rely on playas for many life requisites.



Experimental Design

- Southern High Plains in west Texas
- 40 wet playas selected per year (20 cropland and 20 grassland)
- Sample amphibian, avian, and vegetative communities
- Determine playa hydroperiod, volume, sediment depth.
- Estimate extreme temperature and precipitation patterns.
- Estimate sediment runoff into playas.

2003 8 14

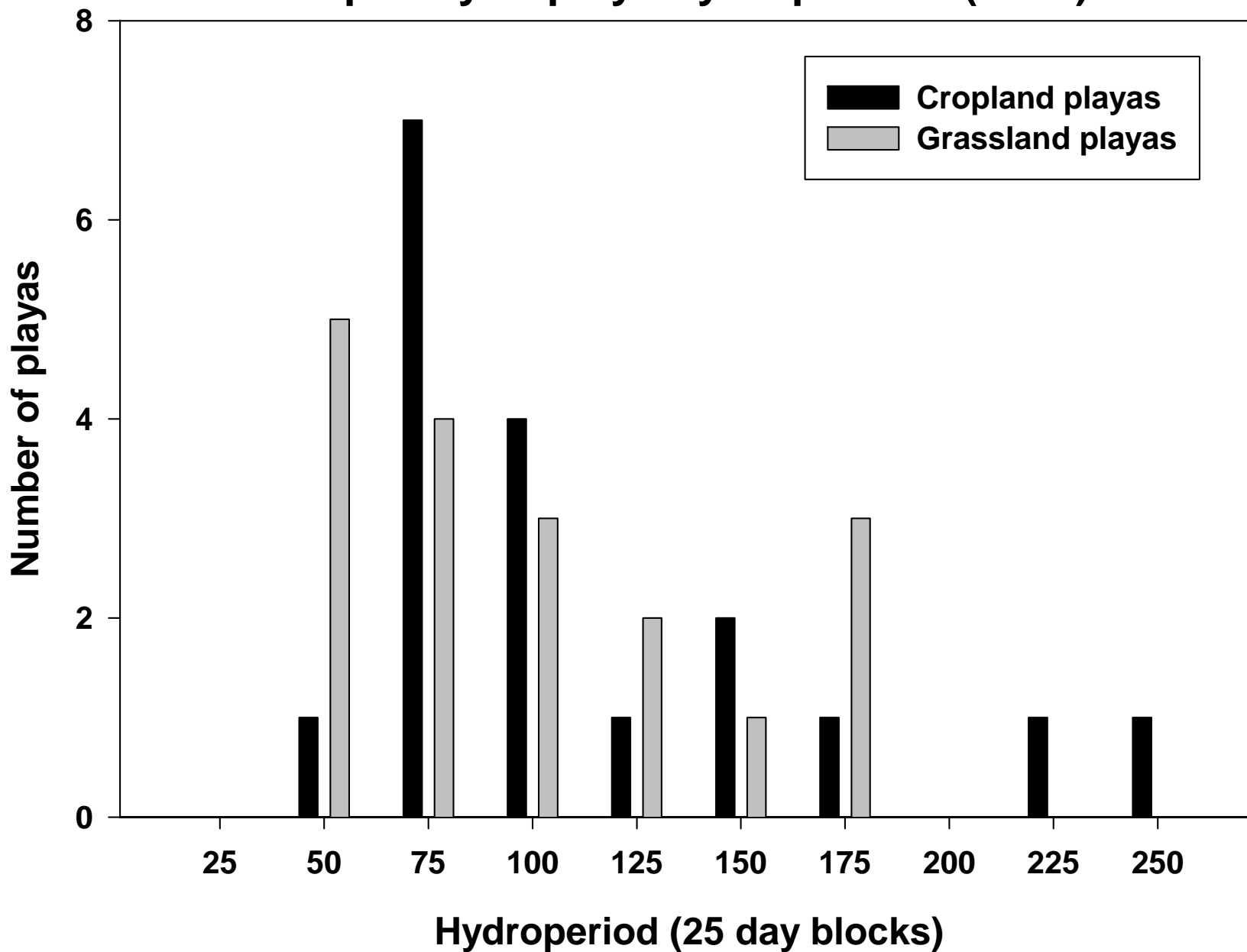
Playa characteristics (Means for 2003 and 2004)

	Grassland		Cropland	
<u>Factor</u>	<u>Medium</u>	<u>Fine</u>	<u>Medium</u>	<u>Fine</u>
N	5	34	20	18
Area (ha)	6.5	13.7	8.9	11.5
Basin depth (cm)	59	49	54	44
Volume (m³ x 10³)	31	67	39	42
Sed depth (cm)	20	8	53	31
Sed Vol. (m³ x 10³)	12	13	38	30
Volume loss (%)	53	29	231	137

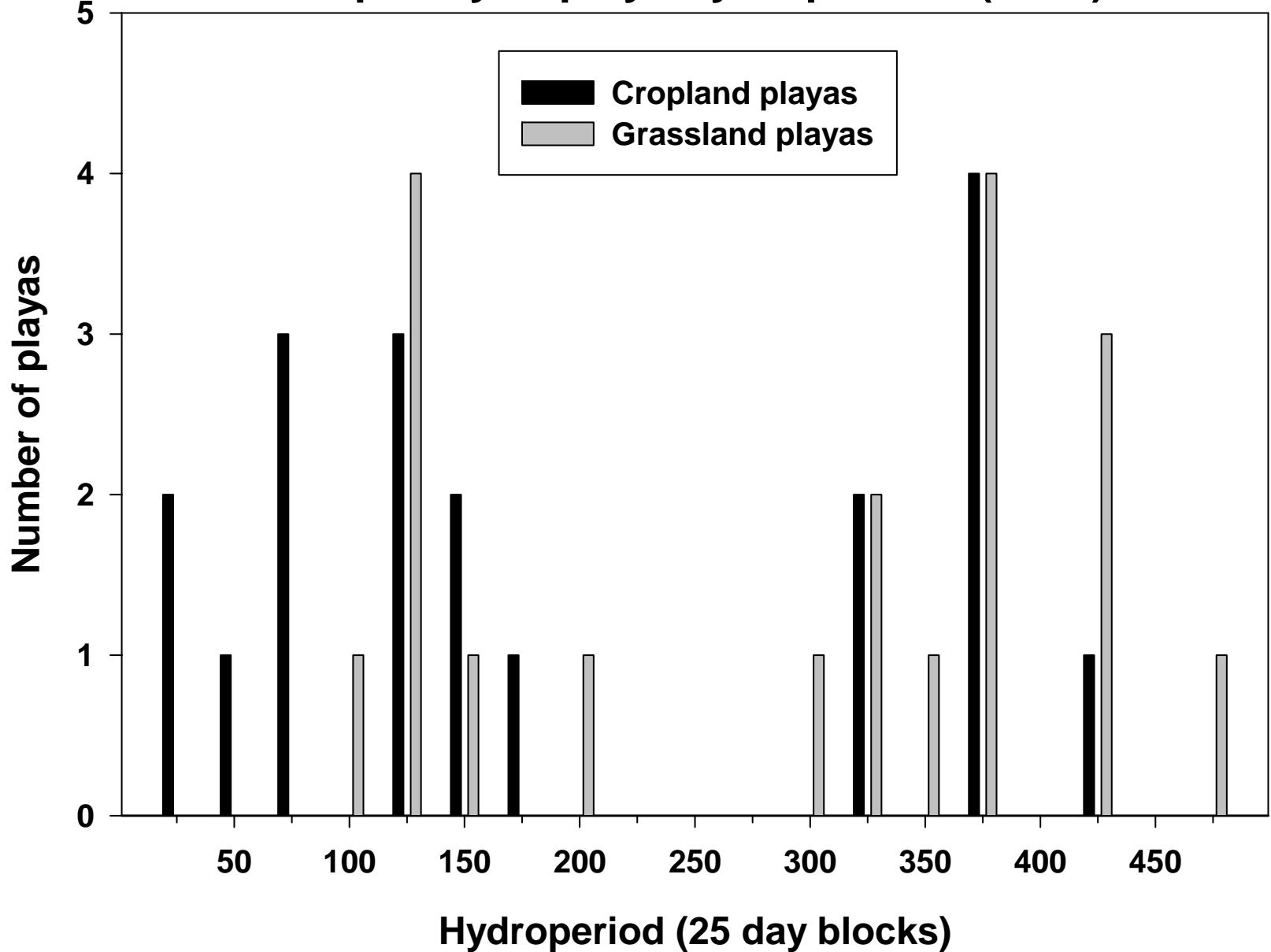
Cropland playas have greater depth and volume of sediment than grassland playas

Cropland playas have greater loss of volume than grassland playas

Frequency of playa hydroperiods (2003)



Frequency of playa hydroperiods (2004)



Vegetation in playas (Mean \pm SE)

<u>Factor</u>	<u>Grassland</u>	<u>Cropland</u>
Height (cm)	21 (2)	17 (3)
Structure (%)	4.6 (0.7)	5.1 (1.0)
Cover (%)	35.6 (4.8)	20.1 (3.2)
No. Species	9 (1)	8 (1)

Percent vegetation cover greater in grassland playas than cropland playas

Avian Results

- Preliminary results from
 - June 2003 – May 2004 &
 - June 2004 – Feb 2005



- No differences in mean species richness between land uses
- Wet playas had higher mean species richness than dry playas

Table 1. Total mean species richness (by playa within a season), standard error (SE), and number (n) of wet and dry playas in each treatment of SHP, June 2003 to May 2004.

	Cropland Playas			Grassland Playas		
	Mean	SE	n	Mean	SE	n
Wet						
Summer	17.95	1.65	20	17.75	1.34	20
Fall	19.83	4.16	6	18.00	2.02	10
Winter	11.50	3.50	2	3.00	0.82	4
Spring	12.22	1.52	18	13.71	2.21	14
Dry						
Summer	3.27	0.68	11	4.10	0.55	11
Fall	5.33	1.09	18	4.22	0.47	18
Winter	4.10	0.90	20	2.10	0.28	20
Spring	5.24	0.69	17	4.53	0.74	15

Avian Results

- Differences in species composition
 - Greater frequency of exotic species in cropland playas ($p < 0.01$)
 - Some species restricted to grassland playas (i.e. long-billed curlew)
 - 2003-2004
 - 4/20 for cropland
 - 14/20 for grassland



Avian Conclusions



- No differences in mean species richness between cropland and grassland treatment
- Had differences in species composition
- Results support species-area relationship in wet playas
- Previous study on wetland plants had the same trend
- Further analyses will test for land use preference by guild using density and species diversity indices

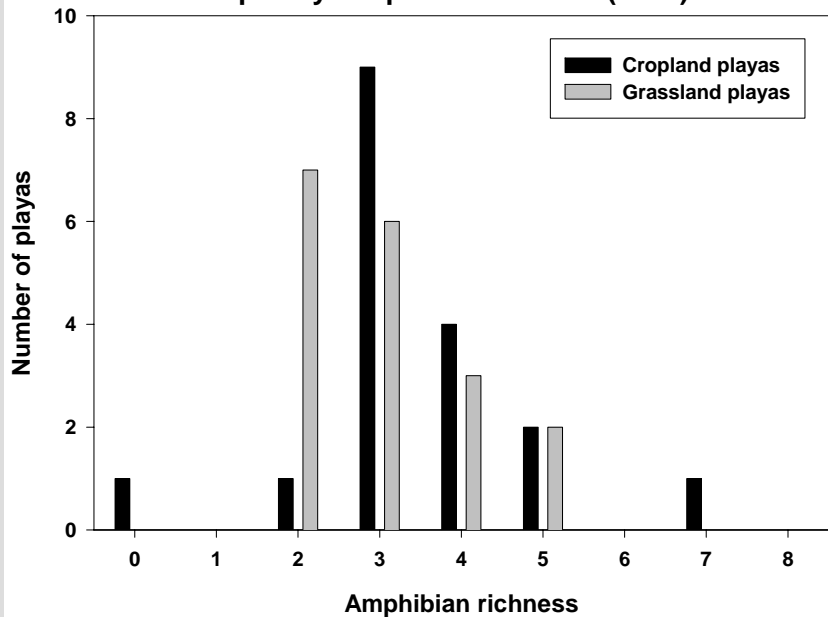
Amphibian Results



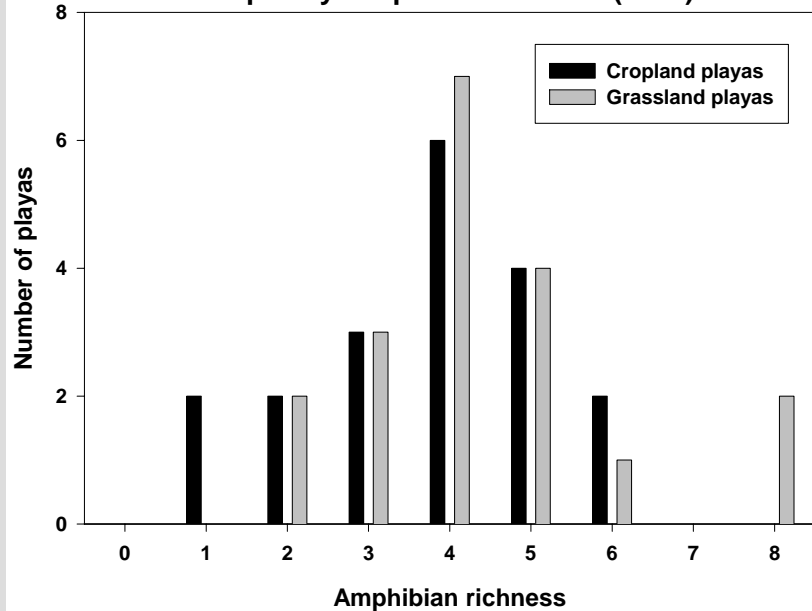
	2003		2004	
	Grassland	Cropland	Grassland	Cropland
Richness	3.1 (0.2)	3.4 (0.3)	4.3 (0.4)	3.8 (0.4)
Min. species	2	0	2	1
Max. species	5	7	8	6
Total species	6	8	10	8
Hydroperiod (d)	97 (33-194)	100 (32-249)	269 (78-453)	193 (18-418)

No differences in mean richness between grassland and cropland playas

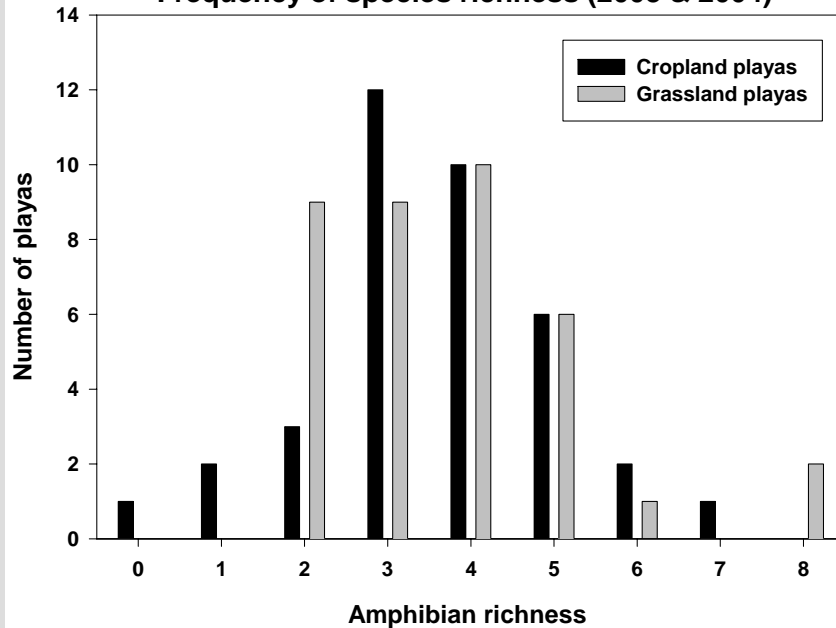
Frequency of species richness (2003)



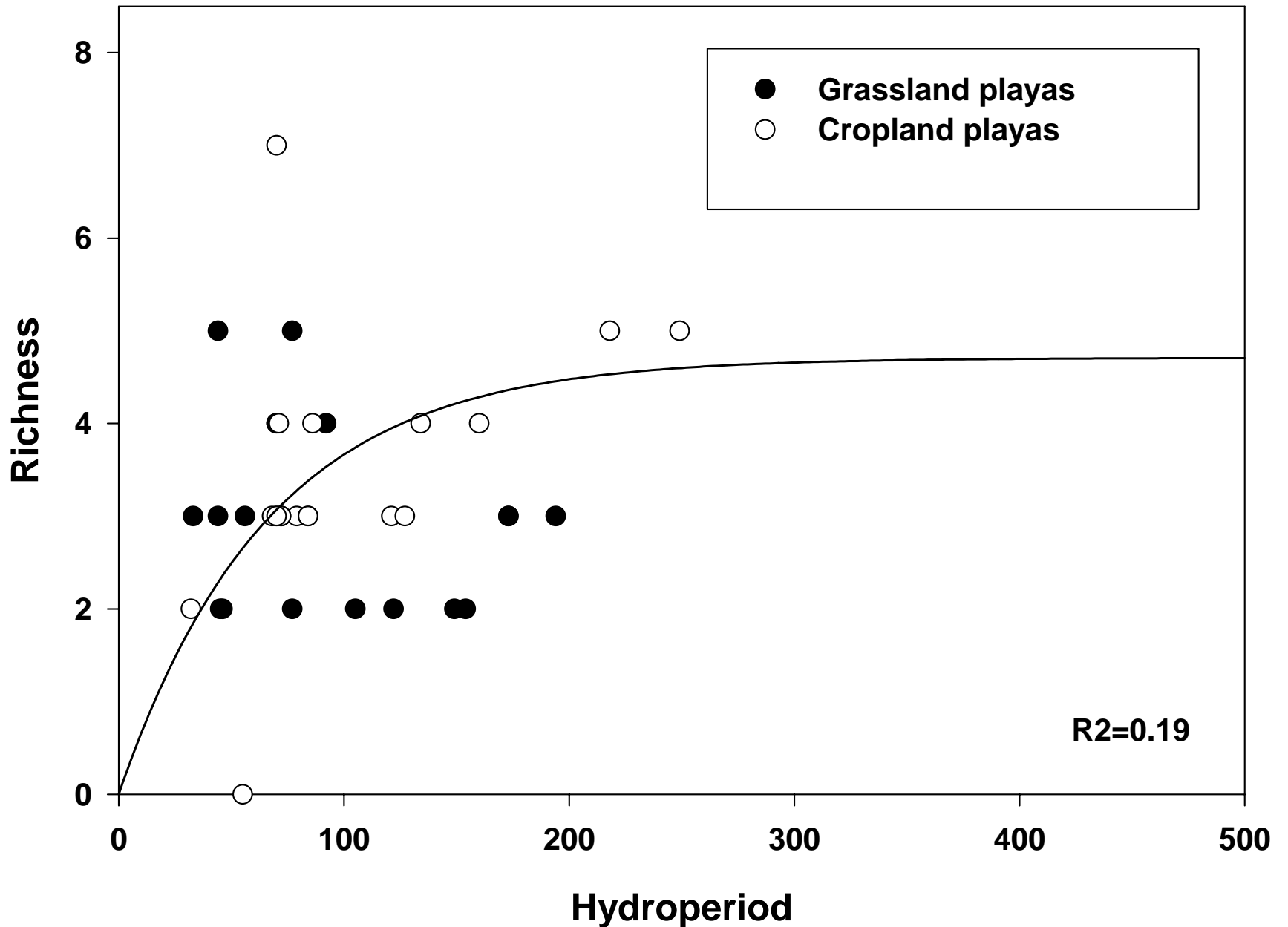
Frequency of species richness (2004)



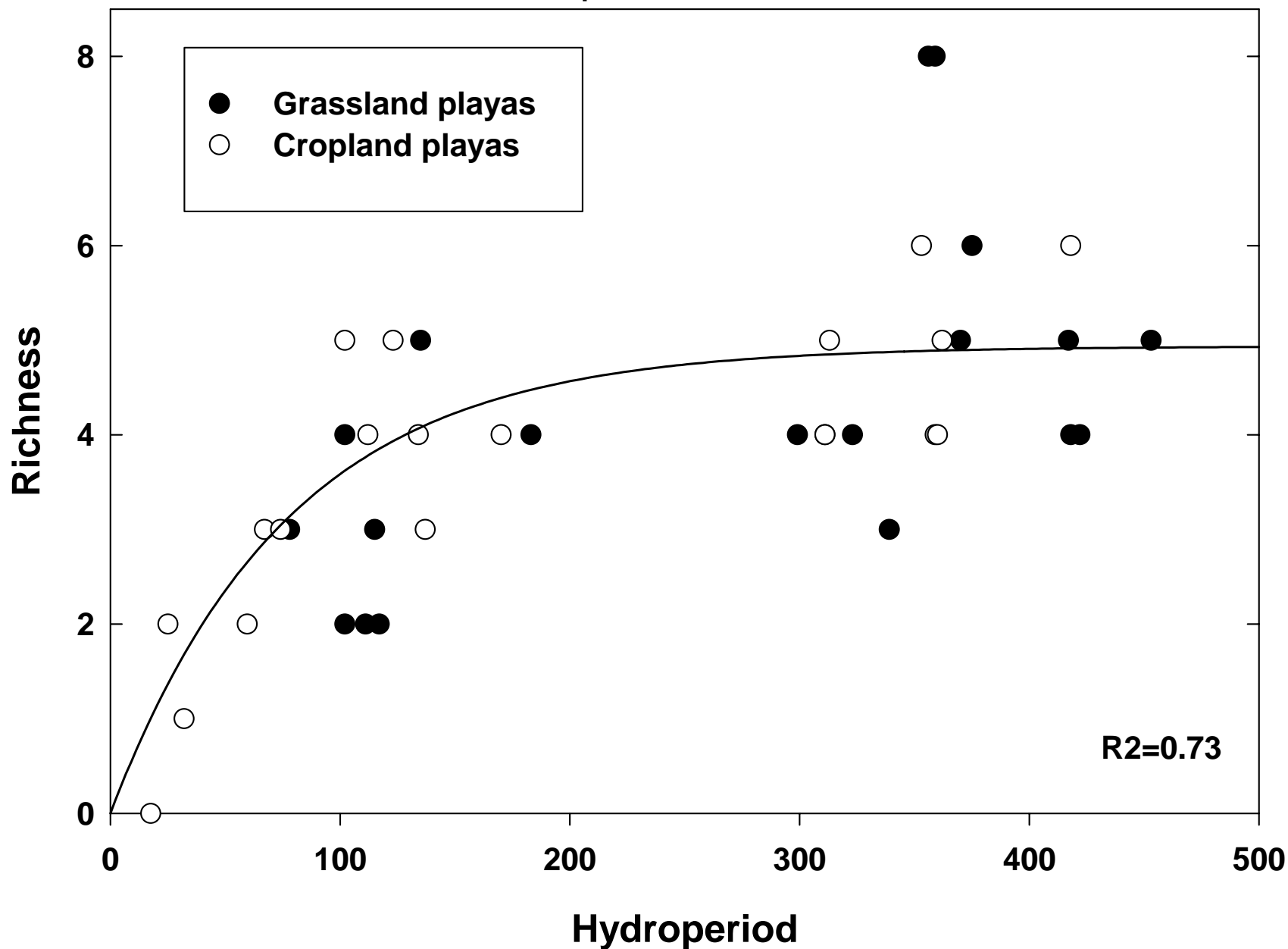
Frequency of species richness (2003 & 2004)



Cumulative Amphibian Richness - 2003



Cumulative Amphibian Richness - 2004



Proportion of playas within a hydroperiod category that contained a particular species

<u>Hydroperiod</u> (days)	<u>Spea</u>	<u>Buco</u>	<u>Pscf</u>	<u>Rabl</u>	<u>Bude</u>	<u>Buwo</u>	<u>Gaol</u>	<u>Accr</u>	<u>Raca</u>	<u>Amti</u>
≤50	78	78	22	11	0	11	0	0	0	22
>50	92	85	65	37	6	13	15	6	10	46
≤100	88	70	52	24	0	3	6	3	0	48
>100	91	94	66	40	9	19	19	6	15	40

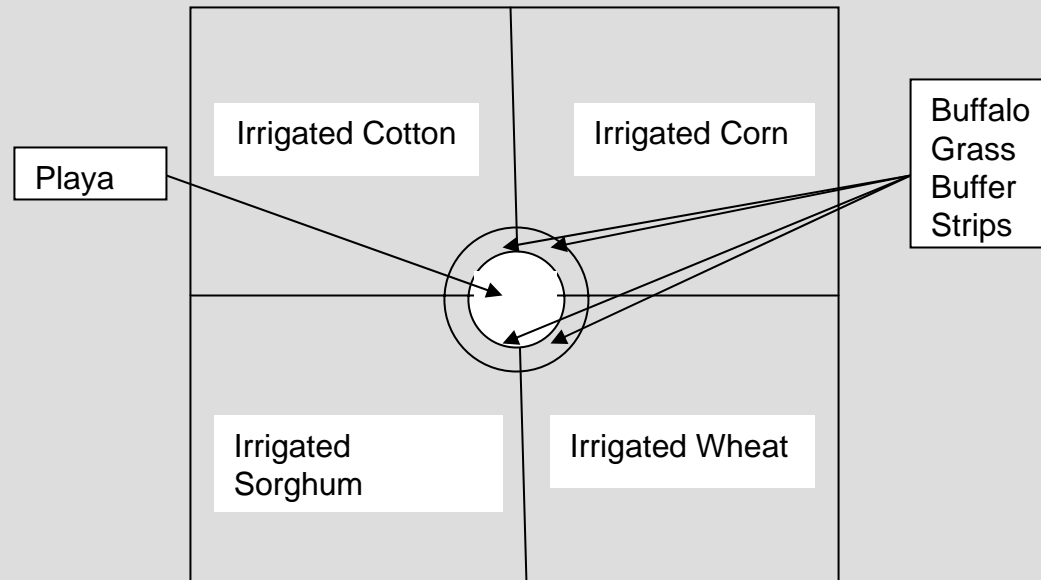


Amphibian Conclusions



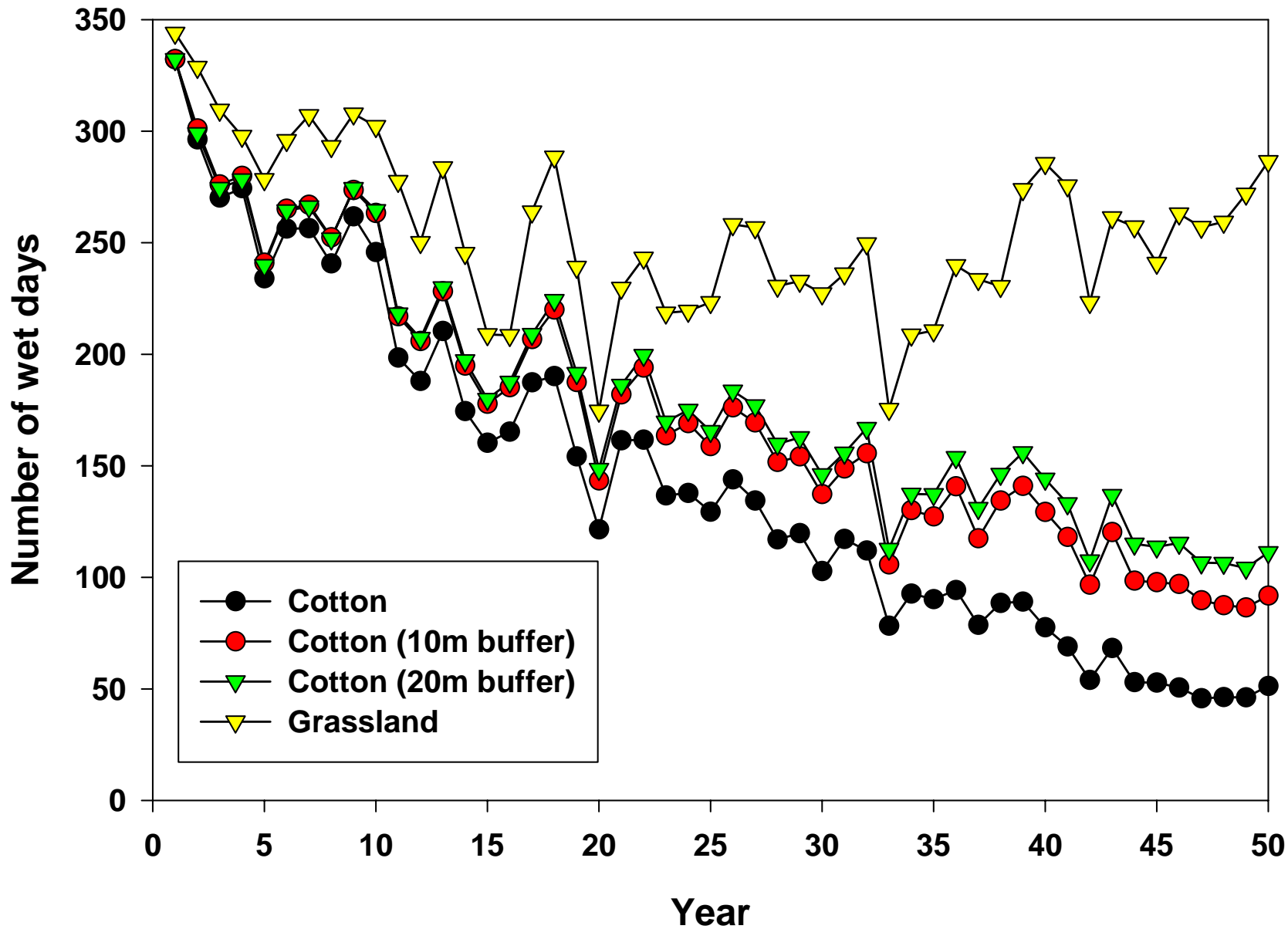
- Richness does not differ between landuse types
- Richness does relate to hydroperiod
- Species with long hydroperiod requirements and less common species rarely found in playas with hydroperiods less than 100, and especially 50 days.

Modeling



Representative playa watershed to be modeled in APEX.

Hydroperiod of cotton and grassland playas



Overall Conclusions

- Fewer wet playas and shorter hydroperiods = reduced biodiversity of birds and amphibians
- For example, 18 vs 4 species of birds in wet vs dry playas in summer & fall
 - Thus, as playas are lost or hydroperiods shortened, fewer playas will be available to support bird communities and existing playas will support birds for a shorter period of time.
- Also, several amphibian species are not present in playas with hydroperiods less than 50 days, and even 100 days.
 - Thus, as playas fill with sediment and hydroperiod is further reduced, only the dominant amphibian species will persist.
- Playa function is impaired before it is fossilized.
 - Although some amphibian species may breed, tadpoles may never metamorphose.
 - Mitigation strategies can slow sedimentation and extend the functional life of the playa.

Acknowledgments

The background of the slide is a photograph of a sunset over a dark ocean. The sky is a gradient of orange and red, with a bright yellow sun low on the horizon. The water is dark, with some lighter patches reflecting the light from the sky.

- Jo Szu (Ross) Tsai
- Louise Venne
- Undergraduate technicians