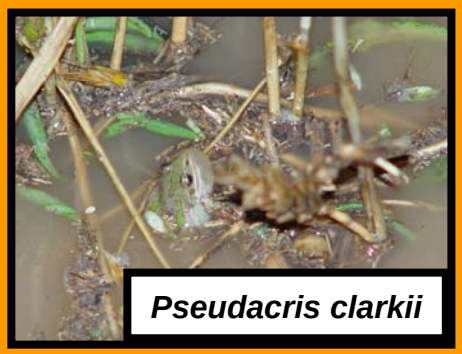
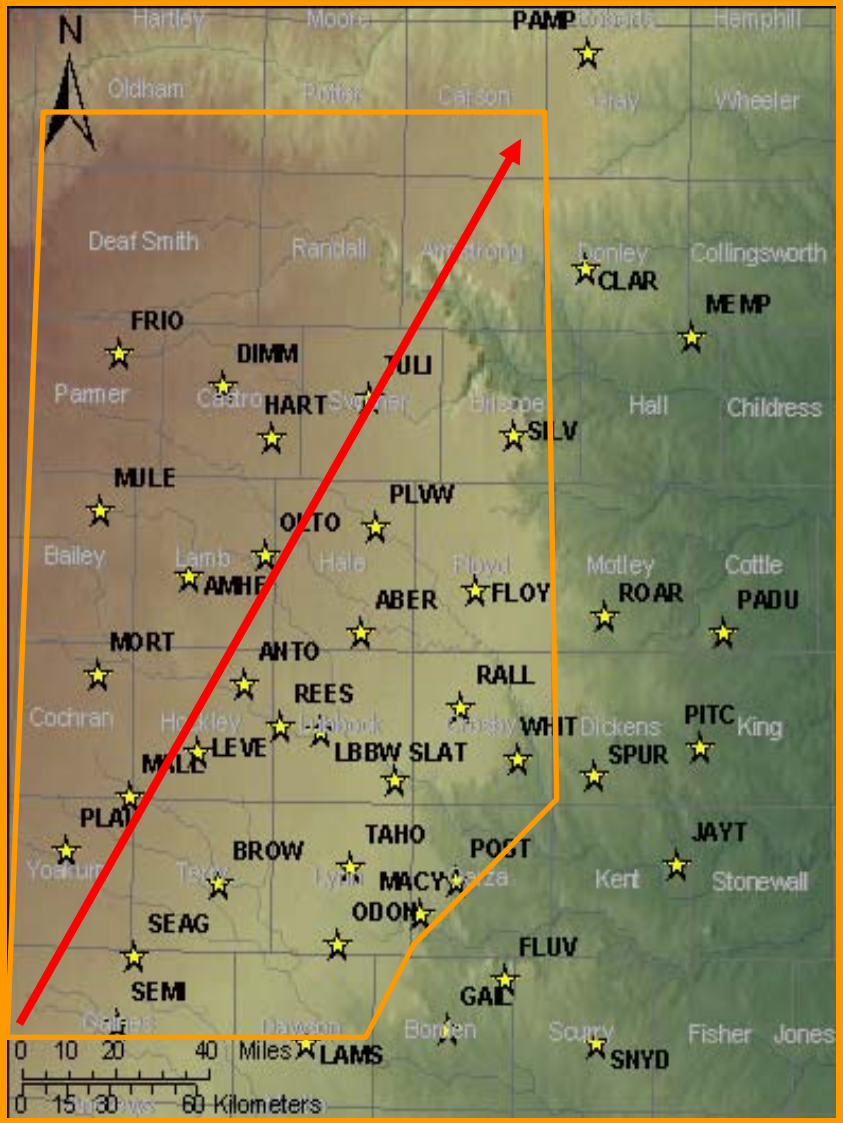
Amphibian studies in playa wetlands in the SHP

And the need for a multi-factor approach to understanding the effects of anthropogenic stressors on amphibians


Pseudacris clarkii


Bufo speciosus



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Gradient of increasing rainfall, decreasing temperature, and finer textured soil.

Ca. 25,000 playas

Intensive agriculture

Semi-arid environment

Heavy mining of Ogallala aquifer

40 miles

What are the issues for amphibians

- Agricultural activity
  - Sedimentation
    - Playa extinction
    - Playa degradation
      - Reduced hydroperiod
      - Rate of water loss
      - Altered water quality
      - Altered plant community
      - Altered amphibian community
      - Contaminants

Bufo cognatus

Some physical characteristics of playas

Table 1. Means (2003 & 2004) of playa characteristics In two soil texture zones in the Southern High Plains.

	Grassland		Cropland	
Factor	**Medium**	**Fine**	**Medium**	**Fine**
N	5	34	20	18
Area (ha)	6.5	13.7	8.9	11.5
Basin depth (cm)	59	49	54	44
Volume ($m^3 \times 10^3$)	31	67	39	42
Sed. depth (cm)	20	8	53	31
Sed. vol. ($m^3 \times 10^3$)	12	13	38	30
Volume loss (%)	53	29	231	137

Amphibian Responses
(related to land use)

- Body size (length and mass)
- Abundance
- Community composition
- Physiological responses
- Body condition
- Diet

Body mass, length, and body fat of *Spea* spp.

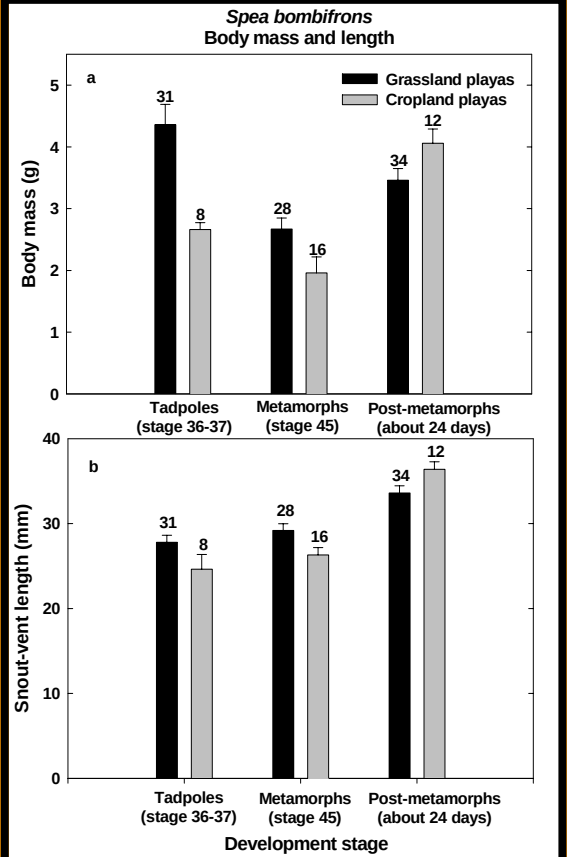

Fig. 1. Mean (±SE) body mass and snout-vent length of *Spea bombifrons* at three stages of development from grassland and cropland playas in the Southern High Plains in 2004. Values above bars are sample sizes (n).

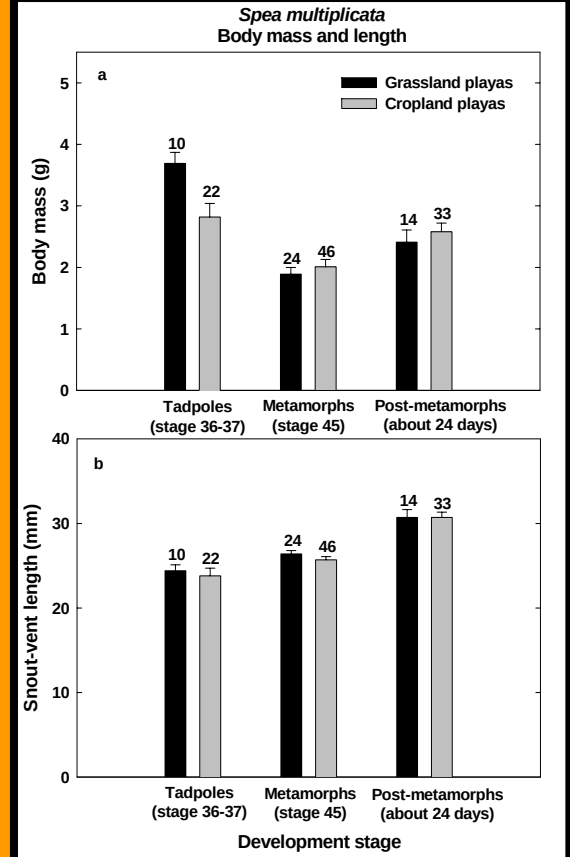

Fig. 2. Mean (±SE) body mass and snout-vent length of *Spea multiplicata* at three stages of development from grassland and cropland playas in the Southern High Plains in 2004. Values above bars are sample sizes (n).

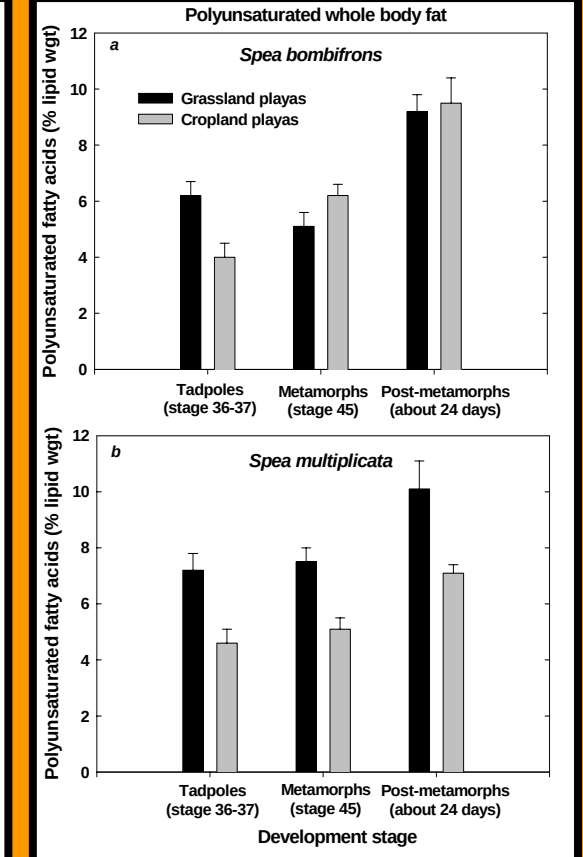

Fig. 3. Mean (±SE) polyunsaturated fatty acids in whole bodies of *Spea bombifrons* (a) and *S. multiplicata* (b) at three stages of development from grassland and cropland playas in the Southern High Plains in 2004.

Immunity endpoints for *Spea* spp.

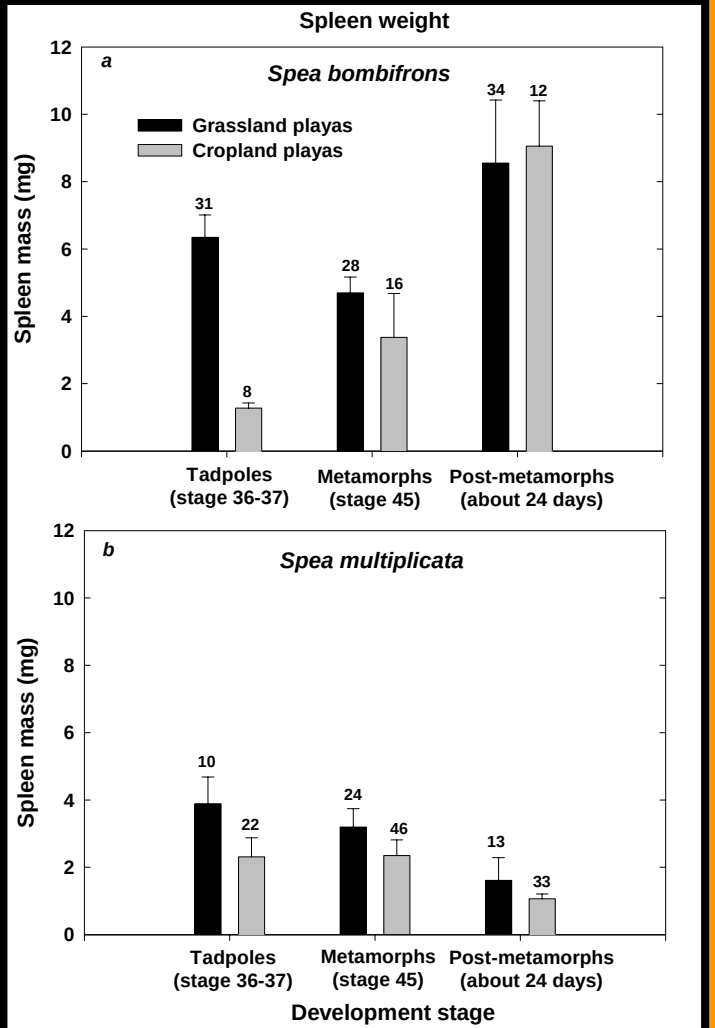

Fig. 4. Mean (±SE) spleen mass from *Spea bombifrons* (a) and *S. multiplicata* (b) at three stages of development from grassland and cropland playas in the Southern High Plains in 2004. Values above bars are sample sizes (n).

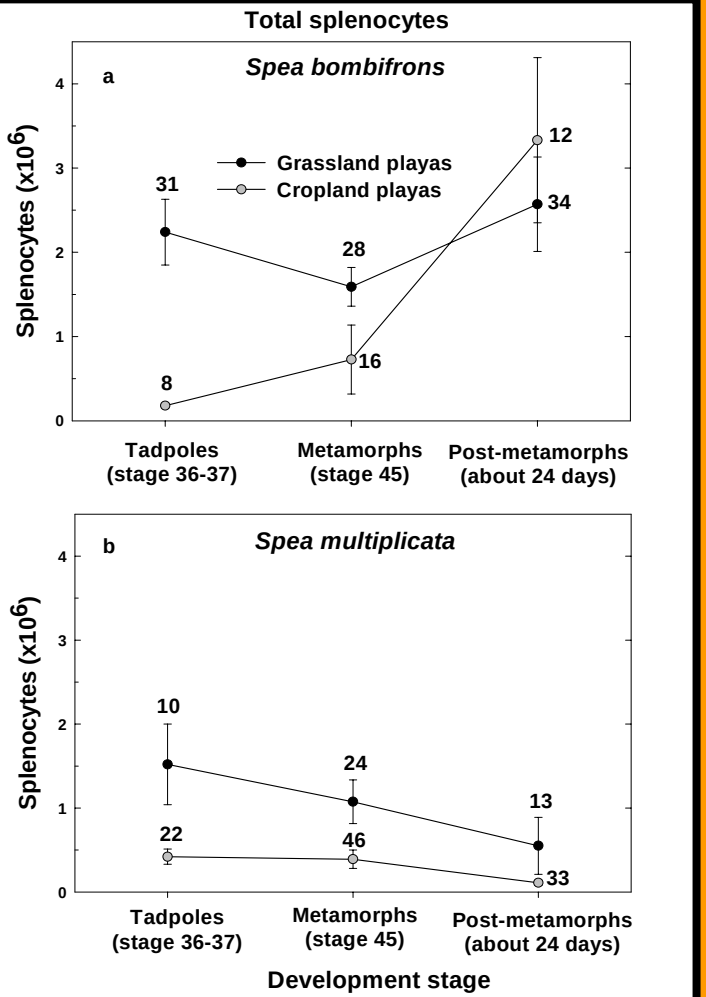

Fig. 5. Mean (±SE) number of leucocytes in spleens from *Spea bombifrons* (a) and *S. multiplicata* (b) at three stages of development from grassland and cropland playas in the Southern High Plains in 2004. Values above bars are sample size (n).

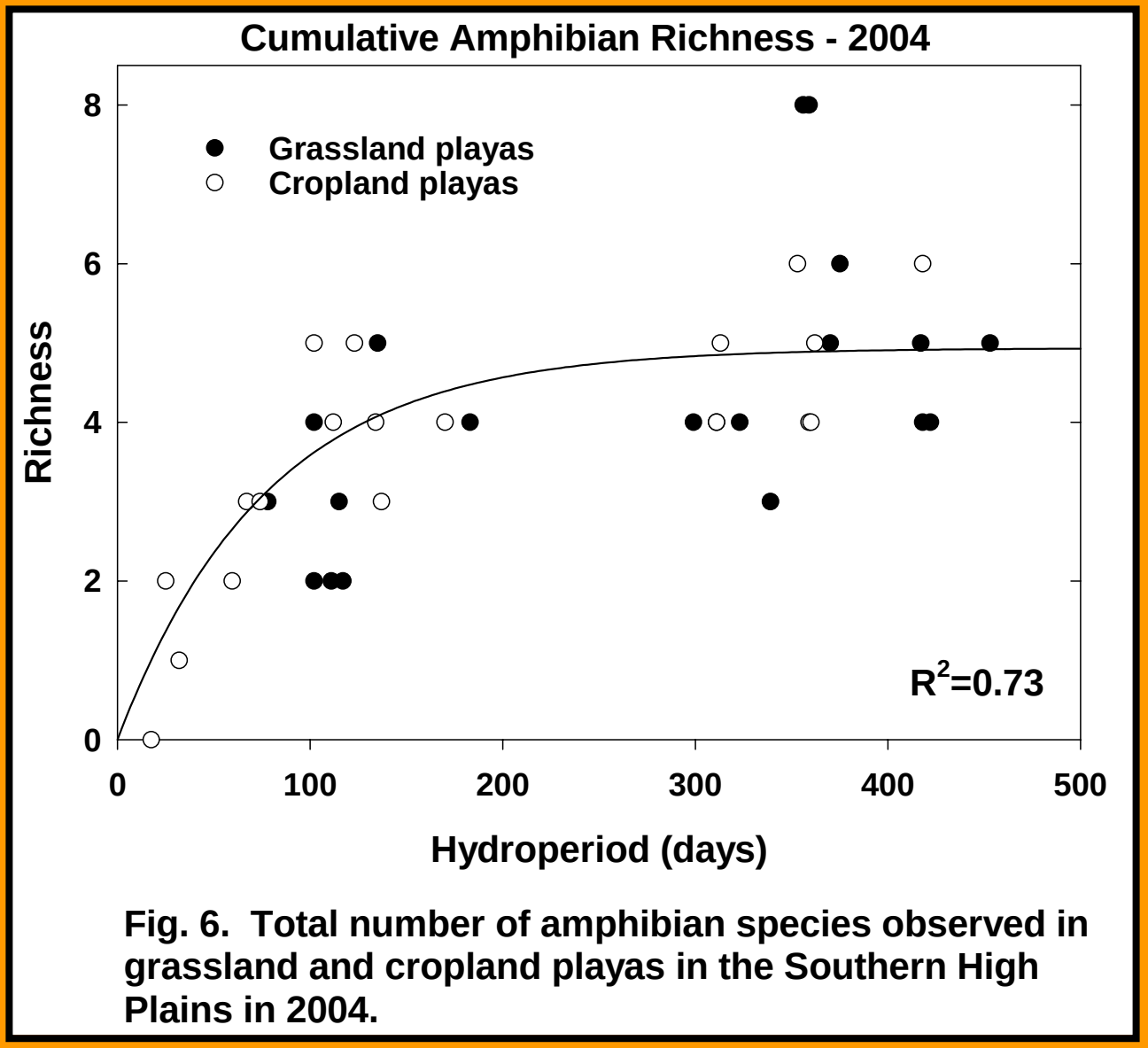

Fig. 6. Total number of amphibian species observed in grassland and cropland playas in the Southern High Plains in 2004.

Table 2. Proportion of playas within a hydroperiod category with a particular species of amphibian (Southern High Plains in 2003 & 2004; 80 total playa wetlands). Note complete loss of several species or reduction in occurrence of species below hydroperiods of 50 and 100 days.

Hydroperiod (days)	Spea	Buco	Bude	Pscl	Gaol	Buwo	Accr	Rabl	Raca	Amti
≤50	89	78	0	22	0	11	0	11	0	22
>50	91	87	6	68	16	13	6	38	10	46
≤100	91	72	0	53	6	3	3	25	0	47
>100	91	96	9	69	20	20	7	42	16	40

Contaminants
(remarkably little known for SHP)

- Metals (paper in press)
- Pesticides
  - OCs (paper in prep)
  - Current insecticides (data analysis)
  - Herbicides (Glyphosate; study beginning)

Just the beginning – studies on sublethal effects, aquatic vs. terrestrial exposure, assessment of risk

Metals - Sediments

Table 3. Mean (±SE; ug/g) metal concentrations found in sediment collected from playas in the SHP in 2003.

Metal	Cropland	Grassland (F)	Grassland (DS)
Al	43800 ± 5300	35800 ± 3480	48000 ± 8040
As	35.4 ± 3.89	29.8 ± 2.85	38.5 ± 5.90
Ba	124 ± 13.8	124 ± 10.7	190 ± 14.7
Be	1.18 ± 0.13	1.08 ± 0.09	1.28 ± 0.17
Cd	1.10 ± 0.12	1.02 ± 0.08	1.25 ± 0.16
Cr	23.5 ± 2.34	21.1 ± 1.62	25.4 ± 2.85
Cu	15.8 ± 1.79	14.9 ± 1.32	18.9 ± 2.19
Ni	12.5 ± 1.21	11.1 ± 0.99	13.7 ± 1.47
Pb	22.6 ± 2.45	21.8 ± 1.54	24.7 ± 2.88
Zn	55.0 ± 7.24	53.1 ± 4.46	65.4 + 6.92

n=6 for cropland and grassland (F)
n=3 for grassland (DS)

Metals - Toads

Table 4. Mean ± SE (µg/g) metal concentrations found in whole body tissue of *Spea* spp. and *Bufo cognatus* metamorphs collected from playas in the SHP in 2003.

	Spea spp.		*B. cognatus*	
Metal	**Cropland**	**Grassland**	**Cropland**	**Grassland**
Al	125 ± 22	201 ± 56	255 ± 40	185 ± 48
As	0.11 ± 0.03	0.18 ± 0.05	0.33 ± 0.09	0.12 ± 0.05
Ba	18.1 ± 5.8	21.7 ± 1.3	3.9 ± 0.4	4.8 ± 0.4
Be	ND	ND	ND	ND
Cd	0.02 ± 0.007	0.03 ± 0.004	0.03 ± 0.002*	0.04 ± 0.003*
Cr	0.14 ± 0.002	0.19 ± 0.018	0.22 ± 0.024	0.17 ± 0.022
Cu	1.33 ± 0.30	1.64 ± 0.12	1.46 ± 0.21	1.51 ± 0.15
Hg	0.018 ± 0.005	0.020 ± 0.009	0.016 ± 0.006*	0.003 ± 0.001*
Ni	0.23 ± 0.13	0.11 ± 0.03	0.17 ± 0.02*	0.08 ± 0.02*
Pb	0.36 ± 0.04	0.49 ± 0.04	0.37 ± 0.03	0.40 ± 0.06
Zn	7.90 ± 0.40	8.46 ± 0.57	10.8 ± 1.85	10.2 ± 0.60

Spea spp. cropland n=2, *Spea* spp. grassland n=5, *B. cognatus* cropland n=4, *B. cognatus* grassland n=5

OC's - Sediments

Table 5. Mean (+SE, ng/g) organochlorine concentrations in sediment collected from playas in the SHP in 003.

OC	Cropland	Grassland (F)	Grassland (DS)
α-BHC	(0.4-0.6) n=2	(0.4-0.6) n=2	1.1 ± 0.3
β-BHC	<1.1	<1.1	<1.1
Dieldrin	0.6 ± 0.03	0.7 ± 0.03	1.2 ± 0.6
DDT	14.6 ± 3.9	19.7 ± 4.4	13.1 ± 1.9
DDE	4.1 ± 2.6	2.0 ± 0.9	0.5 ± 0.1
Heptachlor	(0.3-0.4) n=2	(0.3-0.4) n=2	<0.5
γ-Chlordane	(0.4) n=2	(0.2-0.3) n=2	<0.4

n=6 for cropland and grassland (F)
n=3 for grassland (DS)

OC's - Toads

Table 6. Mean ± SE (ng/g) organochlorine concentrations found in *Spea* spp. and *Bufo cognatus* metamorphs collected from playas in the SHP in 2003.

	Spea spp.		*B. cognatus*	
OC	**Cropland**	**Grassland**	**Cropland**	**Grassland**
α-BHC	<0.3	<0.3	<0.6	<0.6
β-BHC	<0.5	(0.7) n=1	<1.3	(2.1) n=1
Dieldrin	<0.4	<0.4	<0.8	<0.8
DDT	(2.4) n=1	4.7 ± 0.7	(3.2) n=1	4.2 ± 1.7
DDE	1.2 ± 0.3	(1.0) n=1	1.6 ± 0.3	0.6 ± 0.1
Heptachlor	<0.3	<0.3	0.6 ± 0.1	<0.6
γ-Chlordane	<0.2	<0.2	<0.5	<0.5

n=2, 4, 4, and 3, respectively, unless otherwise noted.

What stressors are important?

- Sedimentation
- Hydroperiod
- Water quality
- Food availability
- Chemicals
- Predators
- Climate change
- Others?

What needs to be studied?

- Broad range of playa types
- Multi-factor experiments
- Contaminant exposure and effects
- Genetics
- Condition and survival
- Physiological effects (immune function)
- Climate change effects
- Mitigation strategies