

Differences in Benthic Community Structure of Headwater Streams Related to Size, Season, and Sample Habitat in an Acidified Watershed

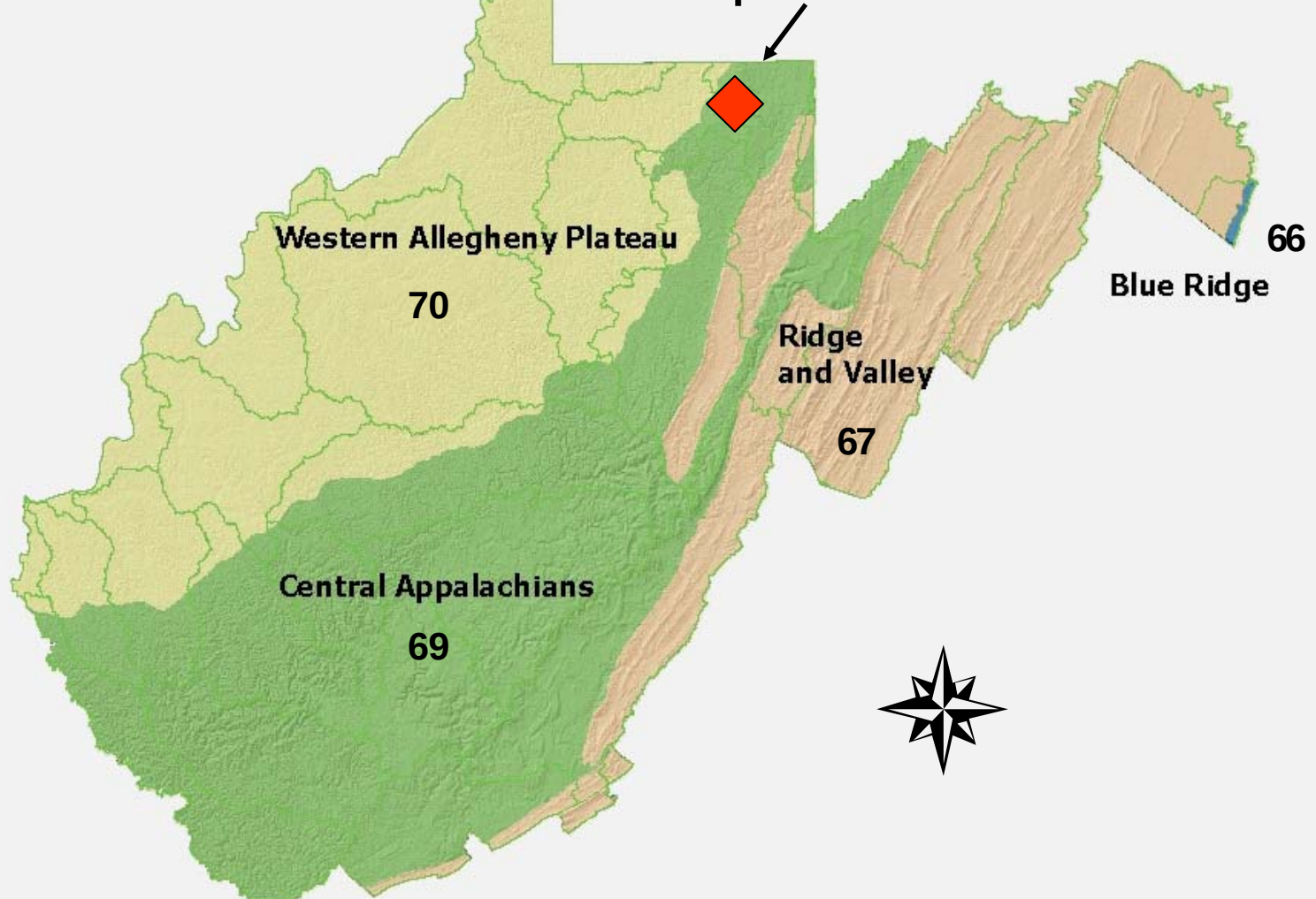


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Level III Ecoregions in West Virginia

Coopers Rock State Forest

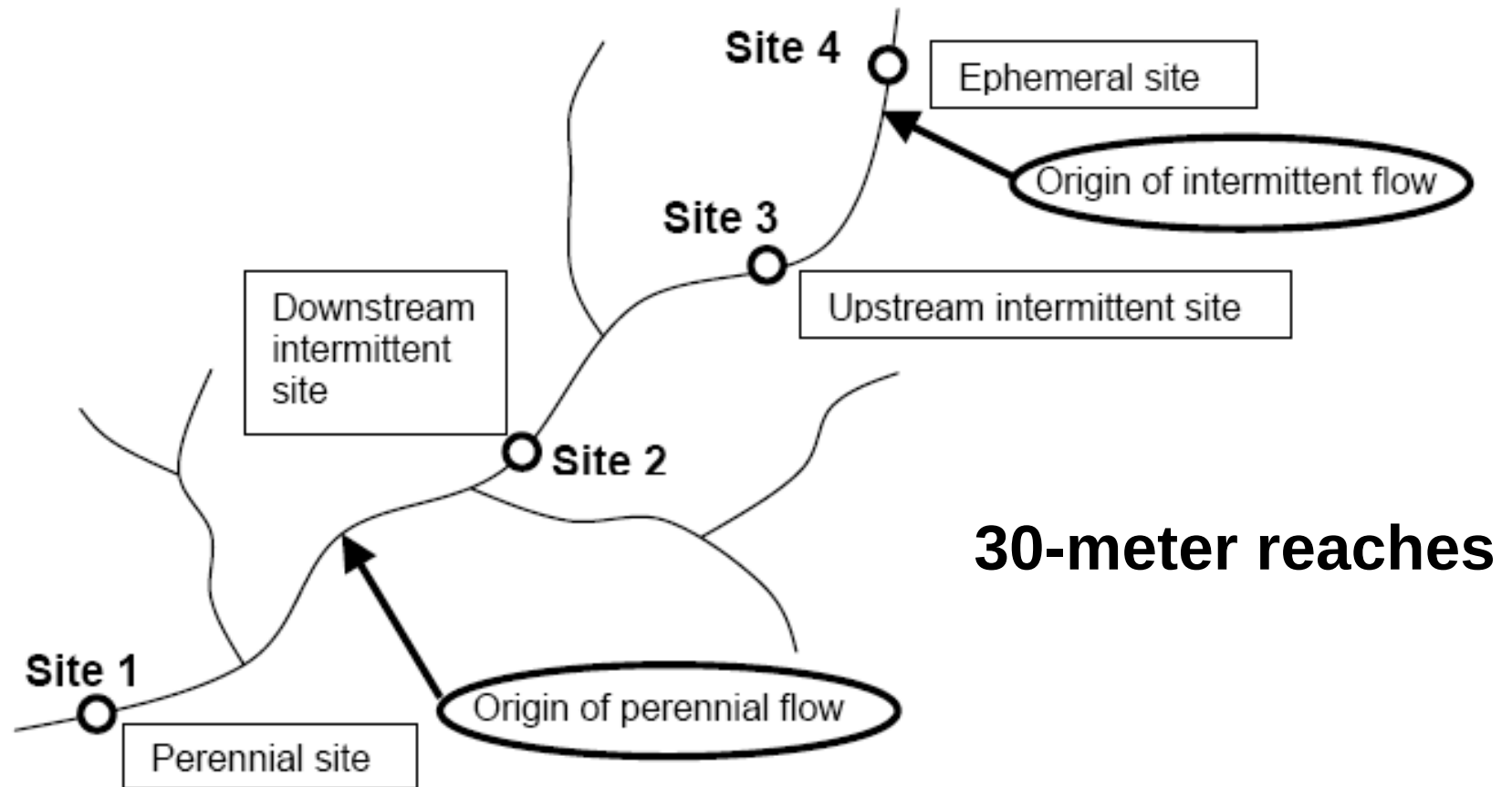


Why did we do this study?

- Part of national research effort by EPA's ORD-Cinci:
 - Headwater/Intermittent Stream Study (HISS)- Regional Methods \$ (K. Fritz, B. Johnson, and D. Walters)
- Coopers Rock Forest chosen by Wheeling Lab as a satellite forest to be used for validation of models developed from HISS core forests
- A desire to better understand headwater stream benthic communities

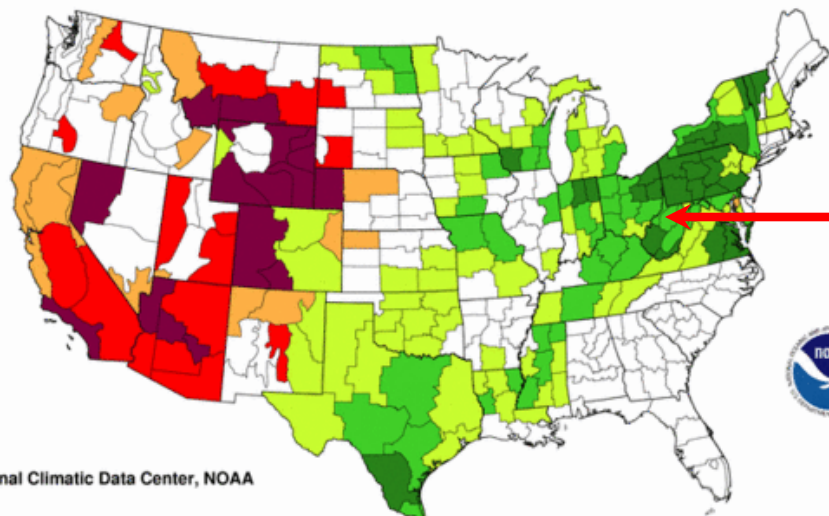
Basic Site Layout

(based on spring and summer visits)

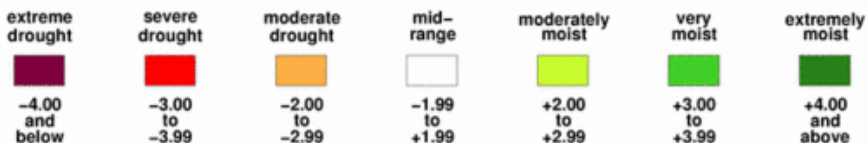
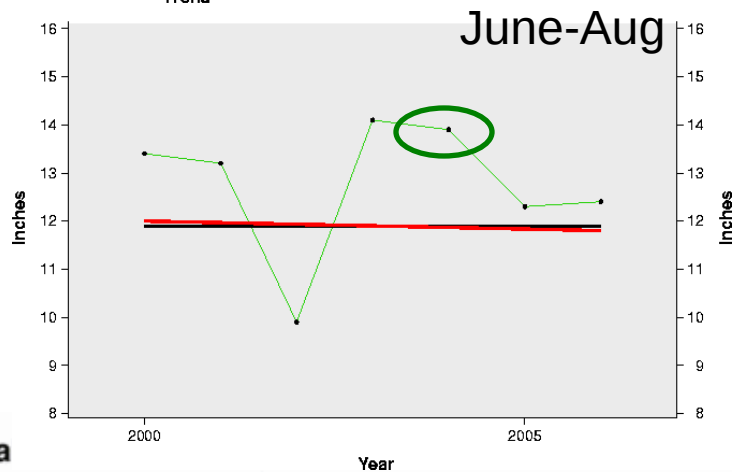


Palmer Drought Severity Index
August, 2004

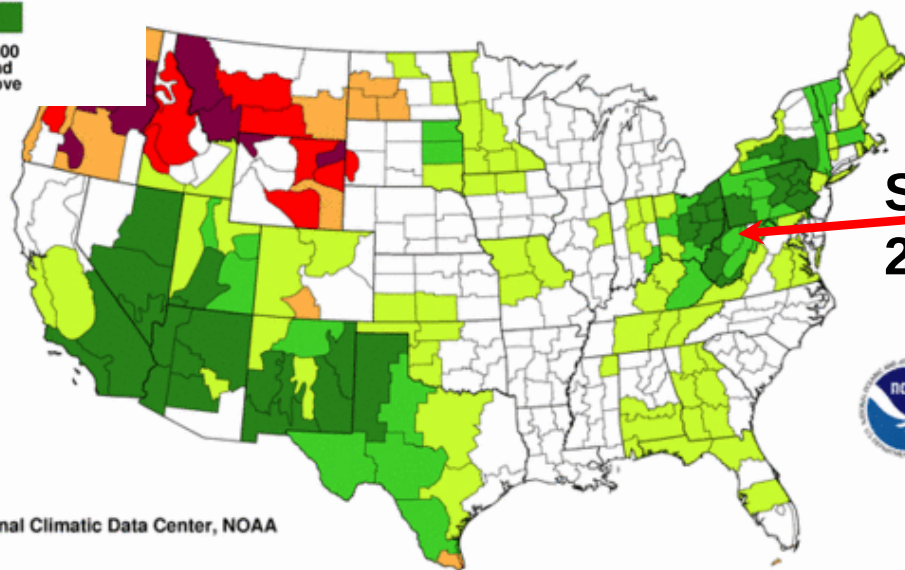
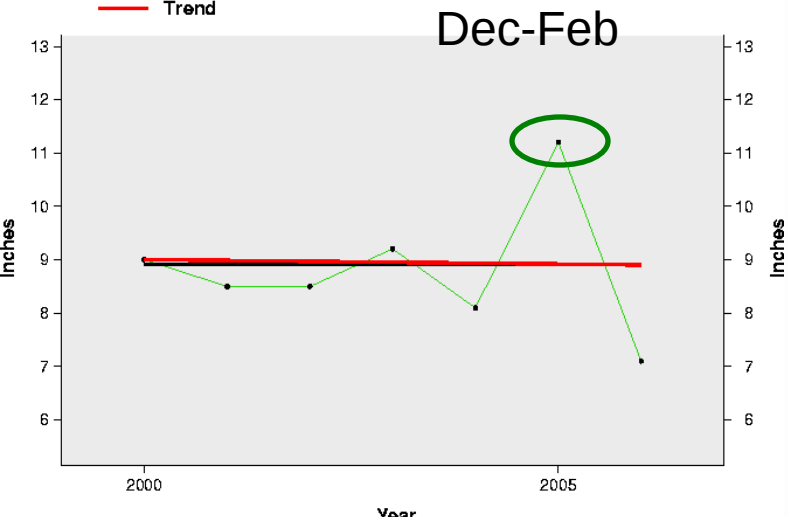
Above Average Precipitation



Actual Precipitation
Average Precipitation
Trend



Actual Precipitation
Average Precipitation
Trend



Seeps as Origins



**Headcuts
too**



flow accumulation...



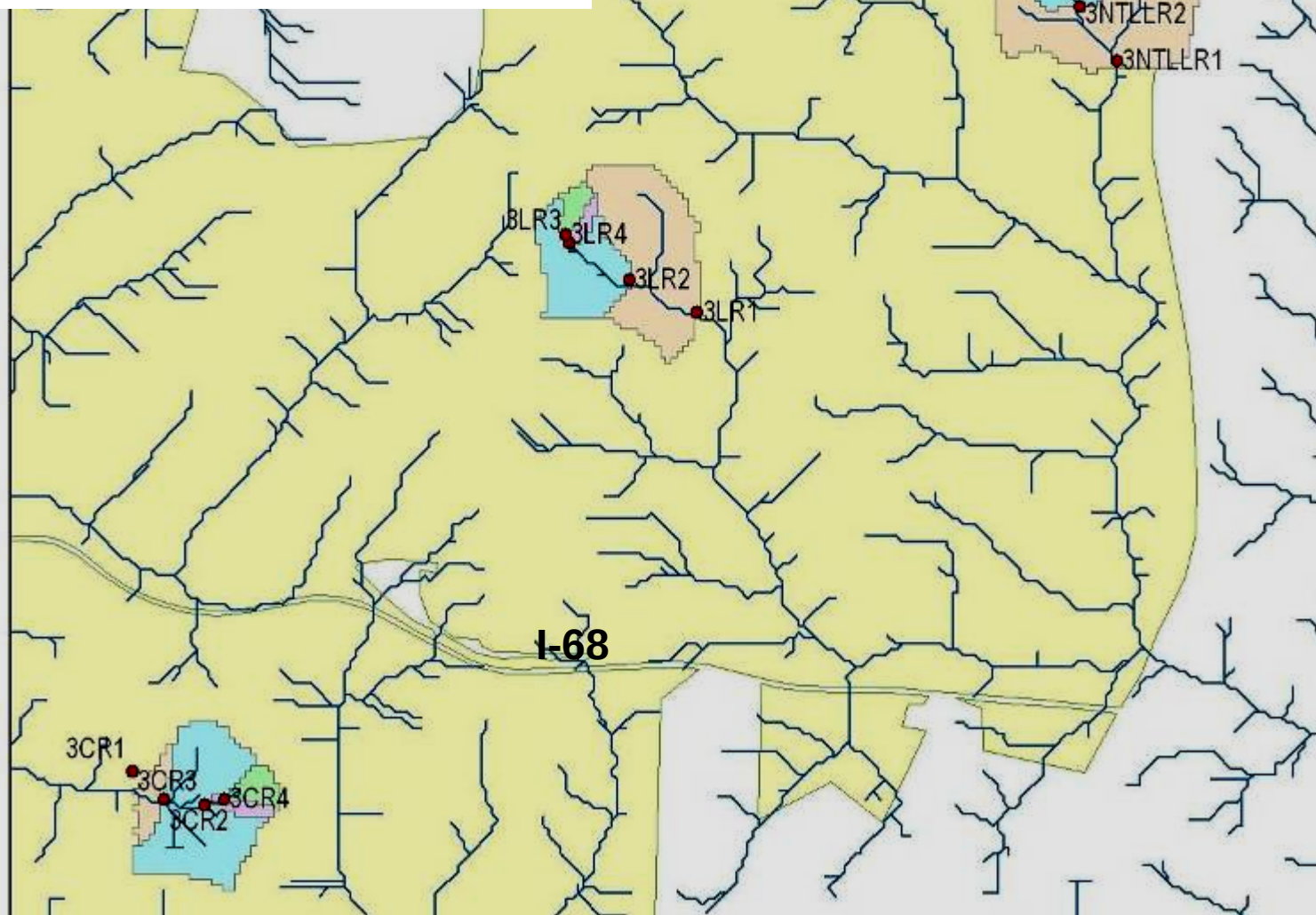
4 sites per stream

(1) Perennial

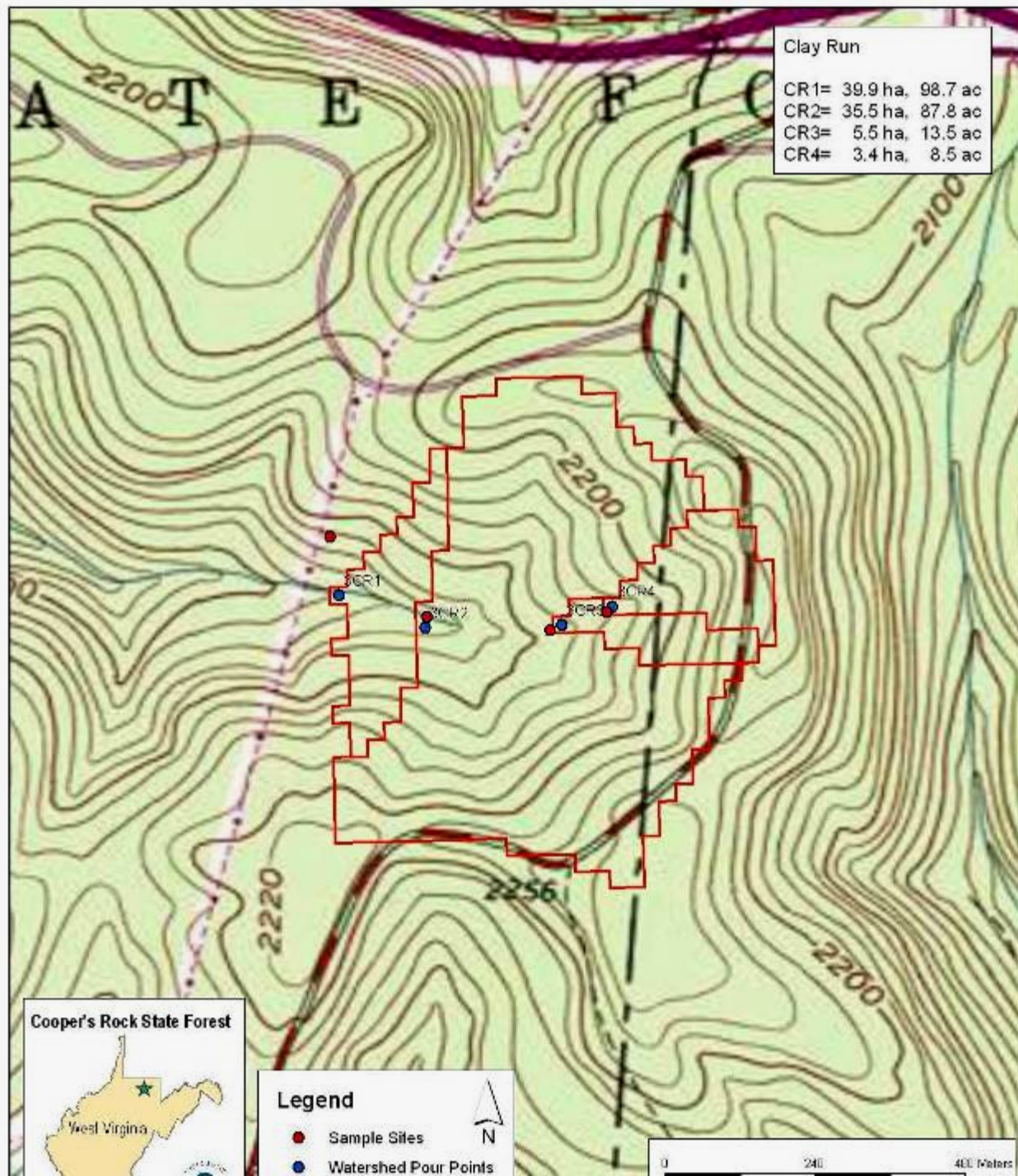
(2) Intermittent

(3) Intermit / Ephem transition

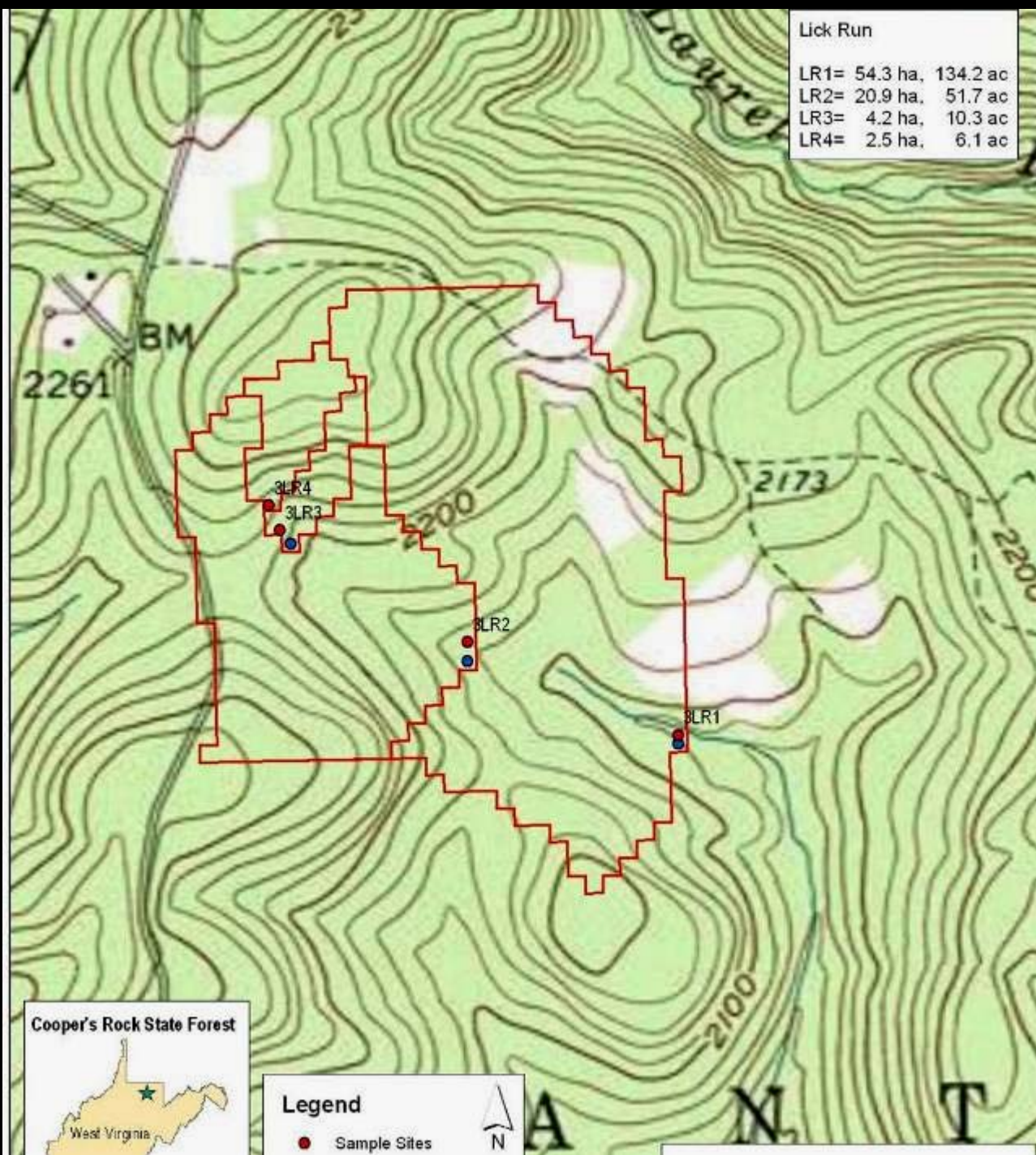
(4) Ephemeral



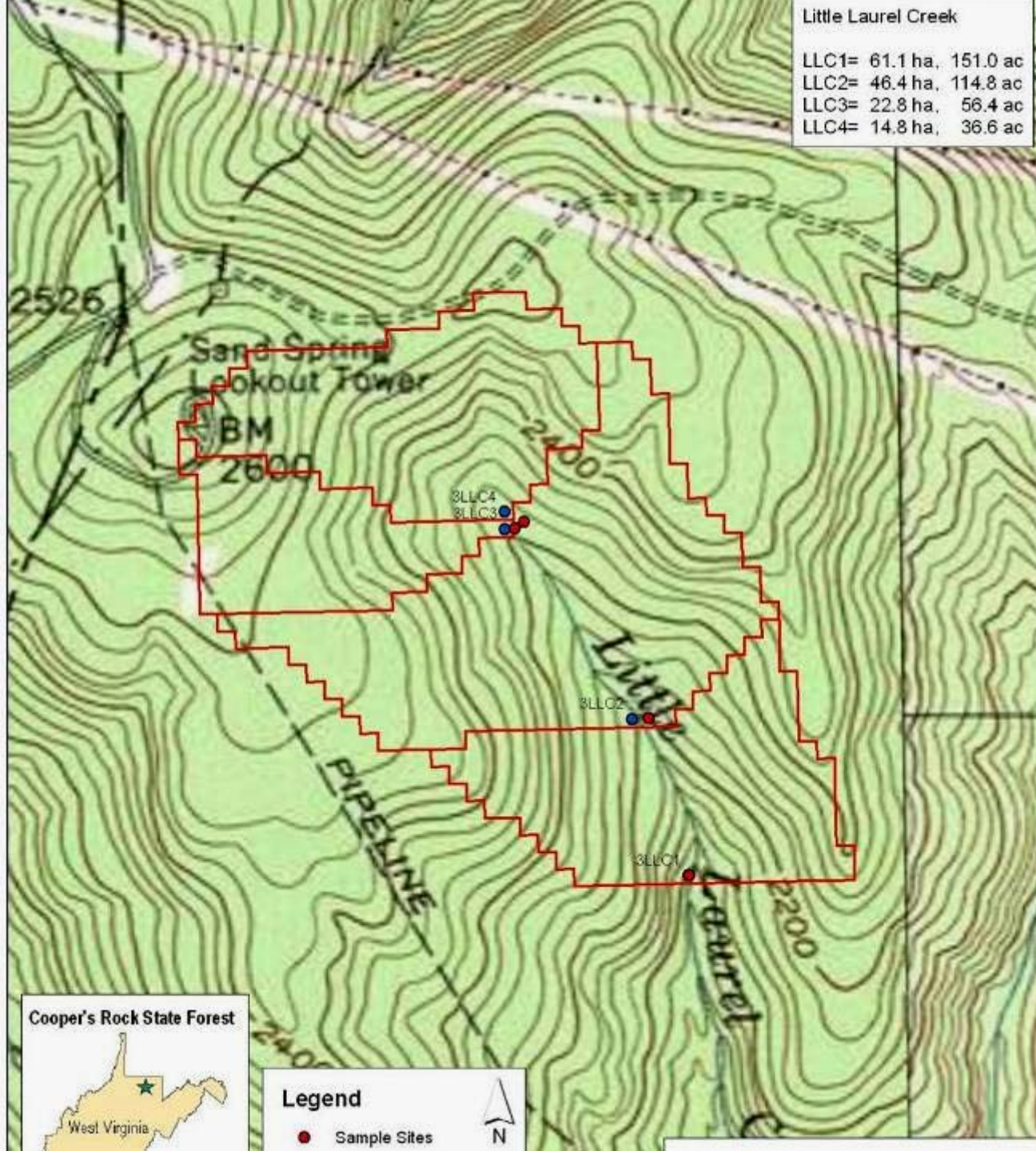
Clay Run



Lick Run



Little Laurel Creek

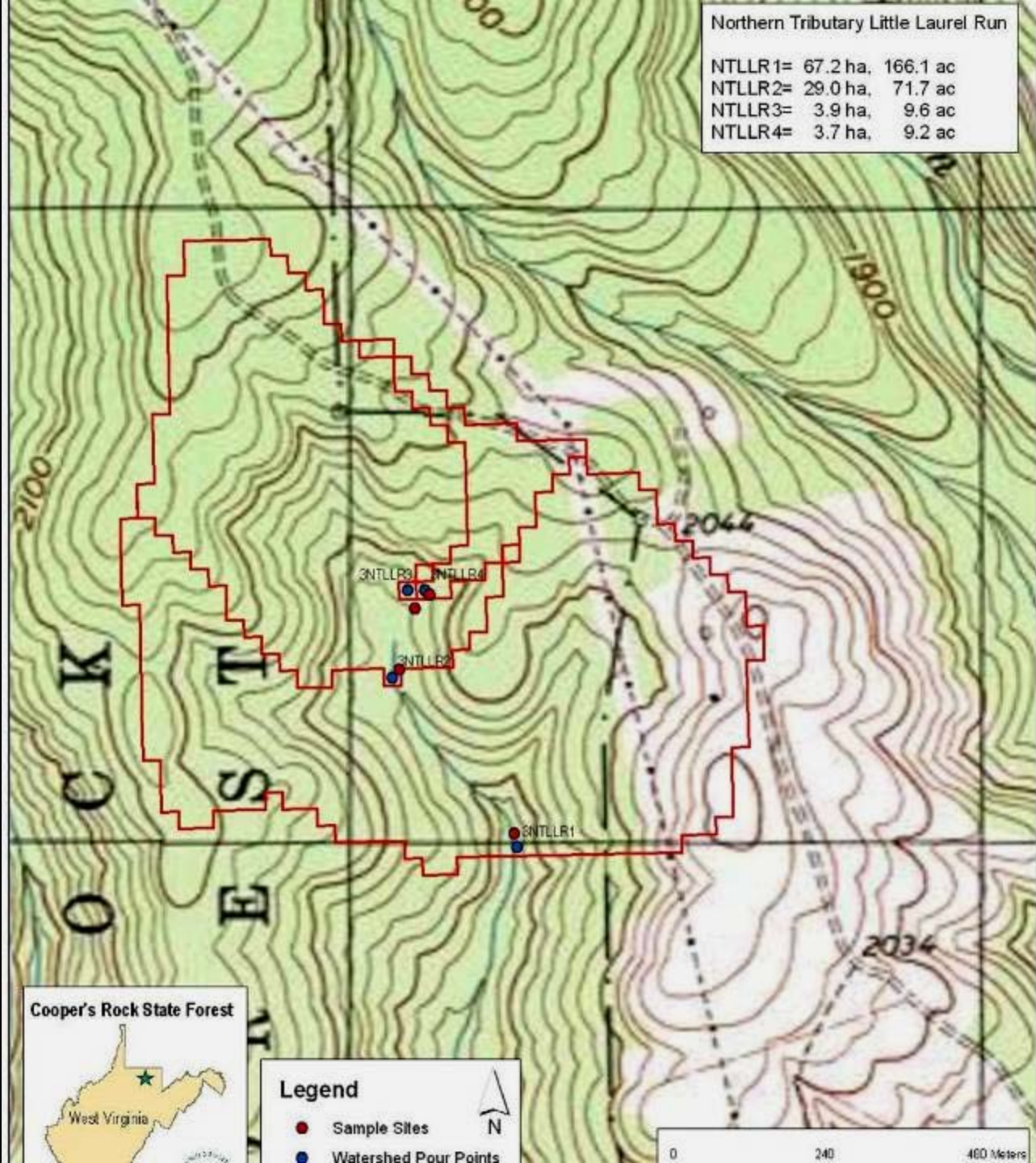




LLC
Aug 2004



Northern Trib Little Laurel Run



1



2



NTLLR
April 2005



4

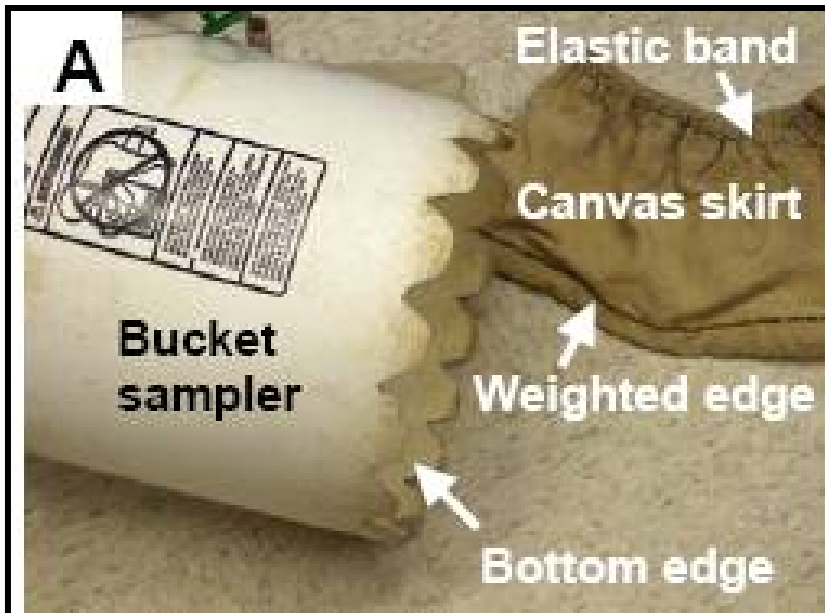


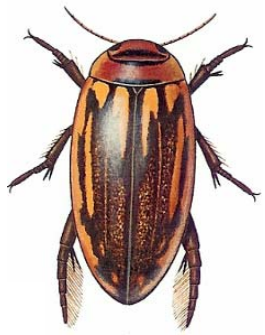
3

Invertebrate Sampling

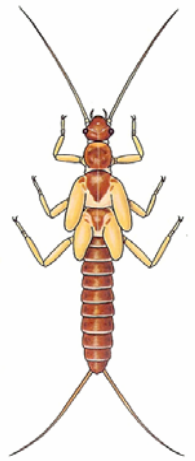
Bucket Sampler w/ 250 μm mesh handnet

- Remove and wash stones/wood; swirl with hand or trowel (10s) and net for 10s (3x)
- Erosional [4–0.05m²]
- Depositional [4–0.05m²]

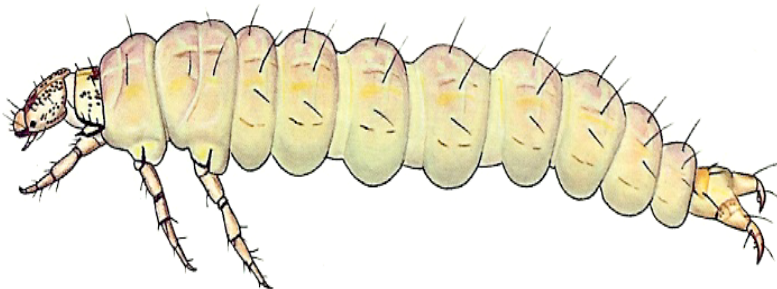
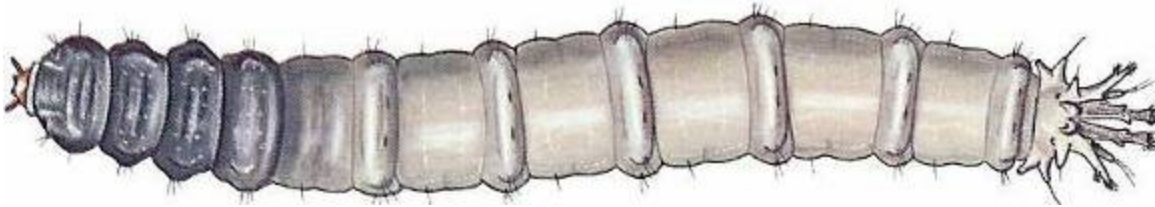




Laboratory Processing



- Full picks (no subsampling)
- Macroinvertebrates ID'd to lowest positive taxon
 - Measured each individual to nearest 1mm



Basic P-chem Results (Means Across Positions 1-3)

	LL		CR		LLC		LR	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
Temperature (C)	7.7	15.2	6.5	16.4	11.1	15.1	7.7	15.7
DO (mg/L)	10.9	6.8	11.2	7.1	9.4	7.4	9.5	8.9
pH (S.U.)	5.86	4.45	5.81	5.05	6.81	4.25	5.86	5.06
Conductivity (uS/cm)	40	46	44	53	37	41	40	45

Data Analysis

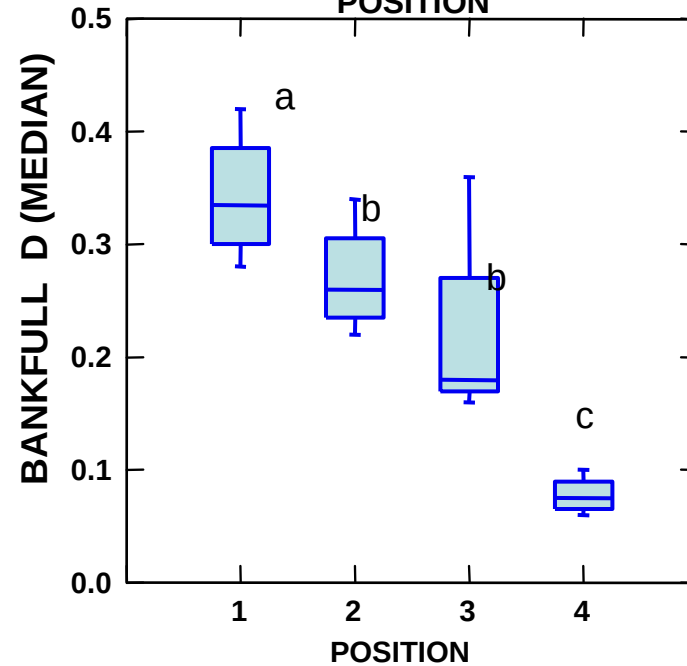
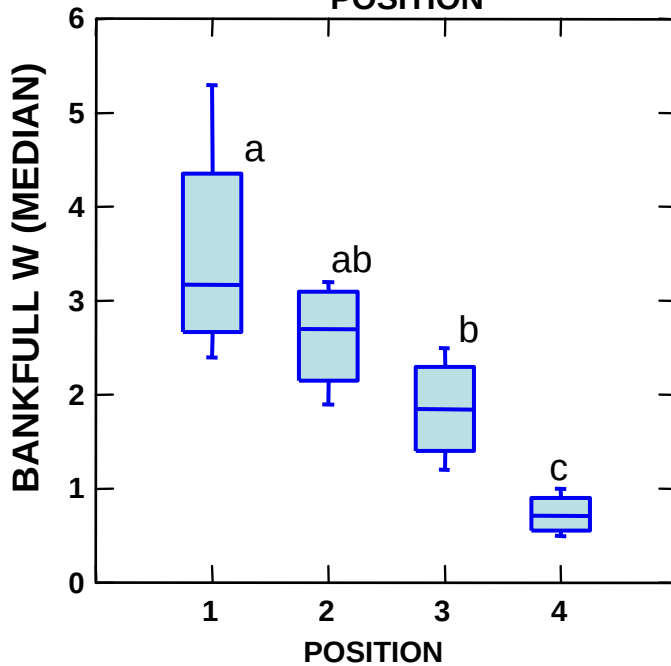
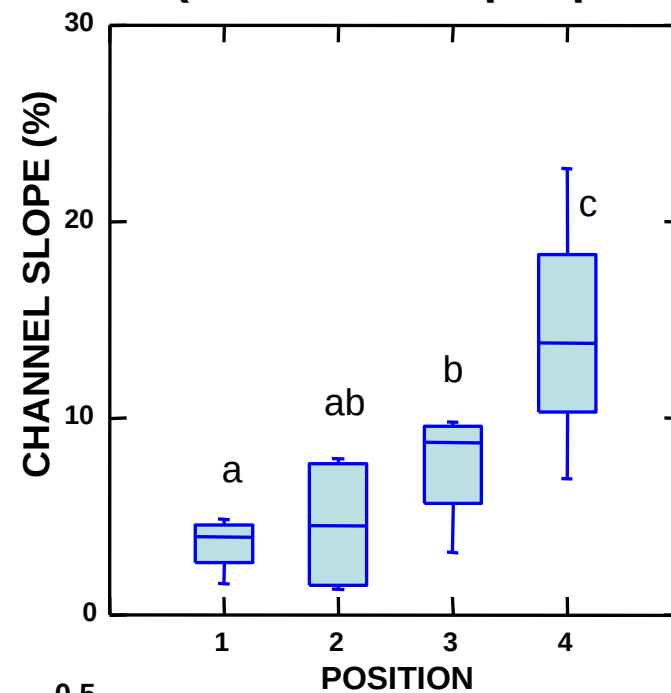
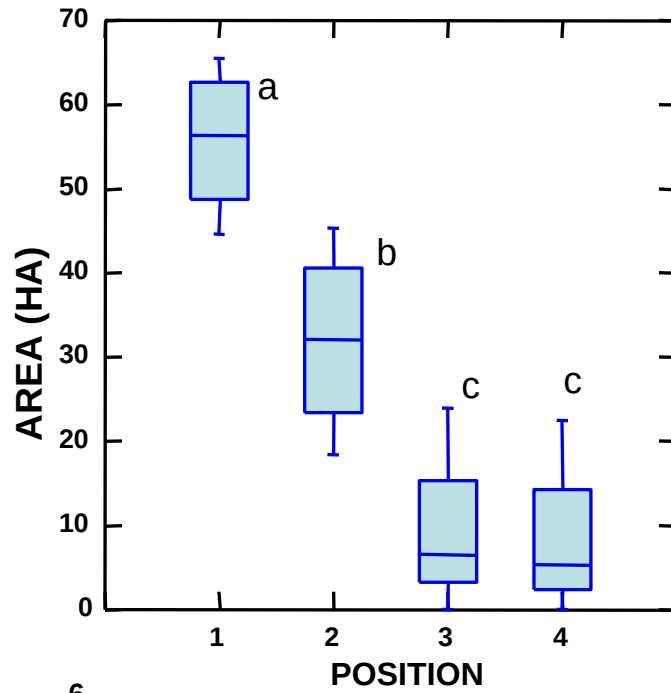
- **Exploratory: taxonomic**

- Ordination (NMS--Bray-Curtis)
- Cluster Analysis (Sorensen Distance, flexible beta -0.7)
- MRPP (Sorensen Distance)-tests for group differences
 - (More like ANOSIM when based on rank transformed distance)
- Indicator Species Analysis (rel. abund. * rel. freq. = Importance)
 - Monte Carlo (1000 runs) for significance

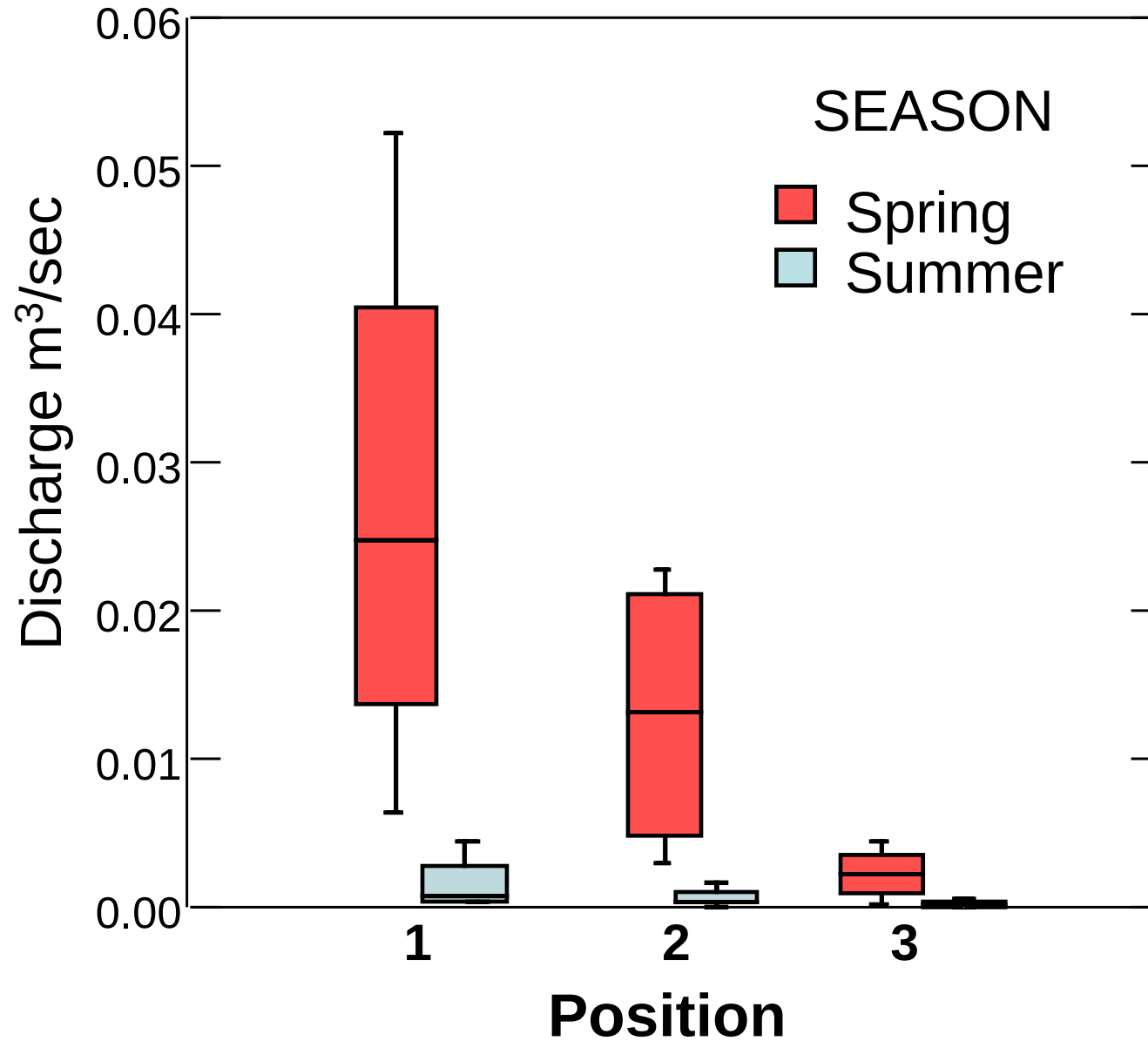
- **Non-Parametric Tests: metrics**

- Kruskal-Wallis

Mean Watershed Characteristics (n=4 streams per position)



Discharge (m^3/sec)

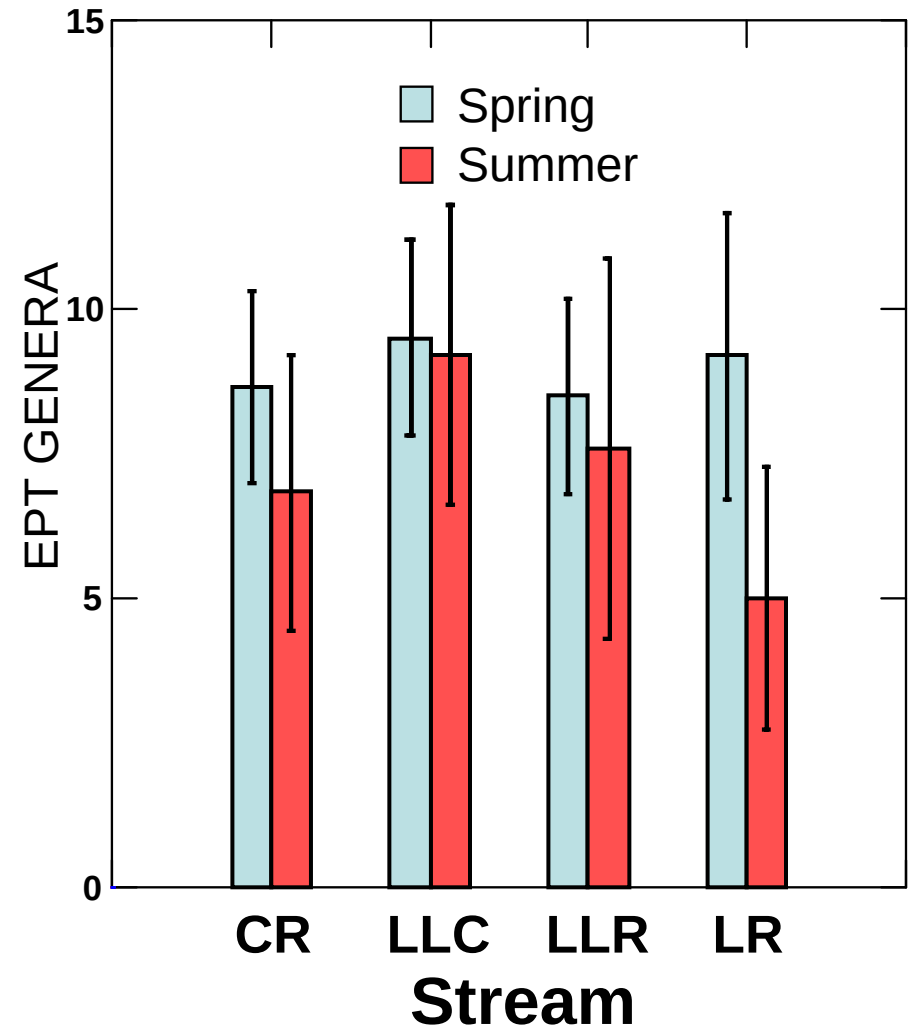
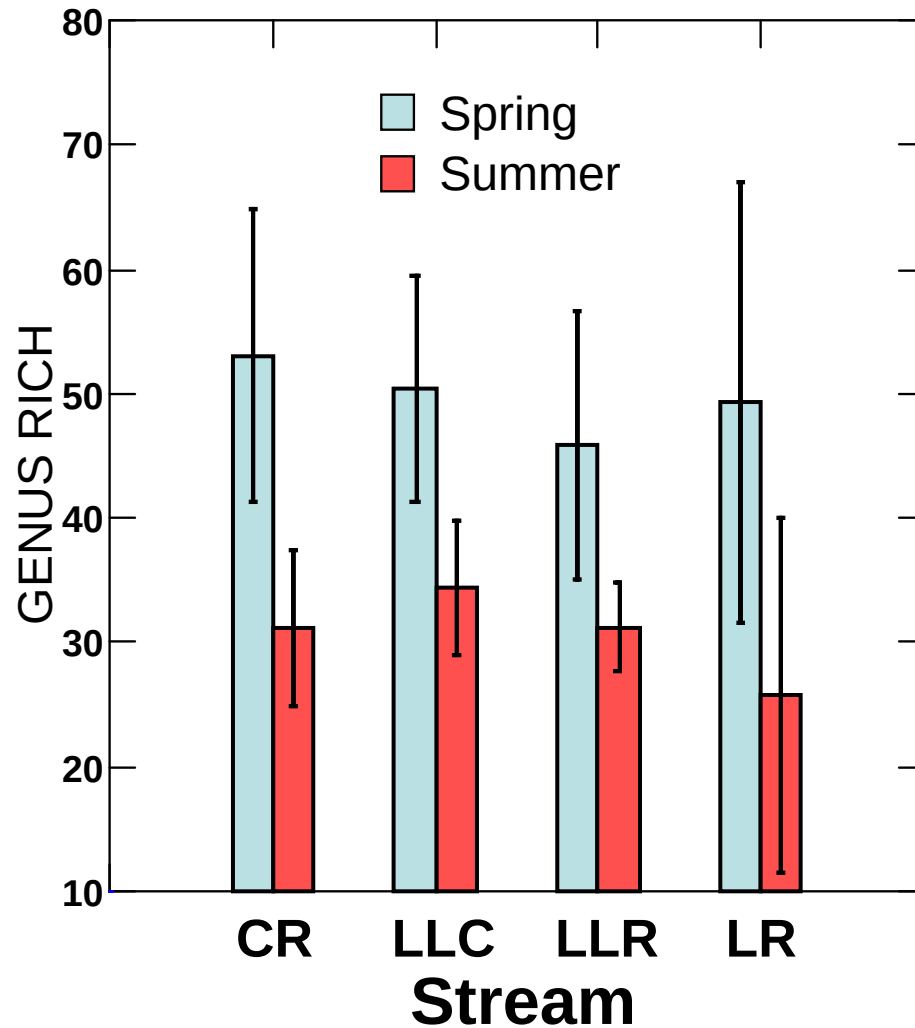


Bug Data

- **All Samples Combined**
 - **106,731 total organisms**
 - **292 taxa, 186 genera**
 - 2 Ephemeroptera
 - 11 Plecoptera
 - 21 Trichoptera
 - 3 Odonata
 - 3 Megaloptera
 - 8 Coleoptera
 - 106 Diptera genera; 180 taxa
 - 39 “Other” taxa (isopods, amphipods, mites, worms, etc)

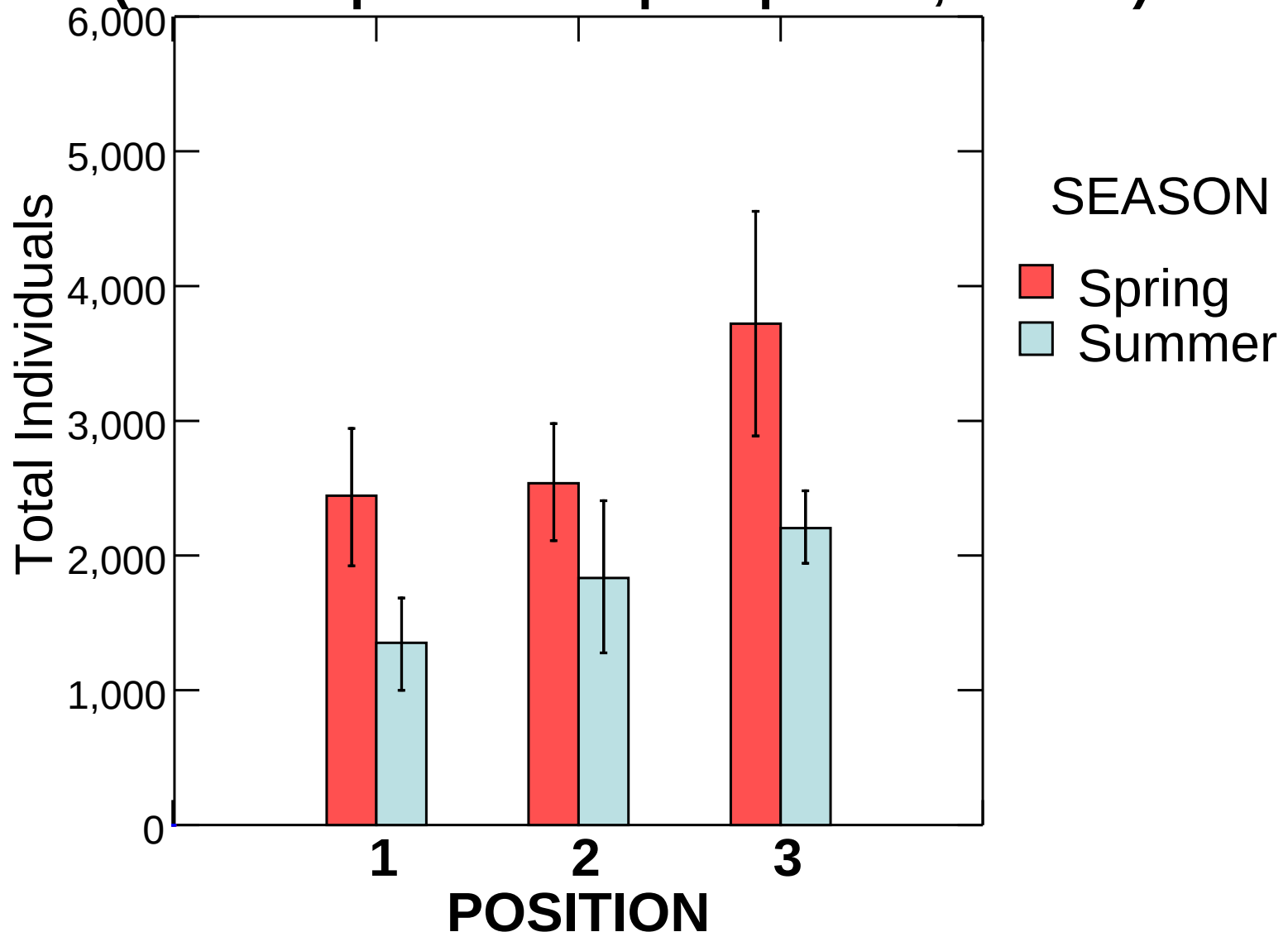
Mean ($\pm 1SD$) Richness Between Streams

(habitat-specific and longitudinal position samples averaged; n=6)

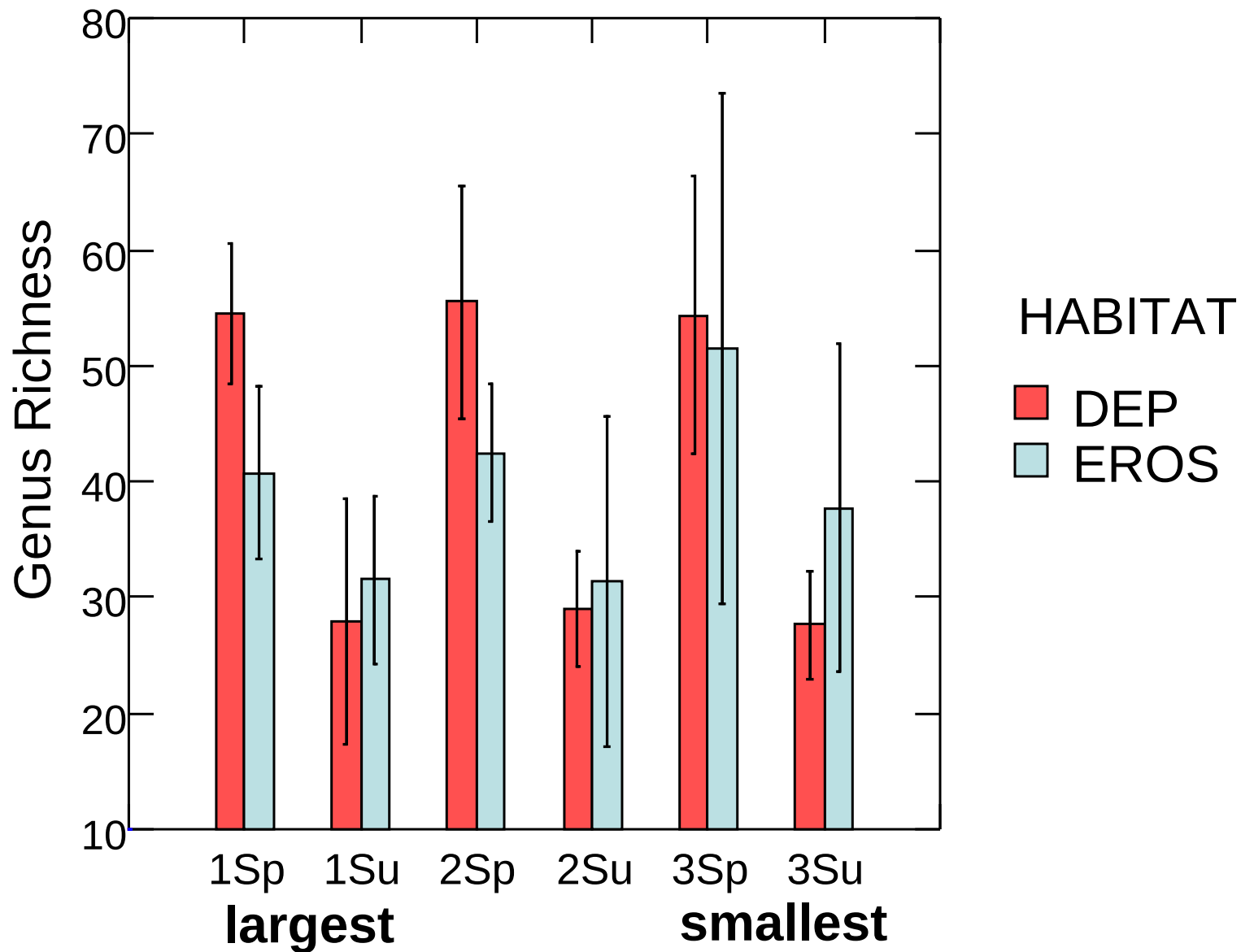


Mean (± 1 SD) Individuals Between Positions

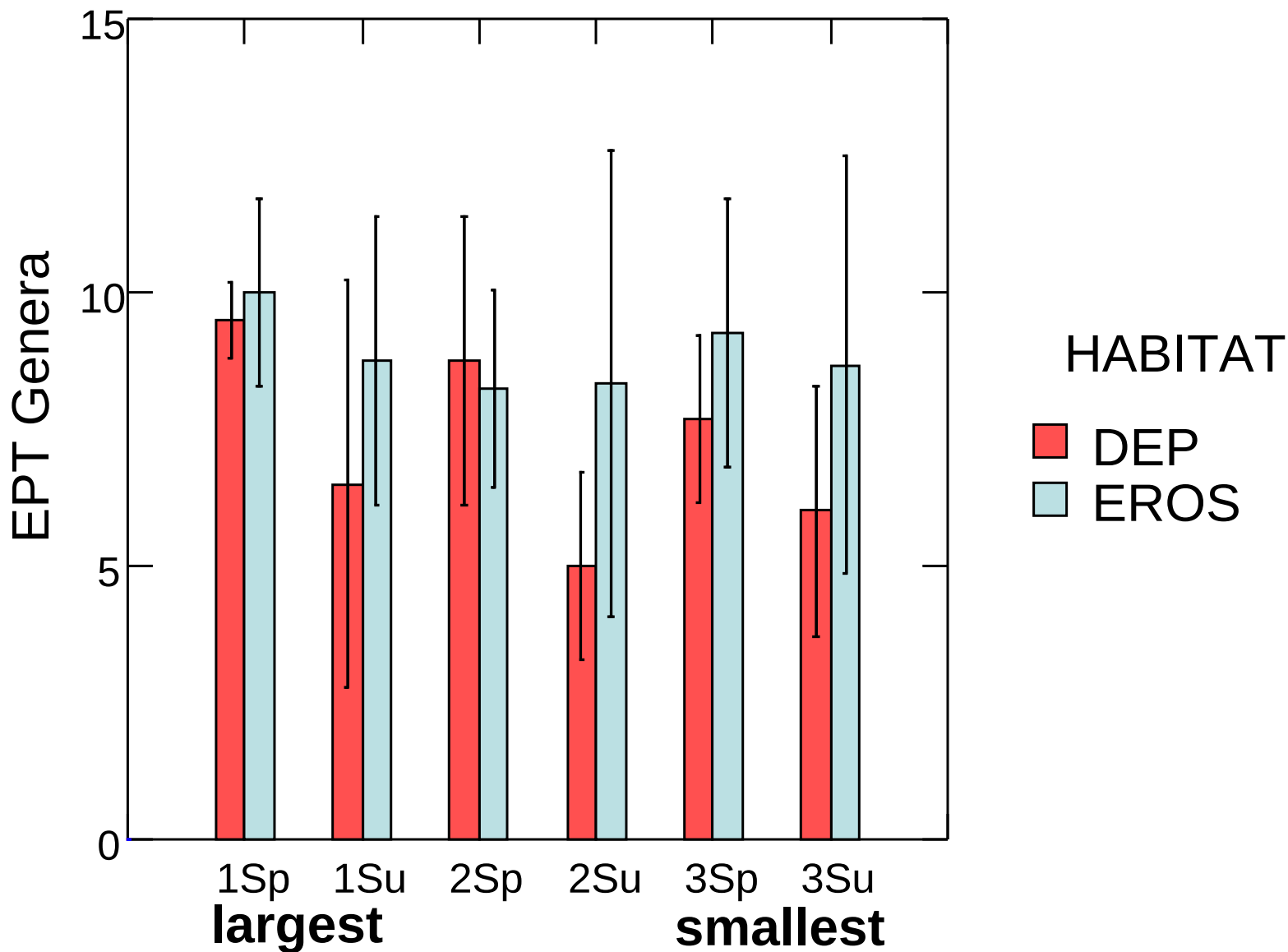
(habitat-specific samples pooled, =0.4m²)



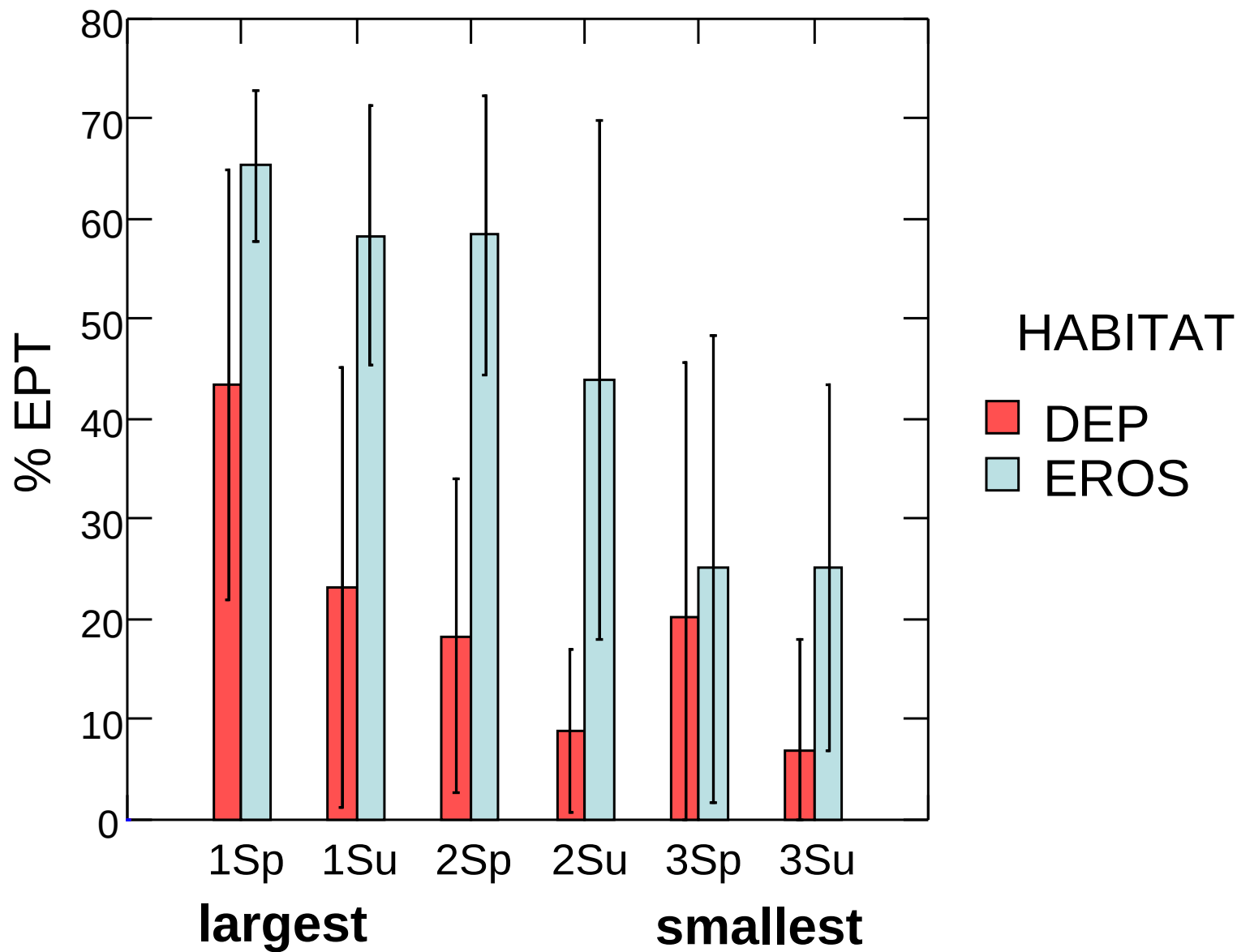
Mean (± 1 SD) Richness Between Position/Habitat/Season



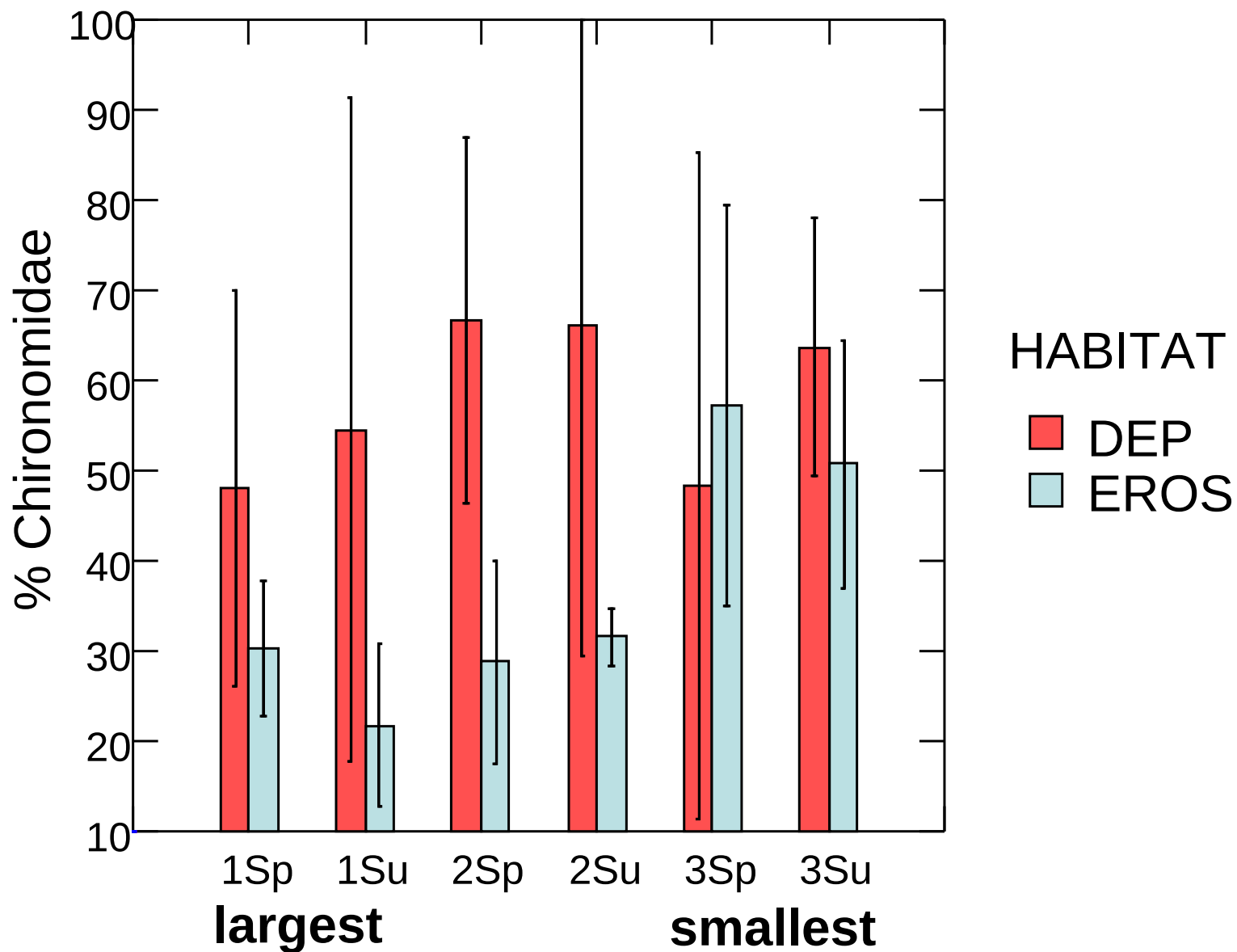
Mean (± 1 SD) EPT Between Position/Habitat/Season



Mean (± 1 SD) %EPT Between Position/Habitat/Season



Mean (± 1 SD) %Chiro Between Position/Habitat/Season



Kruskal-Wallis Results

OVERALL	df	KW-stat	p-value
Genus Richness	11	31.5	0.001*
EPT Richness	11	16.9	0.109
Chironomidae Richness	11	34.5	0.001*
% EPT	11	29.9	0.002*
% Chironomidae	11	21.2	0.030*

Seasonal
Effect

SPRING	df	KW-stat	p-value
Genus Richness	5	9.5	0.090
EPT Richness	5	5.4	0.372
Chironomidae Richness	5	7.5	0.190
% EPT	5	15.1	0.010*
% Chironomidae	5	11.3	0.045*

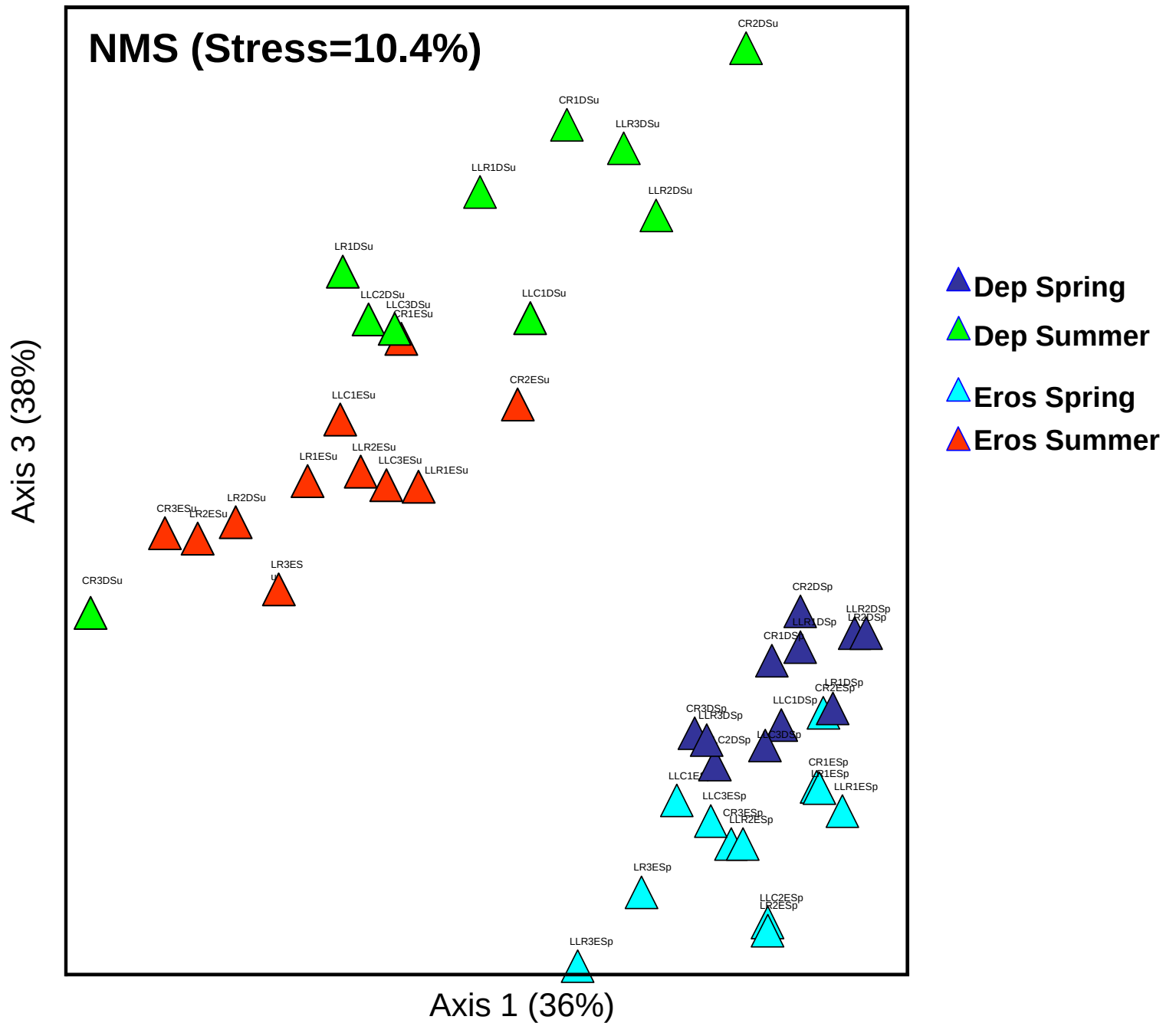
Habitat/Longitudinal
Effect

SUMMER	df	KW-stat	p-value
Genus Richness	5	3.3	0.660
EPT Richness	5	6.4	0.270
Chironomidae Richness	5	1.1	0.950
% EPT	5	13.7	0.018*
% Chironomidae	5	1.1	0.950

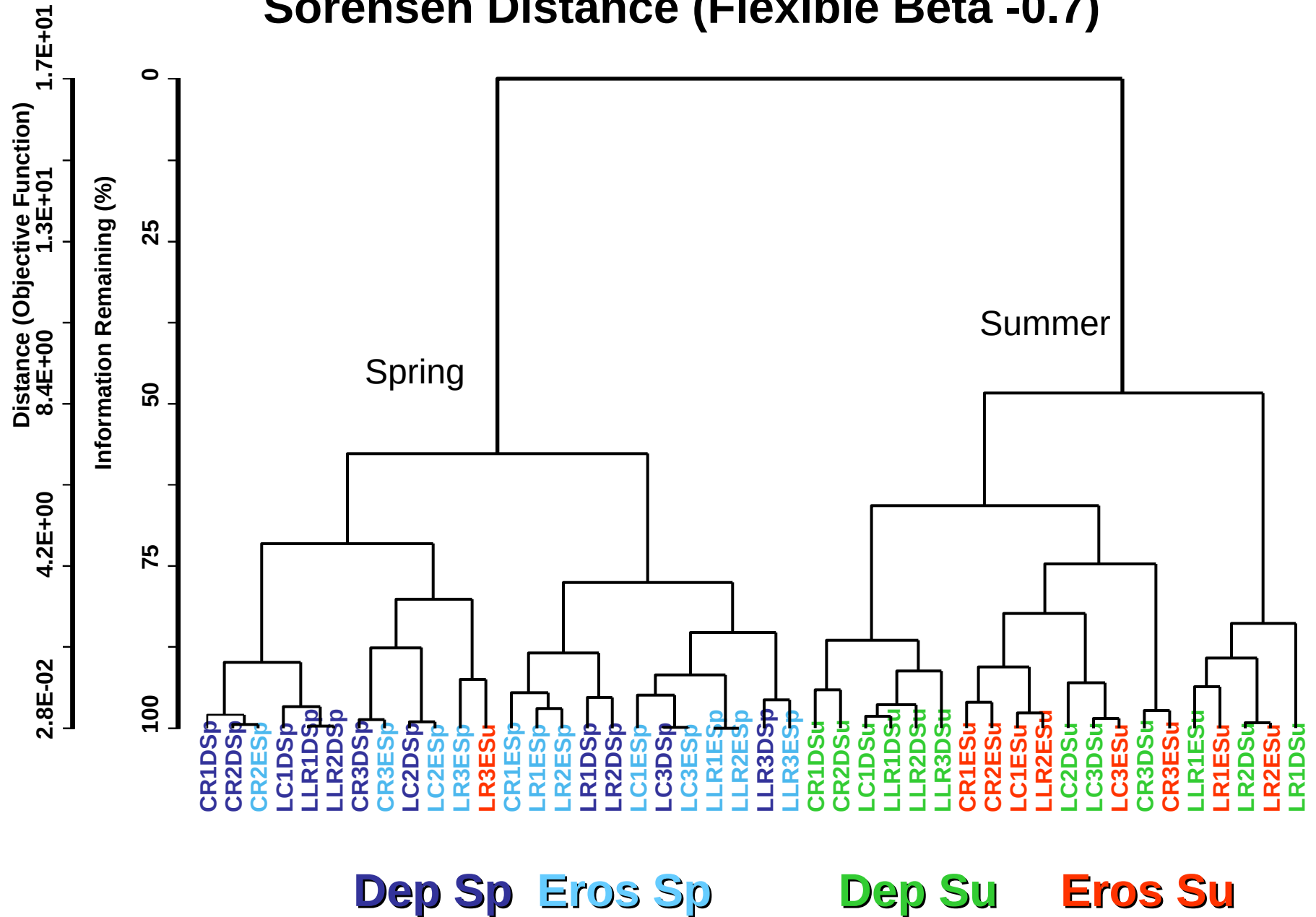
Habitat/Longitudinal
Effect

Multivariate Results





Sorensen Distance (Flexible Beta -0.7)



Multi-response Permutation Procedure (Sorensen Distance)

	T-statistic	A	P-value	A is Chance-corrected Within-group agreement
Stream	-4.1	0.11	0.002	A = 1 - (observed delta / expected delta)
Position	-1.4	0.03	0.09	
Position (Spring)	-1.4	0.06	0.09	Delta is ave. distance
Position (Summer)	-1.5	0.07	0.08	A - ranges from 0-1
Habitat (Spring)	-5.6	0.16	0.00045	A > 0.3 indicates High within-group Homogeneity
Habitat (Summer)	-4.05	0.12	0.003	
Season	-24.1	0.38	0.000001	
Position_Season	-11.6	0.43	0.000001	
Habitat_Season	-16.9	0.47	0.000001	
Habitat_Season_Position	-8.3	0.49	0.000001	

Indicator Species Analysis

Position 1; Spring

	Genus	Maxgrp	IV	Mean	S.Dev	p *
EPT taxa	Ameletus	1 Sp	87.5	18.7	8.45	0.002
	Amphinemura	1 Sp	61.4	24.3	7.68	0.001
	Prosimulium	1 Sp	50	15.6	8.08	0.008
	Zavrelimyia	1 Sp	45.6	23.5	8.1	0.013
	Tanytarsus	1 Sp	43.1	29	4.45	0.001
	Krenosmittia	1 Sp	42.7	21.9	7.97	0.019
	Thienemannimyia	1 Sp	42.3	29.8	3.8	0.001
EPT taxa	Mesocricotopus	1 Sp	39.5	23.1	7.93	0.045
	Neophylax	1 Sp	35.5	21.4	7.69	0.05
	Leuctra	1 Sp	33.2	28.2	1.7	0.002

Position 3; Spring

EPT taxa	Achaeta	3 Sp	81.3	23	8.97	0.001
	Eclipidrilus	3 Sp	67.1	25.2	7.96	0.001
	Platysmittia	3 Sp	66.5	25.5	7.64	0.001
	Pseudorthocladius	3 Sp	60.2	24.7	9.38	0.004
	Culicoides	3 Sp	58.3	24.6	8.29	0.002
	Contempinella	3 Sp	57.9	24.5	7.96	0.005
	Meropelopia	3 Sp	56.6	25.6	7.16	0.001
	Ostrocerca	3 Sp	54.9	25.5	6.73	0.001
	Lepidostoma	3 Sp	50.6	26.9	6.43	0.005
	Bezzia/Palpomyia	3 Sp	48.3	28.4	5.63	0.001
	Eukiefferiella	3 Sp	44.3	25.2	7.64	0.021
	Libellulidae	3 Sp	42.9	15	9.01	0.019
	Polypedilum	3 Sp	41.8	27	6.71	0.037
	Limnophyes	3 Sp	39.5	27.6	5.81	0.044

Indicator Species Analysis

Position 1; Summer

Genus	Maxgrp	IV	Mean	S.Dev	p *
Paracapnia	1 Su	56.5	20.7	8.01	0.002
Oligostomis	1 Su	38.8	18.9	8.21	0.035
Tubificidae	1 Su	38.2	22.6	8.65	0.059
Dicranota	1 Su	37.1	23.7	7.33	0.055

Position 3; Summer

Psilometriocnemus	3 Su	68.1	22.4	7.32	0.001
Hydracarina	3 Su	67.4	21.9	7.77	0.001
Soyedina	3 Su	50	14.4	8.53	0.008
Molanna	3 Su	38.7	24.6	7.59	0.054
Hexatoma	3 Su	36.3	26.3	6.24	0.066
Tipula	3 Su	35.7	20.3	8.53	0.067
Polycentropus	3 Su	35.5	29.7	3.55	0.052
Dolochipodidae	3 Su	33.3	12.7	7.95	0.042

Ubiquitous Taxa

>80% of all samples

NON-CHIRONOMID

- *Caecidotea*
- *Leuctra*
- *Bezzia/Palpomyia*
- *Polycentropus*
- *Rhyacophila*

CHIRONOMIDAE

- *Parachaetocladius*
- *Heterotrissocladius*
- *Corynoneura*
- *Thienemannimyia*
- *Thienemanniella*
- *Micropsectra*

**In combined stream, season and habitat samples,
Positions 1 and 3 shared :**

70% of families 60% of genera 56% of species

Biomass

(based on length-weight equations)

Mean mg AFDM/m²

- Without Crayfishes

Position	Spring	Summer
1	2.35	1.49
2	2.39	1.99
3	4.59	2.66

- With Crayfishes

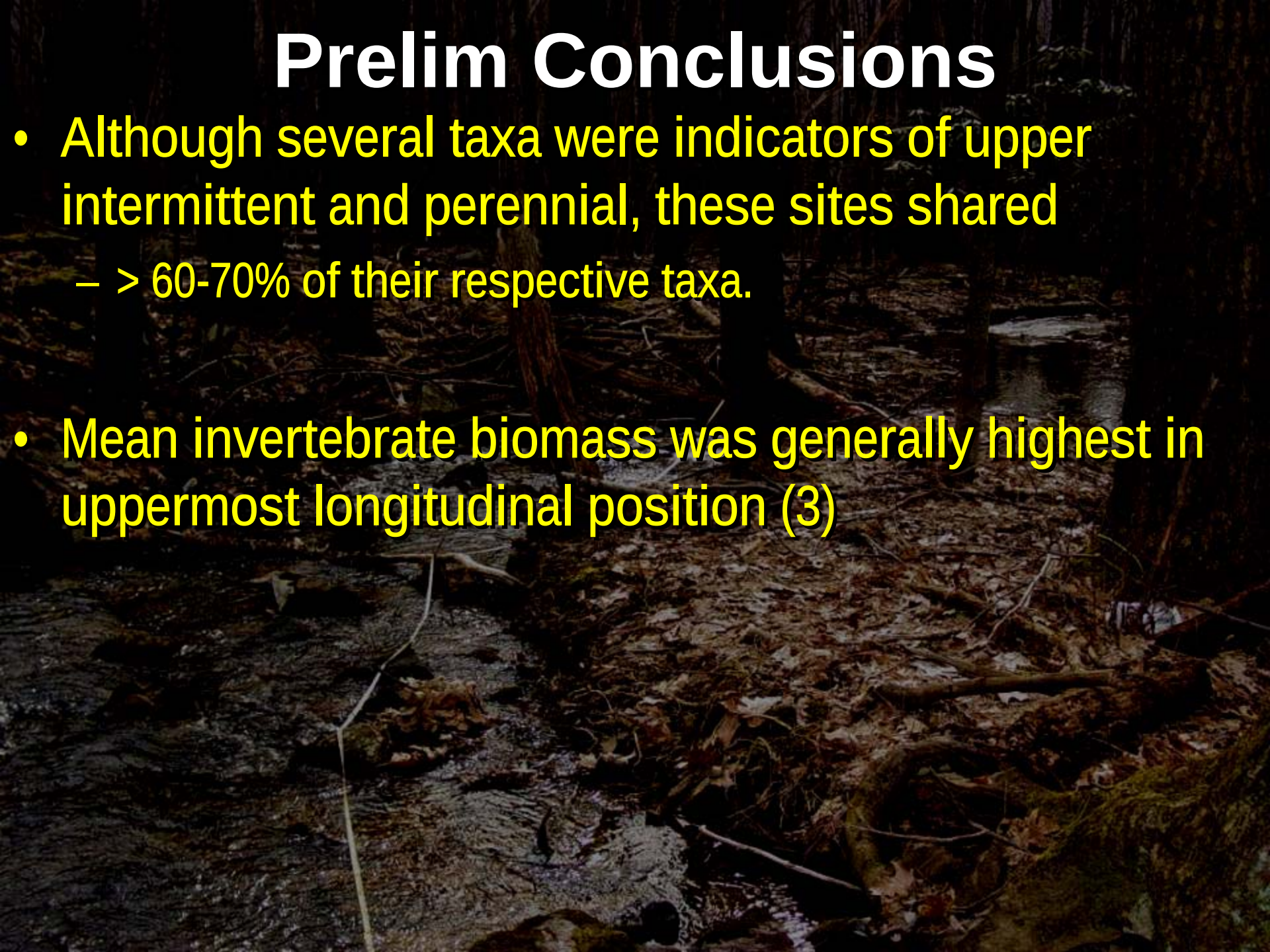
Position	Spring	Summer
1	2.71	27.26
2	4.55	4.68
3	4.64	18.41

Prelim Conclusions

- Community structure and richness at the ephemeral-intermittent interface were very similar to the lower perennial sites
 - %EPT was significantly reduced in upstream position compared to downstream
 - %EPT higher in Erosional; %Chironomidae higher in Depositional
- Season and sample habitat drives community structure more than longitudinal position

Prelim Conclusions

- Although several taxa were indicators of upper intermittent and perennial, these sites shared
 - > 60-70% of their respective taxa.
- Mean invertebrate biomass was generally highest in uppermost longitudinal position (3)





Acknowledgements

**Coopers Rock State Forest, Jeff Bailey, Jim Green,
Carole Rose, Doug Ross**