Stream and Wetland Response to Landscape Changes in the Redmond Ridge and Trilogy UPDs

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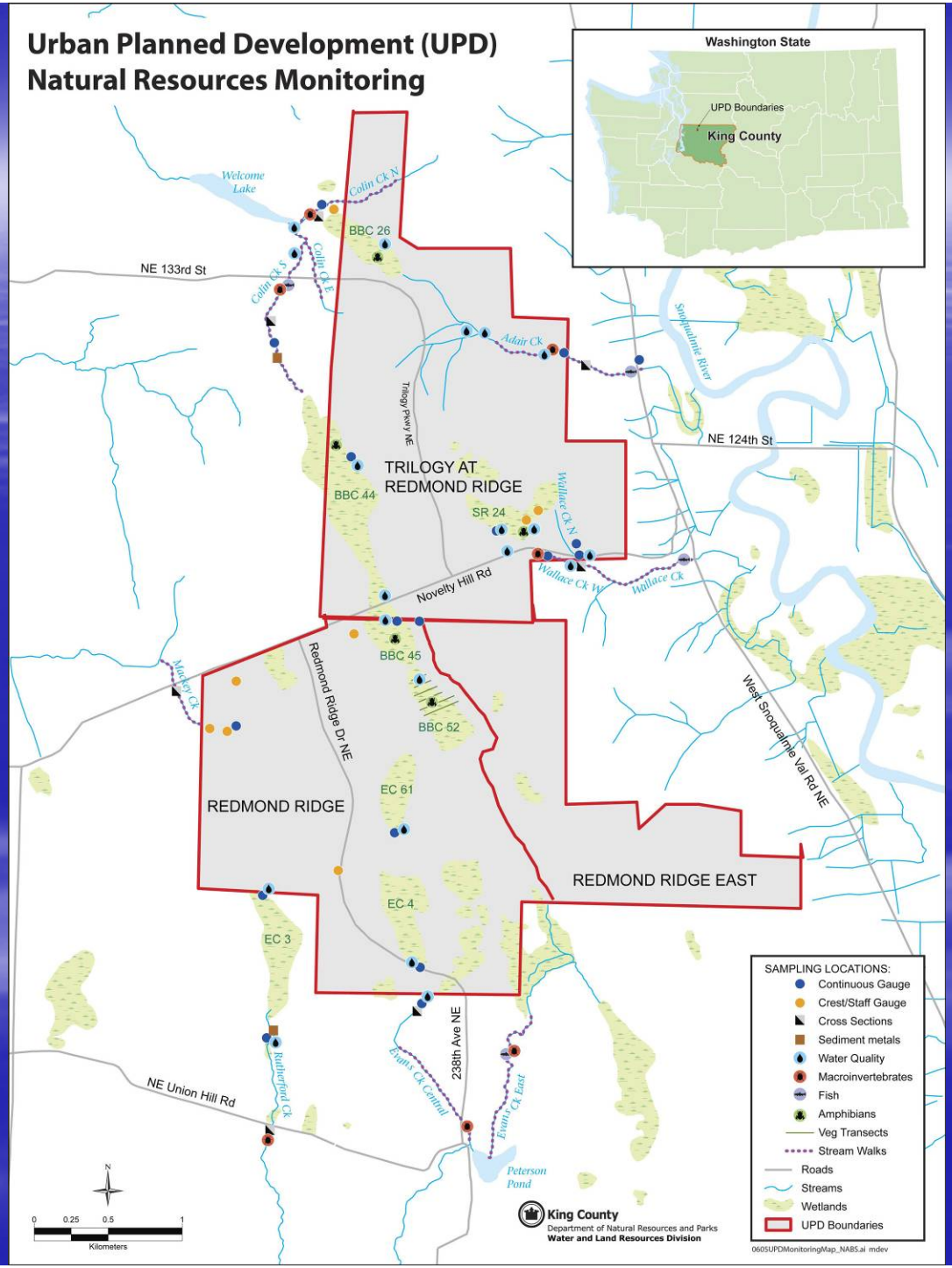
King County

Introduction

- Natural Resource Monitoring
  - Hydrology
  - Stream Geomorphology
  - Water Quality
  - Amphibians
  - Fish
  - Macroinvertebrates
  - Vegetation
  - Welcome Lake Water Quality
  - Sediment Quality
  - Groundwater Quantity and Quality


Urban Planned Development (UPD)
Natural Resources Monitoring
Washington State
UPD Boundaries
King County
Welcome Lake
Colin Ck N
Colin Ck S
Colin Ck E
BBC 26
NE 133rd St
Adair Ck
Snoqualmie River
Trilogy Pkwy NE
NE 124th St
TRILOGY AT
REDMOND RIDGE
BBC 44
SR 24
Wallace Ck N
Wallace Ck W
Wallace Ck
Novelty Hill Rd
BBC 45
Mackey Ck
Redmond Ridge Dr NE
BBC 52
West Snoqualmie Val Rd NE
EC 61
REDMOND RIDGE
REDMOND RIDGE EAST
EC 4
EC 3
238th Ave NE
Evans Ck Central
Evans Ck East
Rutherford Ck
NE Union Hill Rd
Peterson Pond
N
0 0.25 0.5 1
Kilometers
King County
Department of Natural Resources and Parks
Water and Land Resources Division
SAMPLING LOCATIONS:
Continuous Gauge
Crest/Staff Gauge
Cross Sections
Sediment metals
Water Quality
Macroinvertebrates
Fish
Amphibians
Veg Transects
Stream Walks
Roads
Streams
Wetlands
UPD Boundaries
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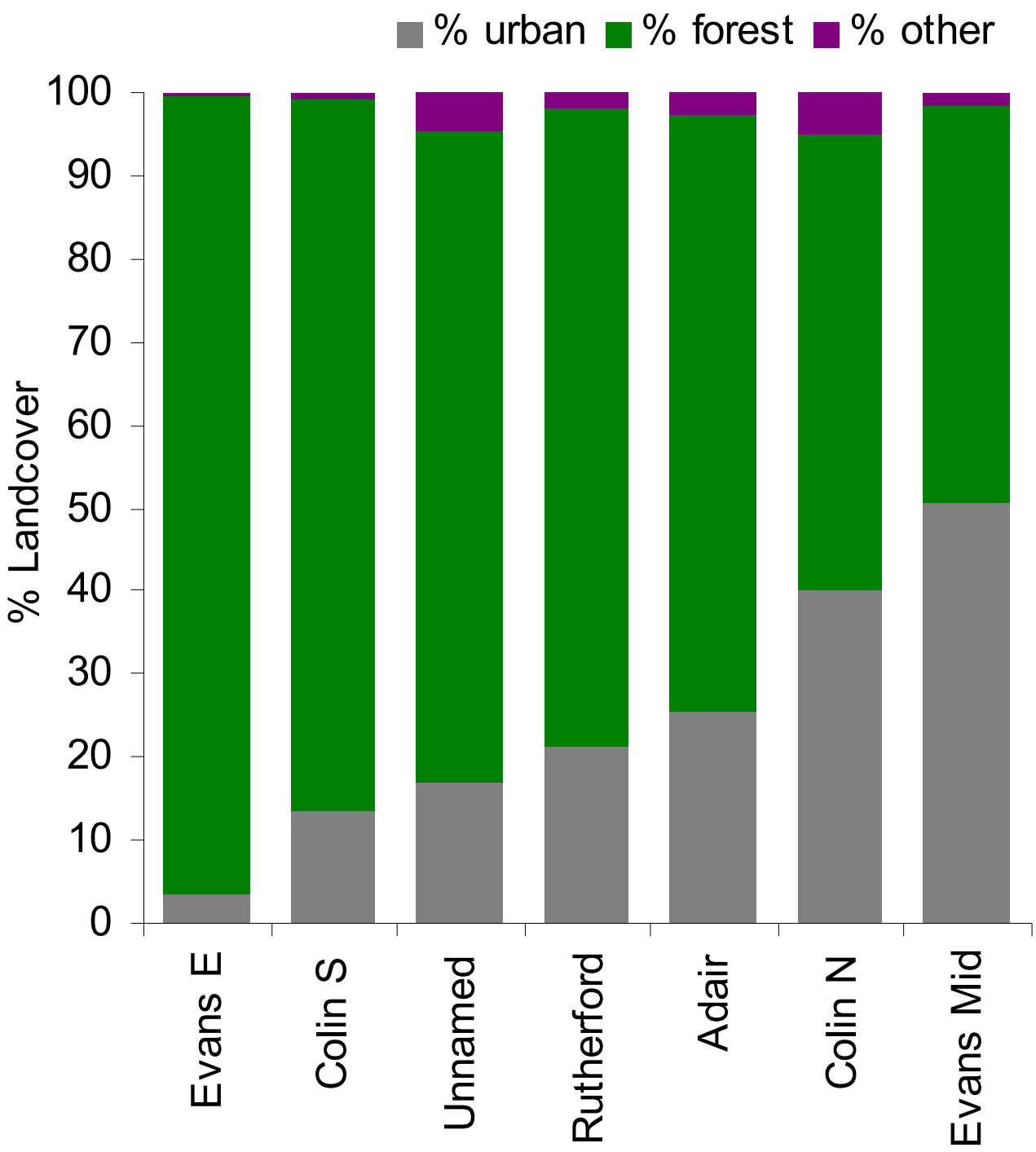
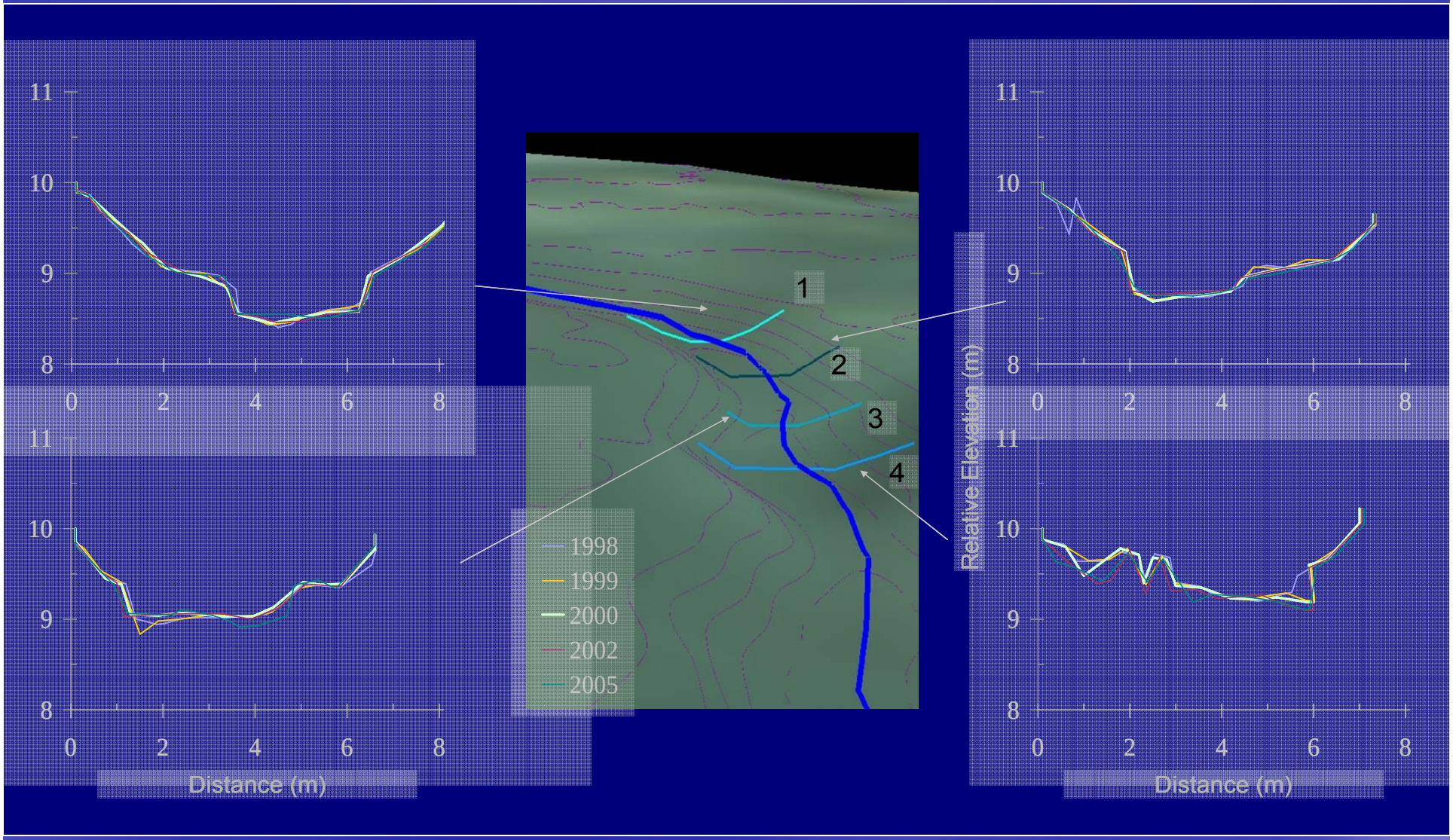
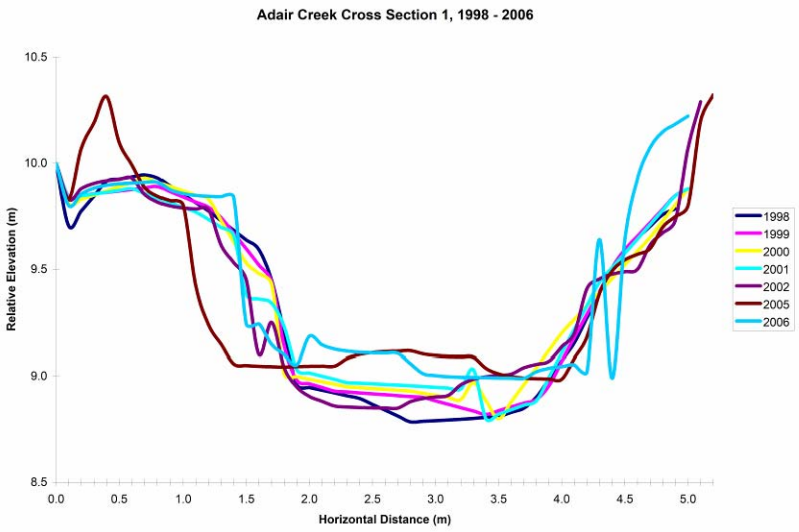
Landcover by Basin during 2003




11
10
9
8
0
2
4
6
8
1
2
3
4
1998
1999
2000
2002
2005
Relative Elevation (m)
Distance (m)

alldatachart



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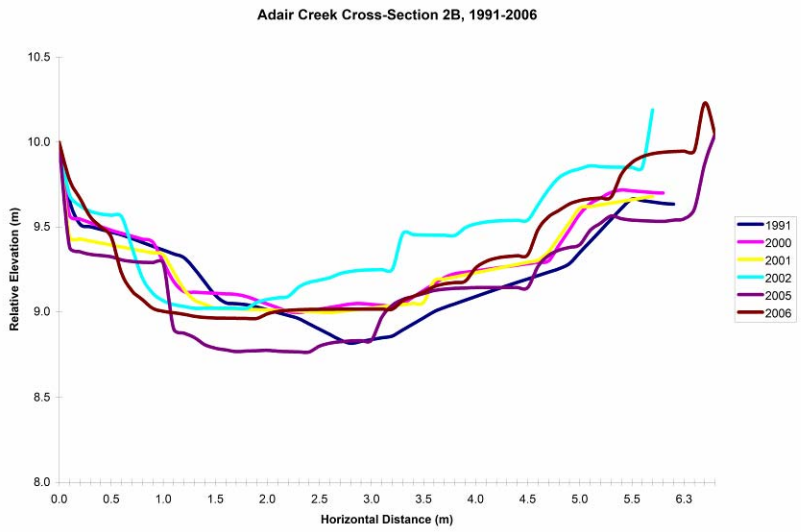

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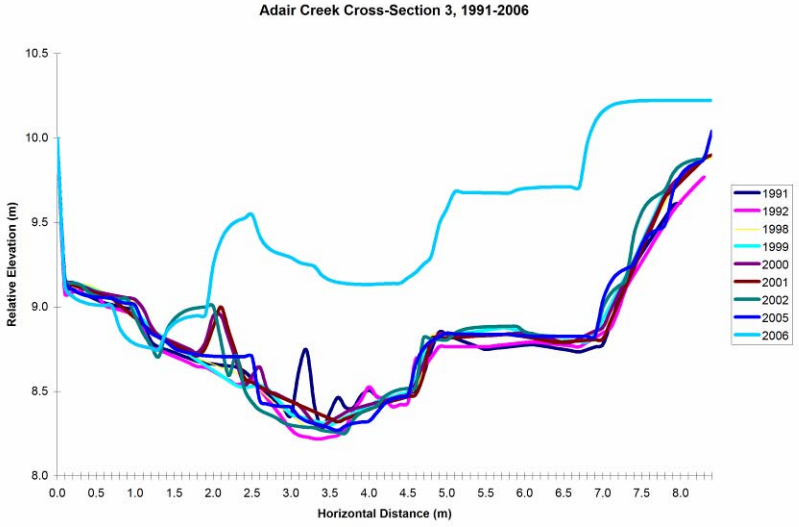

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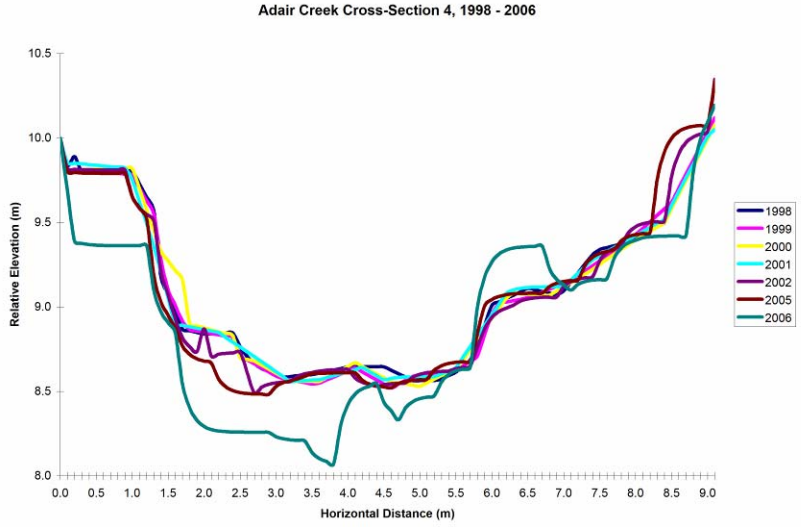

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Water Quality

Cross-Correlation Matrix

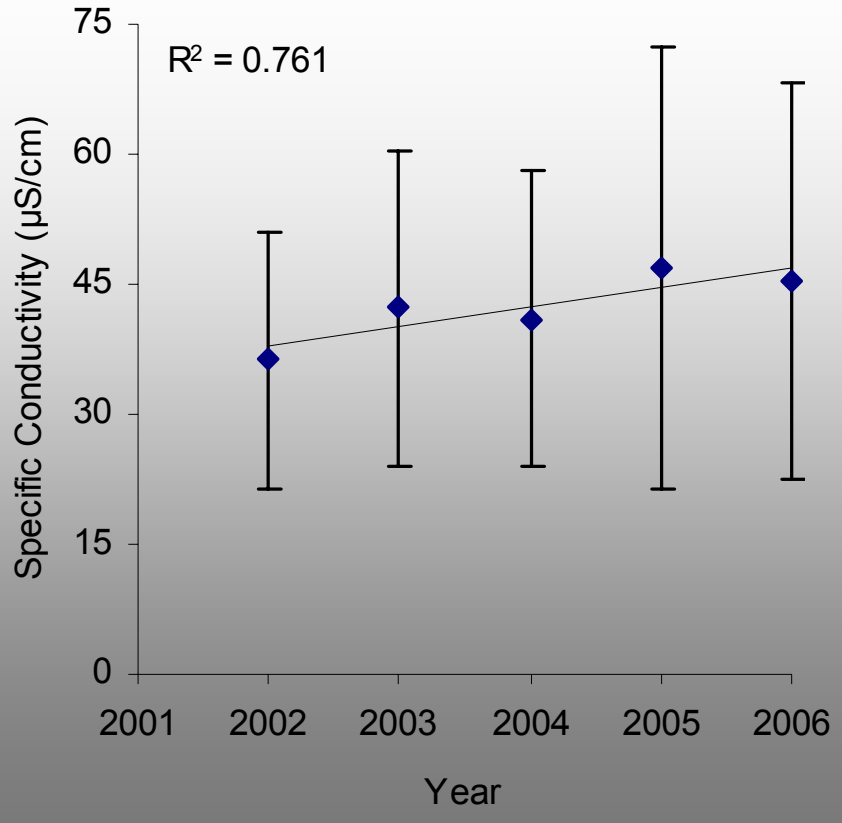
For all Sites and all Years

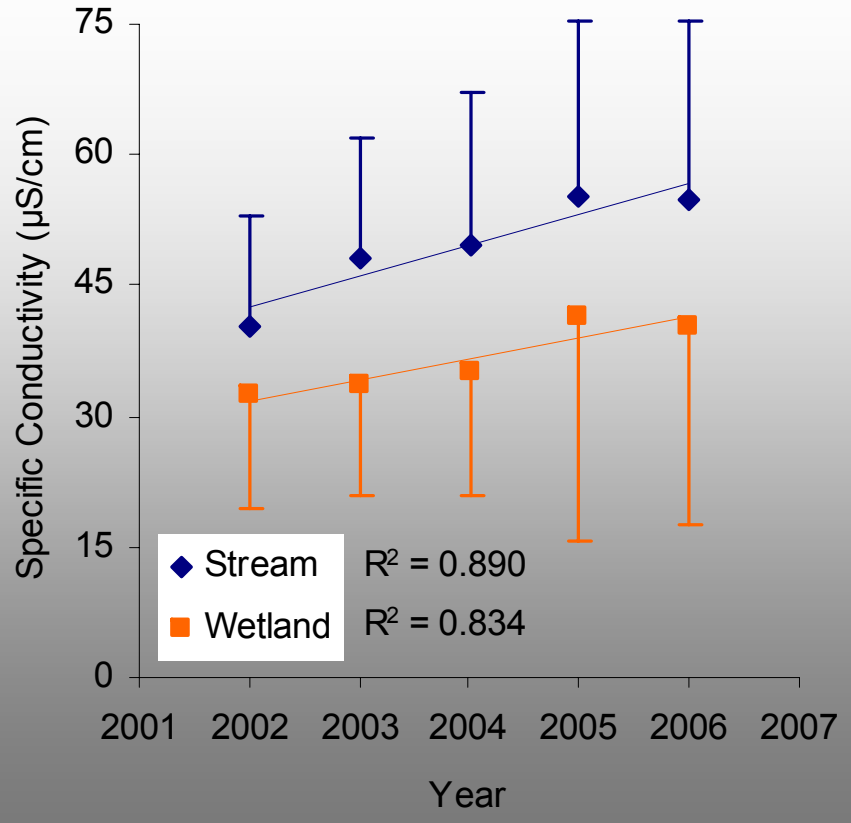
	site_yr	%Developed	Week	Water Temp - YSI (^{o}C)	pH paper (4-7)	Cond (uS/cm)	Sp Cond (uS/cm)	%DO	DO (mg/L)	Turb (NTU)
site_yr	1.00									
%Developed	0.28	1.00								
Week	0.05	-0.06	1.00							
Water Temp - YSI (oC)	0.06	-0.02	0.80	1.00						
pH paper (4-7)	0.09	0.24	0.05	0.07	1.00					
Cond (uS/cm)	0.42	0.15	0.12	0.27	0.32	1.00				
Sp Cond (uS/cm)	0.43	0.16	-0.02	0.10	0.32	0.98	1.00			
%DO	0.07	0.03	0.13	0.14	0.35	0.30	0.29	1.00		
DO (mg/L)	0.07	0.02	0.01	-0.02	0.34	0.26	0.27	0.98	1.00	
Turb (NTU)	0.15	-0.03	0.09	0.03	0.32	0.11	0.12	0.15	0.14	1.00

Note: correlation matrix of water quality parameters by site_yr

Mean Specific Conductivity (µS/cm)

For all Locations by Year

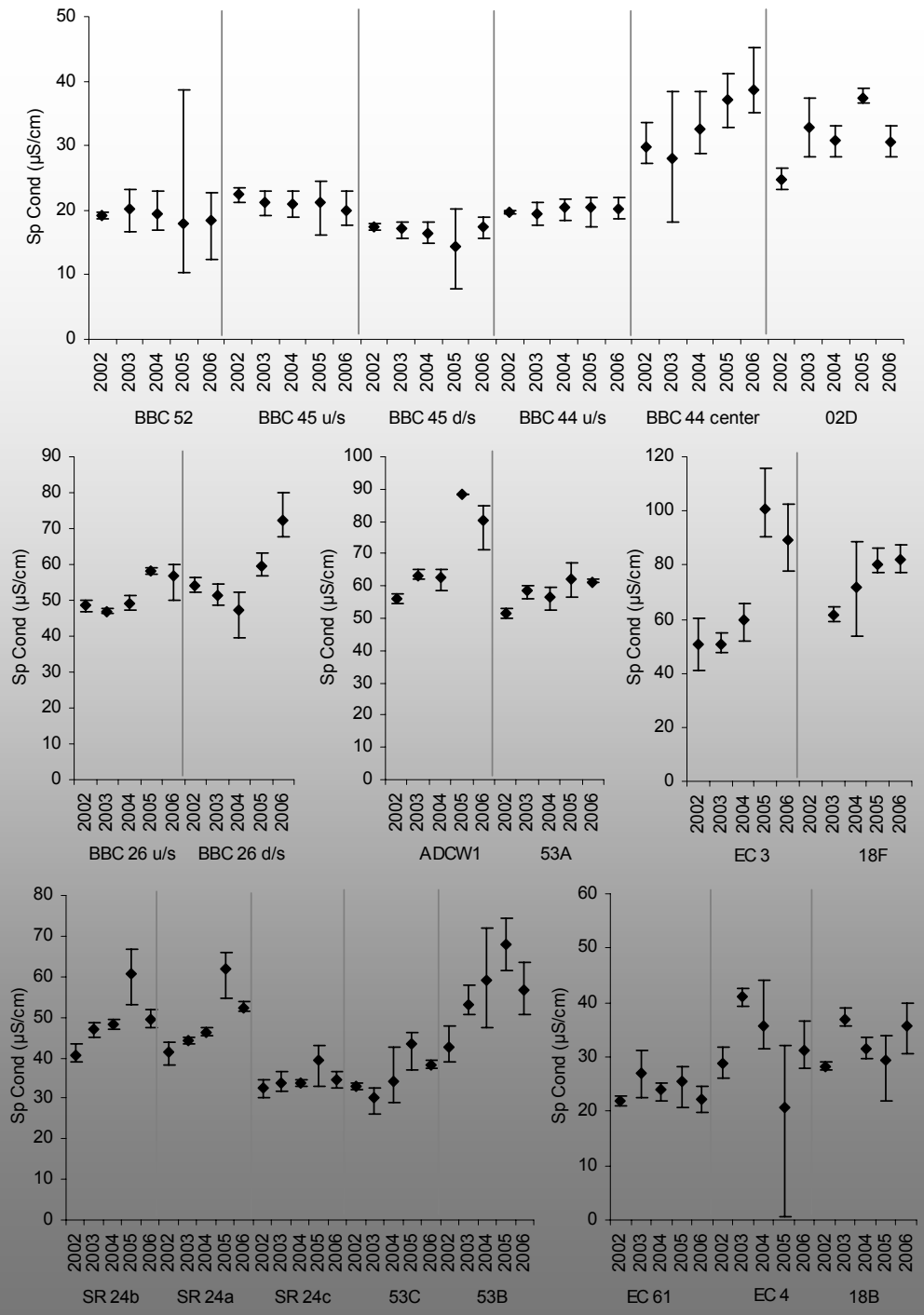




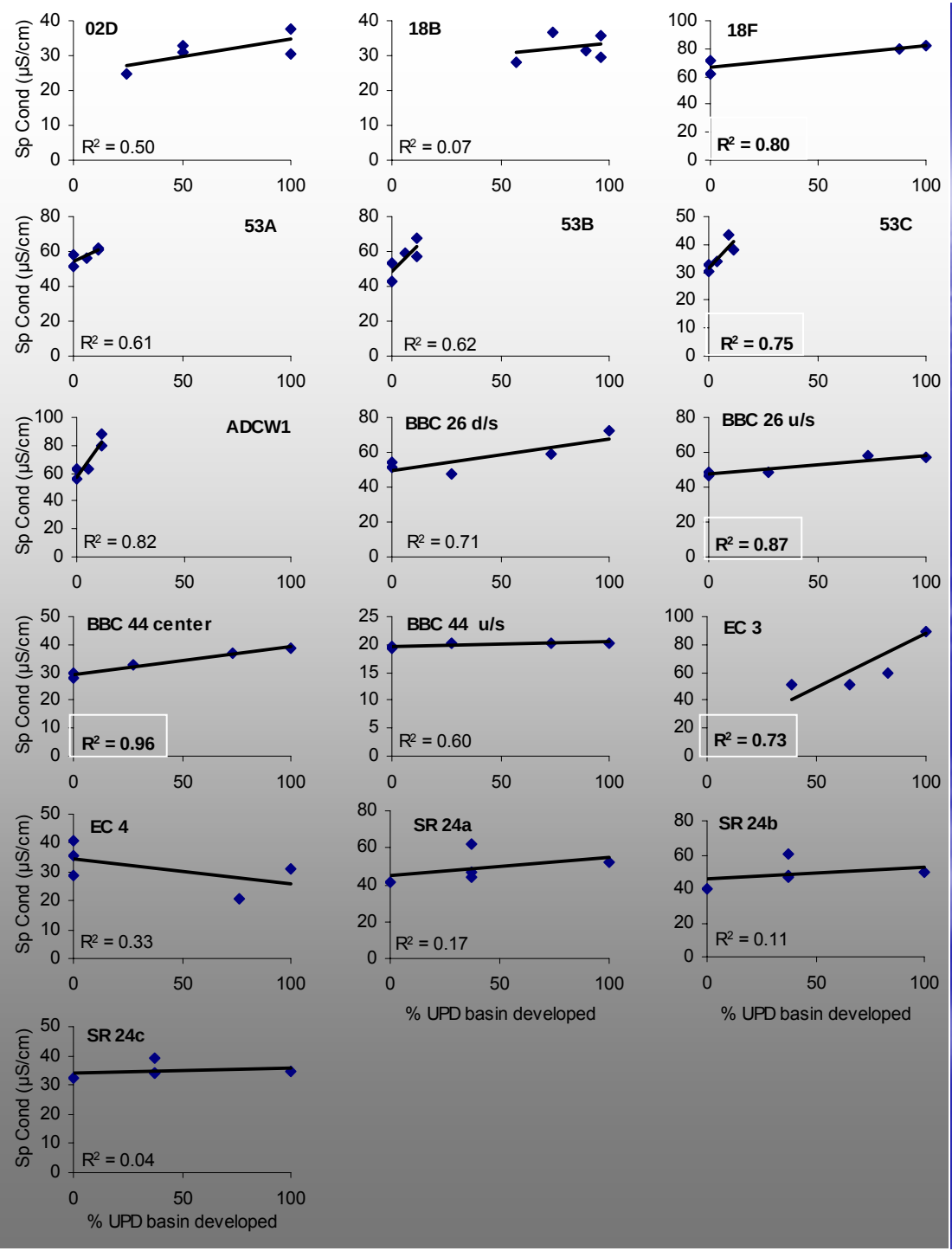
Mean Specific Conductivity

(µS/cm)

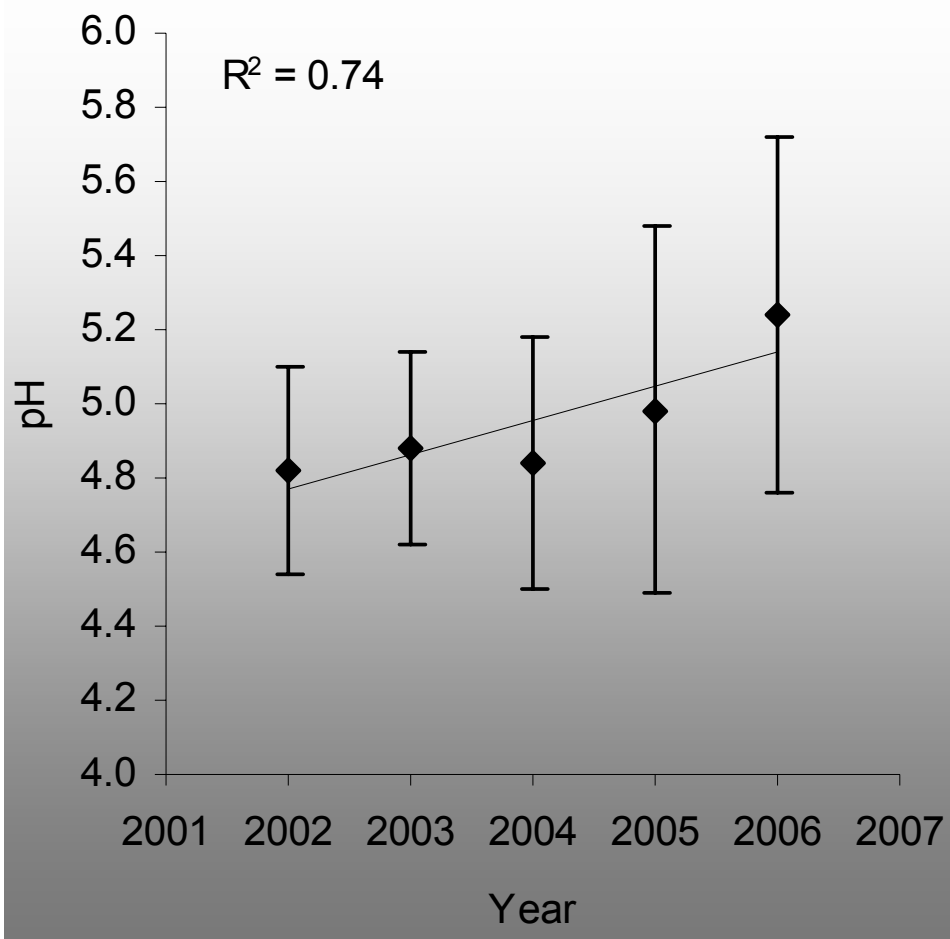
By Location and Year

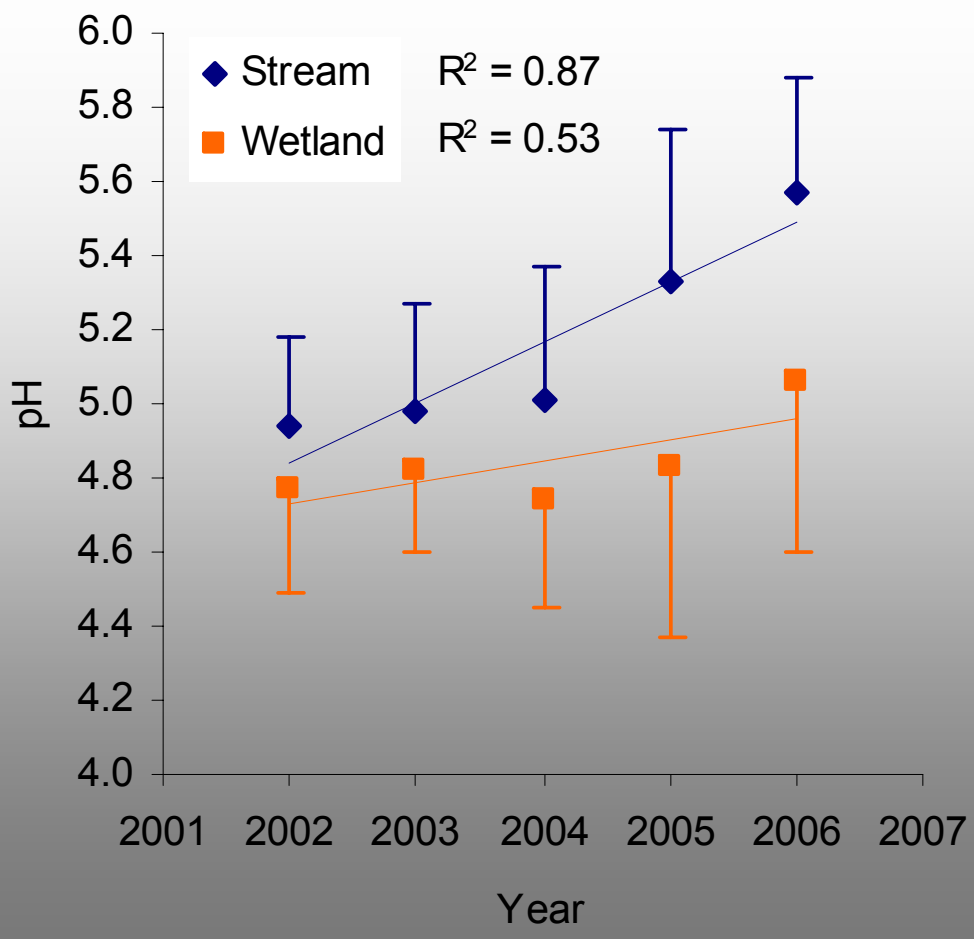


Correlations between % Basin Development and Specific Conductivity (µS/cm)



Mean pH
For all
Locations by Year

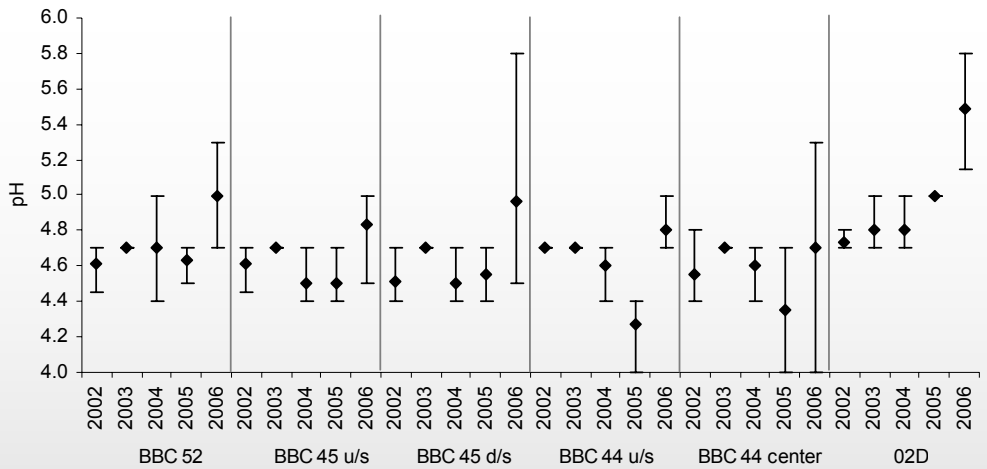


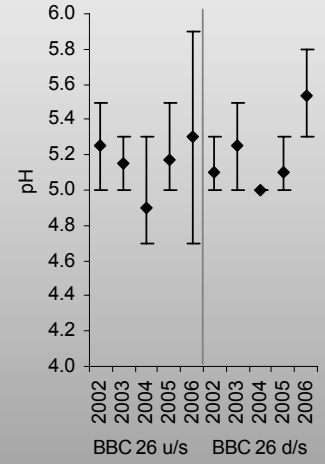


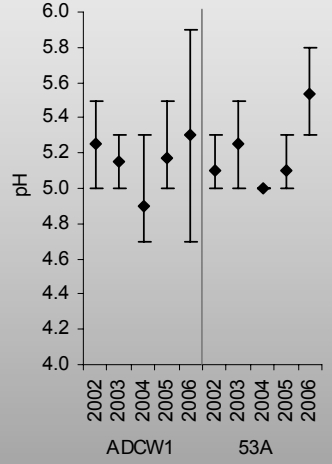
Mean pH

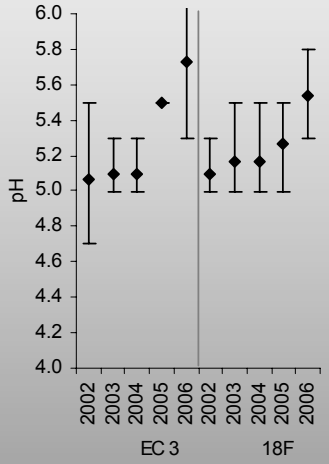
by

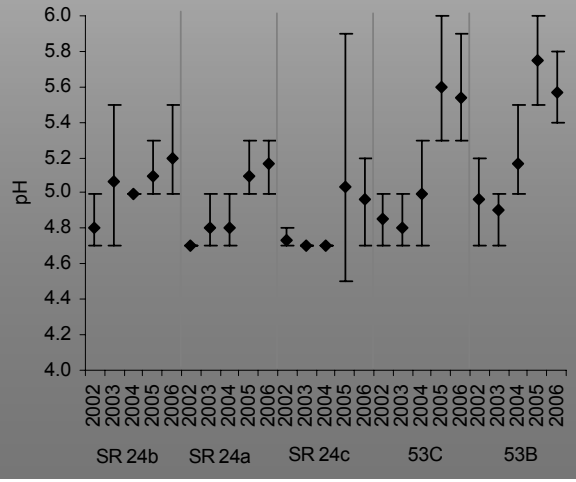
Location and Year

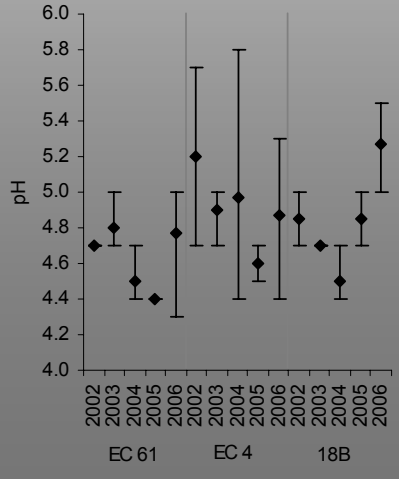




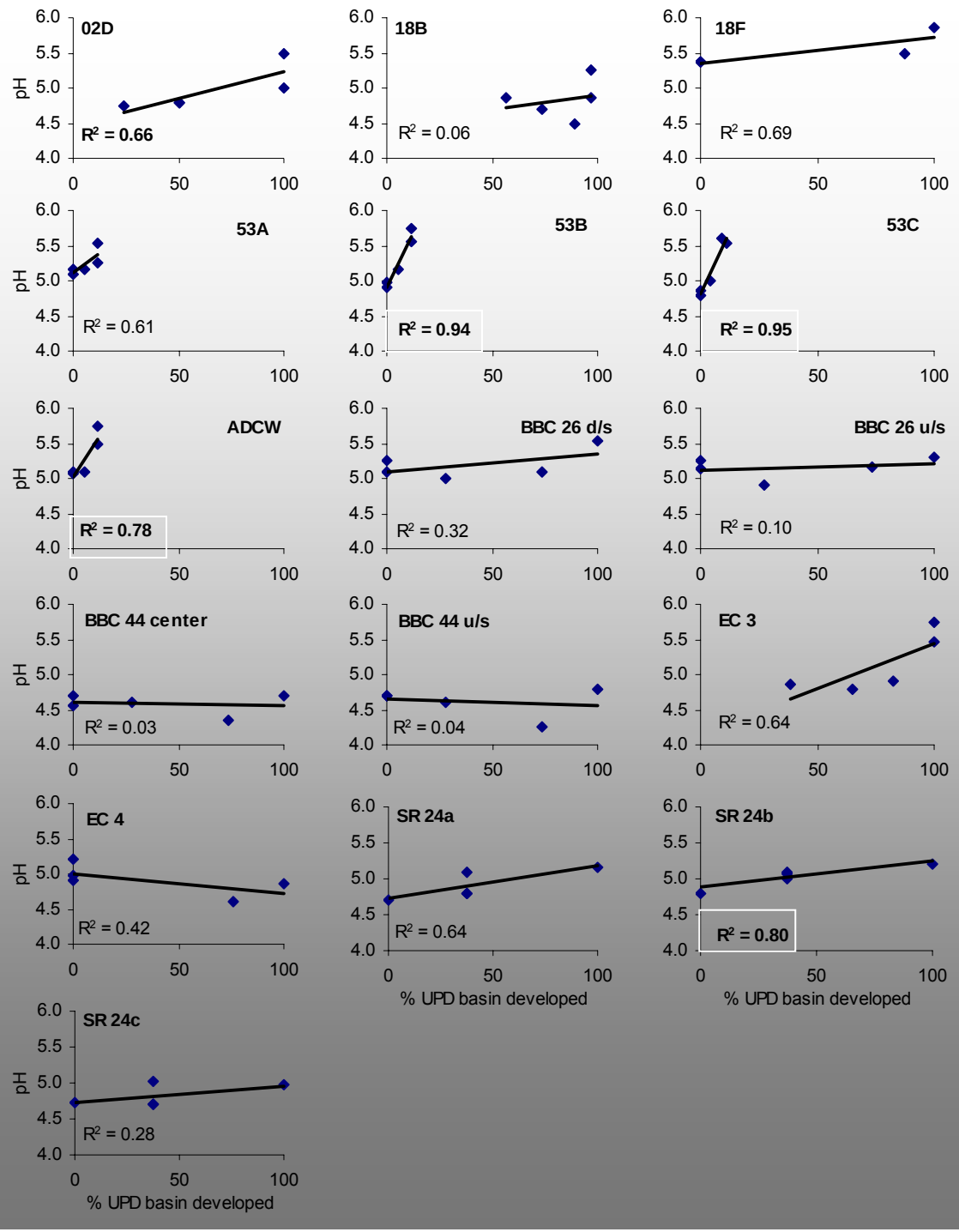








Correlations between pH and % Basin Development

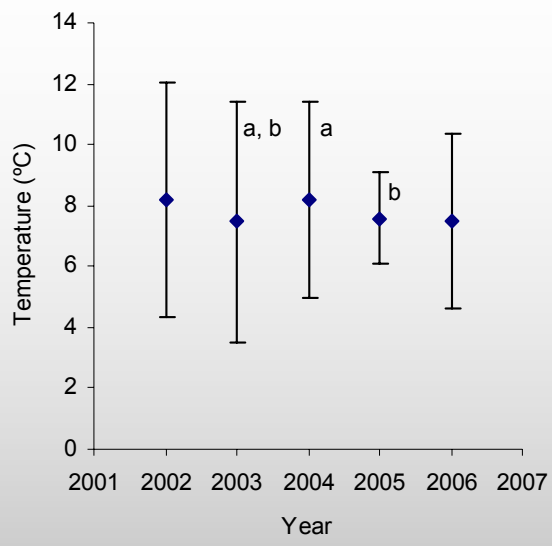


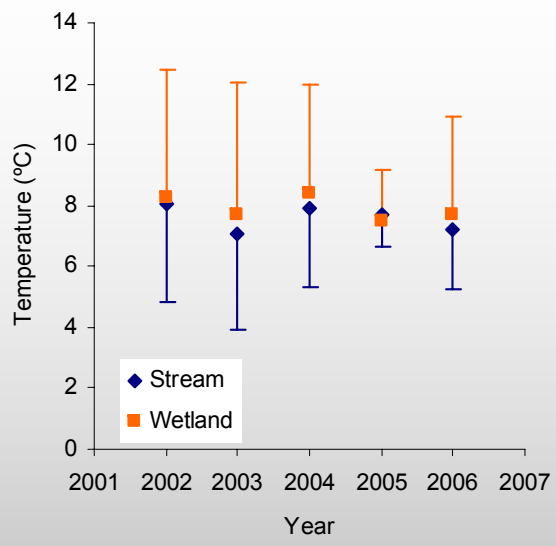
Mean T (ºC)

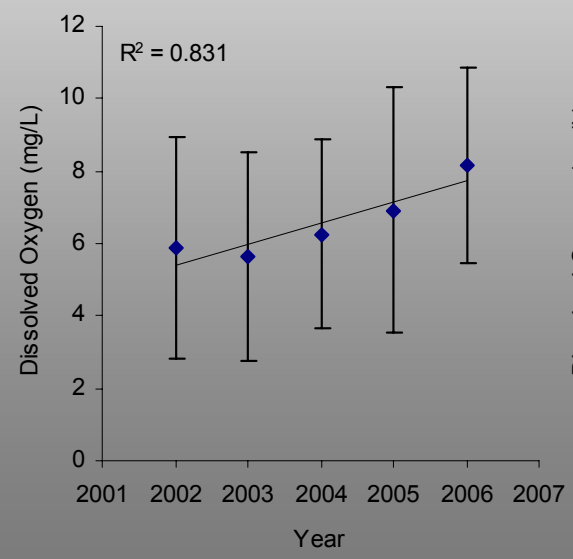
For

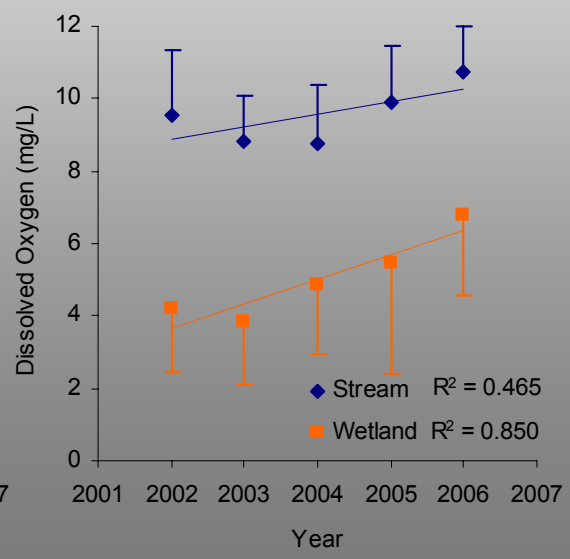
All Locations and Years

Mean DO (mgL^{-1})
For
All Locations and Years







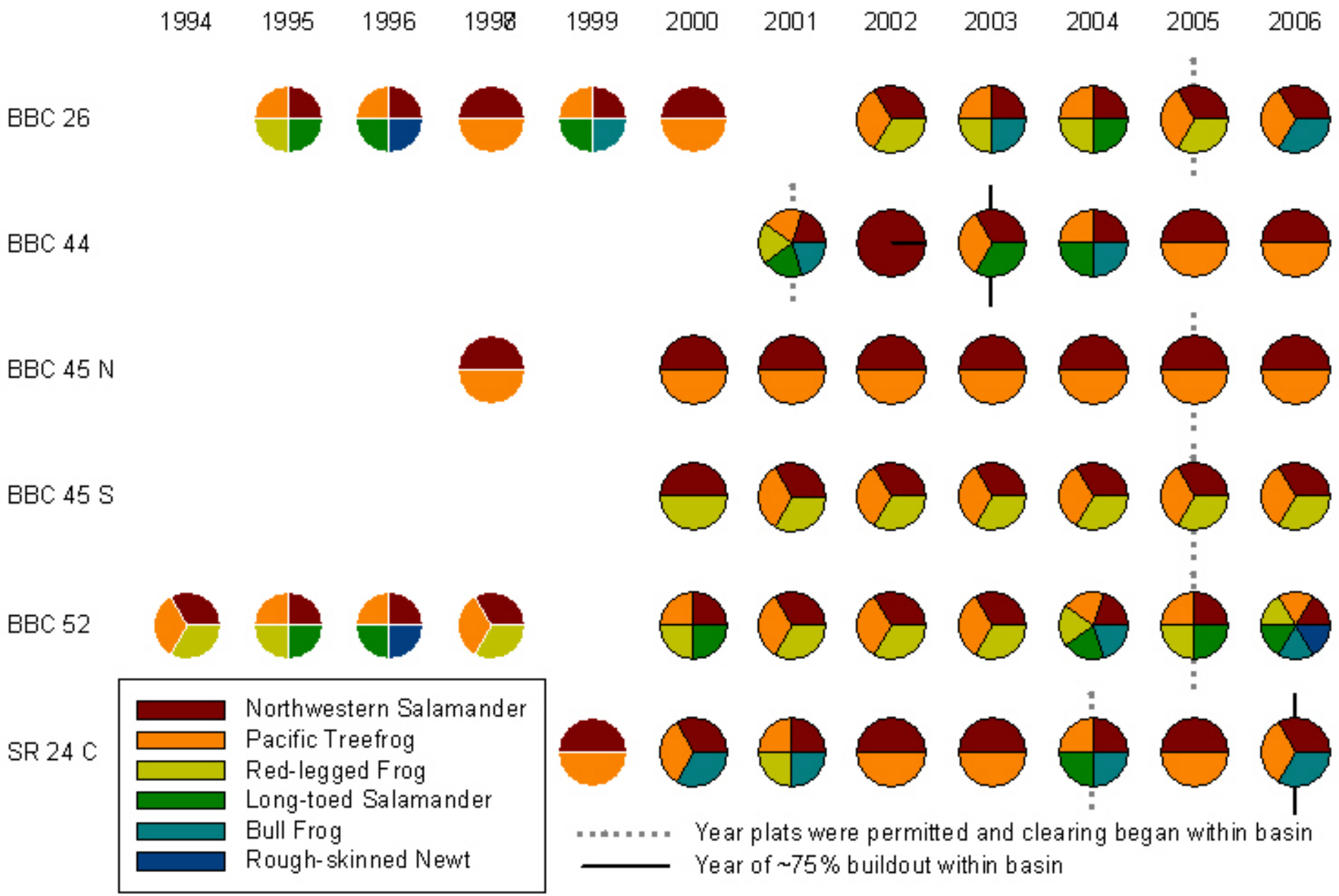


Dissolved Metals Concentrations Exceeding State Acute Toxicity Water Quality Standards for UPD Waterbodies during 2006

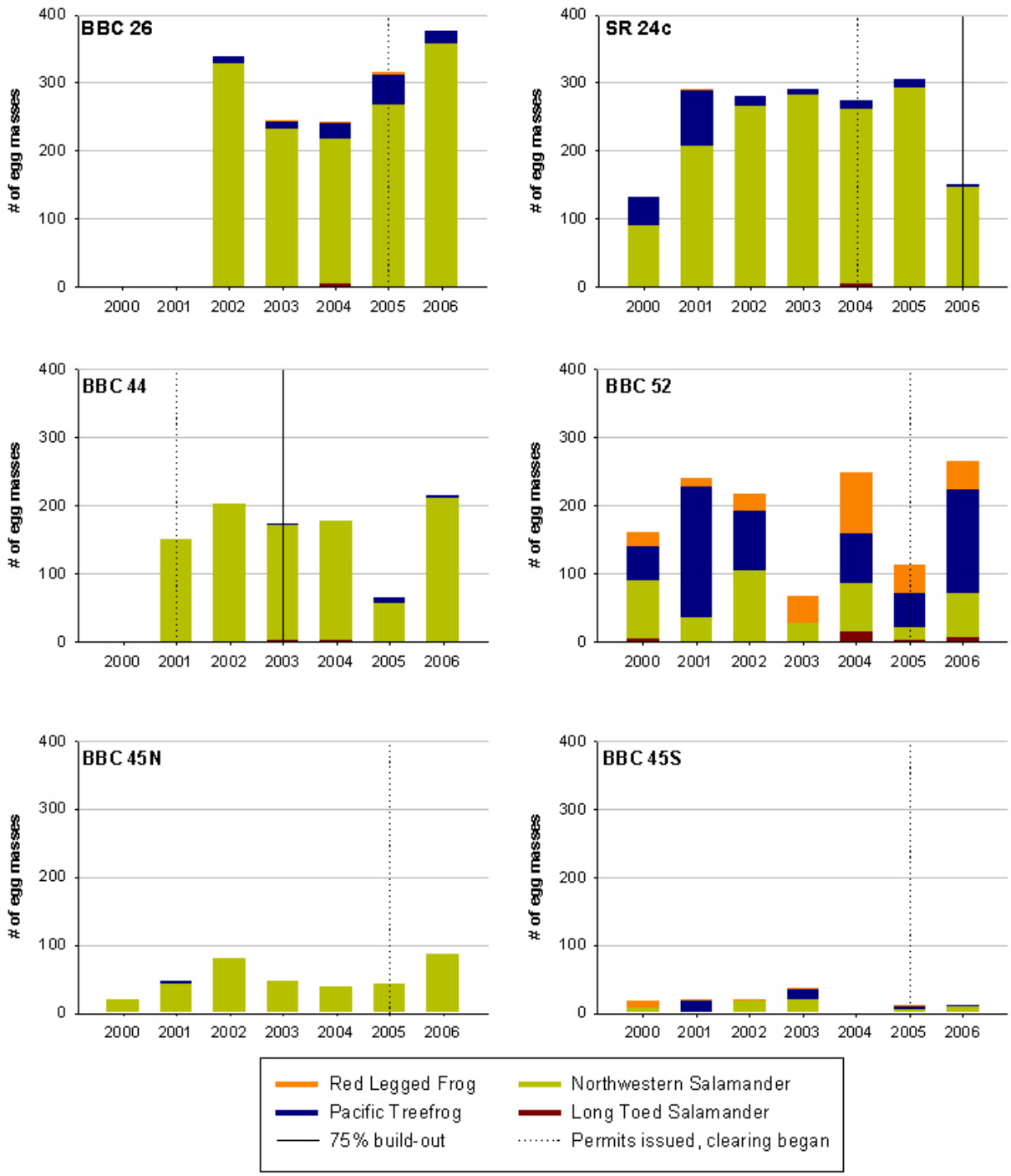
Location	Date	Hardness (mg $CaCO_3L^{-}1$)	Analyte	Total Metal ($\mu gL^{-}1$)	Dissolved Metal ($\mu gL^{-}1$)
53 C	1-25-06	11.4	Zinc	0.0259	0.0251
53 C	2-28-06	12.5	Zinc	0.0320	0.0310
53 C	4-20-06	13.7	Zinc	0.0325	0.0315
BBC 44 u/s	1-25-06	4.7	Zinc	0.0083	0.0081
BBC 45 u/s	2-28-06	4.3	Zinc	0.0110	0.0107
SR 24b	2-28-06	16.6	Copper	0.0456	0.0442

Klaus Richter

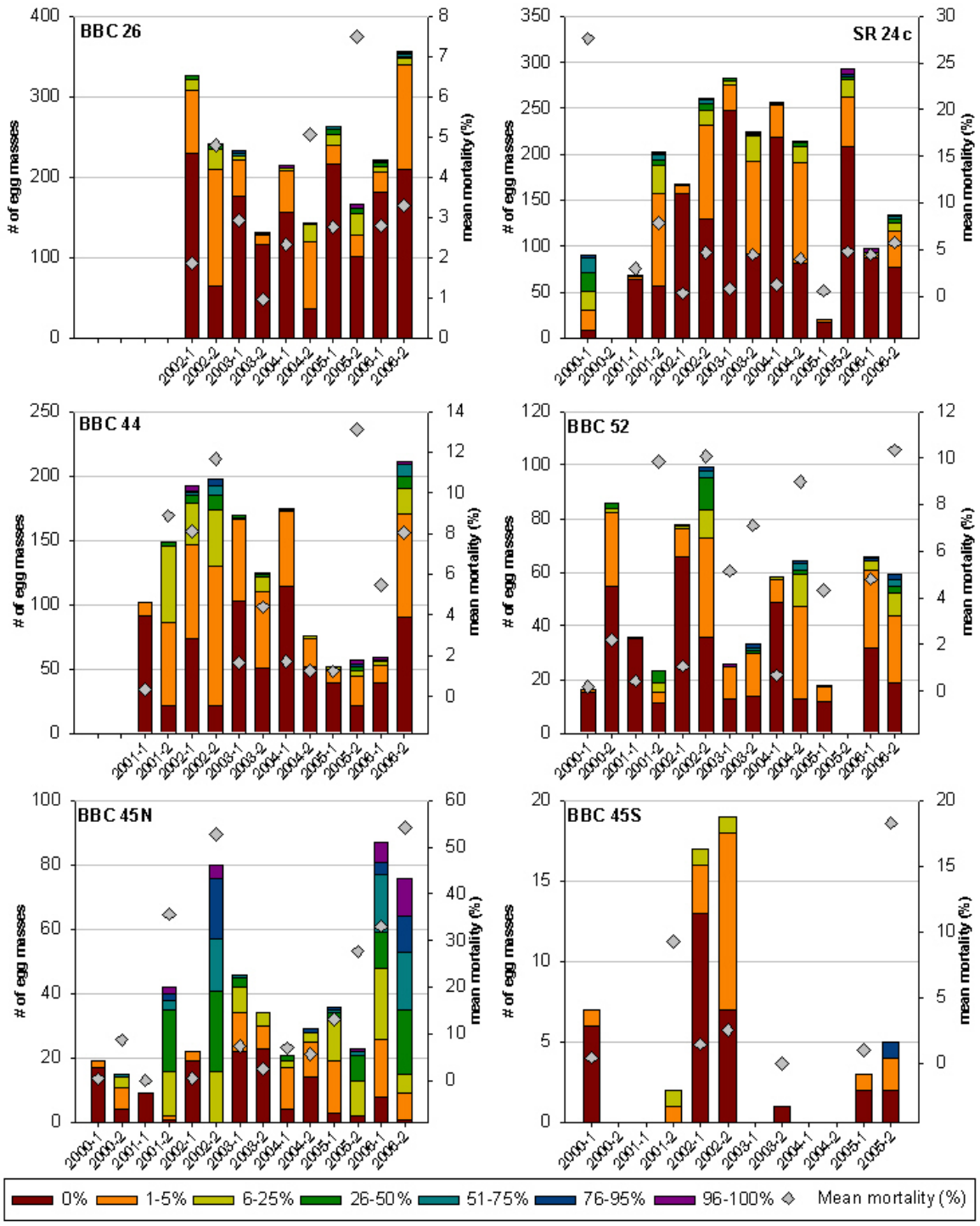
Amphibian Community Composition and Distribution at UPD Monitoring Locations 1994 - 2006



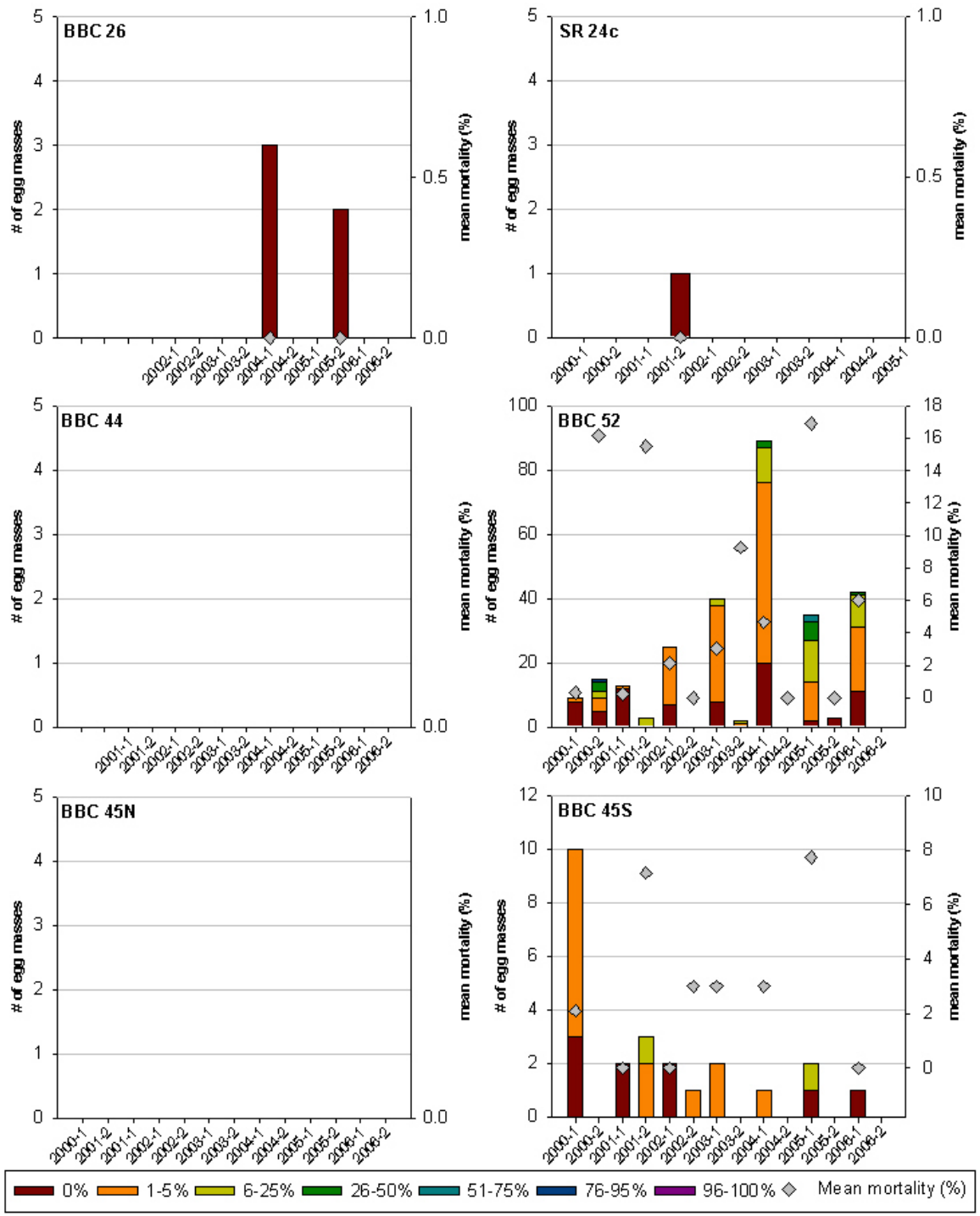
Amphibian Egg Mass Abundance by Location and Year



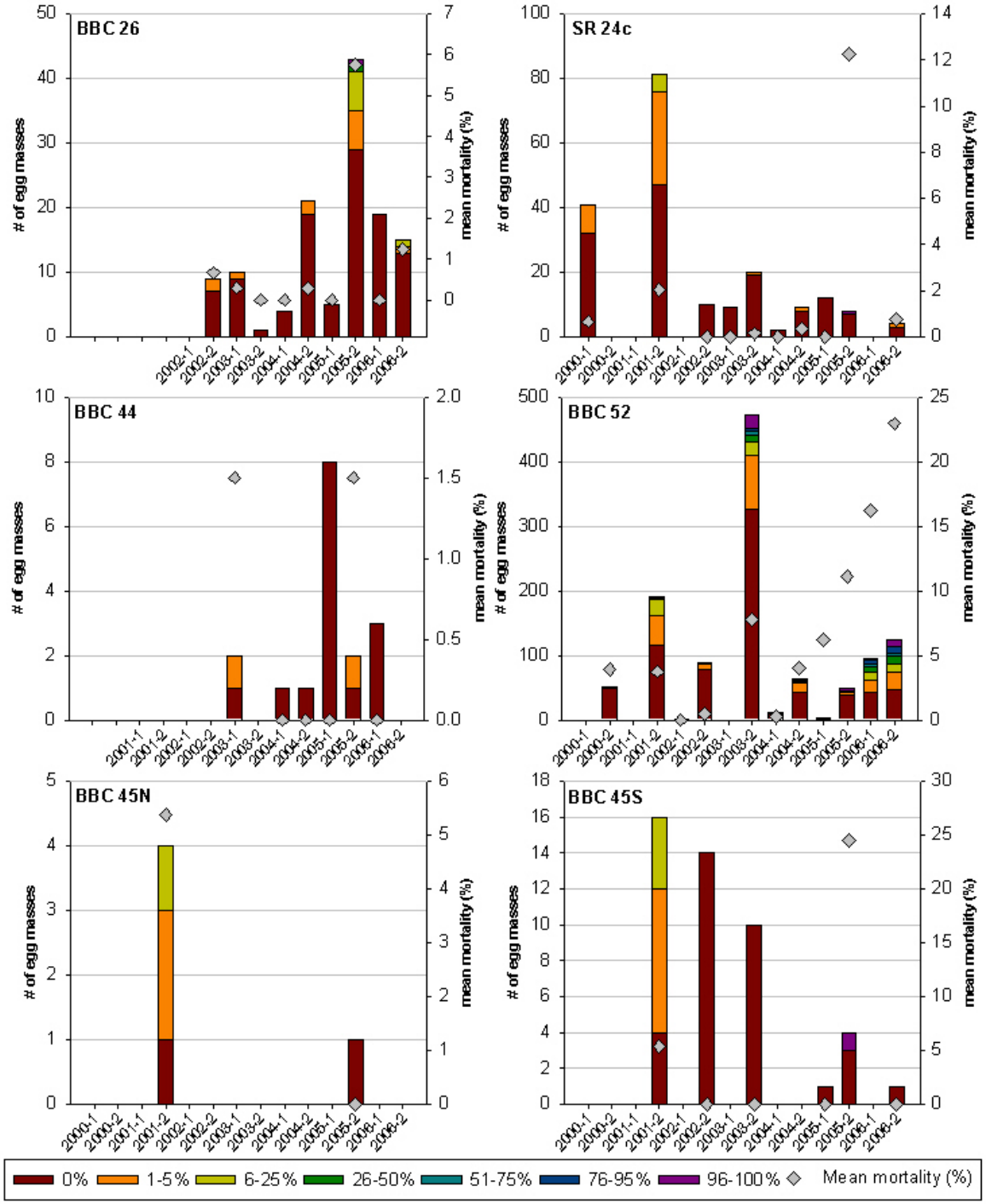
Northwest Salamander Egg Mass Abundance and Mortality by Location and Year



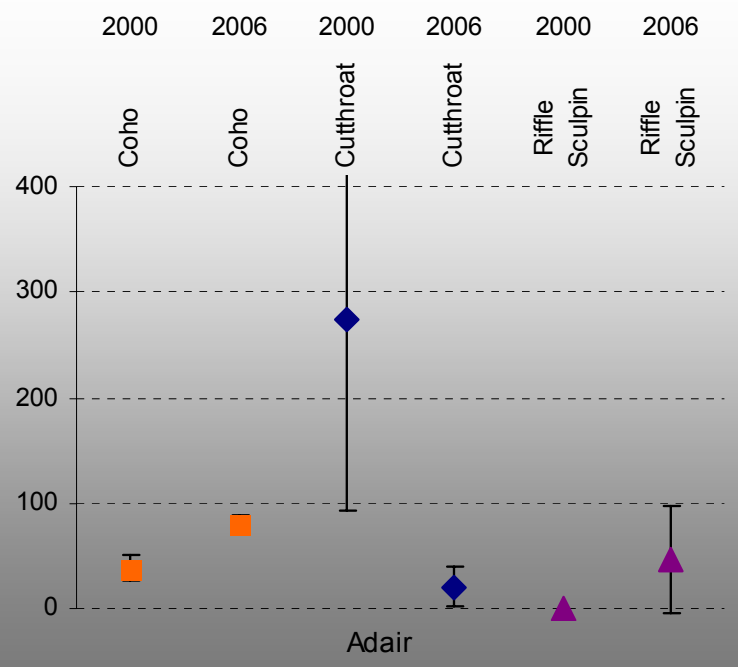
Red-Legged Frog Egg Mass Abundance and Mortality by Location and Year

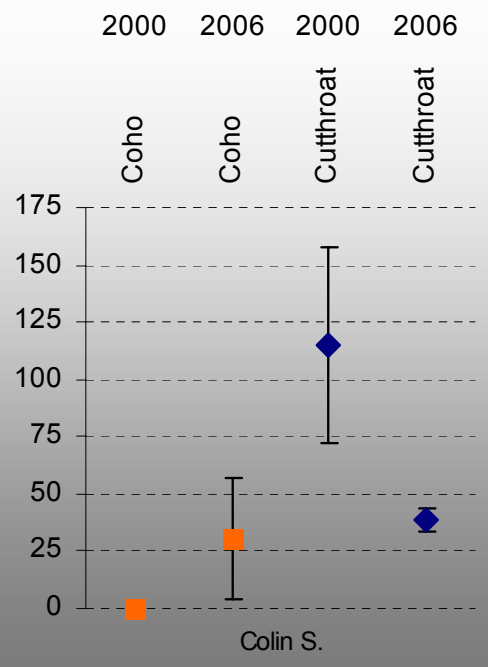


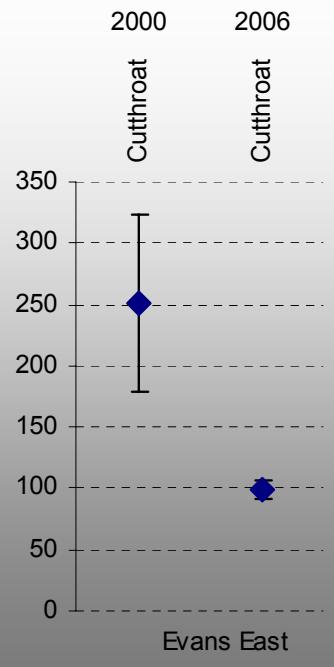
Pacific Tree Frog Egg Mass Abundance and Mortality by Location and Year



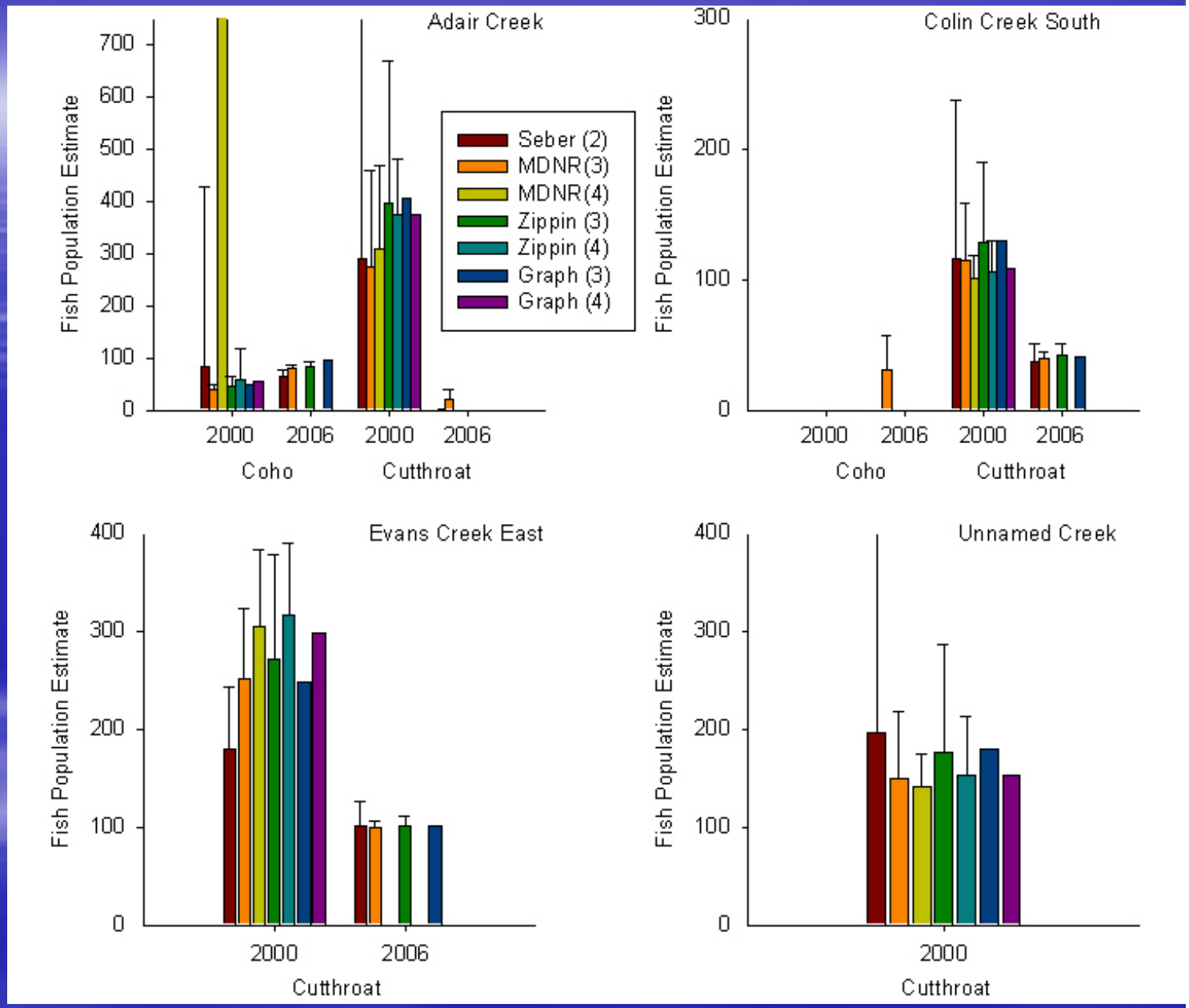
Fish Abundance Estimates in UPD Streams 2000 & 2006







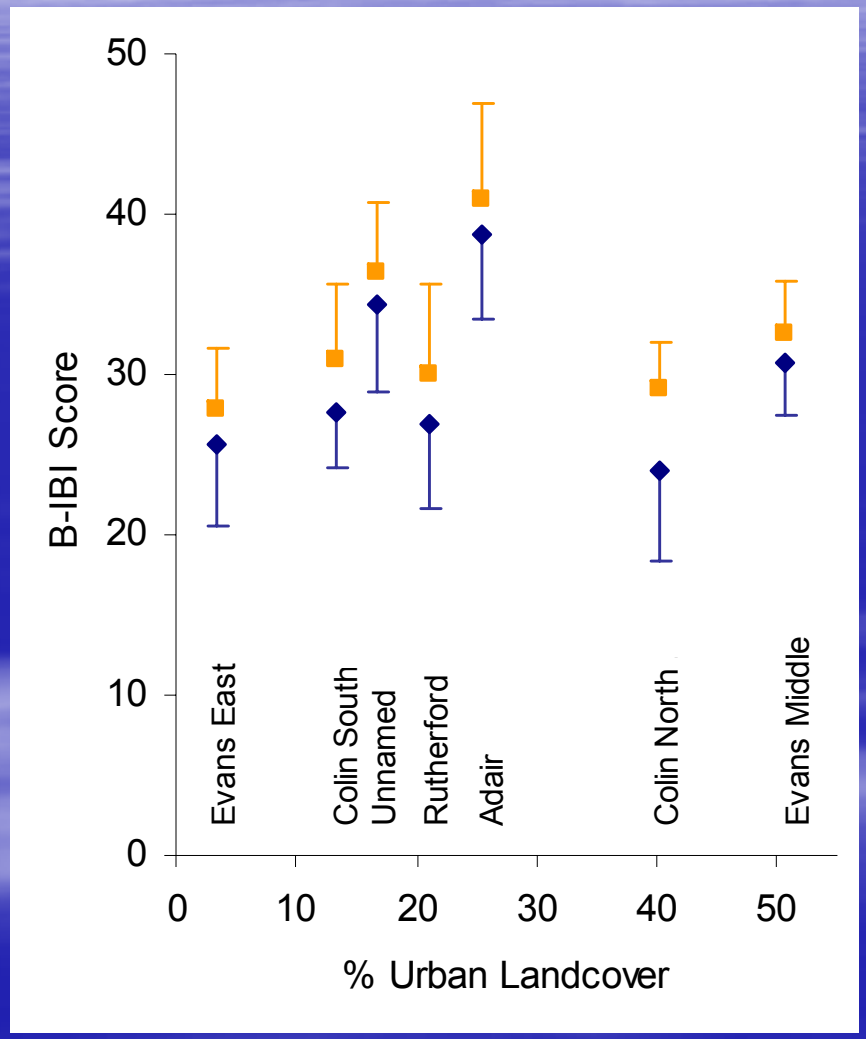
Variability Among Population Estimate Algorithms for Fish in UPD Streams

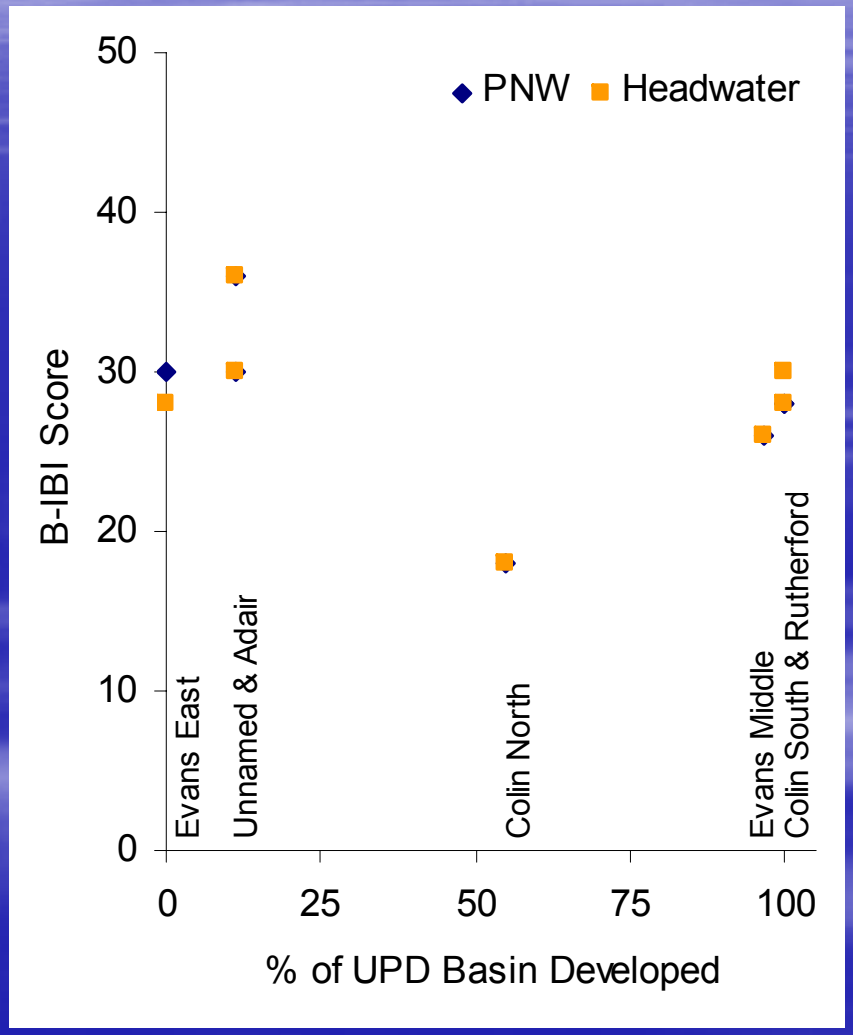


Summary of Fish Sampling Results in UPD Streams, 1991 - 2006

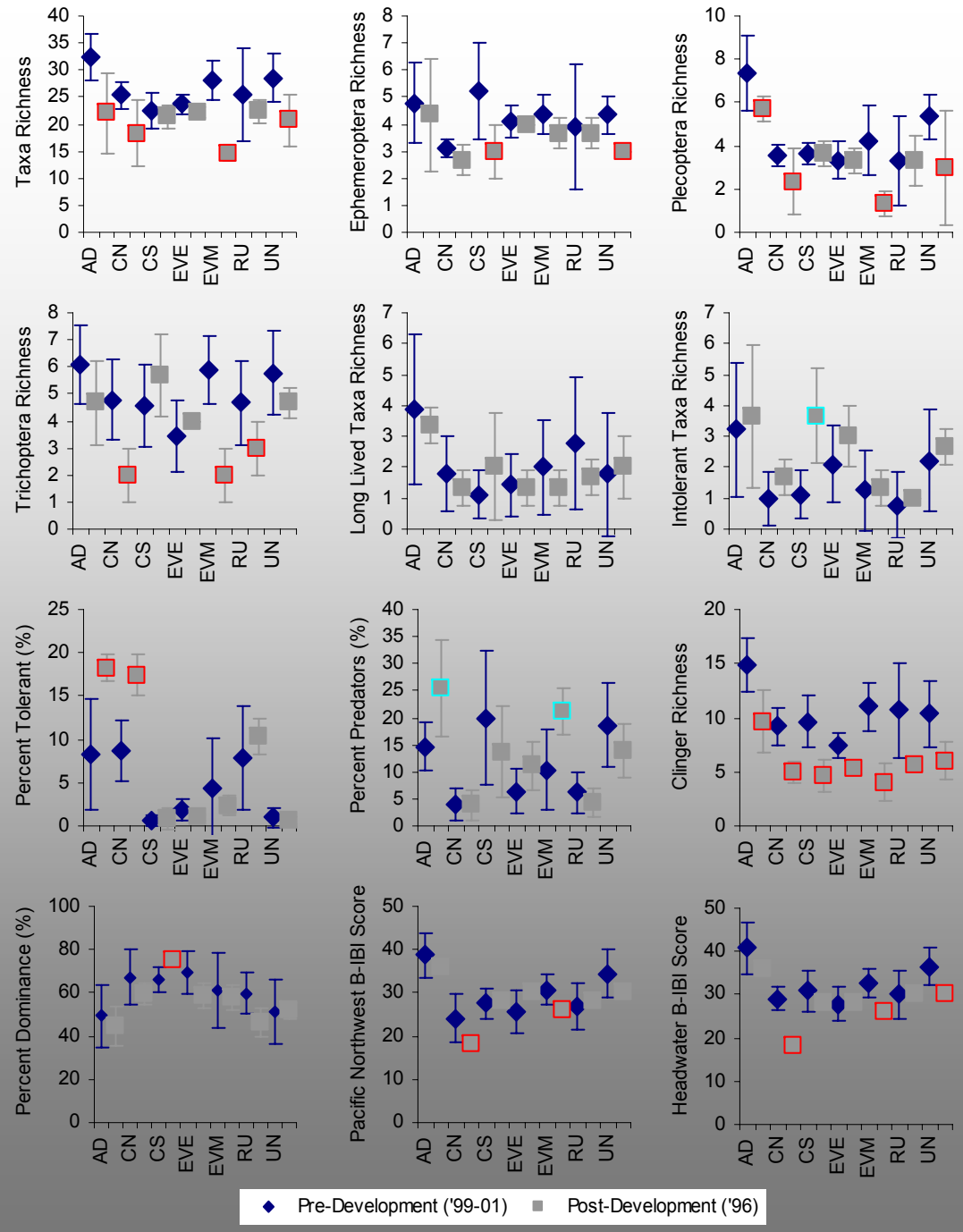
Stream	1991	2000	2006
Adair	Cutthroat	Cutthroat, Coho	Cutthroat, Coho, Riffle Sculpin
Colin South	Cutthroat	Cutthroat	Cutthroat, Coho
Evans East	No fish	Cutthroat	Cutthroat, Pumpkinseed
Unnamed	Cutthroat	Cutthroat	Not Sampled

B-IBI Scores for % Urban Landcover by Basin (left panel) and relative to % Developed by Basin (right panel)





Mean Values for 10 B-IBI Metrics relative to Pre- and Post-Development Conditions in the UPDs



Mean B-IBI scores for pre- and post-development for the PNW B-IBI and the headwater (HW) B-IBI

	Pre-development			Post-development		
	PNW B-IBI	HW B-IBI	Biological Condition	PNW B-IBI	HW B-IBI	Biological Condition
Adair	**39**	**41**	**Good**	**36**	**36**	**Fair**
Colin N	**24**	**29**	**Poor/Fair**	**18**	**18**	**Poor**
Colin S	**28**	**31**	**Poor/Fair**	**28**	**28**	**Fair**
Evans East	**26**	**28**	**Poor/Fair**	**30**	**28**	**Fair**
Evans Middle	**31**	**33**	**Fair**	**26**	**26**	**Poor**
Rutherford	**27**	**30**	**Poor/Fair**	**28**	**30**	**Fair**
Unnamed	**34**	**36**	**Fair**	**30**	**30**	**Fair**

Change matrix for individual metrics and total B-IBI scores between pre- and post-development periods

Individual Metric	Expected response to urbanization	Adair	Colin North	Colin South	Evans East	Evans Middle	Rutherford	Unnamed
Taxa Richness	Decrease	Y	Y	N	N	Y	N	Y
E Richness	Decrease	N	N	Y	N	N	N	Y
P Richness	Decrease	Y	Y	N	N	Y	N	Y
T Richness	Decrease	N	Y	N	N	Y	Y	N
Long-lived Richness	Decrease	N	N	N	N	N	N	N
Intolerant Richness	Decrease	N	N	N	N	N	N	N
% Tolerant	Increase	N	Y	N	N	N	N	N
% Predators	Decrease	N	N	N	N	N	N	N
Clinger Richness	Decrease	Y	Y	Y	Y	Y	Y	Y
% Dominance	Increase	N	N	Y	N	N	N	N
PNW B-IBI	Decrease	N	Y	N	N	Y	N	N
Headwater B-IBI	Decrease	N	Y	N	N	Y	N	Y

Mean B-IBI scores for 1999-2001 (pre-development) and 2006 (post-development) calculated with two scoring methods (PNW and Headwater) along with the percent change between periods

	Pacific Northwest B-IBI				Headwater B-IBI		
	pre-	post-	% change		pre-	post-	% change
Adair	39	36	-6.9		41	36	-12.0
Colin N	24	18	**-25.0**		29	18	**-38.2**
Colin S	28	28	1.6		31	28	-9.4
Evans East	26	30	17.4		28	28	0.8
Evans Middle	31	26	-15.4		33	26	**-20.0**
Rutherford	27	28	4.1		30	30	0.0
Unnamed	34	30	-12.9		36	30	-17.7

Conclusions

- SEPA and UPD permit conditions have largely been met
- Everything is changing
- Difficult or impossible to assign causation
- Need more monitoring
- Hypothesis testing framework

Acknowledgements

- Kari Osterhaug
- Liz Ritzenthaler
- Many many dedicated and talented King County personnel
- Jo Wilhelm