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Benthic-invertebrate Biomonitoring in Muskoka

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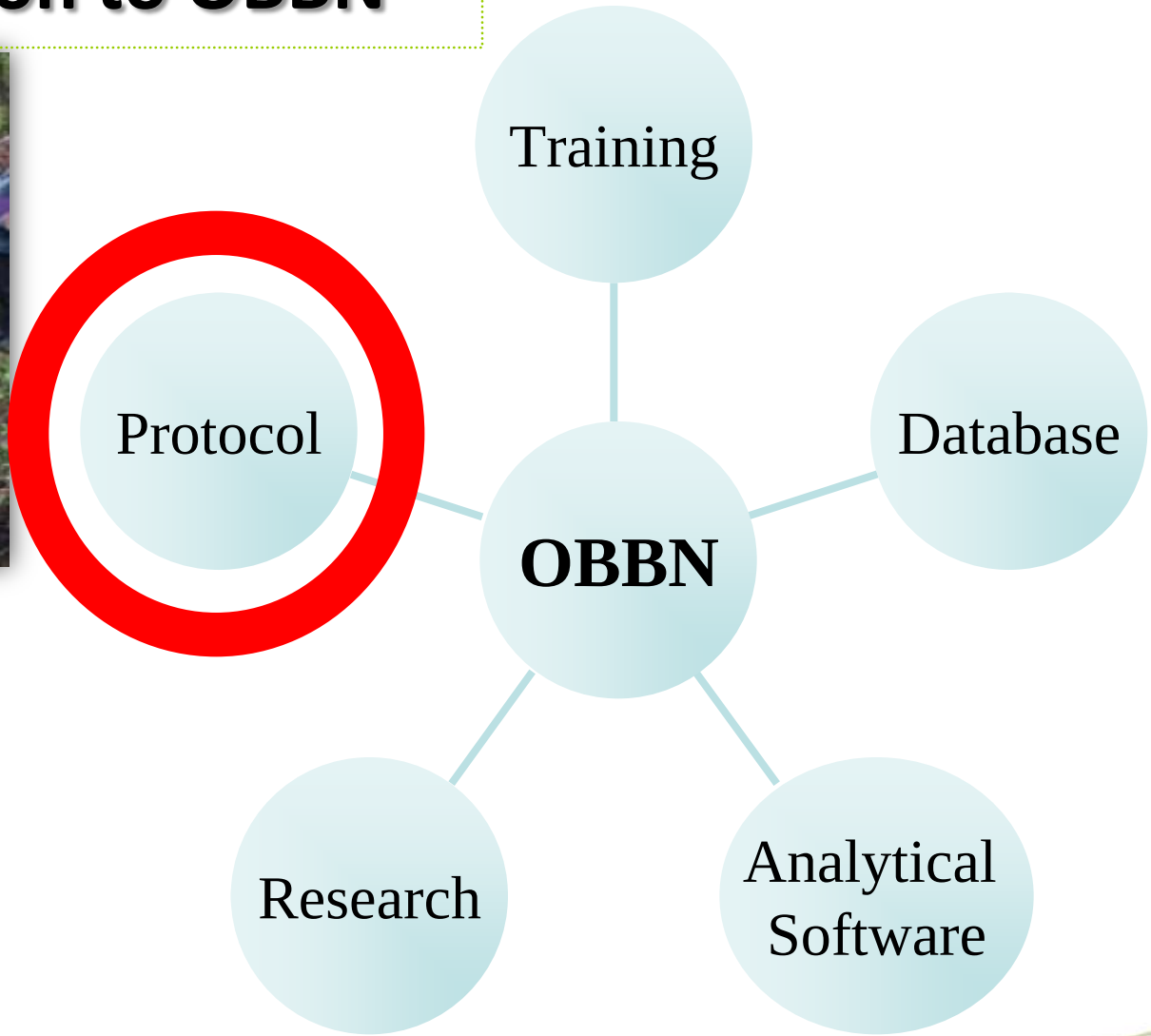
Biomonitoring Rationale

"Biomonitoring is required … because the consequences of environmental stress can only be determined by an appraisal of the biota". –Wright (2000)

"Since the effect of stream pollution is an alteration of the aquatic ecosystem, evaluation of that ecosystem is the logical way to detect pollution" –Hilsenhoff (1977)

Introduction to OBBN



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Biomonitoring Questions: Muskoka

1. How biologically diverse are the benthic communities in Muskoka's lakes and streams?

2. How variable is biodiversity in Muskoka?

3. Have spatial or temporal patterns emerged?

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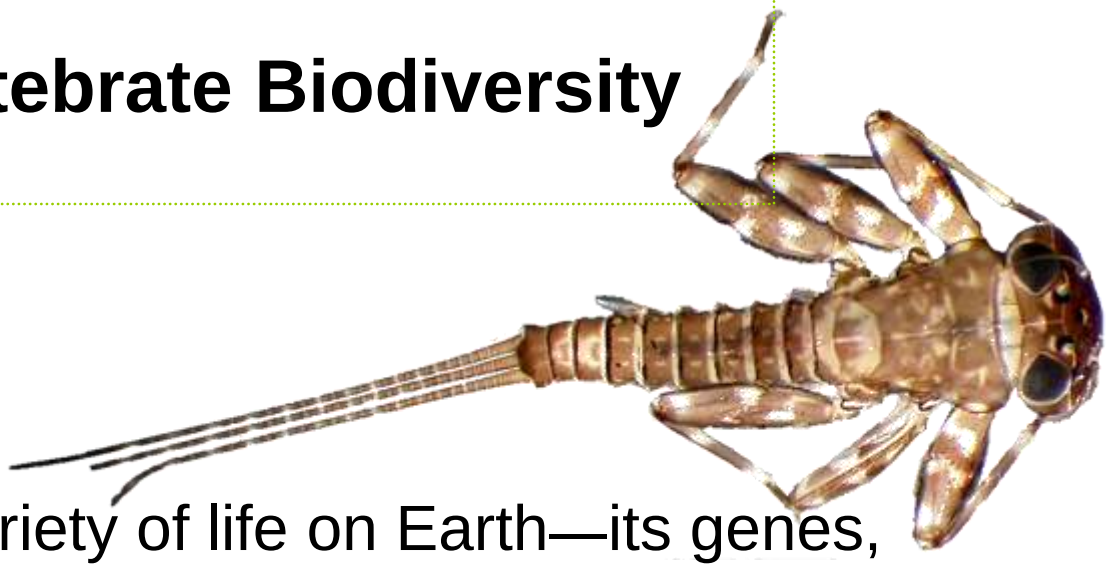
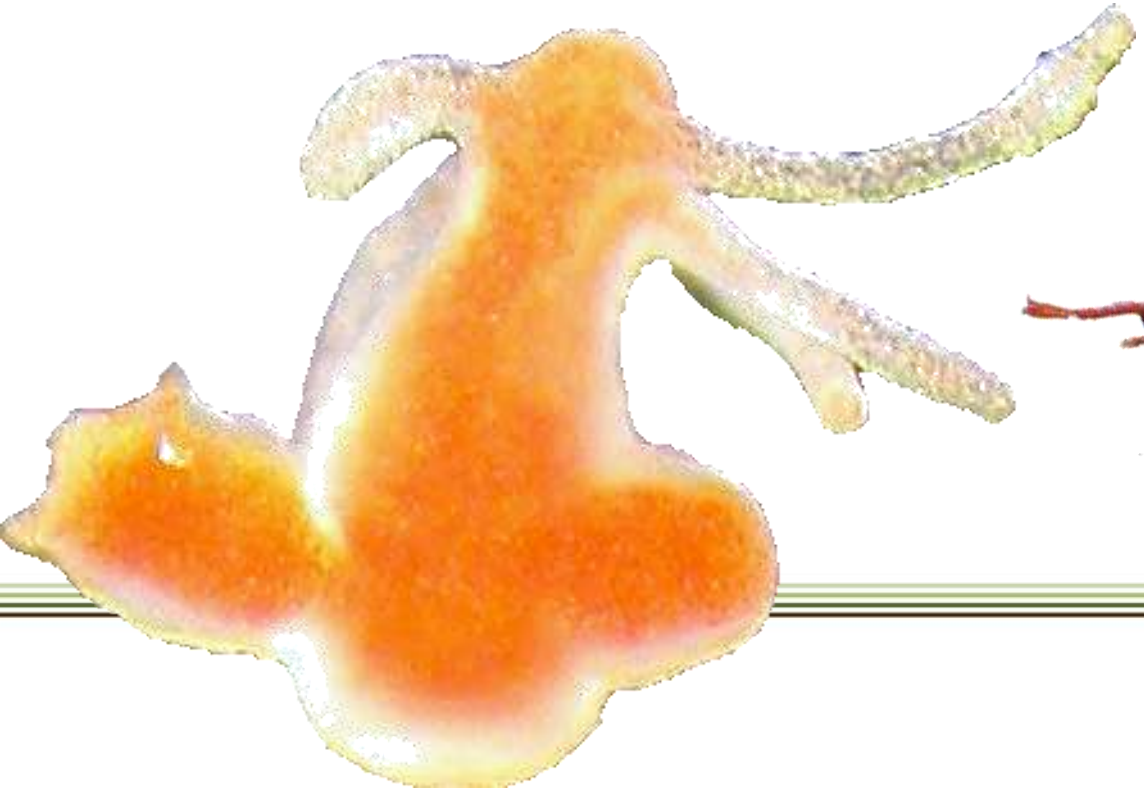
Benthic-invertebrate Biodiversity



Biodiversity ... Is the variety of life on Earth—its genes, species, populations, and ecosystems (Pimm et al. 2008)



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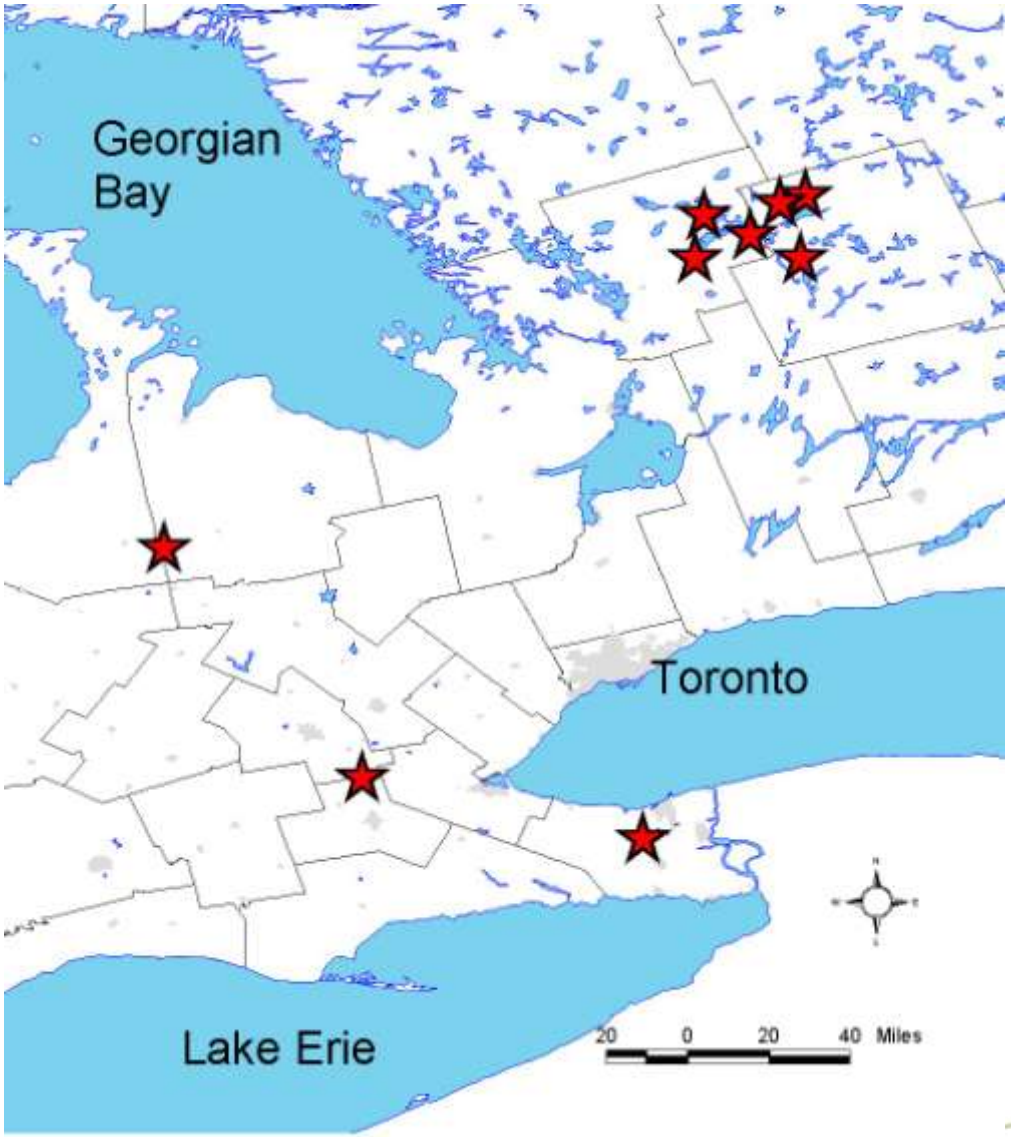
Biodiversity is Important

- Our own health and happiness depends on it
- Makes ecosystems resilient
- Most ecosystem services are linked to it

Temporal Study of Streams

- 9 reference streams sampled 2004-2007
- 3 transect locations set-up in a single riffle in each stream
- Single transect sampled every 2nd week, ice-free season (same transect sampled every 6th week)
- $Richness_{27\text{-}grp}$ corrected to standard 100-count



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27-group "Order-level" taxonomy

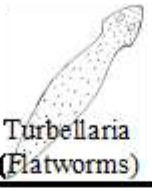
Water Body Name: _____ Site #: _____ Replicate #: _____ Date (mm/dd/yyyy) and Time: _____

Organization: _____ Department: _____ Address: _____

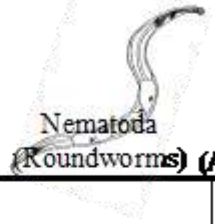
Contact: _____ Phone: _____ E-mail: _____ % picked for 100-count _____ # of vials: _____

Circle Method: (Sub-sampling) Marchant Box / Teaspoon (Location) Field / Lab (Preservation) Live / Preserved (Magnification) Microscope / Unaided

Coelenterata (Hydras)



Turbellaria (Flatworms)

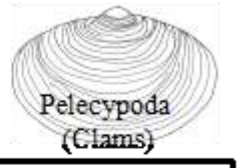


Nematoda (Roundworms)

Oligochaeta (Aquatic Earthworms)

Hirudinea (Leeches)

Isopoda (Sow Bugs)



Pelecypoda (Clams)

Amphipoda (Scuds)

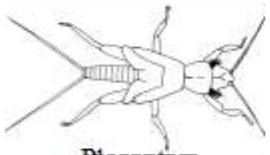
Decapoda (Crayfish)

Trombidiformes-Hydracarina (Mites)

Ephemeroptera (Mayflies)

Anisoptera (Dragonflies)

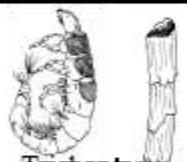
Zygoptera (Damselflies)



Plecoptera (Stoneflies)

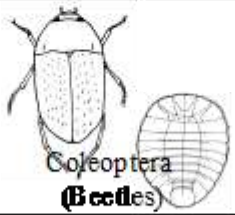
Hemiptera (True Bugs)

Megaloptera (Fishflies, Alderflies)



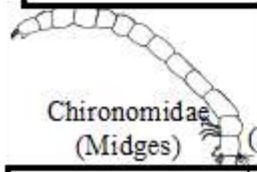
Trichoptera (Caddisflies)

Lepidoptera (Aquatic Moths)



Coleoptera (Beetles)

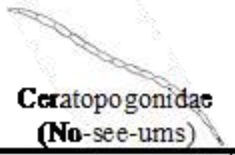
Gastropoda (Snails, limpets)



Chironomidae (Midges)

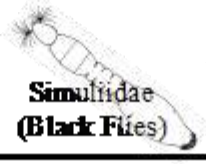
Tabanidae (Horse and Deer Flies)

Culicidae (Mosquitos)



Ceratopogonidae (No-see-ums)

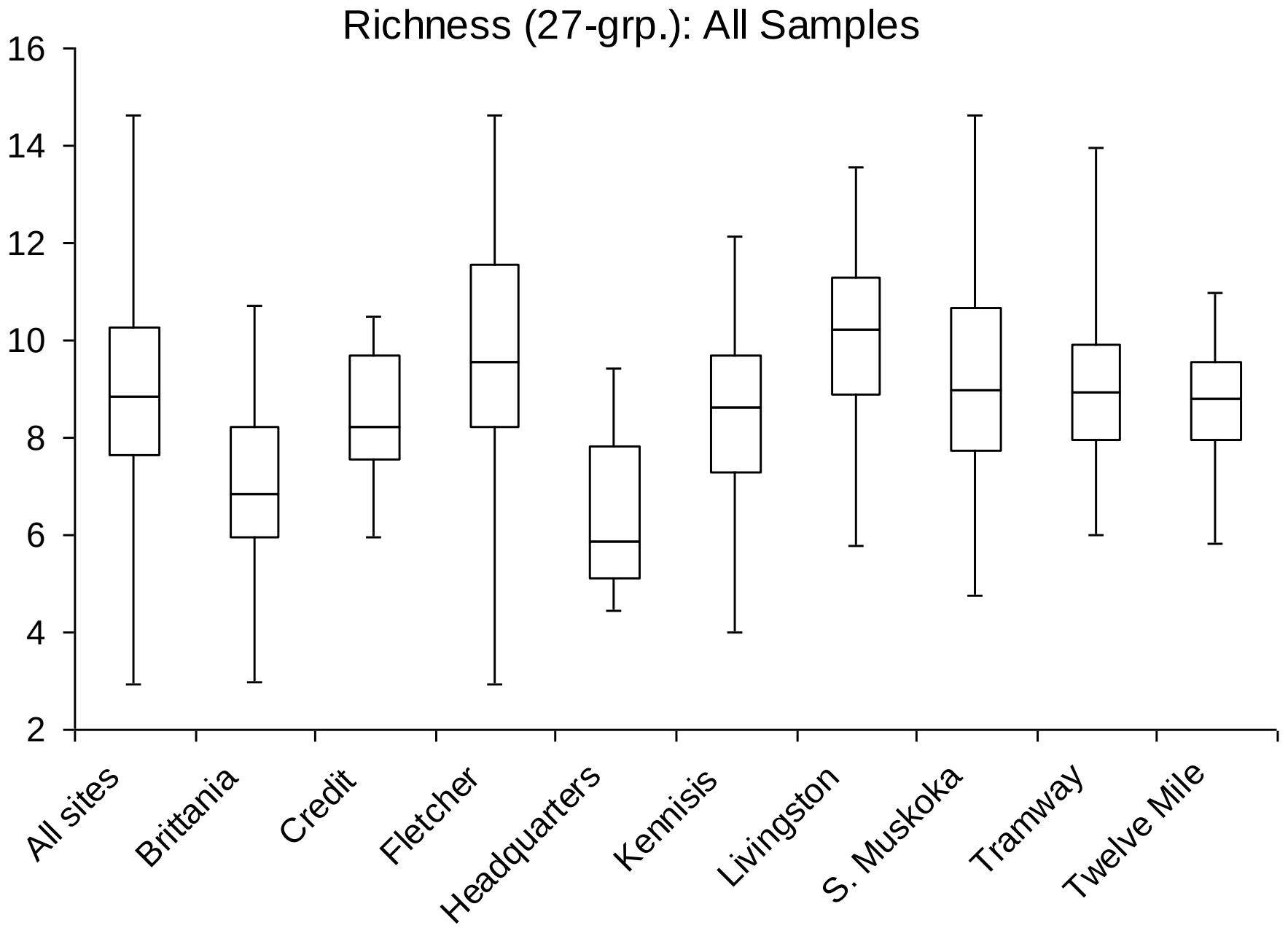
Tipulidae (Crane Flies)



Simuliidae (Black Flies)

Misc. Diptera (Misc. True Flies)

Temporal Study of Streams (27-grp.)



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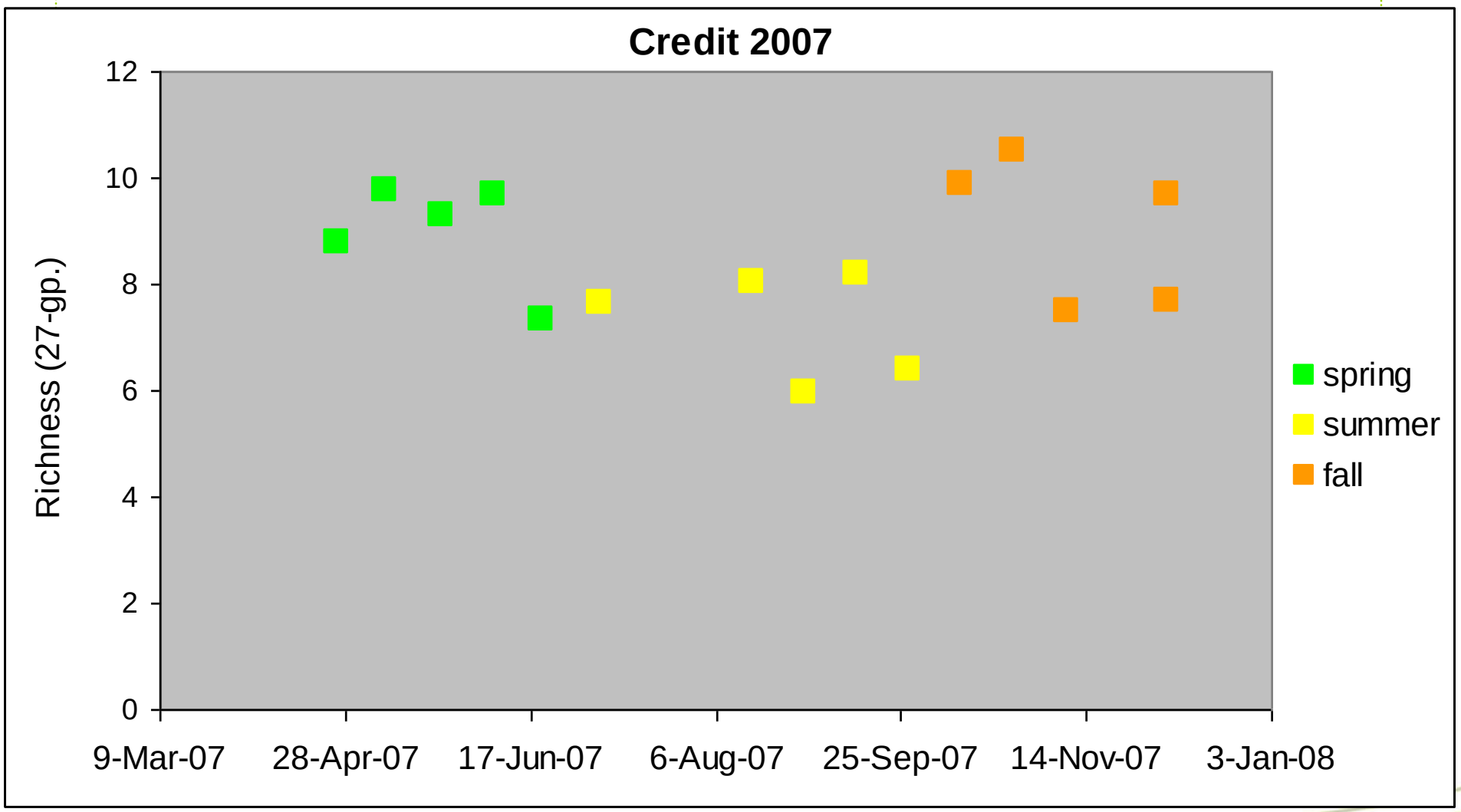

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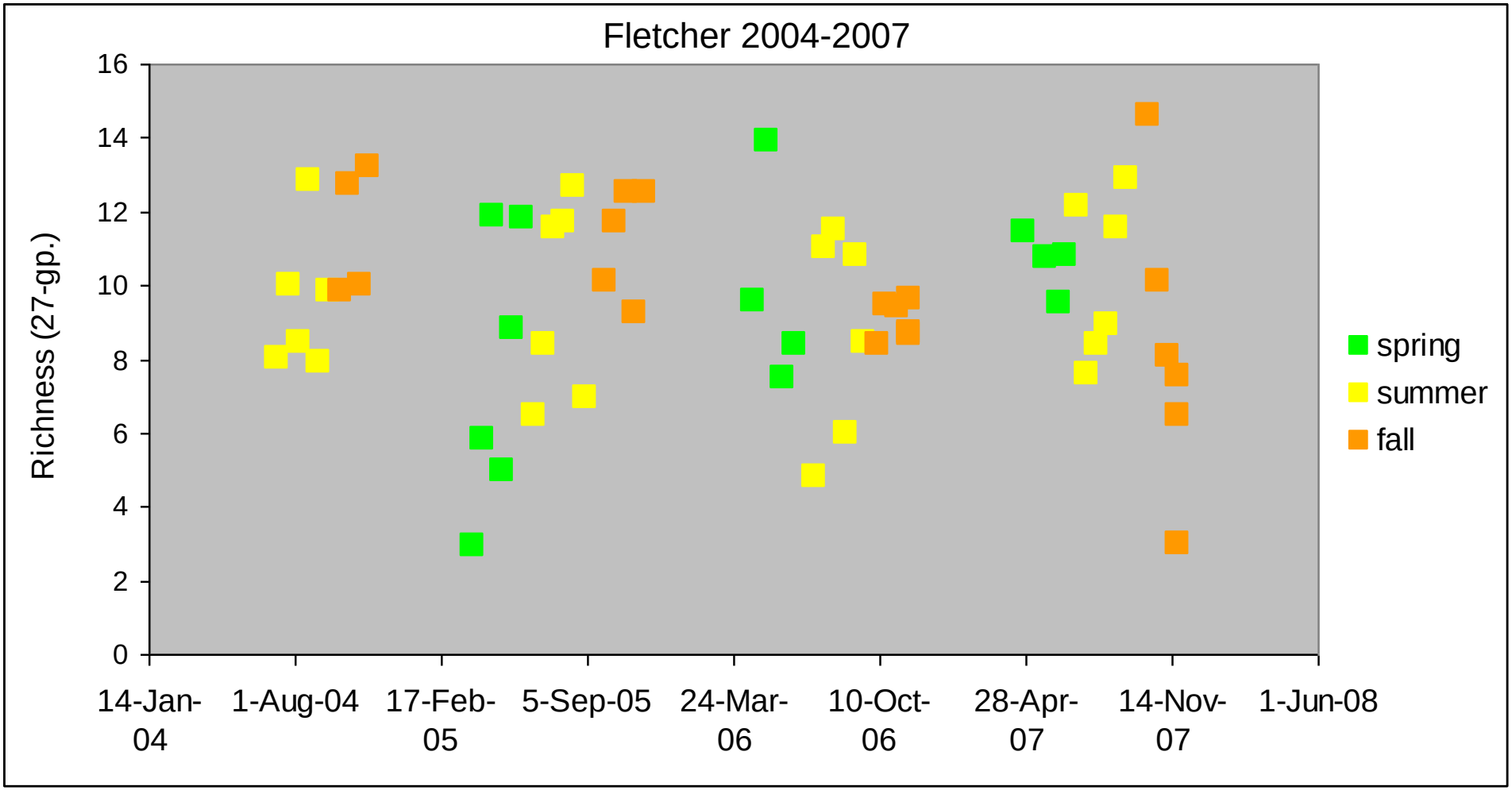
Temporal Study of Streams (27-grp.)



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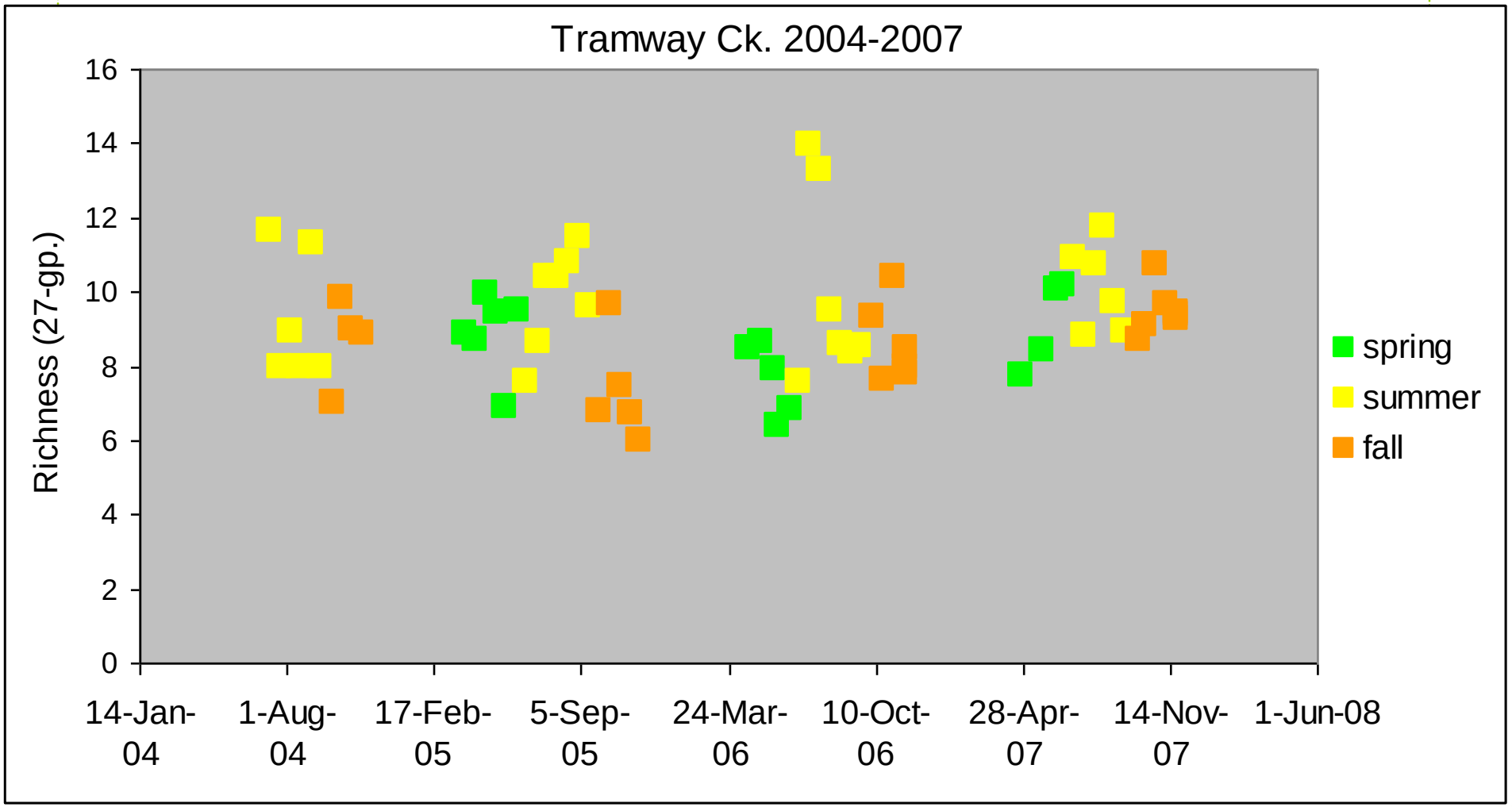

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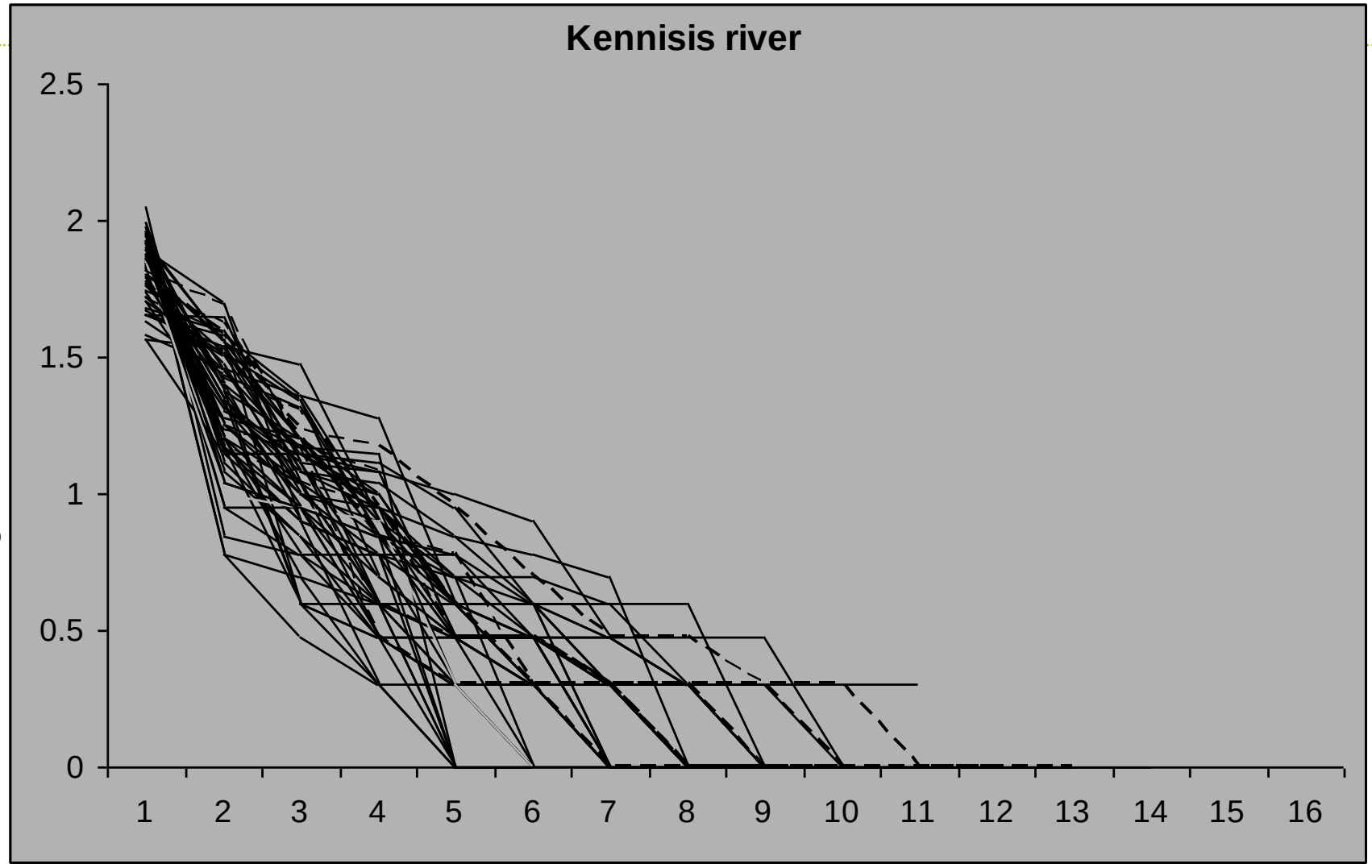
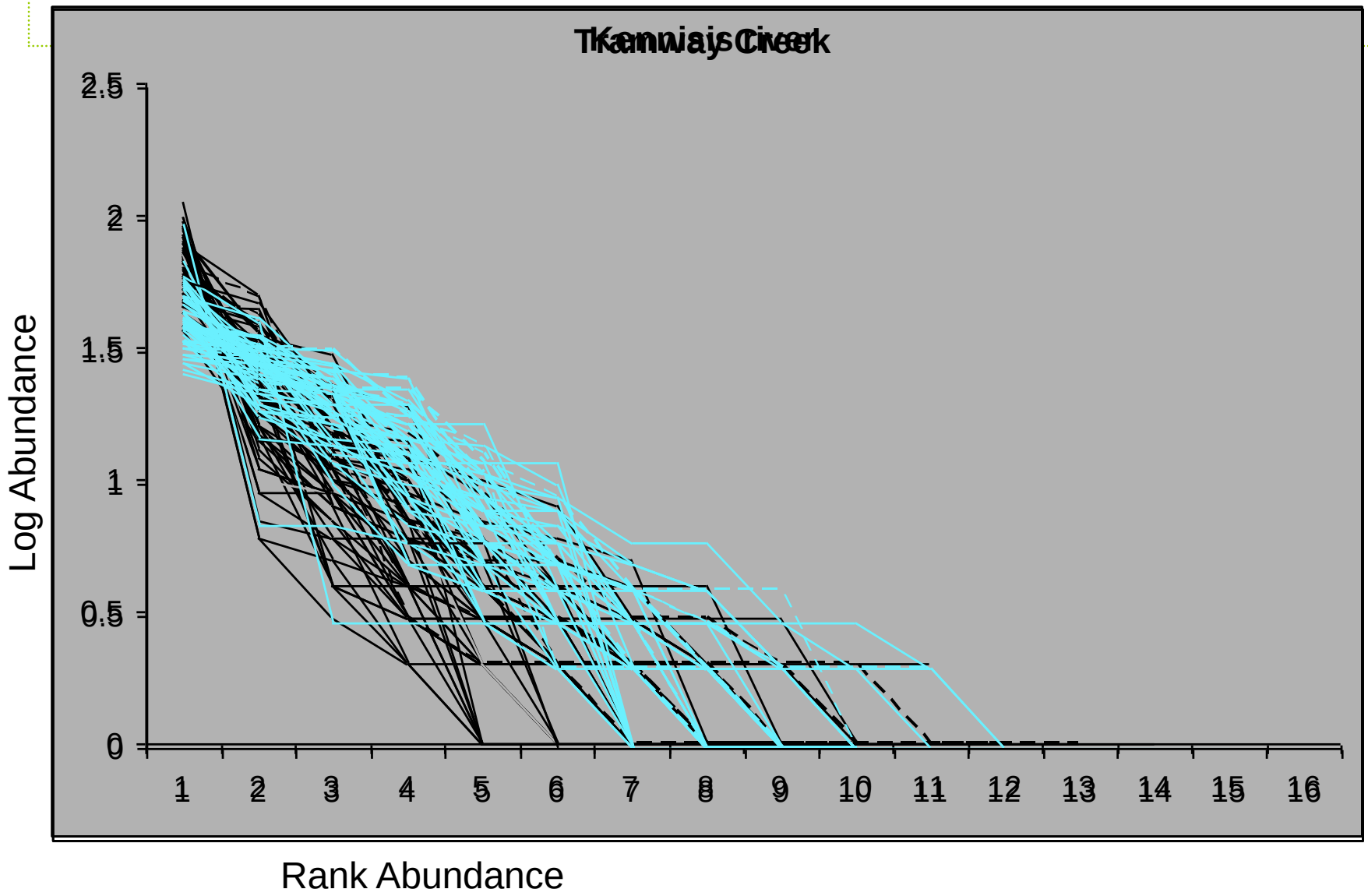
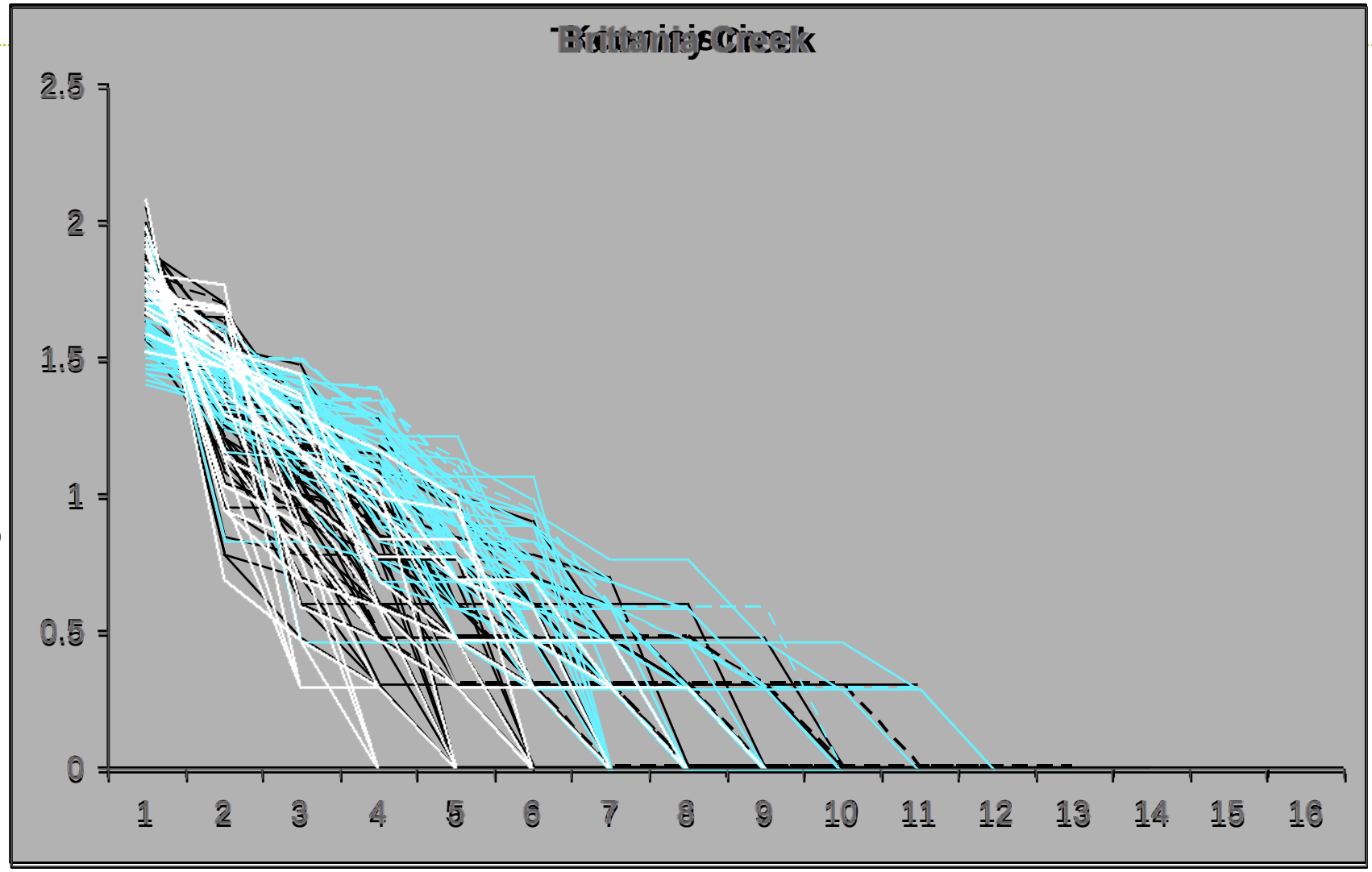
Rank Abundance: Temporal Study



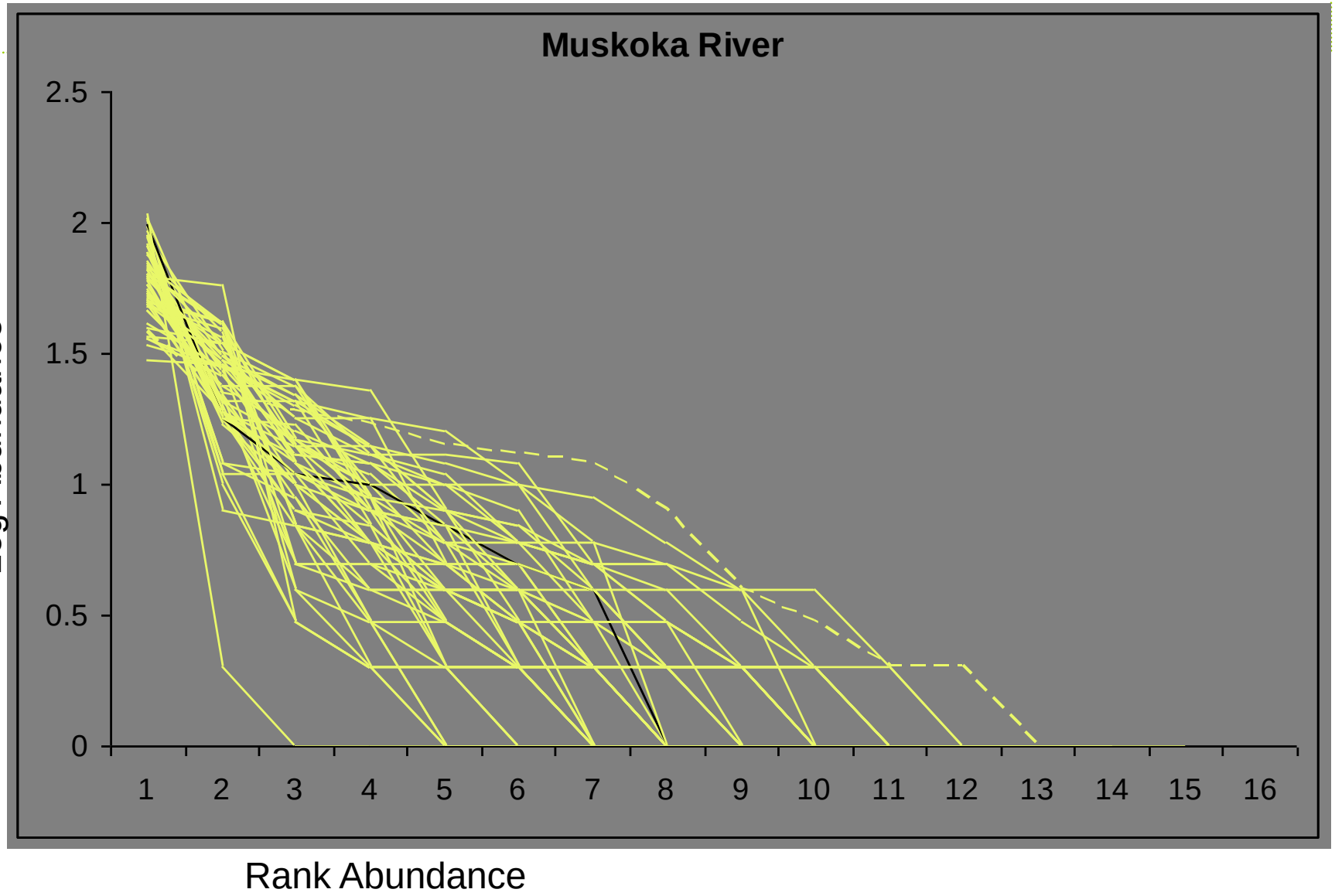
Rank Abundance: Temporal Study



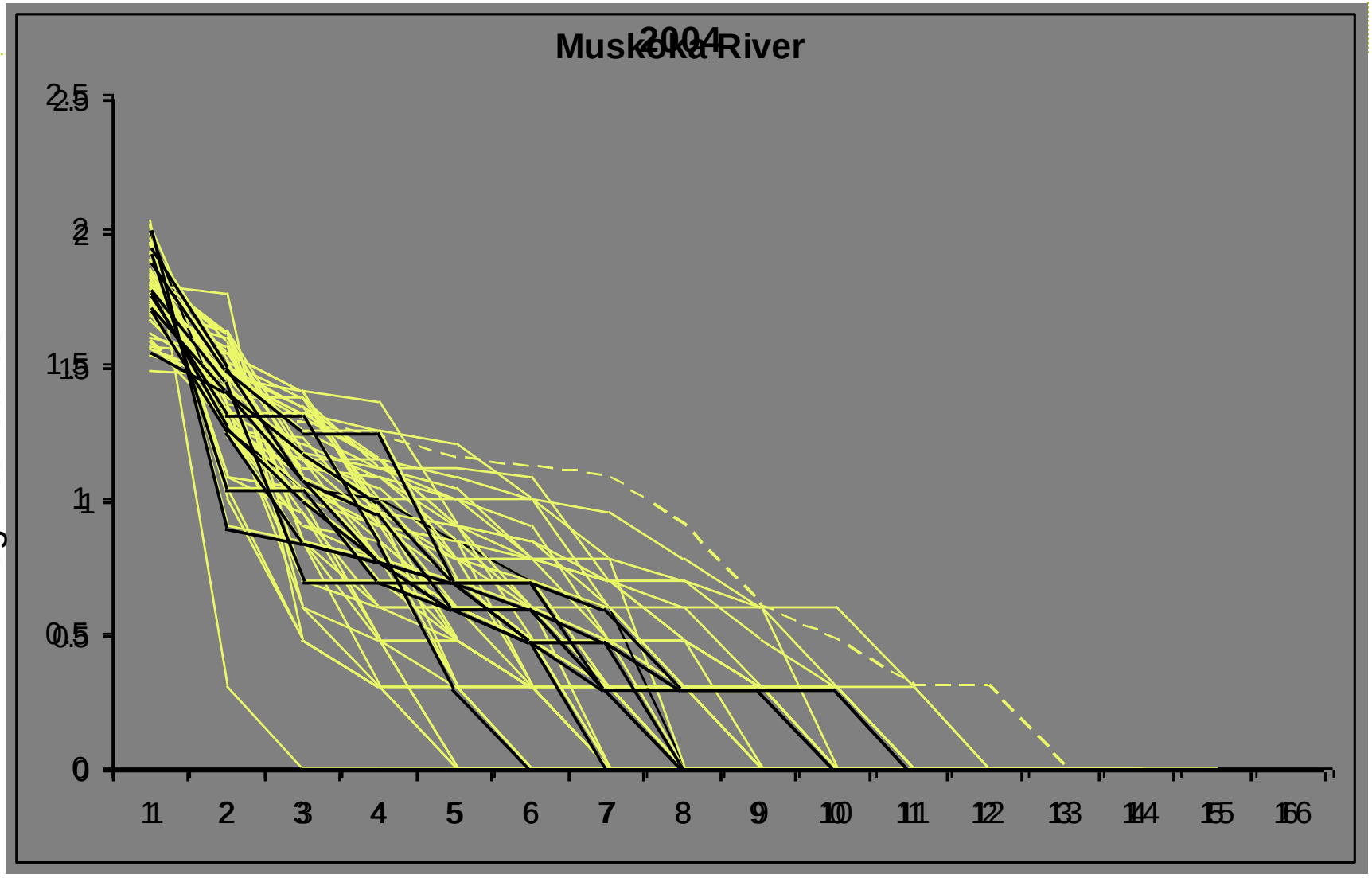
Rank Abundance: Temporal Study



Muskoka River: by Year



Muskoka River: by Year



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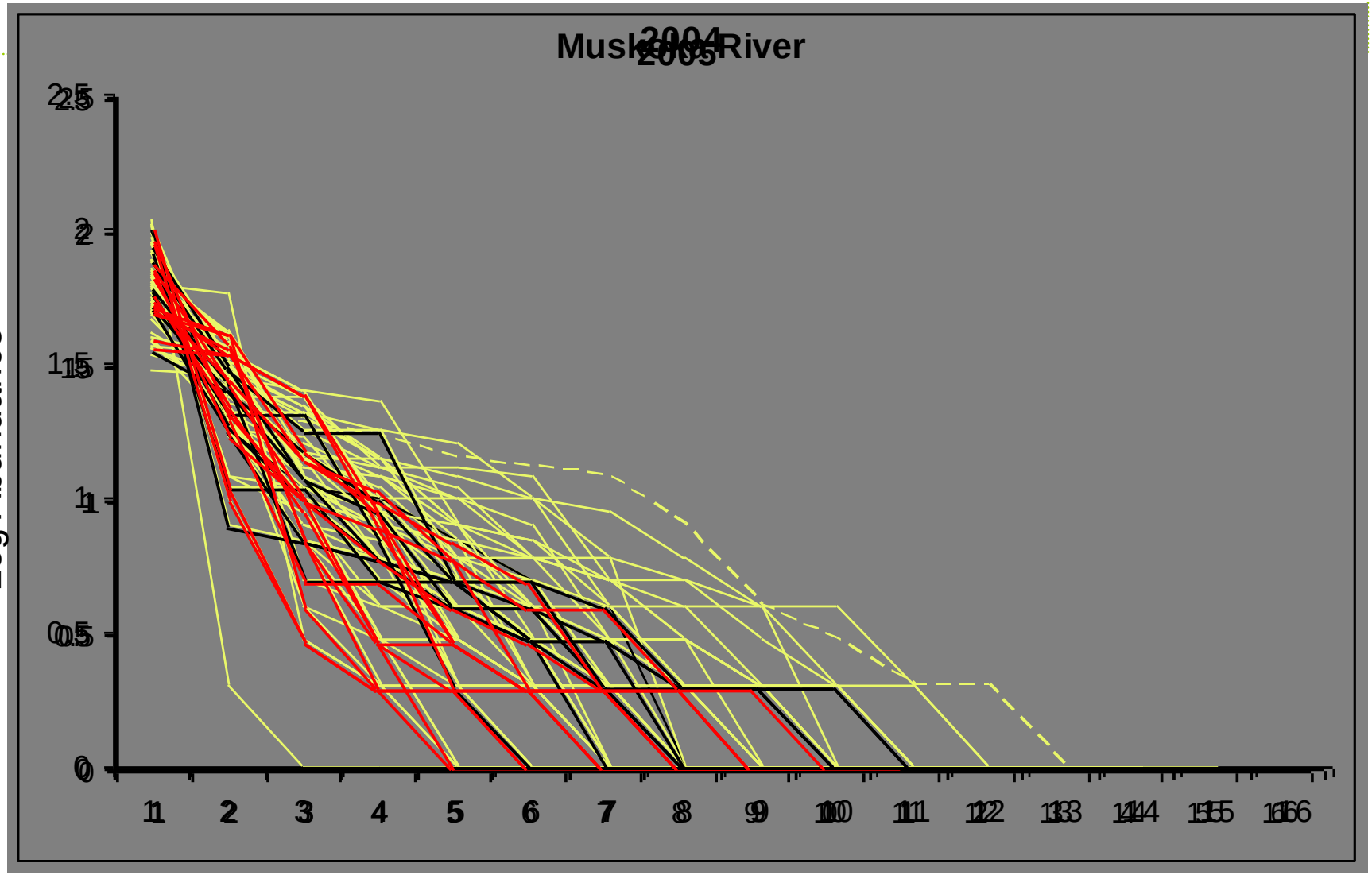

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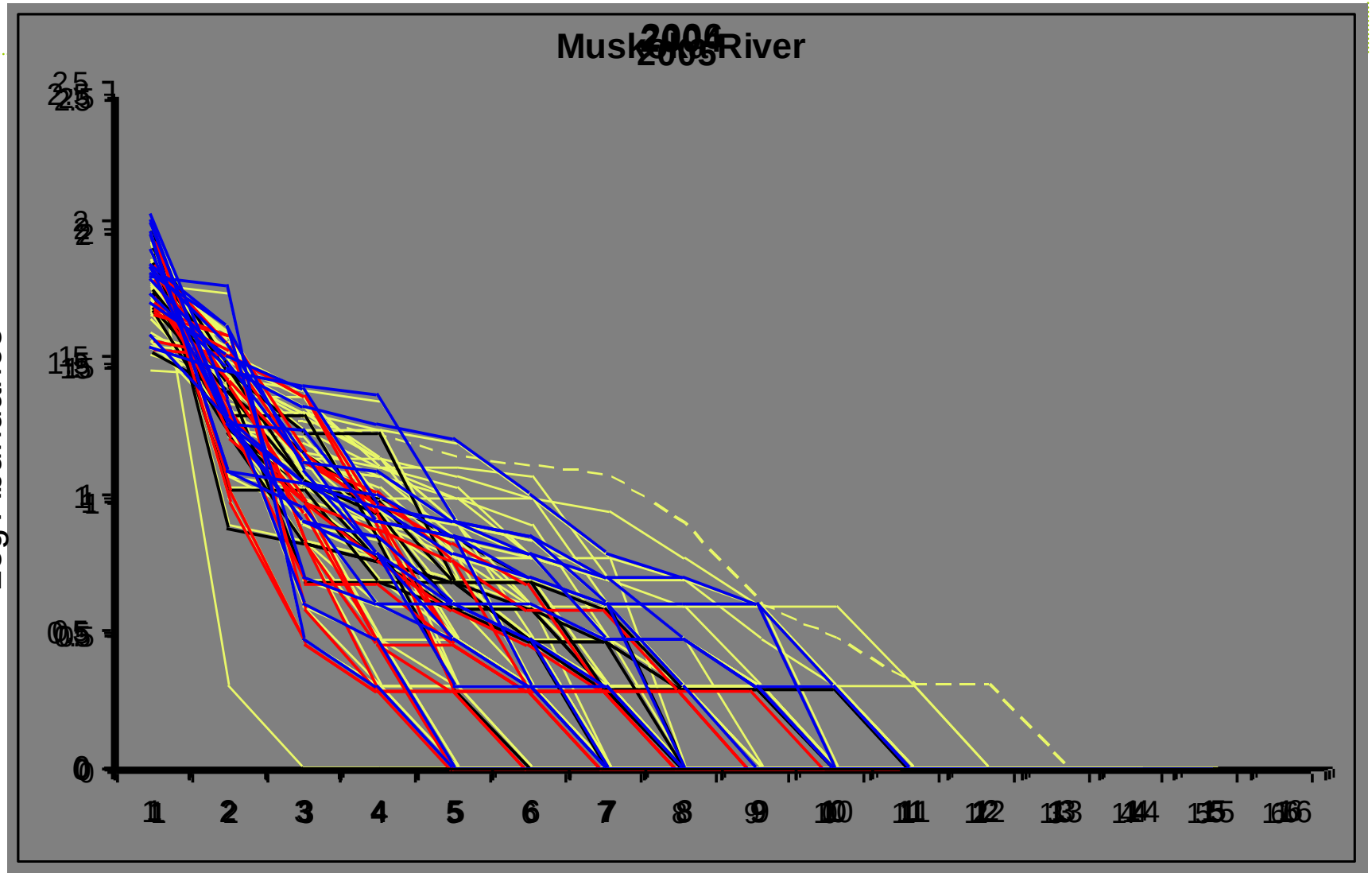

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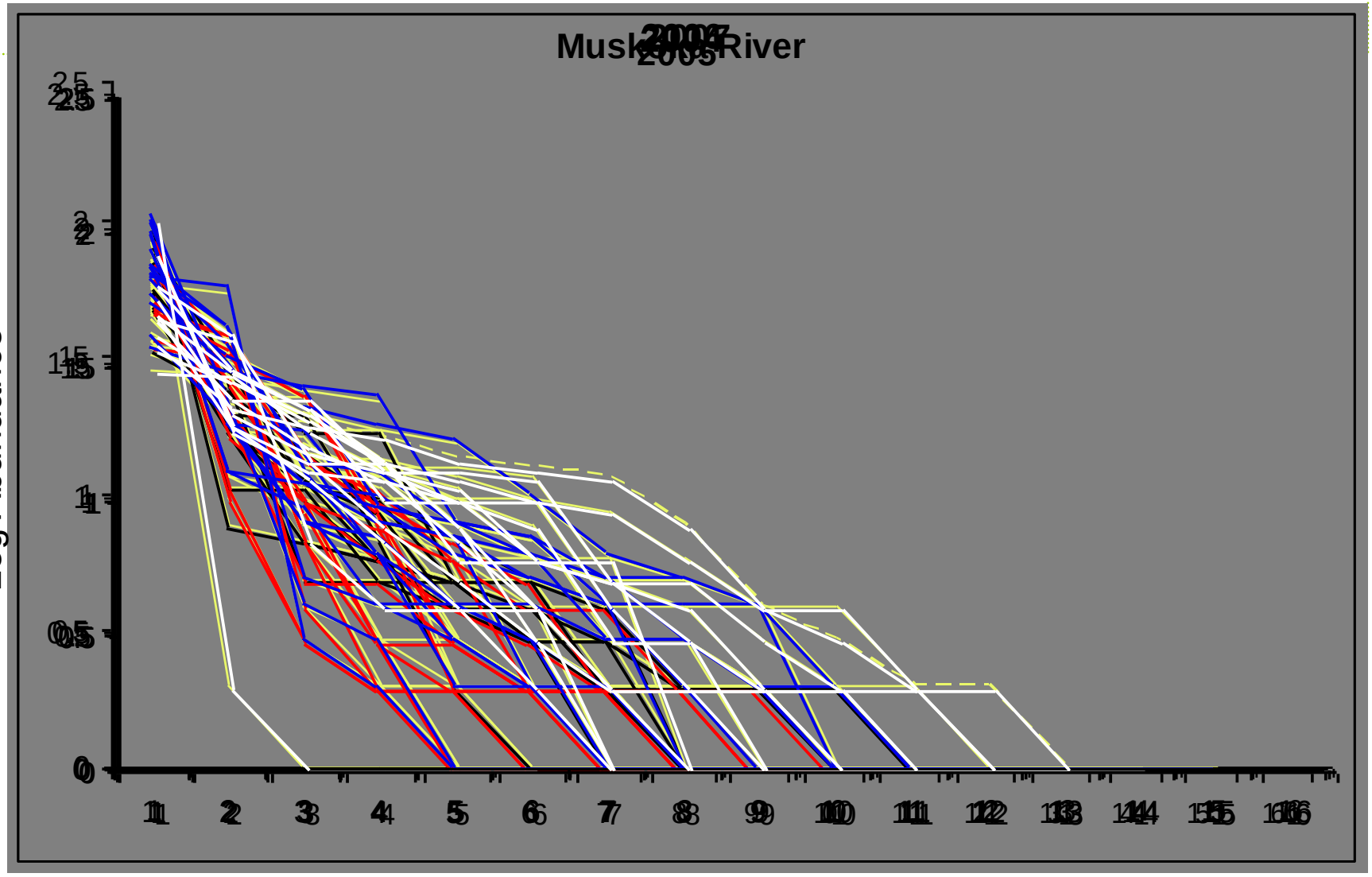
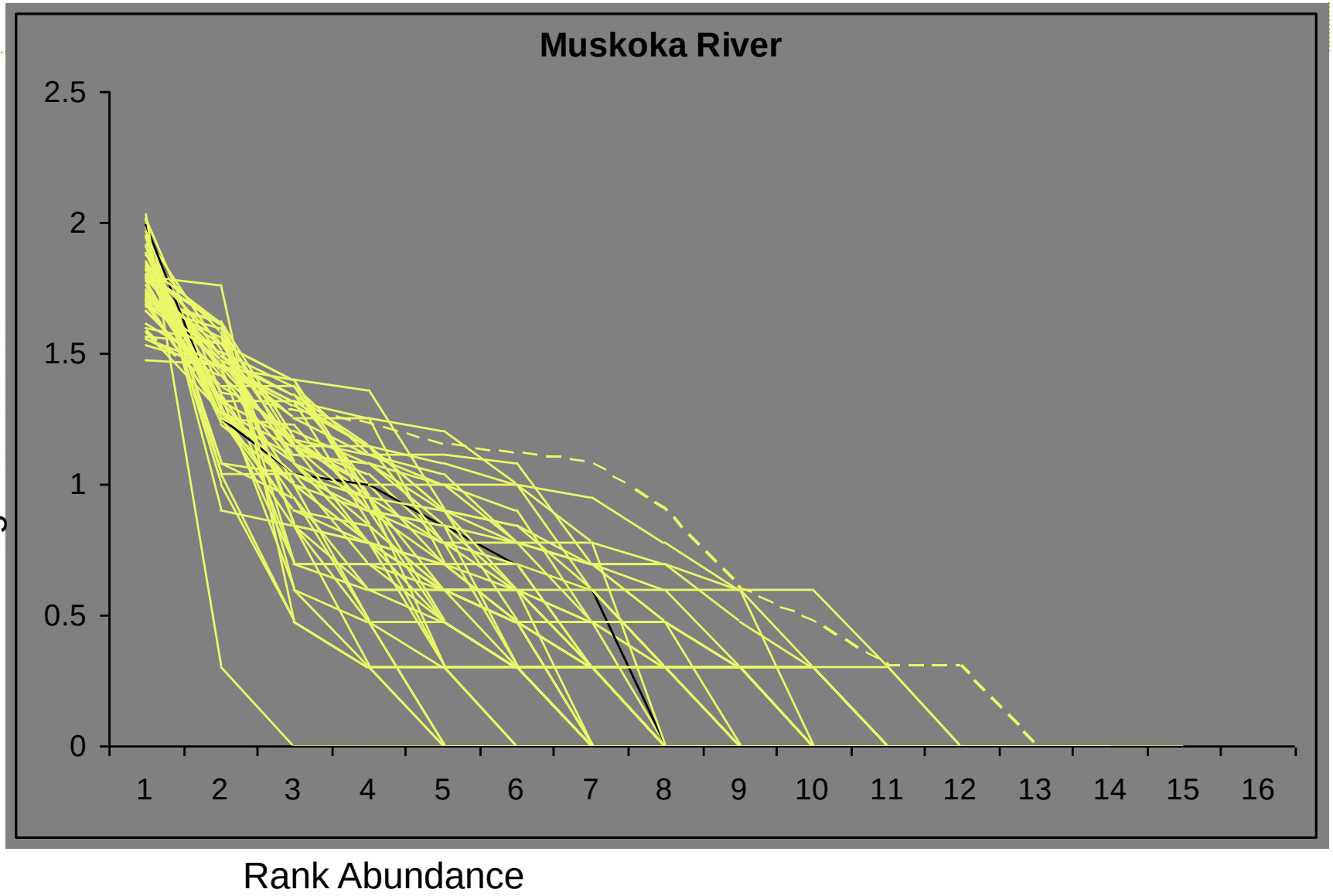
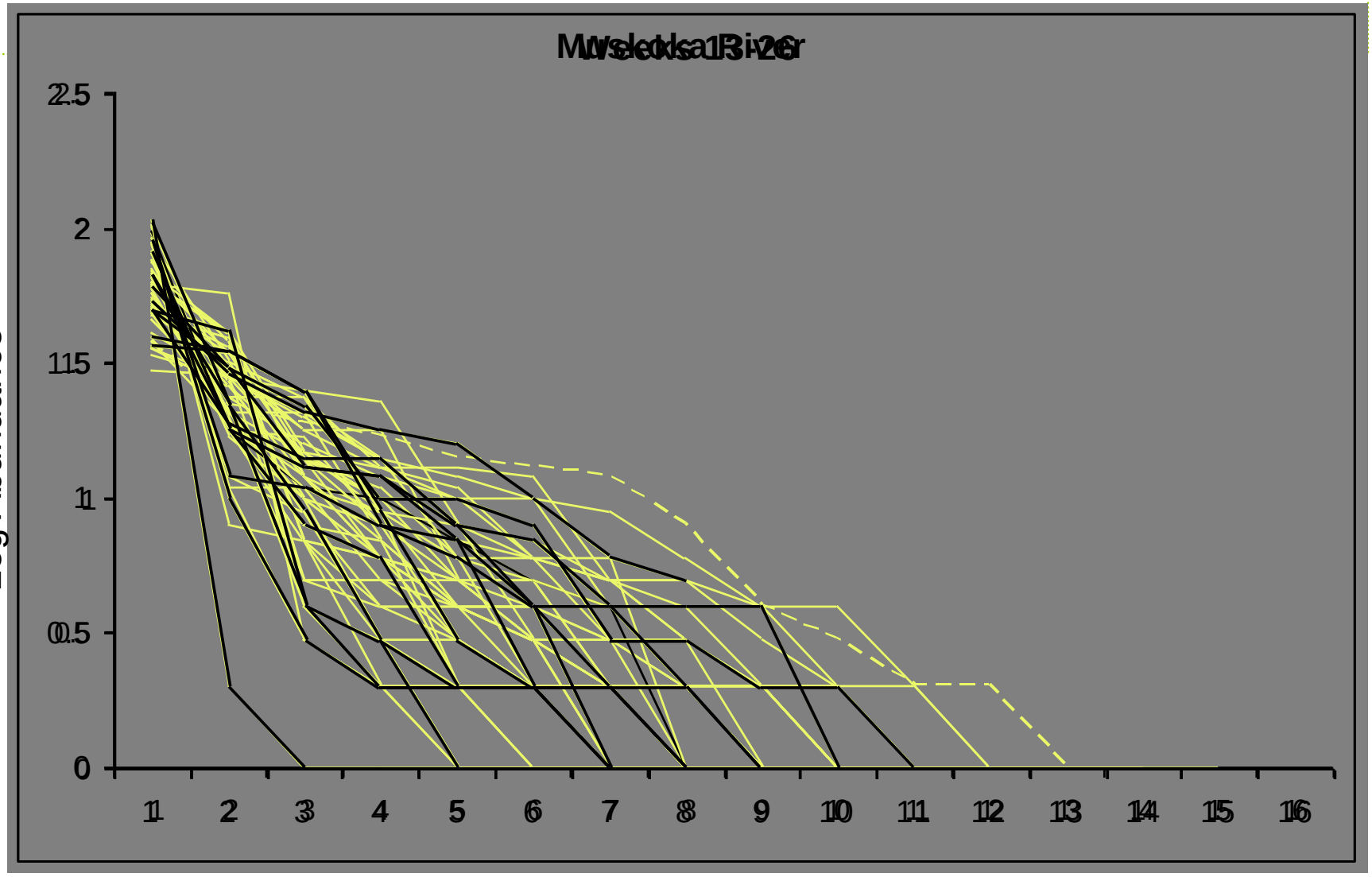


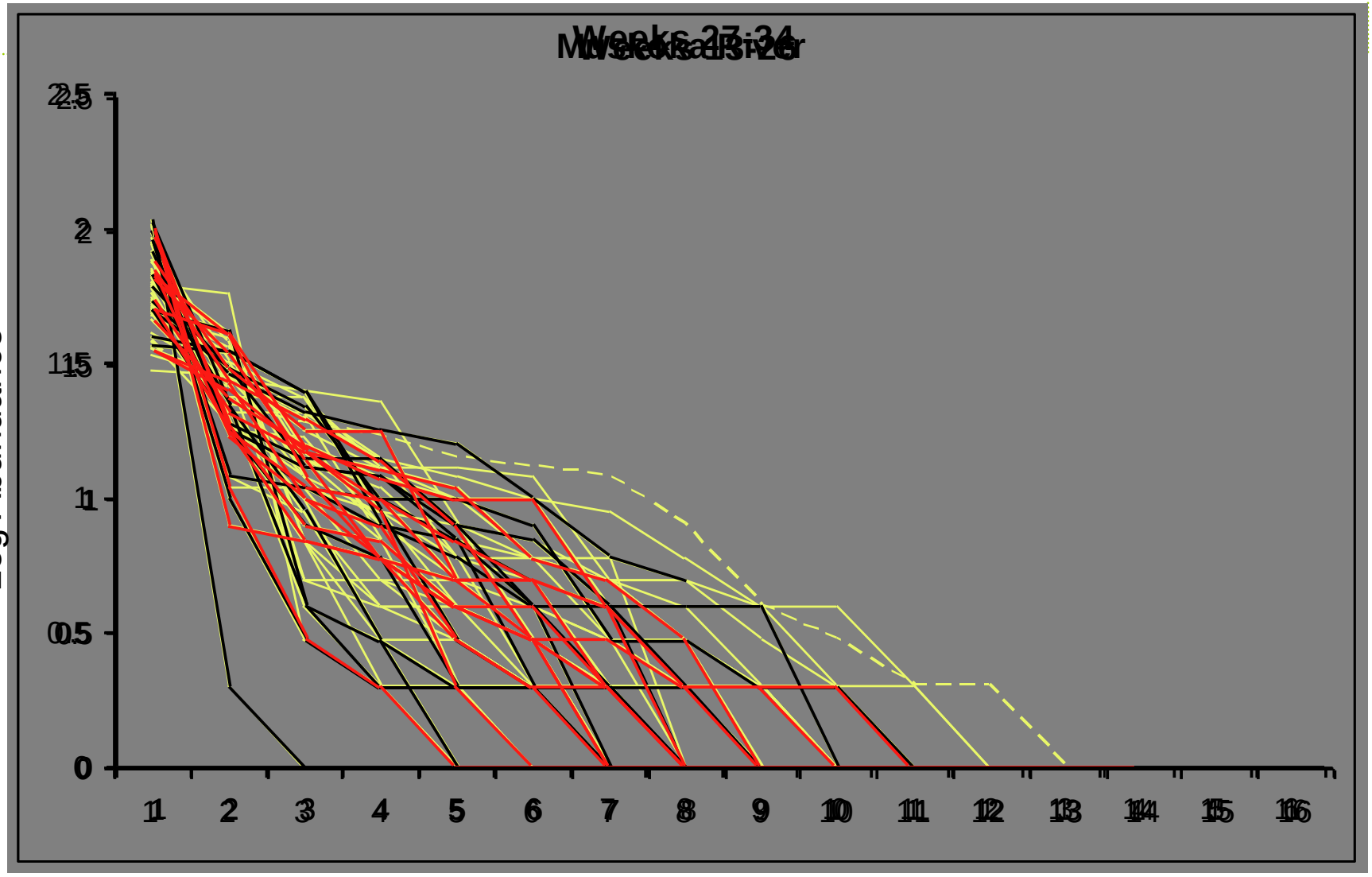
Muskoka River: by Week



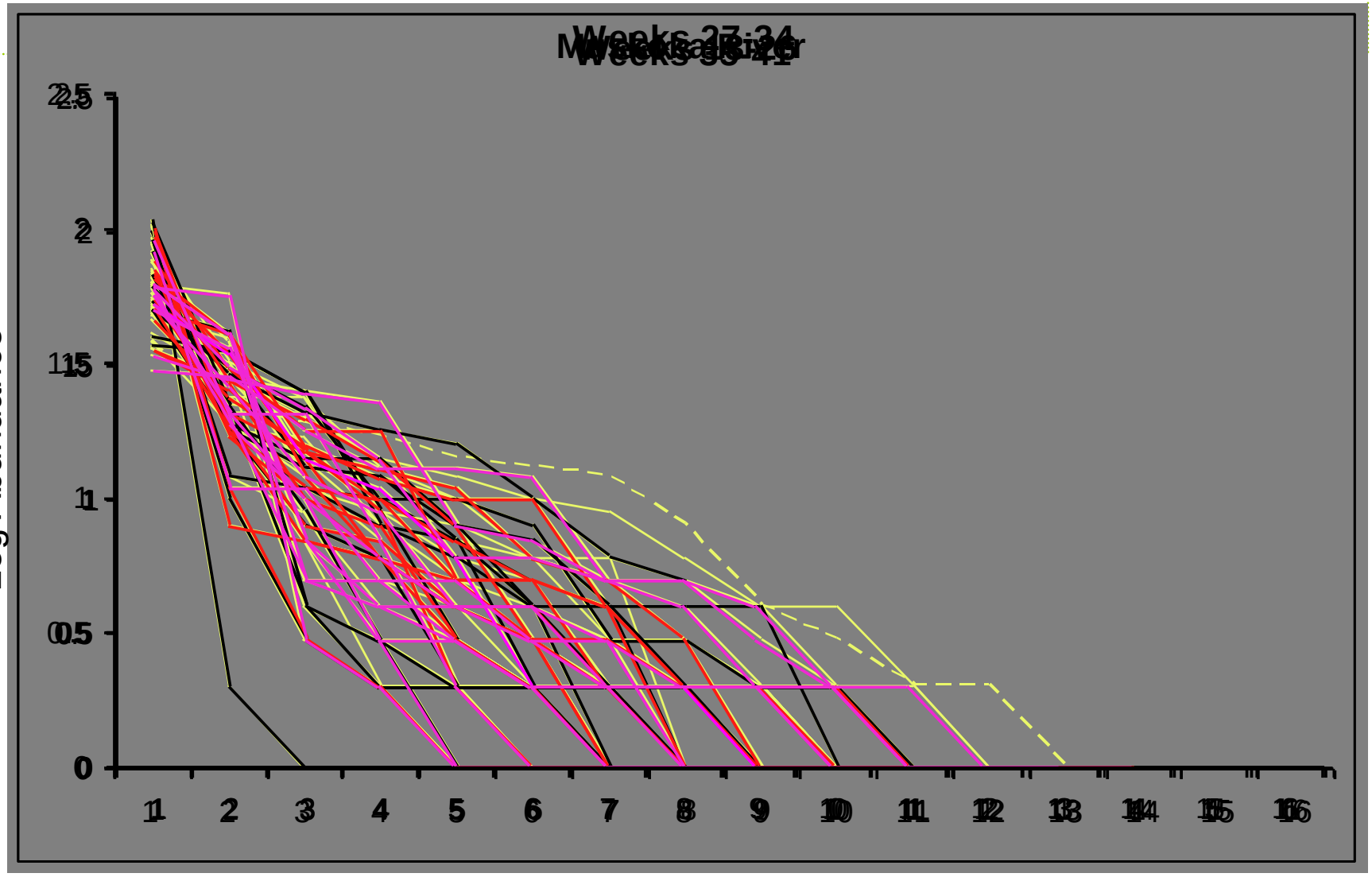
Muskoka River: by Week



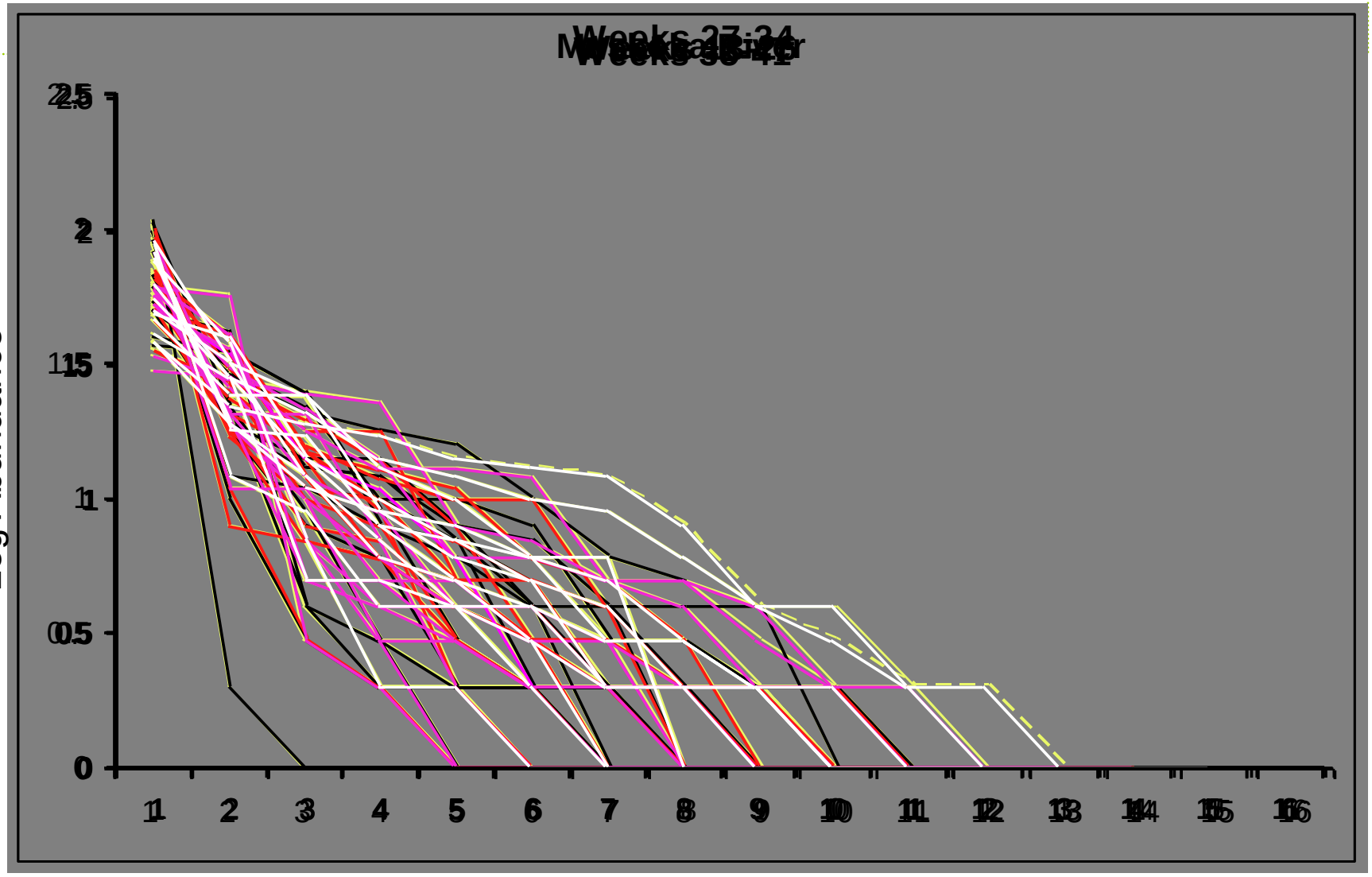
Muskoka River: by Week



Muskoka River: by Week

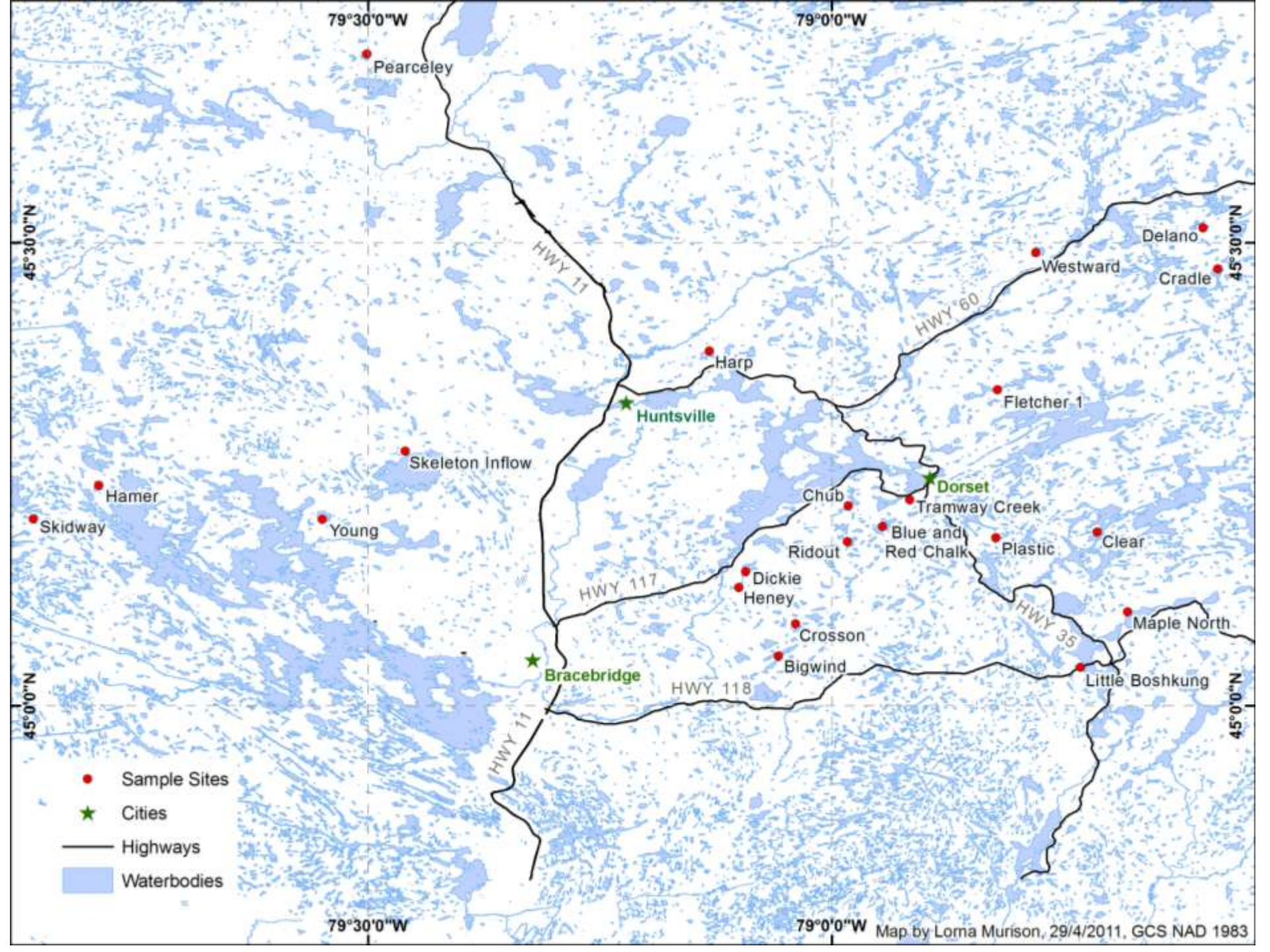


Muskoka River: by Week



Dataset 2: Lakes and Streams, DESC

Lakes	Streams
Bigwind (1994-2005) Blue Chalk (1994-2006) Chub (1994-2006) Clear (1995-2006) Cradle (1993-2006) Crosson (1994-2006) Delano (1993-2006) Dickie (1994-2006) Hamer (1995-2006) Harp (1994-2006) Heney (1994-2006) Pearceley (1995-2006) Plastic (1994-2006) Red Chalk East and Red Chalk Main (1994-2006) Ridout (1994-2006) Skidway (1993) Westward (1995-2006) Young (1995-2006)	Dickie Inflows 5 and 6 (1996-2007) Fletcher 1 (1999-2007) Fletcher 3 (1999-2007) Harp Inflow s 3 , 4, 6, and 6a(1995-2007) Little Boshkung Inflow (1999-2007) Maple Lake Inflow 1 (1999-2007) Plastic Inflow 1 (1995-2007) Skeleton Inflow 1 (2000-2007) Tramway Creek (1999-2006)

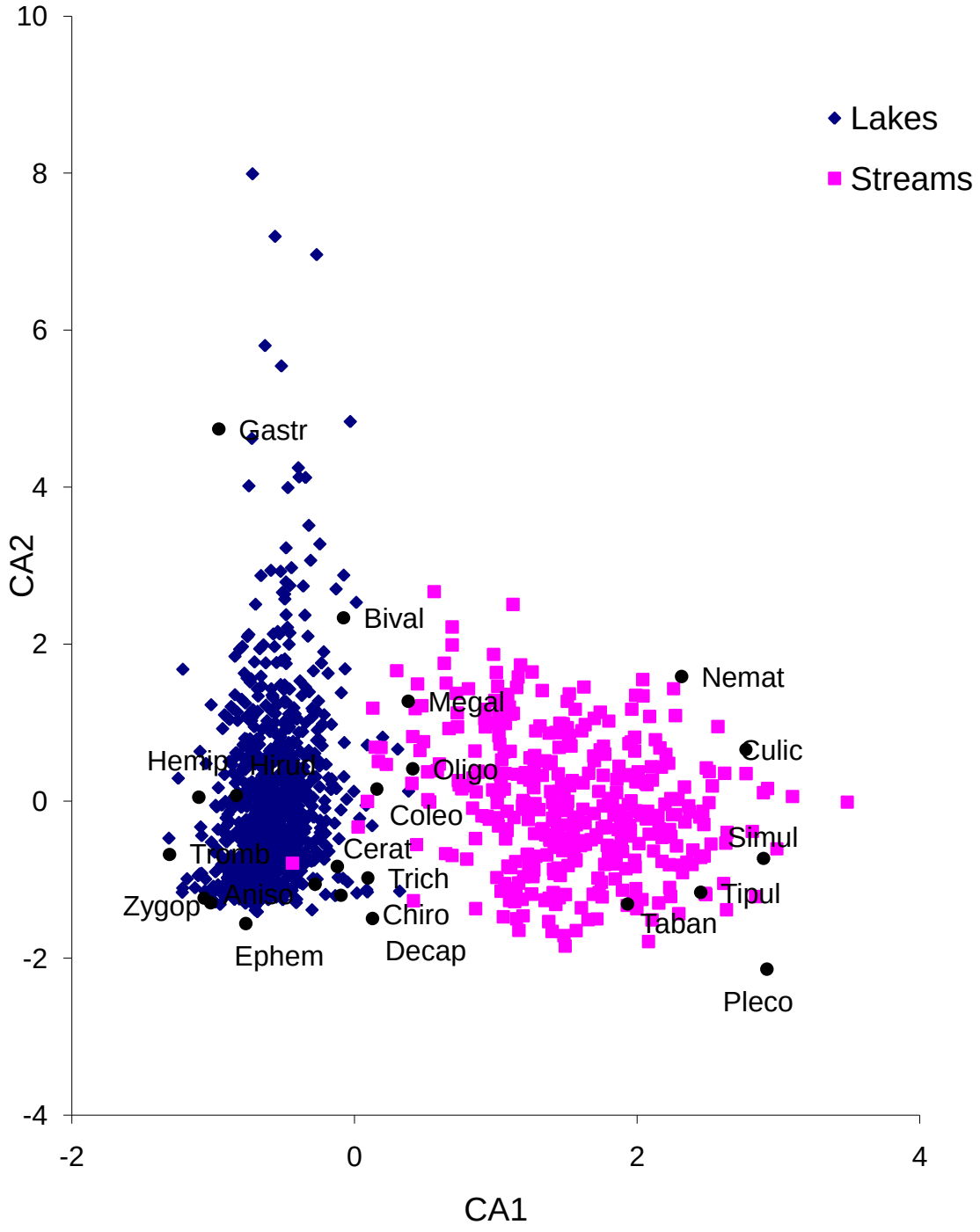

79°30'0"W
79°0'0"W
45°30'0"N
45°0'0"N
Pearceley
HWY 11
Delano
Westward
Cradle
HWY 60
Harp
Huntsville
Fletcher 1
Skeleton Inflow
Hamer
Skidway
Young
Dorset
Chub
Tramway Creek
Blue and
Red Chalk
Plastic
Clear
Ridout
Dickie
Heney
HWY 117
HWY 35
Maple North
Crosson
Bigwind
Bracebridge
HWY 118
Little Boshkung
HWY 11
Sample Sites
Cities
Highways
Waterbodies
Map by Lorna Murison, 29/4/2011, GCS NAD 1983

DESC Lakes and Streams: Questions

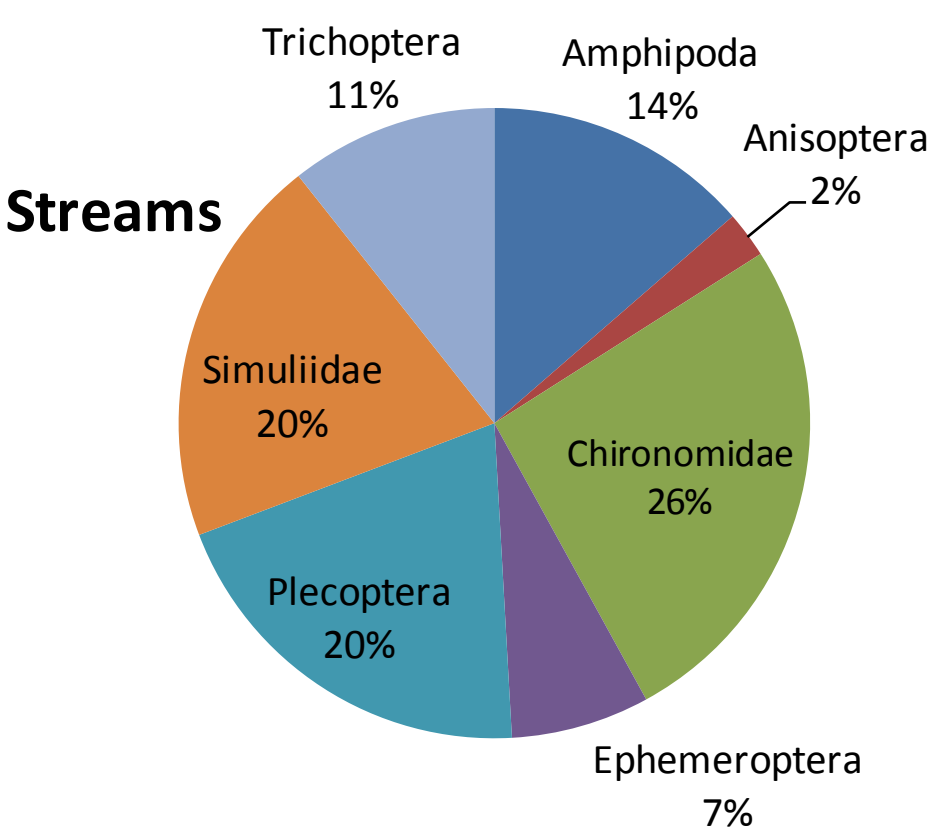
Spatial and temporal patterns in richness and community structure (relative abundances of taxa)?

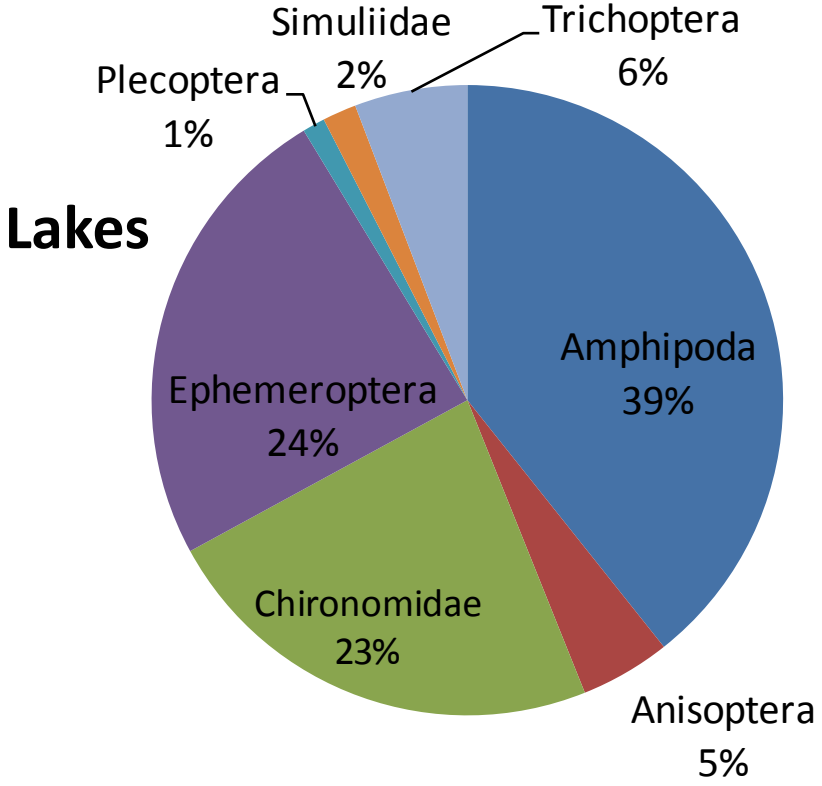
Data Exploration: any stories emerging?

DESC Lakes and Streams



DESC Lakes and Streams





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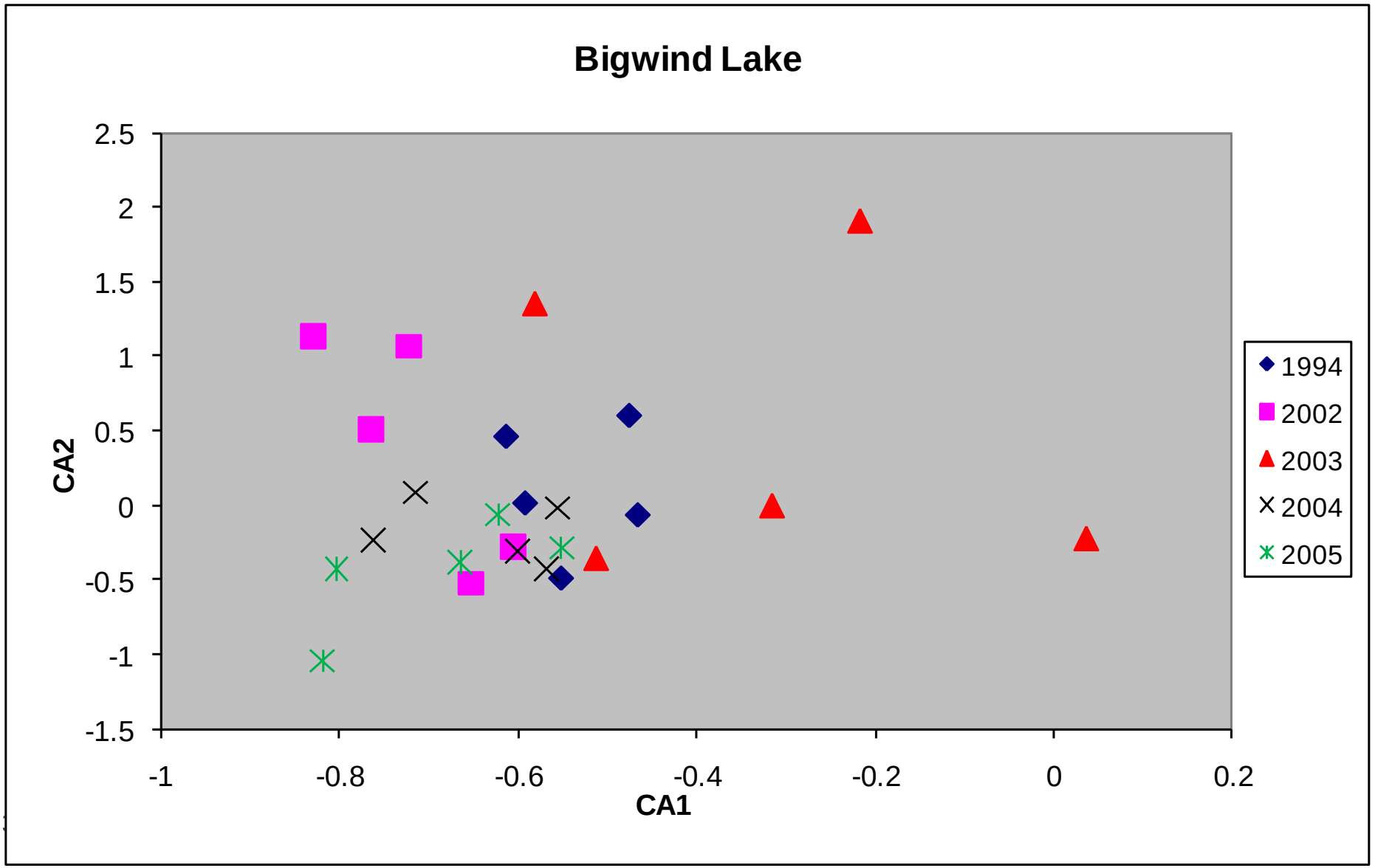
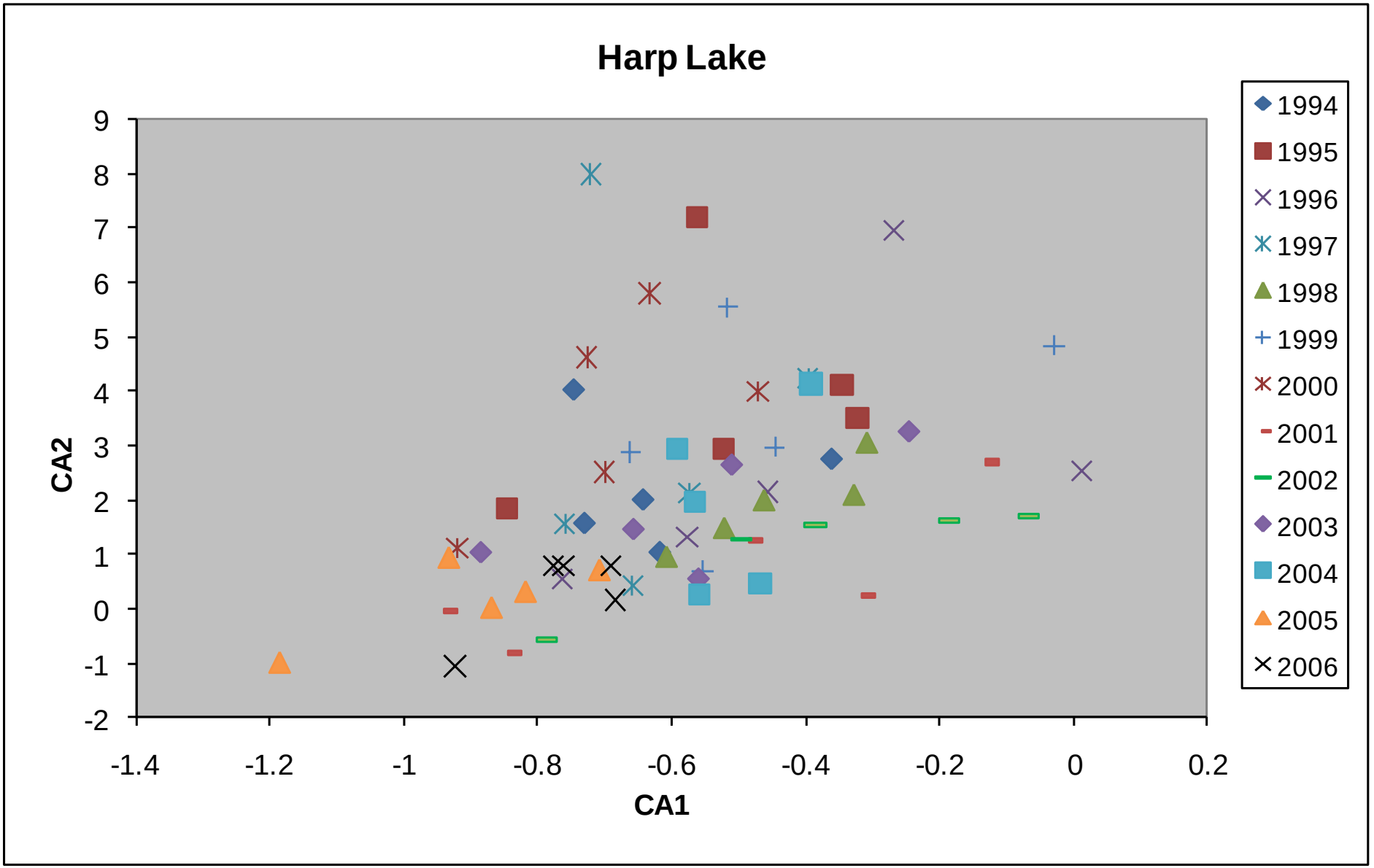
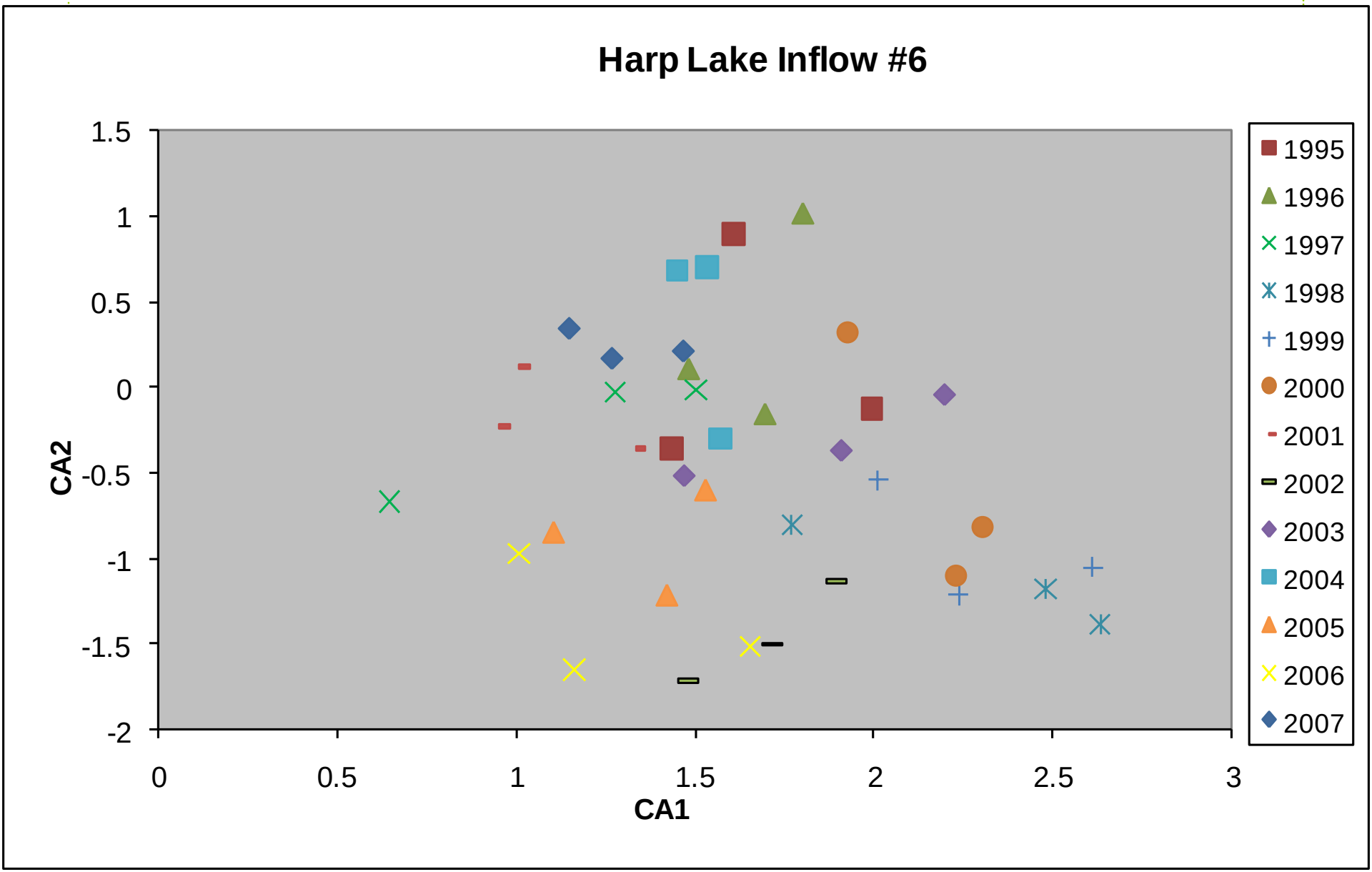
DESC Lakes and Streams

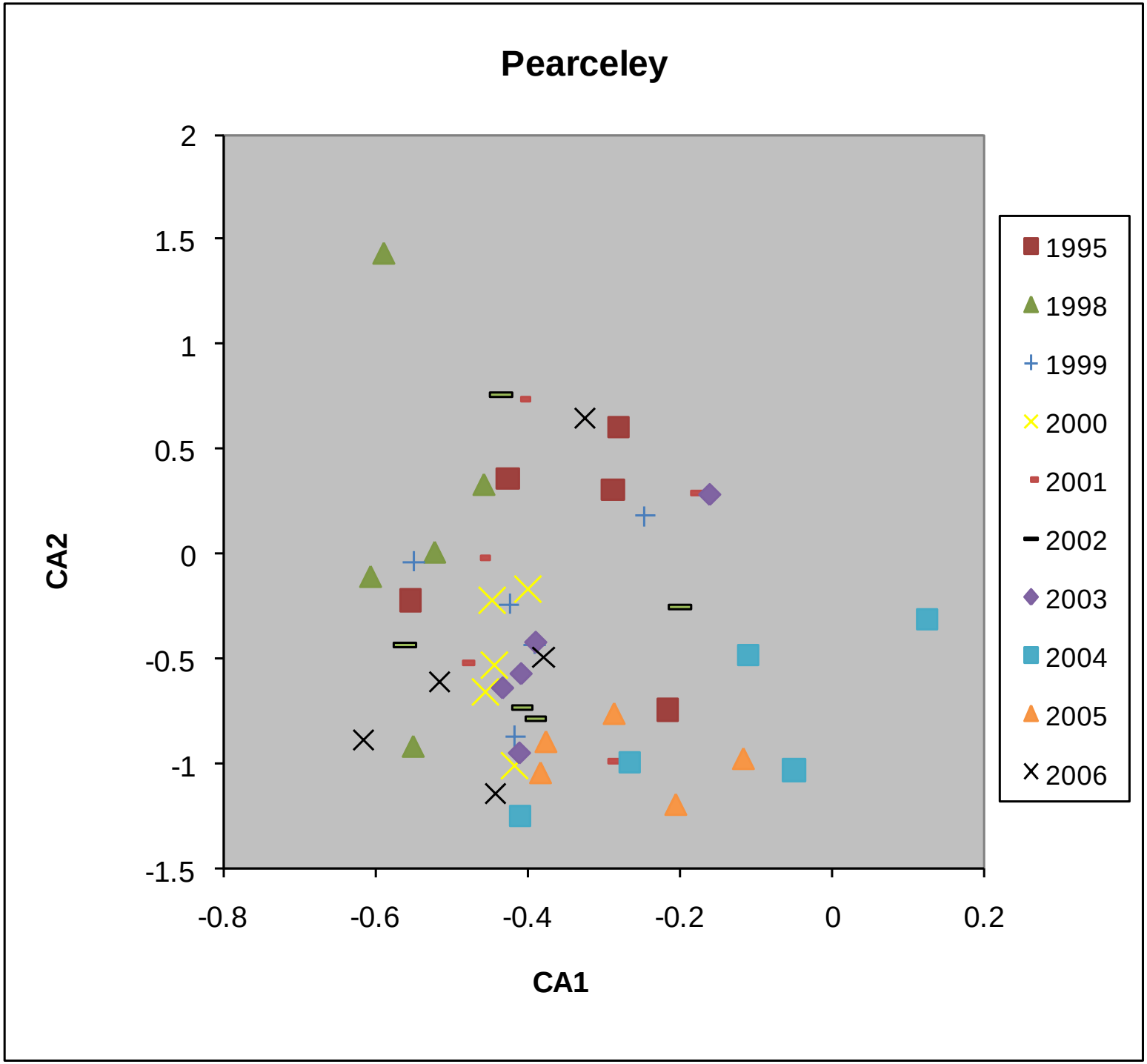


DESC Lakes and Streams

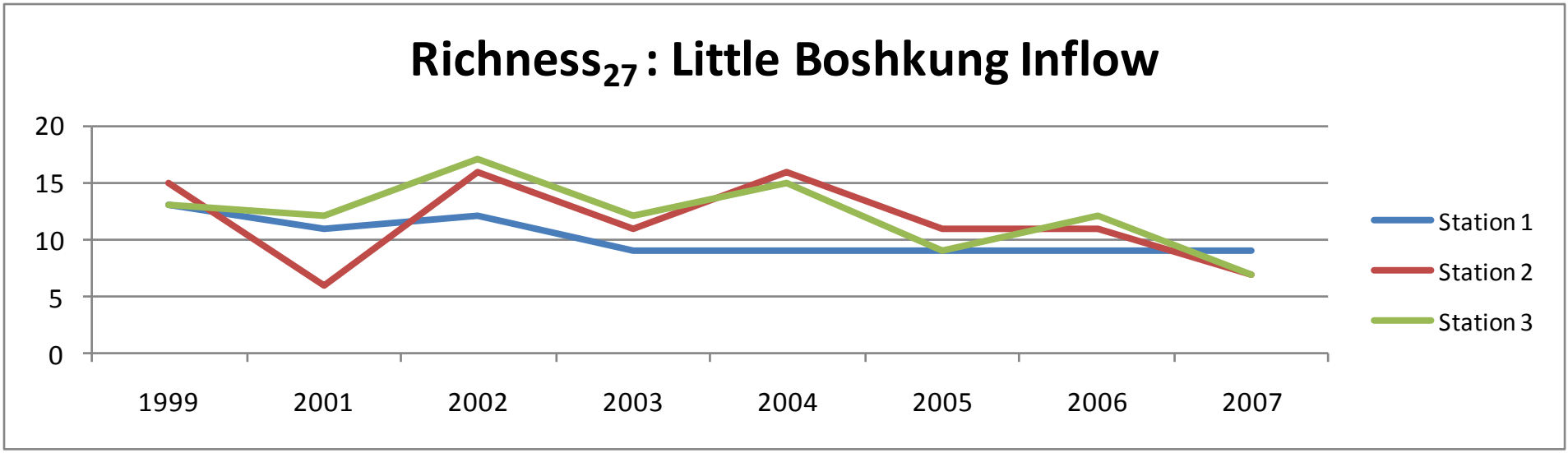


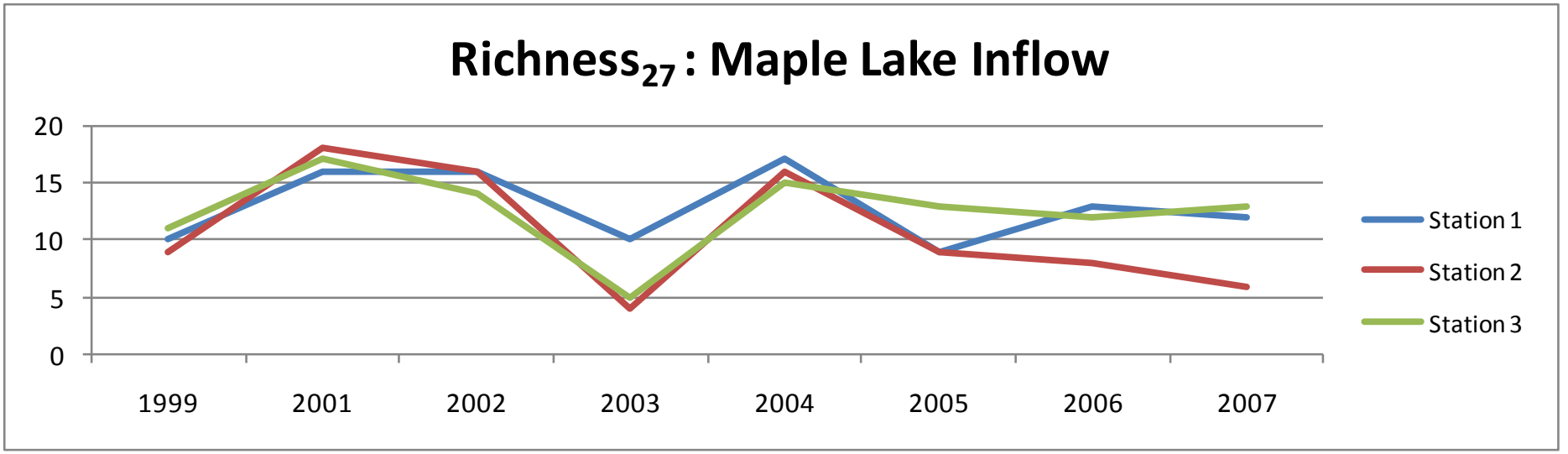
DESC Lakes and Streams



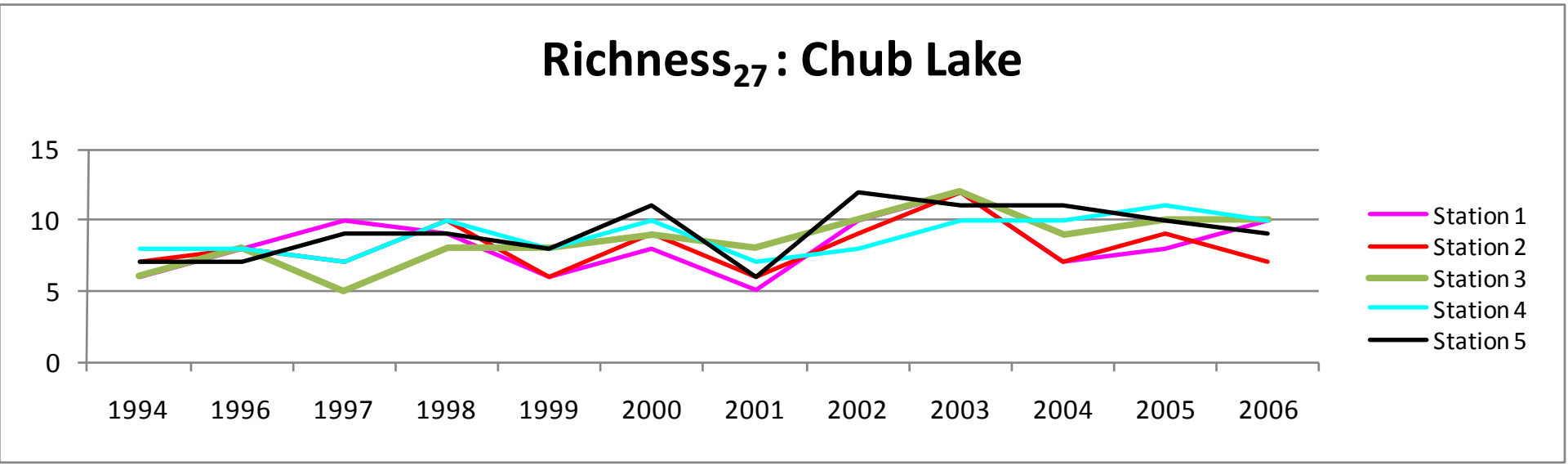

Pearceley
2
1.5
1
0.5
0
-0.5
-1
-1.5
CA2
-0.8
-0.6
-0.4
-0.2
0
0.2
CA1
1995
1998
1999
2000
2001
2002
2003
2004
2005
2006

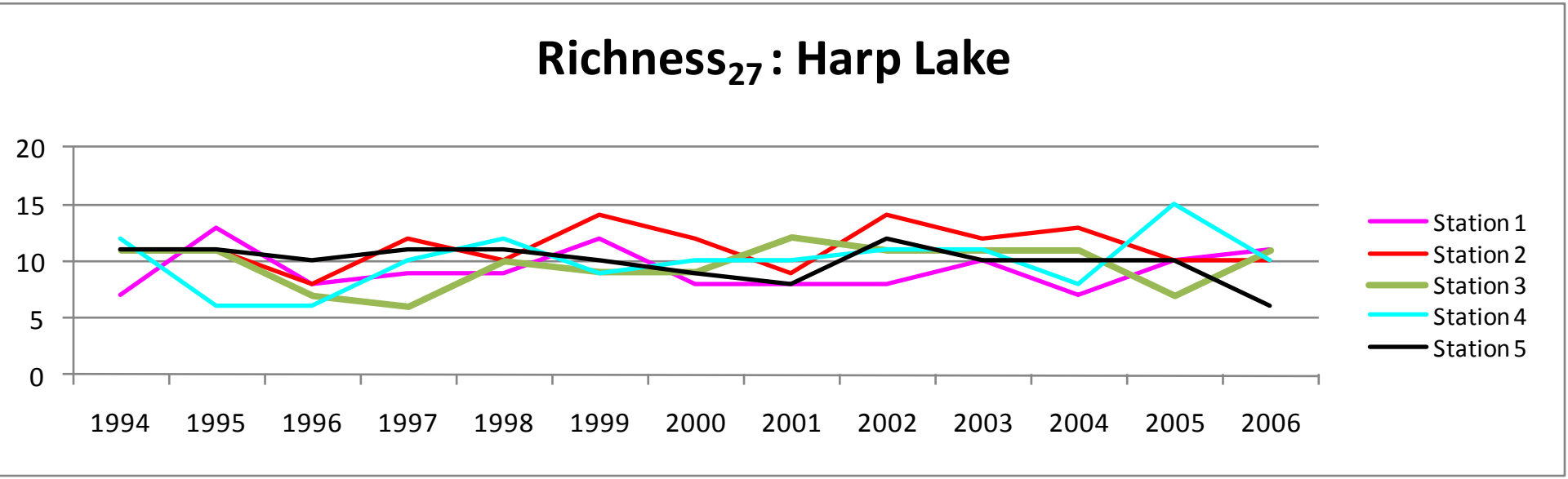
DESC Lakes and Streams: Richness





DESC Lakes and Streams: Richness





Dataset #3: District of Muskoka

Reference Lakes

Ada Lake
Bay Lake
Bella Lake
Bigwind Lake
Bigwind Lake
Buck Lake
Chub Lake
Dickie Lake
Fairy Lake
Gilleach Lake
Go Home Lake
Kahshe Lake
Lake of Bays
Lake Rosseau
Lake Vernon
Leech Lake BB
Leonard Lake
Little Long Lake
Longs Lake
Loon Lake GR
Mary Lake
Menominee Lake
North Muldrew Lake
Otter Lake
Palette Lake
Peninsula Lake
Pine Lake
Rebecca Lake
Ril Lake
Six Mile Lake
South Muldrew Lake
Sunny Lake
Walker Lake
Waseosa Lake

Impacted Streams

McCready's Creek
Beaver Creek
Hoc Roc River
South Muskoka River

Impacted Lakes

Ada Lake
Fairy Lake
Halfway Lake
Lake Muskoka
Leech Lake
Mary Lake
Ril Lake

District of Muskoka Data: Questions

Spatial patterns in relative taxa abundance?

How biologically similar are “reference” lakes, “impacted” lakes, and “impacted” streams?

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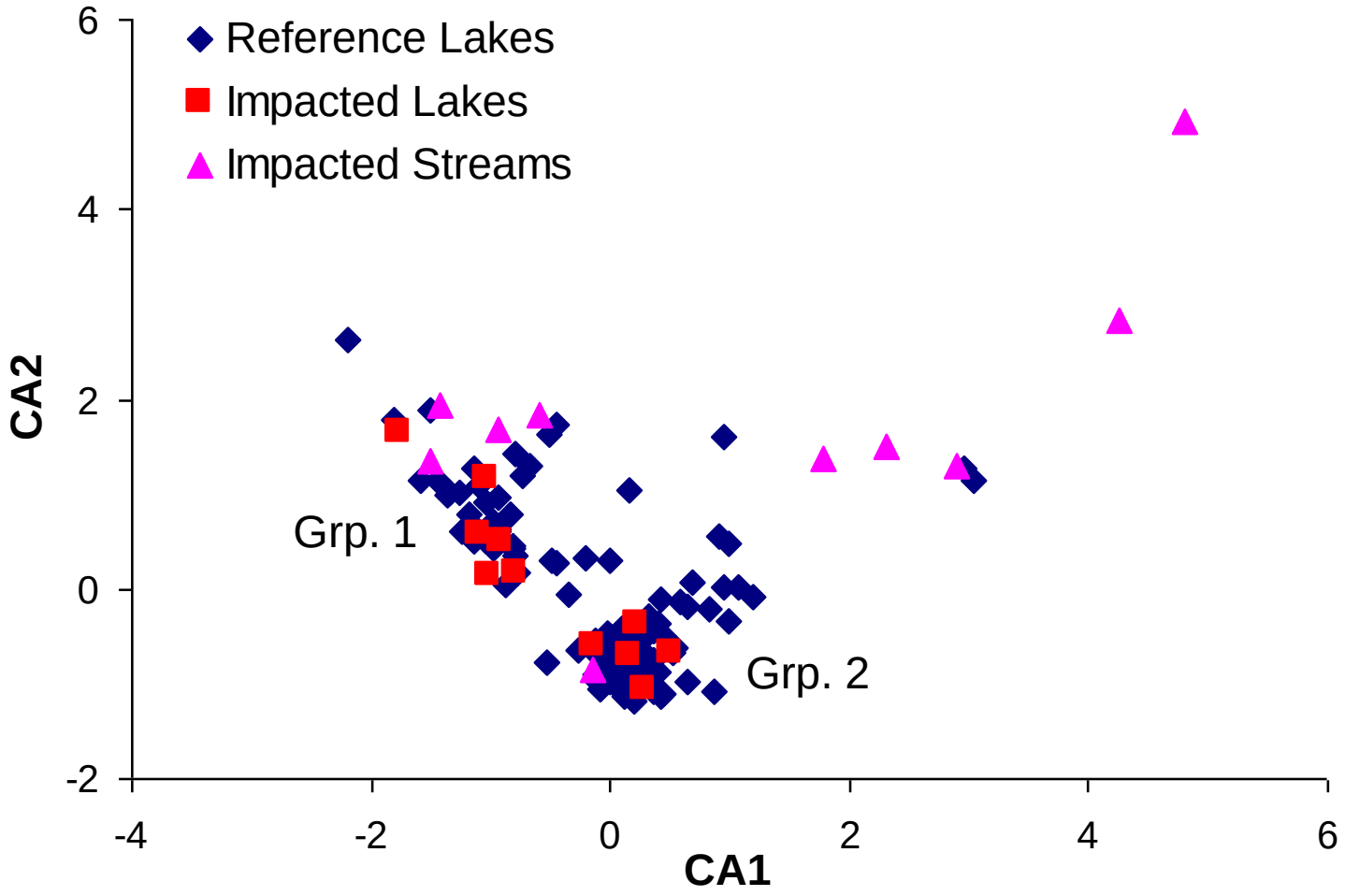
District of Muskoka: Results



District of Muskoka: Normal Ranges from Reference Lakes

	Reference Lakes				
	$Richness_{27}$	% EPTO	% Chir	% Worms	% Dom
mean	10	23	12	2	43
median	10	21	10	1	43
5th percentile	8	5	2	0	23
10tn percentile	8	7	2	0	27
25th percentile	9	12	5	0	33
75th percentile	12	30	17	3	53
90th percentile	13	43	28	6	64
95th percentile	13	53	31	8	68

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