Quagga Mussels have Limited Impact on Phytoplankton & Zooplankton Phenology and Composition in Lake Mead, NV (2007-2013)

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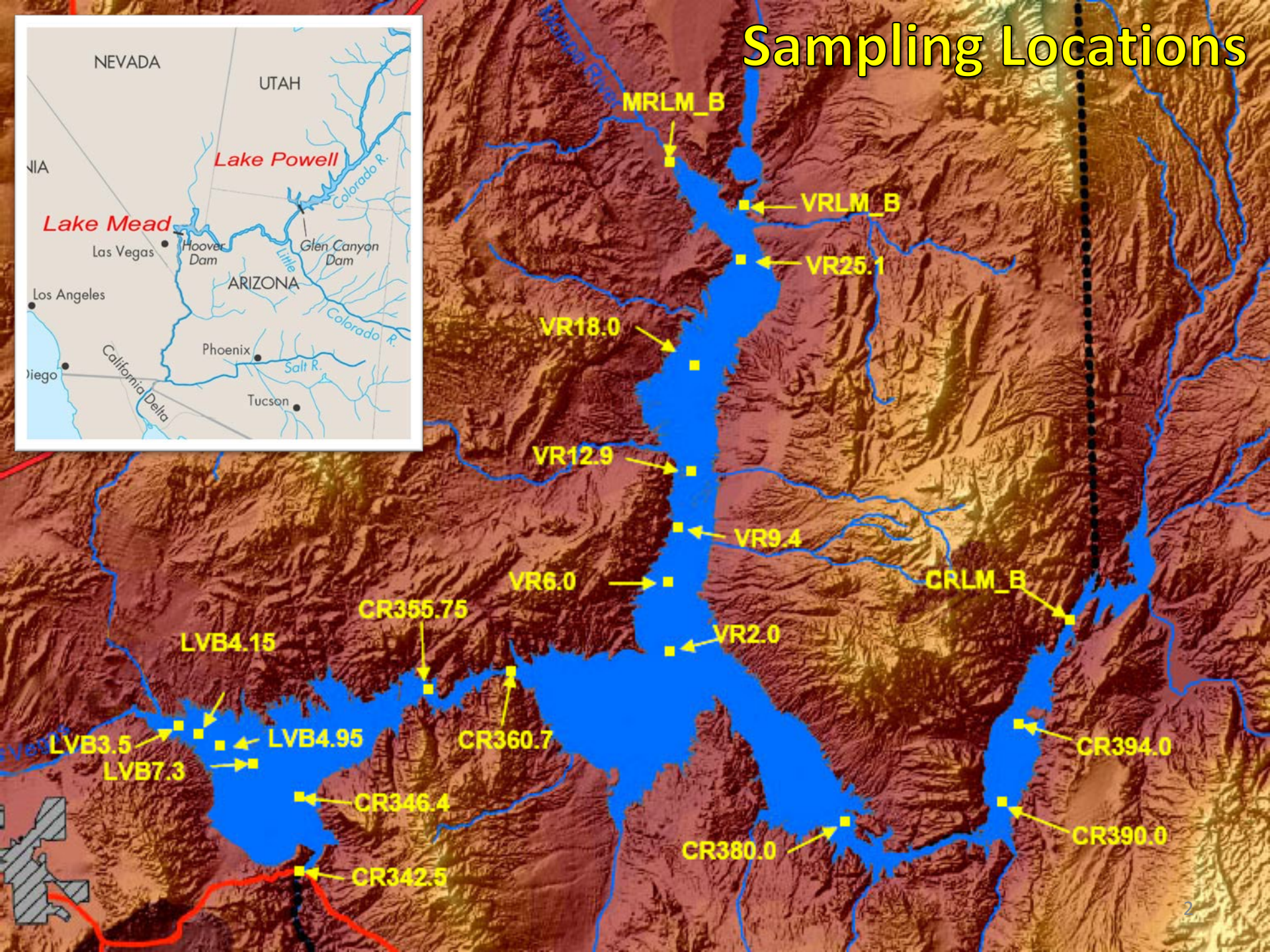
Sampling Locations

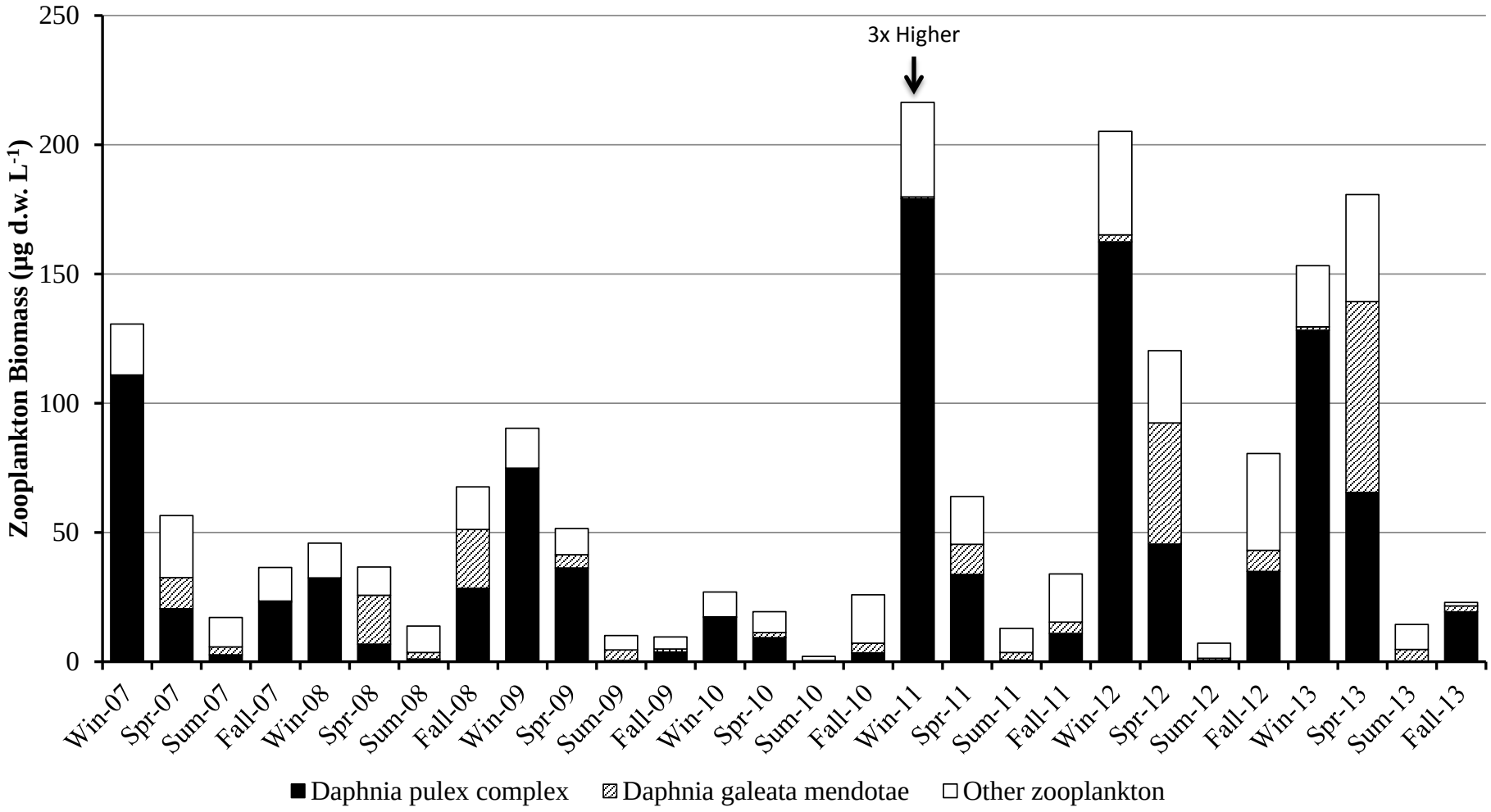


Daphnia pulex complex vs. *Daphnia galeata mendotae*

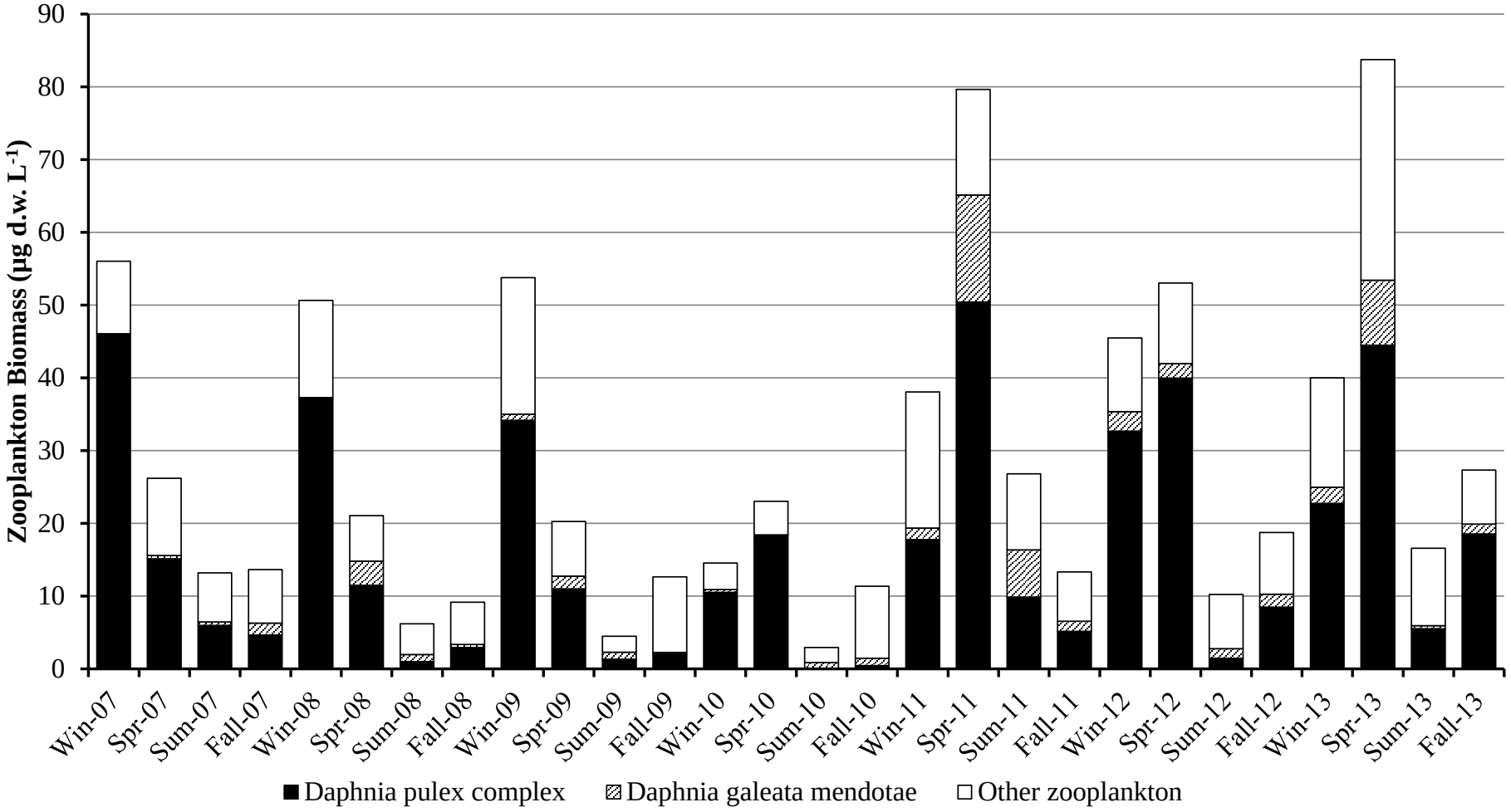
D. pulex complex

D. galeata mendotae

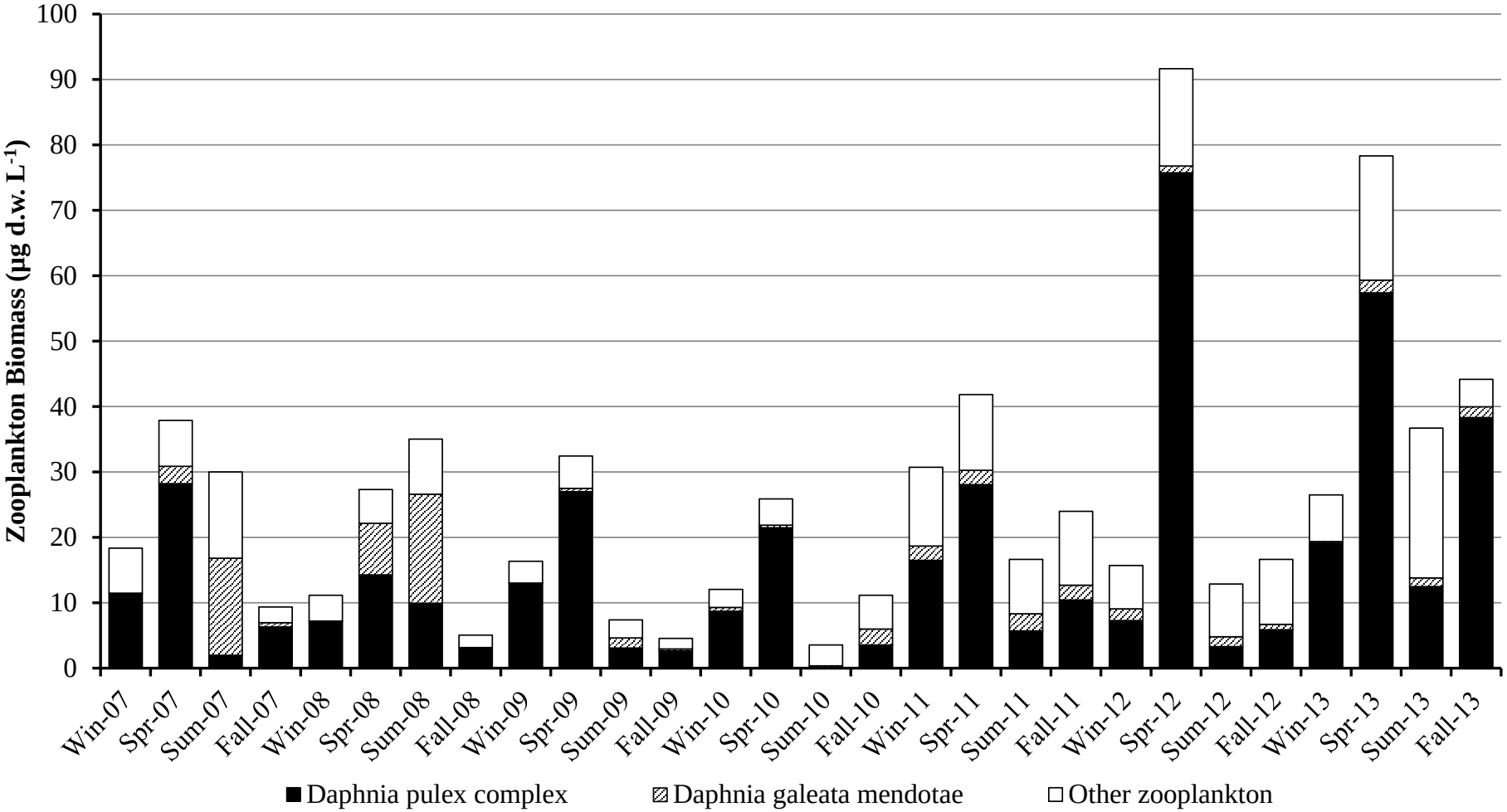
Boulder Basin – Quarterly Zooplankton Biomass Means



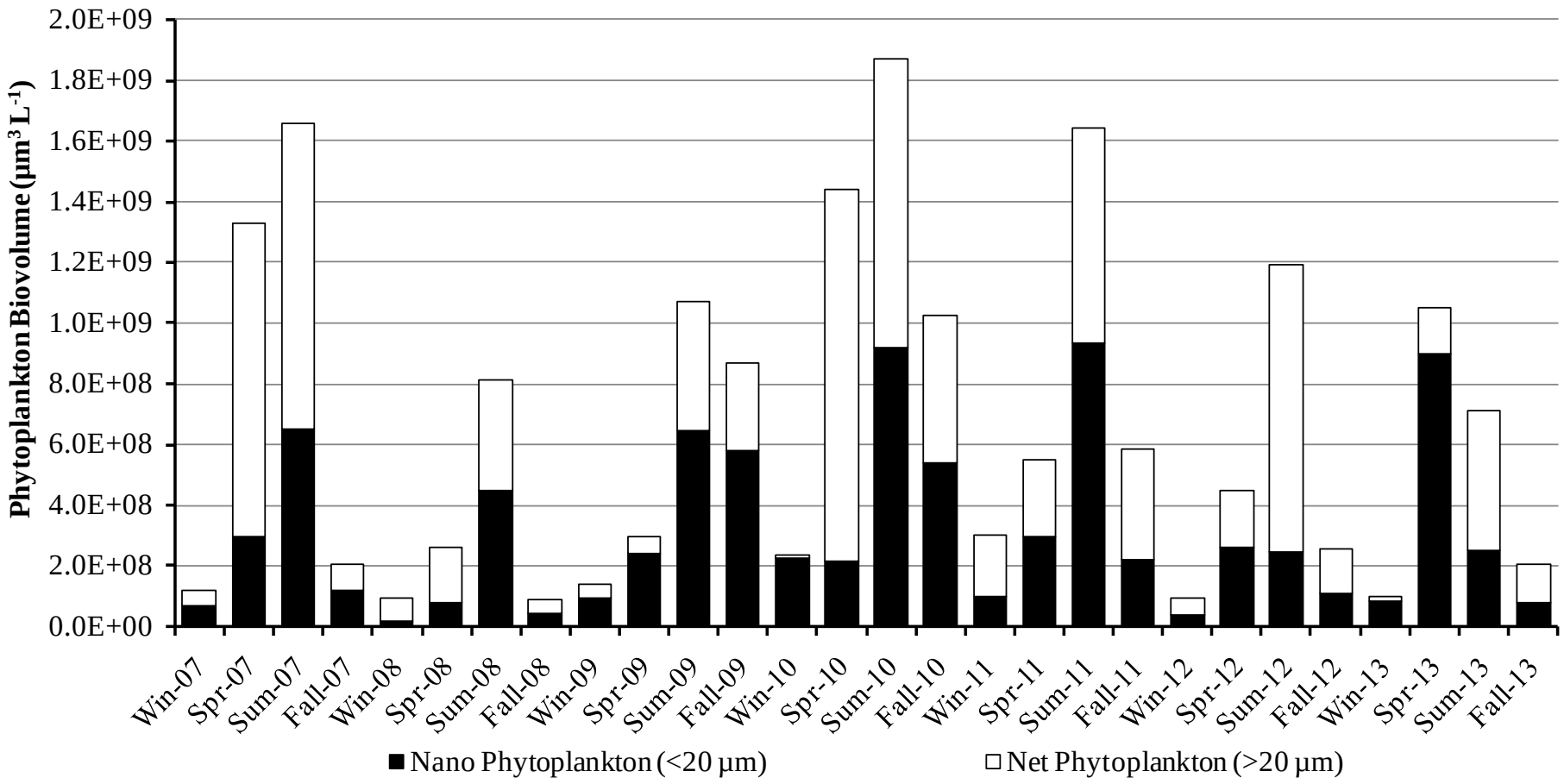
Overton Basin – Quarterly Zooplankton Biomass Means



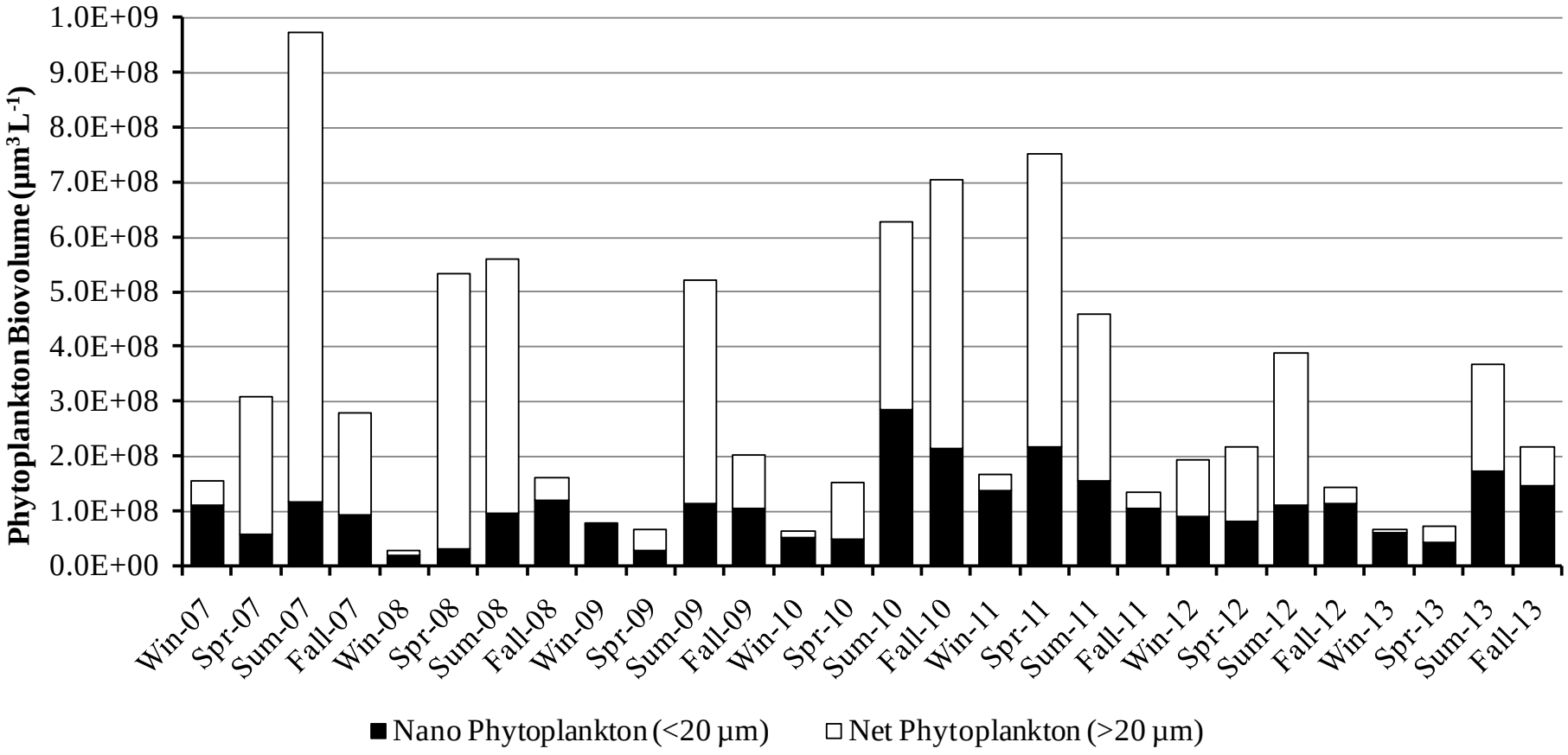
Colorado Basin – Quarterly Zooplankton Biomass Means



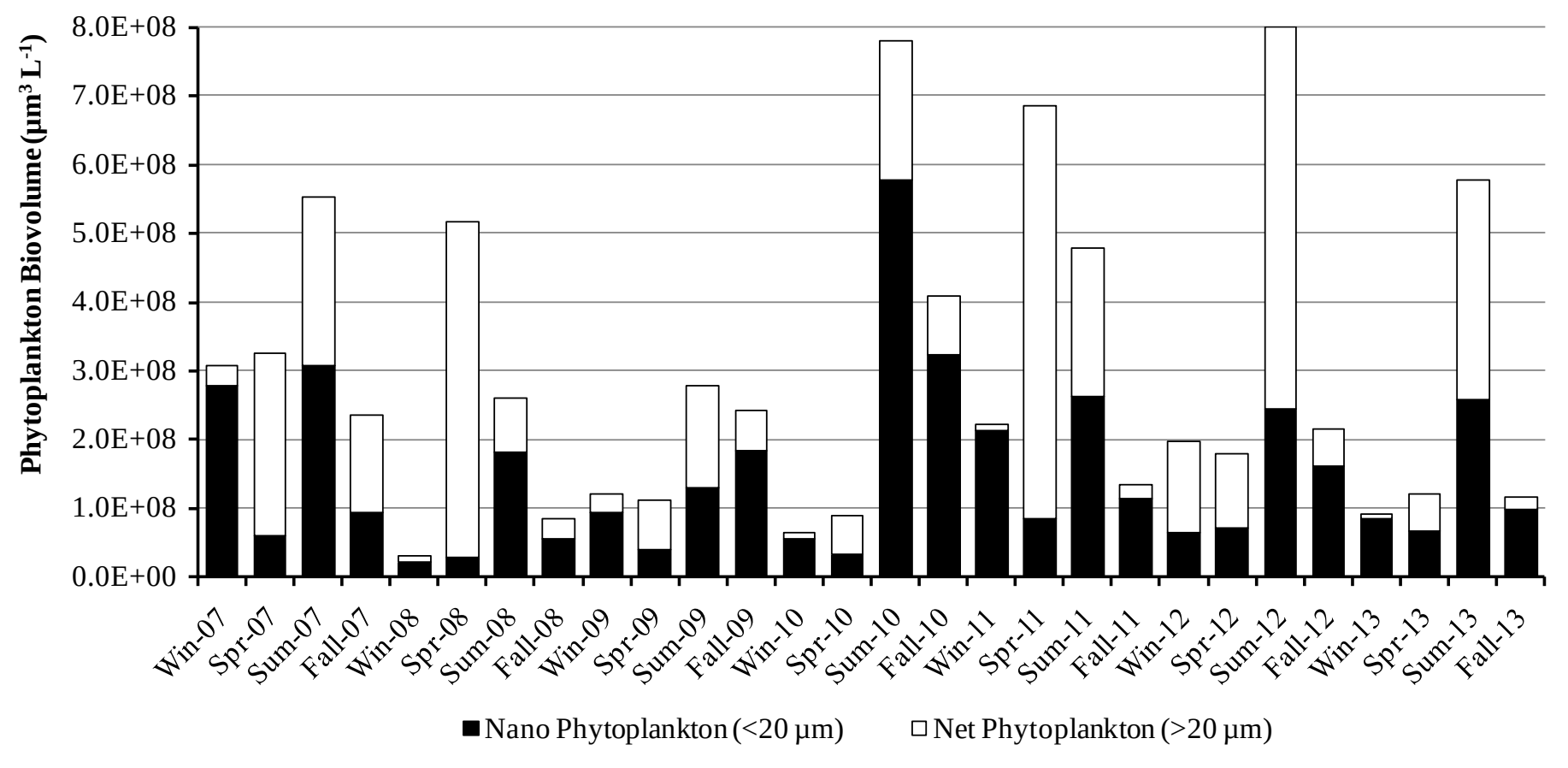
Boulder Basin – Quarterly Nano/Net Phytoplankton Biovolume Means



Overton Basin – Quarterly Nano/Net Phytoplankton Biovolume Means



Colorado Basin – Quarterly Nano/Net Phytoplankton Biovolume Means



Daphnia spp. Seasonal Mean Comparisons

Daphnia spp. Biomass (µg d.w. L^{-1})				
Basin	Season	2007-2009	2010-2013	*p*
Boulder	Winter	72.8	213.0	0.24
	Spring	33.3	76.1	0.12
	Summer	4.7	2.6	0.26
	Fall	26.6	22.5	0.9
Overton	Winter	42.0	22.6	0.14
	Spring* **	14.4	44.7	<0.0005
	Summer	3.6	6.7	0.33
	Fall	4.0	10.4	0.06
Colorado	Winter	10.6	14.1	0.39
	Spring	26.9	47.1	0.12
	Summer*	16.2	6.9	<0.05
	Fall*	4.4	16.7	<0.05

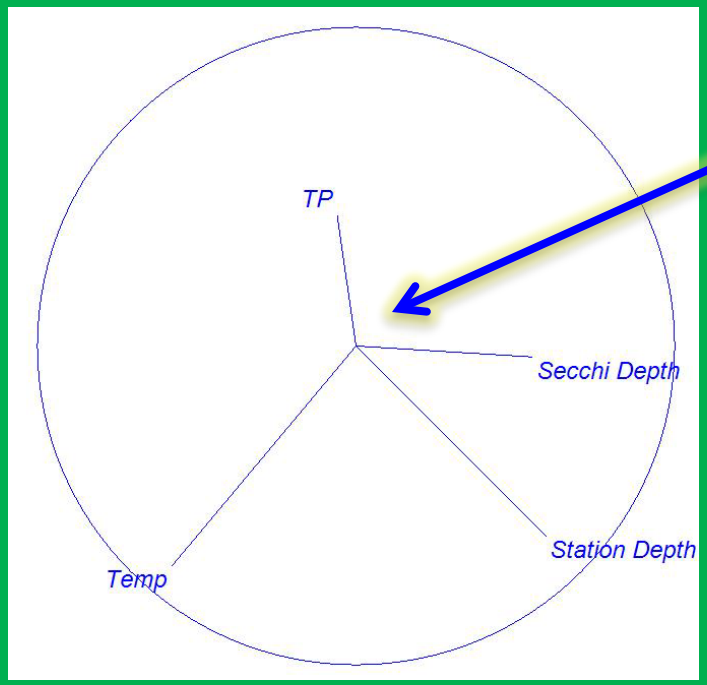
Phytoplankton Seasonal Mean Comparisons

Phytoplankon Biovolume/10^6 ($\mu m^3 L^{-1}$)				
Basin	Season	2007-2009	2010-2013	*p*
Boulder	Winter	12	18	0.69
	Spring	63	47	0.19
	Summer	120	120	0.83
	Fall	39	37	0.93
Overton	Winter	8.8	12	0.18
	Spring*	30	9.6	<0.005
	Summer	68	45	0.70
	Fall	21	25	0.37
Colorado	Winter	15	14	0.36
	Spring***	32	6.8	<0.0001
	Summer*	36	65	<0.05
	Fall	19	19	0.79

Statistical Approach

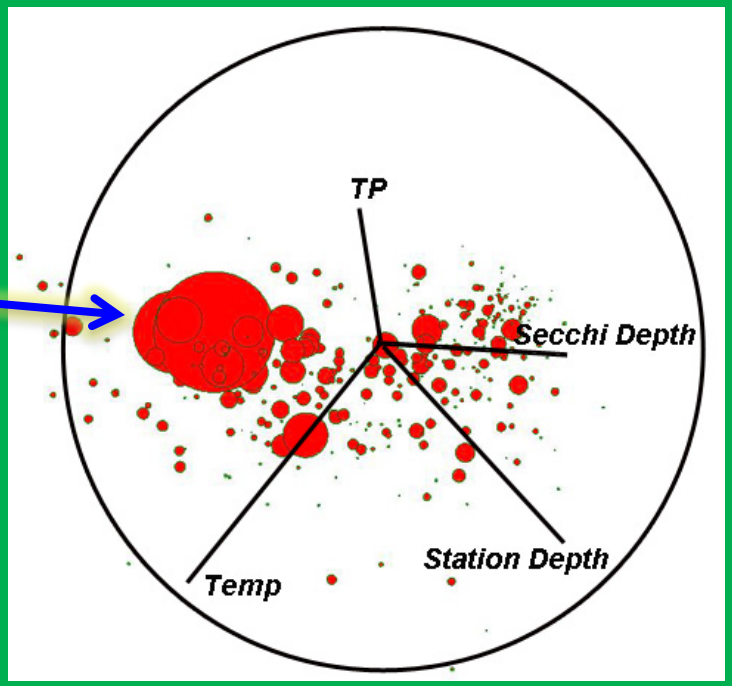
- Relative placement (resemblance) reflects similarities between biomass (zooplankton) and biovolume (phytoplankton) compositions
- Canonical Correlation Analysis (CCA) – explore relationships between paired biotic and environmental data
- Two CCAs – 1 zooplankton and 1 phytoplankton

Reading an Ordination

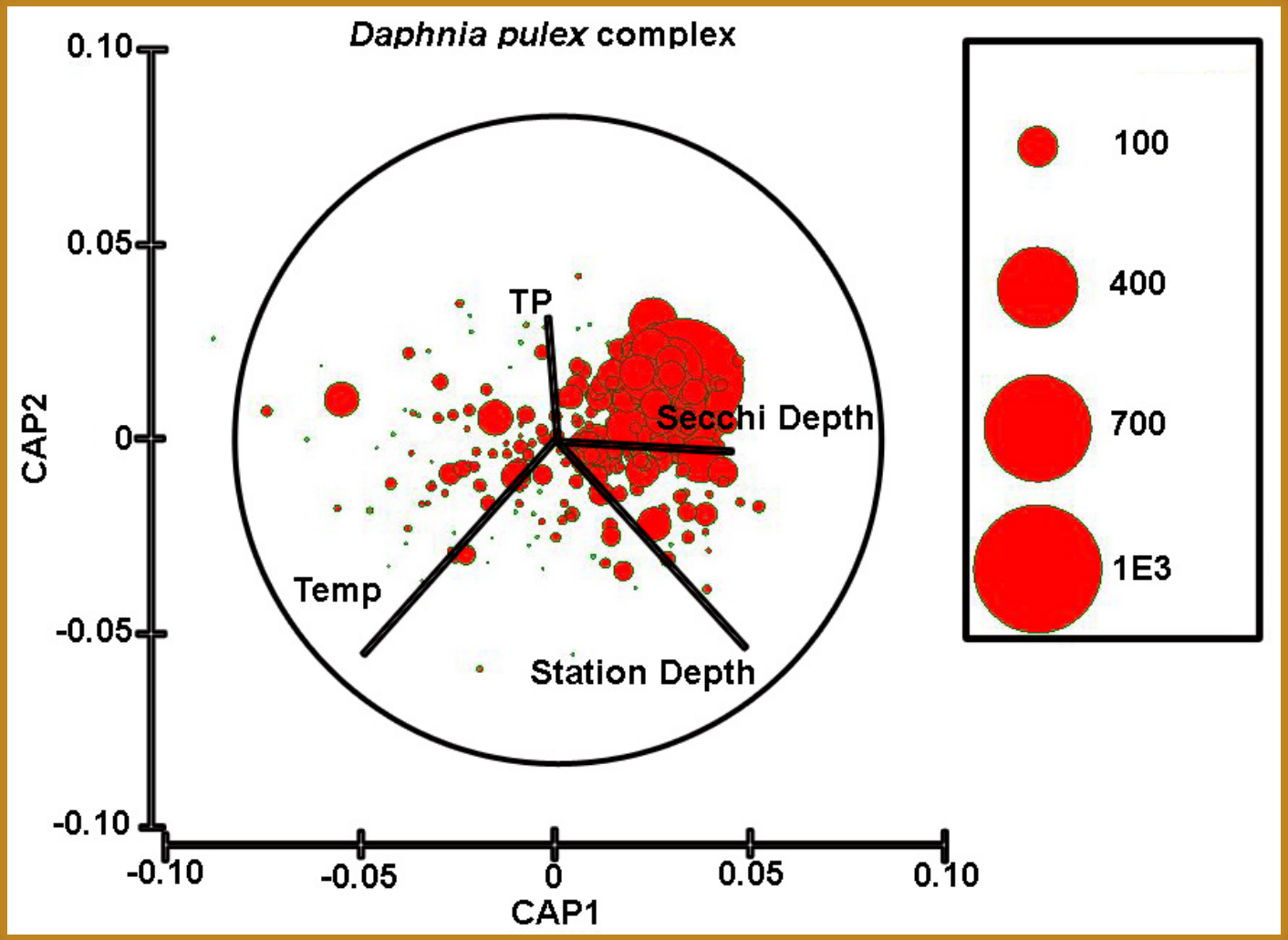


- Lines from center of graph (vectors) represent environmental variables
- Line direction = change of environmental variable across ordination
- Length of line = strength of relationship

- Bubbles = biomass/biovolume for each sample
- Bubble position = taxa preference in relation to environmental variables

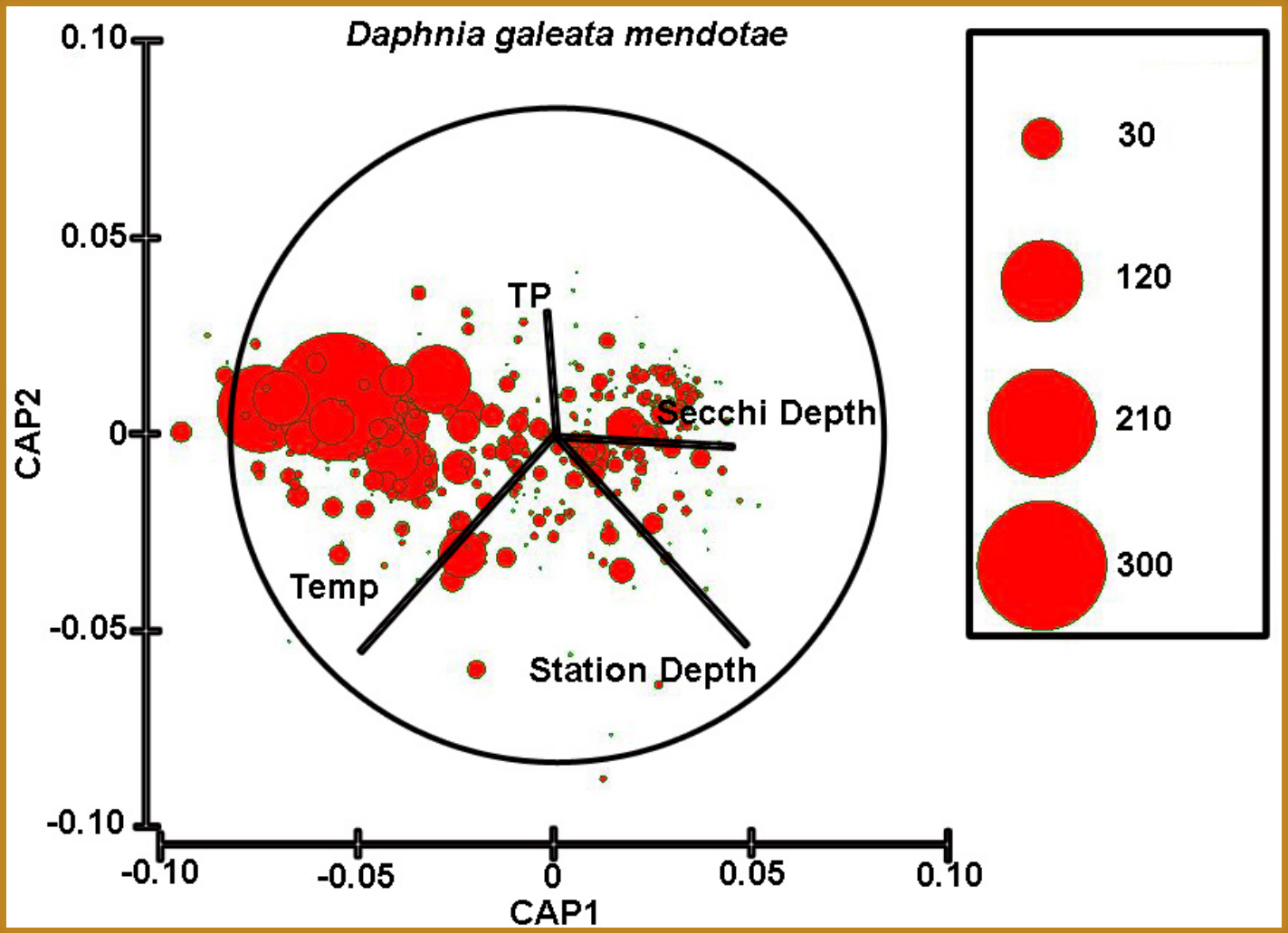


Daphnia pulex complex



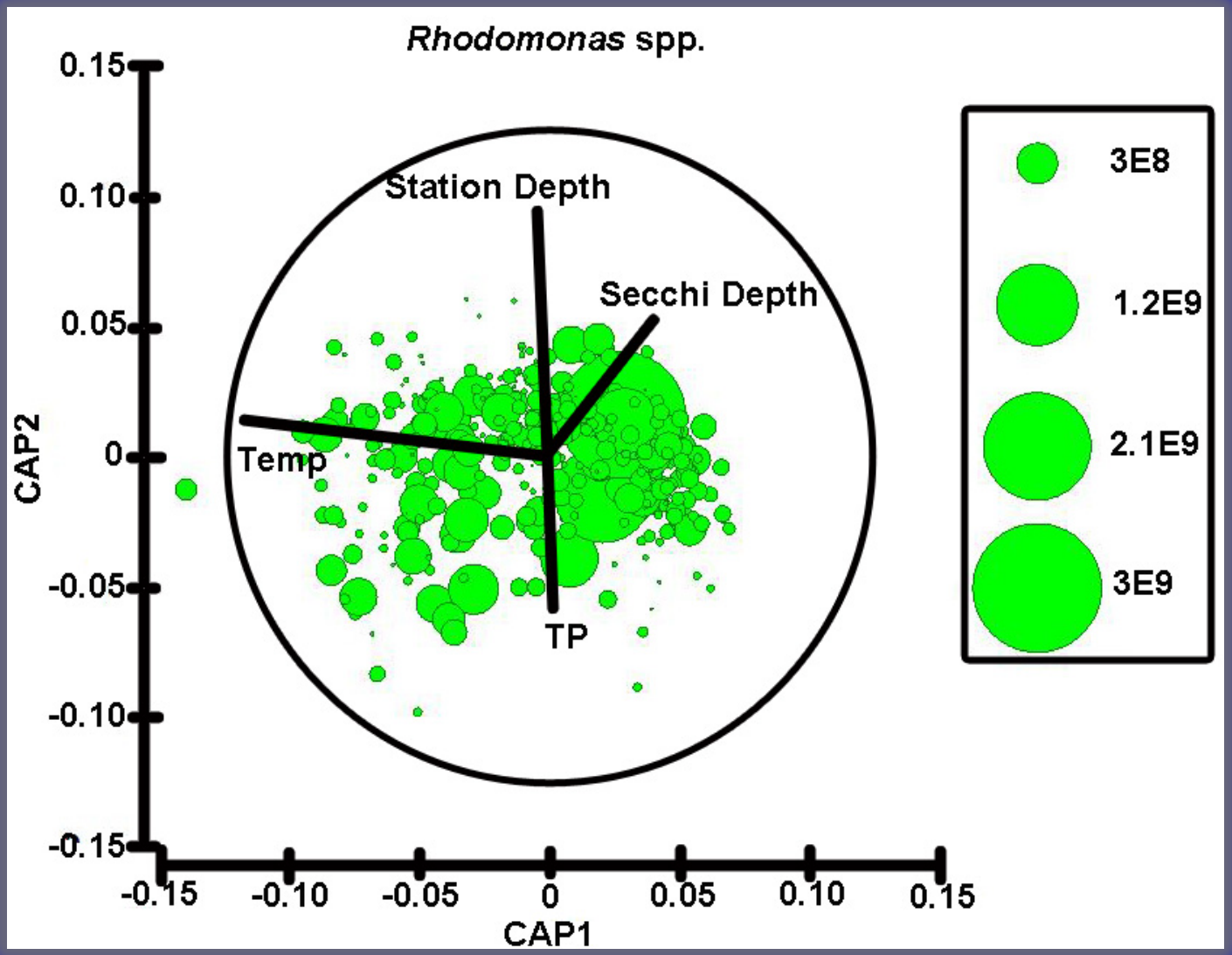
- **Bubble represents biomass (µg d.w. L^{-1})**
- **Bubble size corresponds to magnitude of biomass**

Daphnia galeata mendotae



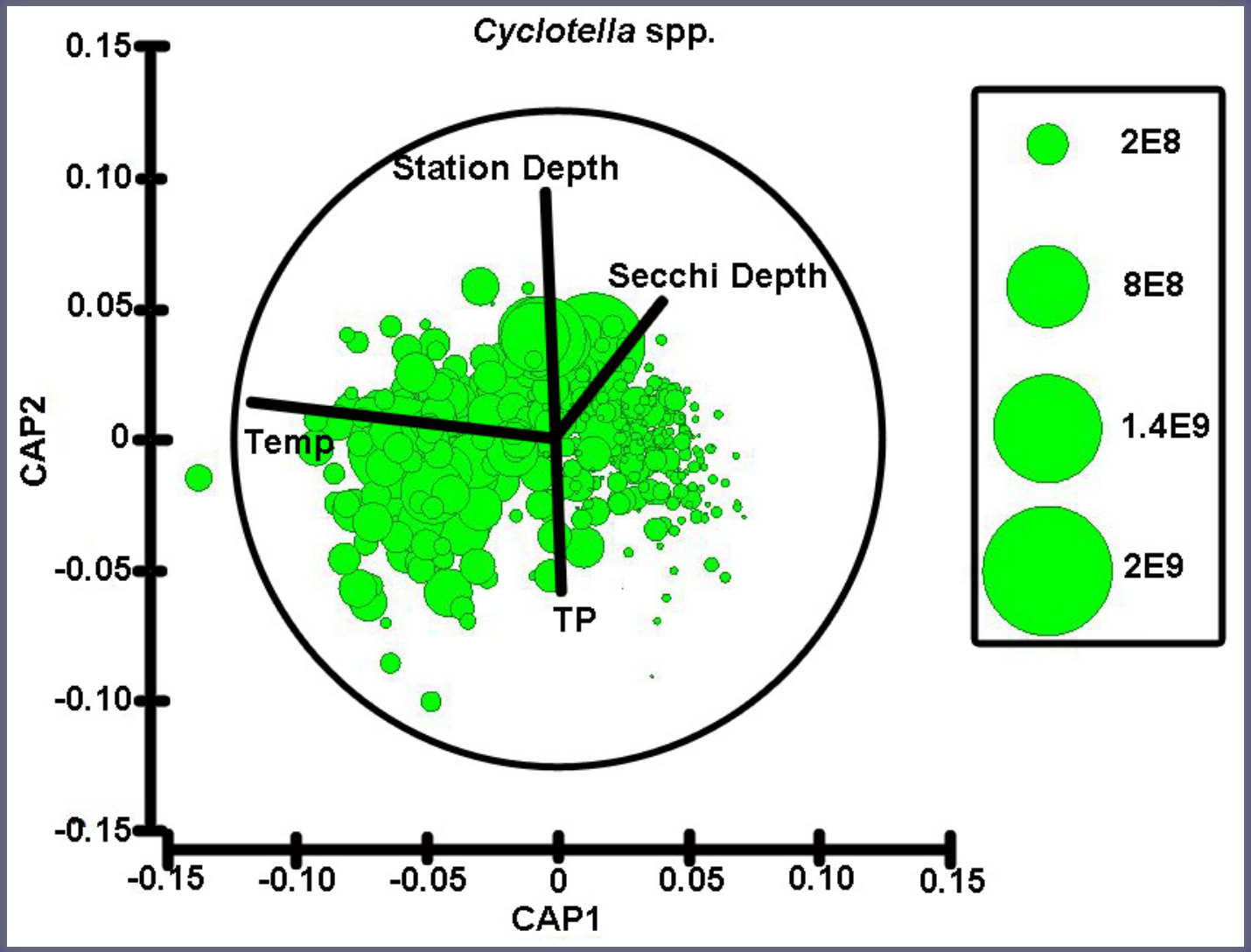
- **Bubble represents biomass (µg d.w. L^{-1})**
- **Bubble size corresponds to magnitude of biomass**

Rhodomonas spp.



- **Bubble represents biovolume ($\mu m^3 L^{-1}$)**
- **Bubble size corresponds to magnitude of biovolume**

Cyclotella spp.



- **Bubble represents biovolume ($\mu m^3 L^{-1}$)**
- **Bubble size corresponds to magnitude of biovolume**

Niche Centroid Temperature Optima

***Daphnia pulex* complex**	**16.7°C**
Daphnia galeata mendotae	**21.9°C**
***Rhodomonas* spp.**	**20.8°C**
***Cyclotella* spp.**	**23.9°C**

Daphnia spp. Biomass Comparisons

Reservoir	*Daphnia* spp. Biomass (µg d.w. L^{-1})
Boulder	60.3
Overton	19.0
Colorado	18.3
Havasu	0.25
Powell	23.6
Western Xeric Reservoirs*	11.4

*Beaver *et al*. (2014) The late summer crustacean zooplankton in western US reservoirs reflects ecoregion, temperature and latitude. *Freshwater Biology*, in press.

Conclusions

- Based on historical data, plankton phenology appears to remain unchanged in the presence of Quagga mussels
- Does habitat separation prevent Quagga mussels from having a significant impact on plankton?

Questions?