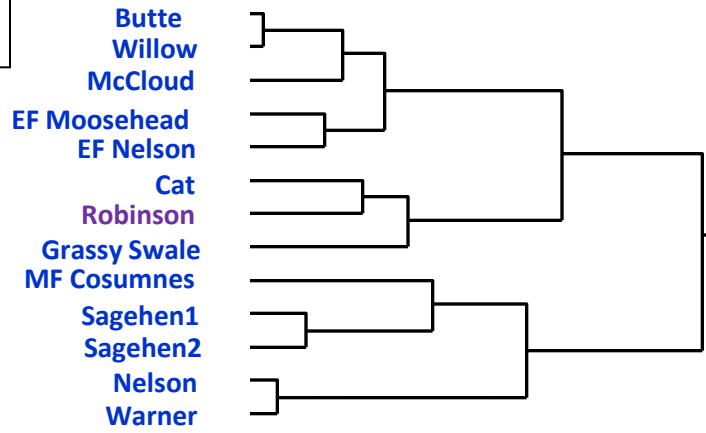


# Stream Biological Community Groupings

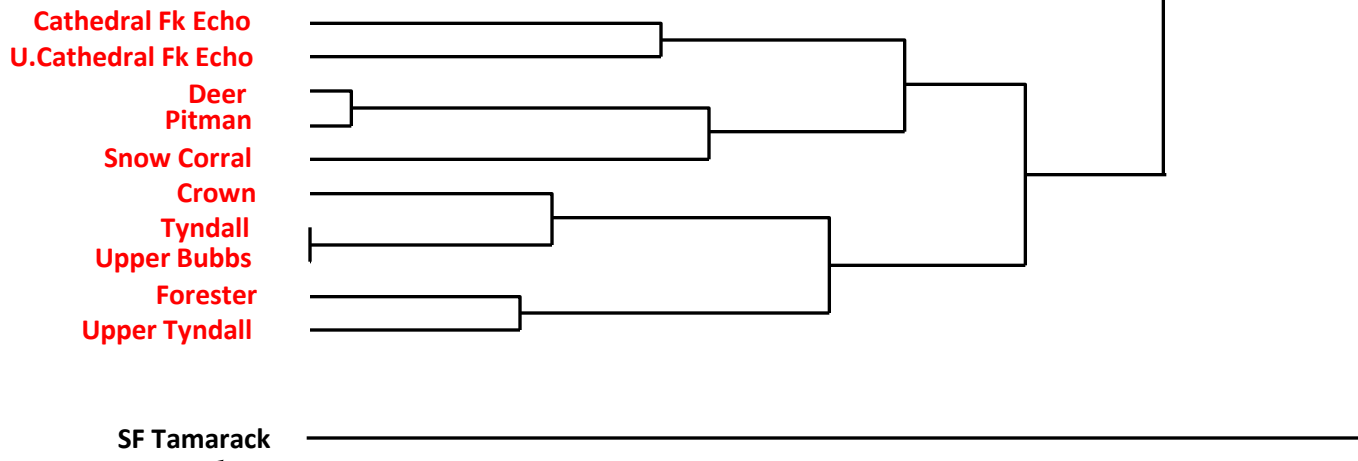
North of  
Yosemite



**Northern streams** have significant groundwater inflows (volcanic terrain) and have greater species diversity but more to lose in the face of the greatest predicted loss of snowpack

Yosemite  
and South

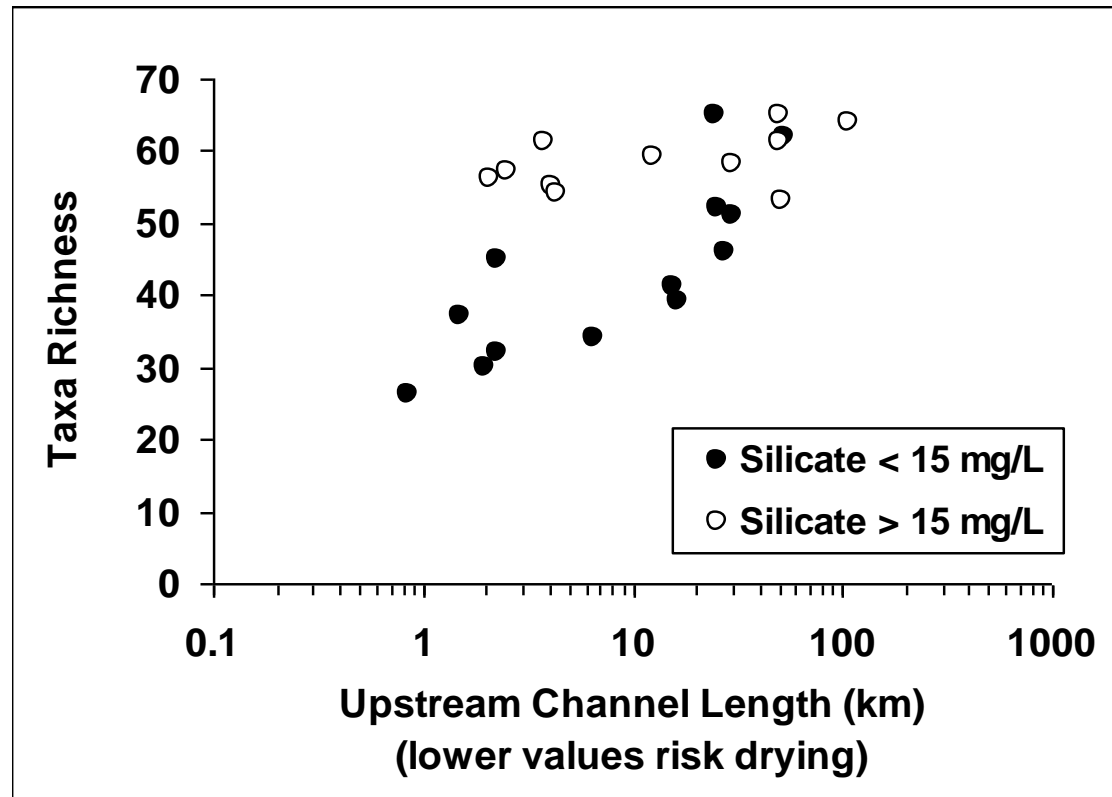
**Southern streams** are snowmelt-dominated (granite terrain) and so are more at-risk to drying and have less species diversity



**Intermittent channel** = shortest upstream length, snowmelt

~350 BMI taxa identified to date (genus/species)

**Closer look at intermittent flow: stress of periodic summer drying  
>perennial upstream length used as indicator of dependable flow**



**Short headwater streams most susceptible, having least taxa richness.  
But what protects some headwaters and not others?  
>Groundwater inflows (higher SiO<sub>2</sub>) sustain baseflow and resist drying  
>low SiO<sub>2</sub> snowmelt-dominated streams risk drying but support more  
richness as channel length increases (=perennial flow)**

# Sentinel Streams: How does stream habitat change?

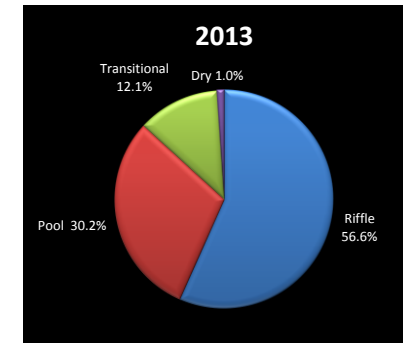
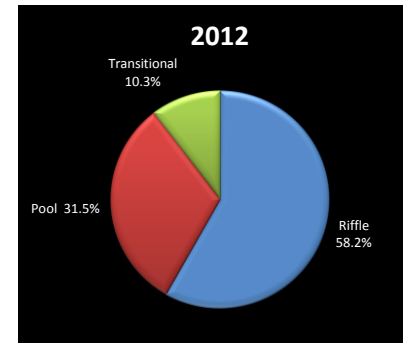
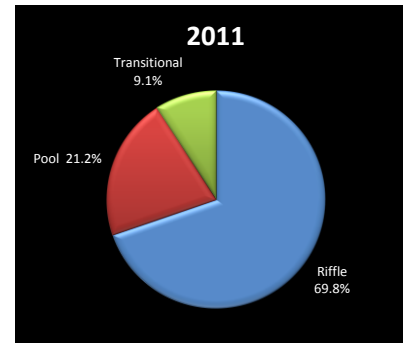
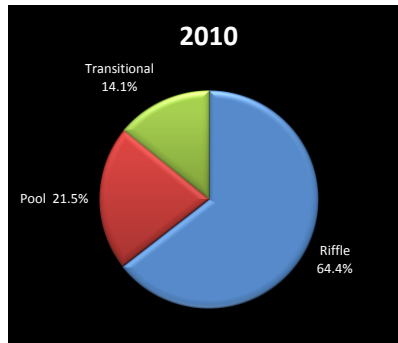
## Pools and Riffles, transition zones

Average to +

High Flow

Drought

Drought



Paired-comparison between years, within each stream (n=24), p<0.05

2010 vs 2011	ns
2010 vs 2012	*
2010 vs 2013	*
2011 vs 2012	*
2011 vs 2013	*
2012 vs 2013	ns

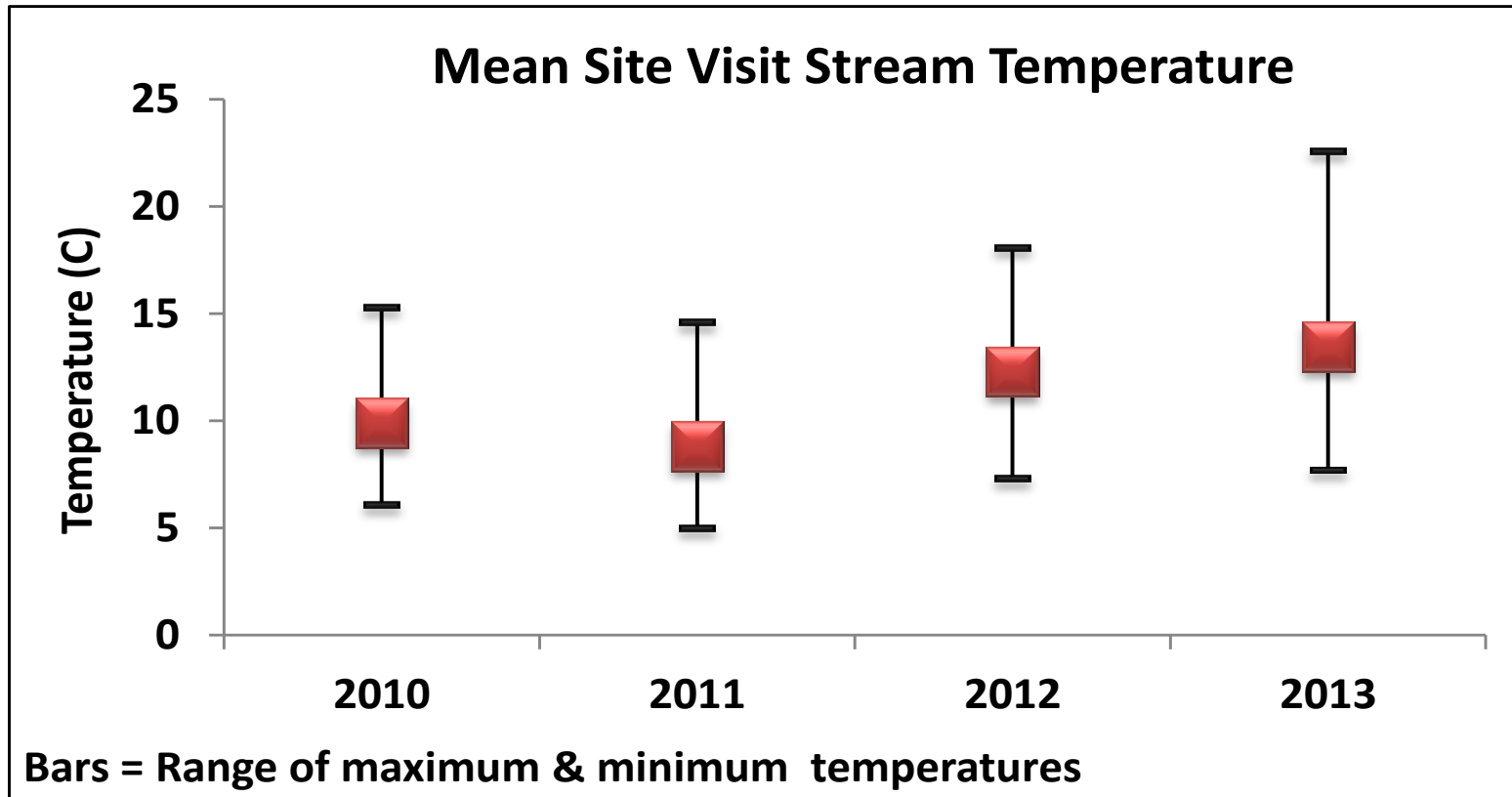
Wilcoxon paired signed-rank tests

**Significant increase in pools w drought, from 20% to 30% of habitat area.**

**Slower-moving POOL habitats come to make up more of the stream environment as the drought progresses.**

**Pools harbor less diversity than swift-flowing riffles. More sediment deposition and less oxygen.**

# Sentinel Streams: have streams warmed with drought?



**Yes, significant increase from average and high flow years to drought (from ~10 to 13°C). Last year some sites rising into the range of >20°C, can be lethal to some aquatic life**

2010-2011	ns
2010-2012	*
2010-2013	*
2011-2012	*
2011-2013	*
2012-2013	ns

2011: high / prolonged spring runoff (50%+ higher, 3wks+ later)  
*and* water chemistry change: **lower pH** (-0.75 mean)

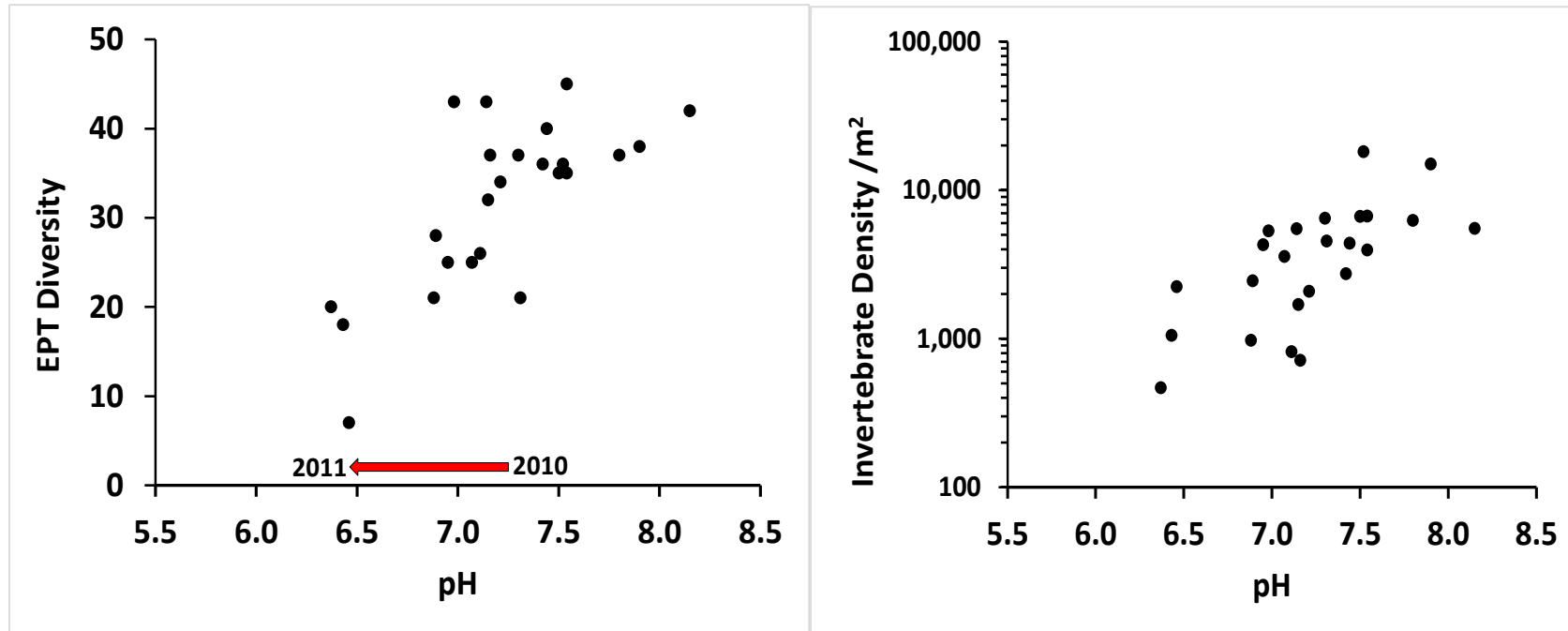
Wilcoxon signed-rank paired comparison 2010 to 2011

$p < 0.0001$  (22 of 24 streams), decrease from average of 7.22 to 6.47

pH decrease with runoff dilution of inflows, washout of acid-neutralizing capacity? Most severe at streams with initially lower pH

Biological Consequences? Duration of pH acidification?

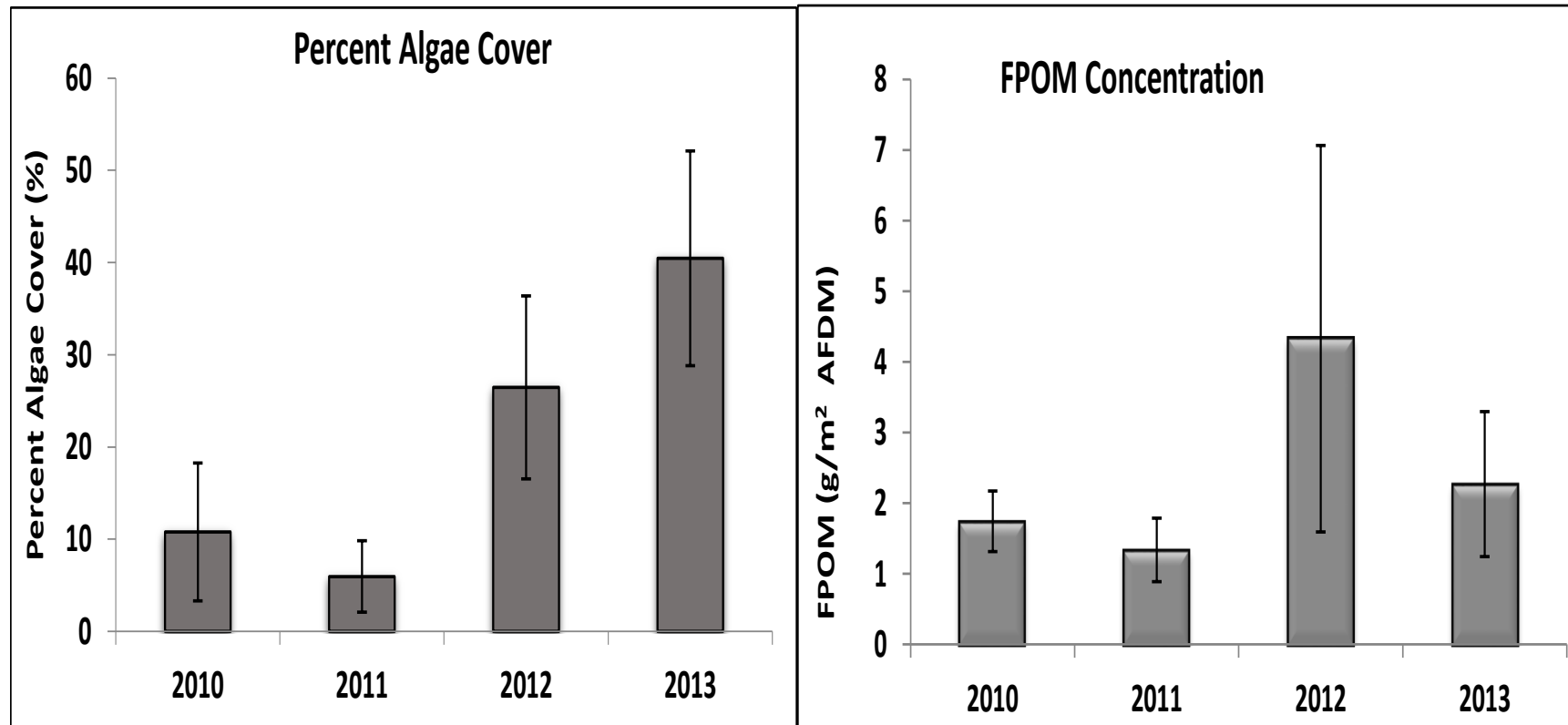
Network shows fewer species & numbers as pH drops



pH rebounds in 2012-2013

## Resource Base and changing flow regime

- Benthic algae percent cover increased during drought years compared to higher flows, and fine particulate organic matter retained then exported/consumed

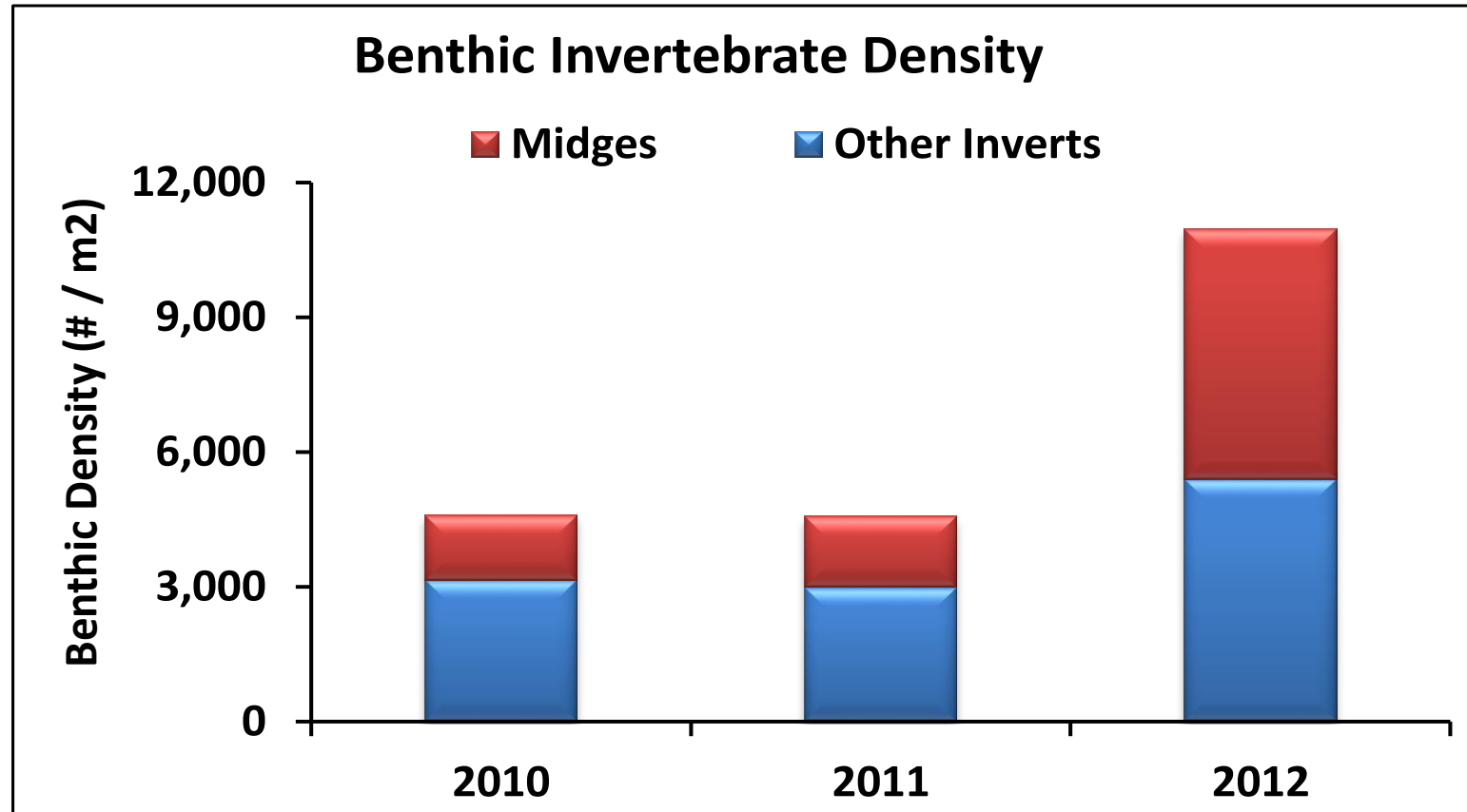


Cannot explain significant increase  
in algae or FPOM due only to  
habitat contraction

**But no significant change in CPOM**

Sentinel Streams:

Does benthic invertebrate density change with drought?



**Overall density increases significantly and becomes dominated by midges over other invertebrates:**

**Midges are small, and more tolerant of poor water quality**