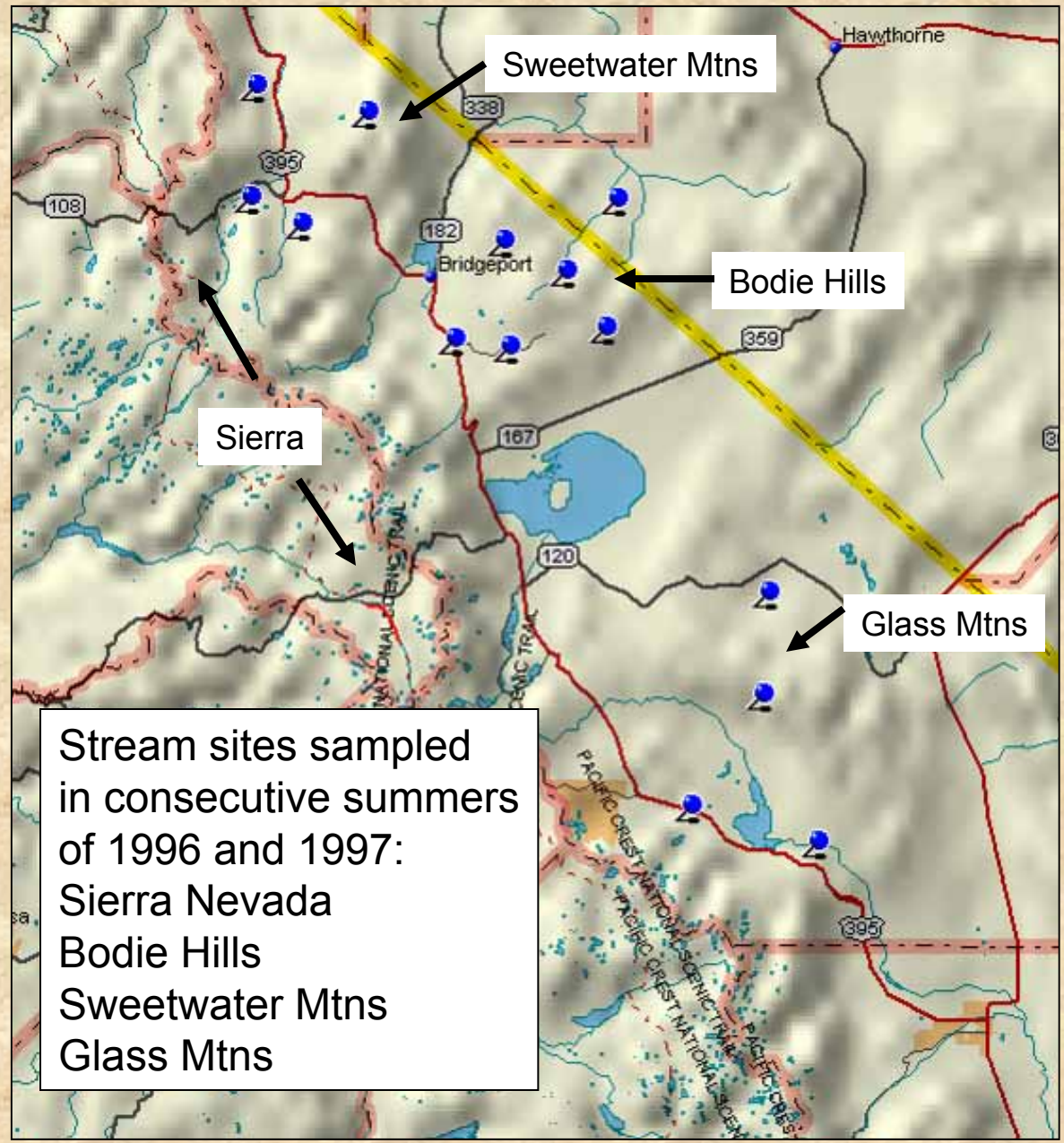
BEFORE AND AFTER THE DELUGE: SNOWMELT FLOODING EFFECTS ON AQUATIC INVERTEBRATE COMMUNITIES OF EASTERN SIERRA NEVADA STREAMS

Lesson One in data collecting:
If you collect enough of it, over and over again, something is bound to happen in between.

Accidental before and after studies:
*Wildfires
*Exotic species invasions
*Pollutant spills

Case in point:
New Year's flood rain-on-snow event in 1997, and alternating years of low and high spring snowmelt flooding in 1992-1995



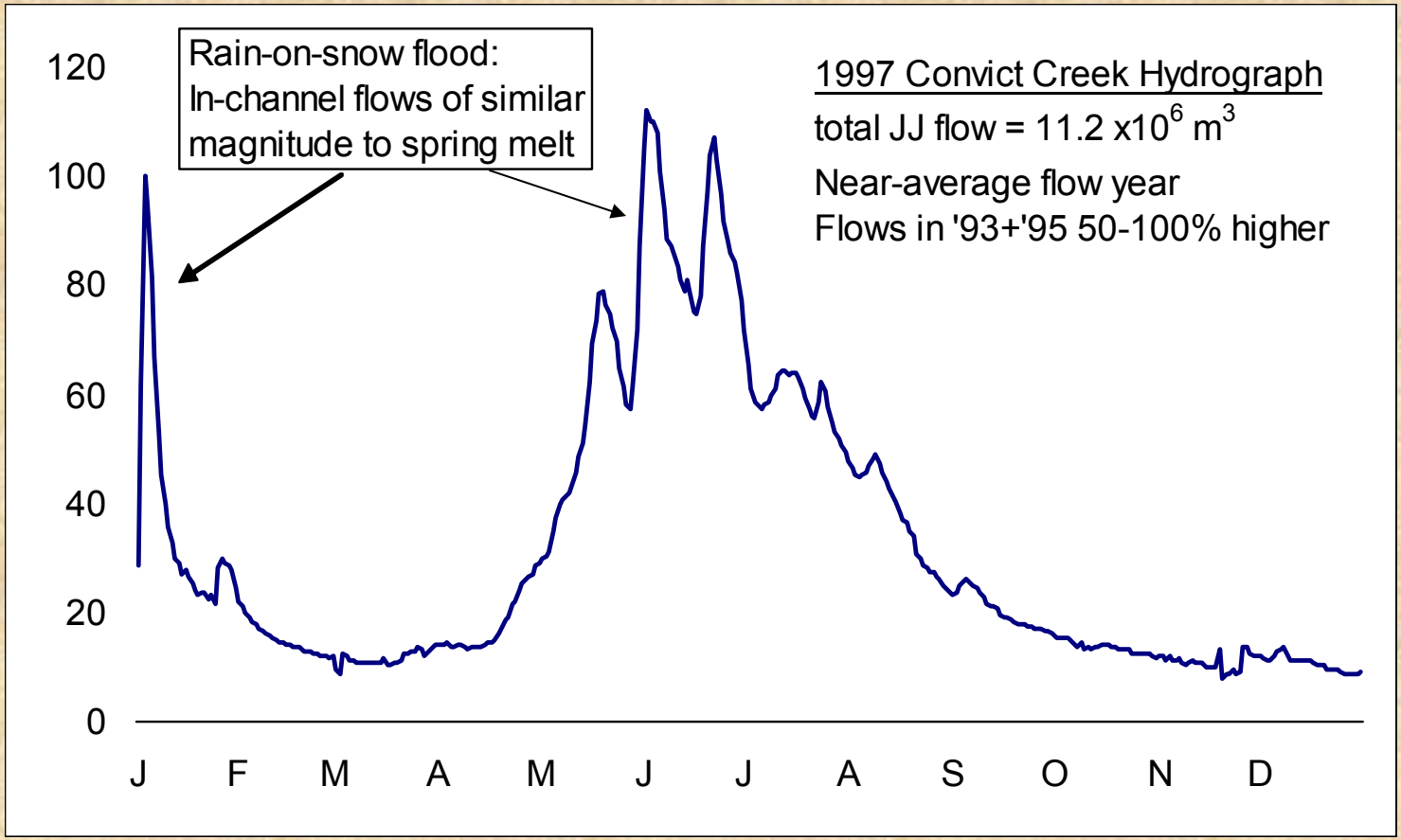
Stream sites sampled in consecutive summers of 1996 and 1997:
Sierra Nevada
Bodie Hills
Sweetwater Mtns
Glass Mtns

Set-up for New Years Flood

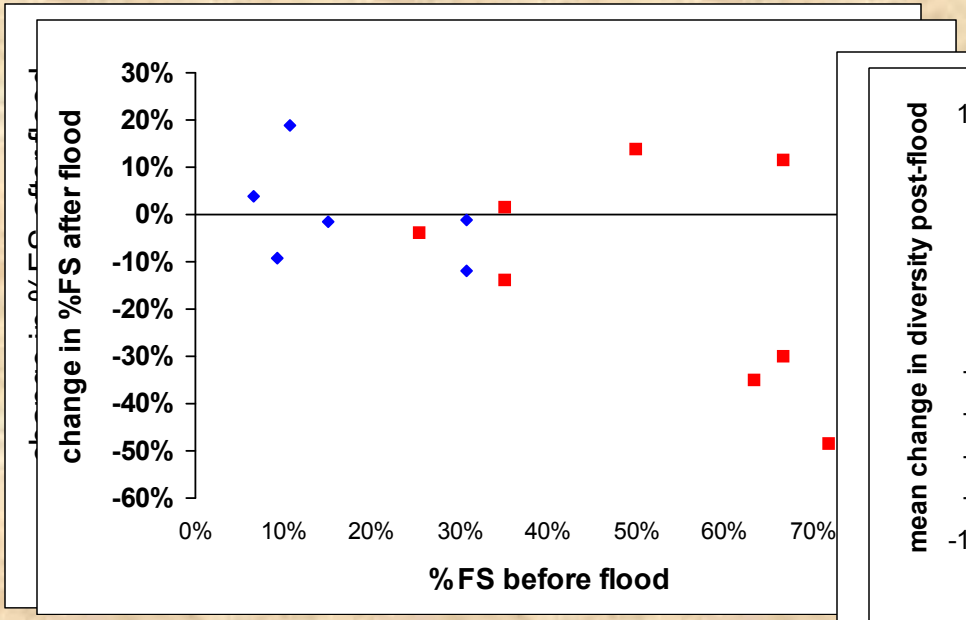
<u>14 sites:</u>
<u>6 reference streams</u>
(defined by minimal upstream road crossings or local bank erosion, no point-source pollution)
<u>8 test streams</u>
(local & upstream grazing disturbance)

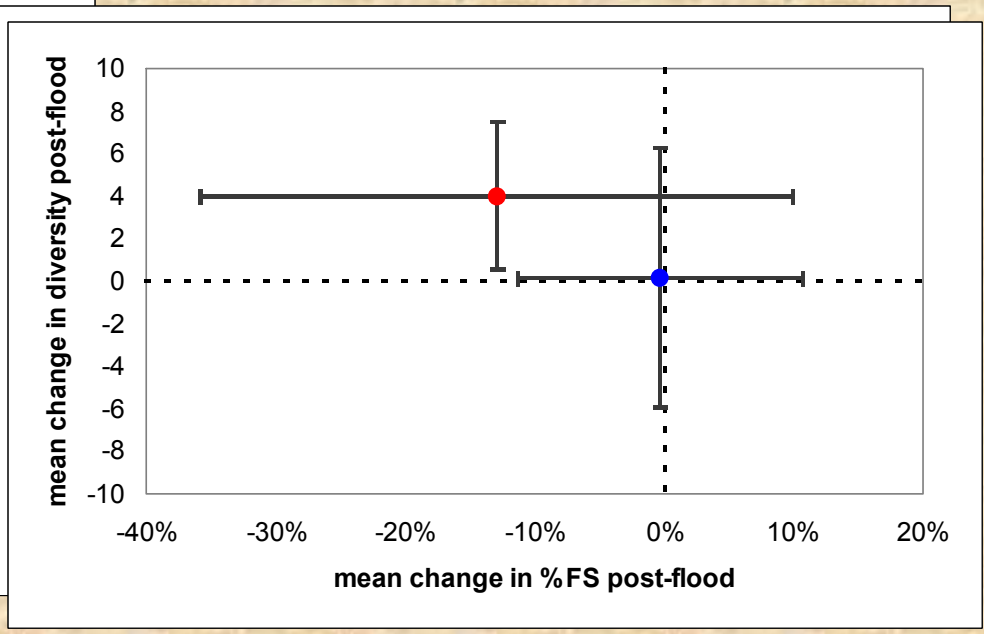
Data collected 6 months before and 6 months after New Year's flood of 1997 that destroyed Hwy 395 in Walker Cyn and flooded many other Sierra streams

Rain-on-snow flood:
pulse disturbance



Scour and erosion and flushing all happening in a flood:
Stream power index (bankfull discharge x slope) = QS
Sediment deposition: %fines+sand (%FS)
Some of the test sites at low power have FS flushed out,
and sites with the most pre-flood FS seem to benefit most.





Although there is substantial variation, there is little net change among reference sites in FS or invertebrate density and diversity. In test sites, low power flushing flows remove sediments and increase number and types of invertebrates present.

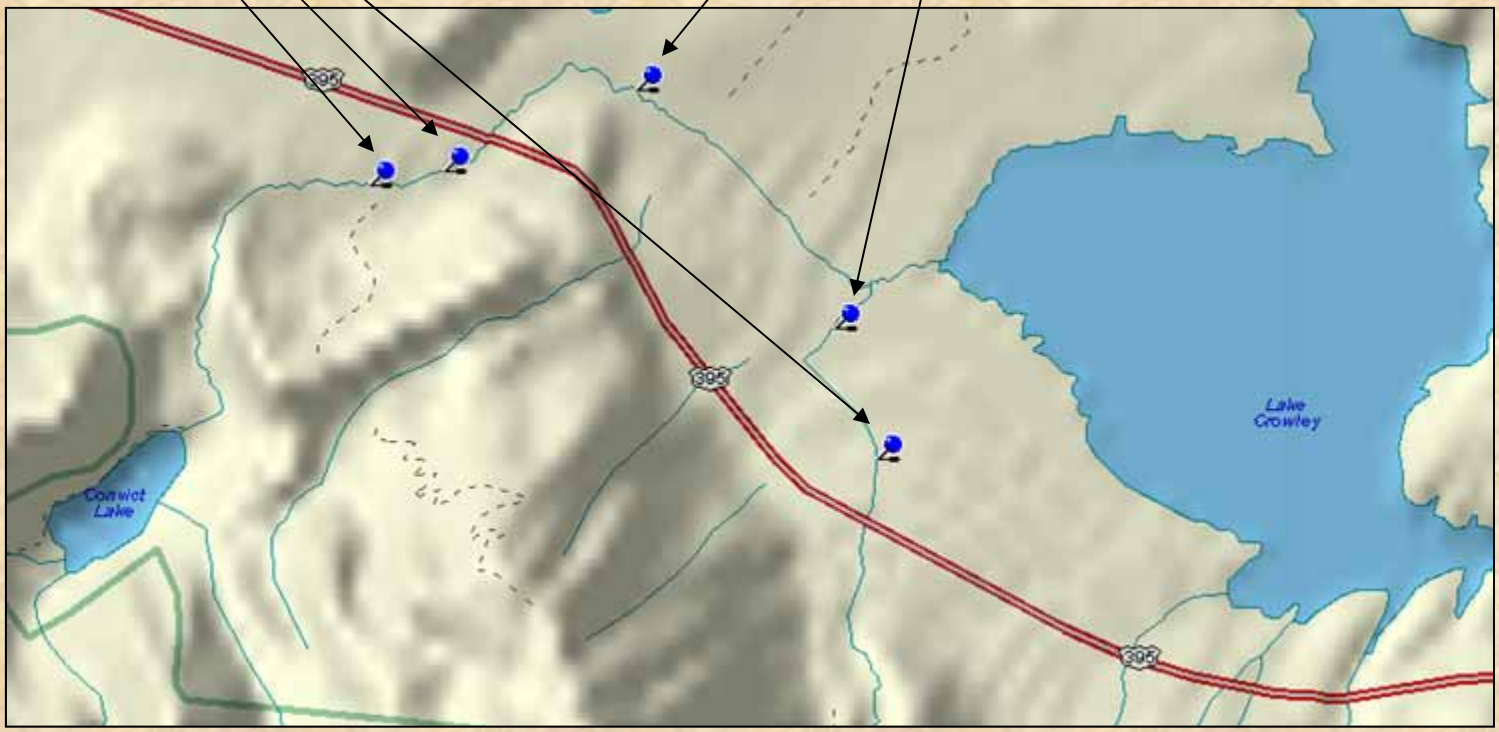
Net effect in these small streams seemed to be beneficial, or at least not detrimental.
Why? small w/ low gradient & power, 6 month recovery, periodic disturbance maintains patch diversity.

Set-up for study of spring snowmelt flooding

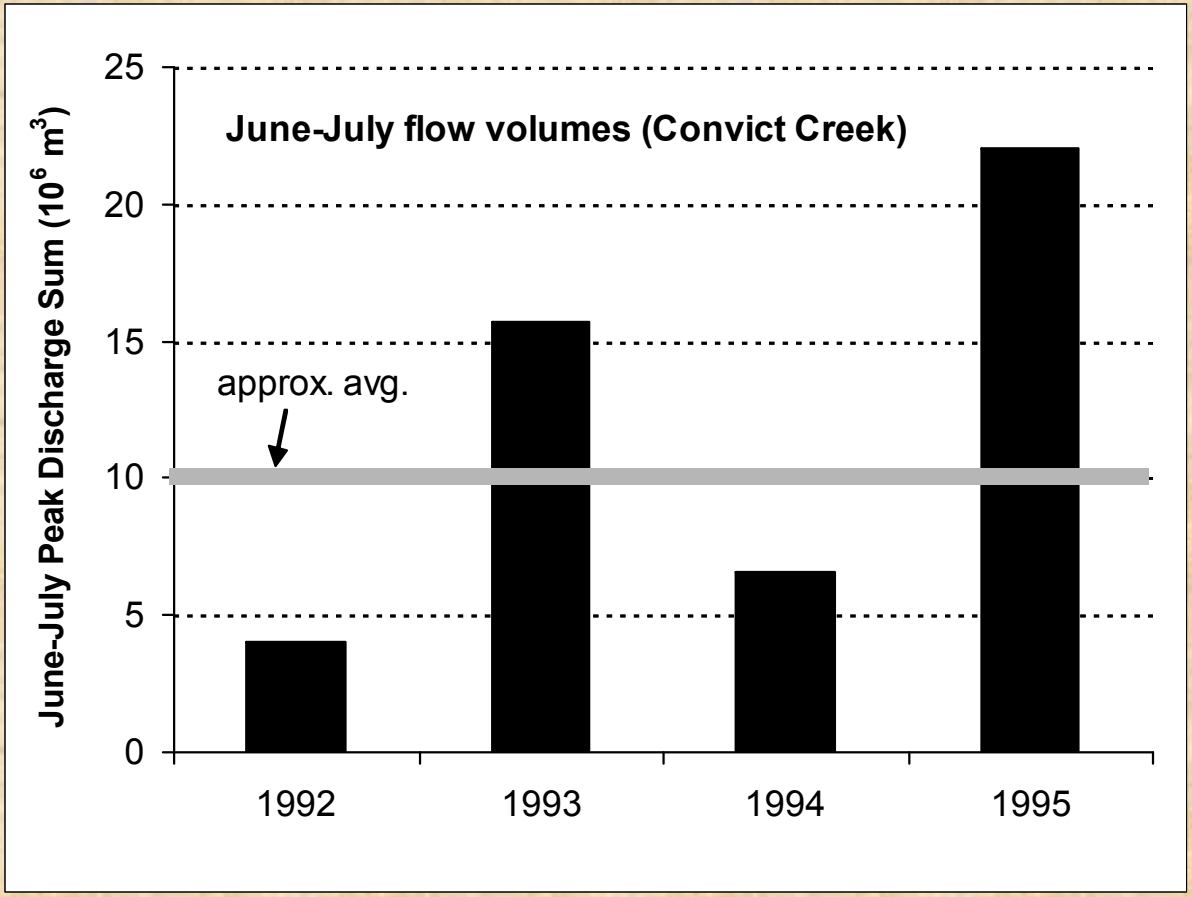
5 sites in Long Valley sampled repeatedly 1992-93-94-95

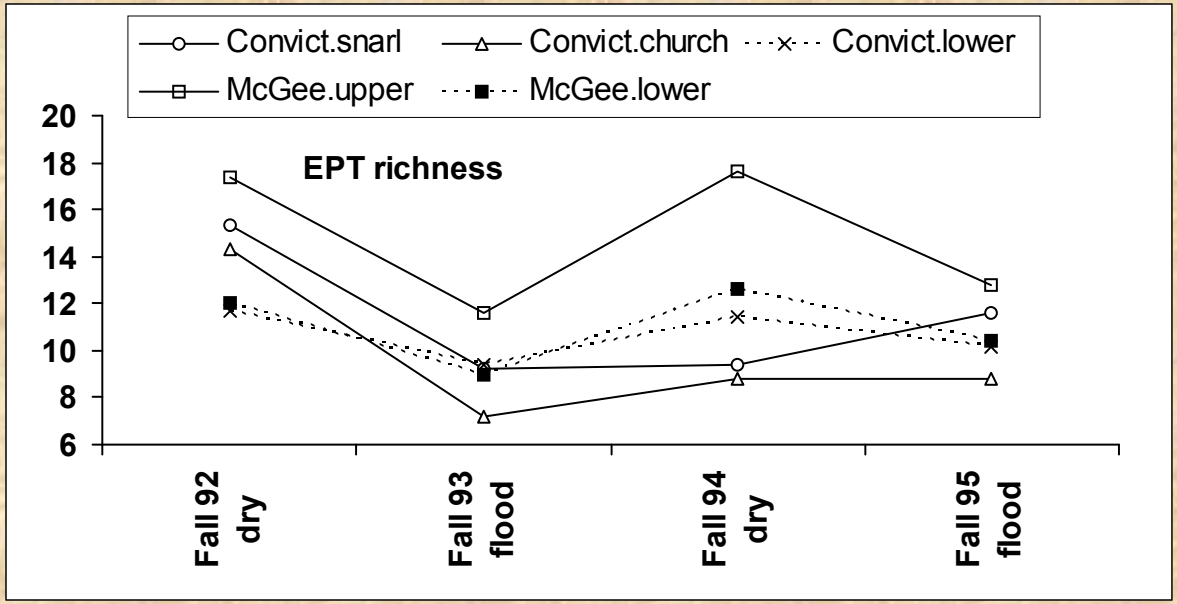
3 sites either ungrazed or with minimal exposure/impact

2 sites with more extensive grazing-related degradation



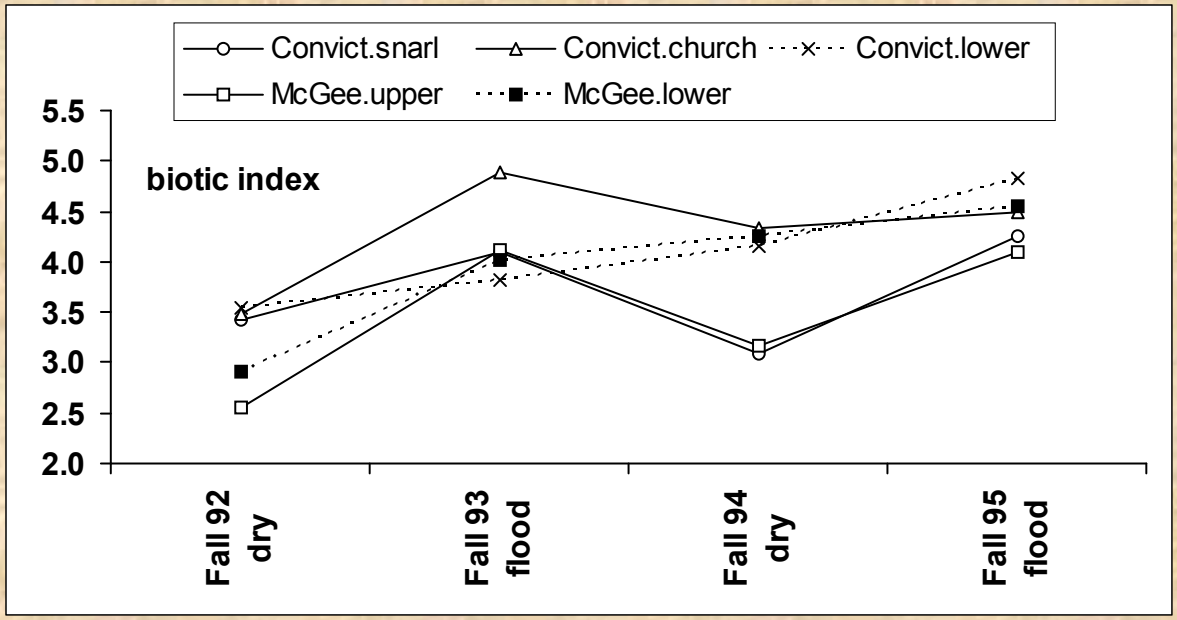
Alternating years of >50-100% below and above average spring snowmelt flows:
press (sustained) disturbance



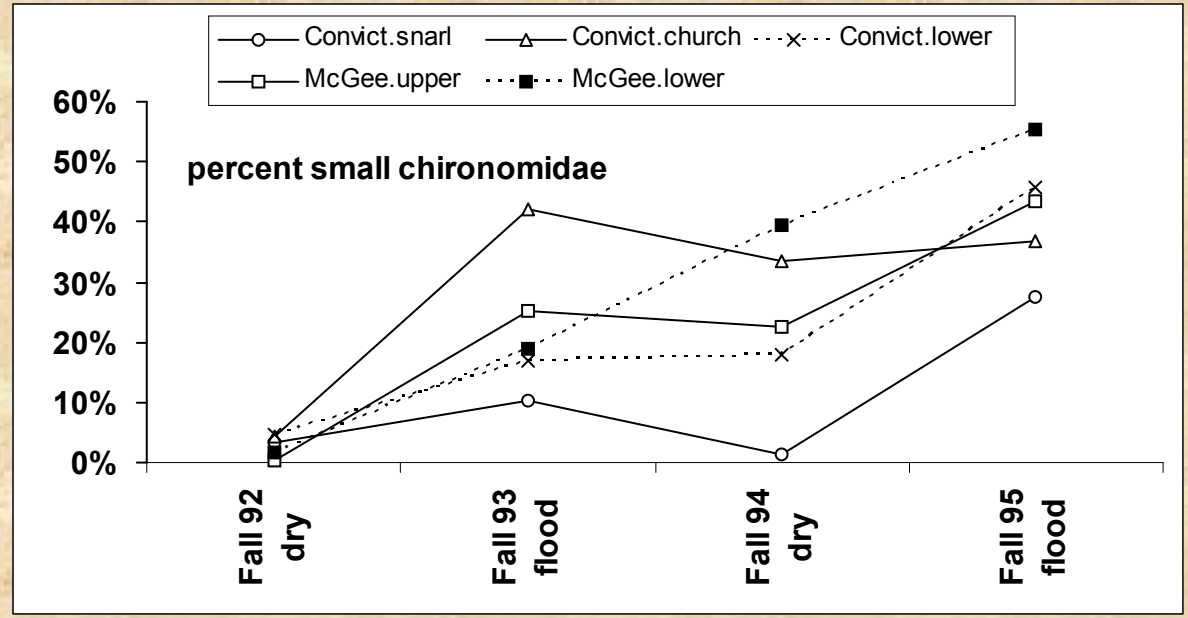


Most sites show losses in diversity during flood years, then rebound.

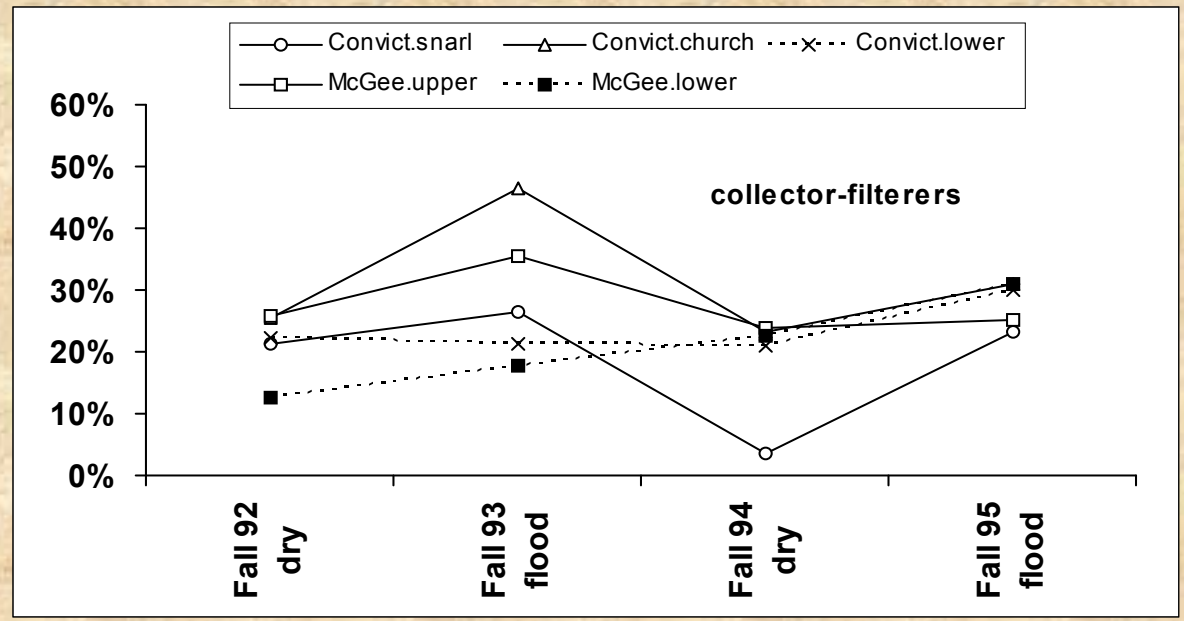
While diversity declined from 12-18 to 9-13 taxa over the period, by 1996-97 in average flow years, recovery to 18-19 taxa was found on Convict Creek.



Composite tolerance of stress increased during flood years, and rebounded in drier years. But the most grazing-impaired sites continued to accrue more tolerant species comprising the community.



Small-bodied midges come to dominate under flood conditions, and also increase over the period (but again recovery occurred in the average water years following, 1996-97) Grazing-impaired sites again showed less capacity for recovery.



Invertebrates feeding on suspended organic particles appear to be subsidized under flood conditions as possibly deposited organics are mobilized. Again the less impaired sites seem most responsive.

Conclusions

- While episodic rain-on-snow floods may increase under changing climate, reduced snowpack may result in fewer spring snowmelt floods
- At least for small streams, a pulse flood had no detrimental biological effect and may even produce sediment flushing benefits for habitat, density and diversity in some sediment-laden streams
- The sustained flows of repeated spring snowmelt floods appear to result in transient loss of diversity, increased numbers of tolerant and small organisms and a shift in the food web structure
- Streams in an existing state of impaired habitat quality do not seem as resilient, and invertebrate communities were instable during the period of high hydrological variation of 1992-95