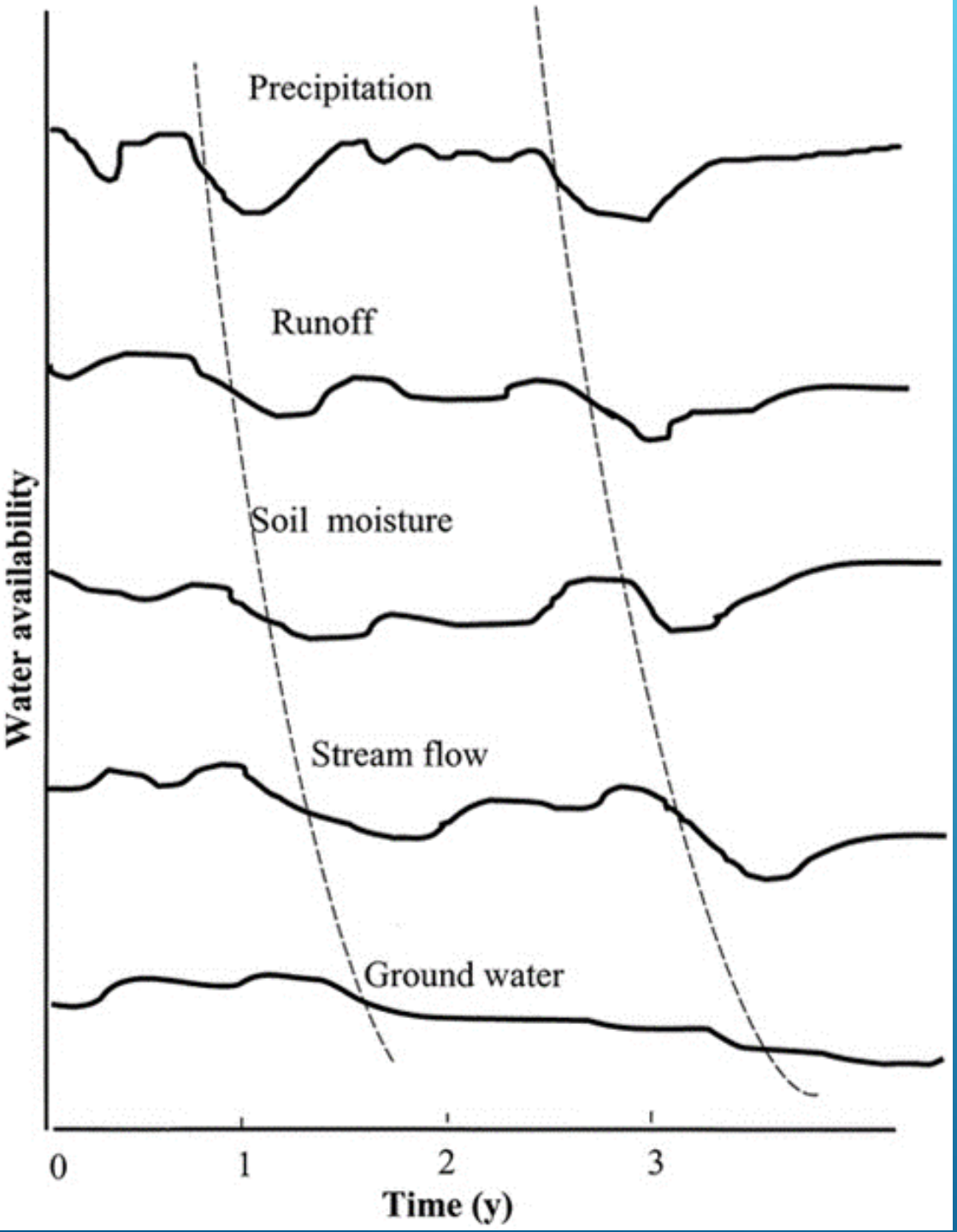
RHEOPHILY – WHAT HAPPENS WHEN THE FLOW STOPS?

- Drought
- Water abstraction
- Intermittent vs Perennial Conditions
- Dams (including beavers)
- Potential concerns for project effectiveness

FUNCTIONAL ASSESSMENT OF STREAM BIOTA

- Life History
  - Voltinism
  - Development
  - Synchronization of emergence
  - Adult ability to exit
  - Ability to survive desiccation
- Mobility
  - Female dispersal
  - Adult flying strength
  - Occurrence in drift
  - Maximum crawling rate
  - Swimming ability
- Morphology
  - Attachment
  - Armoring
  - Shape
  - Respiration
  - Size at maturity
- Ecology
  - Rheophily
  - Thermal preference
  - Habit

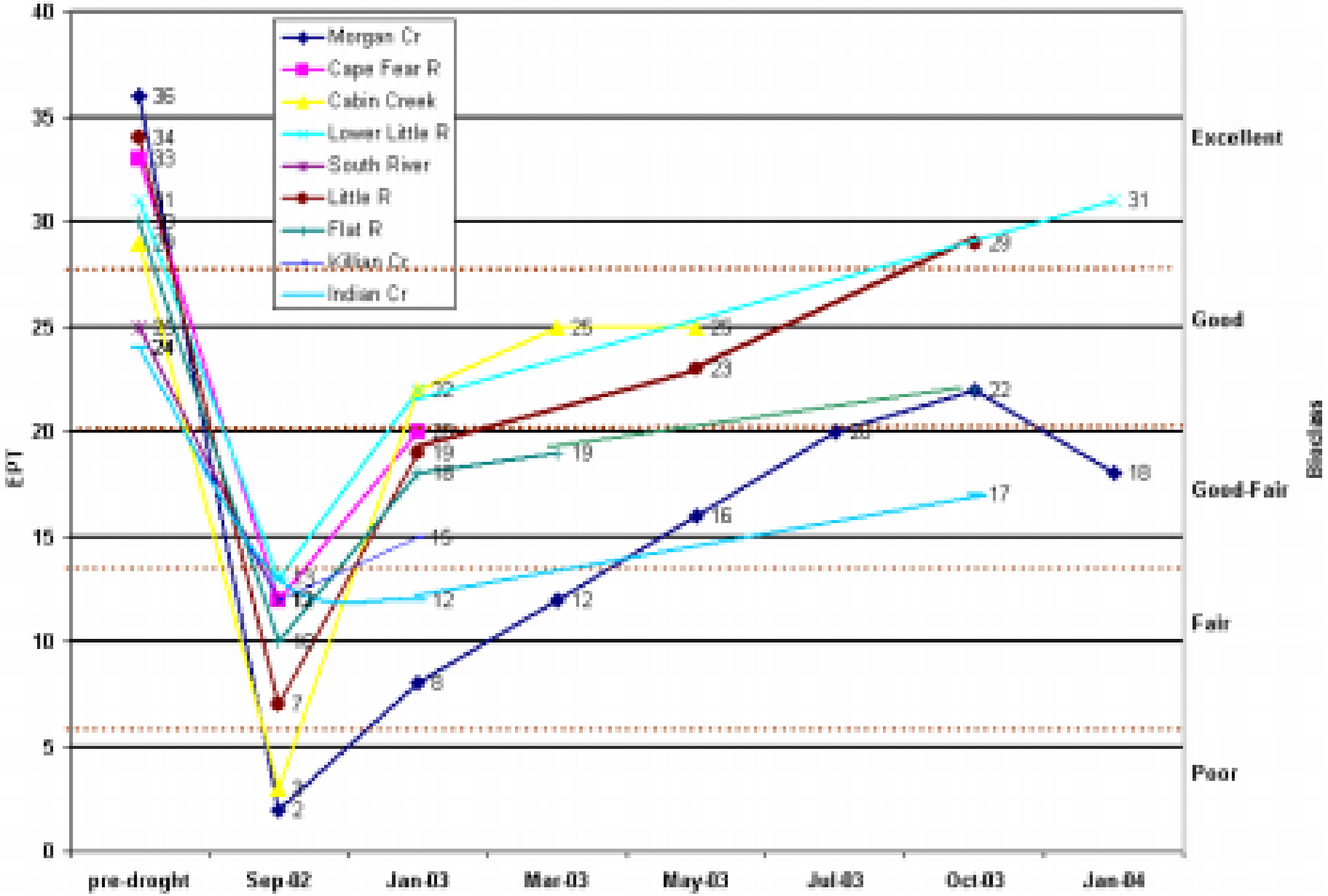


DROUGHT

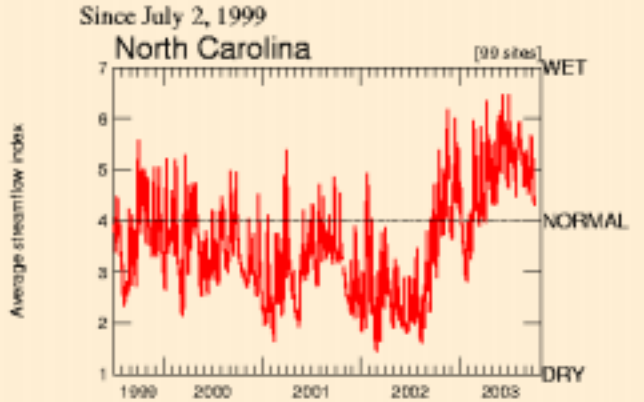
1) disturbance is not only the most important feature of streams to be studied, it is the dominant organizing factor in stream ecology".

2) Steady changes in temperature, precipitation, and stream hydrology will influence stream biota, but such effects may be minor compared to the impact of extreme events

P. S. Lake, Disturbance, patchiness, and diversity in streams. JNABS 2000 19:573-592.



DWQ internal memo documenting effects of drought on benthos (Aug 2004 – Kathy Herring)



EFFECTS ON THE BENTHOS (DWQ)

Some taxa recovered quickly (months)

- Baetid mayflies
- Stoneflies

Flow dependent taxa recovered slowly (years)

- Hydropsychidae
- *Heterocloeon* spp
- Heptageniidae
- *Hydroptila* spp

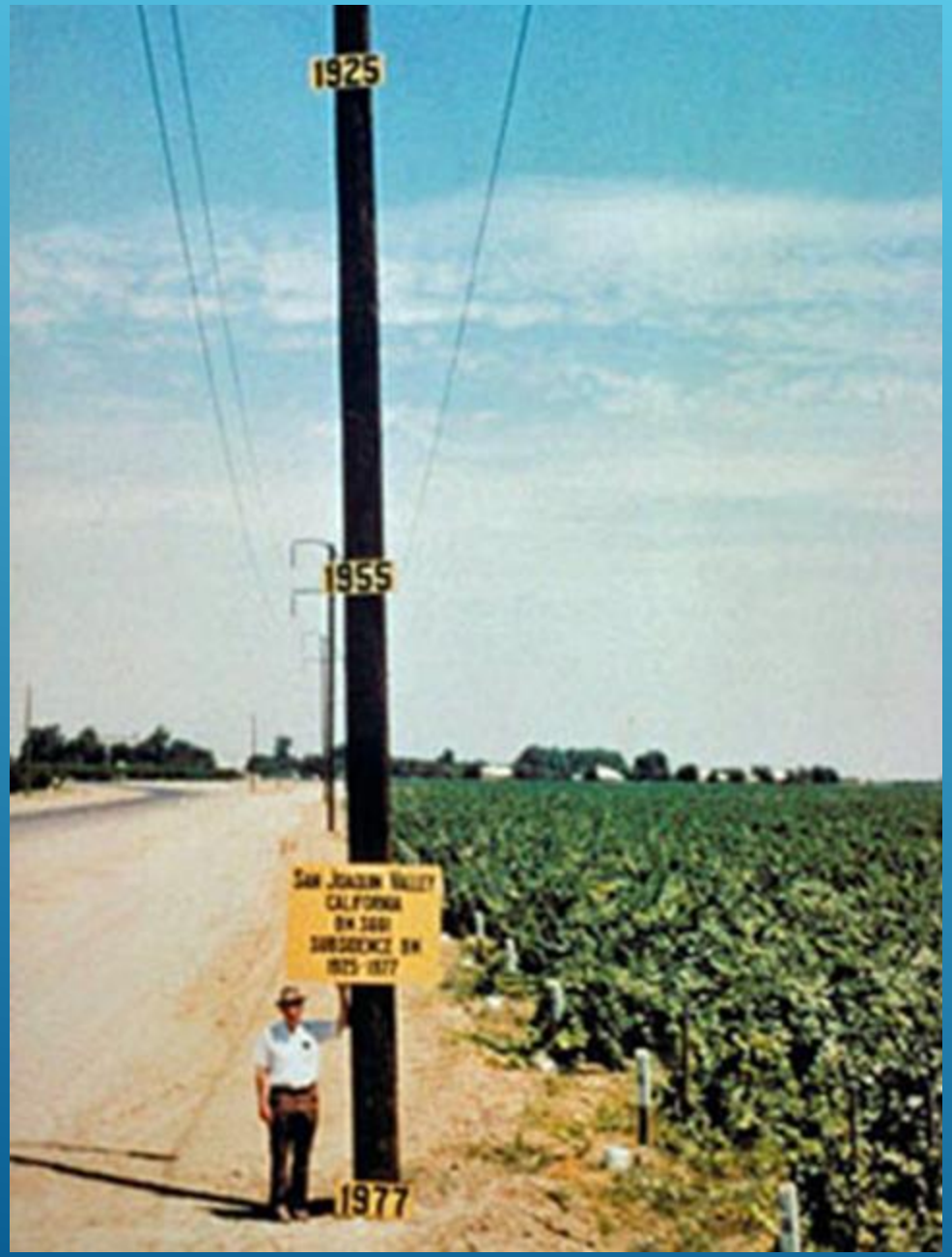
Some species did not recover – August 2004 (multiple years?)

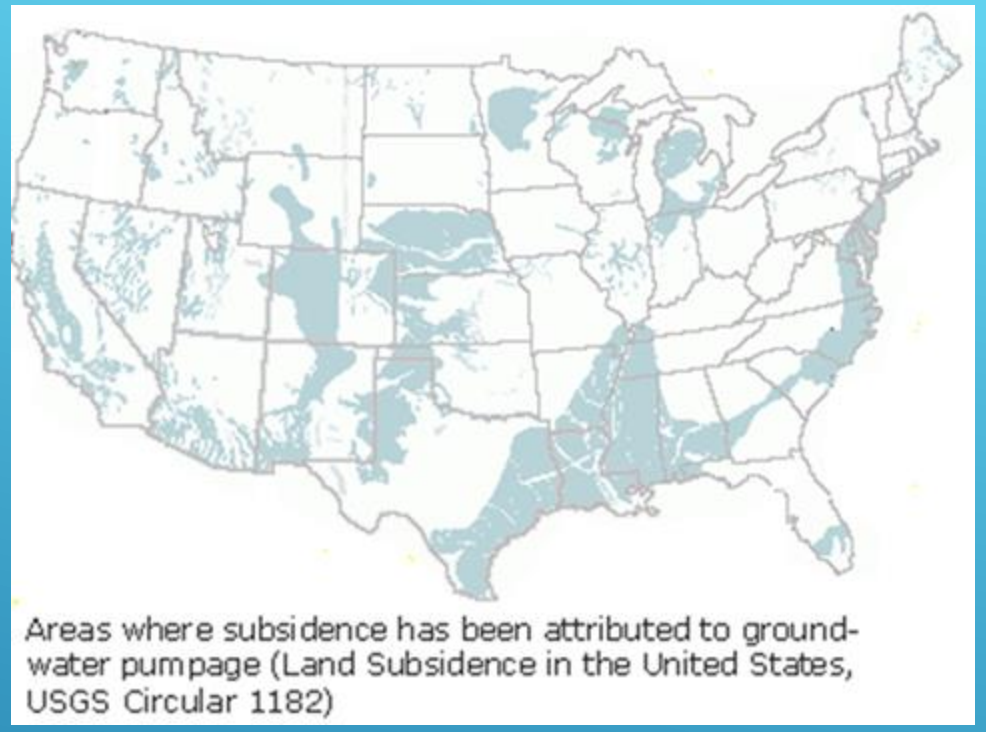
- Edge species; *Triaenodes* spp. and *Nectopsyche* spp

INVERTEBRATE STRATEGIES FOR DRYING*

- **Anhydrobiosis** - some larvae and adults are capable of entering a state of dehydration
- **Diapause** – a period of suspended development, especially during a period of unfavorable environmental conditions.
- **Alternate Life Cycle** - reproductive flexibility or the capacity to alter development
- **Resistant Eggs or Cysts** – may experience a period of dormancy prior to emergence
- **Aestivation** – construction of special structures in which to aestivate [I'm not sure if pupation in Trichoptera would fit here]

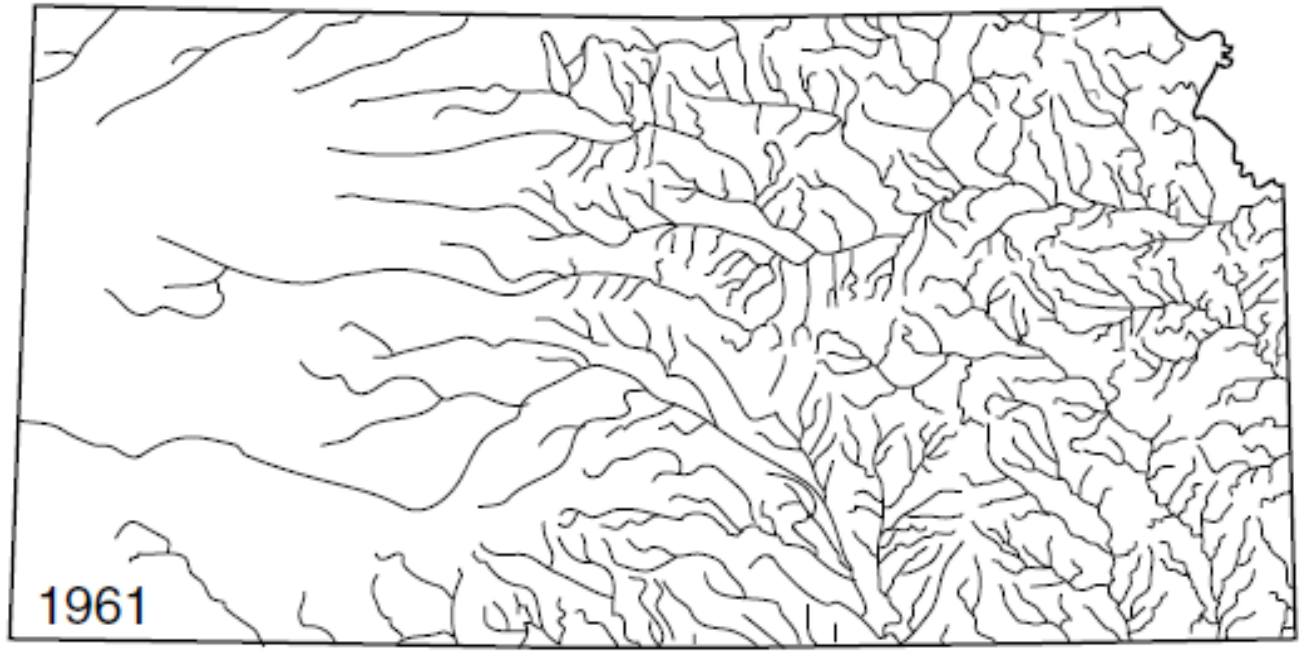
*Strachan, Scott R. Invertebrate Resistance to Wetland Drying. 2016. PhD thesis at Murdoch University, Environment and Conservation Sciences

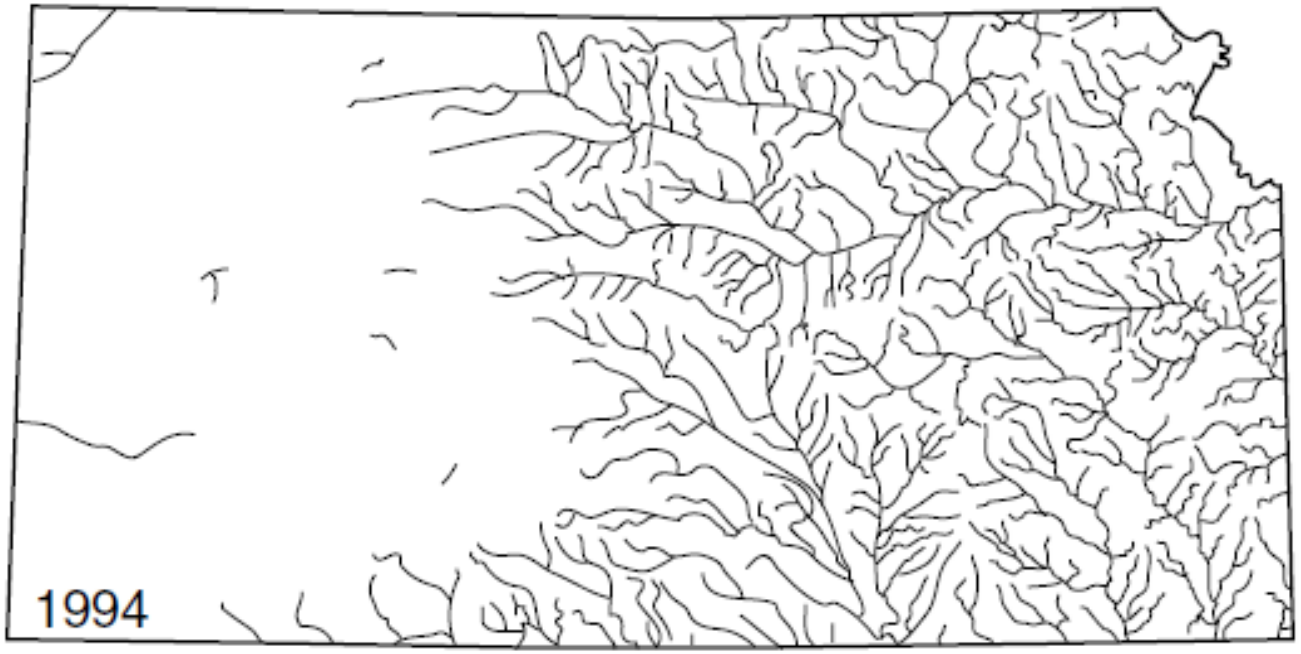




Areas where subsidence has been attributed to ground-water pumpage (Land Subsidence in the United States, USGS Circular 1182)

WATER ABSTRACTION, IRRIGATION PRIMARILY





Loss of Perennial Streams in Kansas (Sopocleous 2000)

DOMINANT INVERTEBRATE FAUNA

Terrestrial; ants, spiders, etc.

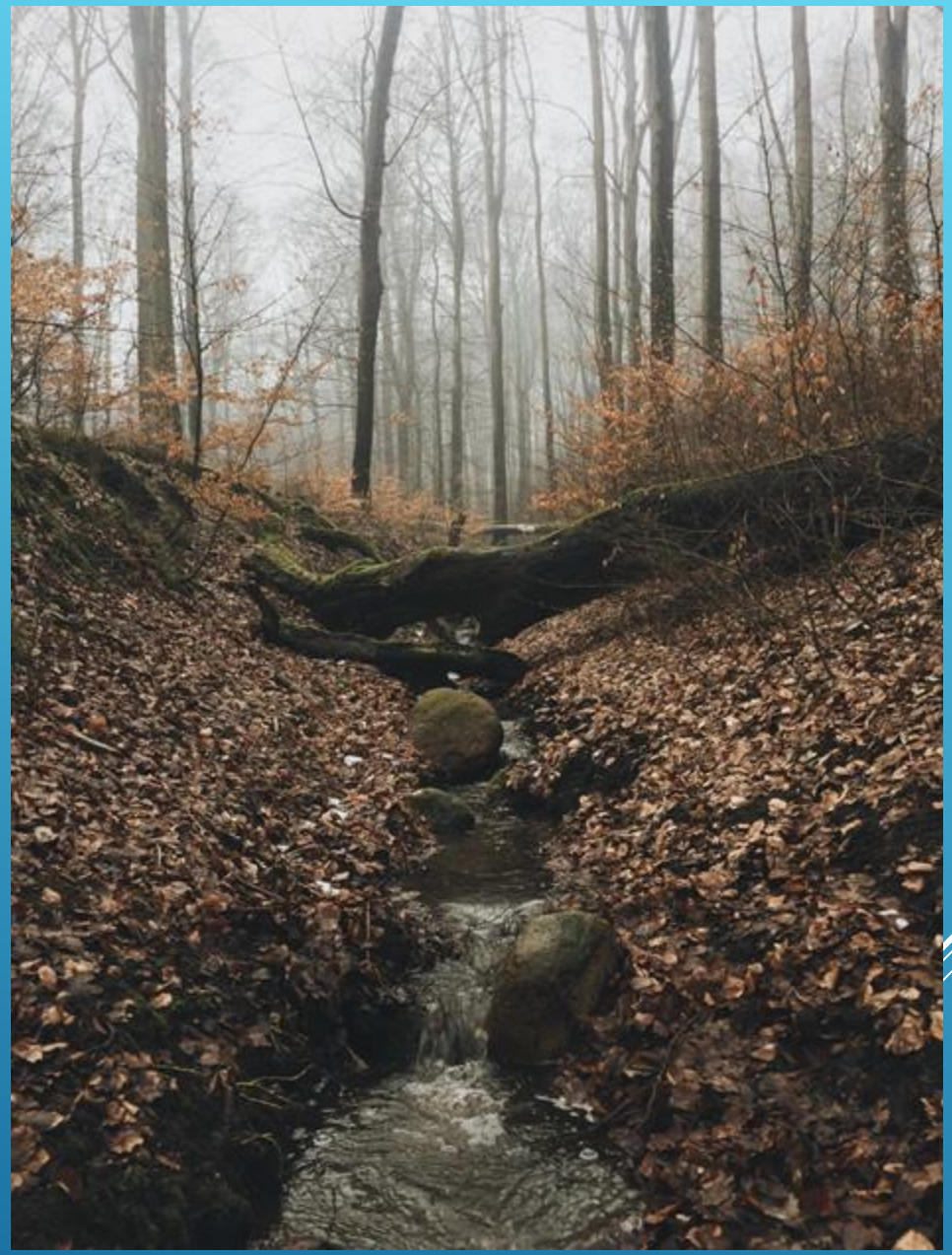
Ephemeral/Intermittent

Crustacea; Amphipods and Isopods

Intermittent/Perennial

Perennial Indicators; Caddisflies, some Mayflies, Diptera

A perennial stream is defined as a well-defined channel that contains water year round during a year of normal rainfall with the aquatic bed located below the water table for most of the year. This definition also notes that perennial streams exhibit the typical biological, hydrologic and physical characteristics commonly associated with the continuous conveyance of water*. Note – in NC, DWR does not require mitigation for impacts to intermittent streams



*NC Division of Water Quality – Mythology for Identification on Intermittent and Perennial Streams and Their Origins v.4.11. 2010

Perennial Stream Indicators*

Ephemeroptera

Baetidae

Caenidae

Ephemerellidae

Ephemeridae

Heptageniidae

Leptophlebiidae

Siphlonuridae

Trichoptera

Hydropsychidae

Lepidostomatidae

Limnephilidae

Molannidae

Odontoceridae

Philopotamidae

Polycentropidae

Psychomyiidae

Rhyacophilidae

Plecoptera

Peltoperlidae

Perlidae

Perlodidae

Megaloptera

Coleoptera

Odonata

Mollusca

Diptera

*NC Division of Water Quality – Mythology for Identification on Intermittent and Perennial Streams and Their Origins v.4.11. 2010

MAP ERROR

Region	USGS Maps
Coastal Plain	+35%
Piedmont	-25%
Northern Mountains	-48%
Central Mountains	-30%
Southwestern Mountains	-54%

*NC Division of Water Quality – Mythology for Identification on Intermittent and Perennial Streams and Their Origins v.4.11. 2010

Williams, D. Dudley and N.E. Williams. 1975. A contribution to the Biology of Ironoquia punctatissima (Trichoptera: Limnephilidae). Can. Ent. 107:829-832.

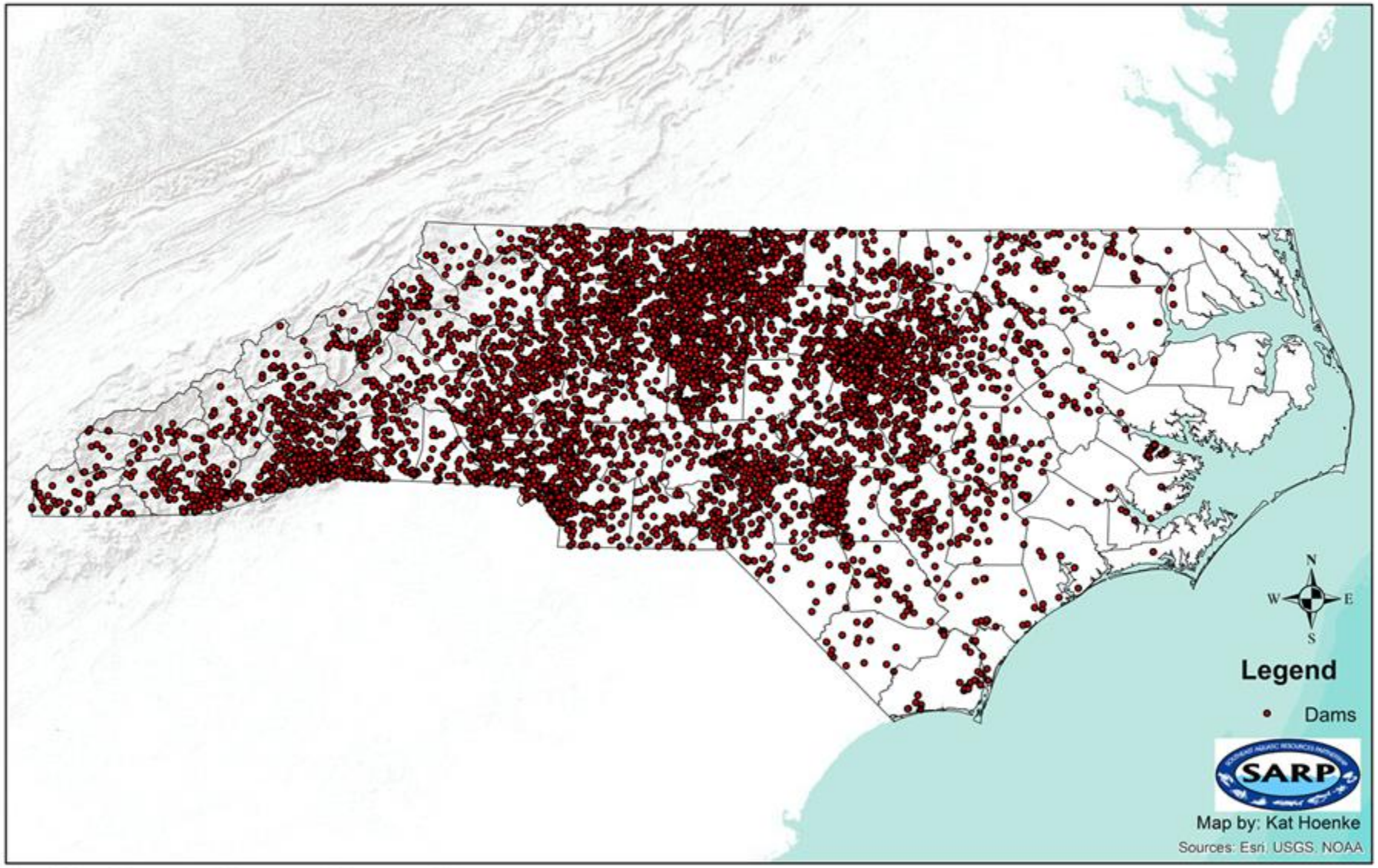
Ironoquia punctatissima

Williams and Williams (1975) reported that 1st instar larvae can be found in streams that are dry 5 months of the year.

It's listed as endangered in Minnesota because the habitat (very small streams are not sampled).

DAMS AND RESTORATION

6246 Dams in North Carolina



80 – 85% are earthen dams (hypolimnetic releases)

REFERENCES

Arscott, David B., L. Learned, M.R. Scarsbrook and P. Lambert. Aquatic invertebrate community structure along on intermittence gradient; Selwyn River, New Zealand. J.N.Am. Benthol. Soc. 2010. 29 (2): 530-545.

Lake, P.S. Disturbance, patchiness, and diversity in streams. J.N. Am. Benthol. 2000. 19: 573-592.

North Carolina Division of Water Quality. Methology for identification of intermittent and perennial streams and their origins. V 4.11. 2010

Sopocleous, Marios. The origin and evolution of safe-yield policies in the Kansas Groundwater Management Districts. Natural Resources Research 9, 99 – 110. 2000.

Strachan, Scott R. Invertebrate Resistance to Wetland Drying. 2016. PhD thesis at Murdoch University, Environment and Conservation Sciences

Williams, D. Dudley and N.E. Williams. 1975. A contribution to the biology of *Ironoquia punctatissima* (Trichoptera: Limnephilidae). Can. Ent. 107:829-832.

Questions??