



The Influence of Urban Stream Syndrome on Freshwater Fish Stream Communities Implications for Restoration

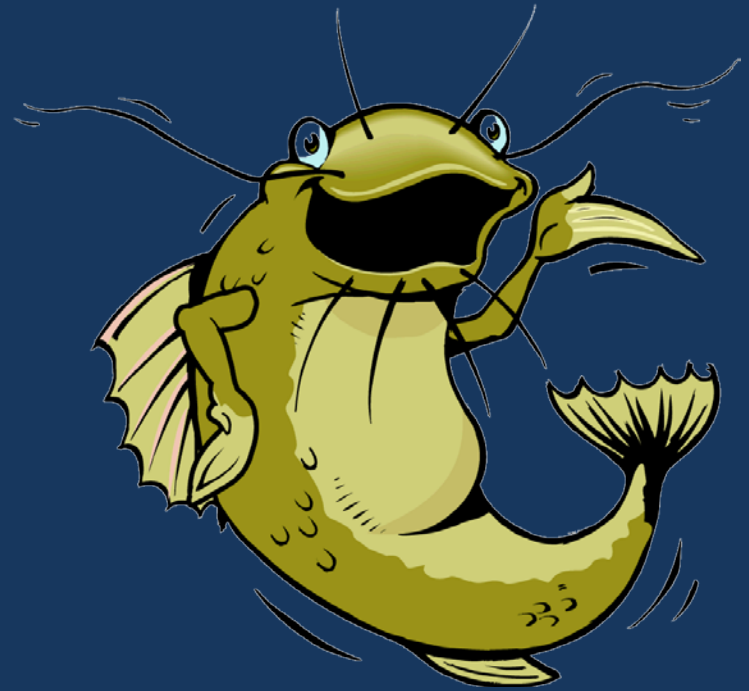
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Environmental Institute of Houston
University of Houston Clear Lake
Presented at Urban Riparian Symposium
February 12, 2015**

Outline

- Stream Restoration Goals -
- Modified Landscapes - LULC
- Classical Urban Stream Syndrome
- Role of Reservoirs – now and later
- Influence of Wastewater – now and later
- Invasive Species – interactions
- Validation Monitoring

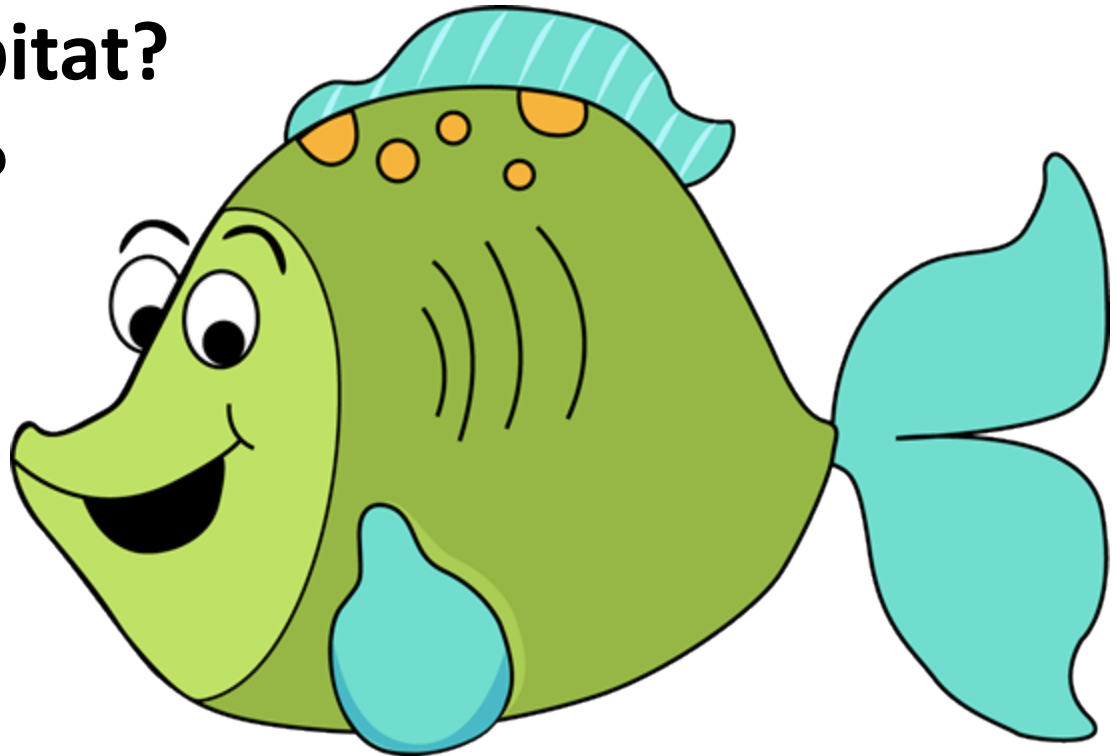
Stream Restoration Project Goals

- Water Quality Improvement
 - Biota
 - Human Use
- Riparian Habitat
 - Aesthetics
 - Water Quality
- Instream Habitat
- Biological Integrity?
- Urban Fisheries?
- Can these be achieved given the landscape you are working in?

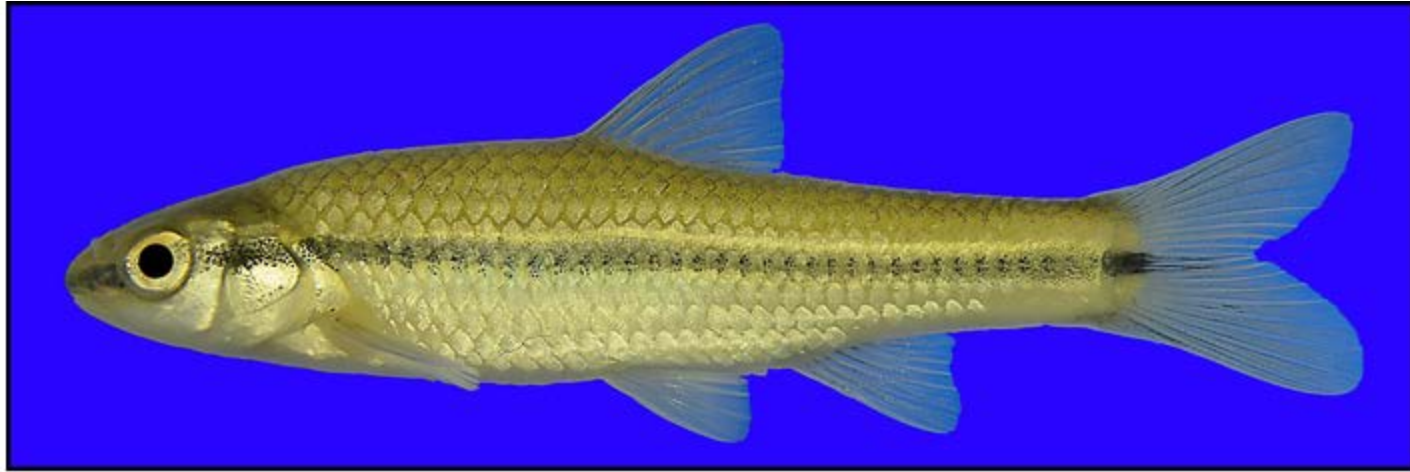


Fish Habitat - *What Fish Need*

- **Flowing water or ponds?**
- **Enough water and safe passage?**
- **Thermal refugia?**
- **Instream habitat?**
- **Food supply?**



Stream Morphology vs. Species Guilds

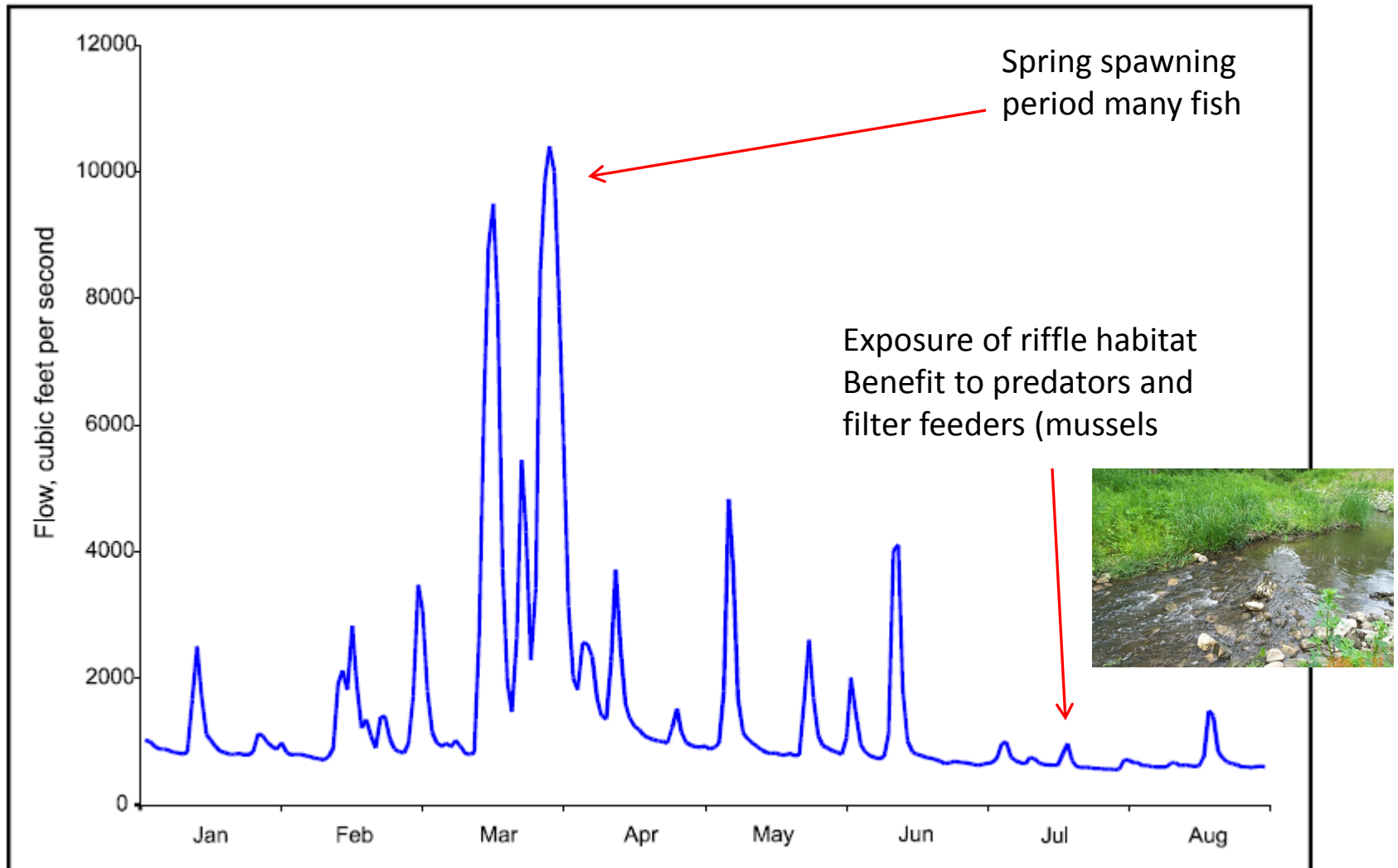


Fluvial specialists

Fluvial specialists, such as are almost always found only in streams and rivers or are described as needing flowing water habitats throughout their life cycle.

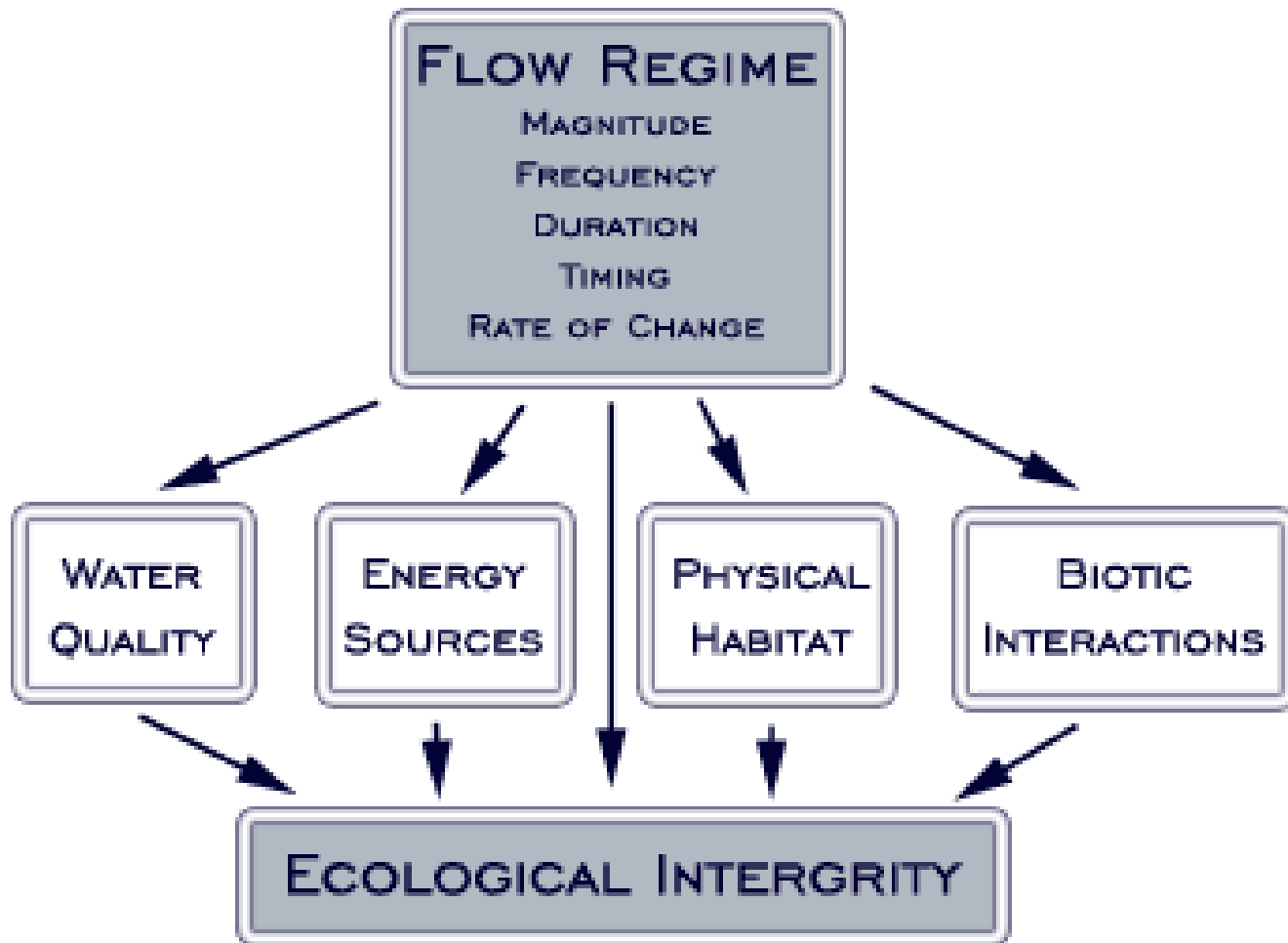
***Notropis atrocaudalis* blackspot shiner**

Stream Flow Alteration



**FIGURE 2-2 MEASURED DAILY FLOWS DURING JAN–AUG OF 1984
ON THE TRINITY RIVER AT TRINIDAD**

Hydrology – the Master Variable



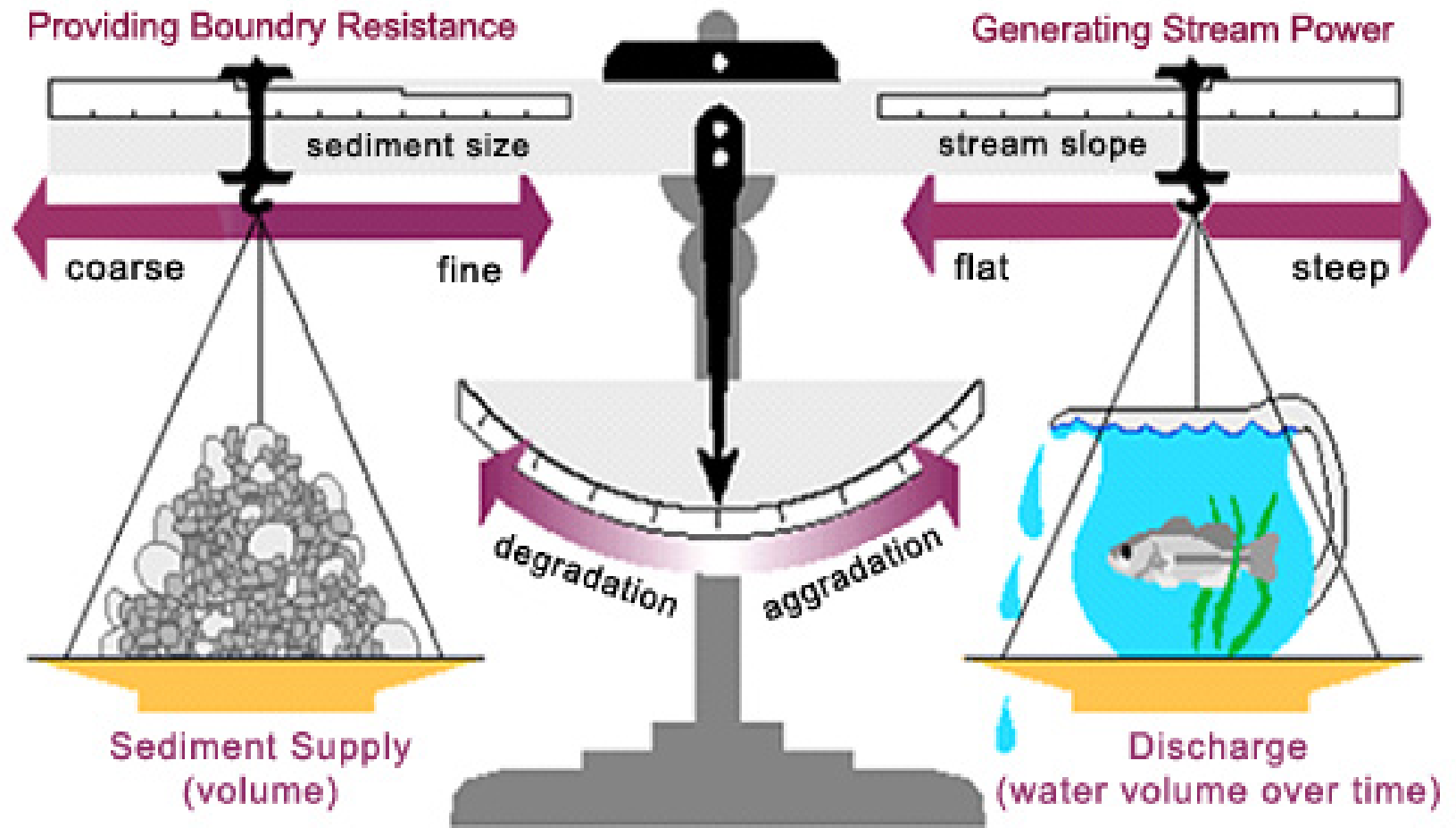
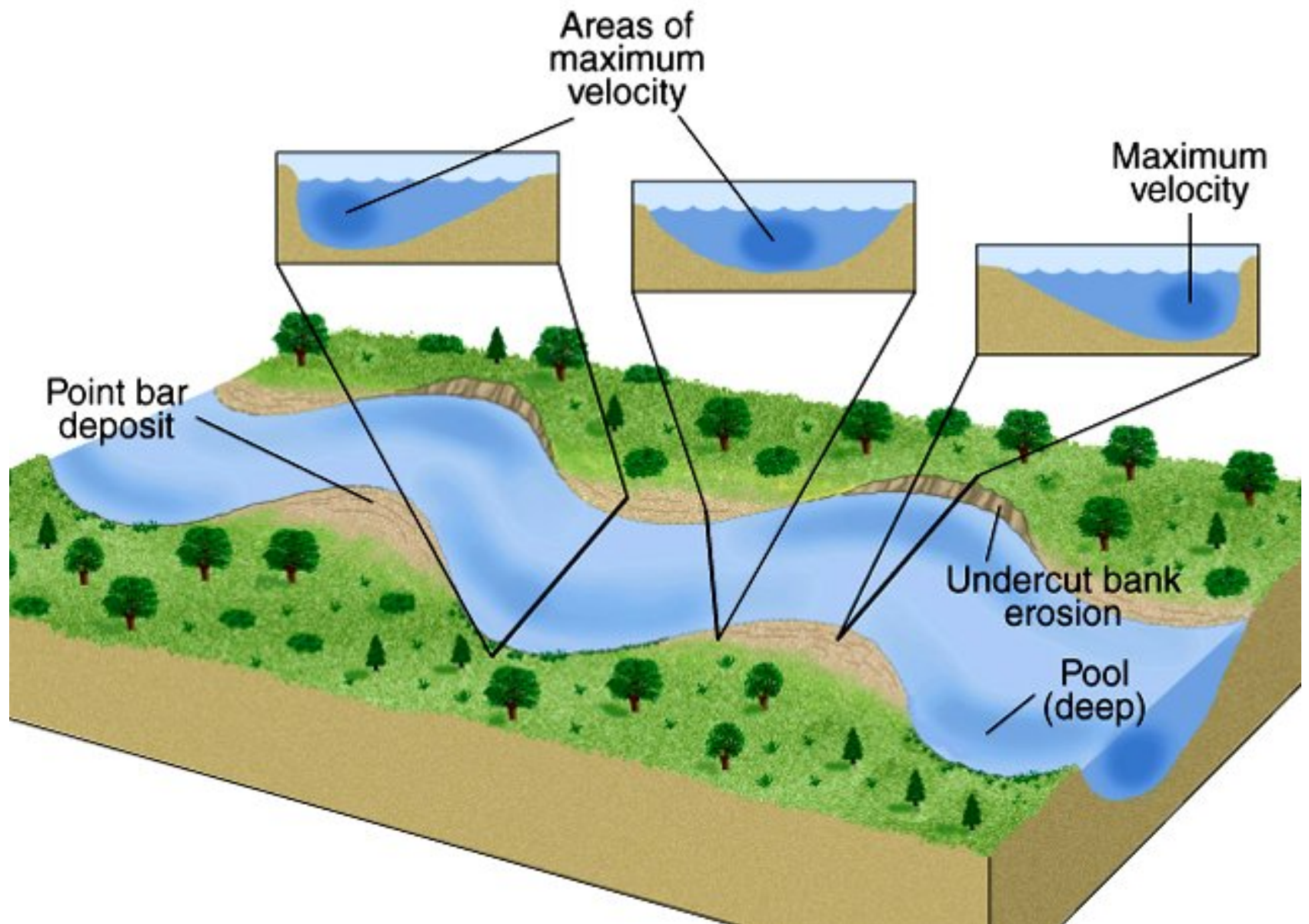


Figure 3. Balance of water supply and sediment supply (after Lane, 1955). Reproduced by permission of the American Society of Civil Engineers.



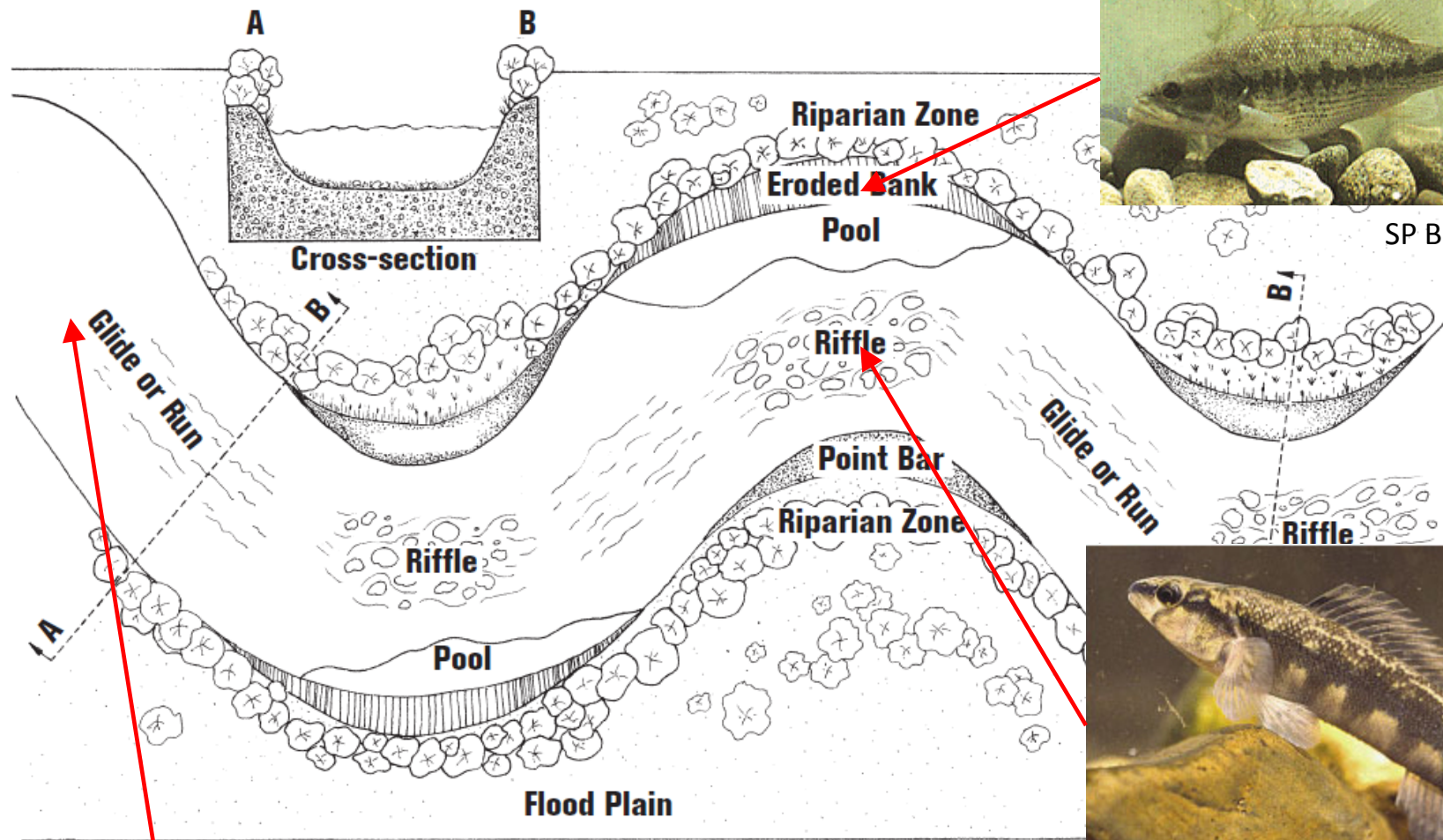
Stream Habitats



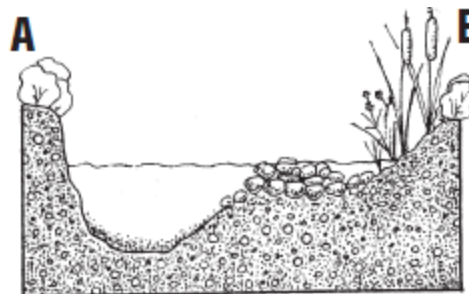
SP Bass



Dusky Darter



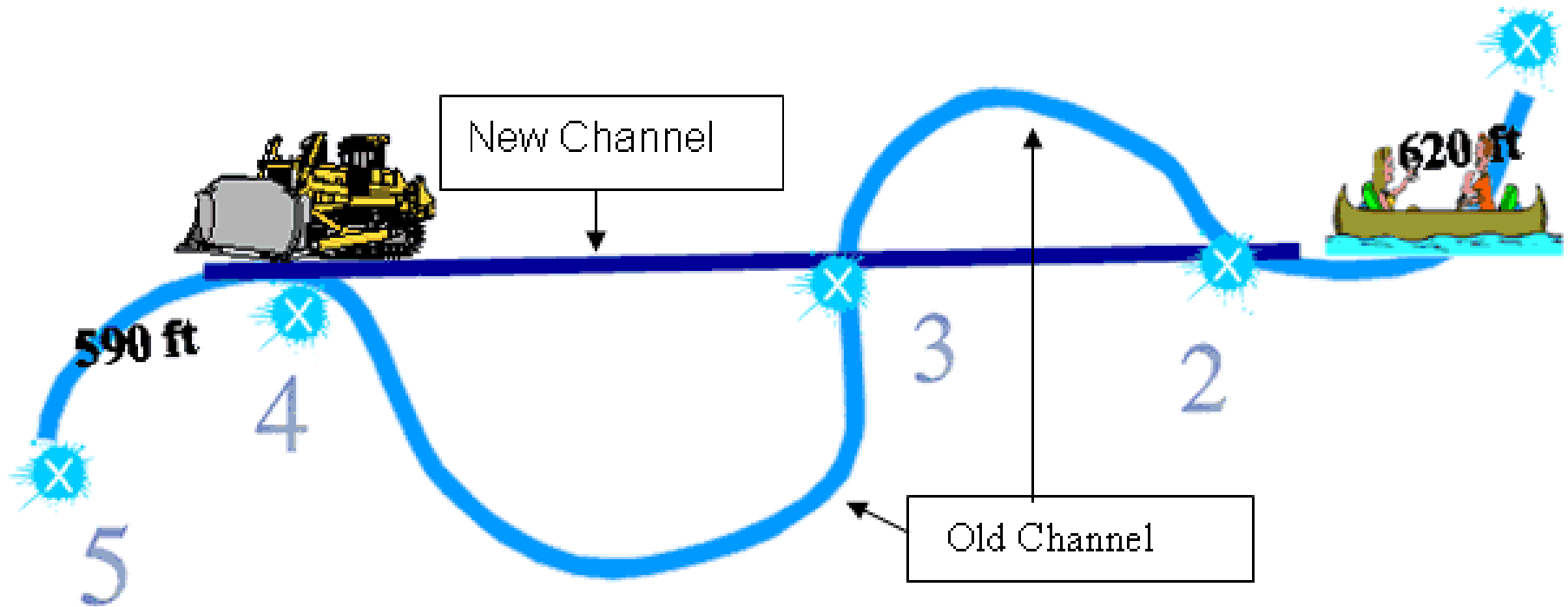
Blackspot shiner



Cross-section

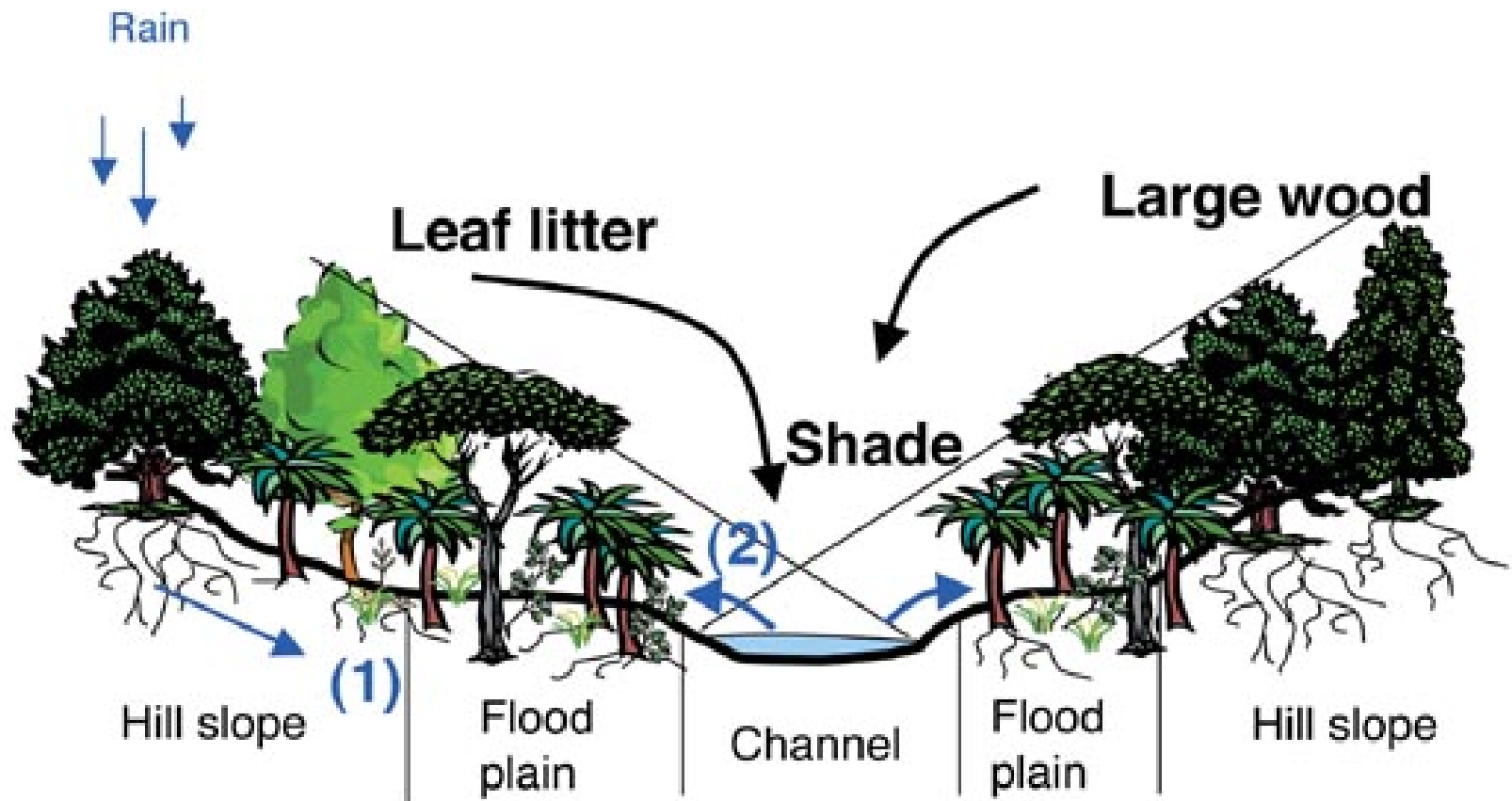
Kolbe and Luedke 2005

Channelized stream

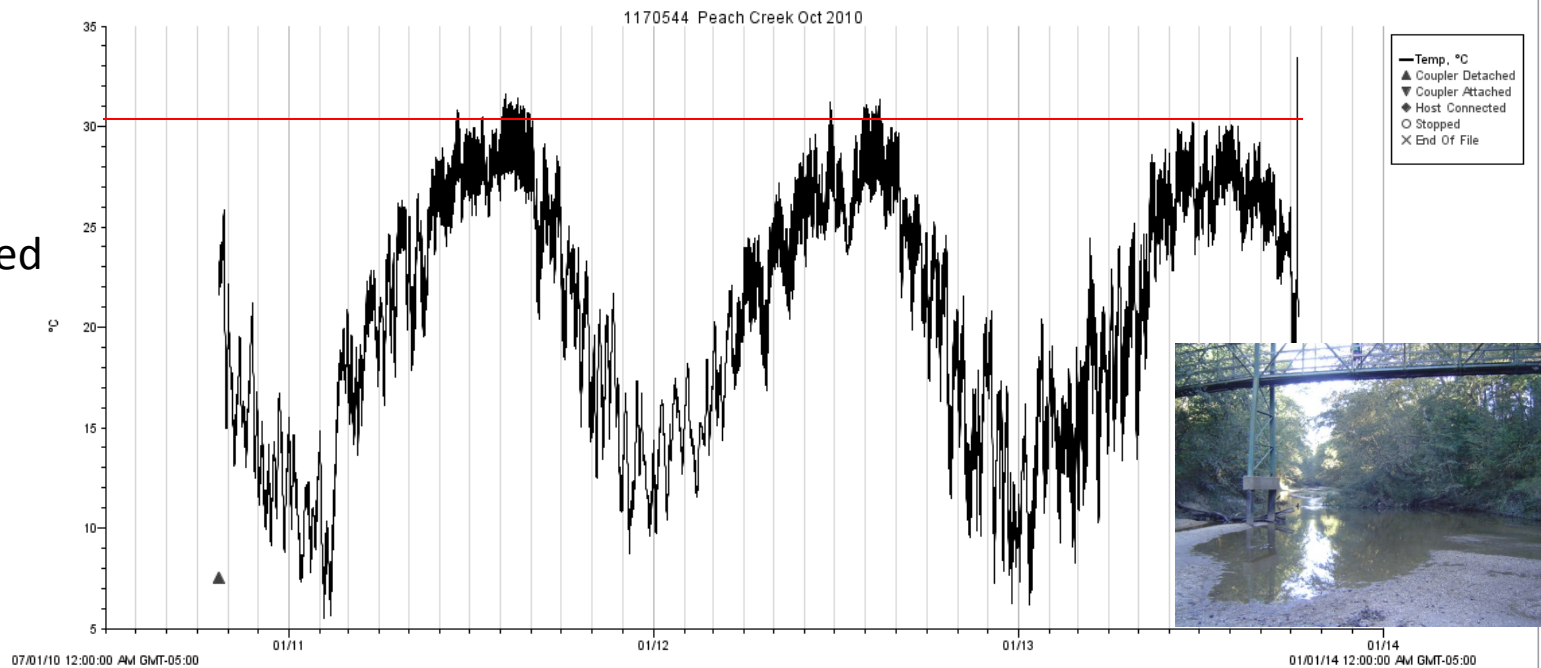


Historical solution to deal with increased flooding due to increase in impervious surfaces

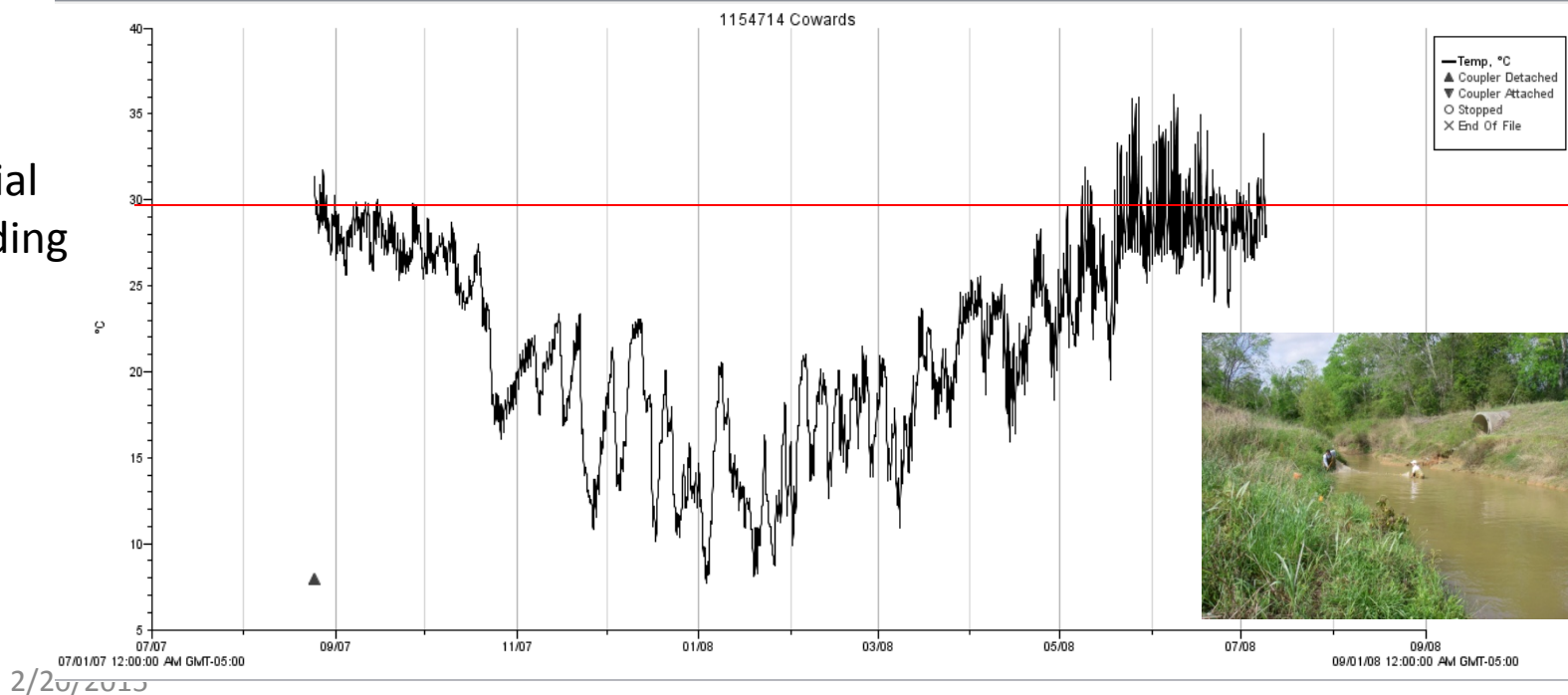




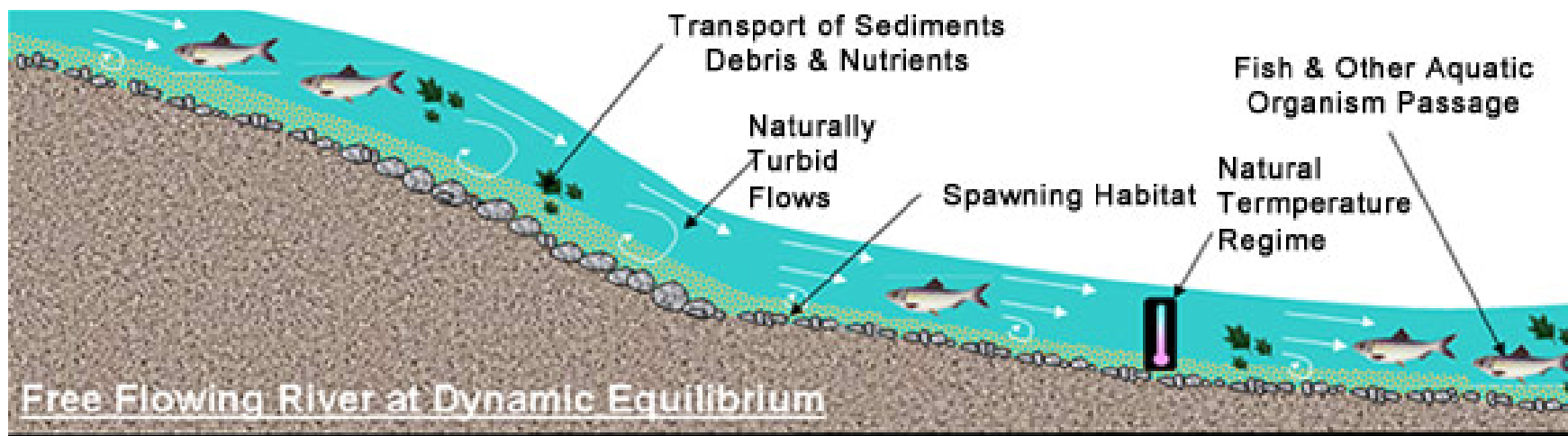
Shaded



Partial Shading



2/20/2013



UPSTREAM IMPACTS*

Reduced:
Natural Function, Water Quality, Oxygen, Turbid Flow, Circulation, Available Habitat
Rivers ability to adjust horizontally and vertically (reduced resilience to change)

Increased:
Pollutant Accumulation, Stratification, Temperatures, Algae Blooms

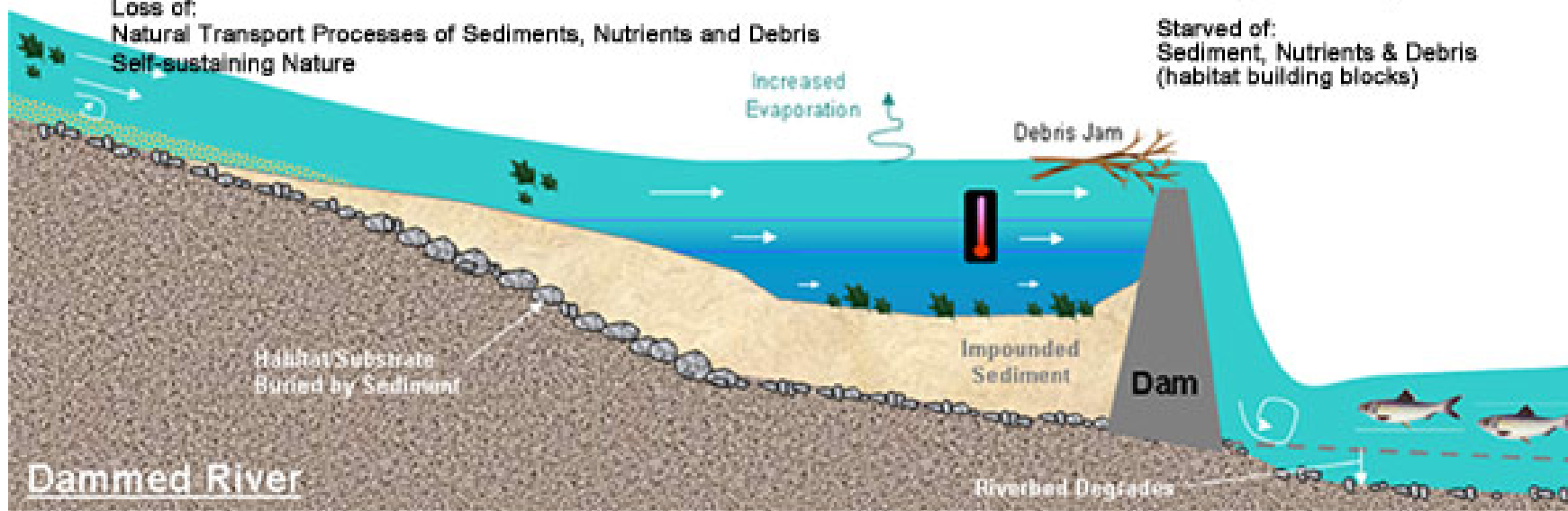
Loss of:
Natural Transport Processes of Sediments, Nutrients and Debris
Self-sustaining Nature

DOWNSTREAM IMPACTS*

Reduced:
Water Quality & Riverbed Elevation

Altered:
Flow Regime & Temperatures

Starved of:
Sediment, Nutrients & Debris
(habitat building blocks)



Fish Passage

- American Eel



- Paddlefish



- Blue catfish



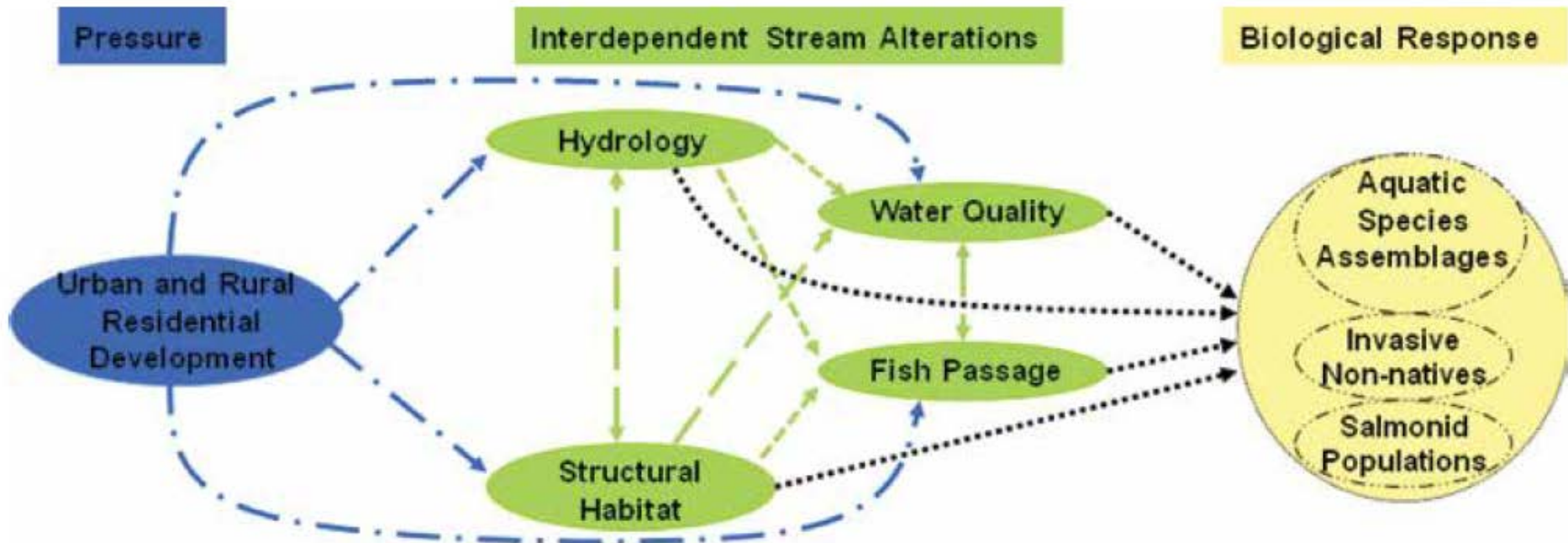
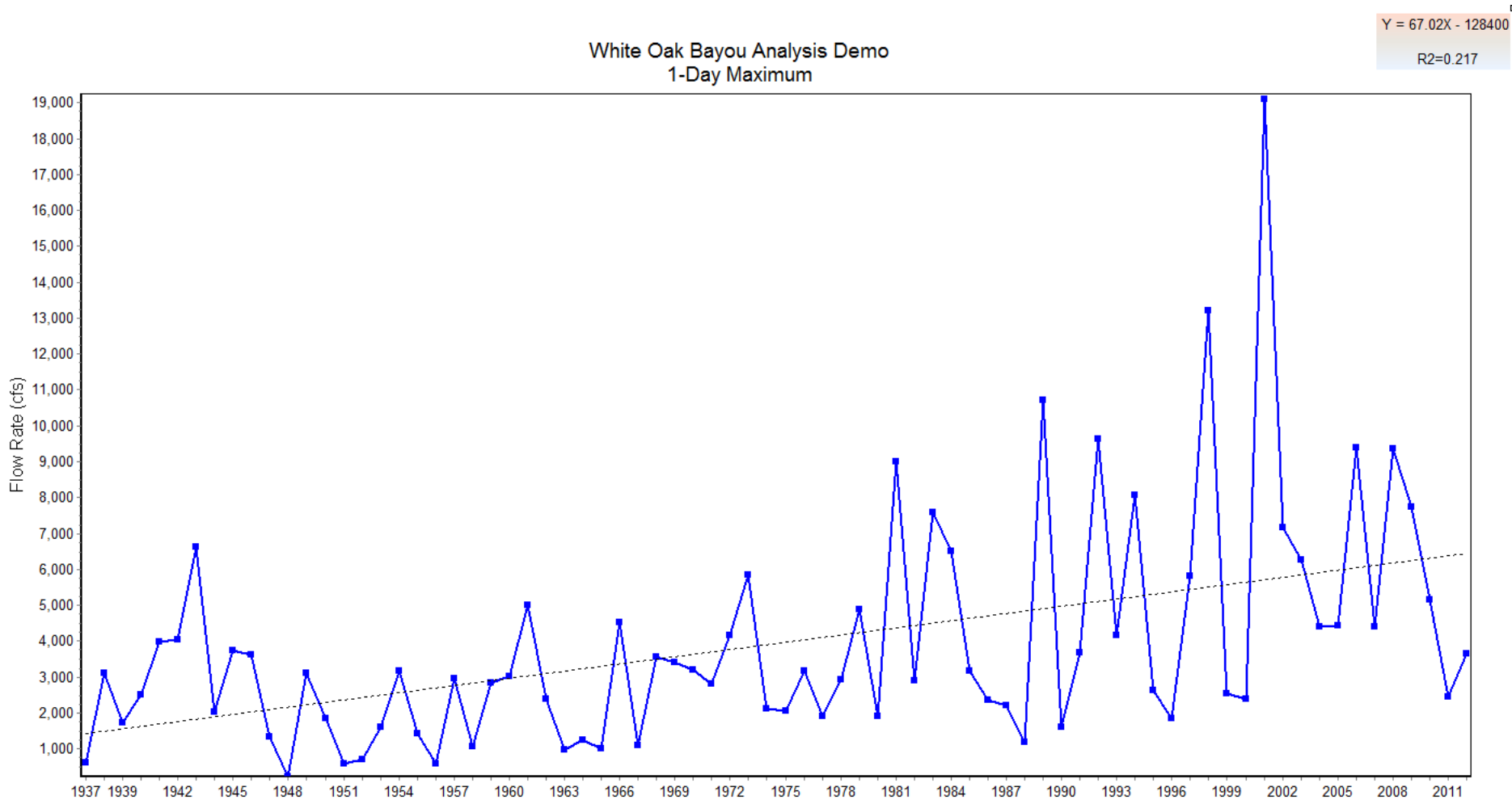


Figure 2. Interrelationships between urbanization pressures, interdependent stream alterations, and biological responses (IMST 2010).

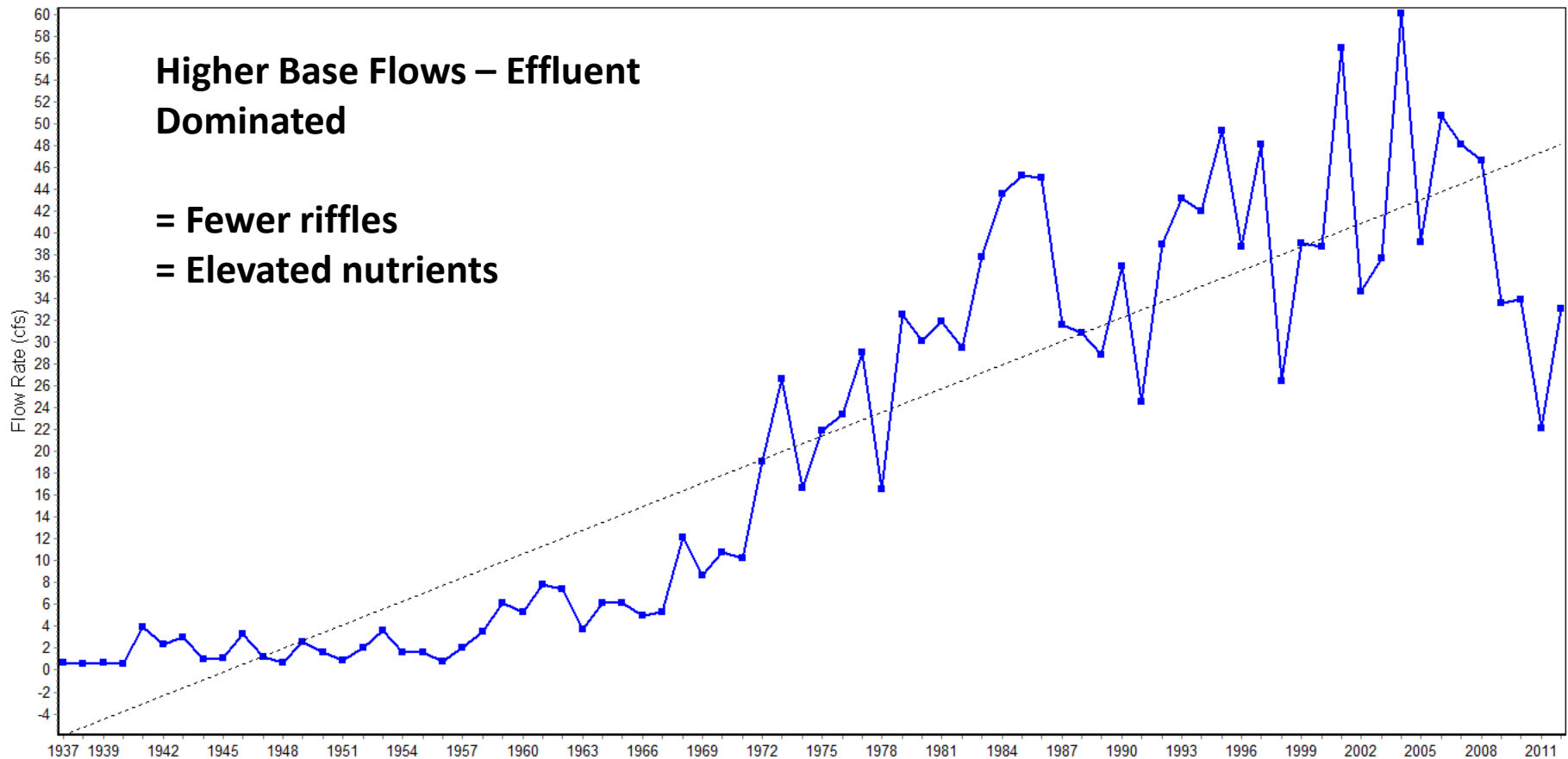
Urbanization results in a phenomenon commonly known as the “urban stream syndrome,” whereby hydrographs become flashier (i.e., increased flow variability), water quality is degraded, channels are homogenized and incised, biological richness declines, and disturbance-tolerant and alien species increase in prevalence.

Higher Peak Flows



White Oak Bayou Analysis Demo
30-Day Minimum

$Y = 0.7197X - 1400$
 $R^2 = 0.7948$



Index of Hydrological Alteration – IHA 7 Output – White Oak at Heights 1937-2012
30 day minimum flow

Urban Flow Regimes – typically favor opportunistic species - generalists

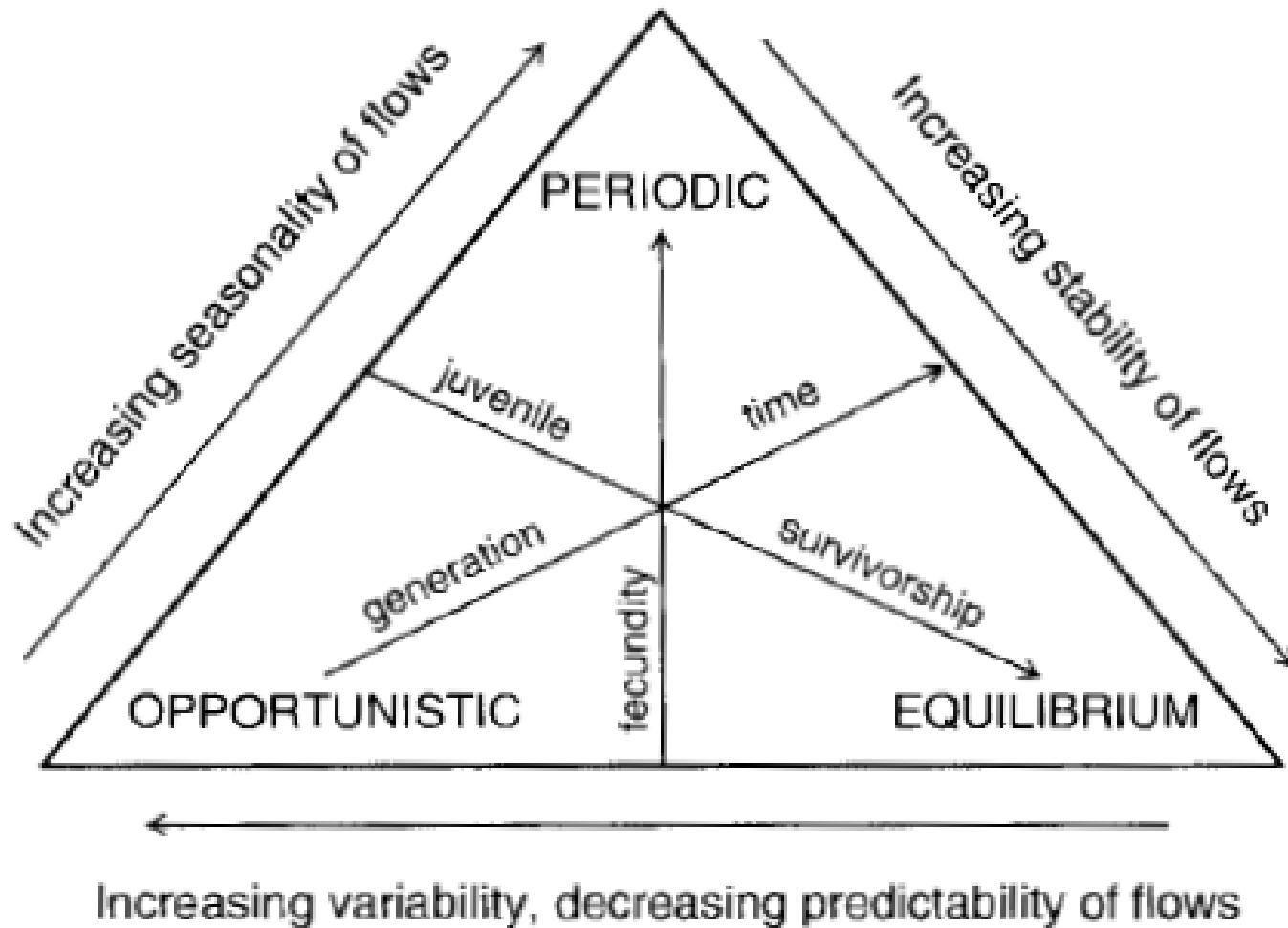


FIG. 1. Life history continuum model adapted from Winemiller (2005) and originally conceptualized in Winemiller and Rose (1992). Inside arrows summarize fundamental trade-offs

The Role of Invasives

- Disturbed habitat
- Conducive to invasion
 - Most are herbivorous
 - Generalist spawners or mouth brooders
 - Aggressive
- Sources:
 - Aquarium releases
 - Aquaculture
 - Vegetation control
 - Transplants – Wetland restoration

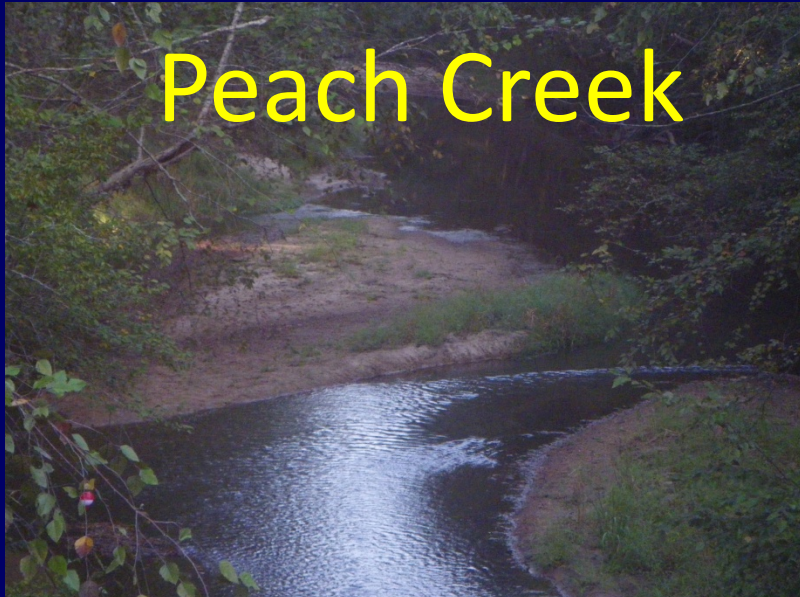


Role of Invasive Species



Fish Community – Rural Streams

Peach Creek





Blacktail Redhorse



Longear sunfish



Brook Silverside



Dusky Darter



Made in U.S.A. by Wildco® 800-799-8301 • 716-877-9518 Model # 118-E40



Channel Catfish



Scaly Sand Darter



Blacktail Shiner



Madtom



Slough Darter

Fish Community – Urban Streams



Rummels Creek



Cowards Creek



White Oak Bayou



White Oak Bayou



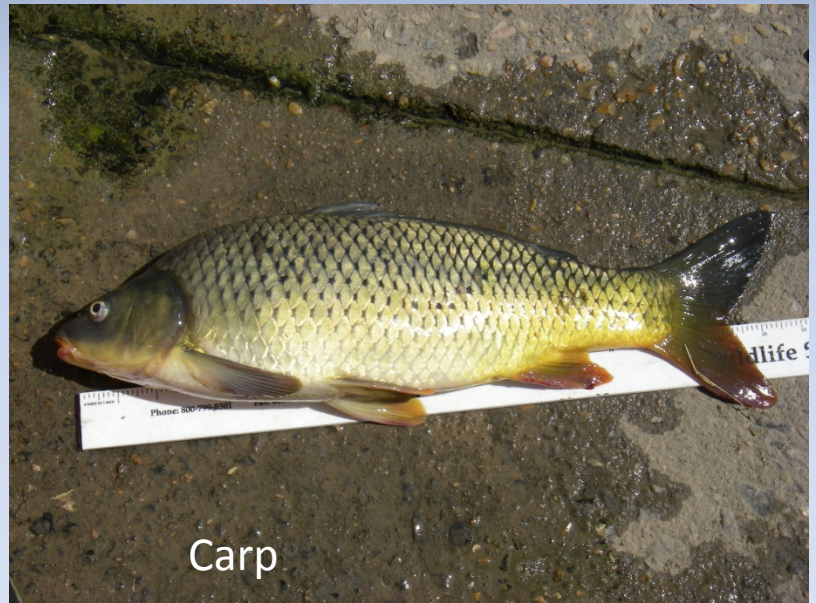
Texas Cichlid



Spotted Gar



Redear Sunfish



Carp



Spotted
Bass



Armored Catfish



Gizzard Shad

Triploid grass carp - *Ctenopharyngodon idella*
averages 18-25 inches



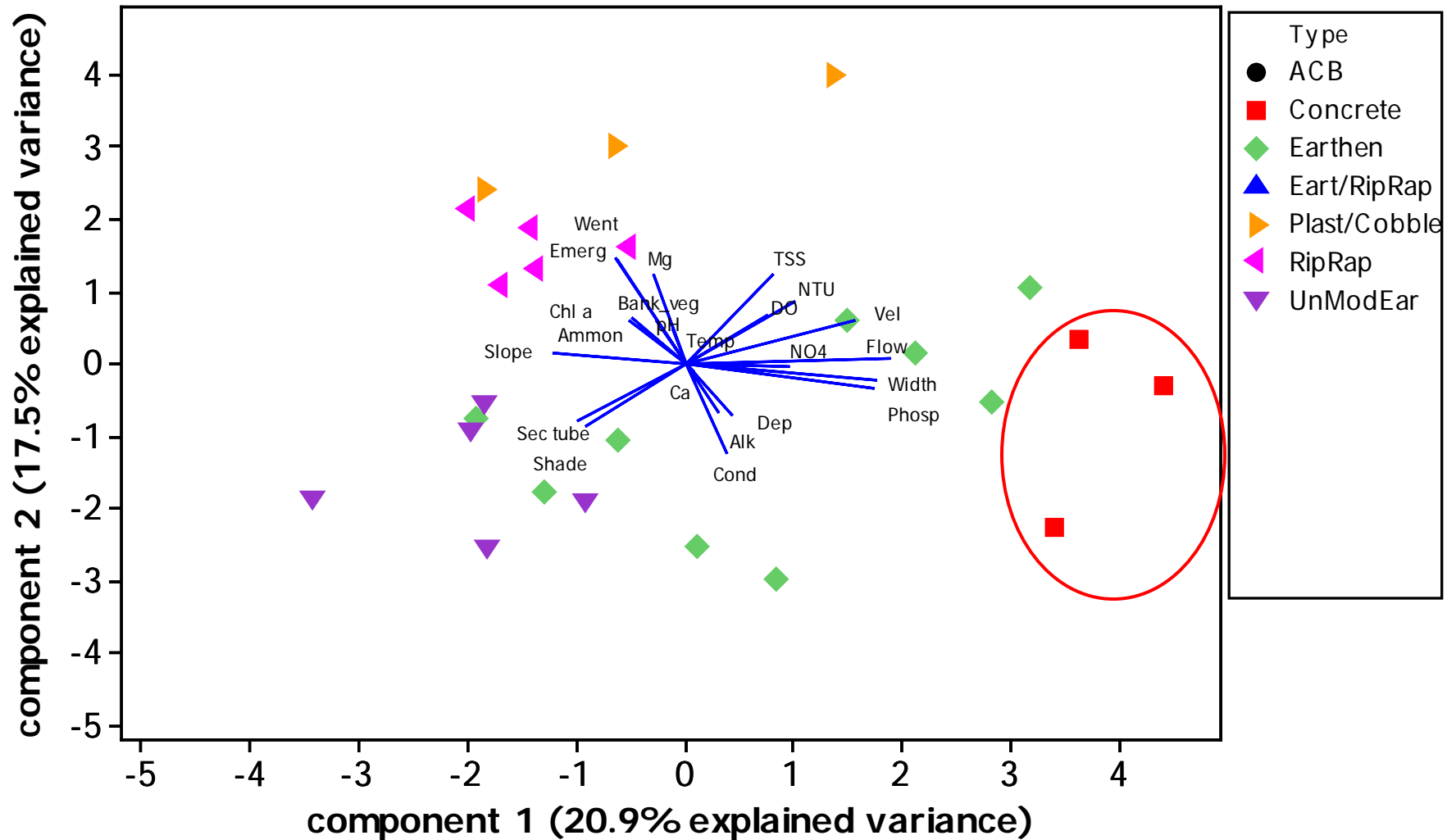


Golden Shiner



Tilapia

PCA Results – Relationship with other Variables (2007)



Comprehensive Restoration Strategy

- First rehabilitate the watershed if you can
- Need to evaluate restoration goals in the framework of existing and plausible changes in watershed characteristics
 - Demographics –potential for growth
 - Likely changes in LULC
 - Likely changes in public works
 - Future pressures on riparian land

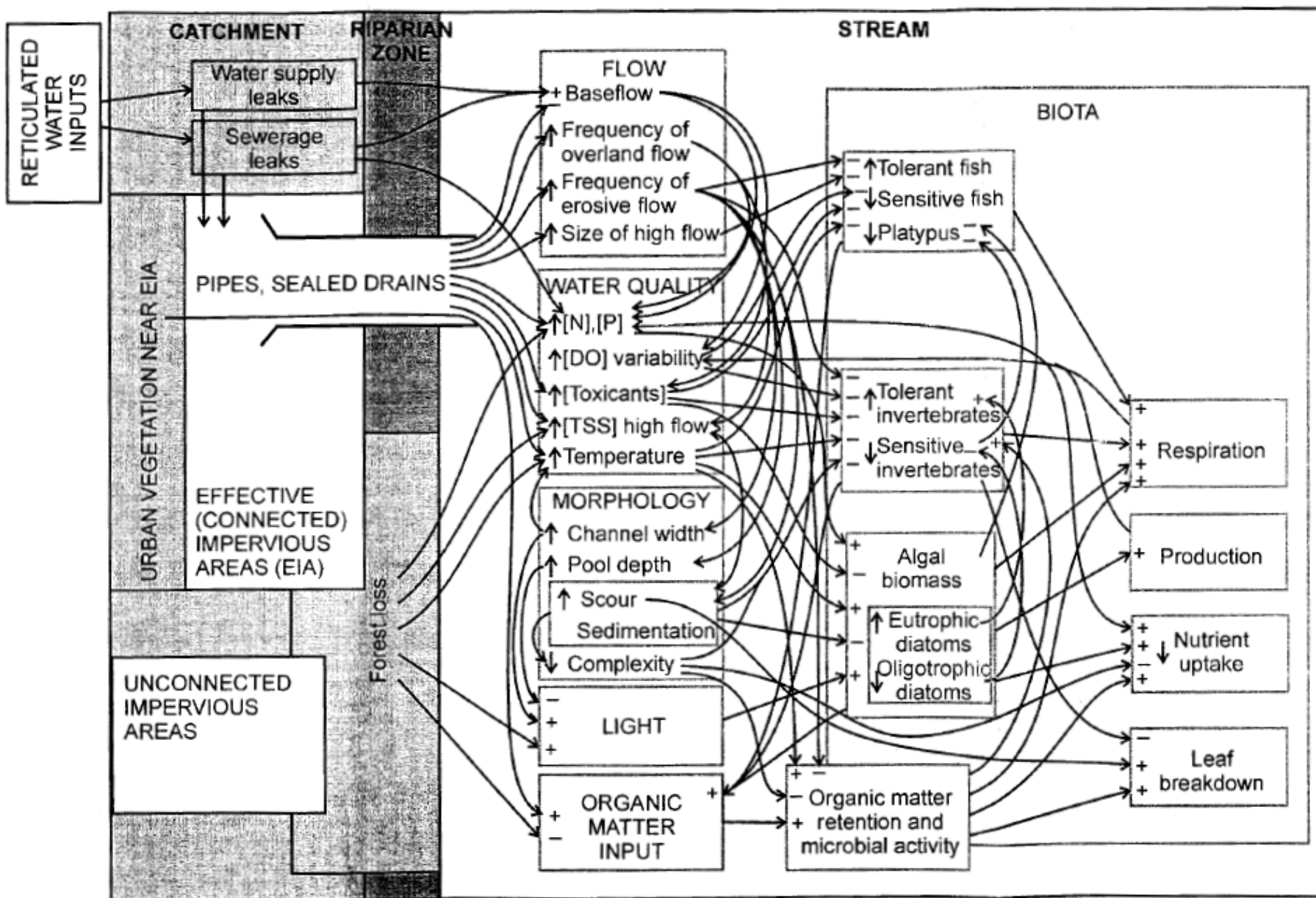
Validation Monitoring

- The need to learn and expand our knowledge base.
- Incorporate metrics that address structure and function
- E.g. nutrients and attached algae, chlorophyll
- Monitor forms of chemicals – breakdown products

Questions?



Complex Feedback Mechanisms between Flow, Water Quality and Geomorphology



Walsh et al. 2005. - Solutions to Urban Stream Syndrome

Restoration measure	Aesthetics/ amenity	Channel stability	Enhanced N processing	Improved ecological condition	
				Riparian	Instream
1. Riparian revegetation	S			S	
2. Instream habitat enhancement	S	S	S		
3. End of pipe stormwater treatment	*?		*		
4. Eliminate allied stressors	*?		*?		
5. Dispersed stormwater treatment		*	**		
3 + 4	*?		*		
5 + 4	*?	*	**		*
5 + 4 + 2	*	*	***		**
5 + 4 + 2 + 1	*	*	***	*	***