Stream Ecology

NTRES 2100 – Field Biology

20th Sept 2016

What is a stream?

What is a stream?

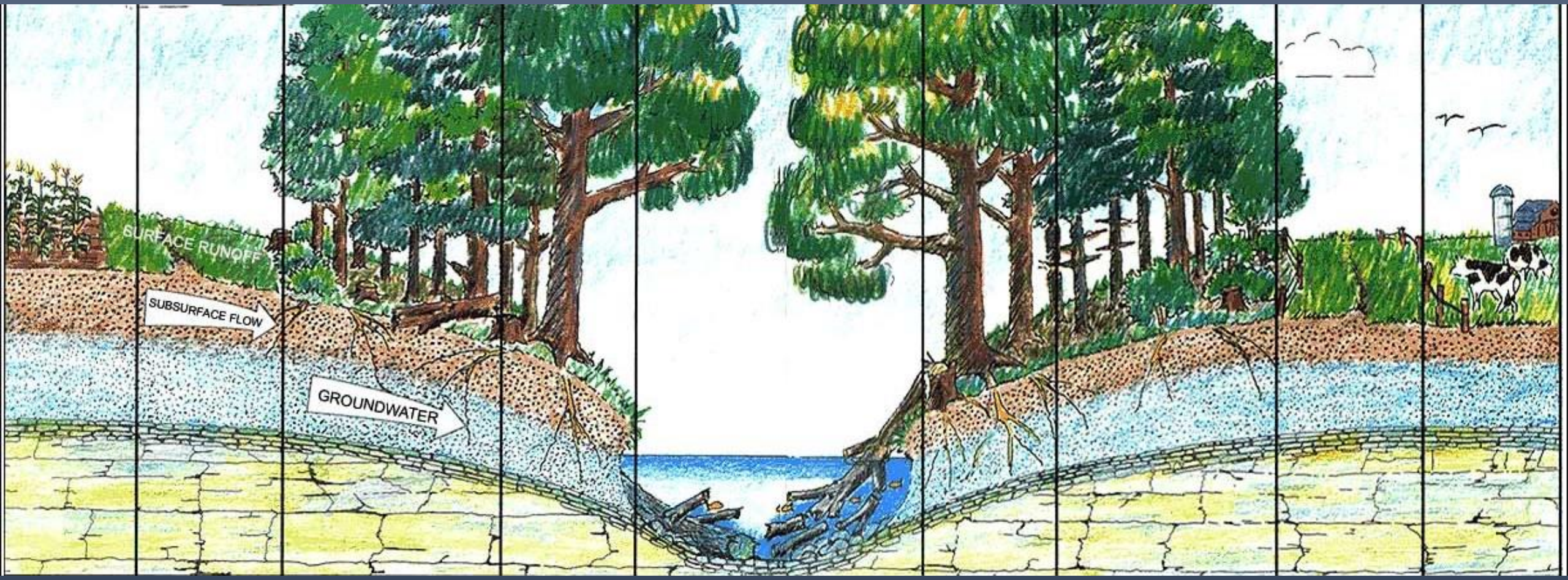
Take a moment to think how you would define a stream.

What is a stream?

Water flowing downhill on the surface of the landscape in a channel

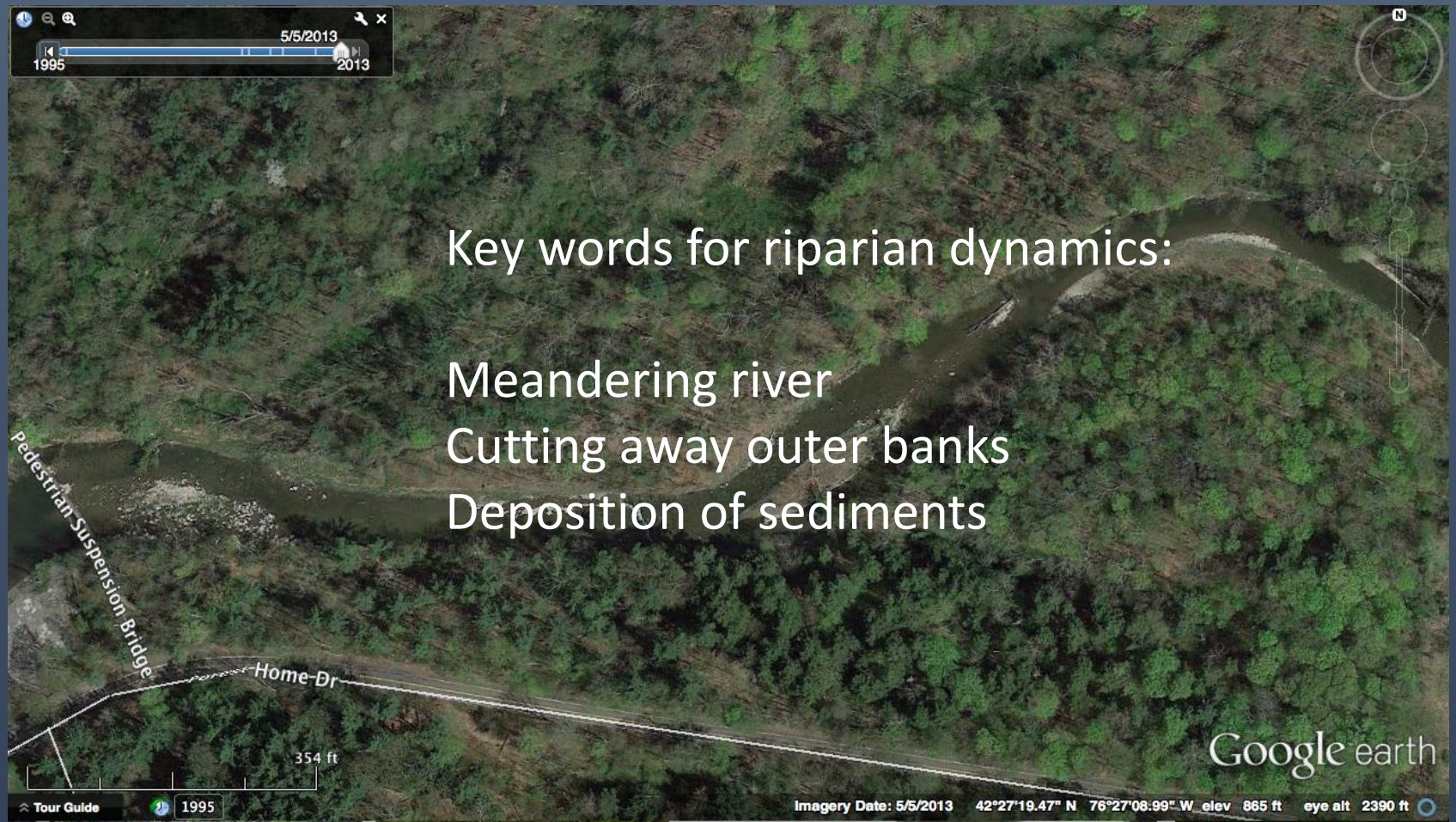
- Toby

Streams



Forest dynamics - Floodplain Forest

(riparian zone)



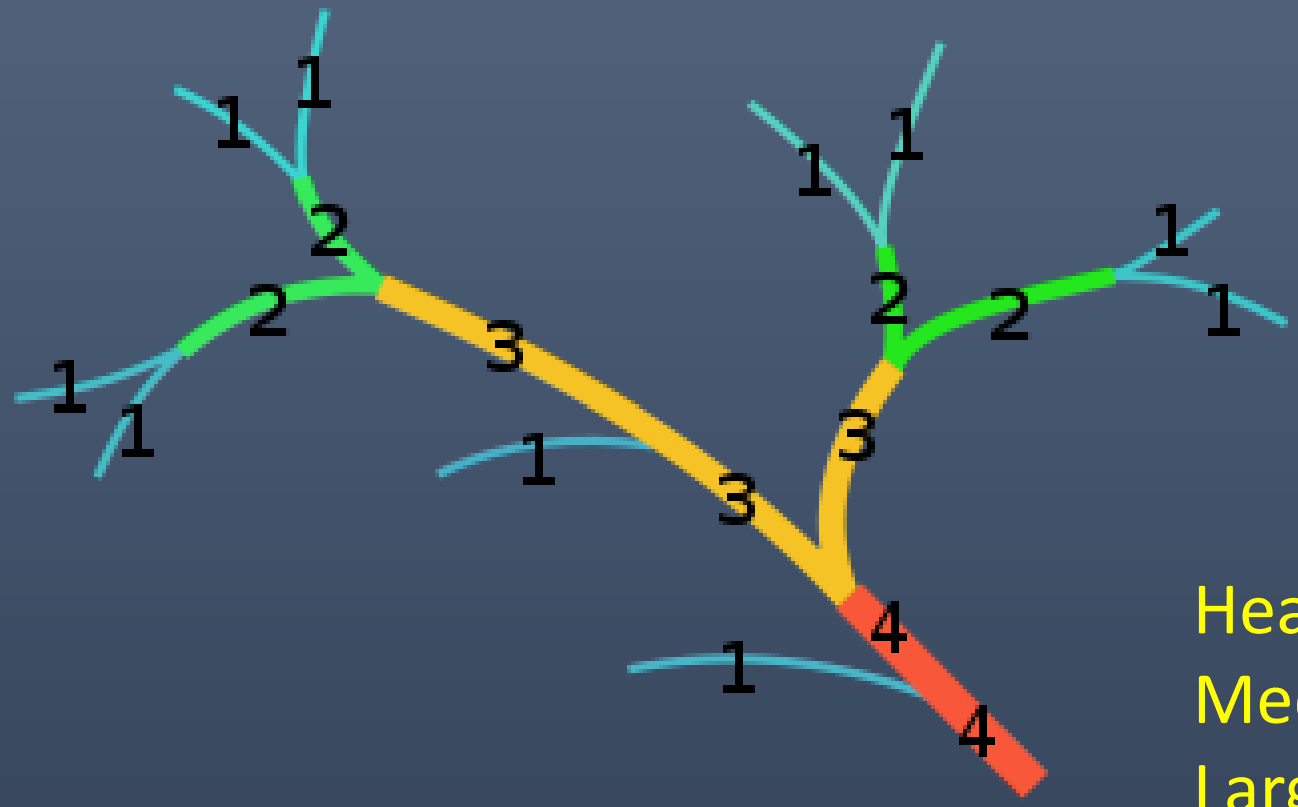
What are some names?

You tell me.

What are some names?

Rivers, streams, channels, creeks, oh my!

Stream Order



Headwaters = 1-3
Medium-sized rivers = 4-6
Large rivers = >6!

Vannote's "River Continuum Concept", 1980

PERSPECTIVES

The River Continuum Concept[1]

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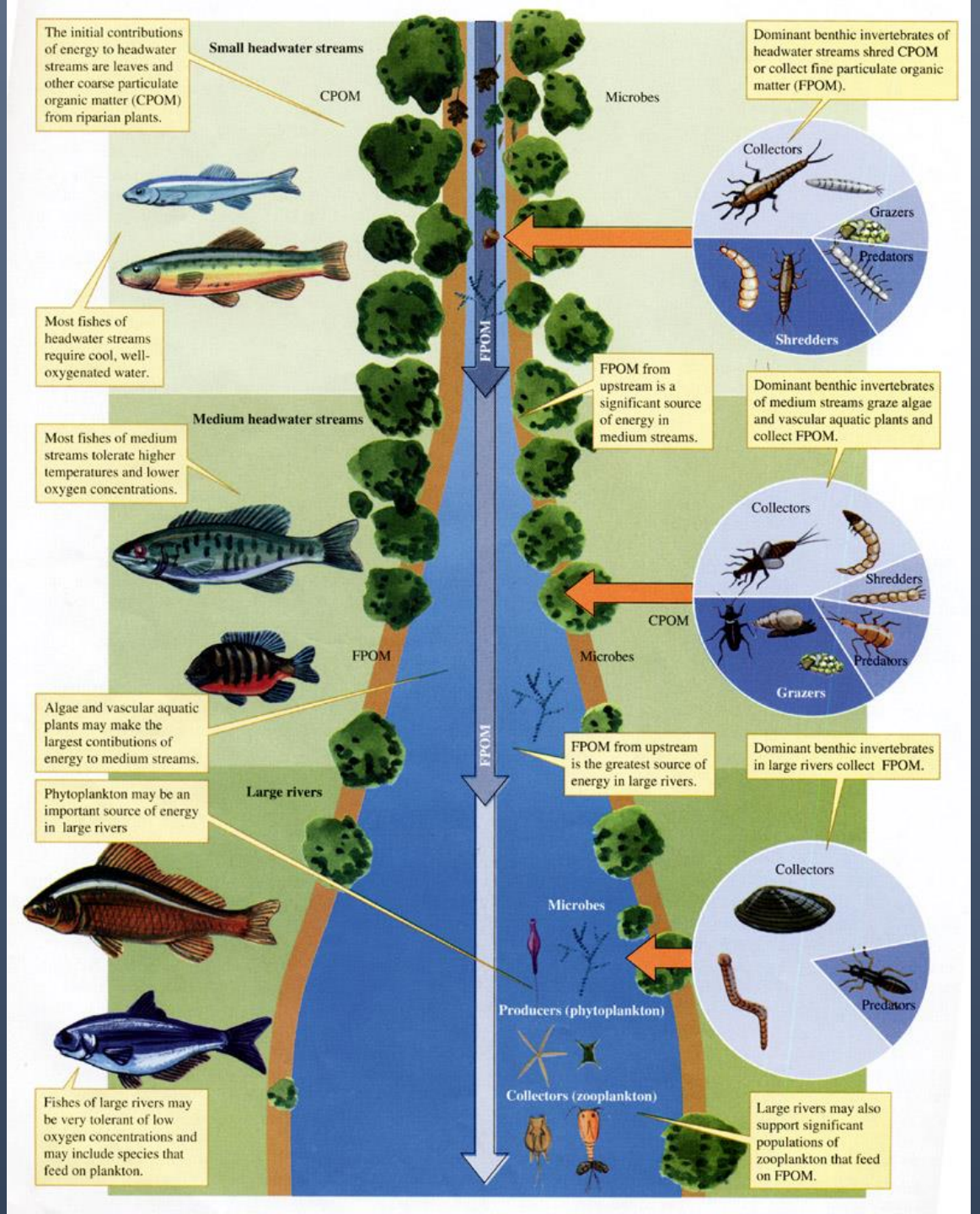
KENNETH W. CUMMINS
Department of Fisheries and Wildlife, Oregon State University, Corvallis, OR 97331, USA
JAMES R. SEDELL
Weyerhauser Corporation, Forestry Research, 505 North Pearl Street, Centralia, WA 98531, USA
AND COLBERT E. CUSHING
Ecosystems Department, Battelle-Pacific Northwest Laboratories, Richland, WA 99352, USA

VANNOTE, R. L., G. W. MINSHALL, K. W. CUMMINS, J. R. SEDELL, AND C. E. CUSHING. 1980. The river continuum concept. Can. J. Fish. Aquat. Sci. 37: 130–137.

From headwaters to mouth, the physical variables within a river system present a continuous gradient of physical conditions. This gradient should elicit a series of responses within the constituent populations resulting in a continuum of biotic adjustments and consistent patterns of loading, transport, utilization, and storage of organic matter along the length of a river. Based on the energy equilibrium theory of fluvial geomorphologists, we hypothesize that the structural and functional characteristics of stream communities are adapted to conform to the most probable position or mean state of the physical system. We reason that producer and consumer communities characteristic of a given river reach become established in harmony with the dynamic physical conditions of the channel. In natural stream systems, biological communities can be characterized as forming a temporal continuum of synchronized species replacements. This continuous replacement functions to distribute the utilization of energy inputs over time. Thus, the biological system moves towards a balance between a tendency for efficient use of energy inputs through resource partitioning (food, substrate, etc.) and an opposing tendency for a uniform rate of energy processing throughout the year. We theorize that biological communities developed in natural streams assume processing strategies involving minimum energy loss. Downstream communities are fashioned to capitalize on upstream processing inefficiencies. Both the upstream inefficiency (leakage) and the downstream adjustments seem predictable. We propose that this River Continuum Concept provides a framework for integrating predictable and observable biological features of lotic systems. Implications of the concept in the areas of structure, function, and stability of riverine ecosystems are discussed.

Key words: river continuum; stream ecosystems; ecosystem structure, function; resource partitioning; ecosystem stability; community succession; river zonation; stream geomorphology



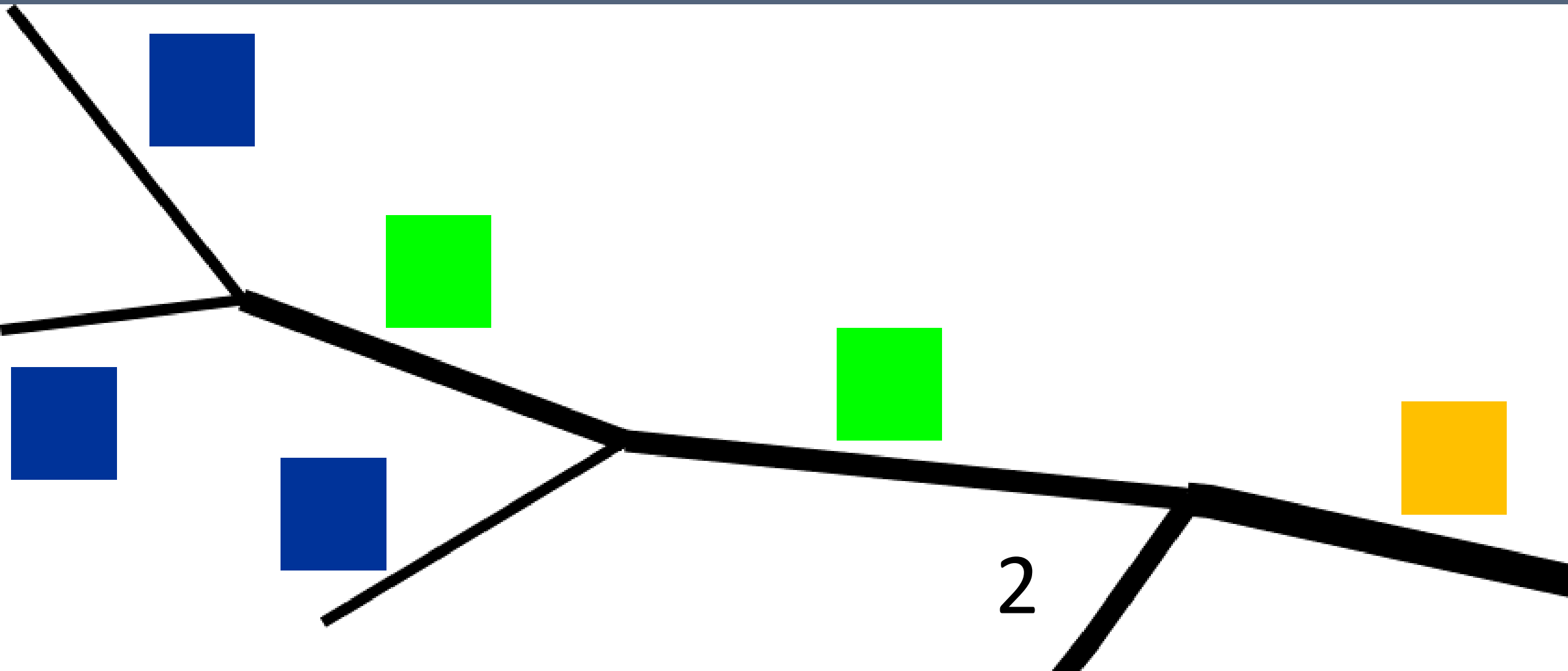
Cited 7,964 times!

Former Center director Robin Vannote talks with Robert Kennedy Jr. Stroud scientist Tom Bott is in the background.

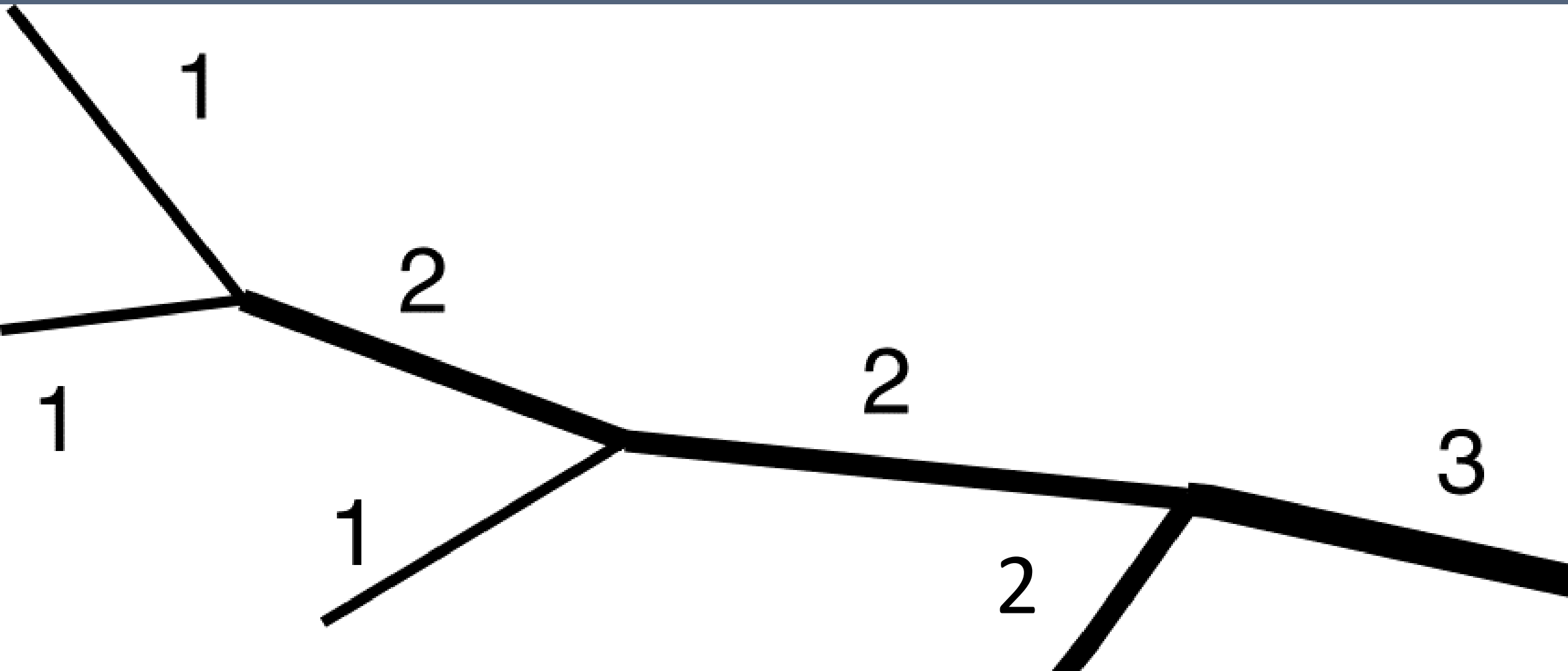
River Continuum Concept

- Gradient
- Velocity & Flow
- Erosion & Deposition (&Transport)
- Sinuosity
- CPOM/FPOM
- Macroinvertebrate Community
- Fish Community

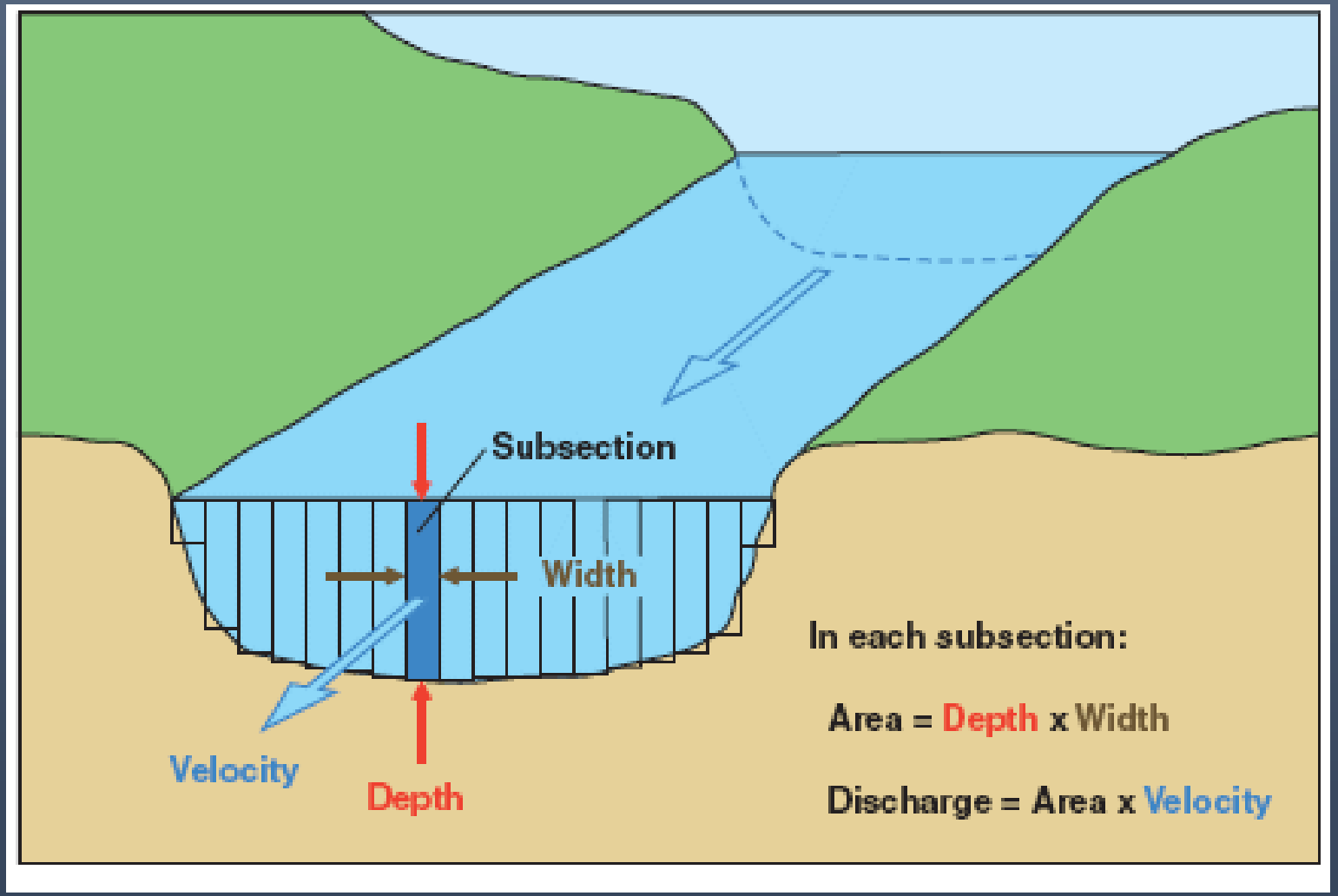
POP QUIZ!



POP QUIZ!



Stream Flow


Subsection
Width
Velocity
Depth
In each subsection:
Area = Depth x Width
Discharge = Area x Velocity

3 Key Concepts

- Wetted width
- Bankfull
- Thalweg

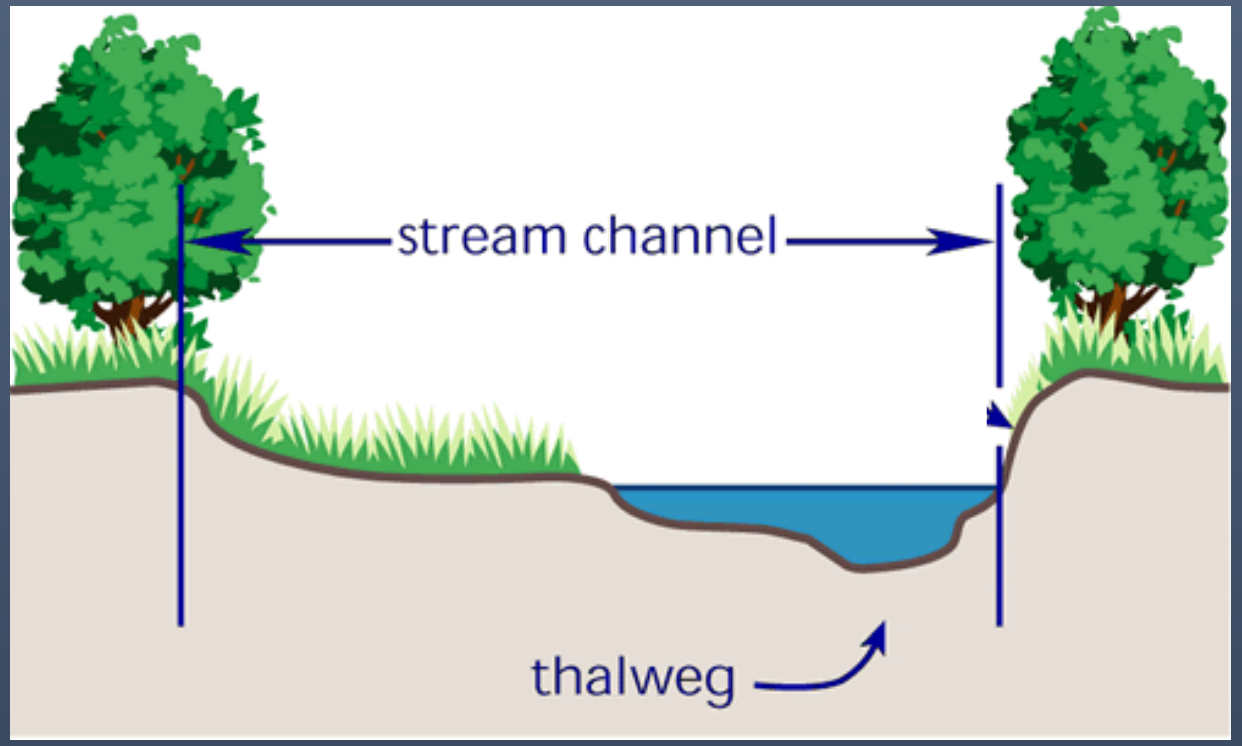
Wetted Width

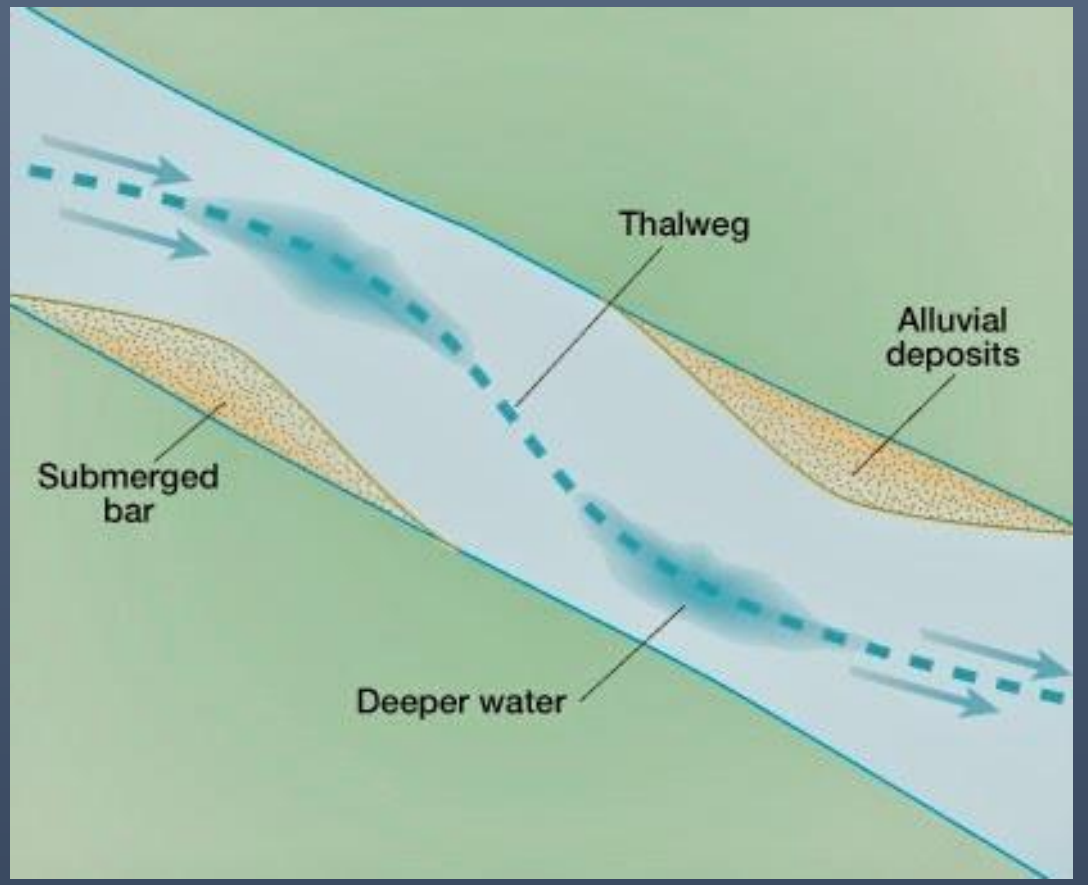
Bankfull Width

Bankfull Width

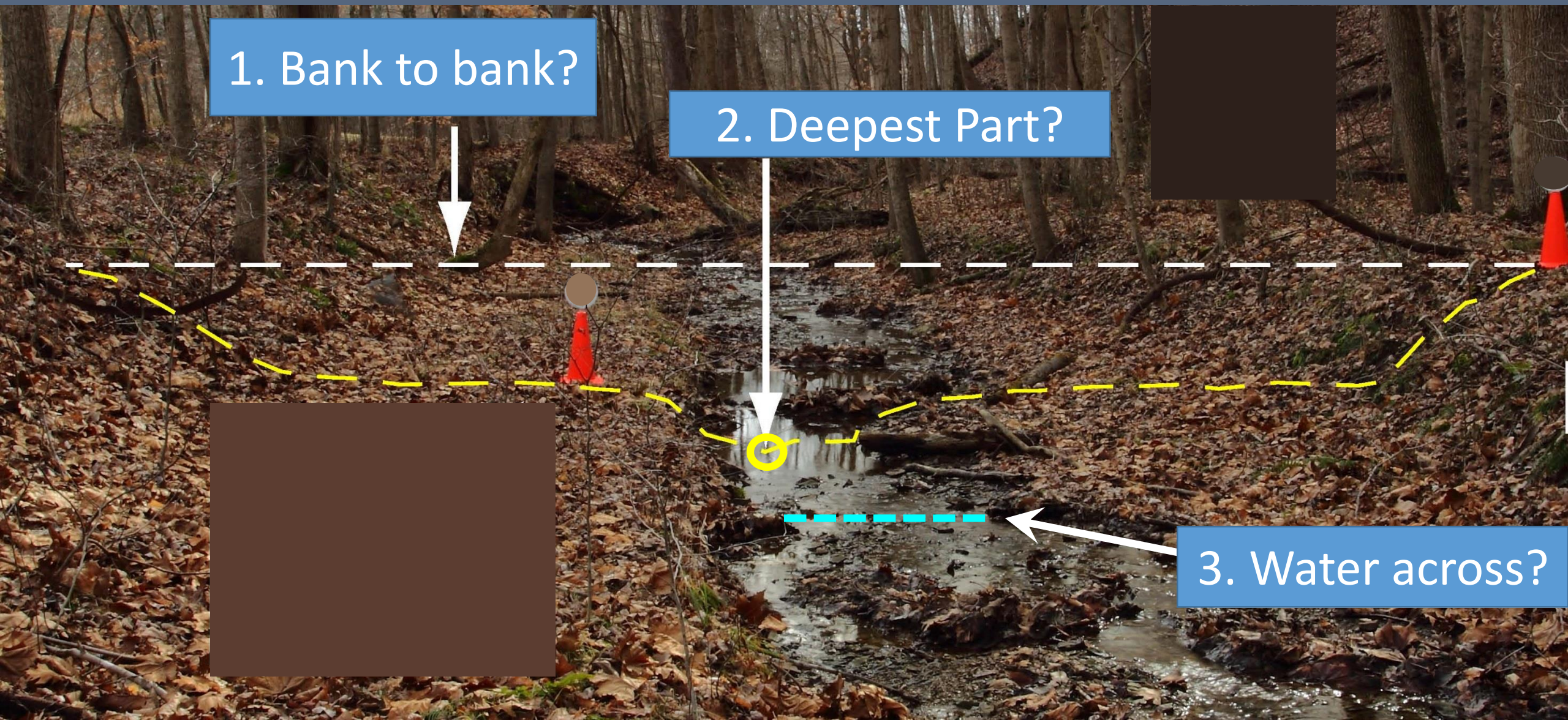
Flooding

Thalweg


stream channel
thalweg


Thalweg
Alluvial deposits
Submerged bar
Deeper water

POP QUIZ!



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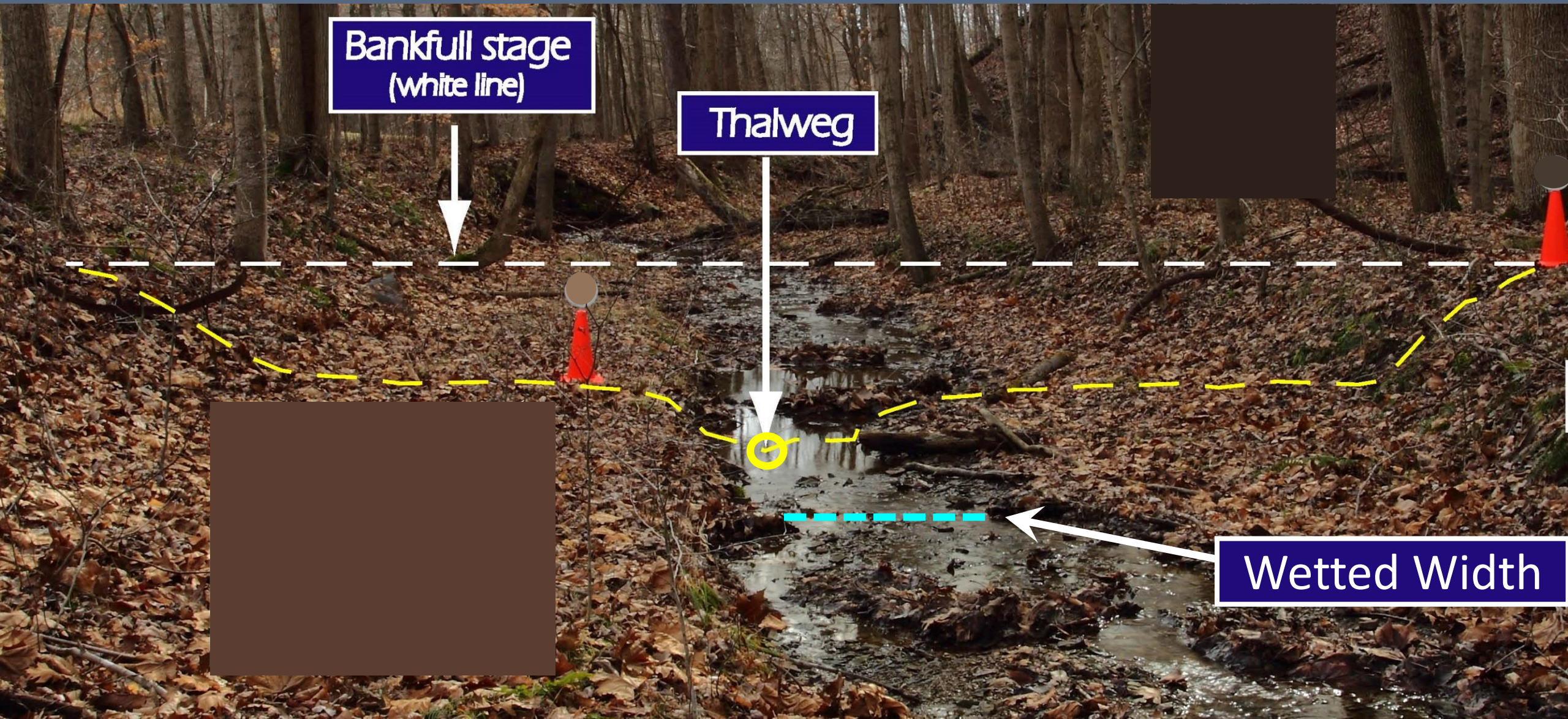
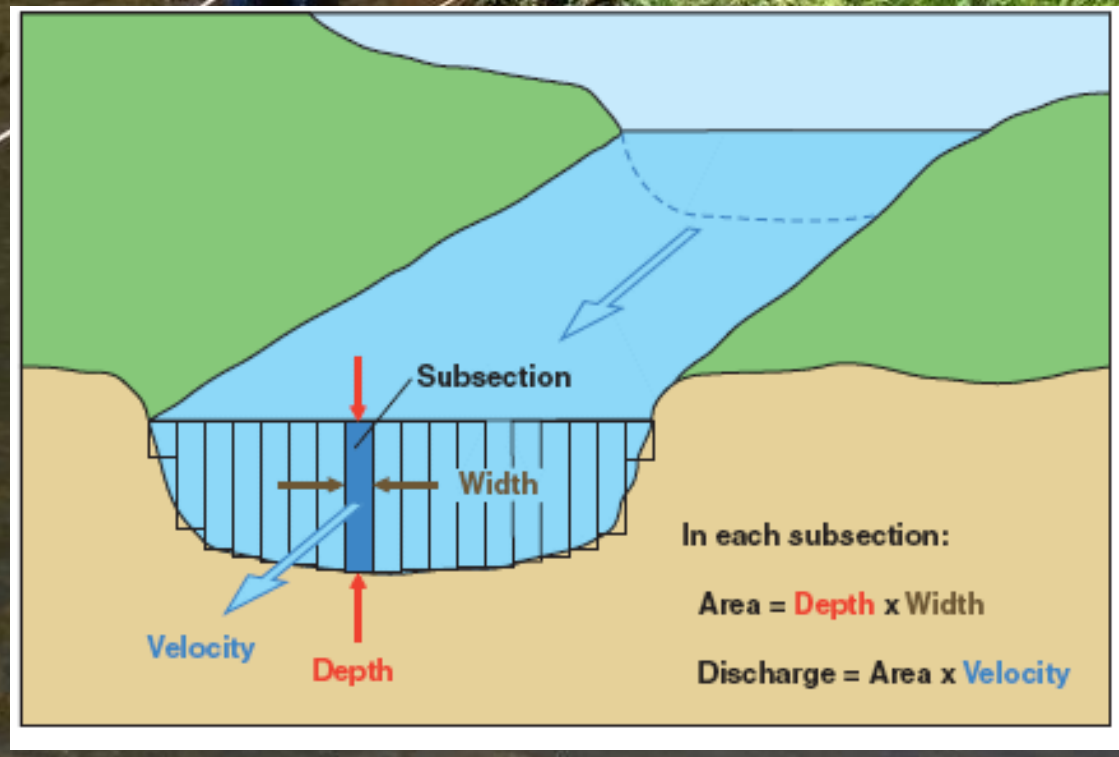


Imagine yourself here!



Stream anatomy

- Velocity

Flow and RCC

Flow and RCC

Flow and RCC

CPOM/FPOM and RCC

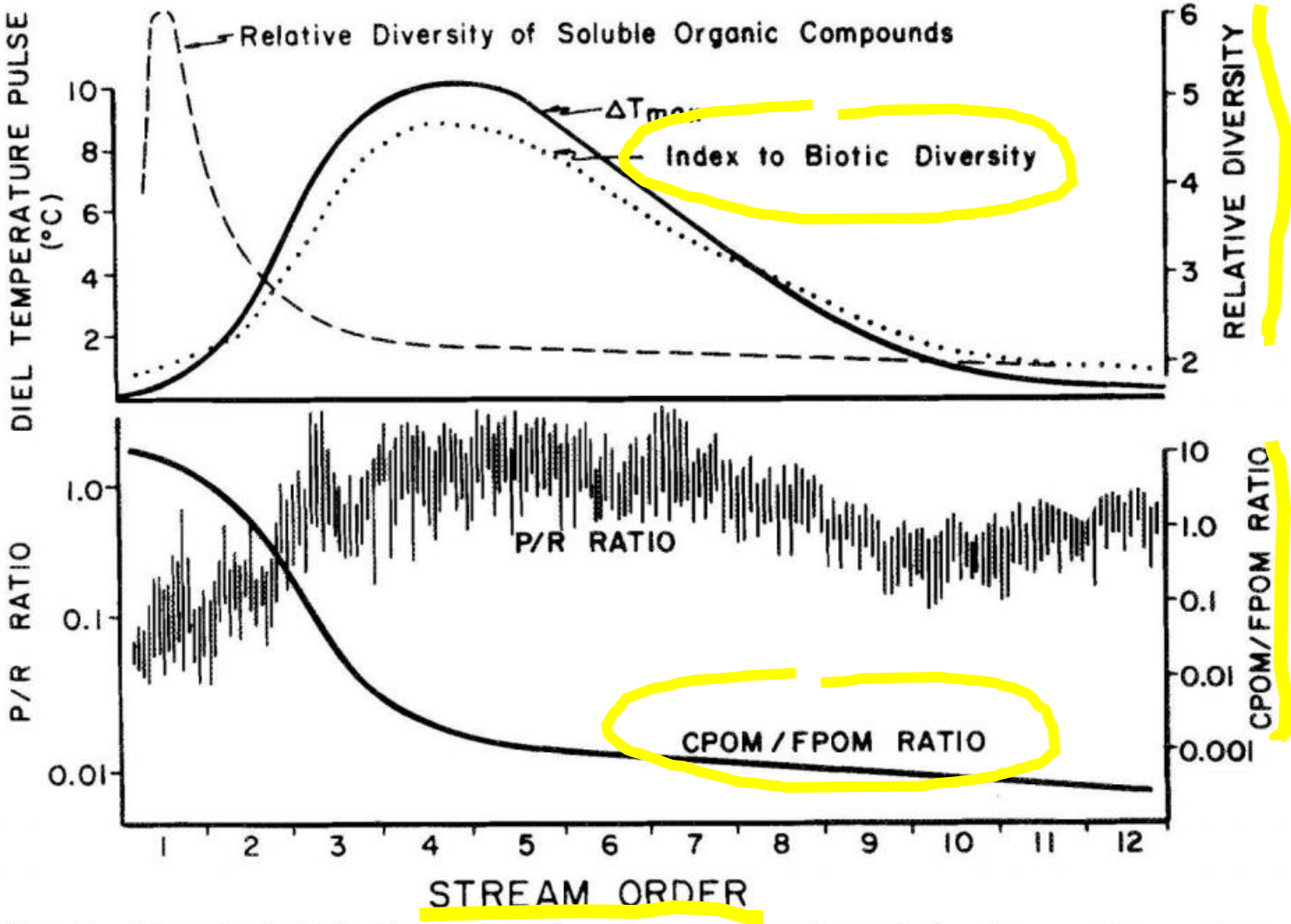
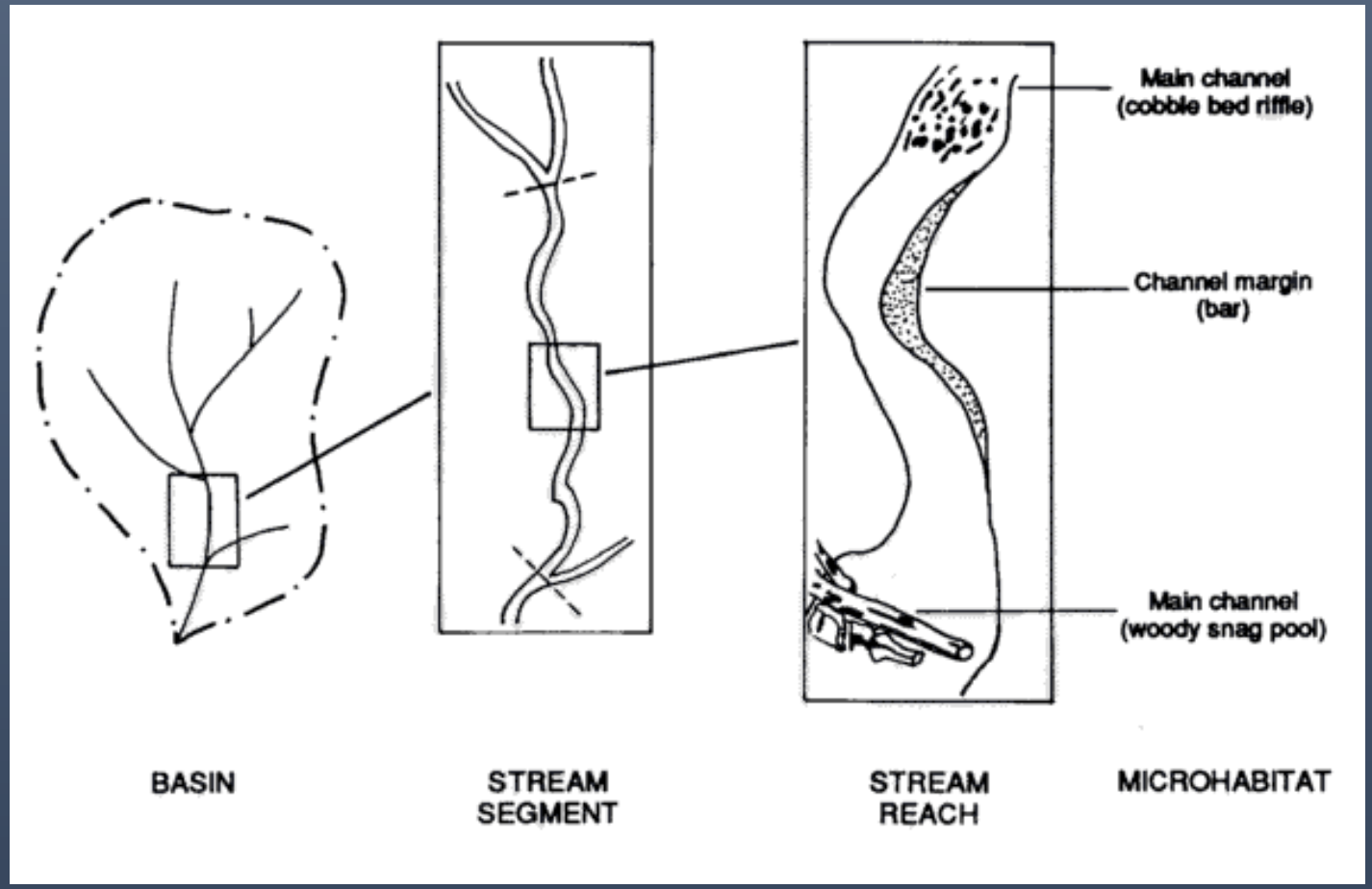


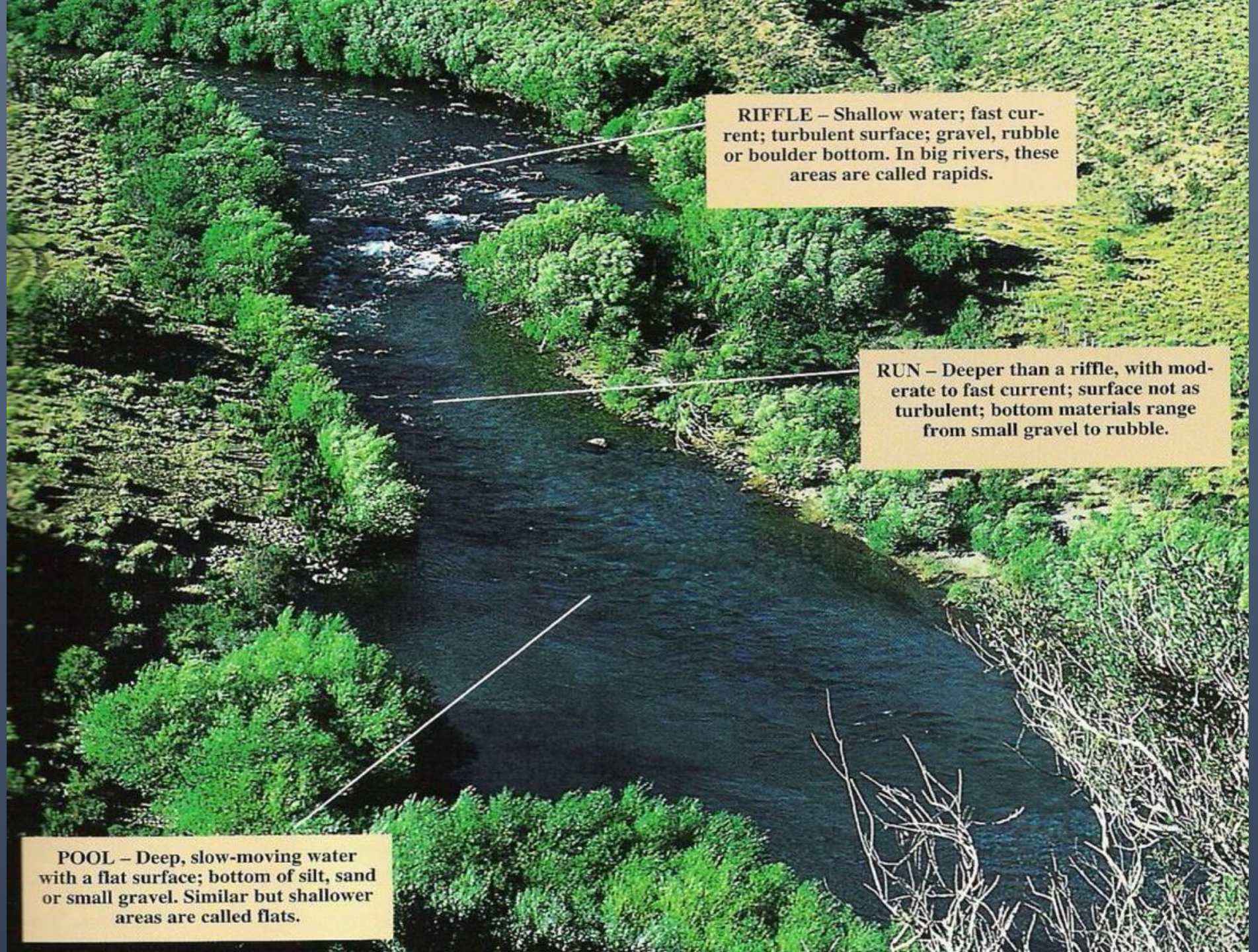
FIG. 2. Hypothetical distribution of selected parameters through the river continuum from headwater seeps to a twelfth order river. Parameters include heterogeneity of soluble organic matter, maximum diel temperature pulse, total biotic diversity within the river channel, coarse to fine particulate organic matter ratio, and the gross photosynthesis/respiration ratio.

Scale

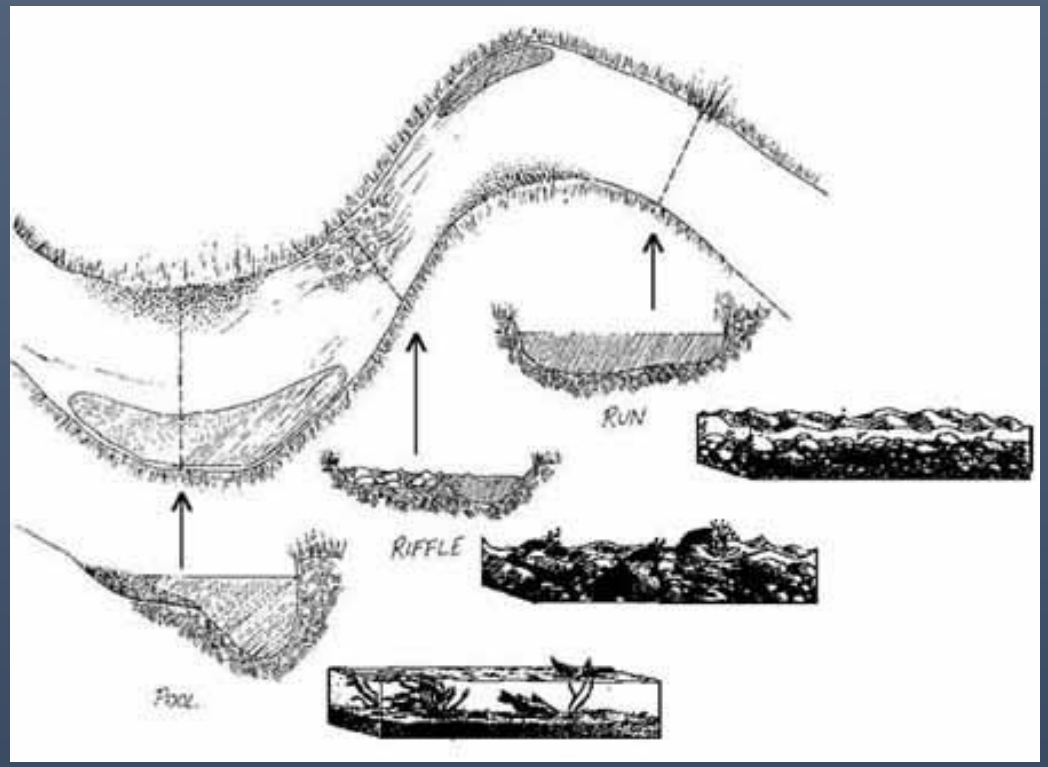

Main channel
(cobble bed riffle)
Channel margin
(bar)
Main channel
(woody snag pool)
BASIN
STREAM
SEGMENT
STREAM
REACH
MICROHABITAT

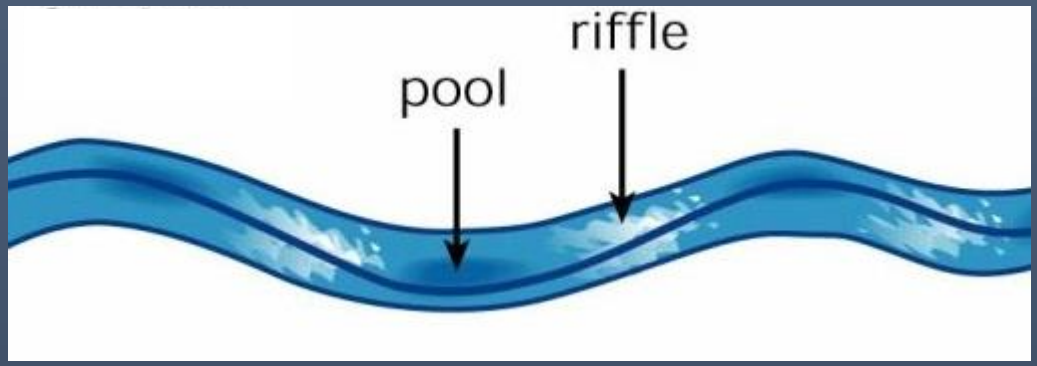
Smaller Scale

- Riffles
- Runs
- Pools


RIFFLE – Shallow water; fast current; turbulent surface; gravel, rubble or boulder bottom. In big rivers, these areas are called rapids.
RUN – Deeper than a riffle, with moderate to fast current; surface not as turbulent; bottom materials range from small gravel to rubble.
POOL – Deep, slow-moving water with a flat surface; bottom of silt, sand or small gravel. Similar but shallower areas are called flats.

Stream habitats





Riffles

Runs

Pools

POP QUIZ!

A	B	C
		

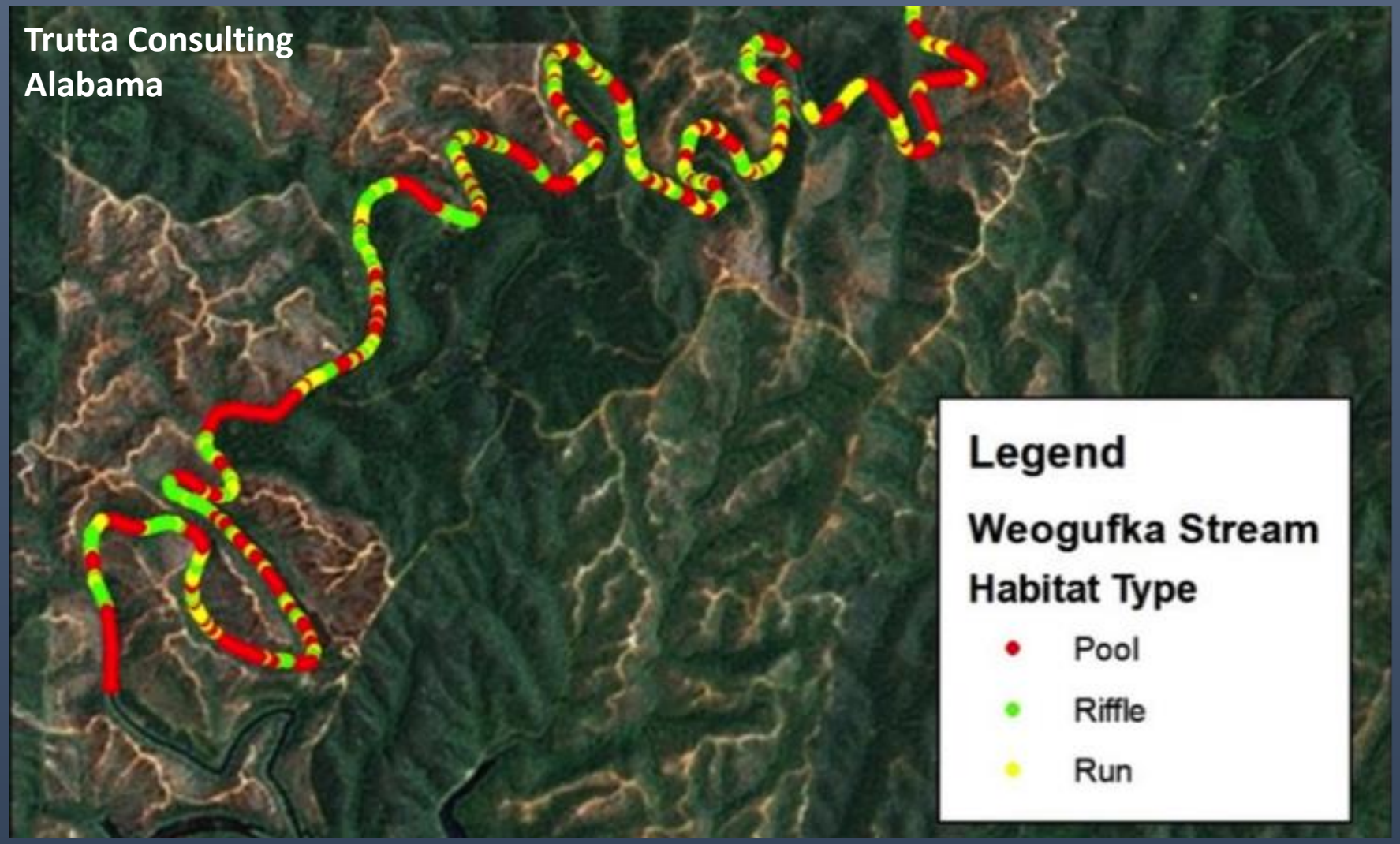
POP QUIZ!

Pool

Riffle

Run

Stream habitats



NTRES 4560 - Stream Ecology

(crosslisted)
(also BIOEE 4560)

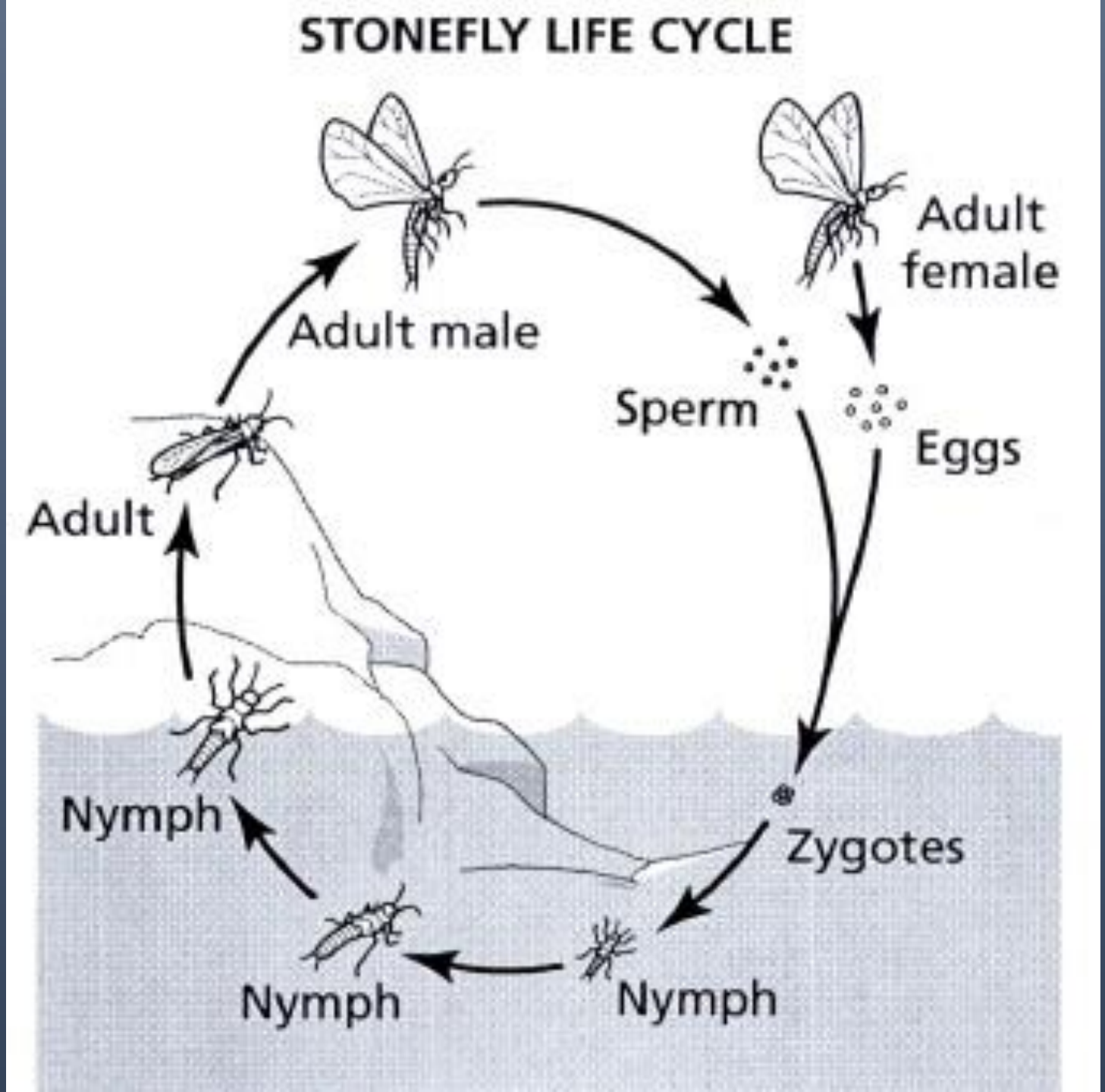
Fall. 4 credits.

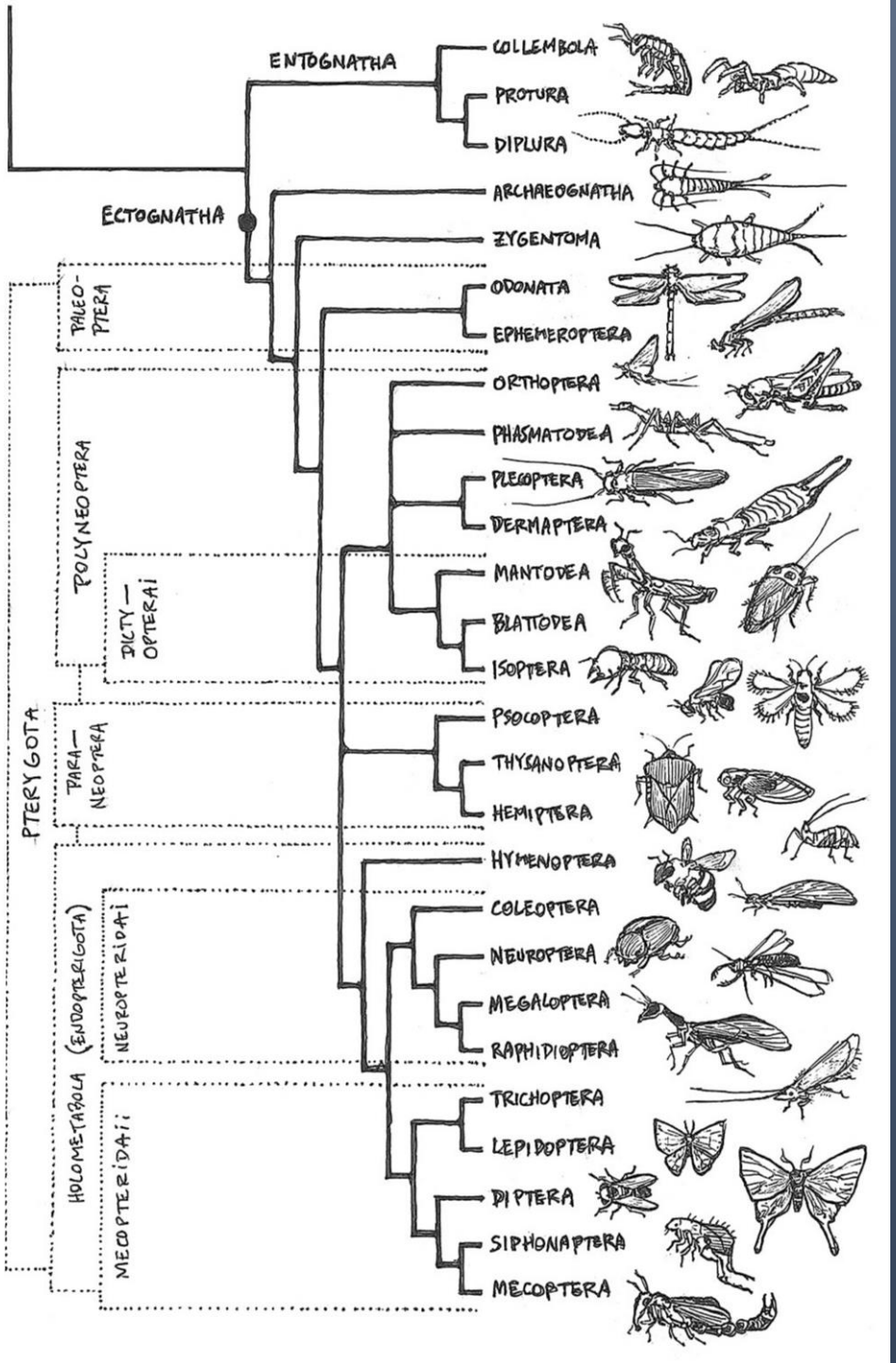
Prerequisite: BIOEE 1610 or permission of instructor. Offered alternate years. One Sat. field trip.

C. Kraft and A. Flecker.

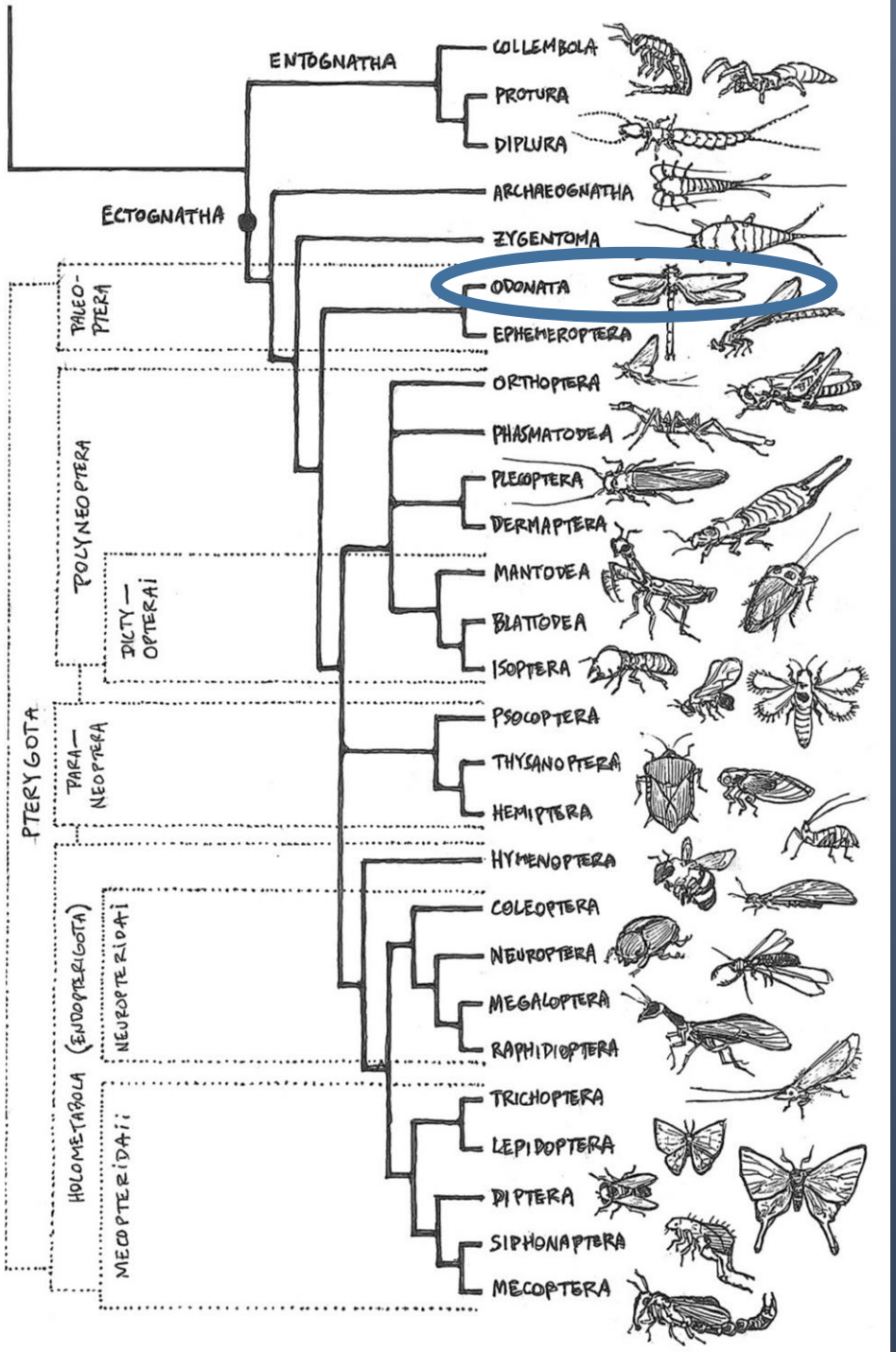
Lecture examines patterns and processes in stream ecosystems, including geomorphology and hydrology, watershed–stream interactions, trophic dynamics, biogeochemistry, disturbance, and conservation and management. Field and laboratory exercises focus on experimental and analytical techniques used to study stream ecosystems, including techniques to measure stream discharge, physical habitat, water chemistry, and stream biota. Field project with lab papers.

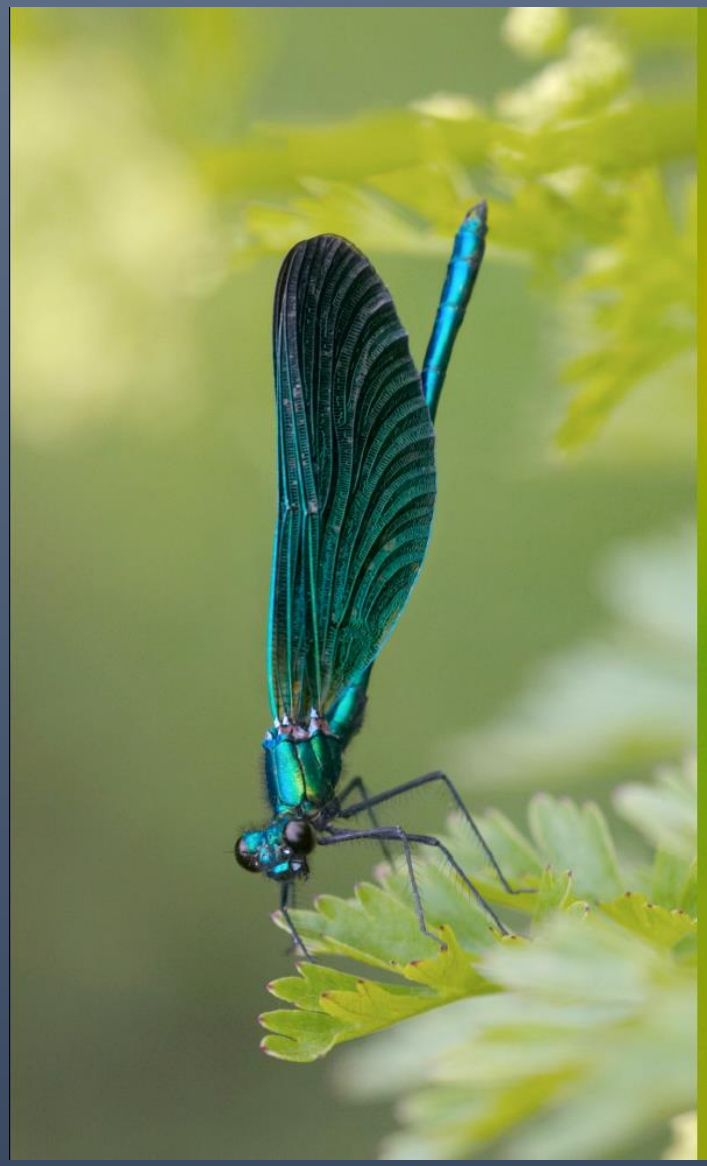
Stream Macroinvertebrates


STONEFLY LIFE CYCLE
Adult male
Adult female
Sperm
Eggs
Adult
Nymph
Zygotes
Nymph
Nymph



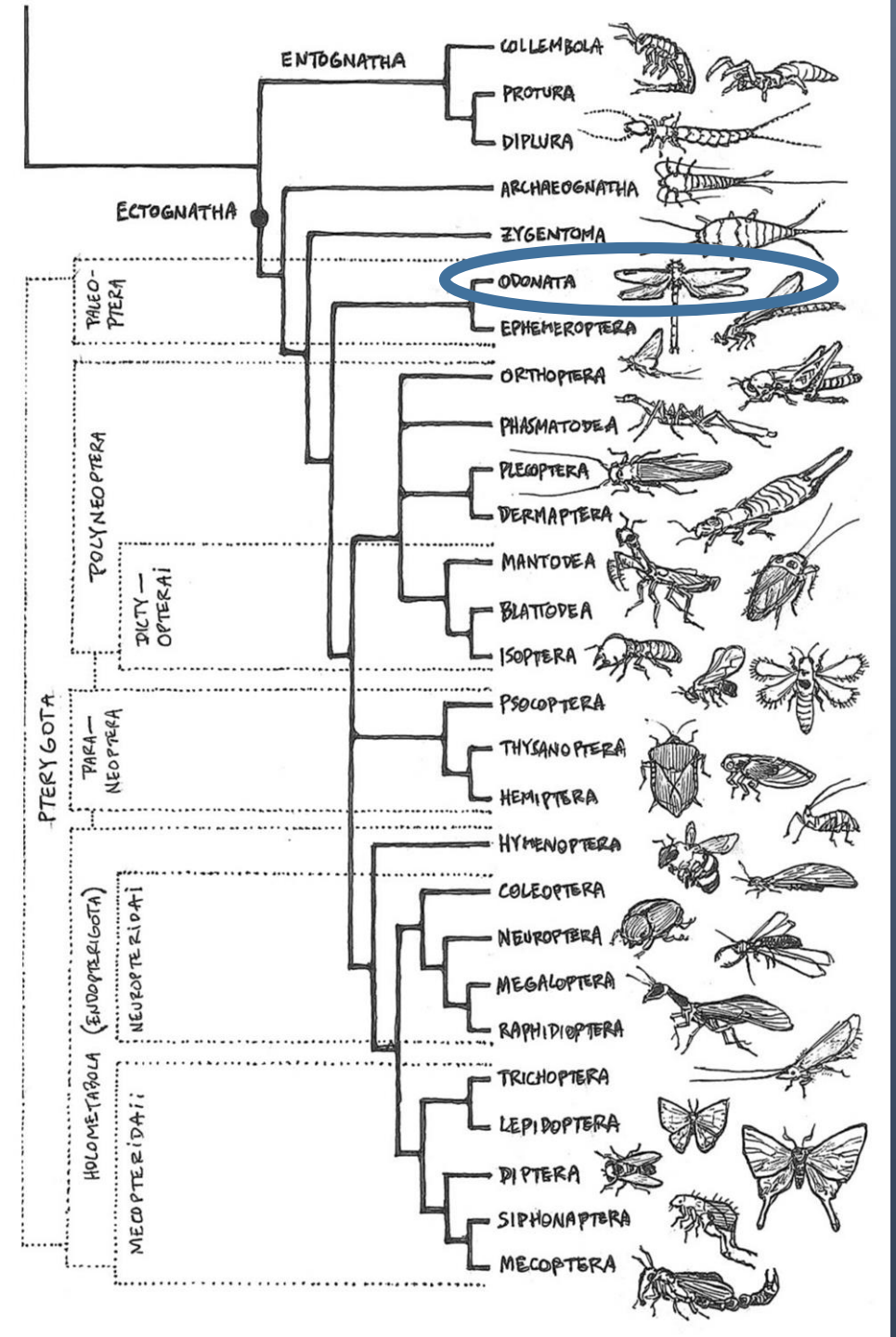
Remember this?





Damselfly

Dragonfly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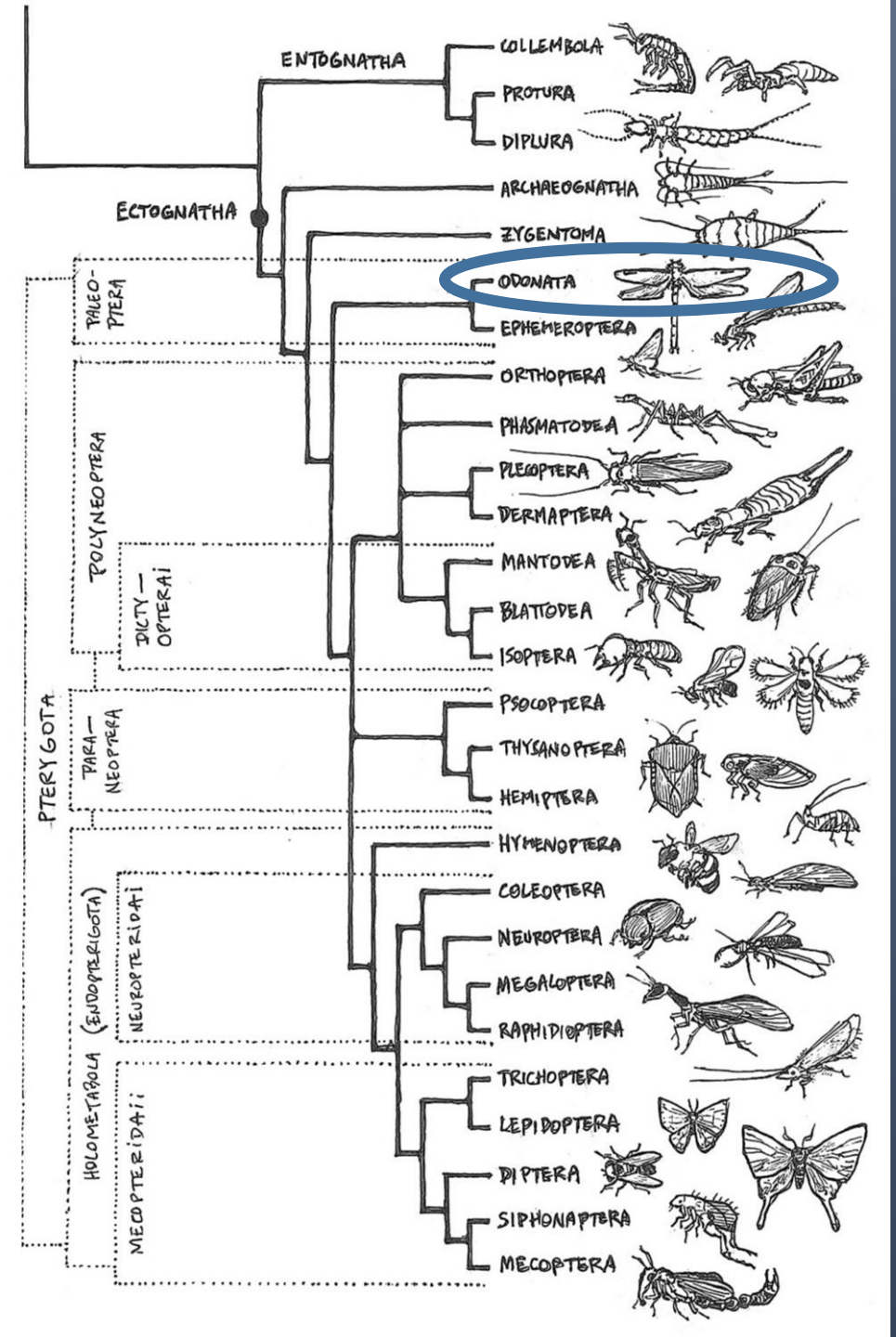
PTERYGOTA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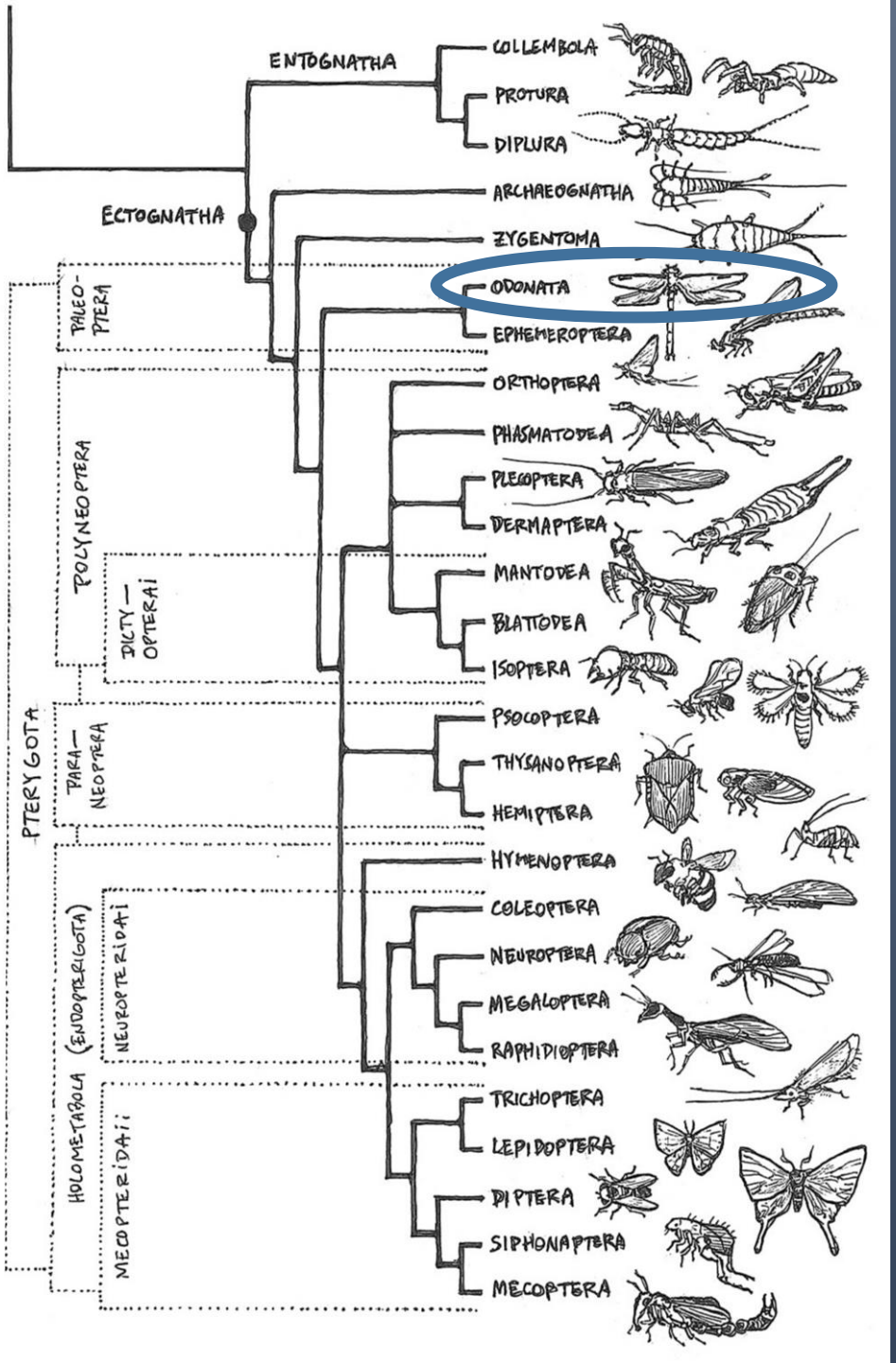
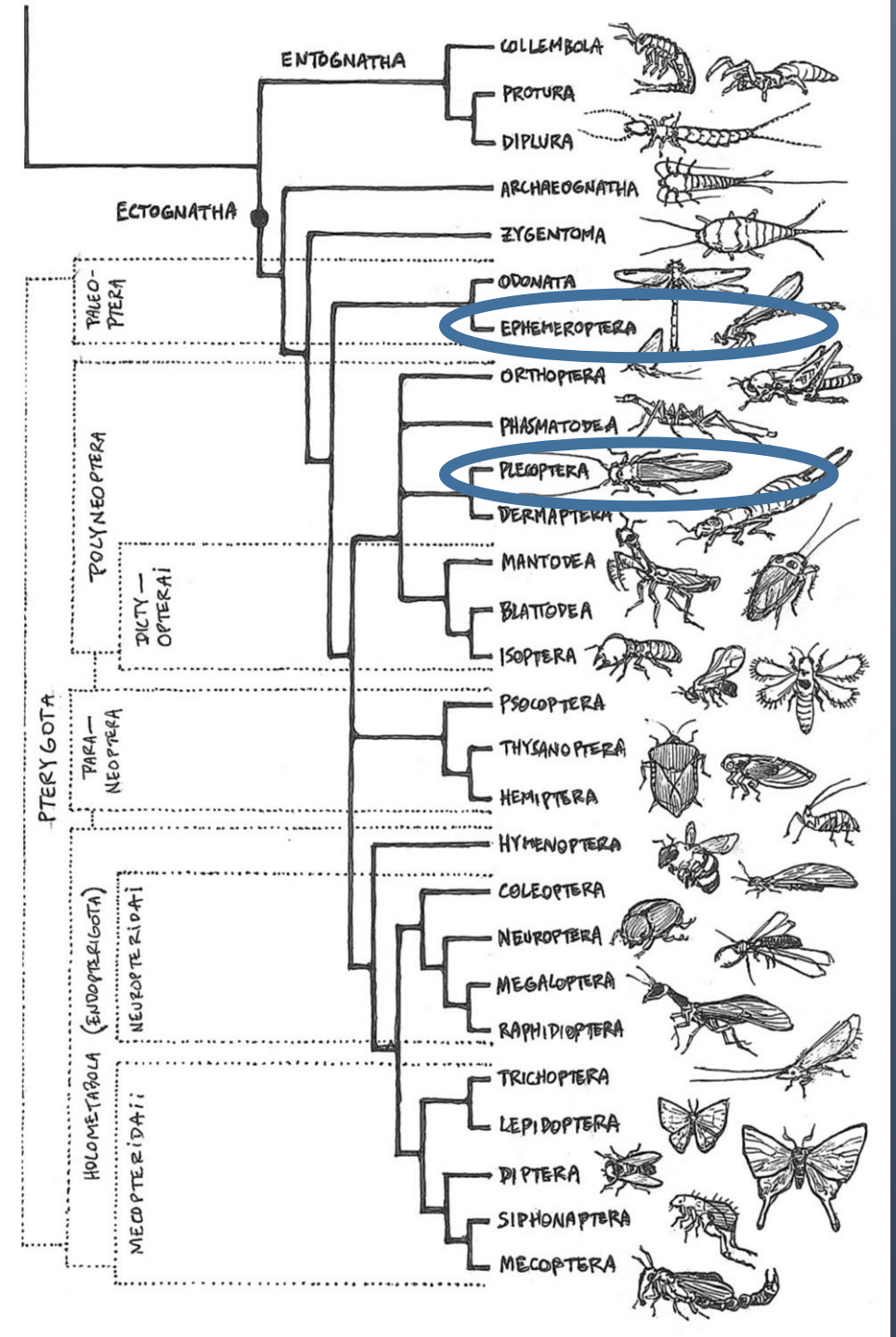


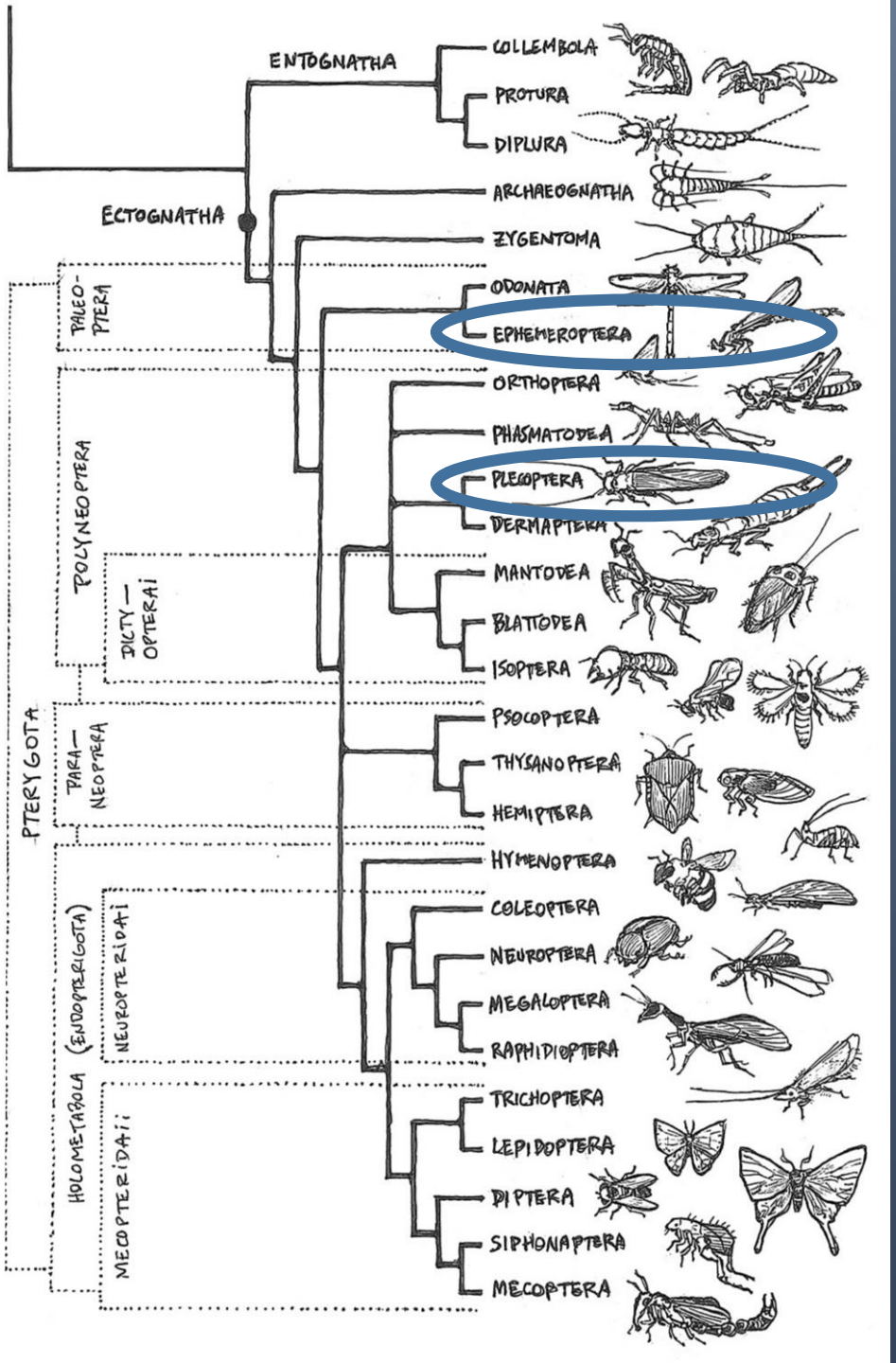
Damselfly

Dragonfly



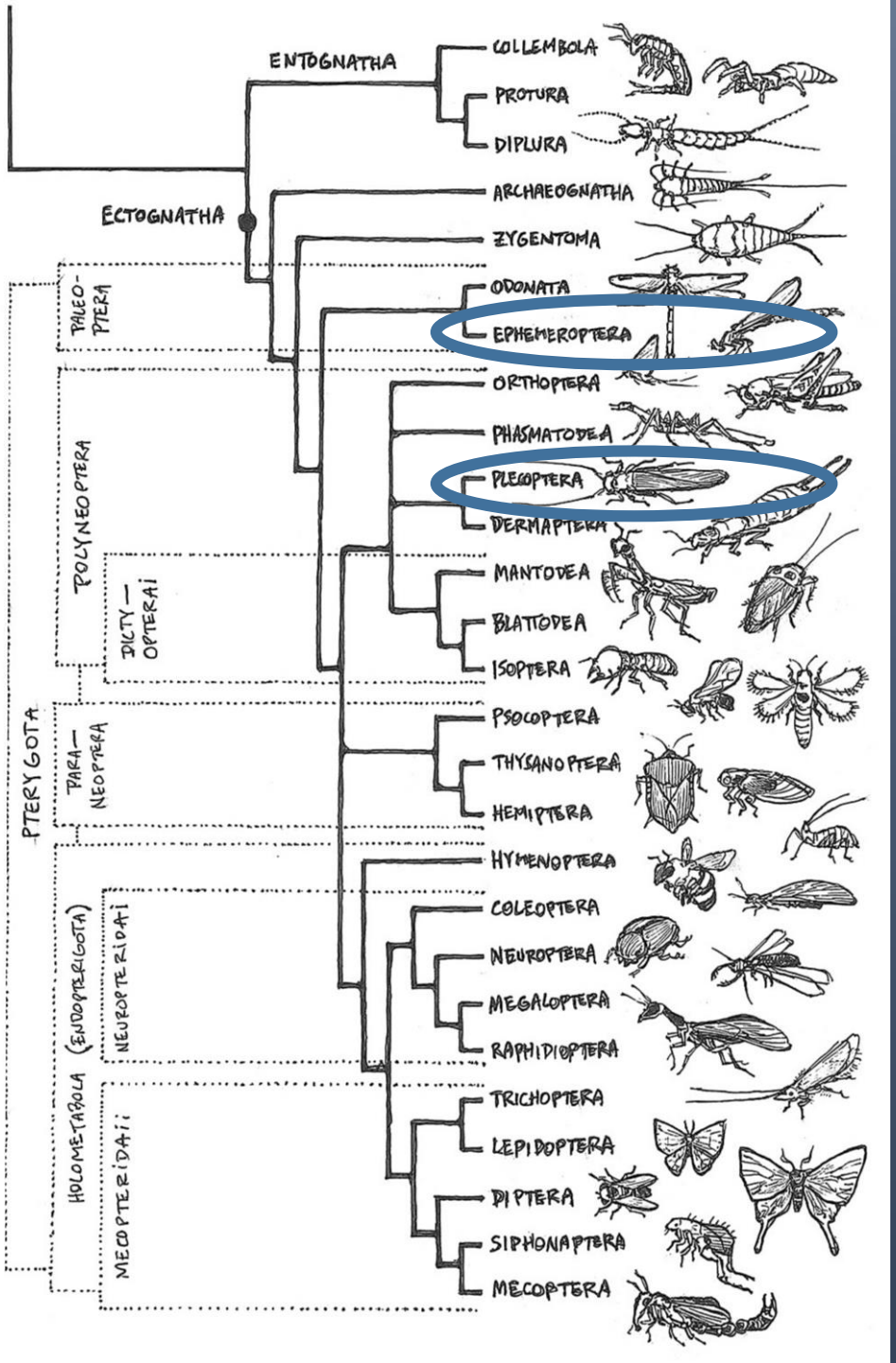
Mayfly

Stonefly



Mayfly

Stonefly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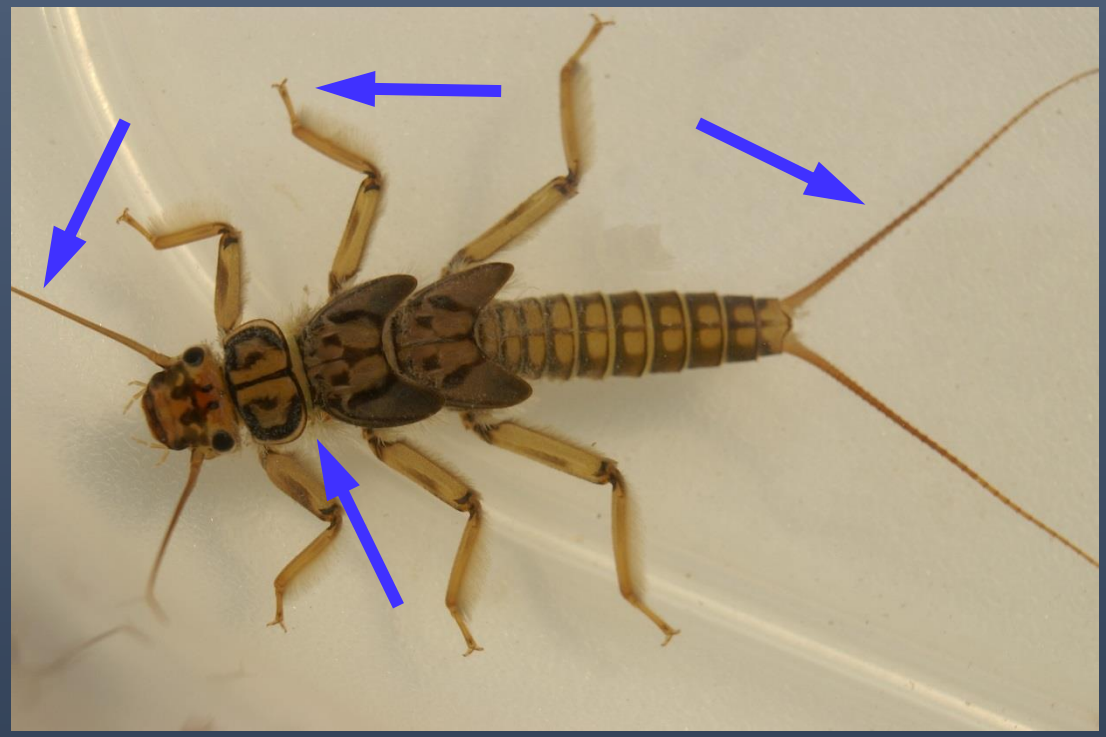
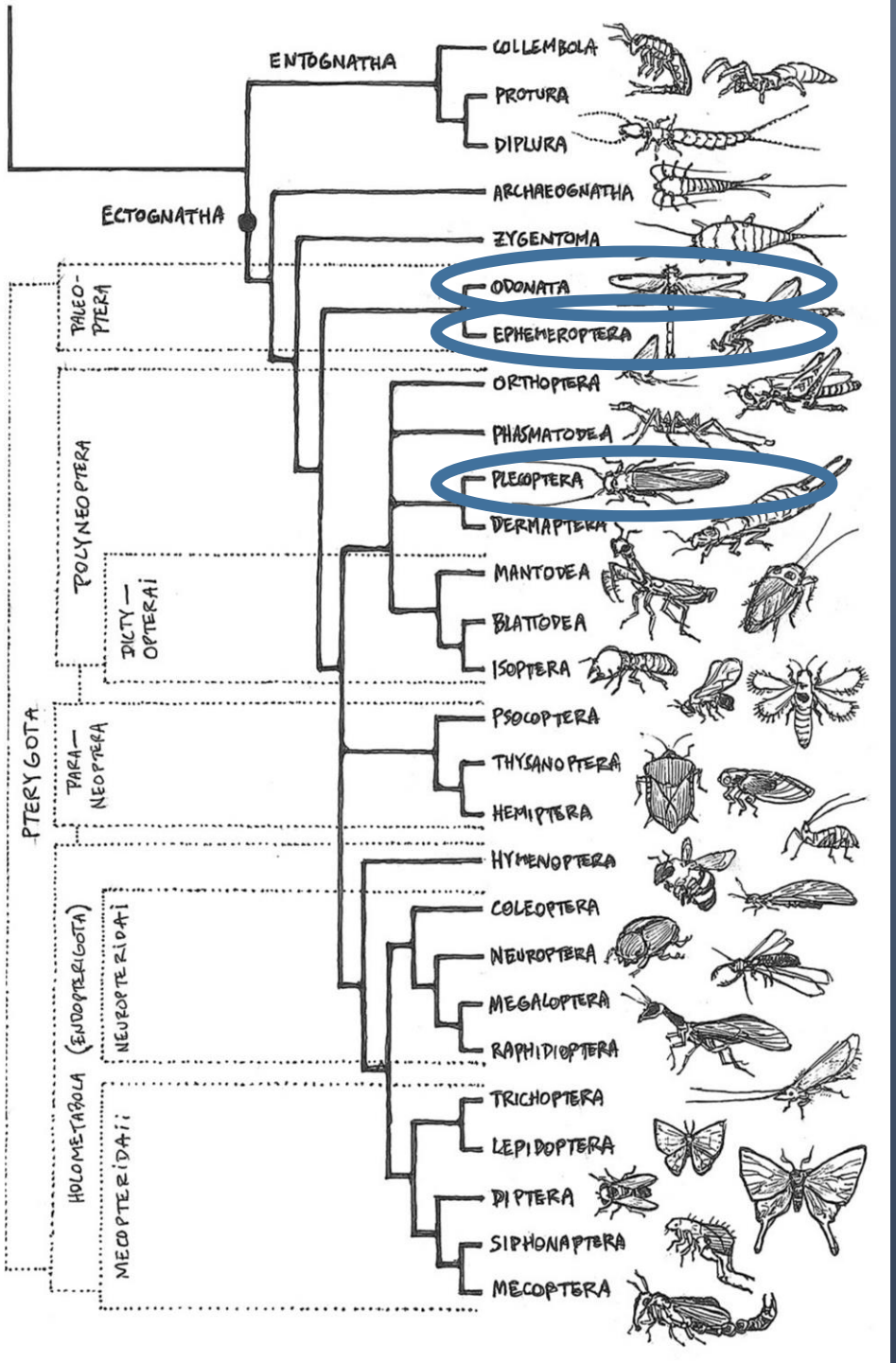
Mayfly


Stonefly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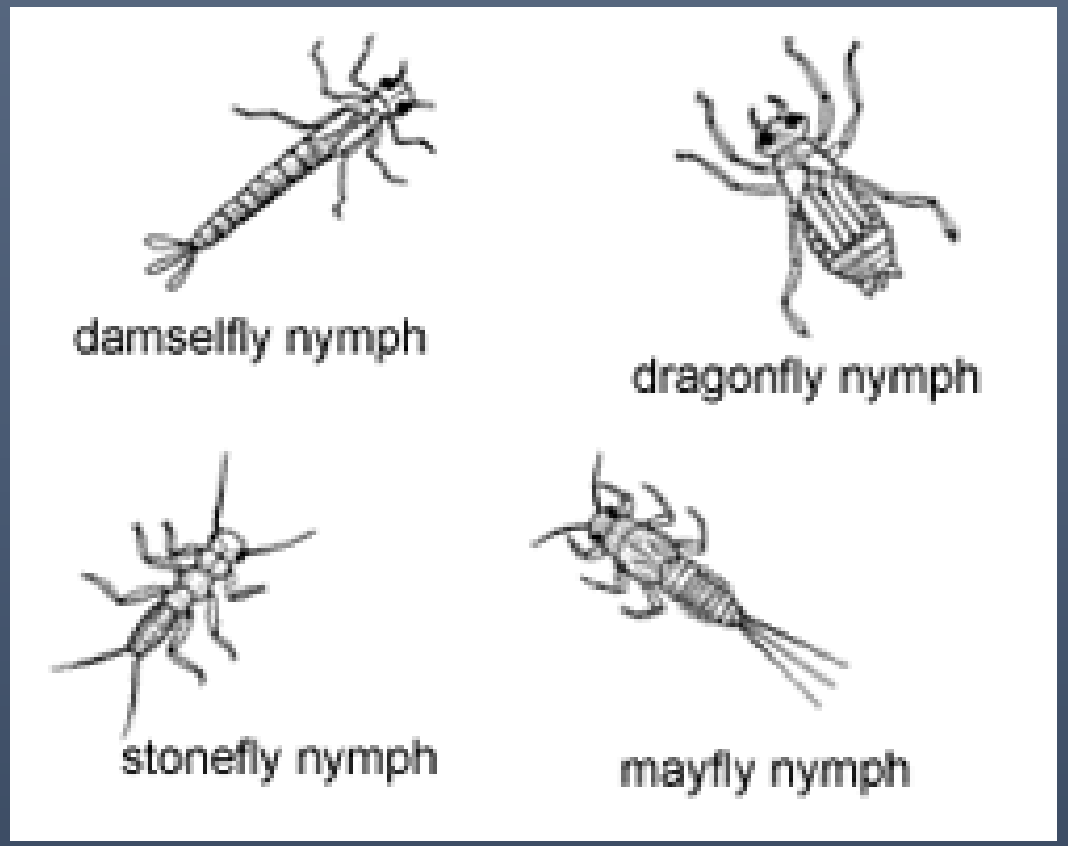
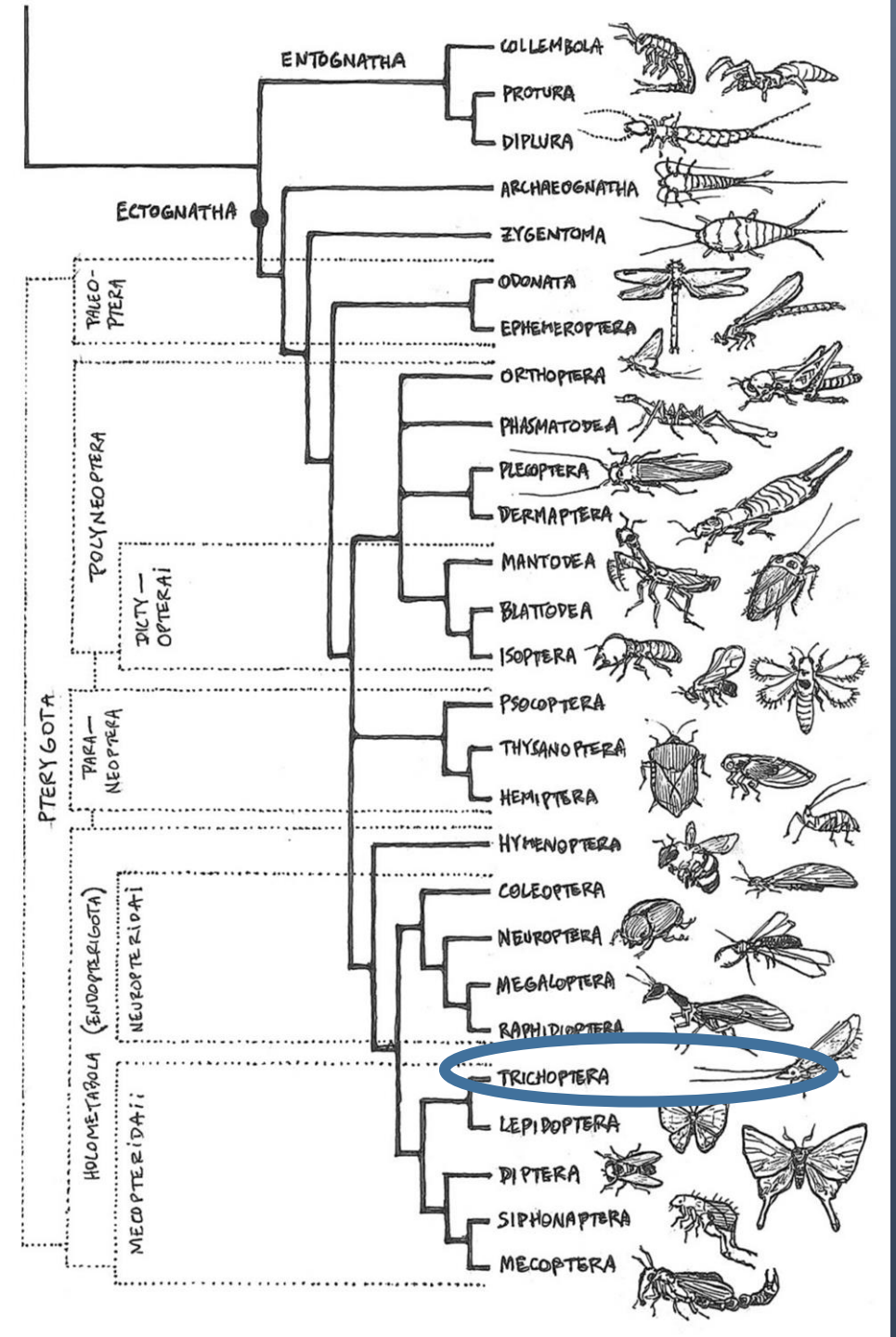
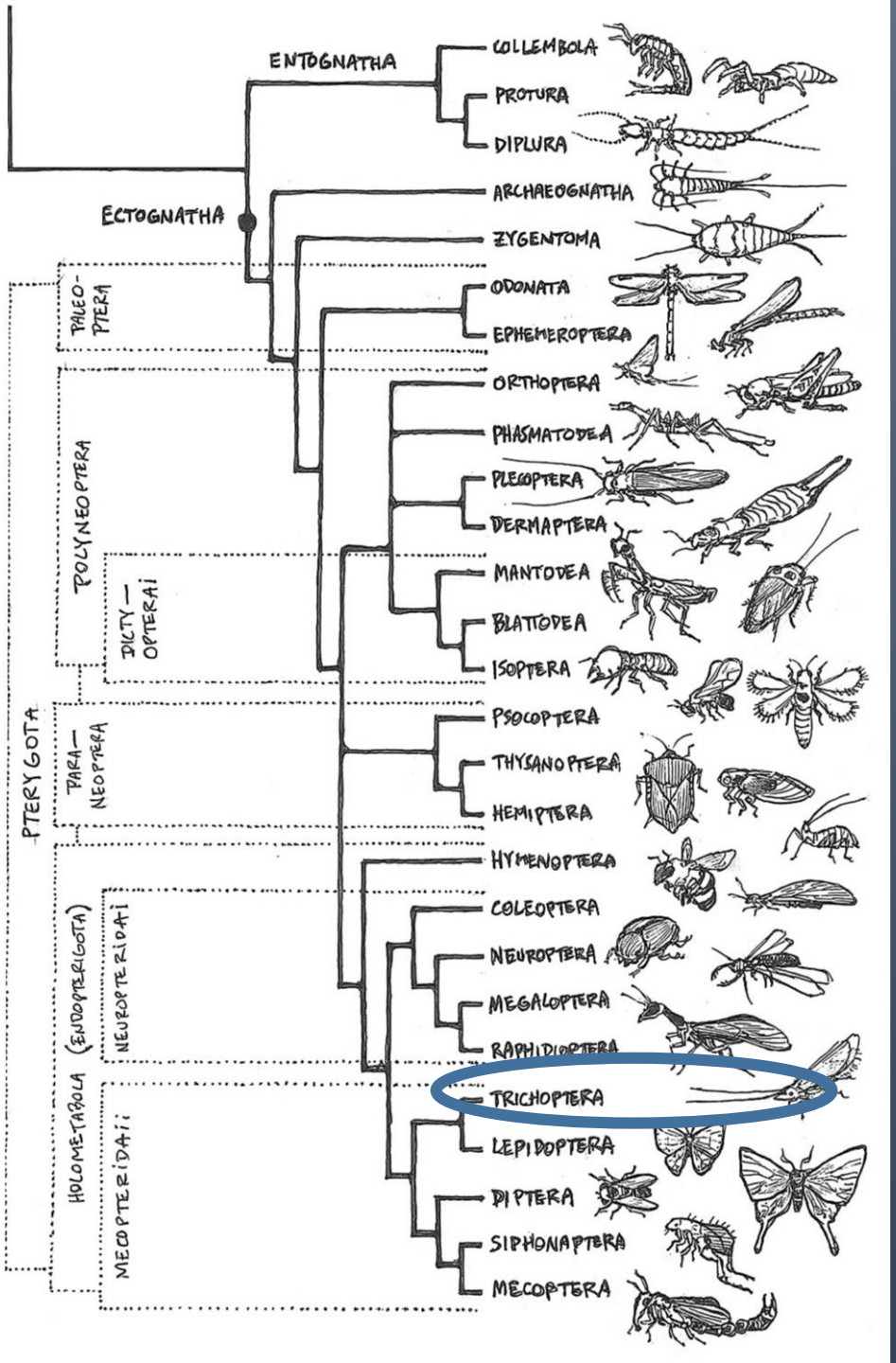

damselfly nymph
dragonfly nymph
stonefly nymph
mayfly nymph



Caddisflies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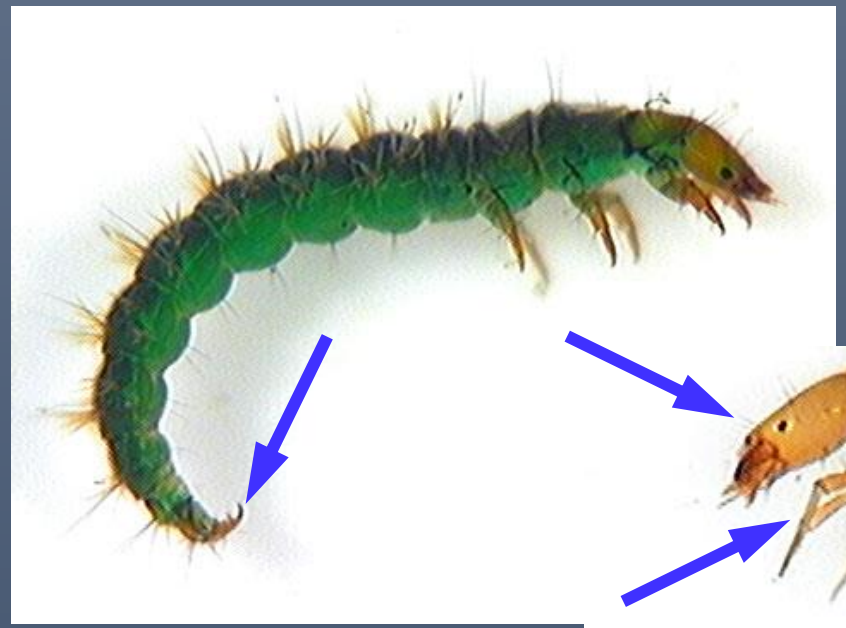
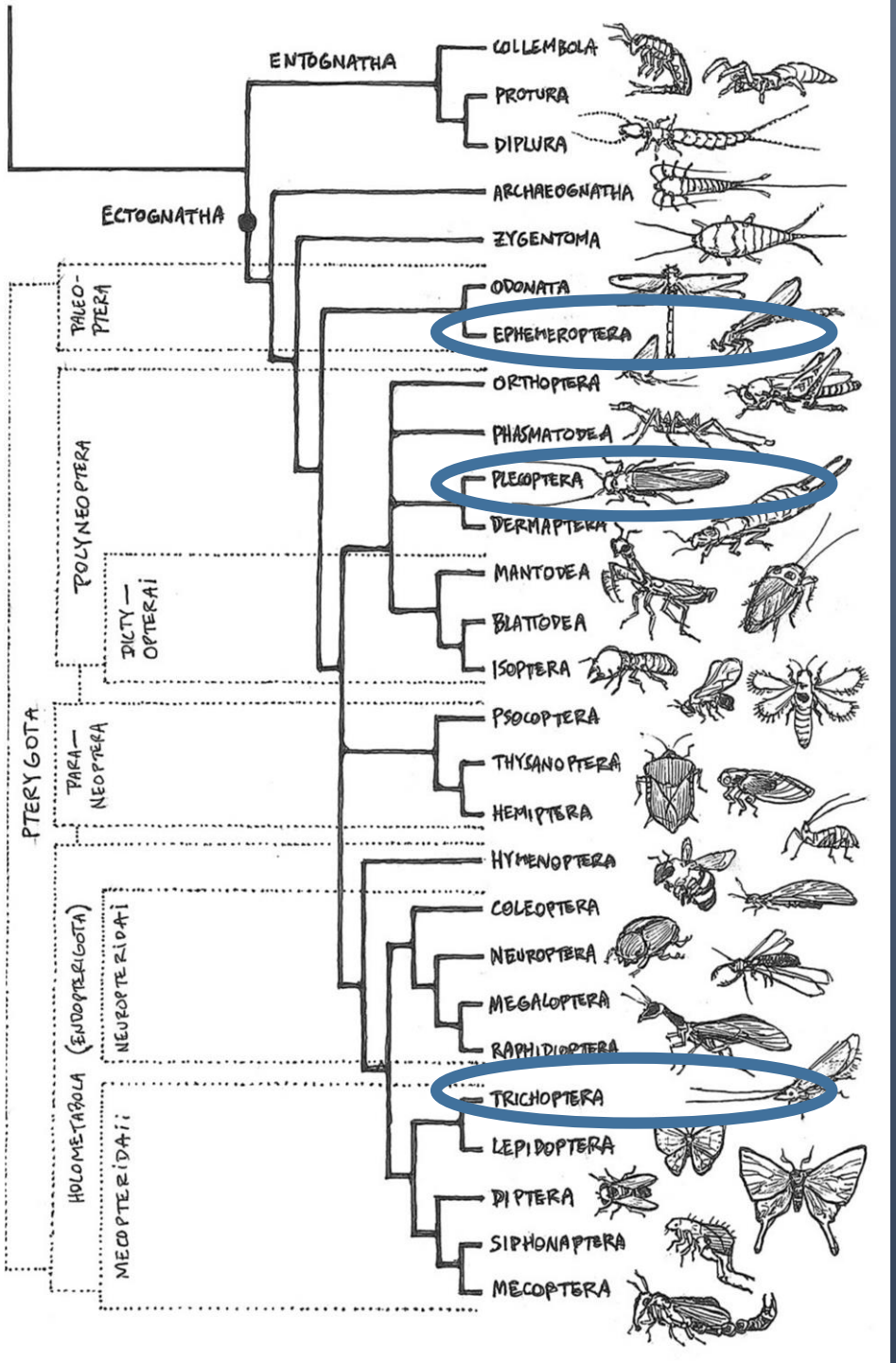




EPT Index

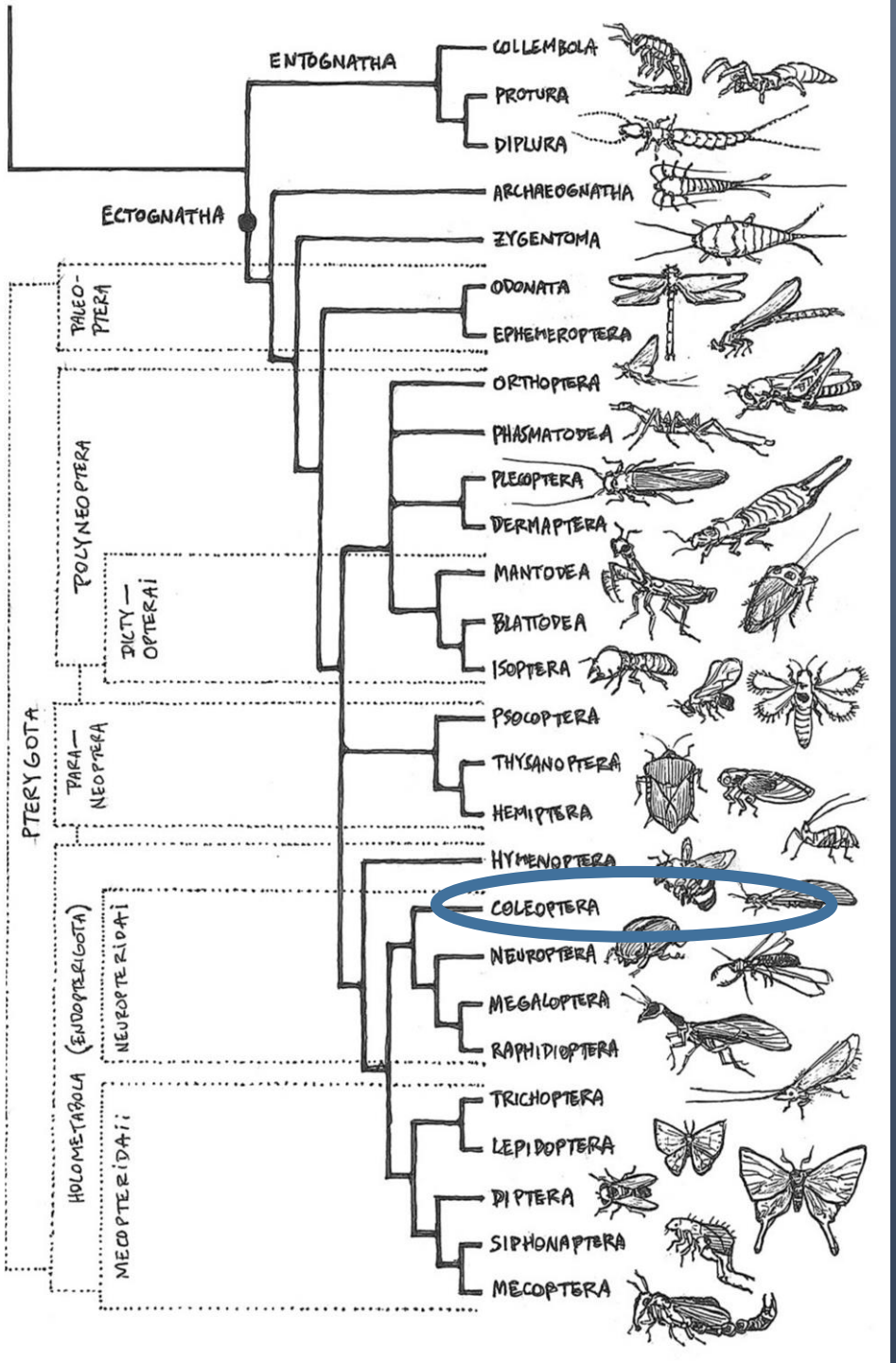
J. N. Am. Benthol. Soc., 1988, 7(3):222-233

Water quality assessment of streams using a qualitative collection method for benthic macroinvertebrates

DAVID R. LENAT

Biological Monitoring Group, North Carolina Division of Environmental Management, Archdale Bldg., P.O. Box 27687, Raleigh, North Carolina 27611 USA

# species	Rating
>27	Excellent
21-27	Good
14-20	Good-fair
7-13	Fair
0-6	Poor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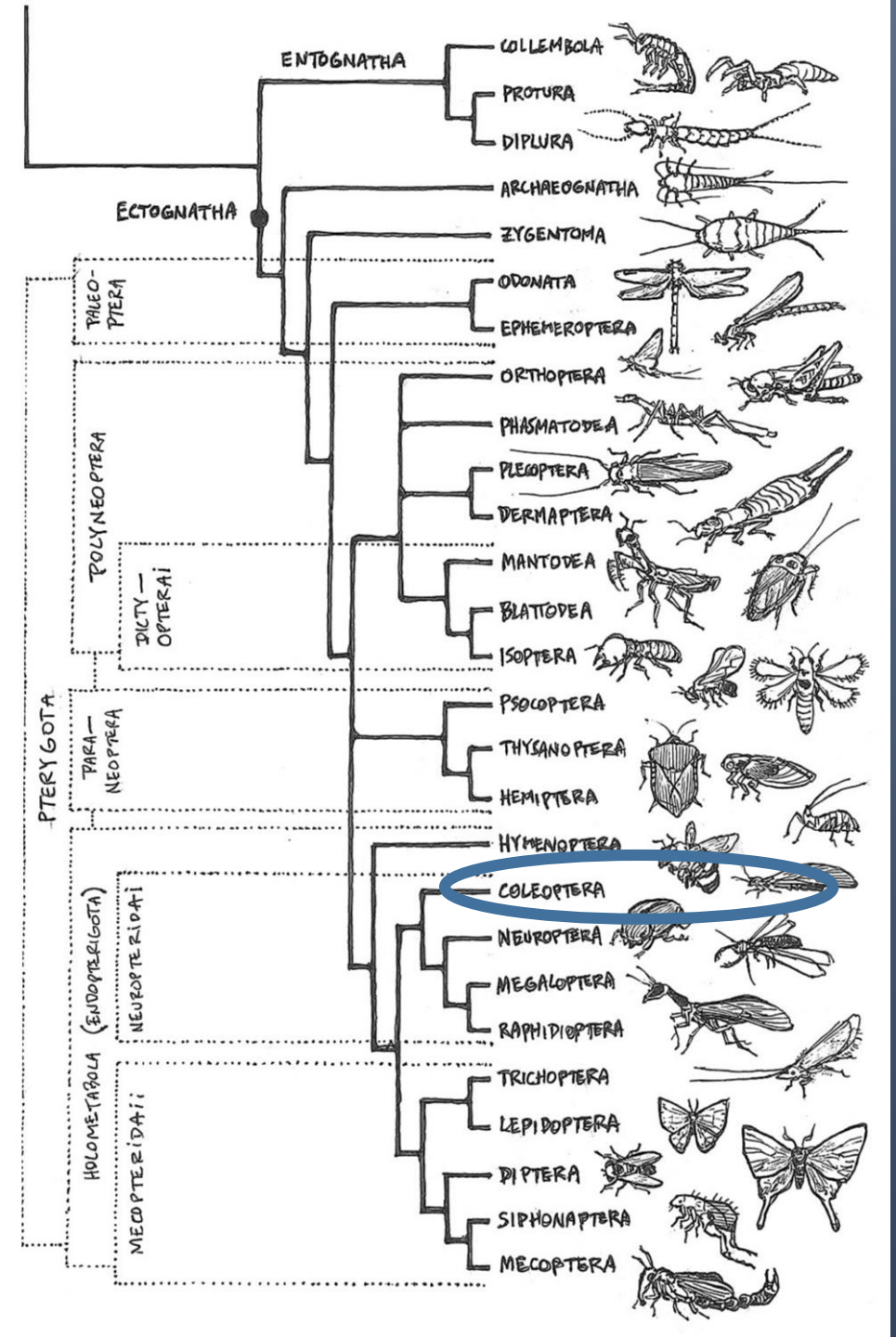
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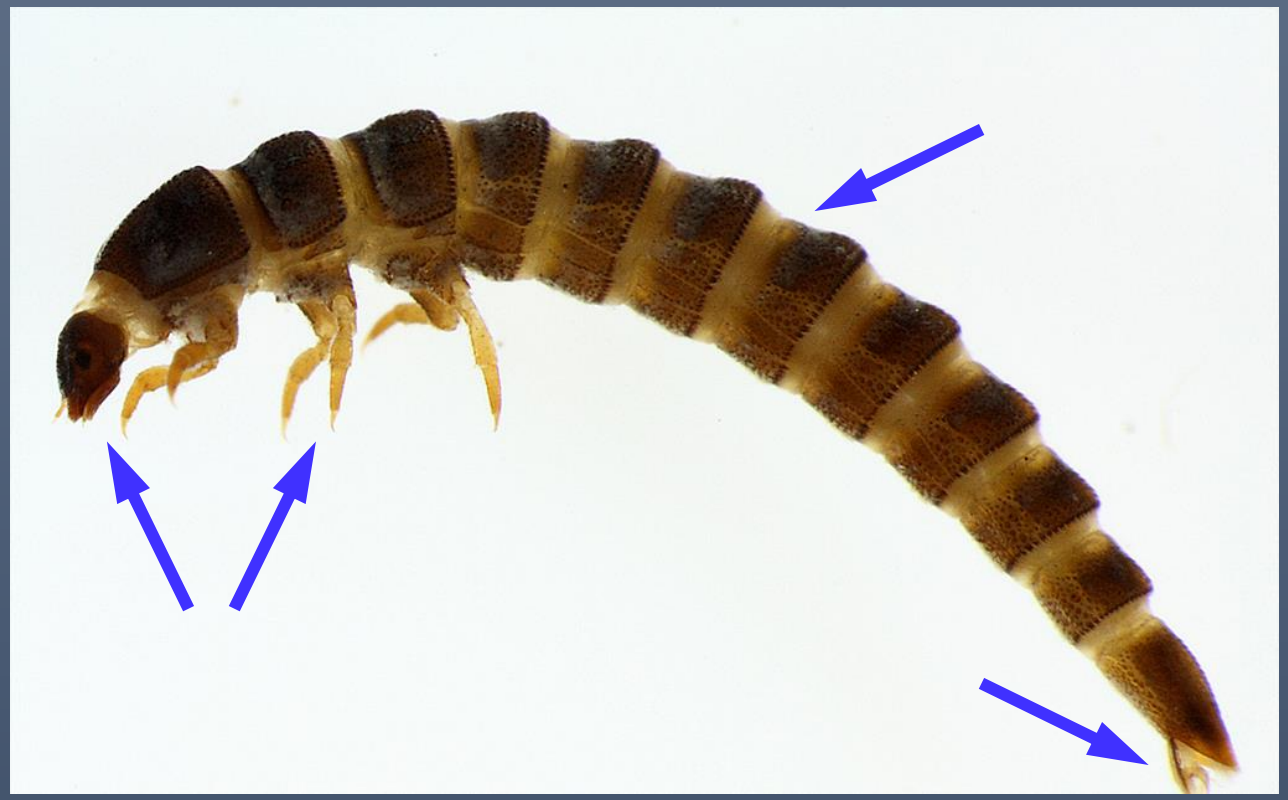

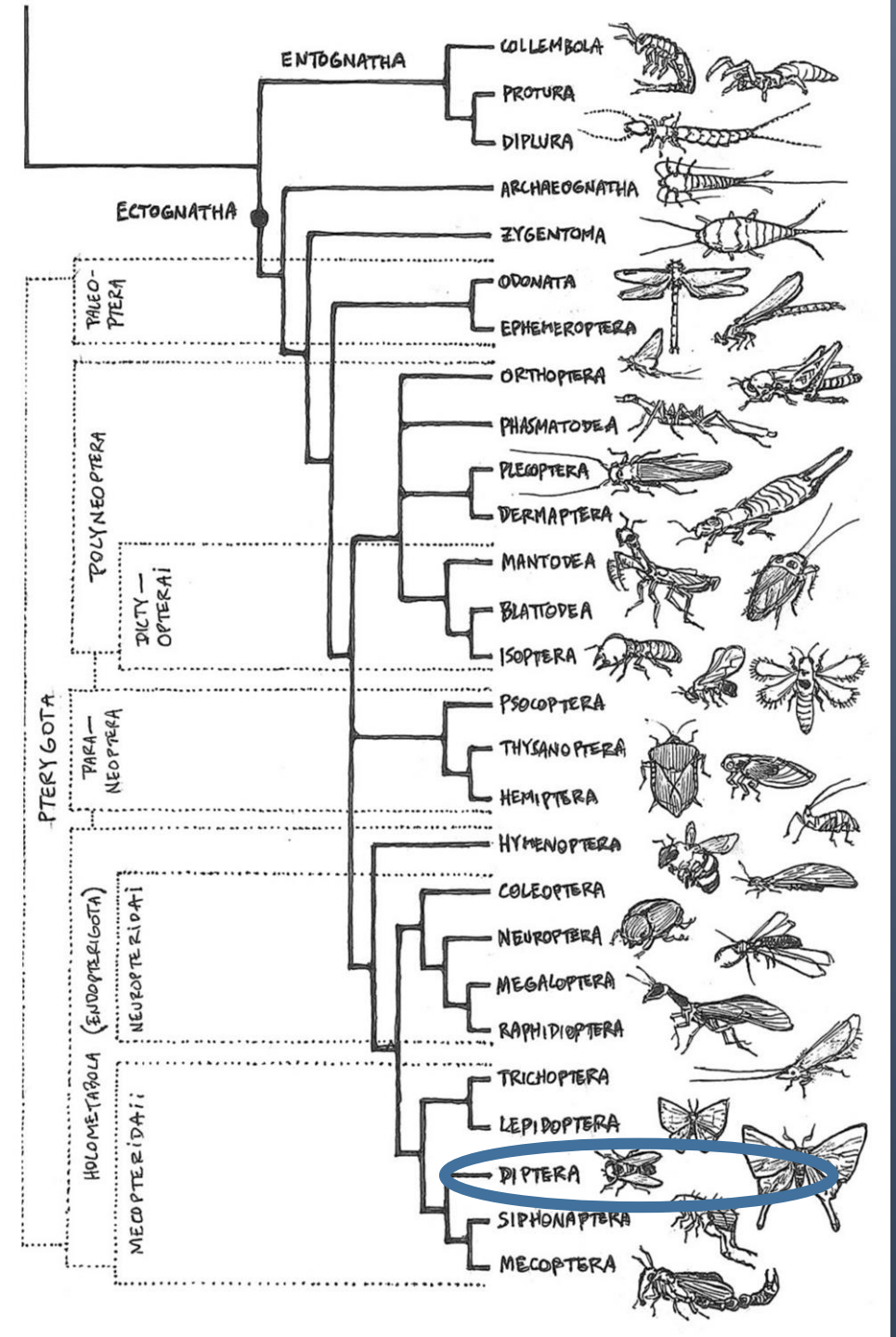
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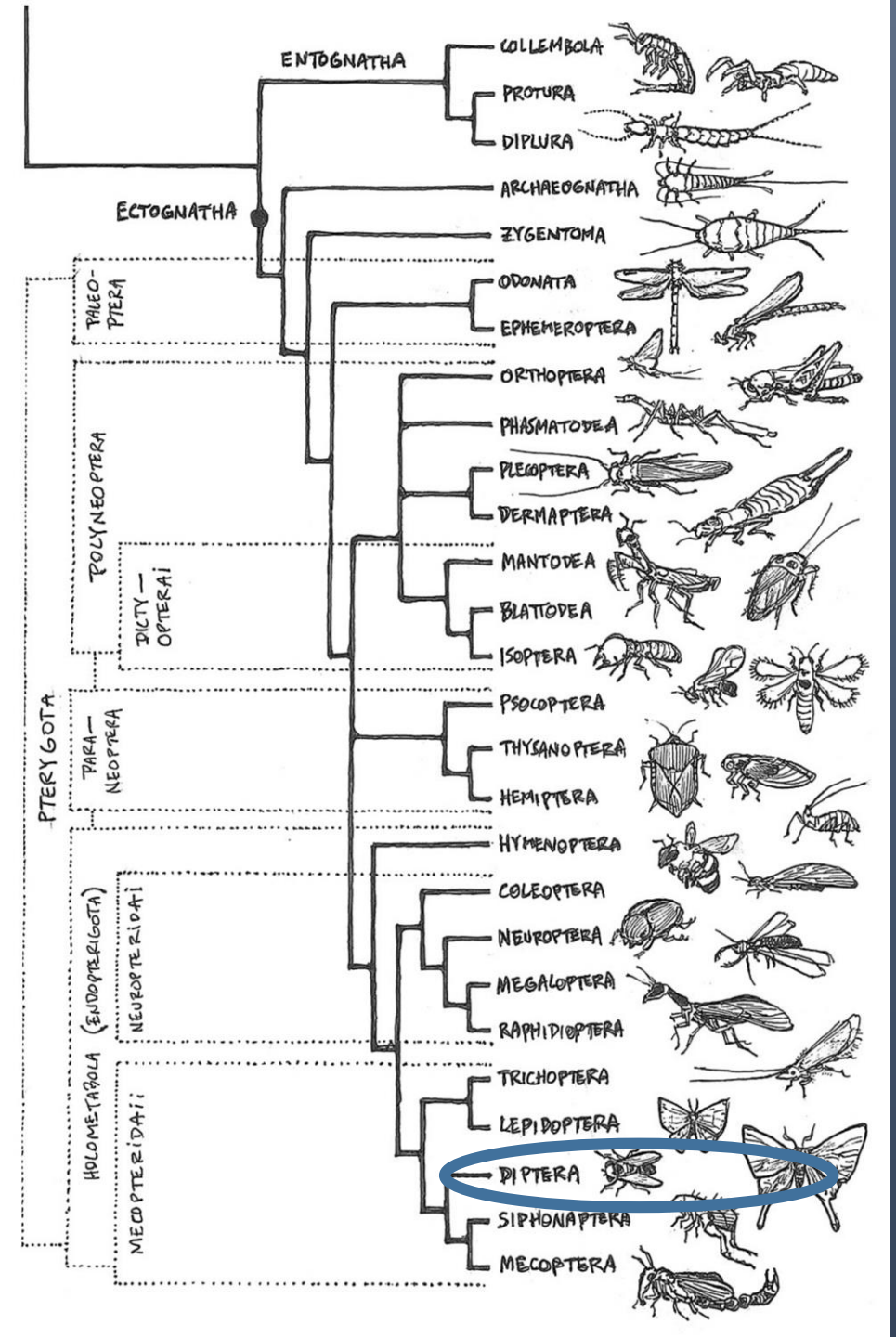
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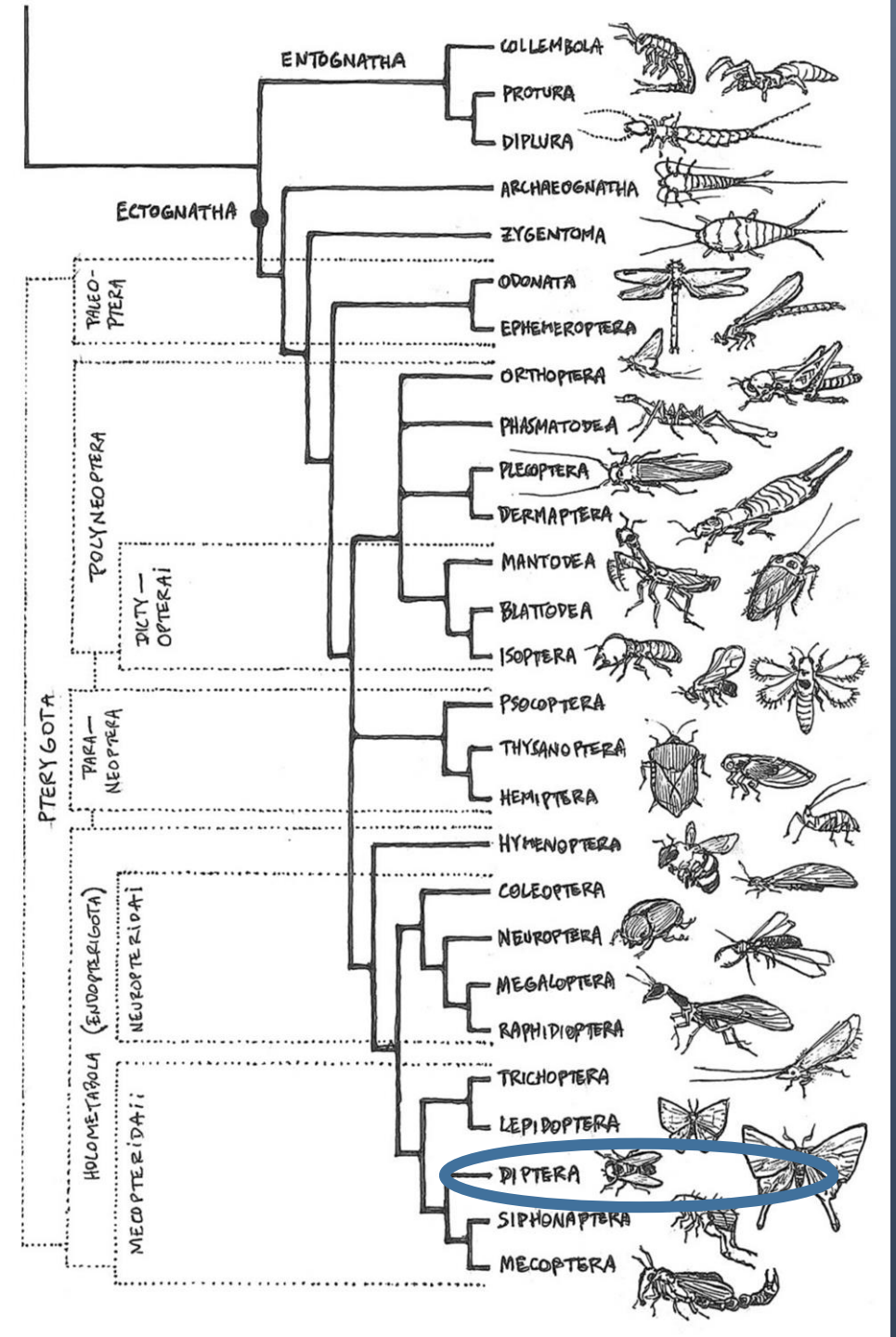
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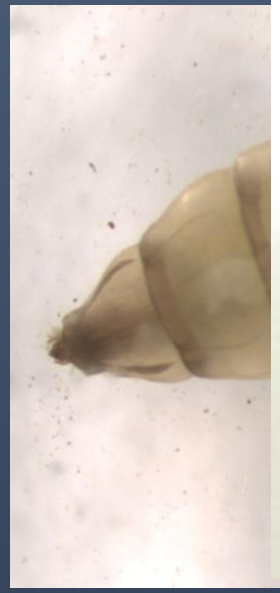

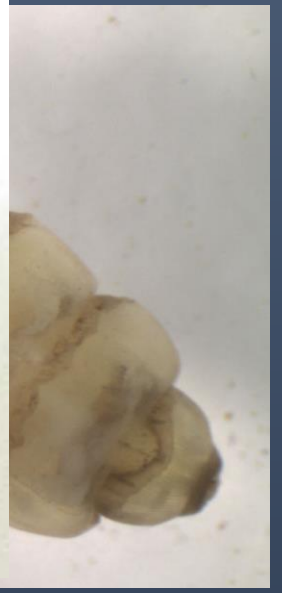

Other stream invertebrates

Crustaceans

Amphipods

Decapods

Other stream invertebrates

Molluscs

Gastropods

Bivalves