Biological Stream Ecology

Major difference between lakes and streams (continued)

4) Primary producers

How and why is the plankton community different than it is in lakes?
Where along a stream-river continuum might plankton be more abundant?

How and why is the macrophyte community different than it is in wetlands?
Where along a stream-river continuum might macrophytes be more abundant?

Where then does the energy to support animal life (secondary producers) come from?

1. **Benthic attached algae** (**periphyton** refers more generally to a matrix of algae and heterotrophic microbes attached to submerged substrata)

Largely diatoms, with some filamentous greens and blue greens. Stream algae have greater access to nutrients. *How?*

Distribution of alga taxa within a stream site is a function of current velocity, depth, light, grazing pressure, seasonal temperature, substrate type... *In what types of streams (based on location) might benthic algae comprise a greater proportion of the primary producers?*

(Marl can form covering algal surfaces as benthic algae removes CO_2 causing deposition of $CaCO_3$ in waters derived from limestone sources.)

Periphyton can be use as indicator organisms in the bioassessment of streams

2. **Allochthonous matter** - leaves and twigs must first be colonized by bacteria and fungi before most of this energy and matter is available for other stream organisms. *How might the contribution of allochthonous matter vs. benthic algae be expected to vary seasonally in temperate, woodland streams?*

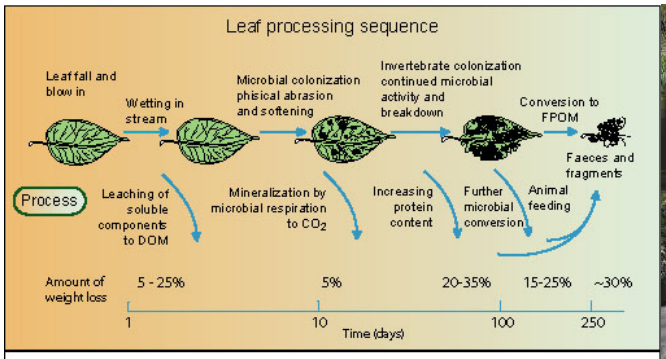
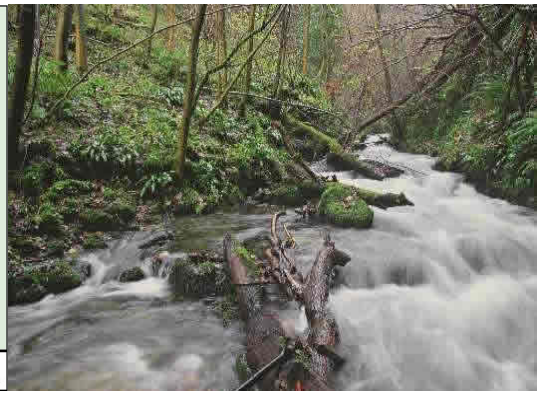


Figure: The processing or 'conditioning' sequence for a deciduous tree leaf in a temperate stream.



This is the major source of energy in many stream systems. *In such a system, how would the ratio of total community primary* ***production to respiration*** *(p/r) differ from that of lakes?* i.e. **autotrophy versus heterotrophy**

So where is the primary production that supplies this energy to the stream ecosystem occurring?

Organic matter not tied up in multicellular organisms (i.e detritus and microbes) can be partitioned into:

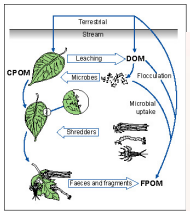
- **course particulate organic matter** (CPOM > 1mm)
- **fine particulate organic matter** (0.5um < FPOM < 1mm)
- **dissolved organic matter** (DOM < 0.5um)

5) Consumers

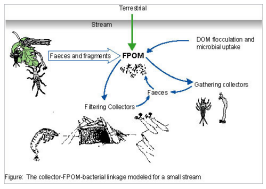
The next trophic level is dominated by **benthic insects** though other invertebrates and some fish also comprise this trophic level.
(Stream fish tend to be carnivores but some groups graze periphyton or collect and scavenge debris along the bottom.)
(Stream "macroinvertebrates" are used as indicators to bioassess environmental perturbation.)

Benthic invertebrates can be categorized into different **functional groups** depending upon what they feed on:

Shredders consume leaves CPOM->FPOM (scraps and feces) (decomposers along with mechanical breakdown are also responsible for this conversion)



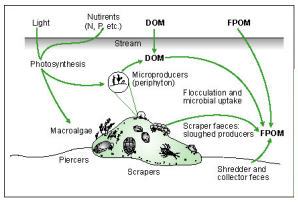

Collectors consume FPOM



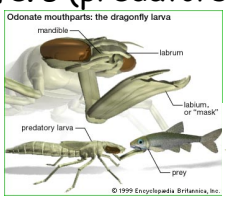
Collector filterers remove particles in suspension

Collector gatherers remove deposited particles - (often with brush-like appendages)

Scrapers consume attached benthic algae. Often flatten since algae on exposed surfaces



Engulfers (predators) consume other animals by engulfing



Piercers suck up fluids within living tissue (many carnivores, some scavengers and herbivores)

So in a heterotrophic, wooded stream, what is the dominant pathway for energy between primary producer and animal consumers?

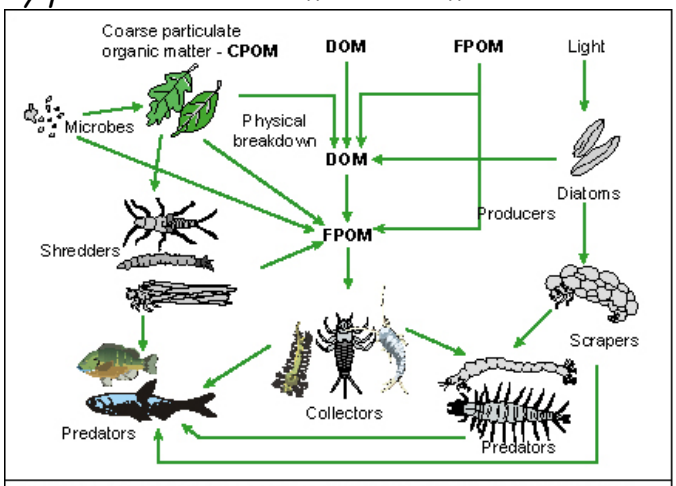
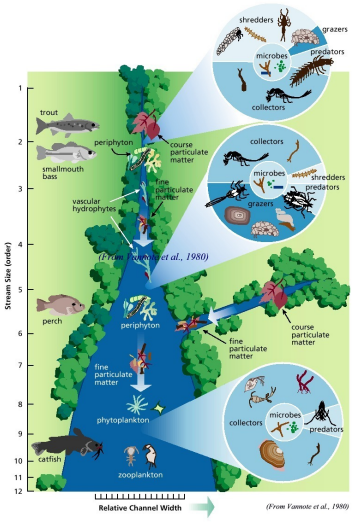


Figure: A simplified view of a food web in a woodland stream. Energy inputs include fallen leaves, subsequently colonized by microbes; small autotrophs, primarily diatoms; and DOM and FPOM, originating from external sources and upstream.

So, how might particle size of organic matter and functional feeding groups change along the length of a stream from headwater to mainstem?

Because flow in streams is unidirectional, the **River Continuum Concept** predicts the relative change in functional groups along from upstream to downstream.



What impact might human activity and seasonality have on this pattern?

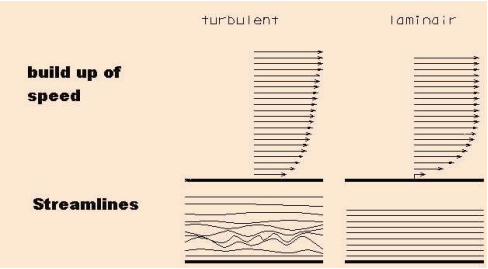
- **Serial Discontinuity Concept**

How would a dam affect longitudinal trends decribed by the River Continuum Concept?

- **The Flood Pulse Concept**

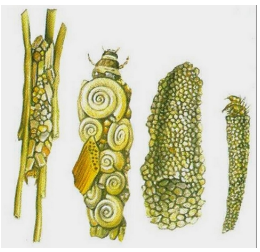
Adaptation for high flow:

- Flattening - to move as much of the body in to the **boundary layer** as possible. The boundary layer reduced by increased velocity. *Is this strategy an option for most fish?*



- Streamlining - fusiform shape is a compromise between reducing drag and turbulence. Other shapes and reduced size also reduces these forces

- Devices for attachment - friction pads, suckers, sticky secretions, ballast, hooks, bristles.

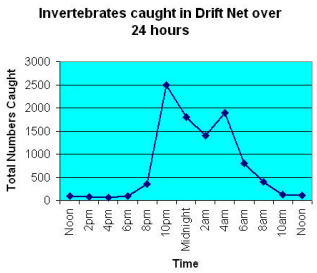


- Behaviorial - dead zones downstream of obstructions to flow, and movement down into the substrate.

Because flow is unidirectional and often strong in streams, maintaining position is not always successful.

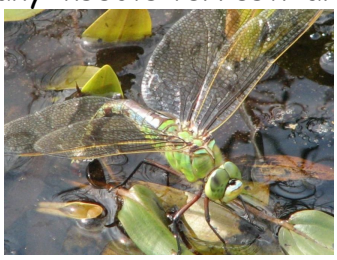
Drift is the downstream movement of detritus, bacteria, algae, and invertebrates downstream.

Invertebrate Drift has a 24h component occurring largely at night. *Why at night? Why drift?*



Drift could also be explained as recolonization, but displacement is always downstream. *How can a population maintain position over generations in face of drift?*

1. Many insects terrestrial and capable of flight.



2. Net movement of other inverts upstream (flatworms, crustaceans, gastropods, insects)

So, in general, what attributes cause stream ecosystems to be so different than lake ecosystems?