Stream communities 1

Limnology

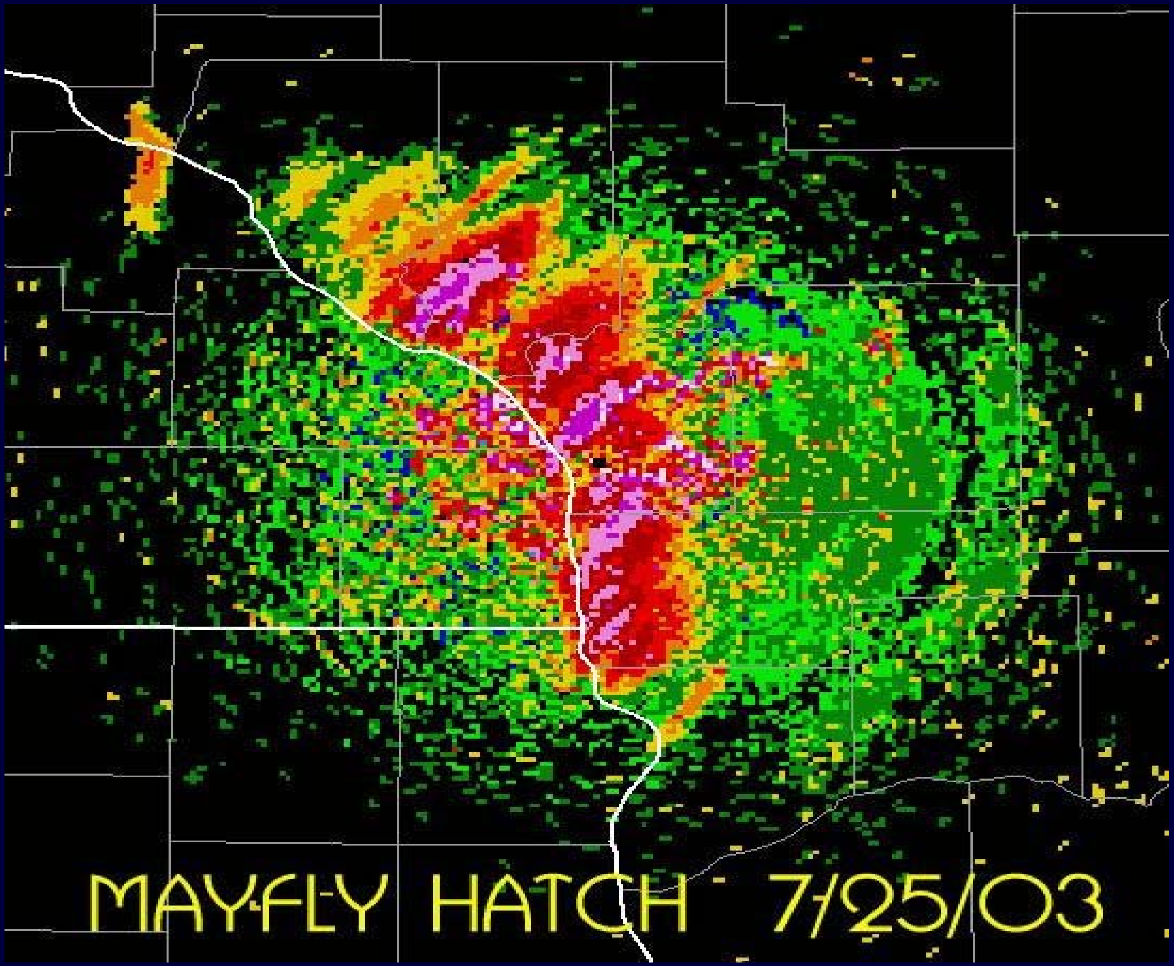
Lecture 21

Boonville, MO

64 million stream invertebrates

200 kg

Berner, L.M. 1951. Limnology of the Lower Missouri River. *Ecology* 32:1-12



50 miles

Drift

Downstream transport of benthic organisms by current

Reasons for drift

1. Constant
   Accidental, mostly in active swimmers

2. Catastrophic
   Flooding

3. Behavioral
   Diel feeding movement s (like what process in lakes?)
   Avoid competition

Drift Periodicity

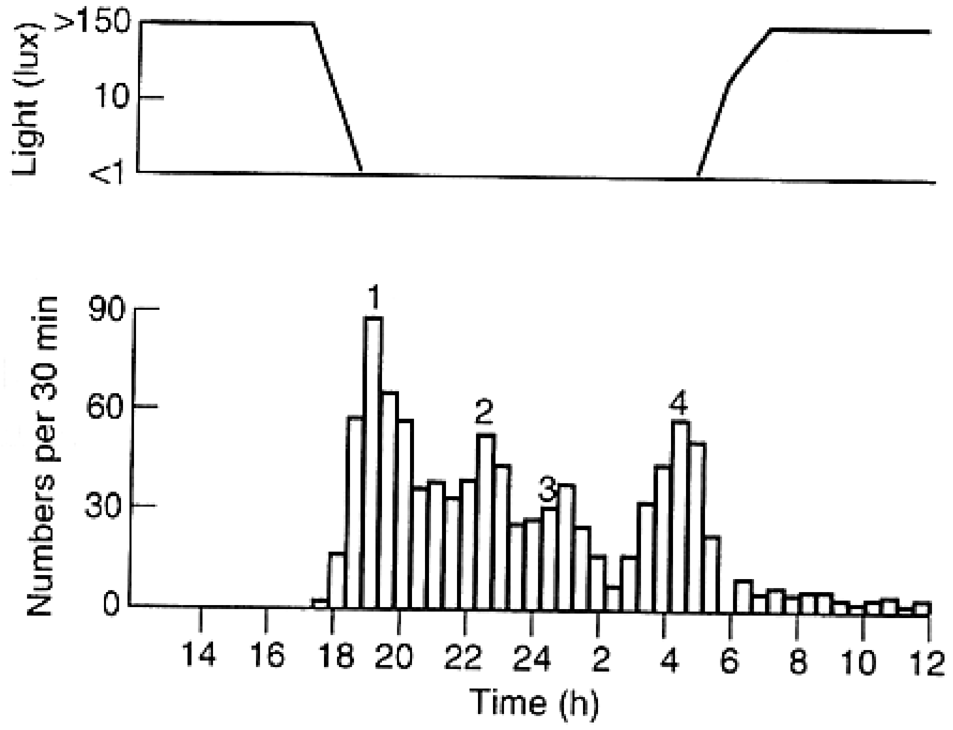


FIGURE 10.1 Diel variation in drift catches of *Baetis rhodani* at 30 min intervals over a 24 h period. Four apparent peaks are indicated (1–4). (From Elliott, 1969.)

Baetis rhodani

Diel movement to avoid predators

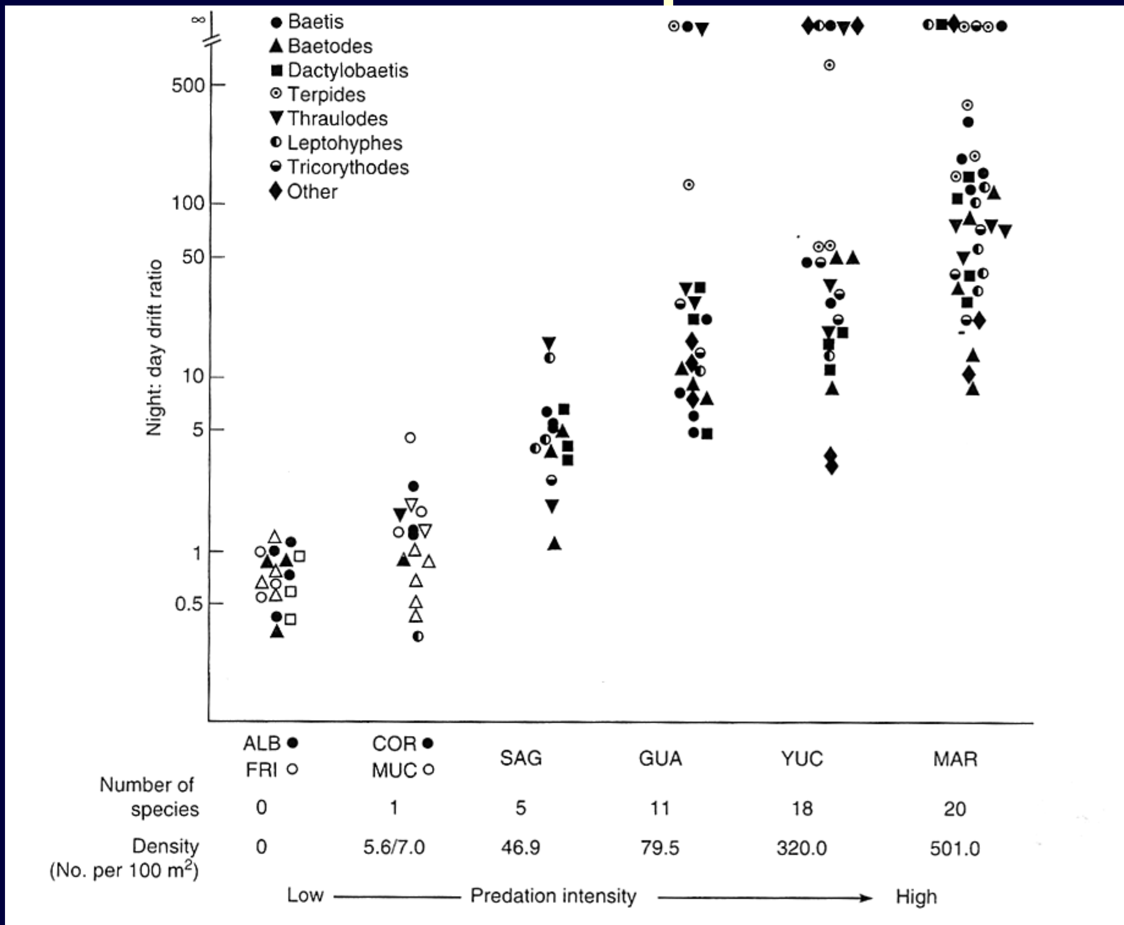


FIGURE 10.6 Night:day drift ratio of mayfly drift densities from a series of streams in the Venezuelan Andes representing a gradient from low to high predation. Note that drift is greater by day in high elevation streams lacking drift-feeding fish (Rio Albarregas [ALB] and Quebrada La Fria [FRI]) compared with nearby streams containing introduced trout (Qda. Coromoto [COR] and Qda. Mucunutan [MUC]). Other rivers are Rio Saguas [SAG], Rio Guache [GUA], Rio La Yuca [YUC] and Rio Las Marias [MAR]. (From Flecker, 1992a.)

Baetis spp.

Drift to avoid competition

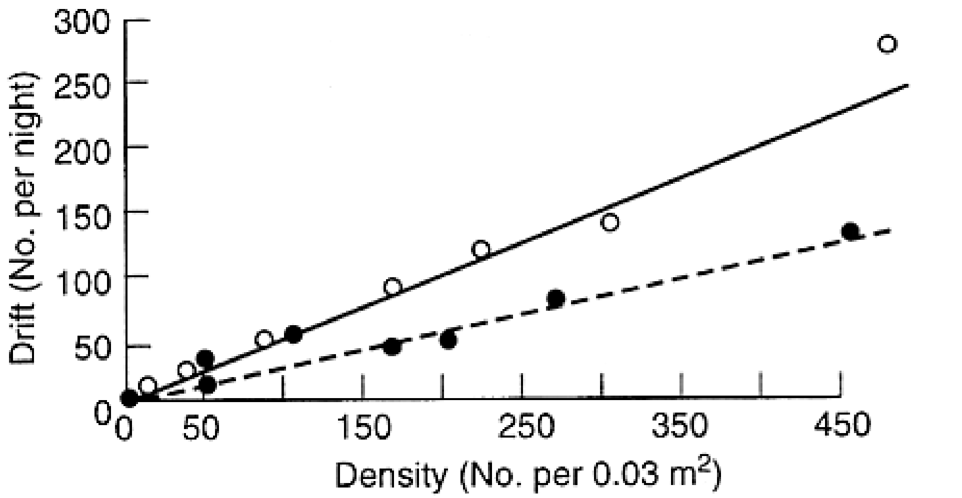
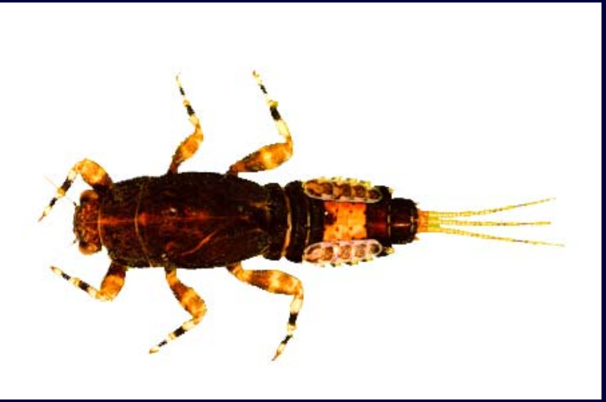


FIGURE 10.8 Relationship between benthic density and numbers in night drift for the mayfly *Ephemerella needhami* in artificial stream channels containing stones with low (○, ——) *versus* high (●, ----) periphyton densities. (From Hildebrand, 1974.)



Ephemerella spp.

In what net direction should stream insects move?

Compensating adult movement

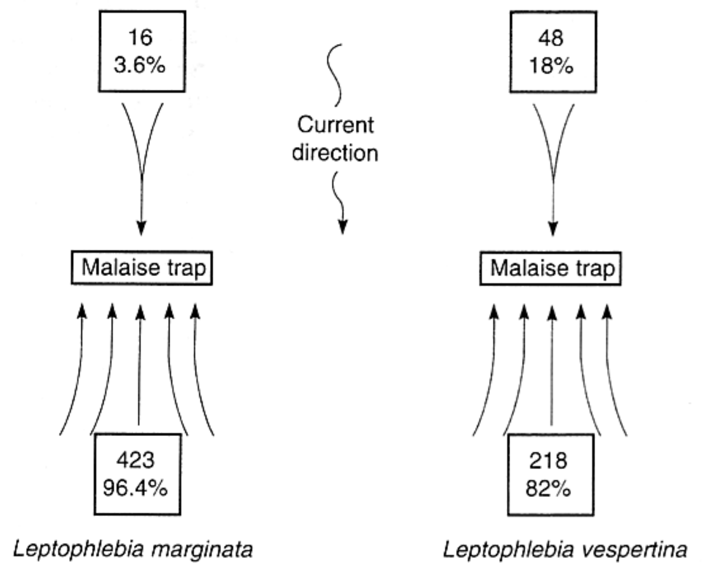


FIGURE 10.4 Flight directionality of two mayflies in the Gysinge rapids of the River Dalälven, showing predominantly upstream flight. (From Müller, 1982.)

Ephemeroptera

colonization cycle
- drift by larvae
- upstream movement by adults

Should adult invertebrates diffuse randomly or direct their movement along the stream?

Directed movement

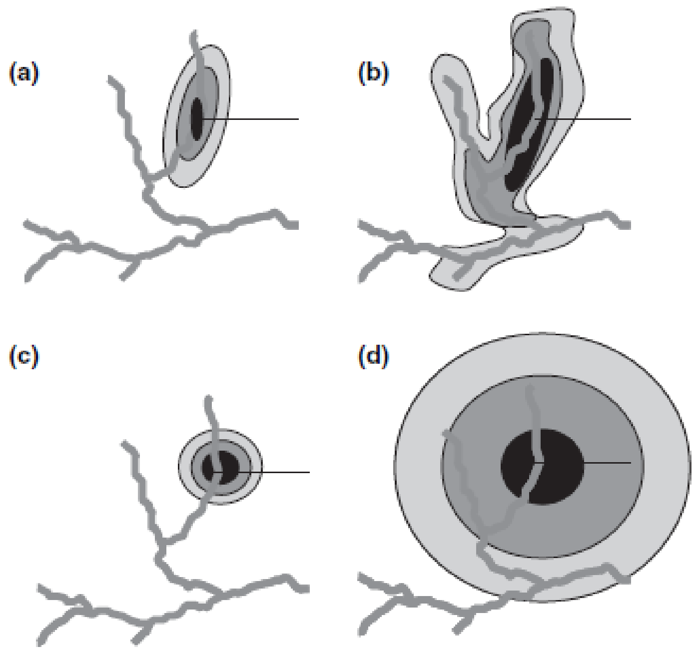


Fig. 1 Conceptual models as alternative hypotheses of population boundaries for stream insects with flying adults. The concentric shapes represent different probabilities that individuals emerging from a site (horizontal lines) will disperse within those areas. Darker shades indicate higher probability of dispersal (black = high, dark grey = medium and light grey = low numbers of individuals). Distributions may vary with the dispersal behaviour of adults: (a) flight distance is minimal and restricted to stream corridors; (b) flight distance is extensive and primarily along streams; (c) flight distance is minimal and random; or (d) flight distance is extensive and random, without regard to stream network.

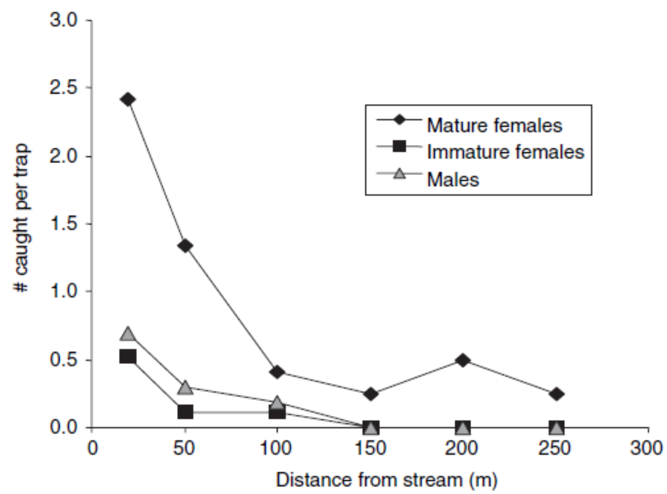
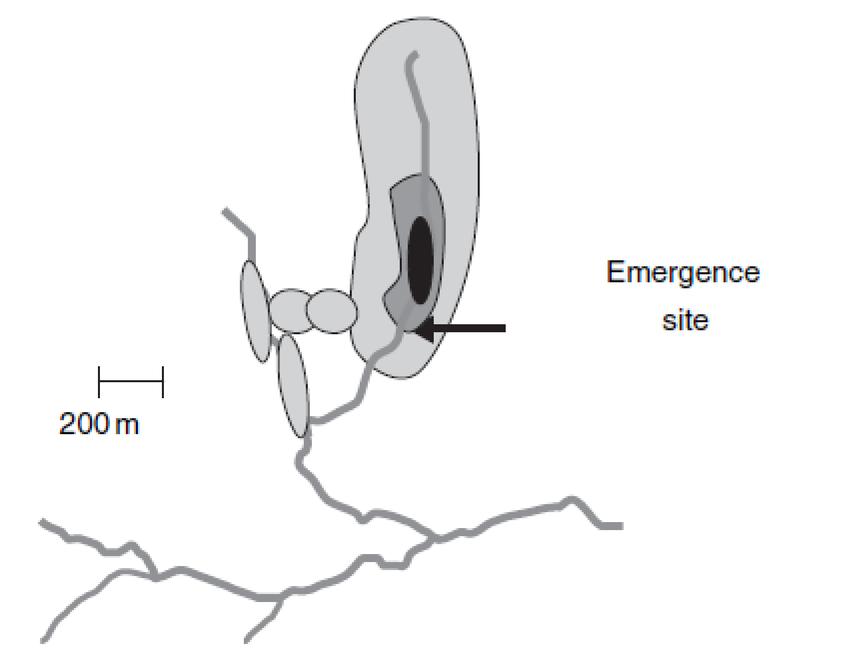


Fig. 6 Number of individuals caught per trap along transects perpendicular to the ^{15}N-labelled section of Bear Brook in 1998. Individuals caught between 20 and 100 m from Bear were taken on transects east and west of Bear Brook; individuals caught over 100 m away were captured only west of Bear Brook.



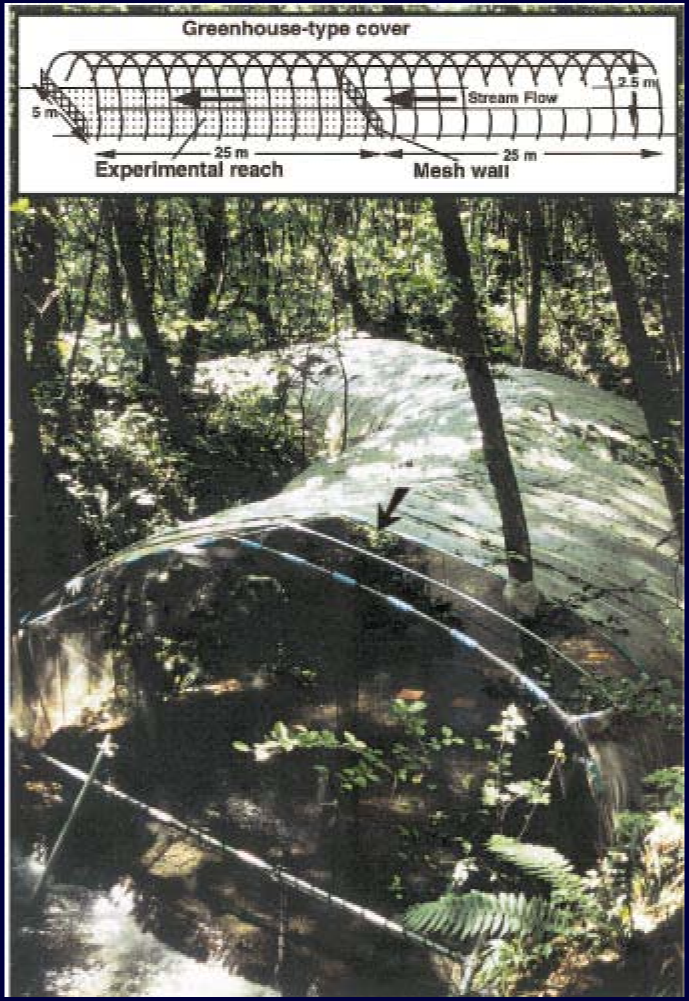
Energy fluxes between stream and forest

E.g., Experimental manipulations of headwater streams (Nakano et al. 1999)

25-50% prey energy comes from riparian forest/stream

Eliminate terrestrial prey, fish eat algae-eaters → higher algae

Eliminate aquatic insect emergence → reduce riparian spiders



Really allochthonous CPOM

Energy/nutrient subsidies
marine to headwaters

Streamside vegetation ~
25-70 % marine nutrients

50% of some bear populations

CA wines

Lotic Food Webs

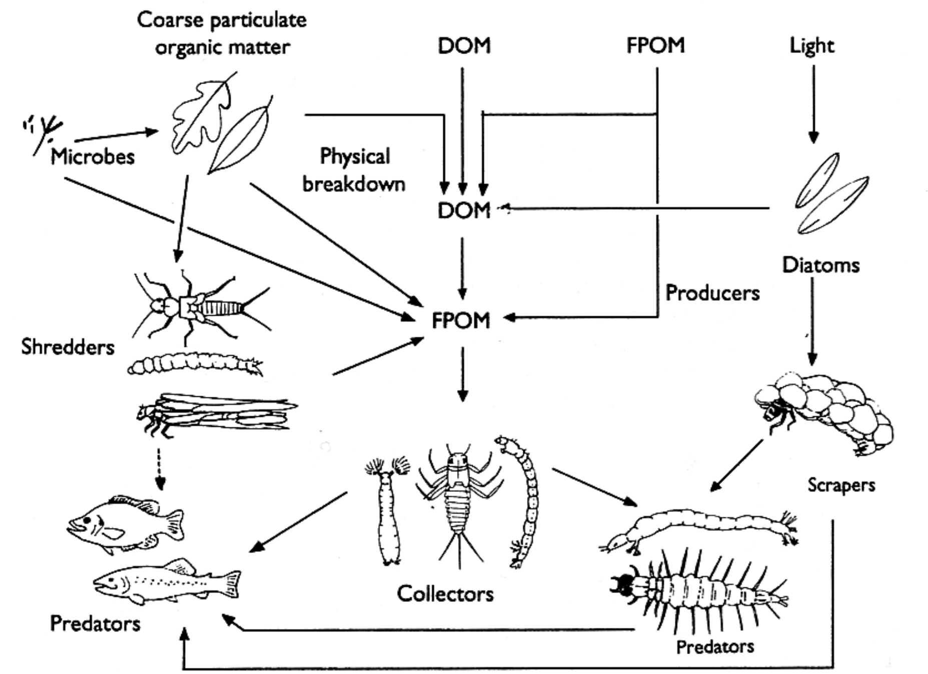
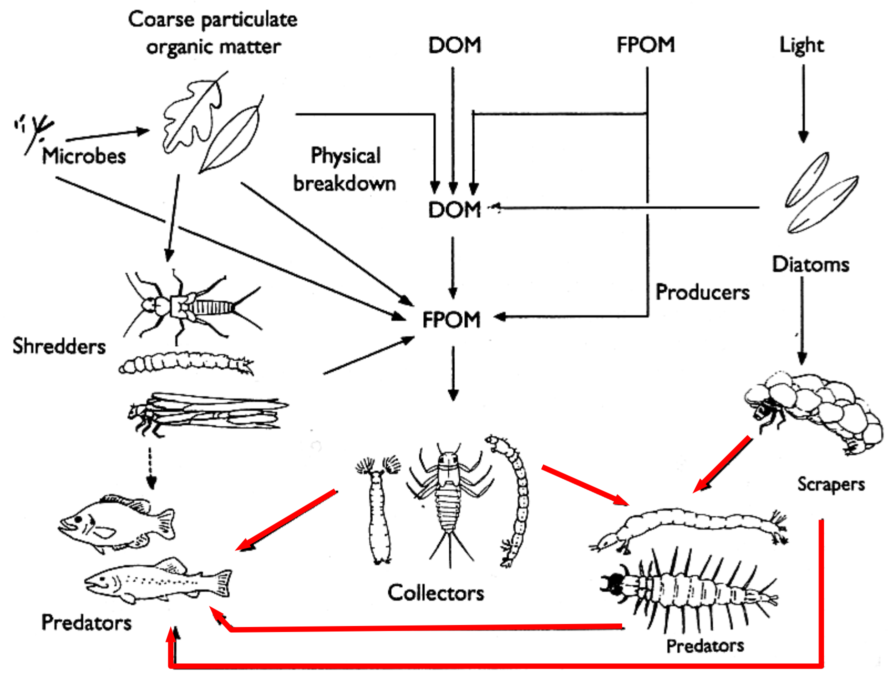


FIGURE 6.14 Lotic food webs. (a) A simplified view of a food web in a woodland stream. Energy inputs include fallen leaves, subsequently colonized by microbes; small autotrophs, primarily diatoms; and DOM and FPOM, originating from external sources and upstream. Feeding categories are based on divisions of Table 6.1: shredders include *Pteronarcys*, *Tipula* and *Pycnopsyche*; *Stenonema* is a deposit feeder, *Simulium* is a filter feeder and *Glossosoma* is a grazer. Examples of predators include *Nigronia* (Megaloptera) and two fish (*Cottus* and *Salmo*). (Modified from Cummins, 1973.) (b) Food web for a species-poor small stream in southern England. Primary consumers include: (e) *Psidium* sp., (f) Simuliidae, (g) *Niphargus aquilex*, (h) microcrustacea, (i) other microinvertebrates, (j) *Heterotrissocladius marcidus*, (k) *Micropsectra bidentata*, (l) *Prodiamesa olivacea*, (m) Oligochaeta, (n) *Leuctra nigra*, (o) *Nemurella picteti*, (p) *Brilla modesta*, (q) *Polypedilum albicornis*, (r) Tipulidae, (s) *Potamophylax cingulatus*. Predators include: (t) *Macropelopia goetghebueri*; (u) *Trissopelopia longimana*, (v) *Zavrelimyia barbatipes*, (w) *Plectrocinemia conspersa*, (x) *Sialis fulginosa*. Note that the predator *Sialis* can be four energy transfers removed from the base of the food web. (Modified from Hildrew *et al.*, 1987.)

Predation



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Direct Effects of Predators on Prey Density

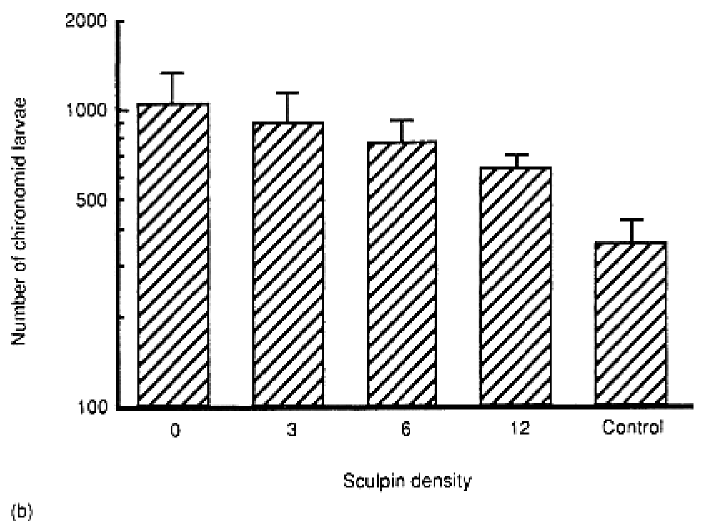
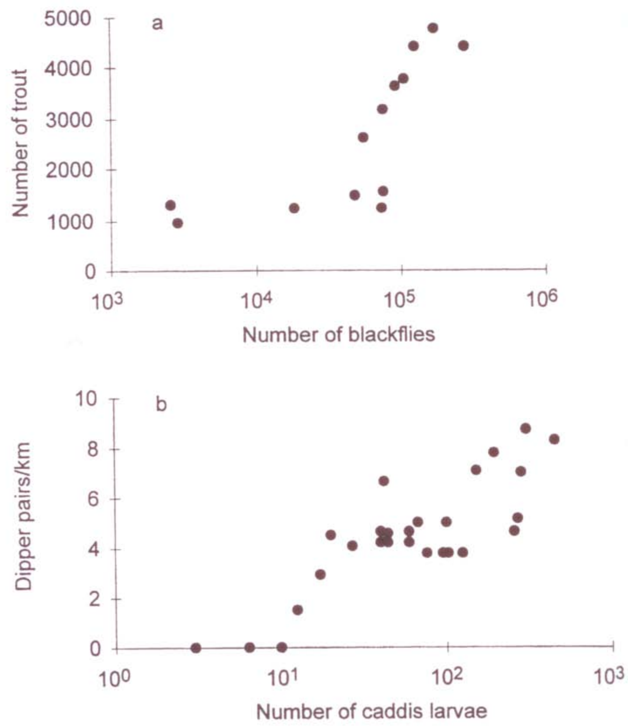


FIGURE 7.8 (a) The experimental design used by Flecker (1984) to investigate the effect of fish predation on the benthic invertebrates of a West Virginia stream.

Direct Effects on Predator Density

samples (redrawn from Ormerod *et al.*, 1985).



(1985) observed a fairly close relationship between the number of these larvae and the density of breeding pairs of birds (Fig. 7.4b); two to three times more pairs were observed with a 10-fold increase in prey densities. In most cases, predators do not compete so strongly for a single type of prey as found in these two studies and therefore correlations will often be weak or non-existent.

Predation: Effects of Prey Size

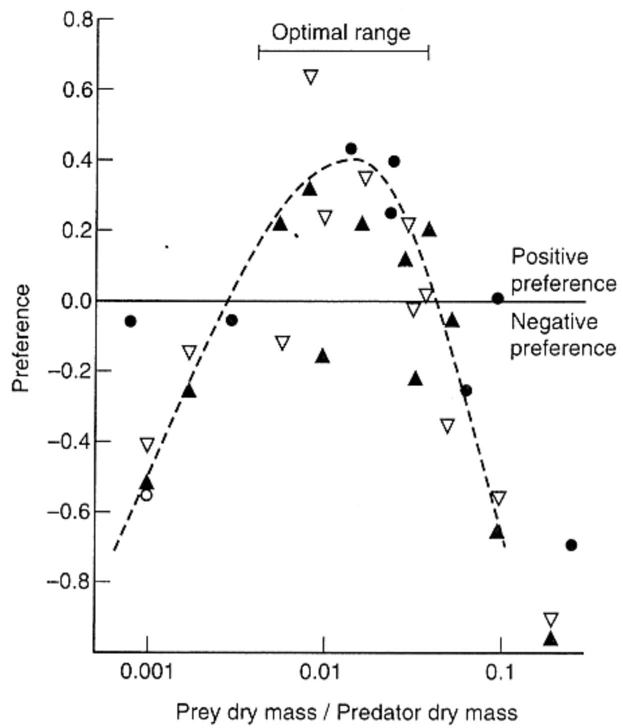
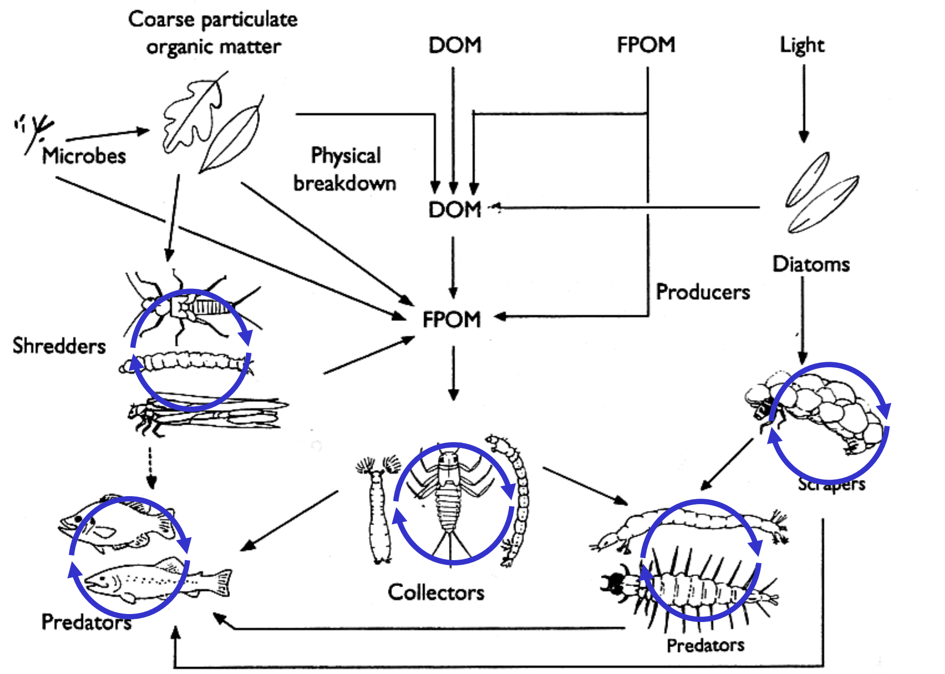


FIGURE 7.7 Prey preference as a function of relative prey size. Data are from experiments of Allan, Flecker and McClintock (1987a,b) where four size classes of prey were offered to stoneflies of a given size. ●, *H. pacifica* and *Prosimulium*; ▲, *H. pacifica* and *Baetis*; ▽, either *M. signata* or *K. modestus* and *Baetis*.

Baetis spp.

Hesperoperla pacifica

Competition



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Competition

Parasite kills off most Glossosoma caddisflies

Evidence for competitive release for other grazers

Kohler & Wiley 1997

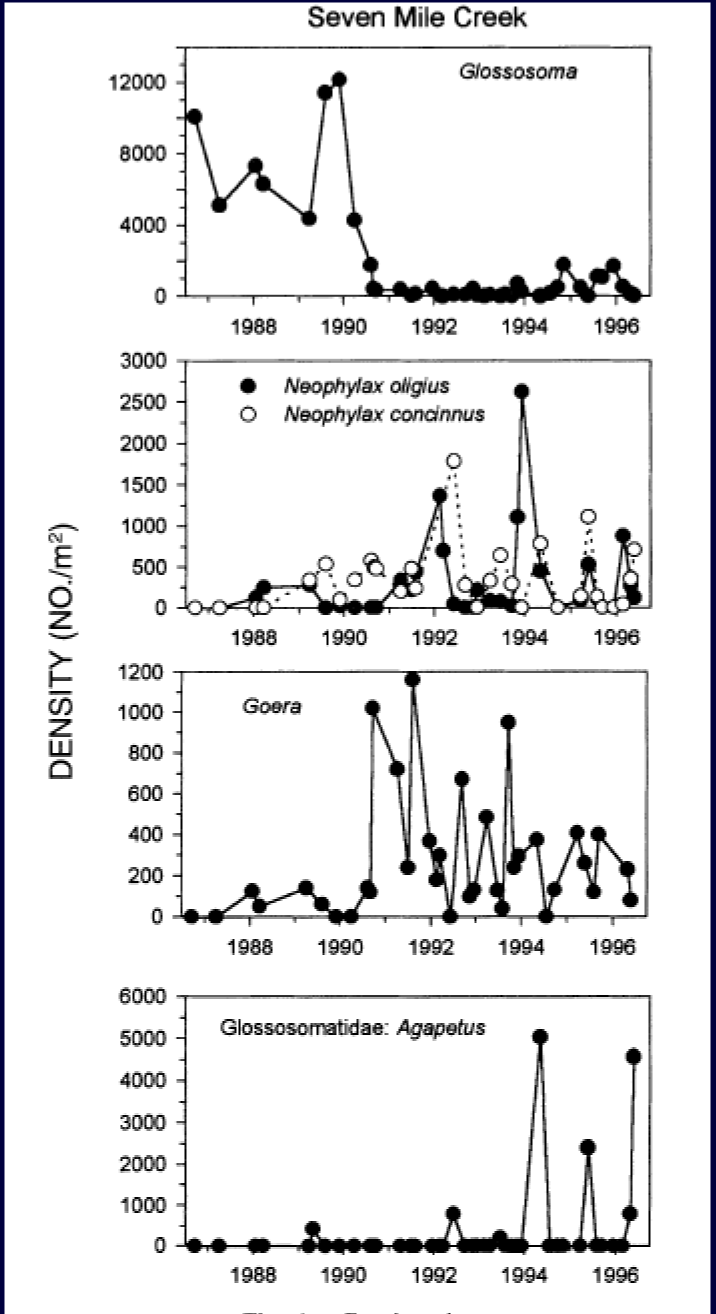

Fig. 4. Continued.

Effect on periphyton

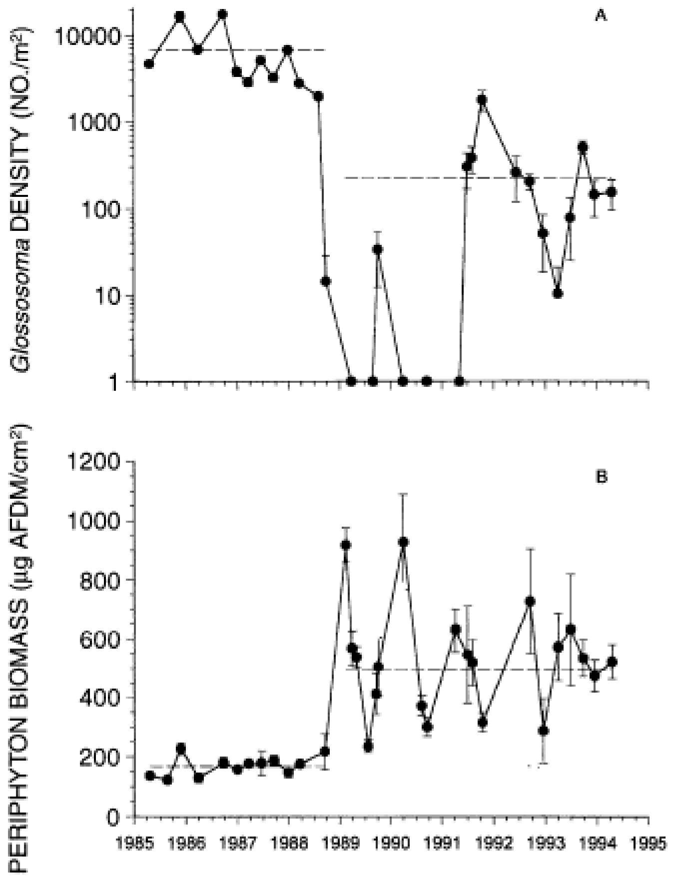

FIG. 1. *Glossosoma nigrior* (A) and periphyton biomass (B) in Spring Brook. Values are means ± 1 SE (N = 5–10). Horizontal dashed lines are the overall mean density or biomass for the periods before and after *Glossosoma*'s collapse in 1988.

Mutualism