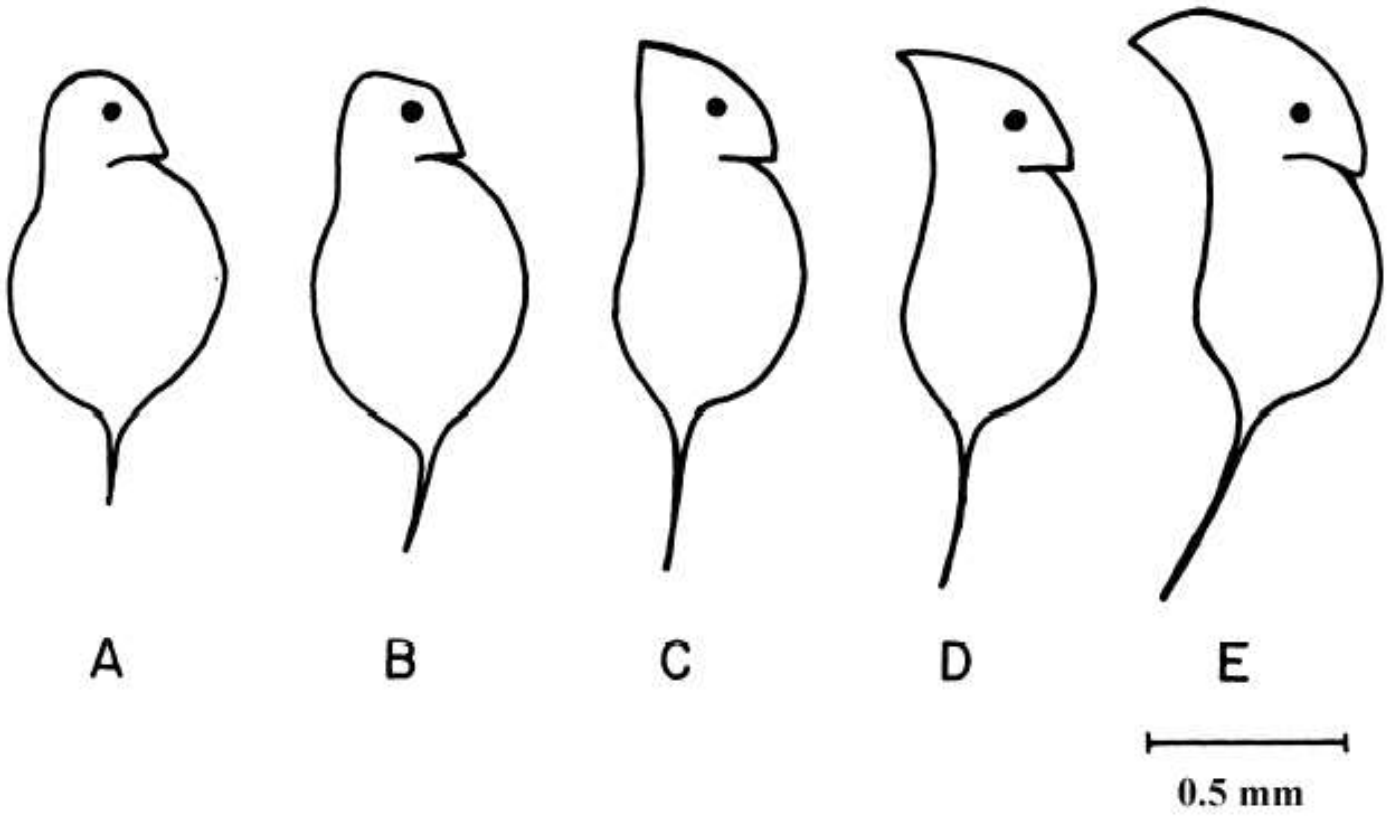
Structural Cyclomorphosis in Populations of Low-motility Zooplankton

A prediction of the individual magnitude and frequency within a population of cyclomorphic response to different predation styles.

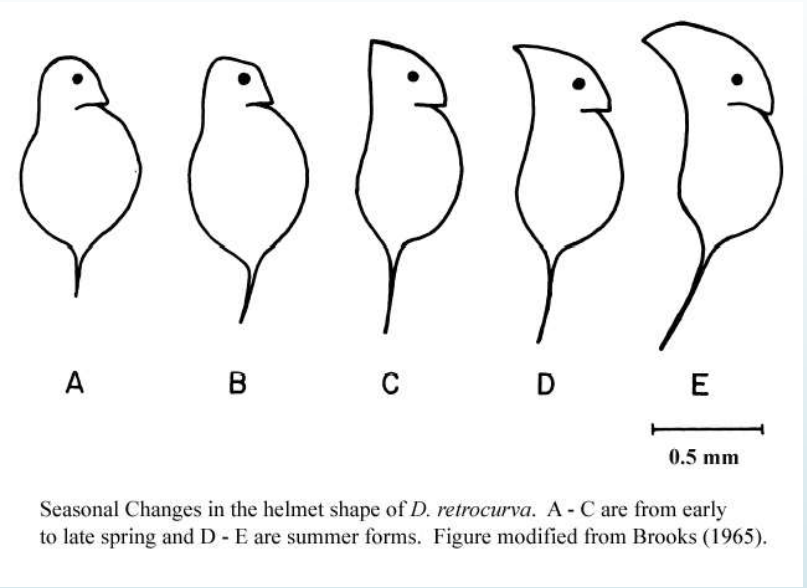
What does it all mean?



Seasonal Changes in the helmet shape of *D. retrocurva*. A - C are from early to late spring and D - E are summer forms. Figure modified from Brooks (1965).

What does it all mean- Cyclomorphosis

- Cyclomorphosis is a well known phenomenon in *Daphnia* and other genus of plankton that involves a regular, seasonal, or induced change in body allometry (Black & Slobodkin, 1987)
- Put simply, it is a reversible change in body shape that can be prompted by any of a number of things.



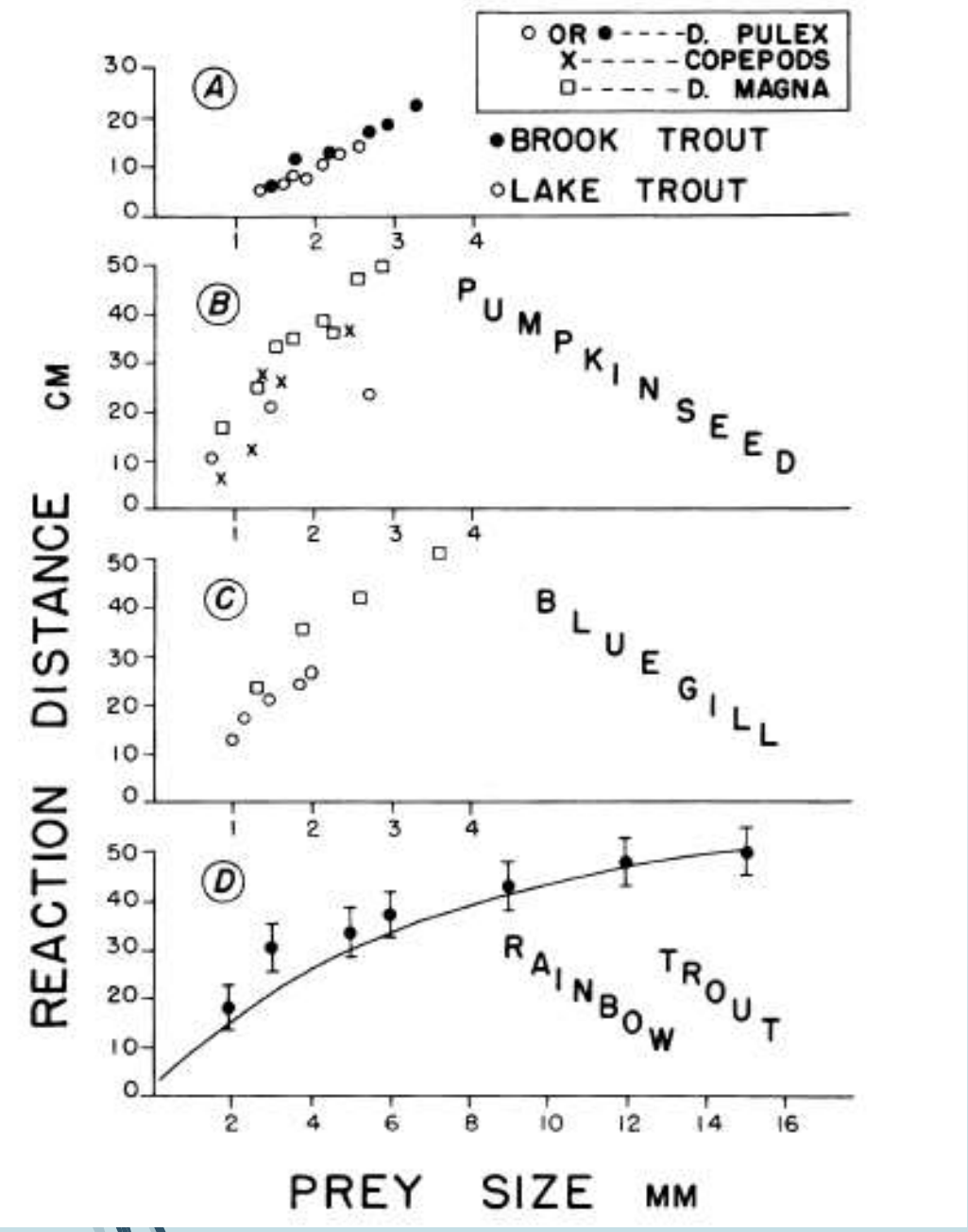
Seasonal Changes in the helmet shape of *D. retrocurva*. A - C are from early to late spring and D - E are summer forms. Figure modified from Brooks (1965).

What does it mean for cyclomorphosis to be predator induced?

- In many cases, cyclomorphic response is prompted by the presence of things that eat zooplankton.
- Zooplankton can sense predator specific kairomones (like pheromones) that indicate predator presence.
- When zooplankton sense these kairomones, they begin to grow defenses.

Differences in Predation styles

- 3 major types of planktivorous predators.
  - Active hunting vertebrates
  - Filter feeding vertebrates
  - Macroinvertebrate predators.
- Each predator hunts in a way that is most effective on a certain prey body size.

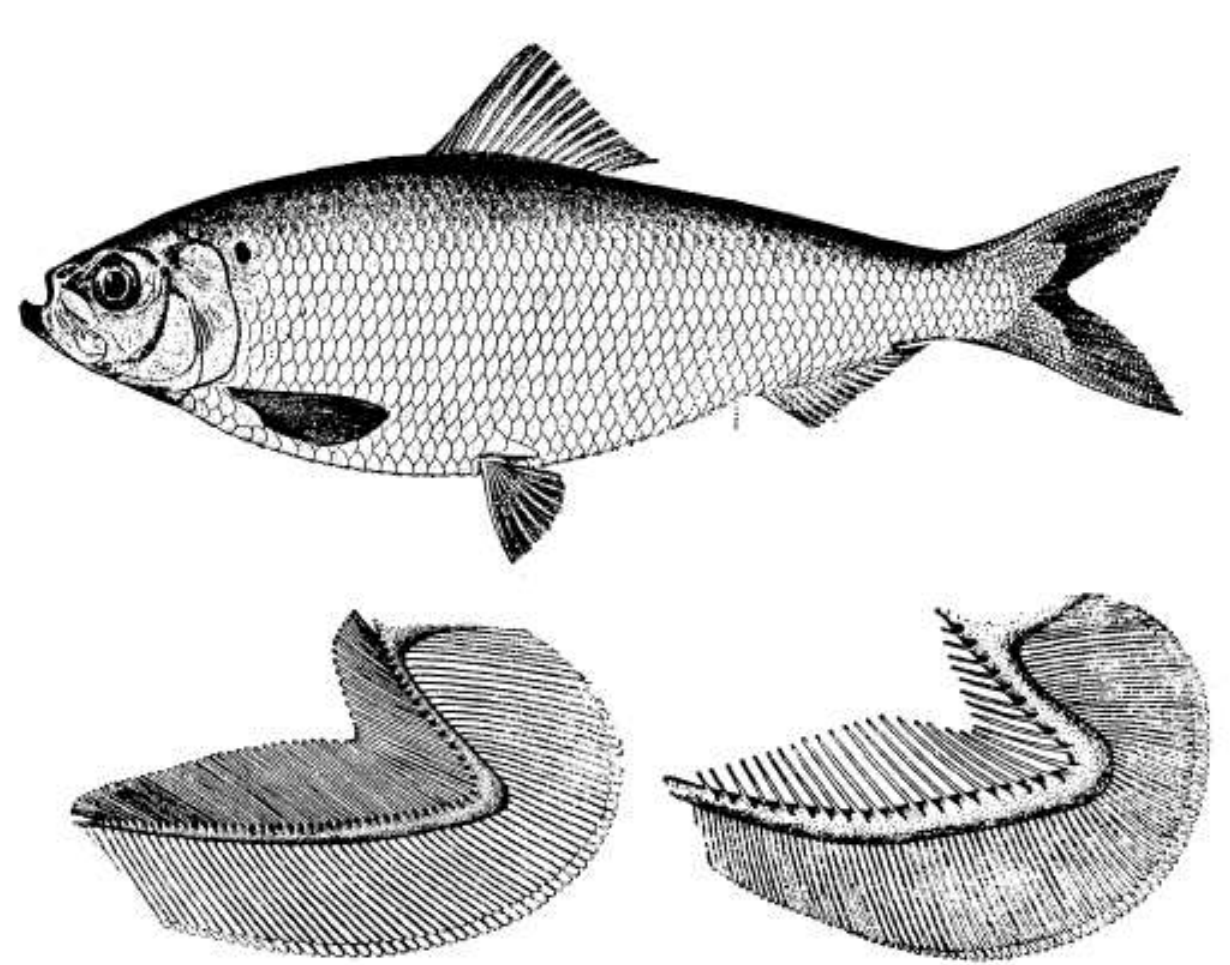


Source: Confer et al 1978

Active hunting vertebrates

- Active hunting vertebrates hunt visually
- They rely upon detecting prey before consuming them

Filter feeding vertebrates



Source: Brooks & Dodson 1968

- These individuals feed indiscriminately, much like a whale feeding on krill.
- By opening their mouths and swimming along, they catch plankton in a sieve-like structure that filters them from the passing water.

Source: Piet Spaans, Netherlands

Macroinvertebrate predators

- These predators rely heavily upon mouthpart correspondence to prey size.
- If something is too big, they cannot eat it.

Effects of cyclomorphosis on zooplankton

TABLE 8. Literature comparison of simplified *Chaoborus* effects on *Daphnia pulex* life history parameters. + = higher for induced morph; − = lower for induced morph; ○ = no difference; n = not reported. B_B = body length at birth; B_M = body length at maturity; C_1 = first clutch size; T_M = age at maturity (+ means longer time to mature); r = calculated fitness component (intrinsic population growth rate); S = survival.

Reference	B_B	B_M	C_1	T_M	r	S
Black and Dodson 1990	n	−	○	+	−	○*; −†
Black 1993	n	+	+	+	○	−
Havel and Dodson 1987	n	−	○	+	−‡	n
Ketola and Vuorinen 1989	○	−	−	+	−‡	−
Lüning 1992	+	○	−	+	−‡	n
Riessen and Sprules 1990	○	○	○	+	−*; ○†	○
Spitze 1992	+	+	+	○	+	n
	+	+	○	○	+	n
	−	○	+	−	+	n
	○	○	○	+	−	n
Vuorinine et al. 1989	○	−	n	+	n	n
Walls and Ketola 1989	○	−	−	+	−	n
Walls et al. 1991	n	○*; −†	○	○	○*; −†	n
Tollrian (*this study*)	○	+	+	+	+	○

* High food conditions.
† Low food conditions.
‡ Estimated from the results.

Source: Tollrian 1995b

Effects of defense development upon *Chaoborus* predation

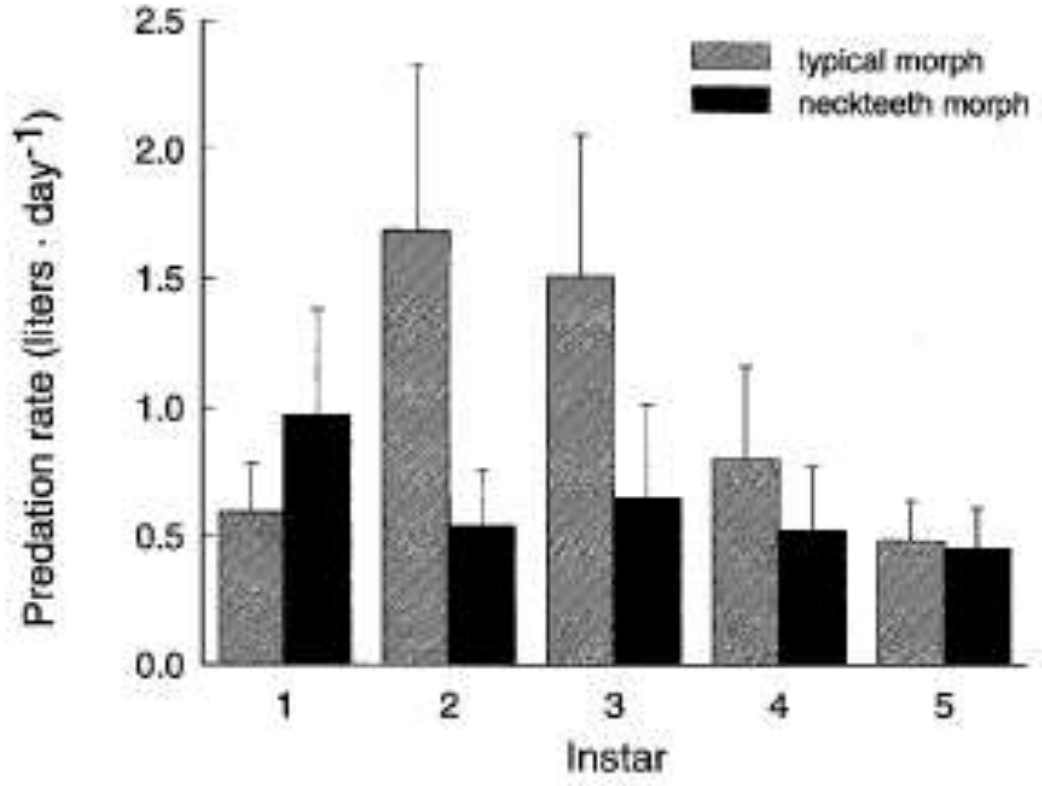


Fig. 2 Predation rate for typical and neckteeth morph of *Daphnia pulex* of different instars (*hatched bars* = typical morph, *solid bars* = neckteeth morph, error bars = 95% CI)

Source:
Tollrian 1995a

Effect of gill raker spacing on prey size.

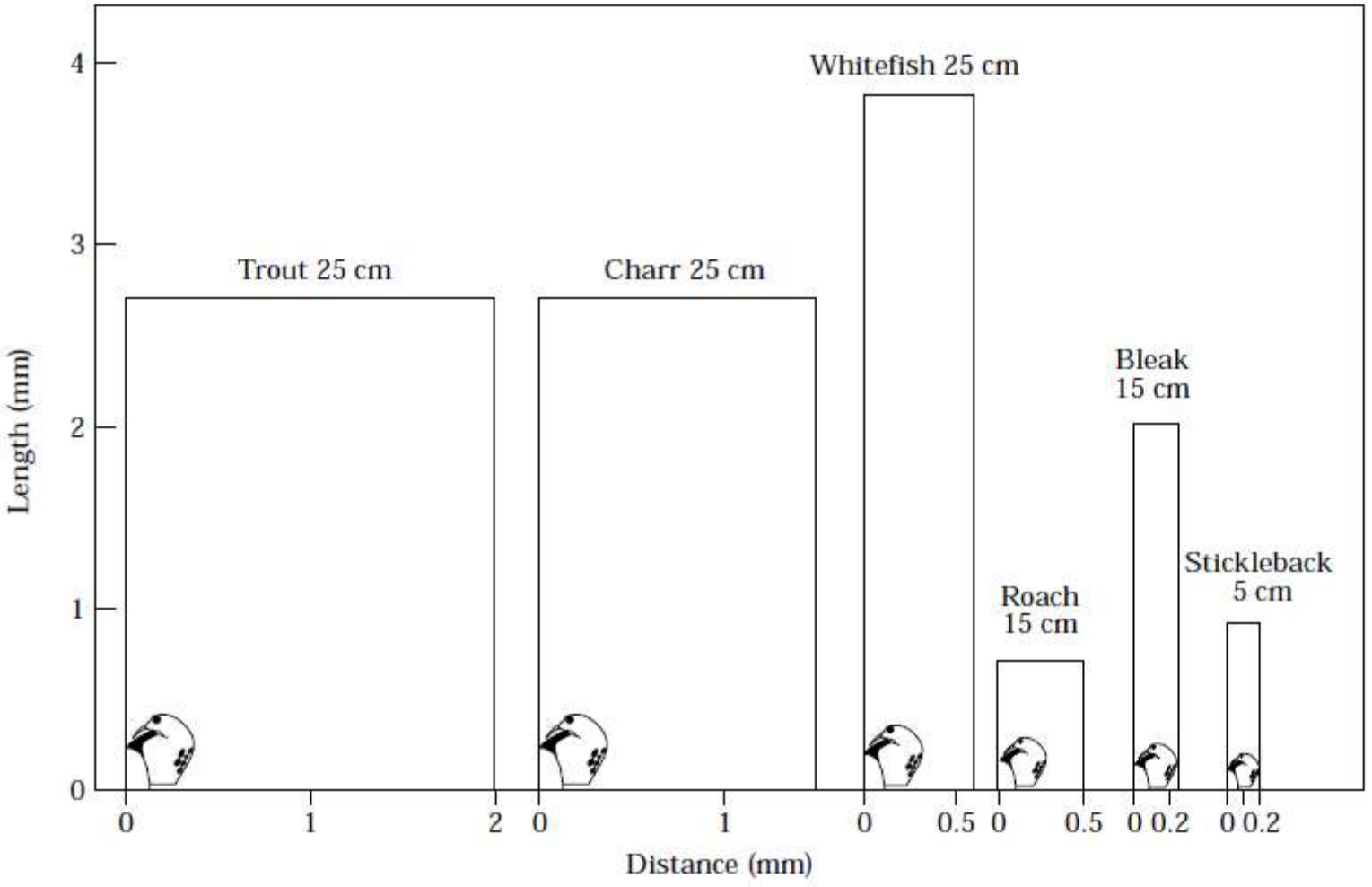


FIG. 6. Gill raker spacing and length relative to minimum size of *Bosmina longispina* found in stomachs of brown trout, Arctic charr and whitefish, and *Bosmina longirostris* recorded in stomachs of roach, bleak and three-spined stickleback.

Source: Langeland & Nost 1995)

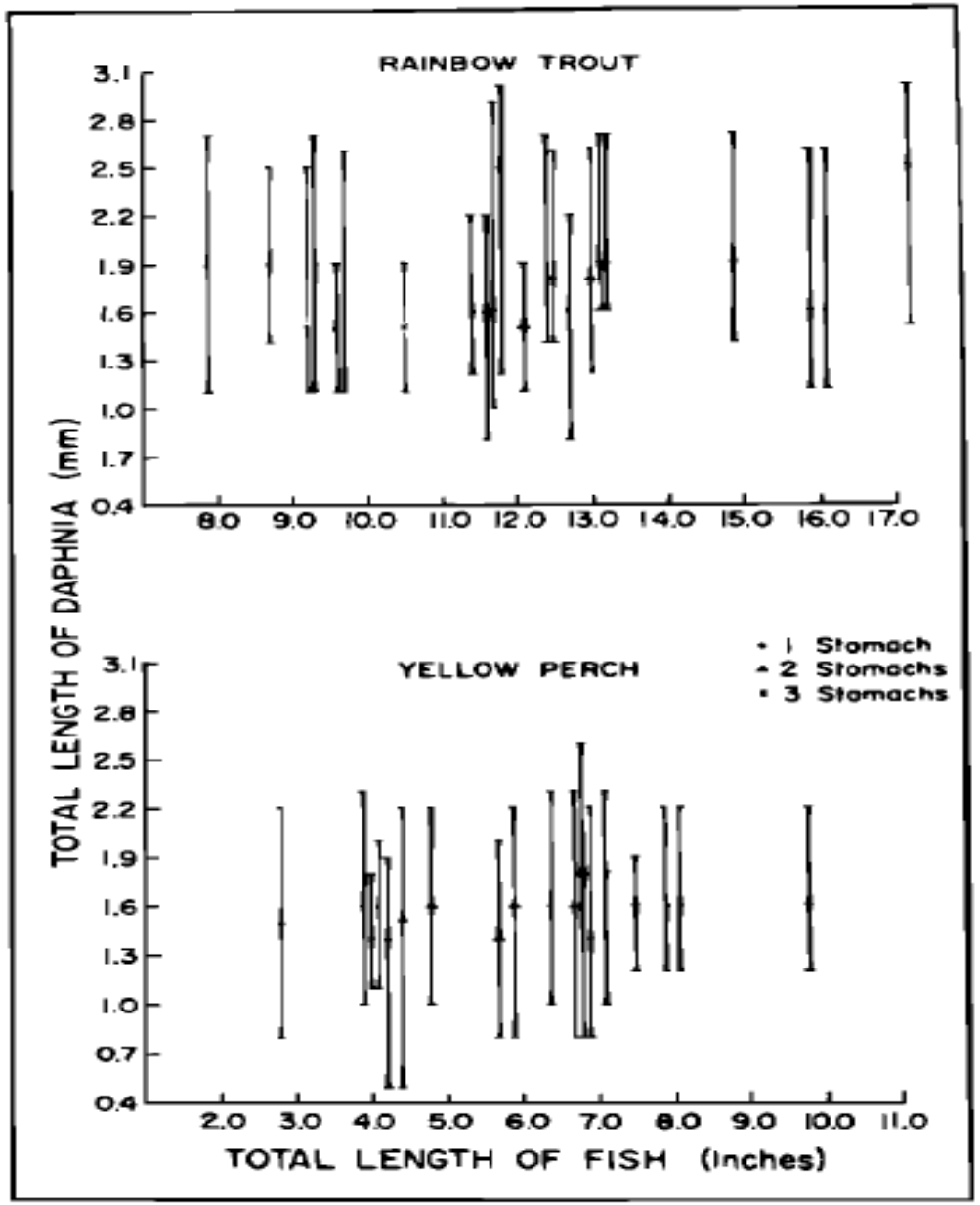


FIGURE 3.—Mean (symbols) and range (vertical bars) in length of *Daphnia* spp. taken from stomachs of rainbow trout and yellow perch of various lengths collected in Stager and Sporley lakes during 1959 and 1960.

Size-selective predation by active hunting vertebrates

Conclusion

- Cyclomorphosis in Zooplankton has limited negative effects on individual *zooplankton*.
- Vertebrate predators feed predominantly on larger individuals.
- Macroinvertebrate predators feed predominantly on smaller individuals.
- Macroinvertebrate predators have a lower population concentration in areas with high vertebrate predation.
- Therefore, zooplankton populations capable of developing structural defenses will develop more defenses in areas with high macroinvertebrate predation and less defenses in areas dominated by vertebrate predators.

References

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