Biology 541 -- Ecology of Fishes and Fisheries Biology

Lecture 11 -- Ecology of Larval Fishes

Why is the ecology of larval fishes important?

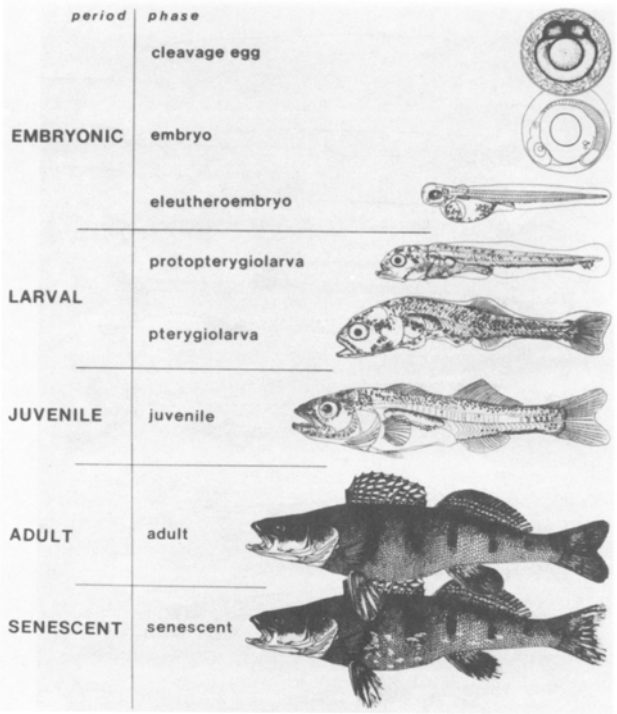

Figure 20-1. *Developmental periods in the life of walleye, including specific phases of development used in larval fish descriptions. From Balon (1975).*

(1) Marine fishes occur in **metapopulations** (local or subpopulations connected by dispersing larval stages).

(2) High rate of mortality (up to 99+%)

(3) Successful recruitment into a population

(4) Relatively new development: larval behavior may mediate retention and transport;

What happens to larvae during the pelagic larval phase?

(1) growth
(2) development
(3) transport or retention to suitable sites
(4) mortality

Precocial vs. Altricial Larvae

Precocial -- develop rapidly (more energy available)
Altricial -- poorly developed (less energy available)

Tradeoff -- fewer precocial larvae to greater number of altricial larvae produced per female (fecundity vs. survival)

Table 20-1. *Some reproductive characteristics of adult fish that produce larvae that are altricial or precocial at hatching, as well as species examples of fishes across the continuum.*

	Altricial					Precocial
Development at hatching	Limited					High
Fecundity of adults	High					Relatively low
Yolk per egg	Low					High
Parental care	None					Variable to much
Breeding types	Pelagic	→	nesting	→	mouthbrooding	→ Live bearing
Examples	Herring		Bluegill		Cichlids	Guppy
	Cod		Trout			Shark
	Alewife					

Body shapes

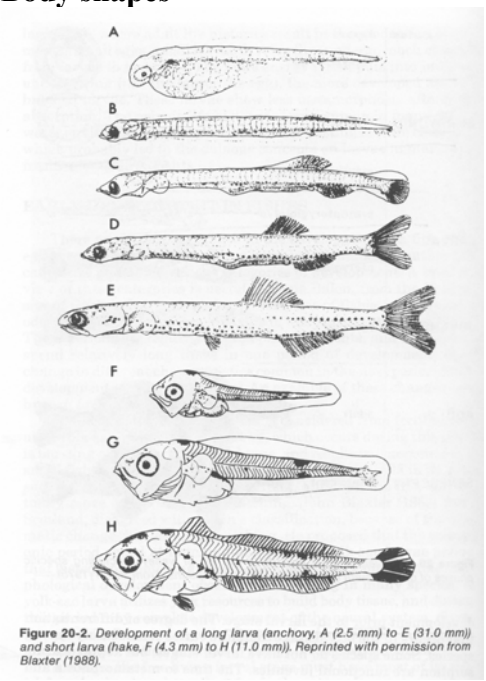

Figure 20-2. *Development of a long larva (anchovy, A (2.5 mm) to E (31.0 mm)) and short larva (hake, F (4.3 mm) to H (11.0 mm)). Reprinted with permission from Blaxter (1988).*

Unusual body shapes are common for fish larvae, and these shapes do not appear to be good hydrodynamically.

Mortality

Hypotheses to explain variability in larval supply:

- Examples from temperate fisheries ecology
- Fishes produce enormous numbers of offspring (indiv. ⇒ 100's to 1000's)
- Mortality of larvae very high (ca. 99%)

(1) "Critical Stage" Ho (Hjort 1914):

- what drives survival of cohort is abundance of food at first feeding
- low food ⇒ starvation poor year class
- predicts positive relationship between larval survivorship and food abundance at time of first feeding

(2) "Match-Mismatch" Ho (Cushing):

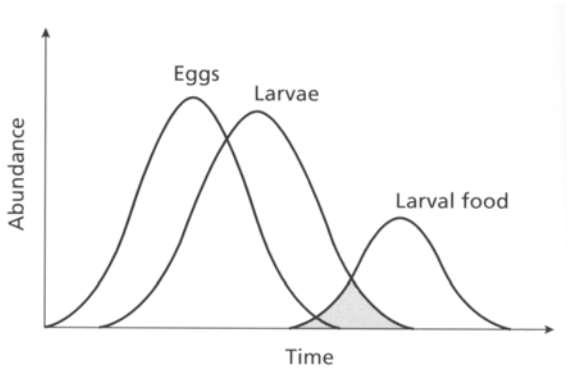

Fig. 4.11 The match–mismatch hypothesis suggests that the timing of larval production in relation to the timing of the production cycle will determine larval survival. The larger the shaded area, the higher survival will be. After Cushing (1982).

- extension of Critical Stage Ho
- Food production varies in time but timing of spawning and first feeding doesn't.
- Timing of feeding ≠ timing of food production ⇒ starvation ⇒ poor year class
- If larvae compete, maybe density dependent
- predicts positive relationship between larval survivorship and match between 1st feeding and production

(3) "Prey Dispersion" Ho (Lasker 1975):

- threshold prey density for larval survival, density achieved in patches
- oceanic conditions (storms) break up patches ⇒ reduce prey density ⇒ larvae starve
- predicts larval survivorship negatively related to storm frequency and intensity

(4) "Larval Advection" Ho (Parrish 1976, Nelson 1977, Methot 1983, Sinclair 1985):

- current patterns carry larvae away from areas (e.g., nearshore) of high food availability
- larvae advected offshore ⇒ starve ⇒ poor year class
- coastal upwelling: Pacific mackerel & northern anchovy (west coast) and menhaden (east coast)
- predicts larval survivorship negatively related to strength of offshore currents / upwelling

(5) "Larval Predation" Ho (Bailey & Houde 1989):

- variation in predator abundance ⇒ variation in year class survival
- may be density independent or dependent.
- predicts larval survivorship negatively related to predator abundance

(6) "Stage-Duration" Ho (Chambers and Leggett 1987)
= **"Growth-Mortality" Ho** (Ricker & Foerster 1948)

- combined feeding-predation hypothesis
- low food / low temperature ⇒ low growth
- small fish more susceptible to predation
- slow growth prolongs period of susceptibility
- predicts larval survivorship related to size (negatively) and growth rate (positively)