Vital rates of larval fish from Coastal Newfoundland, Canada

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Abstract

The data in the files of this dataset represent the raw and standardized information of the distribution of the number of prey in stomachs of larval fish, the increments widths derived from larval fish, and the mortality rates, that were included in the study by Pepin (2024) into the probability distribution of larval fish vital rates.

Data were collected from different surveys and process-oriented investigations conducted in coastal Newfoundland, Canada, as part of a number of studies into the ecology of the ichthyoplankton community (Supplementary material Tables S1-S3). Field work was carried out between April and September, with most collections taking place from June to August, in three deep bays along the east coast of Newfoundland (Bonavista Bay: 48°45'N, 53°20'W; Trinity Bay: 48°00'N, 53°30'W; Conception Bay: 47°45'N, 53°00'W).

Larval fish were collected using either a ring net (0.75m diameter, 165 µm mesh; Pepin and Penney (1997)), bongo nets (0.6m diameter, 333 µm mesh), or a 4 m^2 variable-mesh Tucker trawl (333, 570 and 1000 µm mesh;) towed at 1.5 m s^{-1}. Samples were preserved in 4-5% buffered formaldehyde, or in 95% ethanol for otolith-based estimation of growth rates. Ichthyoplankton were sorted from samples, identified to the lowest taxonomic level possible, and measured to the nearest 1 mm using an ocular micrometer or to the nearest 0.1 mm using an image analysis system in studies focussed on comparison of growth rates.

The number of prey In the stomachs of larvae were derived from seasonal surveys (May to September) conducted in 1985 and 1986 in Conception Bay, in which eleven taxa were sufficiently abundant to be considered for stomach analysis (Supplementary Table S1; Stomach content data EN.csv). The fish species were *Clupea harengus*, *Mallotus villosus*, *Gadus morhua*, *Glyptocephalus cynoglossus, Hippoglossoides platessoides*, *Myzopsetta ferruginea*, *Pseudopleuronectes americanus*, *Tautogolabrus adspersus*, *Stichaeus punctatus*, *Ulvaria subbifurcata,* and *Liparis* spp. (Pepin and Penney, 1997). The digestive tract of each specimen was removed, and the contents teased apart using fine dissecting needles. The stage of digestion was noted, and the contents were counted and identified to the lowest taxonomic and life stage possible. The number of observations per species ranged from 92 to 272 larvae.

Stomach contents are considered representative of a 3-8 hour foraging period, and dependent on temperature based on a Q_{10} of 2. Within species, most larvae were collected within a 30 day period.

Patterns of variation in growth rates were based on analysis of daily increment widths determined from the sagittal otolith of several cohorts of *U. subbifurcata* (Supplementary material Table S2; Otolith data EN.csv, Otolith data standardized EN.csv), as well as unpublished data for *U. subbifurcata, G. cynoglossus, H. platessoides*, *M. ferruginea, M. villosus* and *T. adspersus* (Supplementary material Table S2). Each otolith was mounted in a small drop of cyanoacrylate, ground to the mid-plane, with a series of graded silicon carbide papers (1000 and 1200 grits), before polishing with 0.3 µm diameter alumina powder. The width of each increment was identified by marking the outer edge of that increment along the longest axis of each otolith, which occasionally required refocusing of the image. An Olympus BH-2 compound microscope (500 or 1000 × magnification) and a computer-imaging system were used for the measurements. Otoliths were aged twice to evaluate the accuracy and excluded from further analysis if the error in ageing exceeded 1 increment. Each otolith increment was assumed to represent one day.

Length-based estimates of mortality rate were derived from the application of ratio-based estimators, as per Pepin (2016), which provide highly resolved estimates of rates of loss for 1 mm length classes (Supplementary material Table S3; Mortality rate EN.csv). Abundance data were taken from 18 different surveys of the study region. Analyses were performed for 13 collections based on the use of a 4 m^2 Tucker trawl with variable mesh size. In five surveys, paired 60 cm diameter bongo nets with 333 µm mesh were used to collect larval fish. The analyses were restricted to larvae from 3 to 20 mm standard length. Although survey designs differed among studies, estimates of average abundance (number m^{-2}) for were derived from each survey for 1mm length intervals from 4 to 17 species of larval fish, depending on the location and time of year. The survey grids were sampled from 1 to 3 times during the course of a study, and each sampling period was treated independently to derive mortality estimates in the same manner as large-scale population surveys commonly used in process studies. Although length-based estimates of mortality integrate the possible effects of variations in growth rates, the use of 1 mm length classes limits the bias consequences of these variations to integration periods of 3-4 days based on the age-based growth rates estimated for the fish species used in this study.

To combine the data across broad ranges of length (feeding and mortality data) and ages (increment width data) all observations (x_i) were standardized to zero mean and unit standard deviation (y_i – Z-scores) for each length or age interval with more than 3 observations (i, based on n observations) ($y_i = (x_i - \bar{x})/\sqrt{\sum_1^n (x_i - \bar{x})^2/n}$) for each species, length or age interval. Standardization transforms feeding count data into a continuous distribution. In the case of feeding and growth data, the standardization was carried out for each species and cohort within species, respectively. Because mortality data were less numerous, standardization was performed for 1 mm interval using all taxa because previous analyses had failed to identify significant differences among taxa (Pepin, 2016).

References

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