# ESTIMATION OF AGE AND GROWTH RATE IN NORWEGIAN SPRING SPAWNING HERRING *(CLUPEA HARENGUS* L.) LARVAE AND JUVENILES

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Herring larvae and juveniles were aged by use of developmental stages and daily growth increments in the otoliths. The results indicate that developmental stages are useful in ageing larvae till the end of the yolk-sac stages, while daily growth increments in the otoliths are to be preferred in older larvae and juveniles.

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The age and growth rate of larvae and juveniles of the Norwegian spring spawning herring *(Clupea harengus* L.) taken in the field bring about considerable indefiniteness. The purpose of the present study was to test existing methods for estimation of age and back-calculation of growth rate.

The herring were stripped at the spawning area in western Norway and the fertilized eggs were incubated in the laboratory at Flødevigen Biological Station. Newly hatched herring larvae were transferred to starving and feeding experiments at four temperatures, 3.5, 5.0, 6.5, and 8.0° C in the laboratory and one group was released in a 2500 $m^3$ outdoor basin. The herring larvae used were from different hatching dates, however, larvae in each experiment were hatched within 24 hours. Daily samples in the laboratory were both frozen and preserved in formaldehyde. Those preserved in formaldehyde were later examined for standard length, dry weight, yolk-sac volume, gut content, and developmental stages according to DOYLE (1977) and ØIESTAD (1983). The sagittae in the frozen larvae from the laboratory experiments and in the frozen juveniles from the basin experiment were dissected out and mounted on a glass slide. Standard length and dry weight of the fishes were measured. A few otoliths were later examined in a Scanning Electron Microscope (SEM) and 100 otolith pairs were examined using an otolith reading system, developed at SWFC, La Jolla (METHOT & KRAMER 1979). The otolith reading system consisted of a video camera attached to a light microscope with a magnification up to 1000 times, a monitor, a digitizer, and a micro-computer. The otoliths were read in several subsessions as the rings were exposed by grinding. The micro-computer received data on the number of rings and the distances between the observed rings. Two software programmes were used to estimate the age and back-calculate the growth rate of each larva or juvenile. The radius of the nucleus and the initial distances between the rings in the otoliths were measured to respectively 10 μm and 0.6–0.8 μm by the help of SEM.

The estimated age of the laboratory-reared larvae was from 20 to 30 days less than their real age. The cause of the difference is probably the low growth rate (less than 0.10 mm/day) observed on the laboratory groups from the end of yolk-sac stages till an age of 20 to 30 days. The estimated ages of the basin-reared herring juveniles were all from 9 to 11 days less than their real age. This corresponds with earlier observations on herring larvae where they start laying down daily rings from the end of yolk-sac stages (LOUGH & al. 1982, MCGURK 1984). The back-calculated growth rate of the basin-reared herring corresponds with earlier observations on the growth rate of basin-reared larvae (GJØSÆTER & ØIESTAD 1981). Table 1 gives the main results from the stageing of the herring larvae. The results accord with the observations by DOYLE (1977). The yolk-sac herring larvae can be aged within three to eight days of their actual age. The duration of later stages are more than 10 days, which is a too big error for age estimation.

Table 1. The duration of the different sub-developmental stages of fed herring larvae *(Clupea harengus* L.) at 6.5° C in the laboratory. Stages according to DOYLE (1977) and ØIESTAD (1983).

| Stages | 1a | 1b | 1c | 1d | 2a |
|---|---|---|---|---|---|
| Present study | 3.6 | 3.2 | 6.1 | 6.5 | – |
| DOYLE (1977) | 3.2 | 3.7 | 3.9 | – | 16.6 |

In conclusion stageing herring larvae according to DOYLE (1977) and ØIESTAD (1983) could be useful for estimating the age in yolk-sac herring larvae, while larvae that have passed the yolk-sac stage should be aged by their otoliths. The latter method will in addition give the growth rate of the larvae from the end of the yolk-sac stage.

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