

SOME ASPECTS OF THE LIFE HISTORY OF LABORATORY-REARED  
PACIFIC MACKEREL LARVAE (*SCOMBER JAPONICUS*)

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The early life history of Pacific mackerel (*Scomber japonicus*) is described using laboratory rearing studies and an examination of the stomach contents of sea-caught larvae (Hunter and Kimbrell, 1980). The incubation period for mackerel ranged from 33 h at 23°C to 117 h at 14°C. At hatching, larvae were 3.1 mm long and weighed 0.04 mg of which 50% was yolk. At 19°C, the first incidence of feeding occurred 46 h after hatching and by 60 h (age 2.5 days) all larvae were capable of feeding. At this time, larvae were 3.6 mm long, eyes were fully pigmented, and only 10% of the yolk remained. Starvation became irreversible if larvae were not fed before age 4.5 days. At age 5 days, larvae were still capable of feeding but were not able to capture enough prey to survive.

Growth of mackerel larvae is characterized by a relatively slow, almost linear trajectory over the first 10–15 days, when larvae reached 6–7 mm, followed by a rapid acceleration of growth through metamorphosis (15 mm). Growth rates ranged from 0.58 mm day<sup>-1</sup> at 16.8°C to 0.92 mm day<sup>-1</sup> at 22.1°C and had a Q<sub>10</sub> of 3.0. Mackerel larvae had a relatively high metabolic rate: oxygen consumption of larvae in a Warburg apparatus was 6.1 μO<sub>2</sub> mg dry wt<sup>-1</sup> hr<sup>-1</sup> at 18°C and 11.4 μO<sub>2</sub> mg dry wt<sup>-1</sup> hr<sup>-1</sup> at 22°C.

Cruising speeds of mackerel larvae increased from 1.3 body lengths sec<sup>-1</sup> for first-feeding larvae to 3.8 body lengths sec<sup>-1</sup> for fish at metamorphosis. At typical cruising speeds, 3–5 mm mackerel larvae swam with a high tail beat frequency (~30 beats sec<sup>-1</sup>) and principally modulated tail beat amplitude to change swimming speed.

Larval mackerel fed on zooplankton by executing a high amplitude tail beat and engulfing with an open mouth. When they reached 8 mm, 50% became

capable of feeding on other fish larvae; larvae were seized from the side and manipulated before ingestion. Cannibalism was common in rearing groups, but ceased as larvae approached metamorphosis and began to school.

The ability of mackerel larvae to capture prey by engulfing them with an open mouth was correlated with the width of the mouth. Fifty percent of the larvae were able to capture a prey when the width of the prey was 85% of the width of the mouth, and 95% were able to do so when they prey was 57% of the width of the mouth.

Food of mackerel larvae in the sea consisted chiefly of stages of copepods. The maximum width of foods eaten increased rapidly with larval length and was equivalent to the maximum width of the mouth; the minimum size of prey eaten increased much more slowly. The mean width of prey eaten was about 40% of the mouth width. The larger organisms, constituting half of the prey eaten, accounted for 85–90% of the total volume consumed.

In conclusion, mackerel larvae are fast swimming, metabolically active, and grow rapidly in the laboratory, reaching metamorphosis in 16–24 days. The maximum size of prey eaten increases rapidly with larval size, but in the sea many prey are eaten that are substantially below the maximum size mackerel larvae are capable of ingesting. These observations indicate that growth or survival in the sea may be limited by the availability of larger prey.

## REFERENCES

- Hunter, J. R., and Kimbrell, C. A. 1980. Early life history of Pacific mackerel (*Scomber japonicus*). Fish. Bull., U. S. 78(1): (in press).