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EGG DEVELOPMENT RATES OF THE SCAD (*Trachurus trachurus* L) OVER A RANGE OF CONSTANT TEMPERATURES

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ABSTRACT

The effect of temperature on the rates of development of artificially fertilized scad eggs was studied in a thermal gradient incubator. The resulting data are compared with those reported in the literature and related to the temperatures at which scad spawn in the sea.

INTRODUCTION

As part of a programme to estimate the size of the spawning stock of mackerel, *Scomber scombrus*, to the south-west of the British Isles a number of cruises were carried out by Ministry of Agriculture, Fisheries and Food, (MAFF) and Institut Scientifique et Technique des Peches Maritimes (ISTPM) between March and July 1977. Within the survey area are known spawning grounds of the scad (Polonskii and Tormosova, 1969) and it was thus possible to obtain material for the study of egg development rates in this species during these cruises. Artificial fertilizations previously carried out on the scad (Polonskii and Tormosova, 1969; Arbault and Boutin, 1968) give no indication as to the duration of embryonic development and were carried out at a single incubation temperature.

MATERIALS AND METHODS

Male and female scad were caught by Granton trawl off SW Ireland in 250 m of water on 14 May 1977. A dry artificial fertilization was performed using one male (34 cm) and the only running female (34 cm) taken during the cruise. The fertilized eggs were held at 18°C until first cleavage.

Subsamples of approximately 100 eggs were transferred to tubes containing 60 ml of seawater and incubated at a series of temperatures maintained along a thermal gradient incubator (Halldal and French, 1958, Thomas *et al*, 1963). At 24-hourly intervals dead eggs were removed and counted and the seawater replaced by clean seawater at the same temperature.

At four hourly intervals a sample of 5 eggs was removed from each tube, photographed and preserved in 4% formalin for future study, at the same time the water temperature was measured.

Newly hatched larvae were counted and transferred to separate incubation tubes at the same temperature. The development of the larvae was monitored photographically in the same way as the eggs.

Measurements of egg and oil globule diameters six hours after fertilization and larval length on hatching were made on fresh material by visual inspection under a binocular microscope.

RESULTS

The diameters of eggs measured varied between 0.86 mm and 1.00 mm with a mean of 0.94 mm and a standard error of 0.0046. The oil globule diameters ranged between 0.22 mm and 0.28 mm with a mean of 0.25 mm and a standard error of 0.097.

Egg development through to hatching occurred within the temperature range of 10.5 to 21.2°C with the highest percentage survival at the intermediate incubation temperatures of 12.27 to 15.84°C (Table 1). At temperatures of 8.5°C and below no eggs survived through to hatching although early development did take place. The upper temperature limit at which hatching occurs was not reached but the percentage survival was very low at 21.15°C indicating that the maximum temperature for survival would not be very much greater than this.

The mean hatching times at the temperatures employed were calculated as arithmetic means and are shown in Figure 1 with the time range over which hatching was observed. The mean temperature is given with +/- one standard deviation. The equation for the fitted curve is defined by:

log.n.y = - 1.929 log.n x + 9.55. R = - 0.998

At an incubation temperature of 16°C newly hatched larvae varied in length between 2.20 mm and 2.68 mm with a standard error of 0.0286 (Table 2).

DISCUSSION

The measurements of egg diameter, oil globule diameter and larval length on hatching when compared with values obtained by previous workers (Table 3) show good general agreement. Detailed comparisons of our results, based on eggs from a single female, are not worthwhile because of the seasonal variability in egg size both within and between individuals (Ehrenbaum, 1905-9) and also the size of artificially extruded eggs may differ from those occurring naturally.

As would be expected the temperature range at which the greatest percentage of eggs survived through to hatching (12.27-15.24°C) relates favourably to the surface water temperatures previously recorded at scad spawning grounds; 13-15°C by Arbault and Boutin (1968) and 12.4-14.5°C by Polonskii and Tormosova (1969). At temperatures below 12°C the percentage survival of eggs was extremely low (Table 1) which appears to support observations by Letaconnoux (1951) who suggested that spawning will not commence with surface water temperatures below 11.0°C.

The hatching times obtained (Figure 1) show close similarity with those recorded for other Carangidae eggs: *T mediterraneus* - 36 hours at 20-22°C (Kosyakina, 1938) and *T symmetricus* - approximately 4 days at 14.3°C (Ahlstrom, 1956).

The preserved samples will be used for determining the egg stage durations at different temperatures after the method of Simpson (1959).

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TABLE 1 Survival of scad eggs over the temperature range employed

Mean incubation temperature (°C)	Survivors to hatching	Number of eggs (excludes those removed in sampling)	Percentage survival
4.39	0	76	0
6.47	0	99	0
8.47	0	69	0
10.42	4	118	3.3
12.27	64	139	46.0
14.10	63	151	41.7
15.84	64	145	44.1
17.53	43	140	30.7
19.33	39	126	30.9
21.15	4	244	1.6

TABLE 2 Larval length on hatching from eggs maintained at 16°C

Length (mm)	Time after hatching		Total (Sample 1 + 2)
	Less than 5 minutes (Sample 1)	Less than 30 minutes (Sample 2)	
Range	2.20-2.56	2.25-2.68	2.20-2.68
Mean	2.44	2.47	2.46
Standard error	-	-	0.0286
Number of observations	4	13	17

TABLE 3 A comparison of scad egg and larval measurements

Location	Egg diameter (mm)	Oil globule diameter (mm)	Larval length (mm)	Source
Grimsby	1.03-1.09	0.26-0.27		Holt (1897)
NE Atlantic	0.90-1.05	0.25-0.275	< 2.5	Polonskii and Tormosova (1969)
English Channel	0.95-1.00	0.24-0.26		Canu (1894)
Bay of Biscay	0.87-0.98	0.21-0.24		Letaconnoux (1951)
SW Ireland	0.86-1.00	0.22-0.28	2.44	This paper (1977)
North Sea	0.84-1.04	0.19-0.28	< 2.5	Ehrenbaum (1909)
Plymouth	0.81-0.93	0.22-0.23		Holt (1897)
Marseille	0.76-0.78	0.19-0.20		Holt (1899)

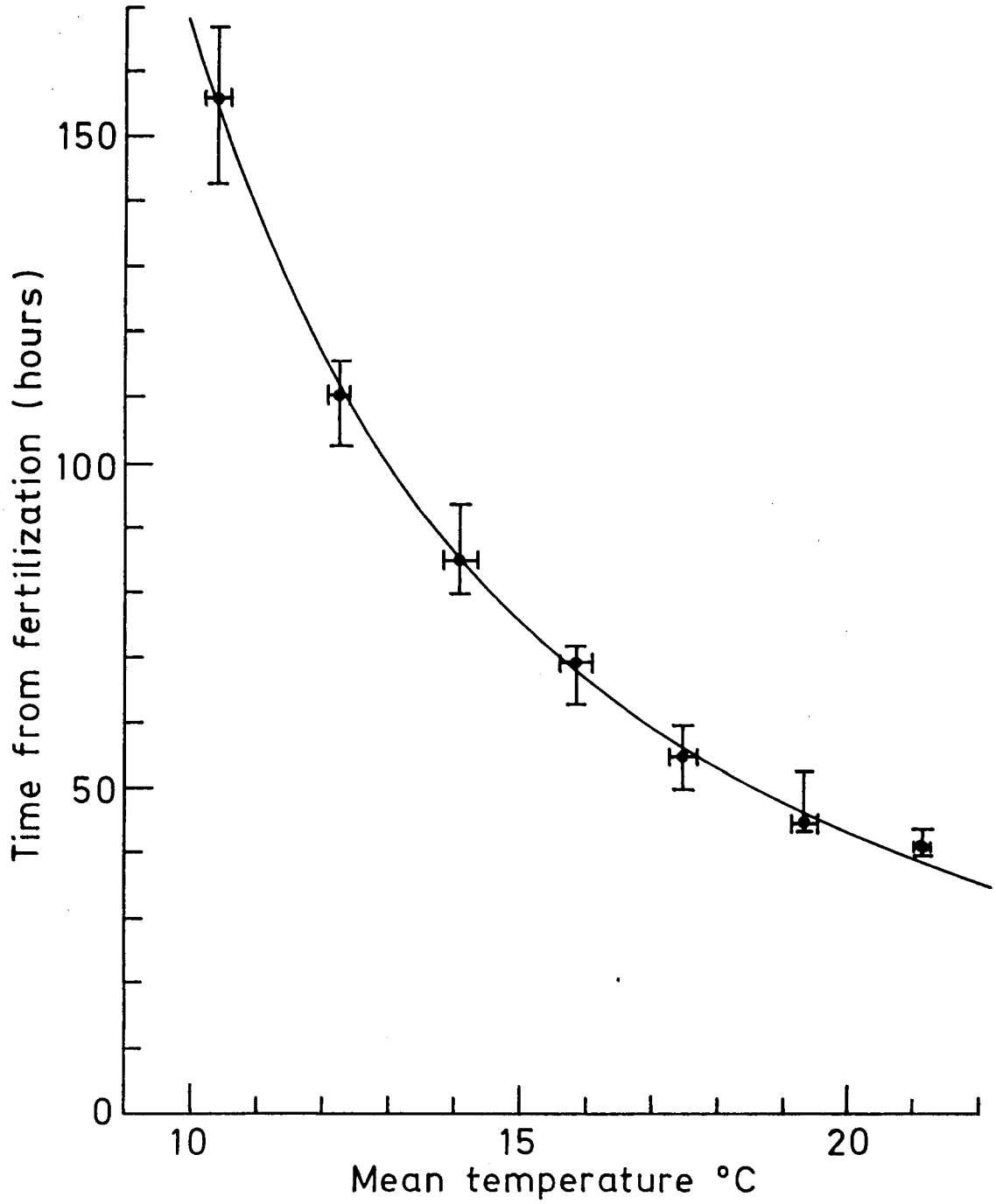

Figure 1 Scad egg incubation times to hatching. Range of observed hatching times is shown and +/- one standard deviation in temperature.