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NOTES ON *LEANDER SQUILLA* L.

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(Text-figs. 1–5)

After the monograph on *Leander squilla* by Höglund (1943) in Sweden, any further work might seem repetitive; however, at Plymouth some differences in the biology of this species have been noticed, as might be expected from the different climates. It has been thought worth while to record these additional notes on the age and growth, together with records of the food.

De Man (1915) has separated the Scandinavian population as the forma *typica* from those of Holland, France and Britain, which he grouped into the variety *intermedia*, the only distinctive character being the length of the carpus of the second leg relative (either longer or shorter) to that of the chela. It is not known whether the two forms intergrade.

Habitat

L. squilla is widely distributed in Plymouth Sound and in the river estuaries, being most abundant in the upper shore pools. Around harbour walls and pier piles where it occurs with *L. serratus* there is usually a segregation, *L. squilla* keeping in the shallower water. This was noted many years ago by Sinel (1906) at Jersey. It also appears to be less tolerant of wave action than *L. serratus*, being rare in more exposed localities. During the winter *L. squilla* tends to be scarce in the estuaries but remains in the shore pools and is scarcely ever taken with the prawn trawl. This contrasts with its behaviour in the Clyde (Elmhirst, 1921) and in Sweden (Höglund, 1943) where there is an offshore winter migration; and is presumably related to the warmer temperatures prevailing at Plymouth. (Mean sea surface temperatures in February: Plymouth 7 to 8° C., Millport 6° C., Kristineberg −1 to +1° C.)

Age and Growth

Spawning took place towards the end of April in 1950, and continued well into August, for of the females caught on 16 August 57% were berried. Since the period of egg-carriage would not be more than 6 weeks (data from Höglund, 1943), it is possible that a third brood may be produced. The post-larval stages first appeared on the shore during the second week of August, a month later than those of *L. serratus*. By October the mean lengths for the O-group

were: 1949, males 2·54 cm., females 2·95 cm.; and in 1950, males 1·85 cm., females 2·12 cm. Thus there is a clear divergence between the 1949 and 1950 year groups which, as with *L. serratus* (see Forster, 1951), may be ascribed to the difference in temperature conditions between the two years. As a check, from these figures the temperature characteristic μ can be calculated as shown by Needham (1931). Using the average sea temperatures 17·27° C. in 1949 and 15·57° C. in 1950, values of 34,140 (females) and 31,320 (males) for μ were obtained, instead of 17,000–21,000 as would be expected from the large numbers of already known values of μ for growth processes. However, it must

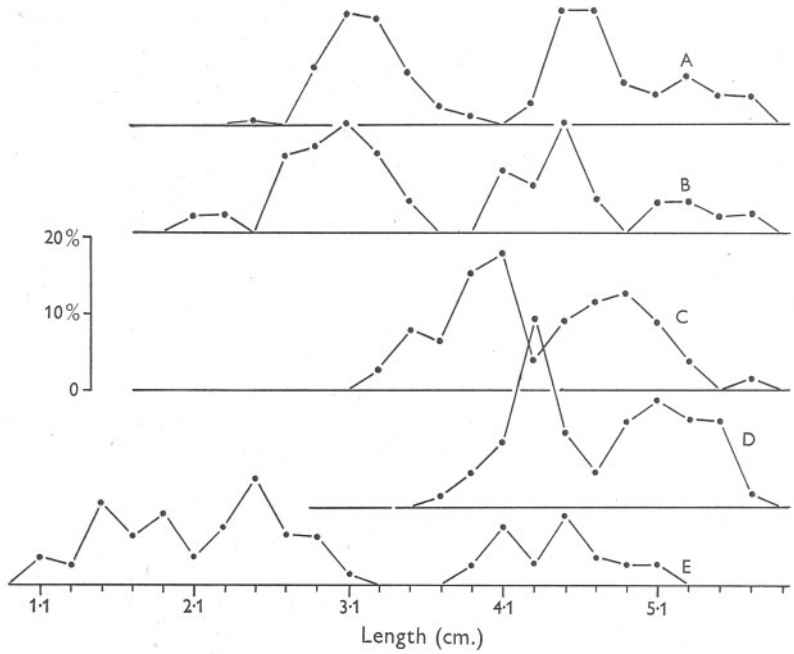

Fig. 1. Length frequencies of female *L. squilla*. A, Trevol, October 1949 (178); B, Rum Bay, October 1949 (50); C, Trevol, April 1950 (79); D, Trevol, August 1950 (73); E, Rum Bay, October 1950 (81).

be remembered that these young *L. squilla* are found in upper shore pools, and at high tide may move into shallow water so that they are affected to a considerable extent by air temperatures. On Plymouth Hoe (height 108 ft.), average air temperature from August to October (inclusive) was found to be 16·50° C. in 1949 and 13·76° C. in 1950. Using these figures μ comes to 20,020 for females and 19,160 for the males. It seems therefore that in the shallow-water conditions under which this species lives the effective temperatures are those of the air rather than of the sea surface.

Figs. 1 and 2 show the percentage size frequencies of various samples of

L. squilla. The samples from Trevol Pier, situated in a creek off the Tamar estuary, differ considerably from those from Rum Bay, in the Sound (Table I).

In 1949 the O-group males, unlike the females, did not penetrate the estuary, being virtually absent from the Trevol catches. This compares with the

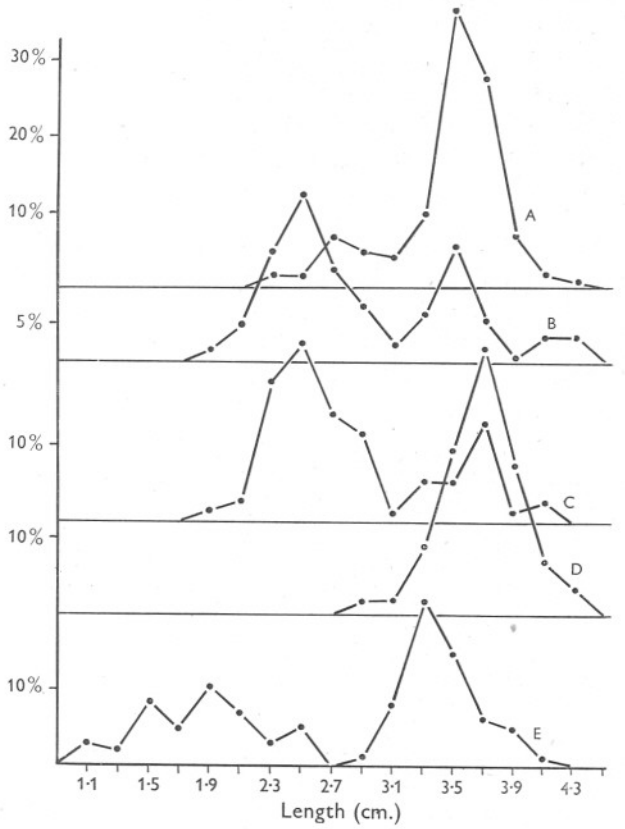

Fig. 2. Length frequencies of male *L. squilla*. A, Trevol, October 1949 (133); B, Rum Bay, October 1949 (123); C, Rum Bay, November 1949 (77); D, Trevol, April 1950 (56); E, Rum Bay, October 1950 (102).

TABLE I. SEX RATIO: PERCENTAGE OF MALES

Trevol Pier	41	13	43	48	—
Rum Bay	63	64	58	73	51

observations of Lloyd & Yonge (1945) on *Crangon vulgaris*, who found that the males tended to inhabit more saline conditions than the females. In an estuary, where the surface water may at times be of low salinity, the males might well keep in slightly deeper water and so affect the sex ratios of samples taken with a hand-net. The sex ratios found in the Gullmar Fjord by Höglund have been

plotted in Fig. 3 as the percentage of males. Although he has attributed the fluctuations solely to chance, it may be seen that this is very unlikely owing to the extent of the fluctuations and the manner in which the points reinforce each other. The two years differ considerably; in 1940 there appears to be a steady decline in the percentage of males, whereas in 1941 there was a more rapid decline partly due to the 1939-year-group males disappearing, followed by further large fluctuations. In both years the females of the O-group appeared at first in much greater numbers than the males. It would have been interesting to compare the rainfall of the two years to see whether any correlation with the sex ratio could be traced, but no data are available.

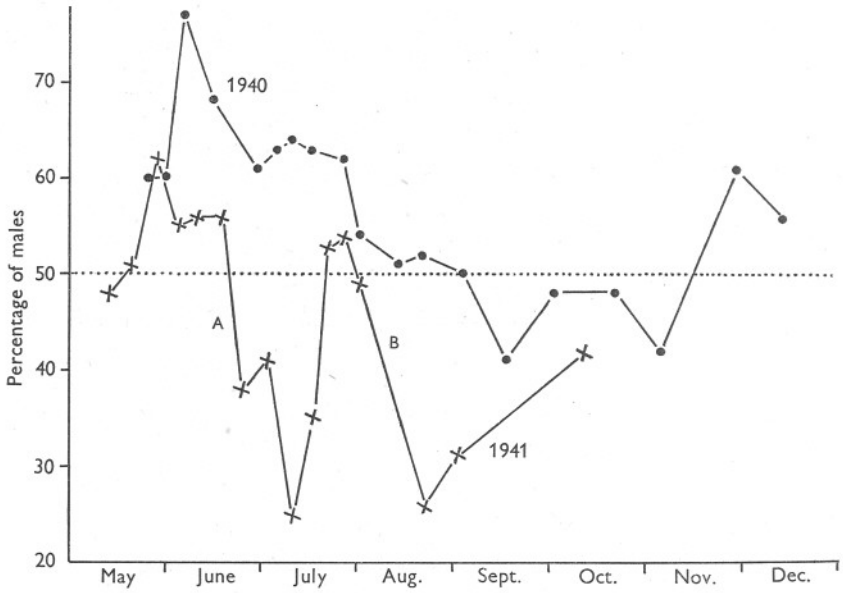

Fig. 3. Percentage of males in catches from Sweden (data from Höglund, 1943). A, 1-year-old males disappearing; B, 'O-group' females arriving.

Variation in the stock from place to place was apparent from a sample from Paignton harbour taken on 21 November which in both males and females showed one very dominant group, presumably the O-group, but with a mean length approximately 4 mm. greater than that of a comparable catch from Trevol Pier (Fig. 5). Whether this represented a difference in growth rate or in the method of sampling is unknown.

The growth of females is shown in Fig. 4, together with Höglund's data on age and growth. Growth is seen to continue throughout the year at Plymouth in contrast with the complete cessation found by Höglund. This appears to be correlated with the temperature of the sea which is much lower in winter and higher in the summer in Sweden. Also the 2-year-olds appear to have grown

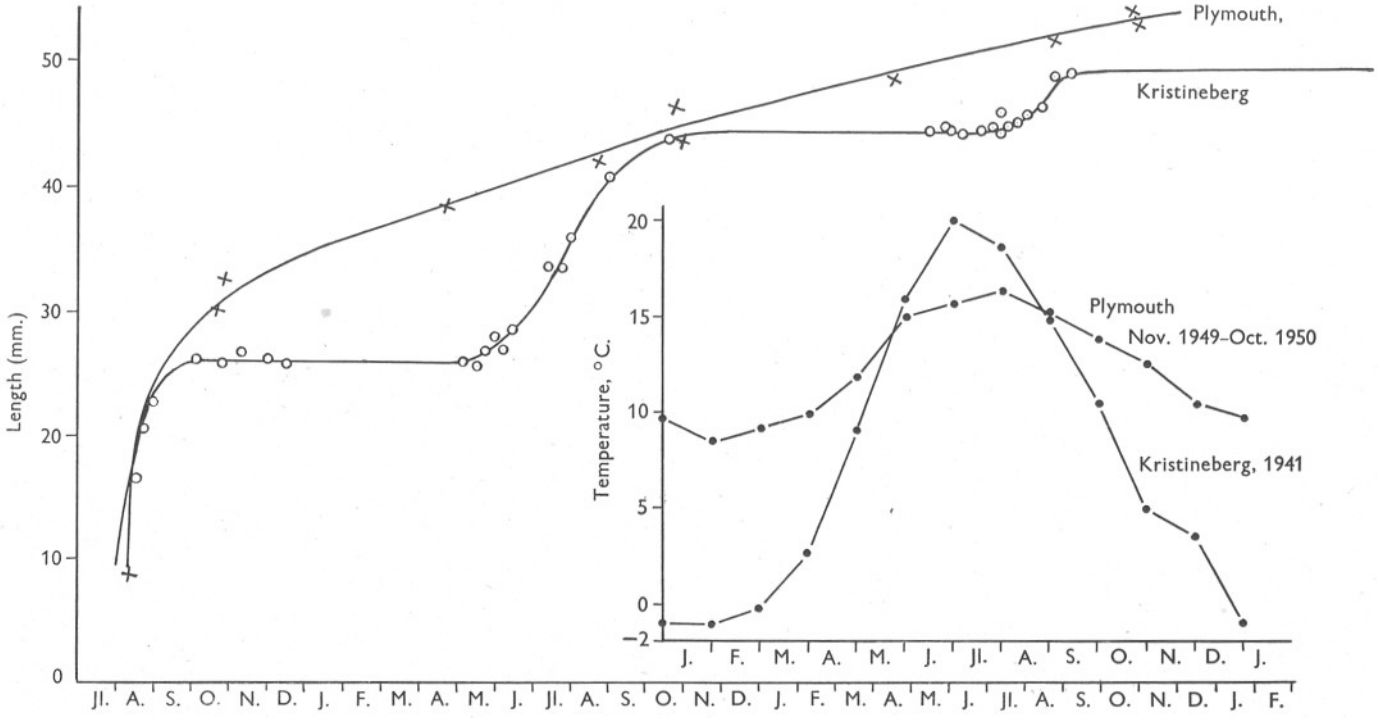

Fig. 4. Age and growth curves of *L. squilla* at Plymouth and in Sweden, together with sea-surface temperatures. Swedish data from Höglund (1943).

somewhat larger at Plymouth. As with *Leander serratus*, both males and females do not appear to survive the third winter, while in 1950, even by the end of October, they had almost disappeared from the catch.

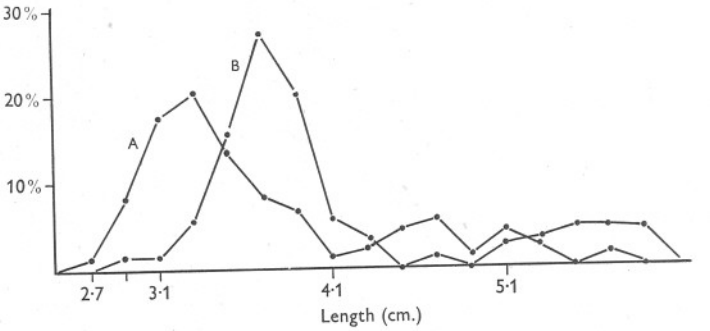

Fig. 5. Comparison of catches from: A, Trevol, 11 November (79); B, Paignton, 21 November (70).

Food

A table of the stomach contents of *L. squilla* appears in the paper on *L. serratus* (Forster, 1951, p. 356). Like *L. serratus* the species is also omnivorous, though in the summer, as the table shows, it seems to select a considerable amount of filamentous algae, especially *Pylaiella littoralis* (kindly identified by Dr M. Parke). In the autumn, however, many crustaceans were also sometimes taken.

Although they did not appear in the stomachs examined, it seems probable that both cypris and nauplius barnacle larvae might commonly be taken in the spring. On one occasion a number of *Leander squilla* in a tank were observed behaving in a peculiar fashion, swimming up to the surface and hovering upside down underneath the surface film. Closer examination showed that they were feeding vigorously on several small swarms of nauplii which had originated from a few large specimens of *Balanus porcatus* attached to a stone on the tank.

Summary

The habitat preferences of *Leander squilla* in the Plymouth area are briefly discussed. Length measurements were taken over a period of 12 months to compare the growth and breeding biology in this area with Sweden.

The 1949 year group grew to a considerably larger average size in October than did the 1950 year group in the corresponding period. The average sea surface temperature was approximately 1·7° C. higher in 1949 and the air temperature about 2·74° C. higher. A more reasonable growth characteristic

was derived by using the mean temperature of the air rather than that of the sea surface, a result consistent with the fact that the species inhabits the upper shore pools.

The O-group males did not move up the estuaries so that the percentage of males was always higher in the Sound. This difference in behaviour, well known in *Crangon vulgaris*, is discussed in relation to the sex ratios found by Höglund (1943).

In contrast with Sweden, growth continued during the winter at Plymouth, and the maximum length attained was slightly higher.

The stomach contents showed a varied diet but with a predominance of filamentous algae.

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