SIZE DIFFERENCES IN CICADAS FROM DIFFERENT PLANT COMMUNITIES

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In 1952 Dr. R. A. Cumber published the only account of the nymphal life history of a New Zealand cicada, based on studies at the **Phormium** Research Laboratory at Paiaka in the Manawatu district of the common grass cicada **Cicadetta muta** (Fabr.), for which, following Myers (1921), he used the name **Melampsalta cruentata** (Fabr.). As well as determining the number and duration of nymphal stages, Cumber investigated the variation in size of a sample of 143 males and 74 females collected during one season from his study area, a flax experimental plantation in which rows of **Phormium** plants were separated by mixed grass pasture. Owing to indications of bimodality in both sexes, Cumber next compared samples of fifth instar nymphs obtained from beneath **Phormium** and from beneath pasture grass a few feet away, finding highly significant differences between them, specimens of both sexes from beneath **Phormium** plants being more robust that those beneath pasture. He concluded that nymphs associated with **Phormium** roots are at a definite advantage over nymphs feeding on annual grasses.

Although Cumber concluded (correctly) that the bimodality was not due to the presence of two closely related sympatric species, the state of systematic studies of **C. muta** and its close relatives in 1969 left a slight possibility that there might indeed be two taxa in the Manawatu lowlands, so on January 2, 1970, one of us (C.A.F.) visited the flax plantations at the Moutoa Estate

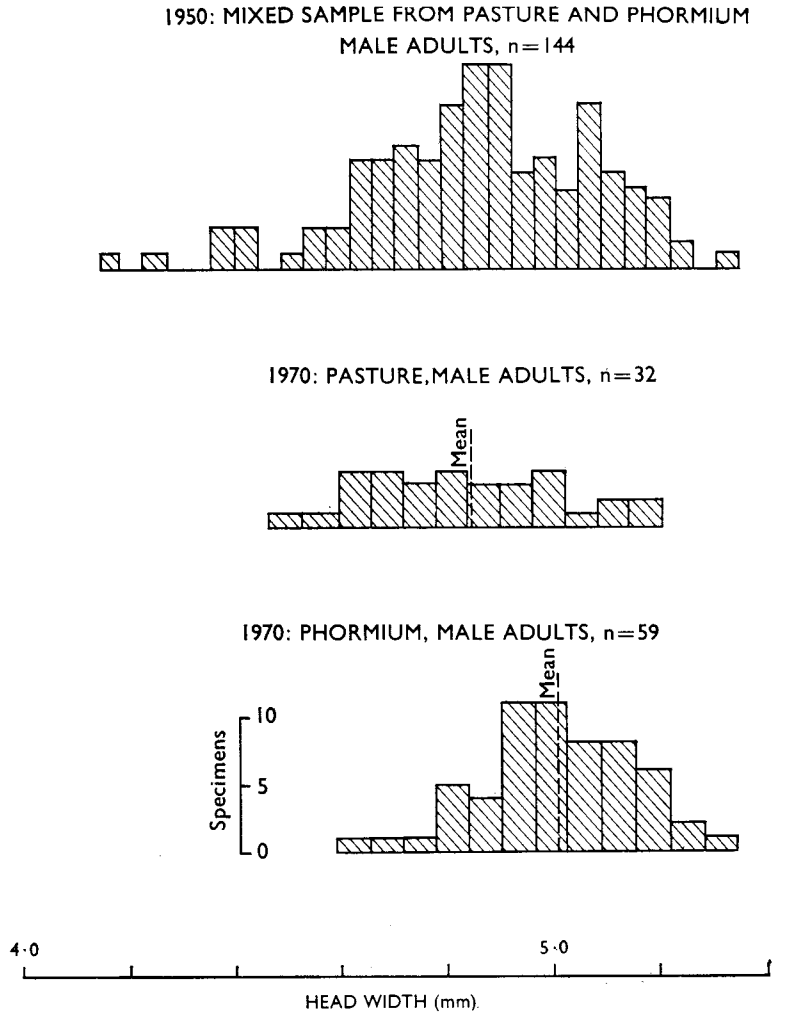

Fig. 1: Frequency distributions of head width in **Cicadetta muta** (males): relation of 1950 mixed sample to 1970 localised samples.

flax scheme, on the north bank of Manawatu River (NZMS1, Sheet N152, grid reference 845132), about 200 m SW of the locality of Cumber's investigations, to obtain specimens and acoustic records. Thirty-two males and 6 females were first collected from rough pasture (lacking **Phormium**) on and adjacent to a levée separating **Phormium** plantations from the Manawatu River flats and then 59 males and 4 females from the rows of **Phormium** plants (separated by grass) extending from about 50 to 600 m north of the levée. The pasture insects were mostly singing on grasses, but some were caught on herbs; the other sample was restricted to insects on **Phormium** plants. The samples were pinned and dried and in March, 1970, the width of the head capsule at the level of (and including) the eyes was measured with a micrometer eyepiece (1 scale unit = 0.0625 mm).

Results: The female samples were too small to give significant results, their ranges and means (in brackets) being 81.5-96 (87.3) units (grass sample) and 83-93.5 (88.2) units **(Phormium).**

Only samples of males are further considered. Frequency distributions of head width for pasture and **Phormium** samples (1970 survey) are plotted on a metric scale (Fig. 1) for comparison with Cumber's data (1952, Table VI). Sample means and 95% confidence intervals for 1970 samples and Cumber's fifth instar nymphs (1952, Table VII) are plotted in Fig. 2 together with the respective coefficients of variation and their confidence intervals. The latter are calculated using the normal approximation.

(1) Cumber's mixed sample of adults from **Phormium** and pasture includes specimens with smaller head widths than were encountered in the 1970 survey. The upper limit of his sample is closely coincident with that of the 1970 **Phormium** collection.

(2) The location of mean head width in the 1970 sample of pasture adults lies close to the major mode in Cumber's mixed sample of **Phormium** and pasture adults. Correspondence betweeen the mean of the 1970 **Phormium** adults and the weak secondary mode in Cumber's sample is less close. The data crudely support Cumber's view that the tendency for bimodality in his sample was due to pooling of individuals from two vegetation types.

(3) The difference in mean head width between the 1970 pasture and **Phormium** samples of adults is highly significant ($t = 4.683$ P 0.001). Cumber obtained a similar result from a comparison of 5th instar nymphs collected from beneath pasture and beneath **Phormium.** Relationships are shown in Fig 2.

(4) Relative variability (coefficient of variation) of head width in 5th instar nymphs and in adults from pasture is closely similar (Fig. 2). In contrast, relative variability in adults from **Phormium** is lower than in 5th instar nymphs from beneath **Phormium.** The data do not establish that the difference is highly

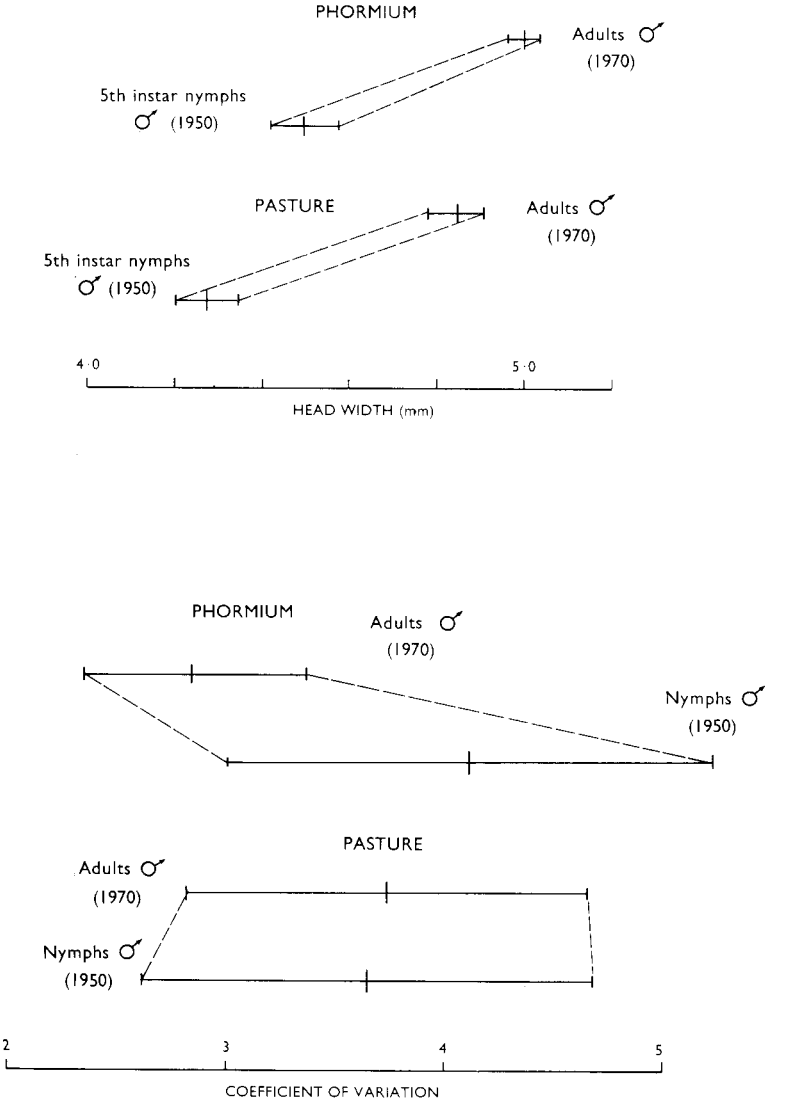

Fig. 2: (Upper). Head widths: mean and 95% confidence intervals for male 5th instar nymphs (1950) and adults, pasture and **Phormium** samples (1970).

(Lower). Relative variability: coefficients of variation and 95% confidence intervals for the same samples.

significant but it is sufficiently marked to merit comment. It is possible that low relative variability in head width in adults living on **Phormium** reflects stronger definition of optimum size in this habitat than in either pasture or in the nymphal habitat below **Phormium.** That adults living on **Phormium** are both larger and less variable than adults living on pasture suggests that something more than nutrition in the organism-environment interaction is required to explain size differences.

CONCLUSIONS

The above results lead to the following conclusions:—

(1) Cumber's demonstration (1952) that cicada nymphs from beneath **Phormium** reach a larger size than nymphs from beneath pasture grass is confirmed by the highly significant difference in size between adult males from **Phormium** and those from nearby pasture.

(2) Adult cicadas on the diverse vegetation of pasture are more variable than those on a monoculture of **Phormium.**

(3) Nymphs from beneath **Phormium** are more variable than the adult males singing on the **Phormium** plants. The reasons for this are obscure but the data suggest factors other than a simple nutritive advantage to cicadas reared on **Phormium.**

(4) Despite their ability to fly considerable distances, adult cicadas, certainly males and probably both sexes, have a strong tendency to remain on the site of their emergence and thus on the vegetation below which they developed as nymphs.

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