

similarity between a portion of its primary structure and a portion of four vertebrate dehydrogenases.

In a private communication, Drs M. Rossmann and C. Brändén have informed us that the portions of three of the four dehydrogenases chosen for comparison are not from comparable areas of their tertiary structure²⁻⁴, and that the statistical treatment given in my paper is inappropriate.

The misalignment of the dehydrogenases does not, of course, affect the primary structure of dihydrofolate reductase shown in Fig. 1 of ref. 1.

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All female butterfly broods

OWEN, Owen and Chanter¹ have invoked Y-linked meiotic drive to explain the high frequency occurrence of all-female broods in some populations of the African butterfly *Acraea encedon*. This mechanism does not account for the following observations² of these populations: first, that they only occur in 'disturbed' areas; second, that females aggregate and lay egg batches in close proximity to each other; and third, that females 'court' other females.

The following explanations are advanced for these observations. First, an environmental disturbance (with its consequent effect upon larval food plants) will alter the spatial relationship between egg batches. In mixed sex progeny this may well increase the probability of the first matings being between brother and sister. All-female

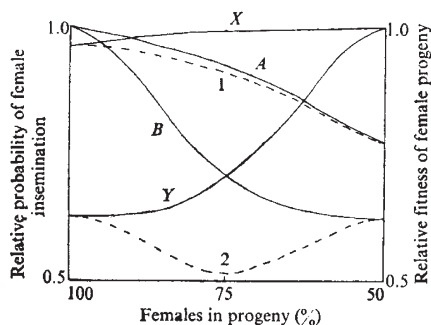


Fig. 1 Net female fitness values (curves 1 and 2) of broods varying in their sex ratio. Curves A and B show a reduction in fitness of females from mixed broods relative to that of all-female broods (as a result of inbreeding). Curves X and Y show the consequent reduction of female insemination probability in all-female broods relative to mixed broods. Net female fitness values calculated by multiplying relative probability of insemination of female progeny by relative fitness of female progeny (curve 1 = $A \times X$, curve 2 = $B \times Y$).

broods do not sustain this disadvantage. Such inbreeding will increase the homozygosity of the genetic environment surrounding the normal Y chromosome and viability loss is a well documented aspect of homozygosity³⁻⁵. Therefore the mutant chromosome will sustain an advantage and spread through the population. As it does so, the probability of all-female broods being laid near mixed broods increases and with it the inbreeding probability of these latter broods.

As male frequency drops, however, mixed brood females have a greater probability of insemination¹. The figure shows that with increased inbreeding the net fitness of all-female broods increases (curve 1) and then reaches equality (curve 2) with respect to mixed broods as male frequency drops.

Second, a mutant female laying its eggs in close proximity to a mixed sex batch will increase the insemination probability of its offspring. The aggregation and egg laying strategies may therefore be accounted for.

Third, any mutant female able to predict oviposition in another female and act as in the second case above will sustain an advantage. This, I suggest, may account for intra female 'courting'.

In non-disturbed (and possibly some disturbed) areas the Y mutant must sustain a net selective disadvantage as evidenced by its non-appearance. The nature of this selective pressure is not yet known.

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DR CHANTER REPLIES—Over the years, we have received many suggestions as to how the curious population biology of *Acraea encedon* might be explained, and we welcome another. There are, however, some difficulties with Manning's explanation of the tendency for the occurrence of all-female broods to be associated with 'disturbed' areas. Here I will confine myself to two of these difficulties, both concerned with the figure.

First, the lines on the graph are quite arbitrary, and the different slopes of curves 1 and 2 result from the fact that while curves Y and B have been drawn as reflections of one another (about a vertical line through the 75% point), X and A have been drawn asymmetrically. It would be easy to alter the asymmetry of curves X and A and reach a different conclusion.

Second, to obtain the net fitness of all-female broods relative to that of females from mixed broods (curves 1 and 2), it is necessary to multiply curves X and Y by the reciprocals of curves A and B rather than by curves A and B as they stand, since the relativity in curves A and B is opposite to that in X and Y.

Manning's explanation of the aggregating behaviour is interesting, but would be more convincing if the eggs laid by participating females were fertile—all the eggs we have collected from aggregations have been infertile¹.

Finally, I must emphasise that we have not established conclusively that the sex ratio trait is caused by a Y-linked gene, and that we also have some idea as to why the trait is not established in some populations, as explained in our paper² in which the peculiarities of an isolated population at Gegbwema in Sierra Leone are described. More recently we have discovered a population at Dar es Salaam in which the trait may be just beginning to appear and we hope that this discovery may yield additional information.

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