SELECTION FOR WEIGHT GAIN IN REDCLAW CRAYFISH

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SUMMARY

Two separate river stocks of Redclaw crayfish *(Cherax quadricarinatus)* were selected for two generations for increased body weight at 7 months. Averaged over both stocks, mean weights of selected and control lines were 46.7 ± .9g and 42.7 ± 1.2g. The realised heritability of harvest weight was 0.24 ± .06. Selection did not alter tail dimensions relative to body weight but reduced the age of sexual maturity.

Keywords: Crayfish, *Cherax quadricarinatus,* selection, growth.

INTRODUCTION

The profitability of Redclaw *(Cherax quadricarinatus)* farming is highly dependant on the age at which market weight is reached (minimum 30g). Examples of successful selection programs to reduce market age abound in farmed animals. Response to such selection depends largely on the variability of the trait and its heritability. Heritability estimates of weight for age obtained over a range of mostly marine crustacea vary from 0.25 to 0.5 (Malecha *et al.* 1984). Redclaw display considerable variability in market weight for age, however there are no estimates of heritability of this trait on which to predict the outcome of a selection program. The principal objective of this project was to estimate by two generations of individual selection, the realised heritability of market weight for age in Redclaw.

METHODS

The two Redclaw stocks, both suitable for aquaculture, were sampled from the Gilbert and from the Flinders Rivers in Queensland. In each stock, 10 cohorts of 5 male and 20 female parents were established in separate 1000*l* fibre glass tanks with a flow-through system in a greenhouse. After mating, males were removed and females redistributed, 20 to a tank, according to the degree of development of their eggs, the aim being to achieve a maximum 2 week range of hatching dates within a tank. Following release of the juveniles, females were removed from the tanks and juveniles reared according to Jones (1995a).

Approximately 2 months after hatching, a weighed sample of 160 juveniles of the base generation 1 was transferred from each tank to a polyethylene mesh cage in an earthen pond. Pond management, described by Jones (1995b) aimed to maximise growth and survival of the crayfish. After 5 months, the pond was emptied and surviving crayfish sexed and weighed and tail length, width and depth measurements made on a random 20% sample. Animals within each cage were ranked on weight and the heaviest 20 females and 5 males taken as parents of the selected generation 2. Males from one cage were mated with females of another. Thus a Gilbert and a Flinders selection line were established, each of 10 cohorts. At the same time males and females of average weight were mated to establish control lines for each river stock. Mating, hatching and growing of generation 2 animals was the same as for generation 1.

To improve the growing conditions for early juveniles (Jones 1995b), female parents of generation 3 were stocked to the pond cages just prior to hatching of their eggs. Two months after hatching, ponds were emptied, all animals removed and 100 randomly chosen juveniles returned to their cages of origin for grow out.

This change of practice improved the survival of the juveniles but a weakness in the cage mesh permitted some migration between pond cages of generation 3 offspring leading to a small but unknown degree of mixing between stocks and lines. This was unlikely to have occurred in generations 1 and 2 so the realised heritability was estimated only on weight measurements made in these generations. However, generation 3 data was included in the overall analysis of variance of stock, line and sex effects. In this generation, sexual maturity was assessed from the percentage of females observed to have eggs attached.

RESULTS

Numbers of crayfish harvested in generations 2 and 3 and their body weights and tail dimensions were subject to analysis of variance (Harvey 1985), effects being river stock, line, sex and generation number. Body weight was corrected by covariance for number harvested (b = -0.2g), and tail measurements for body weight. Error was estimated from cage means.

Data from generations 2 and 3 were combined. For body weight at harvest, significant (p <.05) effects were associated with stock (Gilbert 43.1 ± 1.1g, Flinders 46.3 ± 1.2g), line (selected 46.7± 0.8g, control 42.7 ± 1.2g) and sex (male 47.7 ± 1.1g, female 41.7 ± 1.1g). Only sex had a significant effect on tail dimensions, females having longer, wider and deeper tails than males. A higher percentage of selected line females carried eggs at harvest than controls (38 ± 0.7% vs 22 ± 0.4%).

The superiority of generation 2 selected parents above their generation 1 mean (selection differential) was 19.4 ± 1.1g. The difference between the generation 2 selected and control lines (selection response) was 4.7 ± 1.9g. The ratio of the latter over the former gave a realised heritability estimate of harvest weight of 0.24 ± 0.06 (Hadley *et al.* 1991).

DISCUSSION

This was a first study of the effect of selection on growth rate in Redclaw crayfish. Much was learnt of the management techniques needed to impose a practical individual selection program on the species. A problem of poor viability of young juveniles hatched in the fibreglass tanks in generations 1 and 2 was overcome by transferring hatching to the growing cages in the pond in generation 3. However, the cage mesh used proved permeable to a small number of juveniles allowing them to migrate between cages. To the extent that this may have occurred between selection and control line cages, there would have been a reduction in the difference in mean harvest weights between these lines leading to an under-estimate of selection response in generation 3. Similar migration between pond cages is unlikely to have occurred in generations 1 and 2 since these were stocked by larger juveniles hatched and reared in the fibreglass tanks. Heritability estimates based on data from these earlier generations is therefore unlikely to be biased.

The heritability estimate of 0.24 obtained for harvest weight is at the low end of the range found in studies of other crustacea. It indicates that over 70% of the variation in this trait was due to environmental causes, including measurement error. In this project environmental differences during growth were minimised by confining comparisons for the purpose of selection to crayfish within the same cage and therefore subject to similar growth conditions. However, there would be some error due to lack of knowledge of individual hatching dates of cage fellows. An attempt was made to minimise the effect of this on the accuracy of growth measurement by grouping females contributing offspring to a particular cage on the degree of development and therefore predicted hatching date of their eggs. Further measures to limit the spread in age of cage fellows would be likely to increase the realised heritability of growth. Another possible contributor to the within cage variation found for harvest weight (CV 38%) and thus to a reduced heritability may have been heterogenous individual growth (HIG) similar to that found in male prawns (Malecha *et al.* 1984).

The effect of inbreeding on growth performance in Redclaw is difficult to predict due to lack of prior information. However, from studies in fish (Tave 1993), an adverse effect of inbreeding on growth is to be expected. The subdivision of the lines into cohorts with mating of males selected from one cohort with females selected from another satisfies some of the criteria for within family selection and cyclical mating between families, a known strategy for minimising the rate of increase of inbreeding. In any case it is intended that the two stocks be crossed after a period of selection and this would eliminate any inbreeding which may have accumulated.

A reduction in the age of sexual maturity of the selection relative to the control lines which seemed to occur in this study may not be desirable from the commercial point of view and future selection practices may need to incorporate delayed sexual maturity in their selection criteria.

CONCLUSION

Worthwhile gains in harvest weight are possible in Redclaw through the application of low cost individual selection techniques. Increased rates of improvement are likely by better synchronisation of hatching dates, by increasing the number of crayfish measured per family and by improving the security of grow-out cages.

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