Inbreeding Depression and Ovule Pre-emption in *Bulbine bulbosa* (R. Br.) Haw. (Asphodelaceae)

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This thesis is dedicated to

Neville Owen Walker. 1928 - 2006

Declaration

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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Abstract

This thesis examines the causes of self-sterility and consequences of inbreeding on seed set and progeny fitness in *Bulbine bulbosa* (Asphodelaceae). I conducted my research utilising both glasshouse plants and natural populations of *B. bulbosa*.

I investigated the causes of reduced self-fertility. Two mechanisms can be responsible for self-infertility in hermaphroditic flowers: physiological self-incompatibility and inbreeding depression. I conducted a histological investigation of ovule development after self- and cross-pollination, up to 7-days post-pollination. Examination of cleared specimens at 2-days post-pollination indicated that the mechanism reducing self-fertility was post-zygotic because double fertilisation was apparent after both self- and cross-pollination. This eliminated gametophytic and sporophytic self-incompatibility. Examinations of ovule development at 5- and 7-days post-pollination indicated that abortion was significantly higher after self- compared to cross-pollination. There was no indication that the arrest of selfed ovule development occurred at a single stage, eliminating a late-acting physiological self-incompatibility mechanism. The evidence indicated that reduced self-fertility was probably due to early-acting inbreeding depression.

I investigated the effects of inbreeding on progeny fitness after selfing and mating between related individuals. The fitness of inbred progeny was assessed at ovule fertilisation, seed set, seed mass, seed germination, seedling growth and survival, days to first flower, number of inflorescences and flowers, and ovule and pollen production. After complete selfing and biparental inbreeding, inbreeding depression reduced progeny fitness at all life-cycle stages except ovule fertilisation, seed mass and, percent and speed of seed germination. Cumulative uniparental and

biparental inbreeding depression was 0.99 and 0.74 respectively, indicating it was unlikely inbred progeny would survive to reproductive maturity.

I also examined mating between plants found in close proximity.. Close proximity matings resulted in reduced seed set compared to mating between individuals at further distances. Individuals found in close proximity are likely to be related and mating between these individuals probably represents biparental inbreeding

I examined pollen limitation and self pollen interference. Natural seed set was pollen limited in three flowering seasons. The quantity of pollen deposition exceeded the number of ovules 5-fold in each year. Open seed set was less than cross seed set yet fertilisation rates were similar, indicating that natural seed set was limited by the quality, but not the quantity, of pollen deposited onto the stigmas. Supplementing open pollinated plants with cross pollen did not increase seed set, because ovules had already been fertilised by poor quality pollen. In a pollen chase experiment, the application of cross pollen after self pollen also failed to increase seed set compared to self-pollination, indicating that self-pollen tubes interfere with cross pollen by pre-empting ovules.

I conclude that inbreeding facilitated by both selfing and mating between related individuals is costly to *B. bulbosa* populations. Inbreeding results in inbreeding depression causing ovules to abort reducing natural seed set. Consequently, these ovules are wasted and are unavailable for outcrossing. Inbreeding reduces fecundity and potentially recruitment to successive generations. Finally, inbreeding depression is a major selective force maintaining a predominately outcrossing mating system in *B. bulbosa*.

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