DIRECT METHODS FOR COMPUTING PERTURBATION ANALYSES, WITH APPLICATION TO THE LONG-LIVED PERENNIAL ORCHID *HIMANTOGLOSSUM HIRCINUM*.

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A fundamental component of modelling population dynamics using matrix models is to understand the effects of perturbations on key parameters. A direct method of perturbation analysis, utilising the characteristic equations of population projection matrices, is reviewed and compared to the classical approach involving sensitivities and elasticities. Through using the symbolic algebra package *Maple* and applying the definition of perturbation analysis, exact expressions for the relationship between perturbation and the asymptotic growth rate are obtained. These are used to investigate how the nature and degree of curvature varies for different types of parameter within the model. The direct method of perturbation analysis is compared to an alternative approach that utilises a 'transfer function' to obtain the exact relationship, and these are shown to be mathematically equivalent. These methods of perturbation analysis are applied to a 15 year data set for the orchid species *Himantoglossum hircinum*. This provides an illustrative example of the potential impacts of using linear approximations via sensitivity analyses in preference to the exact relationship when predicting the effects of parameter perturbation on the dynamics of populations.