ESTIMATION OF SELECTIVE PRESSURES USING MIXTURE MODELS

D.A.J. Ryan

University of Prince Edward Island, Charlottetown, Canada

Email: *dryan@upei.ca*

Mixture models are used to identify the presence of selection and estimate the proportion of a wild population selectively removed during an at-risk period. This is accomplished by assuming that the population before the at-risk period (reference population) represents a mixture of two groups of individuals: those that will survive the period of mortality, and those that will not survive. Since both groups are members of the same population, estimation of the mixing proportion may not be possible using only a sample from the reference population. However, it is often the case that samples from one or more of the mixture components are also available. In the case of wild fish populations, survivors of the at-risk period represent a sample from one of the two components in the reference population. Using these samples, a likelihood ratio test provides a simple method for detecting the presence of selection. One difficulty with the likelihood ratio test statistic is that its asymptotic distribution breaks down under the null hypothesis. This breakdown has been well documented in the literature, and various adjustments to the asymptotic distribution have been suggested to correct this problem. In this study, the likelihood ratio test statistic is developed, and the significance level of the statistic under the null hypothesis is assessed using a variety of the proposed adjustments and a randomization test. A study simulating various levels of selection and different sample sizes was carried out. It was found that in general the randomization test performed better than the corrected tests, and performed reasonably well even at small sample sizes. A maximum likelihood estimate and confidence interval for the mixing proportion was also calculated. Confidence intervals were estimated using both a simple asymptotic confidence interval and a bootstrap technique. Based upon the simulation study, neither confidence interval faired well at any combination of the selection or sample size, with both methods giving much higher than stated coverage probabilities.

In summary the proposed method of modelling selective pressures using mixture models appears to provide a reliable method for detecting selection, but better methods for developing confidence intervals are required.