

ABSTRACT

This thesis addresses the question whether natural mortality can be estimated reliably in a heavily exploited fish population such as Irish Sea plaice and if so whether the natural mortality on this population is the same as the values found for plaice in the North Sea. The method used for estimating natural mortality involves the analysis of tagging experiments and the data consist of fish recaptured from a large series of experiments carried out along the North Wales coast and off the Irish coast during the early 1960's and a new series of experiments off the North Wales coast during 1979 and 1980. The latter experiments were designed and carried out specifically for the present work. All the tagging used Petersen discs.

Available methods for analysing tagging experiments are reviewed and a new method using a minimization routine based on cohort analysis is developed. The assumptions underlying the new method are i) that the product of initial survival after tagging and rate of reporting of recaptures (SB) is constant for all experiments and (ii) that the SB are lognormally distributed. These assumptions were tested and found to be plausible. Simulated data with known parametric values were used to check the minimization routine and the sensitivity of the estimators to errors in the input data and auxiliary parameters.

A procedure and flow chart is given for selection of data prior to analysis in order to ensure that the assumptions underlying the method are fulfilled. A number of auxiliary parameters which are needed for the estimation of natural mortality are calculated. The fishing mortalities experienced by the Irish Sea tagged fish population were found to be high and the SB values were found to be low, of the order 0.37, but fairly constant for all experiments. The tag loss rate was low, of the order 0.028 (± 0.008). Tag planting experiments indicated that 94% of tagged fish which passed through fishermen's hands undetected were subsequently reported. The natural mortality values obtained from the minimization routine were 0.166 (± 0.063) for male plaice and 0.108 (± 0.083) for female plaice for the Irish Sea. These estimates were found to be higher, more precise and more representative of the adult ages of plaice than the estimates for North Sea plaice made by Beverton and Holt (1957). The less precise estimate for female plaice leaves open the possibility of higher natural mortality as well as similar natural mortality among both sexes in the Irish Sea. Applying the estimation procedure only to mature male plaice gave a natural mortality value of 0.117, which suggests that natural mortality may vary with age and may be lower on mature fish.

Suggestions are made about the design of tagging experiments and the analysis of results in order to estimate natural mortality.