Bayesian inference of discrete parameter, including population size, is sensitive to the choice of priors. In this dissertation I will develop objective priors for several population size parameters appeared in different models. Complete Bayesian analysis for several datasets will be presented.

In the first part, a capture-recapture model (M_t model) is studied and the objective prior for the population size is developed. Simulation results demonstrate the advantages of the objective prior over the ad-hoc non-informative priors. Two real data examples are presented.

In the second part, another capture-recapture model (M_th model) is studied. The capture probabilities are modeled by both time effect and individual covariates via logit link function. A detailed analysis of Turtle data is presented to demonstrate our model and method.

In the third part, I consider the survival model with exponential failure rate and type-I censored failure times. The total number of failures is unknown due to censoring and needs to be estimated. The problem is attacked with a hierarchical Bayesian model. Simulation results are reported to compare several objective priors.