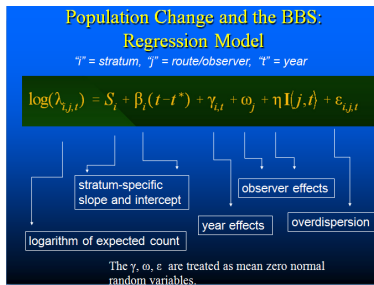


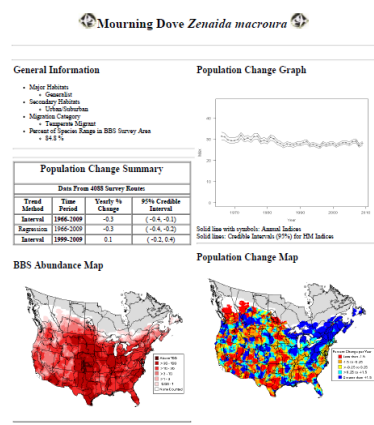
## Design and Analysis of Surveys for Estimation of Temporal and Spatial Change in Animal Populations



- The Challenge:** Population status information is required for management of migratory bird populations, and structured decision making and adaptive management place additional emphasis on the need for rigorous survey designs and robust estimation methods. The North American Breeding Bird Survey (BBS) and Christmas Bird Count (CBC) provide continent-scale information on breeding and wintering populations of >450 species of North American birds, and for many species these two surveys are our only data source for population status and trend information. Appropriate analyses of these important surveys require sophisticated methods to accommodate variation in survey efficiency over the large areas covered by the surveys and to control for factors that influence detection of birds. Factors such as observer quality and effort, if not appropriately controlled for in the analysis, can lead to biased estimates of population change.



- The Science:** We have developed and implemented hierarchical log-linear models for analysis of BBS and CBC data. These models control for observer differences in counting along BBS routes by treating observers as random effects and including a start-up effect that models lower counts for the first year an observer surveys a route. Effort effects in CBC data are controlled for by including a 2-parameter model component, that allows the effort adjustment to vary by species or region. For both of these surveys, hierarchical components control for regional differences in survey quality, allowing for estimation of composite population indices at the continental scale.



- The Future:** Hierarchical models have been fit to BBS and CBC data, and a comprehensive analysis of BBS data is featured on the BBS Analysis and Summary Website (<http://www.mbr-pwrc.usgs.gov/bbs/bbs.html>). These analyses provide a reasonable means of summarizing complicated data sets, and the modeling is extremely flexible, permitting incorporation of spatial effects, covariates, and integration of multiple surveys to address seasonal effects and complex dynamical features. Hierarchical model results are featured in the 2009 State of the Birds report (<http://www.stateofthebirds.org>). Collaboration with National Audubon Society staff is underway to complete an analysis of long-term changes in populations of wintering birds.