LAB 9. OCCUPANCY MODELS

<u>Modelling the spatial distribution of a species</u>

A fundamental goal in landscape ecology is to understand how landscape structure shapes variation in the abundance of species. We will use data from the Swiss Survey of Common Breeding Birds to model habitat occupancy by a common, resident bird in the Swiss Alps, the willow tit (*Parus montanus*). The data come from annual surveys of 1 km^2 quadrats distributed across Switzerland (Fig. 1, File: *"Swiss BB data.csv"*). Surveys are conducted during the breeding season on three separate days, but some quadrats have missing data so that the number of replicate observations is less than three. During each survey, an observer records every visual or acoustic detection of a breeding species and marks its location using a GPS or paper map. Because we are observing a resident species during the breeding season, we assume that the true state (occupied or unoccupied) does not change among sample dates. We will use occupancy data, which = 1 if the bird is observed and 0 if it is not observed (columns y1, y2, y3 in the data file). In our analysis we wish to understand the influence of forest cover and elevation on the distribution of the willow tit. For each quadrat searched, we have data on forest canopy cover (% closure, column forest) as well as elevation in meters (column elev).

The challenge in these data is that failure to observe the bird can mean two different things: the bird was truly absent from the quadrat or the bird was present and unobserved. It follows that we must estimate the probability that the bird is present and the probability that we would detect the bird given that it is present.

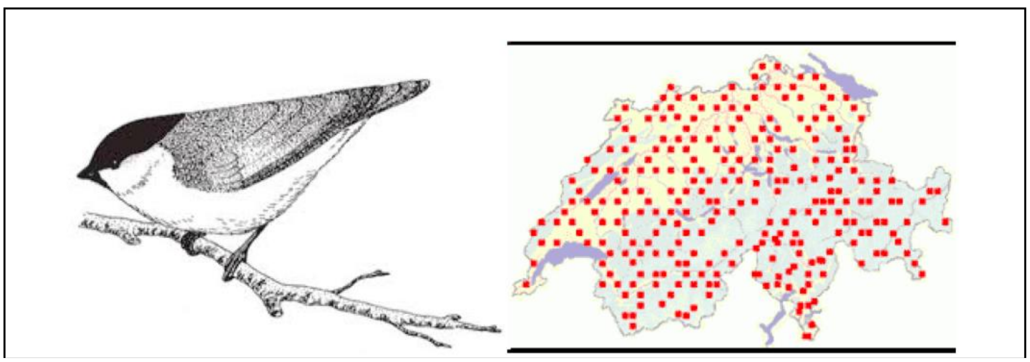

Figure 1: The willow tit (left) is one of 70 bird species that are surveyed annually for abundance in 2,671 Km^2 sampling units distributed across Switzerland (right).

Develop a model that allows you to evaluate the influence of forest cover and elevation on the distribution of willow tits. Diagram the network of knows and unknowns. Write out a mathematical expression for the posterior and the joint distribution of the data and the parameters. Estimate the posterior distributions of the model parameters using JAGS. Estimate the posterior distribution of a derived parameter, the optimal elevation of the habitat for the bird. Write 2-3 paragraphs describing your results with appropriate statistics and figures.