For the model `twolevelrandomslope2.stan`, which has one hierachical level for species, represented here by j, each observation is i, and partial pooling on the slopes (β) only:

$$y_i = \alpha_{j[i]} + \beta_{j[i]} X_i + \epsilon_i \tag{1}$$

$$\beta_j \sim N(\mu_\beta, \sigma_\beta) \tag{2}$$

Which is the same as this:

$$y_i = \alpha_{sp[i]} + \beta_{sp[i]} X_i + \epsilon_i \tag{3}$$

$$\beta_{sp} \sim N(\mu_\beta, \sigma_\beta) \tag{4}$$

Or this:

$$y_i = a_{j[i]} + b_{j[i]} X_i + \epsilon_i \tag{5}$$

$$b_j \sim N(\mu_b, \sigma_b) \tag{6}$$

Or this:

$$y_i = \alpha_{j[i]} + \beta_{j[i]}(Year_i - 1981) + \epsilon_i \tag{7}$$

$$\beta_j \sim N(\mu_\beta, \sigma_\beta) \tag{8}$$

Or this:

$$y_i = \beta_{0j[i]} + \beta_{1j[i]}(Year_i - 1981) + \epsilon_i \tag{9}$$

$$\beta_{1j} \sim N(\mu_\beta, \sigma_\beta) \tag{10}$$

My personal favorite of all possible combinations:

$$y_i = \alpha_{sp[i]} + \beta_{sp[i]}(Year_i - 1981) + \epsilon_i \tag{11}$$

$$\beta_{sp} \sim N(\mu_\beta, \sigma_\beta) \tag{12}$$

Note that I did not write out the priors on μ_β and σ_β and the α_j, which are not specified and thus are uniform. I think you could just say in the text that we used the default priors. Also note that I think you could leave the $_\beta$ off μ and σ if you really wanted, but perhaps nice for clarity?

See also: 12.5 in Gelman & Hill, pages 262-265.