F&WL 502
Lab 10 – Occupancy models for single-species, single-season

This week's lab provides you with an introduction to single-species occupancy modeling. You'll first run a simple pair of models in MARK on a salamander example. Next, you'll use Program PRESENCE and work with data from multiple observers and use a habitat covariate.

A. Salamander data: work in Program MARK using *salamanders.inp* and the occupancy model type to run two models *psi, p(t)* and *psi, p(.)*.
    1. How many occasions are there in the study?
    2. How many plots were used (*S*) and how many plots were salamanders detected on?
    3. What was the proportion of plots on which salamanders were detected, i.e., what was the naïve estimate of occupancy?
    4. Based on the *psi, p(.)* model, what was your estimate of *p**?
    5. Use the count (C) of sites where the species was detected and your estimate of *p** to estimate the number of sites occupied (N).
    6. Use the number of sites (*S*) and your estimate of the number of sites occupied to estimate the proportion of sites occupied. How does this value compare to the estimate of *psi* that you obtained from the *psi, p(.)* model?
    7. What do you infer from the modeling results about *psi* and *p*?

B. Weta data: download and install PRESENCE from the following site: http://www.mbr-pwrc.usgs.gov/software/bin/setup_presence.zip. Once you have the program installed, start the program, click on Help, and work through "Single-season Tutorial 2." The excel file for the Weta data is put on your computer as part of the installation, but to make this a bit easier, I've also put the file on the course web page (Weta_pg116.xls). As you work through the steps in the tutorial, pay close attention to each step and follow instructions carefully. If you've done things properly, you should get a results table with results that match the subset of results provided below. Run each model listed below and fill in the model-selection results.

Model	AIC	deltaAIC	AIC_wgt	Model_Like	no.Par.	-2*LogLike
psi(Browse),p(Day+obs)	257.60	0.00		1.0000	9	239.5994
psi(.), p(Day+obs)			0.17			
psi(.),p(Day+obs+Browse)			0.11			
psi(Browse),p(Day)						
psi(Browse),p(Day+Obs+Browse)						
psi(.),p(Day)						
psi(.),p(Day+Browse)						
psi(Browse),p(Day+Browse)						
psi(Browse),p(Obs)						
psi(Browse),p(.)						
psi(.),p(.)						
psi(Browse),p(Browse)						
psi(.),p(Browse)	266.45	8.85			3	260.4498

If you have trouble, examine the data file in PRESENCE (View menu, 'Data') and make sure that each part of the file is correct: check each tab: Presence/Absence data, Site covariates, and each of the 2 sample covariates ('obs1' and 'obs2'). Finally, I've posted a pdf of pages 116-122 of the PRESENCE book for you so you can see what the authors wrote about the work (http://www.montana.edu/rotella/502/Weta_text.pdf).

1. Use competing models to evaluate whether *psi* seems to be influenced by browsing or not. To do so, it's important to have appropriate models of *p*. Consider models that evaluate whether *p* is best modeled as a function of *Browsed*, *day, and/*or *observers* (We'll always use both '*obs1'* and '*obs2*' when modeling *observer* differences, but this wouldn't have to be done this way. For example, if you though that observers 2 & 3 might be the similar in their ability to detect the species, you might only use '*obs1'*.) Which models are best supported? [Note: the researchers provide an interesting discussion of the fact that there was an *a priori* prediction that browsed sites would have higher occupancy. Thus, they noted that it might well be most appropriate to construct 1-tailed confidence intervals for the beta-hat associated with the effect of browsing on *psi* (see their text for more on this topic).]
2. What are the estimated beta's and estimates of associated precision for coefficients in the top model?
3. Given that the beta's were estimated with a logit link function, what are the estimates of *psi* from the top model for browsed and for un-browsed sites? Be sure to (a) show how you would obtain those estimates (what equation you would use) and (b) provide a measure of uncertainty (look through results for the model to find this information).
4. How do the estimates of *psi* from occupancy modeling compare to the naïve estimates obtained by simply calculating how many plots had the species detected on them?
5. Given that the beta's were estimated with a logit link function, what are the estimates of *p* from the top model for each day and for each observer?
6. What are some reasons that detection probabilities might differ among observers? Please provide an example where detection probabilities might differ among observers for occupancy surveys of a species that is of interest to you.
7. Please provide a table of estimated occupancy (& associated precision) for browsed and unbrowsed sites from each model within 4 AIC units of the top model (stopping there to save you time, but you could go through the whole list if you wanted to) using the table format I provide below. Given those values, what inferences can you draw from the results? I encourage you to read over what the authors had to say in their book.
8. Given the results, what recommendations would you make to managers trying to preserve Weta?
9. Please briefly describe a situation where occupancy models would be useful for species of interest to you.

Model name	Model weight	Browsed site		Unbrowsed Site		Difference[1]
		$\hat{\psi}_{browsed}$	SE	$\hat{\psi}_{unbrowsed}$	SE	$\hat{\psi}_{browsed-unbrowsed}$
psi(Brow),p(day+obs)	0.2859					
psi(.),p(day+obs)	0.1778					
psi(.),p(day+obs+brow)	0.1157					
psi(Brow), p(day)	0.1139					
psi(Brow),p(d+obs+brows)	0.1052					
psi(.), p(day)	0.0580					
psi(.),p(day+brow)	0.0477					
psi(Browse),p(day+brow)	0.0425					

[1]Note: We would want to provide a confidence interval on the difference here and could use the delta method to do so. This would involve working with the variance-covariance estimates for the beta's that are used to construct estimates of psi in the relevant model.