Multi-season occupancy study design.

Project Description and Context

In this module, we shall determine the effects of different study designs on the precision of occupancy estimates using "expected-value" data. Since data collection can be expensive with repect to time and money, it makes sense to try to get the most information from the effort applied. The way this is done is to pretend that you know true population parameters (occupancy, colonization, extinction, detection), *generate data* with those parameters, then analyze the generated data with PRESENCE to see how precise the estimates are.

The "*generate data*" phrase, can mean one of two things: 1) simulate detection histories using a random number generator, or 2) compute the expected numbers of sites with each possible detection history. Simulating data gives more realistic results when sample sizes (and/or) parameters are low, but many simulations are needed in order to get consistent results. Computing expected detection histories will give consistent results, but is predicated on the assumption that sample-sizes are infinite.

As the precision of occupancy estimates is determined by sample size (number of sites and surveys) as well as the true values of the parameters (psi, gamma, epsilon, p), an important question when designing a study is whether higher precision can be obtained by implementing more surveys on fewer sites, or more sites with fewer surveys. The following two designs were proposed which have a fixed amount of effort (total sites X surveys).

Design 1: 24 sites, 2 surveys per season at each site for 4 seasons. (effort = 24 X 8 = 192)

Design 2: 12 sites, 2 surveys per season at each site for 4 seasons, 24 sites surveyed twice per season in seasons 2 and 4 (effort = 12 X 8 + 24 X 4 = 96 + 96 = 192).

Design 1 samples fewer sites (24) more extensively (8 times each), while Design 2 samples more sites (36), less frequently.

Reference:

Bailey, L., Hines, J.E., Nichols, J. D., Hines, J.E., MacKenzie. 2007. Sampling design trade-offs in occupancy studies with imperfect detection: examples and software. Ecological Applications, 17(1): 281-290.

Exercise Objectives

- Learn how to generate simulated or expected value data using GENPRES
- Learn what input is needed in order to address questions about precision and/or power.

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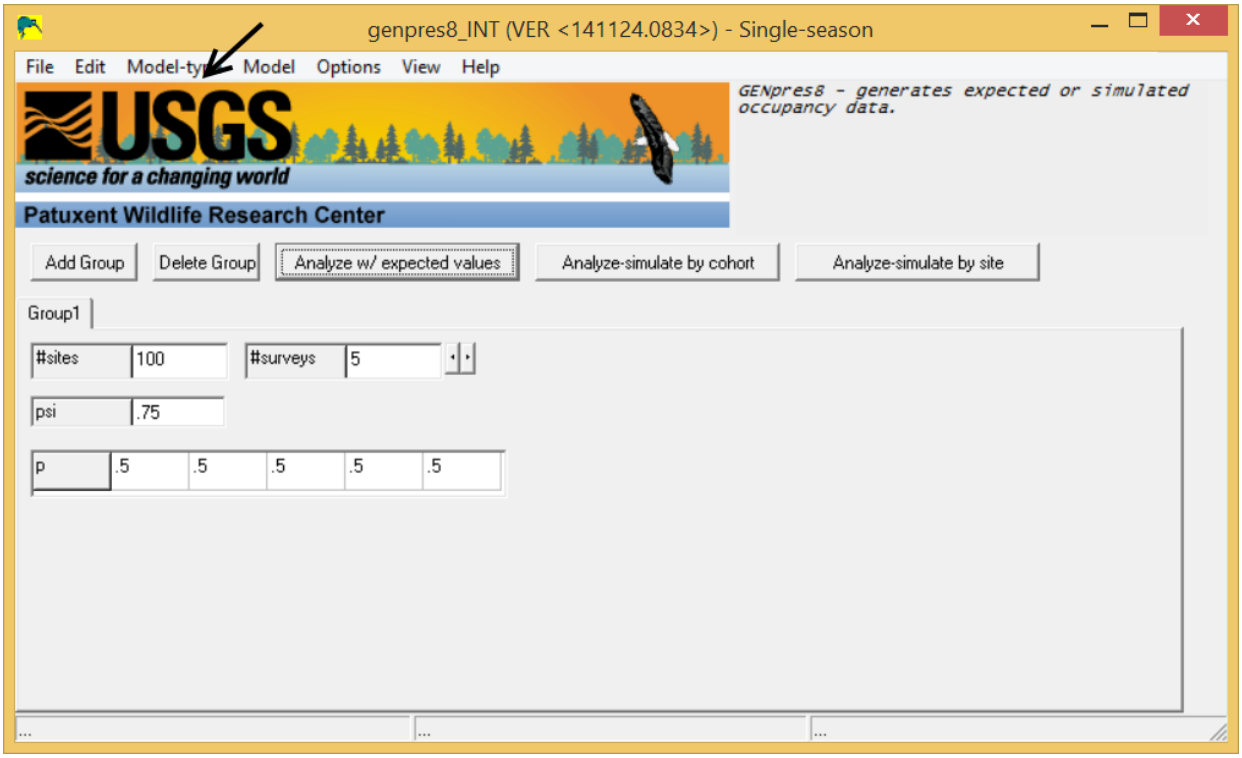
INSTRUCTIONS

Step 1 – Data Generation for Design 1: Begin GENPRES and select the 'Multi-season' model type from the model- type menu.



From previous studies and/or expert opinion, true occupancy is believed to be 0.6, detection 0.25, extinction 0.2, and colonization 0.1.

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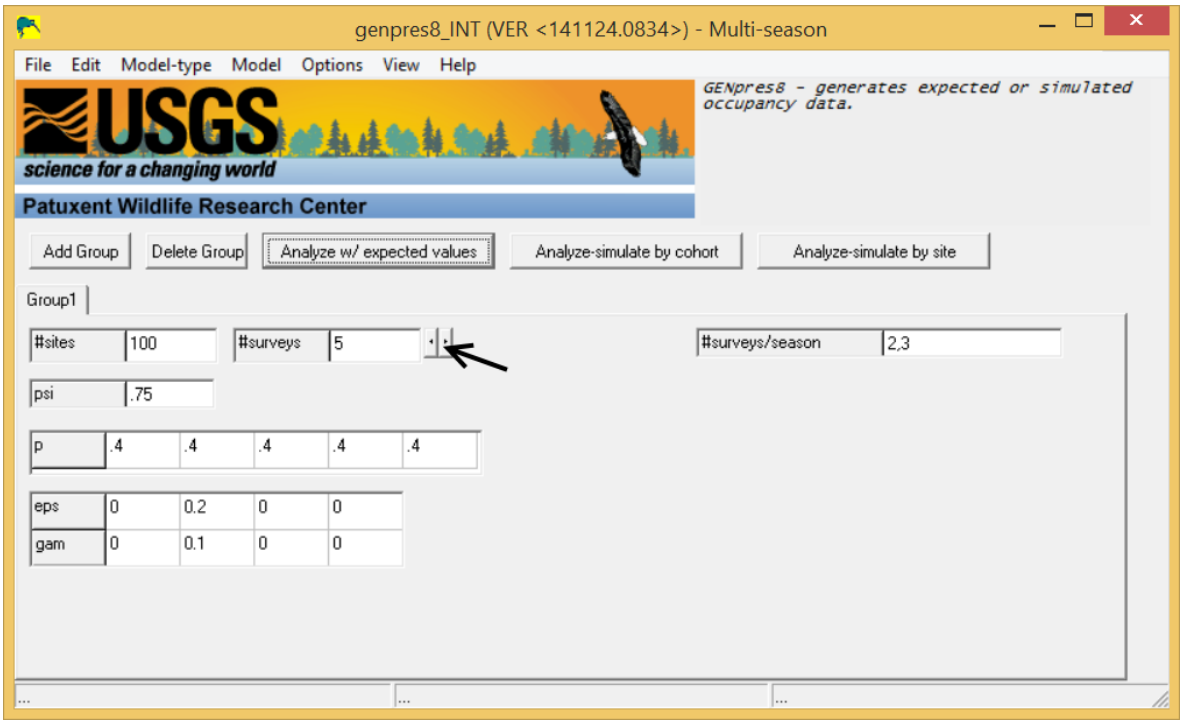
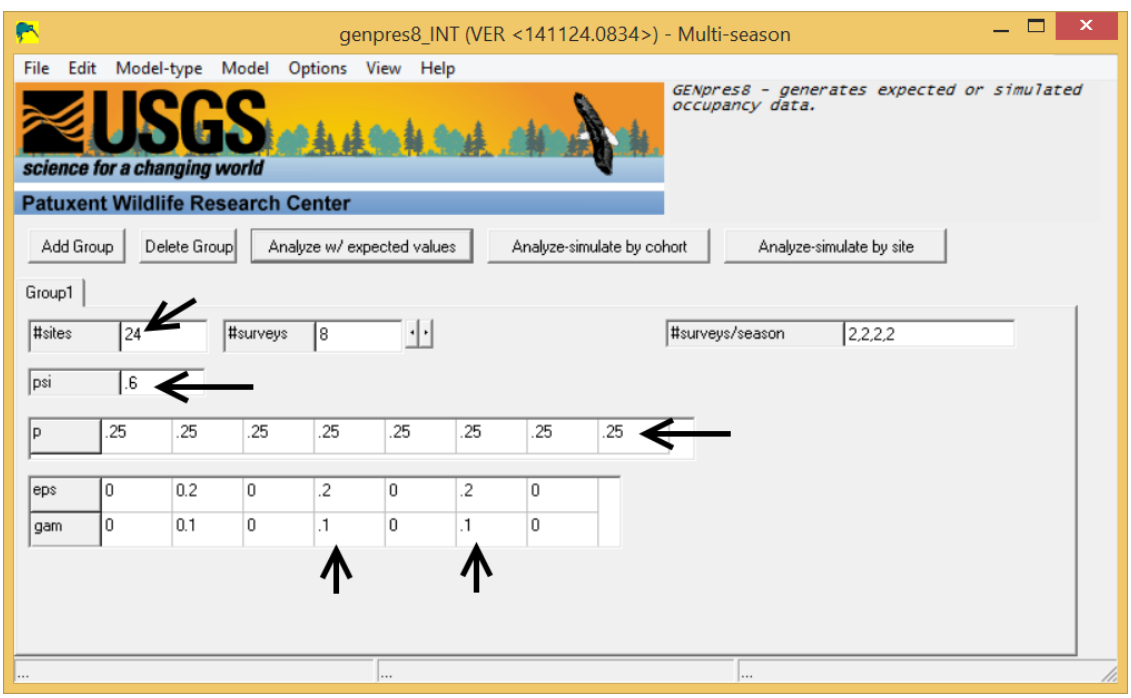
Change the number of surveys to 8.



Change the number of sites to 24, occupancy (psi) to 0.6, detection probabilities (p) to 0.25, extinction (eps) to 0.2, and colonization (gam) to 0.1. Note that there are 2 surveys per season, so colonization and extinction between within-season surveys is zero.



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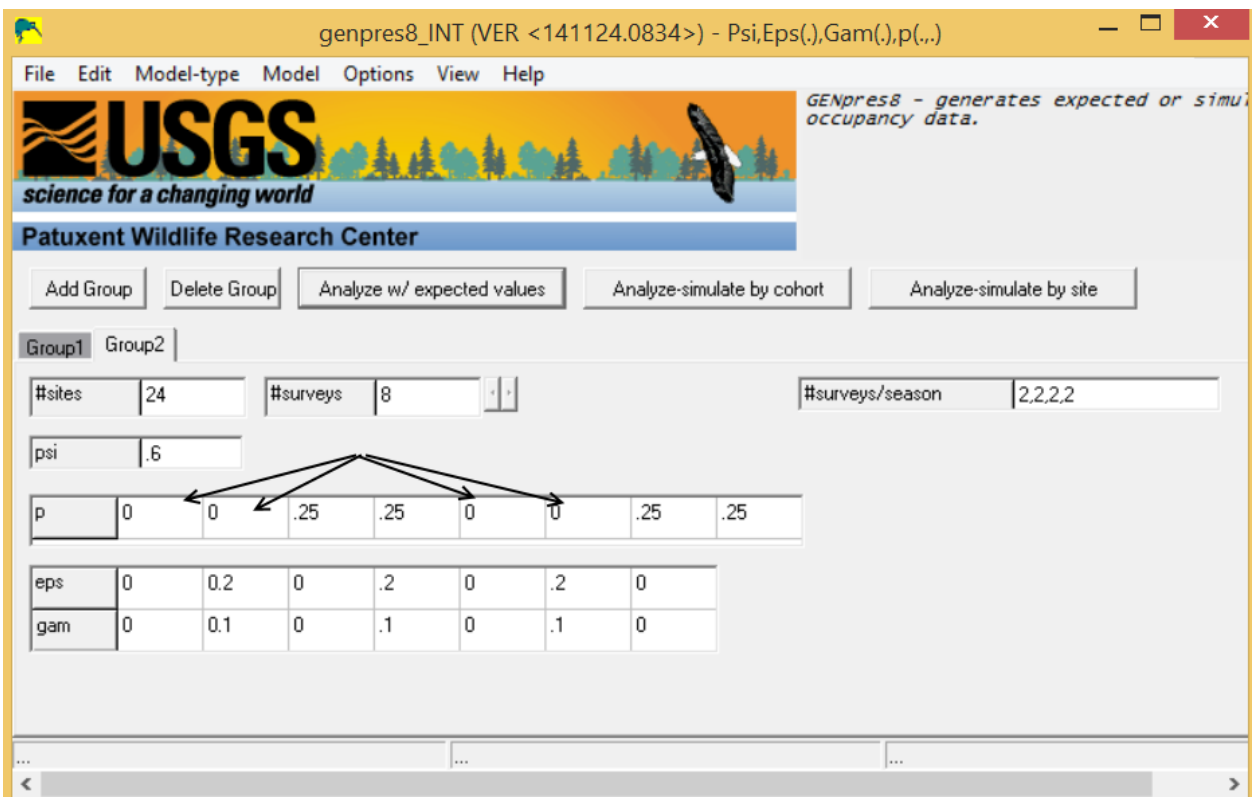
Step 2 – Select model for analysis: From the Model menu, select the model, "Psi(.),gam(.),eps(.),p(.,.)". De-select the default selected model.

Step 3 – Generate data and run the model : Click the "Analyze w/ expected values" button. GENPRES will produce an output file and open it with Notepad. Save this output file as "Design1output.txt".

Step 4 – Data Generation for Design 2: Return to GENPRES and change the number of sites to 12. Next, click the "Add Group" button and click on the "Group 2" tab. Change the number of sites for group 2 to 24 and change the detection probability for surveys 1,2,5,6 to 0.0. In summary, group 1 will have 12 sites with 0.25 probability of detection at each of the 8 surveys. Group 2 will have 24 sites which will not be surveyed in the 1st two occasions or occasions 5 and 6 (p=0.0), but will have a probability of detection =0.25 in surveys 3,4 and 7,8.



Step 5 – Generate data and run the model : Click the "Analyze w/ expected values" button. GENPRES will produce an output file and open it with Notepad. Save this output file as "Design2output.txt".

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Exercise:

Multi-season occupancy study design exercise:

Compare the precision of occupancy estimates from a 'Standard' design vs, a 'Rotating Panel' design. Which design yields a more precise estimate of initial occupancy?

A third potential design was one where 18 sites were surveyed in all 8 surveys (144 surveys), 6 sites were surveyed in surveys 1 and 2 only (12 surveys), 6 other sites were surveyed in surveys 3 and 4 only, 6 sites were surveyed in surveys 5 and 6 only, and 6 sites were surveyed in surveys 7 and 8 only. Does this design yield better precision for the estimate of initial occupancy than the other two?