ST 506 Sampling Animal Populations
Exam 2. Due Tuesday November 11, 2008

You may use any notes or books but must not talk to anyone except me about this test. This is very important.

My exams are meant to help you learn the material. Please ask me when you have any need for clarification on what questions mean. However, I plan on making you work a little more without my help this time than in the first exam.

With this signature I verify that I did not accept any help whatsoever on this take home exam.

Name: _____

Signature: _____

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1. (25 pts) Let us look at our mythological species the phoenix again. First a CJS study was done where 1000 animals were tagged at time 1 and then resighted in periods 2 and 3 generating the following data:
   111 26;
   101 102;
   110 134;
   100 738;
   Run the appropriate software and estimate the first survival rate using the best model. Present your output.

   Next a 3 period band-return study was done with 1000 tagged each year generating the following matrix of recoveries

Band	1	2	3
1000	100	90	81
1000		100	90
1000			100.

   Run the appropriate software and estimate the first survival rate using the best model. Present your output.

   Present the two estimates of survival for period 1 with their SE's. Explain why the two estimates could be different. Use these two estimates to obtain an intuitive estimate of another important parameter and explain what it is and why it is important.

2. (10 pts) This question concerns different approaches to estimating survival rates. I would like you to contrast the assumptions needed for a band-return (tag-return) based survival estimate and a survival estimate based on age distributions (life tables). Then discuss the strengths and weaknesses of studies using both approaches. (1 page answer).

3 (20 pts) Some short answer questions follow:
--What component of the capture history does the Cormack-Jolly-Seber model use?

-- Just what nationality was Richard Cormack?
-- What parameters are estimated in the CJS model and what option in MARK is used?
--Who were the first authors to come up with the more realistic super population modeling approach for handling recruitment in open capture-recapture models?
--In the super population model what constraint is necessary on the entry probabilities?
--In the old fashioned Jolly-Seber approach how does one estimate the number of new animals entering the population?
--Write down the cell probability structure for a history 011 if one is using the super population model.
--Would you say apparent survival rates or recruitment numbers are usually estimated with better precision for open capture-recapture data?
-- Do standard open capture-recapture models allow for unequal catchability of animals?
-- If one was concerned about possible tag loss in an open popn model application first what would be the direction of bias of apparent survival estimates and second how should one solve the problem at the design stage?

4. (10 pts) Many years back I was working with a biologist on an alligator capture-recapture study. He also mentioned that the alligators had a very wide range of lengths and that the large ones were harder to capture. At first he told me he had a 4 year study and ran a standard Jolly Seber model based on whether an animal was captured or not in a year. That is an analysis with standard 4 period capture history information. In this study therefore with the full model he was able to estimate population sizes in year 2 and year 3 and these were 56 (SE=6.7) and 69 (SE=12.6). He then said that in the third year he had done a detailed within year capture-recapture study over a 1 month period and on this data. After model selection he used the M(h) Jackknife estimator in CAPTURE and had obtained a population size estimate of 140 (SE=28.5). Why do you think the two estimates for the third year turned out so differently from each other? Explain in about one paragraph

5. (10 pts) In an open capture-recapture model on a butterfly there were 5 periods of 1 day and the following output was obtained from POPAN for the best model:

Par	Est	SE
phi	0.62	0.06
p	0.27	0.07
Pent 0	0.16	0.04
Pent 1	0.16	0.04
Pent 2	0.24	0.05
Pent 3	0.34	0.06
Pent 4	0.10	0.03
N	295.11	56.89

Note- Normally there would be more periods.

Give the notation for the best model (ie are parameters time varying or not?)
What is the meaning of N? Is it a precise estimate?
What is the butterfly survival rate? What assumptions are made if you state this estimate?
Are the butterflies easy to catch?
Any constraint placed on the emergence probabilities? What can you say about the emergence pattern?

6. (25 pts) Consider a small stream electro-fishing removal study. In week 1, the biologist does 2 removals in quick succession of $n_{11} = 89$ and $n_{12} = 73$ fish which are then replaced. In week 2, removals give $n_{21} = 61$ and $n_{22} = 51$ fish which are then replaced. In week 3, removals give $n_{31} = 75$ and $n_{32} = 44$ which are then replaced. In week 4, removals give $n_{41} = 40$ and $n_{42} = 35$ which are then replaced. (This can be viewed as a modification of the robust design used for capture-recapture methods which we will study soon but you don't need that material to figure out this question).
    a. Estimate the population size in weeks 1, 2, 3, and 4.
    b. If we have external estimates of survival of 0.6, 0.4, and 0.5 for each interval, use them together with the other information you have to estimate recruitment for the three intervals.
    c. List all the assumptions of this model.
    d. Would one get better estimates if one used marked animals? Why? Brief answer please with no calculations at all.