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**Sex ratio power analysis proposal**

**Question 1: How many hatchlings should be sampled from a nest to robustly estimate the number of males that contributed?**

Strategy:

* Values that would help:
* Maximum number of hatchlings allowed to be sampled from a nest according to permits
* For each potential number of males (1-5), simulate mating with females
* Simulate nesting - 100 eggs per nest
* Simulate sampling
* Take samples of size 1 to maximum nest size (or maximum allowed due to permitting)
* Determine if proper number of males has been identified (yes or no)
* Repeat this process many times (say 10,000 times) and determine proportion of successful estimates of total number of males by sample size
* Note: need to decide cutoff for “robust” estimate – correct 90% of the time? 95%? Lower?

**Question 2: How many females and nests should be sampled to get a robust estimate of the number of breeding males, and therefore the breeding sex ratio?**

Values that would help:

* Total number of nesting females (per cycle)
* Total number of males on breeding ground
* Incidence of multiple paternity
* ~~Mean (m1) and standard deviation (sd1) of number of nests per female per year~~
* ~~Mean (m2) and standard deviation (sd2) of number of eggs per nest~~
* ~~Maximum number of females we think males mate with (if they mate with multiple females) = MaxF~~
* Maximum number of hatchlings allowed to be sampled from a nest according to permits
* The probabilities of females mating with 0 – 5 males per sampling data

Strategy:

Iterate through samples of females size 50 to the total number of census females in population. For each sample size:

* Simulate breeding
* Set probabilities of mating with 1-5 males as equivalent or separate values, depending on if females are more or equally likely to mate with a certain number of males
* ~~If females and males can both only mate once, then the number of nesting females = the number of breeding males that year~~
* ~~If females can mate with multiple males (1 – 5) but males can only mate with 1 female~~
* ~~for each female, randomly draw a number from 1 to 5 until the total number of males is equal to the total number of males observed on the breeding ground that year~~
* If females can mate with a single male, but males can mate with multiple females (1 – MaxF)
* For each female, randomly draw one male from a pool with MaxF copies of each male
* If both males and females can mate with multiple partners
* For each female, randomly draw 1 – 5 males from a pool of males with MaxF copies of each male
* Simulate sampling
* Assuming perfect information
* Sample and determine if correct number of males was identified
* Assuming sampling error / less than optimal sampling size per nest
  + - Sample X hatchlings from each of 1 nest total – 1 nest per female (X determined by results from Question 1)
* Repeat process many times (say, 10,000) to see proportion of times we get all breeding males represented for each sample size of hatchlings

Repeat process many times (say, 10,000) to see estimated breeding sex ratio (as average number of females to average number of males out of 10,000 trials) for each sample size of females

**Question 3: Given 700 females total, and 50 nests sampled, how confident are we in our estimate of the number of breeding males and therefore the breeding sex ratio?**

* Largely depends on results from Questions 1 and 2, but some initial thoughts...

Strategy:

1. Assuming males only mated with one female
2. Given each nest is an independent observation with no overlap, calculate the population mean and confidence interval for the number of males per nest given the sample of 50 nests
3. Assuming males could mate with more than one female
4. Still need to think about this one