Raccoon and Squirrel Population Studies

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The natural world around us is filled with many types of wildlife. Everything from mice to bears can be found roaming the woods from looking at all the tracks we passed by each day in the snow of West Central Wisconsin. Just how many of these creatures are out there? That is the question we tried to answer with our squirrel and raccoon population studies. The process through which we tried to answer these questions was a mark and recapture study.

In Ecology a population is defined as "all the organisms that constitute a specific group or occur in a specific habitat." In our case it is the number of squirrels that inhabit our study area at Beaver Creek. There are many types of population models that can be used in study such as ours to estimate the number of squirrels. The model which we chose is a Capture-Recapture model. Capture-Recapture models are widely used in ecology for studies such as ours and much information and literature is available about Capture-Recapture. Other types of models include just capture models, the equal catch ability model, the heterogeneity model, the trap response model, the time variation model and other time dependant models.

The basic concept of a Capture-Recapture model remains the same throughout the different studies it is used for. The first step is to sample the population that you want to estimate, in our case squirrels on Beaver Creek property. This is generally done by live-trapping but observation without actual capture can be used as well. We chose to live-trap for our study. When a specimen is captured it is marked in a unique way that

separates it from the other specimen in the population. The marks can be anything from ear clipping to dying a part of the body. We chose ear tagging with metal tags. Once the specimen is marked it is recorded and released back into the general population. A typical study, which ours is, uses two types of information: the number of marked animals recaptured and the ratio of that number to the number of unmarked animals recaptured.

There are two categories that Capture-Recapture models can fall into; those suitable to closed populations or those suitable for open populations. A closed population is a population in which factors such as birth, death, emigration and immigration are not present, usually because the study is conducted over a short period of time so that effects of these factors on the final estimate are minimal. Our study falls into this category. Open population estimates, while sometimes more precise, are harder to conduct because the aforementioned factors must be accounted for with variance factors.

The simplest of all Capture-Recapture models is the Lincoln-Petersen model. Simply put, a sample of animals, $n_{1,}$ is captured, marked and released. Then, a second sample of animals, $n_{2,}$ is captured and some are from the original group marked, m_2. The number of marked animals in the second sample should be equivalent to the proportion of marked animals in the total population so that the ratio of m_2 to n_2 is equal to that of n_1 to N where N is the total population size, so $N=n_1n_2/m_{2.}$

The marking period of our study for raccoons was conducted in the fall in October and November and the squirrel marking period lasted about two months from the beginning of January to the middle of February. This is the period in which we live-trapped the animals in order to mark as many individuals as possible.

The area which we chose to trap was formed in two different ways. For the raccoons we scouted likely locations to find raccoons along creek corridors and the river. We then placed the traps in areas where we thought we could likely capture raccoons. For the study area of the squirrels we used a different method. We constructed a grid on the computer that would be used to set the squirrel traps.

Making sure that the traps were equally spaced and in the right area required the use of a GPS. To use a grid pattern we went on the computer and made a grid of the land that we were trapping using the program Arc view, with the help of our teacher. Then we used a fire wire and downloaded it onto the GPS. After that was done all we had to do was follow the GPS coordinates that had been downloaded onto a GPS and place the traps at the intersections of the grid.

Once we had the trap locations set we were ready to start trapping. The raccoon traps were left out for a period of three weeks, four nights a week. This gave us twelve trap nights per trap and 72 trap nights overall. A trap night is simply a term meaning one trap was open for one night. The squirrel grid we had developed was divided into six trap areas with eight trap locations in each trap area. The traps were left out for three nights in each trap area, giving us 24 trap nights per area.

The main focus of this period of time was to capture as many squirrels and raccoons as possible, mark the specimens and record their information. We recorded the date of each capture, the species of the squirrel, the tag number, the trap number and sometimes the weather conditions.

Handling the squirrels and raccoons was a factor we had to deal with once we had captured an animal. Tagging squirrels took lots of careful hand placement and

concentration. The squirrels became hard to catch as soon as you got close enough for them the see or hear you. Then they would start going crazy running from one end of the trap to the other. To settle them down we pick the trap up, making sure the opening is up towards the sky and sit there a minute without handling it .When the squirrel settled down we were able to work with it. The squirrels would try anything to get out if they could see any little spot that they could possibly squeeze through.

To make sure the squirrels wouldn't get out we had one person with the animal handling gloves reaching into the trap to get the squirrel while another person covered any opening at the top so it looked like there wasn't any room to get out. The red squirrels were hard to catch because they were small and very quick when it came time to grabbing them. After we had a good grasp on the squirrels we would place an ear tag in them. Sometimes you would get a feisty squirrel that would latch onto the gloves and try to squirm out of your hands. Then we would have one person write down the number of the ear tag, type of squirrel, what trap, and weather condition.

Trapping squirrels became easier as we went because we learned tricks that helped catch the squirrels that were getting away with corn before. One of those tricks was using cob corn wired to the back of the trap. This would make sure that the squirrels would have to go to the back of the trap to get the corn, therefore, they had to step on the trap pan and trigger the door of the trap. They would also have to move around to try to get the corn off the back of the trap so there was a better chance to set the trap off. The last benefit of having the corn wired to the back of the trap was that the cob couldn't roll underneath the trap pan and prevent it from being triggered. We used loose corn for a while and the squirrels figured out that if they tipped the trap over that they wouldn't

have to go into it to get the corn. One other trick we learned was if you backed the trap up to a stump or a tree the squirrels couldn't pick at the corn out from the back of the trap. This also helped keep some of the mice from taking the corn. The last thing we did was try to set the traps lighter which meant the trap pan needed less weight to close the door.

To help in the handling of the raccoons we not only used animal handling gloves, but we also developed a squeeze trap. The squeeze trap, that we built ourselves, consisted of one of our raccoon traps and some plywood. Two pieces of plywood were connected with 24 inch bolts, one was in the trap and one outside of the trap. When the raccoon was placed in the squeeze trap and the trap placed on the ground the raccoon was squeezed against the top of the cage making tagging the raccoon a whole lot easier.

Once we had completed the mark and recapture periods for both the squirrels and raccoons it was time to put our data to use to give us an estimate of the raccoon and squirrel populations in our study area. But first we had to practice using the data. In order to better understand how we would use our information to estimate the number of squirrels and raccoons we did a test run of a mark and recapture survey with mock data. We made a brief model of the mark and recapture data. We started out getting corn and noodles for the model. We counted 25 pieces of corn and 25 pieces of noodle and marked them with a marker to signify the already captured pieces. Then we threw them back with all the other ones. The corn had a total of 200 pieces and the noodles had 276. We put them in a beaker and shook them up and then threw them in separate pans, one all noodles and one all corn. After the corn and noodles were separated into a flat pan two of us had closed our eyes and picked out 25 pieces of each. After we had picked 25 pieces

we counted the pieces that we had recaptured and put this into a ratio with the unmarked pieces. We did this step 9 times for each result. After we had calculated all the data we entered our information into the mark and recapture formula. The formula we used was, population total is equal to total number of marked individuals multiplied by the total number of captured individuals all divided by the number of marked individuals (recaptured). That gave us the calculated population. After we figured out that we did the percent error calculation which is, % Error= Actual-Calculated over Actual X 100. That gave the percent error for each population. For the noodles we got 14% and for the corn we got 17%. The total class average for this project was Corn-233.78 and Noodles-314.8.

Using the same data we did a test for statistical analysis. We used the corn for the native species and the noodles for the alien species. We used the calculated population of each side by side, then if the native was greater than the alien it was a +, and if the alien was greater we used a -, and finally if they were the same we used a 0. The pluses added up to 0, the – were 3, and 0's were 5. We had used the sign rank test to determine whether two related samples differ. The data we had collected was then compared to a given graph. According to the graph the information we had collected showed no significant difference between the two populations.

Once we had completed our test run we were ready to put our own data to use. Double Sampling is one method we used to estimate populations. To get the estimate, the number of animals from the first sample, the marking period, can be compared to the number of animals from the second sampling period, the recapture period. The proportion of the first sample to the second sample divided into the first. The number of

total captures is then divided by the ratio between the two periods to give us the population estimate. The other method we used was a catch per unit effort model. The catch per unit effort is based on the premise that as more and more animals are removed from a population, fewer are available to be "caught," and catch per unit of effort should decline. In our case, as we tagged more individuals the number of untagged individuals declined. The population estimate can be achieved by plotting the data on a graph and using linear regression estimating the x intercept where captures would equal zero and the population would be estimated.

The data we compiled is as follows:

Double Sampling Data

Period 1. 18 captures

Period 2. 19 captures

Ratio: 18/19 or .947

Total Cap. 37

Pop. Est. 37/.947 or 39.1 individuals

Catch Per Unit Effort Data

Table 1. Squirrel Trapping Period 1.

Grid Number	1	2	3	4	5	6
Traps	8	8	8	8	8	8
Nights	3	3	3	3	3	3
Trap Nights	24	24	24	24	24	24
Captures	3	3	2	3	3	4
Cumulative	3	6	8	11	14	18
Catch/Night	0.125	0.125	0.083333	0.125	0.125	0.166667

Table 2. Cumulative Squirrel Captures Trapping Period 1.

Cumulative	Captures	Cap/Night

4	4	0.167
7	3	0.125
10	3	0.125
13	3	0.125
16	3	0.125
18	2	0.083

Figure 1. Squirrel Catch Per Unit Effort Period 1.

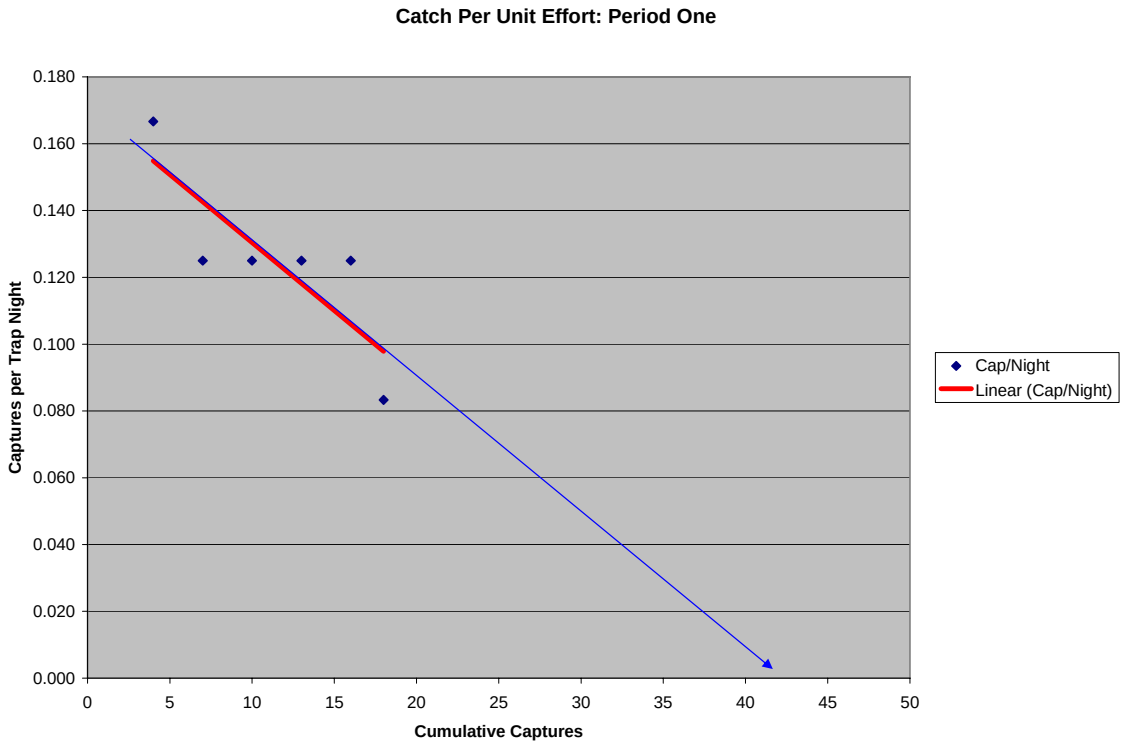


Table 3. Squirrel Trapping Period 2.

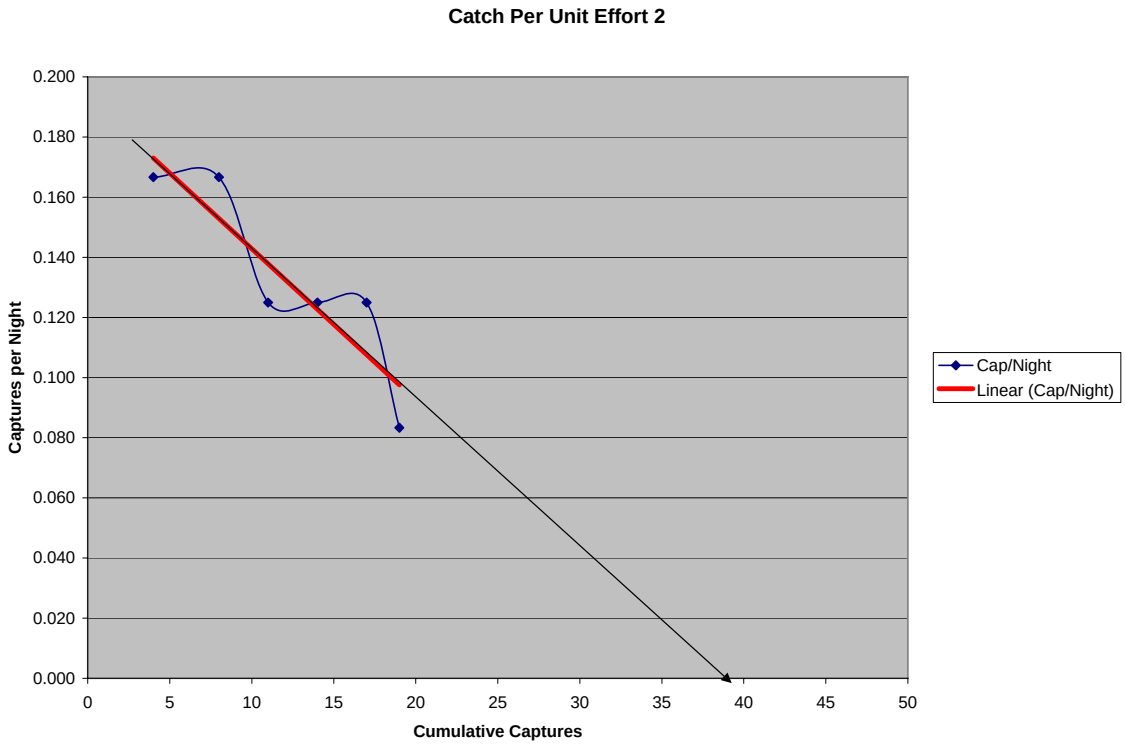
Grid Number	1	2	3	4	5	6
Traps	8	8	8	8	8	8
Nights	3	3	3	3	3	3
Trap Nights	24	24	24	24	24	24
Captures	3	2	3	4	4	3
Cumulative	3	5	8	12	16	19
Catch/Night	0.125	0.0833333	0.125	0.166667	0.166667	0.125

Table 4. Cumulative Squirrel Captures Period 2.

Cumulative	Captures	Cap/Night

4	4	0.167
8	4	0.167
11	3	0.125
14	3	0.125
17	3	0.125
19	2	0.083

Figure 2. Squirrel Catch Per Unit Effort Period 2.



During the recapture period of both of our studies we didn't capture any tagged individuals. Therefore, when we ran our data through the mark and recapture formulas the results we got were not conclusive. We got a population estimate of 363 squirrels with a variance of 478. Obviously we weren't satisfied with these numbers so we decided to use the double sampling and the catch per unit effort formulas. When we ran the data from both periods through the double sampling formula we got a population estimate of 39.1 individuals. We then used the data from tables 1-4, and ran them

through the catch per unit effort formulas. The results we achieved are illustrated in figures 1 and 2 and as the graph shows we got population estimates of 42 and 39. So, when coupled the double sampling estimate we have a pretty confident population estimate of somewhere around 40 individuals.

As mentioned before the numbers from the raccoon study when entered into the mark and recapture formula gave unrealistic estimates, rendering the estimates relatively useless. When the double sampling formula was used we got an estimate of 18 raccoons.

So, even though the study didn't go exactly as planned we were still able to get a rough population estimate of both squirrels and raccoons. The method used was different than originally planned but it worked out in the end and both the studies were a success.

Appendix 1

Site One	Night 1	Night 2	Night 3
Trap One		Gray	
Trap Two			
Trap Three			
Trap Four			Gray
Trap Five			
Trap Six			
Trap Seven		Red	
Trap Eight			

Site Two	Night 1	Night 2	Night 3
Trap One	Gray		
Trap Two			
Trap Three			
Trap Four			
Trap Five			
Trap Six			
Trap Seven		Red	
Trap Eight			

Site Three	Night 1	Night 2	Night 3
Trap One			Red
Trap Two			
Trap Three			
Trap Four			Gray
Trap Five			
Trap Six		Red	
Trap Seven			
Trap Eight			

Site Four	Night 1	Night 2	Night 3
Trap One			
Trap Two			
Trap Three			Red
Trap Four		Gray	
Trap Five		Gray	
Trap Six			
Trap Seven			
Trap Eight	Red		

Site Five	Night 1	Night 2	Night 3
Trap One			Gray
Trap Two		Gray	
Trap Three			
Trap Four			
Trap Five	Red		Red
Trap Six			
Trap Seven			
Trap Eight			

Site Six	Night 1	Night 2	Night 3
Trap One			
Trap Two		Gray	
Trap Three			
Trap Four			
Trap Five		Red	
Trap Six			
Trap Seven			
Trap Eight			Gray

Total Trap Nights=144

Total Catches=19

Percent Success=13.1%

Number of Recaptures=0

Appendix 2

Site One	Day 1	Day 2	Day 3
Trap 1	0	0	ESC
Trap 2	0	0	0
Trap 3	0	0	0
Trap 4	0	0	0
Trap 5	0	0	0
Trap 6	0	0	3096
Trap 7	0	0	0
Trap 8	0	3075	0
	TN=24	Catches=3	

Site Two	Day 1	Day 2	Day 3
Trap 1	0	0	0
Trap 2	0	0	0
Trap 3	0	0	3097R
Trap 4	0	0	3024
Trap 5	0	0	0
Trap 6	0	0	0
Trap 7	0	3023	0
Trap 8	0	0	0
	TN=24	Catches=3	

Site Three	Day 1	Day 2	Day 3
Trap 1	0	0	0
Trap 2	0	0	0
Trap 3	0	3003	0
Trap 4	0	0	0
Trap 5	0	0	0
Trap 6	0	0	0
Trap 7	0	0	3050
Trap 8	0	0	0
	TN=24	Catches=2	

Site Four	Day 1	Day 2	Day 3
Trap 1	0	3002	0
Trap 2	0	0	0
Trap 3	0	0	0
Trap 4	0	0	0
Trap 5	0	0	3004R
Trap 6	0	0	0
Trap 7	0	ESC	0
Trap 8	0	0	0
	TN=24	Cathes=3	

Site 5	Day 1	Day 2	Day 3
Trap 1	0	0	0
Trap 2	0	3020	0
Trap 3	0	0	0
Trap 4	0	0	0
Trap 5	0	0	ESC
Trap 6	0	0	0
Trap 7	0	0	0
Trap 8	0	3021	0
	TN=24	Catches=3	

Site 6	Day 1	Day 2	Day 3
Trap 1	0	0	0
Trap 2	0	0	0
Trap 3	0	0	3029
Trap 4	0	0	0
Trap 5	0	0	0
Trap 6	0	ESC	0
Trap 7	0	0	0
Trap 8	0	0	3034
	TN=24	Catches=3	

Total Trap Nights=192 144

Total Catches=18

Total Marked=13

Gray=11 Red=2

Appendix 3

	Trap 1	2	3	4	5	6
1	O	O	O	O	O	O
2	O	O	O	O	O	O
3	O	O	O	O	O	O
4	O	O	C	O	O	O
5	O	O	O	O	O	O
6	O	O	O	O	O	Ca[1]
7	O	O	O	O	O	O
8	O	O	O	O	O	O
9	O	O	Ca[2]	O	O	O
10	O	O	O	Ca[3]	O	O
11	O	O	O	O	O	O
12	O	O	O	O	Ca[4]	O
13	O	O	O	Ca[5]	O	O
14	O	O	O	O	O	O
15	O	O	O	O	O	O
16	Ca[6]	O	O	O	O	O
17	O	O	O	O	O	O
18	O	O	O	O	O	O
19	O	O	O	O	O	O
20	O	O	O	O	O	O