Dear Jeremy,

Thank you for your response and your helpful suggestions. I apologize for the delayed reply. We’ve considered your feedback, and I’d like to address your points and share some updates.

We initially used the beta estimate of the slope from the normalized count ~ relative year equation as an estimate of population growth at each site. This method allows us to account for the population counts before the onset of WNS and estimate how quickly populations are returning to a “steady state.”

Per your suggestion, I also tried using the realized population growth rate, taking the average growth starting from the minimum

I am sorry for the late reply. I considered all your suggestions.

We used the beta estimate of the slope of the normalized count ~ relative year equation for an estimate of population growth at each site because it considers the population counts before WNS. So we are estimating how fast the population is returning to a “steady state.”

I included an attachment where I used realized population growth. I took the average of the population growth rate starting from the minimum count value which would be after the initial population crash from the introduction of WNS to the current survey at each site. Since the equation does not consider the size of the populations, the hibernacula that started with fewer bats would appear to be growing much faster than the hibernacula that started with lots of bats because a change from 8 to 30 would appear much larger than a change from 800 to 1400, even though that is a difference of approximately 600 bats. This of course is an extreme example but demonstrates why it does not work for the data we have. If you look at the scatter plot in the excel file, there are a few sites that have a high average population growth rate, but these are sites that started with very few bats and gained tens of bats, not because they are necessarily great hibernacula sites.

Answers to your other questions/suggestions.

1. Posterior Predictive Check

I changed the likelihood families of the models. I used the Beta distribution for the “crash” models and the observed data and replicated data seem to overlap quite well. I think this is a good indicator that the Beta model is appropriately modeling the observed data. Potentially, we are seeing some variation because of the small sample sizes and potential for large variations in the data.

I used the Gamma distribution for the “slope” model, but still think there may be a misfit in the model. The observed data appears to be skewed towards 0 then the simulated data.

The posterior check does not capture some of the smaller notes. However, some unmeasured variables we are not considering in this model include: complexity in size (passage length, levels, shafts, stopes, etc.), temperature, humidity, water, distance to other mines, exterior climates, airflow, change in temperature over time, etc.

1. Weighting

We are using last population count as a weight to the recovery rate model to give more weight to the sites that hold more bats. There is a large discrepancy between the number of bats at each site. The table shows the sites we are using for the recovery rate model, the last survey count that was conducted at each site and the mean temperature. So we wanted to weight the response variable so we aren’t directly comparing a site with 22 bats to a site with 1400 bats. However, one issue we are experiencing if you look at Figure 3, one site has about 5 times more bats than any other site. Therefore, the model is skewed towards this site when we incorporate weights to the model. We think the sites with more bats are more influential to the population. Because a site that holds 9,000 more bats is significantly more important to the bat population than a site that only holds 25 bats even though they are both recovering in population size.

|  |  |  |
| --- | --- | --- |
| Site | last survey count | mean temperature |
| Adventure Mine | 1413 | 4.27 |
| Child's Adit | 22 | 6.76 |
| Delaware Mine | 1382 | 6.31 |
| Derby Adit | 35 | 7.26 |
| Flinsteel Adit | 7 | 6.6 |
| Glen Adit #1 | 47 | 4.17 |
| Iron Mountain Iron Mine | 770 | 7.66 |
| Jones' Adit | 25 | 8.68 |
| Keel Ridge Shaft | 370 | 6 |
| Lafayette East Shaft | 1103 | 7.88 |
| Mead Mine | 700 | 7.95 |
| Merchant Mine | 38 | 5.33 |
| Norway Mine | 9535 | 2.43 |
| Quinnesec Adit | 29 | 8.79 |
| South Bluff Adit | 13 | 8.1 |
| South Lake Mine | 882 | 3.57 |
| Taylor Adit | 34 | 8.41 |
| Windsor Shaft #3 | 1982 | 4.07 |
| Belt Mine | 972 | 3.75 |

A graph with a line

Description automatically generated

Figure . PP Check for crash model (crash ~ mean\_temp) using the Beta() family distribution for the likelihood.

A graph with numbers and lines

Description automatically generated

Figure . PP\_check for the best model for recovery rate. Weighted\_slope ~ mean\_temp + log\_passage + offset(recovery\_years) using the Gamma(link = "log") family distribution for the likelihood.

A graph with a blue line

Description automatically generated

Figure . Weighted Recovery Rates ~ mean temperature + log(passage length) + offset(recovery years). The weighted recovery rate is recovery rate \* sqrt(count).