Environmental Noise and Ross-Macdonald Transmission Models

Karin Ebey, John Vinson and Kyle Dahlin

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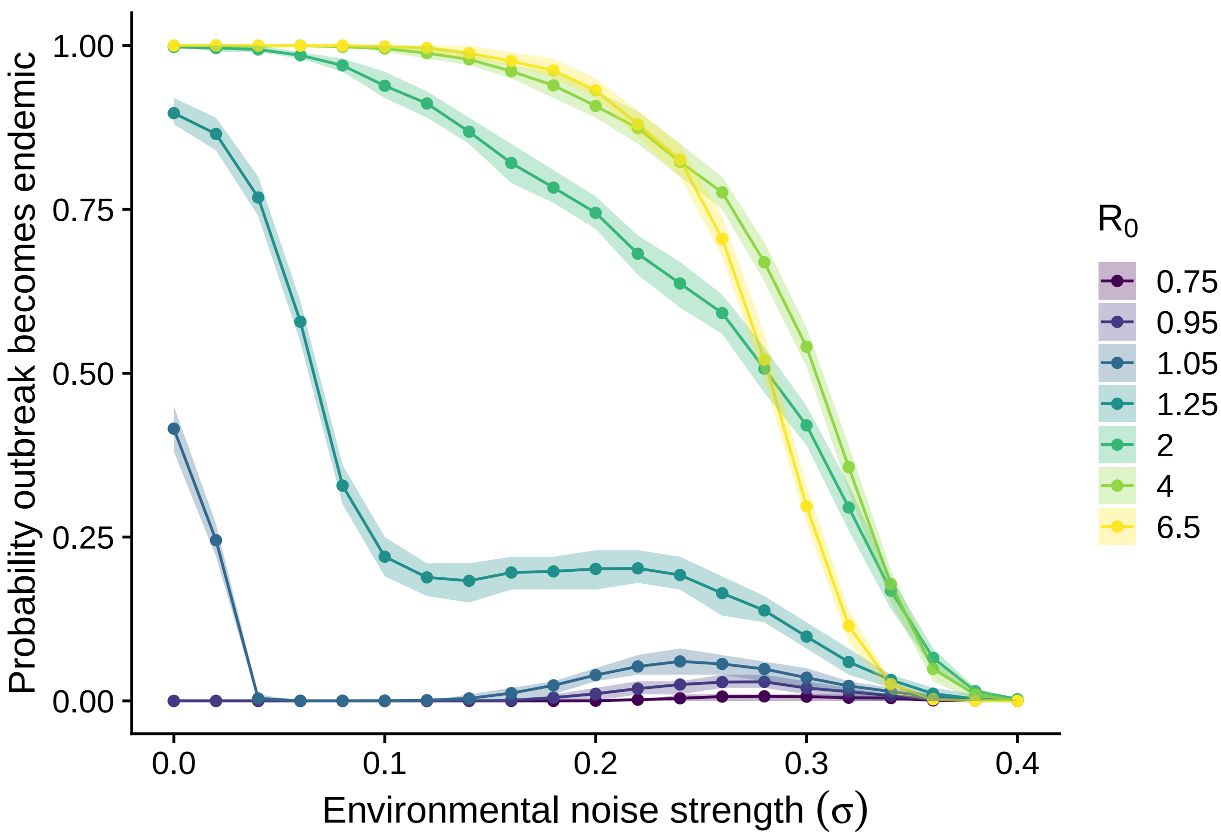
Outbreak probability

Number of cases

Time to outbreak extinction

#Results from Julia

\begin{figure}[H]



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\caption{ Probability of the disease becoming endemic by sigma and R0 based on 1000 runs of 100 iterations. Overall, increasing environmental noise strength cases the probability that the disease becomes endemic to decrease. For smaller R0 values (i.e. <1.25), there is a slight increase in endemic disease probability at high environmental noise levels. Above environmental noise strength of 0.4 (where there is up to 40% variation in parameter values), the probability of endemic disease goes to zero. There is a greater probability of the disease going endemic at higher values of R0.} \end{figure}

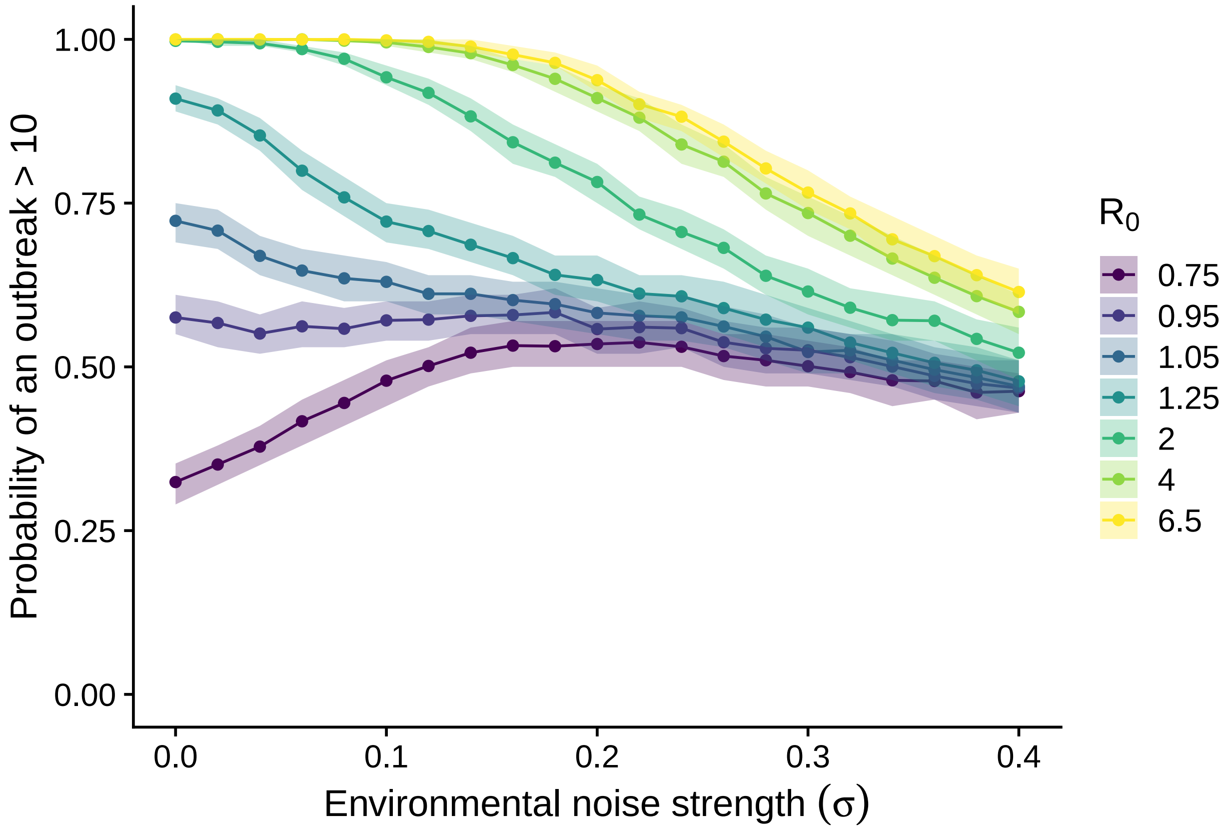


Figure 1: Probability of an outbreak (defined as 10 host cases at one time point) occuring by sigma and R0 based on 1000 runs of 100 iterations. For R0 values greater than 1, as environmental noise strength increases the probability of an outbreak decreases. For R0 values less than 1, as environmental noise strength increases, the probability of an outbreak increases until sigma= 0.2 and then decreases. There is a greater probability of an outbreak at higher values of R0.

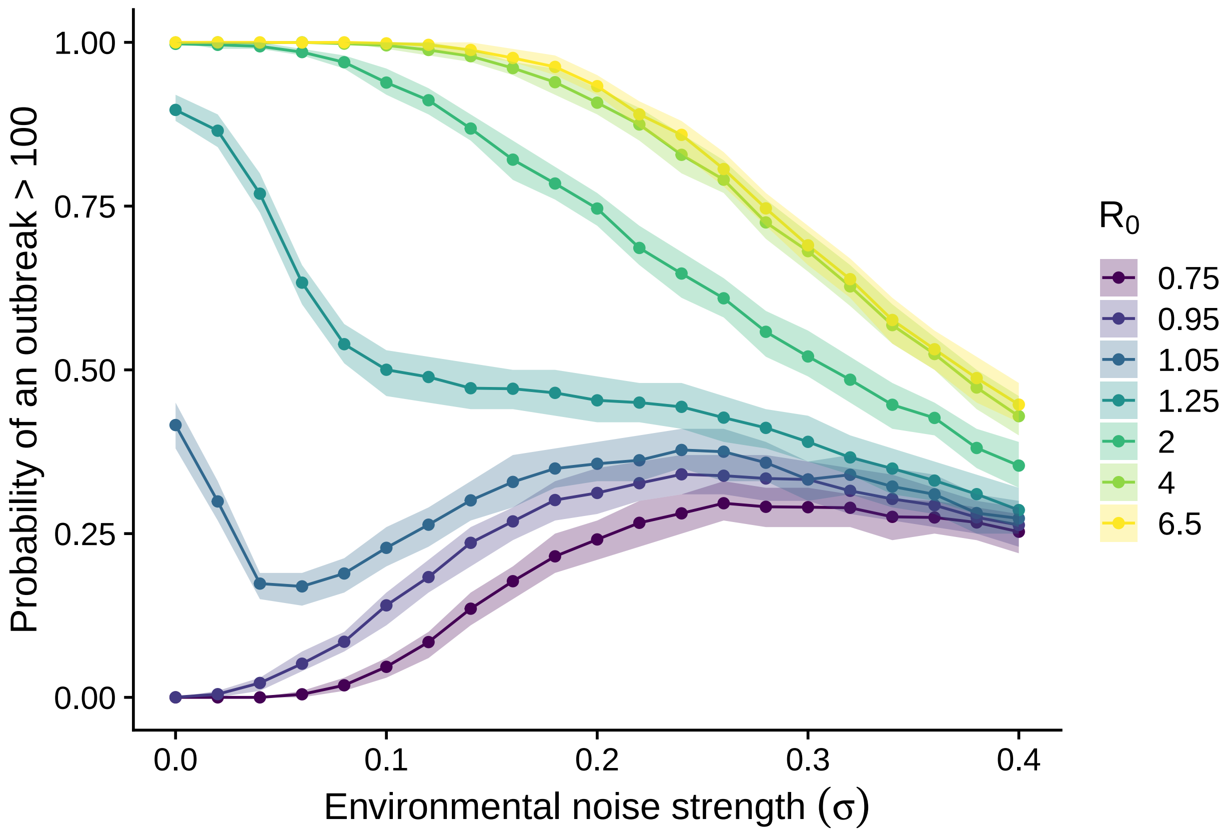


Figure 2: Probability of an outbreak (defined as 100 host cases at one time point) occuring by sigma and R0 based on 1000 runs of 100 iterations. In general, for R0 values greater than 1, as environmental noise strength increases the probability of an outbreak decreases. For R0 values less than 1, as environmental noise strength increases, the probability of an outbreak increases until sigma= 0.25 and then decreases. R0=1.05 follows both patterns to some degree. There is a greater probability of an outbreak at higher values of R0.

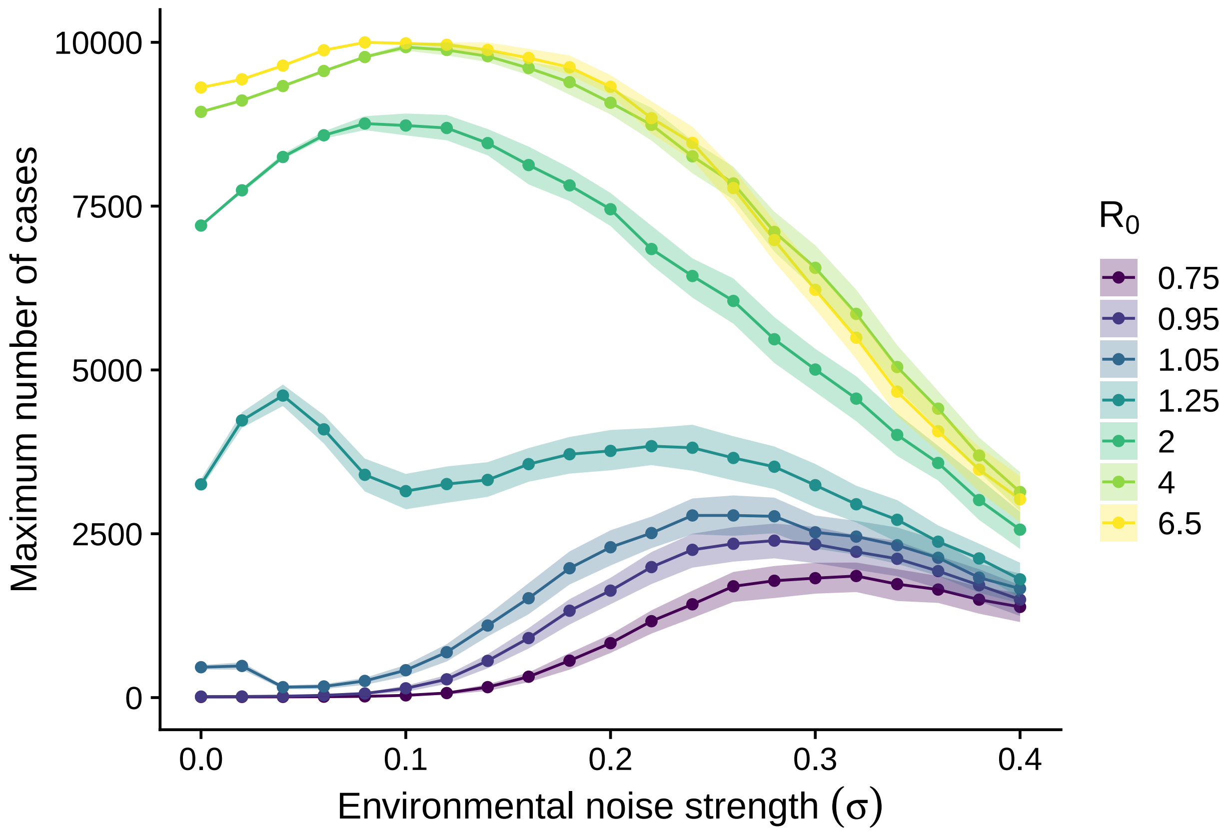


Figure 3: Maximum number of cases during the simulation by sigma and R0 based on 1000 runs of 100 iterations. For all R0 values, the maximum number of cases increases with environmental noise strength initially and then decreases as environmental noise strength gets too high. For high R0 values, the shift occurs at sigma= 0.15, and for lower R0 values, the shift occurs at sigma= 0.25. R0=1.25 shows intermediate behavior responding at both sigma values. With higher values of R0, more hosts are infected.

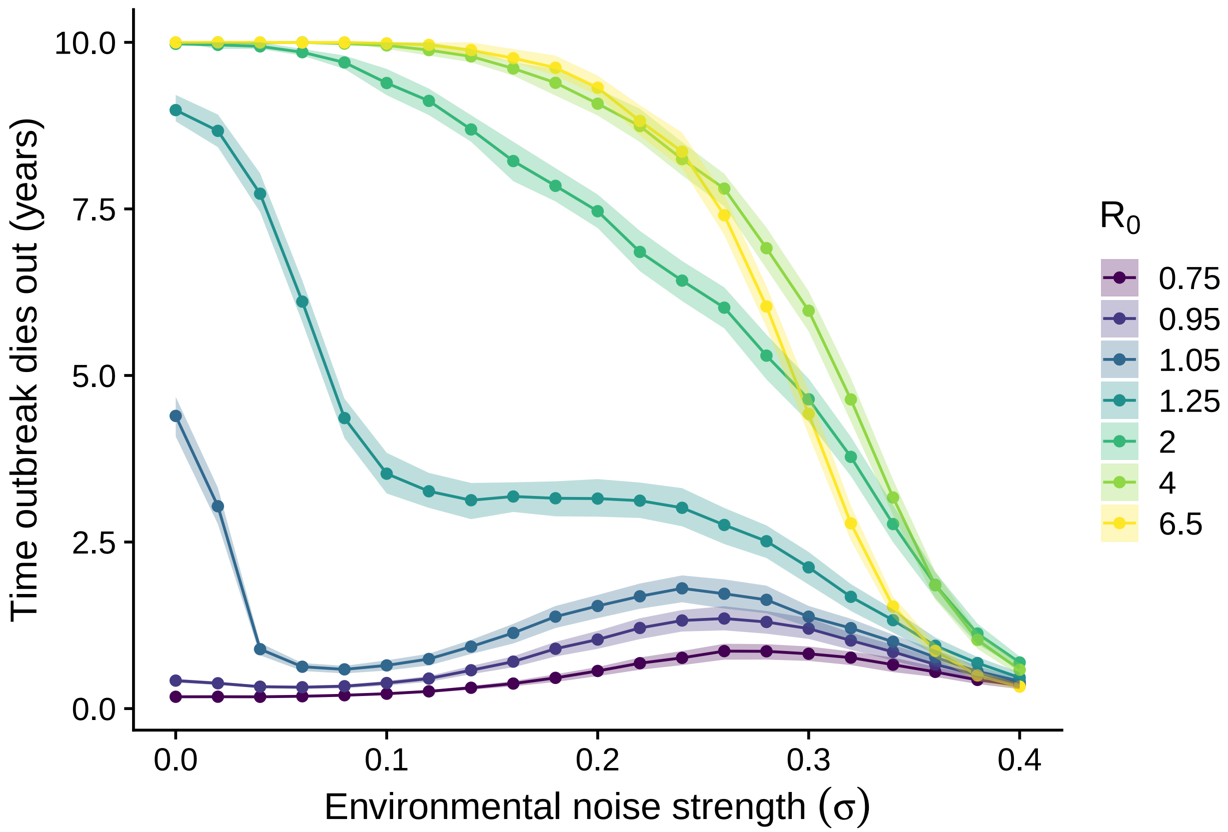


Figure 4: Time that the outbreak dies out (or 10 years-end of simulation) by sigma and R0 based on 1000 runs of 100 iterations. This graph looks quite similar to that of the probability of disease going endemic, because if the disease does not go endemic, the disease goes extinct early on in the simulation.

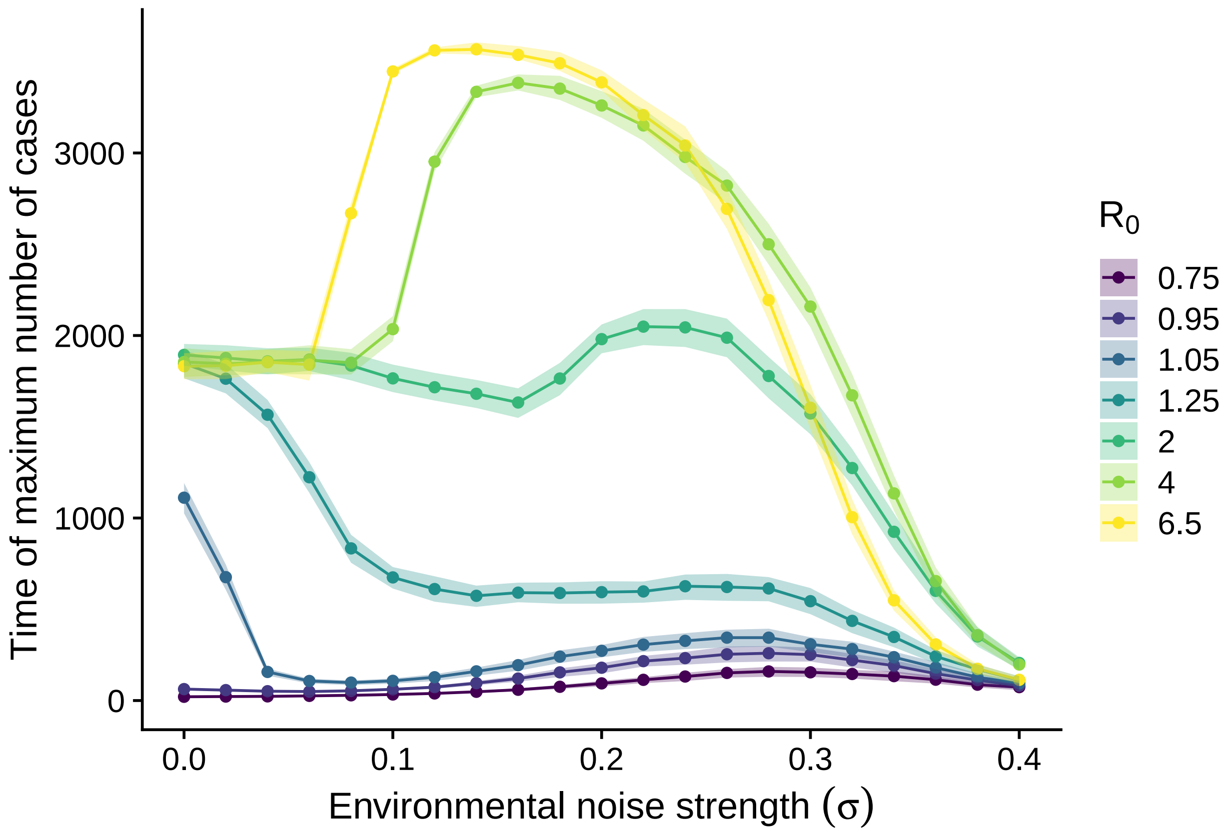


Figure 5: Time when the maximum number of cases occured during the simulation by sigma and R0 based on 1000 runs of 100 iterations.

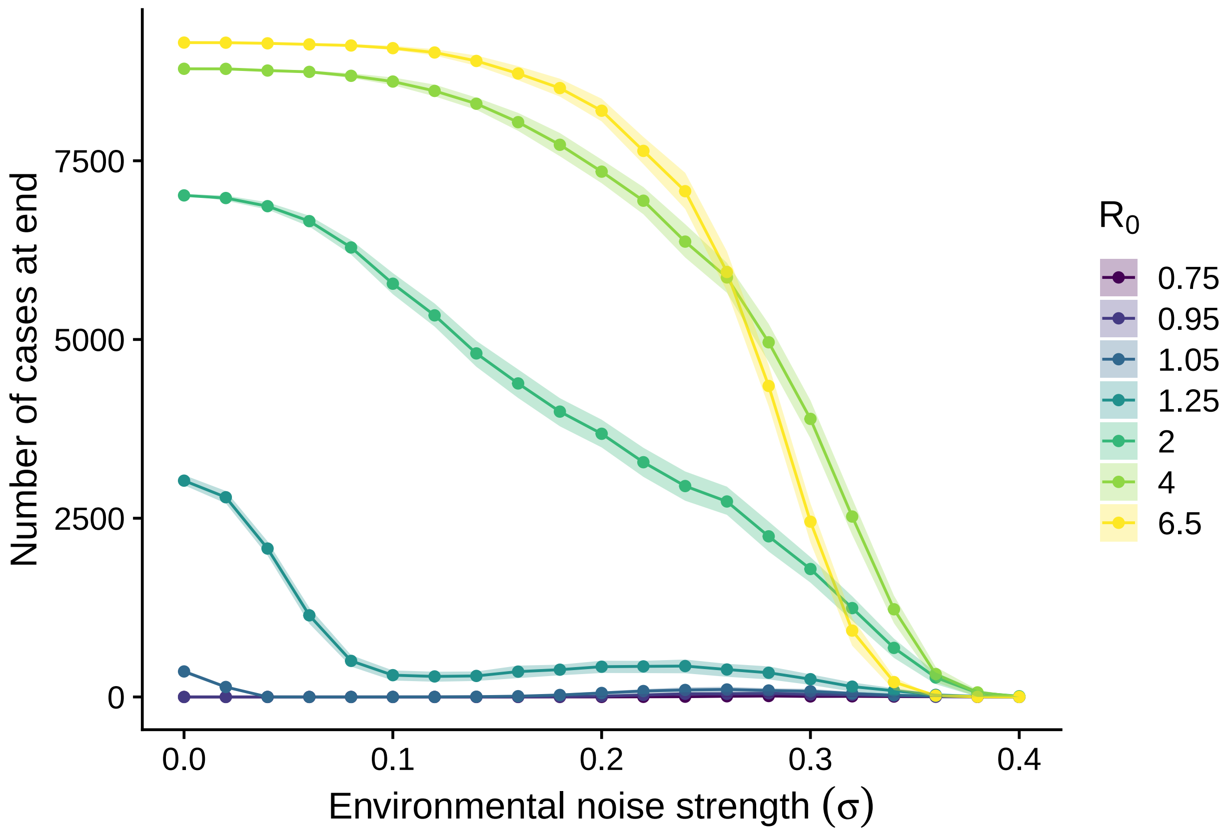
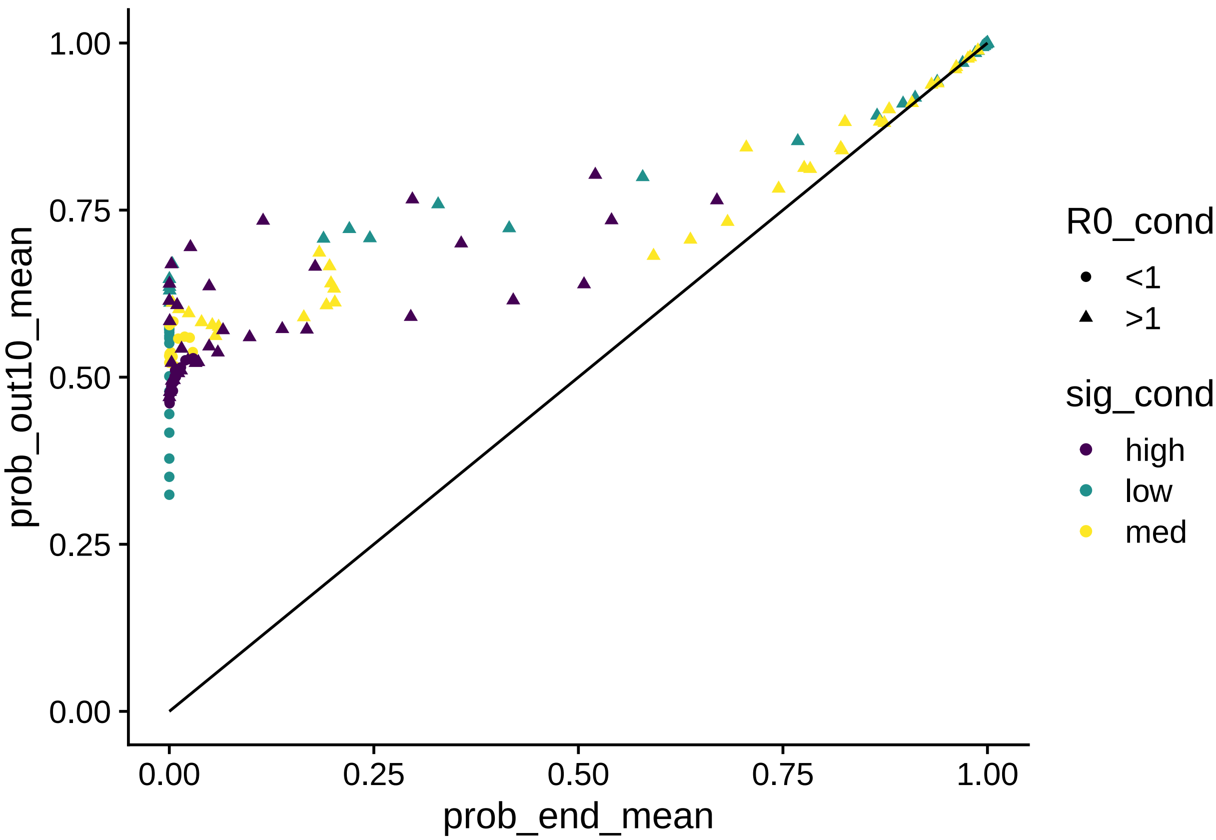
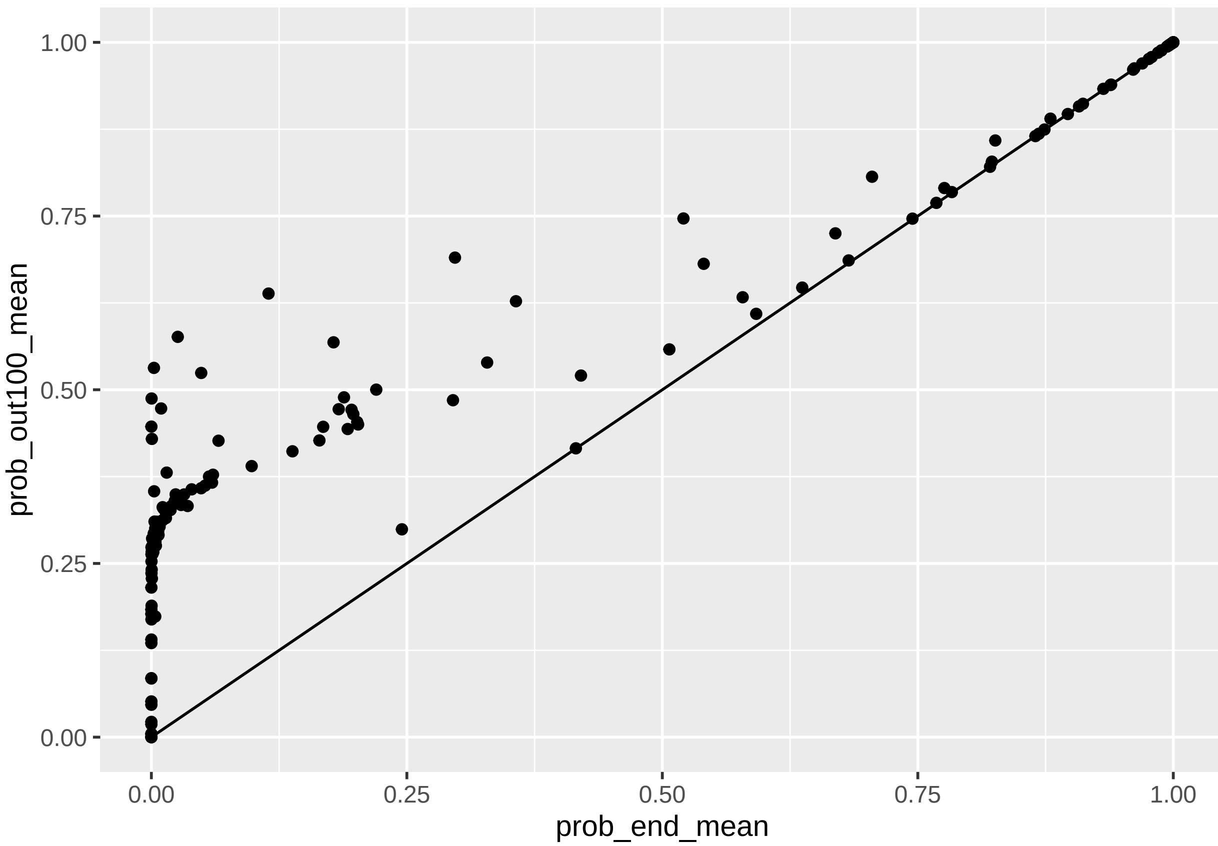


Figure 6: Number of host cases at the end of the simulation by sigma and R0 based on 1000 runs of 100 iterations. This graph looks similar to that of the probability of disease going endemic, because if the disease does not go endemic, then zero hosts are infected at the end. More hosts are infected at higher R0 values.



1.00
0.75
0.50
0.25
0.00
prob_out10_mean
0.00
0.25
0.50
0.75
1.00
prob_end_mean
R0_cond
<1
>1
sig_cond
high
low
med



#Trajectories Plot

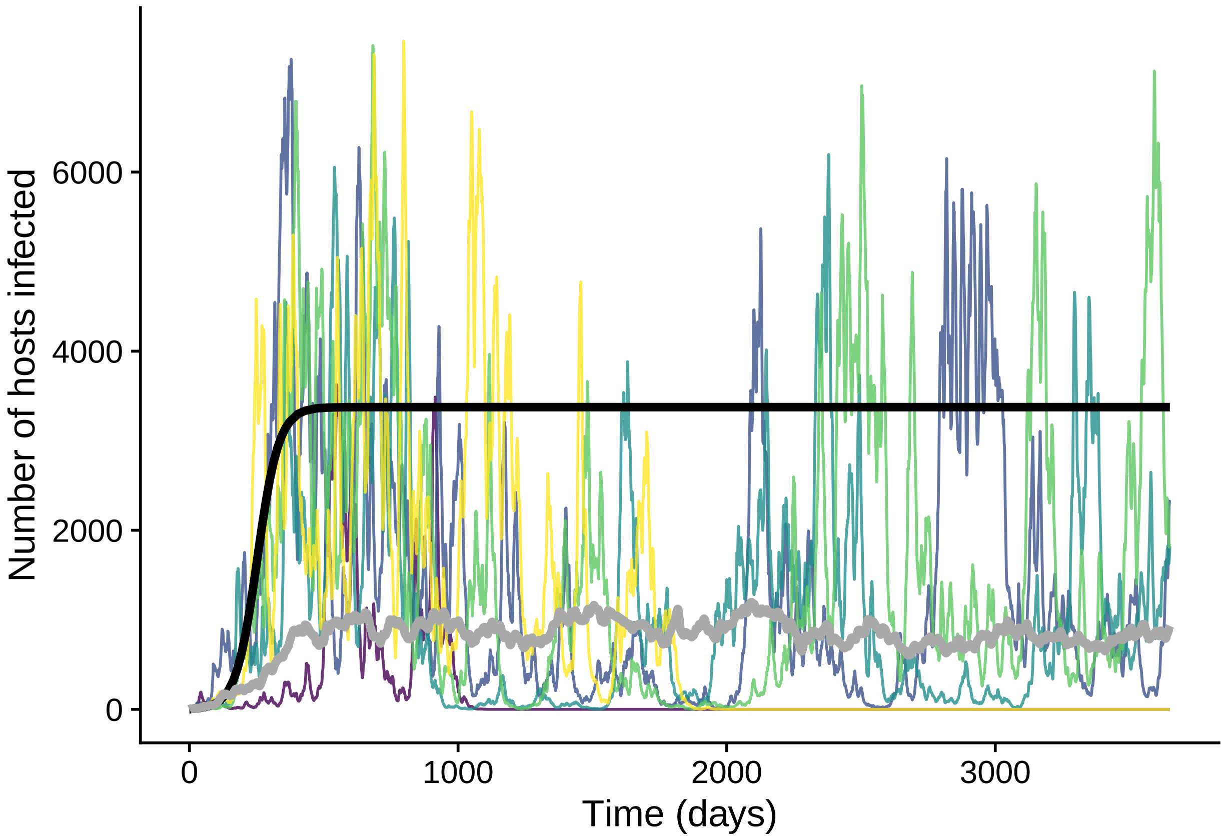


Figure 7: For R0=1.25 and sigma=0.08, the number of hosts infected at each time period in deterministic solution (black line) and 5 stochastic solutions (colored lines) are plotted.

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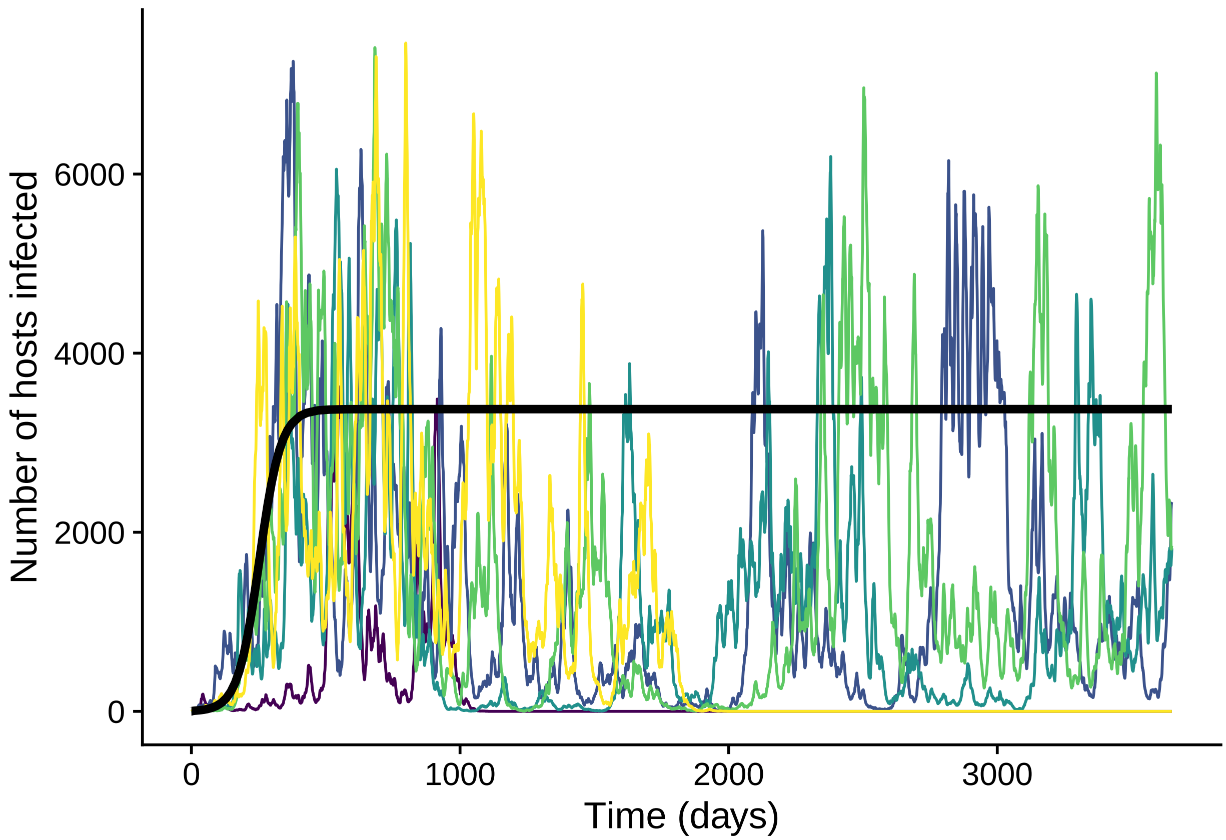

Figure 8: For R0=1.25 and sigma=0.08, the number of hosts infected at each time period in deterministic solution (black line) and 5 stochastic solutions (colored lines) are plotted.