1. a. The best logistic growth model fitting the *Oryzaephilus surinamensis*, the saw-tooth grain beetle, data is given by

$$P_{n+1} = 1.9615P_n - 0.0021893P_n^2 = f(P_n).$$

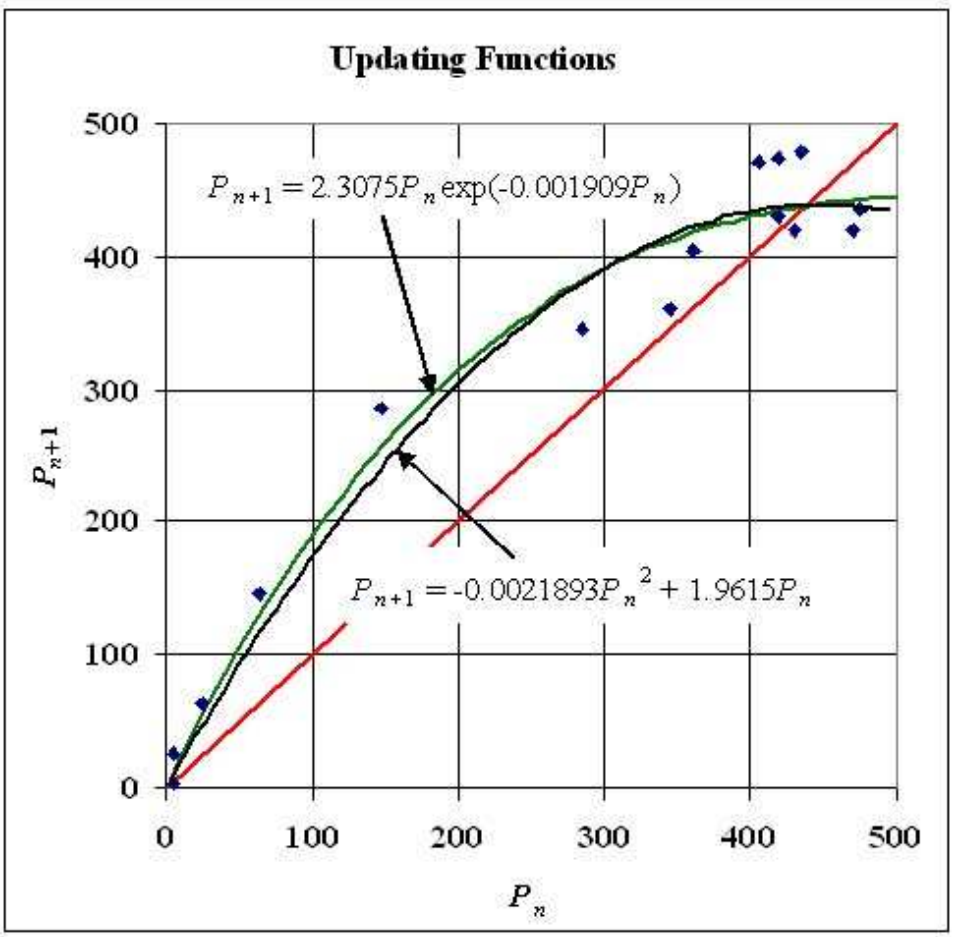
The sum of square errors for this model is 13273. The graph of the updating function is below with the Ricker's updating function.

b. The equilibria of the logistic growth model are $P_e = 0$ and 439.18. Since $f'(p) = 1.9615 - 0.0043786p$, it follows that for $P_e = 0$, $f'(0) = 1.9615$, so this equilibrium is unstable. For $P_e = 439.18$, $f'(439.18) = 0.0385$, so this equilibrium is stable. A graph and discussion of the simulation is shown below with the Ricker's model.

c. The best Ricker's growth model fitting the *Oryzaephilus surinamensis* data is given by

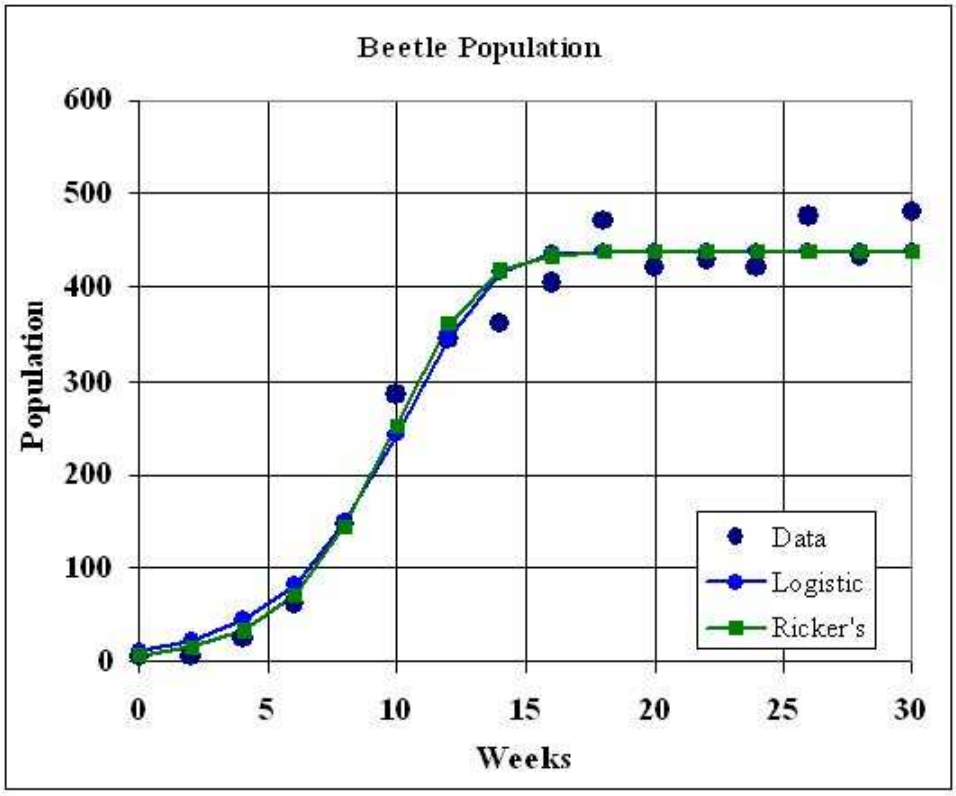
$$P_{n+1} = 2.3075P_n e^{-0.001909P_n} = R(P_n).$$

The sum of square errors for this model is 11476. The graph of the updating functions for the logistic and Ricker's models are below. We see that both models fit the data fairly well, and are hard to distinguish. The square error measure makes the Ricker's model only slightly better.



d. The equilibria of the Ricker's growth model are $P_e = 0$ and 438.01. Since $R'(p) = 2.3075\, e^{-0.001909p}(1 - 0.001909p)$, it follows that for $P_e = 0$, $R'(0) = 2.3075$, so this equilibrium is unstable. For $P_e = 438.01$, $R'(438.01) = 0.1638$, so this equilibrium is stable.

A simulation was run where a least squares best fit of each of the models to the data by varying only the initial condition. In the case of the logistic model, the best fit had $P_0 = 12.01$ and the sum of square error was 12,026. The Ricker's model had a best fit of $P_0 = 6.47$, which is closer to the actual data, and its sum of square error was 10,599. The graph below shows that the simulations are very close to the point of being almost indistinguishable.



Both models approach a carrying capacity with 439.2 for the logistic and 438.1 for the Ricker's model. Thus, if the experimental conditions continued, we would expect this to be the large time behavior of the population. The qualitative behavior of each of these models is very similar, so either model would work well for this experimental set up.