Other Predator-Prey Models

Because of the lack of physical justification for the Lotka-Volterra model, we tried the following new model:

$$\dot{N}_1 = N_1\left(1 - N_1 - \frac{N_2}{N_1 + d}\right),$$
$$\dot{N}_2 = bN_2\left(1 - \frac{N_2}{N_1}\right).$$

We noted that the only nontrivial fixed point changed stability depending on the values of b and d, as shown in the graph below.

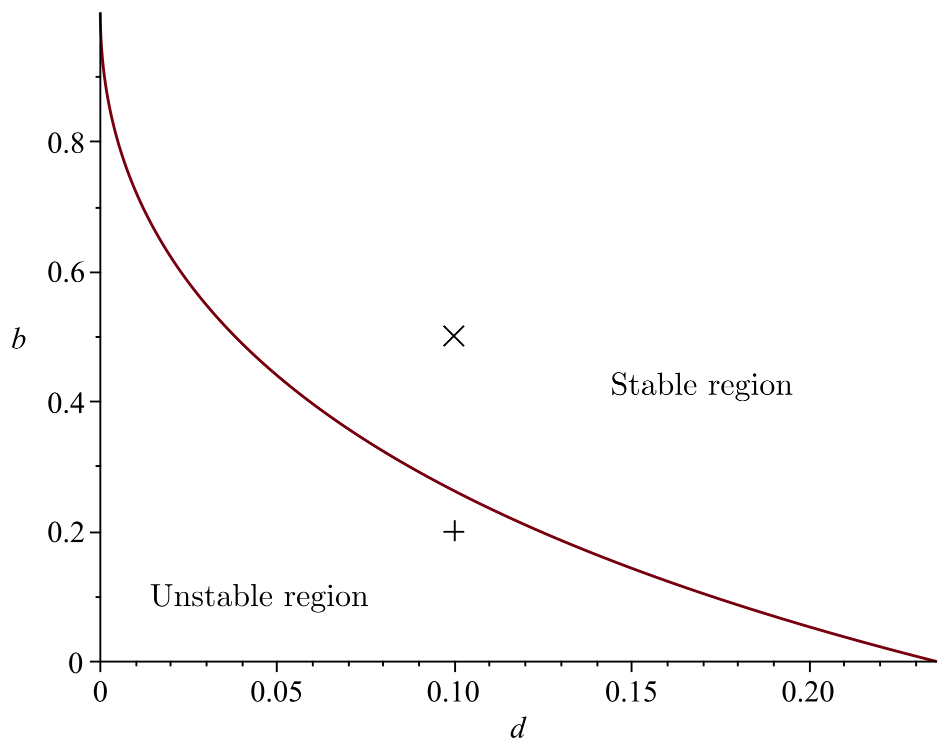

Figure 2. Stability regions for fixed point in new model.

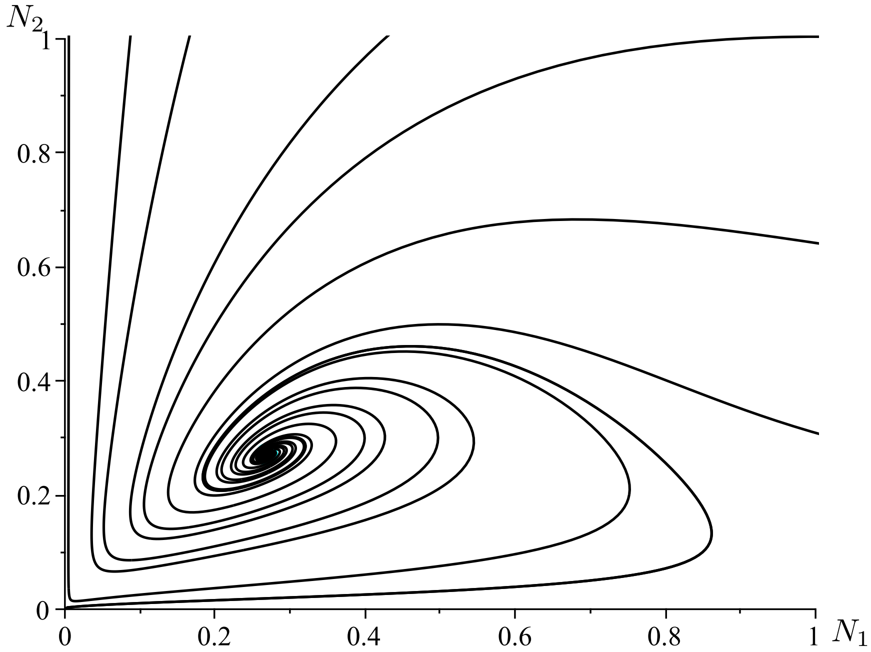

Figure 3. Stable fixed point: $d = 0.1$, $b = 0.5$. (marked by $\times$ in Figure 2).

For regions above the curve in Figure 2, the fixed point is stable.

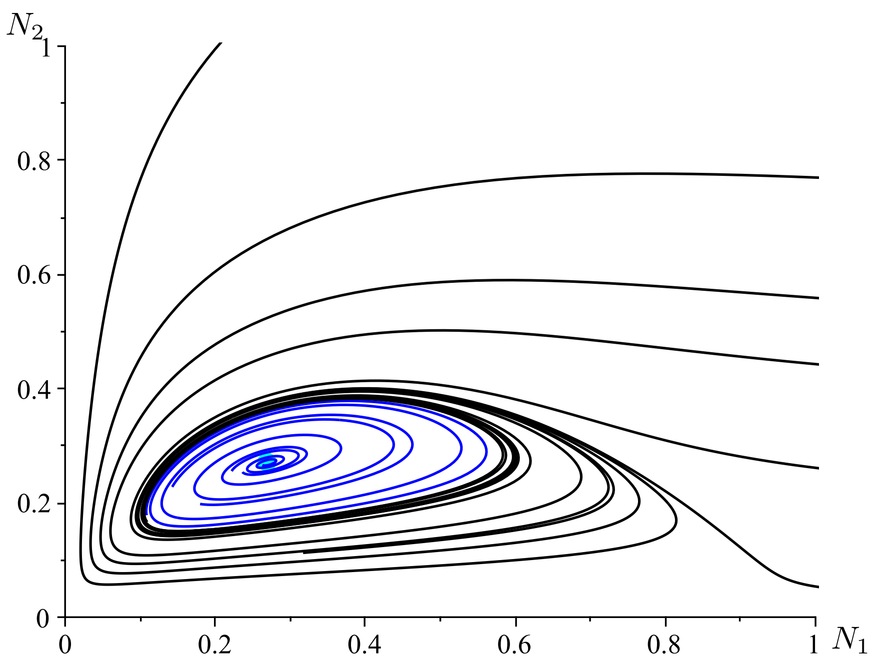

Figure 4. Limit cycle in unstable region: $d = 0.1$, $b = 0.2$ (marked by $+$ in Figure 2).

Whenever the fixed point was unstable, we saw that the only possibility (due to inward flow from infinity) was that there must be a stable limit cycle, shown above.