The effects of the size and shape of landscape features on the formation of traveling waves

Read the paper and understand the biology and mathematical models constructed by the authors. You are required to make presentation and project report with the following details:

1. Find all possible steady-state points of the non-dimensional equations (1a) & (1b) and (2a) & (2b).
   [10 points]

2. Linearize the non-dimensional equations (1a) & (1b) by taking into account inhomogeneous perturbations.
   [10 points]

3. Calculate eigenvalues from the linearized equations (calculate Jacobian matrix and solve the characteristic polynomial).
   [10 points]

4. Investigate the stability of all steady states.
   [10 points]

5. Produce dispersion relations from each steady state.
   [10 points]

6. Solve/simulate the non-dimensional equations in 1D space using Forward, Backward, and Crank-Nicolson methods:
   - Compare the results of each method.
   - Determine the most efficient method to use (based on accuracy and time).
   - Using the most efficient method, reproduce figure 1 for prey in the paper and produce solution for predators.
   - Using the most efficient method, solve/simulate the $\lambda - \omega$ system of equations (2a) and (2b) in 1D as in figure 7.
   [20 points]
(8) Solve/simulate the non-dimensional equations in 2D space using either Crank-Nicolson, Alternating Direct Implicit (ADI), or Method of Lines (choose only 1 method):

– Reproduce figure 3 and 8 in the paper.

[30 points]

Presentation and report should include:

• Biological background.
• Mathematical formulation.
• Mathematical analysis (non-dimensionalization and linear stability analysis).
• Numerical methods used and results of simulations.
• Biological interpretation of results and discussion