

Supplementary Material for:

**Social-ecological models with social hierarchy and spatial
structure applied to small scale fisheries**

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Equations 2), 4), and 5) are as follows:

$$\frac{dX_i}{dt} = k_i X_i (1 - X_i) [U_{A,i} - U_{B,i}] \quad (2)$$

$$U_{A,i} = \frac{1}{(F_i + c_i)} + d_i X_i + \rho_i X_j \quad (4)$$

$$U_{B,i} = \omega_i + d_i (1 - X_i) + \rho_i (1 - X_j) \quad (5)$$

Substituting equations 4) and 5) into equation 2 Gives:

$$\frac{dX_i}{dt} = k_i X_i (1 - X_i) \left[\frac{1}{(F_i + c_i)} + d_i X_i + \rho_i X_j - \omega_i - d_i (1 - X_i) - \rho_i (1 - X_j) \right]$$

$$\frac{dX_i}{dt} = k_i X_i (1 - X_i) \left[\frac{1}{(F_i + c_i)} - \omega_i + d_i (X_i - 1 + X_i) + \rho_i (X_j - 1 + X_j) \right]$$

$$\frac{dX_i}{dt} = k_i X_i (1 - X_i) \left[\frac{1}{F_i + c_i} - \omega_i + d_i (2X_i - 1) + \rho_i (2X_j - 1) \right]$$