Self-organized predation and migration model

Abstract

[1]

Author Summary

Introduction

Results

Steady State

Space of Parameters

Metabolic Theory of Ecology

Discussion

Materials and Methods

Fluxogram of the model

Please see Figure 1

Predation Equations

- **General Equation**

$$N'\left(sp\right) = N\left(sp\right) \times \Bigg\{ \left[1 - NDp\left(sp\right)\right] \left[\sum_{b \in H(sp)} \rho\left(b\right) Dp\left(b\right)\right] \left[Bp\left(sp\right)\right] - \left[\sum_{c \in P(sp)} \rho\left(c\right) \left(1 - NDp\left(c\right)\right) \frac{\rho(sp)}{\sum_{d \in H(c)} \rho(d)} Dp\left(sp\right)\right] - \left[NDp\left(sp\right)\right] \Bigg\}$$

- **Self-Organized Parameters: Birth Probability**

$$Bp\,(sp) = [1-\rho\,(sp)] \times \left[\sum_{b\in H(sp)} \rho\,(b) \left(1-\sum_{c\in P(b)} \rho\,(c)\right)\right] \times \left[1-\sum_{c\in P(sp)} \rho\,(c)\right]$$

Where: Availability of Resources of Basal Species is 1.0

- **Self-Organized Parameters: Death Probability**

$$Dp\,(sp) = [\rho\,(sp)] \times \left[\sum_{b\in H(sp)} (1-\rho\,(b)) \left(\sum_{c\in P(b)} \rho\,(c)\right)\right] \times \left[1-\sum_{c\in P(sp)} \rho\,(c)\right]$$

Where: Death Probability of Basal Species is 1.0

- **Self-Organized Parameters: Natural Death Probability**

$$NDp\,(sp) = [\rho\,(sp)] \times \left[\sum_{b\in H(sp)} (1-\rho\,(b)) \left(\sum_{c\in P(b)} \rho\,(c)\right)\right] \times \left[1-\sum_{c\in P(sp)} \rho\,(c)\right]$$

- **Self-Organized Parameters: Carrying Capacity (for each species in each site)**

$$CC\,(sp) = \left[\sum_{b\in H(sp)} \frac{(\rho(b))}{\left(\sum_{c\in P(b)} \rho(c)\right)}\right]$$

Migration Equations

- **Mobility of species *sp* from site *i* to *j***

$$\Delta N_{sp}\left(i\right) = \sum_{j \in Neigh(i)} \left(\left(N_{sp}(j)\; M_{sp}(j,i) \;-\; N_{sp}(i)\; M_{sp}(i,j) \right) \right)$$

$$M(i,j) = \overbrace{\left[\lambda^{i} \frac{\Delta_{ij}\, f\, \Theta\left(\Delta_{ij}\, f\right)}{\sum_{k \in Neigh(i)} \Delta_{ik}\, f\, \Theta\left(\Delta_{ik}\, f\right)}\right]}^{Biotic} \overbrace{\left[w_{ij} \frac{\Delta_{ij}\, f_{\eta}\, \Theta\left(\Delta_{ij}\, f_{\eta}\right)}{\sum_{k \in Neigh(i)} \Delta_{ik}\, f_{\eta}\, \Theta\left(\Delta_{ik}\, f_{\eta}\right)}\right]}^{Abiotic}$$

$$\Delta_{ij}\, f = f^{i,j} - f^{j,i} \begin{cases} f^{i,j} = \rho_H(j) + \rho_P(i) \\ f^{j,i} = \rho_H(i) + \rho_P(j) \end{cases}$$

$$\lambda^{i} = \tfrac{1}{2}\left(1 - RE^{i}\right)$$

$$RE^{i} = \tfrac{New^{t}}{N^{t}}$$

$$\Delta_{ij}\, f_{\eta} = f_{\eta}^{j} - f_{\eta}^{i} \begin{cases} f_{\eta}^{i} = \eta_{sp}^{*} - \eta_{sp}^{i} \\ f_{\eta}^{j} = \eta_{sp}^{*} - \eta_{sp}^{i} \end{cases}$$

$$w_{ij} = Connectivity\; between\; sites\; iand\; j$$

Acknowledgments

References

1. de Santana CN, Rozenfeld AF, Marquet PA, Duarte CM (2013) Topological properties of polar food webs. Marine ecology Progress series 474: 15–26.

Figures

Tables

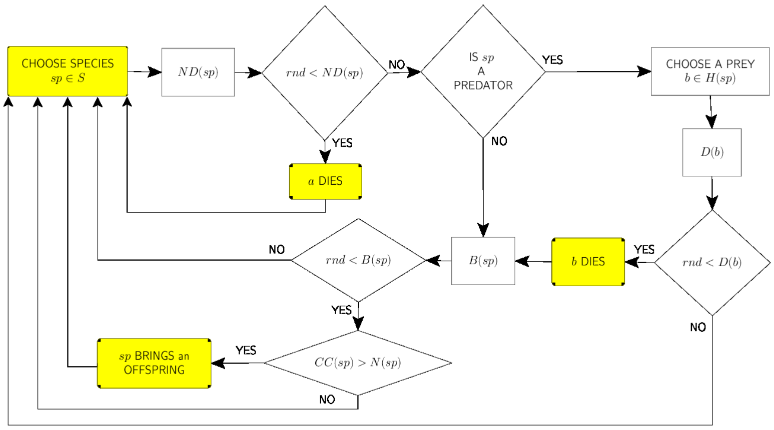

Figure 1. Fluxogram. Fluxogram of the model.