The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
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2022-21

Workshop on Theoretical Ecology and Global Change

2 - 18 March 2009

Lectures outline

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Workshop on Theoretical Ecology and Global Change
Abdus Salam International Centre for Theoretical Physics (ICTP)
Trieste, Italy
02-13 March 2009

LECTURES OUTLINE

LECTURE 1 (Thursday, March 5, 14:00)

The Dynamics of Variable or Conditional Population Interactions: Nature and Models.

General definition of population interactions in nature, leading to cases of species with variable or conditional interactions and change in roles. The notion of costs and benefits involved in the interactions.

Basic Models. Quick review on basic linear population interaction models (Lotka-Volterra competition, predator prey, mutualism).

More realistic models: non-linearities. Variations in the strength of the interaction.

Models for Variable or Conditional interactions: Variations in strength and nature, changes in the roles of species. The definition of Interaction Functions: DD costs/benefits balance. Graphical stability analysis.

References

Barkai A & C McQuaid. 1988. Predator-prey role reversal in a marine benthic ecosystem. *Science* 242, 62-64.

Bronstein JL. 1994. Conditional outcomes in mutualistic interactions. *Trends Ecol.Evol.* 9, 214-217.

Hernandez MJ. 1998. Dynamics of transitions between population interactions: a nonlinear interaction α-function defined. *Proc.R.Soc.Lond.B.* 265, 1433-1440.

Hernandez MJ & I Barradas. 2003. Variation in the outcome of population interactions: bifurcations and catastrophes. *J.Math.Biol.* 46, 571-594.

Vandermeer JH & DH Boucher. 1978. Varieties of mutualistic interaction in population models. *J.theor.Biol.* 74, 549-558

Wolin CL & LR Lawlor. 1984. Models of facultative mutualism: density effects. *Amer.Natur.* 124, 843-862.

Zhang Z. 2003. Mutualism or cooperation among competitors promotes coexistence and competitive ability. *Ecol.Model.* 164: 271-282

LECTURE 2 (Friday, March 6, 10:00)

The Dynamics of Variable or Conditional Population Interactions: Nature in Models.

Models applied to natural cases. 1_Pollination dynamics and pollination mutualims: functional responses of benefits and costs (Senita cacti- Senita moth). 2_Plant–mycorrhizae model: a mutualism parasitism continuum model. 3_Ants and aphids: the mutualistic, parasitic and predator roles of ants.

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Bifurcations and Catastrophes.

Bifurcation and catastrophes in the variable outcome of population interactions. The interchange of roles in a predator-prey interaction: the whelks-lobsters case in South Africa. Catastrophic shifts and empirical evidence for alternative stable states or alternative attractors.

References

Hernandez MJ & I Barradas. 2003. Variation in the outcome of population interactions: bifurcations and catastrophes. *J.Math.Biol*. 46, 571-594.

Holland JN, D De Angelis & JL Bronstein. 2002. Population dynamics and mutualism: functional responses of benefits and costs. *Amer.Natur*. 159, 231-244.

Neuhauser C & JE Fargione. 2004. A mutualism-parasitism continuum model and its application to plant-micorrhizae interactions. *Ecol.Model*. 177, 337-352.

Scheffer M, S Carpenter, JA Foley, C Folkes & B Walker. 2001. Catastrophic shifts in ecosystems. *Nature* 413, 591-596.

Scheffer M & S Carpenter. 2003. Catastrophic regime shifts in ecosystems: linking theory to observation. *Trends Ecol. Evol*. 18, 648-656.

Schroder A, L Persson & AM De Roos. 2005. Direct experimental evidence for alternative stable states: a review. *Oikos* 110, 3-19.

LECTURE 3 (Monday, March 9)

The Dynamics of Variable or Conditional Population Interactions in Space.

Spatially heterogeneous environments and DD Interaction Functions. Source-sink dynamics in variable population interactions.

Discussion on the characterization of population interactions.

Disentangling strength, nature and stability issues in population interactions

References

Amarasekare P. 2004. Spatial dynamics of mutualistic interactions. *J. Anim. Ecol*. 73, 128-142.

Amarasekare P & RM Nisbet. 2001. Spatial heterogeneity, source-sink dynamics, and the local coexistence of competing species. *Amer. Natur*. 158, 572-584.

Armstrong RA. 1987. A patch model of mutualism. *J.Theor.Biol.* 125, 243-246.

Hernandez MJ. 1998. Dynamics of transitions between population interactions: a nonlinear interaction α-function defined. *Proc.R.Soc.Lond.B*. 265, 1433-1440.

Hernandez MJ & I Barradas. 2003. Variation in the outcome of population interactions: bifurcations and catastrophes. *J.Math.Biol*. 46, 571-594.

Hernandez MJ. 2008. Spatiotemporal dynamics in variable population interactions with density-dependent interaction coefficients. *Ecol.Model*. 214, 3-16.

Neuhauser C & JE Fargione. 2004. A mutualism-parasitism continuum model and its application to plant-micorrhizae interactions. *Ecol.Model*. 177, 337-352.

Zhang Z. 2003. Mutualism or cooperation among competitors promotes coexistence and competitive ability. *Ecol.Model*. 164: 271-282.

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