Disturbance-generated niche-segregation in a structured metapopulation model

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ABSTRACT

**Question:** Does limiting similarity apply for co-existence maintained by disturbance in a metapopulation?

**Methods:** In contrast to patch occupancy modelling, we follow both local- and meta-population-scale dynamics explicitly. The theory of structured metapopulations is used for this purpose. Adaptive dynamics is employed to study evolution.

**Key assumptions:** Local catastrophes at a given rate. Fixed dispersal rate, trade-off between fecundity and local competitiveness.

**Results:** Co-existence of a few (up to 5) but not more species is observed. They are distinctly different along the trade-off variable and partition the patch-age axis. A series of evolutionary branchings leads to an evolutionarily stable coalition.

**Conclusions:** The usual niche theoretical picture of decreased competition with increased differentiation applies. The patch age is the proper niche axis. Niche differentiation along this axis is the requirement of co-existence. Constraints of co-existence are overlooked in patch occupancy models.

**Keywords:** disturbance, diversity, metapopulation, niche.

INTRODUCTION

Maintenance of species diversity via disturbance (Connell, 1978; Huston, 1979, 1994; Hastings, 1980) is a central issue of ecology. In the most commonly considered case, it is assumed that the ability to colonize and/or exploit an empty habitat can be increased at the cost of decreasing local competitiveness. In a constant environment, the better competitors (the ‘\(K\)-strategists’) outcompete the good colonizers/exploiters (the ‘\(r\)-strategists’) in each habitat, so that the latter disappear. If, however, the local sub-populations are destroyed regularly, the \(r\)-strategists may always have the chance to exploit a newly emptied habitat before they are expelled from the previous one. In this way, the long-term co-existence of the \(r\)- and
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