Effects of a heterogeneous landscape on gene flow in a coastal Natterjack Toad metapopulation

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Introduction

Habitat fragmentation, loss and alteration might not be the sole threats to amphibian population viability, but they are considered as some of the main causes of the declines. Human land-use has changed landscapes tremendously, progressively reducing size and increasing isolation of habitat patches for amphibian populations. Effective dispersal is a crucial process in metapopulation persistence, both in terms of colonization-extinction dynamics and as a means to counter genetic drift and inbreeding in local demes. We therefore investigated effective dispersal in a coastal dune metapopulation of Natterjack Toad (Epipolaelecoleopalmare.Laurent), because spatial landscape heterogeneity is expected to influence dispersal and genetic structure, we analyzed which landscape features affect functional connectivity and to what degree.

Material and methods

• Study site: the highly fragmented grey dune area on the West-Coast of Belgium where the last Belgian coastal metapopulation of Natterjack Toad resides.
• Sampling tail clips of 256 larvae in 4 potential subpopulations + genotyping with 11 microsatellites. After removing members of the same full-sib family except one from the dataset, 152 individuals remained.
• Population structure analysis: principal component analysis (PCA), a spatial PCA and the calculation of population differentiation (Ft and D) and Wrights isolation by distance (IBD).
• Detection of recent gene flow (GeneClass2) and BMW 1.0.
• Estimating genetic diversity, fixation index and effective number of breeders (Hr, sub-assignment method in COLONY 2.0.5.8) and linkage disequilibrium method LDNe (in COLONY)

Results

• Low genetic differentiation among Ter Yde and Westhoek
• Congruent with the observed genetic structure, a high number of migrant alleles originating from Westhoek in Ter Yde (with a minimum distance of 8.5 km between them).
• Few migrant alleles in the geographically intermediate subpopulation Noordduinen-Oosthoek.

Conclusions

• Natterjack Toads seem to have increasing difficulty to disperse in the order of open areas, to surfaces covered by vegetation with increasing height, and with the highest resistance delivered by urbanized areas.
• Beach as dispersal route with dunes as corridors between habitats surrounded by the urban core of the city of Koksijde. Suggestions for management:
  – making the private gardens more toad friendly
  – creating dispersal corridors, e.g. toad tunnels

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