Are roads and railroads barriers for the moor frog?

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Background

Roads and railroads have been repeatedly identified as potential barriers for amphibian movements. Both the physical features of (rail)roads and traffic-induced mortality of animals that attempt to cross are believed to result in populations that are partly or fully isolated from each other. For many amphibian species, however, potential barrier effects of (rail)roads have not been empirically assessed.

Objective

- Our objective is to explore whether (rail)roads are a barrier to moor frog (*Rana arvalis*) movements and result in genetic differences between moor frog populations.

Study area

Our study area comprises the wetlands *Naardermeer* and *Ankeveense Plassen* and their surroundings in the central parts of the Netherlands. The study area is bisected by two two-track railroads and a two-lane provincial highway.

Figure 1. Railroad 087 that bisects the Naardermeer wetland was constructed in 1874. Traffic volume: ~400 trains/24h.

Figure 2. Highway N236 was constructed in 1937. Traffic volume: ~20.000 vehicles/24h.

Methods

In spring and summer 2019 we collected DNA samples of 145 moor frogs across both preserves. Furthermore, we collected 43 DNA-samples in reference populations, both in areas immediately adjacent to the study site and in areas in other parts of the country. All samples were genotyped using eight microsatellite markers to analyse population structure and determine whether differences occur in genetic diversity and heterozygosity between populations.

Figure 3. DNA was collected through collecting eggs as well as by toe clipping frogs.

Results

- We found a genetic structure in which the populations north (STU-NO) and south (STU-M) of railroad 087 did not significantly differ.
- We found genetic differentiation for the populations north (STU-M and STU-NO) and south (STU-Z) of highway N236.
- We found genetic differentiation for the populations east (STU-NO) and west (STU-NW) of railroad 135.

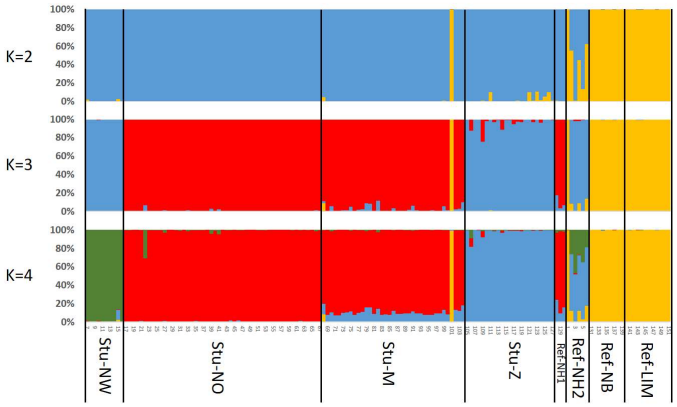

Figure 4. Results of clustering models [software STRUCTURE] for different K-values, i.e., number of genetic clusters to be identified. Each identified cluster has its own color. Each bar is the genetic profile of one sampled individual.

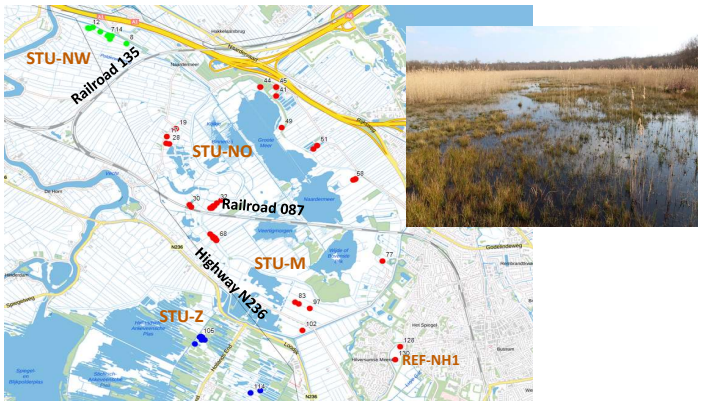

Figure 5. Genetic structure of moor forg in the study area and a nearby reference population. Each dot is one sampled frog. The color of the dots resembles the cluster to which the animal has been most strongly assigned.

Conclusions

- Roads and railroads can be barriers to moor frog movements and gene flow.
- Our study highlights the value of applying genetic techniques in the assessment of barrier effects, provides baseline information for future evaluations of planned crossing structures and eventually help improve decision-making on mitigating barrier effects of (rail)roads for amphibians.

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