ECOGRAPHY

E4052.
Fang, W. 2005. Spatial analysis of an invasion frontier of *Acer platanoides*: dynamic inferences from static data. – Ecography 28: 283–294.

Appendix. Detailed description of data analyses.

Ripley's L

For the population distribution of *A. platanoides*, *A. rubrum* and all native trees combined, Ripley's L, a scale-independent measure was used (Ripley 1976, 1977, Fortin 1999, Perry et al. 2002). The function $K_i(d)$ is the ratio between the number of plants (regardless of size) counted within distance d around an individual plant i at a location s and the local intensity $\lambda(s)$ (λ=n/A, i.e. the number of plants per unit area in area A at location s). Function K(d) was calculated as mean $K_i(d)$ values for all relevant individual plants for distances d increasing from 0.1 m to 25 m (25% of the maximum scale) in 0.1 m increments, using circumference to control edge effects (i.e. correct K(d) values for plants near the edges of the mapped plot) (Diggle 1983, Rosenburg 2001). L(d), the standardized K(d), is then calculated as the difference between d and square root of $K(d)/\pi$, i.e. $L(d) = d - \sqrt{(K(d)/\pi)}$. The expected value of L(d) is zero when points are randomly distributed; values less than zero indicate aggregation while values greater than zero indicate more regular spacing. A more negative value of L indicates a higher intensity of aggregation. The d value at the valley of the L(d) curve indicates the average size of the clump.

Importance value

Importance value of a species used in this study is the average, instead of the summation, of its % relative abundance (RA), % relative frequency (RF) and % relative dominance (RD).

$$RA = \frac{n_i}{\sum_i n_i} \times 100\%$$

$$RF = \frac{f_i}{\sum_i f_i} \times 100\%$$

$$RD = \frac{\sum_j (\pi r_{ij}^2)}{\sum_i (\sum_j (\pi r_{ij}^2))} \times 100\%$$

where n_i is number of individuals of species i, f_i is frequency of species i (number of plots with species i present), and r_{ij} is trunk radius at breast height of individual j of species i.

Envelope effects and quantile regression

I used a semi-quantitative analysis on the upper and lower edges of the data distribution detect the effects of unmeasured limiting factors on the response variables. Then I used rank-score test procedure of quantile regression (Cade et al. 1999, Koenker and d'Orey 1987, 1994) for constructing confidence intervals and hypotheses testing.

To detect the upper and lower limits of the "envelope effect", I divided the data points into 20 classes with equal distance intervals on the X-axis (i e. every 5 m), and picked the maximum and minimum values of that class. Then I plotted two regression lines (one using the maximum value per class, one using the minimum value per class) against the same X-axis. The lines with slopes significantly different from zero indicate the presence of significant upper or lower limits of the "envelope effect".

A regression quantile rank-score test procedure was adapted initially by Cade et al. (1999) based on an algorithm described by Koenker and d'Orey (1994), and implemented in the computer package R (Casgrain and Legendre 2002) to test hypotheses and to compute confidence intervals. Quantile regression is based on the concept of estimating quantiles for a distribution. The τth quantile of two dimensions is the estimated linear function from a distribution such that the line cuts the distribution at the points dividing the distribution into two portions, with the proportion τ of the sample observations below or on the line (Cade et al. 1999). In this study, I calculated the 10th, 25th, 50th, 75th, and 90th regression quantiles for the DBH vs. distance for *A. platanoides*, *A. rubrum*, *Quercus* group, *C. flora*, and *S. albidum* using computer package R.

Spatial autocorrelation (correlograms)

To detect the presence and degree of spatial autocorrelation (SA), Moran's I was calculated using the software of PASSAGE 1.01.0 (Rosenberg 2001) to construct correlograms (Cliff and Ord 1973, 1981, Sokal and Oden 1978a, b). The significance of individual autocorrelation coefficients was determined from their moments, and the significance of an entire correlogram was calculated using a Bonferroni procedure (Oden 1984). It was assumed that there was no specific distribution in the point data, and the significance test was given all possible random permutations of the data.

Additional references

Casgrain, P. and Legendre, P. 2002. Computer package R 4.0d6. – Uni. of Montreal.
Diggle P. J. 1983. Statistical analysis of spatial point patterns. - Academic Press.
Oden, N. L. 1984. Assessing the significance of a spatial correlogram. – Geogr. Anal. 16: 1-16.

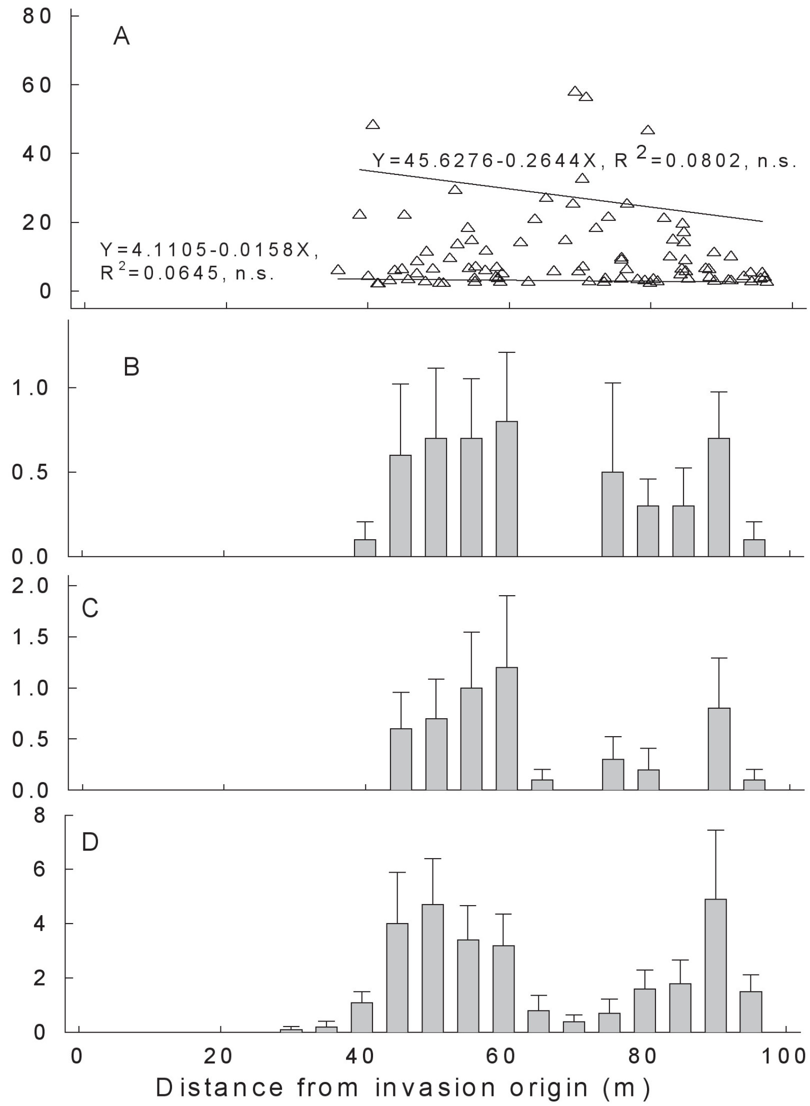

Fig. 1. Red maple stage/age structure over distance, with X axis along the west-east direction of the mapped area. Panel A: DBH of each adult *A. rubrum* individual. Two regression lines plotted against the maximum and minimum DBHs in 5 m intervals to detect the significance of any envelope effect. Panel B-D: *A. rubrum* juvenile (B), sapling (C) and seedling (D) densities at each of 5 m intervals into the forest interior (at west-east direction). The means and standard errors of the mean were calculated over values from 10 plots (at south-north direction) at the same 5 m intervals of the X-axis.

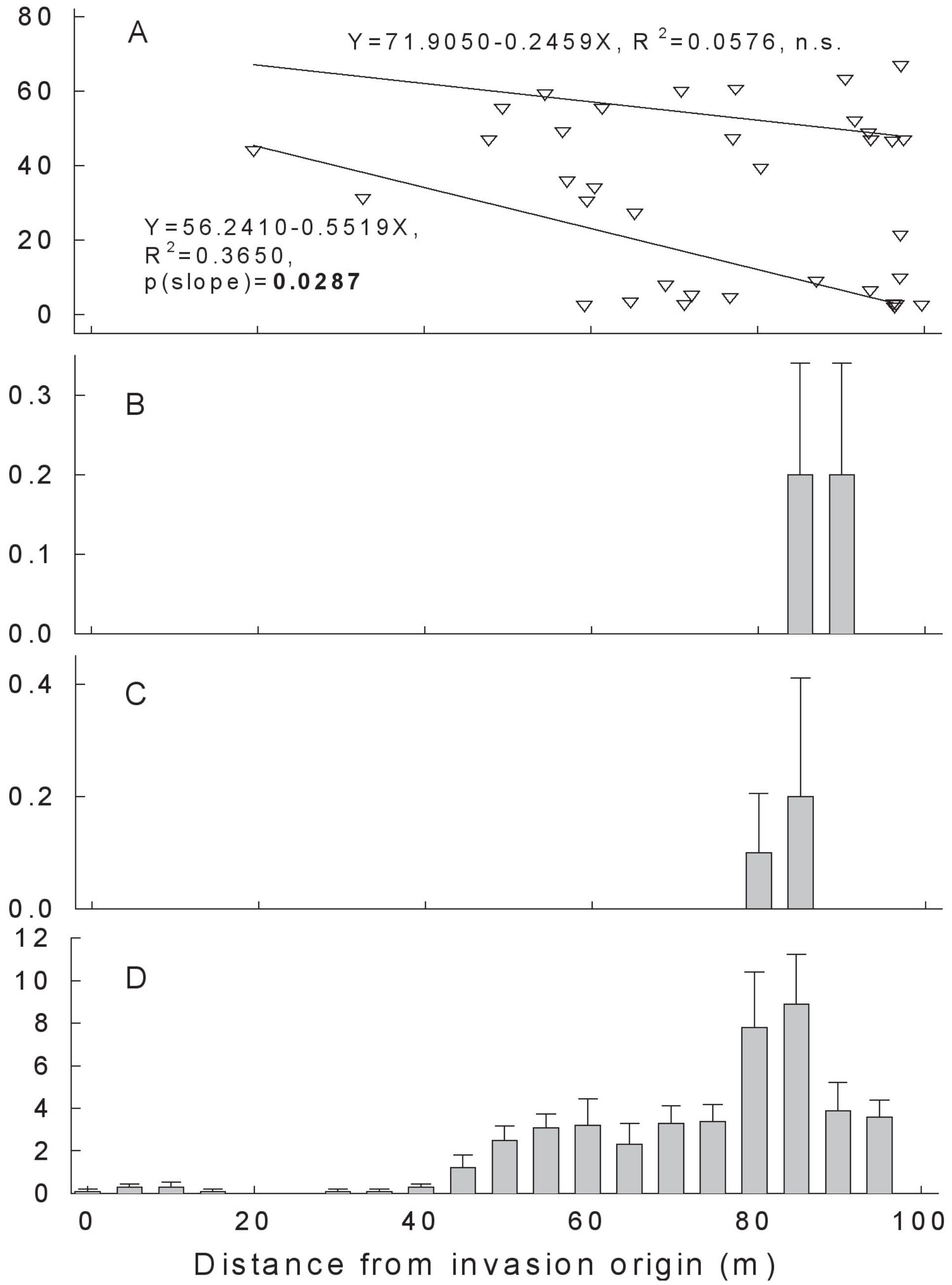

Fig. 2. Oaks stage/age structure over distance, with X axis along the west-east direction of the mapped area. Panel A: DBH of each adult oak individual. Two regression lines plotted against the maximum and minimum DBHs in 5 m intervals to detect the significance of any envelope effect. Panel B-D: *Quercus* juvenile (B), sapling (C) and seedling (D) densities at each of 5 m intervals into the forest interior (at west-east direction). The means and standard errors of the mean were calculated over values from 10 plots (at south-north direction) at the same 5 m intervals of the X-axis.

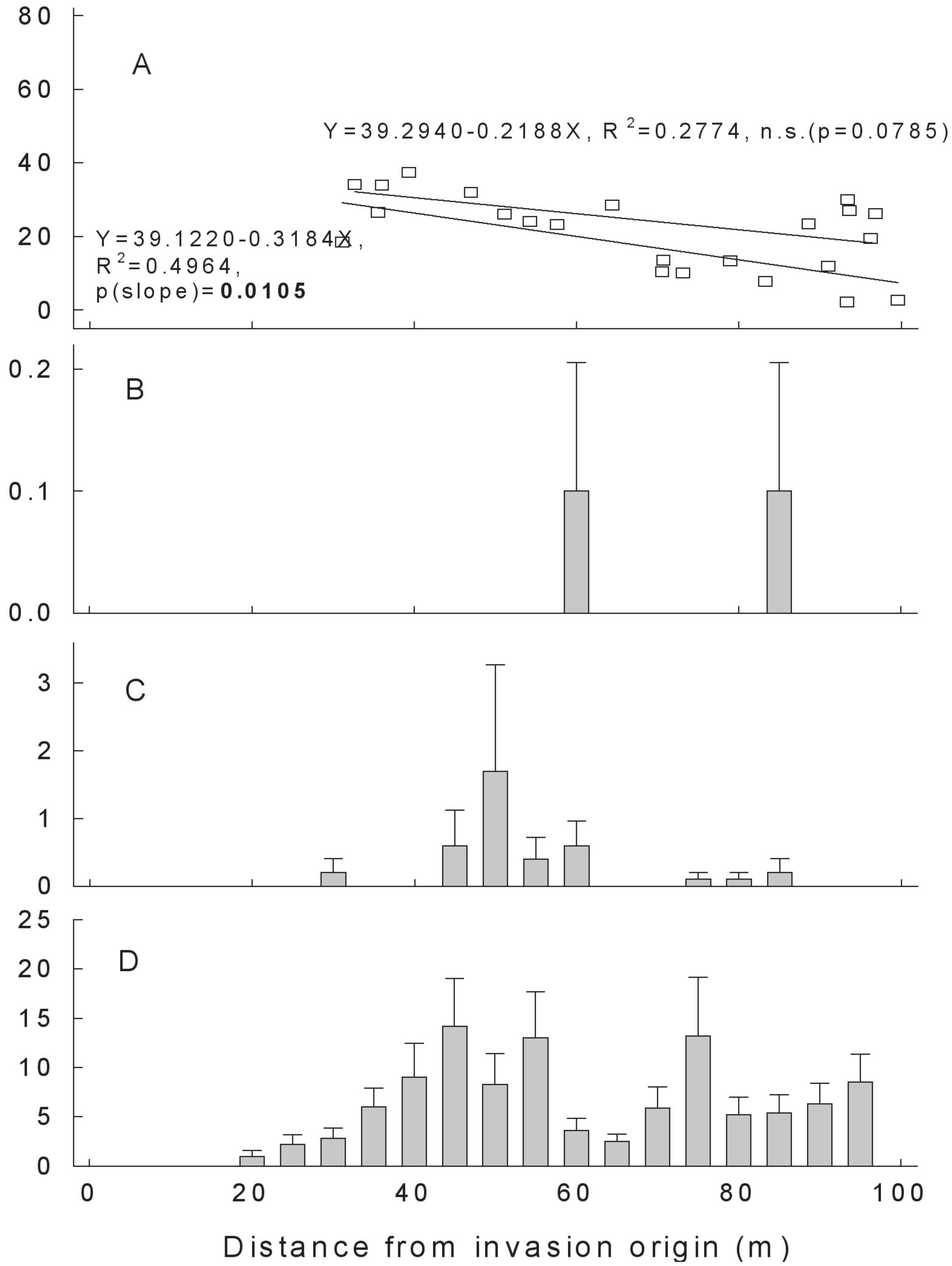

Fig. 3. Sassafras stage/age structure over distance, with X axis along the west-east direction of the mapped area. Panel A: DBH of each adult *S. albinum* individual. Two regression lines plotted against the maximum and minimum DBHs in 5 m intervals to detect the significance of any envelope effect. Panel B-D: *S. albinum* juvenile (B), sapling (C) and seedling (D) densities at each of 5 m intervals into the forest interior (at west-east direction). The means and standard errors of the mean were calculated over values from 10 plots (at south-north direction) at the same 5 m intervals of the X-axis.