Lymantria dispar Gypsy moth (5th instar larva)

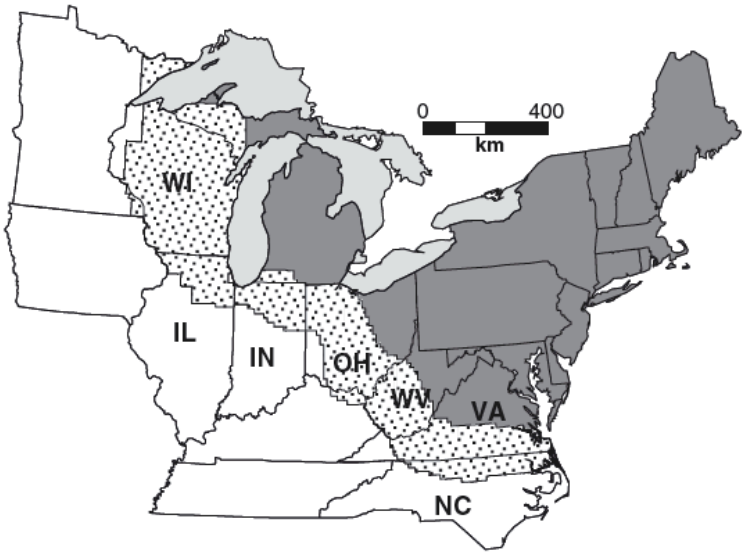

Figure 1 Areas of the USA where the gypsy moth is endemic (dark grey) or absent (white) in 2005. The dotted area between the two is the 'transition zone' that was monitored in 2005. Data from labelled states were used in this study (WI, Wisconsin; IL, Illinois; IN, Indiana; OH, Ohio, WV, West Virginia; VA, Virginia; NC, North Carolina).

We tested the utility of our novel definition of the Allee threshold with synthetic data generated with a known Allee threshold and carrying capacity. Data were simulated using a discrete time logistic growth model (Keitt *et al.* 2001; Liebhold & Bascompte 2003):

$$N_{i,t} = N_{i,t-1} \exp\left(r_i\left(1 - \frac{N_{i,t-1}}{K}\right)\left(\frac{N_{i,t-1} - C}{K}\right)\right), \qquad (1)$$

where N is the local population density at location i in space at either time step t or $t - 1$, K is the carrying capacity, and C is the Allee threshold. Fifty local populations were each

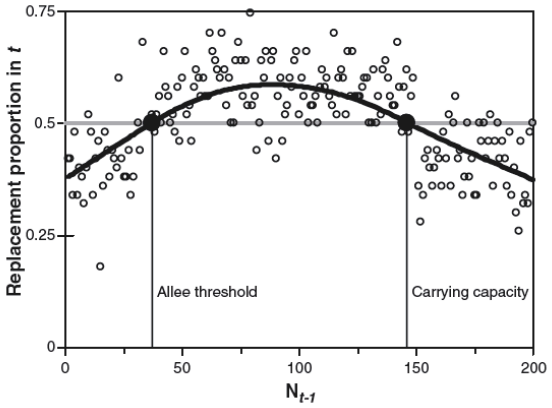

Figure 2 Theoretical representation, based on eqn 1, of the Allee effect and carrying capacity using the definition of population replacement from one time step to the next. When the initial density, N_{t-1}, is less than the Allee threshold or greater than the carrying capacity, populations are less likely to replace themselves, and hence decline in abundance, at the next time step.

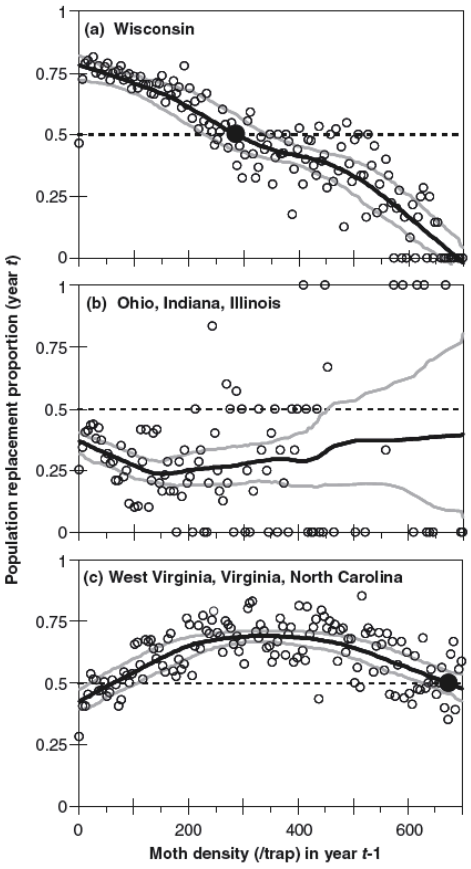

Figure 3 Region-specific relationships (mean, black line; 95% CI, grey lines) of population replacement rates and the respective population density in the prior year, pooled across 1996–2004. The carrying capacity (closed circle), as defined as the initial moth density estimate at which the replacement rate decreases to 0.5, is indicated in (a) and (c), but not in (b) due to replacement rates that were consistently < 0.5.

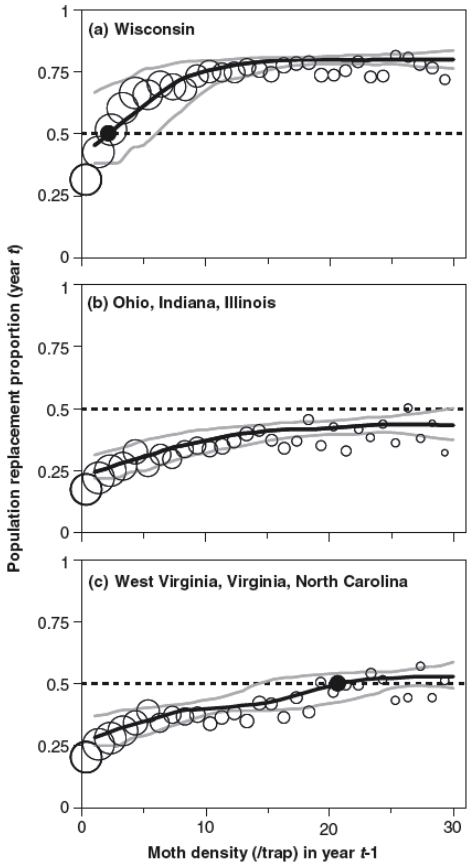

Figure 4 Region-specific relationships (mean, black line; 95% CI, grey lines) between population replacement rates and initial population densities ≤ 30 moths/trapping area (data pooled across 1996–2004). Estimates of the Allee thresholds (closed circle) is indicated in (a) and (c), but not in (b) due to replacement rates that were consistently < 0.5. The size of the observations (open circles) reflects the sample size in each population bin. For graphical purposes, the largest sized circle is for sample sizes > 1000. The range of sample sizes per bin is (a) 129–5838, (b) 63–3938 and (c) 93–4040.

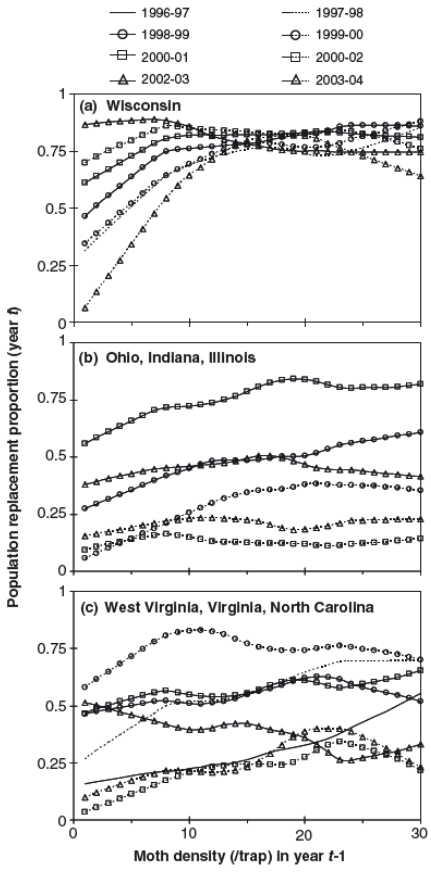

Figure 5 Temporal variation (year $t-1$ to t) in the region-specific estimates of the Allee thresholds. Note that in Wisconsin, the Allee effect is consistently minimized or non-existent, while considerable year-to-year variation exists elsewhere (the estimates of the y-intercepts were used as a surrogate for the strength of the Allee effect, cf. Fig. 6).

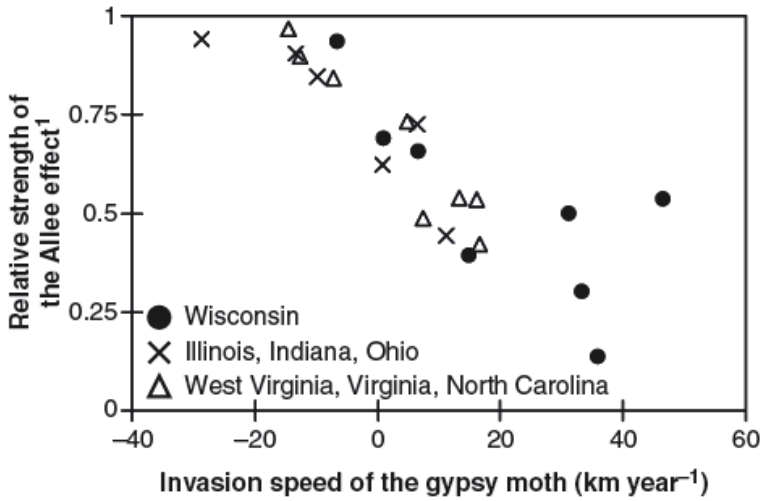

Figure 6 Invasion speed by the gypsy moth declines with an increase in the strength of the Allee effect in all regions of the USA. [1]Relative strength was estimated as 1 – the *y*-intercept estimates for each region and for each pair of consecutive years as shown in Fig. 5.