Environment – Land Use and Rural Stewardship

PROGRAMME 3

Can parasites drive population cycles in mountain hares?

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Introduction

Understanding the drivers of population fluctuations fascinates ecologists and can inform species management. Although theory suggests parasites can drive cyclic population fluctuations in their hosts (Anderson & May (1978), field evidence is lacking. Theory predicts that a parasite that loosely aggregates in the host population and has stronger impact on host fecundity than survival should induce cycling. The helminth *Trichostrongylus retortaeformis* in mountain hares in Scotland has exactly these properties, and the hares exhibit strong population fluctuations. Here we use host-parasite models parameterised using available empirical data to test if the host-parasite interaction can drive population cycles in mountain hares.

Table 1. Characteristics of the highly variable dynamics of mountain hare populations across Scotland (Newey *et al.* 2007)

Period	4-15 years
Mean hare density	20-200 km^{-2}
Amplitude of oscillations	Coefficient of variation 0.39-1.80
Mean parasite burden	200-5000 worms per hare

Model 1: Simple host-parasite model

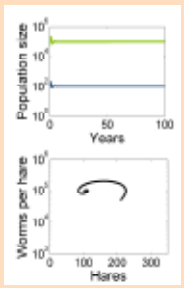
Parameters were estimated using parasite-reduction experimental data (Newey *et al.* 2004a,b, 2005). We used a variation of the the classic Anderson & May (1978) model for host-parasite systems.

Conclusion: Model 1 showed that the estimated parasite effects were not sufficient to drive observed hare population cycles.

SIMULATED POPULATION DYNAMICS FOR HARES AND PARASITES

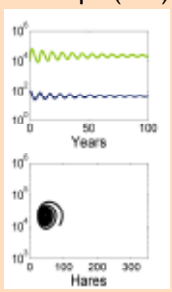
Increasingly realistic cycles

Empirical point estimate



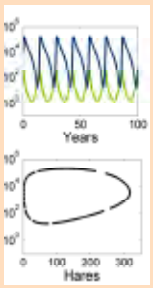
- Very stable
- Period 4 yrs
- Unrealistic worm burdens

Closest within plausible parameter envelope (PPE)



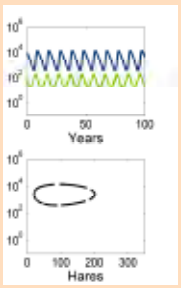
- Period 8 yrs
- Unrealistic worm burdens

Increase in parasite effect on fecundity (δ) outside of PPE



- Period 14 yrs
- Amplitude too large

Increase δ and tweak other parameters



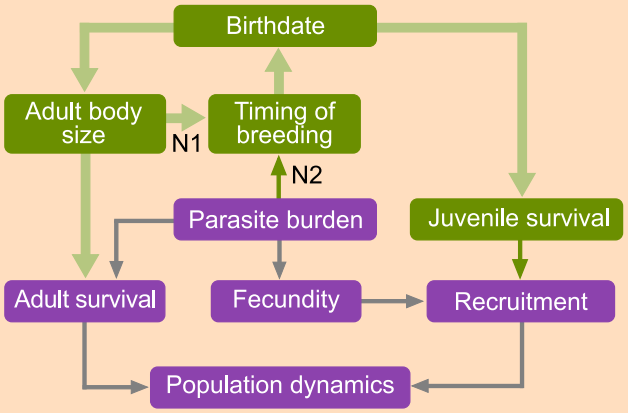
- All characteristics conform to Table

Model 2: Individual based model (IBM)

An IBM framework was used to allow the model to include more ecological realism, and allow indirect parasite and delayed life history effects to influence hare population dynamics.

Conclusion: The additional indirect effects reduced the parasite mediated effect on fecundity necessary to generate observed cycles. The IBM also suggests that delayed hare maturity and seasonal breeding reduce the extent to which parameters need to deviate from our point estimates to generate realistic hare cycles.

Ongoing work is extending the modelling to incorporate spatial elements and greater knowledge of leveret recruitment, dispersal and meta-population dynamics.



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