Climate change and population dynamics of a temperate amphibian

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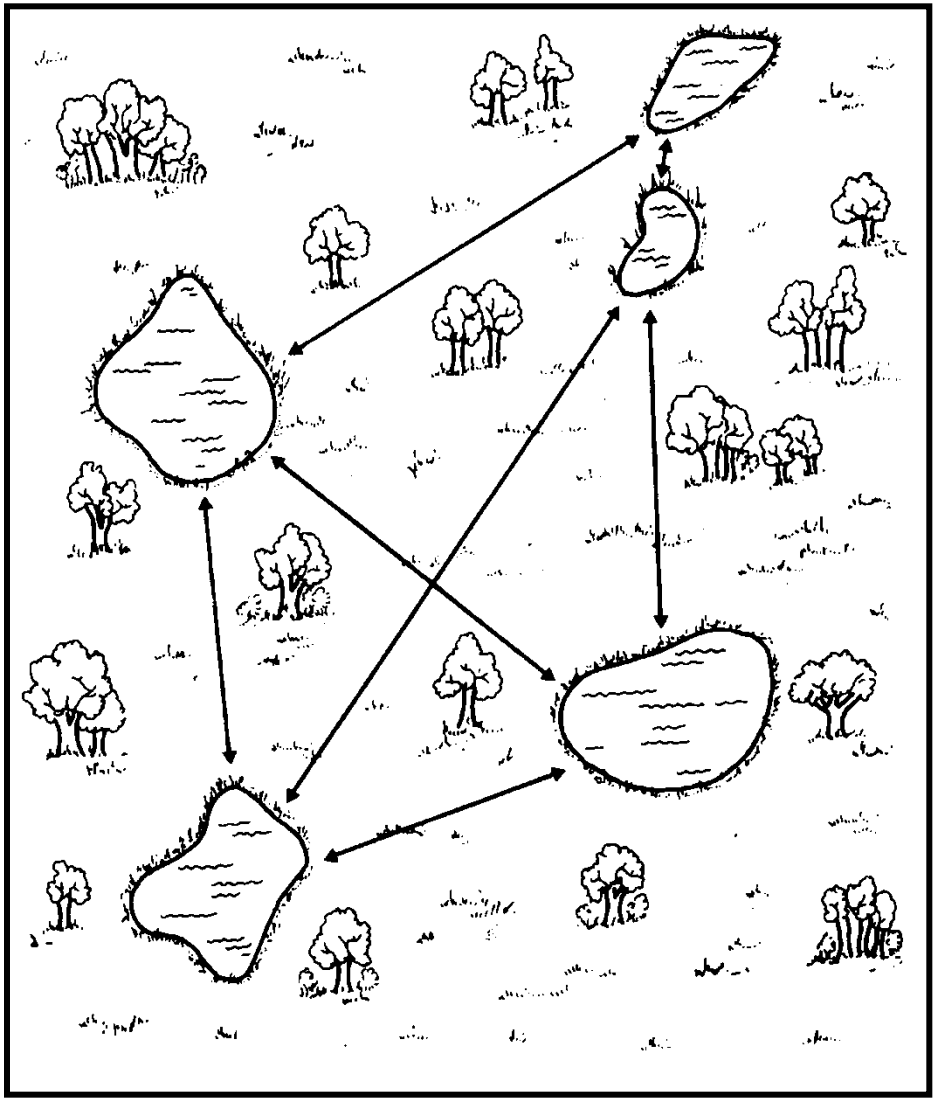
UK climate change

Projections suggest that by 2080-2090:

- Annual temperatures rise by 2.0-3.5^{o}C
- Overall rainfall remains similar, but...
- Summer precipitation may decline by up to 50%
- Winter precipitation increases

Hulme *et al.* (2002)

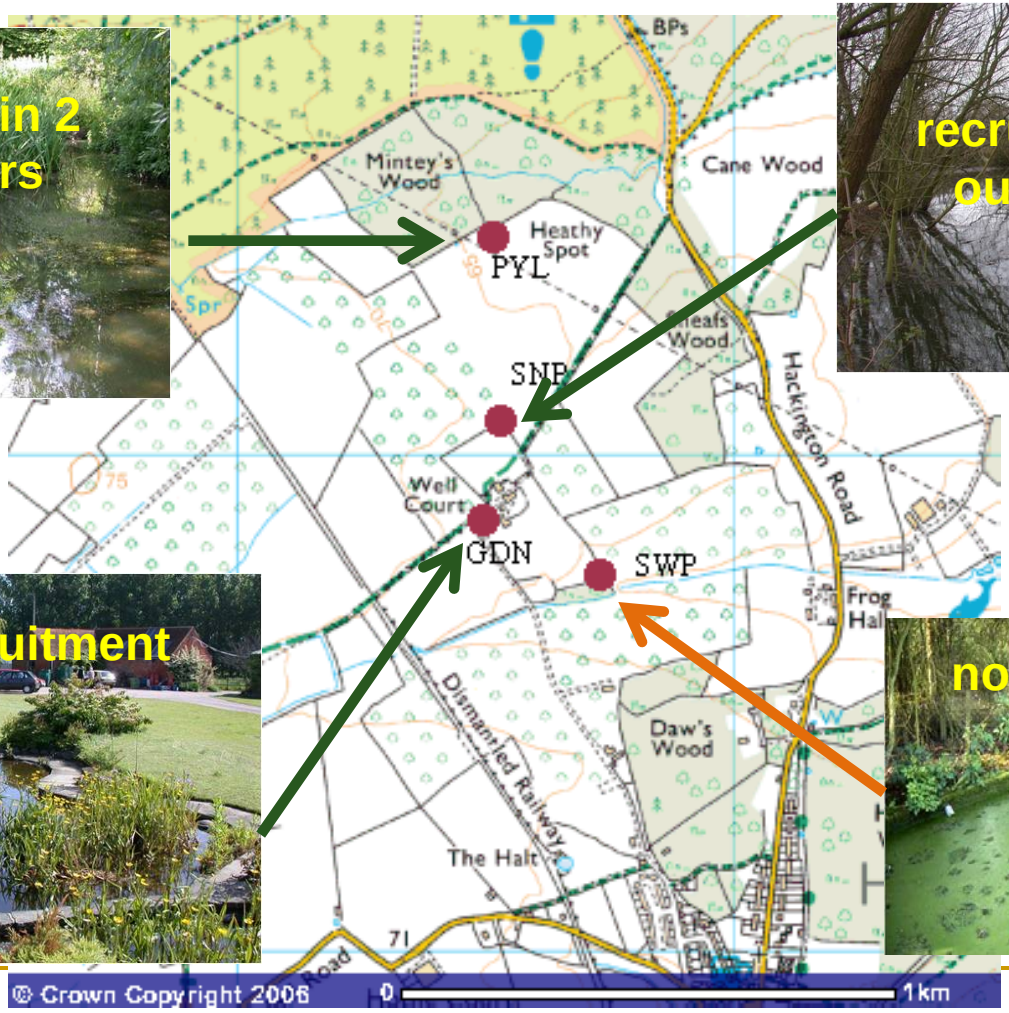
Patchy populations or metapopulations?



Great crested newt

- breed in ponds
- long-lived (<14 yrs)
- high fecundity (c. 300 eggs)
- erratic larval survival
- exists in metapopulations

Well Court Study Site



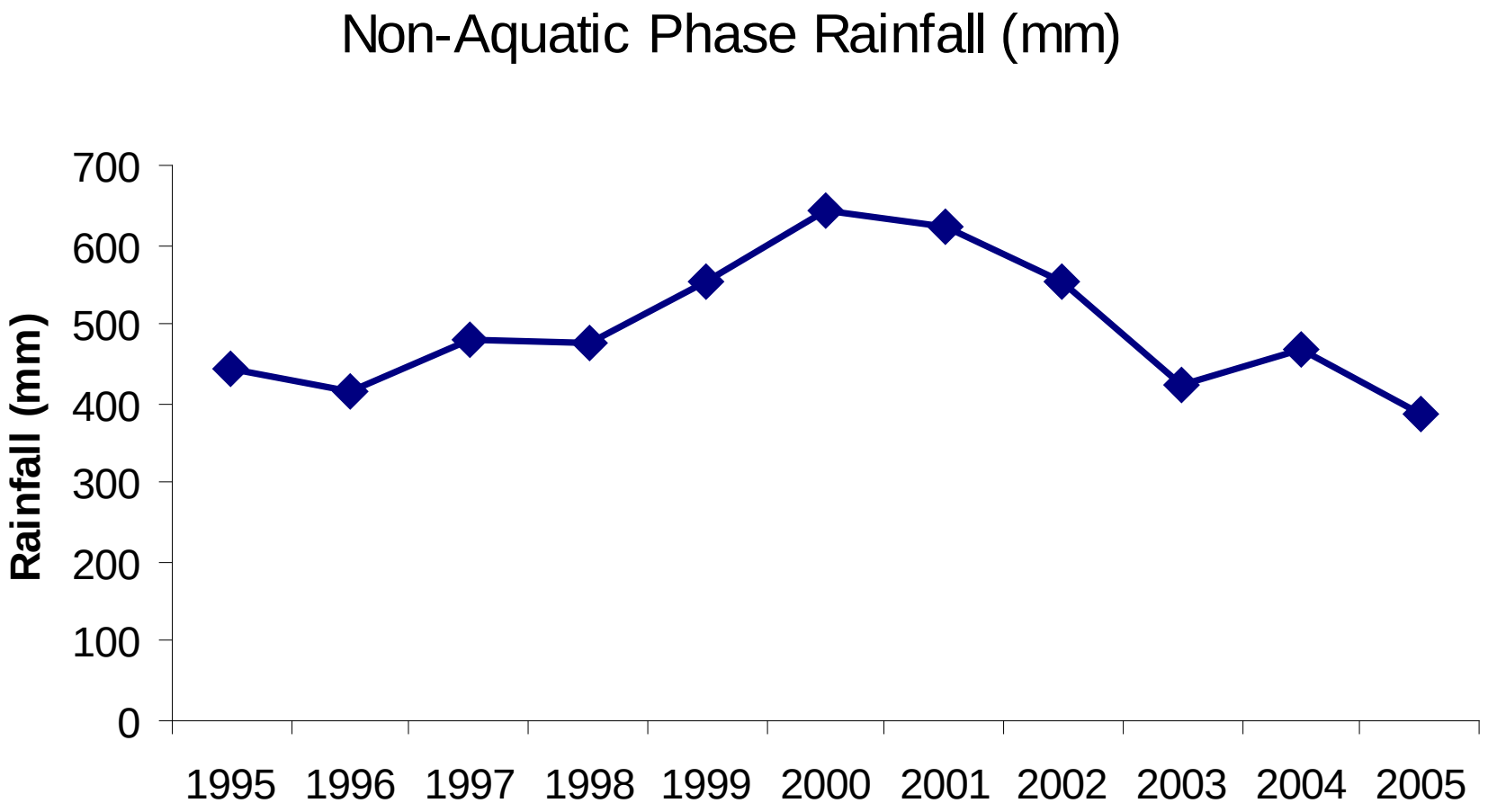
Great crested newt dataset

- 12 years of capture-mark-recapture data (1995-2006)
- 2647 captures
- 1013 individuals
- Average individual captured 2.6 times over 1.6 seasons
- Data analysed using Cormack-Jolly-Seber method in program MARK

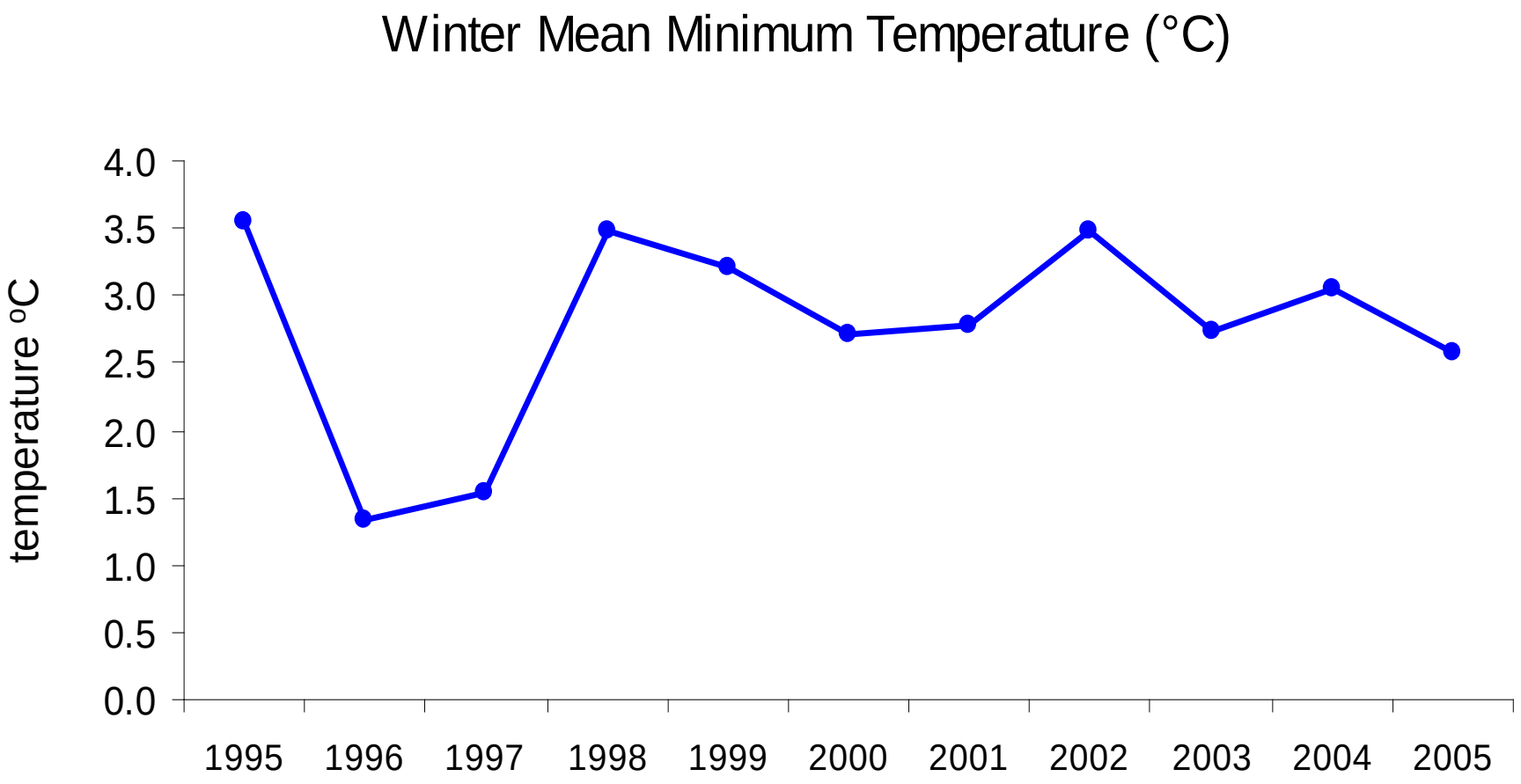
Climatic data

- Available on line from the Meteorological Office at: http://www.metoffice.gov.uk/research/hadleycentre/obsdata/ukcip/index.html
- *Winter mean minimum temperature (WT):* mean daily minimum temperature (^{0}C) from December-February each winter
- *Non-aquatic period rainfall (NAR):* total rainfall (mm) Jan-Feb and Jun-Dec in each calendar year
- Spring rainfall and winter ground frost also examined

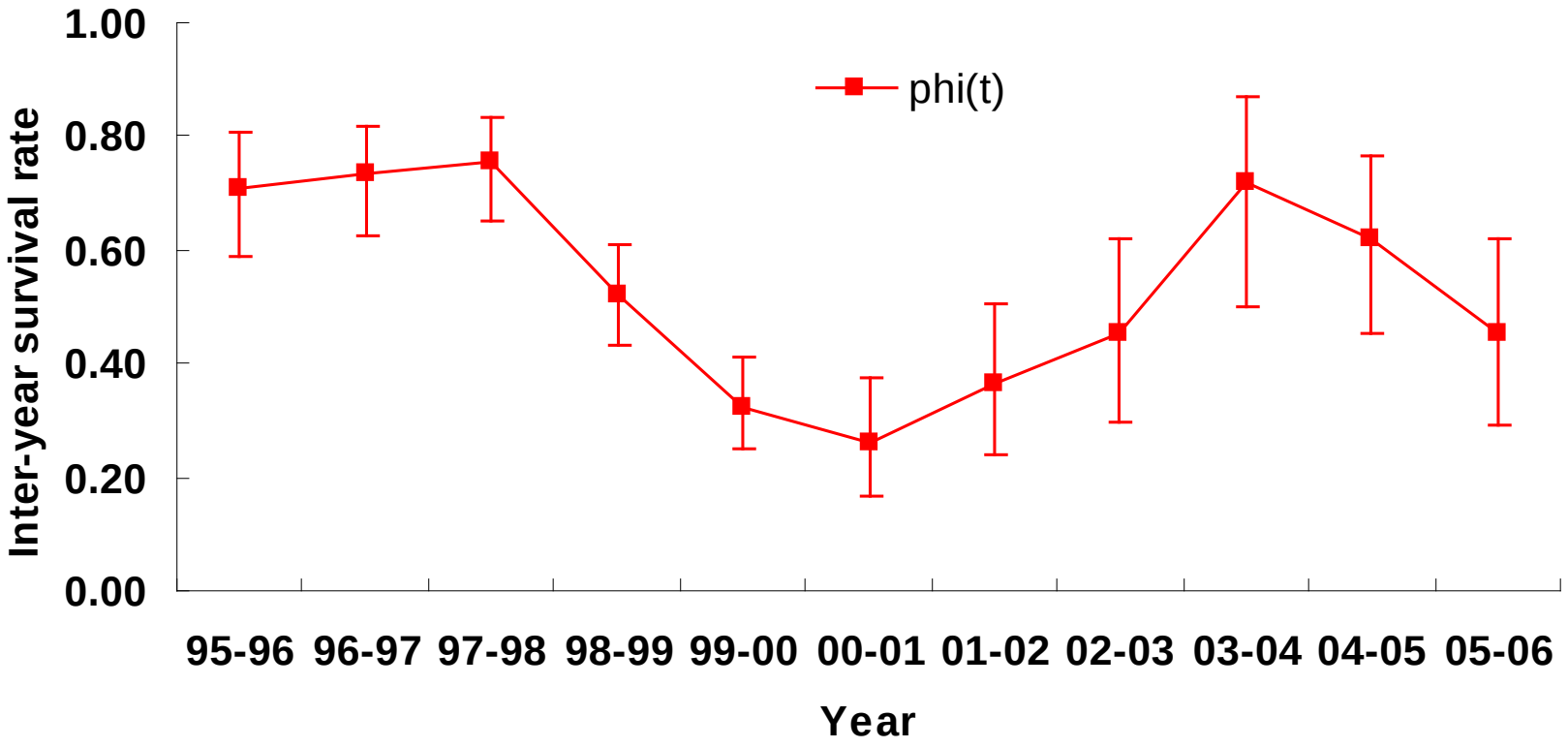
Rainfall (NAR)



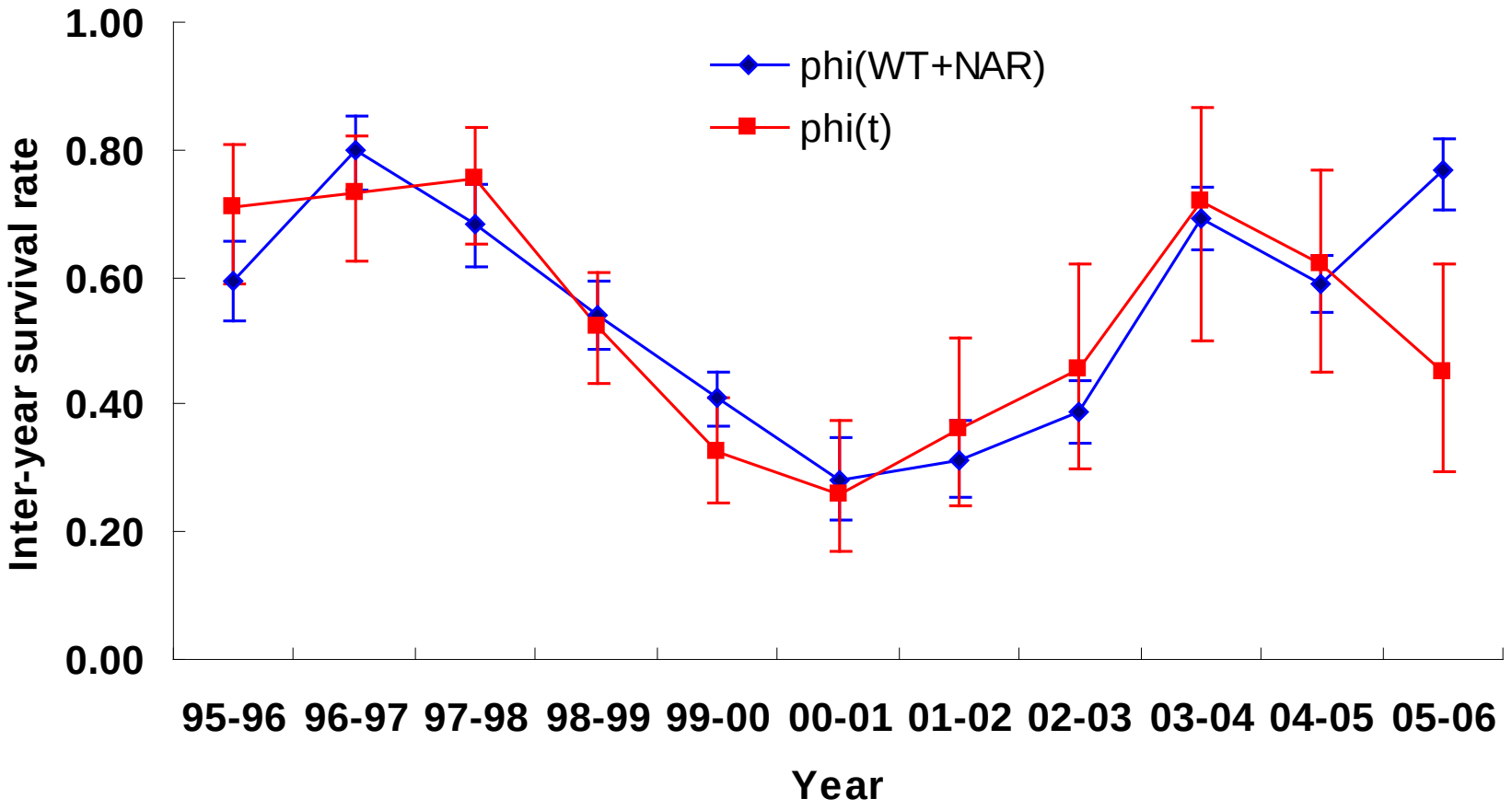
Temperature (WT)



Annual survival 1995-2006

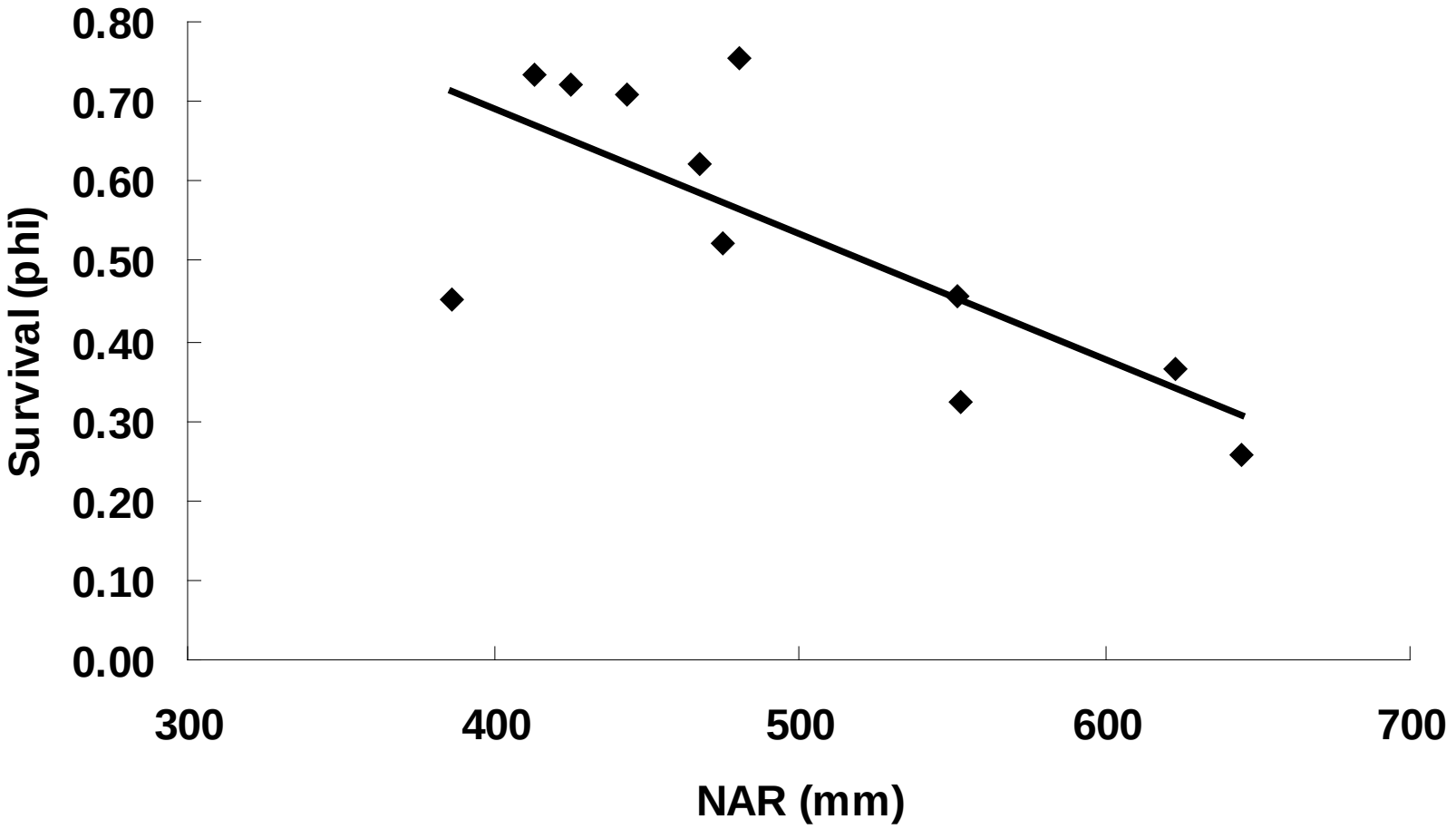


Survival, mean winter temperature and non-aquatic rainfall



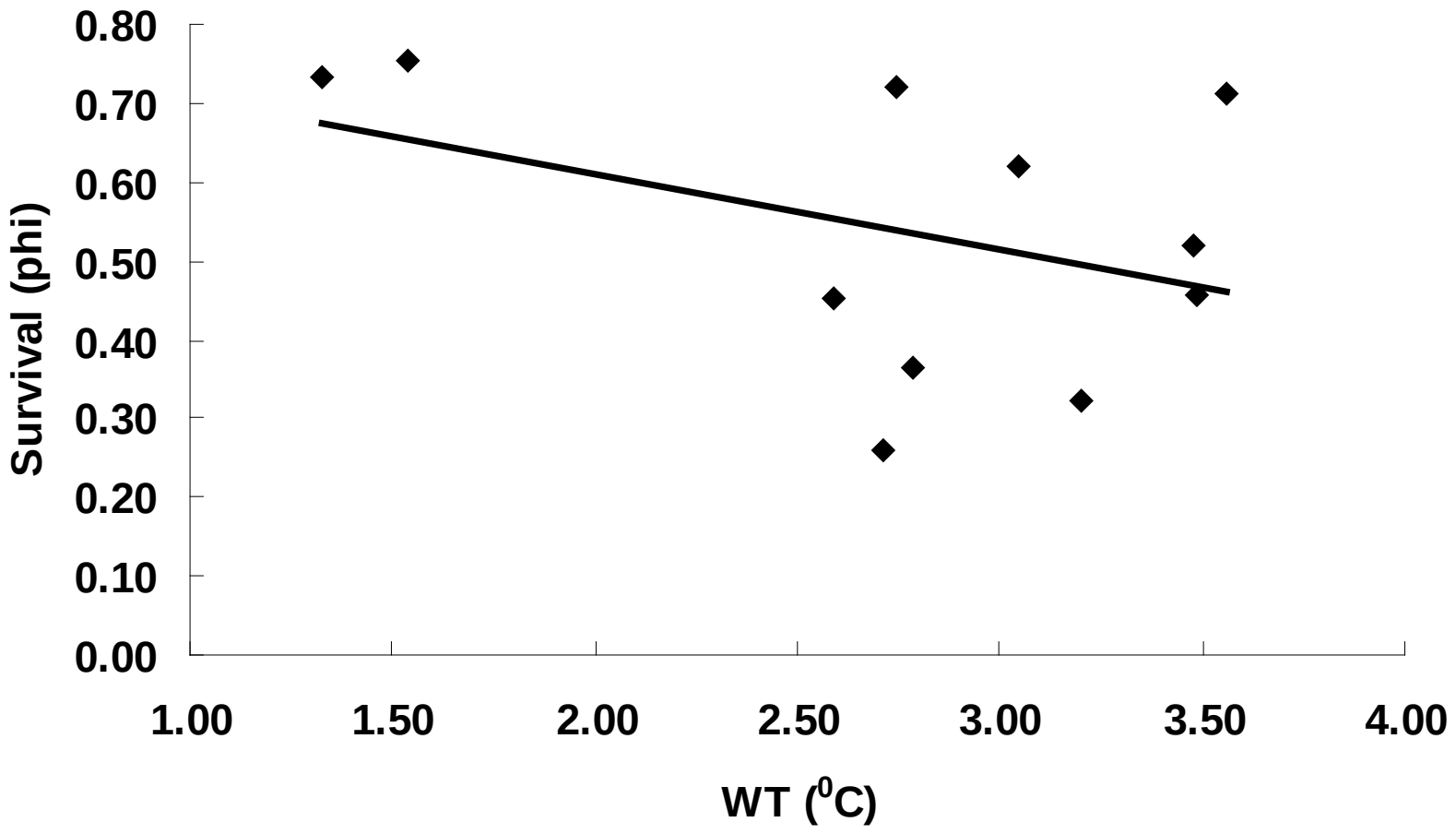
$R^2 = 0.60$, $F_{2,8} = 6.09$, $P = 0.025$, $y = 0.54 - 0.72x_1 - 0.152x_2$

Survival and non-aquatic rainfall (NAR)



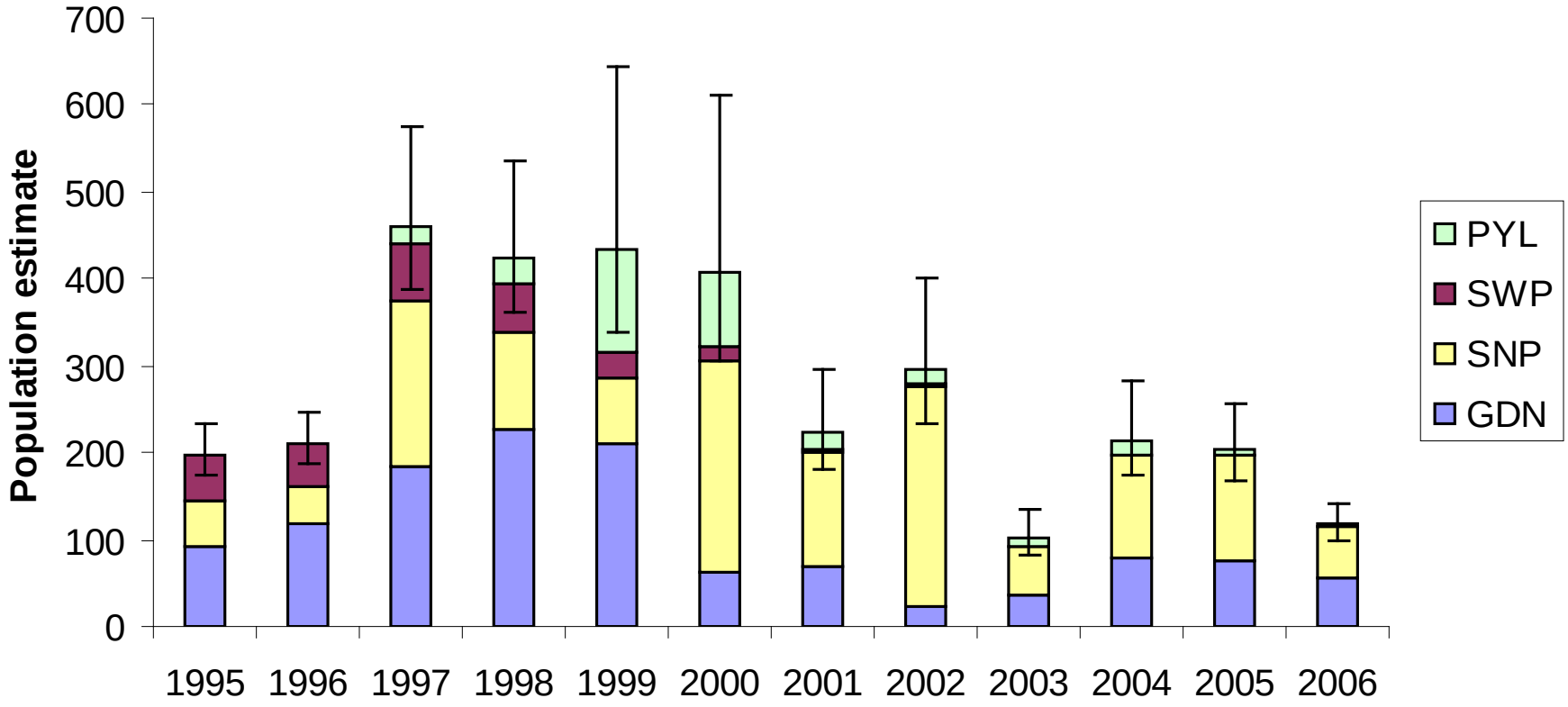
r^2 = -0.55, t= 3.0, P = 0.017

Survival and mean winter temperature

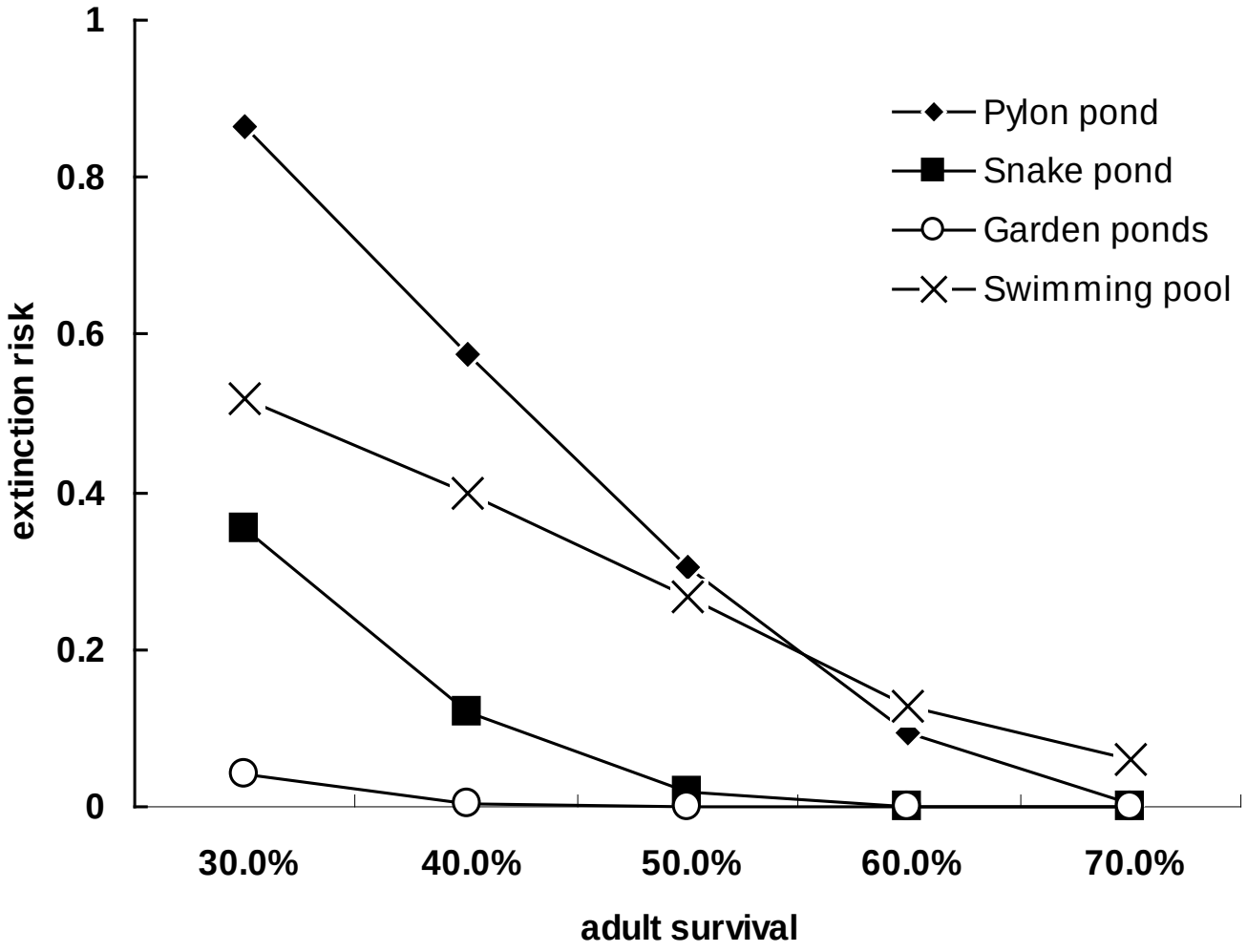


r^2 = -0.16, t = 1.0, P = 0.35

Population estimates

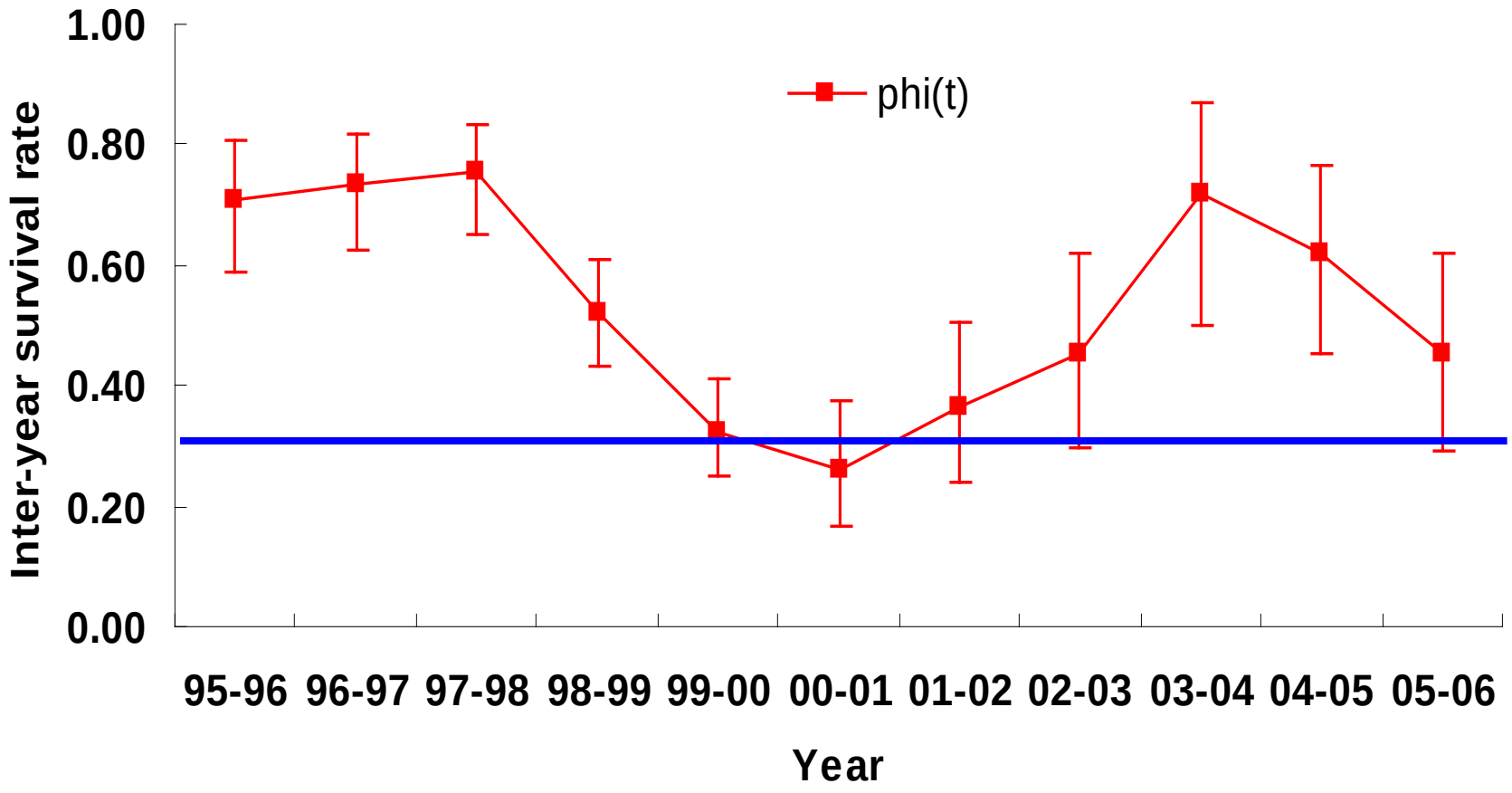


Population viability analysis



At an adult survival rate of <30% extinction risks are high

Annual survival 1995-2006 (reminder…)



Conclusions

- Recruitment varied between ponds and between years
- Local and regional factors affected larval survival
- Adult survival varied between years, but not between ponds
- Regional – rather than local – factors influence adult survival
- Adult survival was lowest in mild winters with heavy rainfall in the non-aquatic period, with rainfall the more important factor
- Climate variation does not affect all amphibian species the same way

Thanks!

- The Atkins family for site access
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