Herpetofauna Workers Meeting 2015

How easy is it to translocate amphibian and reptile populations? Lessons from removal modelling

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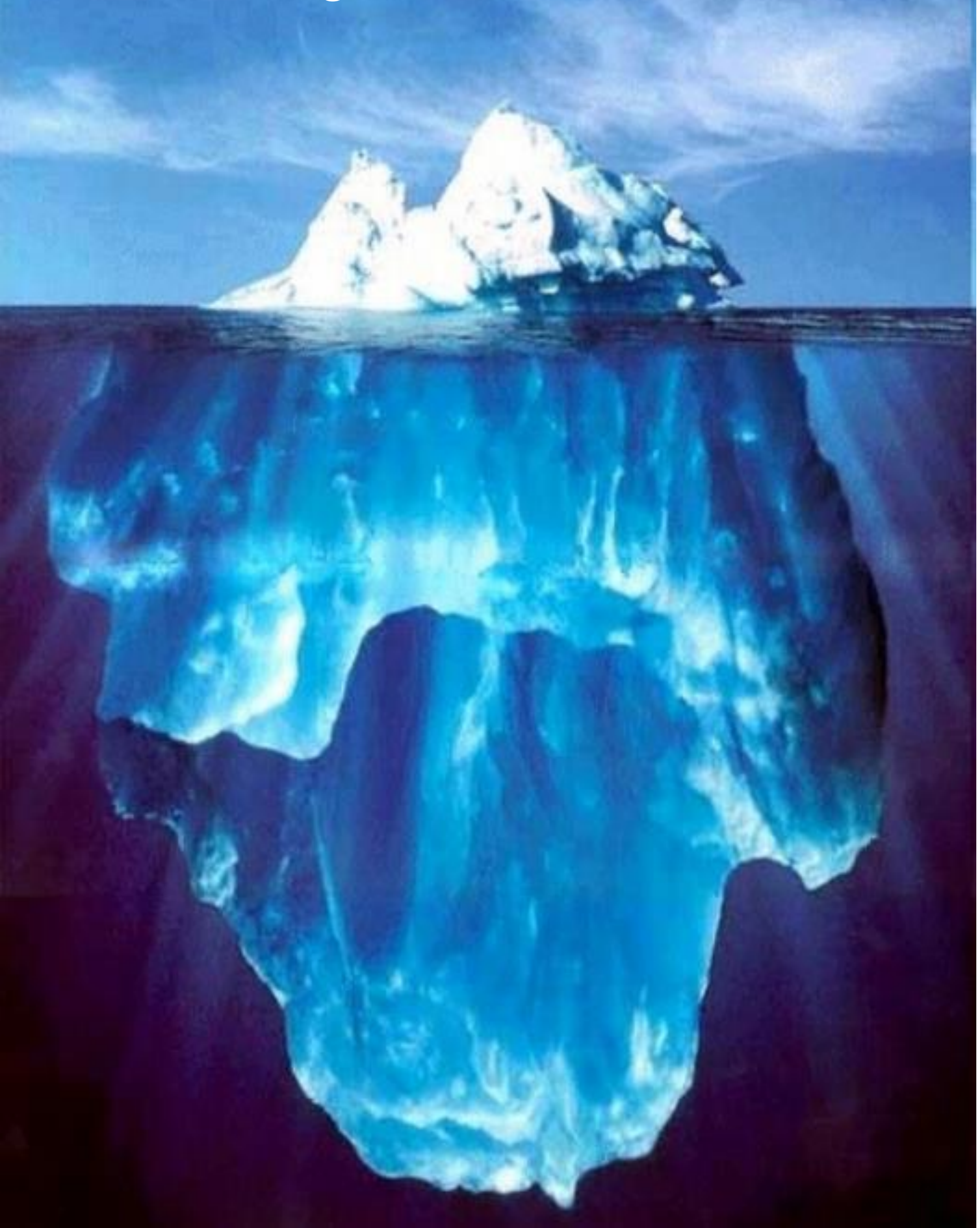
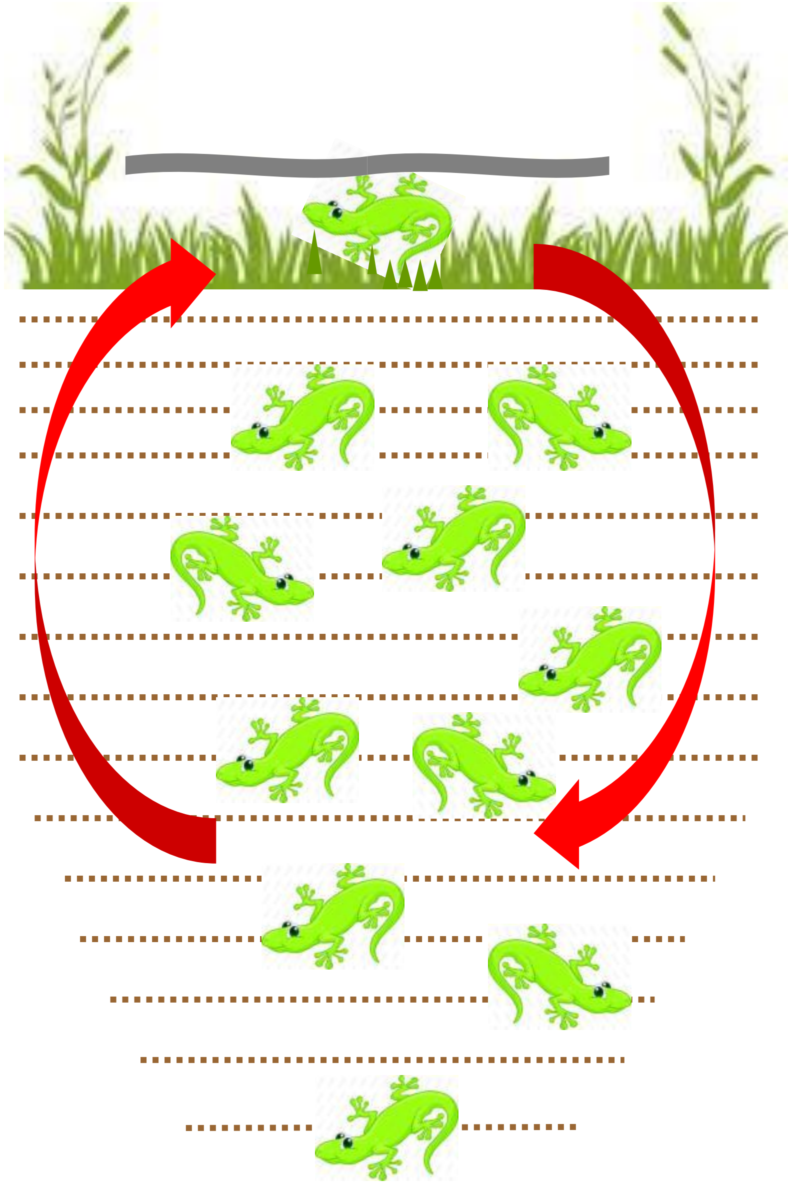
The iceberg effect





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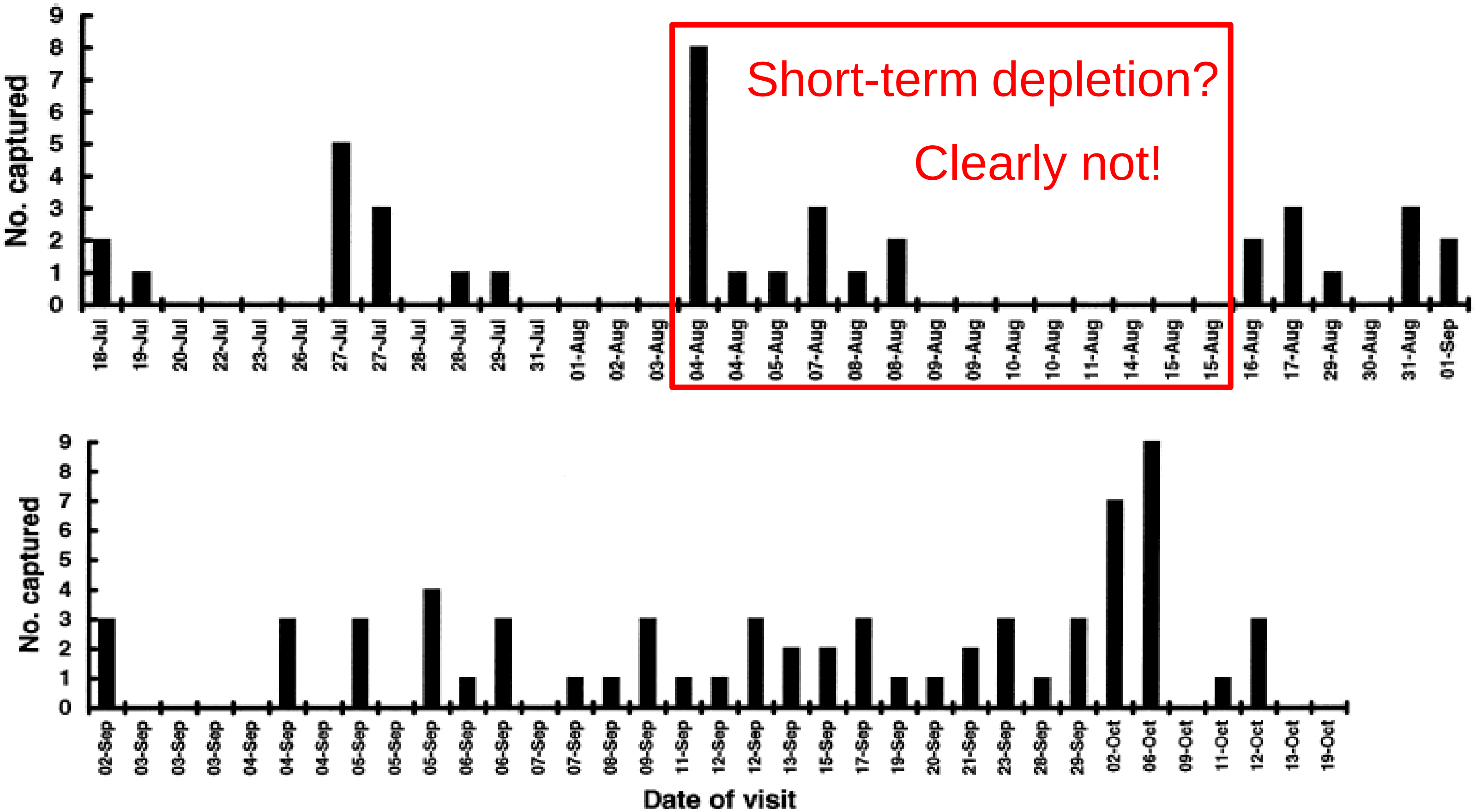
How much survey effort is needed to remove a population?

- Numbers available for capture on the day – ‘the iceberg effect’
- As animals are removed, more animals replace them
- Real depletions confounded by responses to weather conditions

  - *aestivation in the summer*

  - *hibernation in the winter*

Number of slow-worms removed from donor site July-October 1995



From: Platenberg, R.J. & Griffiths, R.A. 1999. *Biological Conservation* 90: 125-132

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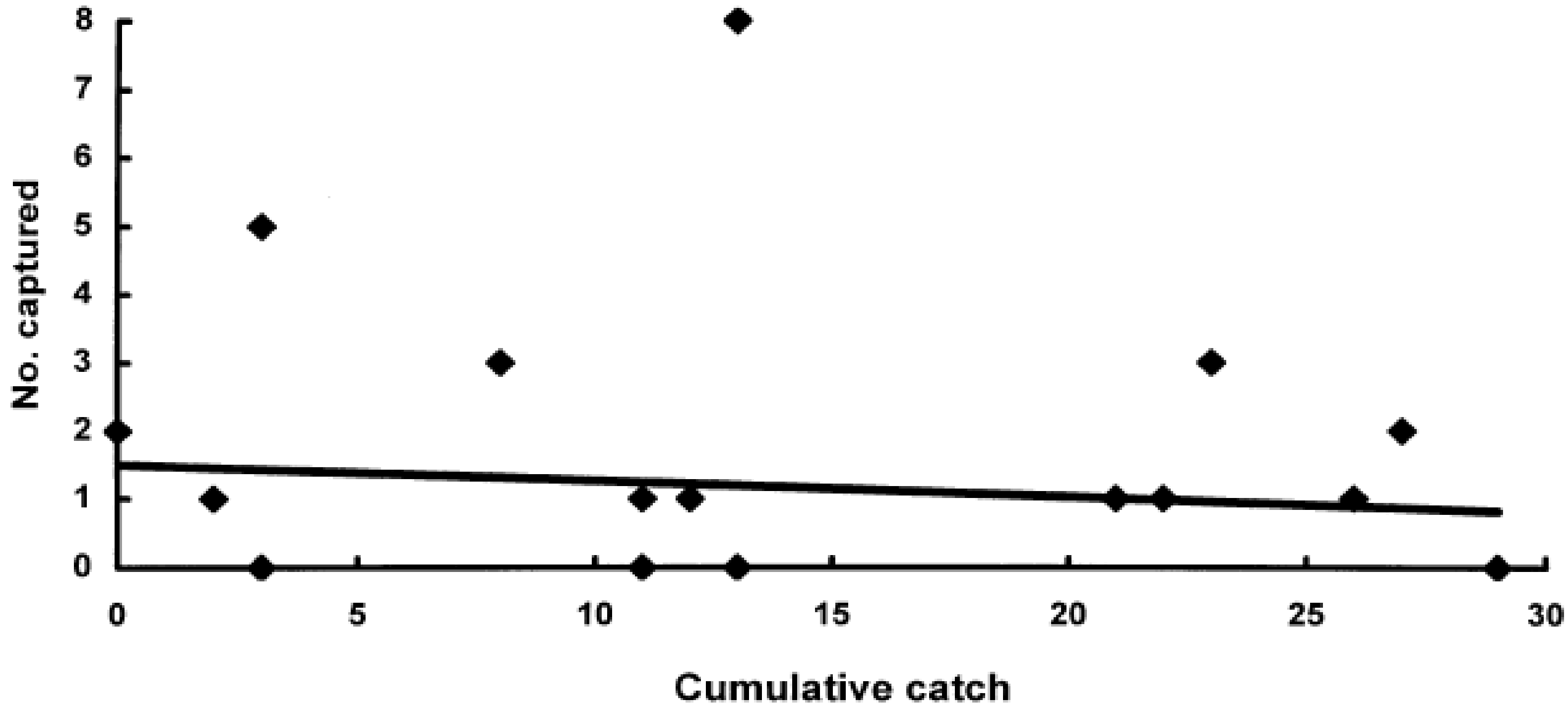


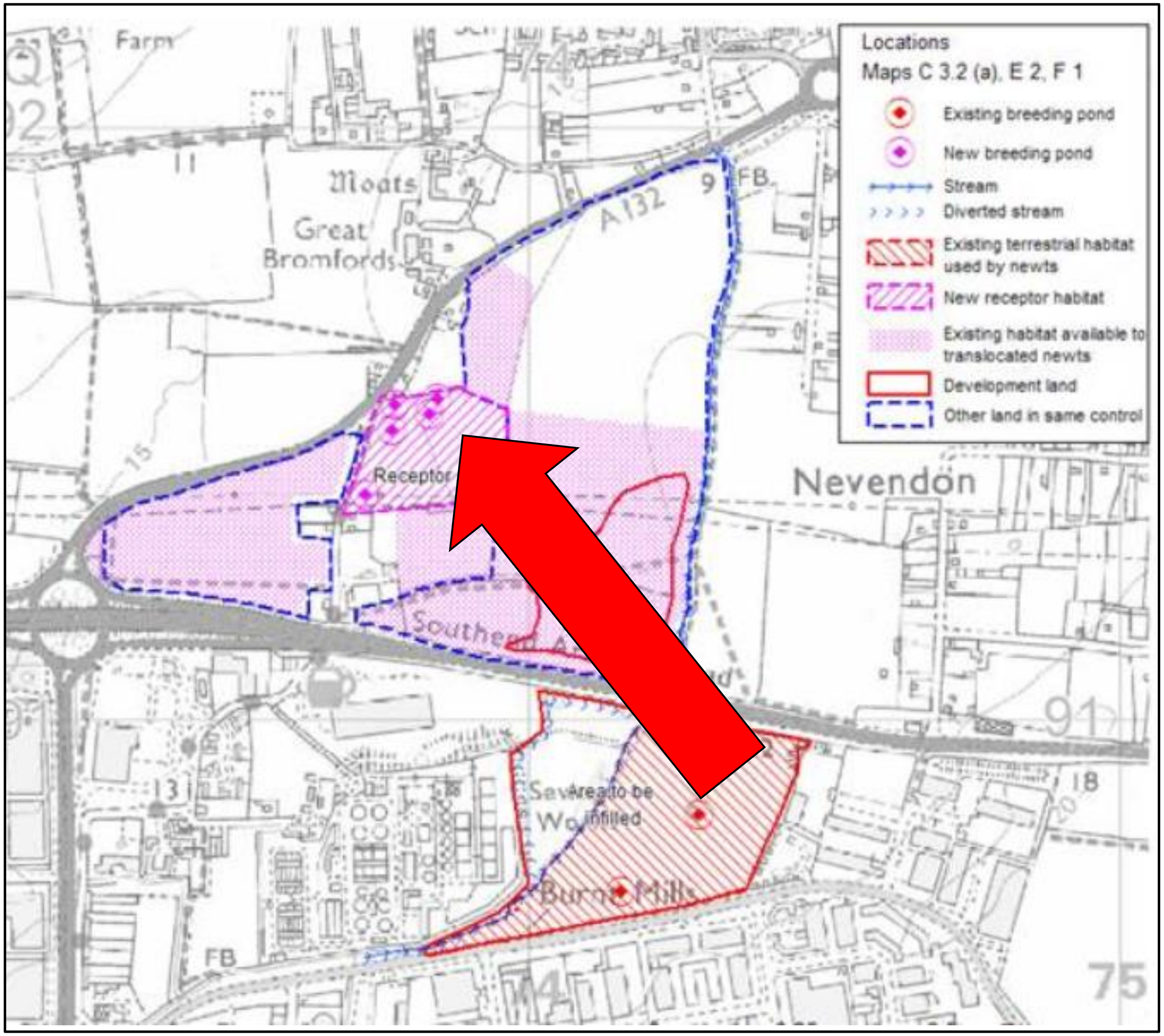
Fig. 2. Catch-depletion analysis by linear regression after 25 visits ($y = -0.0234x + 1.4961$; $r^2 = 0.0151$, $p > 0.05$).

From: Platenberg, R.J. & Griffiths, R.A. 1999. *Biological Conservation* 90: 125-132

Statistical models are like lamposts...

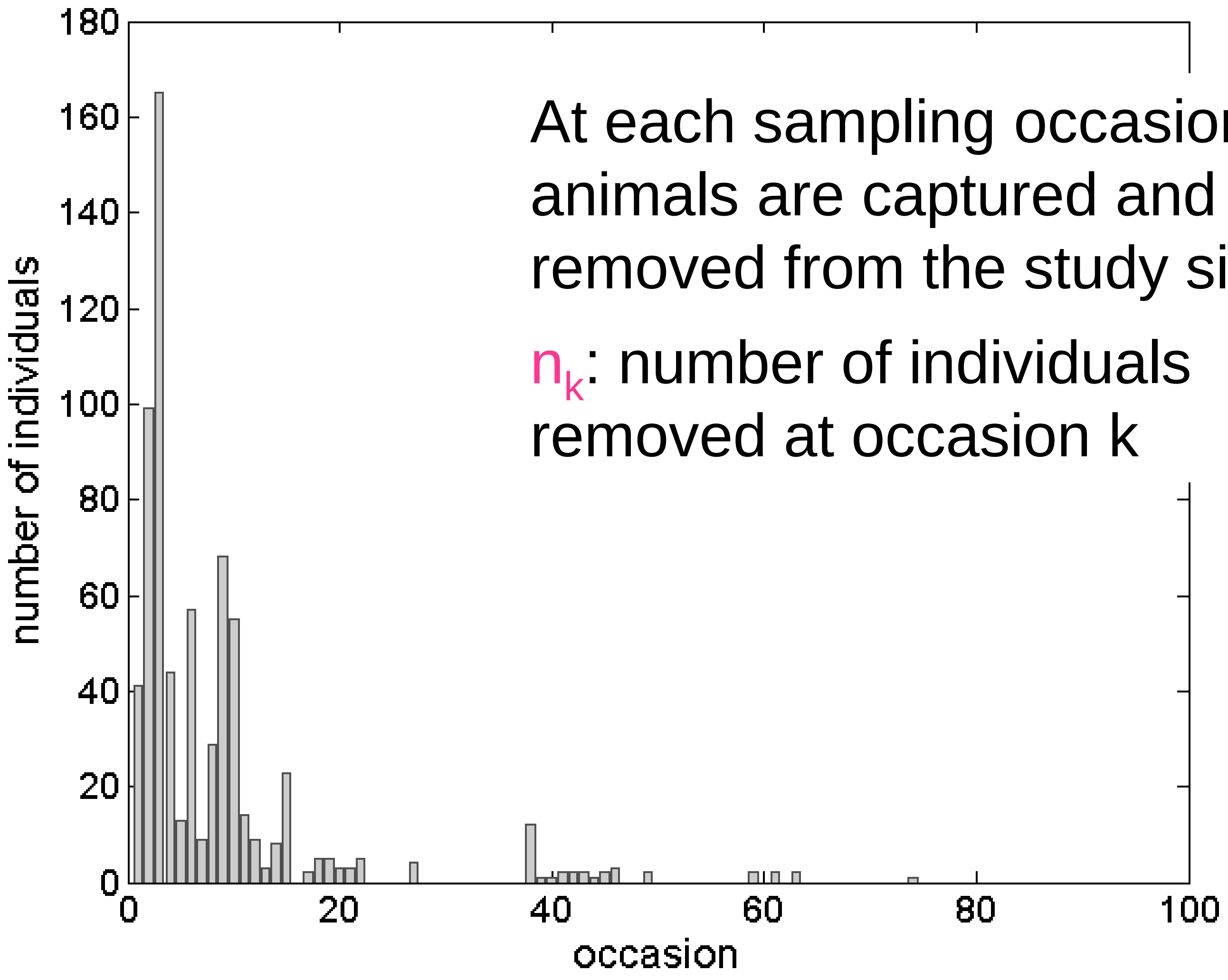
"...they should be used for illumination not for support."

Case study A: great crested newts



- 100 + days of removal
- Drift-fence, pitfalls, terrestrial searches
- Released into enhanced receptor site 600 m away

Removal data



At each sampling occasion animals are captured and removed from the study site

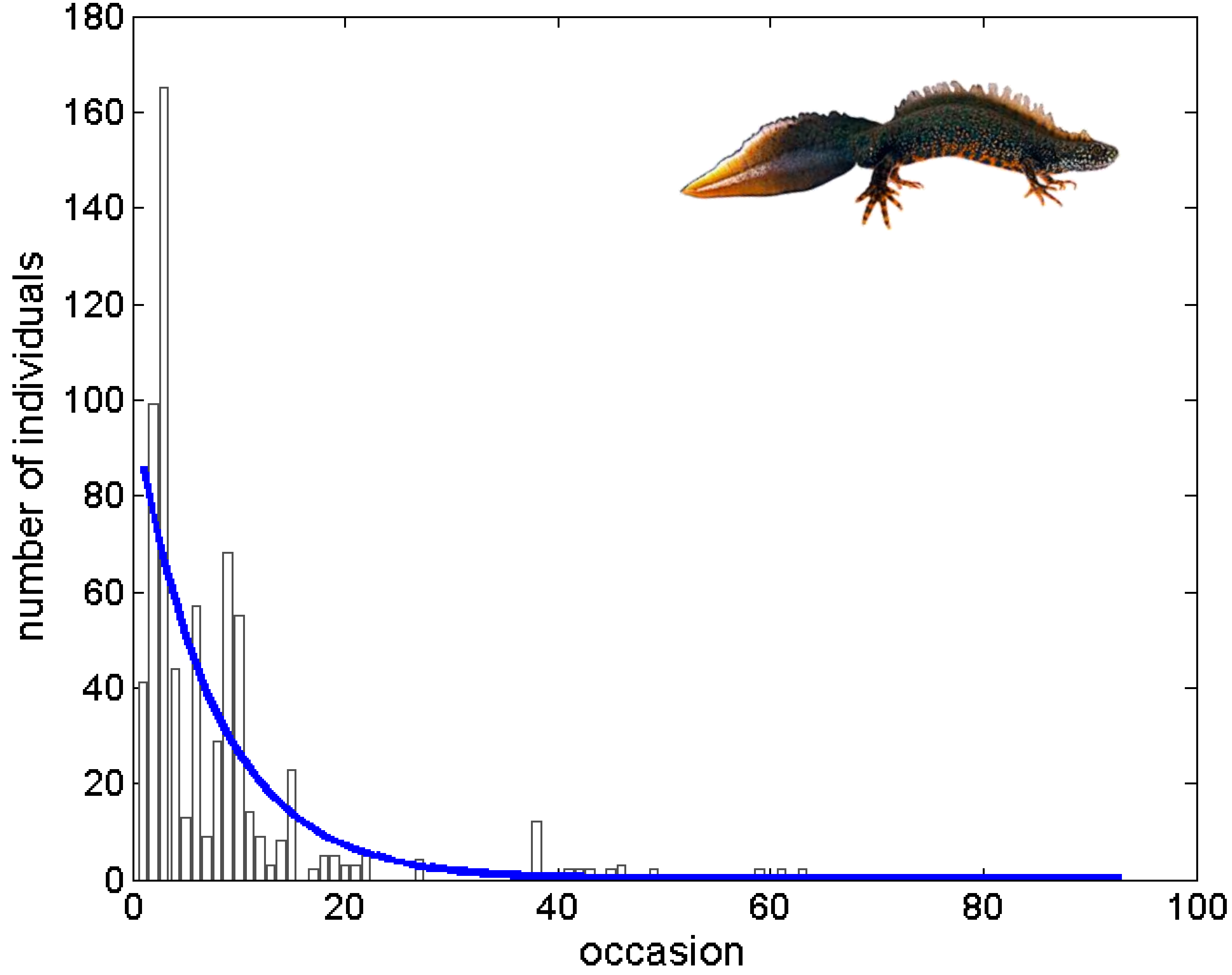
n_k: number of individuals removed at occasion k

Basic removal model

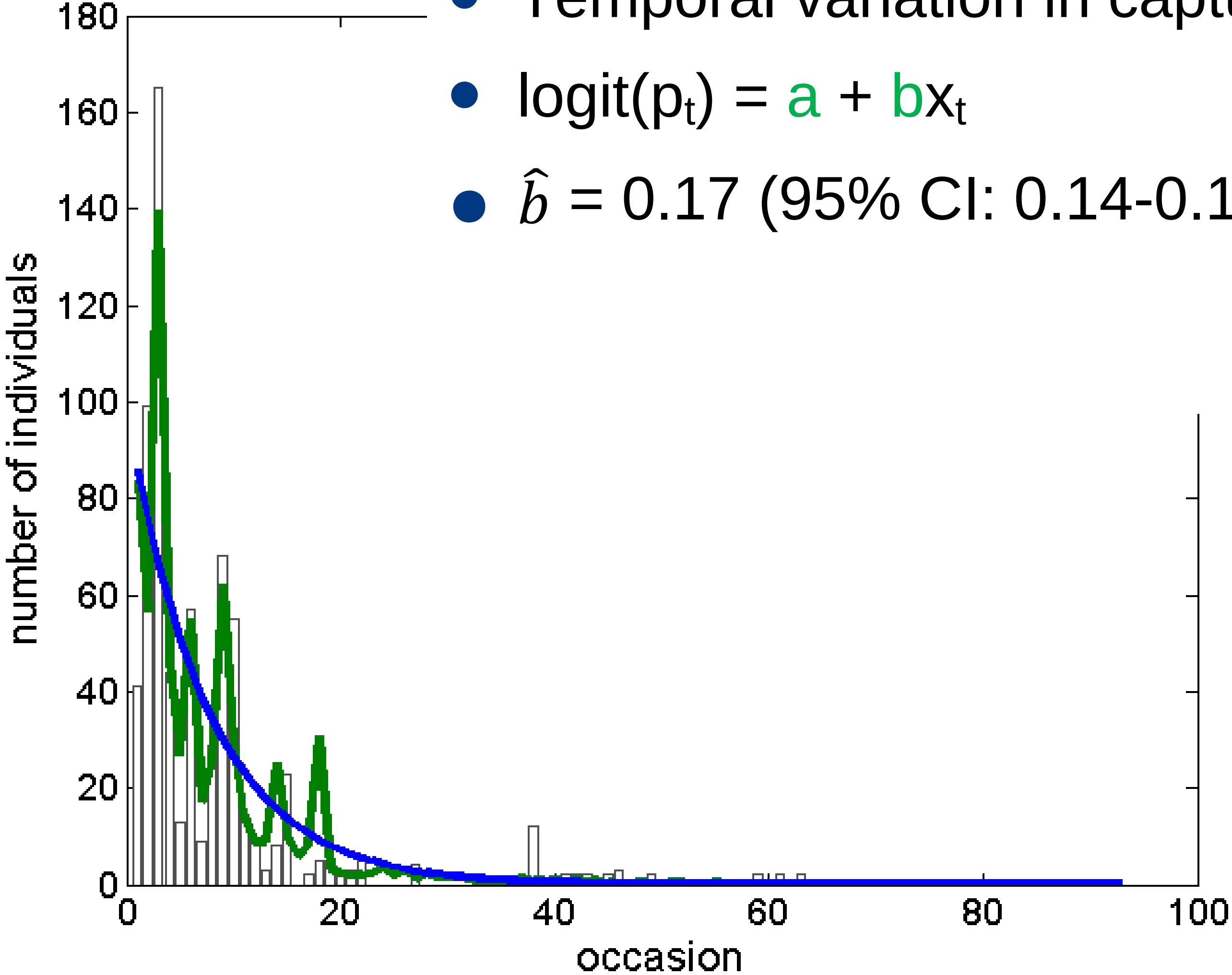
- Geometric model
  - Assume the population is closed
  - p: constant capture probability
  - Pr(an individual is captured at occasion k) = $(1-p)^{k-1} \times p$

- Commonly used statistical model
  - Time to conception for human couples
  - Time until a machine fails

Basic removal model



Weather covariates



- Temporal variation in capture probability
- logit(p_t) = a + bx_t
- $\hat{b}$ = 0.17 (95% CI: 0.14-0.19)

Are sites really being cleared?

- If capture probabilities vary with weather conditions, consecutive days without any captures may reflect the weather conditions rather than indicating that the population has been cleared.

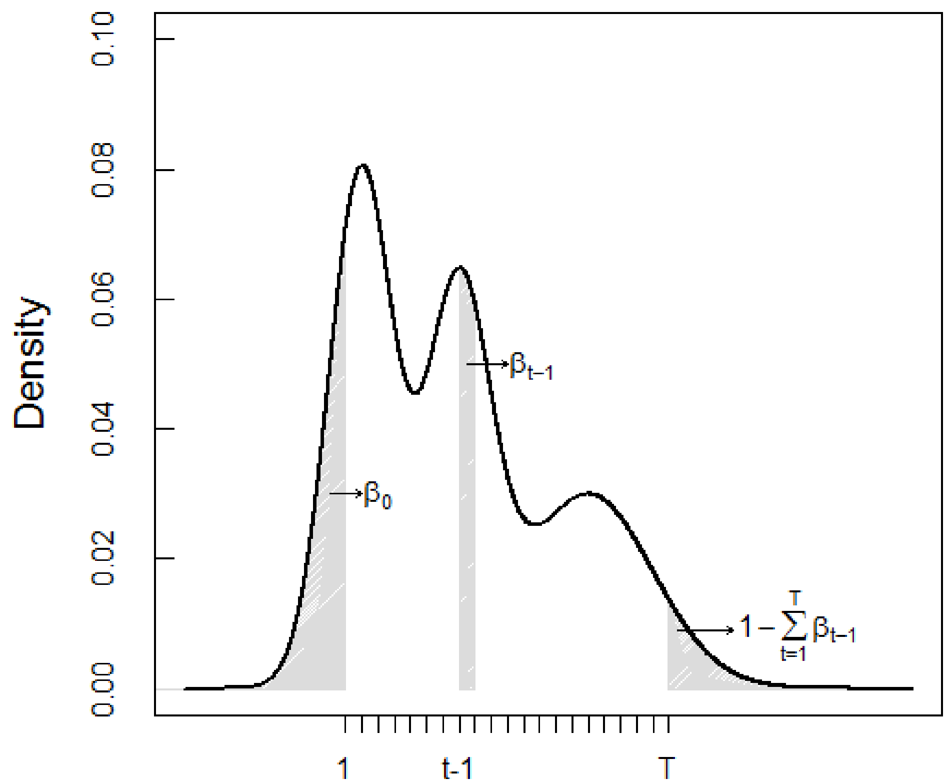
- What if the population is not in fact closed and new individuals arrive during the study period?

Case study B: common lizards

- Modelled removals from September October 2011(twice daily: 81 visits)
- Exclosure fencing with high density of ACOs
- 334 lizards removed

Modelling emergence/arrival

- New individuals are assumed to arrive in groups (pulses).
- These can for example be juveniles or individuals that are emerging from underground.
- The number of arrival groups and their size(s) are unknown.

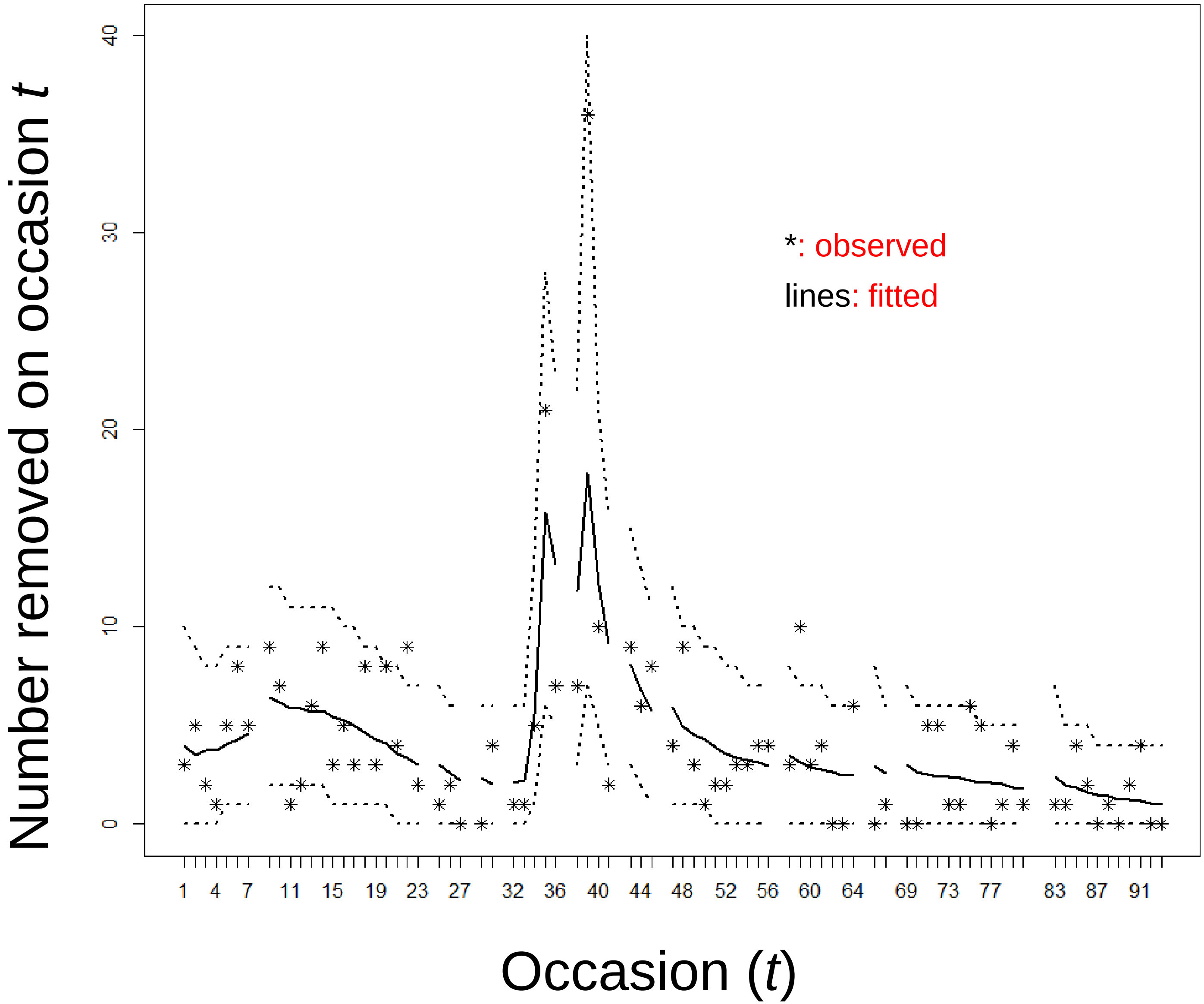


Model and algorithm

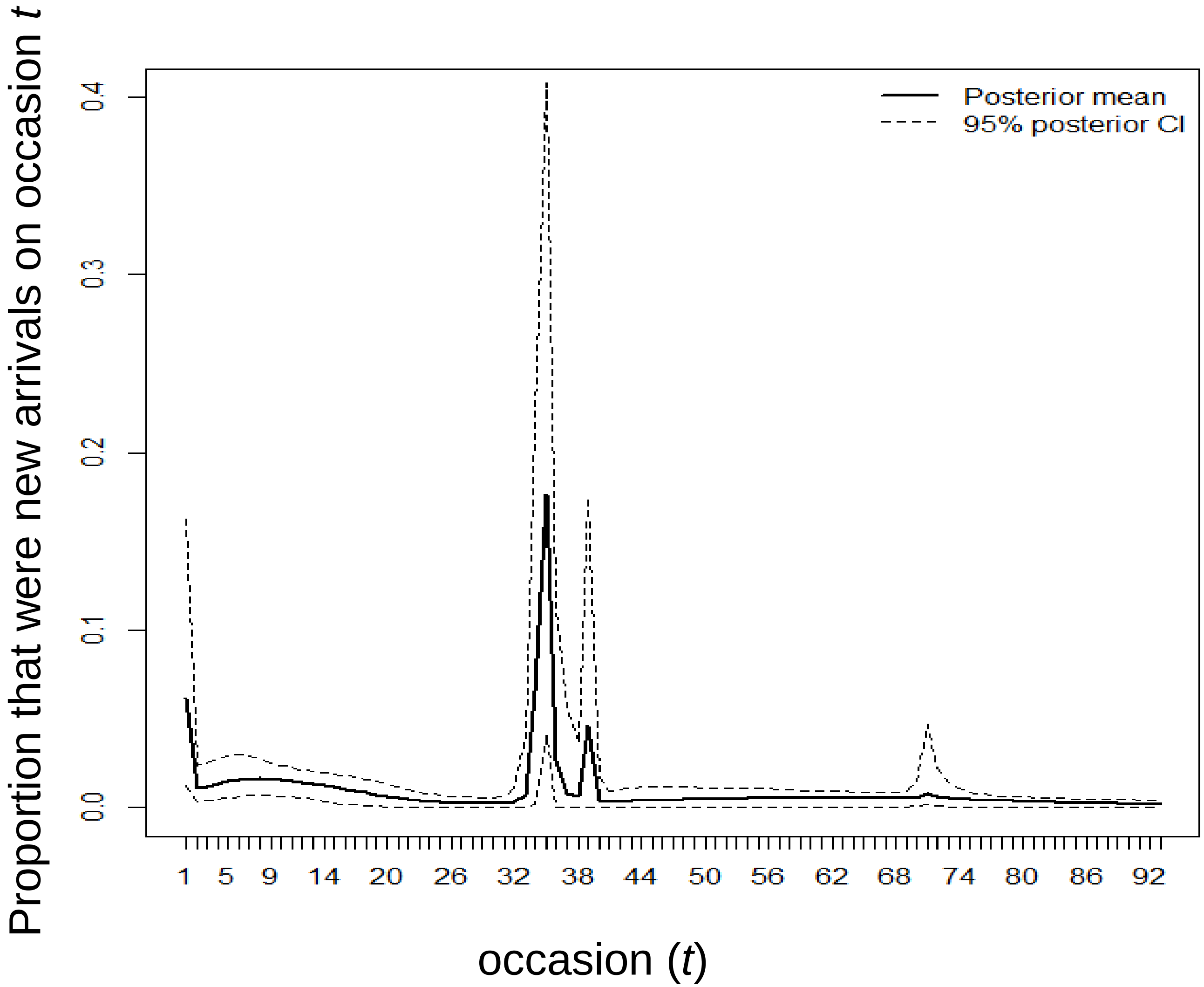
- We use a RJMCMC algorithm (Green 1995*) to fit our model and obtain estimates of:
  - The population size, N.
  - The arrival pattern.
  - The probability that fewer than x individuals are still present at the site at the end of the study.

*Green, P. J. (1995). Reversible jump Markov chain Monte Carlo computation and Bayesian model determination. *Biometrika*, *82*(4), 711-732.

Common lizards-numbers removed

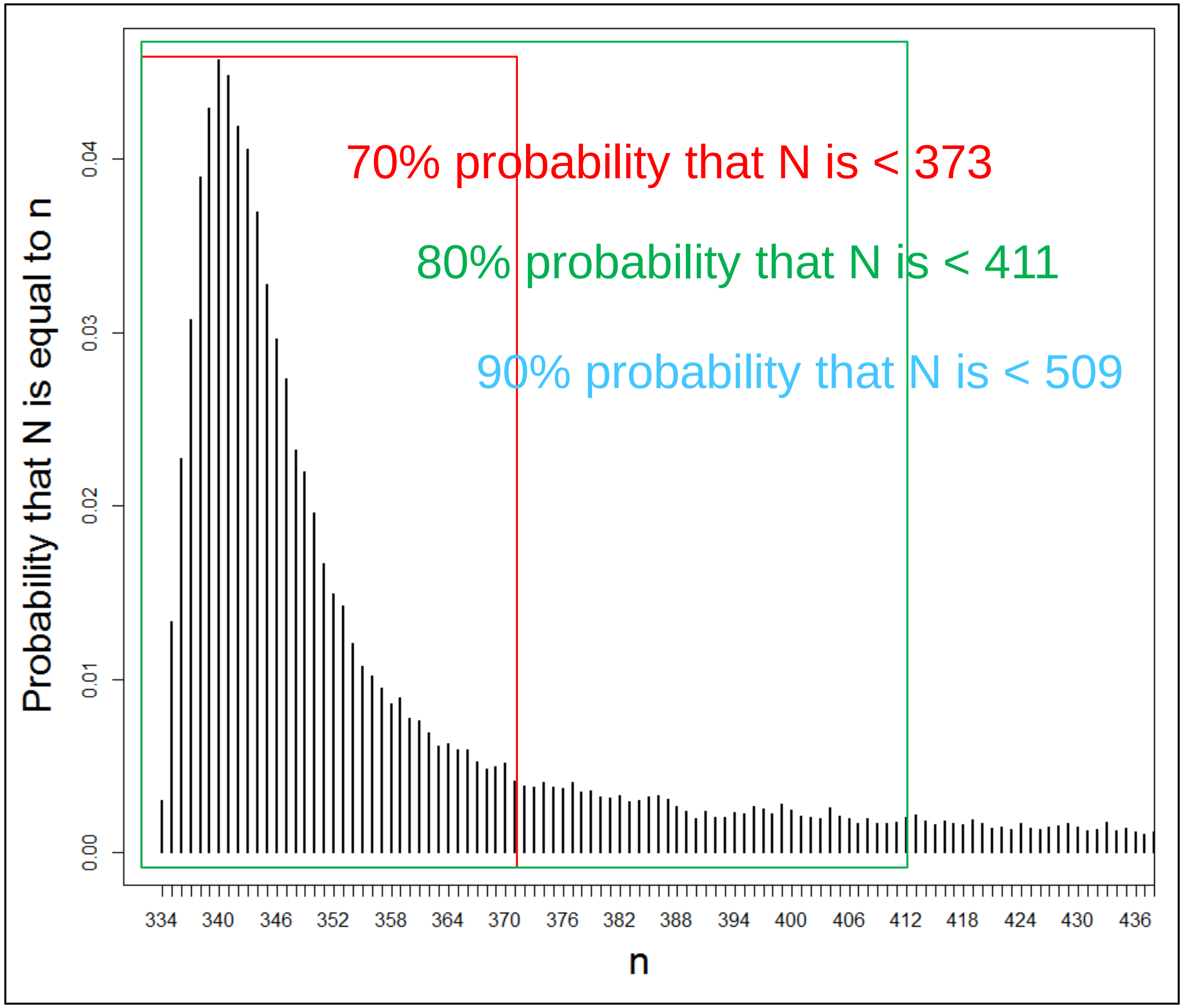


Common lizards: arrival pattern



Common lizards: population size

- The value of N with the highest probability is 340 individuals (removed = 334).



Conclusions

- We have depletion models that can account for changes in detectability due to weather conditions
- We have depletion models that can account for new arrivals
- We can estimate the number of animals that were actually present, BUT
- The estimate of N has a high degree of uncertainty
- Methodological improvements may help reduce this level of uncertainty...

Where do we go from here?

- Incorporate more covariates to account for seasonal/climatic variations in detectability and arrivals.
- Allow for individuals to become temporarily unavailable for detection.
- Increase precision of parameters by incorporating expert knowledge.
- Build an R-package.
- Develop a user-friendly front-end…eventually...
- *Watch this space!*

Thanks!

- Amy Wright
- Jon Cranfield and Herpetologic