Bayesian integrated population modeling using JAGS

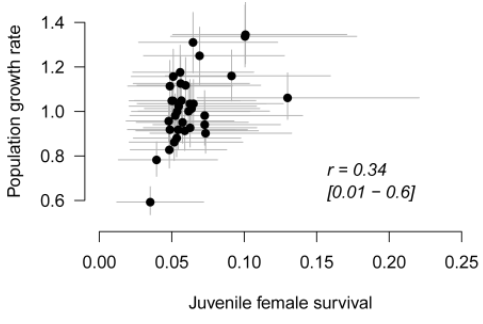
Beyond IPMs: Prospective and retrospective analyses, PVA

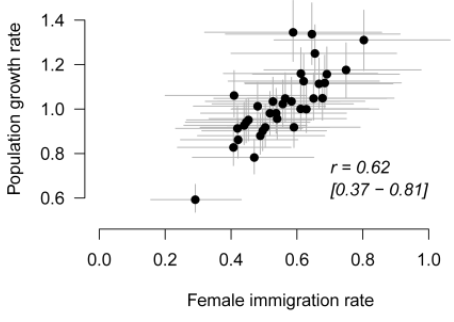
What can we do with the results from an IPM?

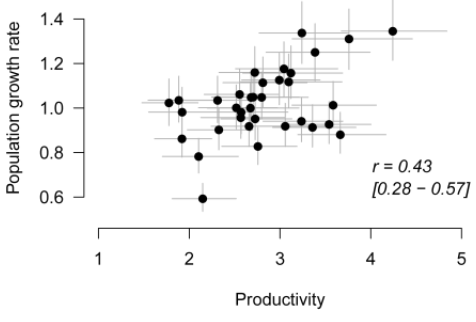
- We get estimates of the demographic rates, of population size and of population structure from an IPM
- Perhaps one is interested in the estimation of the demographic rates only
- Understand the reasons of past population changes: **retrospective analysis**
- Predict future behaviour of the population: **prospective analysis** (population viability analysis)

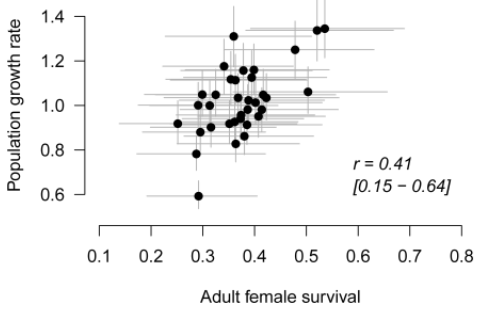
Retrospective population analyses

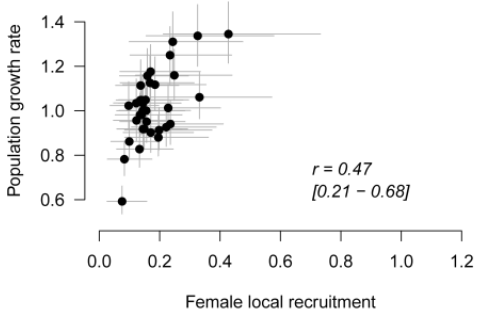
- Different possibilities
- Correlation between demographic rates and pop. growth rate











Schaub et al. 2013, Ecology

Retrospective population analyses

- Different possibilities
- Correlation between demographic rates and pop. growth rate
- Asymptotic life table response experiment (Horvitz et al. 1997, Cooch et al. 2001): decomposition of the variance of λ into contributions of variability of the demographic rates

Retrospective population analyses

- Different possibilities
- Correlation between demographic rates and pop. growth rate
- Asymptotic life table response experiment (Horvitz et al. 1997, Cooch et al. 2001): decomposition of the variance of λ into contributions of variability of the demographic rates
- Transient life table response experiments (Koons et al. 2016, 2017)

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LETTER

A life-history perspective on the demographic drivers of structured population dynamics in changing environments

David N. Koons[1]* David T. Iles[1] Michael Schaub[2] and Hal Caswell[3]

Abstract

Current understanding of life-history evolution and how demographic parameters contribute to population dynamics across species is largely based on assumptions of either constant environments or stationary environmental variation. Meanwhile, species are faced with non-stationary

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Understanding the demographic drivers of realized population growth rates

David N. Koons,[1,2,5] Todd W. Arnold,[3] and Michael Schaub[4]

Prospective population analyses

- Forecast population size into the future
- Population viability analysis (PVA):
  - Extinction probability
  - Sensitivity of extinction probability to changes in demographic rates
  - Compare management options
- Advantages of using an IPM for PVA
  - Propagation of errors correct (process and estimation errors)
  - No translation errors
  - Probability statements possible (due to Bayesian approach)

PVA for a woodchat shrike population

- „Typical“ data over 20 available
- Goals:
  - Forecast population size for the next 15 years
  - Calculate extinction probability
  - Calculate conditional time to extinction
  - Compare three management options – find out which one is the most efficient

Further comments on IPMs

When does an integration of data sets make sense?

- Data sets must originate from populations that share a *common* dynamics
- If a benefit can be expected (e.g. more precision, parameter estimability)

Specific sampling design needed?

- Better inference, if a proper sampling design is respected
- Yet, Bayesian IPM offer great flexibility in modelling
- Bad data in → bad estimates out
- Yet, if data sets are small, IPM are better than piecewise analyses