Predictive Modelling of the Maternal Transfer of Organic Pollutants to Next Generations in Reptile Species

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Introduction

Maternal transfer of organic pollutants
- First exposure route to chemical cocktails for developing embryos (a sensitive life stage)
- Can affect next generations: embryo vitality and survival; health and disease later in life

Challenges in reptile ecotoxicology
- Susceptible to organic pollution: long lifespan, late sexual maturity & slow metabolism
- Lack of comprehensive biomonitoring data resulting in scattered, published measured concentrations of pollutants in eggs and females

Data processing
- Censored data coding
- Unit homogenization
- Lipid basis standardization
- 1 single integrated database

Aims

Support risk assessment for reptile embryos, and the use of eggs as biomonitoring tools
- Synthesise scattered, published data across reptile species (Fig. 1.2)
- Develop a predictive model of maternal transfer (Fig. 3):
  - Applicable across several reptile species
  - Applicable to specific organic pollutants

Database development

1. Systematic search & data gathering
   - Identification n=27
   - Selection n=17
   - Screening n=14
   - 8 species
   - 14 studies
   - 18,729 datapoints

2. Data processing
   - Censored data coding
   - Unit homogenization (Fig 1.3)
   - Lipid basis standardization
   - 1 single integrated database

3. Meta-analysis

Predictive model

Orthogonal regression model
- Measured concentrations of pollutants in eggs and females both have uncertainty
  - Violates assumptions of traditional linear regression
  - Move towards an orthogonal model:
    - Uncertainty around explanatory variable (X-axis)
    - Probability distribution on explanatory variable

Bayesian inference
- Flexible in model formulation
- Account for priors
- Quantify uncertainty in parameters
- Propagate uncertainty into predictions

Extensions under development
- Differences in maternal transfer between multiple species
- Account for chemical compound specificity

Conclusion

Systematic search, homogenization and integration of scattered data provides valuable datasets that:
- Effectively use already available data and knowledge (Fig. 1.2)
- Contribute to the reduce, refine and replace (3R) strategy
- Support sensitive spp. conservation where novel data collection faces limitations

Predictive modelling provides quantitative insights for use in risk assessment and species conservation management
- Allows to predict pollutant concentrations in mothers to eggs and vice versa (Fig. 3)
- Allows to correctly implement statistical requirements of the modelled variables