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# Putting life history theory to the test:

## the estimation of reproductive value from field data

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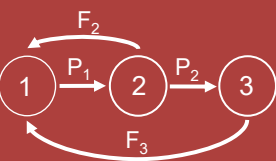
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### Background

Reproductive values (RVs) are useful for making fitness comparisons involving different categories of individuals, like males and females. By definition, the reproductive value of a category is the expected per capita contribution of that category to the gene pool of future generations. Here we compare two methods for estimating RVs regarding accuracy and precision. The first is based on the estimation of life-history parameters and the calculation of RV by matrix methods (mRV). The second is more direct, and based on following the descendants of a category of individuals down the pedigree (pRV).

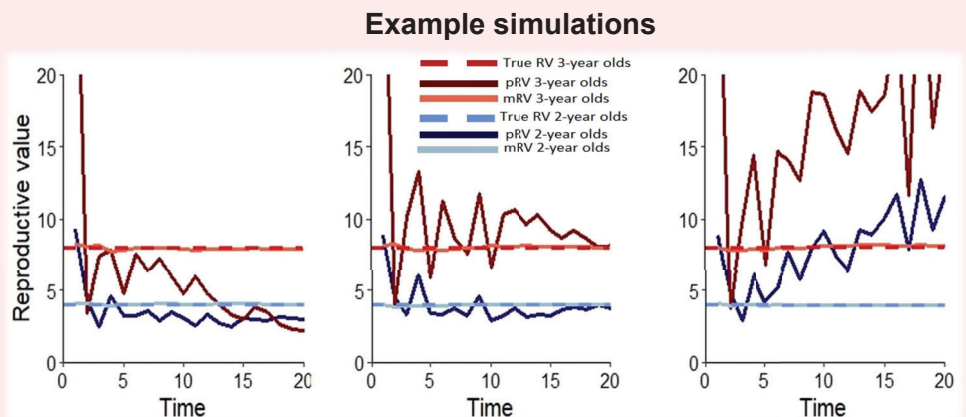


### Methods

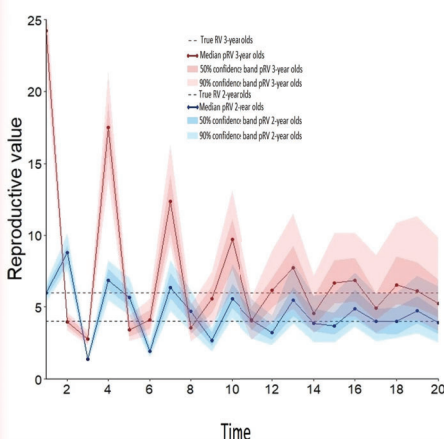
We started with various life-history models, like the three-age-class model shown to the left. Using individual-based simulations, we produced data allowing us to estimate RVs via both methods and to compare these with the (true) RVs of the underlying life-history model. Here we only show results for the three-age-class model.

### Results

The graphs on the right show three example simulations, each corresponding with a field study. RVs of age classes 2 and 3 are given, relative to the RV of age class 1. In each simulation, mRVs estimate true RVs well. In contrast, pRVs were not consistent across simulations and did often not approach true RVs.



### Summary of 100 simulations



The graph on the left shows median and 50% and 90% confidence bands of pRVs of 100 simulations. Initially, pRVs oscillate regularly and do not approach true RVs. Eventually, pRVs tend to converge to the true RVs, however individual simulations (corresponding to specific field studies) still deviate a lot from true RVs.

mRVs are not shown because they correspond almost perfectly with the true RVs.

### Discussion

pRVs do not estimate true RVs well. They either exhibit low precision or low accuracy. In contrast, mRVs estimate true RVs very well. However, also mRVs can go wrong if an incorrect life-history model is assumed. In summary, RVs are extremely useful for quantifying selection in the field, but their estimation requires considerable care.

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