Monitoring under uncertainty for informed management decisions

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I thought I was interested in uncertainty but now I'm not so sure.
Observation

Monitors

Managers

Are we able to detect change in wildlife abundance when it actually happens?

Assessment

How does wildlife react to different threats?

Natural resources

Observation

How well do we count animals?
Study-area: Serengeti, Tanzania
Illegal bushmeat hunting
1. How do different monitoring budgets translate into data quality (accuracy and precision)?

2. How are different types of error affected by budgetary, observational and ecological conditions?
Types of error

- **Type I errors (α):** rejecting the null hypothesis when it is true

- **Type II errors (β):** failing to detect a difference that is present

- **Shape errors:** misclassifying a trend as linear when it is actually non-linear or vice-versa
1. Operating biological model

Wildebeest

“True” abundance of different species under realistic scenarios of change
2. Observation model
## Types of factors

### Wildebeest monitoring:

<table>
<thead>
<tr>
<th>Population characteristics</th>
<th>Population size</th>
<th>Proportion of juveniles (%)</th>
<th>Aggregation</th>
<th>Spatial autocorrelation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling characteristics</td>
<td>Distance between transects (km)</td>
<td>Time between photos (seconds)</td>
<td></td>
<td></td>
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<tr>
<td>Flight characteristics</td>
<td>Mean flight altitude (m)</td>
<td>CV (coefficient of variation) error altitude</td>
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<tr>
<td></td>
<td>Mean flight speed (km/sec)</td>
<td>CV (coefficient of variation) error speed</td>
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<tr>
<td>Observer effects</td>
<td>Minimum error counting juveniles (%)</td>
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<td>Number of animals in a photo for which 50% juveniles are missed</td>
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<td>Mean error counting adults (%)</td>
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</tr>
<tr>
<td></td>
<td>CV (coefficient of variation) error counting adults</td>
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</tbody>
</table>
Results: monitoring wildebeest

The likely effect of budget on data quality

“Observed” abundance of different species under realistic scenarios of change

3. Assessment model & Analysis
Results

Type II error

- ▲ Impala
- ● Wildebeest

Frequency (years between surveys)
Results

Type II error

- High monitoring budgets
- Low monitoring budgets

Comparison of Type II error for Impala and Wildebeest.
Key messages

• To make robust management decisions, we should account for multiple types and sources of uncertainty

• Need to integrate ecological modelling, threat scenarios and costs into decision-theoretic approaches to NRM and conservation

• Our uncertainty mitigation efforts must be focused on the kinds of information which are most valuable
Acknowledgements & Questions

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