Quantifying population declines for Red Lists based on historic presence records

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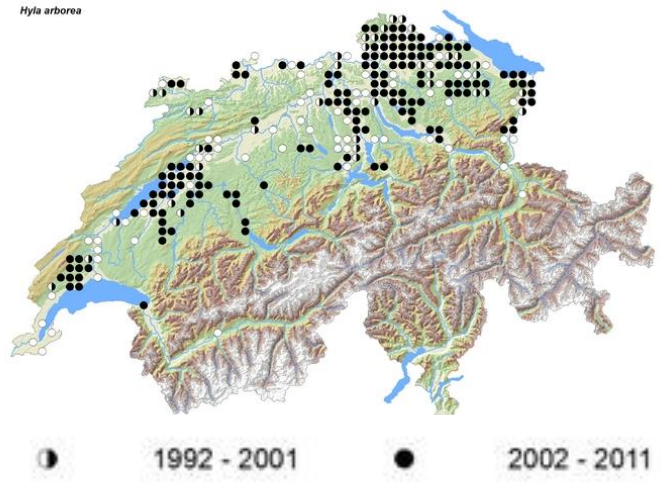
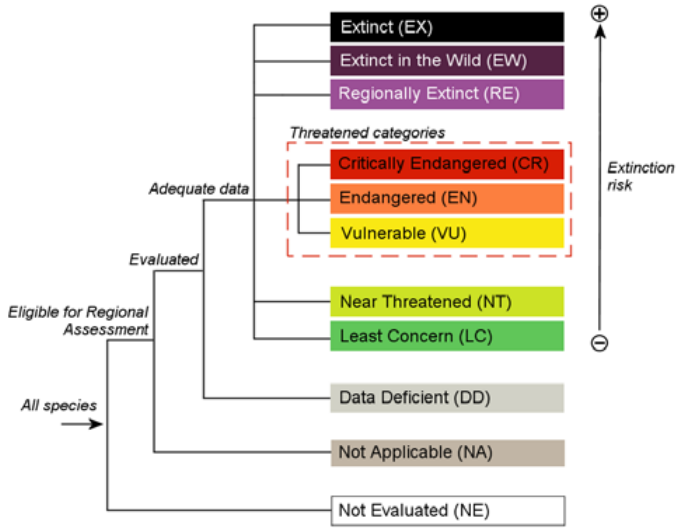
Why measure population dynamics?

- Identify threatened populations/species
- Work out drivers of change
- See when conservation is working

- Prioritisation
  - Limited resources, growing threats

- Red Listing
  - Quantitative rigorous methodologies

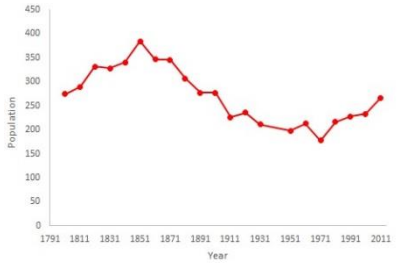




How do we monitor population trends?

- Surveys

  Trend T = $\frac{N2}{N1}$



- Imperfect detection

What you see (Counts) (occupancy/abundance/species richness) = **What's there** * Detection probability

C = **N** * p

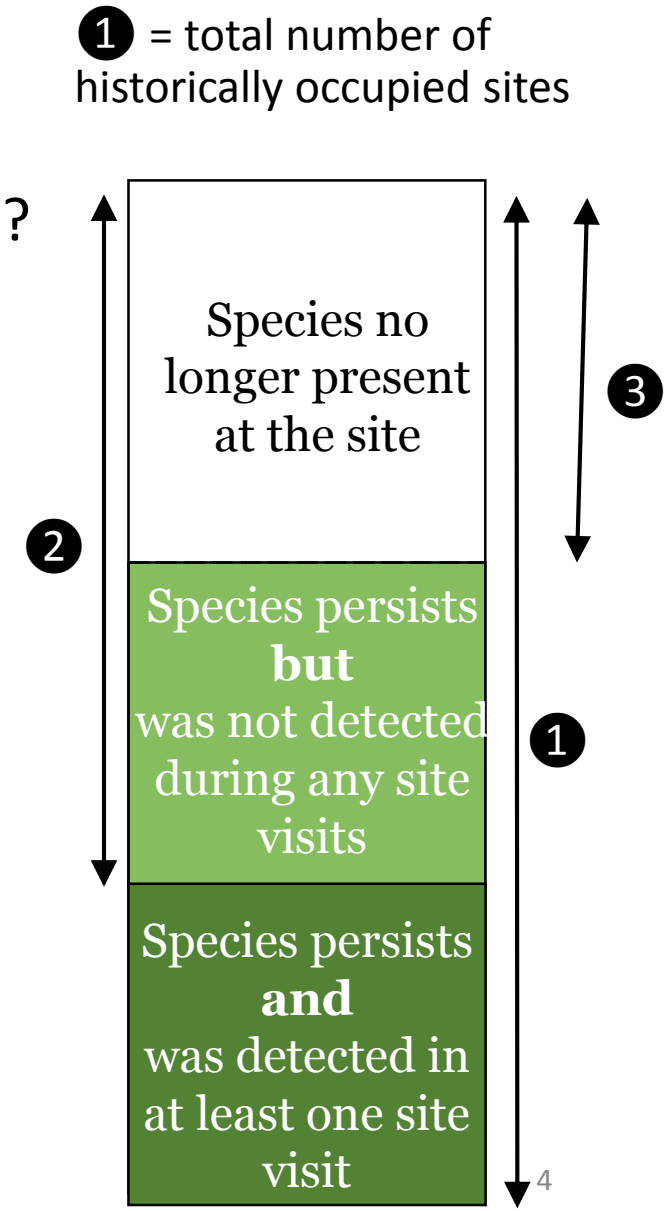
Aims of the Study

How does imperfect detection bias population trend calculation?

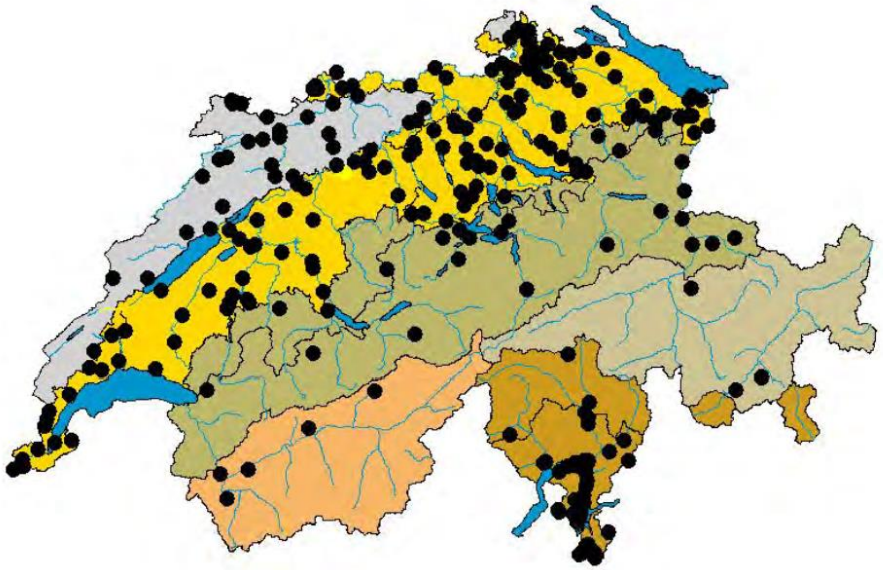
Compare population declines assuming :

1. p=1 “Naïve” observed decline $\frac{3}{1}$
2. True estimate of p Adjusted decline $\frac{2}{1}$

- Effects on Red Listing



Data and Methods



Update of Swiss Amphibian Red-List:

- 289 sites
- 14 Species

For each species and site:

- Historic status
- 4 observational records

Calculated:

- ‘Naïve’ (Observed) decline
- Adjusted decline → Red-list Assignments

Detection Probability

Estimation requires:

- Multiple independent observations
- Population closure

Survey occasions			
0	0	0	0
1	0	0	0
0	1	1	1
1	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

Detection Probability

Estimation requires:

- Multiple independent observations
- Population closure

- Calculated using hierarchical occupancy models:
  - Flexible
  - Can incorporate covariates
  - Bayesian framework

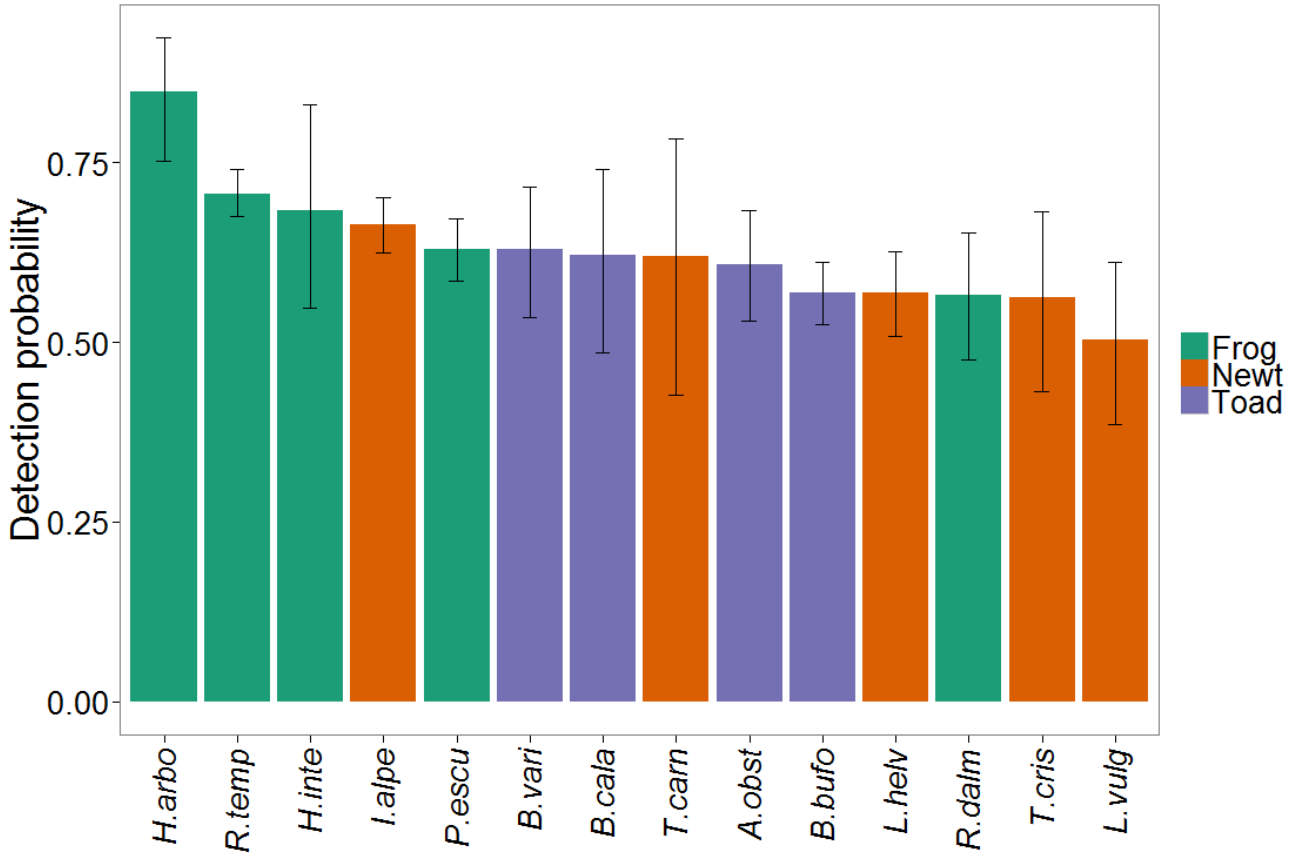
- Estimates p
- Calculates ‘true’ decline

Survey occasions			
0	0	0	0
1	0	0	0
0	1	1	1
1	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0

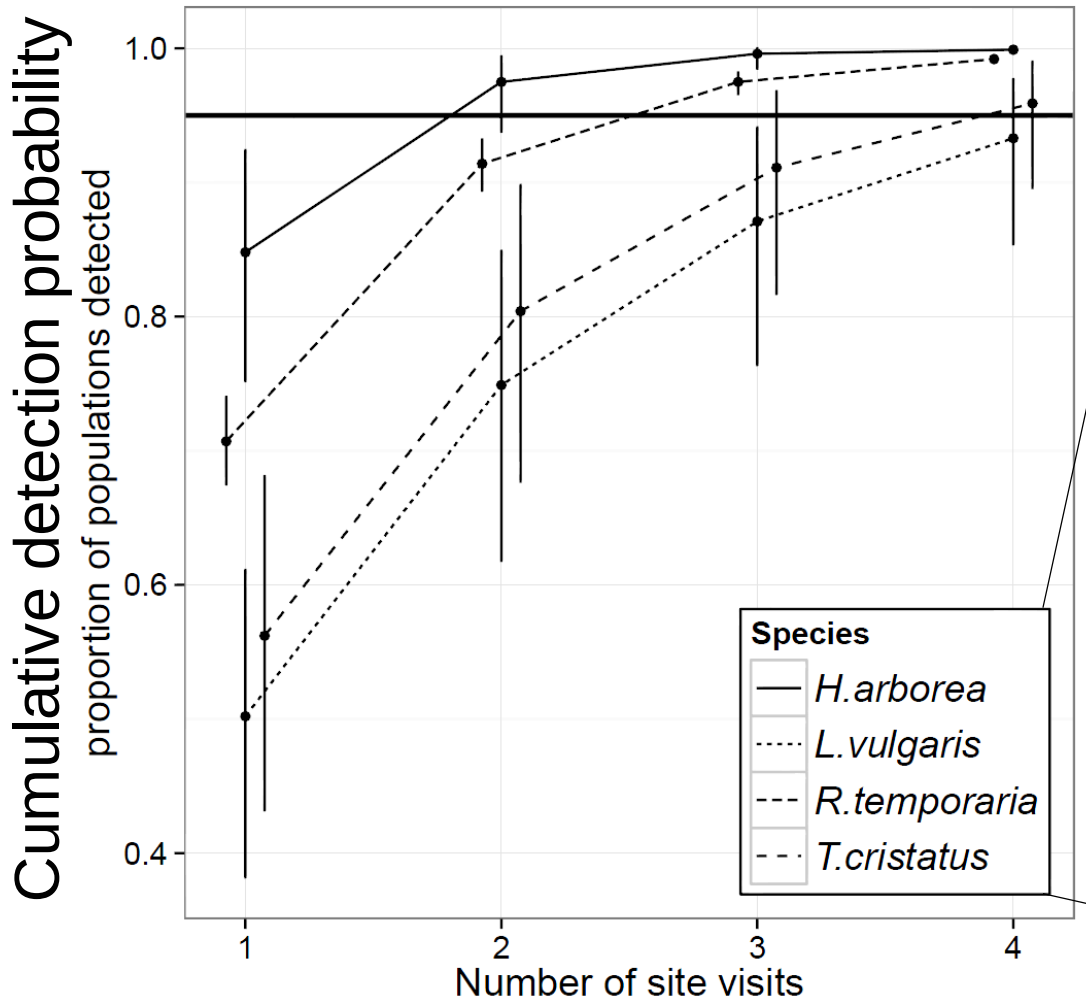
$$P = \frac{5}{12} = 0.412$$

Results- Detection

- Detection is less than 1 and varies among species
- No clear taxa-specific patterns



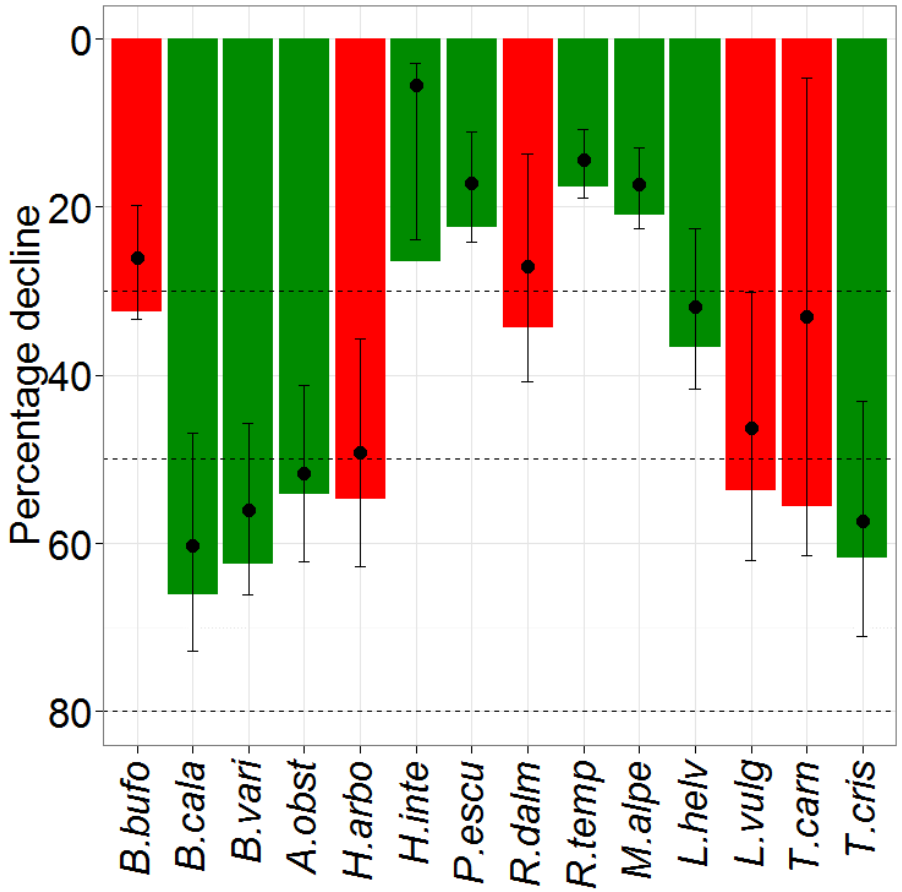
Cumulative Detection



Results- Declines

Estimated ± 95% C.I

Observed (Naïve)



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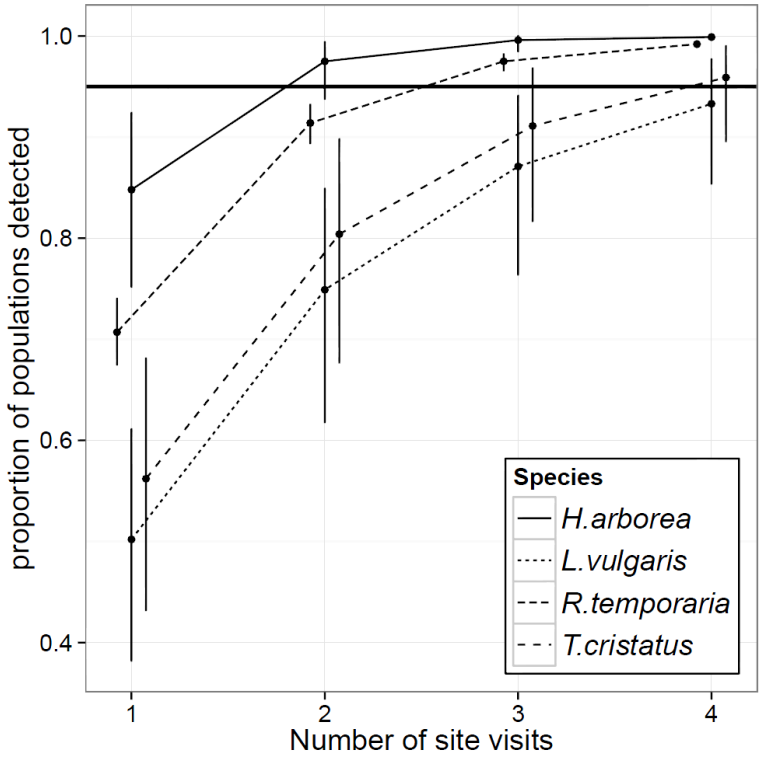
Discussion

- Not possible to observe with 100% accuracy
  - Populations will be overlooked
- Calculating detection probability can be useful in quality control
  - Did you survey enough?
- Imperfect detection leads to overestimation of population declines
- This can result in calculation of unsuitable Red-List category
  - Potential for application of inappropriate management



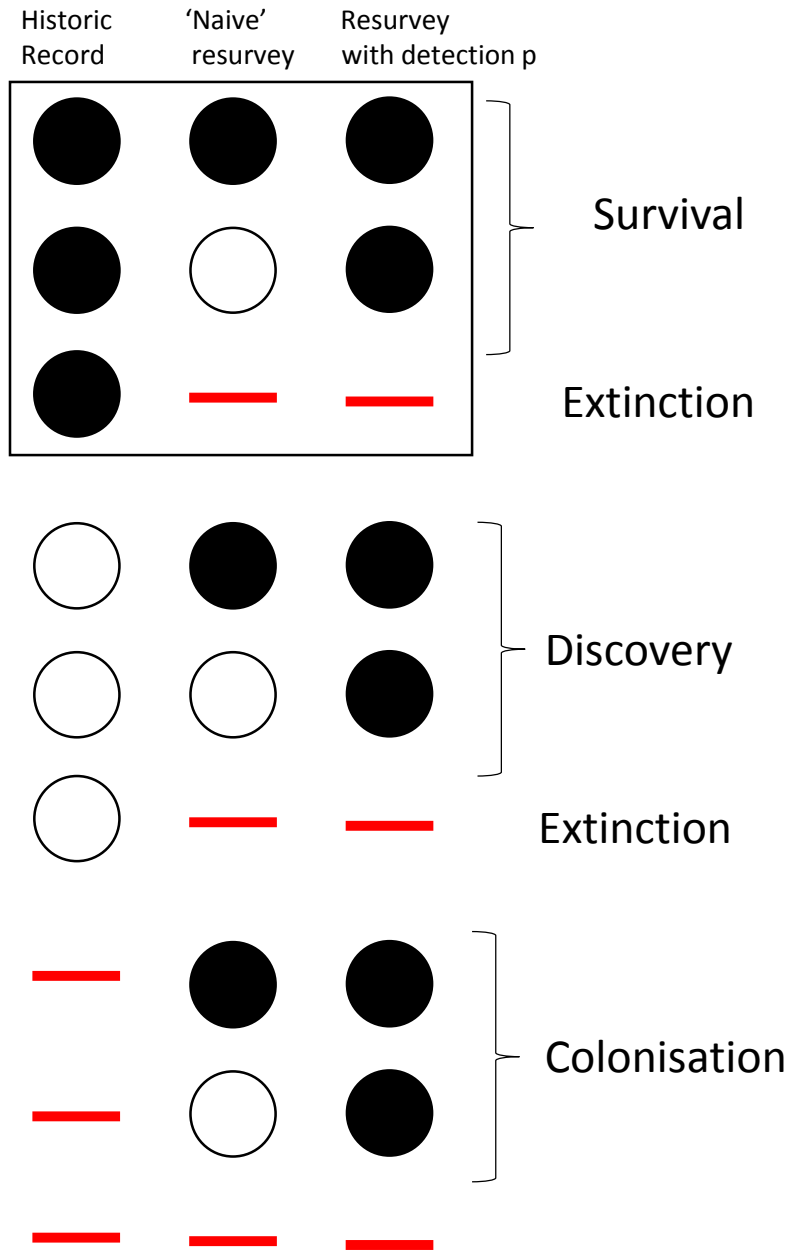
Discussion

- Revisitation studies are conditioned on historic presences
  - Can **only** show population declines
    - Problematic for metapopulations

- What is an “absence” in the historic record?
    - Truly absent **OR** present but undetected?

- Historic presences are only records with certainty
- We don’t really know what absence means in the historic record

- Able to calculate “pseudocolonisation” (discovery + colonisation)
  - Decline rate > pseudocolonisation rate for all species



Conclusion

- Ignoring imperfect detection biases trends to an unknown degree
  - We are able to estimate p using multiple observations

- Methods of dealing with uncertain historic records:
  - Prevent incorporation of new site colonisation, or
  - Make unreasonable assumptions about historic detection
- Modelling methods exist to deal with the problems of imperfect detection
  - Unsatisfactory data is holding back progress

Inferring absence is as important as measuring presence!

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