Designing monitoring programs that can infer species absence:

How much effort is enough?

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The peer told The Telegraph: "I know developers who suspect strongly that Great Crested Newts have been deliberately placed. They look around a site and there are no newts, then they look again and there they are; surprise, surprise.

THE TIMES

Have I got newts for you: Nimbys' secret weapon

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News

Rare newts 'planted' at development sites to stop the bulldozers

BBC RADIO 4

1. Implications of detectability widely misunderstood
2. Misunderstanding can have serious implications

HOUSE OF LORDS

The problem….

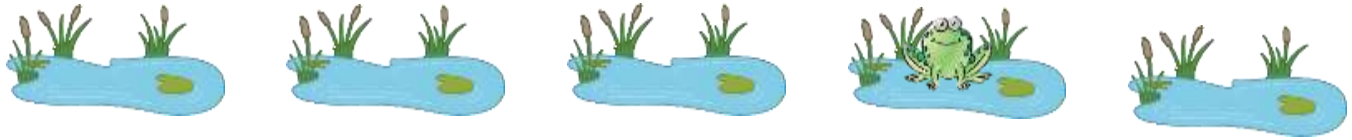
Detection probability: $\frac{3}{6}$

Present?

✓ Site 1: 

✓ Site 2: 

? Site 3: 

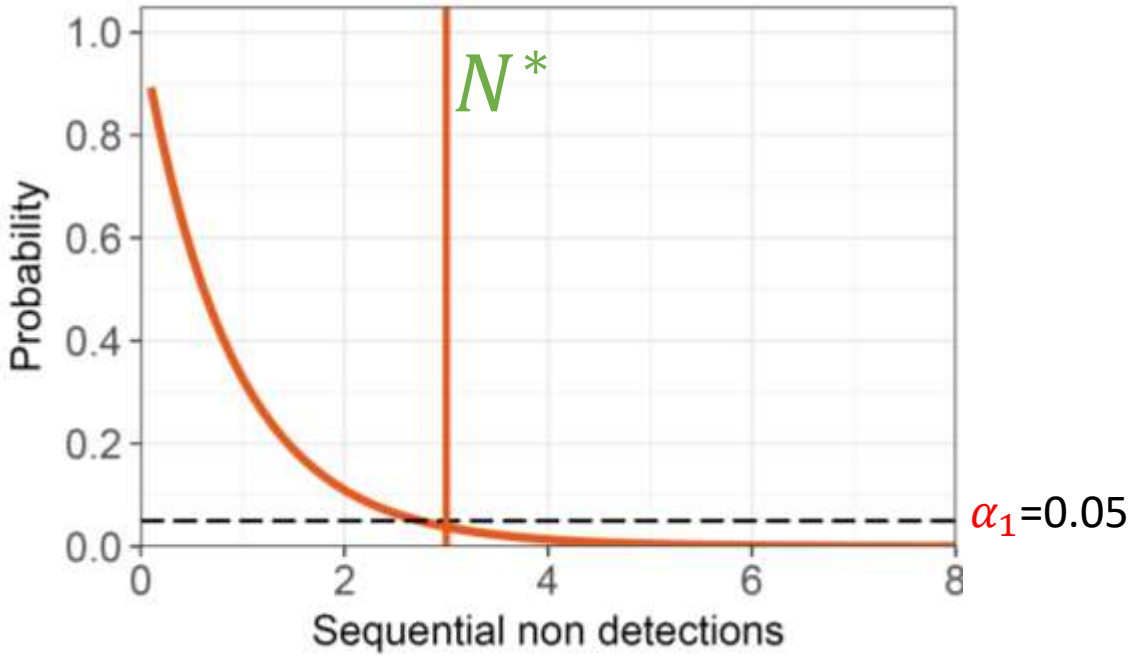
✓ Site 4: 

? Site 5: 

1-parameter framework

When are rare species not there?

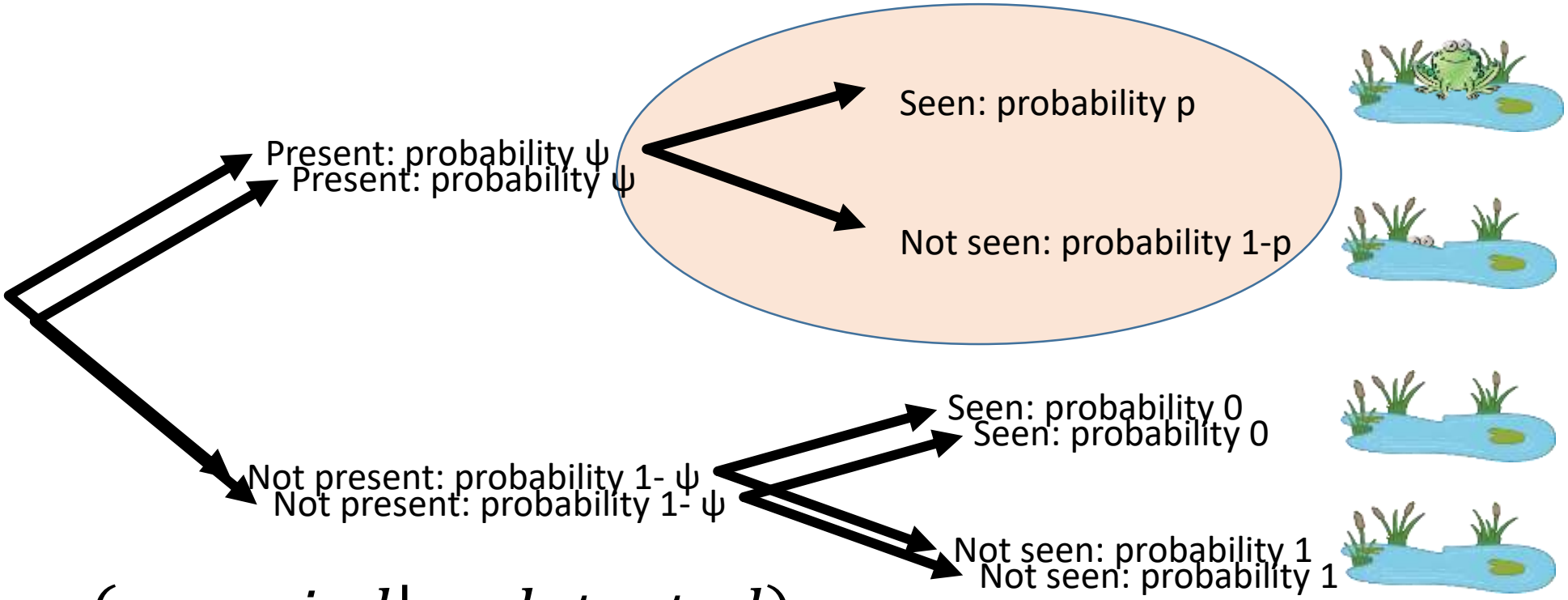
Brian H. McArdle, Dept of Zoology, Univ. of Auckland, Private Bag, Auckland, New Zealand
Oikos, Vol. 57, No. 2 (Feb., 1990), pp. 276-277



$$P(undetected|occupied) = 1 - (1 - p)^N$$

$$N^* = \frac{log(1 - \alpha_1)}{log(1 - p)}$$

2-parameter framework



$$p(occupied|undetected) = \frac{\psi(1-p)^N}{\psi(1-p)^N + (1-\psi)}$$

$$N^* = \frac{log\left(\frac{1-\psi}{\psi} \cdot \frac{\alpha_2}{1-\alpha_2}\right)}{log(1-p)}$$

Aims

Compare recommendations from the two frameworks

- 1-parameter simple but also simplistic
- 2-parameter more complex but realistic

Data

- 12 reptile species
- 294 1km^2 quadrats
- 1-3 visits

Data:

Detection probabilities

Prevalence estimates

Single season occupancy models

Nationwide species database

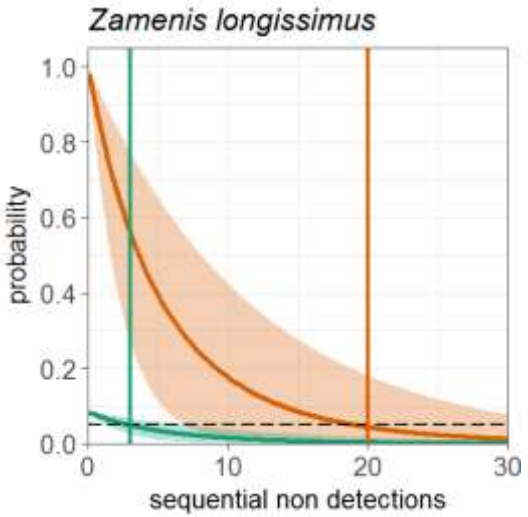
grid squares occupied/potentially habitat

several grain sizes (1x1/5x5/10x10 km)

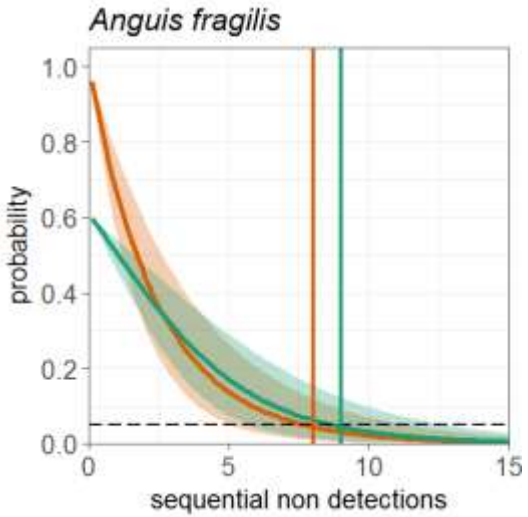
Comparisons

Framework
1-parameter
2-parameter

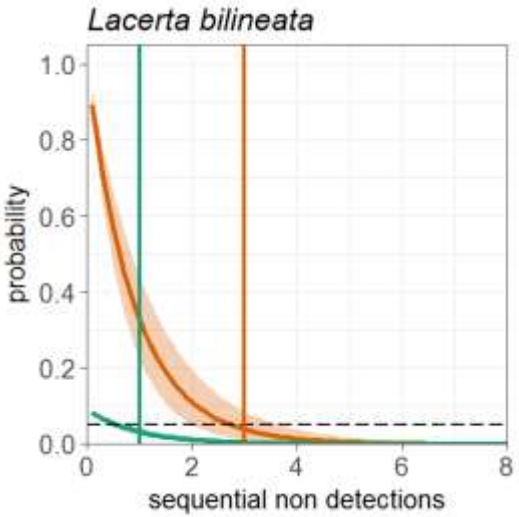
detection: 0.184
prevalence: 8.5%



detection: 0.336
prevalence: 60.6%

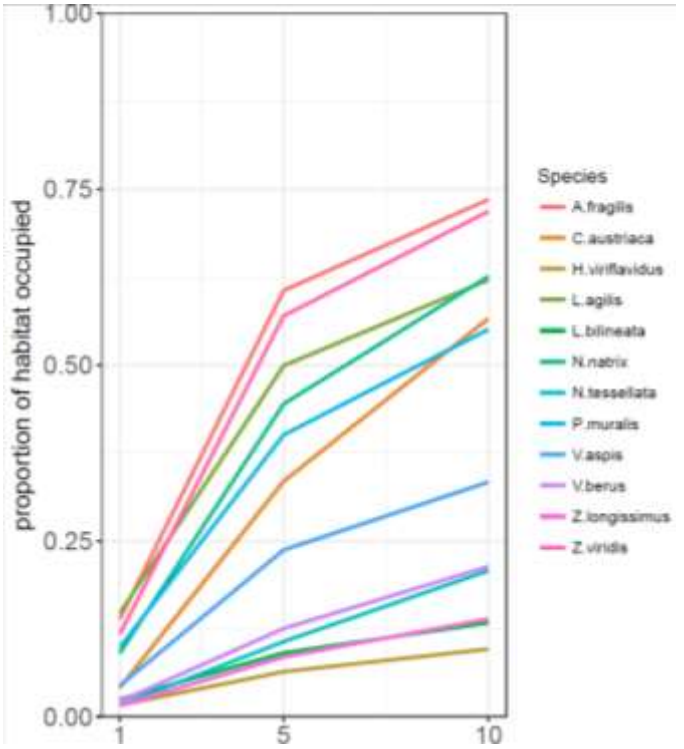


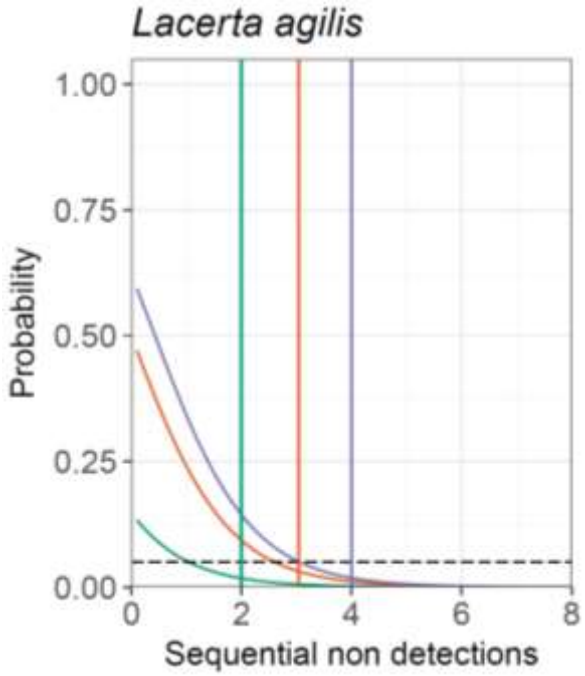
detection: 0.675
prevalence: 62.1%

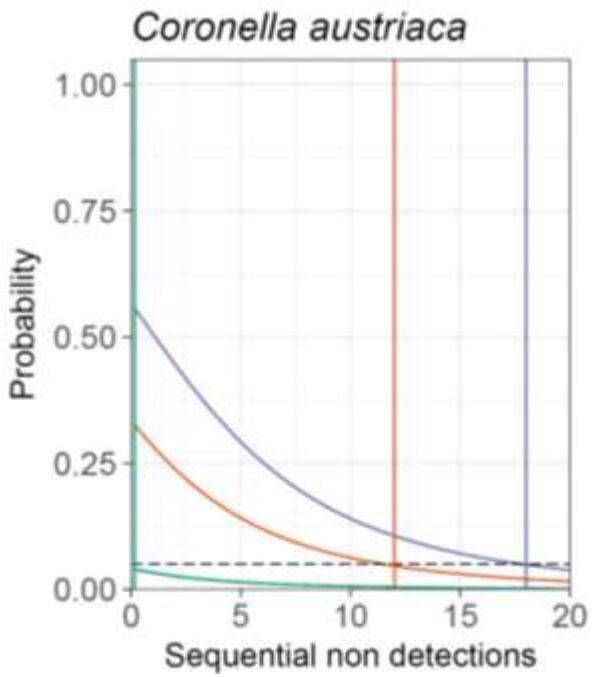


Scale dependency

- Are data available?
- How do you assess prevalence?
- Very sensitive to prior information



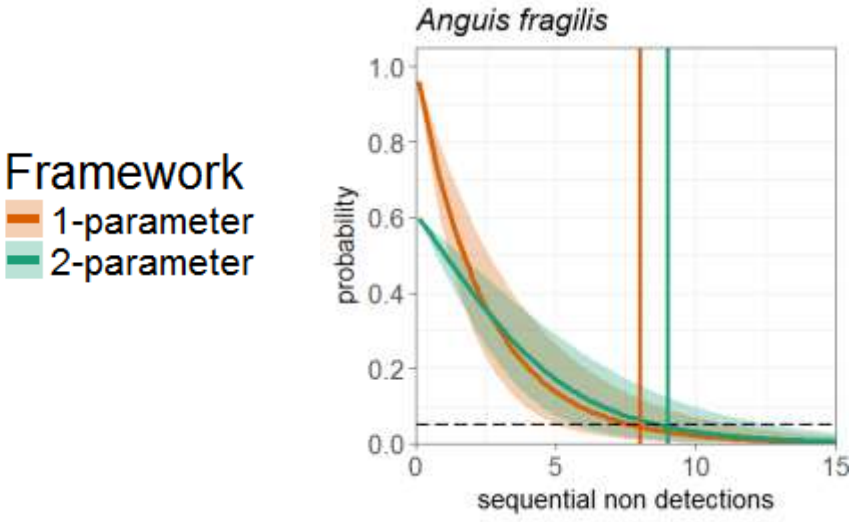




Grid Size
1x1km2
5x5km2
10x10km2

Hard to observe species

- Not feasible to put in enough effort
- Restricted-range species
  - Narrow the scope of monitoring (i.e. increase expected prevalence)
- Hard to detect species- Refine survey protocol to increase detection
  - Fewer, more accurate surveys > more, less accurate



Conclusions

- Inferring absence from non-detections is very hard
- Scale: rarely have useful prior information
- Interpreting the consequences of non-detections is easier when ignoring prevalence
  - α is the maximum proportion of populations you are 'willing' to miss.
  - If you consider expected prevalence, you could miss much more than α
- Plotting the equations can be useful in demonstrating to people how much confidence you can place on your data

They look around a site and there are no newts, then they look again
and there they are; ~~surprise, surprise.~~ but there you go, that's imperfect detection for you!

Acknowledgements

- Benedikt Schmidt
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karch

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Federal Office for the Environment FOEN
Bundesamt für Umwelt BAFU


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Ψ ↓

Present: probability ψ

Not seen: probability 1-p

Not present: probability 1- ψ

Seen: probability 0

Not seen: probability 1