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Are you seeing things that are not there?

A characterization of type I errors in botanical surveying

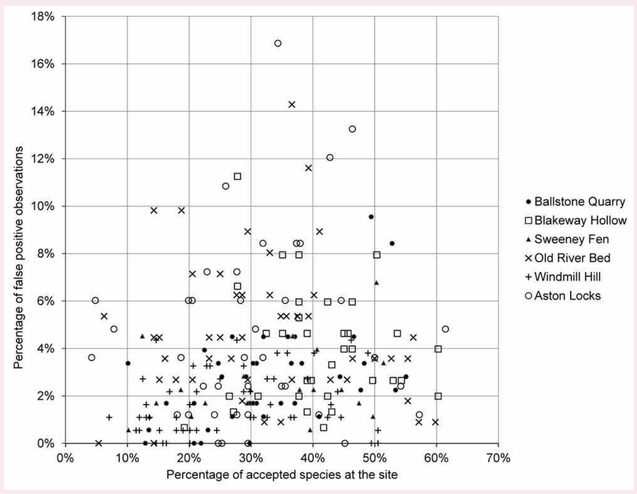
Summary

It is well-known that biological observations are full of errors. Hidden and cryptic organisms are easily overlooked which results in type II errors, otherwise known as false-negatives. However, a potentially more insidious error are the type I errors , that is, observing something that is not there, also known as false-positives. We have used data from field survey tests to characterize the false-positive errors created by observers. We found considerable variability in the creation of errors by different observers and the ability to identify a long list of species was not a useful guide to the accuracy of those lists. We have found no phylogenetic signal to the errors. However, we did find that common species are less likely to be false-positive than rare species. Increasing, the acceptance threshold for observations from field surveys dramatically reduces the number of false-positive observations, but at the expense of more false-negatives. Nevertheless, this is a potential strategy for analyzing field survey data if high numbers of false-positive errors are expected.

Materials and Methods

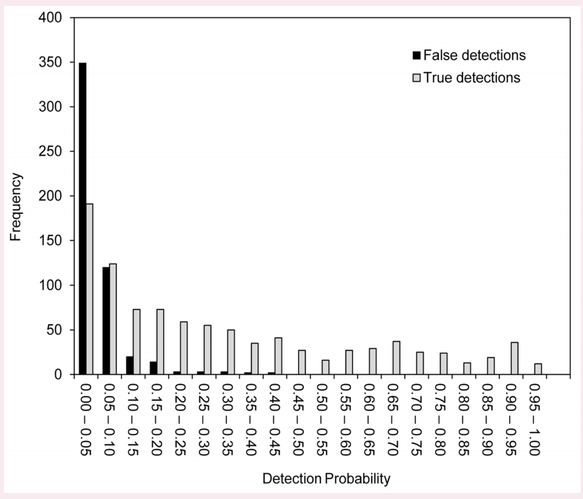
The data used in this study was derived from surveys conducted as part of the Field Identification Skills Certificates conducted under the aegis of the Botanical Society of Britain and Ireland. Participants were instructed to survey the vascular plants in 2-3 hectares. They were informed that they would get marked on the number of correct observations they made, but penalized for mistakes. A total of 238 surveys were conducted at six sites in Shropshire, UK.

Do observers with a long list create more false-positive errors?



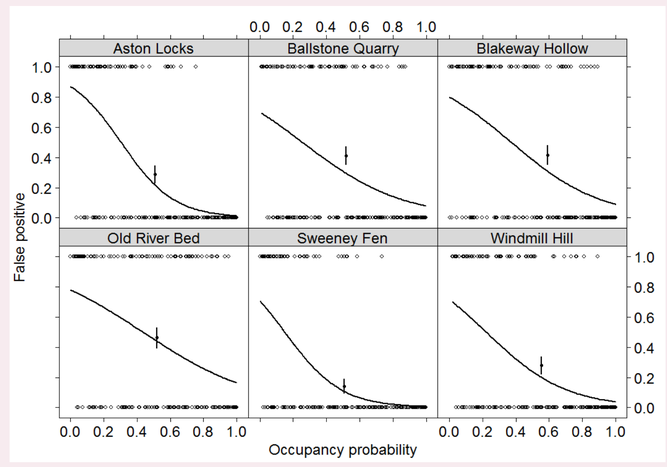
If you compare the number of false-positive errors created by recorders with there number of correct observations there is little correlation

What is the false-detection probability?



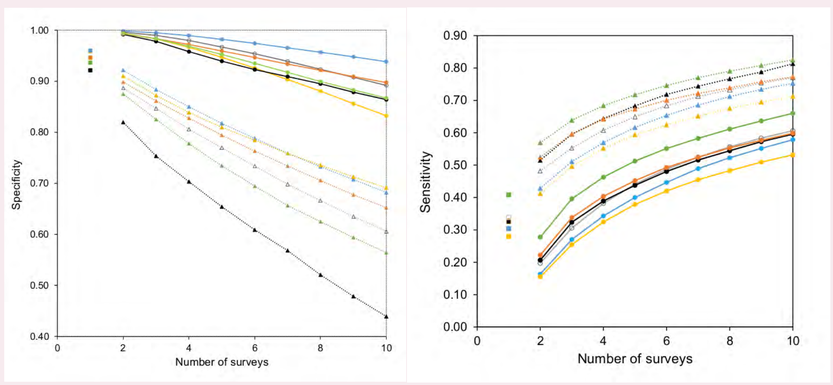
The false-detection probability is always low, but it overlaps with the detection probability of species accepted to be at the site.

Is the abundance of a species linked to the likelihood of it being a false-positive?



False and true positive observations were modelled as a binary trait against the mean occupancy probability of the these species in southern England. At all sites rarer species are much more likely to be recorded as false-positive observations.

Can errors be reduced by combining surveys?



The specificity and sensitivity of surveys at each site. Circles with solid lines are where species are only accepted if they were found in two of the multiple surveys. Squares are where there was only one survey. Triangles with dotted lines are where all observed species are accepted.

Is there a phylogenetic component to errors?

	Ballstone Quarry [173,86]	Blakeway Hollow [149,93]	Sweeney Fen [170,53]	Old River Bed [109,96]	Windmill Hill [177,71]	Aston Locks [162,91]
D Statistic	1.107	1.064	0.916	1.088	0.992	1.112
p Random model	0.927	0.797	0.175	0.879	0.447	0.944
p Brownian model	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
n	259	242	223	205	248	253

The D statistic measures the phylogenetic signal strength of binary data. The p value is the probability that the D value fits the model. Numbers in square brackets are the numbers of true-positive and false-positive observations in the sample.

Conclusions

- ☑ Observers vary widely, some are cautious , while others are reckless.
- ☑ False-positive observations are frequent, but false-positives for any individual species are rare.
- ☑ Common species are less likely to be false positives.
- ☑ False-positives can be eliminated if the threshold for accepting a species at the site is raised, but this results in a loss of sensitivity.
- ☑There is no phylogenetic signal associated with false-positive observations.

Questions?
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