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ROTHAMSTED EXPERIMENTAL STATION

(LAWES AGRICULTURAL TRUST)

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7th May, 1947

Prof.R.A.Fisher,Sc.D.,F.R.S.
Dept. of Genetics,
Whittinghame Lodge,
44, Storey's Way,
Cambridge.

Dear Professor Fisher,

Many thanks for your letter of 1st May. Your remarks are most helpful, and I think I have now got the matter straight. It seems that I was thinking of a different sampling process from yours. Your error variance is appropriate to comparing the estimates of α from several light-traps operating at the same time in the same neighbourhood, so that each species has the same abundance at each trap (or at least so that the species have the same relative abundance). I was considering a different problem, namely to compare the estimates of α from observations on different biological associations, or from observations on the same sorts of species carried out at different places or in different years, when there is no reason to suppose that the individual species identified in each trap have the same abundance (or the same relative abundance) from trap to trap, but when it may nevertheless be reasonable to assume that there is always a balance in the abundance of the species present, expressed by saying that for each trap we observe an independent random sample of species with abundances <u>M</u> distributed proportionally to

$$e^{-m/p} \frac{dm}{m} \quad \dots\dots\dots\dots\dots\dots\dots \quad (1)$$

For such a sampling process, I find, in the notation of your letter,

$$\text{Variance of } N = \frac{M(M+\alpha)}{\alpha}$$

$$\text{Variance of } S = E(S) = \alpha \log.(1 + \frac{M}{\alpha})$$

$$\text{CoVariance of } N \text{ and } S = M.$$

Proceeding as in your letter, I reach my formula

$$V(\alpha) = \frac{\alpha^2}{S - \frac{M}{M+\alpha}} \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

If we consider the variance of M and S (or rather of the expected value of S over replicate trappings for a given set of species abundances) over all possible sets of species abundances given by (1) above, we find quite easily

$$\text{Variance of } M = \frac{M^2}{\alpha}$$

$$\text{Variance of } S = \alpha \log. \frac{\alpha(2M+\alpha)}{(M+\alpha)^2}$$

$$\text{Covariance of } M \text{ and } S = \frac{M^2}{M+\alpha},$$

and these lead to a value for $V(\alpha)$ that is the difference between your formula and mine, as one would expect.

I am much obliged to you for the trouble you have taken to help me to get this matter clear.

Yours sincerely,

F.J. Anscombe

F.J.Anscombe.