Combining pin-point and Braun-Blanquet plant cover data

Christian Damgaard
Bioscience
Aarhus University

Hierarchical plant cover data

Plant cover data has too many zero values and too much variance compared to a binomial distribution

- U- shaped distributions of plant cover are typical

Large-scale ecological processes (among-sites):

- environmental drivers
- extinction / colonization of sites

Small-scale ecological process (within-sites):

- size of individuals
- density-dependent population growth
- inter-specific competition

The pin-point (point-intercept) method

Method for measuring:

i) cover

ii) vertical density

Place a frame with a grid pattern

A pin is inserted vertically through one of the grid points into the vegetation

The pin will typically touch a number of plants and the different species are recorded (to determine cover)

The number of times the pin hits the same species is also recorded (to determine vertical density)

This procedure is repeated for each grid point

Distribution of pin-point cover data within a site

q : mean plant cover – may be regressed to environmental gradients

- **test hypotheses on the effect of environmental gradients on plant abundance** (Damgaard 2008, Damgaard 2012)

δ: degree of spatial correlation - depends on size of individuals and spatial arrangements. This parameter may be generalized to a multispecies case and be used to test for different hypotheses on the level of the *community*

- **test of neutrality** (Damgaard and Ejrnæs 2009)
- **does climate change or nitrogen deposition change the spatial structure or increase size of plants?** (Damgaard et al. in press)

Generalised binomial distribution

q **: mean cover at the site**
δ **: intra-plot correlation**

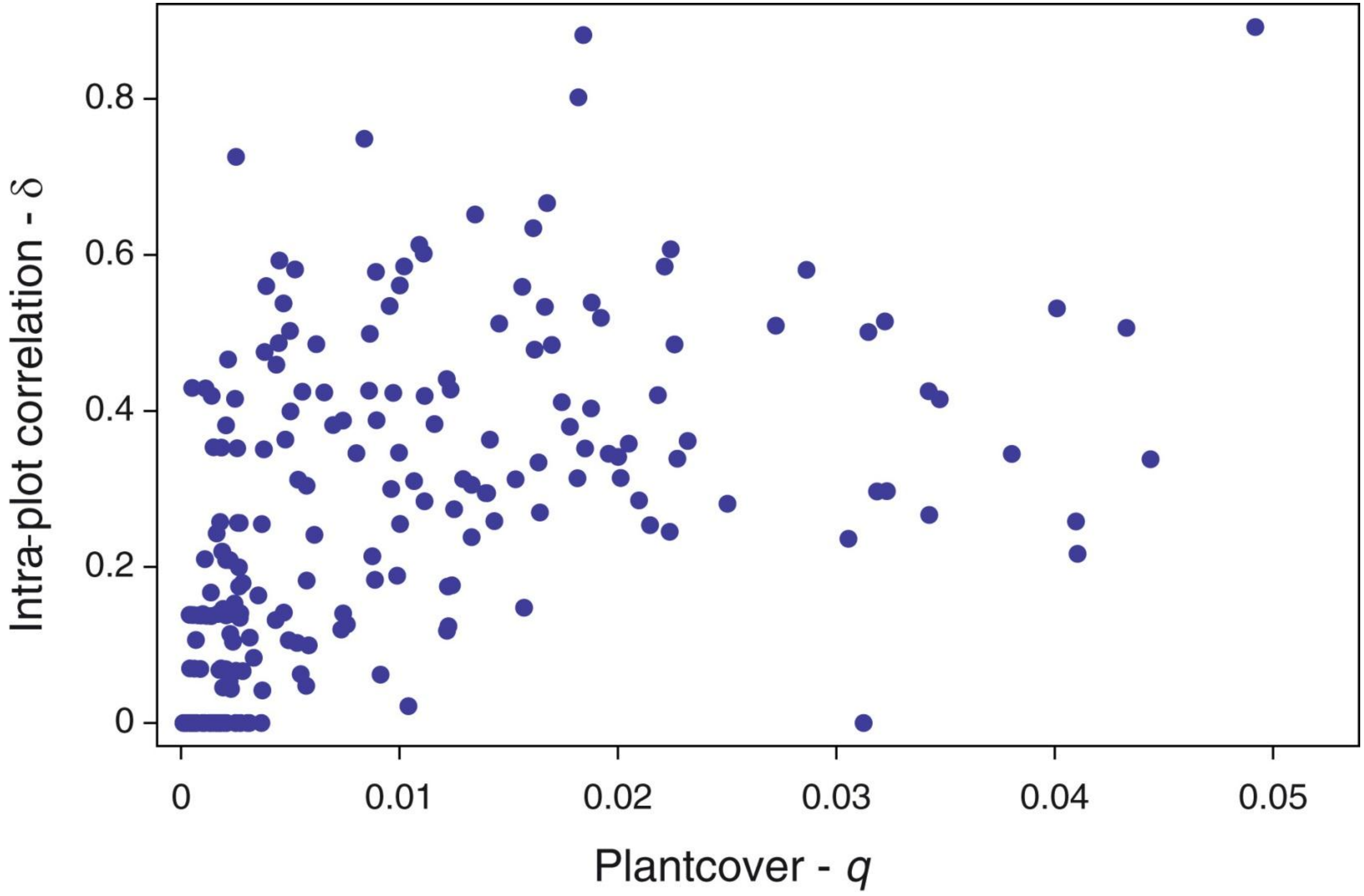
$$f_Y(y;n,q,\delta) = \binom{n}{y} \frac{\varphi\left(q\left(\frac{1}{\delta}-1\right),y\right)\varphi\left(\frac{(1-q)(1-\delta)}{\delta},n-y\right)}{\varphi\left(\frac{1}{\delta}-1,n\right)}$$

$$\varphi(x,n) = \Gamma(x+n)/\Gamma(x) = x(x+1)\dots(x+n-1)$$

$$E(Y) = n\,q$$

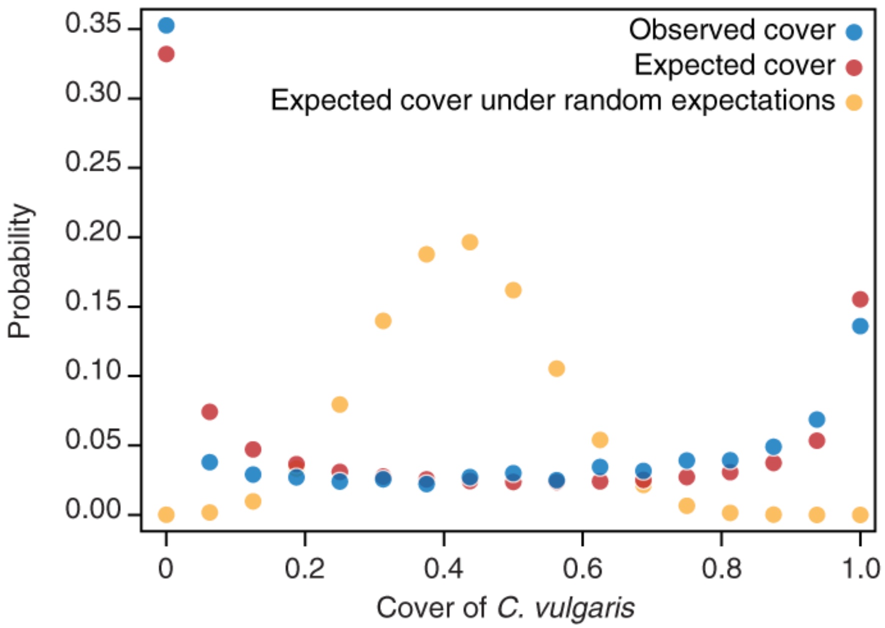
$$Var(Y) = n(1-q)q(1-\delta(1-n))$$

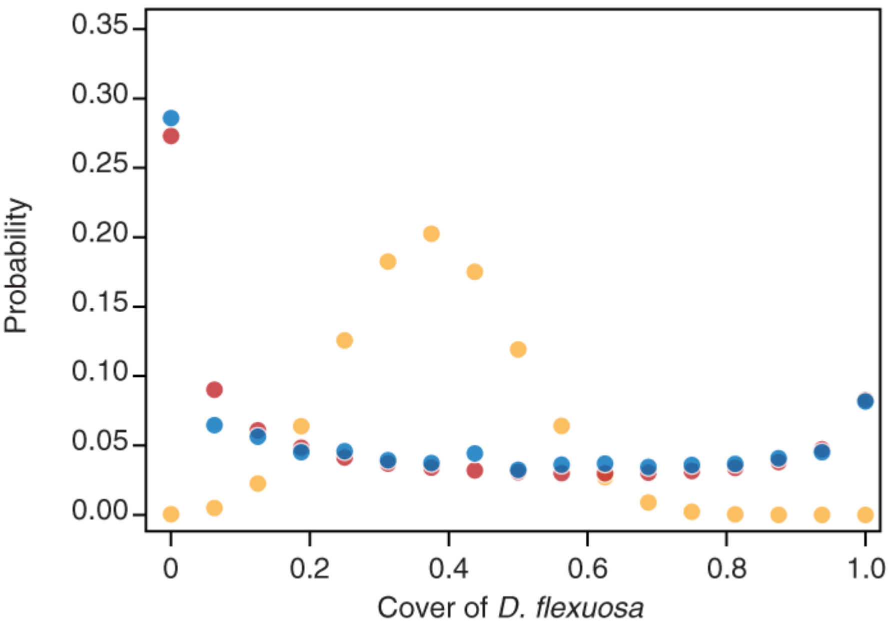
Relationship between plant cover and intra-plot correlation in dune grasslands



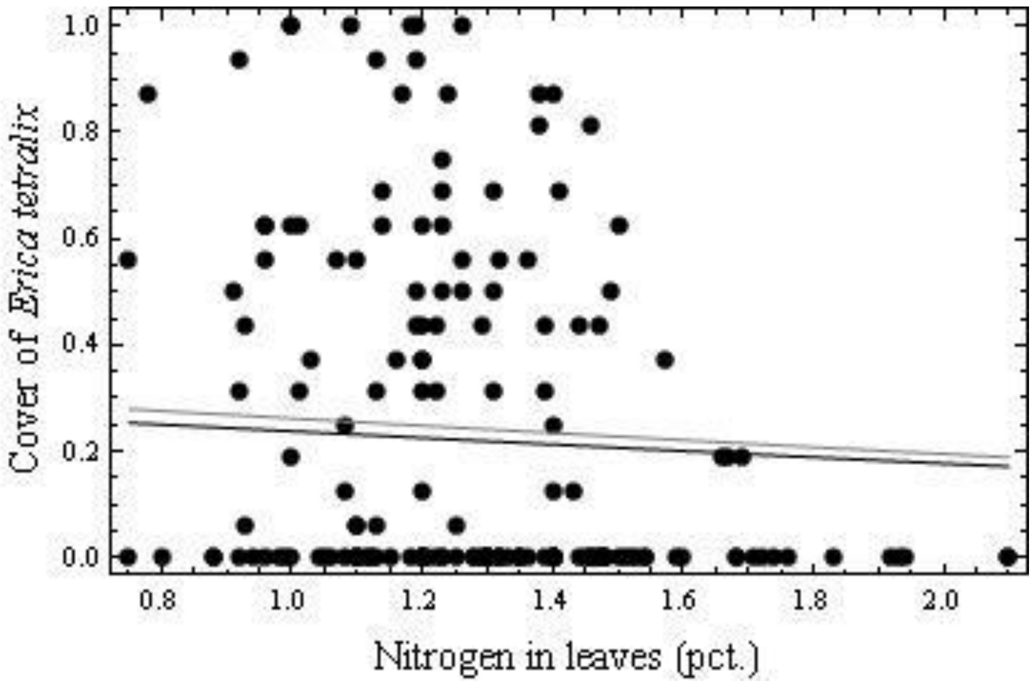
Important to include spatial correlation

The cover of *Calluna vulgaris* and *Deschampsia flexuosa* on dry heathlands





Important to include spatial correlation



If δ was set to zero (no spatial correlation) then there was a strong significant effect (grey line, P < 0.0001)

If δ was allowed to vary then the effect was found to be insignificant (black line, δ = 0.57, P = 0.19)

Braun-Blanquet cover data

A system for classifying visually estimated plant cover data

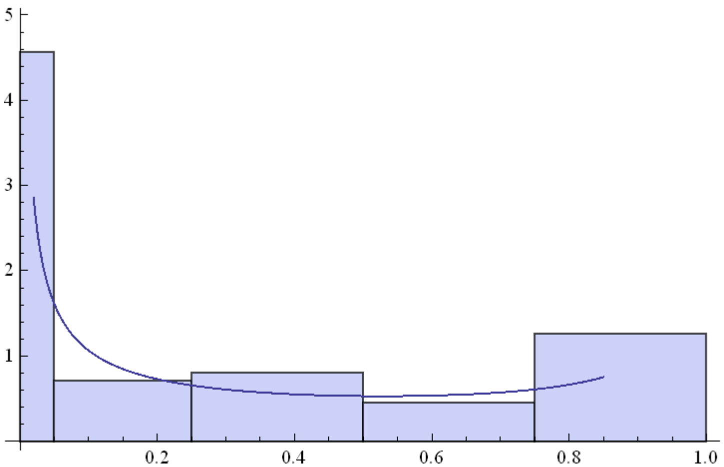
Braun-Blanquet class	Plant cover
1	$x \leq 0.05$
2	$0.05 < x \leq 0.25$
3	$0.25 < x \leq 0.50$
4	$0.50 < x \leq 0.75$
5	$0.75 < x \leq 1$

Piecewise beta distribution

μ : mean cover at the site
ν : intra-plot correlation

$$f_C(c,d;\mu,\nu) = \begin{cases} B(d_1, \mu\nu, (1-\mu)\nu)/d_1 & c \le d_1 \\ (B(d_2, \mu\nu, (1-\mu)\nu) - B(d_1, \mu\nu, (1-\mu)\nu))/(d_2 - d_1) & d_1 < c \le d_2 \\ \dots & d_m < c \le d_n \end{cases}$$

Braun-Blanquet: d={0.05,0.25,0.5,0.75,1}



Data =
{1,2,3,4,3,2,3,5,5,1,2,1,1,3,2,4,5,5,
5,4,3,2,1,1,3,5,4,5,3,5,5,1,1,5,5}

$$\hat{\mu} = 0.45, \hat{\upsilon} = 0.78$$

Conclusions

It is possible to analyse pin-point cover data and Braun-Blanquet cover data in the same framework while accounting for the spatial variation

$\mu_{\text{(Braun-Blanquet)}}) \sim q_{\text{(pin-point)}}$

Erroneous conclusions if the spatial variation is ignored

Framework for analysing trends of plant cover data has been developed

- **Bayesian state-space model**
- **Separation of process and sampling error**
- **Missing values**
- **Effect of treatment or co-variable on change in cover**
- ***Ecology* – preprint**