

Estimating mean and variance of forest attributes in the Danish National Forest Inventory

Thomas Nord-Larsen
Forest & Landscape
Copenhagen University





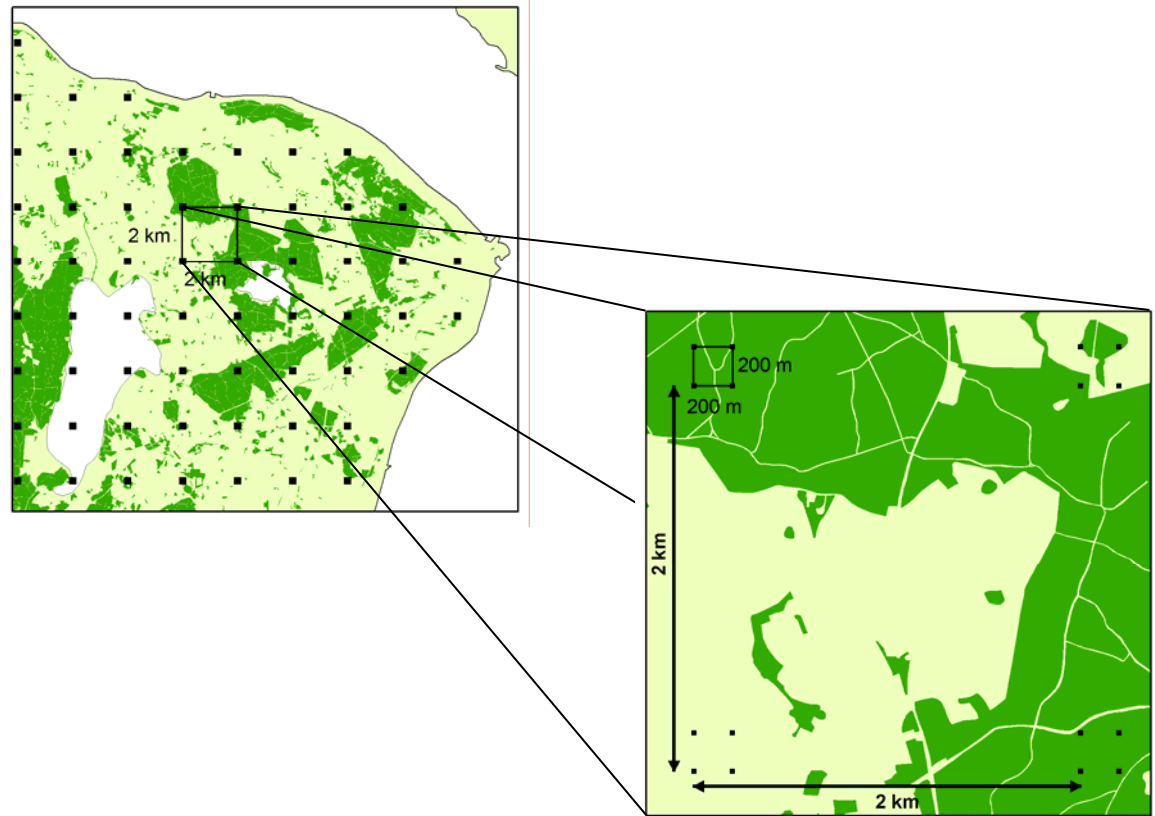
Or:

The story on how a 7.7 cm tree
became 20 mio. m³

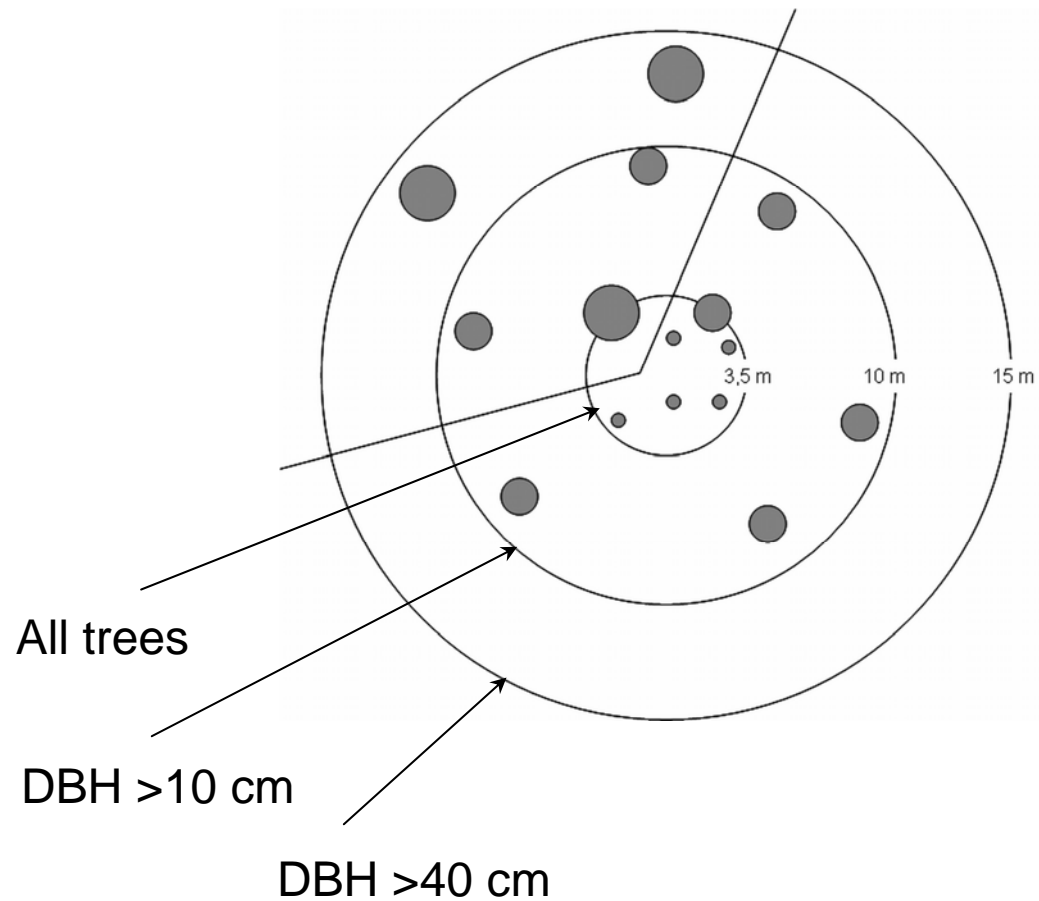
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Sampling design in the Danish NFI



Sampling design in the Danish NFI



Common estimators of mean and standard error

Plot volume

$$V_j = \sum_c \sum_{t=1}^T \frac{1}{A_{cj}} v_{tj}$$

Simple random sampling:

$$\bar{V}_{srs} = \frac{\sum_{j=1}^m A_j V_j}{A_n}$$

$$v(\bar{V}_{srs}) = \frac{\frac{1}{m-1} \sum_{j=1}^m A_j (V_j - \bar{V}_{srs})^2}{A_n}$$



Common estimators of mean and standard error

Cluster sampling:

$$\bar{V}_{cl} = \frac{\sum_{i=1}^n A_i \bar{V}_i}{A_n}$$

$$v(\bar{V}_{cl}) = \frac{1}{A_n} \sum_{i=1}^n \frac{A_i^2}{A_n^2} \frac{(\bar{V}_i - \bar{V}_{cl})^2}{n-1}$$



Another estimator of growing stock mean

Circle volume:

$$V_c = \frac{1}{A_{cj}} \sum_{t=1}^{T_j} R_{ct} v_{tj} \quad c = 3.5, 10, 15 m$$

Mean circle volume:

$$\bar{V}_c = \frac{\sum_{j=1}^m A_{cj} V_{cj}}{A_{cn}}$$

Mean volume:

$$\bar{V}_{cir} = \bar{V}_{3.5} + \bar{V}_{10} + \bar{V}_{15}$$



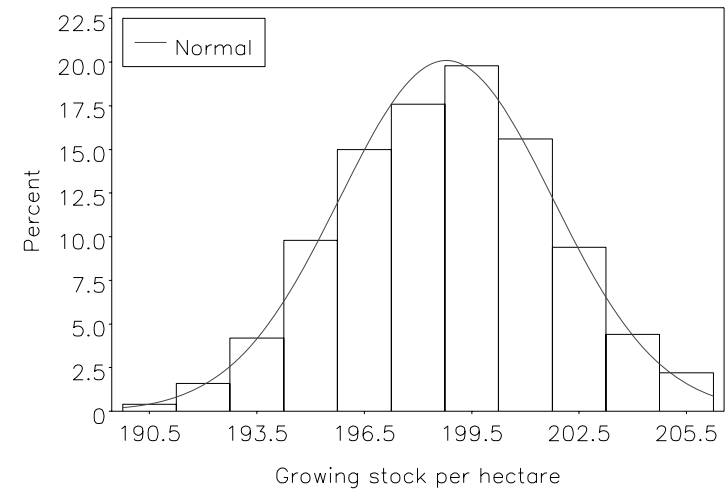
Results

	Mean	Std. error	95 % konf. int.
Simple random sampling	206.98	17.15	173.35-240.60
Cluster sampling	206.98	11.84	183.76-230.19
Circle sampling	198.93	2.84	193.36-204.49

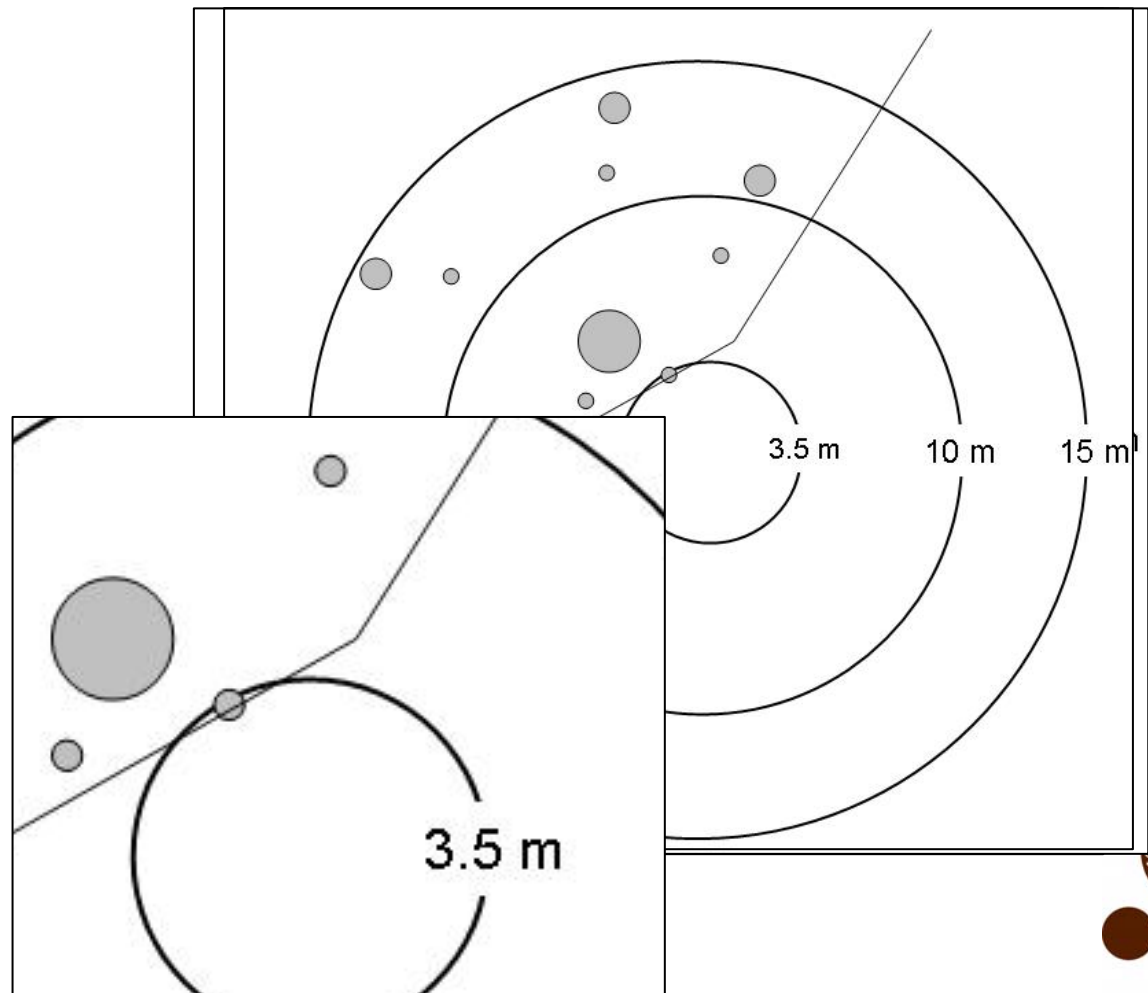


Results

Bootstrap size	Std. error
5	2.55
10	1.81
20	2.99
50	2.50
100	2.82
250	2.83
500	2.98
1000	2.90



Examples



Results

	Mean	Std. error	95 % konf. int.
Simple random sampling	196.99	2.65	191.78-202.18
Cluster sampling	196.99	3.05	191.00-202.98
Circle sampling	198.86	2.90	193.18-204.54



Conclusion

- Estimates based on circular subsamples seems to:
 - be unbiased
 - yield more stable variance estimates

