

0 introduction



0 Introduction

1 Initial evaluation...

1 Initial evaluation (baseline assessment) - population and species



2 Shortcut...

2 Routine monitoring.  
Shortcut: Management objective - MDC\* - sampling design



3 Unavoidable statistics ...

3 Unavoidable statistics. Example: Setting MDC\*



4 Miscellaneous things...

\*minimum detectable change

## 0 introduction

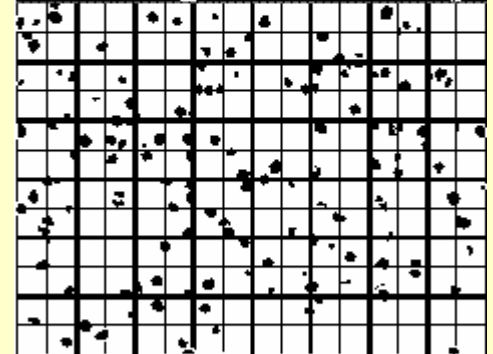
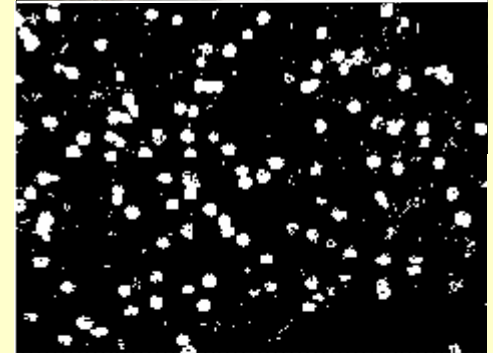





*Bellis perennis*  
(medical use: Flores Bellidis)

1. Complete census possible – no sampling techniques needed
2. Complete census not possible – sampling techniques

- a) appropriate (absolute/relative) field estimates
- b) accuracy & precision
- c) sampling versus nonsampling errors
- d) sampling distributions and confidence intervals
- e) finite versus infinite populations

f) false-change error/missed-change error (power) & minimum detectable change (MDC)



size	total	flowers	frequ.
	768	122	15,9
	192	81	57,8
	48	46	95,8

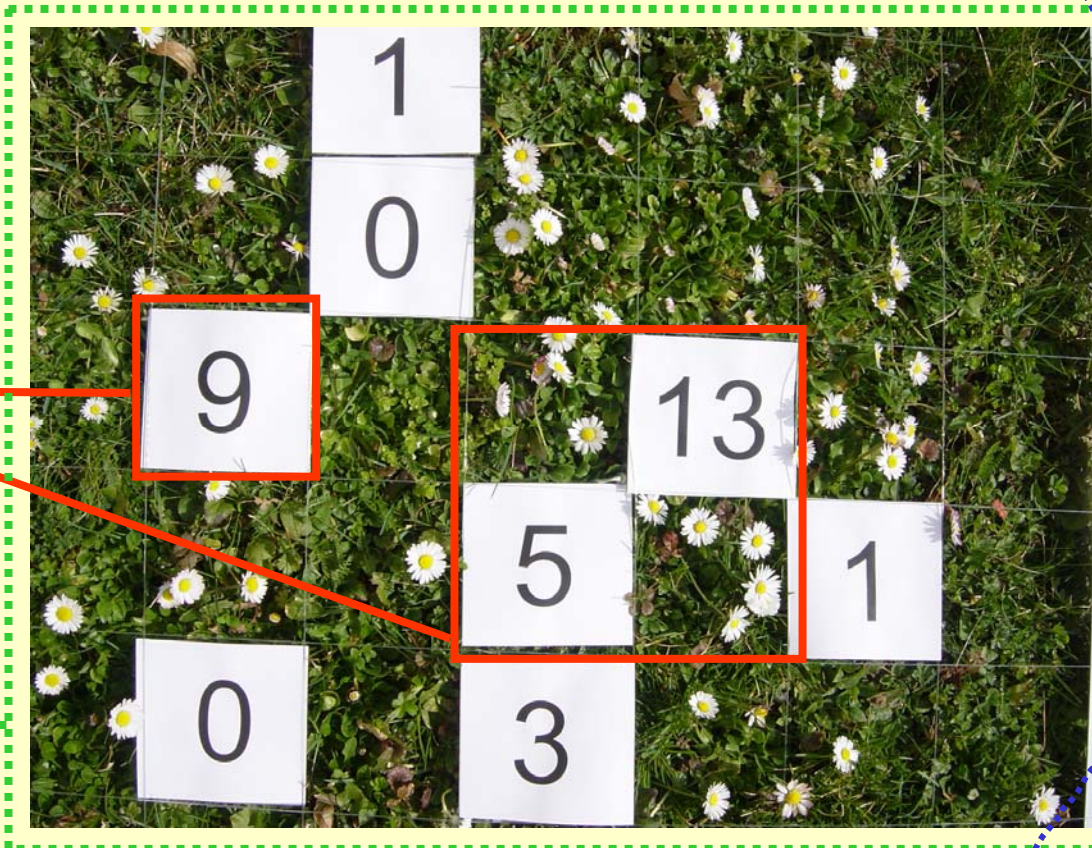
## 0 introduction



Collectors view

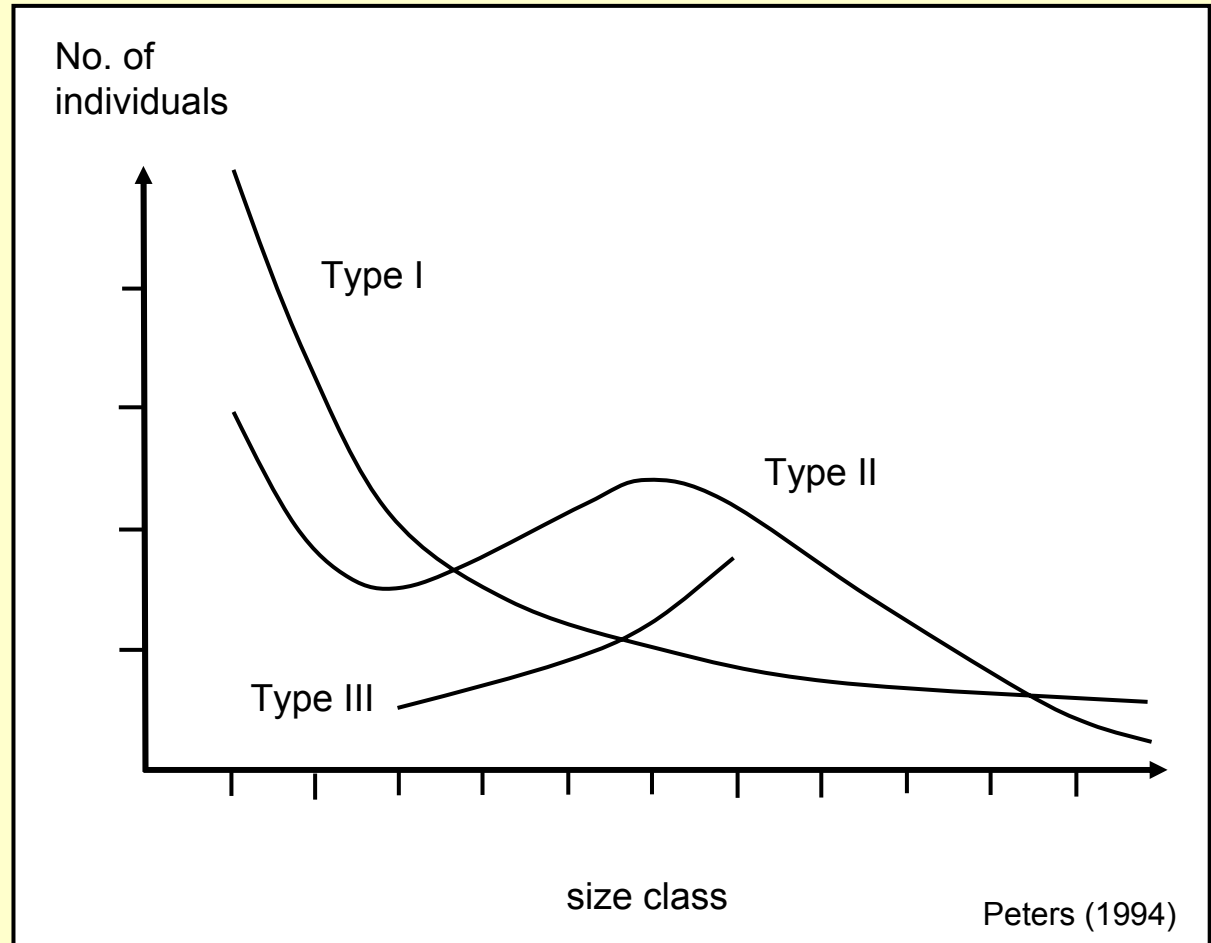
Statisticans view

Ecologists view



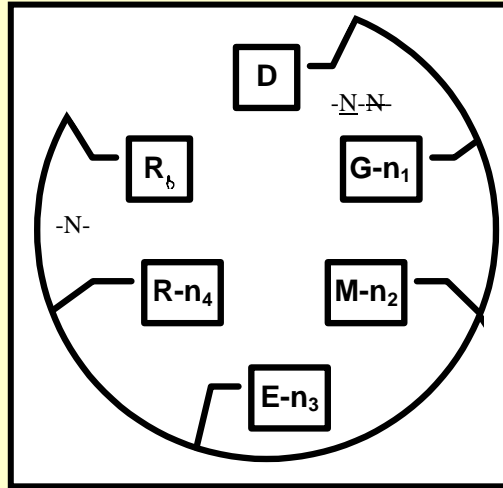


1 Initial evaluation: Population





1 Initial evaluation: Species

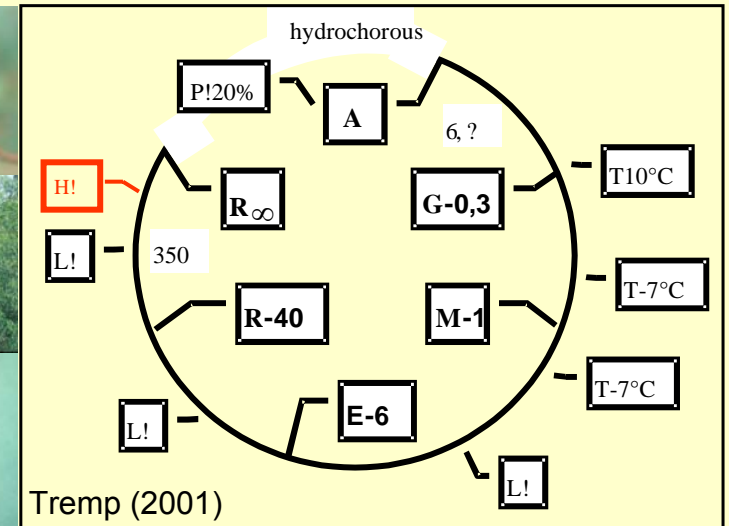


**D:** dispersal  
**G:** germination  
**M:** mature leaf stadium  
**E:** established stadium  
**R:** first reproductive phase  
**R<sub>b</sub>:** old age  
**-N-:** longevity (months maximal)  
**N, N:** diaspores above, undergr.  
**n<sub>1</sub>, n<sub>2</sub>, ...:** (months min. required)

**T!:** temperature deficiency  
**L!:** light deficiency  
**W!:** water deficiency  
**P!:** predation



*Amorpha fruticosa*

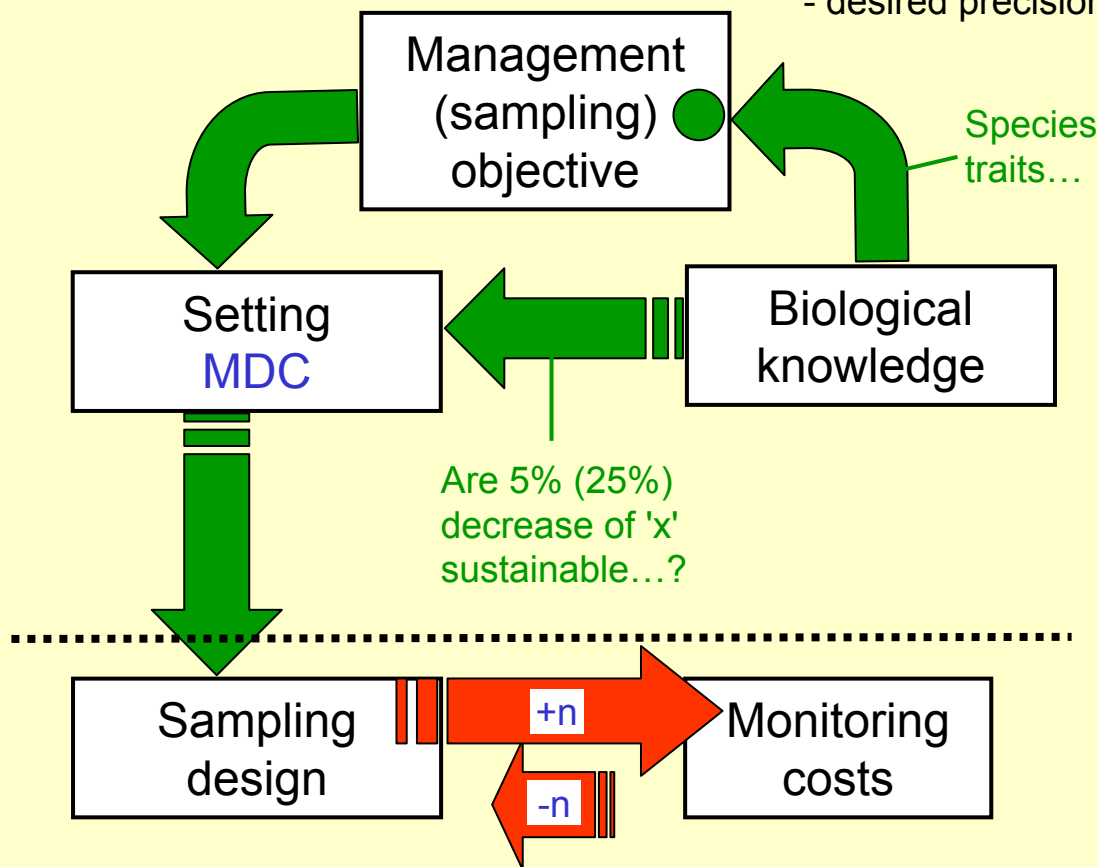




2 Shortcut...



- - action (maintain/increase population)
- time frame (costs)
- geographic area (size ↔  $n$ )
- aspect of the species ( $x$  ↔  $s$ )
- desired precision ( $\alpha$ )



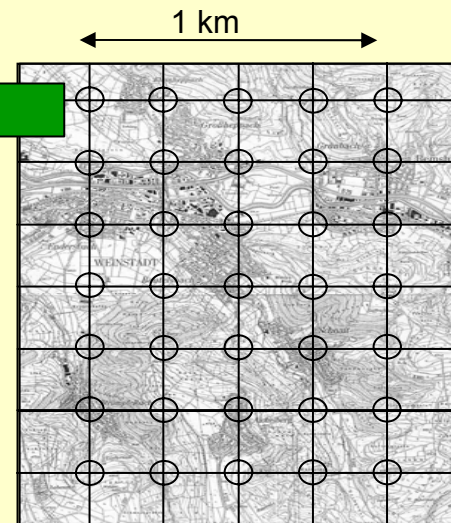
$$\text{Statistical power} = f \{ \text{MDC}, n, s, \alpha \}$$



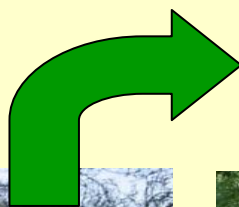
Lichen species (e.g. *Parmelia sulcata*)



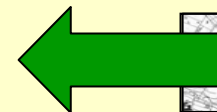
Quantitative estimate  
(sum of frequencies SF)



Sampling area (grid)  
5 trees/site n = 175



Change of  
amount of the  
resource?



3 Unavoidable statistics ...

Preliminary investigation  
(sample size; precision of  
the mean)

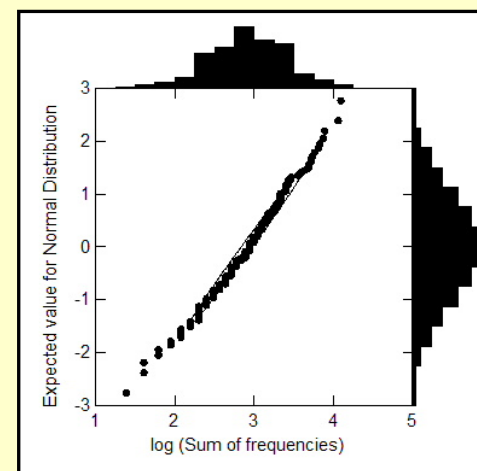
- $KI_{0,95} = 1SF$  (6%):  $n = 164$
- $KI_{0,95} = 2SF$  (12%):  $n = 41$
- $KI_{0,95} = 3SF$  (18%):  $n = 18$

	17
	16
	14
	9
	23
	11
	13
	28
	14
	26
x	17,1
s	6,4

$$KI_{0,95} = \frac{t_{df, 0,05} \cdot s}{\sqrt{n}}$$

$$n = \left( \frac{t_{df, 0,05} \cdot s}{KI_{0,95}} \right)^2$$

$$n = \left( \frac{2 \cdot 6,4}{1} \right)^2 = 164$$





Statistical power = f {MDC, n, s, α}

Setting MDC to determine the number of samples necessary

$$n_{PP} = \frac{s^2 (Z_{\alpha} + Z_{\beta})^2}{MDC^2}$$

$$n_{TP} = \frac{2(s^2) (Z_{\alpha} + Z_{\beta})^2}{MDC^2}$$

From pilot study (n = 10):

$$\bar{x} = 17,1$$

$$s = 6,4$$

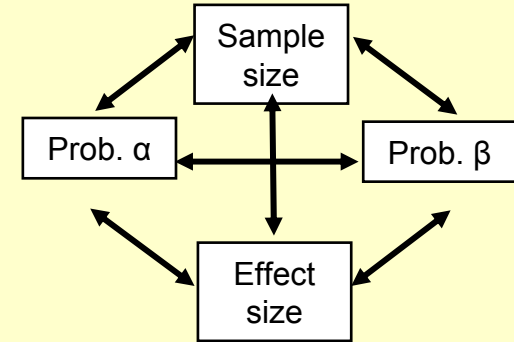
$$MDC = 1,7 (\approx 10\% \text{ change})$$

$$\alpha = 0,05; \beta = 0,10 (\text{Power} = 0,90)$$

$$n_{Lichen PS} = \frac{2(6,4^2) (1,96 + 1,28)^2}{1,7^2} \approx 297$$



3 Unavoidable statistics ...



Statistical distribution of data:

weight, length: normal distribution

counts: binomial, Poisson

counts (patchy patterns): neg. binomial

If nothing works: resampling methods  
(permutation, bootstrap)

References:

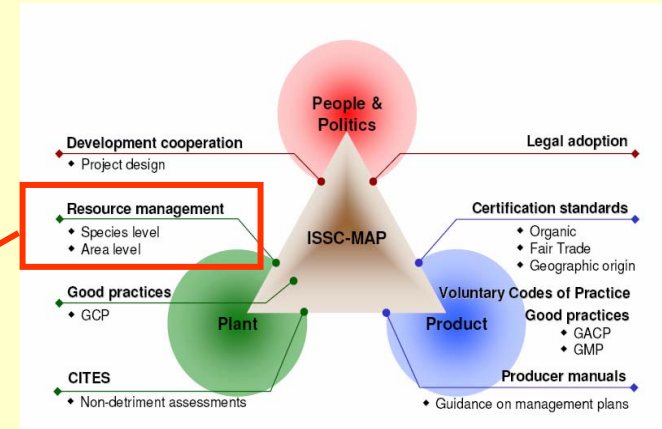
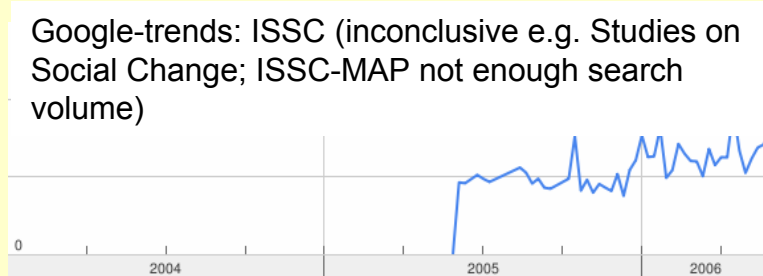
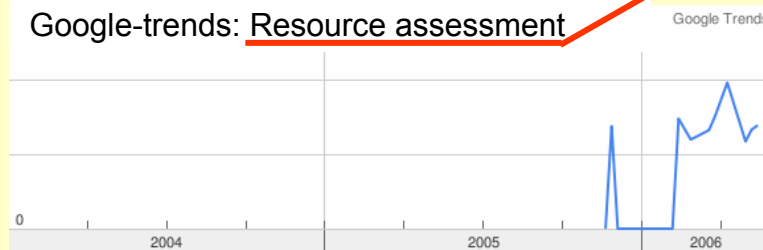
Krebs, C. J. (1998). Ecological Methodology. Addison-Welsey Educational Publishers, Inc...620.

Elzinga, C. L., Salzer, D. W., Willoughby, J. W. & Gibbs, J. P. (2001): Monitoring plant and animal populations. Blackwell Science, Massachusetts. 360.





4 Miscellaneous things...



Medicinal Plant Specialist Group (MPSG). 2006. *International standard for sustainable wild collection of medicinal and aromatic plants (ISSC-MAP. Working Draft (June 2006)).* Steering Group for the Development of an International Standard for the Sustainable Wild Collection of Medicinal and Aromatic Plants.

Top regions (resource assessment) (normalized)

