Balancing statistical reliability and cost efficiency in resource assessment

0 introduction

1 Initial evaluation…

2 Shortcut…

3 Unavoidable statistics …

4 Miscellaneous things…

0 Introduction

1 Initial evaluation (baseline assessment) - population and species

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

3 Unavoidable statistics. Example: Setting MDC*

*minimum detectable change

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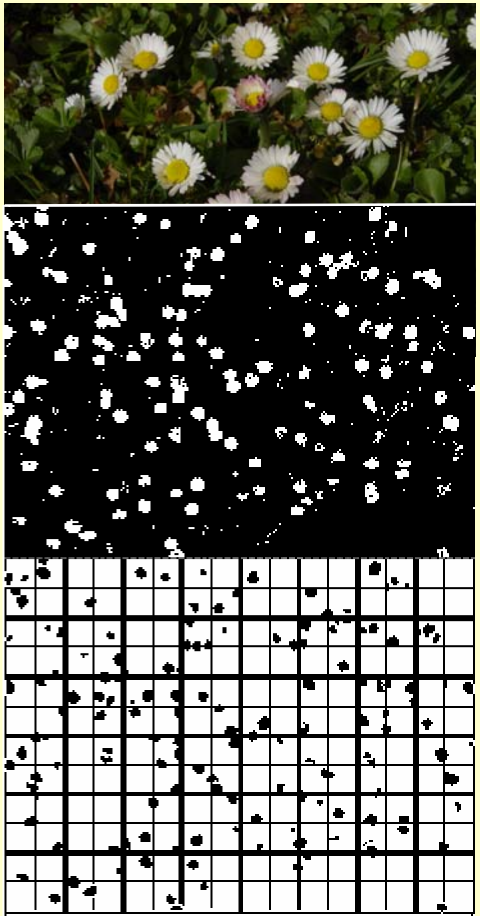
Bellis perennis
(medical use: Flores Bellidis)



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

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)

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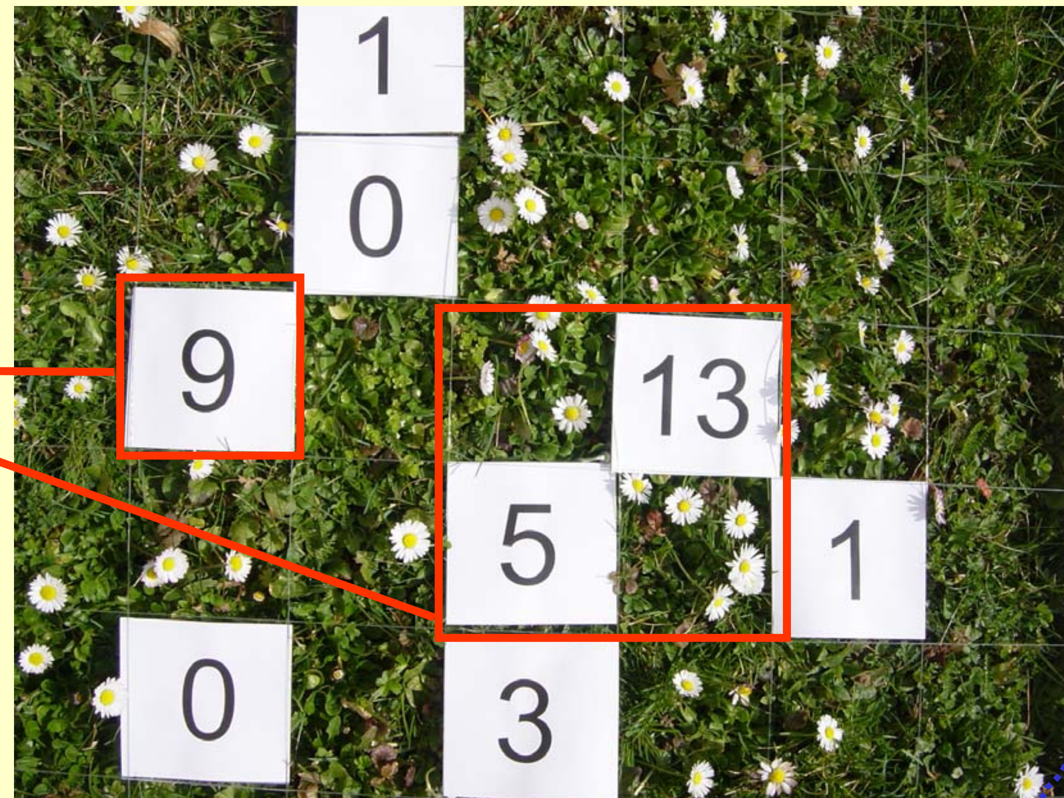
Collectors view

Statisticans view

Ecologists view



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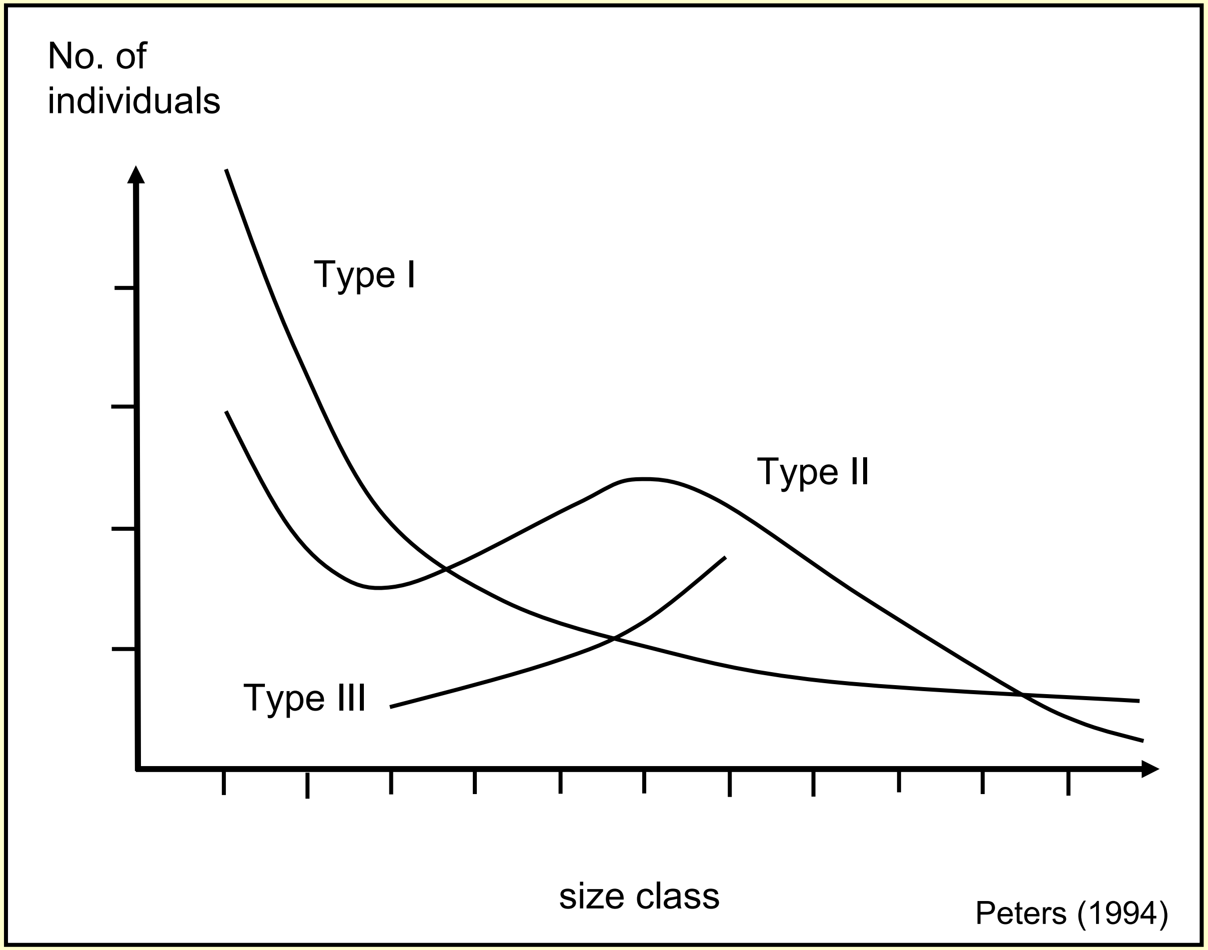
1 Initial evaluation: Population



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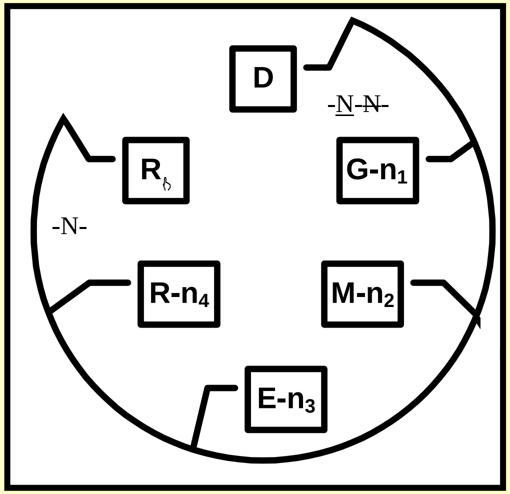
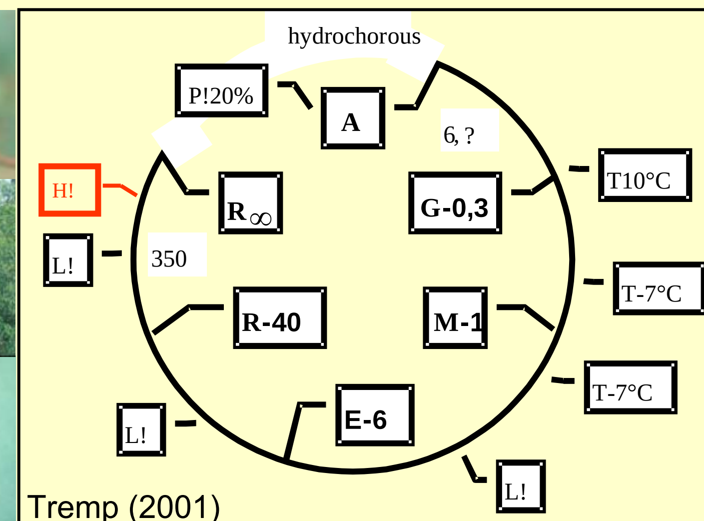
1 Initial evaluation: Species



D: dispersal
G: germination
M: mature leaf stadium
E: established stadium
R: first reproductive phase
R : old age
-N-: longevity (months maximal)
N, ~~N~~: diaspores above, undergr.
n_1, n_2,...: (months min. required)

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



Tremp (2001)

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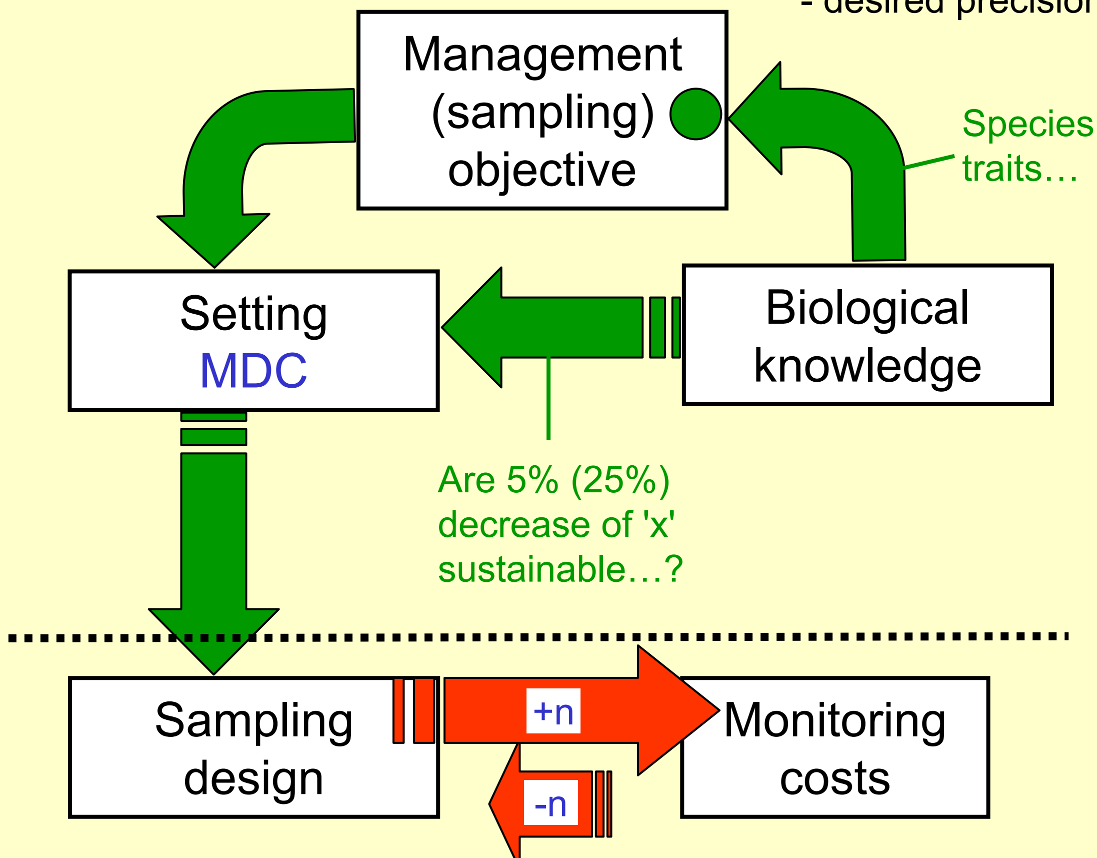
2 Shortcut…

- action (maintain/increase population)
- time frame (costs)
- geografic area (size ↔ n)
- aspect of the species (x ↔ s)
- desired precision (α)



Statistical power = f {MDC, n, s, α}

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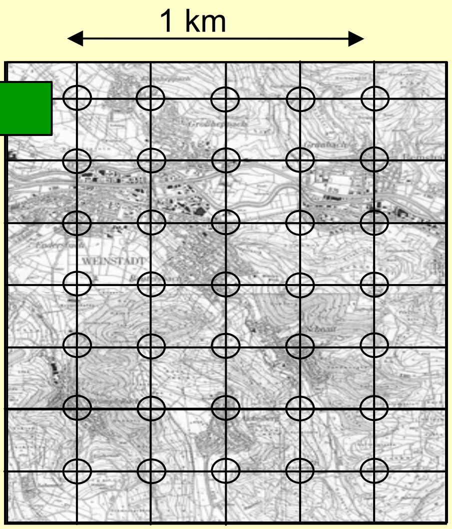
3 Unavoidable statistics …

Change of amount of the resource?

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

Quantitative estimate (sum of frequencies SF)



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

Preliminary investigation (sample size; precision of the mean)

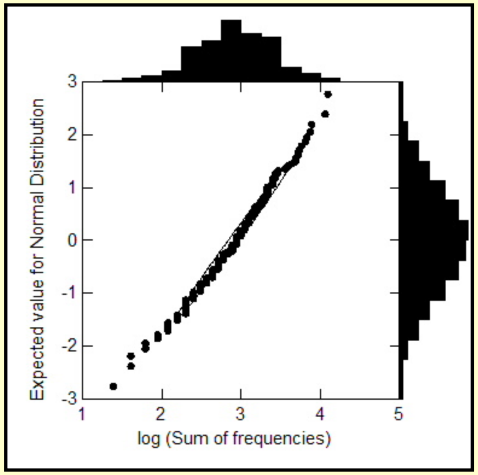
$KI_{0,95}$ = 1SF (6%): n = 164
$KI_{0,95}$ = 2SF (12%): n = 41
$KI_{0,95}$ = 3SF (18%): n = 18

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

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

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

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



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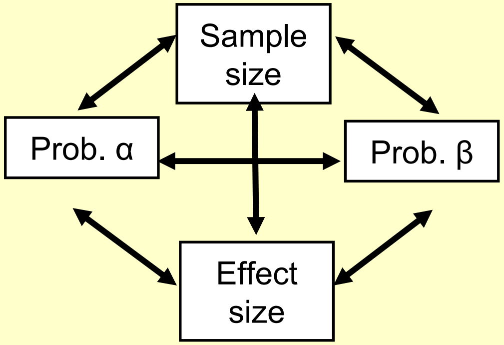
3 Unavoidable statistics …

Statistical power = f {MDC, n, s, α}



Setting MDC to determine the number of samples necessary

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

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

$$From\ pilot\ study\ (n = 10):$$

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

$$s = 6{,}4$$

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

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

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

Statistical distribution of data:

weight, length: normal distribution
counts: binomial, Poisson
counts (patchy patterns): neg. binomial

If nothing works: resampling methods
(permutation, bootstrap)

References:

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

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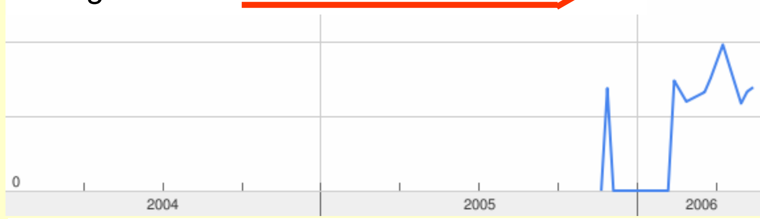
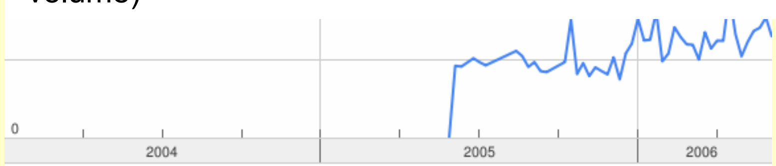
4 Miscellaneous things…

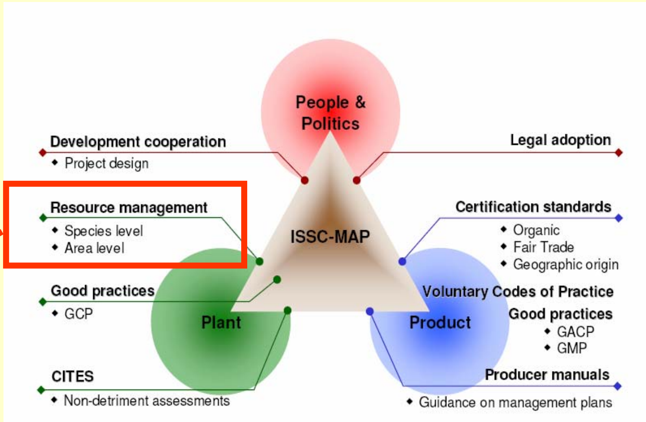
Google-trends: Ecology

Google-trends: Resource assessment



Google-trends: ISSC (inconclusive e.g. Studies on Social Change; ISSC-MAP not enough search volume)





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