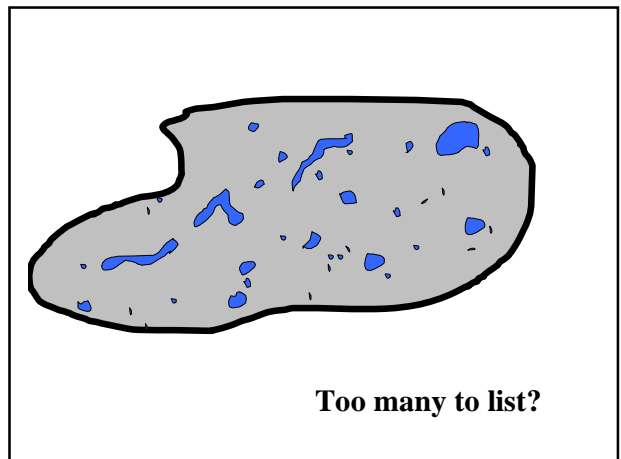
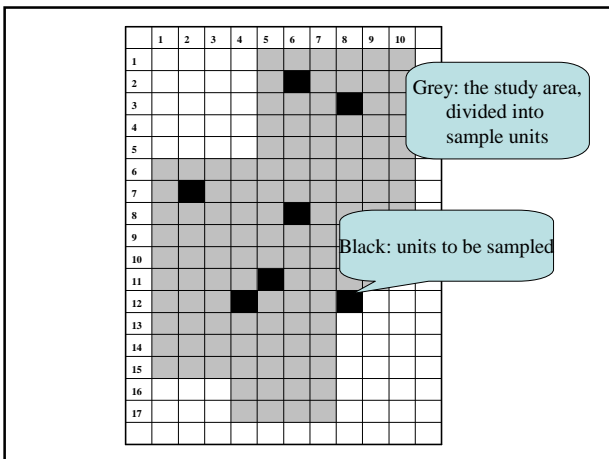
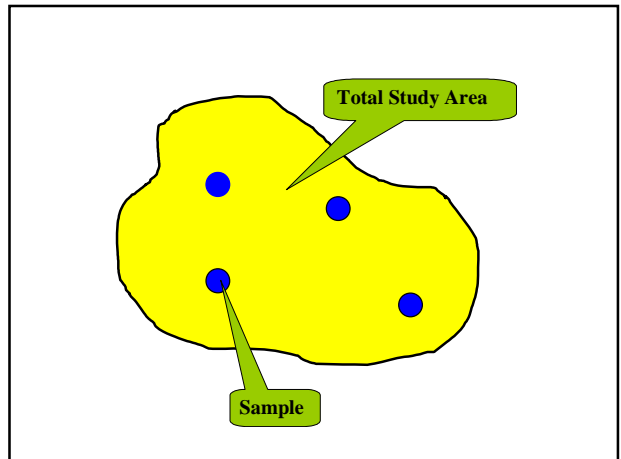
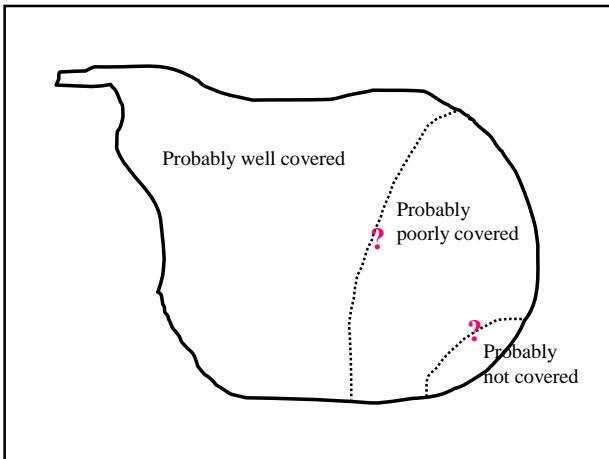
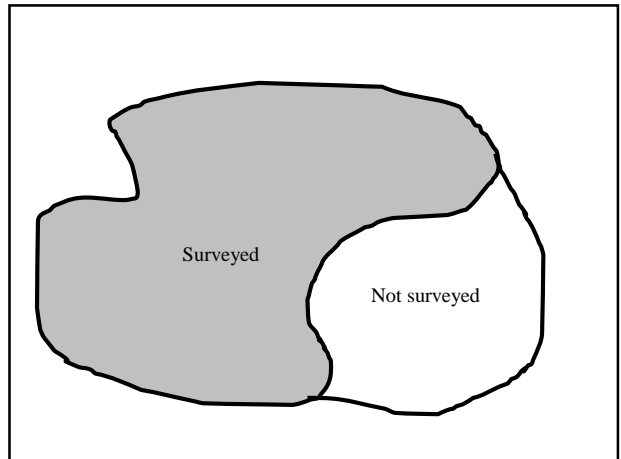
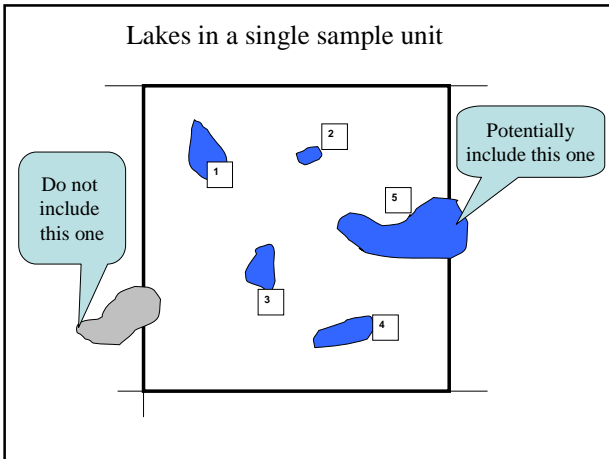


# The effective design of ecological surveys

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Counts (or estimates)  
in *sampled* units

10  
24  
3  
16  
11  
64

Mean in sampled units =  $64/5 = 12.8$

Best unbiased estimate of mean number per unit  
in whole study area =  $12.8^*$

If total number of units in study area is 452,  
then best unbiased estimate of total population  
in whole study area =  $12.8 \times 452 = 5785.6$   
 $= 5800^*$

*\* With standard error or confidence limits*

Sampled square	Number of lakes in square	Count (or estimate) for sampled lake	Estimate of total number for square
a	6	15	$6 \times 15 = 90$
b	3	22	$3 \times 22 = 66$
c	22	17	$22 \times 17 = 374$
d	7	19	$7 \times 19 = 133$
			<u>663</u>

Mean of estimated totals =  $663/4 = 166^*$

If total number of units in study area is 12 000,  
then best unbiased estimate of total population  
in whole study area =  $166 \times 12\ 000 = 1\ 992\ 000^*$

*\* With standard error or confidence limits*

**Precision of estimate for whole study area depends on:**

1. Variation between sample counts (or estimates),  
which depends on:
  - a. natural variation
  - b. precision of individual estimates
2. (Square root of) number of samples

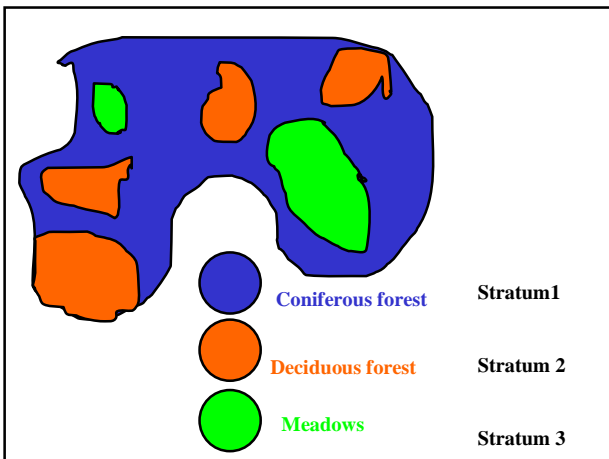
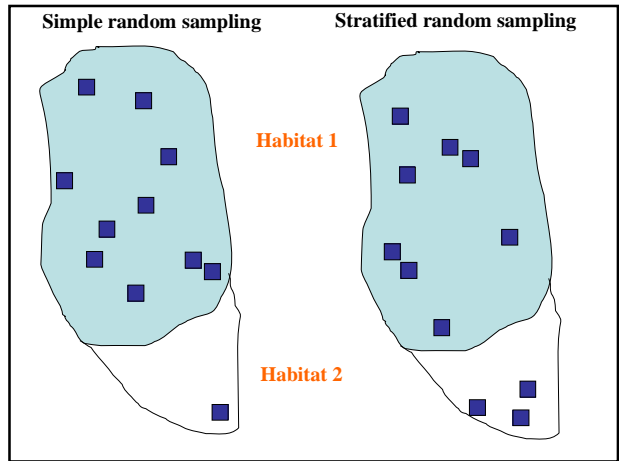
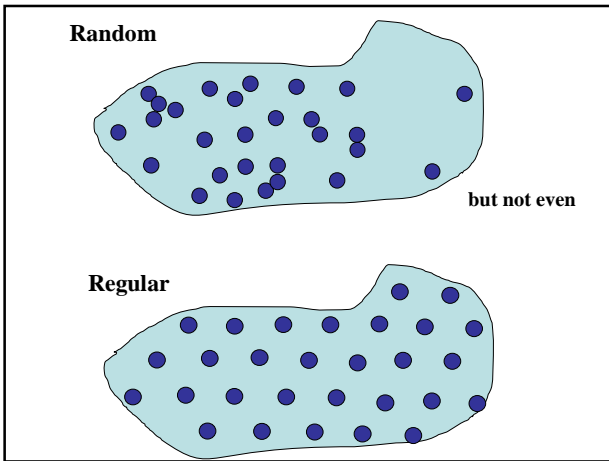
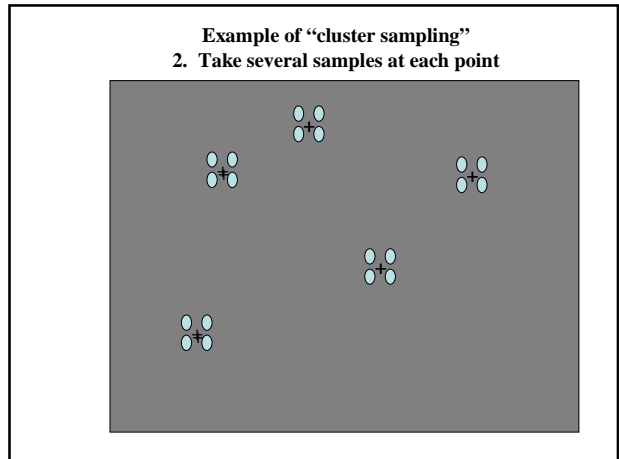
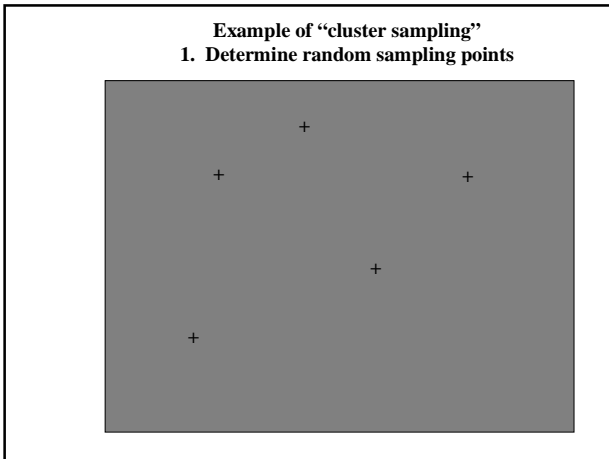
**Estimate variation between sample units through pilot study**  
(or informed guess)

From this, predict

*either* the precision that will be obtained  
from a given sample size

*or* the sample size needed to attain  
a given level of precision

	Survey time per square	Travel time per square	Total time per square	Number covered in 300 hours
1x1 km	1 hr	?	?	<del><math>300 \times 300 = 90\ 000 \text{ km}^2</math></del>
2x2 km	4 hr	?	?	<del><math>75 \times 300 = 22\ 500 \text{ km}^2</math></del>
1x1 km	1 hr	2 hr	3 hr	100 (= 100 km <sup>2</sup> )
2x2 km	4 hr	2 hr	6 hr	50 (= 200 km <sup>2</sup> )



**Sampling effort:**  
the proportion of the units actually sampled out of the total

**How to distribute sampling effort between the strata**

Is the between-sample variation the same in all strata?

**Yes:** Sample all strata with equal intensity

**No:** Sample more intensively in the strata that are more variable  
 (Or those with the higher mean numbers)

