Biodiversity

- Define species, habitat & biodiversity.
- Sampling methods for animals & plants.
- Measuring biodiversity.

A Species

- One type of organism.
- Individuals can interbreed to produce fertile offspring.

A Habitat

- The place where individuals of a species live.

- Each habitat has a specific set of conditions.
  - Eg. Dark, damp, cold, undisturbed
    - A Scottish woodland floor.

Biodiversity

- The variety of life.
  - The range of different species of organism.
  - The range of genes they contain.
    - Even within a single species.
  - The range of ecosystems they are part of.
    - There may be many different habitats within a small area.

Introduction

- UK Oak trees support 284 different species of insect.
- How do we know this?
- Someone has devised methods of catching & studying them all.

Animals or Plants

- Animals are more difficult to sample than plants.
  - Plants don’t often run off.

- The techniques used are therefore different.

Sampling Animals

- This involves using nets or traps in order to catch the animals as they go about their normal activities.
  - See sheet for examples.

Sampling Plants

- Two main types of sampling:
  - Random sampling
  - Systematic sampling

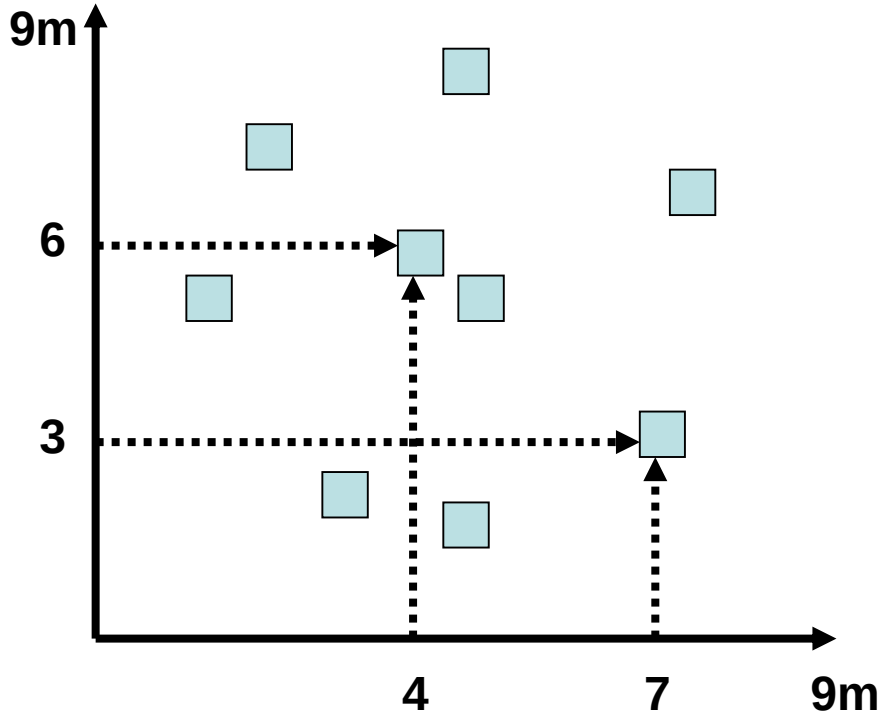
Random Sampling

- When we are only interested in finding out the types & abundance of plants in an area.

- Difficult to look at **every** plant in an area.
  - So we take random samples of the plot

Grid Method

- Make a pair of axes with a tape measure.
- Use random numbers to generate sets of coordinates.
- Visit each site and study the plants in that area.
- Continue until enough samples have been made.



73 = (7,3)

46 = (4,6)

Etc…

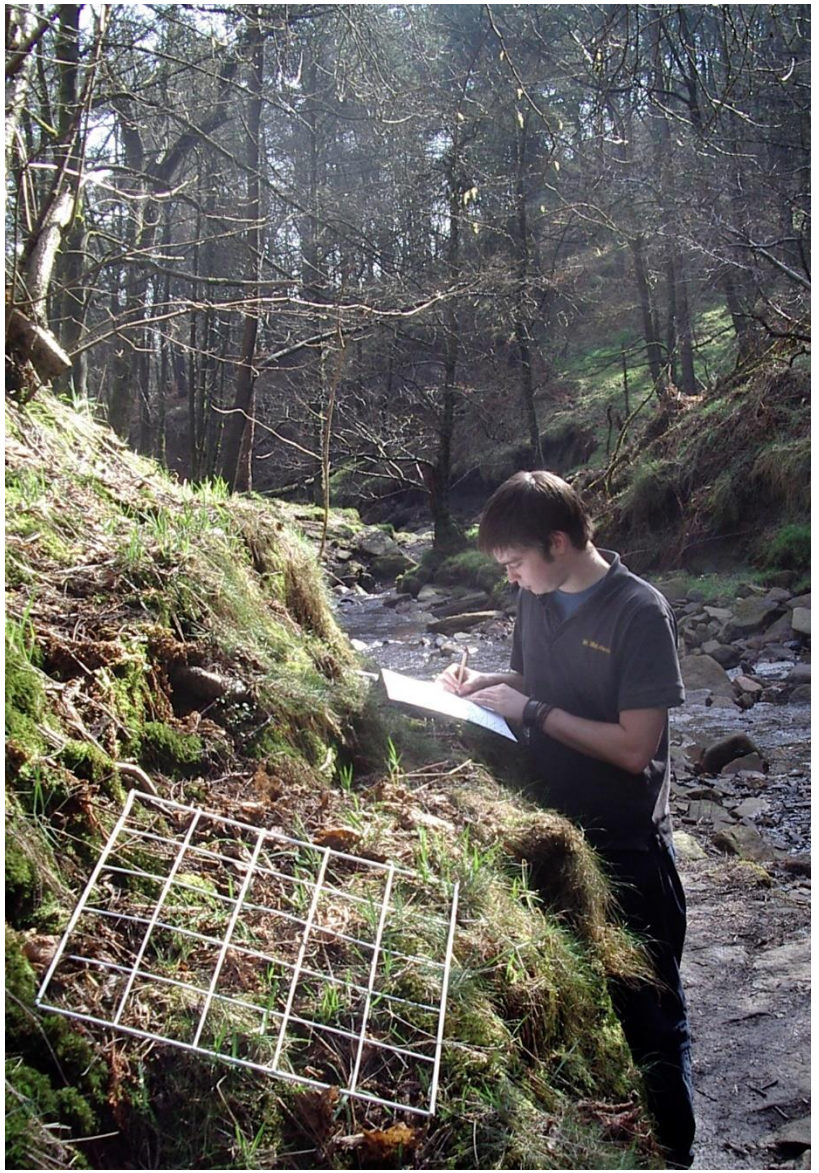
How do you know which plants to look at?

- Use a quadrat.

- There are 2 types:
  - Frame quadrat.
  - Point quadrat.

Frame Quadrat

- A square frame that defines the area of study.
  - Sometimes subdivided into smaller squares.
  - Available in a variety of sizes.



Point Quadrat

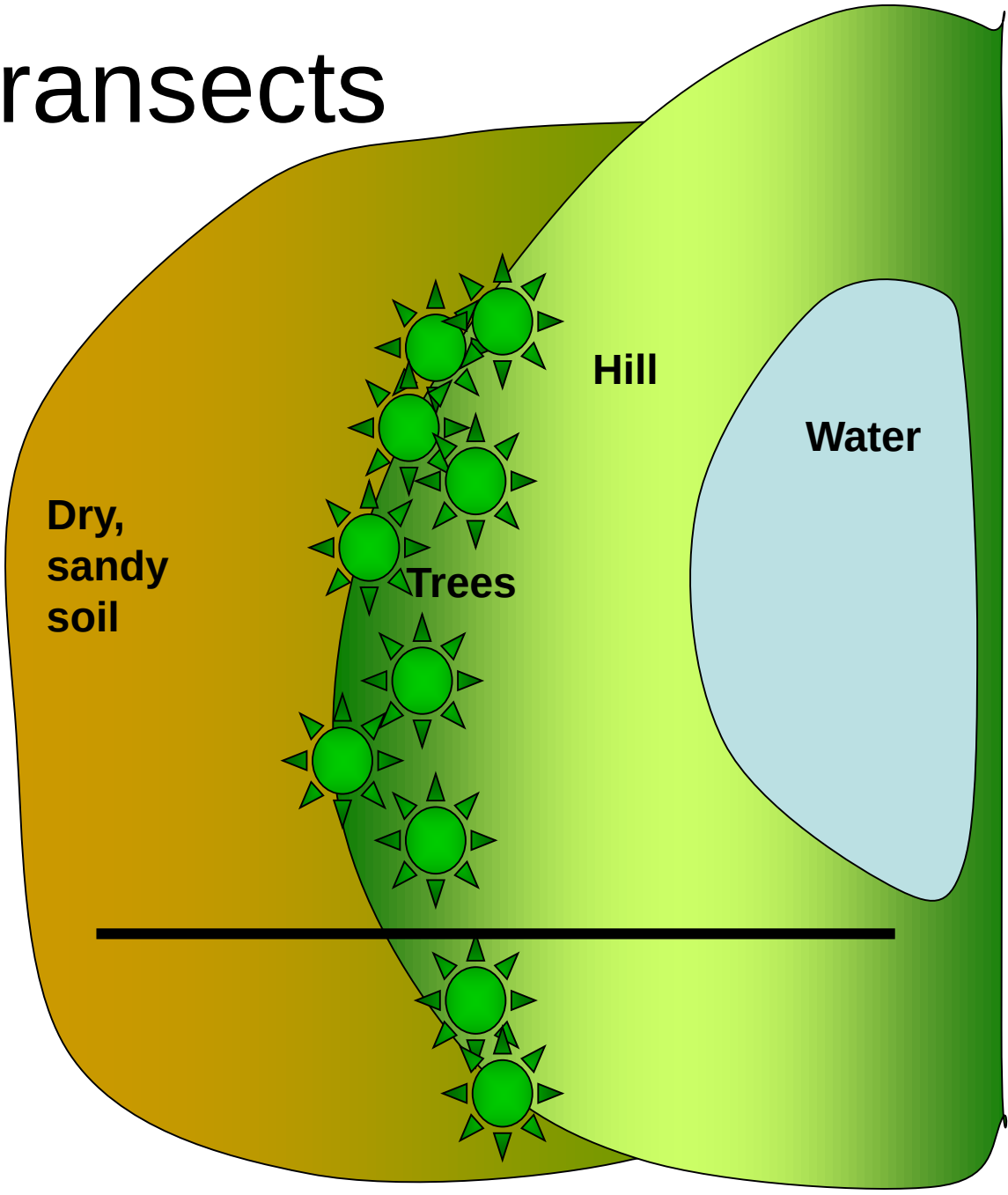
- A horizontal bar through which pins are pushed until they touch the ground.
- Any plant that the pins touch on their way down is counted.

Systematic Sampling

- When we are looking for a pattern of distribution of a plant that may be caused by a change in abiotic conditions.
  - Eg. Looking at how the abundance of a species varies with soil type or light intensity.
  - We use transects to do this.

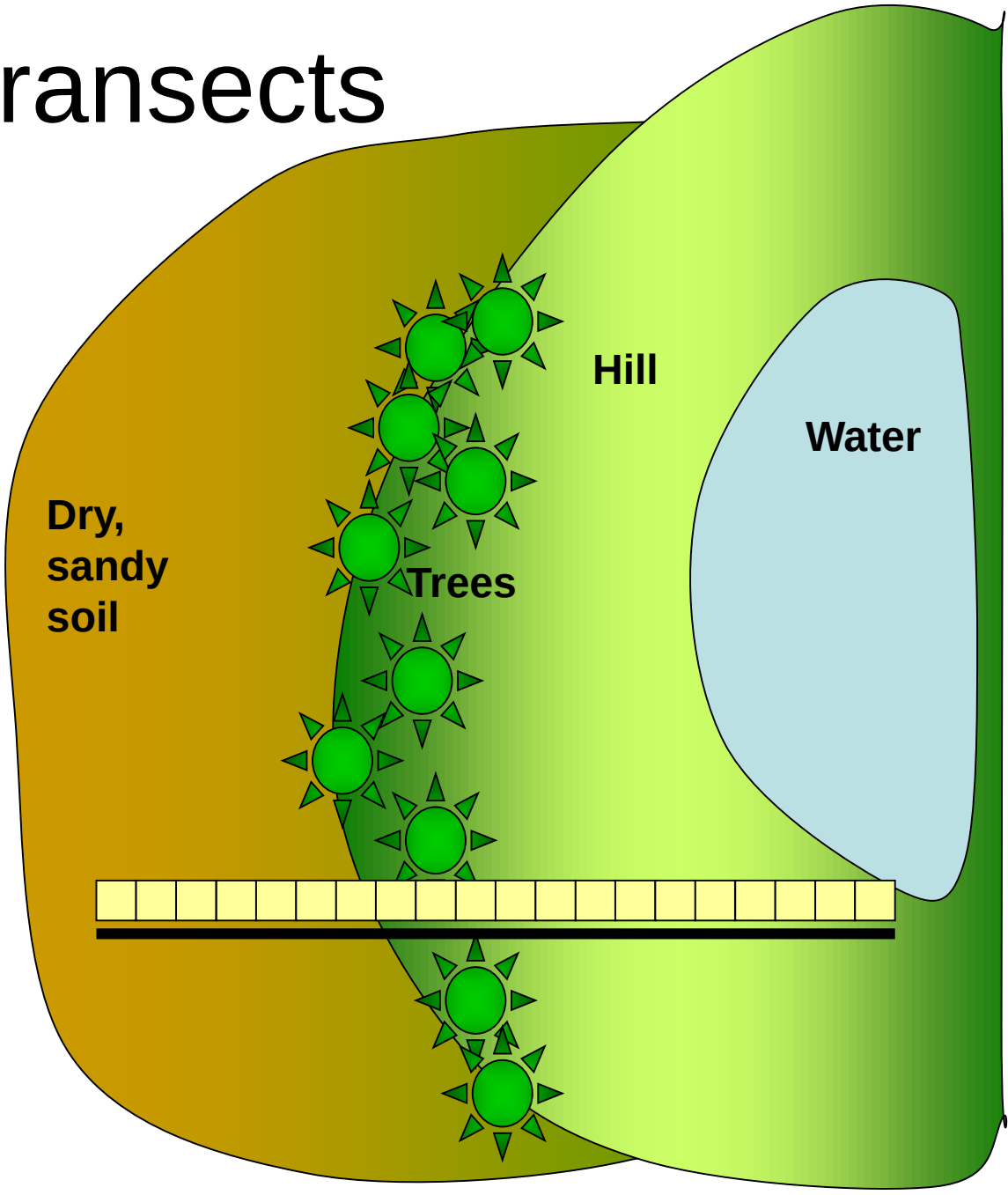
Transects

- Line Transect:
  - A line (often string) marking the area to sample.



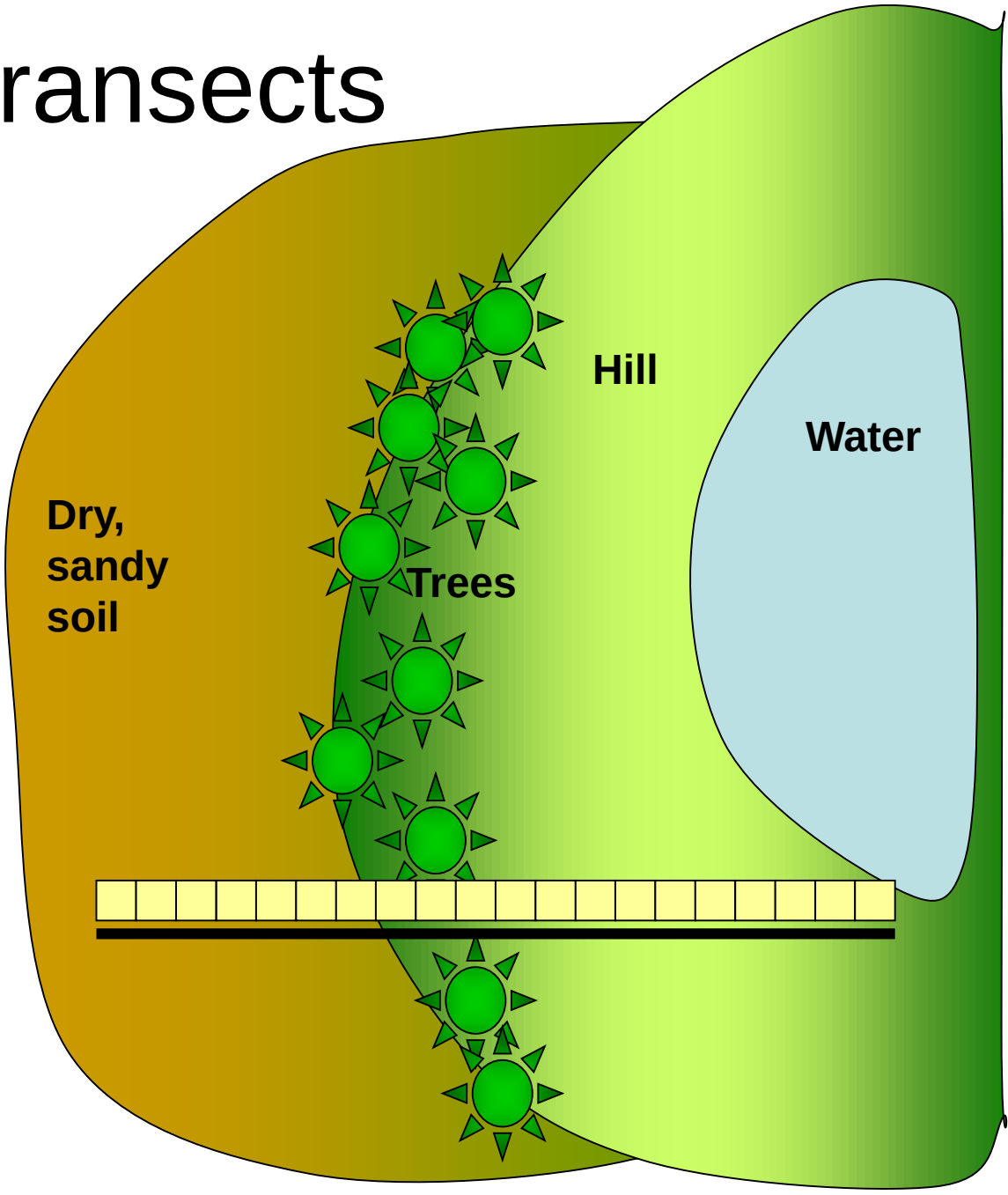
Transects

- Belt Transect:
  - A series of quadrats placed along the transect.
  - Plants within the quadrats can be counted.



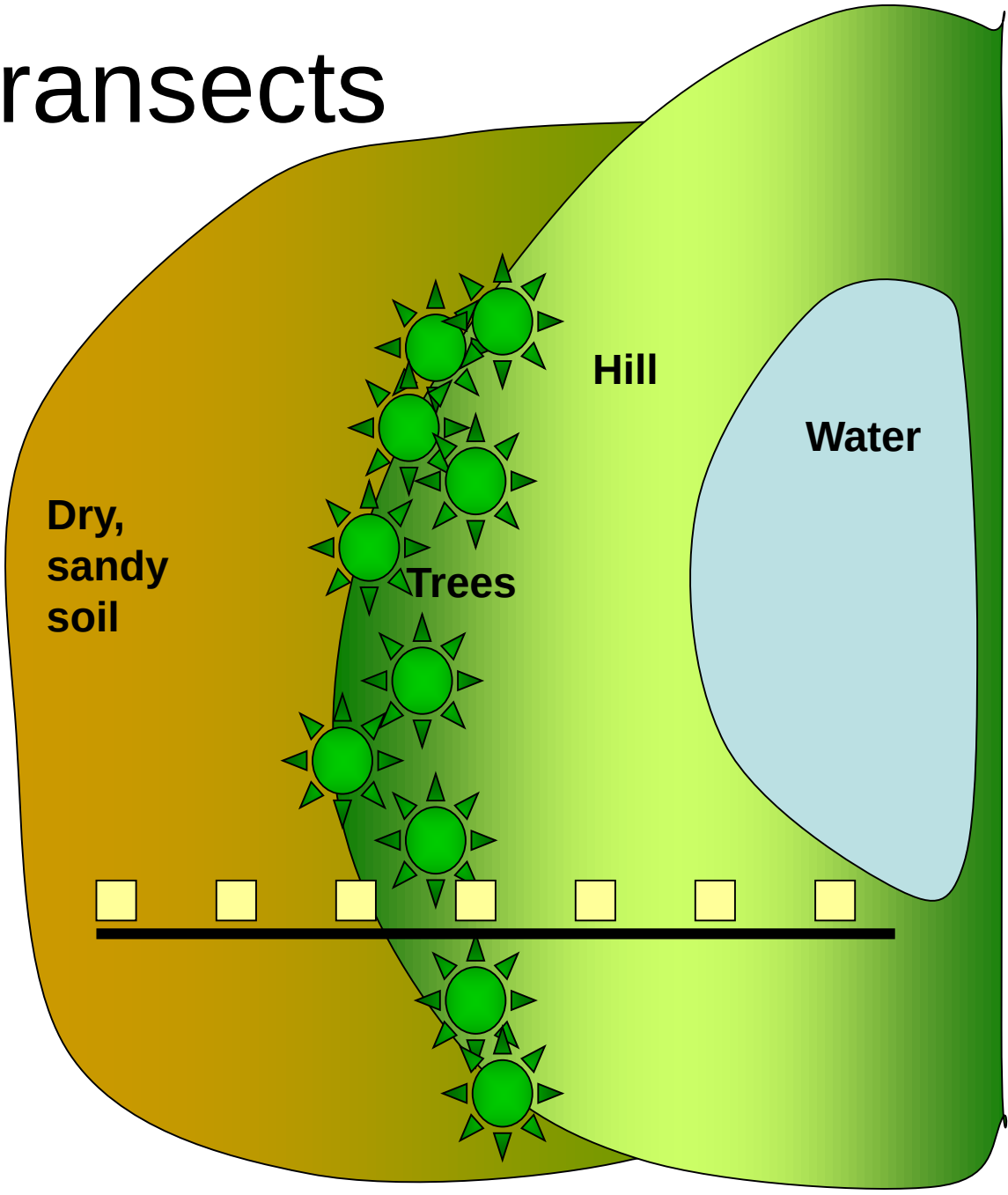
Transects

- Continuous
  Belt Transects can be used where the length of the transect is small.



Transects

- Interrupted
  Belt Transects can be used where the length of the transect is large.



How can we count the plants in our quadrat?

- Density
  - Count the number of individual plants per unit area.
  - This can be difficult and labour intensive.

- Frequency
  - A measure of the presence/absence of a species at a sampling point.
  - Requires a large number of sampling points.

How can we count the plants in our quadrat?

- Percentage Cover
  - The percentage of the ground area covered by a species from a bird's eye view.
  - Overcomes the need for counting individuals.
  - Total percentage is often >100 due to overlapping.

- Biomass
  - A measure of above-ground dry weight.
  - A destructive measure.
    - Plants need to be harvested & dried.

How can we count the plants in our quadrat?

- Abundance Scales
  - Estimating abundance by giving each species a 5 point score.
    - DAFOR Scale
      - Dominant
      - Abundant
      - Frequent
      - Occasional
      - Rare
    - The numerical Braun-Blanquet scale
      - 5 = >75%, 4 = 50-75%, 3 = 25-50%, 2 = 5-25%, 1 = 0-5%.
  - Very subjective.

Measuring Biodiversity

- Need to know:
  - Species Richness
    - The number of different species found in a habitat.
    - Can be measured qualitatively
      - Walk round and record the different species found.
  - Species Evenness
    - The abundance of individuals of each species.
    - Needs to be measured quantitatively
      - Count the number of individuals of each species.
      - Often done by taking samples.

Estimating Species Evenness

- Plants are easy – just count them.

- Animals are more difficult:
  - Large animals (foxes, rabbits):
    - Just observe & count them.
  - Small animals:
    - Mark, Release & Recapture.

Estimating the size of an animal population

- The Mark-Release-Recapture technique:
  - A sample of a species is captured & marked (S_1).
  - This sample is replaced & allowed to mix.
  - Another sample is captured (S_2).
  - The number of marked individuals in the second sample is called R.

  - The total number of individuals in the population (Lincoln Index) can be estimated as:

$$\text{Total population} = \frac{S_1 \times S_2}{R}$$

Simpson's Diversity Index

- Consider two fields:
  - A football pitch and a meadow

Simpson's Diversity Index

- Takes into account both species richness and species evenness.

$$D = 1-[\Sigma(n/N)^2]$$

Where: D is Diversity Index

n is number of individuals of a particular species

N is total number of all individuals of all species

Example

Species	Football pitch			Meadow		
	n	n/N	$(n/N)^2$	n	n/N	$(n/N)^2$
Fescue grass	95	0.950	0.9025	38	0.380	0.1444
Cocksfoot grass	1	0.010	0.0001	16	0.160	0.0256
Buttercup	0.5	0.005	0.0000	14	0.140	0.0196
Clover	2	0.020	0.0004	22	0.220	0.0484
Thistle	1	0.010	0.0001	5	0.050	0.0025
Dandelion	0.5	0.005	0.0000	5	0.050	0.0025
Sum	100		0.90	100		0.24
			0.10			0.76

D ranges from 0 - 1

High D = a more diverse habitat.

- More variety of organisms can live there
- A small change in environmental conditions may affect one species but this represents a low proportion of total organisms so effect on habitat is small.
  - **The habitat is stable and can withstand change.**

Low D = a less diverse habitat.

- Fewer variety of organisms can live there
- A small change in environmental conditions may still affect just one species but this may represent a large proportion of total organisms so effect on habitat may be large
  - **The habitat is unstable and cannot withstand change.**

Genetic Biodiversity

- All members of a species share the same genes.
- However, there is still variation between individuals.

- The variation comes from the different versions (alleles) of the genes.
- The more varied the alleles present in a population, the more diverse the population.
- The genetic biodiversity is often referred to as the gene pool.

Genetic Biodiversity

- Species with greater genetic biodiversity are more likely to be able to adapt to a changing environment

Factors affecting genetic biodiversity

- Mutations creating new alleles.
- Interbreeding between populations creating gene flow between them.
- Selective breeding optimising a particular characteristic or producing a rare breed.
- Captive breeding with only a few individuals to breed from.
- Artificial cloning.
- Natural selection.
- Genetic bottlenecks.
- The founder effect.
- Genetic drift.

Measuring genetic biodiversity

- By measuring polymorphism we can estimate genetic biodiversity.

- Polymorphism:
  - A gene for which there are two or more different alleles.
  - Most genes are monomorphic
    - This is why all members of a species look roughly the same.

Measuring genetic biodiversity

- We use the proportion of polymorphic genes to assess genetic biodiversity.

$$Proportion\ of\ polymorphic\ gene\ loci = \frac{Number\ of\ polymorphic\ gene\ loci}{Total\ number\ of\ gene\ loci}$$

This is often expressed as a percentage.

Individual Projects

- Produce
  - A large poster
  - A factsheet
  - An information leaflet
  - TV report with images
  - Radio programme
  - TV/Radio drama series
- To show what affects biodiversity and why & how biodiversity should be maintained.

Factors affecting biodiversity

- Human influence
  - Deforestation
  - Agriculture
  - Climate change
  - Land management

Reasons for maintaining biodiversity

- Aesthetic reasons
- Economic reasons
- Ecological reasons

Methods for maintaining biodiversity

- In situ conservation
  - Wildlife reserves
  - Marine conservation zones
- Ex situ conservation
  - Botanic gardens
  - Seed banks
  - Captive breeding programmes
- Conservation agreements
  - International Union for the Conservation of Nature
  - The Rio Convention
  - The countryside Stewardship Scheme