### 7.1 EXAMPLES OF ECOSYSTEMS

The previous chapter explained in general terms how to study an ecosystem. We will now take a few sample ecosystems, with some plants and animals you might come across, showing some food chains and the main environmental factors that are important for each habitat.

#### Fieldwork

1. Construct a map of the pond.
2. Collect and identify the plants and animals present.
3. Estimate the numbers of organisms present.
4. Measure the abiotic factors.

#### Map of the Pond

Make a profile map by measuring the drop in ground level from:

(a) one edge of the pond to the other, or (b) from the edge of the pond to a few metres into it, if it is too large or deep to go further.

Try and relate the abiotic factors to the different species of plants and animals along the profile.

#### Collect and Identify Organisms in the Pond

Search for organisms and identify them using a key.

- **Search** under leaves, e.g. lilies often bear snail eggs.
- Put some meat **bait** in jars for scavengers e.g. flatworms.

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**Fig. 1 A simple pond ecosystem**

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**One example of a food chain**

- Heron
- Perch
- Stickleback
- Water flea
- Plankton
- Decomposers and detritus feeders
Mud organisms:
(a) Collect from the upper mud using a tin can.
(b) Collect from the lower mud by sinking a plastic bottle, then pulling it in from the bank.
(Note: Cut off the top and punch small holes in the bottom. Put stones in it to make it heavy.) Back in the lab, add some pond water to the mud samples and after a day examine them for life.

Microorganisms – Incubate water samples and mud samples on nutrient agar for 48 hours at 25°C.

Plankton – Lower a plankton net and tube to the required depth and collect samples. Back in the lab, using small droppers, place some water on a slide and examine it with a microscope. (Note: Adding some vegetable oil to the water will slow the animals down and keep them in view for longer).

I Estimate the numbers of organisms
Sampling methods: direct count, quadrat, transect and capture-recapture technique.

1. DIRECT COUNT (e.g. number of water lilies or plants along the edges)
2. QUADRATS – frequency, percentage cover.
   • Frequency – Record if a species is present (✔) or absent (✗) in the quadrat.
   • Percentage Cover – Estimate the % of the water that the plant is covering in the quadrat.
3. TRANSECTS
   • Profile transect (similar to making a profile map)
     1. Place the rope from 3m outside the pond edge to a few metres into the pond.
     2. Record the plants whose leaves touch or cross the line, either above or below it.
     3. Using plankton nets and tubes, collect water samples from different depths and identify animals present.
     4. Measure the environmental conditions at different depths too, and see if there is a correlation with the animals found.
4. CAPTURE-RECAPTURE METHOD
   Suitable for estimating populations (e.g. snails and fish).

I Measure the Abiotic Factors of the Pond
1. Aspect – Compass
2. Temperature – Thermometer
3. Light intensity – Light meter compare at different depths and times of year
4. pH – pH paper

I Influence of Abiotic Factors in the Pond

Daily variations
• Oxygen levels vary. At night, plants have no light for photosynthesis so they stop producing oxygen. All pond organisms continue to use oxygen for respiration, so oxygen levels will fall very low. During the day more oxygen is released by photosynthesis.
• The temperature is higher during the day than at night.

Seasonal variations
• In summer, there is more light and heat, so plants grow faster, and animals will be more active. Also, some ponds will become much shallower, or even dry up, as water evaporates in the heat.

I Adaptations to the Pond Ecosystem
A Plants
Plants are important in ponds, as they produce oxygen, are a food source for animals and provide good hiding places from predators.

1. Rooted plants with floating leaves (e.g. water-lily)
   Roots anchor the plant at the bottom of the pond. The leaves have air spaces, so they can float to obtain maximum light for photosynthesis.

2. Floating plants (e.g. duckweed)
   Small, circular leaves float on the surface of the water, and short roots hang down. These help to balance the plant, and collect minerals from the water.

3. Submerged plants (e.g. bladderwort)
   There are no roots, but horizontal stems with many small leaves, which absorb water and minerals.

B. Animals
Pond skater
• A small animal which walks on a surface film of water.
• Four long legs angled away from the body, to spread its weight.
• A carnivore, it feeds on other animals on or near the water surface.

Pond snail
• Found on the surface of leaves or stones, where it feeds on algae.
• Produces slime to help it move easily.
• Comes to the pond surface to take air inside its shell, and then use this to breathe underwater.

Midge larva
• Lives in mud tubes at the bottom of pond.
• Feeds on detritus in the mud.
• Moves its body to create water currents and so increase absorption of oxygen.
Fig. 2 Grazing food web in a pond

- **Producers**
  - Phytoplankton (small plants)
  - Elodea
  - Algae

- **Herbivores**
  - Animal plankton (amoeba)
  - Waterflea (filter feeder)
  - Mite
  - Coppod
  - Flatworm
  - Water bug
  - Insect larva
  - Newt

- **Carnivores**
  - Frog (e.g. mallard)
  - Fish (e.g. stickleback)
  - Bird (e.g. heron)

Fig. 3 Detritus food web in a pond

- **Detritus (Dead, decaying, matter)**
  - Water boatman
  - Pond skater
  - Insect larva
  - Midge larva
  - Whirligig beetle
  - Hoverfly larva
  - Water louse
  - Great silver beetle

- **Carnivores**
  - Frog (e.g. mallard)
  - Fish (e.g. stickleback)
  - Bird (e.g. mallard)
A. Woodland

A woodland is an area of land where the dominant plants are trees. They can be deciduous (broad-leaved) or conifers (needle-like leaves).

We can divide the part of a woodland that is above ground into five layers: canopy (tree), shrub, field, ground and leaf litter.

The larger plants shade those under them, and the light levels have a big influence on what plants grow where (as does the soil). This in turn determines which animals can find niches for themselves in the various microhabitats within the woodland layers. A wood is really two interrelated ecosystems: woodland above and soil below.

B. Hedgerow

The patchwork landscape of fields surrounded by high hedgerows is a traditional and familiar feature of Ireland’s countryside.

Hedgerows were originally intended as fences and to mark property and town land boundaries, and were planted with hawthorn mainly. Other plants then invaded and colonised the newly created habitat.

Ash is probably the most common hedgerow tree, with elm saplings here and there.

A hedgerow is like a woodland in miniature – the trees in it are not so tall or numerous, and it is only 3–4 m thick so the shading effect is not as severe. The edge of a wood and a hedgerow are very similar in conditions, and in the plants and animals that live there.

(Note: If you are going to study hedgerows, always ask the landowner beforehand).
Fieldwork

1. Construct a map of the woodland or hedgerow.
2. Collect and identify the plants and animals present.
3. Estimate the numbers of organisms present.
4. Measure the abiotic factors.

Construct a map of the Woodland

Make a profile map outlining the layers that occur in the ecosystem. You will try and relate environmental factors to the different species of plants and animals found in these layers.

Collect and Identify the plants and animals in the Woodland

Search for organisms and identify them using a key.
- Direct search above ground and in soil samples, using a pooter.
- Flypaper on bark.
- Beating tray.
- Tullgren funnel for small animals in soil or leaf litter.
- Agar to grow microorganisms. Place the sample on nutrient agar and incubate at 25°C for 3 days.
- Pitfall traps.
- Mammal traps.
- Nets

Estimating the numbers of Organisms in the Woodland

Use any of these four sampling techniques: direct count, quadrats, transects and capture-recapture method.

1. DIRECT COUNT
   (e.g. number of trees and shrubs)

2. QUADRATS: frequency, percentage cover
   - Frequency – If a species is present (✓) or absent (✗) in the quadrat.
   - Percentage Cover – the % of the ground that the organism is covering in the quadrat.

3. TRANSECTS
   Profile transect
   To be used for a hedgerow and ditch, to show the land rising/falling.
   Belt transect (with quadrats).

4. CAPTURE-RECAPTURE METHOD
   Suitable for woodlice, beetles, spiders, or snails.

Measuring the Abiotic Factors of the Woodland

1. Slope – Construct profile map. Note the direction the habitat faces and the prevailing wind direction. Use a compass and weather vane.
2. pH of soil – pH paper or meter.
3. Temperature – Thermometer (compare shade/full sun; spring/summer; air/soil).
4. Light intensity – Light meter (compare shade/full sun; spring/summer).
5. Air current – Anemometer.
6. Humidity – Hygrometer (compare shade/full sun; spring/summer).
7. Composition of soil – mix a sample in water and let it settle.
8. % Air in soil – Mix the soil and water to allow the air to bubble out.
9. % Water in soil – Evaporate the water in an oven.
10. % Humus in soil – Burn off the humus in a crucible.

NOTE: Light, temperature and humidity readings should be taken at different heights, both in clearings and inside the canopy of trees and among grass. Soil samples from different areas of the ecosystem should be compared.

Influence of Abiotic Factors in the Woodland

How do conditions vary between different regions of the woodland? Conditions will depend on the size of the wood, the type of soil present and how closely the trees are growing.

Daily Variations
- The amount of light, temperature, and humidity varies in the different layers

Seasonal Variations
- The amount of light varies as leaves in the canopy layer grow in spring and fall off in autumn.
- The day length varies throughout the year – this is important because it triggers flowering in many plants and behaviour patterns in some animals (e.g. mating or hibernation).

pH of soil
How do conditions vary with soil type? Some plants prefer acidic soil (e.g. oak, gorse, birch and holly). Others prefer neutral or alkaline soils (e.g. hawthorn, ash, blackthorn, elder).
Adaptations to the Woodland ecosystem

A. Plants
Many plants found in the field layer have adaptations for living in the shade.

Ivy
- Large leaves that can use even a small amount of light.
- Climbs up taller plants and so gets enough light.

Bluebell
- Survives as a bulb under the ground and uses its food store to grow and flower early in spring before the leaves on the main trees come out and cut off the light supply.
B. Animals

**Butterflies and Moths**
- Plenty of flowers for the adults to sip nectar.
- The young larvae (caterpillars) munch on the leaves.
- Often camouflaged, or boldly coloured to warn of poisons if eaten.

**Long eared owl**
- Forward-facing eyes so it can accurately see prey in 3D and judge distances.
- Sharp talons (claws) to catch prey.
- Hunts at night when small mammals (its prey) are most active.

**Squirrel**
- Sharp teeth to gnaw through nuts.
- Claws help it to climb up trees.
- Hibernates during the coldest part of the winter.

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**7.3 ROCKY SHORE ECOSYSTEM**

The rocky shore can be divided into four zones, based on the tides:
- **Splash zone** – never covered by the tide.
- **Upper shore** – does not get covered in seawater, except when there are very high tides.
- **Middle shore** – is covered and uncovered by water twice each day.
- **Lower shore** – is always covered by water, except when there are very low tides.
Within these zones there are many different types of habitat, e.g. rock pools, cracks and crevices in rocks, areas under boulders, etc. Organisms must be able to cope with being exposed to the air when the tide is out, and pounded by the waves when the tide is in.

Fieldwork

**NOTE:** It is important to check the tides before a visit, so that you can get access to all zones.

1. Construct a map of the rocky shore.
2. Collect and identify the plants and animals present.
3. Estimate the numbers of those plants and animals.
4. Measure the abiotic factors.

**Construct a Map of Rocky Shore**

Make a profile map, by measuring the drop in ground level from 3 m above high tide mark down to the low tide mark. Every time you collect or record information, maker sure you also note where along the profile you are positioned.

You will then need to try and relate abiotic factors to the different species of plants and animals found along the profile.

**Collect and Identify the Plants and Animals of the Rocky Shore**

Search for organisms and identify them using a key.

- The only plants found on rocky shores are seaweeds – green, brown and red varieties. Record in which zone they live.
- Many of the animals attach themselves to rocks to cope with the waves and so they can be easily found and studied.
- Search under seaweeds and stones.
- Use a trowel to find animals in the sand.
- Use nets for swimming animals (e.g. fish and shrimps).

**Estimate the numbers of Organisms in the Rocky Shore**

Use any of these four sampling techniques: direct count, quadrats, transects, capture-recapture method.

1. **DIRECT COUNT** (e.g. large animals like birds)
2. **QUADRATS**
   - Frequency – if a species is present (✔) or absent (✗) in the quadrat.
   - Percentage Cover – the % of the ground that the organism is covering in the quadrat.

3. **TRANSECTS**
   **Profile (Belt) transect**
   - Place a rope from the top of the rocky shore down to the low tide mark.
   - Place quadrats all along the line, recording frequency and % cover for both the algae and the animals, as well as counting the number of animals of each type (if possible).
   - Mark each quadrat by a number on your profile map for later reference.

4. **CAPTURE-RECAPTURE METHOD**
   - Suitable for estimating populations (e.g. shell animals such as limpets, snails and barnacles).
   - You don’t actually have to collect the shell animals that are stuck to rocks; just mark them and if possible return in a few days to see if they have moved.

**Measure the Abiotic Factors of the Rocky Shore**

1. **Slope** – Construct a profile map. Note the direction the habitat faces and the prevailing wind direction. Use a compass and weather vane.
2. **pH of water** – pH paper or meter (compare rock pool/sea).
3. **Temperature** – Thermometer (compare water/sand; spring/summer; rock pool/sea).
4. **Light intensity** – Light meter (compare air/under water; spring/summer; rock pool/sea).
5. **Air current** – Anemometer.
6. **Humidity** – Hygrometer.
8. **Salinity** (Salt concentration) – Conductivity meter (compare spring/summer; rock pool/sea; where a stream may join the sea).
9. **Degree of exposure** – Record the exposure of intertidal organisms to air and wave action in the different zones. Measure how long a section is covered (and uncovered) by each tide cycle. Evaporation rate can be measured using a test tube with filter paper and water – weigh every hour.
10. **Oxygen concentration** – Oxygen meter (compare spring/summer; rock pool/sea).
Influence of Abiotic Factors in the Rocky Shore

How do conditions vary between the different regions of the shore? Because of the tides, conditions vary significantly.

**Daily variations**
- The amount of water covering an organism changes as the tide goes in and out (twice each day). The temperature varies due to the tides. Exposed to the air and sun, organisms will heat up or cool down a lot compared to when they are covered.
- The amount of light that reaches an organism varies. When the tide is in, less light can penetrate the water.

Adaptations to the Rocky Shore

Animals and plants on the rocky shore must be able to cope with the following difficulties.
- Drying out; there are large changes in temperature when they are left uncovered.
- Being moved around and swept off the rocks by the power of the waves.
- Getting enough oxygen from the water to survive.
- Plants under the water must trap enough light for photosynthesis.

Animals and plants have a particular region of the shore where they can survive best, and where they are abundant.

A. Plants

The seaweeds (algae) attach themselves to rocks with a holdfast. They have no proper roots, stems or leaves, but they have tissues that can carry out photosynthesis.

**Green seaweeds** (e.g. sea lettuce)
- Found mainly on the upper shore.
- Usually small and can withstand drying out when uncovered.

**Brown seaweeds** (e.g. bladder wrack)
- Found on the middle and lower shore.
- They are brown because they have an extra pigment that helps them to trap light when they are covered with water.
- Some have air bladders so that they will float closer to the surface of the water.
- Some have strong, leathery stems that can withstand being pounded by the waves.

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**Fig. 10**

**Muddy or Sandy Seashore**

- Bivalves (e.g. razorshells, cockles)
- Curlew
- Godwit
- Bristle worm (ragworm)
- Particle feeders, filter feeders
- Detritus
- Oystercatcher
- Knot
- Snail
- Crab
- Lugworm
- Worm casts
- Turnstone

**Fig. 9 Some animals of a sandy (or muddy) seashore**
Red seaweeds (e.g. Corallina)
- Found in rock pools and on the lower shore.
- They are red because they have an extra pigment which helps them to trap light when they are covered with water, which is most of the time.

B. Animals
Many of them are fixed to the rock, or move very slowly, so they are easy to record. Their position on the shore will depend on several factors (how they feed, how they prevent themselves drying out or being damaged by waves).

Periwinkle
- Lives in rock crevices on the upper and middle shore.
- Clamps itself to rock when tide is out to reduce water loss.
- Shell protects it from predators.
- Feeds on algae growing on rock surfaces.

Barnacle
- Firmly attaches to rock surface in the middle shore.
- When the tide is out, the shell closes to prevent drying out and attack from predators.
- When the tide is in, six pairs of legs are exposed, and these filter food particles from the water.

Starfish
- Found on the lower shore, sheltering under weeds or in crevices when the tide is out.
- A carnivore which grips its prey with ‘tube feet’.
- Can grow new arms if damaged by waves.

Fig. 11 Periwinkles, barnacles and starfish
1. Use one or more of the terms listed below to describe each of the following features of a freshwater lake: population, ecosystem, habitat, abiotic factor, community.
(a) The whole lake
(b) All the frogs in the lake
(c) The flow of water through the lake
(d) All the plants and animals present
(e) The mud of the lake
(f) The temperature variations in the lake.

2. The diagram shows part of a food web in a pond.
(a) (i) Name a carnivore shown in this food web.
(ii) How many primary consumers are shown in this web?
(b) A local fishing club removes all of the pike from the pond. Explain what will happen to:
   (i) the number of sticklebacks and
   (ii) the number of frogs.
(c) The fishing club now stocks the pond with many carp. These are fish that eat a lot of plants. Explain the effect this is likely to have on the food web.

3. The drawing shows the shapes of trees grown on their own and inside a wood.
(a) Write down two differences you can see between the tree grown on its own and those growing inside a wood.
(b) Trees inside the wood have to compete with each other for the things which they need to grow. List three things for which the trees compete.
(c) Which abiotic factors are important at field-level and ground-level zones of a woodland?

6. Study the food web, then answer these questions.
(a) Give the names of each trophic (feeding) level (1 to 4) of the food web. Explain why there are rarely more than four or five links in a food chain or web.
(b) Write down four different food chains from the diagram, and construct a pyramid of numbers for each.
(c) Give one example of a predator in the food web, and write down the name of an animal which it preys on.
(d) The food web does not include the leaves of the woodland plants. Write down a food chain which might lead from the leaves.
(e) Construct a simple carbon cycle based on the leaves of the plants.
(f) Select three organisms in the food web which would be affected if the flowers of the plants were not pollinated and fertilised. State a reason for each of your choices.
(g) A chemical substance, poisonous to animals but not to plants, leaks onto the ground in the wood. Explain how this might affect the food web.
(h) What might happen to the wood eventually if all the foxes were destroyed? Explain your answer.

7. (a) Describe how energy enters, passes through and is lost from a woodland ecosystem.
(b) Why are woodland ecosystems being lost?
(c) What measures can be taken to conserve them?

8. (a) Why is a coniferous plantation less environmentally desirable than the same area of mixed woodland?
(b) How would you persuade a landowner to plant deciduous (hardwood) trees?
(c) Suggest ways in which large tracts of forest might influence the climate.

9. The diagram represents part of a food web of a woodland.

(a) From the food web, name:
(i) a primary producer, (ii) a primary consumer, (iii) all the secondary consumers.

(b) From the food web, extract: (i) a simple food chain, (ii) a pyramid of numbers.
(c) Imagine that large numbers of hawks were killed. Predict the short term effect this would have on the numbers of: (i) foxes, (ii) blackbirds, (iii) plants and leaves.

10. Match the animals and plants in Column A below with their correct habitats in Column B:

<table>
<thead>
<tr>
<th>COLUMN A</th>
<th>COLUMN B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lichen</td>
<td>Wood</td>
</tr>
<tr>
<td>Trout</td>
<td>Path</td>
</tr>
<tr>
<td>Hawthorn</td>
<td>Rocky shore</td>
</tr>
<tr>
<td>Groundsel</td>
<td>Pond</td>
</tr>
<tr>
<td>Squirrel</td>
<td>Bog</td>
</tr>
<tr>
<td>Heather</td>
<td>River</td>
</tr>
<tr>
<td>Frog</td>
<td>Hedge</td>
</tr>
<tr>
<td>Crab</td>
<td>Wall</td>
</tr>
</tbody>
</table>

11. *(a) From the table of figures, construct a scale drawing of a profile transect of a rock shore

<table>
<thead>
<tr>
<th>Horizontal (m):</th>
<th>0 2 4 6 8 10 12 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical (m):</td>
<td>.56 .51 .44 .36 .24 .16 .09 .00</td>
</tr>
</tbody>
</table>

(b) Why is the seashore colonised by certain marine organisms but not by many terrestrial organisms?

12. The diagram shows the position of a sewage outflow pipe at a local beach. The whole beach is covered in different types of seaweeds, growing on rocks and in rock pools. The main species of animals are snails, crabs, mussels, barnacles, limpets and fish. The animals live in the rock pools. There is concern that the animals and plants are being affected by the sewage from the pipe. You and a group of friends decide to investigate the situation by collecting some information about the different types of animals and plants.
(a) Describe how you would measure the size of the population of one of the types of animals found in the study area on the beach.
(b) Describe how you would compare the seaweeds growing in the study area on this beach with those growing on a beach where there was no sewage pipe.
(c) Suggest three factors, other than the presence of the sewage pipe, which could affect the types of plants and animals found on the two beaches.

13. Use the key to identify the seashore animals A, B, C, D, E and F.
   1  Divided into segments Go to 2
      Not divided into segments Go to 3
   2  Has large claws Lobster
      No large claws Rag worm
   3  Has a shell Go to 4
      No shell Go to 5
   4  Shell has 2 pieces Mussel
      Shell has 1 piece Dog-whelk
   5  Animal has 5 arms Starfish
      Does not have 5 arms Sea anemone