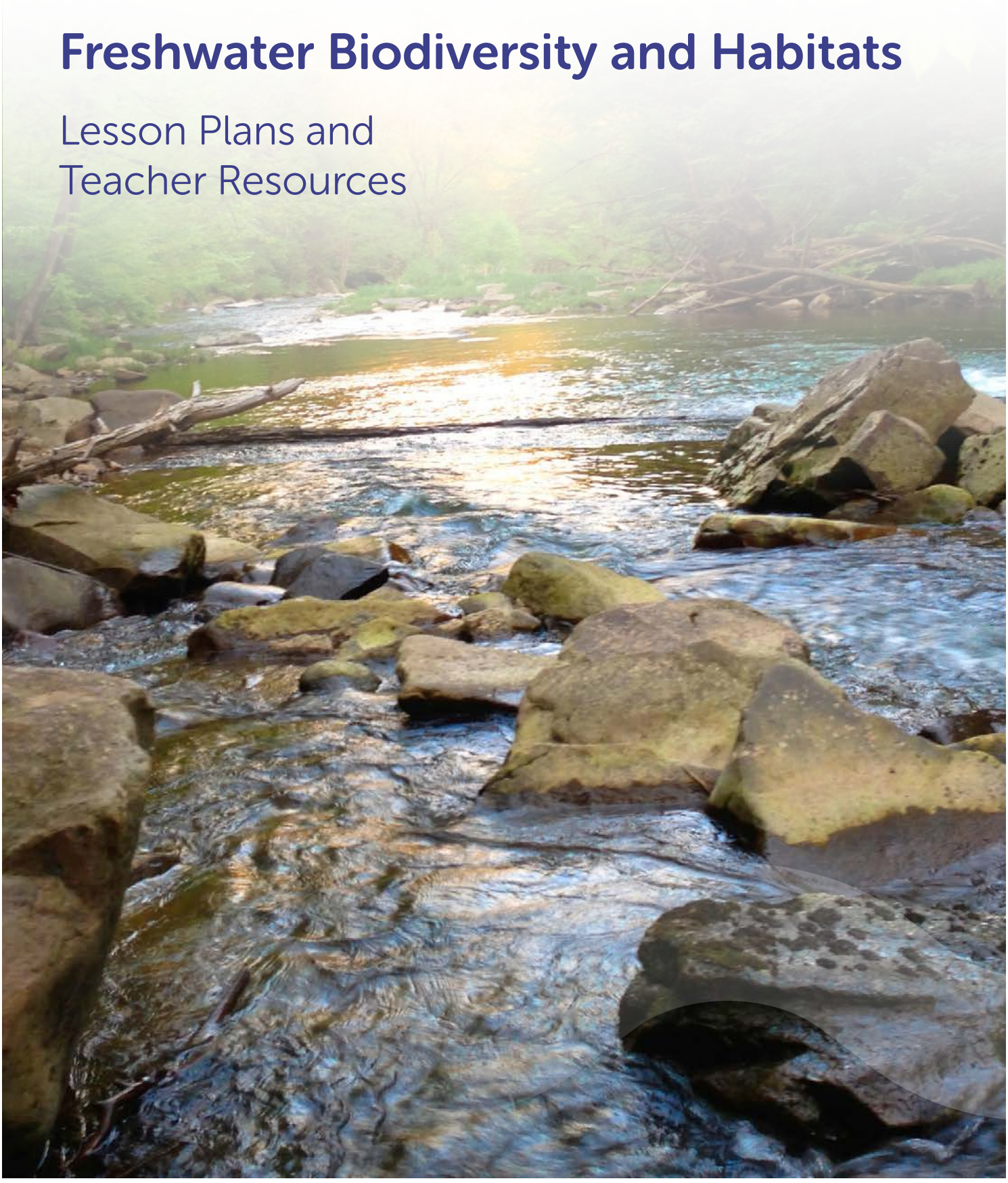
The Water Forum

AN FÓRAM UISCE

Freshwater Biodiversity and Habitats

Lesson Plans and Teacher Resources



Contents

Introduction

This module explores river biodiversity, illustrated by some common animals that live in rivers and the basic food chains that sustain them. Macro-invertebrates that form the base of the food chain have different sensitivity to water pollution. The abundance or absence of pollution sensitive or tolerant species are then used as bio-indicators of water quality. This process is known as the Quality Rating or the Q-system. Students will be introduced to this system and explore the challenges faced by some species such as the Atlantic Salmon. The final lesson will explore the impact of non-native, invasive alien species on local biodiversity.

The content covered will progress learning and capacity for Leaving Cert subjects such as Biology, Agricultural Science and Geography. This module provides a student with an opportunity to develop a range of skills including finding information, researching new topics, learning about citizen science and by extension they will have a greater knowledge and awareness of issues for water management and society.

Module structure

The module consists of 4 lesson plans and supporting materials in the form of PowerPoint presentations and links to further resources. Each lesson begins with an engagement activity, followed by more detailed exploration of the topic, includes student directed activities and a final opportunity to elaborate for further learning. All lessons have an associated student workbook and assessment activity.

Resource needs (internet etc)

Internet access is essential for most of the lessons in this module as online video resources are used. PowerPoint presentations for teachers can be downloaded in advance or accessed online. No prior knowledge of the topic is required.

Learning outcomes

Students will be able to:

1. Identify some of the common animals found in rivers and their connections in a food web and food chain.
2. Name 4 factors that influence river habitats for living things and their importance for biodiversity.
3. Compare and contrast a lowland and upland river.
4. Students will be able to discuss why rivers are important for biodiversity.
5. Distinguish the main groups of freshwater in-vertebrates.
6. Understand that the presence or absence of certain species of river insects indicate the water quality of a stream or river.
7. Know the basics of water quality monitoring using macro-invertebrates.
8. Explain what a bio-indicator species is in relation to water quality.
9. Know that adequate oxygen in water is the critical factor for good water quality.
10. Be introduced to Citizen Science Stream Index (CSSI) and how it can be used to monitor water quality.
11. Hear of the reasons for the decline of salmon species and what can be done to reverse the decline.
12. Understand the significance of non-native species and their impact of these on native habitats and species.

Lesson 1

River Life and Habitats

Introduction & Engagement (10 minutes)

The teacher will introduce river life emphasising the importance of rivers for biodiversity. Slides 3 to 20 engages students with the diversity of life in rivers by identifying the different animals. Macroinvertebrate diversity will be returned to in the next lesson but in the context of their usefulness as bio-indicators.

Exploration – Freshwater Biodiversity and Rivers (45 Minutes)

As well as naming the organisms in **slides 3 to slide 20** (Animated slides) the students will have to decide whether they are herbivores, carnivores or omnivores, vertebrates or invertebrates

Activity 1.1 *Identifying River Animals*

- How many animals can the students identify in their student's workbook?

Slides 14-20 illustrate examples of macro-invertebrates found in rivers. Students will probably not be familiar with these except perhaps mayflies. They will reencounter these in Lesson 2 where their role as bio-indicators of water quality will be explored.

Slide 23-26 explores these representative river organisms in an ecological context: 'what eats what' expressed as food webs. From Junior Cycle Science, students will be familiar with the concepts of trophic levels and energy flow through ecosystems and will be able to apply this knowledge. Terms such as 'producers', herbivores (grazers) carnivores, top carnivores can be applied to the organisms.

Activity 1.2 *Construct a Freshwater Food Chain*

- Construct a Freshwater Food Chain in the student workbook before viewing the animation of the food chain (slides 23 and 24).

Slide 27-33 introduce river habitats. Students can be encouraged to explore the factors that determine river habitats- 3 examples given in Slide 27. Examples of how river habitats change from turbulent headwaters to lowland reaches to the river mouth are shown. Students will be familiar with the idea that a river changes physically from its source to its mouth but less familiar with the accompanying ecological changes.

The importance of rivers as repositories of biodiversity in our highly modified landscapes is emphasized in **Slide 34**. Modifications to rivers for land drainage and flood relief alter rivers and riverbanks, reducing their biodiversity. Students will discuss why rivers are important sources of biodiversity, particularly in intensively farmed and urban areas and why the removal of riverside habitats harms biodiversity. An extreme example is shown in the second last **Slide (36)**

Elaboration

Ask students to have a conversation at home about where their water comes from. Chat about how you can impact on water less. Ask students to complete the workbook Lesson 1 tasks and write-up.

Activity 1.3 *Explore River Habitats*

- Students are asked to answer questions relating to **Slides 28-37** in their workbook.

Students have 7 questions to answer in relation to this topic for which they will be required to apply their ecological knowledge. This task will allow them to make connections to what they learned in Junior Cycle in regard to how ecosystems function.

Activity 1.4 *Class discussion (10-15 minutes)*

- Discuss why landowners remove river-bank vegetation. Discuss why farmers take this action, what the problems are with it and how this practice might be changed?

Assessment Student Workbook Lesson 1

- ✓ Students will have identified river animals by name.
- ✓ Students will have drawn of food chain showing the interconnection of species.
- ✓ Students will answer questions about the different river habitats and list their characteristics.

Additional Resources

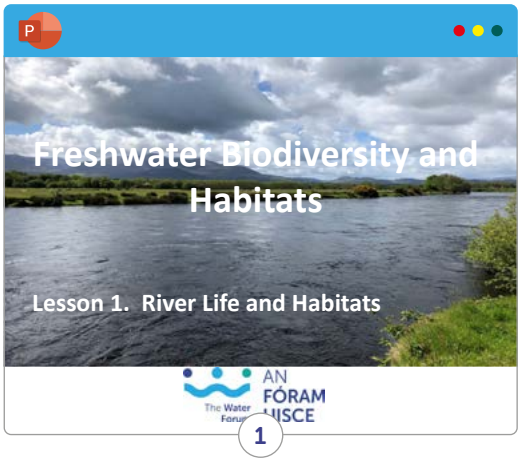
- You tube video of a conversation between the United National Environment Programme Director and Rotary International Director about the Adopt a River programme and the importance of protecting rivers for biodiversity and humans. UNEP Executive Director Inger Andersen speaks with Rotary International President Jennifer Jones (youtube.com).

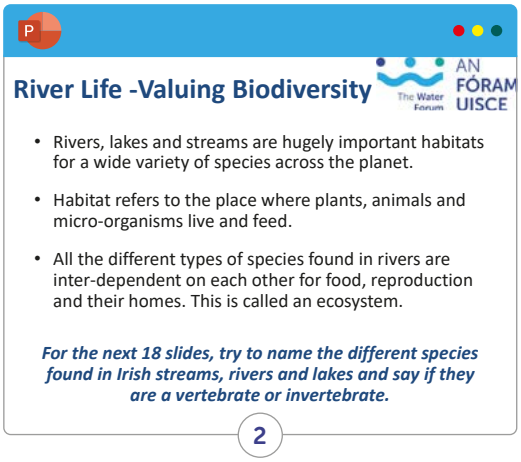
Lesson 1

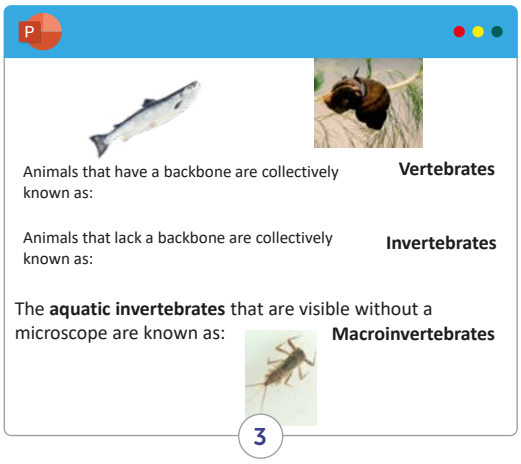
Teacher resource link to presentation

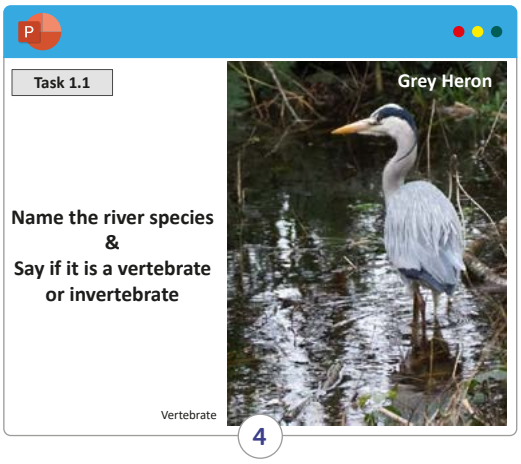
Direct link to the powerpoint
Module title: Freshwater Biodiversity and Habitats
Lesson 1 - River Life and Habitats

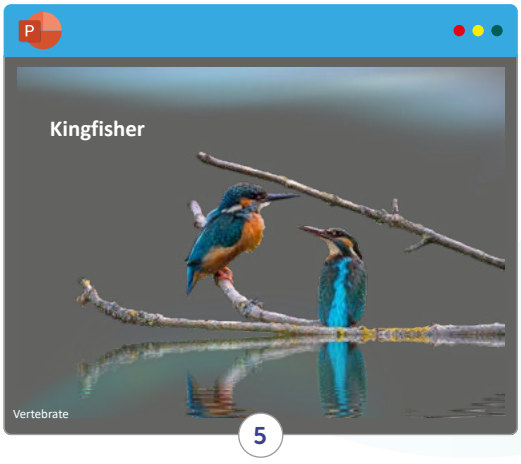
https://thewaterforum.ie/resources-category/education-resources/

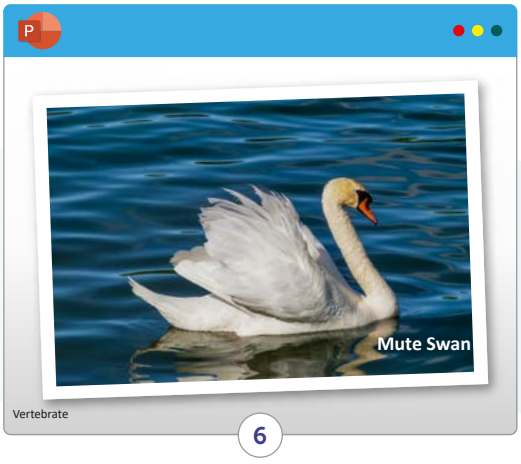


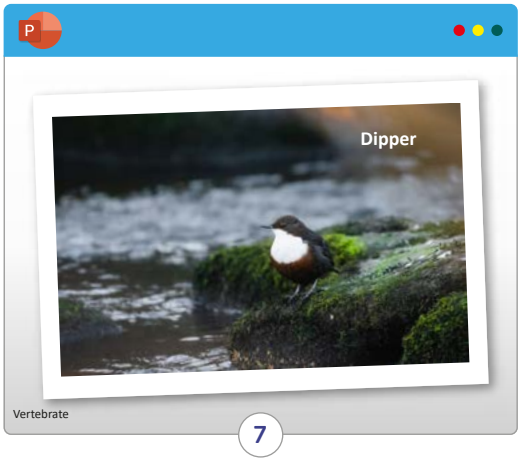


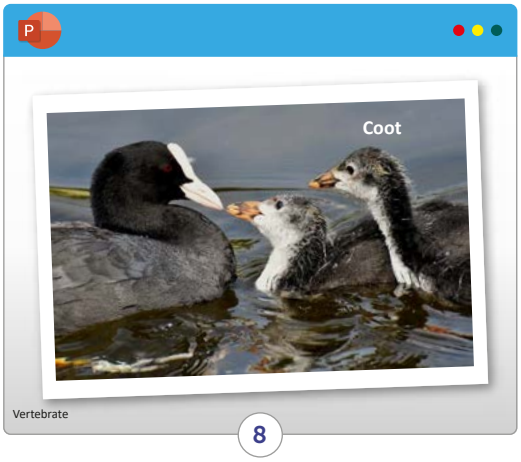


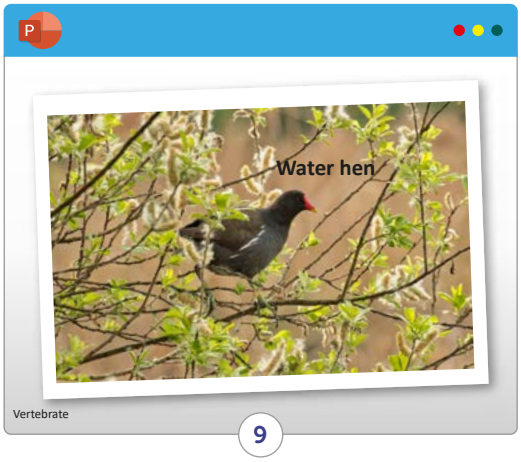


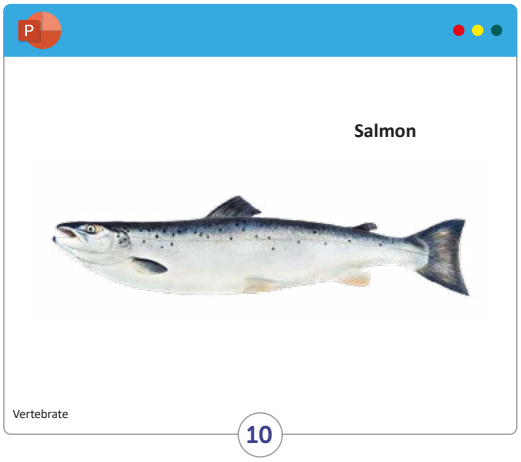


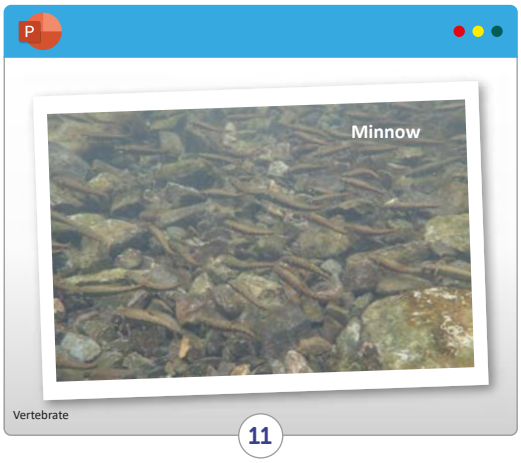


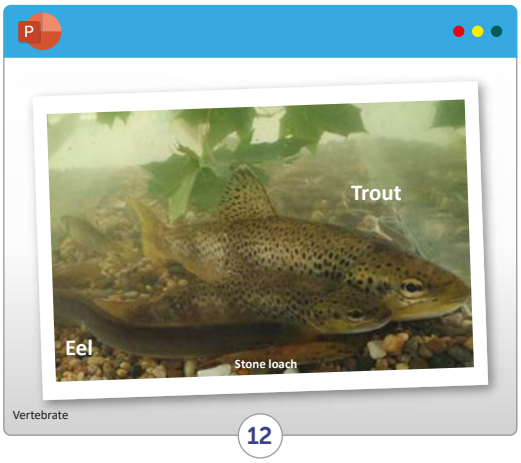

Dipper
Vertebrate
7


Coot
Vertebrate
8

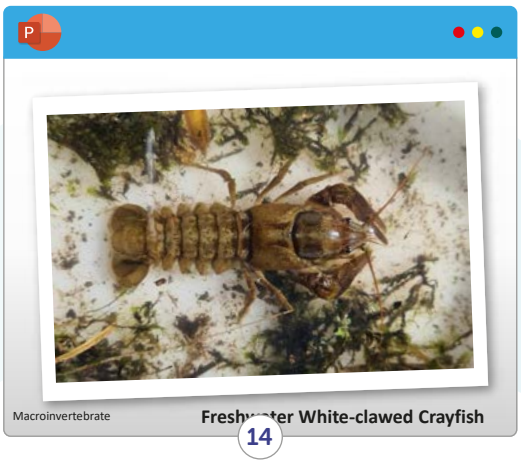

Water hen
Vertebrate
9


Salmon
Vertebrate
10


Minnow
Vertebrate
11


Trout
Eel
Stone loach
Vertebrate
12


Otter
Vertebrate
13


Macroinvertebrate
Freshwater White-clawed Crayfish
14

River Fly

Macroinvertebrate

15

River Fly

Macroinvertebrate

Needs very clean & cold water – Pollution sensitive

16

River Fly

Likes clean, healthy water – Pollution sensitive

17

River Fly

Macroinvertebrate

18

River Fly

Macroinvertebrate

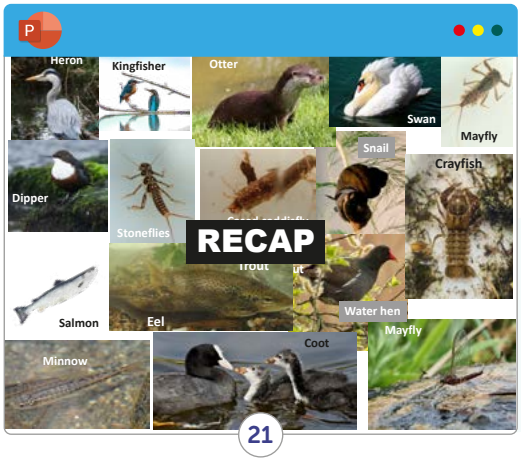
19

River Insects (macroinvertebrates)

Snails | Water louse | Leeches

Pollution Tolerant Species

20



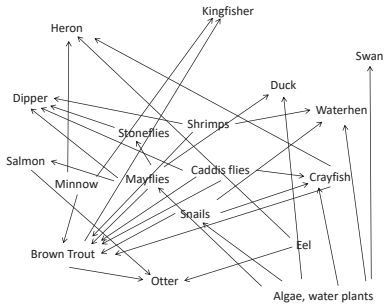
21

What is a Food Web?

Describes the interconnection of feeding relationships among different species in a community

22

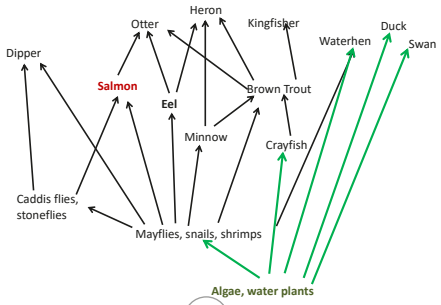
River Food Web



This looks complicated, lets simplify it!

23

Task 1.2 A River Food Chain



24

River Habitats

*A **river habitat** is the environment in which different organisms can survive in and around a river.*

25

River Habitats

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Task 1.3

Different organisms have different living requirements.

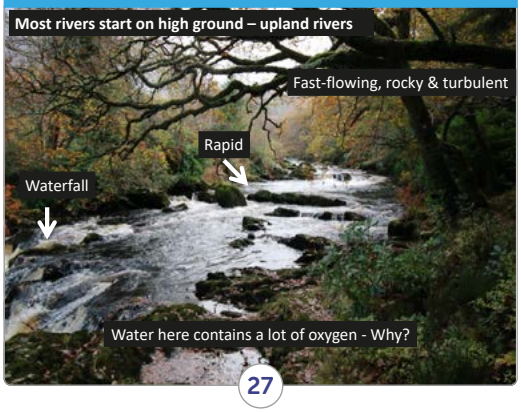
Where different species are found in a river, their habitat-depends on:

The depth of the water and how fast it's flowing.
- Q: What kind of organisms could survive well in fast flowing water?

The chemistry of the water - alkaline water has lots of calcium and other minerals, acid water has much less.
- Q: What kind of organisms would be much more common in alkaline water?

The river bank is home to lots of life if there is lots of bank vegetation and a wide variety of plants.

26



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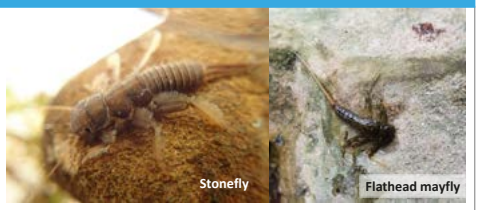
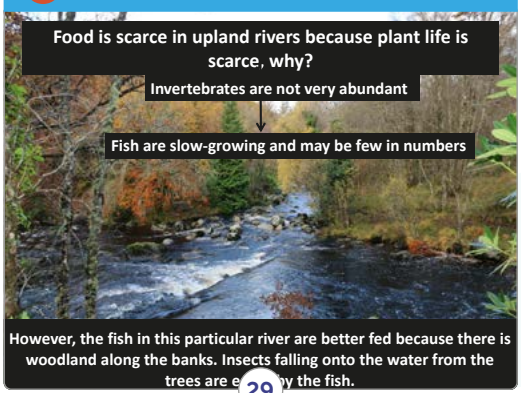


Stoneflies (20 species) and **Mayflies** (33 species) are important river fly species.
Before stoneflies and flathead mayflies emerge as insects with wings they spend the majority of their lifecycle clinging and living under rocks and plants to avoid being washed away by fast flowing oxygenated waters. These species like clean, cold water. The do not survive in polluted conditions.
Anglers like to see these insect species – they call them ***stone clingers***.

28



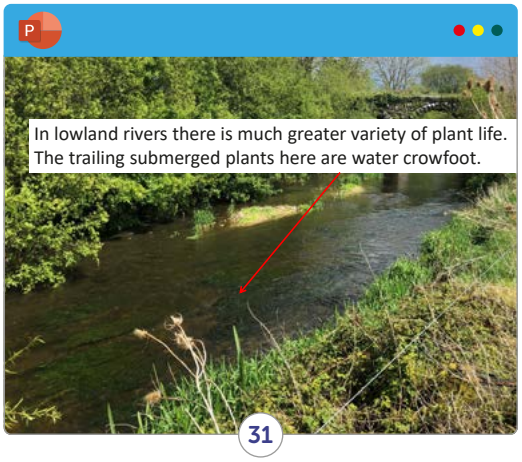
29

As a river flows downstream to lowland

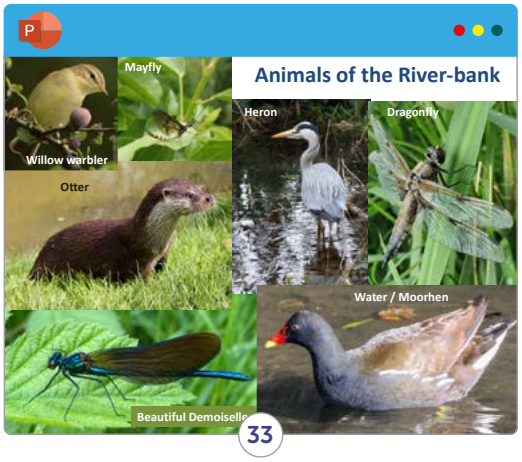
- It slows down & is less turbulent; few rocks, no waterfalls.
- No rapids – *riffles* and *glides* instead.
- More plant life
- More invertebrates
- Fish are bigger
- Greater fish variety

No woodland along the river banks – why? What is there instead?

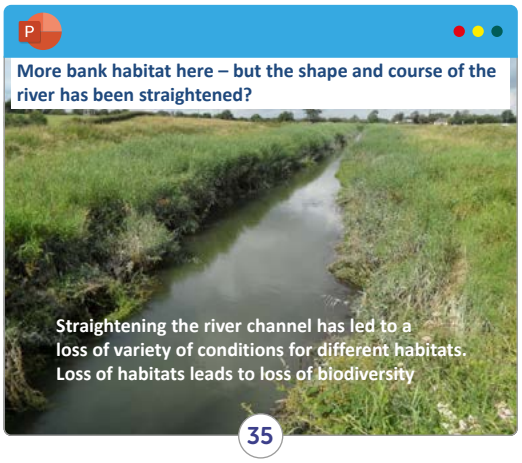
30


In lowland rivers there is much greater variety of plant life.
The trailing submerged plants here are water crowfoot.
31

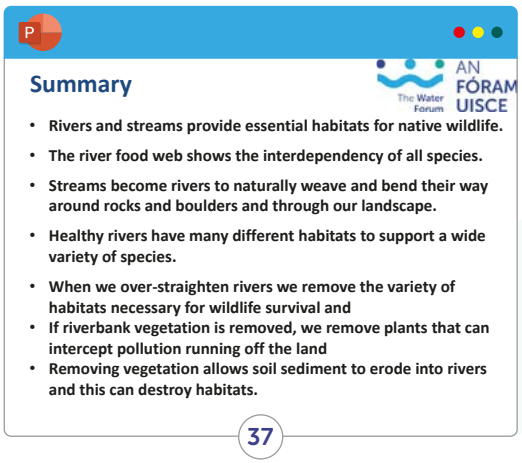

In intensively-farmed areas, and often in urban areas, most of the biodiversity is in the rivers and streams and on the riverbanks
32


Animals of the River-bank
Mayfly
Willow warbler
Heron
Dragonfly
Otter
Water / Moorhen
Beautiful Demoiselle
33


Most of our rivers have been modified to allow drainage, there is very little bank habitat here.
However, the original course of the river is still the same.
34


More bank habitat here – but the shape and course of the river has been straightened?
Straightening the river channel has led to a loss of variety of conditions for different habitats. Loss of habitats leads to loss of biodiversity
35


Discussion - Is this a good idea?
Task 1.4
36


Summary
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Rivers and streams provide essential habitats for native wildlife.
The river food web shows the interdependency of all species.
Streams become rivers to naturally weave and bend their way around rocks and boulders and through our landscape.
Healthy rivers have many different habitats to support a wide variety of species.
When we over-straighten rivers we remove the variety of habitats necessary for wildlife survival and
If riverbank vegetation is removed, we remove plants that can intercept pollution running off the land
Removing vegetation allows soil sediment to erode into rivers and this can destroy habitats.
37

Lesson 2

Invertebrates as bio-indicators

Introduction & Engagement
(10 minutes)

This topic contains abstract concepts such as bio-indicators, water quality assessment and so on. Consider engaging the students at the start of the lesson with a concrete example using a short online video; the BBC's Mayfly's Incredibly Short and Action-Packed Life Cyle (3:37min) is a good one and some students may have heard of mayflies.

There is also excellent footage of caddis flies and their amazing abilities as 'stonemasons' in Sticky. Stretchy. Waterproof. The Amazing Underwater Tape of the Caddisfly – 3:50 min (see Additional Resources).

Exploration – The Water Cycle
(50 Minutes)

Slide 2 introduces the idea of water quality and that nature requires good water quality, just as humans do (students may think of water quality in terms of benefits to human use). It highlights the fact that some macro-invertebrates require very good water quality and that we can use their presence or absence as an indication of water quality.

Slides 3- 5 illustrate the so-called 'Clean Water Macro-invertebrate Fauna'. These are the important bio-indicators of good water quality. An abundance of these and a wide range of these species in a river or lake implies that water quality is good.

Slide 6 Shrimps and snails - these may indicate polluted water or the onset of polluted conditions, particularly if the clean water fauna is reduced or absent.

Slide 7 Water louse and bloodworms - These are definite indicators of poor water quality because they are adapted to conditions of lower oxygen levels and increased nutrients. After delivering Slide 7, ask students to complete

Activity 2.1. Distinguishing different river macro-invertebrates

- Names are important but it is more important that students discern and remember distinguishing features, which are highlighted in the PowerPoint

Slide 9 introduces the Q Value System used in Ireland for classifying water quality (the 'Q-System' for short). This is a colour-coded or 'traffic light' type classification. The diagram on the right shows (in very simplified terms) how the presence of macro-invertebrates determines the Q value. For example, if a sample from a river is dominated by mayflies, stoneflies and caddis flies, this indicates very clean water (Q 4-5 and Q5). On the other hand, if these are absent and shrimps, water lice and snails dominate, the water is polluted.

Slide 10 explores in very general terms why pollution causes this to happen –the concept of replacement through competition by macro-invertebrates that are better suited to the changed conditions caused by pollution. (This is explored more fully in the next module, which looks in more detail at water quality and pollution.)

Slide 12 describes how the sampling of invertebrates (kick-sampling etc.) is carried out and is shown in the Ecological Wonder of water video. This allows students to see living macroinvertebrates and to use their knowledge of distinguishing features to identify them.

Activity 2.2 Watch the Magic of Water Kick Sampling Video

Link on **Slide 12**, allows students to see living macroinvertebrates and to use their knowledge of distinguishing features to identify them. Seeing living examples has much more impact on learning and delivers more engagement. However, it may not be feasible to bring a class to a river/stream, although it might be possible to bring the river to the classroom if sampling equipment, time and an easily accessible stream are available.

- Alternatively, it may be possible to arrange for a local River Trust, the Local Authority Water Officer or a representative from Inland Fisheries Ireland to provide material and a demonstration.

Elaboration

Slides 12 and 13 introduce the idea of water quality monitoring and a simplified water quality index used by amateur groups across the country interested in finding the water quality in their local streams.

Activity 2.3 Calculating the Citizen Science Stream Index (CSSI)

A really good activity is assessment water quality in a local stream using the CSSI scorecard (reproduced in the student workbook). This task is an option if a class visit to a local stream or collection of macroinvertebrates is not feasible. The CSSI is a very simplified version of other indices such as the EPA's Q System but it does convey the fundamentals of how a numerical index works in ascribing a value to water quality.

The questions following each task will encourage the students to expand on the concepts and knowledge they have learned in this lesson. They will be able to make connections to concepts and knowledge they have acquired previously and to lay the foundation for more complex concepts, such as ecological status.

Given the specific content of this lesson, it may be worth contacting your Local Authority Waters Programme Officer or Rivers Trust organisation to request a field workshop on CSSI kick sampling and macroinvertebrate identification. https://lawaters.ie/citizen-science/

Assessment Student Workbook Lesson 2

- ✓ Distinguished river macroinvertebrates
- ✓ Watched the kick sampling video
- ✓ Calculated a CSSI score for a local stream

Additional Resources

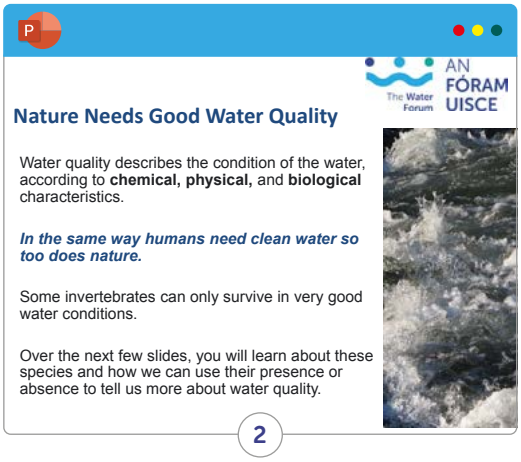
- Mayfly's Incredibly Short and Action-Packed Life Cyle. Great footage in a short BBC production. https://www.youtube.com/watch?v=dzbLuLzMWE4
- Sticky. Stretchy. Waterproof. The Amazing Underwater Tape of the Caddisfly https://www.youtube.com/watch?v=Z3BHrzDHoYo
- Bugs of the World. An America fly fishing video showing nice foot age of stoneflies underwater and adult emergence. https://www.youtube.com/watch?v=E4Al8cwkb4I
- Magic of Water Video 3 Ecological Wonder of Water. An Fóram Uisce. https://www.youtube.com/watch?v=DphFA-i27XY

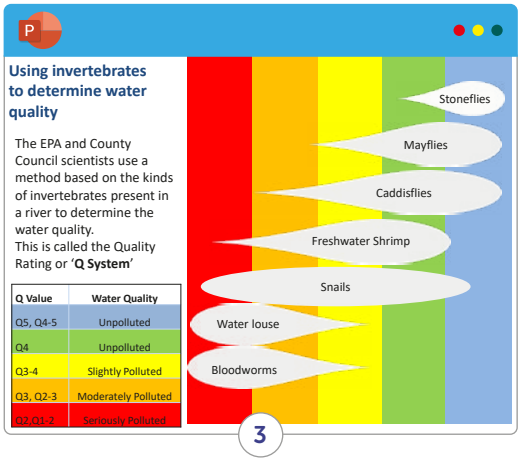
Lesson 2

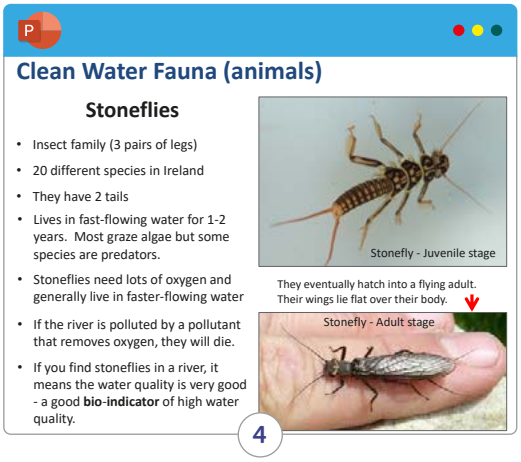
Teacher resource link to presentation

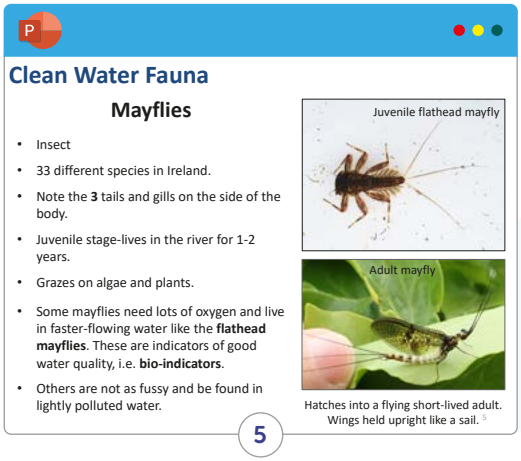
Direct link to the powerpoint
Module title: Freshwater Biodiversity and Habitats
Lesson 2 - Invertebrates Life as Bio-indicators

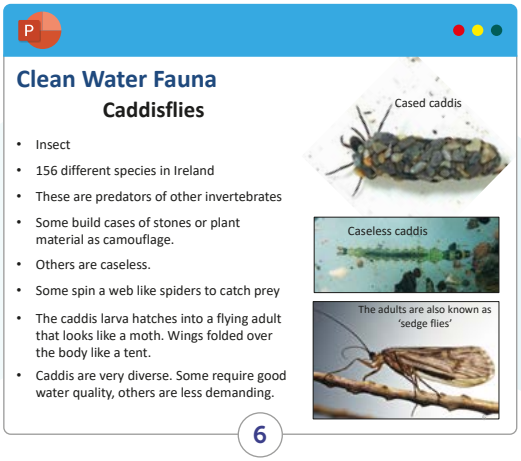
https://thewaterforum.ie/resources-category/education-resources/











Polluted Water Fauna

Freshwater shrimps

- Crustaceans
- Note-lots of legs and body segments!
- Shrimps can live in clean or even heavily polluted water.

Snails

- Molluscs
- They are herbivores and are important as food for fish.
- Some types require clean water, while other types are less demanding

If these are present **and** the clean water fauna are reduced or absent, it means the water is polluted.

7

Polluted Water Fauna

Water Louse (*Asellus*)

- Crustacean
- Are an aquatic type of woodlouse
- They are scavengers and can tolerate the very low oxygen levels found in polluted rivers and lakes .
- If you find a lot them, you know the water is polluted.

Bloodworm or chironomid

- These are not worms but are the larvae of an insect.
- Hatch into a small fly, like a mosquito.
- Red because they contain haemoglobin (usually not found in insects). This allows them to live in water that has very little oxygen.
- If you find a lot them, you know the water is polluted.

Task 2.1

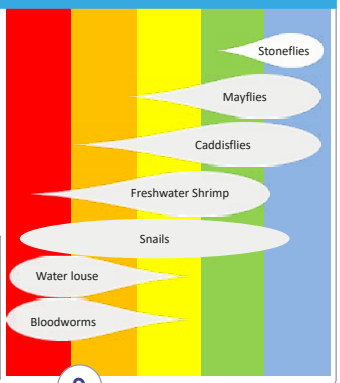
8

8

Using invertebrates to determine water quality

The EPA and County Council scientists use a method based on the kinds of invertebrates present in a river to determine the water quality.
This is called the Quality Rating or '**Q System**'

Q Value	Water Quality
Q5, Q4-5	Unpolluted
Q4	Unpolluted
Q3-4	Slightly Polluted
Q3, Q2-3	Moderately Polluted
Q2,Q1-2	Seriously Polluted



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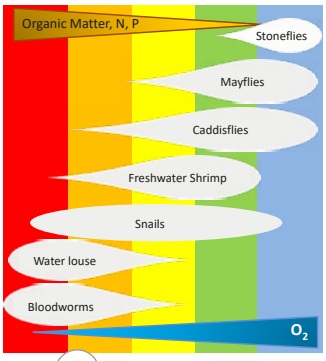
Pollution of rivers is most frequently caused by organic matter on **nutrient such as nitrogen and phosphorus**. These pollutants reduce the amount of oxygen in the water.

When **oxygen** levels in a river are reduced by pollution, the clean water fauna are replaced through competition with organisms that are better suited to lower oxygen levels.



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How do find the water quality or Q value of a river?

Kick sampling!

- A surveyor places a hand-held net in a shallow riffle part of the river and disturbs the bed of the river just upstream of the net by kicking.
- This dislodges the invertebrates, which are then caught in the net.
- These are then transferred into a tray and sorted and identified.
- If there are a lot of species that require clean water –the '**clean water fauna**' (mayflies, stoneflies and some caddis flies) - the sample will get a high score - Q4 or possibly Q5.
- If however, the clean water fauna is reduced or absent, and replaced by species that can tolerate polluted conditions, then the sample will be scored lower, possibly even as low as Q1 if only very pollution-tolerant organisms are present.

11

Magic of Water – Ecological Wonder

Task 2.2

https://www.youtube.com/watch?v=DphFA-i27XY (3:15min – 7:37min)

12

12

Water quality monitoring

Water quality in rivers and lakes is monitored across the country by the EPA and local authorities using the Q system. Monitoring started in the 1980s so monitoring gives a picture of how water quality has changed over time.

Local communities and environmental groups also monitor water quality through '**Citizen Science'.**

They use a simplified version of Q System based on the '**Good Guys'** and the '**Bad Guys'*.**

Citizen science monitoring increases the information about water quality, especially in small streams that the EPA or councils do not monitor

The small streams are really important for biodiversity and salmon spawning.

*Properly known as the Citizen Science Stream Index (CSSI)

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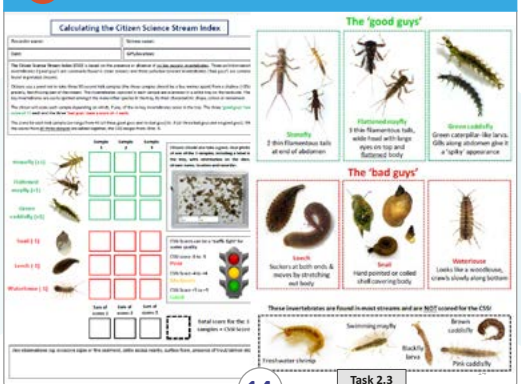


Task 2.3

14

River A

River B

Which river is likely to have the greatest diversity of invertebrates?

15

15

Remember

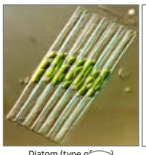
The plant life in a river or lake is the foundation of the food chain

Aquatic plants are not only food but also habitat for macroinvertebrates.

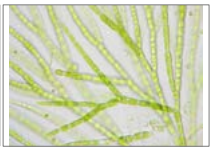
BUT there needs to be balance of the right amount and type of plants for a healthy river system.

Hornwort (aquatic plant)

Diatom (type of alga)



Diatom (type of



Green alga

16

Lesson 3

The strange lives of Atlantic Salmon

Introduction & Engagement
(10 minutes)

Initial student engagement with the topic depends on how the teacher wants to approach the topic. For example, you could focus on the unique biology; e.g., you could play the YouTube clip at the bottom of Slide 6 first showing salmon attempting to overcome the barrier on the R. Severn; or ask the question "what is the longest-living animal in our rivers"? Alternatively, you could focus on biodiversity loss - "what are the most threatened animals in our rivers"?

Exploration – Life Cycle of the Atlantic Salmon
(50 Minutes)

Slide 2 explains why we should worry about this species. Some students may have heard of 'salmon farms' but may not be aware that salmon is a wild species and under extreme threat.

Slides 3-5 Atlantic salmon also have an intriguing lifecycle involving long-distance migration and a homing instinct. The spawning phase of the life cycle is illustrated in the video produced by the Atlantic Salmon International Research Station on the River Bush, Northern Ireland. The video is 15 minutes long, but the most relevant parts showing spawning and young salmon are from minutes 5:48 to 7:10 and 9:00 to 10:00.

Slides 6-8 look at the reasons behind the decline of salmon numbers returning to our rivers.

Slide 9 looks at what we need to do to halt the decline of this species to extinction.

Activity 3.1 *Locating river barriers using Google maps*

- **Slides 10-12** illustrate the Task 3.1 included in the workbook.

Aspects not addressed in the presentation but relevant could be explored by questioning. For example:

- Why do salmon go to sea in the first place? Why not stay in the river?
- How do they cope with switching from freshwater to salt water and vice versa? (Saltwater fish will die if put in freshwater, and freshwater fish like perch or pike will die if put in salt water).
- How does the salmon life cycle compare to that of European eel, another long-distance migrant that travels much further?
- Why is the impact of salmon farms controversial? (A good but tricky subject for a class debate because it involves sustainability, economics, local employment, big business, biology, among other things)

Elaboration

The students can make a connection between the issues and concepts raised in the presentation and their locality by attempting the tasks outlined in the workbook. These can be carried out in class or as homework.

Activity 3.1 *Digital search for fish barriers along a river?*

- Students will need to locate a river and find out how many potential barriers to fish migration are on it using Google Earth or Google maps (using Satellite View).

Details are on Slide 11 of the PowerPoint. The example used is a 25 km stretch of the R. Maigue (because it has a lot of barriers that are visible from the air), but any river can be examined. This task will reinforce an appreciation of the obstacles we have put to salmon migration by modification of our rivers.

Assessment Student Workbook Lesson 3

- ✓ Students will be able to locate their local river using digital maps.
- ✓ Students will be able to identify river barriers on Google Earth.

Additional Resources

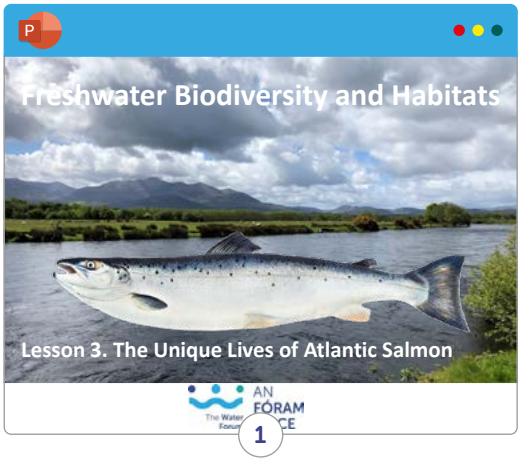
- Salmon Watch Ireland. www.salmonwatchireland.ie
- Inland Fisheries Ireland (IFI). https://www.fisheriesireland.ie/species (Descriptions and ecology of all fish species in Irish freshwater.)
- Atlantic Salmon International Research Station on the River Bush, Northern Ireland www.youtube.com/watch?v=yjL4vnkU2wA

Lesson 3

Teacher resource link to presentation

Direct link to the powerpoint
Module title: Freshwater Biodiversity and Habitats
Lesson 3 - The Unique Lives of Atlantic Salmon

https://thewaterforum.ie/resources-category/education-resources/



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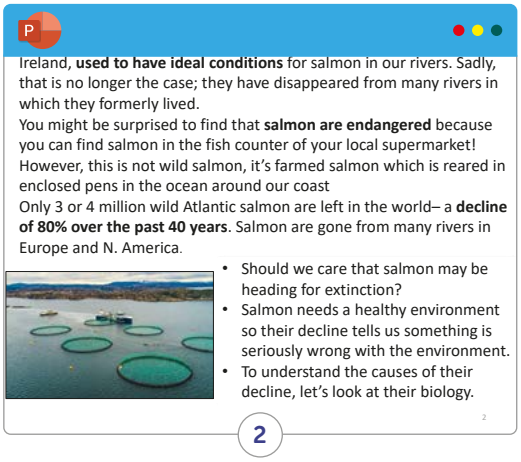

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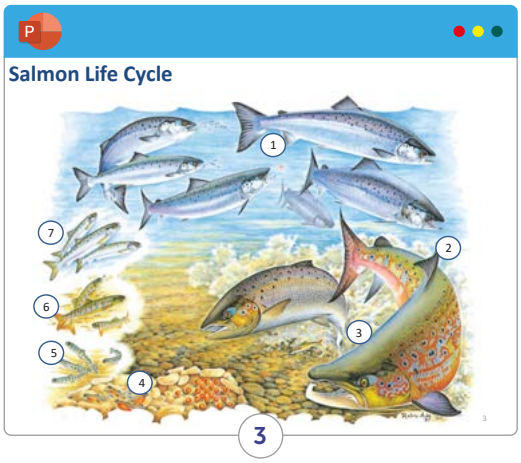

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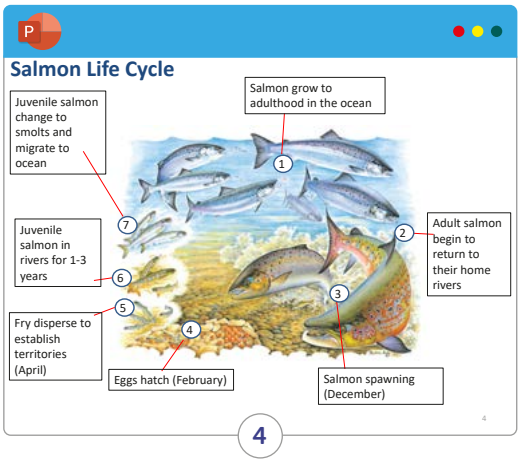

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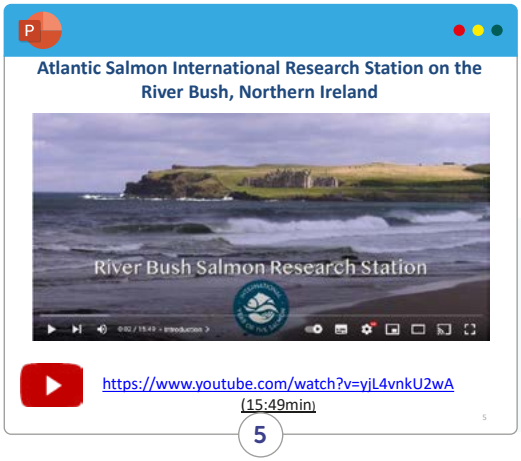

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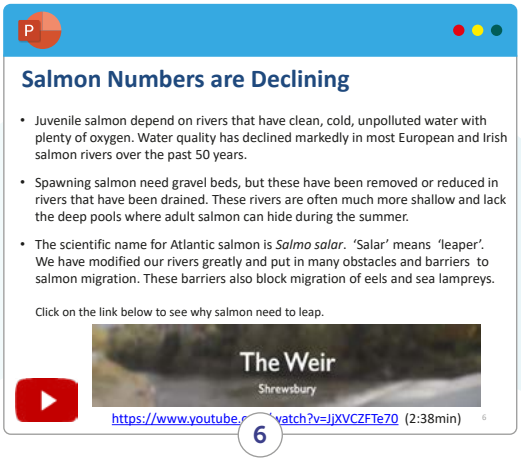

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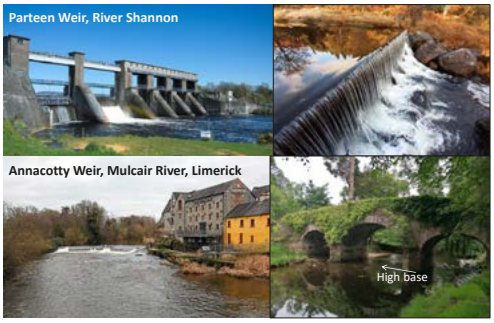
River barriers come in all shapes and sizes



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7

Salmon Decline

- Salmon farms are claimed to have caused the decline of salmon in some rivers. Infection of salmon smolts with sea lice from salmon farms and breeding of wild salmon with escaped farm salmon are thought to be involved. This is controversial!
- Climate change is harming young salmon in rivers and adult salmon in the ocean:
  - Warming oceans cause the salmon's feeding grounds to shift further north and is reducing the availability of food. This may be the reason fewer salmon are returning to our rivers.
  - Higher temperatures in summer make life tougher for young salmon in rivers - they don't thrive when temperatures exceed 16˚C.
  - More rainfall and bigger floods in winter will destroy salmon spawning sites- redds.

Compared to 30 years ago, it now takes about double the amount of eggs to produce one adult compared that will return to the same river to spawn. Our rivers have to be clean and healthy to [illegible] young salmon.

8

What we need to do

For salmon it will be difficult to improve things in the oceans. Improvement efforts should focus on our freshwater rivers, streams and lakes.

- **Clean up the water quality in our rivers – remove the sources of pollution.**
- **Create more spawning habitat for salmon.**
- **Remove barriers to fish migration.**
- **Restore natural habitats along riverbanks especially woodland that will provide shade in summer and reduce temperatures.**
- **Control illegal fishing.**
- **Change salmon farming practice.**

If we don't do these things, salmon will become extinct.

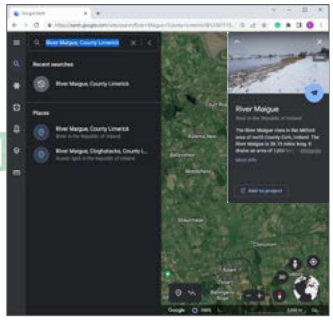
9

9

Task 3.1 Locating river barriers using Google Earth/Maps

1. Go to Google Earth, and type in 'River Maigue, Co. Limerick' in the search box. Click 'Search'.
You can also use Google Maps – Satellite view.

2. Zoom in and follow the river upstream through Adare, Croom, up as far as Bruree, a distance of about 25 km, and see how many artificial barriers you can find. You will see structures like the following .



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Task 3.1 How many river barriers can you find?

3. You will see structures like the following.
4. You can mark them with a label in Google Earth and produce a map.

A 'V-shaped ' weir with the point facing upstream

A road bridge – may or may not be a barrier

Could be an old weir or just a natural rocky party of the river

11

11

Lesson 4

Invasive (non-native) Alien Species - Freshwater plants and animals

Introduction & Engagement
(5 minutes)

Students tend to respond better to animal stories, so the story of mink is a good starting point for engagement. The Wildopedia video (link on Slide 3) shows the hunting prowess of mink and other aspects of its biology with very good footage. The impact of mink on our own wildlife can be inferred from this video (1.5 minutes).

Exploration - An introduction to invasive alien species
(45 Minutes)

The students will explore biology and ecological impact of the four invasive organisms by viewing the PowerPoint presentation.

Slide 2 gives a definition of invasive organisms. Students should be encouraged to look up other invasives than the examples covered here, in https://invasives.ie/.

Slides 3-5 explore the impact of mink on native wildlife.

Activity 4.1. *Find out if there are invasive species in your local waterway?*

- The students could find if these or other invasives occur along the rivers and lakes in their locality using the Explore Maps tool in the National Biodiversity Data Centre website. (Details of how to do this are shown on the student workbook).

Slides 6-9 explore the impact of a plant invader –giant hogweed and highlight the health risks to humans from coming in contact with it.

Activity 4.2. *Use Google Earth to explore Giant Hogweed infestations.*

- As mentioned in Slide 9, Google Earth can be used to explore the extent of Giant Hogweed infestation along rivers in their locality (provided the images have been taken in mid-summer).

Slides 10-11 explore the impact of an attractively-flowering invader – Himalayan or Indian balsam. Its attractive flowers were probably the main reason for its introduction from India in the 19th century.

Slides 13-14 Highlight the impact of crayfish plague – a disease caused by a microscopic fungus-like organisms. Introduced micro-organisms can have a devastating effect on native plant and animal life and ecosystems (for example, Dutch elm disease, and ash die-back disease are now ravaging ash trees)

Aspects not addressed in the presentation but relevant could be explored by questioning. For example:

- Why was mink introduced? What happened to the fashion for fur coats?
- The relationship between otters and mink - is that competition?
- Why are rivers and lakes more vulnerable to invaders than land habitats?
- Why do introduced species often explode in numbers (this is usually due to the absence of the predators, diseases or conditions that would control numbers in the invasives home ranges)
- Is climate change influencing the arrival of non-native animals and plants?
- Are some countries more affected than others by introductions (New Zealand is the best example – they have stringent controls)
- Are there many other non-native invasives that we should worry about? (Check out Invasives.ie) and the clean, dry, check video shows how to prevent spreading invasive species.

Elaboration

The students can make a connection between the issues and concepts raised in the presentation and their locality by attempting the tasks outlined in the workbook.

Assessment Student Workbook Lesson 4

- ✓ Use the National Biodiversity Data Centre website to find Invasive Alien Species (IAS)
- ✓ Use Google Earth to identify the extent of IAS infestations.

Additional Resources

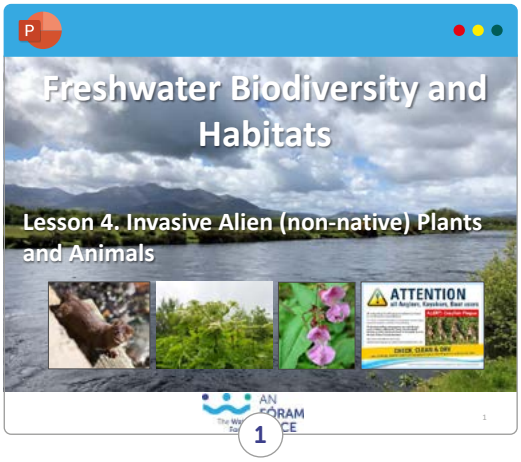
- Invasives.ie. Invasive Alien Species in Ireland. https://invasives.ie/
- Ireland's Invasive and Non-Native Species: Trends in Introductions. NBDC. https://invasives.ie/app/uploads/2022/01/NBDC-Trends-Report-2013_FINAL1.pdf
- Species Profile –Otter. Vincent Wildlife Trust. https://www.vincentwildlife.ie

Lesson 4

Teacher resource link to presentation

Direct link to the powerpoint
Module title: Freshwater Biodiversity and Habitats
Lesson 4 - Invasive Alien (non-native) Plants and Animals

https://thewaterforum.ie/resources-category/education-resources/



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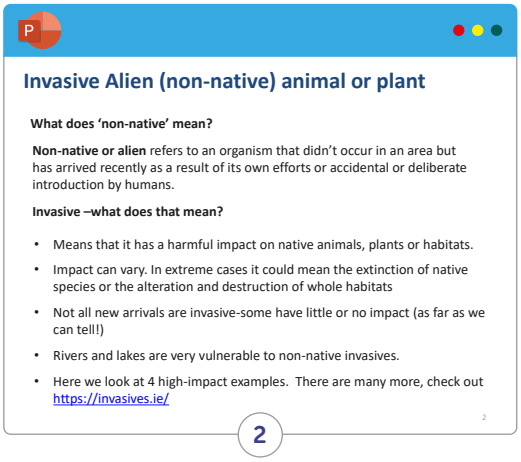

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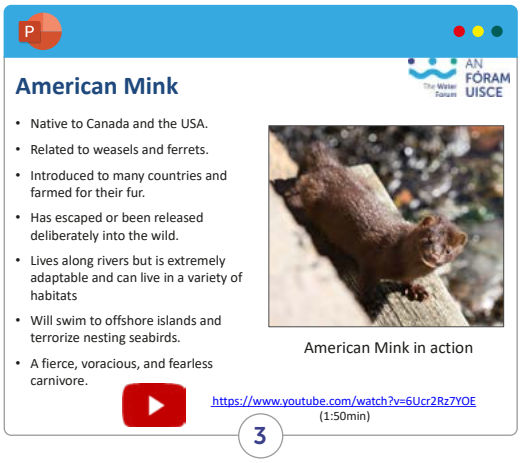

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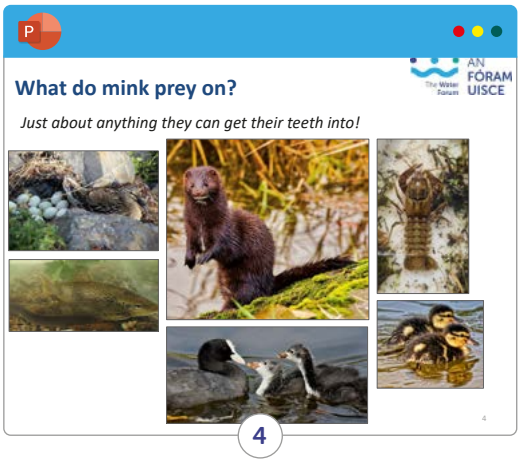

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6

Giant Hogweed is not native

- Introduced from Caucasus in late 19th century (as a garden plant!)
- Grows mainly near water, infests river banks
- Is a biennial, dies after flowering
- Produces huge amounts of seed, which are spread downstream by water, and by wind
- Seeds can survive in soil for up to 10 years

7

Giant Hogweed out competes native species

Impact

- Forms dense stands up to 3m tall
- Shades out native plants
- Dies back in winter - leaving bare river banks exposed to erosion
- Is poisonous
- Many of our rivers are infested by Giant Hogweed

Giant Hogweed plants in seed - August

8

Giant Hogweed forms large stands

- Giant Hogweed (GHW) forms large colonies or 'stands' that can be seen from the air when it is in flower in June-July.
- The image to the right from Google Earth shows stands GHW along the R. Mulkear in Limerick. Each white dot is a flower head which can be up to metre across and is composed of thousands of small white flowers.
- You can use Google Earth to explore the extent of GHW infestation along rivers in your locality (provided the images have been taken in mid-summer)

Tall large white flowerheads are seen along the riverbank

9

Giant Hogweed is a sever health hazard

Task 4.2

Giant Hogweed can cause serious damage to the unwary!

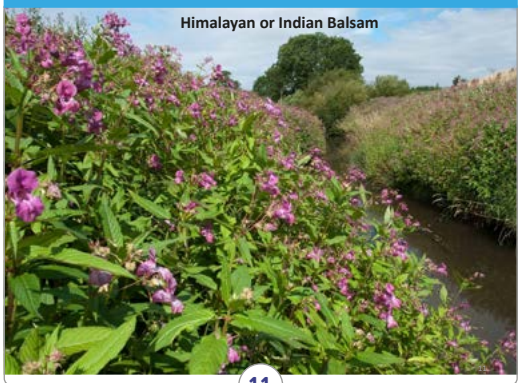
Get to know it if you spend a lot of time outdoors.

Keep well away if you see it!

- The sap of the GHW contains furanocoumarins.
- If sap comes in contact with skin and sunlight, it destroys the skin's ability to protect itself against sunlight.
- Results in 3rd-degree burns and severe blistering.
- Scars can be disfiguring and last for years.

You don't want to see days 8, 9 or 10!

10



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Himalayan or Indian Balsam

- Himalayan Balsam is native to India.
- An annual plant but can grow up to 2m or more in height.
- Forms extensive stands. Like GHW, shades out native plants along river banks.
- Has attractive flowers that produce more nectar than native species making the plant more attractive to bees resulting in less pollination of our native species.
- This encourages some beekeepers to misguidedly cultivate it.
- Dies in autumn after flowering-leaving bare riverbanks exposed to erosion.

Has explosive seed dispersal, and seed is spread downstream by water.

12

Crayfish Plague

- A 'plague' in the modern sense is a rapidly spreading contagious disease of animals or humans.
- Crayfish Plague is virulent fungus disease of our native crayfish.
- It doesn't mean that there is a plague of crayfish about to attack us!

- Crayfish are a crustacean.
- Very important in the ecology of rivers in limestone areas - a keystone species.
- Food for trout, otters and herons.
- A protected species.

13

13

Crayfish Plague

- Crayfish plague is caused by a microscopic non-native aquatic fungus like organism (*Aphanomyces astaci*)
- Originated in N. America. There it lives on American crayfish but doesn't harm them.
- American crayfish were brought into Europe in early 1900s to be farmed.
- The fungus spread to native European crayfish (white-clawed crayfish) which is also ours.
- Plague got to Ireland in 1980s, possibly introduced on boating or angling equipment.
- Once it gets into a river, it wipes out all the crayfish.

Impact??

Can alter food chains in rivers because trout and otters feed on crayfish.
Too early to tell…. yet.

14

14

How can we get rid of non-native invasive species?

It can be very difficult and costly once they become established.
The best way to fight invasive species is to prevent them from occurring in the first place (the video link provides ideas).

- Don't release aquarium fish and plants, live bait or other exotic animals into the wild.
- If involved in kayaking, angling or other water sports, always check, clean, dry and disinfect boats and equipment thoroughly before transporting it to a different water body.
- Don't plant garden plants that are invasive.
- Report sightings of invasive non-native animals/plants on:

Check Clean Dry - Invasives.ie

Invasives.ie
Invasive Alien Species in Ireland

15

15


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