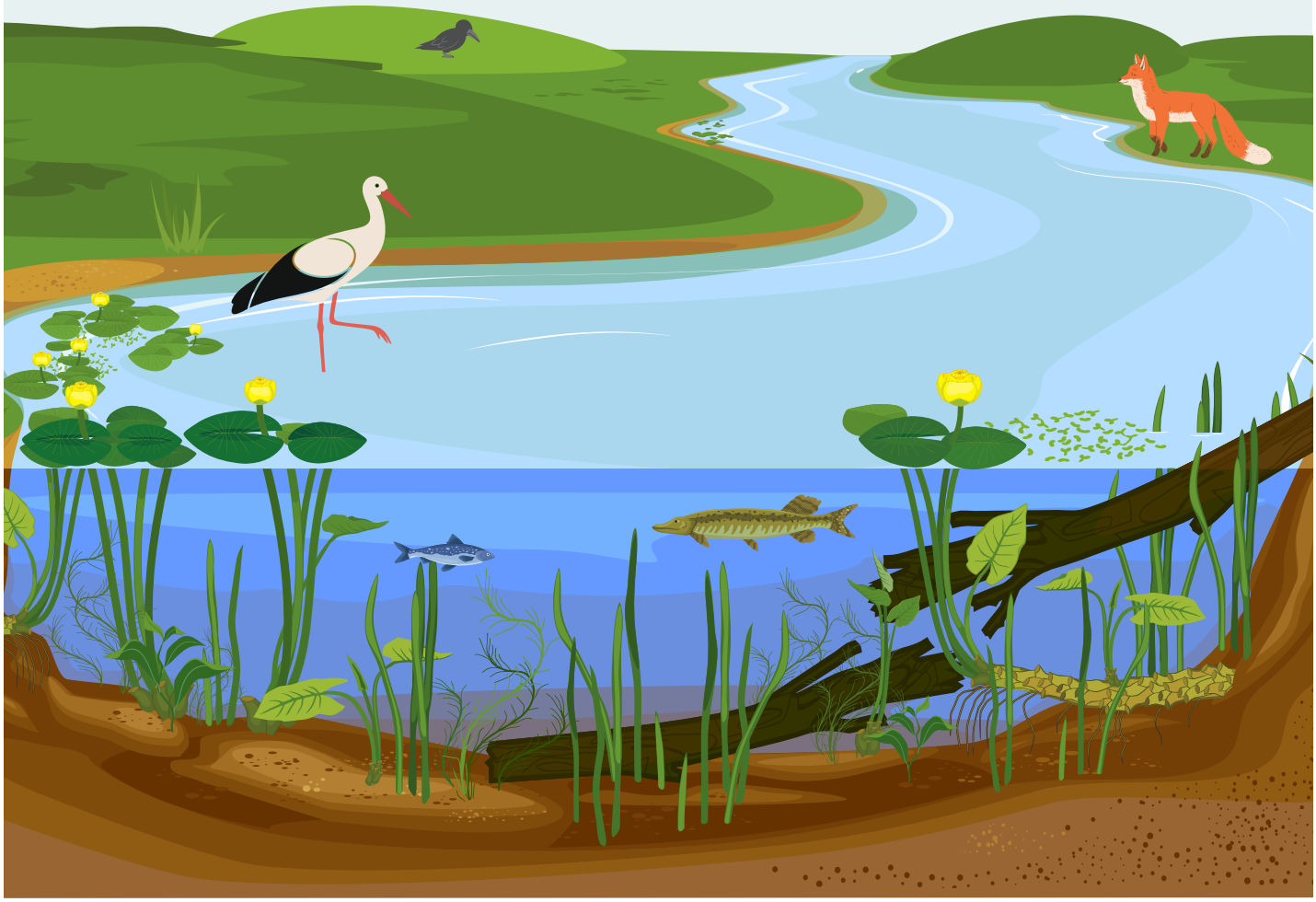
The Water Forum

AN FÓRAM UISCE

Freshwater biodiversity and habitats

Student's Workbook



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Overview

Natural waterbodies are vital habitats for wildlife and essential to a healthy environment. The lessons in this module will convey the important idea that rivers, lakes and wetlands are major reservoirs of biodiversity in Ireland. In urban areas and intensively farmed areas, watercourses are often the last of the wild places.

The freshwater and biodiversity theme is explored by examining what biodiversity is and why we must protect it. You will conduct research to discover the iconic animals of rivers and lakes (e.g. salmon, eels, trout, mayflies, kingfisher, dipper, heron, otter). Understanding how these animals live (their habitat requirements), how they migrate and why they are important to in our environment will give you an insight into the interdependency of different species. You will discover that the kinds of invertebrates living in a river can tell you a lot about the water quality. This is because some are very sensitive to pollution and will be killed off by pollution. You will learn about the Quality Rating or 'Q System' - a method based on the kinds of invertebrates present in a river to determine the water quality. A basic citizen science methodology is introduced as well.

Alien invasive species have become a major threat to native biodiversity all over the world, and Ireland is no different. Students of this programme will have the opportunity to research these species and determine if they are present in their local waterbody and what is their impact.

Minnow in Morningstar River, Co. Limerick, April 2022.

Lesson 1

Freshwater Life and Habitats

In this lesson you will explore some of the animals that contribute to biodiversity in rivers and how they relate to one another in food webs and food chains. You will encounter changes in the river habitat as flows from the headwaters/source to the sea.

Task 1.1 - Identifying river animals

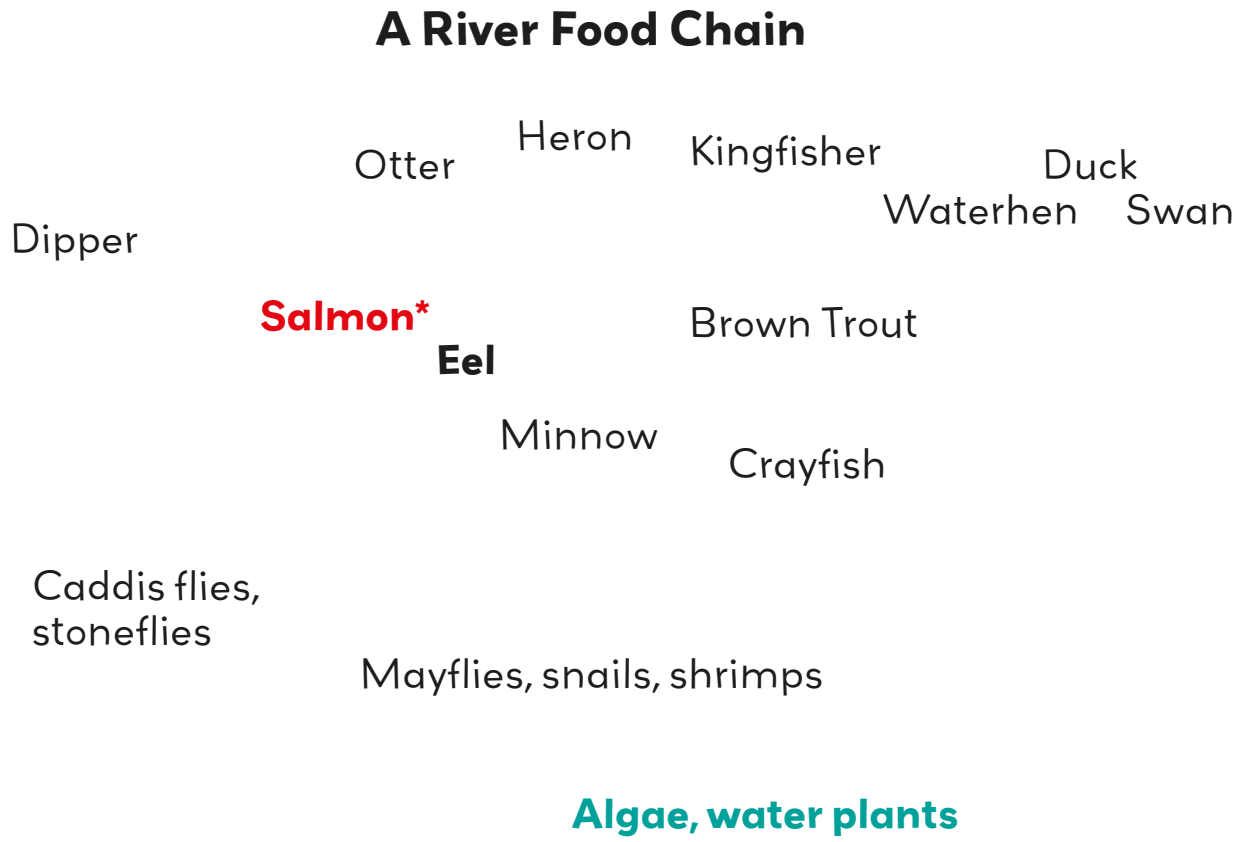
Identify and say whether you think it is a vertebrate or invertebrate, and a carnivore, herbivore or omnivore.

	Animal Name & Vertebrate or Invertebrate	Carnivore, herbivore or omnivore?

	Animal Name & Vertebrate or Invertebrate	Carnivore, herbivore or omnivore?

Task 1.2 - Constructing a Freshwater Food Chain

Use arrows to show the links in the food chain (what eats what- Slide 23).



Q1: Why is the salmon different from the rest?

Q2: What group of organisms will have the greatest biomass per m2 of river area?

Q3: What organisms or group of organisms would have the least?

Q4: Why would you expect differences?

Do not be afraid to look up any terms you do not understand

Task 1.3 - Exploring River Habitats

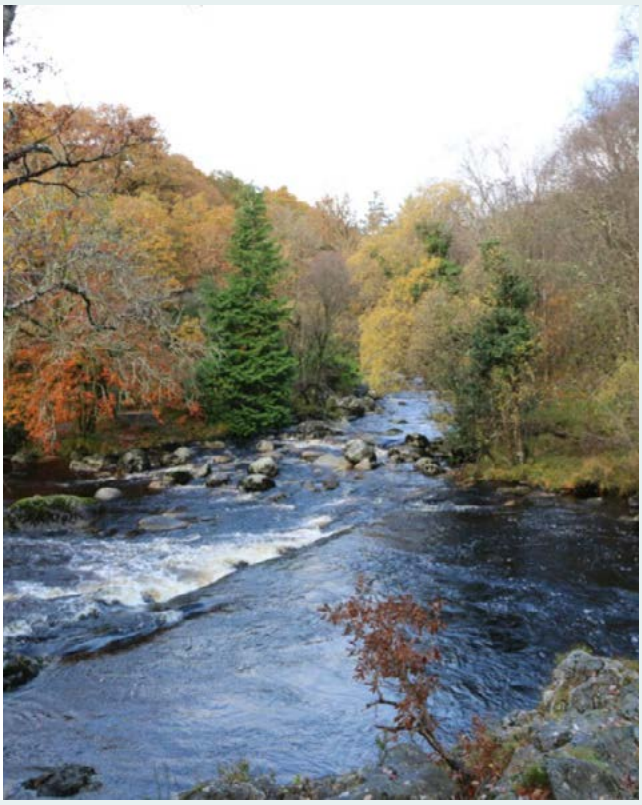
Slide 27

Q1: What kind of organisms could survive well in fast flowing water?

Q2: What kind of organisms would be much more common in alkaline water, and why?

Slide 29

Q3: Life in the river itself will benefit if there is lots of bank vegetation containing a wide variety of plants, for example woodland. Why is that?



Slide 30

Q4: What has happened the woodland from along this lowland river?

Slide 32

Q5: In the lowland stretches of rivers there is much greater variety of plant life than in the upland rocky stretches. Why is that do you think?

Q6: What does water crowfoot look like in flower (Google it!) and draw the flower.

Task 1.4 -Discussing riverside land management

Slide 36

Q7: Is transforming the riverbank like this a good idea? Discuss with your class and note the answers.

Lesson 2

Invertebrate life as Bio-indicators

The last lesson/topic looked at the interconnections between different organisms and how they are connected in food webs and food chains. This lesson examines more closely the invertebrates that form the base of the food chain. In this lesson you will discover that the kinds of invertebrates living in a river can tell you a lot about the water quality. This is because some are very sensitive to pollution and will be killed off by pollution. You will learn about the Quality Rating or 'Q System' - a method based on the kinds of invertebrates present in a river to determine the water quality.

Task 2.1 - Distinguishing different river macroinvertebrates

Identify the animals in slides 4 to Slide 8 and note their distinguishing features.

Slide #	Animal Name	Distinguishing Features

Slide #	Animal Name	Distinguishing Features

Q1. Which ones are good bio-indicators?

Q2. Why do stoneflies, mayflies and caddisflies have an aquatic juvenile stage and an adult winged stage in their lifecyles? Can you think of other insects that have similar life cycles?

Task 2.2 – Kick Sampling Video

Identify the animals in slides 4 to Slide 8 and note their distinguishing features.

www.youtube.com/watch?v=DphFA-i27XY

Q1: How many different types of mayflies can you distinguish in their collection in the tray?

Q2: Did you see shrimps?

Q3: Waterlouse?

Q4: Stoneflies?

Task 2.3 – Calculating the Citizen Science Stream Index (CSSI)

The aim is compare the water quality in two rivers A and B using the CSSI Index. Here is data on the macroinvertebrates found in 3 kick samples collected from each river.

	River A			River B		
	Sample 1	**Sample 2**	**Sample 3**	**Sample 1**	**Sample 2**	**Sample 3**
Stonefly species 1				✓		✓
Stonefly species 2					✓	
Flathead Mayfly				✓	✓	✓
Swimming Mayfly	✓	✓	✓		✓	
Green Caddis				✓		✓
Brown Caddis	✓	✓	✓	✓	✓	
Shrimp	✓	✓	✓			✓
Waterlouse	✓		✓			
Blackfly Larva				✓		
Leech	✓	✓				
Snail species 1		✓		✓		
Snail species 2	✓		✓			

Calculate the CSSI score of river A and River B using the Guide on pages 7 and 8 below. Remember, only 3 'Good Guys and 3 'Bad Guys' are used for the calculation. Some of the macroinvertebrates from river A and River B are not scored. Each 'Good Guy' gets a score of +1 and each 'Bad Guy' gets a score of -1. Add up the scores from each of the three samples for each river. The maximum score obtainable for 'Good Guys' from the three samples is +9 and for 'Bad Guys' -9. The CSSI has three levels of water quality rating - Good, Moderate or Poor. Check the traffic light on the first page of the Guide to translate the CSSI scores for each river into a water quality rating and fill in the table below.

	CSSI Score	Quality
River A		
River B		

Q1: Which river would have the higher Q value do you think?

Q2: Is either river showing signs of pollution?

Q3. Looking at the pictures of the two rivers (Slide 15), could any other factor be responsible for the difference in scores?

Calculating the Citizen Science Stream Index

Recorder name:	Stream name:
Date:	GPS/location:

The Citizen Science Stream Index (CSSI) is based on the presence or absence of six key aquatic invertebrates. Three pollution-sensitive invertebrates ('good guys') are commonly found in clean streams and three pollution-tolerant invertebrates ('bad guys') are commonly found in polluted streams.

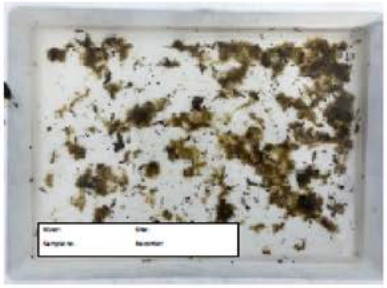
Citizens use a pond net to take three 30-second kick-samples (the three samples should be a few metres apart) from a shallow (<20cm), gravelly, fast-flowing part of the stream. The invertebrates captured in each sample are examined in a white tray on the bankside. The six key invertebrates are easily spotted amongst the many other species in the tray, by their characteristic shape, colour or movement.

The citizen will score each sample depending on which, if any, of the six key invertebrates occur in the tray. The three **'good guys' have a score of +1** each and the three **'bad guys' have a score of -1 each.**

The score for each kick-sample can range from +3 (all three good guys and no bad guys) to -3 (all three bad guys and no good guys). When the scores from all three samples are added together, the CSSI ranges from +9 to -9.

	Sample 1	Sample 2	Sample 3
Stonefly (+1)			
Flattened mayfly (+1)			
Green caddisfly (+1)			
Snail (-1)			
Leech (-1)			
Waterlouse (-1)			
	Sum of scores 1	Sum of scores 2	Sum of scores 3

Citizens should also take a good, clear photo of one of the 3 samples, including a label in the tray, with information on the date, stream name, location and recorder.



CSSI Scores can be a 'traffic light' for water quality

CSSI score -9 to -5
Poor

CSSI Score -4 to +4
Moderate

CSSI Score +5 to +9
Good

Total score for the 3 samples = CSSI Score

Any observations (eg. excessive algae or fine sediment, cattle access nearby, surface foam, presence of trout/salmon etc):

The 'good guys'

Stonefly
2 thin filamentous tails at end of abdomen

Flattened mayfly
3 thin filamentous tails, wide head with large eyes on top and flattened body

Green caddisfly
Green caterpillar-like larva. Gills along abdomen give it a 'spiky' appearance

The 'bad guys'

Leech
Suckers at both ends & moves by stretching out body

Snail
Hard pointed or coiled shell covering body

Waterlouse
Looks like a woodlouse, crawls slowly along bottom

These invertebrates are found in most streams and are NOT scored for the CSSI

Freshwater shrimp

Swimming mayfly

Blackfly larva

Brown caddisfly

Pink caddisfly

Lesson 3

The strange life of Atlantic salmon

Salmon have extraordinary life cycles that illustrate many important biological concepts – migration, parasitism, adaptations and habitat requirements, and extinction.

Salmon populations are in steep decline and are great examples of the impact of over-exploitation, habitat degradation and climate change on freshwaters and oceans.

In this lesson you will also find if there are barriers to salmon migration in your local river using Google Earth or Google Maps.

Background

In Ireland, we used to have ideal salmon conditions in our rivers. Sadly, that is no longer the case; salmon numbers are now in steep decline and are seriously endangered.

You might be surprised that salmon are endangered because you can find salmon in the fish counter of your local supermarket! However, this is not wild salmon, it is farmed salmon which is reared in enclosed pens in the ocean around our coast.

It is estimated there are only 3 or 4 million wild Atlantic salmon left in the world – a decline of 80% over the past 40 years. Salmon have vanished from many rivers in Europe and North America.

Salmon may be heading for extinction.

Q. Why should we care?

A. Salmon need a healthy environment, therefore, their decline tells us something is seriously wrong with that environment.

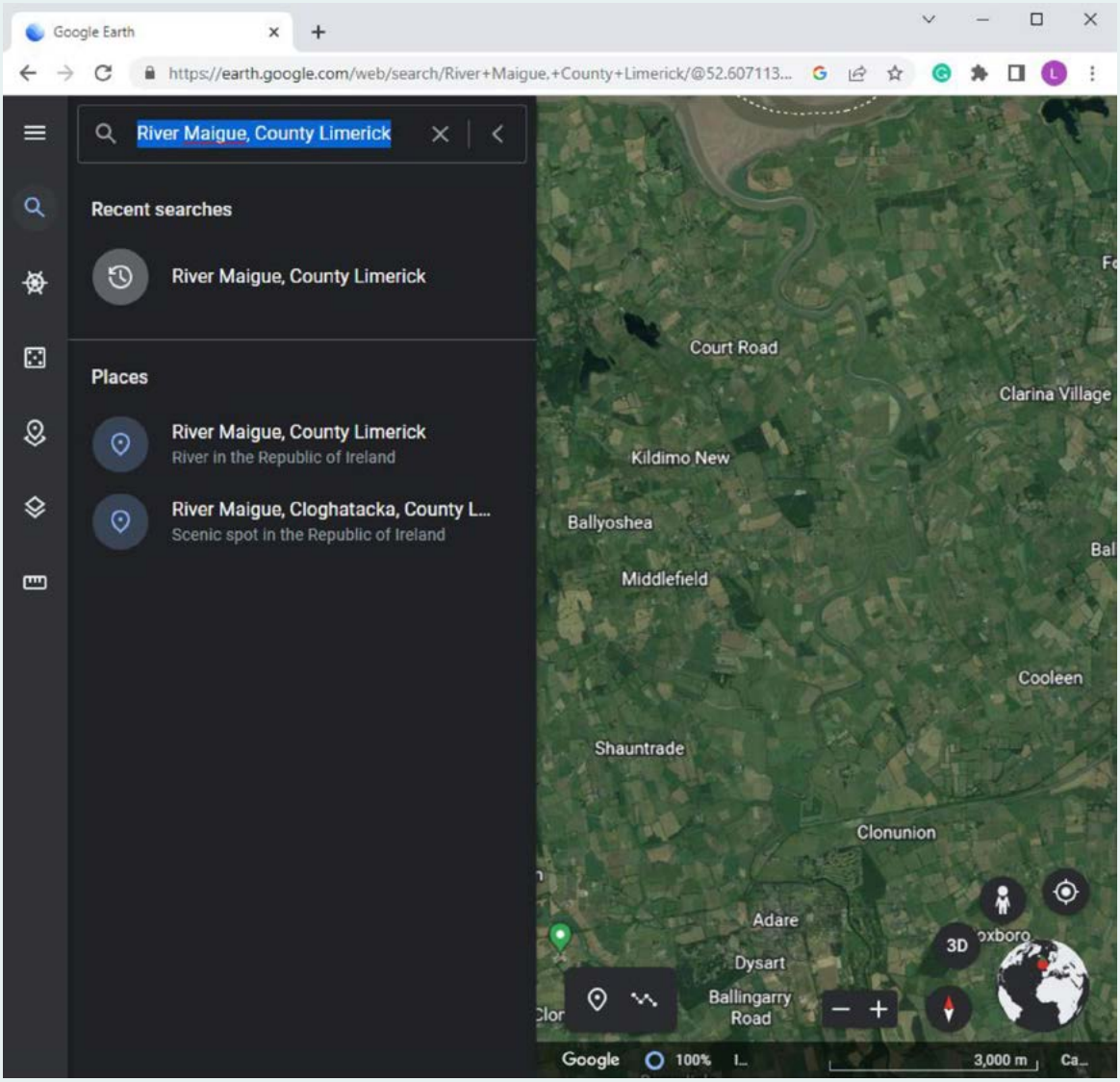
Requirements

- Internet
- Use of a laptop or PC

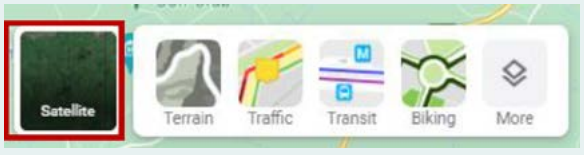
Task 3.1 – Locating barriers to fish migration along a river

1. Go to Google Earth, and type in 'River Maigue, Co. Limerick' in the Search box (upper left-hand corner). You can search any river you wish, but the R. Maigue has many barriers on it.

2. Click 'Search'.



3. You can also use Google Maps – use the Satellite view.



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

5. Mark them with a label in Google Earth and produce a map. If you are using a laptop or PC you can copy the image and download it.

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 part of the river

Q1: Why are most of the barriers V-shaped and facing upstream?

Q2: Most of the barriers are low and small but there are two very big barriers that are associated with mills. Can you find them?

Q3: Besides salmon, what other migratory fish would find it difficult to get over these barriers? (Use Google).

Save your map of river barriers along a named river for your assessment.

Lesson 4

Invasive Non-Native Freshwater Plants and Animals

A big agent of change in river ecosystems is the arrival of plants and animals that are new to the area or non-native. Some have arrived by accident, and others have been introduced deliberately by humans. Some introductions are harmless and do not spread; often the Irish climate conditions may not suit them and they cannot reproduce very well. Others may find the climate and surroundings very suitable, and because of particular traits, they begin to spread and invade existing habitats. They can muscle-out native species through competition for space and resources or through predation. An example of the former is the introduction of grey squirrels from North America that led to the extinction of native red squirrels in many parts of the former range in Ireland. Thankfully red squirrel numbers are beginning to recover. You should google why this is happening.

Lakes and rivers have been badly affected by invasive species, and freshwater non-native species are more likely to be high-impact invaders. This lesson deals with three non-native alien plants - Giant Hogweed, Japanese Knotweed and Himalayan (Indian) Balsam - that infest rivers; one animal – American Mink; and an aquatic fungus-type organism that has eliminated native crayfish from many of our rivers.

Task 4.1 – Find Out if Giant Hogweed, Himalayan Balsam and Mink occur on your local river or a nearby river

Find if these invasive organisms occur along the rivers or lakes in your locality using the Explore Maps tool in the National Biodiversity Data Centre website. A map showing the 10-km Grid squares where the organism has been found will appear. This map is interactive, you can zoom in to see an individual river or lake and it switches to a satellite image. (It can also be downloaded.)

If Giant Hogweed, Himalayan Balsam and Mink don't occur on your local river, find their nearest location. Assess the danger that they might spread to your local river or lake.

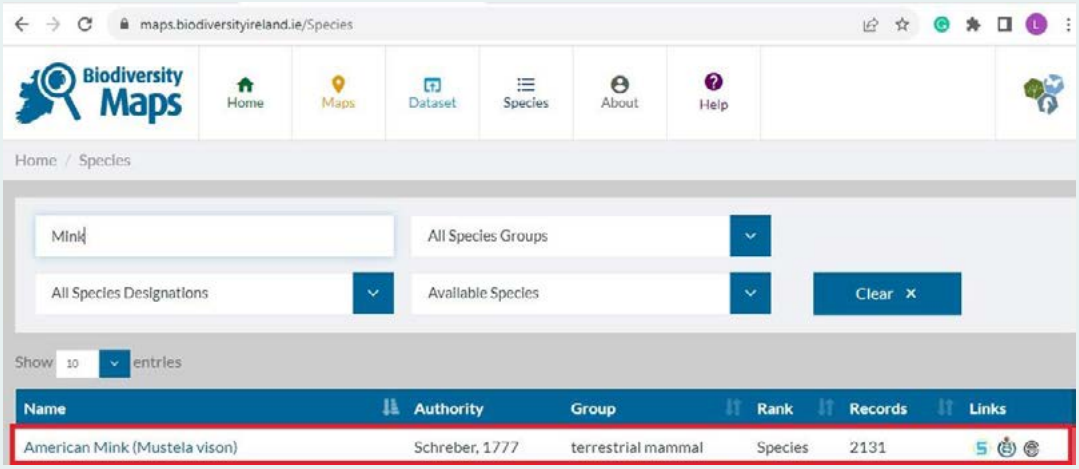
*This task should be carried out on a laptop or desktop computer. *

1. **Go to National Biodiversity Data Centre Website: https://biodiversityireland.ie/**

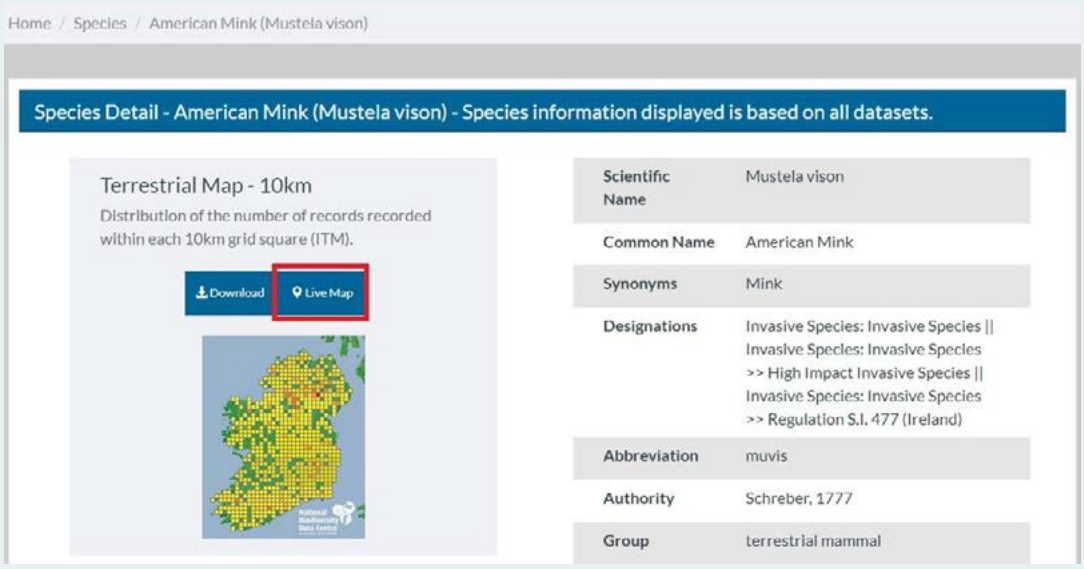
2. **Scroll to the bottom of webpage and click on 'Explore Maps' - Biodiversity Maps page will appear.**

3. **Type in e.g. 'Mink' in the Search box on the right of that page and click on 'Search'**

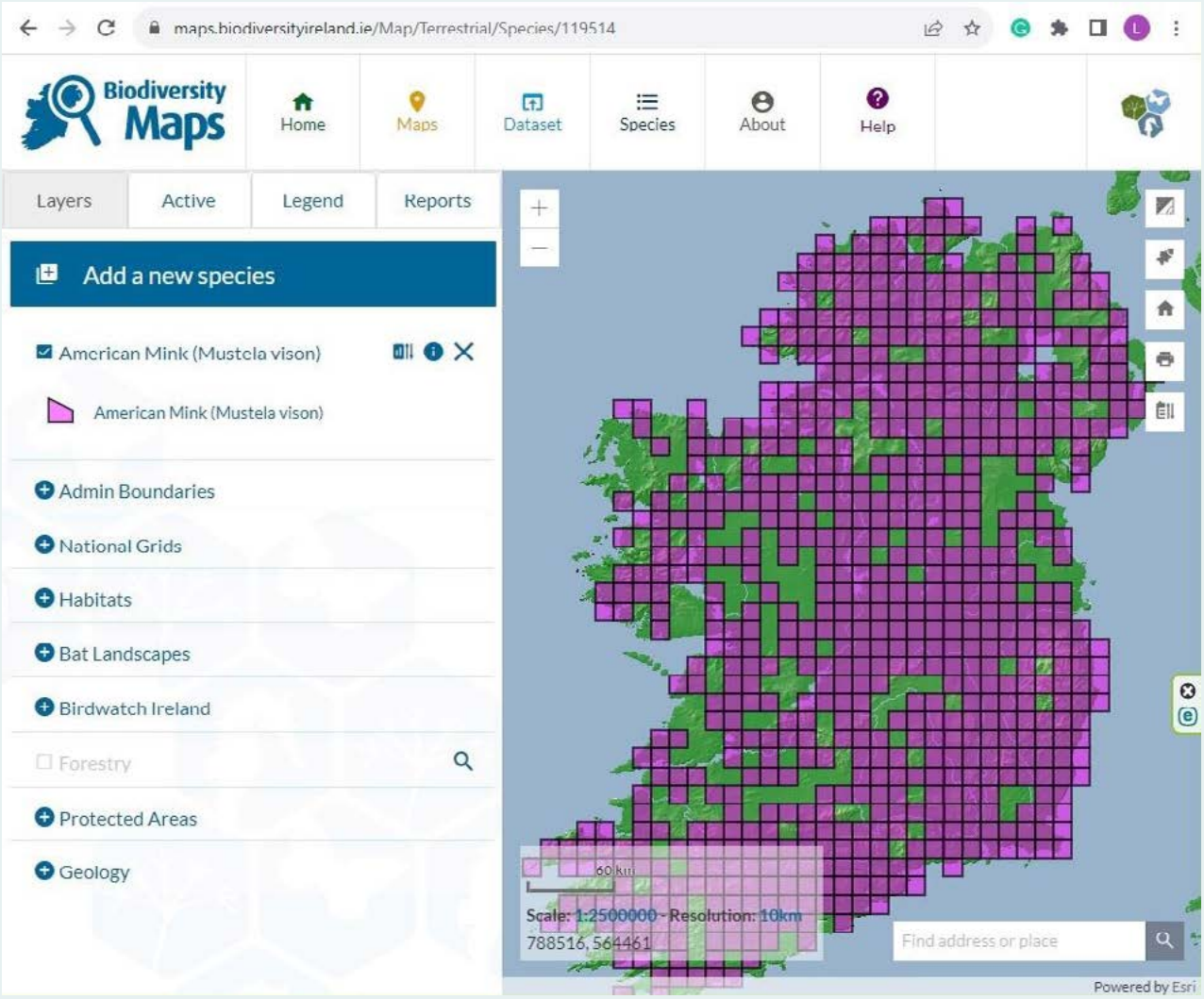
4. A results page will appear. Click on the name American Mink (Mustela vison)



5. A map page will appear : Click on 'Live Map'



6. A map showing the 10-km Grid squares where freshwater mussel has been found will appear. This map is interactive, you can zoom in to see an individual river or lake and you can switch to a satellite image. It can also be downloaded.



Q. Are Mink, Giant Hogweed, Himalyan Balsam, Crayfish Plague found in your locality?

Task 4.2 – Use Google Earth to explore the extent of Giant Hogweed infestation along a river

Giant Hogweed has such large and conspicuous flower heads in summer that individual plants are visible on satellite images. Large stands of the plant are even more visible.

Provided the satellite images have been taken in mid-summer, it is possible to use Google Earth or Google Maps to see the extent of Giant Hogweed infestation along a river. Many rivers around Ireland have become infested with Giant Hogweed. For example, the Mulkear, Newport, Maigue and Loobagh rivers are heavily infested in Limerick.

1. Open Google Earth or Google Maps on a laptop, PC or mobile phone.
2. Search for one of the rivers mentioned or one of your choice if you suspect it is infested with Giant Hogweed.
3. Focus on the river and search upstream starting near its mouth or where it joins another river.
4. If there are Hogweed stands and the satellite images have been taken in midsummer, you should be able to see them:

5. Try to find out the following information:

- How many kilometres upstream does the infestation extends? (Use the Measuring Tool in Google Earth)
- Is it on both banks?
- Where on the river are the largest stands?
- What's the area of the largest stand?
- Do stands extend inland away from the banks?

6. Using the information you have gathered previously, write a short description below of the extent of Giant Hogweed infestation on the river. If you were given the unenviable task of trying to control or eradicate Giant Hogweed on the river (very difficult to do!), at what point on the river would you start, given what you know about the biology of the plant?

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