Researchers in Schools

How to hunt underwater aliens

Key Stage 4 Programme

Pupil Name

Coursebook Designed by **Dr. Jennifer Loxton**

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Uni Pathways launch event

Welcome to Uni Pathways! We are delighted to be able to launch the Uni Pathways programme with you. We hope that you are ready to embark on your Uni Pathways journey and that you enjoy the video.
You will be asked to pause the video at times to complete some work in this workbook, so make sure you have a pen / pencil to hand when you start the video.

By the end of the video, you will have

- Learnt about what studying at university means
- Learnt about some of the skills that you will develop during Uni Pathways
- Heard from pupils who have participated in Uni Pathways or The Scholars Programme (which is the same programme!)
- Heard from current university students talking about what life is like at university

If you are in school your teacher will play the video. If you are at home and logged in to a session with your teacher, your teacher will play the video and show it to you. If you are participating independently your teacher will email you the link to the video or the video file. There are opportunities for you to answer some questions, and you will be told when to pause the video to answer them.

Introduction to Uni Pathways

1. Write down what you think a supra-activity is

_____
_____
_____

2. Independent learning is

_____
_____
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3. Write down in your own words what resilience means, and come up with a different example to the one mentioned in the PowerPoint.

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4. Why do you think analysis and evaluation skills are useful in your academic career?

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5. Why do you think analysis and evaluation skills are useful in life in general?

_____
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_____
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6. What are the different types of learning that university students do?

Pupils' experience of Uni Pathways

You will now watch some pupils talk about their experience of learning a PhD topic and producing a final assignment. Some may refer to The Scholars Programme rather than Uni Pathways. As you heard in the introduction PowerPoint, The Scholars Programme is a very similar programme to Uni Pathways. Listen carefully and then respond to the questions below. Be prepared to share some of your responses with your peers.

1. How did the pupils describe talking about writing a long essay for their final assignment?

2. Write down something that one of the pupils mentioned was particularly interesting in their course.

3. What were some challenges that the pupils met?

Virtual campus tours

You will now go on a virtual tour of some universities! Once you have seen some of the university campuses, respond to the questions below.
Note down something that you liked out of any of the campus tours you saw. It may be a particular building, space, city etc.

1. Were there any similarities between the different university campuses? If so, what are the similarities?

2. If you had to pick one of those universities to go and visit in person, which one would it be and why?

3. Note down some of the societies that you could join at different universities

Meet university students!

You are about to virtually meet or hear from some current university students.
If you are virtually meeting them, think about what questions you would like to ask the students, share your questions with a partner and note those questions down in the space below.

If you are not meeting them but watching some videos that they have made, use the space below to note down what else you would like to find out about university. You can then ask your teacher during Uni Pathways tutorials!

Reflection

Congratulations on completing the launch of the Uni Pathways programme. Before you go, take some time to reflect on what you have learnt by answering the following questions:

1. Are there any aspects of university style learning that you would look forward to? If so, what are they?

2. What challenges do you think students face when learning at university? How would you try to overcome these challenges?

3. What skills do you hope to develop during your Uni Pathways course?

4. What part of Uni Pathways seems the most challenging for you?

5. What are you most looking forward to about Uni Pathways?

Timetable and Assignment Submission

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			
6 (Feedback)			
7 (Feedback)			

Timetable – Homework Assignments

Homework Assignment	Description	Due Date
Tutorial 1	Are invasive species a threat to today's world?	
Tutorial 2	How our super 6 invaders are super spreaders.	
Tutorial 3	Understanding stakeholder impacts for my invasive species	
Tutorial 4	Invasion prevention and management techniques for my invasive species	
Tutorial 5	Write a Biosecurity Plan to stop an alien invasion!	

Assignment Submission – Lateness and Plagiarism

Lateness	
Submission after midnight on due date	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Course Rationale

During this course you will be introduced to marine invasive species, also known as marine aliens.

Invasive species are plants or animals that have spread from their natural home to a new geographical area and are putting ecosystems, economies and human health at risk in that new location. Invasive species are considered one of the greatest threats to marine and coastal biodiversity worldwide and in the UK alone the annual cost of marine invasions to the economy is estimated to be over £2 billion per year.

Using case studies of six notorious marine invasive species, you will learn about what makes a species a successful invader, how they spread, the potential impacts of an invasion, and how invasions are prevented and dealt with. You will learn about the challenges of protecting the marine environment in a modern world, balancing ecological, financial, industrial and human perspectives.

During this course you will develop transferable skills of critical analysis, presenting and scientific writing. During the course, teaching will be delivered through university-style tutorials and discussion to give you an idea of the university experience.

Uni Pathways Mark Scheme 2020

	Subject Knowledge	Critical Thinking	Written Communication
1st	The work shows a depth of knowledge and understanding of key concepts and scientific methods, through engaging with relevant sources. Knowledge is used to build and support highly effective scientific arguments and explanations.	Analyses key scientific evidence, arguments, and reasoning. Interprets meaning and makes connections. Identifies and critically evaluates key scientific arguments and evidence, deciding on their credibility, strength, and relative significance, drawing convincing conclusions.	The work has a coherent flow and is well structured. The writing style is appropriate; scientific language and key scientific terms are used accurately and effectively to support the arguments and explanations made. There are no, or very few, errors in spelling or grammar. Consistent referencing, appropriate paragraphing and use of correctly labelled tables and graphs matching the style taught in the course.
2:1	The work shows an understanding of key concepts and scientific methods, drawing on relevant sources. Knowledge is used to build and support effective scientific arguments and explanations.	Analyses relevant scientific evidence, arguments, and reasoning. Identifies and critically evaluates relevant scientific arguments and evidence, deciding on their credibility and strength, drawing reasonable conclusions. Shows some understanding of the relative value of evidence and arguments.	The work is well-structured. The writing style is appropriate; scientific language and key terms are used correctly. There are few errors in spelling or grammar. Mostly consistent referencing and use of tables and figures; matching the style taught in the course.
2:2	The work shows an understanding of key concepts and scientific methods, with no major misconceptions. Beginning to apply this knowledge to build and support effective scientific arguments and explanations.	Identifies and uses basic scientific evidence, arguments, and reasoning. Showing some understanding of the quality of scientific arguments and evidence. Not yet showing understanding of the relative value of evidence and arguments.	The work has some structure. The writing style can sometimes be informal; occasionally scientific language and key terms are not used when it would be appropriate to do so. There are some errors in grammar and spelling do not get in the way of communicating the content. Referencing has some consistency; matching the style taught in the course Limited use of tables and graphs.
3rd	Shows a developing understanding of key concepts and scientific methods, with some misconceptions. Does not yet apply this	Beginning to analyse scientific evidence, arguments, and reasoning. Describes evidence and arguments, while not	The grammar, spelling, style, and structure of the work need improving in order to communicate ideas to

	knowledge to build and support scientific arguments and explanations.	yet evaluating them.	the reader. Scientific language, key terms and references are not always used correctly. Limited, or no use of tables and graphs.

Baseline Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark

Final Assignment: Pupil Feedback Report

Name of Pupil	
Name of School	
Name of RIS teacher	
Title of Assignment	

How your assignment is graded:

Grade	Marks	What this means
1st	70+	Performing to an excellent standard at A-level
2:1	60-69	Performing to a good standard at A-level
2:2	50-59	Performing to an excellent standard at GCSE
3rd	40-49	Performing to a good standard at GCSE
Working towards a pass	0-39	Performing below a good standard at GCSE
Did not submit	DNS	No assignment received by The Brilliant Club

Lateness	
Any lateness	10 marks deducted
Plagiarism	
Some plagiarism	10 marks deducted
Moderate plagiarism	20 marks deducted
Extreme plagiarism	Automatic fail

Marks

OVERALL MARK / 100		FINAL MARK / 100 (including any deductions)	
DEDUCTED MARKS		FINAL GRADE	

If marks have been deducted (e.g. late submission, plagiarism) the teacher should give an explanation in this section:

Mark Breakdown and Feedback

Subject knowledge	
	mark
Critical thinking	
	mark
Written communication	
	mark

Subject Vocabulary

Word	Definition	In a sentence
Marine	**Marine** animals and plants are ones that live in the sea or ocean.	The parrotfish is a **marine** species that can be found in many tropical oceans.
Invasive species	**Invasive species** are plants or animals that have spread from their natural home to a new geographical area and are putting ecosystems, economies and human health at risk in that new location.	The lionfish is an **invasive species** originally from the Indian Ocean. It is now causing problems in The Caribbean, Western Atlantic and Mediterranean oceans.
Non-native species	**Non-native species** are plants or animals that have spread from their natural home to a new geographical area but are not causing any problems in that new location.	Wheat does not naturally grow in the UK, but is a **non-native species** introduced for farming.
Biodiversity	The variety of plant and animal life found in a particular place. The more varied the plant and animal life, the higher the **biodiversity!**	The forest was very **biodiverse** – it had lots of different animals and plants living there.
Biosecurity	**Biosecurity** is a set of measures aimed at preventing the introduction or spread of unwanted plants or animals into a specific area.	The UK has a **biosecurity** plan to prevent invasive species being introduced or spread.
Vector	**Vectors** are the specific way a species is either accidentally or deliberately transported from its natural home to a new geographical area.	Commercial ships are often **vectors** for invasive species like barnacles and mussels because they can attach themselves to the hull and hitchhike to new locations.
Native range	The **native range** is the maximum and minimum geographical extents of where a species is naturally found.	Lemurs are only naturally found on the island of Madagascar – this is their **native range**.
Distribution	**Distribution** is where a particular species can be found. It may be general e.g. in the world, or describe where the species can be found in a specific place.	Native oysters are widely **distributed** all around the Shetland Islands but are rare in the rest of Scotland.

Tutorial 1 – Understanding the threat of invasive species

What is the Purpose of Tutorial 1?

Tutorial objectives.

By the end of this tutorial I will be able to...

- Define what an invasive species is.
- Identify the key differences between a non-native species and an invasive species.
- Recognise six notorious marine invasive species.

Activity 1: What are invasive species?

Invasive species are plants or animals that have spread from their natural home to a new geographical area and are putting ecosystems, economies and human health at risk in that new location. Invasive species are considered one of the greatest threats to marine and coastal biodiversity worldwide and in the UK alone the annual cost of marine invasions to the economy is estimated to be over £2 billion per year.

We are going to watch the TED-Ed video – The Threat of Invasive Species. While we watch make notes on:

- What an invasive species is.
- Some of the effects of invasive species around the world.

Notes

What is an invasive species?

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What are three effects of invasive species around the world?

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Useful definitions: native, non-native and invasive species

Native species are plants or animals that are living in their natural home.

Non-native species are plants or animals that have spread from their natural home to a new geographical area but are not causing any problems in that new location.

Invasive species are plants or animals that have spread from their natural home to a new geographical area and are putting ecosystems, economies and human health at risk in that new location.

Examples:

NATIVE

Red Squirrel
Originally found across the UK although quite rare now.

NON-NATIVE

Potato
Arrived in UK from the USA, brought here by the colonists sent there in 1584 by Sir Walter Raleigh. Delicious!

INVASIVE

Giant Hogweed
Introduced in the UK in the 19th century as a decorative plant but it escaped into the wild. Now a problem UK-wide.

Native, non-native or invasive? Look at the pictures below and decide if they are native, non-native or invasive. Write a short reason for your choice.

AMERICAN MINK

Introduced from the USA in the early 20th century for fur farms. Some escaped and now there are many in the wild where they compete with the native water vole for habitat.

Native, non-native or invasive?
……
Why do you think that?
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……
……

RING-NECKED PARAKEETS

It became established in the wild in the 1970s after captive birds escaped or were released. Not known to cause any significant problems in the wild.

Native, non-native or invasive?
……
Why do you think that?
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……

GREY SQUIRREL

American grey squirrels were introduced in the UK between 1828 and 1929 when captive animals were released. Now widespread they compete with the native red squirrel.

Native, non-native or invasive?
……
Why do you think that?
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WHEAT

Introduced from the Middle East to the UK nearly 5000 years ago. Now the staple food for millions and important for the UK economy.

Native, non-native or invasive?
……
Why do you think that?
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……

RED DEER

Naturally found across the UK although numbers are higher in rural areas such as Scotland.

Native, non-native or invasive?
……
Why do you think that?
……
……
……

BEAVER

Originally widespread in the UK although they were hunted to extinction in the 16th century. They are now being re-introduced in parts of Scotland.

Native, non-native or invasive?
……
Why do you think that?
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Activity 2: What about invasive species in the marine world?

Useful definitions: marine and biodiversity

Marine animals and plants are ones that live in the sea or ocean.

Biodiversity: The variety of plant and animal life found in a particular place. The more varied the plant and animal life, the higher the biodiversity.

Take a look at these pictures of a coral reef. What differences can you see between the before and after pictures?

REEF 1 **REEF 2**

BEFORE

AFTER

These pictures show two areas of coral reef before and after a **lionfish** invasion. The lionfish is an invasive species, originally from the South Pacific and Indian Oceans; they are now becoming increasingly common on coral reefs around the world.

LIONFISH FACTS

Feeding:

- Carnivores, eating other fish.
- Lionfish are always hungry – they will binge until they run out of fish!
- Stomach can expand to 30 times original size.
- Like to eat young and baby fish, cleaner fish (fish which clean parasites off other fish), shrimp and grazing fish (fish that eat algae – sea plants).

Breeding:

- Can produce 30,000 eggs at a time and reproduce every thirty days.

In pairs, discuss why you think the reefs have been changed by the lionfish invasion. Write notes here

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Activity 3: Meet the invaders!

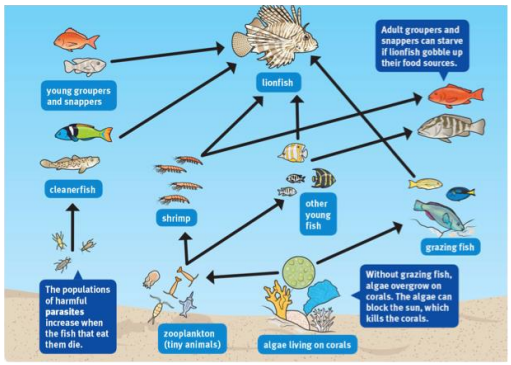
Lionfish (*Pterois volitans*)

Where they are naturally from: South Pacific and Indian Oceans.

Where they are found now: Western tropical Atlantic (East and South USA), the Caribbean, and the Mediterranean.

Invasion impact:
- Reduced reef biodiversity
- Can kill coral and damage habitat

How do they have an impact?
- Lionfish population quickly grows.
- It has good defence (poison) so few predators outside it's native habitat.
- Other fish have more parasites because lionfish eat the cleaner fish.
- Coral is overgrown with algae and can die because there are fewer grazing fish.
- Fewer adult fish because lionfish eats the young fish.



Carpet Seasquirt (*Didemnum vexillum*)

What is it? A marine colonial seasquirt. Many thousands of tiny squishy animals live together in a big mass.

Where they are naturally from: Japan

Where they are found now: Europe, North America and New Zealand

Invasion impact:
- Reduced biodiversity
- Expensive to remove from boats, machinery and shellfish.

How do they have an impact?
- Can survive a wide range of sea temperatures.
- No natural predators
- Very fast grower – can quickly smother the native plants and animals.
- Likes to grow on manmade surfaces and other plants and animals.
- Increases the weight of marine equipment and can cause breakages.

Japanese wireweed(*Sargassum muticum*)

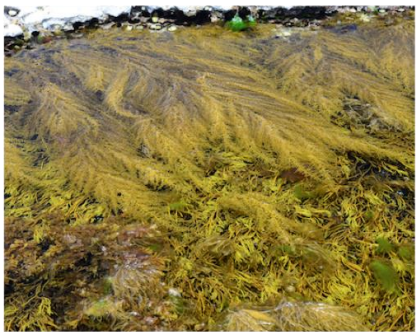
What is it? A seaweed which grows in long strands. Strands are covered in many small bubbles so it floats.

Where they are naturally from: Japan

Where they are found now: Europe, North America and North Africa

Invasion impact:
- Reduced biodiversity
- Expensive to remove from boats, machinery and shellfish.

How do they have an impact?
- Forms large mats on the sea surface which block the light and prevent other plants from growing
- Broken pieces can grow in a new place after travelling long distances on ocean currents.
- Very fast grower
- Can get wrapped around equipment like propellers.
- Increases the weight of marine equipment



Chinese mitten crab(*Eriocheir sinensis*)

What is it? A crab with large furry claws. Spends time in both the sea and rivers

Where they are naturally from: Asia

Where they are found now: Europe, North America

Invasion impact:
- Damage riverbanks and habitats
- Can damage fishing equipment
- Competes with native species for space and food

How do they have an impact?
- One female can release up to a million eggs!
- Burrows into river banks causing erosion and damage
- Competes with native species
- Damages natural habitats
- Sharp claws can damage to fishing nets

Wakame(*Undaria pinnatifida*)

What is it? A large seaweed which can grow up to 3m long

Where they are naturally from: Japan

Where they are found now: Europe,

Invasion impact:
- Reduced biodiversity
- Expensive to remove from boats and machinery
- Can smother shellfish

How do they have an impact?
- Produces millions of spores
- Grows very fast
- Competes with native species
- Can replace native kelp forests which are important habitats
- Can get wrapped around equipment like propellers.
- Grows on shellfish and is difficult to remove
- Increases the weight of marine equipment

Northern Pacific Seastar (Asterias amurensis)

What is it? A starfish

Where they are naturally from: North Pacific waters (Japan, Korea, etc.)

Where they are found now: Australia

Invasion impact:
- Reduced biodiversity
- Can destroy shellfish fisheries

How do they have an impact?
- Female seastar can carry up to 20 million eggs
- Populations grow very fast
- Eats virtually anything – including dead and decaying animals
- Eats the egg masses of some endangered species.

In pairs discuss which one of the alien species we have spoken about today you think is the biggest threat.

Write your reasoning below

The species that we think is the biggest threat is …

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Our reasons for thinking this are…

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Activity 3: Check your understanding

We have been introduced to some new terms today. For each of the following words now write your own definition in your own words.

Word	Definition	Definition in your own words
Marine	**Marine** animals and plants are ones that live in the sea or ocean.	
Invasive species	**Invasive species** are plants or animals that have spread from their natural home to a new geographical area and are putting ecosystems, economies and human health at risk in that new location.	
Non-native species	**Non-native species** are plants or animals that have spread from their natural home to a new geographical area but are not causing any problems in that new location.	
Biodiversity	The variety of plant and animal life found in a particular place. The more varied the plant and animal life, the higher the **biodiversity!**	

Homework – Baseline Assignment

Q: Are invasive species a threat to today's world?

Write your answer in approximately 500 words, using diagrams or pictures where helpful to illustrate your points.

Key Points to Discuss:

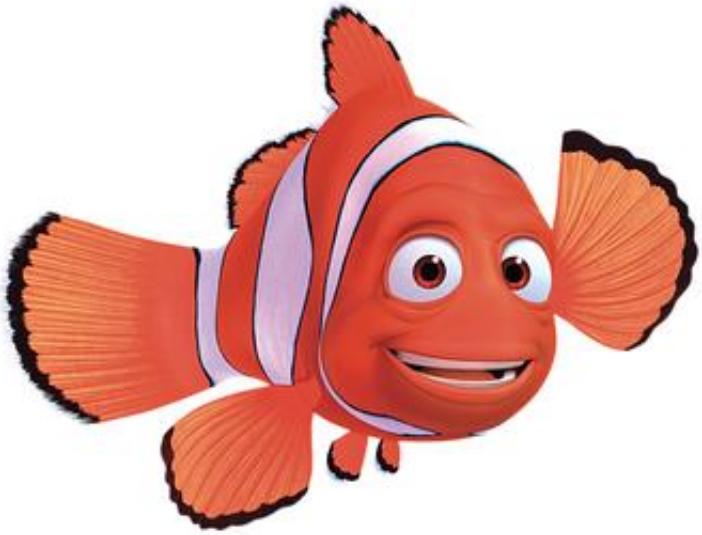
- What is an invasive species?
- What is the difference between a non-native species and an invasive species?
- What kind of problems can invasive species cause? Use examples of invasive species to illustrate potential invasive impacts.

Use your tutorial notes to help you.

You can also conduct your own independent research using relevant books, videos and websites such as:

- https://www.youtube.com/watch?v=gYNAtw1c7hI
- https://www.iucn.org/resources/issues-briefs/invasive-alien-species-and-climate-change

Tutorial 2 – Hitchhikers, stowaways and "Finding Nemo"



What is the Purpose of Tutorial 2?

Tutorial objectives.

By the end of this tutorial I will be able to...

- Define what a vector is.
- Summarise how evolution and adaptation enables species to adapt to their native environment.
- Give examples of three adaptations and specialisations that can help species be successful invaders in a new location.

Activity 1: How are they getting around?

For a species to invade a new geographical location it first has to get there! There are many ways that marine species can travel the world. For example they could…

- **Hitchhike**. This is one of the most common modes of travel for invasive species. Animals or plants stick themselves onto something that is moving through the ocean and hitch a lift to a new place!
- **Stowaways.** Sometimes species can accidentally stow away with transport of other marine things that are being moved to a new place. For example there may be stowaways in batches of oysters that are being moved to a different country to be farmed.
- **Going with the flow.** Eggs, spores or larvae (baby marine animals) can often survive for long periods of time in the sea without food. They might get swept long distances in storms or can get "sucked up" and moved accidentally in water that is being transported.
- **Deliberate or accidental release**. People may deliberately or accidentally release some species into new locations.

Think, pair, share

Have a look at the pictures below. Dr Loxton will allocate each pair a picture to discuss. In pairs see if you can think of how your picture might be involved in moving species into a new location. Make some notes on your ideas and be ready to share with the group.

Notes.

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Activity 2: Group Think

Look at the images below of things that are involved in the spread of invasive species. In pairs see if you can think which type of species might be able to use each to move around and how they do it.

CARGO SHIPS

Types of species that might travel this way…

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How might invasive species travel this way?…

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Cargo ships often travel many thousands of miles moving at quite slow speeds. When the ships are being loaded they put some seawater in the bottom of the ship to balance the heavy weights they are carrying. This water is called ballast water and it is released back into the sea when the ship arrives at its destination.

AQUARIUM/ PET FISH SHOPS

Types of species that might travel this way…

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……

How might invasive species travel this way?…

……

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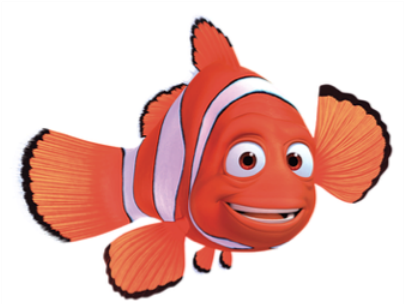
Aquarium shops may transport fish species all over the world to be sold as pets. Some shops are more careful than others at transporting species. Some traders have been known to release fish that don't sell.

THE "FINDING NEMO" EFFECT



Types of species that might travel this way…

……

……

How might invasive species travel this way?…

……

……

In the 2003 film Finding Nemo, a small fish is trying to get back home after getting lost. In the film Nemo is told that "all drains lead to the ocean" – this has led to many thousands of pet fish being flushed down toilets or being released into the sea.

SHELLFISH FARMING

Types of species that might travel this way…

……

……

How might invasive species travel this way?…

……

……

In shellfish farming (for example oyster, clam or mussels) live shellfish is often moved to different locations to grow. Some species are moved across the world – for example oysters from Japan to the USA, UK or Europe. Shellfish farming usually takes place in the sea.

RELIGIOUS CEREMONIES

Types of species that might travel this way…

……

……

How might invasive species travel this way?…

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In some religions animals are released into the wild as part of a ritual or ceremony. Buddhists, for example, have the ceremony of "Fangsheng" which is a mercy release ritual. Fish or shellfish are purchased from shops such as pet shops and then released into the ocean.

OCEAN LITTER

Types of species that might travel this way…

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How might invasive species travel this way?…

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There are an estimated 5.25 trillion pieces of floating litter in the sea. Most of these will spend many months or years at sea before washing up in a new location.

Useful definitions: Vector, native range and distribution

Vectors are the specific way a species is either accidentally or deliberately transported from its natural home to a new geographical area.

The **native range** is the maximum and minimum geographical extents of where a species is naturally found.

Distribution is where a particular species can be found. It may be general e.g. in the world, or describe where the species can be found in a specific place.

Activity 3: How to make a super invader

Adaptation and specialisation
Over thousands or millions of years of evolution, marine species have adapted to become the best they can be in their native environment.

For example they may have evolved adaptations to help them:

- Find food.
- Escape predation (stop it being eaten).
- Breed successfully.
- Fight off competition for food or space.
- Thrive in the temperature range of their native environment.
- Make the most of the seasonal changes in day length in their native home.

Think

Can you think of any specialisations that marine creatures have evolved? Have a think and make some notes below. Be ready to share your ideas with the group.

Notes.
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Think, pair, share

What might these specialisations mean for species that then settle in a new location in another part of the world? Discuss with your partner and make some notes below. Be ready to share your ideas with the group.

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Group task: Let's look at our 6 star invaders

As a group, let's work through our 6 star invaders and see if we can identify any specialisations, which are helping them to be a successful invader. Make notes in the table below.

Check back in the notes from tutorial 1 if you need to remind yourself about these species.

Species	Specialisation	How does this give them an advantage?
Lionfish		
Carpet seasquirt		
Japanese wireweed		
Chinese mitten crab		
Wakame		
Northern Pacific seastar		

Activity 4: Check your understanding

Give examples of three adaptations or specialisations that can help species be successful invaders in a new location.

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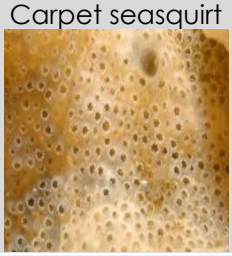
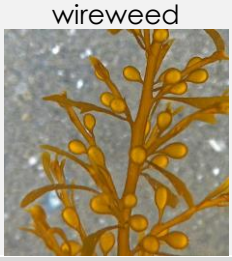
We have been introduced to some new terms today. For each of the following words now write your own definition in your own words.

Word	Definition	Definition in your own words
Vector	**Vectors** are the specific way a species is either accidentally or deliberately transported from its natural home to a new geographical area.	
Native range	The **native range** is the maximum and minimum geographical extents of where a species is naturally found.	
Distribution	**Distribution** is where a particular species can be found. It may be general e.g. in the world, or describe where the species can be found in a specific place.	

Homework title: How our super 6 invaders are super spreaders.

Homework instructions: **Note. There are 2 parts to this homework**

Part 1: Complete the table below with your ideas of how our super 6 invaders are spreading. Use information from this tutorial and previous tutorials to inform your thinking. There is further information and signposts to further resources in Appendix 2.

Species	Vector	How is it using this vector to move around?
Lionfish		
Carpet seasquirt 		
Japanese wireweed 		
Chinese mitten crab		
Wakame		
Northern Pacific seastar		

See the next page for Part 2!!

Part 2: Read the background sheet hand-out for the role assigned to you by Dr Loxton. You will need to have read this for next week so you are ready for the tutorial. Be prepared to introduce yourself to your group in the next tutorial and talk a little bit about your profession (30 seconds).

You can write the script for your introduction here

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Tutorial 3 – Who cares about invasive species anyway?

What is the Purpose of Tutorial 3?

Tutorial objectives.

By the end of this tutorial I will be able to...

- Discuss the balancing act of ecological, commercial and human roles in marine invasions.

Did you know that it is estimated that invasive species cost the UK £2 billion every year! That is £2,000,000,000 - enough to pay for free school meals for 5 million children

Activity 1: Ecological, commercial and human roles in invasions

First, some definitions

A **stakeholder** is a person or group with an interest or concern in something.

An **ecological stakeholder** is a person or group with an interest or concern in something who are thinking about it from a mostly environmental perspective.
For example: The RSPB (Royal Society for the Protection of Birds) would be an ecological stakeholder for anything that might concern birdlife.

A **commercial stakeholder** is a person or group with an interest or concern in something and who are thinking about it from a mostly financial or business perspective.
For example: Fishing trawler operators would be commercial stakeholders for anything that might concern fish.

A **human stakeholder** is a person or group with an interest or concern in something and who are thinking about it from a cultural, societal or individual perspective.
For example: Surfers Against Sewage are a group of surfers who are concerned about pollution in the ocean.

Can we group the vectors from last tutorial into ecological, commercial or human?

Work in pairs to discuss the vectors from last tutorial and see if you can fit them into the following table.

Vectors:

- Hurricanes and storms
- Cargo ships
- Aquarium shops
- The "finding nemo" effect
- Shellfish farming
- Religious ceremonies
- Ocean litter

Ecological	Commercial	Human

Many of the same stakeholder groups, which may have been involved in the introduction of invasive species, are often subsequently impacted – although sometimes this may be many years, or even decades after the introduction.

Activity 2: Roleplay – let's put on our different "hats"

Everyone will now take it in turns to introduce themselves (30 seconds) and the role they will be playing today. You can make a note of the roles for each person below:

- Community Biodiversity Officer .....
- Offshore wind farm operator .....
- Cargo ship captain .....
- SCUBA diving company owner .....
- Oyster farmer .....
- Yacht owner .....

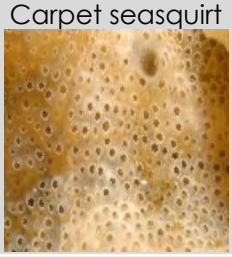
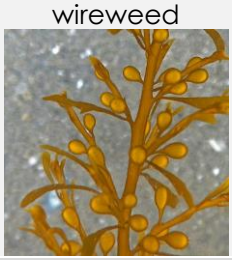
Preparation makes perfect

You have 5 minutes to think about positive and negative impacts of a species invasion for your specific role.

My role is .....

You can note your thoughts in this table (continued on next page):

Species	Positive impacts	Negative impacts
Lionfish		

Species	Positive impacts	Negative impacts
Carpet seasquirt 		
Japanese wireweed 		
Chinese mitten crab		
Wakame		
Northern Pacific seastar		

Speed mingling

You will now move around the room as instructed by your teacher to the different invasive species stations. At each station you will be paired with a different person. At each station you will:

1. Discuss the positive and negative impacts the species may have on you and your business (2.5 minutes)

2. Summarise your views on the post-it notes provided and fix them to the species station before you move on. (1.5 minutes)

Review

As a group we will now go over each species in turn and look at similarities and differences between the impacts on different stakeholders.

For each species make a note of the stakeholder you think is most impacted, and the stakeholder you think is least impacted.

Lionfish

Most impacted stakeholder .....

Least impacted stakeholder .....

Carpet seasquirt

Most impacted stakeholder .....

Least impacted stakeholder .....

Japanese wireweed

Most impacted stakeholder .....

Least impacted stakeholder .....

Chinese Mitten Crab

Most impacted stakeholder .....

Least impacted stakeholder .....

Wakame

Most impacted stakeholder .....

Least impacted stakeholder .....

Northern Pacific seastar

Most impacted stakeholder .....

Least impacted stakeholder .....

Think, pair, share

Can you think of any stakeholders who we haven't mentioned today but that might be impacted by marine invasive species? Be ready to share your views with the group.

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Activity 3: Check your understanding

We have been introduced to some new terms today. For each of the following words now write your own definition in your own words.

Word	Definition	Definition in your own words
Ecological stakeholder	An **ecological stakeholder** is a person or group with an interest or concern in something who are thinking about it from a mostly environmental perspective.	
Commercial stakeholder	A **commercial stakeholder** is a person or group with an interest or concern in something and who are thinking about it from a mostly financial or business perspective.	
Human stakeholder	A **human stakeholder** is a person or group with an interest or concern in something and who are thinking about it from a cultural, societal or individual perspective.	

Homework title: Understanding stakeholder impacts for my invasive species

Homework instructions:

Dr Loxton will randomly allocate you an invasive species. You will be given the species sheet we have all been working on this lesson.

For your species write a short (300 words) summary of the potential positive and negative impacts of your invasive species on different stakeholders.

Don't forget to use the words ecological, commercial and human when describing the different stakeholders.

You can use the information on your species from the tutorials so far and also Appendices A and B for signposts to further reading.

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Tutorial 4 – How to prevent an alien invasion!

What is the Purpose of Tutorial 4?

Tutorial objectives.

By the end of this tutorial I will be able to...

- Describe three different ways to prevent alien invasions.
- Give an example of a monitoring technique.
- Define what a biosecurity plan is.
- Discuss 3 invasion management techniques.

Activity 1: Prevention is better than cure

We have already identified a number of different potential vectors for marine invasive species in earlier tutorials. Now we are going to think if there are any things that we could do to prevent species being introduced via these routes.

Some things, such as storms or hurricanes, might be beyond our control but where people are involved then hopefully we could take some steps to minimise the risk of an invasion.

Think
See if you can think of one step that we could potentially take to reduce the risk of invasive species being introduced through each of these routes. Write your notes in the table below. Be ready to share your ideas with the group and add in any additional ideas that you missed.

Vector	Ideas for prevention
Cargo Ships	
Aquarium shops	
The "Finding Nemo" effect	
Shellfish farming	
Religious ceremonies	
Ocean Litter	

Activity 2: How do we know what's out there?

One of the big challenges with invasive species is knowing when an invasive species arrives and when and where it is spreading to. The faster we know about an invasion then the more chance we have of stopping it taking hold and spreading!

To tackle this problem we need monitoring. There are two main ways that invasive species distribution is monitored:

1. Formal government or university-led surveys. But these are expensive and there are not enough staff to do these regularly.
2. Using citizen science. This is where members of the public help to keep an eye out in their local area for the arrival or spread of invasive species.

We are going to watch a video by Eco Sapien on citizen science – during the video take a note of any potential pros or cons of citizen science that you notice.

Notes

Pros of citizen science

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Cons of citizen science

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Let's do some citizen science!

In pairs you will each be handed a record and a photo of an invasive species sighting near you. These are real sightings of an invasive species called Giant Hogsweed from our local area.

We are going to prepare the information we will need to report these sightings through PlantTracker

PlantTracker

Read all the information you have been given carefully and complete the boxes below, ready to be uploaded onto PlantTracker.

Species name:

Amount: (low, medium, high, v high)

Latitute and Longitude

Date

Now let's log all of these records onto PlantTracker!

Well done – you just participated in citizen science!

Think, Pair, Share
In pairs, think about whether you think citizen science is a useful tool to monitor or prevent the spread of invasive species. Make notes in the table below. Be ready to share your thoughts with the group.

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Activity 3: Introducing the biosecurity plan

Useful definition: biosecurity

Biosecurity is a set of measures aimed at preventing the introduction or spread of unwanted plants or animals into a specific area.

As you are probably realising there might be lots of different steps and actions that a country or region need to do to prevent and manage invasive species, and those actions might involve lots of different stakeholders. To bring all of this together so that everyone is working towards the same goal, the best thing to do is put it all together in a biosecurity plan.

A biosecurity plan is:
- Specific to the region that is at risk of invasion.
- May be for just one species or for multiple species.
- Pulls together all the necessary information about that species, potential impacts, potential vectors and prevention and monitoring steps.
- This should be presented in a clear way so that all stakeholders can understand.

What do you think are the most important things to put in a biosecurity plan? In pairs discuss and make notes in the box below. Be ready to share your ideas with the group.

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Activity 4: We've been invaded! Don't panic!

Sometimes, despite the best efforts of everyone involved, it is not possible to prevent an invasion. Maybe a large storm blew floating rafts of ocean litter to shore… Maybe an industrial accident released live animals into the wild…. Sometimes we might not even know how a species got there. But what do we do now?

There are three main management approaches we can take to deal with an invasion once it has happened:

1) Eradication attempt (all the invasive species is killed or removed)
2) Population control (keep the invasive species population low so as to prevent impact on native species)
3) Learn to live together

Each pair is going to be given a scenario which used one of these management techniques. In pairs think about which technique was attempted, the pros and cons of this technique and whether it was successful. Be prepared to present your findings to the group

Species:

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Management technique:

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Pros:

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Cons:

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Was it a success?

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Let's watch a National Geographic video on how lionfish populations are being managed in Florida, USA.

Homework title: Invasion prevention and management techniques for my invasive species

Homework instructions:

Last week Dr Loxton allocated you an invasive species.

For your species write a short (300 words) summary of the potential prevention and/or management techniques that might be suitable for your invasive species.

You can use the information on your species from the tutorials so far. Some prevention or management techniques may have been tried for your species already in different parts of the world and Appendix 2 will give you for signposts to further reading.

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Tutorial 5 – How to write a great final assignment

What is the Purpose of Tutorial 5?

This tutorial is dedicated to helping you develop all the important skills needed to plan and write your final assignment.

By the end of this tutorial I will be able to:

- Understand how to plan my final assignment using a mind map.
- Structure my essay in the correct way.
- Reference my essay with relevant sources.
- Confidently write my final assignment.

Activity 1 – Plan it!

The most difficult part of writing an essay is knowing what to write, so it's a very good idea to prepare what you want to say before you start writing. The first thing you should always do is look at the essay title and information and underline or highlight the keywords.

Task: Have a go at highlighting or underlining the keywords in your final assignment question.

Final assignment: Write a Biosecurity plan to stop an alien invasion!

You are the head marine biologist of your own island nation! Your island is being threatened by a marine alien, which has been spotted on the coastline of a nearby country. Your island has all the same industries, habitats, social structures and transport connections as the UK, but none of the invasive species - yet….
Your task is to write a biosecurity plan for your island on your own marine invasive species (each student has been given their own supplied by Dr. Loxton). The biosecurity plan should be 2000 words in length and should include:

- An introduction to what invasive species are
- A description of your species including its origins and where it is now considered invasive
- What do you think the invasion pathways and vectors might be for your species? Explain your thinking and use past invasions to guide you
- What adaptations and characteristics does your species have which help to make it a successful invader?
- What impacts might your species have on your island, thinking from an environmental, commercial and human perspective?
- What could be done to prevent your species from spreading to your island?
- A conclusion, which summarises the overall risk you think is posed by your invasive species to your island. Do you think your biosecurity plan will ultimately be successful in preventing an alien invasion? Explain your reasoning.

A mind map is a great way to start putting your ideas down on paper, just remember to keep referring back to the keywords in the assignment question to make sure all your ideas are relevant. Use the box below to make a mind map for your final assignment.

Your mindmap

Activity 2 – Structure it!

The next things to think about are the different parts of an essay and what to put in each of those parts.

In pairs, think about which parts of your final assignment you would include in the introduction, main body and conclusion, then write them in the boxes below.

Introduction	Main body	Conclusions

Activity 3 – Good Versus Bad!

In pairs read the short essay being handed out by Dr Loxton and use the space below to write about what "what went well" and "even better if". Be ready to share your thoughts with the group.

Make sure that you make good notes as you can use these as tips for when it comes to writing your final assignment.

What went well:

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Even better if:

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Activity 4 – Reference It!

Whenever you use information that someone else has written you need to acknowledge them by referencing them after the piece of information you have used. Look back at the essay you were reading and see how the work was referenced.

Read Appendix 1 and then in pairs discuss how to write a reference and summarise it in a short sentence below

To write a reference I need to include:

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Homework – Final Assignment

Write a Biosecurity Plan to stop an alien invasion!

You are the head marine biologist of your own island nation! Your island is being threatened by a marine alien, which has been spotted on the coastline of a nearby country. Your island has all the same industries, habitats, social structures and transport connections as the UK, but none of the invasive species – yet…

Your task is to write a biosecurity plan for your island on your own marine invasive species (each student will have their own which was supplied by Dr Loxton in tutorial 3). The biosecurity plan should be 2000 words in length and should include:

- An introduction to what invasive species are
- A description of your species including its origins and where it is now considered invasive
- What do you think the invasion pathways and vectors might be for your species? Explain your thinking and use past invasions to guide you
- What adaptations and characteristics does your species have which help to make it a successful invader?
- What impacts might your species have on your island, thinking from an environmental, commercial and human perspective?
- What could be done to prevent your species from spreading to your island?
- A conclusion, which summarises the overall risk you think is posed by your invasive species to your island. Explain your reasoning.

Your report should be structured using appropriate subheadings, including introduction and conclusion.

Include diagrams where they help you to explain your point. These must be labelled and referred to in the text.

Extra reading and research are encouraged. Search for information about marine invasive species in general, and your species specifically, on the internet and look out for news articles and scientific and environmental websites. Make sure to comment on the reliability of these sources and reference them as detailed in Appendix 1.

Tutorial 6 – Feedback tutorial

What is the Purpose of Tutorial 6?

- To receive feedback on your final assignment
- To respond to the feedback from your Uni Pathways teacher
- To write targets for improvement on your final assignment

Final assignment feedback from your Uni Pathways Teacher

(Remember to look at the mark scheme to help you understand what you have done well so far, and how you can do even better in your final assignment)

Here are three things that my Uni Pathways Teacher thought I did well in my draft assignment
•   •   •

Here are three things that my Uni Pathways Teacher thinks that I could do to get a higher mark in my final assignment
•   •   •

Tasks from my Uni Pathways Teacher to do during the feedback tutorial to help me improve
•   •   •
My response:

Actions I will take to improve my final assignment after this tutorial…
•   •   •

Hand in date for my final assignment:	

Tutorial 7 – Final tutorial

What is the Purpose of Tutorial 7?

- To receive feedback and a grade on your final assignment.
- To reflect on the programme including what you enjoyed and what was challenging.
- To ask any questions you may have about university.

Final assignment feedback from my Uni Pathways Teacher

Final mark:	University style grade:
Feedback: Here are three things that my Uni Pathways teacher thought I did well in my final assignment • • •	

Here are three things that my Uni Pathways teacher thinks I should remember for when I am doing this kind of study in the future
• • •

University

What questions do you still have about University after taking part in Uni Pathways?
•   •   •

Reflecting on Uni Pathways

What did you most enjoy about Uni Pathways?
•   •   •

What did you find challenging about the programme?	How did you overcome these challenges?
• • •	• • •

Appendix 1 – Referencing correctly

When you get to university, you will need to include references in the assignments that you write, so we would like you to start getting into the habit of referencing in your Brilliant Club assignment. This is really important, because it will help you to avoid plagiarism. Plagiarism is when you take someone else's work or ideas and pass them off as your own. Whether plagiarism is deliberate or accidental, the consequences can be severe. In order to avoid losing marks in your final assignment, or even failing, you must be careful to reference your sources correctly.

What is a reference?

A reference is just a note in your assignment which says if you have referred to or been influenced by another source such as book, website or article. For example, if you use the internet to research a particular subject, and you want to include a specific piece of information from this website, you will need to reference it.

Why should I reference?

Referencing is important in your work for the following reasons:

- It gives credit to the authors of any sources you have referred to or been influenced by.
- It supports the arguments you make in your assignments.
- It demonstrates the variety of sources you have used.
- It helps to prevent you losing marks, or failing, due to plagiarism.

When should you use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

There are a number of different ways of referencing, and these often vary depending on what subject you are studying. The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1. **A marker in your assignment**: After you have used a reference in your assignment (you have read something and included it in your work as a quote, or re-written it your own words) you should mark this is in your text with a number, e.g. [1]. The next time you use a reference you should use the next number, e.g. [2].
2. **Bibliography**: This is just a list of the references you have used in your assignment. In the bibliography, you list your references by the numbers you have used, and include as much information as you have about the reference. The list below gives what should be included for different sources.

    a. **Websites** – Author (if possible), title of the web page, website address, [date you accessed it, in square brackets].

    E.g. Dan Snow, 'How did so many soldiers survive the trenches?', http://www.bbc.co.uk/guides/z3kgjxs#zg2dtfr [11 July 2014].

    b. **Books** – Author, date published, title of book (in italics), pages where the information came from.

    E.g. S. Dubner and S. Levitt, (2006) *Freakonomics*, 7-9.

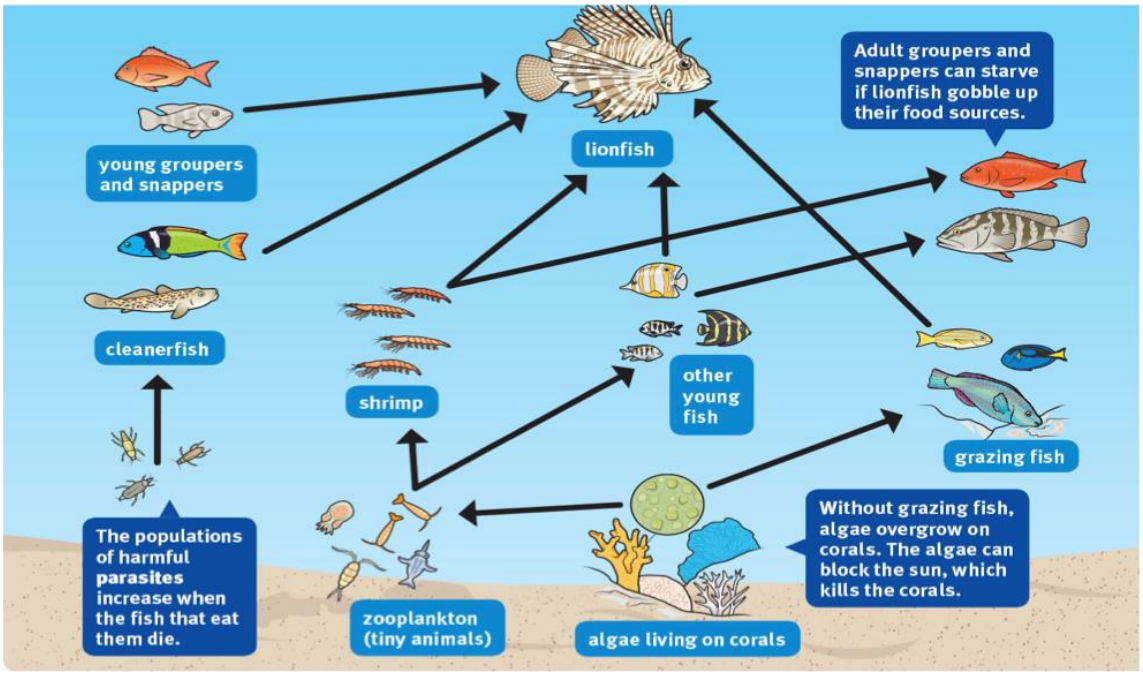
    c. **Articles** – Author, 'title of the article' (with quotation marks), *where the article comes from* (newspaper, journal etc.), date of the article.

    E.g. Maev Kennedy, 'The lights to go out across the UK to mark First World War's centenary', Guardian, 10 July 2014.

Appendix 2 – Invasive species knowledge organisers

Lionfish

Lionfish (*Pterois volitans*)



Overview: Lionfish are one of the most notorious invasive species in the USA. Their bold colours and frilly fins make lionfish popular in the aquarium trade; over the past 25 years or so, it seems aquarium fish owners have sometimes dumped unwanted lionfish — which are native to the Indo-Pacific region — into the Atlantic Ocean.

Lionfish are fast and powerful, but their biggest advantage is novelty. Atlantic prey fish simply don't know what's going on. Biologists call this phenomenon prey naivety, and they believe it is largely responsible for the lionfish's dramatic success as an invader.

Since the first breeding populations were spotted in the USA in 2000, lionfish have rapidly overtaken coastal environments in the Atlantic Ocean, Gulf of Mexico and the Caribbean Sea; they are also becoming increasingly common in the Mediterranean. (livescience.com, 2019)

Where they are naturally from: South Pacific and Indian Oceans.

Where they are found now: Western tropical Atlantic (East and South USA), the Caribbean, and the Mediterranean.

Invasion impact:

- Reduced reef biodiversity
- Can kill coral and damage habitat

How do they have an impact?

- Lionfish population quickly grows.
- It has good defence (poison) so few predators outside it's native habitat.
- Other fish have more parasites because lionfish eat the cleaner fish.
- Coral is overgrown with algae and can die because there are fewer grazing fish.
- Fewer adult fish because lionfish eats the young fish.

Further Resources:
https://www.smithsonianmag.com/science-nature/invasion-of-the-lionfish-131647135/
https://www.fisheries.noaa.gov/southeast/ecosystems/impacts-invasive-lionfish
https://video.nationalgeographic.com/video/news/00000157-251f-d8c6-a77f-6d1fcb700000

Carpet Seasquirt

Carpet Seasquirt (*Didemnum vexillum*)

Overview: The carpet seasquirt (*Didemnum vexillum*) was first recorded in the UK in 2008 in Holyhead, Wales and is now well-established in marinas along the south coast of England. This highly invasive carpet sea-squirt is a sac-like marine invertebrate filter feeder that can form huge mats or hanging colonies on artificial and natural hard surfaces.
It is very robust, tolerating a wide range of environmental conditions. Thousands of larvae are brooded within the seasquirt and when released, swim for a short period before attaching to a hard surface. It can also reproduce asexually by budding and fragments of colonies readily reattach.

What is it? A marine colonial seasquirt. Many thousands of tiny squishy animals live together in a big mass.

Where they are naturally from: Japan

Where they are found now: Europe, North America and New Zealand

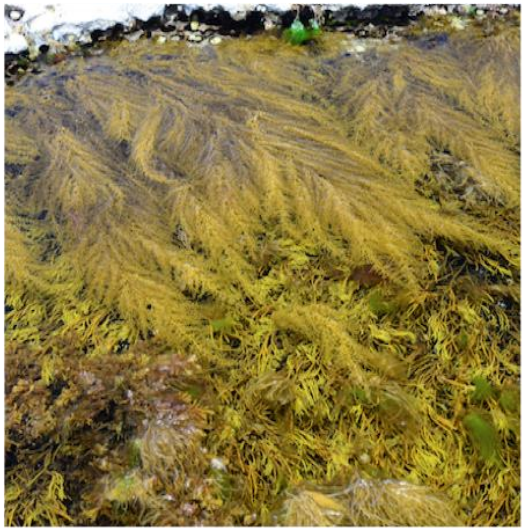
Invasion impact:
- Reduced biodiversity
- Expensive to remove from boats, machinery and shellfish.

How do they have an impact?
- Can survive a wide range of sea temperatures.
- No natural predators
- Very fast grower – can quickly smother the native plants and animals.
- Likes to grow on manmade surfaces and other plants and animals.
- Increases the weight of marine equipment and can cause breakages.

Further Resources:
http://www.plymouth-mpa.uk/codeless_portfolio/carpet-sea-squirt/
https://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=RAPID_Good_Pratice_Management_Carpet_sea_squirt_EN.pdf
http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=1209

Japanese Wireweed

Japanese wireweed (*Sargassum muticum*)



Overview: Japanese wireweed is a long brown seaweed. Originally from japan it is now found in Europe, North America and North Africa. It was most likely introduced to Europe unintentionally with commercial oysters from Japan (possibly via North America). The overall consensus is that it was first introduced into northern France and from there it spread to the UK by spores in ballast water or on ships hulls or that entire plants rafted and floated. The current school of thought on this matter is that the dispersal most likely occurred by the natural, floating method. By using this method of dispersal, it can spread up to 30 miles. If you add this large dispersal to the rapid growth rate and the fact that it can produce a lot of spores that can float and survive for 3 months, it is no surprise that this species has been so successful in many parts of the world.

What is it? A seaweed which grows in long strands. Strands are covered in many small bubbles so it floats.

Where they are naturally from: Japan

Where they are found now: Europe, North America and North Africa

Invasion impact:

- Reduced biodiversity
- Expensive to remove from boats, machinery and shellfish.

How do they have an impact?

- Forms large mats on the sea surface which block the light and prevent other plants from growing
- Broken pieces can grow into a new plant in a new place after travelling long distances on ocean currents.
- Very fast grower
- Can get wrapped around equipment like propellers.
- Increases the weight of marine equipment

Further Resources:
https://www.conservationjobs.co.uk/articles/a-z-of-invasive-marine-species-wireweed/
http://www.iucngisd.org/gisd/species.php?sc=727
https://www.cabi.org/isc/datasheet/108973
https://www.marlin.ac.uk/species/detail/1477

Chinese Mitten Crab

Chinese mitten crab (*Eriocheir sinensis*)

Overview: Chinese mitten crab (*Eriocheir sinensis*) are listed as one of the worlds 100 worst invasive species due to the damage they can cause to fishing gear, river banks, native species and habitat. Both economic and ecological damage combined make this crab highly problematic. The extent of the Chinese mitten crab within UK waters is currently unclear, however, research institutes and public engagement forums are working to clarify the distribution of this species.

The Chinese mitten crab originates from eastern Asia, in temperate and tropical regions between Vladivostock (Russia) and southern China, including Japan and Taiwan. They are thought to have been present in the Thames estuary since 1935 and were most likely introduced in ballast water associated with shipping, mariculture and clinging on to ships' hulls. (Inside Ecology, 2017)

What is it? A crab with large furry claws. Spends time in both the sea and rivers

Where they are naturally from: Asia

Where they are found now: Europe, North America

Invasion impact:
- Damage riverbanks and habitats
- Can damage fishing equipment
- Competes with native species for space and food

How do they have an impact?
- One female can release up to a million eggs!
- Burrows into river banks causing erosion and damage
- Competes with native species
- Damages natural habitats
- Sharp claws can cause damage to fishing nets

Further Resources:
https://insideecology.com/2017/09/13/invasive-non-native-species-uk-chinese-mitten-crab/
https://www.invasivespeciesinfo.gov/aquatic/invertebrates/chinese-mitten-crab
https://mittencrabs.org.uk/

Wakame

Wakame (*Undaria pinnatifida*)

Overview: Wakame (*Undaria pinnatifida*), has been regarded as a noxious invasive seaweed in countries other than those where it's native. Its believed wakame was introduced to foreign waters through the ballast water of cargo ships from Asia, as the spores (gametophytes) contained in the water can survive long-distance journeys.

Wakame spreads in two ways: naturally, through the millions of microscopic spores released by each fertile organism, and through human activities, most commonly via the hull of shipping vessels or marine farming equipment. It is a highly successful and fertile species, which makes it a serious invader. However, its impacts are not well understood and can vary depending on the location.

What is it? A large seaweed which can grow up to 3m long

Where they are naturally from: Japan

Where they are found now: Europe, New Zealand, USA

Invasion impact:
- Reduced biodiversity
- Expensive to remove from boats and machinery
- Can smother shellfish

How do they have an impact?
- Produces millions of spores
- Grows very fast
- Competes with native species
- Can replace native kelp forests which are important habitats
- Can get wrapped around equipment like propellers.
- Grows on shellfish and is difficult to remove
- Increases the weight of marine equipment

Further Resources:
http://www.nonnativespecies.org/factsheet/factsheet.cfm?speciesId=3643
https://depts.washington.edu/oldenlab/wordpress/wp-content/uploads/2015/09/Unidaria_pinnatifida_Bloch_2014.pdf
http://www.iucngisd.org/gisd/species.php?sc=68

Northern Pacific Seastar

Northern Pacific Seastar (Asterias amurensis)

Overview: Originally found in far north Pacific waters and areas surrounding Japan, Russia, North China, and Korea, the northern Pacific seastar (*Asterias amurensis*) has successfully invaded the southern coasts of Australia and has the potential to move as far north as Sydney. The seastar will eat a wide range of prey and has the potential for ecological and economic harm in its introduced range. Because the seastar is well established and abundantly widespread, eradication is almost impossible. However, prevention and control measures are being implemented to stop the species from establishing in new waters.

What is it? A starfish

Where they are naturally from: North Pacific waters (Japan, Korea, etc.)

Where they are found now: Australia

Invasion impact:
- Reduced biodiversity
- Can destroy shellfish fisheries

How do they have an impact?
- Female seastars can carry up to 20 million eggs
- Populations grow very fast
- Eats virtually anything – including dead and decaying animals
- Eats the egg masses of some endangered species.

Further Resources:
https://www.cabi.org/isc/datasheet/92632
http://www.iucngisd.org/gisd/species.php?sc=82
https://www.youtube.com/watch?v=9V7v7dudlOI&feature=emb_logo
https://animaldiversity.org/accounts/Asterias_amurensis/

Notes

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