The Blue Natural Curriculum

A SUSSEX BAY AND KNEPP WILDLAND FOUNDATION COLLABORATION – FUNDED BY REWILDING BRITAIN

What is the Blue Natural Curriculum?

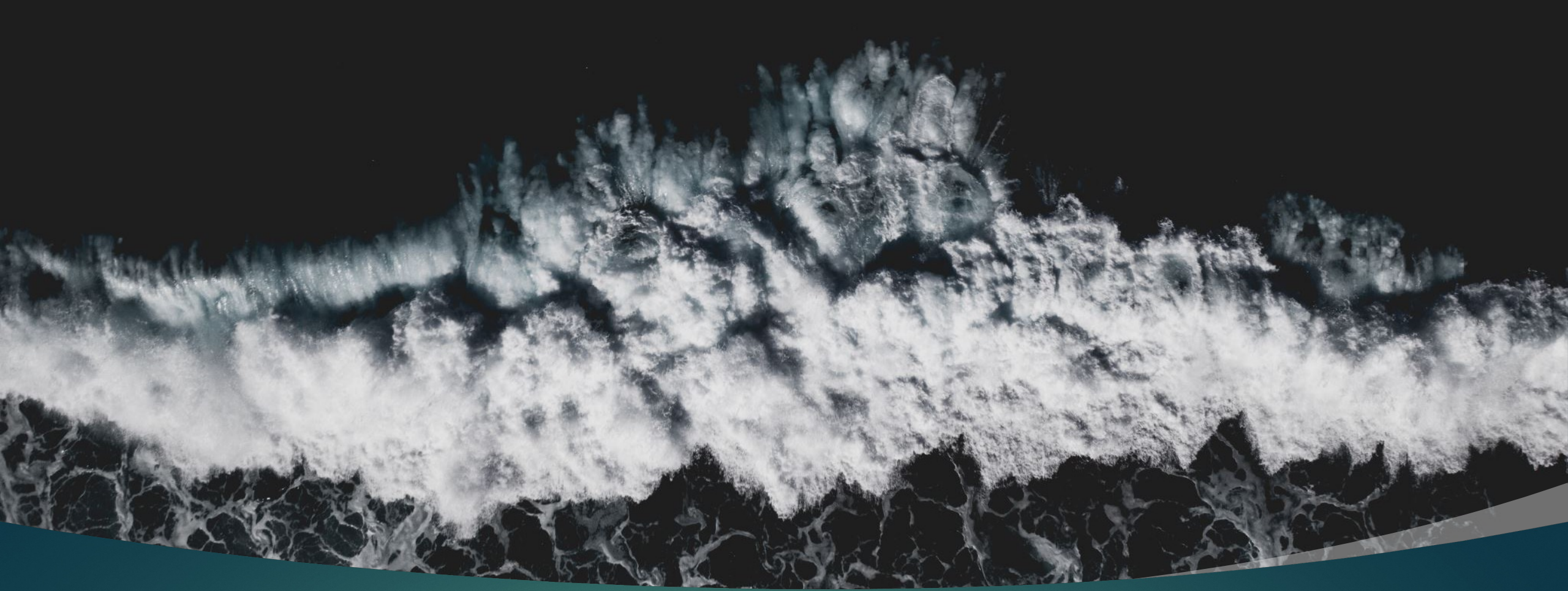
1) Our Ocean - Habitats of the Sussex Bay

2) Our Problem - Threats to the Sussex Bay

3) Our Asset - The Importance of the Sussex Bay

4) Our Treasure - The Species of the Sussex Bay

5) Our Recovery - The Restoration of the Sussex Bay



Session 1 – Our Ocean

Habitats of the Sussex Bay

What is the Knepp Wildland Foundation?

"The Knepp Wildland Foundation was founded to galvanise nature recovery across Sussex and contribute to the reversal of our biodiversity crisis.

Using the lessons learned from the rewilding of the Knepp Estate to provide the evidence, knowledge and inspiration to support nature recovery at scale, with a particular focus on the next generation"

Sussex Bay

What is the Sussex Bay?

"The blue mirror to the South Downs. Sussex Bay encompasses the sea, coast and rivers along 100 miles of Sussex coastline, from Selsey in the West to Camber Sands in the East"

This session will cover:

- The key coastal habitats of the Sussex Bay
- The structure and distinguishing characteristics of each habitat, as well as the types of creatures they support
- Examples of where they can be found in Sussex
- Pressures that might impact their distribution in history and now

What Features Come To Mind When You Think of the Sussex Coast?

Biomes

- Biomes are major ecological community types. They are defined by factors such as climate, soils and vegetation.

- Within the ocean we have five main biomes: Atlantic Ocean, Pacific Ocean, Indian Ocean, Southern Ocean, and the Arctic Ocean. In Sussex our larger Biome is the Atlantic Ocean and our sea is known as the Eastern Channel.

Ecosystems

- An ecosystem is a community of organisms and their physical environment interacting together. Environment involves both living organisms, known as the "biotic factors", and the non-living physical conditions, known as the "abiotic factors".
- These two are inseparable but inter-related. The living and physical components are linked together through nutrient cycles and energy flows.

Ecosystems

The Sussex Bay encompasses several different ecosystems, including chalk cliffs, shingle beaches, intertidal zones, salt marshes, and coastal woodlands, supporting a variety of species and ecological processes.

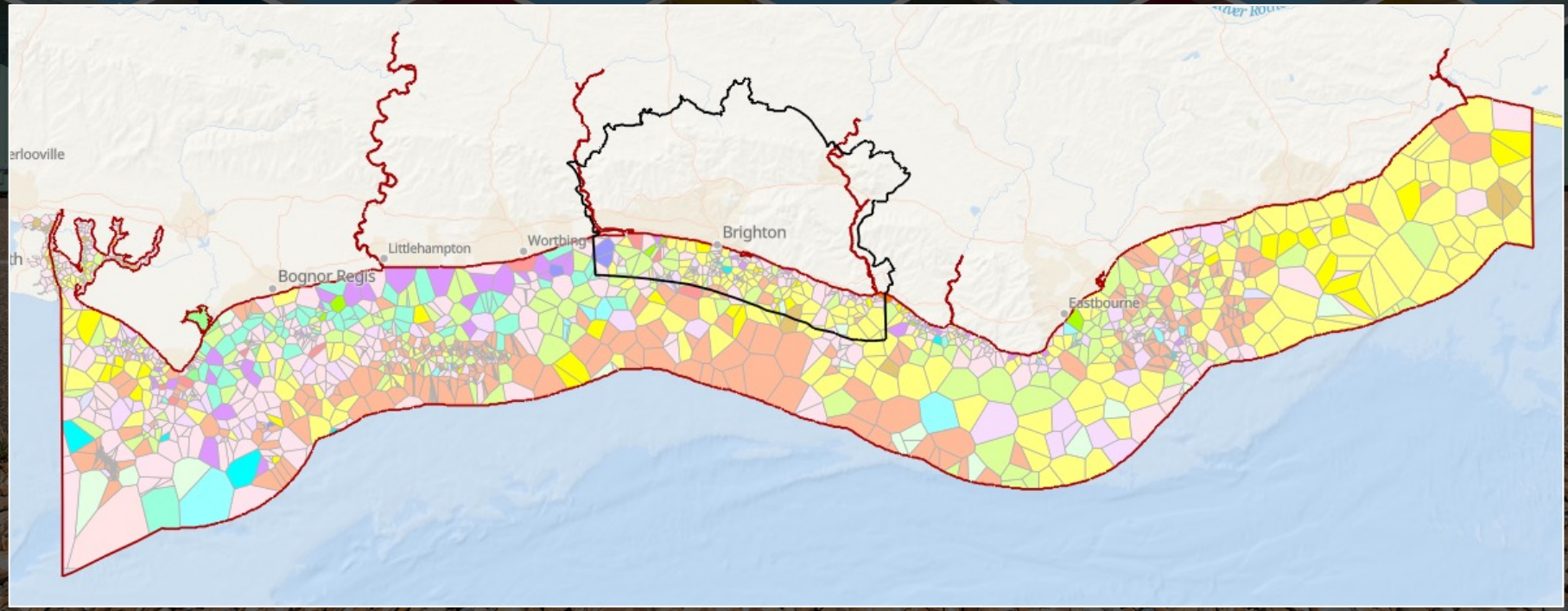
Potential Student Preparation Task

Work in small groups to research a UK marine habitat and create a short worksheet outlining the following:

- Habitat name and location
- Key species and their adaptations
- Physical features and biodiversity
- Human threats and ecosystem value
- Present your findings to the class!

Habitats

- Habitat can be defined as the natural environment of an organism, the type of place in which it is natural for it to live and grow.
- The Sussex Bay is home to some very rare and unique habitats, which we will now begin to explore



Habitat 1 – Chalk Reefs

Composition and Structure - Chalk reefs are unique coastal features formed from soft white chalk deposits laid down during the Late Cretaceous period, around 65 to 100 million years ago!

These reefs are composed primarily of microscopic coccolithophores, a type of plankton, whose calcareous remains accumulated in a shallow, warm sea. Over time, these deposits compact into the characteristic chalk we see today.

Chalk reefs, extend into the intertidal and subtidal zones, forming striking underwater landscapes that include vertical cliffs, wave-cut platforms, and fissured gullies. These create amazing rockpools, some of our most biodiverse habitats anywhere along the coastline.

The development of these reefs is influenced by a dynamic interplay of natural processes, including coastal erosion, tidal action, and biological colonization.

Habitat 1 – Chalk Reefs

Life they support - Sussex chalk reefs are distinguished by their rich biodiversity, supporting species such as lobsters, sea anemones, and diverse algal communities

The soft chalk substrate allows burrowing organisms such as piddocks and worms to thrive, while the reef structures provide surfaces for sea squirts, limpets, and seaweeds.

The chalk's high porosity allows water to penetrate, creating microhabitats. Chalk reefs support a variety of species, some unique to this habitat, and serve as nursery sites for fish like plaice and sole.

Habitat 1 – Chalk Reefs

Location - The chalk reefs in the eastern English Channel constitute approximately 75% of all such reefs found throughout Europe and the UK host approximately 57% of Europe's coastal chalk exposures.

Notable locations include Seven Sisters, Beachy Head, and Seaford, as well as the intertidal and subtidal zones near Newhaven, Ovingdean and Rottingdean. Offshore reefs extend into the eastern English Channel, particularly around the Brighton and Worthing areas,

Threats – These reefs face threats from human activity, including trawling, pollution, and coastal development. Unlike harder rock reefs, chalk is soft and porous, making it especially vulnerable to erosion yet fostering unique habitats.

Habitat 2 – Vegetated Shingle

Composition and Structure - Vegetated shingle consists of dynamic coastal habitats formed on ridges of shingle (pebble and gravel) deposited by waves and tidal currents. These habitats are typically found along exposed coastlines and are among the most extensive and ecologically important shingle systems in Europe.

The development of vegetated shingle habitats is a slow process, heavily influenced by natural factors such as wave action, wind, and the availability of seeds. Their distinguishing characteristics include the scarcity of nutrients, high permeability, and salt-laden conditions, which limit the types of plants that can thrive.

Over time, as vegetation becomes established, organic matter builds up, enabling further colonization by more diverse species. The structure of these habitats is shaped by patterns of sediment deposition, creating a mosaic of ridges and hollows.

Habitat 2 – Vegetated Shingle

Life they support - The structure of these habitats is shaped by patterns of sediment deposition, creating a mosaic of ridges and hollows. This diverse topography supports specialized plant communities adapted to the challenging environment, including pioneer species like sea kale and yellow horned-poppy, as well as more established vegetation like lichens and low shrubs in older, more stable areas.

These habitats also provide critical breeding grounds for birds such as terns and ringed plovers. The invertebrate fauna is also notable, featuring species like the brown-banded carder bee (Bombus humilis) and the medicinal leech (Hirudo medicinalis).

Habitat 2 – Vegetated Shingle

Location - Coastal vegetated shingle is a globally rare habitat, But in the UK, shingle beaches are widespread, fringing approximately 30% of the coastline.

In Sussex, vegetated shingle habitats are primarily found along the coastline at key locations such as Rye Harbour and Pett Level. These areas host some of the most extensive and ecologically significant shingle systems in the region. Smaller vegetated shingle features can also be found at Cuckmere Haven, Shoreham Beach, and Pagham Harbour.

Threats – these fragile ecosystems face threats from human activities, such as gravel extraction, coastal development, and climate change, necessitating conservation efforts to ensure

Habitat 3 – Underwater Sand

Structure and composition - Dynamic ecosystems primarily found in shallow coastal waters and along the seabed. These habitats are characterized by their loose, sandy substrates, which shift with tides and currents, creating a constantly changing environment. They are often interspersed with features such as sandbanks, ripples, and small depressions that provide shelter for a range of marine life.

Life they support - Sussex's sandy seabeds support species like flatfish, sandeels, and crustaceans, which are well-adapted to burrowing or camouflaging themselves in the shifting substrate. These habitats also act as important feeding grounds for birds and larger marine species, including rays and sharks.

Sandbanks within these areas serve as nursery grounds for commercially important fish species like plaice, cod, and sole.

Habitat 3 – Underwater Sand

Location - Underwater sand habitats in Sussex are primarily found in shallow coastal waters and along the seabed, with notable locations including areas around Selsey Bill, Beachy Head, and the offshore sandbanks near Rye Bay and the Sussex coast. These sandy seabeds are shaped by tidal flows and wave action.

Many of these habitats fall within Marine Conservation Zones, such as the Beachy Head East MCZ and the Selsey Bill and The Hounds MCZ, which aim to protect their ecological importance.

Threats - Human activities, including fishing, dredging, and coastal development, can impact their structure and ecological balance.

Habitat 4 – Sand Dunes

Structure and composition - Sand dunes are dynamic coastal features formed by the accumulation of wind-blown sand, primarily found in areas where large intertidal zones provide a steady supply of sediment.

These dunes develop in a series of stages, from the initial formation of low, unstable foredunes dominated by marram grass to more mature, stable dunes further inland that support diverse vegetation such as mosses, lichens, and shrubs.

The dune systems are typically anchored by pioneer plants, which trap and stabilize the sand, creating a foundation for more complex ecosystems to evolve.

Habitat 4 – Sand Dunes

The UK is home to approximately 71,569 hectares of sand dunes, about twice the area of the Isle of Wight. However, since 1900, the UK has lost around 30% of its dune habitat, with Wales experiencing a nearly two-thirds decline.

Location - In Sussex, sand dunes can be found at key locations such as Camber Sands near Rye and the East Head spit at West Wittering.

Life they support - These dunes are known for their rich biodiversity, providing habitats for rare plants like sea bindweed and sand sedge, as well as invertebrates and ground-nesting birds.

Threats - The development of these dunes is shaped by natural forces like wind, tides, and storm events, but they are increasingly impacted by human activities such as trampling, development, and climate change. Conservation efforts, including fencing, replanting, and sustainable visitor management, aim to protect these fragile ecosystems and ensure their continued ecological value.

Habitat 5 – Sea Grass

Structure and composition - Seagrass meadows are underwater habitats formed by flowering plants that grow in shallow, sheltered marine environments with sandy or muddy substrates. These meadows, consist of species like Zostera marina (eelgrass), which anchor to the seabed using rhizomes. Seagrass beds create dense, grass-like structures that stabilize sediment, reduce wave energy, and provide essential habitats for marine life.

The distinguishing characteristics of seagrass include its ability to photosynthesize underwater and its role as a critical ecosystem engineer, supporting biodiversity and carbon sequestration. seagrass meadows play a significant role in carbon sequestration, capturing carbon up to 35 times faster than tropical rainforests and accounting for 10% of the ocean's total carbon burial despite covering less than 0.2% of the ocean floor.

Habitat 5 – Sea Grass

Life they support - Seagrass is the only flowering plant in the ocean. These meadows are essential for species like seahorses, juvenile fish, and shellfish, serving as nurseries and feeding grounds

Location - In Sussex, seagrass meadows are primarily found in sheltered coastal areas such as Chichester Harbour, Pagham Harbour, and the intertidal zones around Selsey. These locations provide the calm, shallow waters and sandy or muddy substrates that are ideal for seagrass growth. Smaller patches of seagrass may also occur in other suitable habitats along the Sussex coastline.

Threats - Seagrass development depends on clear water for light penetration and stable sediment, making it sensitive to pollution, dredging, and climate change. The UK has experienced a substantial decline in seagrass habitats, with estimates indicating a loss of up to 92% over the past century (MCS UK).

Habitat 6 – Mud Flats

Structure and composition - Mudflats are extensive intertidal areas composed of fine sediments, such as silt and clay, deposited by tidal currents and river outflows in sheltered environments. The structure of mudflats is characterized by their soft, waterlogged substrate, which is exposed at low tide and submerged at high tide. This dynamic environment supports a high abundance of microscopic algae and organic matter, forming the base of a rich food web.

Life they support - They provide critical feeding and resting areas for migratory and overwintering bird species, as well diverse invertebrates like worms, molluscs, and crustaceans. Over time, mudflats can evolve into saltmarshes if conditions are favourable for plant establishment.

Habitat 6 – Mud Flats

Location - In Sussex, mudflats are predominantly found in sheltered estuarine and harbour areas such as Chichester Harbour, Pagham Harbour, and Rye Harbour. These locations provide the calm, low-energy environments necessary for the deposition of fine sediments that form mudflats. Smaller mudflat areas can also be found along tidal inlets and creeks throughout the region.

Threats - Mudflats face threats from land reclamation, pollution, and rising sea levels, making their conservation essential for maintaining biodiversity and supporting coastal ecosystems.

Habitat 7 – Mussel Beds

Structure and composition - Mussel beds in Sussex are dense aggregations of blue mussels (Mytilus edulis) attached to hard substrates such as rocky shores, piers, and subtidal sediments. These beds are often formed by mussels anchoring themselves with byssal threads, creating a complex, interconnected matrix.

This structure stabilizes sediments, enhances habitat complexity, and provides shelter for various marine species, including barnacles, small fish, and crabs. The development of mussel beds is influenced by factors such as substrate availability, tidal currents, and water salinity.

Habitat 6 – Mussel Beds

Life they support - The distinguishing characteristics of mussel beds include their role as ecosystem engineers, improving water quality by filtering suspended particles and serving as feeding grounds for birds like Oystercatchers.

Location - In Sussex, mussel beds are found along the intertidal and subtidal zones of the coastline, particularly in areas with suitable hard substrates such as the rocky shores of Brighton, Shoreham, and Newhaven, as well as in sheltered estuaries like Chichester Harbour and Pagham Harbour. These beds thrive on piers, groynes, and natural rock formations, providing critical habitats for a variety of marine life.

Threats - These beds are vital for biodiversity and local fisheries but are under pressure from overharvesting, pollution, and climate change.

Habitat 7 – Oyster Beds

Structure and composition - Oyster beds are formed by aggregations of oysters, primarily the native European flat oyster (Ostrea edulis) and the introduced Pacific oyster (Crassostrea gigas), which settle on hard substrates like rocky sea beds or existing oyster shells. These beds create complex, reef-like structures that stabilize sediments and provide habitats for diverse marine species, including fish, crustaceans, and other invertebrates.

The distinguishing characteristics of oyster beds include their ability to filter large volumes of water, improving water quality and clarity, and their role as ecosystem engineers that enhance biodiversity. Oysters are vital ecosystem engineers, with each individual capable of filtering up to 200 litres of water per day, thereby enhancing water quality and clarity. (MCS UK).

Habitat 7 – Oyster Beds

Location - In Sussex, oyster beds are primarily found in sheltered coastal waters such as Chichester Harbour, Pagham Harbour, and other estuarine environments along the coastline. Historically, these areas supported abundant populations of the native European flat oyster though populations have declined significantly due to overfishing, habitat loss, and disease.

Native oyster populations in the UK have experienced a dramatic decline of approximately 95% since the mid-19th century, primarily due to overfishing, habitat loss, pollution, and disease.

Threats - Oyster beds have historically been important for both biodiversity and local fisheries but have declined due to overfishing, habitat degradation, and disease. Recent conservation and restoration initiatives, such as re-seeding programs and habitat protection measures, aim to recover these valuable ecosystems and ensure their long-term resilience.

Habitat 8 – Kelp

Structure and composition - Kelp forests are dense underwater ecosystems formed by large brown seaweeds, primarily species like Laminaria hyperborea and Saccharina latissima. These forests grow on rocky substrates in shallow coastal waters, where sunlight penetrates to support photosynthesis.

The structure of kelp forests includes a canopy of fronds that creates a three-dimensional habitat, providing shelter and feeding grounds for a diverse range of marine species. The holdfasts, which anchor the kelp to the seabed, also support smaller organisms by offering microhabitats.

The distinguishing characteristics of kelp forests are their rapid growth rates, high productivity, and role as carbon sinks, making them crucial for combating climate change. In the UK, kelp forests are found along the coastlines, with the country hosting the most diverse community of kelp species in Europe—seven out of the fourteen species found across the continent.

Habitat 8 – Kelp

Life they support - These underwater forests shelter commercially important species such as lobsters, crabs, and bass. They also support invertebrates like brittle stars, anemones, and sponges, which attach to kelp fronds or thrive in the detritus below. Additionally, kelp forests are a haven for smaller fish, which attract predators like seals and seabirds, creating a thriving and interconnected ecosystem.

Location - In Sussex, kelp forests are primarily found along the coastline in areas with suitable rocky substrates and nutrient-rich waters, such as the chalk reefs near Worthing, Brighton, and the Selsey Bill region.

Threats - These vital habitats have experienced significant declines due to factors such as destructive trawling, pollution, and climate change. For instance, since 1987, over 96% of Sussex's kelp has been destroyed. (REWILDING BRITAIN). Restoration efforts, including the Sussex Kelp Recovery Project, aim to revive these ecosystems, recognizing their importance for marine biodiversity, fisheries, and coastal protection.

Habitat 9 – Man Made Structures

Man-made structures in Sussex, such as piers, breakwaters, seawalls, and offshore wind farms, have become important artificial marine habitats. These structures provide hard surfaces for the attachment of marine organisms, such as barnacles, mussels, and seaweeds, creating ecosystems similar to natural rocky reefs.

Over time, these habitats attract a diverse range of species, including fish, crabs, and anemones, which utilize the structures for shelter, feeding, and breeding. For example, the iconic Brighton Pier serves as a habitat for various species, such as Spider Crabs, Fish and Starlings.

Research indicates that man-made coastal structures can be hotspots for invasive species, which may outcompete native marine life and reduce biodiversity.

Potential Class Debate: "Should we protect all our marine habitats at any cost?"

Break into groups of four, choose a stakeholder role between:

- Fisher
- Developer
- Scientist
- Local Council

Prepare a quick argument for or against strong protections, then discuss in your group

Session 1 Summary

In this Session You Have:

- Identified the key coastal habitats of the Sussex Bay
- Discovered the structure and distinguishing characteristics of each habitat, as well as some of the creatures they support
- Looked at examples of where they can be found in Sussex
- Understood the pressures that might impact their distribution in history and now, and the part that different stakeholders play in protecting our marine habitats

Next session we will be exploring the threats being faced by our local marine environment