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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Acorn Barnacles

Zone found in: Upper/ Middle Shore attached to rocks

What and how it eats: Barnacles are filter-feeders and filter plankton out of the sea water, using its feathery legs mentioned above.

Who eats it: Dog whelks are its main predator.

Abiotic Factors that affect it's location and its adaptations:

Desiccation: The barnacle has an exoskeleton which helps to protect itself from drying up. It has two tiny plates which join up with other plates to protect the body when it is exposed to air.

***Wave Action*:** To protect itself from wave action, the barnacle cements itself firmly to the rock and closes its plates.

***Temperature*:** Seawater remains at a more constant temperature (5-15 degrees ...an the land so barnacles while immersed in water are buffe...d against large temperature change. Their exoskeleton plates when closed ...otect them when the tide is out.

Biotic Factors that affect it:

Food and feeding: Barnacles are filter feeders therefore they can only feed when they are immersed in water. Because of this, their feeding time is decreased as they move up the shore. When covered by the sea the plates open and six pairs of feathery legs filter out particles of food.

Reproduction: Barnacles, although hermaphrodite, always cross fertilise – a long penis of one fertilises the eggs of barnacles next door – so they have to settle close to each other. They secrete a chemical to attract other barnacle larvae of the same species to settle on the same rock.

Drumcondra Education Centre
Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Beadlet Anemone (*Actinia equina*)

Zone found in: This is one of the few anemones able to survive on the upper parts of shores. Suitable places include rock pools or moist crevices.

What It eats: crustaceans like crabs, shrimps, small fish, plankton, goby.

Eaten by: Blenny, starfish, sea slugs.

Abiotic factors that affect its location and its consequent adaptations:

Wave action: It attaches itself to surfaces with its sucker base, so as it isn't swept away by the tide.

Temperature: It can withstand fluctuations in temperature because they are found in rock pools. Certainly it has the highest tolerance to stress (low tide and temperature) of any anemone.

Desiccation: It withdraws its six circles of long tentacles, which retain moisture, until the tide returns. It looks like a red/purple blob when it does this. A secretion of mucus reduces water loss yet further.

Biotic factors:

Food: The beadlet anemone (*Actinia equina*) is a carnivore. Its tentacles are covered with stinging cells that paralyze prey and pass the victims to the mouth in the middle. (This is the only opening so it's also where it excretes, so it's not all good). The sting cells paralyze the prey and are triggered to fire by proteins on the surface of the food. The tentacles feel sticky to the touch as they fire the "harpoons" into the skin. As a carnivore, it feeds upon crustaceans, including crabs, shrimps and small fish

Competition: They compete with other shelled animals of the rock pools for space on rocks Beadlets are surprisingly territorial, nudging each other (over a period of days) until one moves. Although they appear to be well attached to the surface they can creep along the shore, if rather slowly.

Reproduction: Beadlets exhibit both asexual and sexual reproduction. The first method involves them budding internally to produce many small anemones, genetically identical. In this way they rapidly colonise the shore. Sperm is released by a male into the water where they swim and internally fertilise the female. She eventually releases minute sea anemones. Exact reproductive details are still elusive

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Bladder wrack (*Fucus vesiculosus*)

Zone it is found on:
Bladder wrack is found on the middle shore.

Food source: Photosynthetic autotrophes

Eaten by: The flat periwinkle

Abiotic factors that affect its location and its consequent adaptations:

***Desiccation*:** Bladder wrack is covered in a layer of mucilage to help it retain water. Some water is retained in its bladders. Bladder wrack can resist drying out for a short period but needs to be covered by the tide at least once a day.

***wave action*:** Bladder wrack has a hold fast to attach it to the rocks and a flexible stipe and frond to with stand wave action .On wave exposed shores bladderless variations occur. They reduce their size and density to ensure survival in heavily exposed shores.

***light*:** Bladder wrack has the pigment fucoxanthin, this allows them to use light that passes through the water. It also has buoyancy aids i.e. bladders to enable the plant to float on the water surface when the tide is in thus facilitating the absorption of more sunlight for photosynthesis

Biotic Factors:

Reproduction: In bladder wrack reproduction is external. There is separate male and female plants. Gametes are secreted into the open sea where they meet each other by chemotaxis. They live for up to three years if they can survive wave action.

Predation: Their main predators are periwinkles.

Competition for space: They compete with the longer lived knotted wrack for space.

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Channel Wrack (*Pelvetia canaliculata*)

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Bije Barrett
Kathlyn Hennelly
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Zone it is found on: Brown algae of the Upper shore

It is eaten by: flat periwinkles

Food source: Photosynthetic autotrophes

Abiotic factors that affects its location and its consequent adaptations:

Desiccation: Their position on the seashore (top of the upper shore) is very inhospitable due to the very short period covered by sea water. As a consequence this species has 'channels' for holding water along its stipe and also its covered in mucilage to help it retain water. It is very tolerant to desiccation and can withstand being almost dried up. It can survive without water for several days on the upper shore.

Wave action: Channelled wrack has a hold fast to attach it to the rocks and a flexible stipe and frond to withstand wave action.

Light: It has the pigment fucoxanthin masking the green chlorophyll to allow it to use ght that passes through the water. It is found in the upper shore not having to compe with dense strands of other algaes for light

Biotic factors:

Space: It competes with spiral wrack, barnacles and other green encrusted algaes for space on rocks.

Reproduction: It has swelling on the tips of its fronds. They form reproductive bodies, which secretes gametes into the open sea so reproduction is external. Gametes are attracted to each other by chemotaxis. These seaweeds, are hermaphrodite, having both male and female structures on the same frond. They take twelve months to mature. Having both sexes on the same plant greatly increases the chances of fertilisation on the upper shore where the tide does not give a long period of immersion in water. Light is an important factor in allowing good settlement of the spores, stimulating the growth of rhizoids (holdfast) which anchor the young plant to the rock.

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Common Limpet

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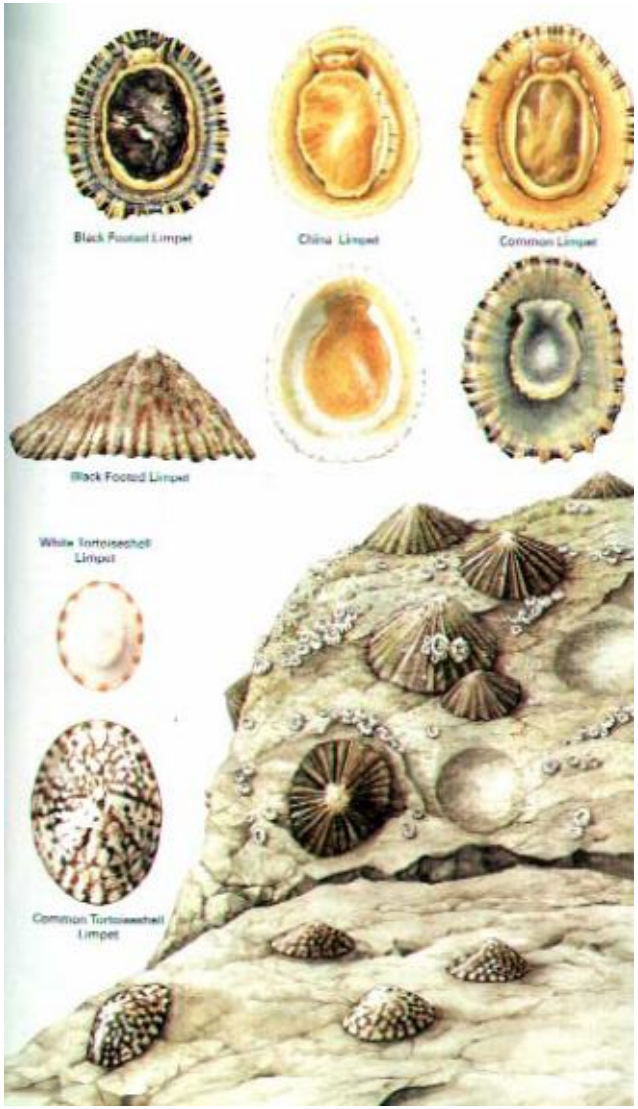
Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Zone it is found in: Mid shore and lower shore attached to rocks



What it eats: A Limpet is a herbivore grazing on encrusted algae and sea mats.

How it eats: It grazes by rasping the algae from rocks with its radula

Who eats it: Dog whelk, crab, herring gull

Abiotic factors that affect its location and its adaptations;

Desiccation: Each Limpet has its own home, an exact spot on the rock, where it stays when the tide is out. It pulls its shell tightly down and traps a spoonful of water inside when the tide goes out. It has a strong muscular foot to anchor it down.

Wave action: On soft rock the Limpet grinds it with its shell to make an exact fit, on hard rock the shell is ground down to fit the rocks shape. A strong muscular foot gets a firm grip on the rock making it difficult for wave action to damage it

Salinity: When Limpets are splashed with fresh water, they pull down their shell hard and remain still on the rocks but if repeatedly splashed with sea water they begin to wander about to graze on microscopic green algae. Their shell helps them withstand the salinity changes of the rock pool as water evaporates.

Biotic factors that affects its location and its adaptations:

Food and feeding: Limpets have a rasping radula (tongue) which scrapes microscopic algae from the rocks. They can often deplete an area of seaweed so seaweeds may not survive where there are a lot of grazers.

Space: Limpets compete with barnacles for space on rocks

Predation: The dog whelk attacks the limpet by producing a shell dissolving acid, which makes a hole in the shell or by boring a hole through the shell using its rough belt-like tongue.

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Common Mussel (*Mytilus edulis*)

Zone it is found in: Mussels live together in huge beds in areas where there is plenty of water movement in rock pools in the lower shore and in the sublitterol zone and inter tidal rocks.

What it eats: They filter out microscopic plankton, others graze on detritus that settles on their shells.

How it eats: Mussels are filter feeders. Water is drawn in through siphons and filtered using the gills. Those mussels living higher up the shore are smaller as feeding time is less. Another method of feeding involves the muscular foot being extended out of the shell, wiped over its outer surface where detritus settles and then drawn in.

Who eats it: They are eaten by dog whelks, starfish, oystercatchers and eider ducks as well as humans.

Abiotic factors that affect their location and their adaptations;

Desiccation:
The inside of mussel shells is a slightly iridescent blue grey. The mussel has an orange body inside the shell. They are bivalve mollusc. The two shells give protection and close at low tide to retain water. Metabolism drops as does the heart beat, conserving energy at a time of stress, when not covered by water.

Wave action: The mussel uses strong fibres to attach to the rocks and other mussels. These *bissus* threads are made from a gland at the end of their foot, which can come out from one of the shell . These byssus threads protect the mussel from wave action. They can move slightly as time goes on by breaking and producing new byssus threads. The threads are loose enough to swing round to meet the thrust of moving water with its narrower end to filter feed.

Biotic factors:

Reproduction; Gametes are released into the water to fertilise externally. There is then a planktonic larva which eventually settles out of the water, triggered by a negative response to light. Roughness of the substrate increases the chance of the settlement.

Food and feeding: They are filter feeders

Predation: its main predators are dog whelks, starfish, oyster-catches , eider ducks and humans.

Space: they compete with each other for space on rocks or any solid surface.

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Common Shore Crab (*Carcinus maenas*)

Zone it's found in: Rock Pools, and all over the sea shore

What it eats: Like most crabs they are carnivores and scavengers. Detritus, Starfish and Limpets

How it eats: It will eat most animals especially molluscs like periwinkles, top shells and dog whelks. Holding them in one claw it snaps off the edge of the shell to get to the softer parts. It ingests through the mouth.

What eats it: Oyster catcher and gannet

Abiotic factors that affect its location and its consequent adaptations:

Desiccation: It has a hard exoskeleton and hides under rocks and algae when the tide goes out and in the rock pools.

Temperature: Its exoskeleton protects it and helps it withstand temperature changes

Salinity: It is very adaptable and copes with varying salinity. In fact it is the only common crab in Europe able to osmoregulate (control the body's water content) effectively. It can osmoregulate in dilute seawater but in freshwater it will soon die. It osmoregulates with antennal glands, small bladder like organs at the base of the antennae. This allows the crab to penetrate far up the shore, living in concentrations of only 0.6% salinity.

Biotic Factors:

Food: Crabs are scavengers and eat decaying flesh. They are also predators, eating small animals and even other crabs. Their first pairs of legs bears large pincers or claws which are used for feeding.

Predation: The crab's carapace looks like a rock or is coloured like seaweed so camouflage is a big factor in it's survival. Also, if it is spotted, Its hard exoskeleton can protect it from most predators. Its pincers or claws are used for defence against larger animals such as sea gulls.

Reproduction: It is possible to tell whether a crab is either male or female by looking at the width of its abdomen. Males have a narrower abdomen than the female broader one. Sometimes you can see the eggs of a female being carried underneath her body between the abdomen and the thorax. These appear as an orange coloured mass. It goes through a larval stage and then through to adult hood. This can take up to four years.

Parasitism It can be parasitized by a barnacle called *Sacculina*

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Dog whelk (*Nucella lapillus*)

Zone it's found in: Mid Shore and Lower Shore

What it eats: Barnacles, mussel, limpet

How it eats: The Dog Whelk has a toothed radula to bore through the shells of barnacles, mussels and limpets. They are carnivores. The radula modified for shell boring is assisted by chemical means. The groove in the shell lip allows water in for breathing as this boring takes many hours: e.g. 48 hours for a barnacle. They are very adaptable feeders, changing diet according to availability.

Who eats it: Seagulls and crabs

Abiotic Factors that affect its location and its consequent adaptation:

Desiccation: The Dog Whelk has a special method of closing its shell with a lid (operculum) to reduce water loss

Wave Action: It has a muscular foot to attach it to the rocks while feeding to survive wave action. There may also be a reduction in the length of shell, with a rounding off ` under exposed conditions. They are much more "pointy" on sheltered shores. Note that a thicker shell gives protection from crabs on sheltered shores.

Temperature: The shell of the Dog Whelk along with its operculum prevent sudden temperature changes effecting its body

Biotic Factors:

Food: The Dog Whelk eats a wide variety of shelled animals. It competes with the star fish, the crab, and the seagull

Predation: The thickness of the shell of the Dog Whelk and its rock like appearance are its defence against its predators.

Flat Periwinkles

Drumcondra Education Centre
Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Zone found in: They are very abundant on rocky shores in the middle and lower shores where they are associated with the Fucus seaweed .

What it eats: Periwinkles are herbivores feeding on spiral wrack, serrated wrack, egg wrack , bladder wrack and pepper dulse.

How it eats: It grazes on the wracks.

Who eats it: dog whelk, crabs and seagulls

Abiotic factors that affect its location and its adaptations:

Dessicaton: Periwinkles have special methods of closing their shells to reduce water loss during periods of exposure to air. They are protected inside a shell with an operculum lid.

Wave action: To protect itself from wave action, the periwinkle has a tough outer shell and attaches itself firmly to the wracks by chemical adhesives.

Temperature: it has gills and breathes dissolved oxygen from the water. Hence, it is found further down the seashore than the Rough winkles. It is the periwinkle with the least tolerance of changes in the temperature and humidity.

Biotic factors:

Food and feeding: The Flat periwinkle competes with the rough and common periwinkle for the wracks . This herbivore feeds (well, nibbles) on *Fucus* seaweeds and Pepper Dulse.

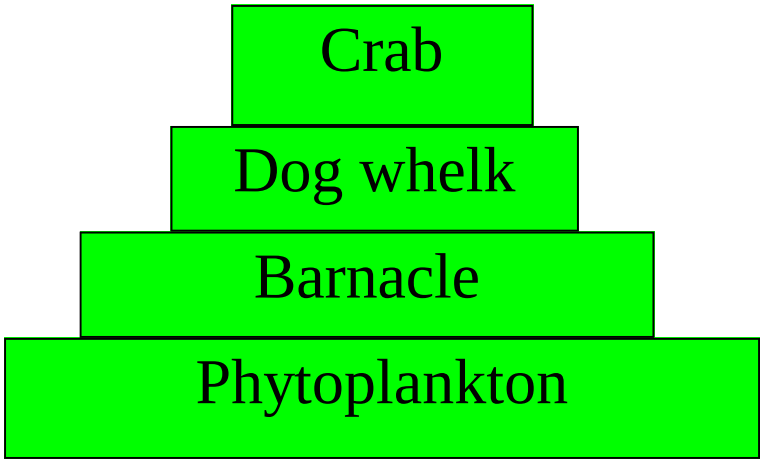
Space: The Flat periwinkle competes with limpets, barnacles, other periwinkles and algae for space on rocks

Predation: Periwinkles have a hard outer shell to protect itself from predators. Its main predator being the crab. The smooth, rounded shell blends in with the bladders of the bladder wrack. Numerous colour variations give camouflage at different seasons as algae change. Intensive crab predation of the lower shore has favoured a strategy where this species grows rapidly and breeds early

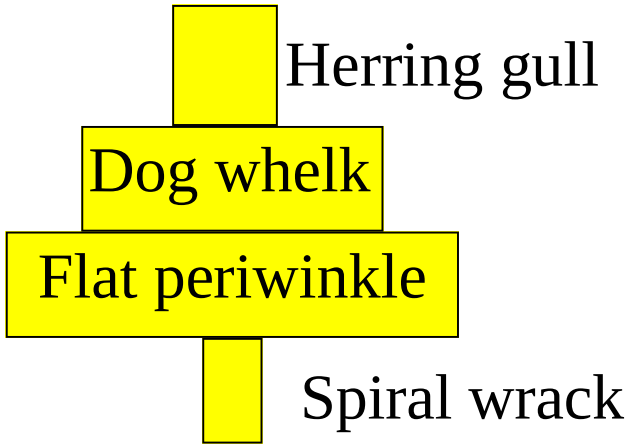
***Reproduction*:** The female sticks jelly like egg masses underneath the fronds of the wracks of the mid shore and one month later the baby snail chews their way out of the jelly.

Pyramids of numbers

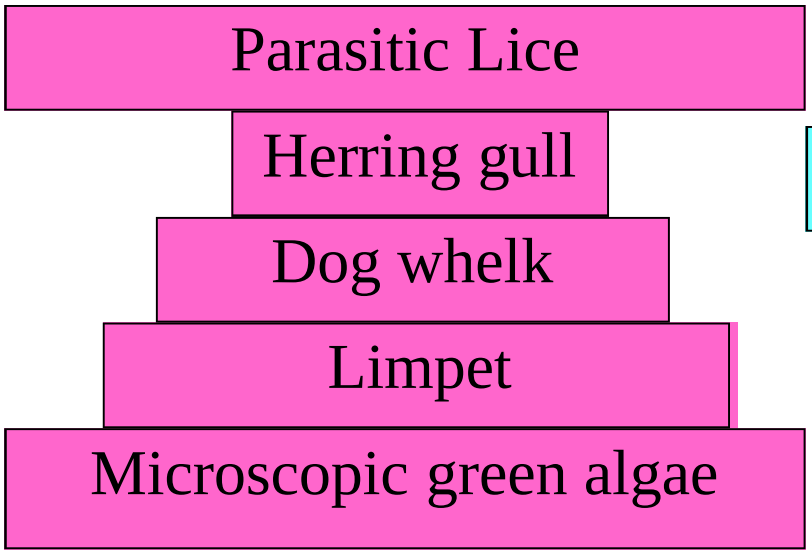
(bar chart showing the number of individuals at each trophic level of a foo chain)



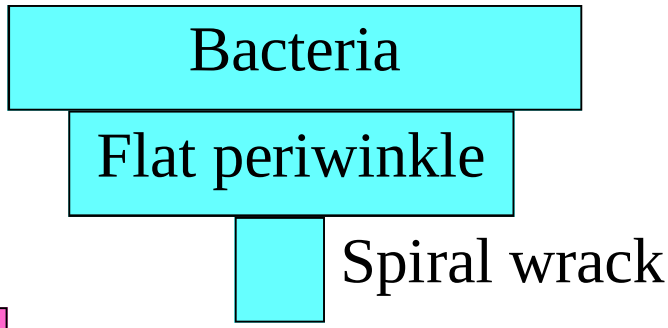
Normal Pyramid



Distorted Pyramid



Distorted Pyramid



Inverted Pyramid

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Food Web

Phytoplankton

Zooplankton

Spiral wrack

Acorn barnacle

Prawn

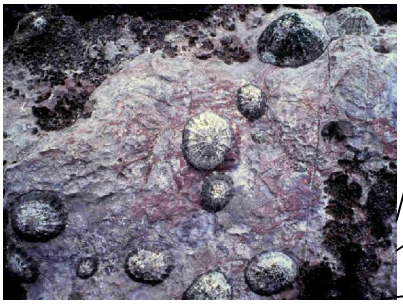
Shanny

Flat periwinkle

Worm

Herring gull

Common dog Whelk



Common limpet

Shore crab

Drumcondra Education Centre
Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

keeping in touch with Biology Teachers in Ireland

Gut weed (*Enteromorpha*)

Drumcondra Education Centre
Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Zones it is found in: Rock pools in the splash zone and upper shore

What eats it: Periwinkle and Limpets

Food source: Photosynthetic autotrophes

Abiotic factors that affect its location and consequent adaptations:

Desiccation: It retains water inside the strands of gut tubing that it is composed of. It can survive out on the rocks near the top of the shore as it rehydrates rapidly when immersed.

Salinity changes and temperature change: It grows where freshwater runs across shore. At low temperatures of -21°C, it ...nctions although the optimum is l7°C.

Turbidity: It is one of the few seaweeds that can survive in polluted ...er and brackish water.

Biotic factors:

Space: It competes with other wracks and shelled stationary organisms of the upper and mid shore for space.

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Irish Moss (*Chondrus crispus*)

Zone its found in: In rock pools and in the lower shore under the large kelps

Who eats it: Irish Moss is not very palatable and few herbivores will graze upon it. This may cause it to dominate the smaller algae in pools It can be dried and used as food or as a thickening agent by humans in cooking

Food source : Photosynthetic autotrophes

Abiotic factors that affect its location and its consequent adaptations:

Desiccation: The moss grows in the rock pools so when the tide goes out it remains in water. It also grows under the kelps in the sublitterol zone so it is only exposed at very low tides i.e. Spring tides

Wave action:It has a holdfast to attach it to the rock. It also has a flexible stipe and flattened frond.

Light: The red algae are very shade tolerant, living under the kelp,:It contains high levels of the pigment phycoerythrin, which absorbs light in dim conditions. In fact, if the light is too intense it soon becomes bleached; the tips of Irish Moss are often white/yellow as a result.

Biotic factors:

Food: It competes with other red algae such as Coralline and Dulse for light for photosynthesis

Space : It competes with other algae and animals for space on the rocks, in the rock pools and on the shore

Kelps (Laminaria digitata)

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Zone it is found on: Only in the sublittoral zone where it will be unaffected by normal tides.

Food source: Photosynthesis autotrophes

Eaten by: The Blue-Rayed Limpets

Abiotic factors:

***Desiccation*:** The stipe is inflexible and supports the kelp in an upright position at low tide. This would cause the alga to dry out and so it survives, therefore, only in the sub-littoral zone where it will be unaffected by the tides. The stipe is flexible so at low tide the plant goes limp and lies flat, thus remaining in the shallow water and not drying out.

***wave action*:** The Kelps cannot tolerate any degree of desiccation and are limited to the extreme lower shore. They grow to about a meter in length. The blade or lamina is split in to many "digits" although as this splitting increases with the wave action, very sheltered areas may have no splits. The holdfast is very branched and broad giving a stronger attachment to rock. The stipe is smooth and oval in section and the length varies with depth. These features enable it to survive a high degree of wave action.

***Light*:** They are limited to the extreme lower shore. where they all adapt well to the [illegible]tensities. They have the pigment fucoxanthin which can absorb low light intensities that passes through water.

Biotic Factors:

Reproduction: Their growth is prolific: most of the productivity is from the continuously growing lamina (blade) which develops more cells at the base and erodes at the tip - like a conveyor belt. Structurally, they are the most advanced of the algae, with trumpet shaped cells in the stipe which are believed to have a conducting function. They exhibit alternation of generations; the dominant phase (the kelp plant) is the sporophyte. This bears sporangia which release zoospores into the water that fertilise and germinate to produce a new algae.

Competition: It competes with serrated wrack for light and space in the lower shore, in the sublittoral zone.

Colonization: Many organisms colonise the kelp both for space and food, e.g. sea mat, grows on the lamina to gain access to circulating water containing their food. The holdfast is a micro-habitat containing a micro-community. Based on plankton as the producer, the primary consumers are thousands of sedentary polychaete worms which filter the water. Most of these worms are minute. Small brittle stars also filter feed. Large carnivorous polychaetes feed on the sedentary worms. At the top of this food web is the Hairy Crab (Pilumnis hirtellus); one or two may live under each holdfast. Dulse also lives underneath the forest of Kelps.

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Knotted or Egg Wrack (*Ascophylum nodosum*)

Zone it is found on: The Knotted or Egg Wrack is the dominant alga in the middle shore on sheltered rocky seashores.

Eaten by: It is unpalatable for most animals to eat and there is a general lack of grazers on the seaweed.

Food source: Photosynthetic autotroph.

Abiotic factors that affect its location and its consequent adaptations

Salinity: Where a dilution of seawater occurs, it can develop into a floating (unattached) form shaped like a ball referred to as an ecad,

wave action Knotted wrack has a hold fast to attach it to the rocks and a flexible stipe and frond .Due to the large surface area it occupies on the mid shore it is easily cut by wave action. It shows no adaptations to strong water movement and the more wave action experienced the more the plant material becomes eroded and the smaller the plant.

Temperature:It has the capability to survive low temperatures

Light: Knotted wrack has the pigment fucoxanthin, this allows them to use light that penetrates through the water for photosynthesis. The long, fronds have a single, large air bladder in the centre of the frond. This gives them buoyancy to maximise light when the tide is in.

Biotic Factors:

Reproduction: It has a longevity of 15 years or more whilst other wracks are barely 3 years old when they die off.. The sexes are found on separate plants. Reproduction is external. Gametes are secreted into the open sea where they meet each other by chemotaxis.

Colonisation: The sexes are found on separate plants and the reproductive structures fall off after the release of spores. This produces small holes which allows the colonisation by a red alga, polysiphonia lanosa. The growth of this epiphyte may cause the death of the wrack by increasing the surface area and weight still further so that wave action will rip it off the rocks.

Competition for space: It competes favourably with other algae particularly bladder wrack by forming a dominant blanket over the rocks, preventing colonisation by new competitors. Little can grow below it as it produces so much shade.However red alga, *Polysi-*

Feeding relationship on the sea shore

Carnivorous Animals
Dog whelk, Octopus, Sea anemones, Starfish, Fishes, Crabs, Sea gulls
Hunt down and eat other animals
Often hunter-prey specific

Filter and Detritus feeders
Barnacles, Tube worms, Mussels, oysters, cockles, Sea anemones, jelly fish
Eat plankton sifted from the water by gills or by mucus,
Or feed on detritus which is finely divided particles of plants and Animals that bacteria are breaking down

Grazers
Top shells, Limpets, Periwinkles, Chitons, Sea hares
Feed on Microscopic layer of micro-algae, spores and macro-algae that coat the moist rocks

Omnivores or Scavengers
Shore crabs, flatworms, Sand hoppers, Sea gulls, Sea slaters
Eat debris; cast up torn off Algae, bodies of dead animals and shore refuse

Producers
Red, green and brown algae, algae mats, microscopic algae which coat the rock and sand Surface
Take nutrients from the surrounding water and absorb energy from the sun by photosynthesis

Drumcondra Education Centre
Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

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Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Saw or Serrated Wrack (*Fucus serratus*)

Zone it is found on: This abundant Fucus algae can form dense layers on the lower shore of rocky seashores. The commonest species of the lower shore.

Eaten by: Periwinkles

Food source: Photosynthetic autotrophes

Abiotic factors that affect its location and its consequent adaptations:

Desiccation: It is intolerant of desiccation. With the flattened fronds only the top surface of the frond dries at low tide.

Wave action: It intolerant of heavy wave action. It has a tough flexible frond to help it reduce damage from wave action and its strong holdfast prevents it from being washed away. In sheltered conditions the fronds become curled and the entire plant becomes more bulky.

Light: It has the brown pigment fucoxanthin masking the chlorophyll,which can use the light that passes through the water. Like many other algae of the lower shore it is adapted to low light intensity by developing additional pigments for absorbing what little light is penetrating the water. One of the reasons that lower shore examples are almost black, absorbing all the light.

Temperature: The fronds are longer with fewer branches in cold climates. Shorter, much-branched individuals are found in warmer waters.

Biotic Factors:

Reproduction: The sexes are separate unlike the Fucoids of the upper shore and the receptacles containing these reproductive parts are more streamlined at the tips. Like the bladder wrack, female gametes produce chemical attractants to attract the male.

Space: It competes with tangled kelp and sugar kelp on the lower shore for space on rocks

Colonization: The Coiled tube worm spirobis favours the fronds of serrated wrack and often covers the whole frond appering like tiny white spiral tubes

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Teacher Design Team 2005-2006
Bije Barrett
Kathlyn Hennelly
Jane Woodlock

Spiral or Twisted Wrack (*Fucus spiralis*)

Zone it is found on: Lower level within the upper rocky seashore.

Eaten by: Periwinkles and Top shells.

Food source: Photosynthetic autotrophes

Abiotic factors that affect its location and its consequent Adaptations:

***Desiccation*:** Prolonged emersion exposes the seaweed to desiccation, temperature stress and reduced nutrient supply. Adaptations include: the spiralling of the frond to trap water and slow down evaporation, .They have thick cell walls and they lack the oiliness; hence, the slightly lower level on the seashore. Spiral Wrack shows better stress-tolerance than other wracks found further down shore

***wave action*:** Spiral wrack has a hold fast to attach it to the rocks and a flexible stipe and frond to with stand wave action .

***light*:** Spiral wrack has the pigment fucoxanthin, this allows them to use light that passes through the water for photosynthesis.

***salinity*:** The frond shows variation in its shape from one shore type to another and will be greatly affected by salinity fluctuations and wave action. It hybridises (crosses) with Bladder wrack under certain conditions e.g. low salinity.

Biotic Factors:

***Reproduction*:** . Like Channel wrack, this plant is also hermaphrodite .Reproduction is external. Gametes are secreted into the open sea where they meet each other by chemotaxis.

Predation: their main predators are periwinkles.

Competition for space: However, the growth is more rapid than Channel wrack and where overlap between the two occurs, *Fucus* will shade out the latter and dominate.