Macroalgae Fact-sheets

Edwards, M., Hanniffy, D., Heesch, S.,
Hernández-Kantún, J., Moniz, M., Quéguineur, B
Ratcliff, J., Soler-Vila, A., and Wan, A.

Edited by:

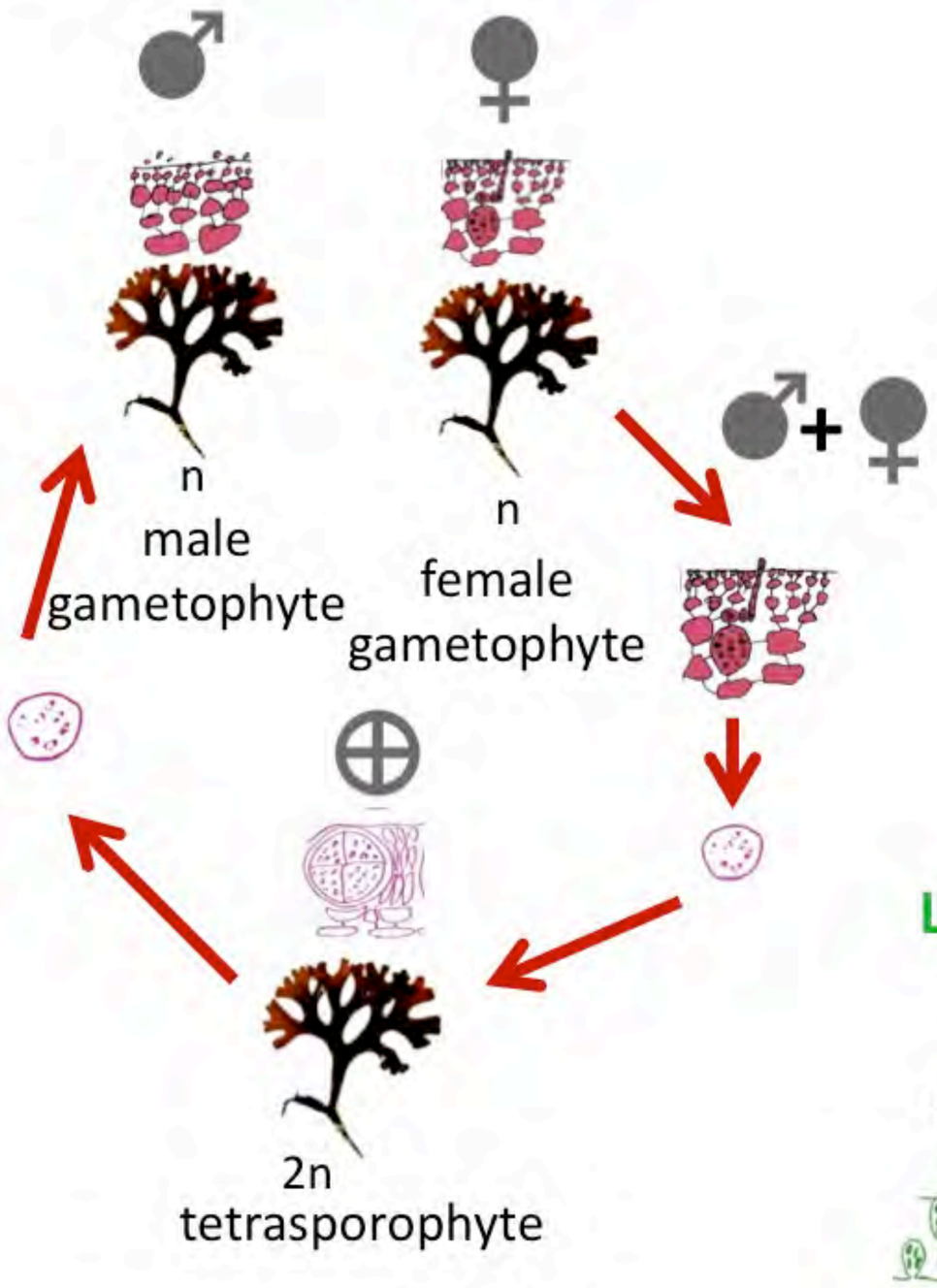
Soler-Vila, A. & Moniz, M.

These Fact-sheets have been created by the Irish Seaweed Research Group at the Ryan Institute, NUI Galway. Some characteristics described within may change outside Ireland. Fact-sheets are available to download from our website www.irishseaweed.com

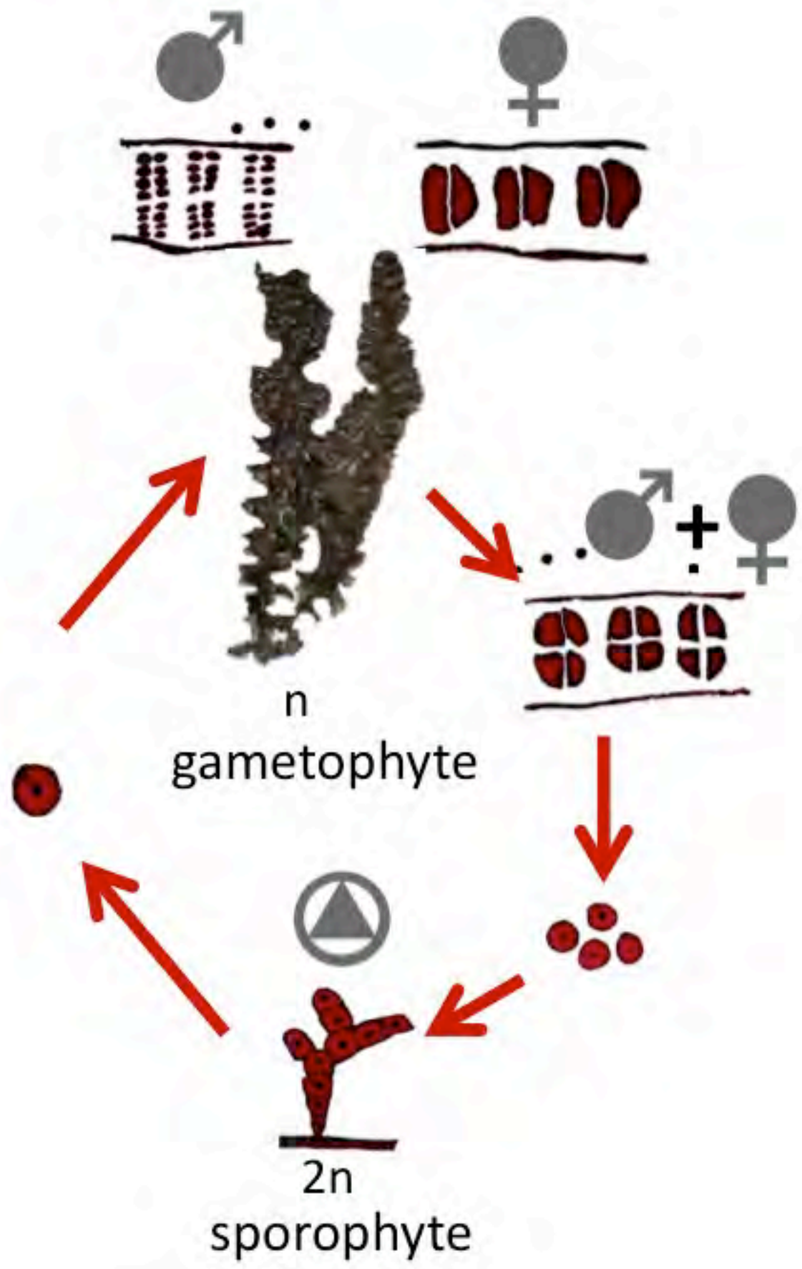
ISRG
Irish Seaweed Research Group

NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

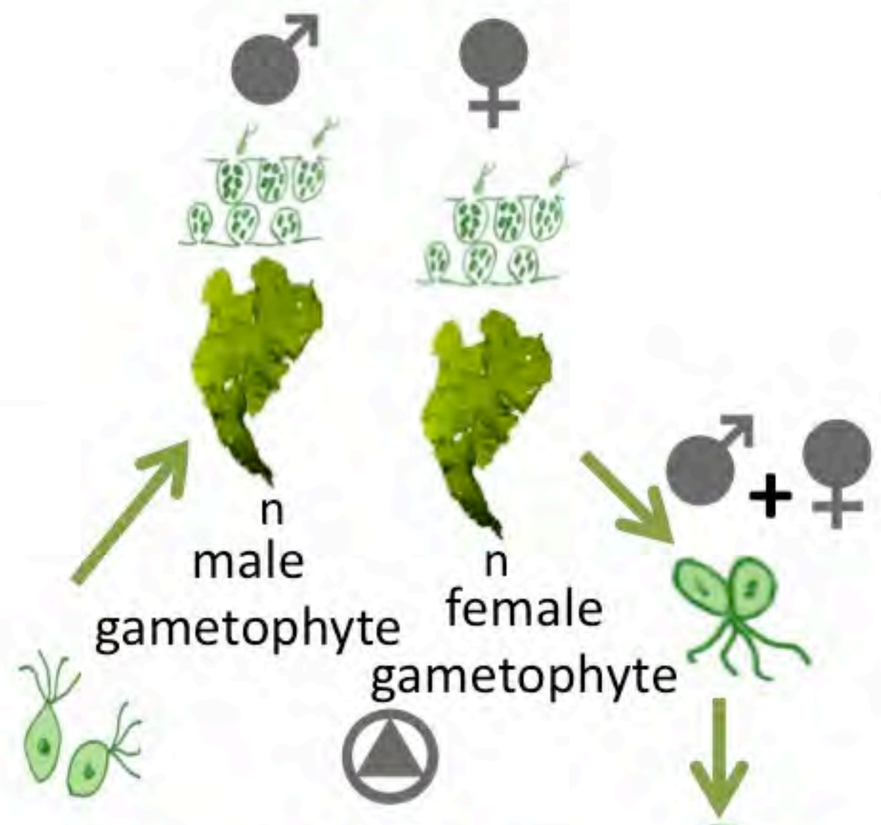
LC1: Red alga (e.g. *Chondrus*)



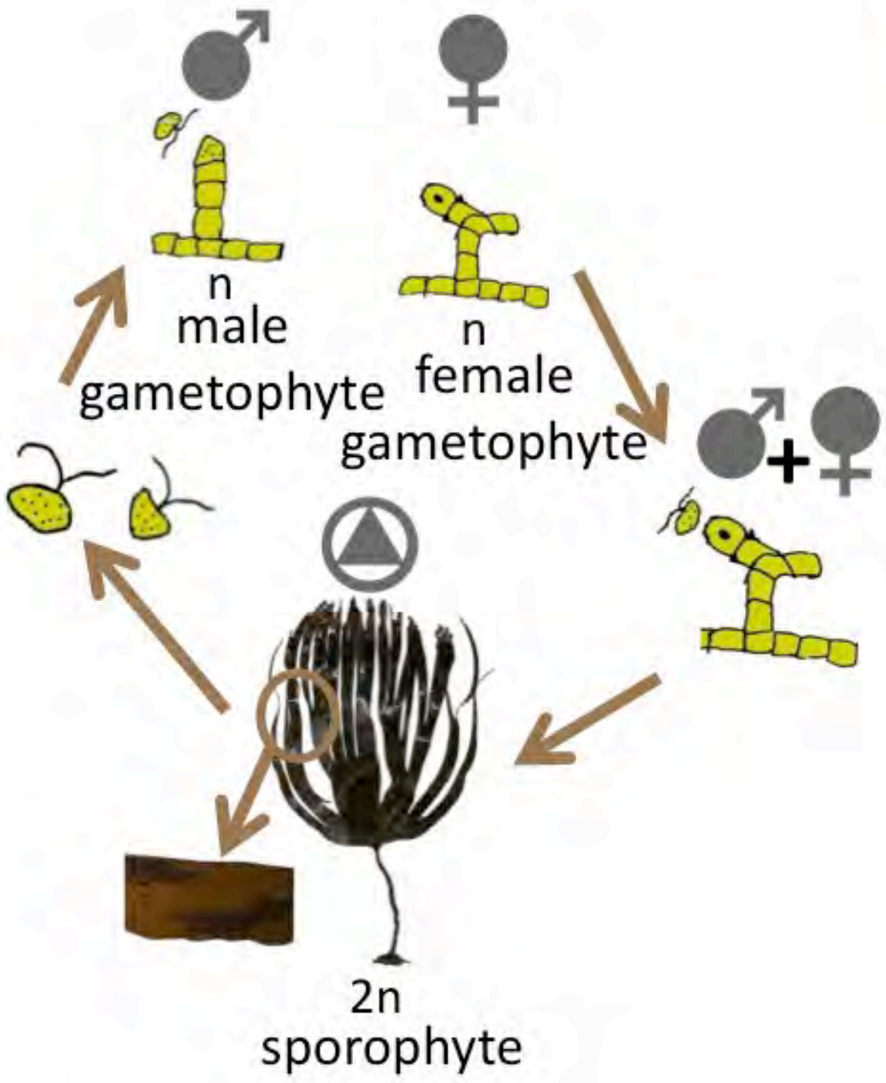
LC2: Red alga (e.g. *Porphyra*)



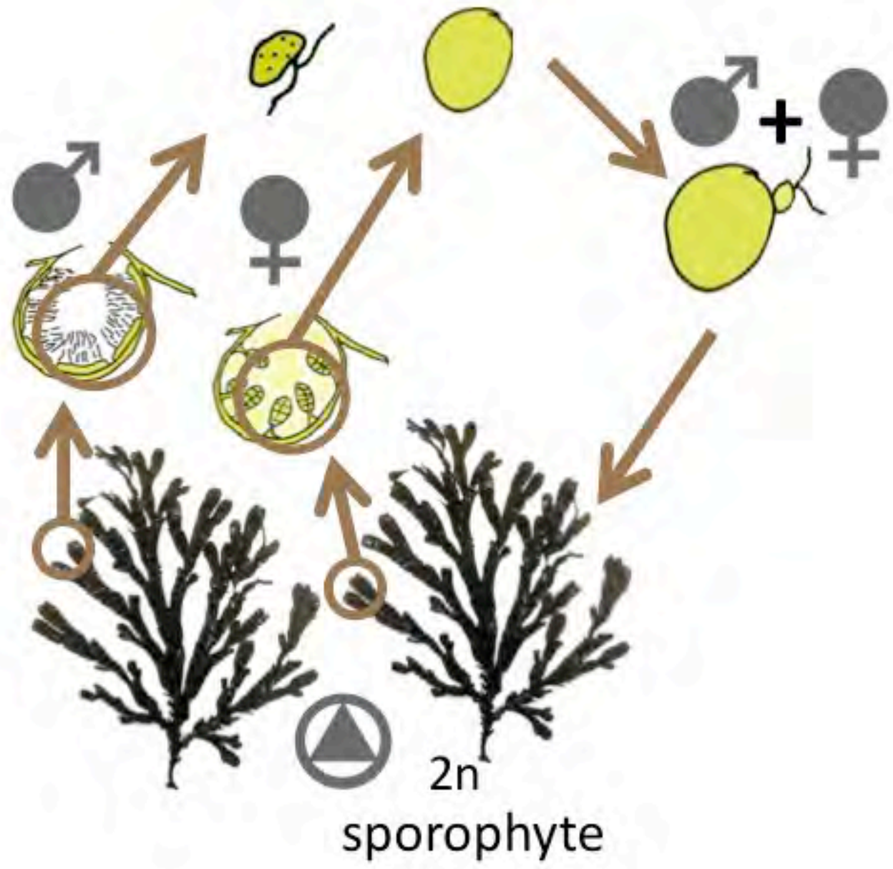
LC3: Green alga (e.g. *Ulva*)



LC4: Brown alga (e.g. *Laminaria*)



LC5: Brown alga (e.g. *Fucus serratus*)



Life-cycles created by Jazmin Hernández-Kantún

Alaria esculenta

Common names: Atlantic Wakame, Dabberlocks, Wing Kelp, Honeyware, Láir, Láracha.

ISRG
Irish Seaweed Research Group

Fig 1. *Alaria esculenta* thalli.

Morphology

- This brown alga has a small holdfast, short stipe that extends from the holdfast and continues as a distinct midrib for the length of the blade.
- The blade is elongated, soft, flexible and rounded at the tip.
- Commonly 1-1.5 m in length, but may be larger, and 5 to 40 cm in width, wider at the base than at the tip.
- The colour varies from green, yellow-green to brown with a paler stipe / midrib.
- This species is difficult to mistake for any other in Ireland because of its distinct midrib.

Fig 2. Morphology.

Reproduction

- *Alaria esculenta* thalli are the macroscopic phase of a two-stage life-cycle (see LC4*).
- Reproductive structures are located on the sporophylls, on dark patches (called sorus). The sporophylls form at the base of the thallus of the stipe. They can be numerous, forming a dense bundle between 10 – 20cm in length.

♀♂ Male and female gametes occur on separate microscopic individuals.

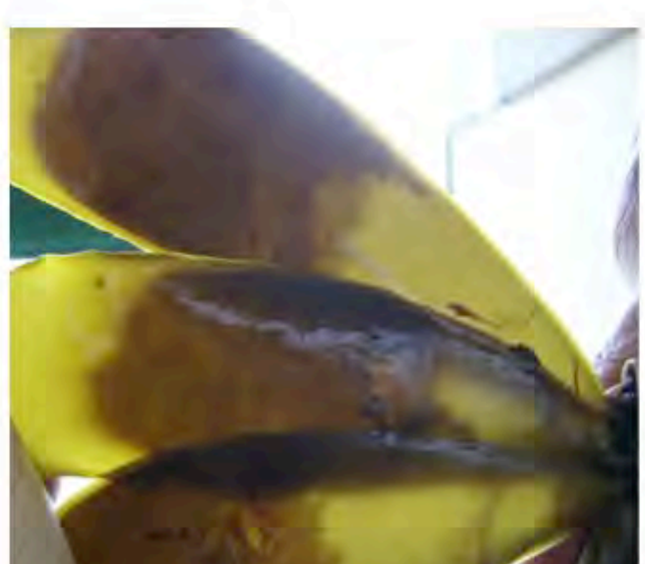
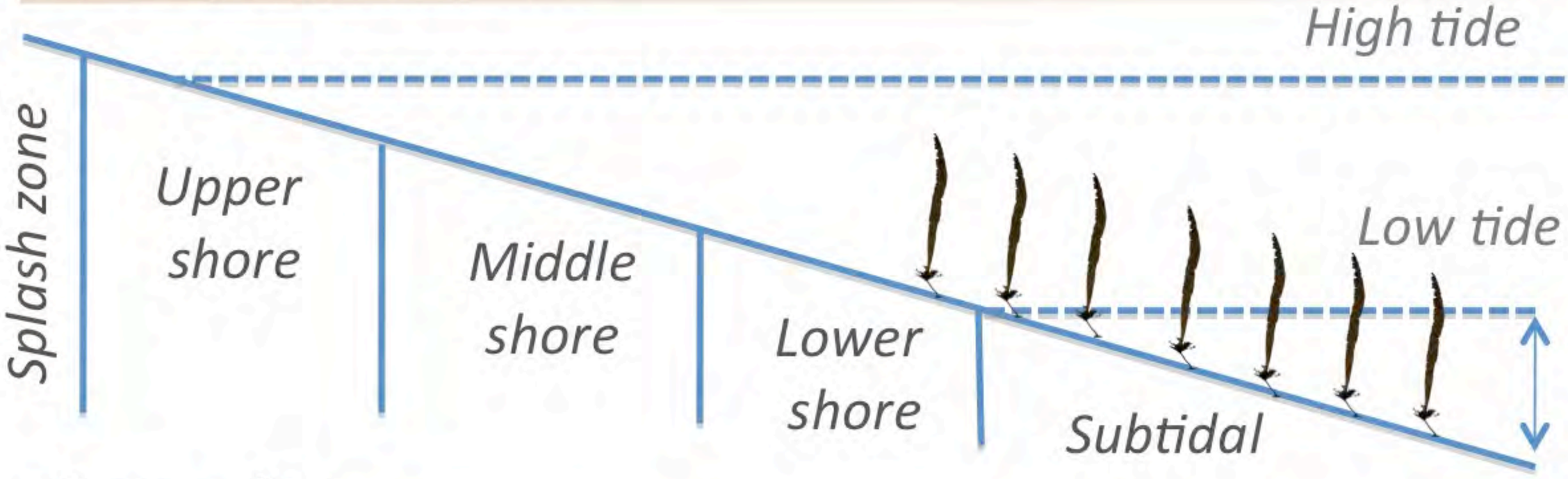


Fig 3. Fertile wing-like sporophylls.

*Note: Life-cycle 4 (LC4) inside front cover.

Distribution and habitat

- Occurs throughout the N. Atlantic (from Greenland to France) and along both western and eastern Atlantic shores. Also found in the N.E. Pacific (Alaska).
- It is common from 0 -8 m depth but may grow deeper in areas of good light penetration. Prefers rocky substrata in weak or strong currents at exposed to extremely exposed locations.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- Known as Atlantic Wakame due to its similarity to the Asian Wakame species (*Undaria pinnatifida*). This is a tasty seaweed that can be used in many dishes – soups, casseroles, breads, and even sweet desserts. Like all the kelps, it is rich in vitamins, minerals, and particularly iodine.
- All the kelps contain alginates which are used as food additives: E400 – alginic acid, E401 – sodium alginate, E402 – Potassium alginate, E403 – Ammonium alginate, E404 – Calcium alginate, E405 – Propane - 1,2 - diol alginate ("PGA").
- Alginates are used as thickeners, stabilizers, and gelling agents.
- This species is cultivated on long-lines in Ireland.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, leave 20 cm of blade above the stipe. This will leave the meristem untouched, allowing new growth.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Ascophyllum nodosum

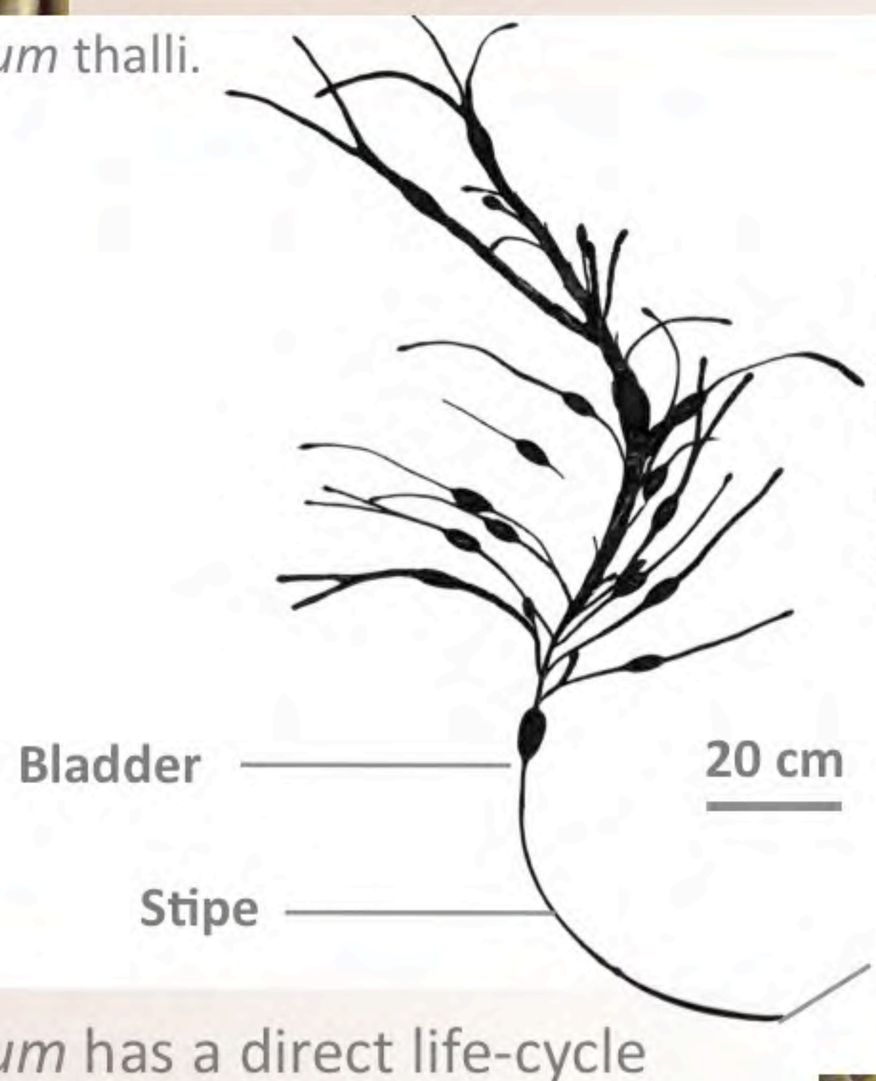
Common names: Yellow Tang, Knotted wrack, Sea Whistle, Egg Wrack, Feamainn bhuí.

ISRG
Irish Seaweed Research Group

Morphology

Fig 1. *Ascophyllum nodosum* thalli.

- Brown alga with long, leathery, irregularly branched fronds carrying large egg-shaped, median air bladders at intervals along the main axis and branches.
- Growing up to 1.5 m long, with branches 1 cm wide.
- Thalli are attached to the substrate by a discoidal holdfast.
- The colouration ranges from olive green to yellow brown, turning greenish black when dried.
- It should not be confused with *Fucus vesiculosus* which has a yellow-green midrib in the middle of the frond.



** The growing tissue is located at the tip of the blade. A new bladder is formed every year except for the first one, which is formed after 5-7 years.

Fig 2. Morphology.

Reproduction

- *Ascophyllum nodosum* has a direct life-cycle (see LC5*).
- Male and female structures occur on different thalli. The reproductive structures or receptacles grow out laterally from the sides of the fronds, usually in pairs.

♀ Fertile female structures are green.

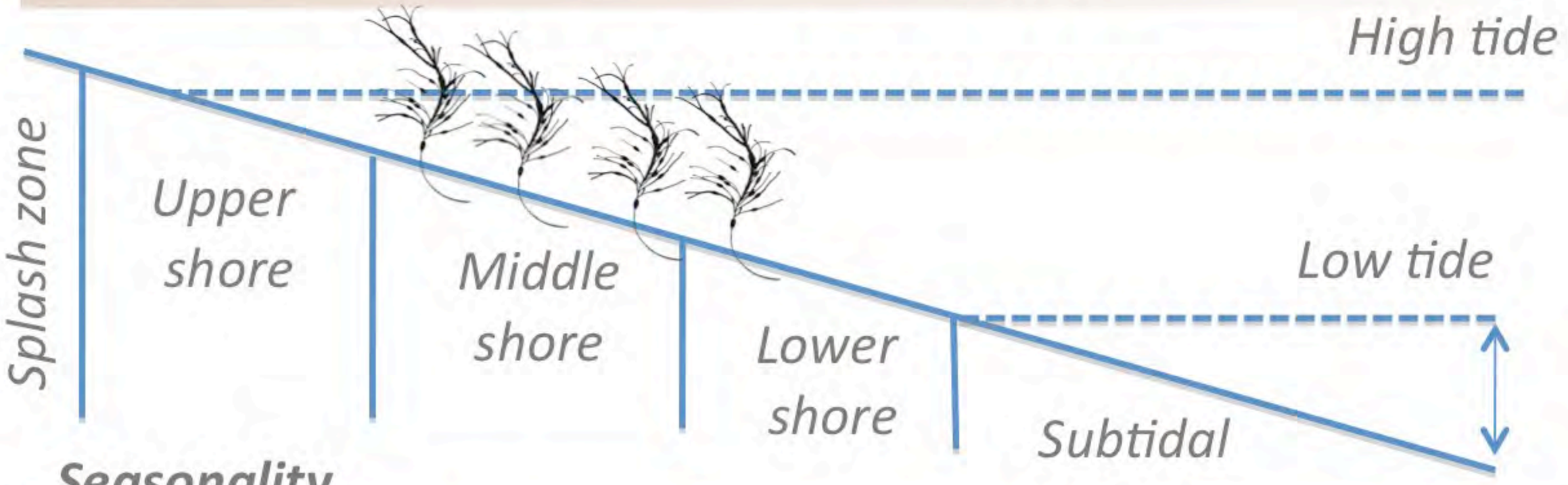
♂ Fertile male structures are green to golden brown.

Fig 3. Detail of the reproductive receptacles.

*Note: Life-cycle 5 (LC5) inside front cover.

Distribution and habitat

- It is found in the N.E. Atlantic (from the Arctic shores to Portugal and the N. Sea) and N.W. Atlantic (from Arctic to New Jersey).
- It grows in the mid-littoral zone in wave sheltered rocky shores.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- Individual fronds can last up to 15 years before breakage. It has been suggested that some clumps can be over 400 years old.
- 25,000 wet tonnes are harvested sustainably in Ireland by hand each year.
- It is used as a stock feed additive. It may make up to 5% of the diet for poultry, sheep, cattle, pigs and horses.
- In some areas it is used as packing material for shellfish transport.
- It is listed in France as a species allowed for human consumption, as a good source of vitamins and trace elements.
- It has been described to have anti-coagulant, anti-thrombotic and anti-inflammatory properties.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- Current practices allow 3 to 5 years for regeneration after harvesting but the exact period depends on the area and the time of harvesting.
- When cutting the individual, leave 20 cm of blade attached to the rock to allow re-growth and recruitment of young individuals.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE
European Union
European Regional Development Fund
NUI Galway OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Asparagopsis armata

Common names: Harpoon Weed, Feamainn Mhuirgha.

ISRG
Irish Seaweed Research Group

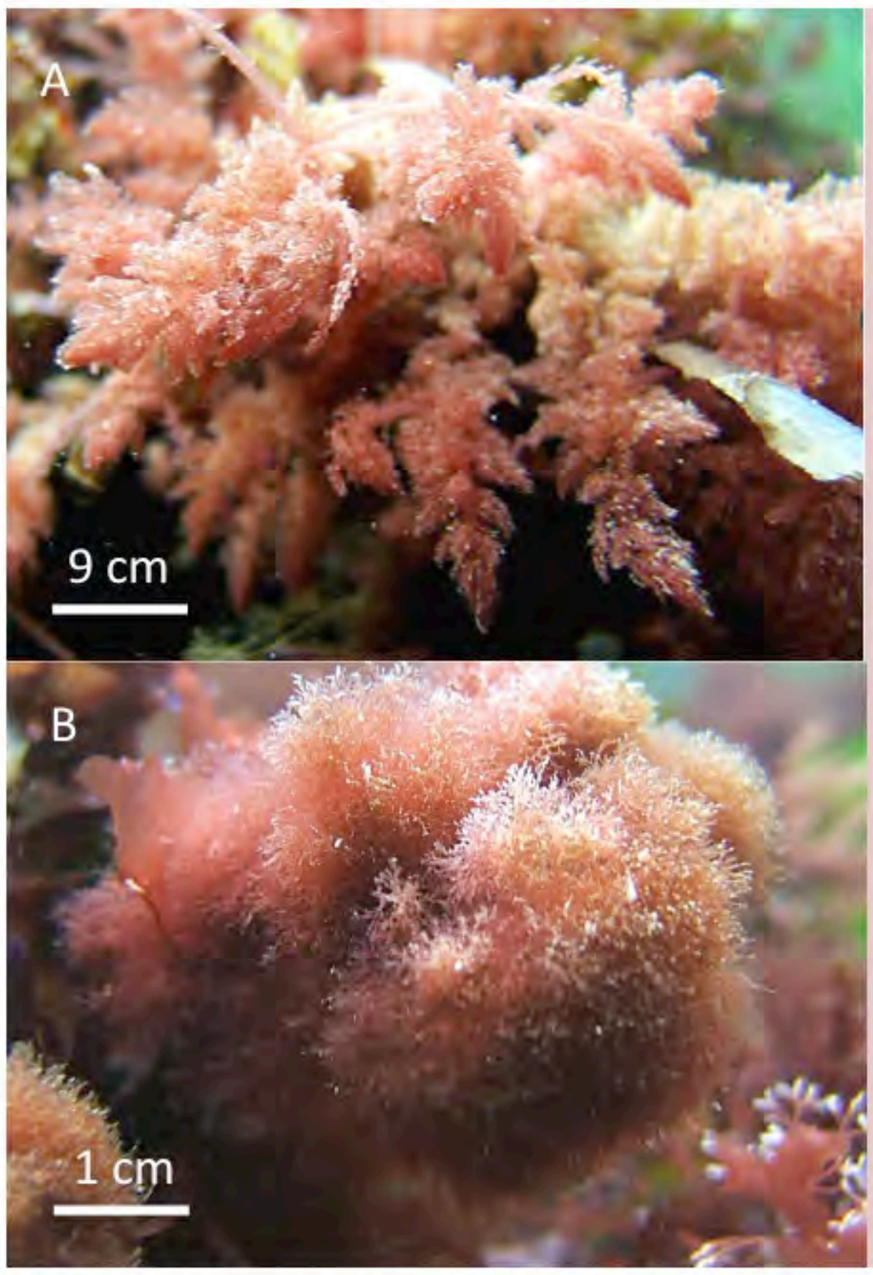


Fig 1. Gametophyte (A) and tetrasporophyte (B).

Morphology

- Red alga with two red to rosy pink macroscopic life phases: The gametophyte is easily identified by some branches developing into harpoon-like anchor structures. The tetrasporophyte looks like a cotton ball and its thallus is highly reduced and profusely branched.
- The gametophyte can reach 30 cm in length but the tetrasporophyte only reaches 3 cm in diameter.
- The tetrasporophyte is often confused with other red tufted seaweeds, particularly with *Bonnemaisonia hamifera* commonly known as Bonnemaison's Hook Weed. Identification requires the use of a microscope.
- There are no other species of this genus in Ireland.

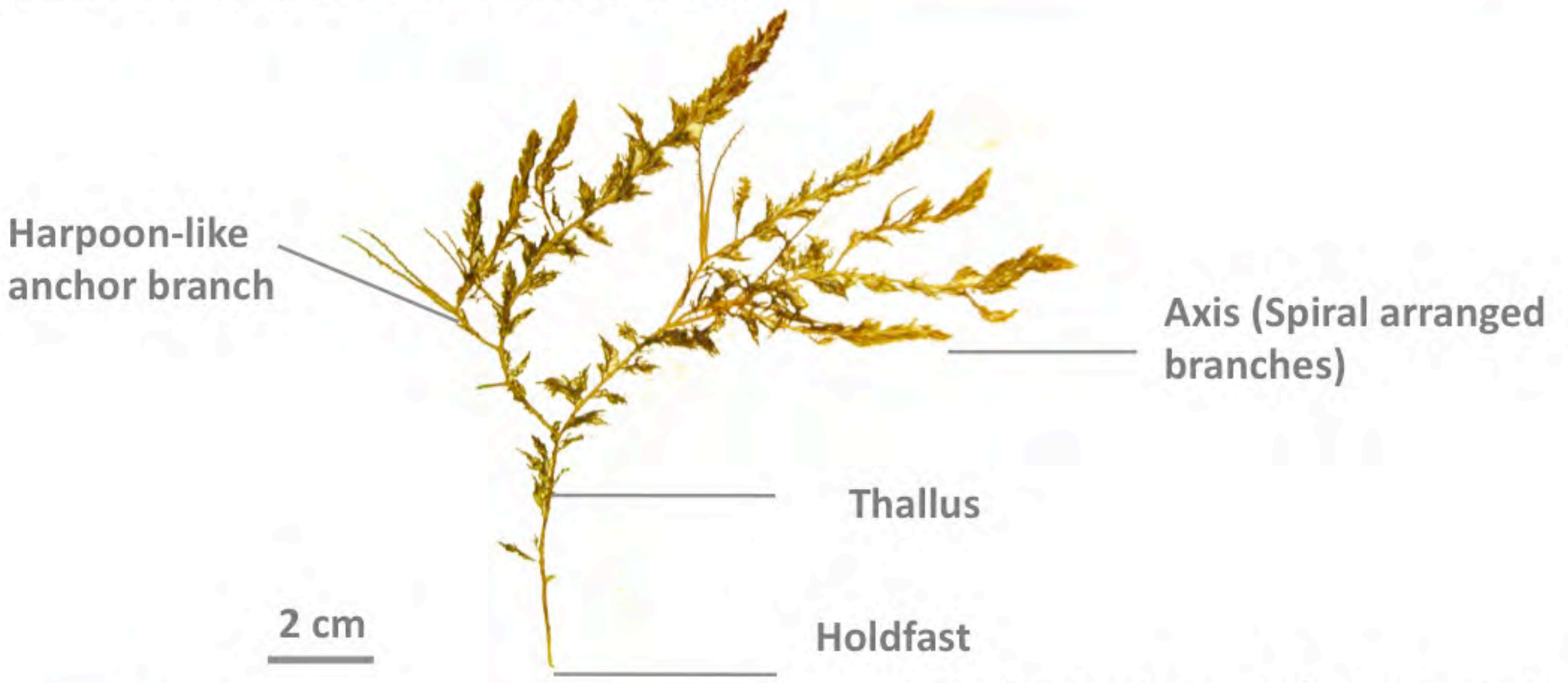


Fig 2. Morphology of gametophyte.

Reproduction

- *Asparagopsis armata* thalli have two morphologically different macroscopic phases in the life-cycle (see LC 1*). Male and female structures occur on different individuals.

♀ Fertile female: The female structures are flask-shaped.

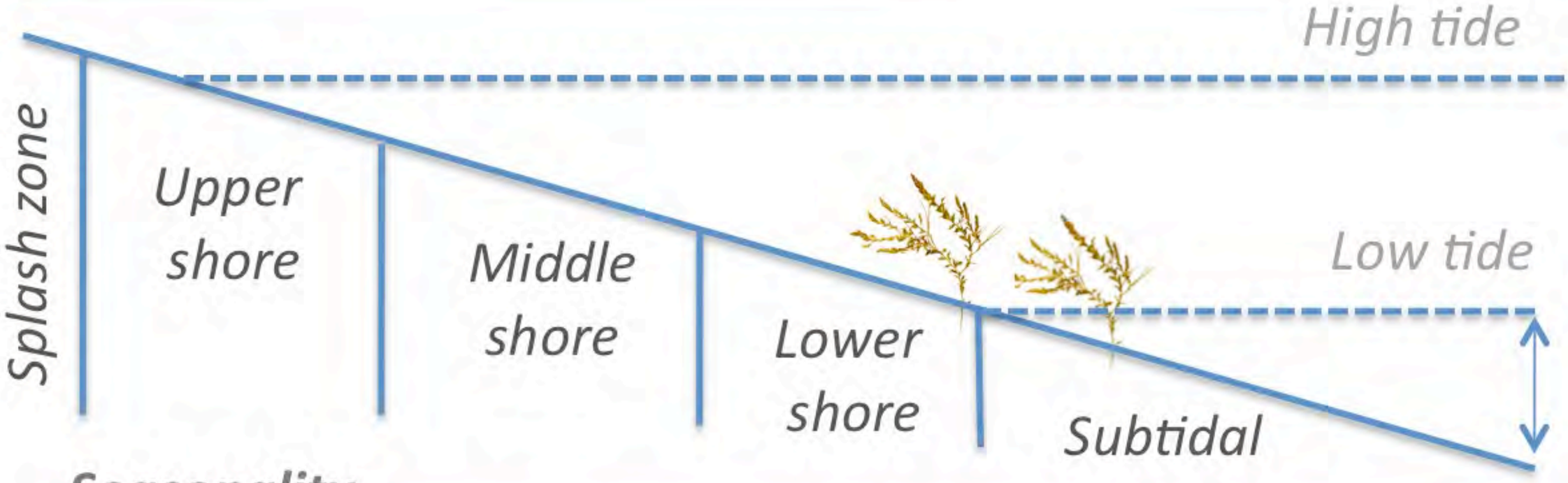
♂ Fertile male: The male branches are club-shaped.
Both, female and male structures are not visible to the unaided eye.

⊕ The tetrasporophyte (Fig 1B) is also known as the *Falkenbergia* phase.

*Note: Life-cycle 1 (LC1) inside front cover.

Distribution and habitat

- Found in New Zealand, Australia, W. Mediterranean and W. Europe.
- ***Gametophyte-*** Attaching to other algae by its hooks, mainly in sandy pools.
- ***Tetrasporophyte-*** Free floating or associated with other seaweeds, in particular *Ulva* spp. and *Corallina officinalis*. Both are found in sheltered to slight wave expose locations.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- This species is known to have several bioactive molecules, mainly sulphated polysaccharides with iodine and bromine groups. These compounds are found to have anti-cancer, anti-fungal and anti-microbial properties. Extracts are used as natural preservatives in cosmetics, in anti-dandruff and scalp cleansers and in anti-acne treatments.
- It is an introduced species from the Southern hemisphere. It was introduced in the Atlantic and Mediterranean in the 1920s. In Ireland it was first recorded in Galway harbour in 1939, as the "Falkenbergia" stage.
- This species was cultivated in Ireland to extract natural preservatives for cosmetics.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove some of the branches of the selected front, by leaving the holdfast and some branches behind.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Chondrus crispus

Common names: Carrageen moss, Carrageen, Irish moss, Jelly moss, Carraigín, Carraigín Fiadhám.

ISRG
Irish Seaweed Research Group

Fig 1. Thalli of *Chondrus crispus*.

Morphology

- Red alga with cartilaginous, smooth regular flat and dichotomously branching fronds. It has a broad fan like shape. Some variants can exhibit thick narrowed fronds.
- The colour varies from deep purple, red, yellow and green tones. When underwater the branched tips of the females show a violet iridescence.
- Low-lying bushy plant, < 15 cm high.
- Often confused with *Mastocarpus stellatus*. This latter species has an incurved thallus with thickened edges, and reproductive structures are formed in surface papillae.

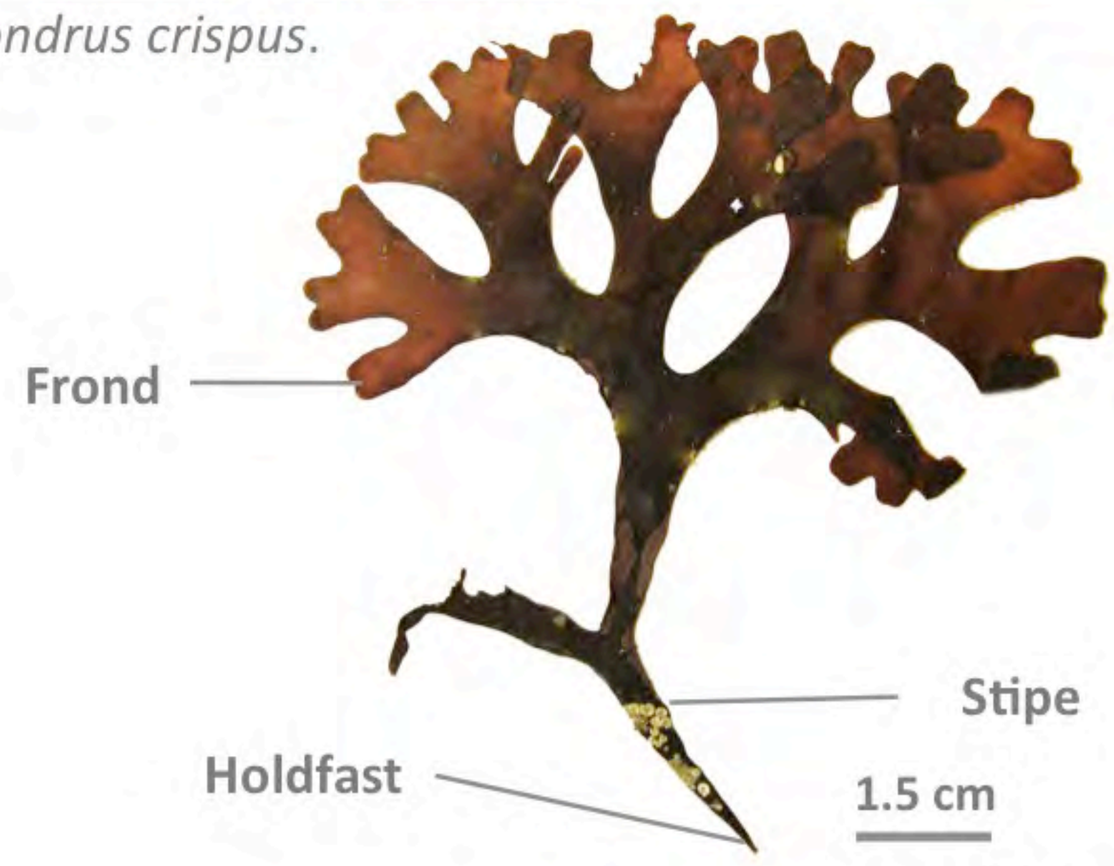


Fig 2. Morphology.

Reproduction

- *Chondrus crispus* thalli have two morphologically similar macroscopic phases in their life-cycle (see LC 1*).

♀ Fertile female: swollen oval nodules, often found in pairs at the tip of the frond (Fig 3B).

♂ Fertile male: Not visible to the naked eye, and difficult to identify.

⊕ Tetrasporophytes: tetrasporangial sori protrude only slightly from the thallus, with an oval or linear shape. Found on the upper part of the frond and abundantly in young individuals (Fig 3A).

*Note: Life-cycle 1 (LC1) inside front cover.

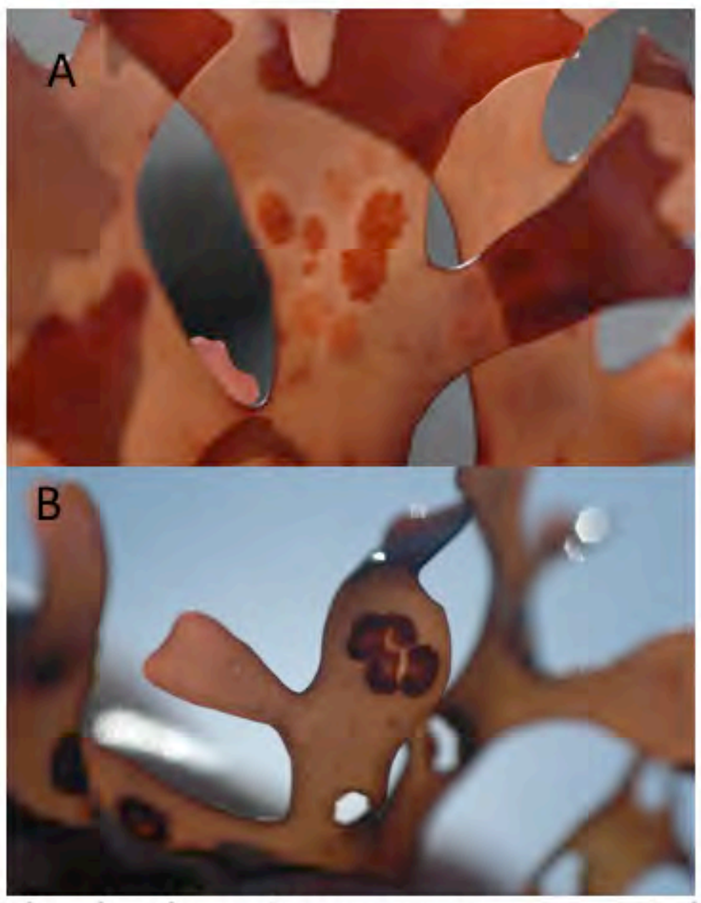
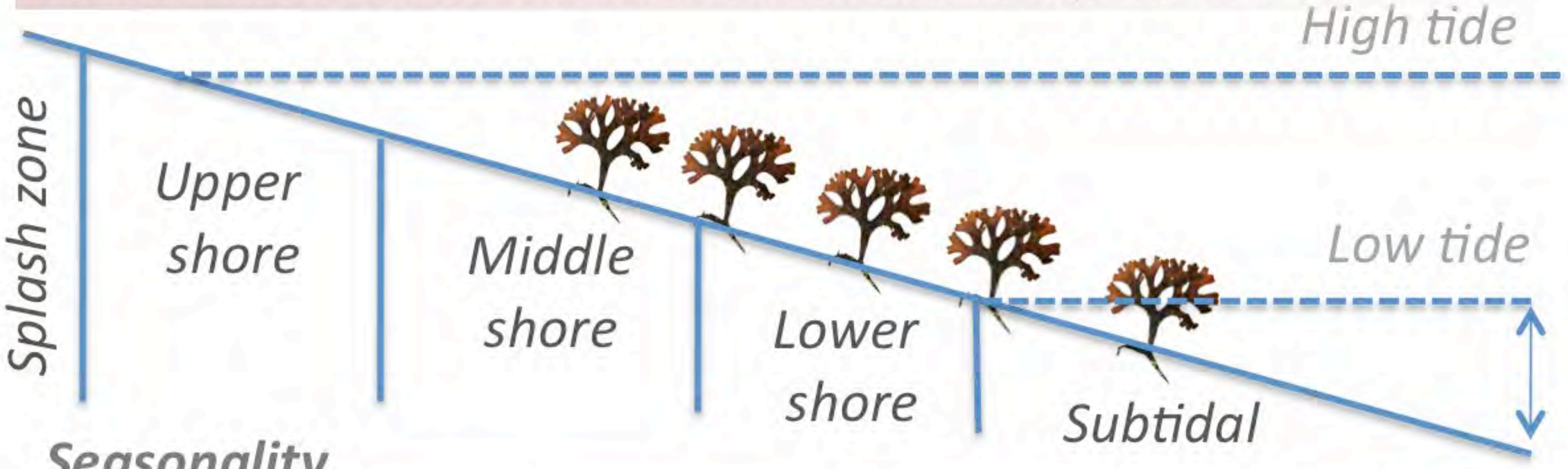


Fig 3.(A) Individuals showing tetrasporangial sori and (B) female structures.

Distribution and habitat

- This species is found on both sides of the N. Atlantic.
- It is typically attached to rocks or stones in the mid to lower intertidal in sheltered areas but also confined to low intertidal in exposed areas.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- *Chondrus crispus* produces large amounts of sulphated polysaccharides with gelling properties, known as carrageenans.
- The name carrageenan is derived from a place name in County Donegal, Ireland, *viz* Carraigín Head.
- Known usages include: food purposes (desserts, jellies, blancmanges, aspics and puddings, food thickener, beer production), folk remedy (cough, colds, bronchitis and asthma), leather-curing, soap-making, shampoos, lubricants and paper and linen production.
- In the food industry, carrageenan is classified as a food additive, E407.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. The Carrasea project -INTERREG IIIC - defined some guidelines for this species.
- Outcomes of the Carrasea project recommend harvesting at exposed sites every two years and in sheltered sites every four years, leaving mature plants to grow every two metres.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove some of the branches of the selected frond, by leaving the holdfast and some branches behind.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Fucus serratus

Common names: Serrated Wrack, Saw Wrack, Toothed Wrack, Míoránach, Dulamán, Múrach Dhubh.

ISRG
Irish Seaweed Research Group

Fig 1. Thalli of *Fucus serratus*.

Morphology

- Brown alga with an irregular branched frond and a distinct midrib. The leaves are flat and smooth with characteristic serrated edges.

- The fronds have an olive-yellow-brown colour when fresh to a green-black when dried. The frond can be up to 80 cm long.

- Other species of this genus found in Ireland are *F. vesiculosus, F. spiralis, F. ceranoides,* rarely *F. distichus* and *F. cottonii.*

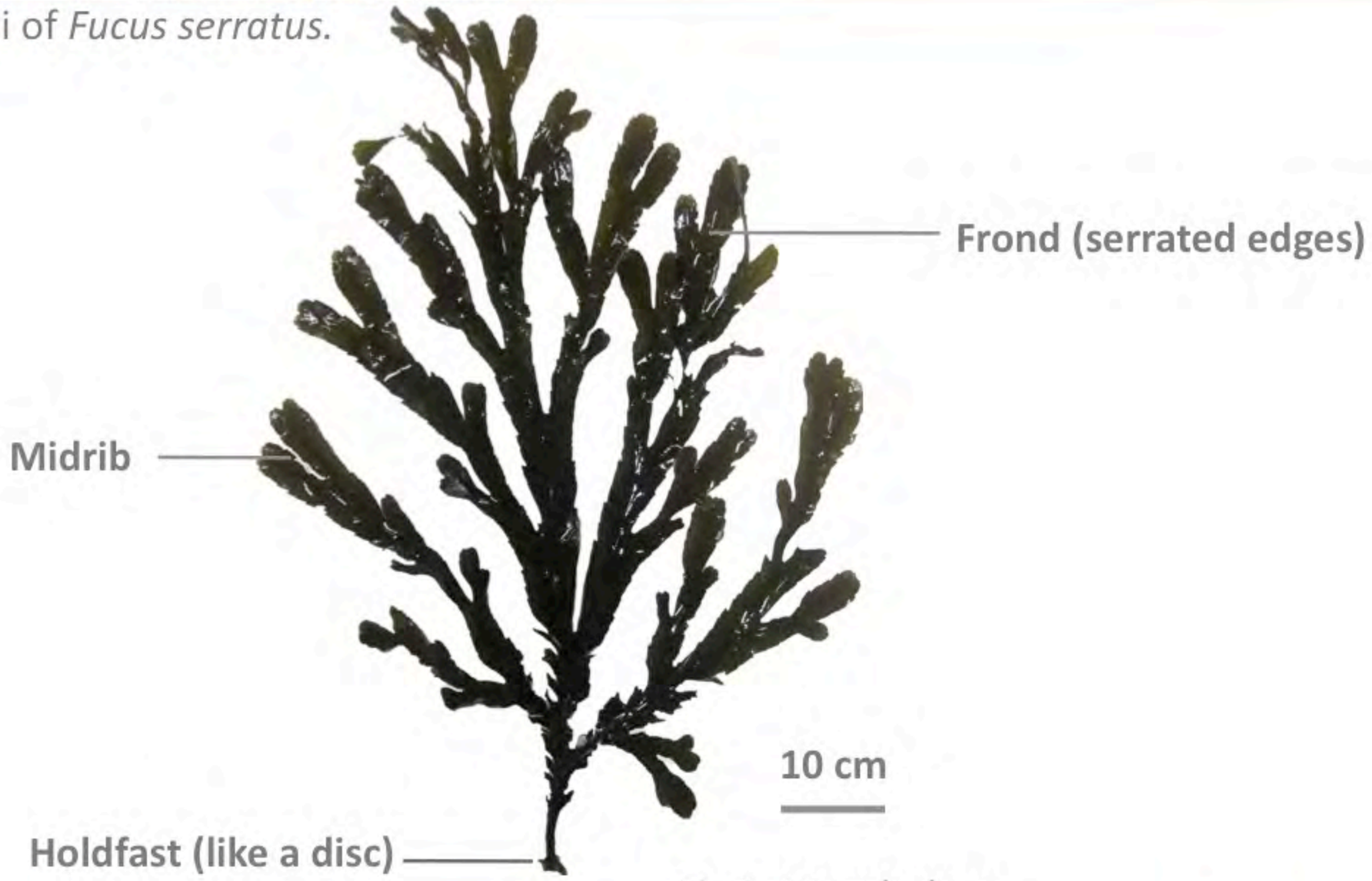


Fig 2. Morphology.

Reproduction

- *Fucus serratus* has a direct life-cycle (see LC5*).
- Reproductive individuals can be easily identified. The tips of the fronds bearing reproductive structures have a thick and granulated texture.

♀
♂

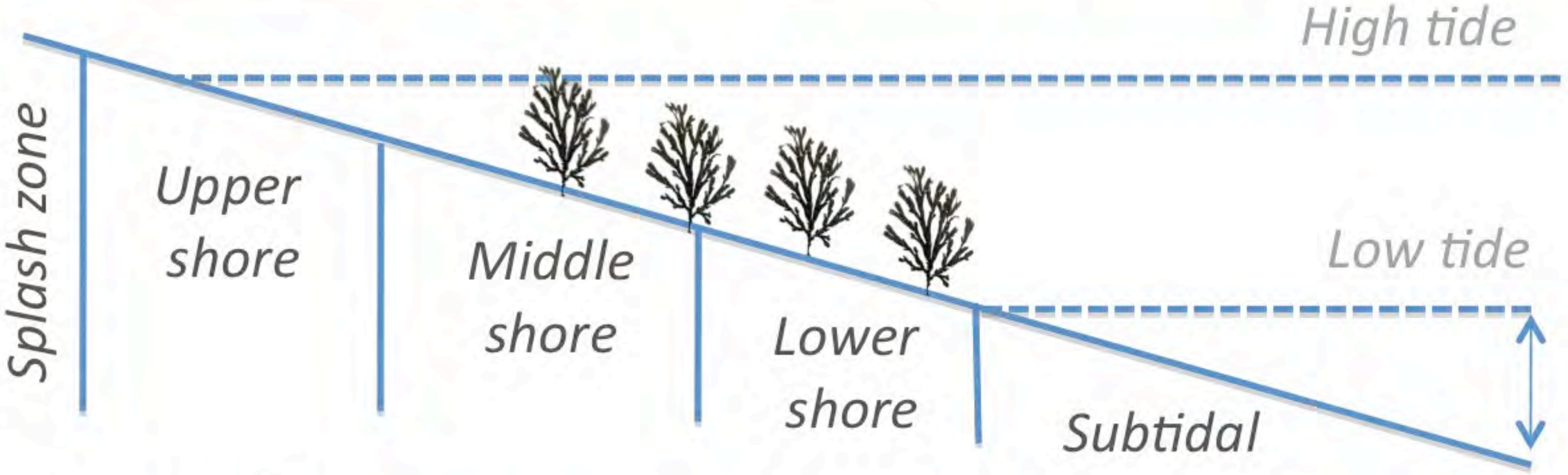
Male and female structures occur on separate thalli.

*Note: Life-cycle 5 (LC5) inside front cover.

Fig 3. Reproductive thallus.

Distribution and habitat

- This species is found in the N.E. Atlantic, from northern Norway to northern Portugal, N. Sea and W. Baltic. It has been introduced into the N.W. Atlantic.
- A common seaweed of wave-exposed shores, widely distributed, growing on rocky substrata. However it is not present on very wave-exposed shores.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- *Fucus serratus* is used in Ireland in bodycare products, seaweed baths and as a land fertiliser.
- It is also used as packing material for transporting shellfish.
- A wide range of bioactivities have been described for species of *Fucus* e.g. antioxidant, antitumor, antivenom, and anticoagulant properties.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove some of the branches of the selected frond, and leave the holdfast and some branches behind.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE
European Union
European Regional Development Fund
NUI Galway OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Gracilaria gracilis

Common name: Slender Wart Weed.

ISRG
Irish Seaweed Research Group

Fig 1. Individuals growing directly in the sand.

Morphology

- Red alga with dark brown to purple-red colour, elongated with branched fronds, round and with tapered apices, attached by a disk-shaped holdfast. In summer the colour of the thalli may become yellow-translucent .
- This species has different growth forms, from branched and bushy to long and irregularly branched.
- The texture is cartilaginous with young plants being softer than older ones.
- The thalli can reach 60 cm height and fronds 3 mm width in cross section.
- Identification of this species requires taxonomic expertise.
- Other species present in Ireland are *G. bursa-pastoris* and *G. multipartita*, but both are aliens and very rare.

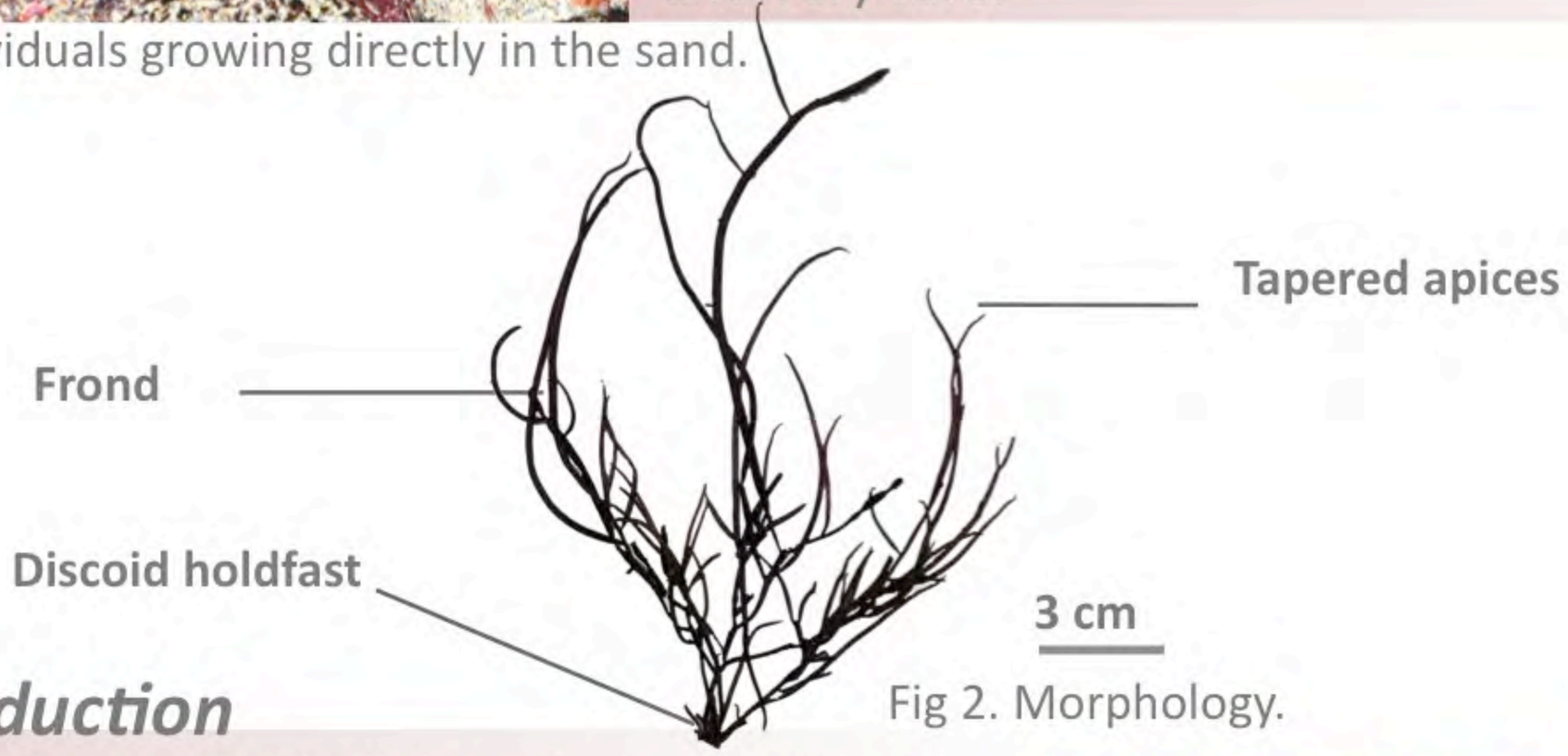


Fig 2. Morphology.

Reproduction

- *Gracilaria gracilis* thalli have two macroscopic phases in their life-cycle (see LC1*). Male and female structures occur on different individuals.

♀ Fertile female: bears wart-like structure of 0.5 to 1 mm in diameter.

♂ Fertile male: Structures not visible to the unaided eye.

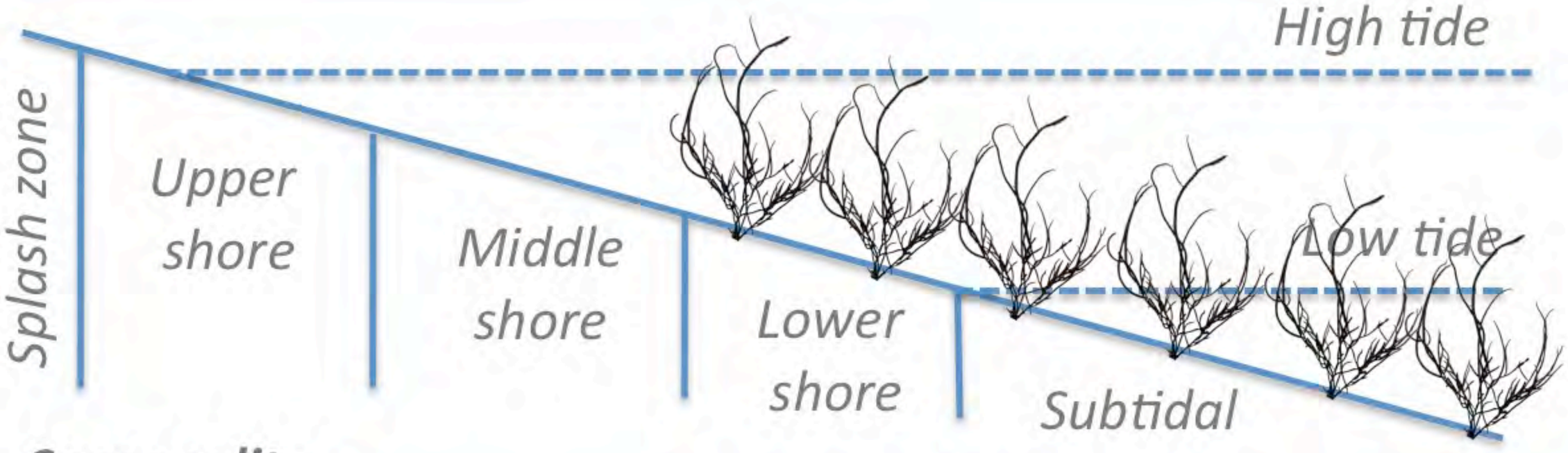
⊕ Tetrasporophyte: tetrasporangia not visible to the unaided eyes.

Fig 3. Fertile female thalli.

*Life-cycle 1 (LC1) inside front cover.

Distribution and habitat

- This species occurs in N.E. and E. Atlantic (Ireland to Canary Is. and W. Africa); S.E. Atlantic (South Africa); and in the W. Atlantic in the Caribbean and Brazil.
- It grows on rocky shores in sheltered locations, often in sandy areas, and can be found in up to 20 m depth.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- Other species of *Gracilaria* are consumed as food in many Asian countries, and are known for their agar content.
- Agar is a gelatinous substance with a wide range of industrial applications. It is used as a thickener for soups, fruit-preserves, ice-cream, as a clarifying agent in brewing and for sizing paper and fabrics.
- Agar is a solid substrate also used as culture medium in microbiological work. In the food industry it is classified as food additive (E406).
- Annual global production is approximately 30,000 tons (dry weight), most of which comes from natural populations in Chile, Argentina, and Brazil.
- The genus *Gracilaria* contains more than 150 species. Some species are now cultivated on large scale in Chile, Taiwan, Vietnam, and parts of Thailand.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove some of the branches of the selected frond, by leaving the holdfast and some branches behind.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Himanthalia elongata

Common names: Sea bean, Sea spaghetti, Thongweed, Rúalach, Ríseach, Raif.

ISRG
Irish Seaweed Research Group

Fig 1. Individuals of *Himanthalia elongata.*

Morphology

- Brown alga closely related to the wracks.
- It has a vegetative base, the so-called 'button', that fixes the thallus to the rocks and from which forked, thong-like fronds arise.
- Receptacles are 1- 3 m long, 5-10 mm wide, flat, of yellow-brown colour and flexible.
- Older individuals are often overgrown by brown epiphytes forming fine, soft tufts especially near the tips of the thongs.
- This species has a distinct morphology that cannot be confused with any other species in Ireland.

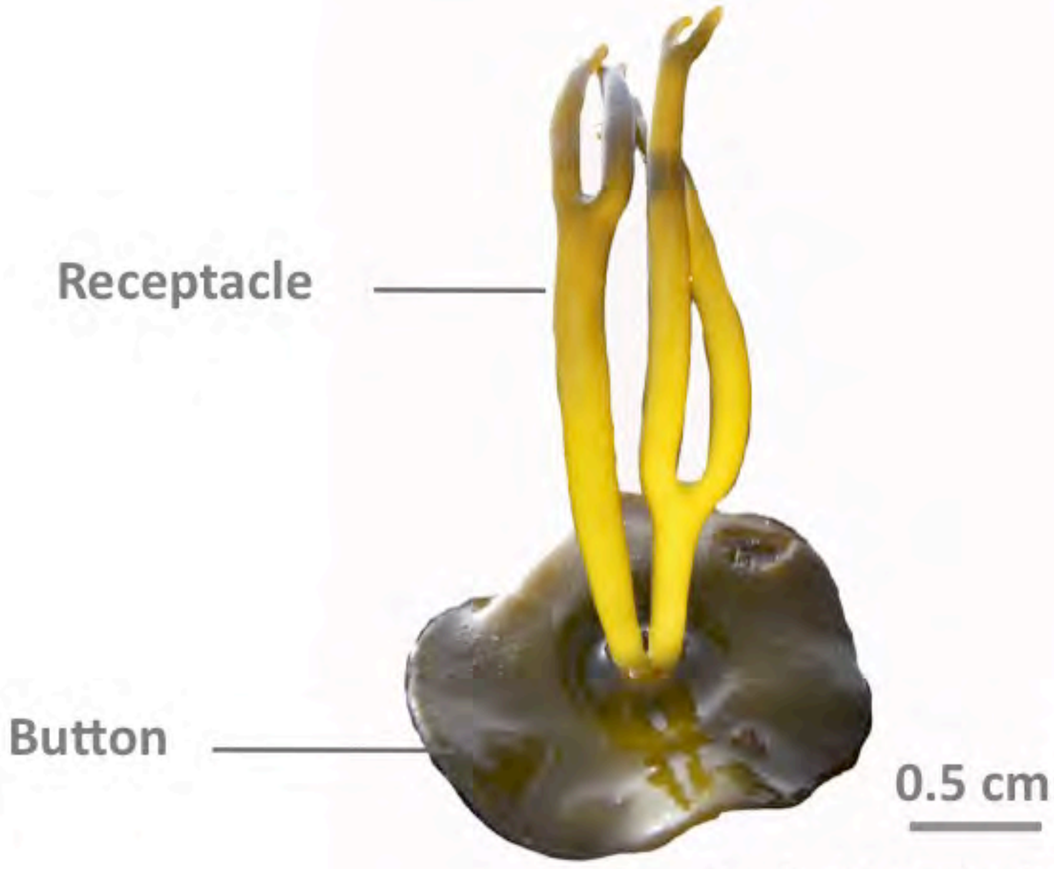


Fig 2. Morphology.

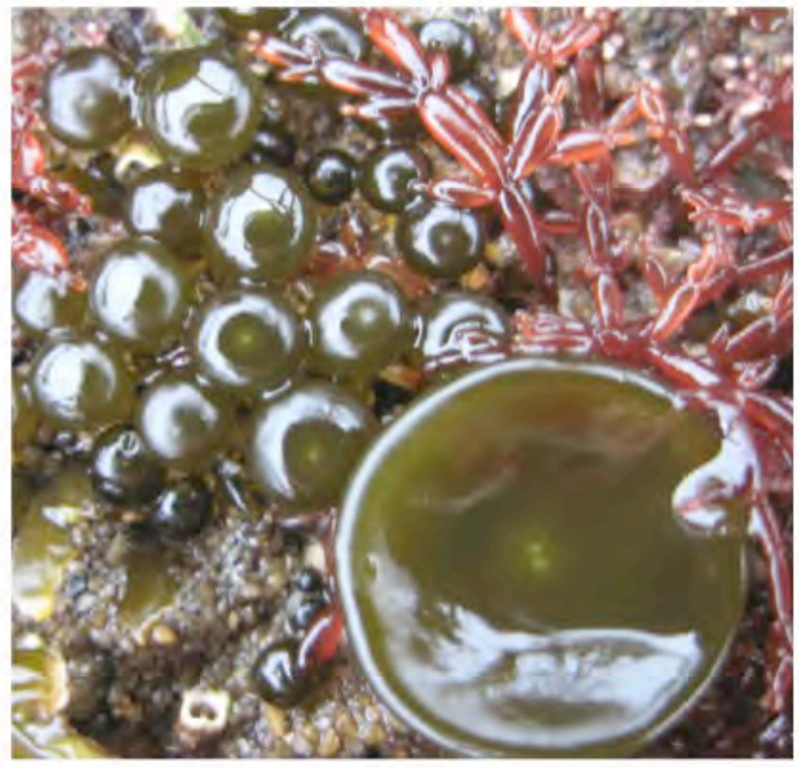


Fig 3. Close-up of buttons growing on the shore.

Reproduction

- *Himanthalia elongata* has a direct life-cycle (see LC5*).
- Reproductive structures are found on the thong-like fronds or receptacles and appear in little brown dimples (conceptacles).

♀
♂

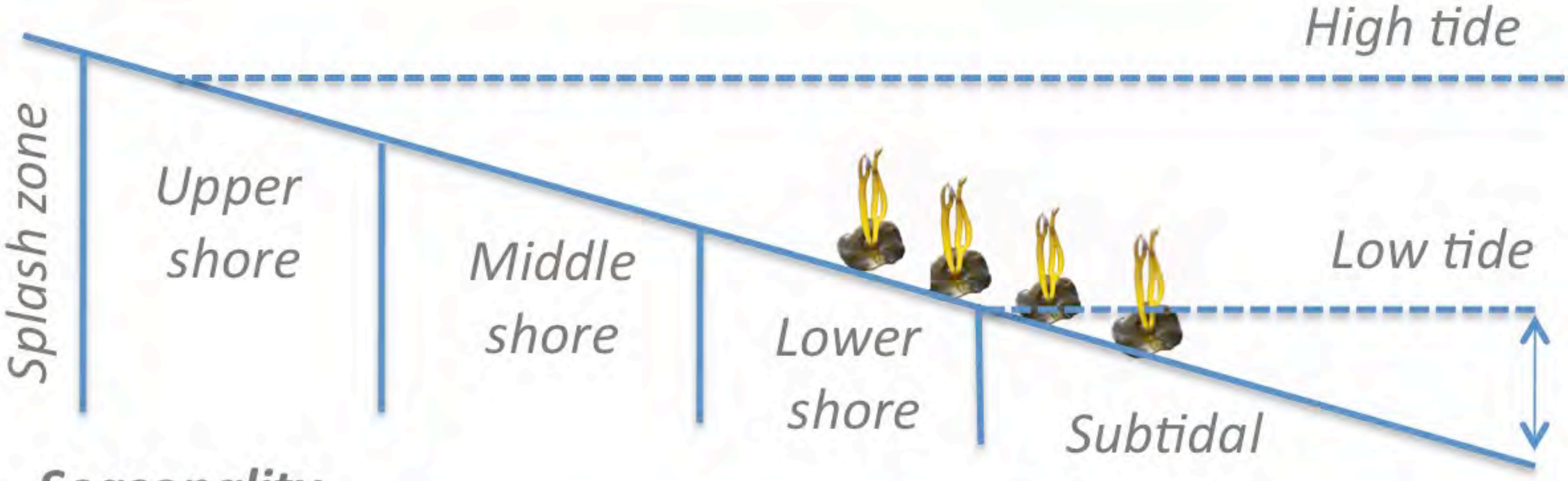
Male and female structures occur on separate individuals.

*Note: Life-cycle 5 (LC5) inside front cover.

Fig 4. Receptacles with brown, spot-like conceptacles.

Distribution and habitat

- *Himanthalia elongata* is found along the European Atlantic coasts (from the Faroe Islands to Portugal).
- It grows on rocks in moderately sheltered rock-pools on wave exposed coast lines.



Seasonality

	Winter	Spring	Summer	Autumn
Buttons				
Fronds				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- Receptacles of *Himanthalia elongata* can be cooked or pickled before eating them as "haricots de mer" (sea beans). Fronds are best when collected young in spring.
- Extracts from this seaweed are used as additives with claimed functions as antioxidants, moisturising, antibacterial and anti-UV properties.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- Only collect the long fronds and leave the buttons behind to allow development of new fronds.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Laminaria digitata

Common names: Kombu, Oarweed, Tangle, Leathrach, Coirleach.

ISRG
Irish Seaweed Research Group

Fig 1. *Laminaria digitata* thalli.

Morphology

- Brown alga with a large holdfast, long stipe and a large, usually split (digitate or finger-like) blade.
- Very smooth, almost plastic-like to the touch.
- Thalli exposed at low-tide collapse on top of one another.
- The stipe is long, flexible, smooth, oval in cross-section, without epiphytes.
- The blade is broad, commonly with 5-20 fingers.
- Generally 1-2 m, but may be larger.
- Frond is golden to deep brown in colour.
- Two *Laminaria* species occur in Ireland: *L. digitata* and *L. hyperborea*. In more mature thalli these can be distinguished by characteristics of the stipe.

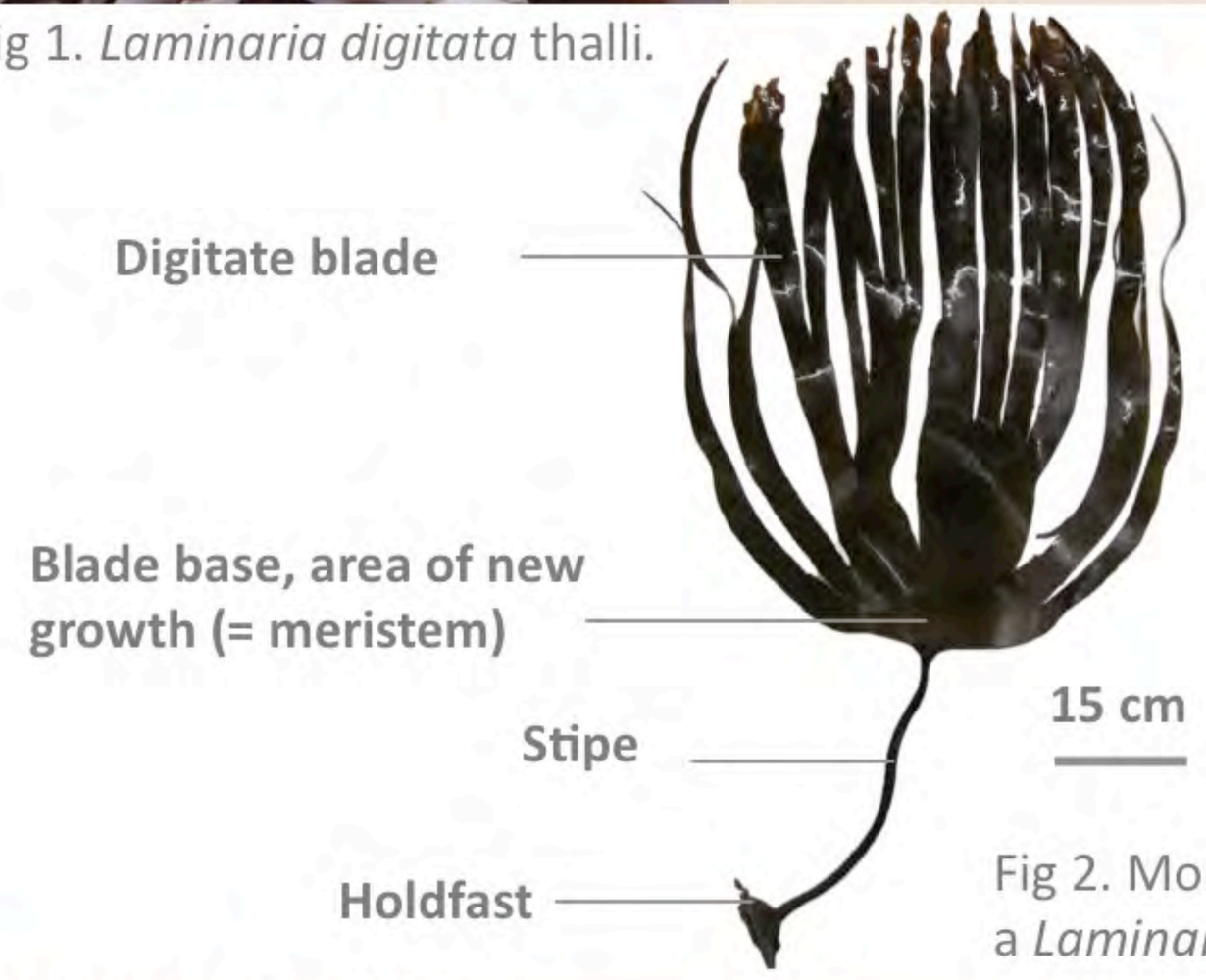


Fig 2. Morphology of a *Laminaria* thallus.

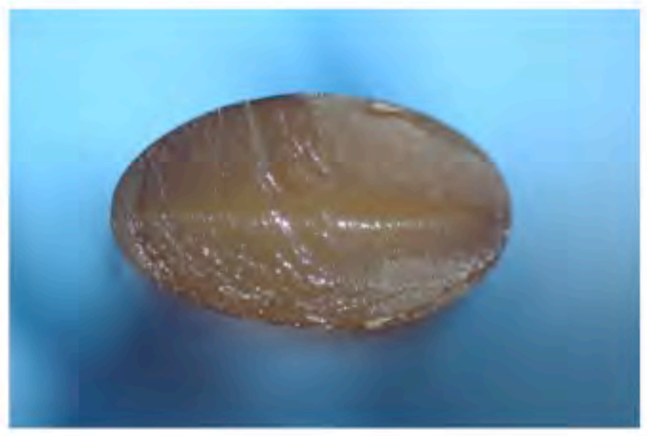


Fig 3. Close up of the stipe – oval in section (above), smooth, flexible (below).

Reproduction

- *Laminaria digitata* thalli are the macroscopic phase of a two-stage life-cycle (see LC4*).
- The reproductive tissue (= sorus) appears as slightly raised and darkened areas on the fingers of the blades.

♀
♂

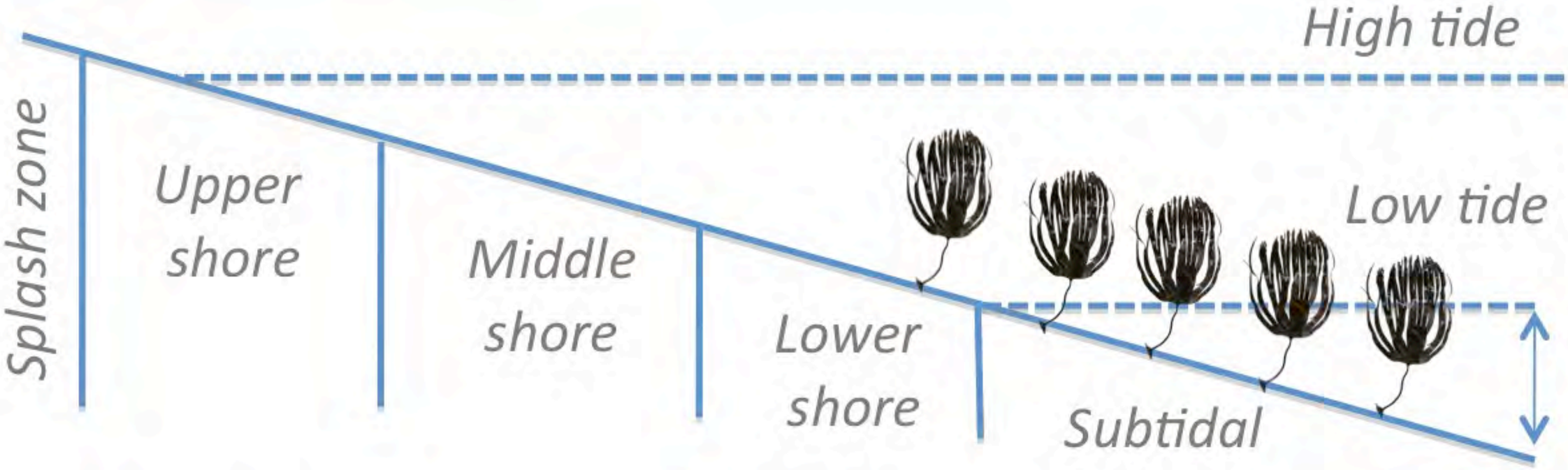
Male and female gametes occur on separate microscopic individuals.

Fig 4. Detail of the sorus on the blade.

*Note: Life-cycle 4 (LC4) inside front cover.

Distribution and habitat

- Present throughout Eastern and Western N. Atlantic shores.
- It inhabits moderately sheltered rock-pools in wave exposed areas, to fully exposed coasts, always at full salinity sites and preferring rocky substrata.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- This alga is of agricultural interest for its growth enhancing properties. It is also a source of bioactive compounds with hypotensive and antibacterial properties.
- All the kelps contain alginates which are used as food additives: E400 – alginic acid, E401 – sodium alginate, E402 – Potassium alginate, E403 – Ammonium alginate, E404 – Calcium alginate, E405 – Propane - 1,2 - diol alginate ("PGA").
- Alginates are used as thickeners, stabilizers and, gelling agents.
- This species is cultivated on long-lines in Ireland.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, leave 20 cm of blade above the stipe, this will leave the meristem untouched, allowing new growth.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE
European Union
European Regional Development Fund
NUI Galway OÊ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Laminaria hyperborea

Common names: Kombu, Sea Rods, Forest Kelp, Cuvie.

ISRG
Irish Seaweed Research Group

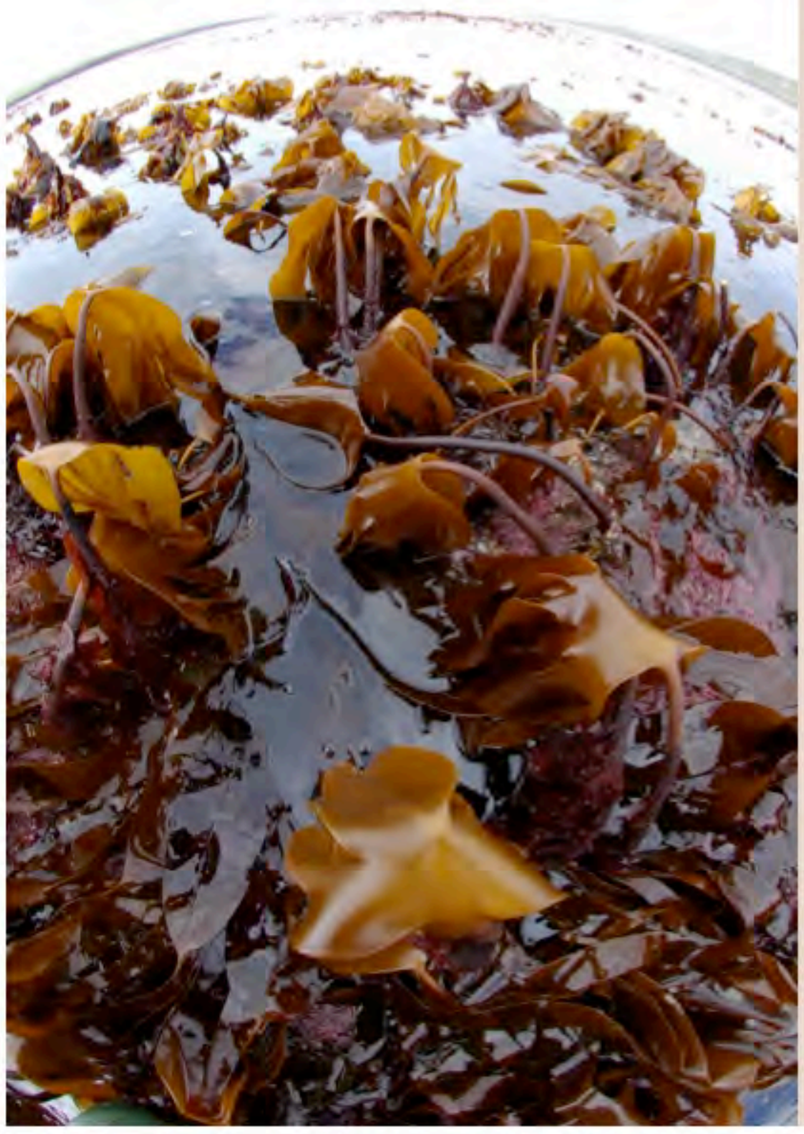


Fig 1. *L. hyperborea* thalli exposed at low-tide.

Morphology

- Brown alga with a large holdfast, long stipe and large, usually split (digitate or finger-like) blade.
- Very smooth, almost plastic-like, to the touch.
- Thalli only exposed at extreme low-tides, stipes remain erect, individuals do not collapse on top of one another. Commonly 1-3 m, but may be larger.
- The stipe is inflexible, rough and circular in cross-section, usually covered with epiphytes.
- The blade is broad, commonly with 5-20 “fingers”.
- Frond is light to dark brown in colour.
- Two *Laminaria* species occur in Ireland: *L. digitata* and *L. hyperborea*. In more mature thalli these can be distinguished by the characteristics of the stipe.

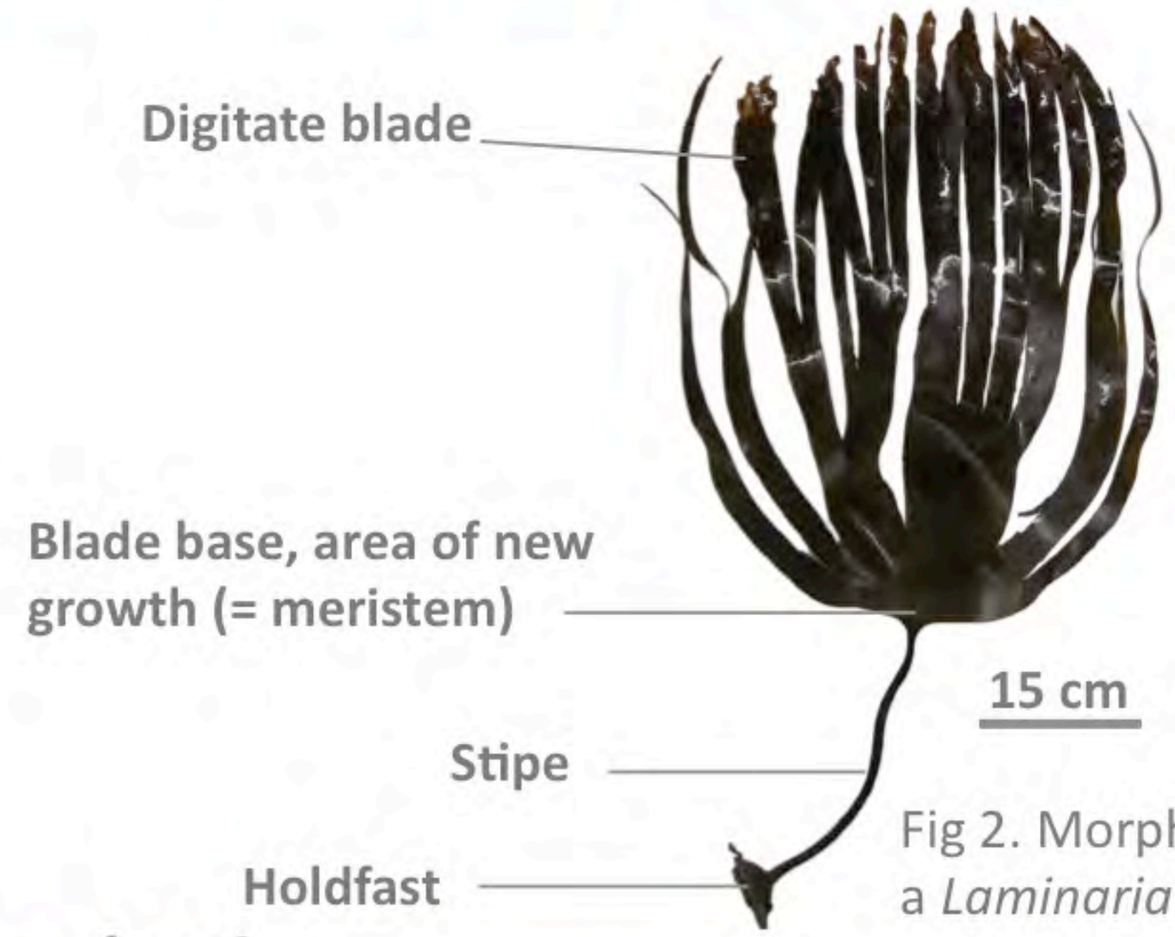


Fig 2. Morphology of a *Laminaria* thallus.

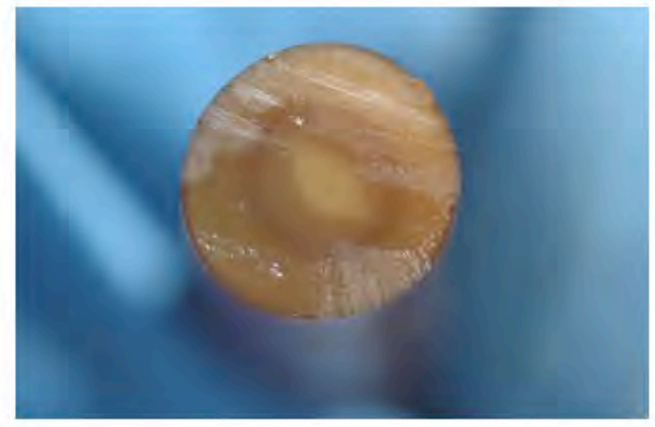


Fig 3. Close up of the stipe – circular in section (above), rough and inflexible (below).

Reproduction

- *Laminaria hyperborea* thalli are the macroscopic phase of a two-stage life-cycle (see LC4*).
- The reproductive tissue (= sorus) appears as slightly raised and darkened areas on the fingers of the blades.

♀
♂

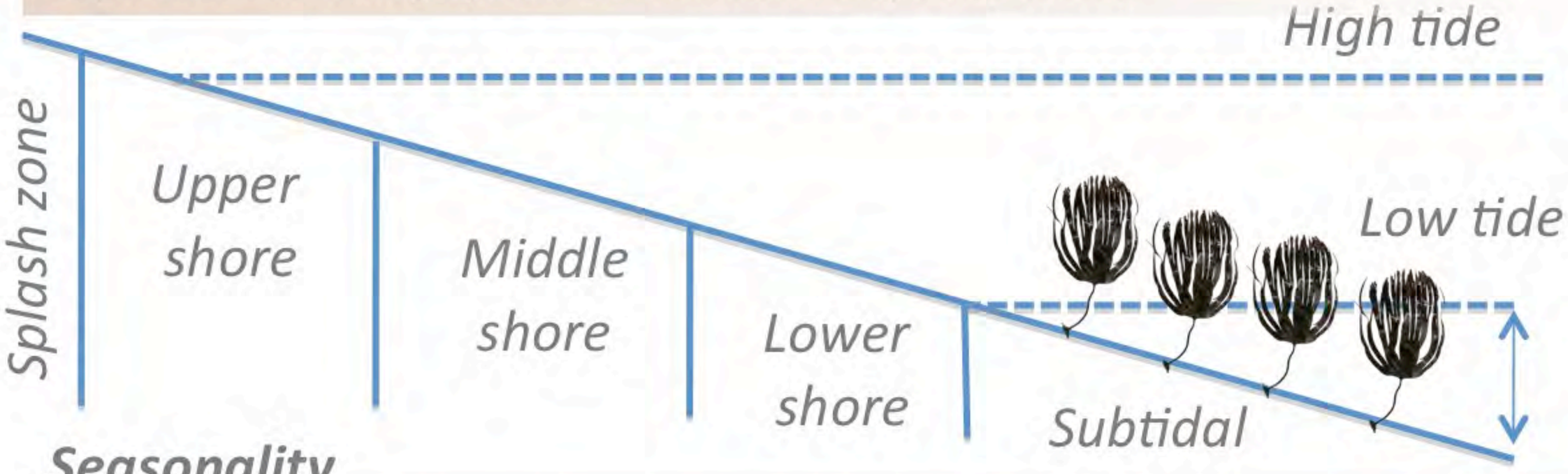
Male and female gametes occur on separate microscopic individuals.

Fig 4. Detail of the sorus on the blade.

*Note: Life-cycle 4 (LC4) inside front cover.

Distribution and habitat

- Present throughout the N.E. Atlantic, from Iceland to the North of Spain.
- It inhabits rocky shores on exposed to very exposed coasts. Always found in full salinity sites. It occupies the zone below *Laminaria digitata*, usually from 0-10 m, depth but extending up to about 30 m in very clear water.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- *Laminaria hyperborea* is a long-lived species, which can be aged from annual growth rings in the stipe, like a tree. Specimens of over 20 years old have been found in the northern parts of their distribution, but it generally lives for 3-4 years.
- It forms extensive subtidal forests which support a huge diversity of other flora and fauna, much like a mature forest would on land. They form a very important part of rocky shore ecosystems in Ireland and energetically provide critical support for nearby ecosystems.
- In Norway it is used for alginate production, which is used as a food additive (see *Laminaria digitata*).
- This species is cultivated on long-lines in Ireland.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, leave 20 cm of blade above the stipe, this will leave the meristem untouched, allowing new growth.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE
European Union
European Regional Development Fund
NUI Galway OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Maërl / Rhodoliths

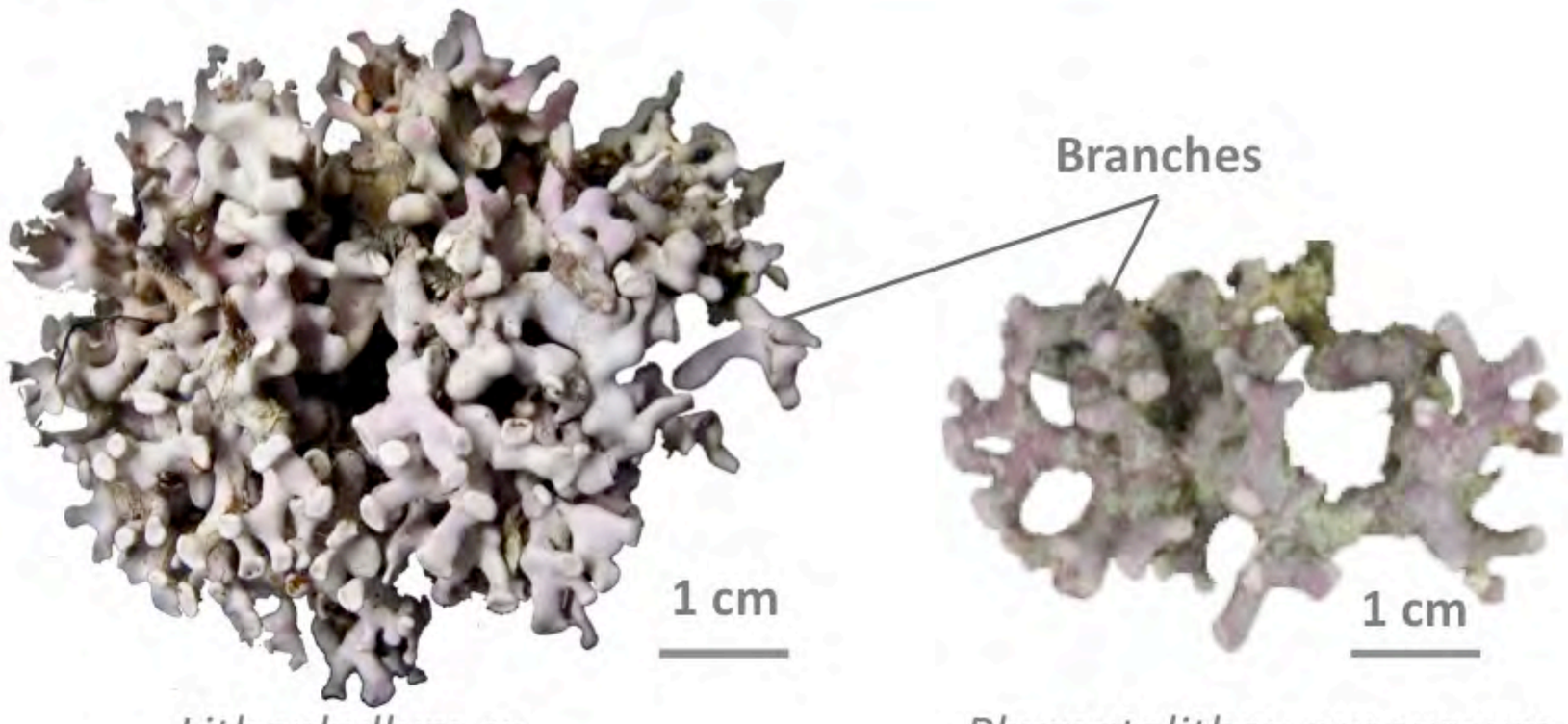
Common names: Maërl, Rhodolith beds, Gruán, Gruánach, Feamainn Choirleach.

ISRG
Irish Seaweed Research Group

Morphology

Fig 1. Mäerl bed with starfish.

- Red algae bright to pale pink in colour, shaped as a nodule calcareous body with branches. When they die the colour bleaches to white.
- The morphology is related to environmental conditions, so the same species can have different morphologies depending on where it is growing.
- Most species are between 1 and 10 cm in diameter.
- They grow only a few millimeters per year.
- The most common genera are *Phymatolithon, Lithothamnion corallioides*, and *Lithophyllum*.



Lithophyllum sp. *Phymatolithon purpureum*

Fig 2. Morphology (two examples).

Reproduction

- Maërl species have two macroscopic phases in the life-cycle (see LC 1*). Male and female structures can occur on the same individual or on different ones (species dependant). Additionally, they also reproduce asexually by fragmentation.

♀♂ Fertile female and male individuals: Both structures are not visible to the naked eye.

⊕ Tetrasporophyte: multiporated chambers on the plant (Fig 3.)

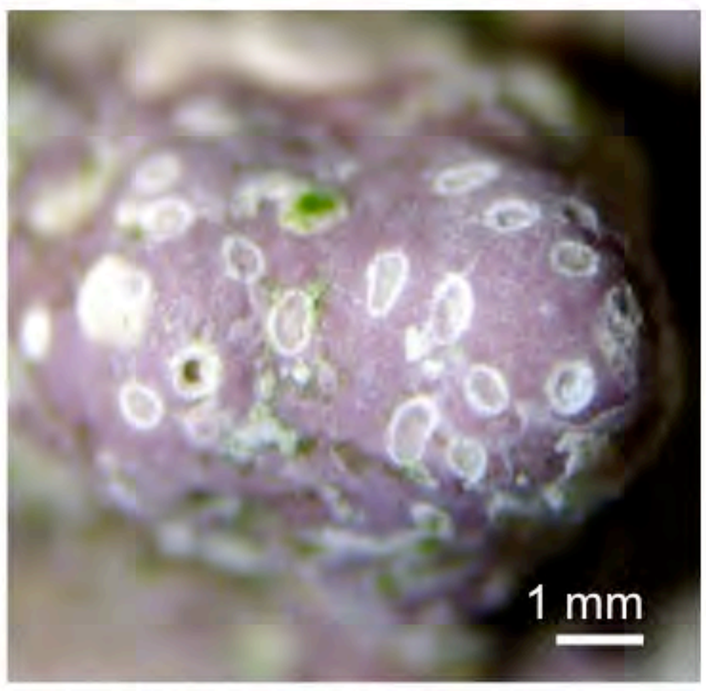
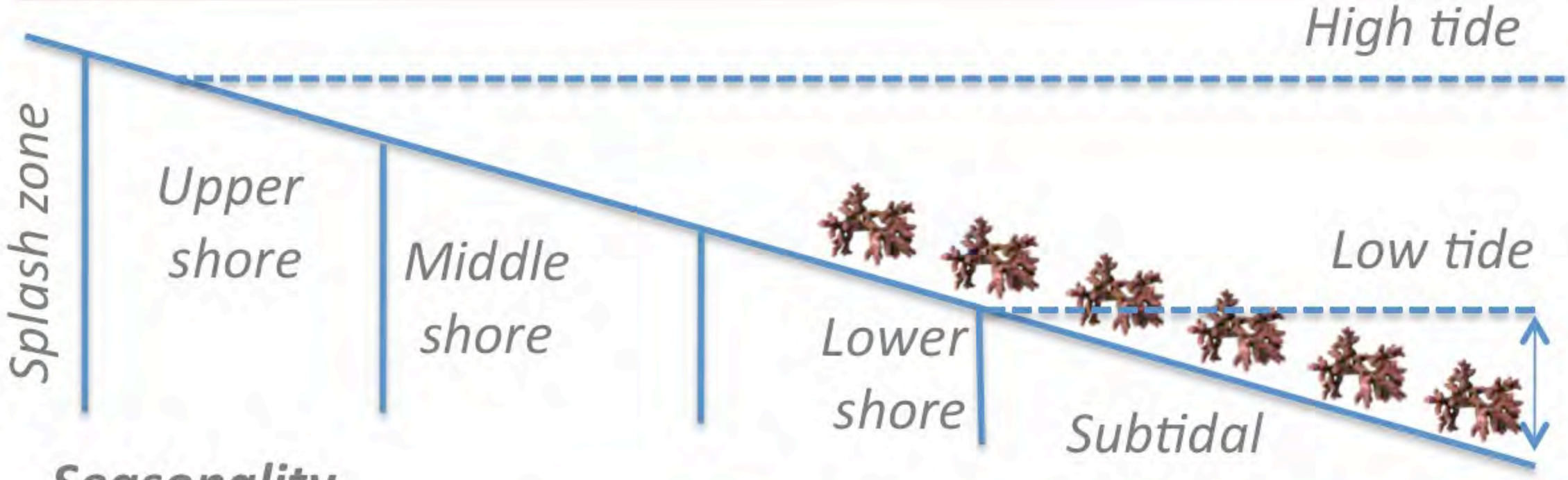


Fig 3. *Phymatolithon purpureum* tetrasporophyte

*Note: Life-cycle 1 (LC1) inside front cover.

Distribution and habitat

- Maërl occurs in the N.W. Atlantic (Scotland, W. Ireland, W. France and W. Spain). There are other mäerl beds around the world but they may not be formed by species that occur in Europe.
- Found in tidal channels and moderately exposed shores from 0 to 32 meters depth.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- Only subfossil deposits are harvested in Ireland, Iceland and France. As plants die, the calcareous remains accumulate.
- The deposits are harvested to be used as calcium supplement for human health, in agriculture industry, and for water filtration.
- Often these deposits are washed on to the beach and form the so called "coral beaches" like those at Carraroe (Co. Galway, Ireland) and Mannin Bay (Co. Galway, Ireland).

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- The Maërl beds are protected under the EU Habitats directive, 92/43/EEC.
- Due to the slow growth rate of this species, extractions could have damaging effects on the Maërl beds and the habitats they form.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Osmundea pinnatifida

Common names: Pepper dulse, Máthair an Duillise, Derida, Griabhán, Míobhán, Uisce beatha.

ISRG
Irish Seaweed Research Group

Morphology

Fig 1. *Osmundea pinnatifida* thalli.

- Red alga with dark purple to brownish-red tufted thallus, with flattened fronds and robust main axes. The holdfast is tangled and creeping.
- Branching is irregular with a roughly pyramidal outline.
- The texture is cartilaginous and thick.
- The plant can reach up to 10 cm length, with fronds being 2-8 mm wide.
- The two most similar species, *O. osmunda* and *O. oederi* have discoid holdfasts and are found on the lower shore or in pools and in the shallow subtidal. *O. osmunda* is a larger species (up to 20 cm long) and *O. oederi* is attached to other algae. Also present in Ireland are *O.hybrida*, *O.truncata* and *O.ramosissima.*

Fig 2. Morphology.

Reproduction

- *Osmundea pinnatifida* thalli have two macroscopic phases in the life-cycle (see LC 1*). Male and female structures occur in different individuals. The reproductive structures occur laterally on the last branchlets.

♀ Fertile female:
Oval structures (~ 1 mm in diameter).

♂ Fertile male: Urn-shaped structures (~ 1 mm)

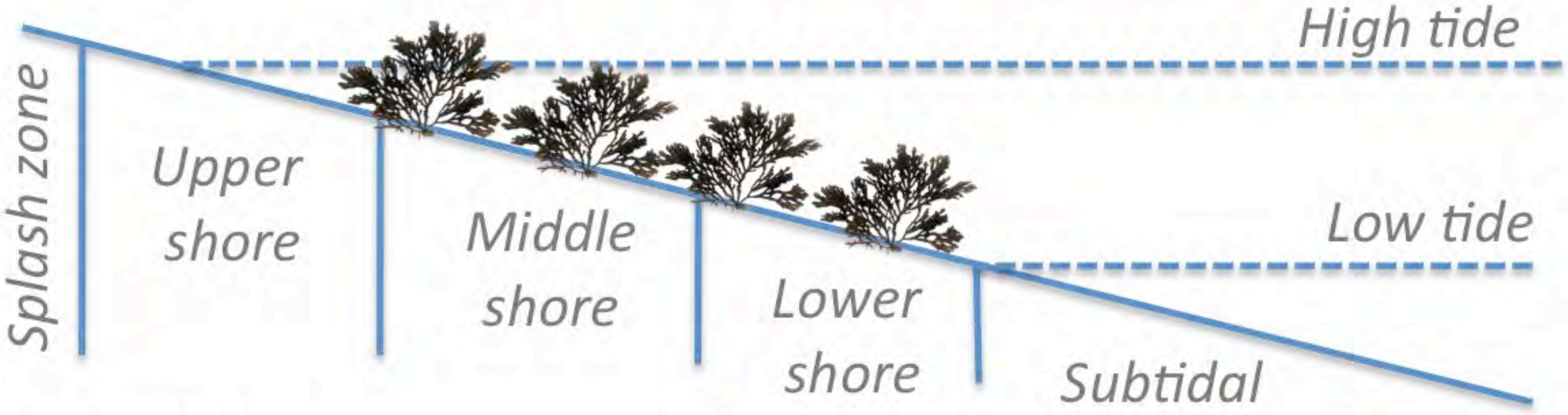
⊕ Tetrasporophyte:
Tetrasporangia appear as tiny dark specks.

*Note: Life-cycle 1 (LC1) inside front cover.

Fig 3. Fertile female thalli.

Distribution and habitat

- This species has been reported in the N.E. Atlantic, N.W. Africa and W. Indian Ocean (India and Pakistan).
- It grows on open rock surfaces, often covering damp slopes.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- It has a peppery flavour and can be used as a condiment.
- This flavour comes from molecules called terpenes. Terpenes often have a protective function and deter grazing by molluscs and fish.
- Terpenes are a large and diverse class of organic compounds produced by a variety of plants, e.g., conifers, but also by some insects such as termites.
- Terpenes have a strong smell. If you get familiar with the smell of *Osmundea* you can tell where it is on the shore by its strong scent.
- *Osmundea* should be consumed in moderation, as the terpenes may be associated with health risks.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove some of the branches of the selected frond, by leaving the holdfast and some branches behind.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÊ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Palmaria palmata

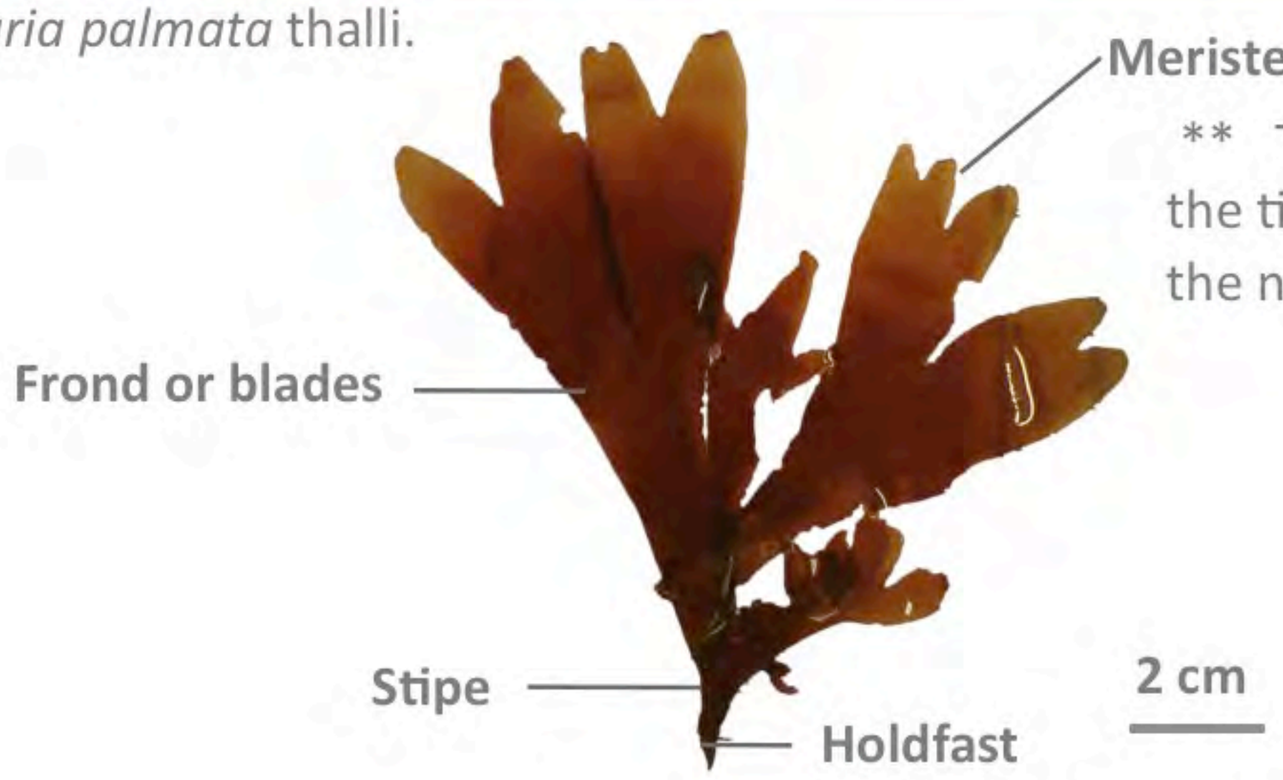
Common names: Dulse, Dillisk, Duilleasc, Chreathanch.

ISRG
Irish Seaweed Research Group

Fig 1. *Palmaria palmata* thalli.

Morphology

- Red alga with smooth, leathery fronds that can be described as 'palmate', or 'hand-like'. Fronds can change over the year from deep red/purple in autumn and winter, to greenish-yellow in the summer.
- The holdfast is small and disc-like. The stipe is short, approximately 1-2 cm in length.
- Older or damaged individuals produce small blades from the edge of the main frond.
- The size of the seaweed depends on the growing conditions, but generally, individuals reach a maximum length of 30-40 cm. Larger ones can be found in exposed areas.
- *P. palmata* is the only species of this genus in Ireland.



** The meristem is located at the tips of the plant, from where the new tissue will be formed.

Fig 2. Morphology.

Reproduction

- *Palmaria palmata* thalli seen on shore are either male or tetrasporophytes (see LC 1*). Female individuals form microscopic crusts and are extremely difficult to find in the wild. The tetrasporophyte thallus overgrows the fertilised female.

♀⊕ Tetrasporophyte of *P. palmata* with spores held in dark patches.

♂ Fertile male thallus with spermatia held in the smooth lighter areas on the frond.

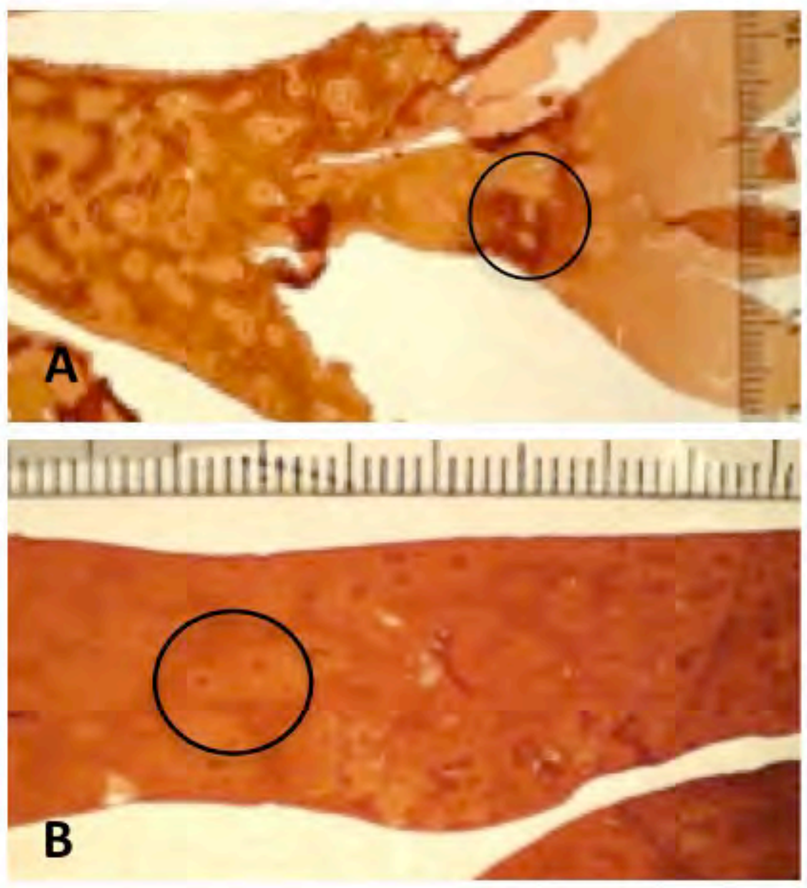
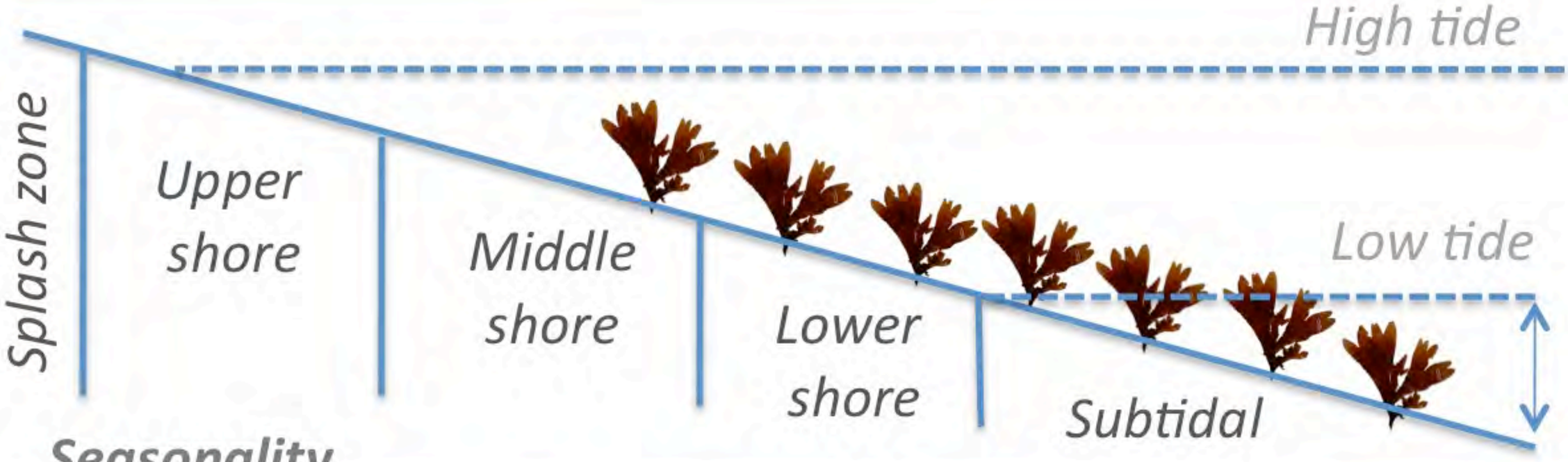


Fig. 3(A) Fertile tetrasporophyte; (B) Fertile male thallus.

*Note: Life-cycle 1 (LC1) inside front cover.

Distribution and habitat

- It grows in the N.E. Atlantic (from Norway to Atlantic Spain and Portugal, and Azores), and in the N.W. Atlantic.
- Found mainly in moderately exposed to exposed shores and in areas subjected to tidal currents rather than waves. Plants can be found growing directly on rocks/ boulders or on other seaweeds such as wrack (*Fucus* species) and kelps (*Laminaria hyperborea*).



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- It is rich in vitamins, minerals, and has a high protein content. It also contains a significant amount of Iodine.
- The earliest record of this species is of monks harvesting it in the 12th century.
- Commonly used in Ireland, Iceland, Atlantic Canada, and New England.
- Most commonly eaten as a dried snack, but can also be eaten, pan-fried quickly into chips, baked in the oven, or simply incorporated in dough.
- It has been successfully cultivated on long-lines and tanks in Europe.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove some of the branches of the selected frond, leaving the holdfast and some branches behind.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Pelvetia canaliculata

Common names: Cow Tang, Channel Wrack, Dubhlamán, Múirín na Muc, Caisíneach.

ISRG
Irish Seaweed Research Group

Morphology

Fig 1. *Pelvetia canaliculata* thalli.

- Brown alga with evenly forked fronds and in-rolled margins, forming a channel on one side and a smooth ridge on the other.
- The fronds are 5-15 cm long and less than 5 mm wide.
- Thalli are tough, smooth and olive-green to brown colour when wet. On drying, the fronds become brittle and dark, almost black in colour, especially when out of water for long periods during neap tides.
- *P. canaliculata* is the only species of this genus in Ireland.

Fig 2. Morphology.

Reproduction

- *Pelvetia canaliculata* has a direct life-cycle (see LC 5*)
- The reproductive structures or receptacles develop at the tips of the thallus and have a beaded, knobbly, forked appearance.

♀
♂

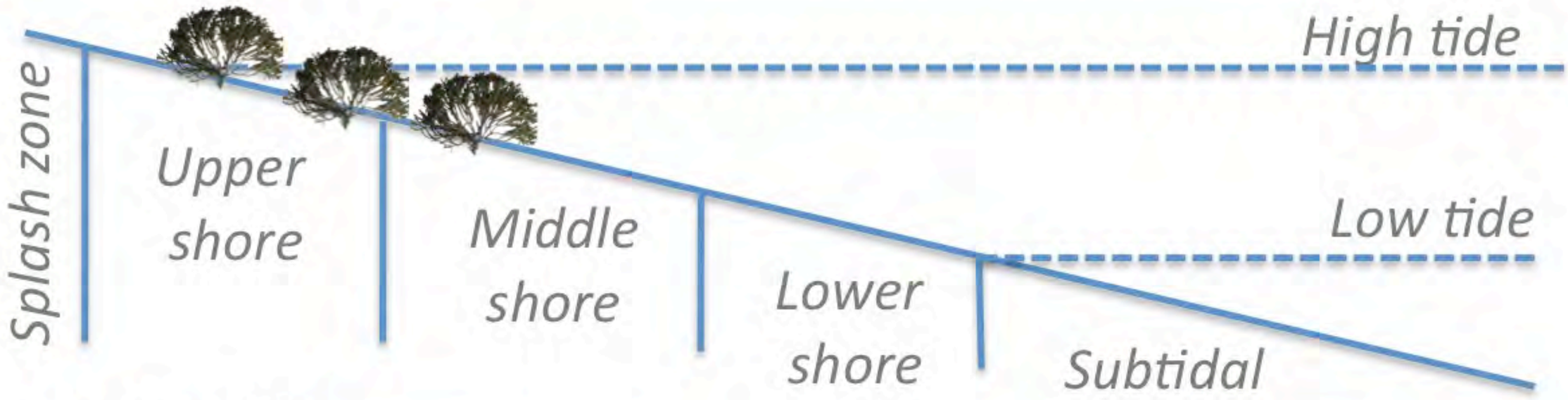
Male and female structures occur on the same individual.

Fig 3. Detail of the reproductive receptacles.

*Note: Life-cycle 5 (LC5) inside front cover.

Distribution and habitat

- This species is found in the N.E. Atlantic, from Iceland to Portugal.
- It grows on bedrock on shores ranging from sheltered to exposed shores. Free living forms can be found in salt marshes.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- *Pelvetia canaliculata* is very drought resistant and can endure high levels of tissue dehydratation without affecting normal functionality. If it stays submerged for more than six hours a day it dies and decays.
- Purified chemicals called fucoidans, from *Pelvetia* have been described as having anticoagulant properties.
- Natural production of chloroform by this species has been reported, likewise from kelps and other wracks.
- The tissue of this alga is colonised by an endophytic fungus called *Mycosphaerella ascophylli.*

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove some of the branches of the selected frond, by leaving the holdfast and some branches behind.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÊ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Porphyra dioica

Common names: Nori, Laver, Sloke, Sleabhcán, Sleabhac.

ISRG
Irish Seaweed Research Group

Morphology

Fig 1. Adult fronds of *Porphyra dioica*.

- Red alga with very thin and membranous fronds with a slippery texture. The blades are usually long and shiny ribbons, and can be olive-green to purple-brown or even black in appearance.
- The fronds fold in half when vertically held up.
- Up to 20 cm long and 3 cm wide.
- Currently, five species of *Porphyra*-like algae (including *Pyropia* and *Wildemania*) are found in Ireland, which are difficult to tell apart by morphology. Other species are *W. amplissima*, *Pyropia leucostica*, *Porphyra linearis*, *Porphyra purpurea* and *Porphyra umbilicalis*. Identification may require molecular taxonomic expertise.

Fig 2. Morphology.

Reproduction

- *P. dioica* thalli have a macroscopic phase in the life-cycle (see LC 2*). Depending on the species, male and female structures usually occur on different individuals, and only occasionally on the same one.

♀ ♂ A microscope is needed to identify male and female structures.

The sporophyte is microscopic and grows inside shells and is known as the *Conchocelis* phase.

*Note: Life-cycle 2 (LC2) inside front cover.

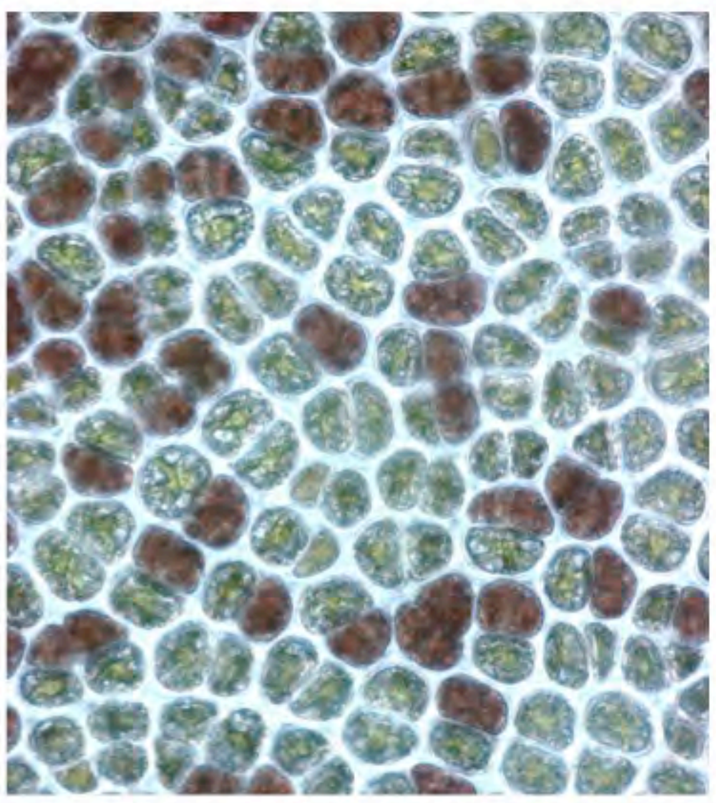
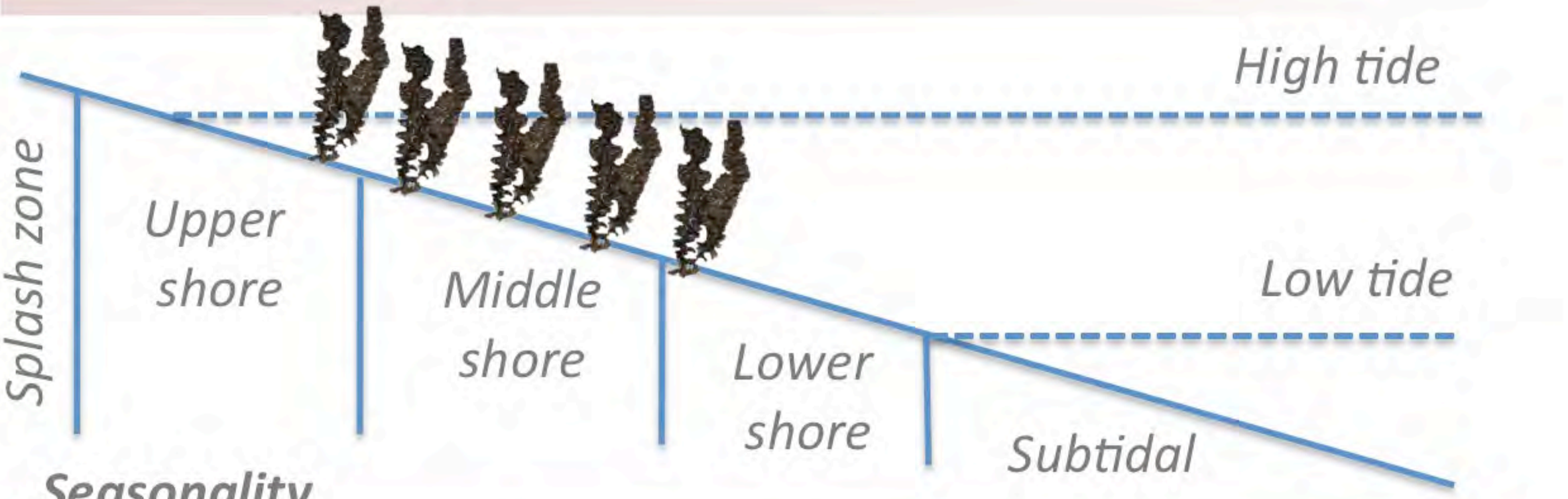


Fig 3. Female thallus under the microscope.

Distribution and habitat

- *Porphyra dioica* is found along the European Atlantic coasts.
- It usually grows on hard surfaces such as stones, rocks and piers and can survive being buried by sand for extended periods.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- Recent research has reclassified many species within this genus. For example, previously known commercial species *Porphyra yezoensis* and *Porphyra tenera* are now referred to the genus *Pyropia*.
- *P. yezoensis* and *P. tenera* are cultivated in Japan from which the traditional nori sheets to make sushi are made.
- China is currently the largest producer of nori, followed by Japan and the Republic of Korea. In 2007, 1.5 million tonnes wet weight were produced globally.
- Its nutritional value lies in the high protein content. Nori is also rich in vitamins and minerals.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove sections of the selected fronds, by leaving the holdfast and part of the fronds behind.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Saccharina latissima

Common names: Laminaria saccharina, Sweet Kombu, Sugar Kelp, Lásaá, Rufa, Rufaí, Fruill, Ribíní, Láin, Cupóg.

ISRG
Irish Seaweed Research Group

Morphology

Fig 1. *Saccharina latissima* thalli.

- Brown alga with a relatively short stipe (< 60 cm), and elongated frilly-edged, crinkled fronds which extend tongue-like up to 4 m long.
- The yellow-brown fronds are undivided, and in older specimens the surfaces are heavily pitted, often torn and heavily indented.
- The stipe is flexible, smooth, and round in cross-section
- The holdfast is a cluster of strong, flat, spreading, branching, root-like growths.
- It is easily recognisable.

Fig 2. Morphology.

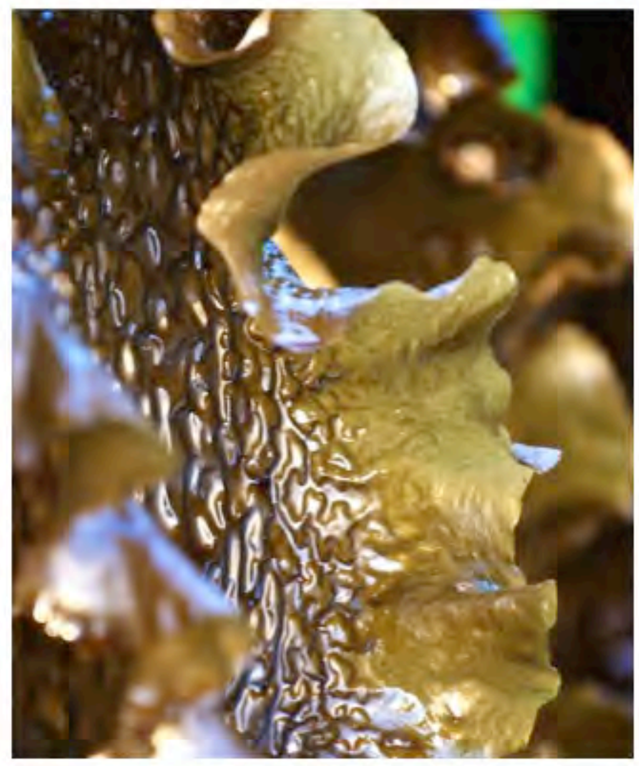


Fig 3. Close up of the blade's edges.

Reproduction

- *Saccharina latissima* thalli are the macroscopic phase of a two-stage life-cycle (see LC4*).
- The reproductive tissue (= sorus) forms in the middle of the blade and appears as darkened patches.

♀♂ Male and female gametes occur on separate microscopic individuals.

*Note: Life-cycle 4 (LC4) inside front cover.

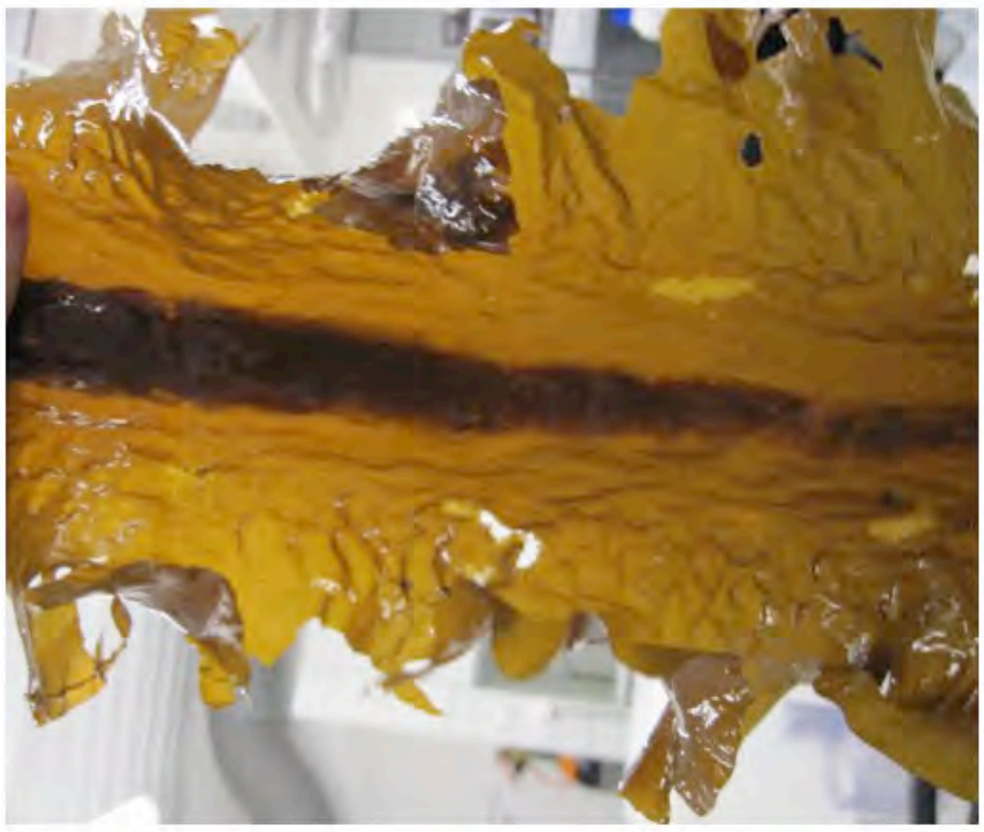
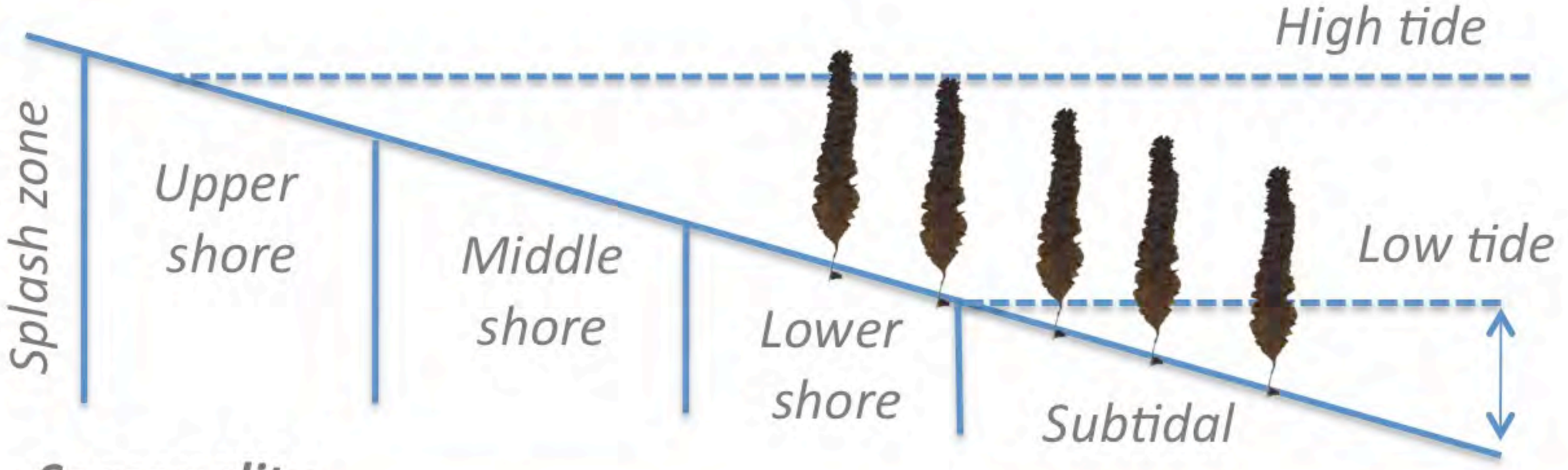


Fig 4. Detail of sorus on the blade.

Distribution and habitat

- *Saccharina latissima* occurs in both the N. Pacific and N. Atlantic.
- It grows in sheltered waters on rocks.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- It is edible and used in French and Irish cuisine.
- All the kelps contain alginates which are used as food additives: E400 – alginic acid, E401 – sodium alginate, E402 – Potassium alginate, E403 – Ammonium alginate, E404 – Calcium alginate, E405 – Propane - 1,2 - diol alginate ("PGA").
- Alginates are used as thickeners, stabilizers and, gelling agents.
- This species is cultivated on long-lines in Ireland.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, leave 20 cm of blade above the stipe, this will leave the meristem untouched, allowing new growth.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE
European Union
European Regional Development Fund
NUI Galway OÊ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Saccorhiza polyschides

Common names: Furbellows, Claíomh, Madra, Clabhthaí.

Morphology

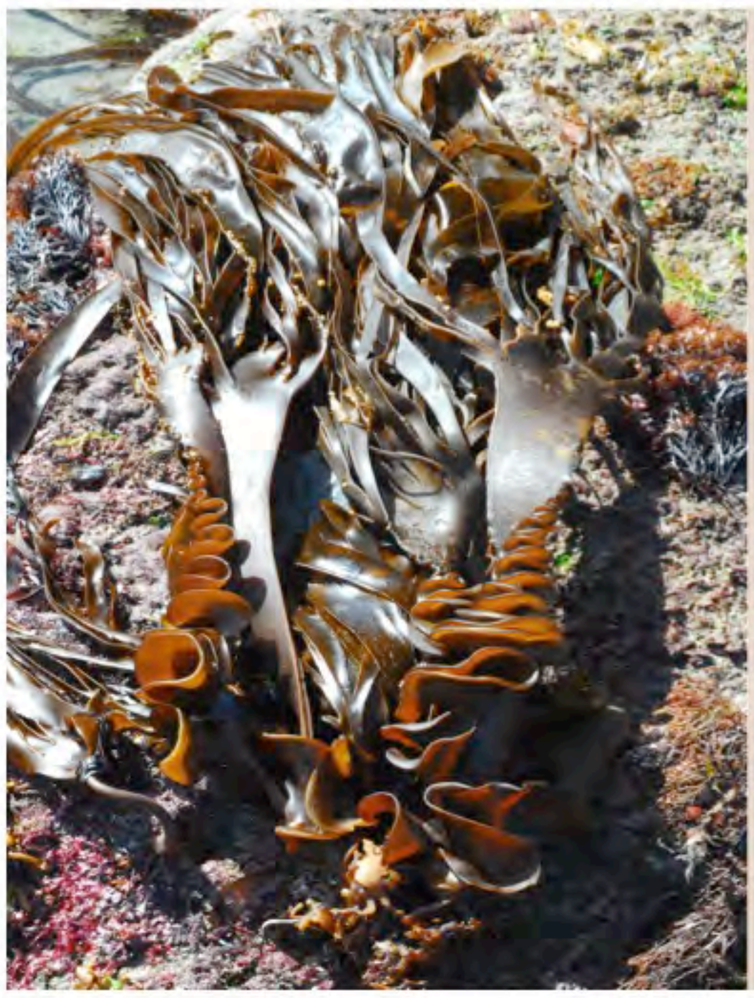


Fig 1. Thalli of *Saccorhiza polyschides*

- Brown alga of a light to dark brown colour, with a digitate "finger-like" blade, a wide stipe and a large holdfast.
- The stipe is rather large and flat, with characteristic marginal undulated wings near the base.
- The holdfast of mature individuals is a hollow bulb (up to 50 cm wide) of a yellow-brown colour covered in smooth short spikes.
- Usually thalli are 3 to 4 m long, but occasionally they can grow up to 10 m length.
- A single individual can weigh up to 22 kg.

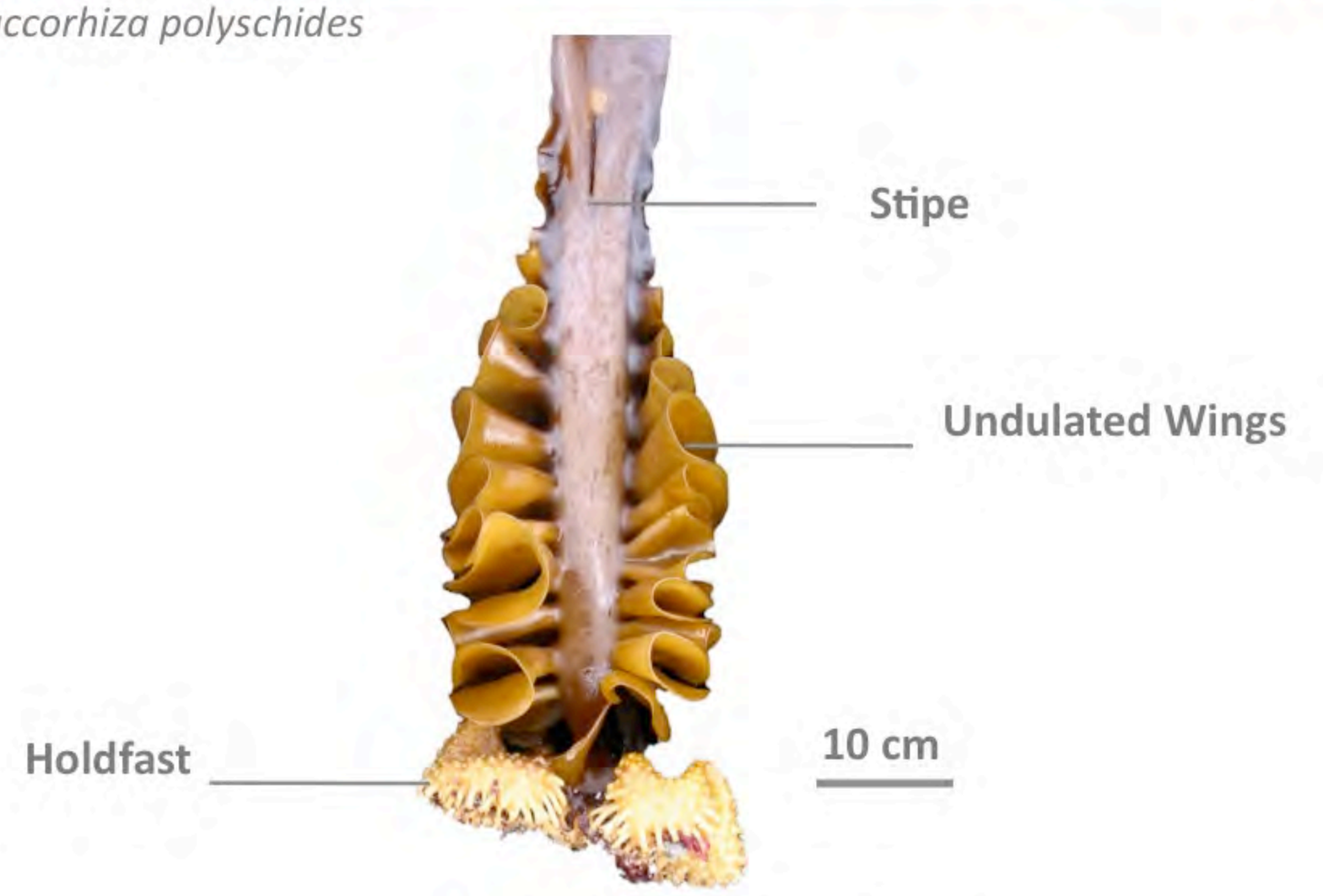


Fig 2. Morphology of the holdfast and lower stipe.

Reproduction

- *Saccorhiza polyschides* thalli are the macroscopic phase of a two-stage life-cycle (see LC4*).
- The reproductive tissue (sorus) appears as slightly raised and darkened areas on the undulated part of the stipe.

♀
♂

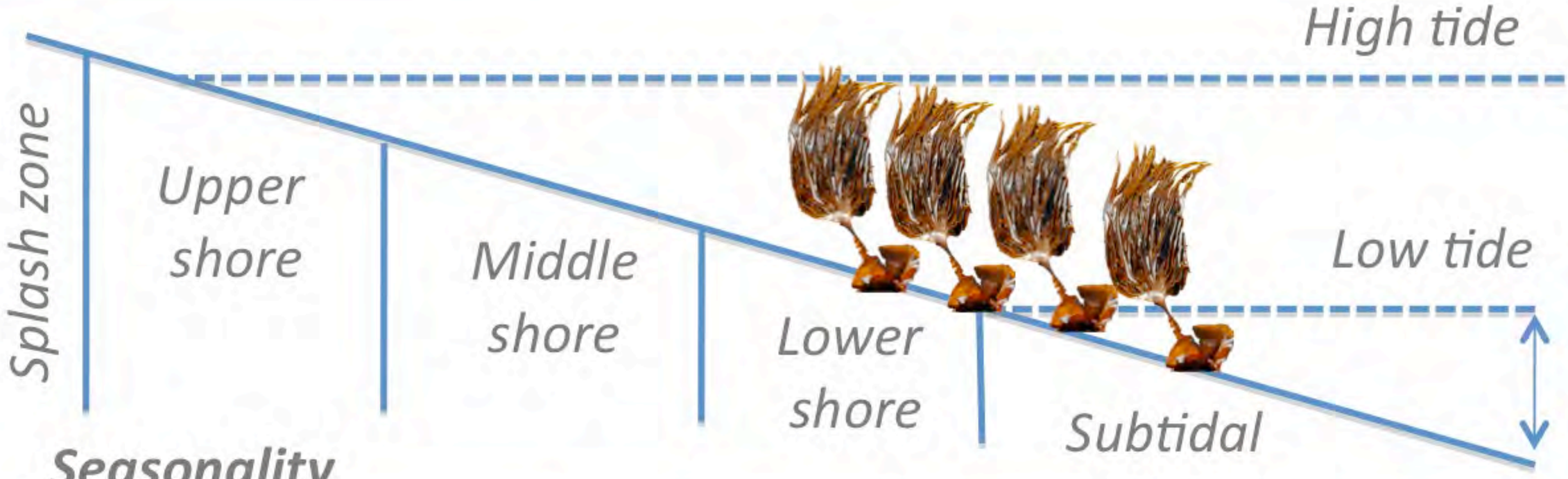
Male and female gametes occur on separate microscopic individuals.

Fig 4. Detail of the sorus on the stipe.

*Note: Life-cycle 4 (LC4) inside front cover.

Distribution and habitat

- Limited to the N. Atlantic Ocean, found from Norway to Morocco.
- Sublittoral species present in exposed to sheltered shores.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- This is the largest brown alga in Europe. As an annual species it grows very fast and is therefore cultivated at experimental scale for its biomass.
- Its shape is highly dependent on hydrodynamic constraints.
- As an opportunistic species, *S.polyschides* fills spaces available after the mechanical harvesting of *L.digitata,* or when *L. hyperborea* individuals are torn off by storms.
- This species is cultivated on long-lines in Ireland.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, leave 20 cm of blade above the stipe, this will leave the meristem untouched, allowing new growth.
- Avoid harvesting fertile individuals as much as possible.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE
European Union
European Regional Development Fund
NUI Galway OÊ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Sargassum muticum

Common name: Wireweed.

ISRG
Irish Seaweed Research Group

Morphology

Fig 1. *Sargassum muticum* thalli under the water.

- Brown alga with bush-like shape and is attached to the substratum by a disc-shaped holdfast.
- The thallus is principally a branched stipe with three characteristic structures: leaf-like proliferations, spherical bladders, and in the reproductive stage, receptacles (small tube-like branches).
- In summer, it can reach up to 10 m length* while in winter only the holdfast remains as a perennial phase (few centimetres). (*M.D. Guiry pers. comm.)
- The colour varies throughout the year from brown to yellow.
- This species can be confused with *Halidrys siliquosa*, but the latter has much more flattened fronds and bladders are several centimetres long (like sausages). This is the only species of *Sargassum* in Ireland.

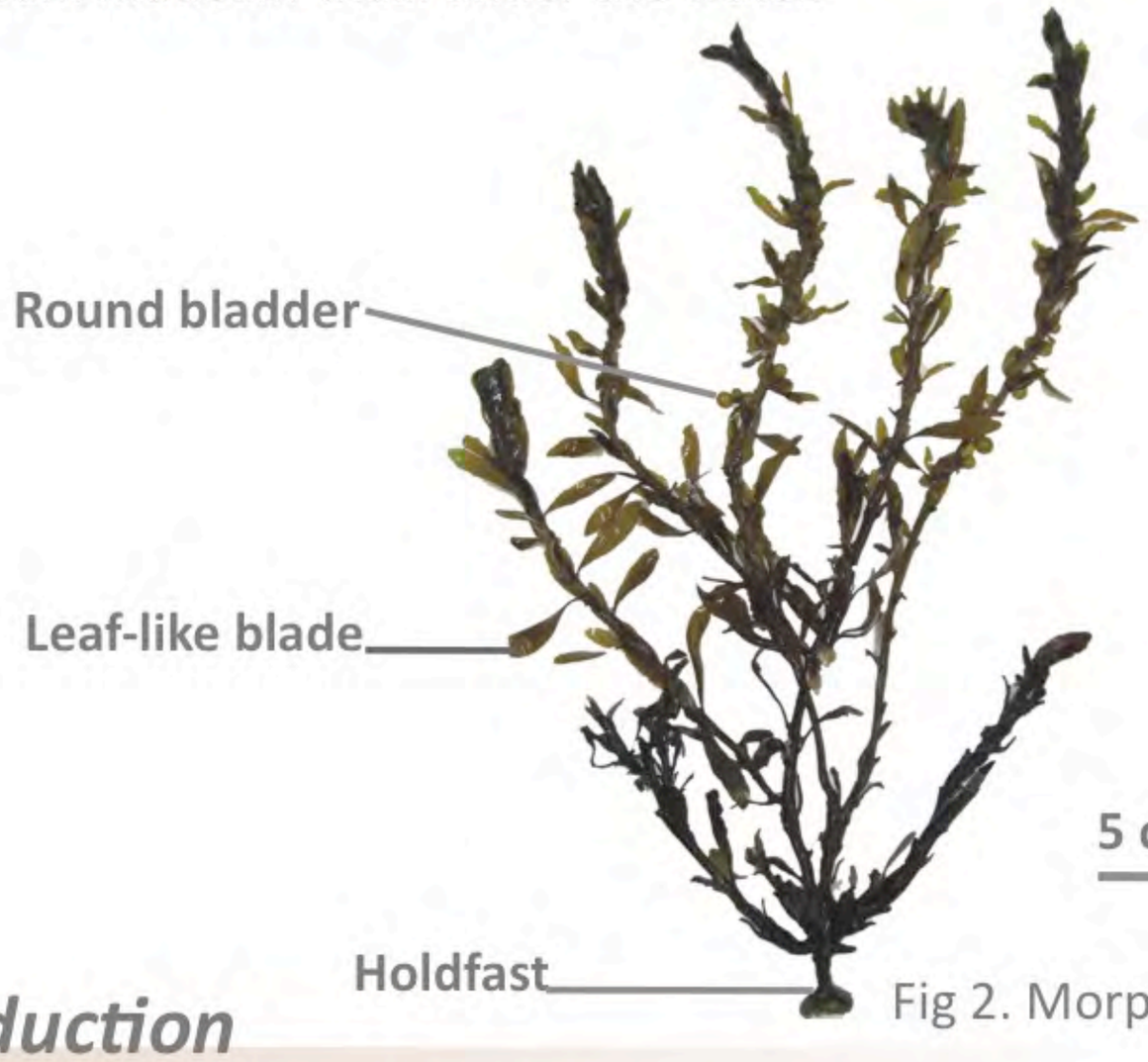


Fig 2. Morphology.

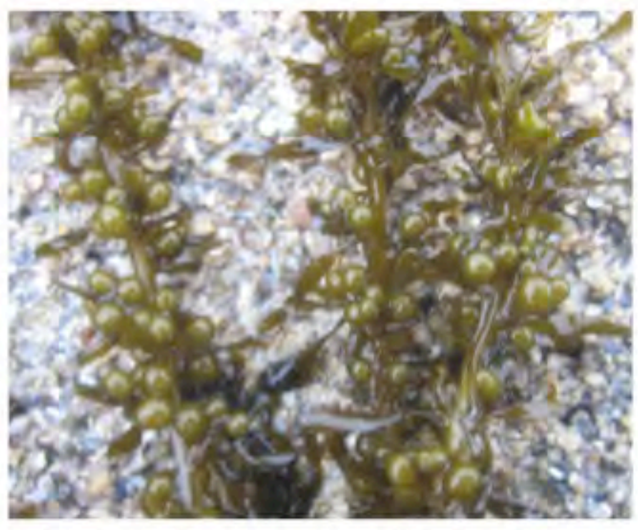


Fig 3. Close-up of bladders.

Reproduction

- *Sargassum muticum* thalli a direct life-cycle (see LC5*).
- The gametes occur in structures called receptacles. The receptacles are tubular structures found at the bases of the leaf-like structures.

♀ ♂ Each receptacle releases both types of gametes, female eggs and male sperm.

*Note: Life-cycle 5 (LC5) inside front cover.

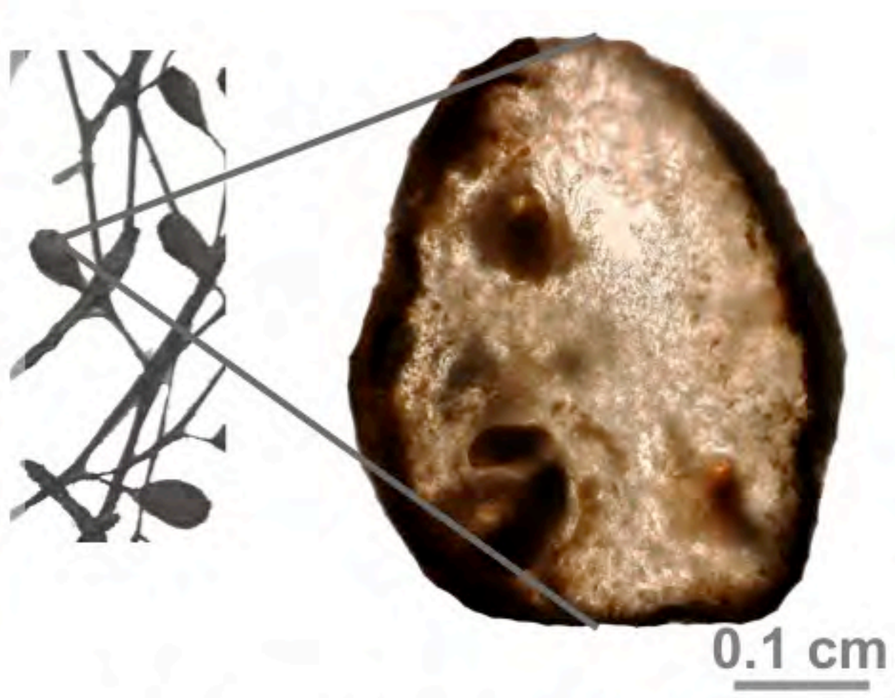
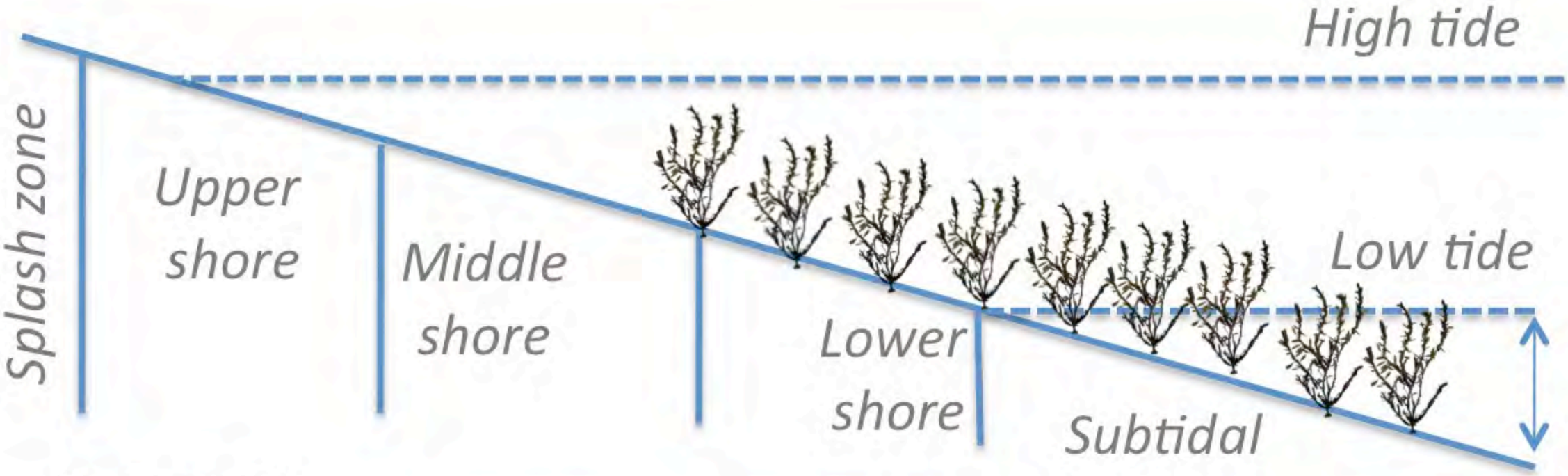


Fig 4. Receptacle with female eggs.

Distribution and habitat

- Originally from Japan, it has spread to W. coast of U.S.A. and W. coast of Europe.
- Occurs in sheltered to moderately exposed shores and associated with tide/rock pools, it can be found in sandy beaches growing on stones or shells. It tolerates moderate freshwater and high nutrients input. It does not tolerate drying.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- *Sargassum muticum* is an invasive species introduced to Ireland in the 1990s. This seaweed is native to the northwest Pacific (Japan, Russia, Korea and China).
- In its native environment, it is relatively small (up to 2 m length), compared to where it is invasive, where it can reach lengths of 16 m (Brittany, France).
- This species, like most Fucales, contains a high percentage of phenolic compounds. These are secondary metabolites, known to act as a chemical defense against grazers.
- Also described are its antiviral, anti-inflammatory, antibacterial and antitumor bioactivities.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweed (Foreshore Acts 1933-1998).
- If an individual breaks, the new frond can easily develop from a remaining primary axis, even after being buried under the sand. Since it is a rapidly invasive species, the removal of the entire individual is recommended.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE

European Union
European Regional Development Fund

NUI Galway OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

Ulva spp.

Common names: Sea lettuce, Glasán.

ISRG
Irish Seaweed Research Group

Fig 1. *Ulva rigida* thalli.

Morphology

- The genus comprises a number of very similar looking green algal species. These can only be distinguished using microscopic characters, or more reliably by genetic markers.
- Their fronds consist of thin, grass-green, irregularly shaped lobed sheets that are two cell layers thick.
- Individuals can grow up to 45 cm or more in length.
- Common lobed species in Ireland are *Ulva lactuca, Ulva rigida,* and *Ulva scandinavica*.
- *Ulva* spp. can be confused with the related *Umbraulva olivascens*, which has an olive-green colour and a plastic-like appearance.

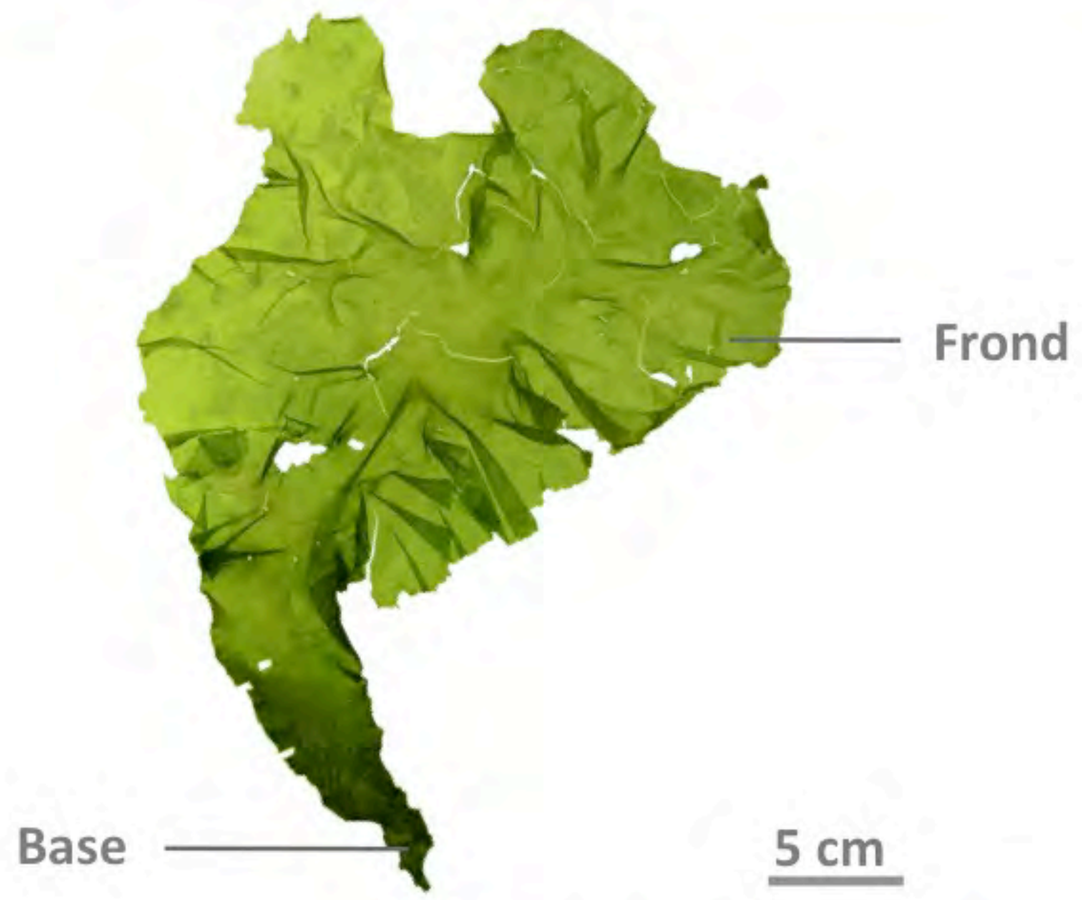


Fig 2. Morphology.

Reproduction

- *Ulva* thalli have two macroscopic phases in their life-cycle (see LC 3*).

♀ Female thalli have olive green coloured edges before the gametes are released.

♂ Male thalli have yellowish coloured edges before the gametes are released.

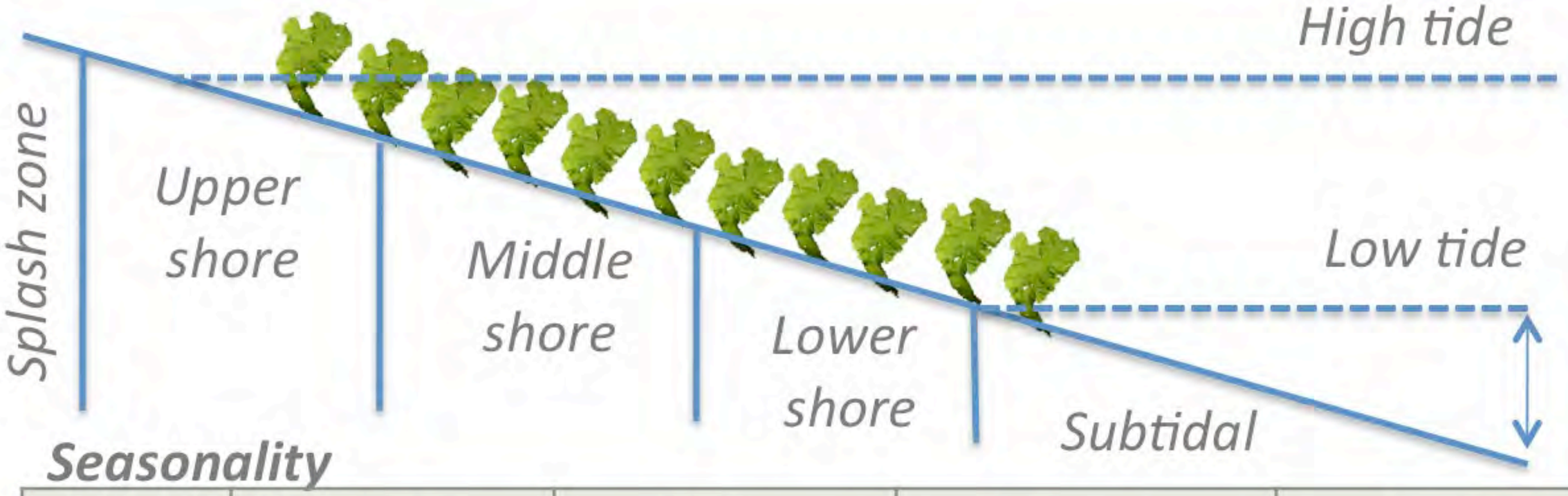
Sporophytes have dark green coloured edges before the spores are released.

Fig 3. *Ulva rigida thalli.*

*Note: Life-cycle 3 (LC3) inside front cover.

Distribution and habitat

- *Ulva* species are found worldwide.
- They grow in both brackish and marine environments, particularly in estuaries, where the water is warm, and nutrient rich. Some species occur in freshwater.



Seasonality

	Winter	Spring	Summer	Autumn
Biomass				
Fertility				

Note: These seasonal characteristics may vary slightly from year to year.

Interesting facts

- All species of *Ulva* are edible.
- *Ulva* can grow rapidly. In summer large amounts, called green tides, can accumulate on beaches, mud flats and saltmarches. They become a nuisance, when the seaweed decomposes and hydrogen sulphide is generated.
- Using genetic markers, green tubular species formerly assigned to the genus *Enteromorpha* have been shown to belong to the genus *Ulva*.
- Some *Ulva* spp. are known to have antibacterial, hypocholesteroelemic and antihelminthic properties.
- *Ulva* spp. can be used as a protein source for fish, shellfish, poultry and cattle.

Harvesting

- Ecological surveys and continuous monitoring are necessary to define best harvesting practices for this species. To date there is not sufficient scientific data to recommend sustainable harvesting levels in Ireland.
- In Ireland a licence is required to harvest seaweeds (Foreshore Acts 1933-1998).
- When cutting the individual, preferably remove sections of the selected fronds, by leaving the holdfast and part of the fronds behind.
- Avoid collecting *Ulva* near sewage outlets, harbours or industrial areas as it may be contaminated.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional
INVESTING IN OUR COMMON FUTURE
European Union
European Regional Development Fund
NUI Galway
OÉ Gaillimh
Ryan Institute
Environmental, Marine and Energy Research

REFERENCES

Bunker, F.S.D., Brodie, J.A., Maggs, C.A., & Bunker, A.R. (2010). SeaSearch Guide to Seaweeds of Britain and Ireland. Marine Conservation Society. Ross-on-Wye. 224pp.

Braune, W. & Guiry M.D. (2011). Seaweeds. A colour guide to common benthic green, brown and red algae of the world's oceans. Ed. by Michael D. Guiry. Koeltz Scientific. 601 pp.

Cabioc'h, J., Floc'h, J.-Y., Le Toquin, A., Boudouresque, C.-F., Meinesz, A & Verlaque, M. (2006). Guide des algues des mers d'Europe. Paris: Delachaux et Niestlé SA, Paris. 272 pp. + 244 figs.

Cole, K.M. & Sheath, R.G., Eds (1990). Biology of the red algae. Cambridge University Press, Cambridge. 517 pp.

Pankow, H. (1990). Ostsee-Algenflora. Fischer-Verlag, Jena. Germany. 648 pp.

Queguineur, B., Morrissey, J., Hanniffy, D., & Kraan, S. (2007) CARRASEA PROJECT - Approach to the sustainable exploitation of carrageen seaweed resources in Galicia (Spain) and Ireland. INTERREG IIIC Report. 63 pp.

Van den Hoek, C., Mann, D.G. & Jahns, H.M. (1995). Algae. An Introduction to Phycology. Cambridge University Press, Cambridge. 623 pp.

The authors would like to thank Prof. Mark P. Johnson, Dr. Fabio Rindi and Prof. Michael D. Guiry for their valuable contribution on this booklet.

BIOTECMAR

This booklet has been created within the Biotecmar project (contract nº 2008-1/032) and was co-financed with the support of the European Union ERDF- Atlantic Area Programme.

ATLANTIC AREA Transnational Programme
ESPACIO ATLÁNTICO Programa Transnacional
ESPACE ATLANTIQUE Programme Transnational
ESPAÇO ATLÂNTICO Programa Transnacional

European Union
European Regional Development Fund

INVESTING IN OUR COMMON FUTURE

Published in Ireland, 2012