

## Marine Plants- Rockweed (*Ascophyllum nodosum*), Irish moss (*Chondrus crispus*), Finger kelp (*Laminaria digitata*), Winged kelp (*Alaria esculenta*), and Cabbage kelp (*Laminaria longicruris*).

### Description, Distribution and Biology

Seaweed is a term often used to describe marine plants found within the ocean environment, however in reality these plants are not weeds but marine algae. Seaweeds are divided into three main classifications, green, red and brown algae, which include both marine and freshwater species. There are numerous marine plants off the east coast of Canada but those of economic significance include the rockweed, Irish moss, finger, winged, and cabbage kelp.

**Rockweed:** Rockweed (*Ascophyllum nodosum*), also known as knobbed wrack, knotted wrack, yellow tang, and sea whistle, is common large brown algae. It has a leathery texture and long strap-like fronds with oval shaped air bladders (pneumatocysts) at regular intervals. The air bladders serve to keep the plant upright during submersion, thereby maximizing exposure to sunlight and reducing access of grazers. Shoots of rockweed arise from a holdfast or root and develop a complex structure of dichotomously branched thallus (plant body with no distinct stem or leaf parts). Rockweed is typically olive green to dark brown in colour depending on the time of year. Although the plant is usually less than 1 m in length, plants over 2 m have been reported in ice-free coastal areas. This species is slow growing and can live up to 15 years.

Rockweed is distributed throughout the North Atlantic Ocean. In the northwest Atlantic, it ranges from the Arctic Circle southward to New Jersey, USA, with high densities throughout coastal areas of Newfoundland. This species prefers rocky intertidal areas with semi-wave exposure and temperatures between 10 and 16 °C.

Rockweeds are dioecious, producing gametes from special reproductive areas called receptacles. During the late winter and early spring, adult plants will form receptacles, which are yellow for males and yellow-green for females and release gametes into the water column. The adults will shed their



Figure 1. Rockweed. Source: Greg Anderson Bates College, Lewiston, ME

receptacles after the release of gametes, typically in July for Newfoundland and August for Labrador. Within 10 days of fertilization, the zygote forms a new plant. Germlings (young) will grow approximately 0.1 to 0.2 cm during the first year and reach 1.0 to 2.5 cm after 2 years.

**Irish Moss:** Irish moss is robust, spherical, perennial red algae. It has a flattened, dark thallus with numerous dichotomous branches near the top. Irish moss grows from a basal disc adhered to the substrate and can reach a size of 25 cm (9.8") or more. The colour of the Irish moss changes with season and habitat. It can vary from a yellow-green to a dark red-purple. Sexual maturity is reached between 3 and 5 years. The life cycle of red algae is unlike other plants and animals. The male cells have no flagella (tail) and therefore rely on currents to unite with the female plant. Fertilization of a cell in the female does not involve eggs. Carpospores are produced by the female from a complex multicellular diploid structure. Carpospores will then germinate to form diploid plants, which resemble the adult (parent) plant. These diploid plants produce meiotic tetraspores during the late summer and early fall in Newfoundland waters that germinate into the haploid sexual generation.



Figure 2. *Chondrus crispus*. Source: Michael Moore-SW School of Botanical Medicine

Irish moss is distributed on both sides of the North Atlantic Ocean. In the eastern Atlantic it ranges from Norway south to Morocco. In the northwest Atlantic it is common from Newfoundland to Cape Cod, Massachusetts. This species is usually found on rocky bottoms from the upper subtidal to depths of 18 meters. Irish moss is a food source for a variety of marine organisms, particularly for the green sea urchin, and also provides a habitat for juvenile lobster and fish.

**Fingered, Winged and Cabbage Kelp:** Kelp has three main parts, a blade or 'lamina', a stipe or 'stem', and a holdfast or 'anchor'. The cabbage, fingered and winged kelp are all perennial brown seaweed species distributed on both sides of the North Atlantic Ocean. On the eastern coastline, the winged and cabbage kelp distribution is restricted to the northern portion of the northwest coast. In the northwest Atlantic all three species range from the Arctic, south to Long Island Sound, New York and are common around Newfoundland and Labrador. The winged, cabbage and finger kelp are primarily found in the low intertidal to subtidal zones and are usually the dominant marine plant on rocky substrates with moderate to high exposure. Cabbage kelp has the highest tolerance for warm water often surviving temperature near 20 °C, while the growth of winged and finger kelp is reduced above 16 °C.

The life cycle of the cabbage, winged and finger kelp are also similar but quite different from terrestrial growing plants. Larger kelp plants form the asexual reproducing half of the life cycle. Haploid spores, which are released from a special structure called the sporangia, will swim in the water column until they find suitable substrate for settlement. These newly settled spores will grow into independent, microscopic filaments responsible for sexual reproduction and the development of

new kelp blades. The fingered kelp is reproductively active during the spring in Newfoundland and by early summer for Labrador. Winged kelp is reproductively active through the winter, spring and early summer in Newfoundland and the entire summer and autumn in Labrador. Cabbage kelp is reproductively active the entire year, except in mid-summer in southern Newfoundland and May to October in the eastern part of Newfoundland and Labrador.

Although the winged, cabbage and finger kelp have similar distribution and biology, they differ in physical appearance. Fingered kelp is typically blackish brown in colour and can grow to a length of 3 m at maturity. It has a wide blade that is split into 6 to 30 more straps (fingers) and lacks a midrib at the center of its blade. The blade is attached to a stipe that is solid and rounded at the base but flattens at the point of attachment to the blade. Growth is rapid during the winter and early spring but will decrease during the summer months or when temperature rises above 15 0C. The winged kelp is a thin seaweed, ranging from a olive to yellowish color, and growing to a maximum 5 m in length at maturity. The blades are long, narrow and shiny with frilly edges that are attached to a solid stipe. There is a midrib running the length of the blade that provides support. The cabbage kelp is typically khaki brown in colour and can grow to a length of 4.5 m at maturity. The blade is undivided, ruffled along the edges, and has no midrib at its centre. The blades are attached to a long solid stipe that is solid near the holdfast but hollow near the base of the blade. The blades grow rapidly during the winter and spring but slow with the onset of summer water temperatures.

## The Fishery

Seaweed and kelp have been harvested throughout the world for centuries as a food and medicinal source and as a fertilizer. The utilization of seaweed and kelp was first recognized in Asia and today over 21 species are used in daily cooking. In North America, kelp and seaweed has become an important health food item over the last 20 years but consumption is still far behind that of Asian countries.

In Atlantic Canada, seaweed was traditionally harvested for animal feed and as a fertilizer for crops, however in recent years there has been a growing interest in commercial harvested kelp and seaweed resources. In 1995, the Canada/Newfoundland Cooperation Agreement for Fishing Industry Development (CAFID) initiated a pilot project for the harvesting, processing and marketing of various seaweed and kelp species found in coastal waters of Newfoundland. The project concluded that harvesting was possible but further research was needed to determine biomass of the various species and market potential. There are at least two seaweed processing companies currently operating within the province and interest in developing the abundant seaweed and kelp resources is avid. Traditionally, seaweed was harvested by hand using a range of cutting and gathering tools. In 1970, an American company designed a mechanized harvesting technique, which consisted of a reciprocating cutter mounted on a paddle driven barge. In 1985, the Norwegians developed a harvester driven by water jets, which cut and pumped seaweed into mesh bags. Between the late 1980s and 1990 there was a switch from mechanical techniques back to manual methods. Today, there are no mechanical harvesters active in the Maritime Provinces and a rake with a cutter is often the preferred method of harvest.

Four main uses of seaweed and kelp include production of phycocolloids (alginates, agar and carrageenan), as food or pharmaceuticals, as soil amendments, and for animal feed. Although there are many species of seaweed that could have economic potential for Newfoundland, rockweed, Irish

moss, and cabbage, winged and finger kelp are the most important species. Rockweed (*Ascophyllum nodosum*) resources are small and distributed throughout coastal areas of Newfoundland. In the Maritime Provinces, this species forms extensive kelp beds and is the most important commercial species of marine plant harvested in Canada.

Rockweed and kelp are commonly used in health food tablets and is a source of sodium alginate, a natural thickener for ice cream, chocolate milk, pie filling and instant mixes and sauces. Irish moss (*Chondrus crispus*) is common in the Port-au-Port bay area of the island. Carrageen or Irish moss was first identified and used in Ireland for direct consumption when dried, as a fertilizer, and for the gelling of milk pudding. Today carrageenan is used in many food and household items including, dairy products, baked goods, pharmaceuticals, beer, shampoo, and cosmetics.

Finger (*Laminaria digitata*), cabbage (*Laminaria longicruris*) and winged (*Alaria esculenta*) kelp are commonly found coexisting in beds around the province. Kelp (*Laminaria spp.*) is eaten extensively in Asian countries. It can be sold dried in sheets, crushed or as a condiment and is rich in vitamins and minerals. Dried winged kelp (kombu) is considered an important food in Japan and an excellent source of natural iodine and potassium.

## Management and Future Development

Traditionally, the harvesting of kelp and seaweed resources in Atlantic Canada was considered an open operation with no limit on the number of harvesters, fishing areas, or harvesting effort. By the late 1970s an area based management plan was introduced in the Maritime Provinces, which placed harvesting controls on geographic units or sub-sectors. In 1995, a new management approach was developed to protect the resource including exclusive licenses, restricted fishing areas, the establishment of quotas, and conservation measures such as leaving the holdfast for future growth.

There is mounting interest in developing the seaweed and kelp resource of Newfoundland and Labrador. Many individuals, companies, and associations have become involved with research and development initiatives and some companies such as Newfoundland Aqua Products Inc., have been successful at developing products and finding success in the emerging nutraceutical industry. Kelp and seaweed are valuable and renewable natural resources, and if managed properly could generate millions of dollars to the regional economy.

At present, the demand on the provinces' seaweed and kelp resources is minimal and thus resource abundance is adequate. Further development of the industry will result in greater pressure on the natural resources therefore, the industry will need to incorporate management measures such as improving harvesting techniques, removing competing species, and the use of artificial structures for new growth.

### **For Further Information Contact:**

Centre for Sustainable Aquatic Resources, Marine Institute of Memorial University of Newfoundland, P.O. Box 4920, St. John's, NL A1C 5R3  
Toll Free: 1-709-778-0521 Website: <http://www.mi.mun.ca/csar/> OR  
Department of Fisheries and Aquaculture, Government of Newfoundland and Labrador, P.O. Box 8700, St. John's, NL, A1B 4J6  
Telephone: 1-709-729-3766

### **Partners/Contributors:**

Centre for Sustainable Aquatic Resources (CSAR)  
Fisheries and Marine Institute of Memorial University of Newfoundland