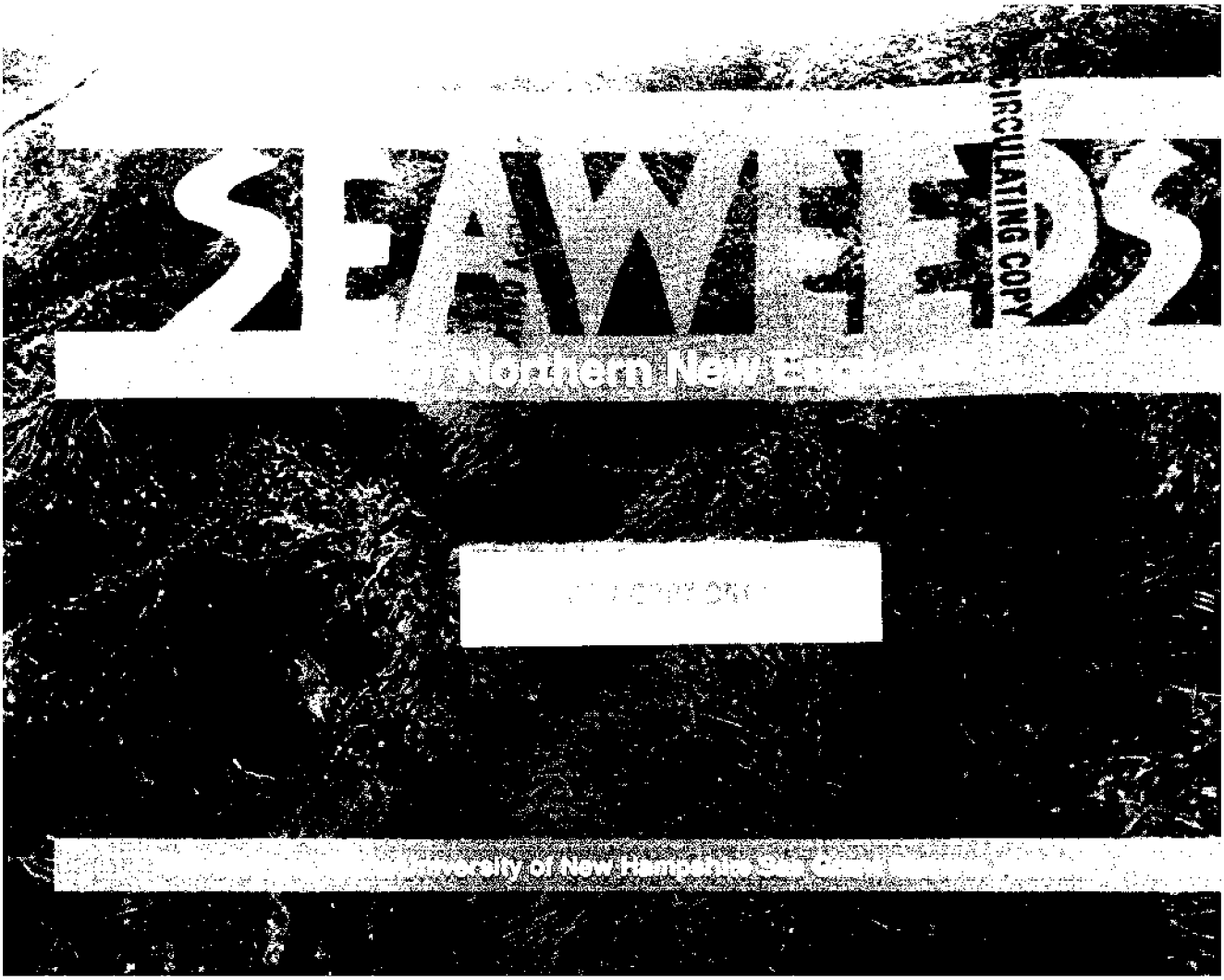
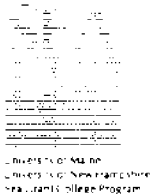

SEAWEEDS
CIRCULATING COPY
Northern New England



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A Field Guide to Seaweeds is a sampling of selected seaweeds of the Maine/New Hampshire coast with suggestions on foraging and preparation, and tantalizing recipes for some of the more commonly used species. ***A Field Guide to Seaweeds*** is a must for everyone who loves exploring the shore and is fascinated by the plants and animals that live there.

A Field Guide to Economically Important

SEAWEEDS

of Northern New England

Susan K. White

Illustrated & designed by
MaJo Keleshian

University of Maine/University of New Hampshire Sea Grant Marine Advisory Program

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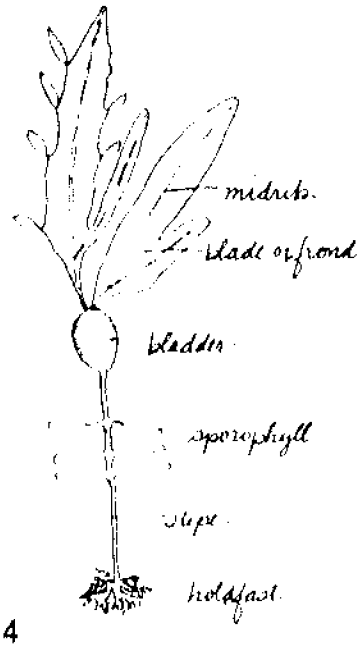
In addition, Kathleen Lignell and Steve Adams of the Maine/New Hampshire Sea Grant Communications Office reviewed the manuscript.

Contents

Introduction

The northern New England coast is one of the more productive seaweed growing areas in the world. Its climate, over 3000 miles of rocky habitat, abundance of nutrient-rich waters during much of the year, and large tidal flow make it an ideal habitat for seaweeds.



What Are Seaweeds?

Seaweeds are large algae (macroalgae) that grow in a saltwater or marine environment. Seaweeds are plants, although they lack true stems, roots, and leaves. However, they possess a blade that is leaflike, a stipe that is stemlike, and a holdfast that resembles a root. Like land plants, seaweeds contain photosynthetic pigments (similar to chlorophyll) and use sunlight to produce food and oxygen from carbon dioxide and water.

Where Do Seaweeds Live?

There are over 250 species of seaweeds in the Gulf of Maine/Bay of Fundy region. Certain seaweeds tend to group together in bands or "stripes" that run roughly parallel to the coast. Seaweeds live in the region between the high and low tide levels (intertidal zone) and below the low tide mark (subtidal zone). The intertidal zone is alternately exposed and submerged by the tides, while the subtidal zone is always covered by water, except at the uppermost level, which may be briefly exposed during extreme low tides.

The intertidal and subtidal zones are further divided into bands. This guide gives examples of common seaweeds found in the upper, mid-, and lower intertidal zones and below the low tide mark. Depending upon local conditions, bands of seaweed within these zones may be narrow or broad. Many seaweeds may also be found in more than one band.

How Are Seaweeds Grouped?

Most seaweeds are divided into three groups according to their color. Generally speaking, the green seaweeds (division *Chlorophyta*) inhabit the shallowest zones along the shore (upper intertidal), the browns (*Phaeophyta*) are usually found in the mid-intertidal and subtidal zones, and the reds (*Rhodophyta*) inhabit the lower intertidal zone and deeper waters.

Some **dominant** plants of protected rocky shores are knotted wrack /rockweed (*Ascophyllum/Fucus*), Irish moss (*Chondrus crispus*), and the kelps (*Laminaria longicruris* and *L. saccharina*).

The dense vegetative stands of rockweeds, Irish moss, and kelp are ecologically very important to other flora

and fauna of the rocky coast, providing food and shelter for many marine organisms. Some animals, such as green sea urchins (*Strongylocentrotus droebachiensis*) and periwinkles (*Littorina littorea*), use seaweed directly for food. When seaweeds break down, they enrich waters by adding dissolved and particulate organic matter to it. This is used by a number of micro-organisms and many species of marine invertebrates.

Uses of Seaweed: Past and Present

Seaweeds have been harvested for food, fertilizer, and medicine for thousands of years. The Chinese used seaweed for medicinal purposes as early as 3000 B.C. One of the earliest records, the Chinese *Book of Poetry*, indicates that sea vegetables were considered a delicacy as far back as the time of Confucius. In Iceland, where seaweed has been eaten for centuries, the oldest law book refers to the "rights and concessions involved before one might collect and/or eat fresh sol (*Palmaria palmata*) on a neighbor's land." Ancient Hawaiian nobility also kept limu (edible algae) gardens where rare and choice varieties of seaweeds were cultivated to provide gourmet food for the royal family.

Other cultures have used seaweed for fertilizer and fodder. For centuries, inhabitants of the island of Lewis in the Outer Hebrides have made a sacrifice each Hallowtide to the sea god Shony, "with entreaties to send seaware to enrich our ground." *Bellum Africanum*, written in 46 B.C., states, "The Greeks collected seaweed from the shore and having washed it in fresh water, gave it to their cattle." Throughout Europe and Great Britain, seaweed has been used for many years to replenish the soil and promote plant growth.

In northern New England, rockweeds (*Ascophyllum* spp. and *Fucus* spp.) have been collected for use as fertilizer since colonial times. *Ascophyllum nodosum* is used as packing material for shipping live lobsters and clams, and for transporting sandworms in the marine bait industry. Dulse (*Palmaria palmata*) and Irish moss (*Chondrus crispus*) have formed the nucleus of a cottage industry in which harvesters collect, dry, and sell the seaweeds for food and industrial use.

Seaweeds have many other important but low volume uses. Because they concentrate trace elements, seaweeds historically have been a source of iodine, potash, and other minerals used in industry and medicine. A number have been used for drugs, including anticoagulants, antibiotics, antihelmenthes (worms), antihypertensive agents, reducers of blood cholesterol, dilatory agents, and insecticides.

In the global market, seaweed is sold primarily for food. This has not been the case in New England, where seaweed has been used mainly for fertilizer, animal feed supplements, and food and pharmaceutical additives. In the past decade, however, there has been increasing interest in using seaweed for food as its health qualities are becoming better known. One seaweed used for food in the rapidly expanding Japanese cuisine market is nori or *Porphyra*. The U.S. has the fastest growing market for nori in the world, with sales in 1990 approaching $25 million and growing at 12 to 15 percent per year.

Growing Seaweeds Through Aquaculture

As the market for seaweed grows, many people have become concerned about the effects of overharvesting. Removing large quantities of seaweed from a rocky shore can upset the balance of plant and animal communities living there. It can also cause more rapid erosion of the shore.

Culturing economically important seaweeds (aquaculture) has many advantages over harvesting wild stocks. By culturing seaweed in suspended structures away from rocky substrata, an existing ecosystem is not substantially altered. In addition, harvesting cultured seaweed is many times simpler and more efficient. If seaweeds are cultured on nets or ropes strung horizontally on the surface of protected bays, harvesters do not have to wait for the proper tides and risk dangerous wave action to gather the crop.

A Note on Foraging

The seaweed collector should make every effort to take plants that are already detached. However, specimens found on the beach that are faded should not be used, especially for food, as they are in the process of decaying.

Seaweeds should be collected sparingly—only gather what you are going to use. Excessive and careless seaweed harvesting could denude an area of plants that took years to establish themselves.

Green Algae

Ulva lactuca

Common name: Sea lettuce

Description: *Ulva lactuca* is a bright green sheet that closely resembles *Monostroma* spp. and *Ulvaria* spp. *Ulva* is two cells thick while *Monostroma* and *Ulvaria* are only one cell in thickness. *Ulva* can be differentiated from *Monostroma* and *Ulvaria* by the fingerprint test. If fingerprints can be seen through the translucent plant, it is *Monostroma* or *Ulvaria*. If they cannot, and the texture is similar to wax paper, it is probably *Ulva*.

The shape of *Ulva* is quite variable; some specimens are almost circular or oval while others are narrow and elongated. Plants have a fine, silky texture with waved or ruffled margins.

Habitat: *Ulva* is found in a variety of places—on exposed rocks, in tide pools, and in quiet shallow bays near the low tide mark. *Ulva* thrives in estuarine, nutrient-rich waters and may be dense in salt marshes and on mud flats where fresh water is abundant.

Foraging: Sea lettuce is an annual or a pseudo-perennial (most of the seaweed dies back and the plant is regenerated by a residual basal material). Young plants should be harvested in early spring for taste and tenderness. Blades are cut or plucked from rocks at low tide. Drifting plants may also be harvested if fresh.

Uses: *Ulva* is occasionally used fresh in salads, but is more often processed before eating. *Ulva* is prepared and eaten in the same manner as *Porphyra* (see page 14), but is not considered as much of a delicacy. Sea lettuce has also been used for burn treatments.

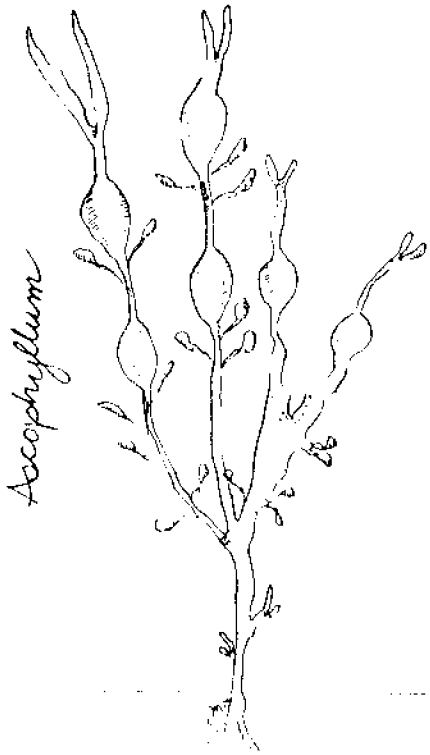
Processing: Sea lettuce may be washed in fresh water, drained, and dried for use as a seasoning (similar to *Porphyra*). It is also used fresh as a fodder or dried, milled, and added to animal feed.

Nutrients: Very high in iron. High in protein, iodine, aluminum, manganese, and nickel. Also contains starch, sugar, vitamin A, vitamin B_1, vitamin C, sodium, potassium, magnesium, calcium, soluble nitrogen, phosphorous, sulfur, chloride, silicon, rubidium, strontium, barium, radium, cobalt, boron, and trace elements.

Brown Algae

The *Fucaceae*

Common names:
Knotted wrack (*Ascophyllum* spp.)
Rockweed, bladderwrack (*Fucus* spp.)



Description: There are several species of the genus *Fucus*, and one species of *Ascophyllum* with several different forms or "ecads." The *Fucus* species generally have dividing, Y-shaped, flattened blades with a prominent midrib. *Fucus* species may reach 2 or 3 feet in length and are not easily distinguished from each other.

Fucus vesiculosus has paired air bladders within the blades that "pop" when they are stepped on. These bladders keep the seaweed afloat so its photosynthetic tissues are more effectively exposed to sunlight. Breeding receptacles are football-shaped structures at the tips of the plant—orange if male and olive-green if female.

F. spiralis lacks bladders and has twisted fronds and numerous tufts of dark brown hairs scattered across the surface. Receptacles at the tips of the plants are "winged"—having a narrow, shelflike tissue bordering each one. *F. distichus* (subspecies *edentatus*, *evanescens*, and *fileformis*) are distinguished by the shape of their receptacles, which are 2 to 4 inches long and have a pointed tip.

Ascophyllum has long fronds without a midrib and narrow, unflattened, straplike blades with air bladders that grow singly and are scattered throughout the plant. Receptacles are small, pea-sized, yellow structures (found during the winter) along the length of the plant and attached by short stalks. *A. nodosum* has been reported to have a life span of about 20 years and is the dominant species of the sheltered and semi-exposed intertidal zone.

Habitat: These algae form the prominent "rockweed" zone of the intertidal region in northern New England. This is the generally dark brown area that is very slippery to those walking on rocky shores and ledges.

F. spiralis is found at the upper level of the intertidal zone, *F. vesiculosus* forms a band toward the middle, and *F. distichus* subspecies are found in tide pools in the high intertidal and extend into the shallow subtidal zone. *Ascophyllum* prefers shores protected from heavy wave action and may also be found in tidal pools of salt marshes. Some of the less common forms of *Ascophyllum* (i.e., *A. nodosum* ecad

scorpioides) are free-living, growing unattached and often entangled in *Spartina* salt-marsh grass.

Foraging: *Ascophyllum* and *Fucus* are perennials. Because they grow slowly, it is best to collect them after they have washed up on the beach after a storm.

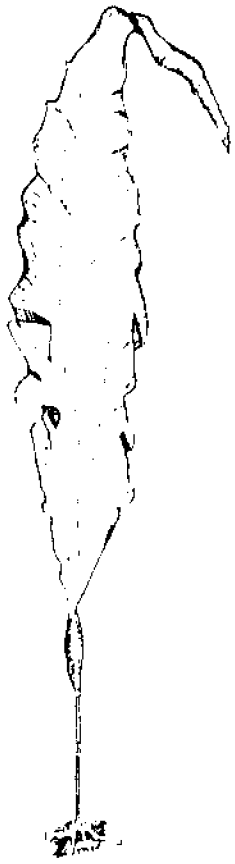
Uses: The main uses of *Ascophyllum* and *Fucus* are as fertilizers, soil conditioners, and sources of micronutrients in animal feed supplements. Studies have shown that seaweed fertilizers promote plant growth by supplying necessary minerals and growth hormones, and by improving soil structure. Studies have shown that when these seaweeds are used in animal feed, cows produce more milk, chicken eggs have better pigmentation, and horses and pets are generally healthier. These seaweeds are also important packing materials for shipping live lobsters and marine bait worms. A special form of *Ascophyllum* called wormweed (*A. nodosum* ecad *scorpioides*) is a gold-colored seaweed with very fine fronds that grows in localized areas and is used exclusively for the sand and bloodworm bait industry.

Processing: Local farmers gather rockweed for use as a fertilizer and soil conditioner, and simply bury it in their gardens. When used as an animal supplement, the algae are dried in commercial dryers to 10 to 12 percent water content and milled to various particle sizes. Some is processed into liquid fertilizer. Alginates are extracted chemically and used in bulking, gelling, and stabilizing processes. Products using alginates include charcoal briquettes, cosmetics, ceramics, cheese, paint, asphalt, rubber tires, polishes, toothpaste, ice cream, and paper.

Nutrients: Very high in magnesium, and high in protein, vitamin A, iodine, bromine, and phosphorous. Also contain sugar, starch, vitamin C, vitamin K, vitamin E, zinc, potassium, calcium, sodium, sulfur, chloride, silicon, iron, manganese, copper, zinc, cobalt, titanium, hydrogen, molybdenum, lead, barium, boron, radium, and trace elements.

Recipes: Rockweed for Clambakes, Rockweed as Flavoring, and Rockweed Tea (pg. 19)

Laminaria longicruris
Common names: Oarweed, kelp



Description: This brown kelp has a very long, narrow stipe (which may be 6 feet long) transforming into an elongated, flat blade with no midrib. The stipe becomes somewhat swollen and hollow before it joins the blade. Blades are fairly thick in the midsection, thin and a bit ruffled at the edges, and may be 6 to 30 feet long and very wide. *Laminaria* has a large branched holdfast. Plants range from olive-tan to olive-brown.

Habitat: A dominant plant of the coast, it grows in dense forests below low tide mark, from the shallow subtidal to deep water along much of northern New England's shores.

Foraging: Peak harvest for oarweed is in April and May. Blades are harvested by cutting with a knife or sickle at low spring tides.

Uses: These kelps are a prominent source of algin and food in the Oriental market. Traditionally, they have been a source of iodine and potash. Their stipes were used to open wounds, aid in cervical dilation, and induce abortions. Oarweed is harvested in Maine for health food stores where it is sold as "kombu." Prepared plants may be cooked as a vegetable or added to soups. As with the other kelps, oarweed is a natural source of monosodium glutamate.

Processing: Oarweed may be air- and sun-dried (or smoke-dried over a woodstove) and sold whole or milled and sold as seasoning.

Nutrients: High in calcium, potassium, magnesium, iron, and trace minerals such as manganese, copper, and zinc. Also provides chromium, instrumental in blood sugar regulation; and iodine, essential to the thyroid gland.

Recipes: Kelp! Hot Potatoes! (pg. 20), Sea Pickles (pg. 20), Candied Kelp (pg. 21)

Laminaria saccharina
Common name: Sugar kelp

Description: A brown kelp with a strong, root-like holdfast supporting a flexible, cylindrical stipe and a blade that is commonly 6 feet or more in length. The margins of the mature blade are quite thin and often very ruffled. When dry, sugar kelp is covered with a sweet, white substance—hence its name *saccharina*, which means "sugary."

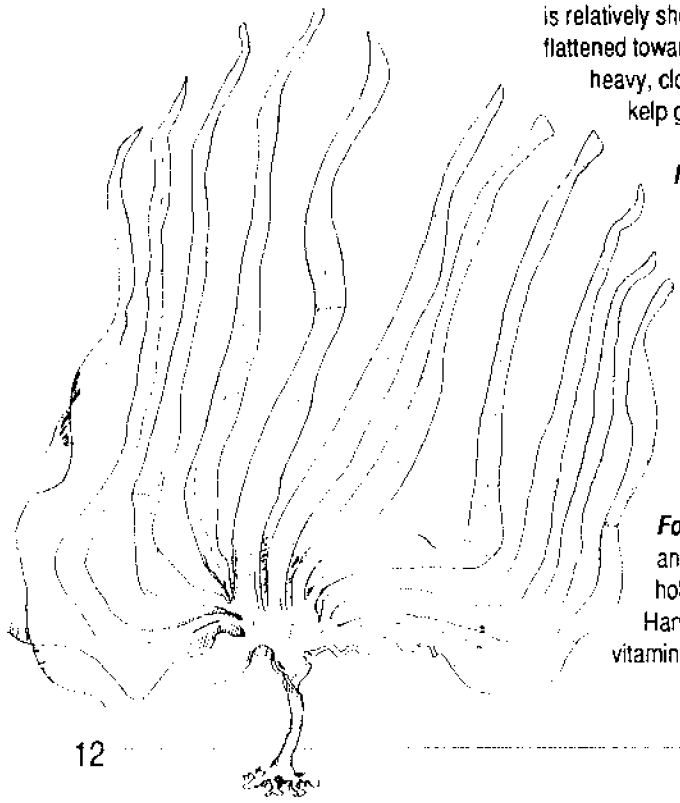
Habitat: *L. saccharina* is found attached to stones and shells below the low tide mark, in areas ranging from the shallow subtidal to around 60 feet deep. Dense masses of these long, leathery blades moving back and forth in the water resemble an underwater forest.

Foraging: Peak harvest for sugar kelp is in late spring (for high vitamin C) and summer (for high sugar alcohol) content. Blades are harvested by cutting with a knife or sickle at low spring tides.

Uses: Similar to those listed on page 10 for *L. longicruris.*

Nutrients: Very high in iodine and bromine. High in protein and sugar. Also contains starch, nitrogen, vitamin K, vitamin B_{12}, vitamin C, sodium, chloride, rubidium, radium, cadmium, cobalt, boron, manganese, nickel, glutamic acid, and trace elements.

Laminaria digitata
Common names:
Horsetail kelp, fingered kelp



Description: Plants are olive-tan to olive-brown. A mature plant is broad at the base, becoming heart-shaped and deeply cleft with 6 to 30 narrow, flattened blades growing from a single stipe—hence its name *digitata* meaning "fingered." Its stipe is relatively short and thick and becomes flattened toward the blade. The holdfast is heavy, close, and fibrous. Horsetail kelp grows to 3 feet long.

Habitat: This kelp is found most abundantly below the low tide mark in areas exposed to heavy surf or strong tidal currents and occurs occasionally in tidal pools. A deepwater form of this plant may also be found in coastal waters at depths of 40 to 60 feet.

Foraging: Horsetail kelp has an annual blade with a perennial holdfast and fruits in winter. Harvest in the spring for high vitamin C but low starch. It is harvested at very low spring tides with sickles.

Uses: In the health food industry, it is used as a flavoring in soups and especially in baked beans. It may also be used as a cooked vegetable.

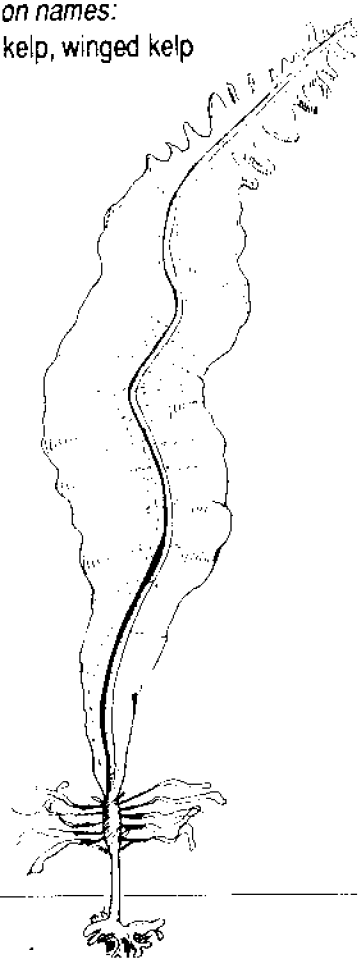
Processing: This kelp is dried, (either air-dried over a clothesline or smoke-dried over a wood stove) until plants are just pliable, then folded or pressed, and packaged in plastic bags. It may also be milled and used as a seasoning.

Nutrients: Very high in iron. High in iodine, bromine, phosphorous, boron, and zinc. Also contains protein, sugar, starch, vitamin A, vitamins B_1 and B_{12}, vitamin C, calcium, magnesium, sodium, cobalt, chloride, potassium, sulfur, silicon, vanadium, soluble nitrogen, strontium, aluminum, rubidium, radium, copper, manganese, titanium, nickel, and trace elements.

Recipes: Hearty Fall Casserole (pg. 21), Summer Pickles (pg. 22)

Alaria esculenta

Common names:
Edible kelp, winged kelp



Description: This single-bladed kelp is olive brown, about 6 inches wide, and 6 to 12 feet long with a distinct flattened midrib, thin ruffled edges, and small, spatula-shaped leaflets (reproductive blades called "sporophylls") growing near the base of the stipe. The blade is usually frayed or split toward the tip.

Habitat: *Alaria* is often found attached to rocks just below low tide out to 25 feet in areas exposed to strong tidal currents and waves.

Foraging: *Alaria* is a biennial (lives for two years) with a peak harvest in May and June. It is harvested from boats with long-handled hooks or hooks attached to long ropes. It is also collected by wading out in hip boots at very low tides and cutting the algae from rocks using a sickle. Regeneration is ensured when the main blade is cut 2 to 3 inches above the stipe and the sporophylls are retained. Leaving some of the blade allows the plant to regrow for another harvest while the sporophylls will produce spores, allowing the plant to reproduce sexually.

Uses: The scientific name *esculenta* means "edible" and describes its primary use as food. *Alaria* is often sold in health food stores as "wakame."

Preparation: Before using, soak fronds (and/or midribs) in fresh water for two days. Reproductive "leaflet" blades may also be eaten. *Alaria* is eaten fresh—chopped and added to a salad—or it may be sun-dried, crumbled, and used as a salty seasoning. It is best to store dried *Alaria* in sealed plastic bags to retain freshness.

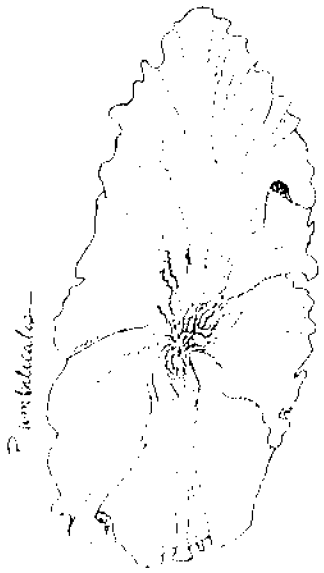
Nutrients: Very high in calcium and vitamin A. High in vitamins B_2, B_6, and B_{12}; and vitamin K, iodine, and bromine. Also contains sugar, starch, vitamin C, nitrogen, boron, radium, rubidium, cadmium, cobalt, nickel, and trace elements.

Recipes: *Alaria*-Cucumber Salad (pg. 23); Pasta with *Alaria* and Maine Shrimp (pg. 23); Edible Kelp Stew (pg. 24)

Red Algae

Porphyra Species

Common names: Laver, nori



Description: There are at least four species of *Porphyra* in northern New England waters: *P. umbilicalis*, *P. miniata*, *P. leucosticta*, and *P. linearis*. They are red algae, with color ranging from dark brown and nearly black to reddish-purple. *P. umbilicalis* is most prominent with broad, very thin, papery, translucent blades, which are one cell thick. Its species name *umbilicalis* (meaning "of the navel") comes from the fact that the small holdfast is usually centrally located and the membrane tends to have a pinched appearance where it joins the holdfast.

Habitat: *P. umbilicalis* is found in the upper and mid-intertidal zone on rocks and mooring balls in protected waters. *P. miniata*, a bright rose-colored species, is found at or below the low tide mark. *P. leucosticta* is smaller and usually grows on kelp fronds and rocks in the shallow subtidal zone. *P. linearis* is also small, has a narrow blade, and grows to be 2 to 3 inches long. It is found in turbulent, coastal waters in the upper intertidal zone.

Foraging: The peak harvest for *Porphyra* is early to mid-spring. Fronds are tough by summer. It is harvested by plucking the seaweed from rocks at low tide.

Preparation: *Porphyra* may be air-dried or pressed into thin sheets. To air dry, seaweed is washed quickly in cold, fresh water and hung on a clothesline or spread on screens to dry in the sun. *Porphyra* can also be toasted over a charcoal fire, broken up, and added to soups and sauces. For use in Japanese cuisine (especially for "sushi"), certain species of *Porphyra* are pressed and dried into paper-like, 3-gram (.11 ounce) sheets, 18 x 21 centimeters (7.09 x 8.27 inches) in size.

Uses: *P. umbilicalis* and *P. miniata* are air-dried and used in soups, in laver bread, and as a seasoning for many dishes. Some *Porphyra* species (such as *P. linearis*, which has a taste very similar to the Japanese species *P. tenera*) are commonly used as a wrapping for sushi, a Japanese dish. Nori has antiscorbutic properties (prevents and cures scurvy), is used as an antibiotic, and reduces blood cholesterol.

Nutrients: High in protein, vitamins B_1, B_2, B_6, B_{12}, vitamin C, and vitamin E. Also contains manganese, fluoride, copper, zinc, sugar, starch, and trace elements

Recipes: Fried Rice with Wild Nori (pg. 25), Sesame Nori Salad Dressing (pg. 25), Apple/Tuna/Nori Salad (pg. 26)

Chondrus crispus
Common name: Irish moss

Description: This red alga has large clumps of fan-like fronds, 3 to 7 inches tall. The fronds are flattened and may be narrow, branched, curled, or twisted. Several blades arise from a single holdfast and the tips of the blades are rounded. The color varies with locality and season, ranging from white, when washed ashore on beaches, to green and dark purple-red.

Habitat: *Chondrus crispus* occurs abundantly on rocks or horizontal ledges at or below the low tide mark and in the shallow subtidal zone. It grows in sheltered, open coastal, and estuarine sites with strong tidal currents. It has also been found in water as deep as 60 feet.

Foraging: Irish moss is a perennial and is at peak for harvest in spring and summer. Harvesting in the summer is best for high vitamin A content. This seaweed is raked by hand at low tide from small boats or cut with sickles by wading out in shallow water. Storm-cast seaweed is often harvested from beaches.

Uses: As a source of the valuable carrageenan, this alga is of great commercial importance. When *Chondrus* is dried and boiled in water, carrageenan is extracted. Carrageenan is a gummy substance made of very large molecules that remain dispersed and suspended in liquids without settling to the bottom. It is used primarily as a thickener, stabilizer, and gelling agent in food and food products (jello, ice cream, salad dressings, chocolate and evaporated milk, pudding, frozen desserts, etc.), pharmaceuticals, toothpaste, cosmetics, paints, and textile sizings.

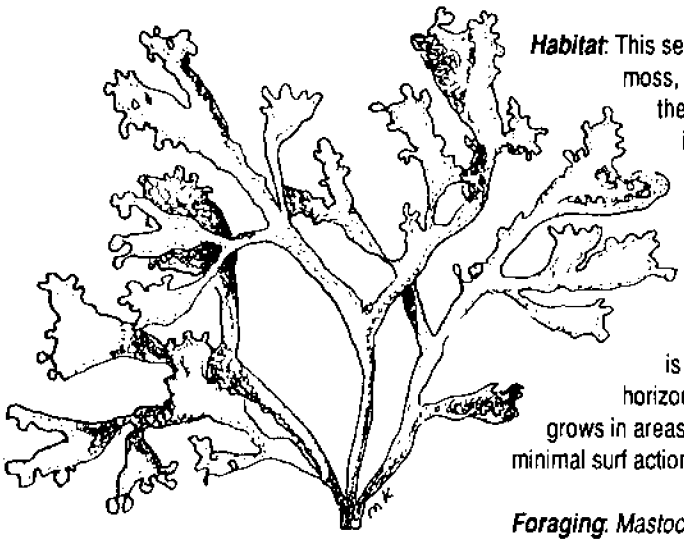
Chondrus was given its common name, Irish moss, because residents in County Carragheen, Ireland, discovered about 600 years ago that a handful of the seaweed cooked with milk and flavored made a delicious pudding. (See recipe for Irish moss pudding on page 27.) Irish moss gelatin (made by boiling the seaweed in water and straining it) has been used as a soothing remedy for ulcers.

Processing: Carrageenan is extracted by boiling the algae.

Nutrients: High in protein, vitamin A and iodine. Also contains sugar, starch, vitamin B_1, iron, sodium, phosophorus, magnesium, copper, calcium, soluble nitrogen, bromine, potassium, chlorine, sulfur, boron, aluminum, and trace elements.

Recipes: Gelled Tomato Salad (pg. 26); Irish Moss Pudding (Blancmange) (pg. 27); Stir-Fried Irish Moss (pg. 27)

Mastocarpus stellatus
Common name: False Irish moss



Description: False Irish moss is a small stiff plant, growing in tufts 2 to 3 inches tall with flattened and often curled blades. The terminal surfaces of the blades are covered with irregular "lumps" that enclose microscopic reproductive cells. It is usually dark red to brown in color and grows densely on rocks, forming a thick carpet.

Habitat: This seaweed, along with Irish moss, forms a distinct zone at the fringe of the low intertidal zone, between the rockweeds above and the kelp below. False Irish moss grows better on sloping and vertical rocky substrates, while Irish moss is more often found on horizontal ledges. *Mastocarpus* grows in areas of strong tides and minimal surf action.

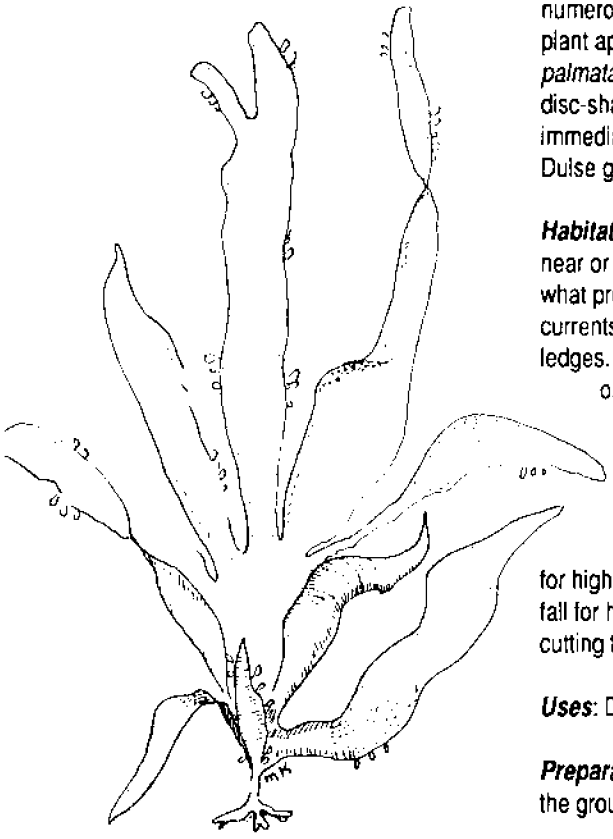
Foraging: *Mastocarpus stellatus* is usually harvested incidentally with Irish moss.

Uses: Its major use is as a source of carrageenan. It has been used medicinally for coughs and chest and stomach ailments.

Processing: Like Irish moss, it is boiled and carrageenan is extracted from the aqueous solution.

Nutrients: See Irish moss on page 15.

Palmaria palmata
Common name: Dulse



Description: Dulse is deep red or purple. The blades are flattened and broad with numerous forks. Lobed segments make the plant appear hand-shaped, thus its name *palmata* meaning "of the palm." It has a tiny, disc-shaped holdfast and widens almost immediately into tough, leathery fronds. Dulse grows to 1 foot in length.

Habitat: This is a common red alga growing near or below the low tide mark in somewhat protected bays with strong tidal currents. It grows best on long sloping ledges. It is also commonly found growing on the stipes of kelps.

Foraging: Dulse is a perennial and is at peak for harvest from late spring to mid-fall. It should be collected in mid- to late summer for high vitamin A content and early to late fall for high vitamin C . It is harvested by cutting the plant from rocks at low tide.

Uses: Dulse is used exclusively for food.

Preparation: Dulse is simply spread out on the ground, air dried, and then packaged in plastic bags for distribution. It may be eaten directly as seaweed "chips" or added to soups, sauces, salads, and relishes. Some dulse is also dried and ground for use as a seasoning.

Nutrients: Very high in protein, iron, and fluoride and vitamins B_6 and B_{12}. High in potassium, iodine, and phosphorous. Also contains sugar, starch, vitamin A, vitamin E, vitamin C, soluble nitrogen, yeast, bromine, magnesium, sulfur, calcium, sodium, radium, boron, rubidium, manganese, titanium, and trace elements.

Recipes: Mediterranean Salad with Dulse (pg. 28), Spinach with Dulse (pg. 29), Zucchini-Dulse Julienne (pg. 29)

Seaweed Research

Rockweeds (*Fucus* spp.) and knotted wrack (*Ascophyllum* spp.) are two of the most commercially important seaweed species in the Northeast. Thousands of tons of these seaweeds are harvested each year for use as fertilizer, animal feed, packing material for the lobster and marine baitworm industries, and the extraction of algin. Several other countries have also expressed interest in harvesting large quantities of these species from the coast of Maine. With the possibility of increased harvesting activity, many are concerned about the effects of overharvesting.

Since *Ascophyllum* and *Fucus* are found mainly in open coastal and estuarine habitats, they are susceptible to overharvesting. Robert Vadas, researcher at the University of Maine, is studying how knotted wrack and rockweeds colonize and attach themselves to rocks in order to determine the best harvesting methods, as well as appropriate rates and amount of harvesting, to avoid damaging the resource.

Vadas found that knotted wrack, which lives 20 to 25 years, should be cut 12 to 15 inches above the substrate where it is attached in order to maintain a healthy plant. If the plant is cut or broken too low, it does not regenerate well. He also discovered that knotted wrack does not "recruit" easily (i.e., the zygotes or early stages of the plant do not stick well to rocks). This could help explain its inability to recolonize or reseed itself.

A species of rockweed (*Fucus distichus* subspecies *evanescens*) lives only two to five years and recruits much more readily. By comparing the recruitment and attachment mechanisms of knotted wrack zygotes to those of *Fucus* species and the effects of water movement on recruitment, this study could provide crucial information for reseeding denuded or overharvested shores.

University of New Hampshire (UNH) researchers Arthur Mathieson and Subhash Minocha are studying the kelps, another ecologically and commercially important group of seaweeds. These large brown algae provide substrata and cover for a host of marine organisms and are another important source of algin. UNH researchers are exploring the genetic basis for the inheritance of desired traits by the kelps *Laminaria longicruris* and *Laminaria saccharina*, information that is essential to their cultivation. In addition, these scientists are seeking to identify genetic markers for desirable traits, indicators that will aid in the selection of the strains most suitable for aquaculture.

Seaweed Recipes

The following are recipes using the dominant seaweed species harvested in our region. They were contributed by local processors, foraging enthusiasts, and cooks. For those species that don't have recipes, you may want to refer to other sources listed in the bibliography. (*Editor's note*: Oven temperatures are given in Fahrenheit.)

Rockweed (*Fucus* Species)

Rockweed for Clambakes

Fresh rockweed makes an excellent bed for steaming seafoods and vegetables—as in traditional clambakes. When laid on hot coals on the beach or in a pot over a fire, its moisture provides the necessary steam for cooking. To steam seafood in a pot, pour in 1 inch of water, followed by a layer of rockweed. Whether in the open on coals or in a kettle, use enough rockweed to create a 5-inch bottom layer. Add the first layer of food; it could be potatoes, corn, onions, clams, mussels, or lobsters. Top with 2 inches of rockweed and continue alternating layers of food and seaweed. Finish with a final layer of seaweed, cover, and steam for about 1 hour, or until the foods test done. If you are steaming these foods in a pit over hot rocks and coals, cover the pile with a canvas tarpaulin to seal in the steam. After picking out the first round of servings, the hot rockweed left in the pit (or pot) tends to keep the remaining foods hot and moist.

Rockweed as Flavoring

When preparing any seafood recipe that uses water as the main cooking medium, be certain to add some rockweed. Rockweed gives a delicious, seawater flavor to poached or steamed seafoods. Add chunks of the seaweed to the cooking water; lift out and discard at serving time. If you are making a chowder or soup, enclose a little rockweed in a bag of doubled cheesecloth. To make the bag, fold the cheesecloth into a square, gather the corners, and tie them together. Remove the bag before serving.

Rockweed Tea

When you make this tea, remember that rockweed is especially high in vitamin A in the summer and vitamin C in the autumn. In general, this tea is made from rockweed that has been air- or sun-dried (or oven-dried at 100° to 150° with the door ajar), but it can also be made from fresh seaweed. Gather a quantity of rockweed, tear or cut the blades from their tough main stalks, and thoroughly wash these pieces in fresh water. Cut or chop into even smaller pieces. Add a small handful of fresh or a teaspoon of the dried and crumbled rockweed to a cup of boiling water. Steep for about 5 minutes. Add honey, if desired.

Raquel Boehmer, *A Foraging Vacation*
Monhegan Island, Maine

Kelp (*Laminaria longicruris*)

Helpful Hints from Maine Coast Sea Vegetables

Kelp is thinner and sweeter than Japanese kombu. It provides minerals, glutamic acid (a natural flavor enhancer), and dietary fiber.

Kelp is good for soup stocks. Leave it in to "dissolve," in approximately ½ hour, or take it out after 15 minutes. A slab of kelp in any bean-based dish will enrich digestibility and shorten cooking time. Dried kelp swells to twice its volume when wet.

To make "chips," cut dried seaweed into bite-sized pieces and place them in a medium hot skillet with sesame or canola oil. Press each piece into hot oil with a spatula until it changes color and becomes crisp. Remove and allow to cool. Chips may also be made with dulse, *Alaria*, or nori.

Helpful Hints from Maine Seaweed Company

Kelp may be roasted in a slow oven at 200° until crunchy. Eat it as is, or pulverize it into a powder in a loosely set flour mill. You can combine 15 parts roasted sesame seeds to 1 part roasted kelp powder, and lightly crush the seeds in a suribashi (or blender) so their oil surrounds the kelp granules.

Kelp can be used as a tenderizer for cooking beans, peas, and lentils. Kelp contains glutamic acid that softens the beans, making them more digestible. Simply add a 4-inch piece of kelp per pound of dried beans and cook until tender.

Reconstitute kelp by cutting 4- to 5-inch lengths with scissors and soaking them in warm water for 5 to 10 minutes.

Kelp! Hot Potatoes!

1½ Tbls. soy sauce
½ tsp. honey
3 potatoes, regular or sweet
1½ Tbls. olive oil or your preferred oil
12 inches dried kelp, lightly rinsed and cut into 1-inch pieces
½ cup water

1. Combine the soy sauce and honey. Mix well and set aside
2. Cut potatoes into bite-sized pieces. Sauté in oil until golden.
3. Add kelp and soy-honey mixture to potatoes and stir thoroughly.
4. Add water, cover, and simmer 15 to 20 minutes. Serves 4.

Maine Coast Sea Vegetables
Franklin, Maine

Sea Pickles

fresh or dried kelp, rinsed and cut into strips 2 in. x ½ in.
equal parts, shoyu (soy sauce) and rice vinegar
fresh garlic cloves to taste

1. Place kelp strips in a sterilized crock or glass pickle jar.
2. Combine remaining ingredients and pour over the kelp. Cover and refrigerate at least 24 hours.

Maine Coast Sea Vegetables
Franklin, Maine

Candied Kelp

12 inches dried kelp
¼ cup honey
½ cup water
1 cup sesame seeds

1. Soak kelp in water until very soft. Cut into desired shapes, enough to fill ½ cup.
2. Bring honey and water to a boil.
3. Reduce heat, add kelp, and simmer uncovered until almost all liquid has been absorbed or evaporated (1 to 1½ hour). Check frequently, adding a dash of water when needed and stirring occasionally.
4. Arrange kelp pieces on sesame seeds, turning to coat.
5. Bake on a clean cookie sheet at 300°, 25 to 30 minutes. Halfway through baking, turn over the pieces, being careful not to scorch the sesame seeds.

Note: Maple syrup may be mixed with the honey for a different taste. You may also replace sesame seeds with ground almonds, pecans, walnuts, or peanuts.

Maine Coast Sea Vegetables
Franklin, Maine

Horsetail Kelp (*Laminaria digitata*)

Helpful Hints from Maine Seaweed Company

Digitata may be roasted in a 200° oven until crisp. Use this as a chip or grind and use as a flaked condiment.

Hearty Fall Casserole

digitata squares
Jerusalem artichokes (tuber of North American sunflower), sliced
carrots, cut into wedges
tamari

1. Cover the bottom of a casserole with *digitata* squares, then a layer of Jerusalem artichoke slices, and finally one of carrot wedges. Bake at 350° until thoroughly soft and sweet, 1½ to 2 hours.
2. Season lightly with tamari or mellow miso. Variation: use onions, carrots, squash, thyme, and tamari.

Maine Seaweed Company
Steuben, Maine

Summer Pickles

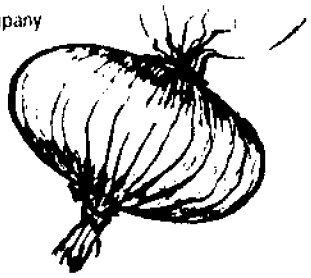
digitata, cut into 1-inch squares
onions, cut into thin half moons
carrots, cut into ovals
green peppers, cut into squares
cauliflower, broken into flowerettes.
5 quarts water
½ cup salt

1. Parboil *digitata* squares for 20 minutes. Drain and cool.

2. Prepare equal quantities of onions, carrots, green peppers, and cauliflower. Arrange the vegetables in a wide mouth glass jar.

3. Bring the water and salt to a boil. Let cool completely before pouring over assorted vegetables. Put a smaller jar on top of the vegetable pieces to keep them fully submerged. Cover with a clean cotton cloth to allow the pickles to breathe but keeping out dust. Check in 10 to14 days.

Maine Seaweed Company
Steuben, Maine



Edible Kelp (*Alaria esculenta*)

Helpful Hints from Maine Coast Sea Vegetables

Presoaking *Alaria* 1 to 24 hours will reduce cooking time up to 50 percent. Removing midribs also shortens cooking time. Add a piece while cooking any grain or bean dish instead of salt. Marinate *Alaria* overnight in vinegar or lemon juice to obtain tender, zesty fronds for salads or stir-fries. *Alaria* swells to twice its volume when wet.

Helpful Hints from Maine Seaweed Company

There are two ways to cut *Alaria*. The quick way is to cut dried *Alaria* with scissors. Another way is to soak the seaweed, and then use a knife. Since *Alaria* expands as it soaks, the second way will give you more control over the size of your final pieces.

Presoaking *Alaria* is a method for tenderizing it. If you use the soak water, you will conserve all of the minerals—just remember to adjust your use of salt.

Total cooking time for *Alaria* (slow boil/fast simmer) needs to be at least 30 to 40 minutes. If you want to cook one part *Alaria* with three parts carrots, for instance, you might cook the *Alaria* for 20 minutes before adding the carrots.

Alaria-Cucumber Salad

This simple summer salad is a slight variation on a recipe by Jan Bellame from her book *Cooking with Japanese Foods*. If you're not into cooking at all, just marinate the de-ribbed *Alaria* a few hours in vinegar or lemon juice until tender. Acidity will tenderize it as easily as heat.

1 cucumber, thinly sliced
½ tsp. sea salt
12 to16 inches dried *Alaria*, soaked in fresh water
2 Tbls. vinegar or lemon juice
2½ tsp. soy sauce
1 tsp. water

1. Sprinkle sliced cucumber with salt, toss gently, and set aside.

2. Drop soaked *Alaria* into boiling water briefly, then plunge it into cold water to brighten and set green color. Remove any tough ribs and cut into bite-sized pieces.

3. Gently squeeze excess water from cucumbers and *Alaria*, and combine them with remaining ingredients. Eat as is or on a bed of lettuce garnished with radish slices and sprouts. Serves 3.

Maine Coast Sea Vegetables
Franklin, Maine

Pasta with *Alaria* and Maine Shrimp

1 pound penne (or tubular) pasta
dried *Alaria*
olive oil
½ pound Shitake mushrooms, sliced and stemmed
1 Tbls. leek, minced
¼ cup white wine
lemon juice
½ cup medium cream
Kelp/Cayenne Sea Seasonings (made by Maine Coast Sea Vegetables) or salt and cayenne pepper to taste
½ pound shrimp meat

1. Cook pasta in salted water. Drain and refresh in cold running water. Set aside.

2. Soak *Alaria*, remove the midrib, and cut into ½-inch sections across the blade.

3. Sauté *Alaria* in a little olive oil with mushrooms.

4. Add leek, white wine, and a few drops of lemon juice. Simmer to reduce the amount of liquid slightly.

5. Add cream and simmer until lightly thickened. Adjust seasoning with Kelp/Cayenne Sea Seasonings (or salt and cayenne pepper).

6. Add shrimp meat and simmer until shrimp is cooked. Add pasta, toss, and combine to heat.

Recipe from Sam Hayward
Provided by Maine Coast Sea Vegetables
Franklin, Maine

Edible Kelp Stew

1 cup washed, fresh *Alaria* (or ½ cup dried and reconstituted), cut across the fronds into 1-inch strips
2 Tbls. oil
2 medium onions, sliced
2 cloves garlic, minced
1 bay leaf
1 cup water
2 or 3 potatoes, washed and cut into chunks (skin on)
4 or 5 carrots, thickly sliced
1 small can tomatoes with juice or 3 fresh tomatoes, peeled
edible pod peas (or shelled peas)
parsley, several stalks
2 cups corn kernels (optional)
1 Tbls. ginger root, grated (optional)
½ tsp. oregano
salt and freshly ground pepper

1. Sauté strips of *Alaria*, onion, and garlic in the oil for 5 minutes, or until the onions are limp. Let stand to cool.

2. Add water and bay leaf. Boil gently for about 2 hours.

3. Add vegetables, additional spices, and water as needed. Simmer covered for ½ hour or until potatoes are done. Check seasonings and serve.

Raquel Boehmer, *A Foraging Vacation*
Monhegan Island, Maine

Nori (*Porphyra umbilicalis*)

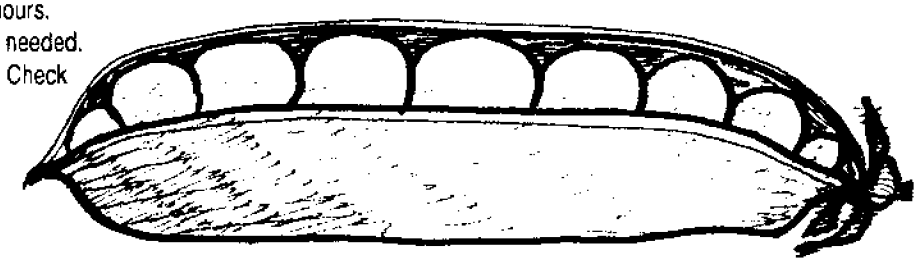
Helpful hints from Maine Coast Sea Vegetables

Before using, roast plants at 350° for 5 to 8 minutes or in a medium skillet until crisp, but not burned. These "chips" may be eaten as is, or crumbled over any grain dish, soup, or salad. Nori may be mixed into stir-fries and casseroles for delicate flavoring. Unroasted plants may be marinated in vinegar or lemon juice 12 to 24 hours to tenderize them. Marinated plants are great for salad and sandwiches.

Helpful Hints from Maine Seaweed Company

Roast unprocessed nori at 200° until crunchy. Eat it as a snack or crumble it into small flakes and use it as a condiment sprinkled over soups, grains, cooked vegetables, or salads.

Roasted nori may be pulverized in a flour mill or suribachi (blender). Add 15 parts roasted sesame seeds to 1 part roasted nori flakes, and lightly crush the seeds in a suribachi or blender so their oil surrounds the nori flakes.



Fried Rice with Wild Nori

1 tsp. sesame oil
1 cup onions, diced
½ cup carrots, cut into matchsticks
1 cup roasted nori (See "Helpful Hints" for roasting on page 24.)
½ cup celery, diced
3 Tbls. soy sauce
2 cups cooked brown rice
3 to 4 Tbls. water
2 Tbls. juice from freshly grated ginger
½ cup almonds, chopped and roasted

1. Sauté onions in oil for 5 to 7 minutes. Add carrots and crumbled nori and cook another 5 minutes.
2. Add celery and 2 tablespoons of the soy sauce and cook another 5 minutes.
3. Add brown rice, water, 1 tablespoon soy sauce, and ginger juice. Stir continuously for 2 to 3 minutes.
4. Add chopped almonds as garnish just before serving. Serves 3-4.

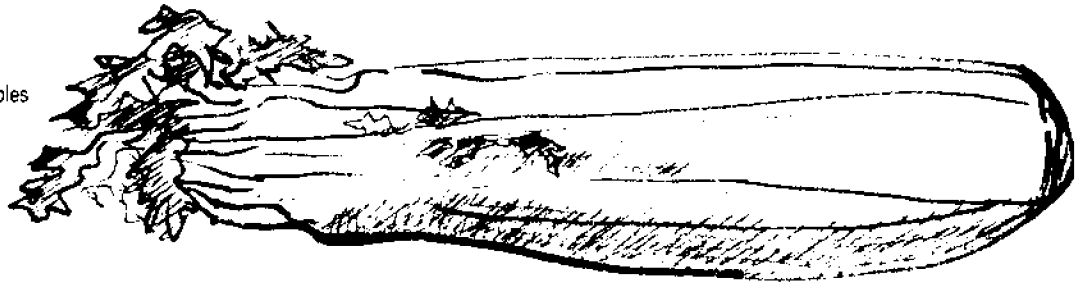
Recipe from Montse Bradford
Provided by Maine Coast Sea Vegetables
Franklin, Maine

Sesame Nori Salad Dressing

1 cup roasted nori (See "Helpful Hints" for roasting on page 24.)
3 Tbls. sesame seeds, roasted
4 Tbls. brown rice vinegar
1 cup water
½ tsp. soy sauce

1. Crumble roasted nori into roasted sesame seeds and coarse grind them together in a flour mill or suribachi (blender).
2. Combine nori/sesame mixture with other ingredients in bottle or jar. Shake vigorously.
3. Serve as a dressing on grain, noodle, or vegetable salads.

Maine Coast Sea Vegetables
Franklin, Maine



Apple/Tuna/Nori Salad

7-ounce can tuna
1 apple, grated
1 celery stalk, finely chopped
3 to 4 Tbls. mayonnaise
2 Tbls. lemon juice
1 Tbls. onion, minced
¼ tsp. dill
2 to 3 tsp. toasted nori to taste
apples
lettuce leaves and sprouts

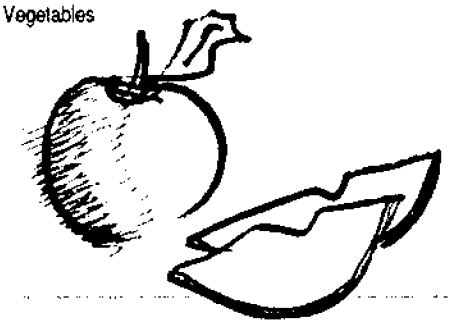
1. Drain tuna and place in bowl. Add apple, celery, mayonnaise, lemon juice, onion, and dill.

2. Add toasted nori.

3. Prepare thin slices of your favorite apple. Spread the apple/tuna/nori salad on the apple slices. (Note: You may want to spread the salad on radicchio leaves instead of apple slices.)

4. Serve on a bed of lettuce and sprouts.

Maine Coast Sea Vegetables
Franklin, Maine



Irish Moss (*Chondrus crispus*)

Gelled Tomato Salad

2 cups tomato juice, or 2½ cups canned or fresh tomatoes, mashed
1 cup fresh Irish moss, washed well in many changes of fresh water and soaked
1 bay leaf
1 cup celery, chopped
¼ cup green pepper, chopped
2 Tbls. onion, chopped
1 Tbls. lemon juice
1 tsp. grated lemon rind (opt.)
½ tsp. paprika
½ tsp. basil
salt and pepper to taste

1. Heat tomatoes or juice in a medium saucepan.

2. Place Irish moss and bay leaf in a large doubled square of cheesecloth. Tie up the corners and suspend this bag in the hot tomato mixture. Simmer gently, squeezing against the bag with a broad spoon and stirring the mixture often. This will cause the gelling properties of the Irish moss to blend with the hot liquid.

3. After ½ hour of simmering and squeezing, remove the bag. Squeeze as dry as possible and discard its contents.

4. Add the celery, green pepper, and onion. (Leftover cooked fish and other seafoods are wonderful additions, too.)

5. Add lemon juice, rind, spices, salt, and pepper. Pour the mixture in a dish and chill the salad a few hours, or until firm. This salad can be unmolded on a plate or scooped out of the dish. It is especially good when topped with some mayonnaise.

Raquel Boehmer, *A Foraging Vacation*
Monhegan Island, Maine

Basic Irish Moss Pudding (Blancmange)

½ cup fresh Irish moss, thoroughly washed
in several changes of fresh water
(or ¼ cup dried moss)
1 quart milk
½ cup honey or sugar
pinch of salt
1 tsp. vanilla (or almond extract)

1. After washing, soak the Irish moss in cold water—10 minutes for fresh and ½ hour for dried moss. Place Irish moss in a doubled cheesecloth square and bring ends up to form a bag.

2. Bring milk to a simmer and suspend bag in the milk. Continue to simmer the mixture for 30 minutes. Press against the bag with a broad spoon to help release the gelling agent.

3. Remove the bag, and add sweetener, salt, and flavoring. Pour into a bowl or a mold that has been dipped in cool water first. Chill until set.

Variations for Blancmange

Chocolate- or Carob-flavored Pudding

After the bag has been removed, add 2 tablespoons of pure cocoa or carob powder. Be sure to check for sweetness and add vanilla and salt. A pure chocolate candy bar can be broken up and added instead of the cocoa, but use less sweetener in that case.

Coffee-flavored Pudding

Add 1 to 2 teaspoons of instant coffee (to taste) or substitute 1 cup strong coffee for 1 cup of the milk in the basic Irish moss pudding recipe.

Apple Pudding

Add 1 to 1½ cups of chopped apple pieces and 1 tablespoon lemon juice to the basic Irish moss pudding mixture. Pour into a mold and cover with foil. This should have a few hours to set.

Raquel Boehmer, *A Foraging Vacation*
Monhegan Island, Maine

Stir-Fried Irish Moss

2 cups packed fresh Irish moss
½ cup olive or vegetable oil,
or a combination of both
2 onions, sliced
2 cloves garlic, minced
soy sauce (optional)

1. Wash Irish moss well in several changes of fresh water. Soak for ½ hour, swishing occasionally to loosen any sand. Drain, pat dry, and tear or cut it into small pieces.

2. Heat oil in a skillet and sauté onions and garlic until soft.

3. Add Irish moss and stir-fry for about 10 minutes, or until tender and soft.

4. Sprinkle with soy sauce if desired. (Note: For a crispier texture, cook longer—up to ½ hour.)

Raquel Boehmer, *A Foraging Vacation*
Monhegan Island, Maine

Dulse (*Palmaria palmata*)

Helpful Hints from Maine Coast Sea Vegetables

Dulse can be served as a chewy snack but must be kept slightly moist to prevent toughness. Rinse lightly to tenderize for salads and sandwiches. The more you soak it, the more tender it is, but also the more minerals are lost. Cooks very quickly (5 minutes) in juicy dishes such as soups, pastas, casseroles, and stir-fries.

Pan fry in medium skillet or roast at 250° until crisp, then crumble over pastas, pizza, soups, and salads.

Helpful Hints from Maine Seaweed Company

If your dulse is too hard and dry, you may soften it by exposing it to more humidity. Just open the bag and let it age.

Mediterranean Salad with Dulse

Dressing

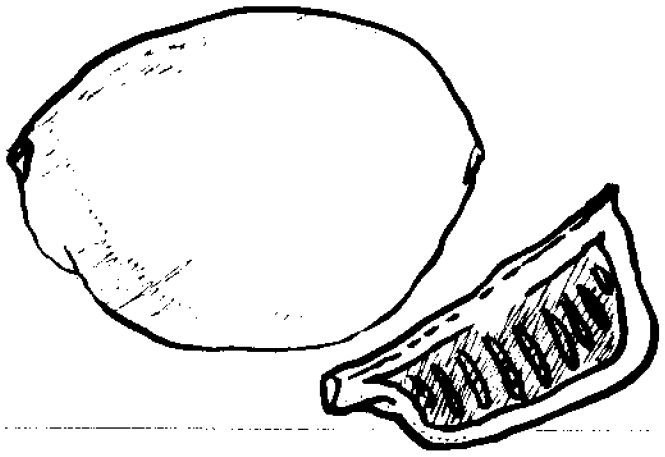
⅓ cup safflower oil
2 Tbls. olive oil
2 Tbls. vinegar
1 to 2 Tbls. lemon juice
½ tsp. each, oregano and cumin power
½ tsp. Kelp Granules or Kelp/Cayenne Sea Seasoning (made by Maine Coast Sea Vegetables) or salt and cayenne pepper to taste
Fresh black pepper to taste

Salad

3 to 4 citrus fruits, peeled and chunked
1 cup dried dulse, rinsed and drained
bed of salad greens
rings of raw purple onion, for garnish

1. Toss fruits with dulse and dressing. Marinate for 15 minutes.
2. Arrange on salad greens and top with onions. Serves 4.

Recipe from Sharon Rhoads, *Cooking With Sea Vegetables*
Provided by Maine Coast Sea Vegetables, Franklin, Maine



Spinach with Dulse

8 ounces spinach
1 small zucchini or summer squash, sliced
1 to 2 cloves garlic, diced
olive oil
¼ to ½ cup dried dulse, rinsed and cut into bite-sized pieces
basil, cumin, and cilantro
lemon

1. Steam spinach and zucchini or summer squash together.
2. Sauté garlic in olive oil for about 1 minute, adding pinches of basil, cumin, and cilantro.
3. Add the dulse and sauté 1 or 2 minutes more. Remove from heat and add the juice of ¼ to ½ lemon.
4. Pour over steamed spinach and zucchini. Serves 2.

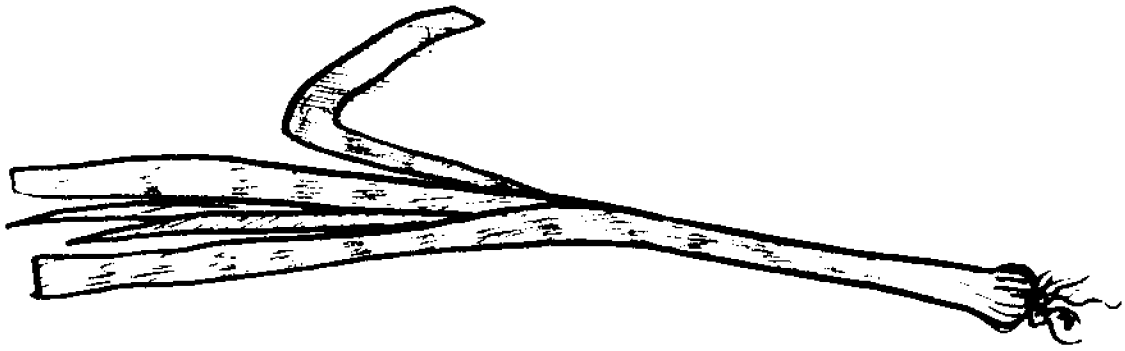
Maine Coast Sea Vegetables
Franklin, Maine

Zucchini-Dulse Julienne

4 small zucchini
½ cup dried dulse, diced
¼ cup olive oil
6 Tbls. red wine vinegar
½ tsp. Kelp Granules Sea Seasonings (made by Maine Coast Sea Vegetables) or salt to taste
1 scallion, chopped
1 tsp. each, oregano, basil, and parsley
1 clove garlic, crushed

Cut the zucchini into matchstick pieces, place in a bowl, and add all of the above ingredients. Toss lightly and chill.

Maine Coast Sea Vegetables
Franklin, Maine



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