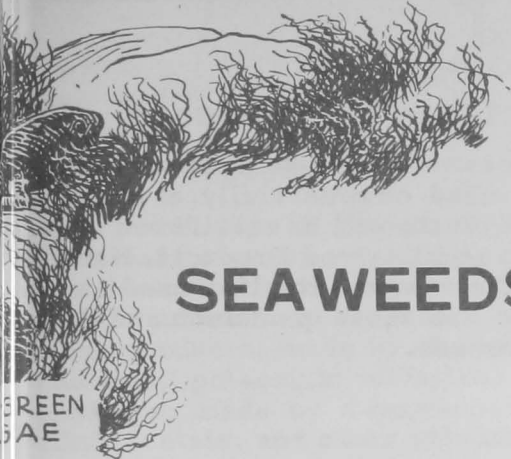


CONSERVATION NOTES

# SEAWEEDS are not weeds



IRISH MOSS



GREEN  
ALGAE

Seaweeds are not weeds but are very useful plants. Some are used as food--in natural form, dried, or ground. Others are subjected to chemical processes and the resulting products used in many articles of commerce, including food substances.

Seaweeds are a good source of vitamins--beta-carotene (which is converted to vitamin A by the body), thiamin, riboflavin, niacin, pantothenic acid, vitamin B-12, vitamin C, and vitamin D. They also contain all the mineral elements necessary to normal growth.

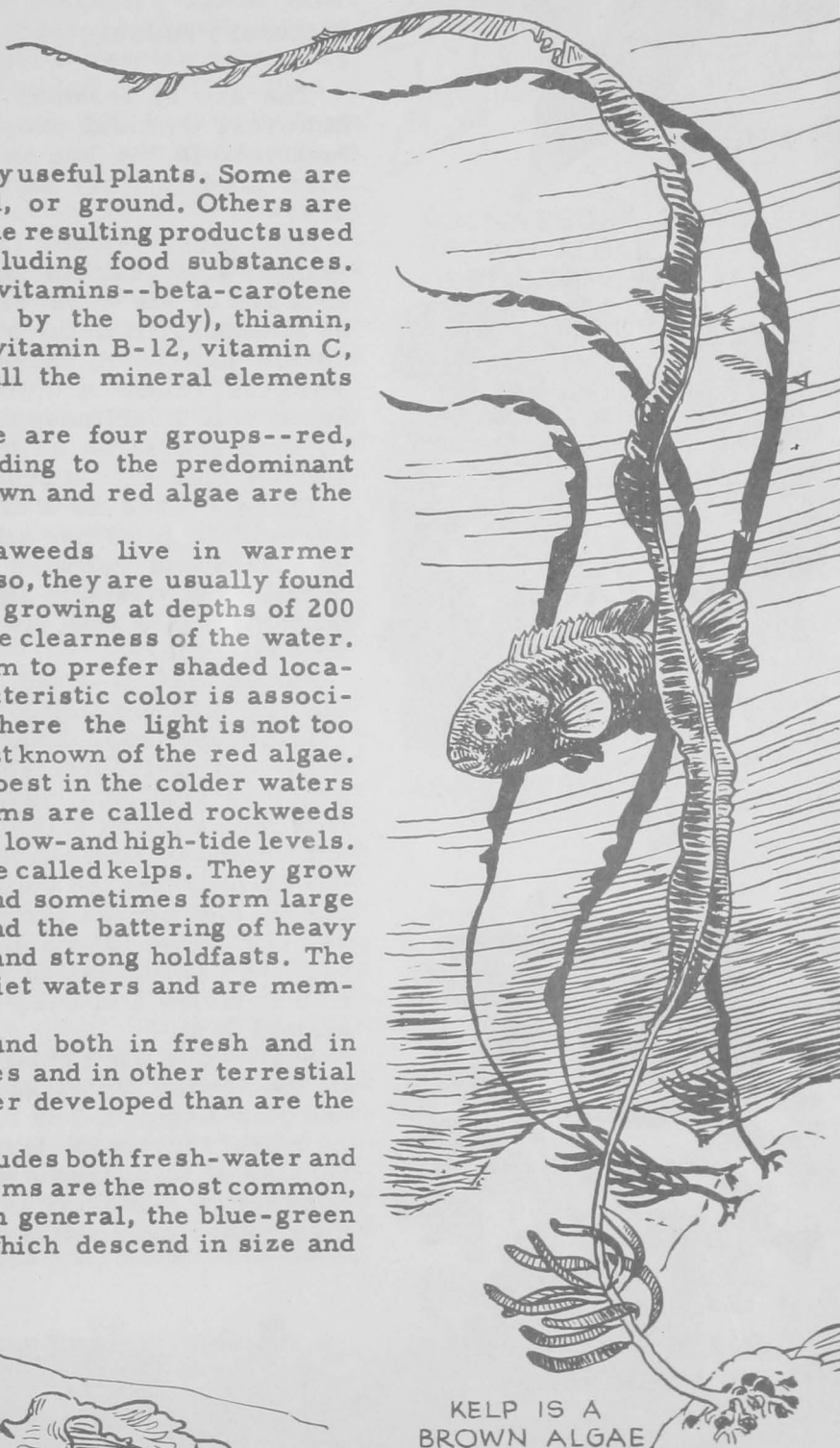
Seaweeds are marine algae. There are four groups--red, brown, green, and blue-green--according to the predominant color. Seaweeds belonging to the brown and red algae are the most important commercially.

*Red algae*.--In general, these seaweeds live in warmer waters than do the brown seaweeds. Also, they are usually found in deeper water, some of the forms growing at depths of 200 feet or more, the depth varying with the clearness of the water. Since most of the red seaweeds seem to prefer shaded locations, it is probable that their characteristic color is associated with their habit of growing where the light is not too intense. Irish moss is probably the best known of the red algae.

*Brown algae*.--These plants grow best in the colder waters of the oceans. Some of the larger forms are called rockweeds because they cover rocks between the low- and high-tide levels. Other of the large brown seaweeds are called kelps. They grow below or just at the low-tide levels and sometimes form large beds. The larger forms can withstand the battering of heavy surfs because of their firm texture and strong holdfasts. The smaller forms generally grow in quiet waters and are membranous or cordlike.

*Green algae*.--These algae are found both in fresh and in salt water. Some forms grow on trees and in other terrestrial locations. The marine forms are better developed than are the fresh-water forms.

*Blue-green algae*.--This group includes both fresh-water and salt-water plants. The fresh-water forms are the most common, often being found in stagnant water. In general, the blue-green algae are relatively small plants, which descend in size and complexity to unicellular organisms.



KELP IS A  
BROWN ALGAE



SEA LETTUCE:  
A GREEN ALGAE

## Commercial Importance of Seaweeds

Several thousand kinds of seaweeds have been identified but only about a dozen are being used commercially at present. The commercial value of these plants will be considered under the topics of Natural Products and Derived Products. Natural products are those in which the seaweed itself is used as the end product. Derived products are those manufactured from seaweeds by some chemical process.

### Natural Products

The use of seaweed as food in the United States is limited; however, Oriental people, especially the Japanese, use it extensively in the human diet. The principal species which have been used in their natural state for food in the United States are--

*Irish moss*.--Used in making desserts, especially blanc-mange; this practice has all but stopped in the United States because of the ease with which the same type of dessert can be obtained "from the store." Much of the commercial dessert comes not from seaweed but from the "derived products." However, there are those persons who still prefer to pluck some soft Irish moss from the sea, let the sun dry and bleach it; then add some of the dried moss to milk, flavor it, and in a short time have a puddinglike dessert.

*Dulse*.--Used as a thickener for soups, sauces, and gravies as well as in salads and relishes. The practice of using dulse in salads and relishes has also about stopped in this country because the vitamins and minerals that man absorbed from the dulse he mixed with his salads are available in other and more convenient forms.

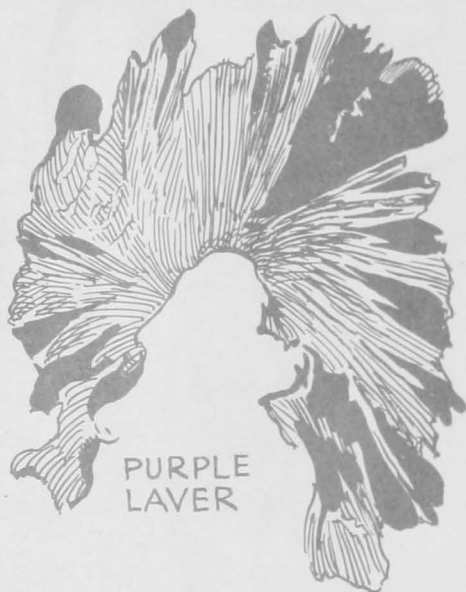
*Purple laver*.--Used by Chinese in the United States for making seaweed soup.

In Europe, considerable seaweed is used for animal food. On the coast of Ireland sheep are said to eat seaweed even when grass is available. Meal made from seaweed can be used in feed mixes but in many instances excess salt must be dissolved and removed. Cattle have a dislike for the odor of seaweed meal but caramelizing the sugar removes the odor. In the feed of pigs, sheep, and horses from 10 to 20 percent of the feed mixture can be seaweed meal. A small amount of seaweed meal is produced in the United States. It is combined with fish meal and fish solubles and used in conjunction with other material for animal feed.

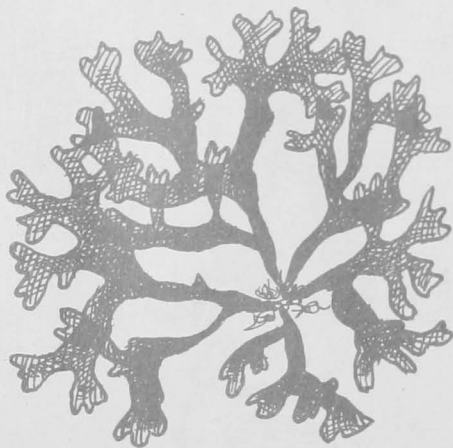
Seaweed is used extensively in Europe and Asia as fertilizer. In the United States such use is limited to areas in California and New England. For the most part, fertilizer can be obtained in more convenient form. As fertilizer, seaweed has the advantage of being free of weed seeds and spores of crop diseases. Seaweed is relatively low in nitrogen and phosphorus but has a high potassium content and contains numerous trace elements.



DULSE



PURPLE  
LAVER



INDIVIDUAL FRONDS  
OF IRISH MOSS



## Derived Products

In World War I, necessity forced us to seaweeds for products that normally would have been more available elsewhere. Ten factories were engaged in the manufacture of numerous products from kelp harvested off the California coast. Some of these products, made by charring the kelp, were iodine, sodium chloride, potassium chloride, and a bleaching agent; other products, made by a fermentation process, produced acetone, ethyl acetate, and other solvents. Should it become necessary, the United States could get an estimated 6 million tons of potassium chloride and 19,000 tons of iodine a year from Pacific kelps near the American coast. Potassium chloride is used in fertilizers.

One of the important products of seaweed today is mannitol, an alcohol which has many uses--in explosives, in foods, as dusting powder for chewing gum, coatings for fine paper and leather, shoe polish, and in some pharmaceutical products.

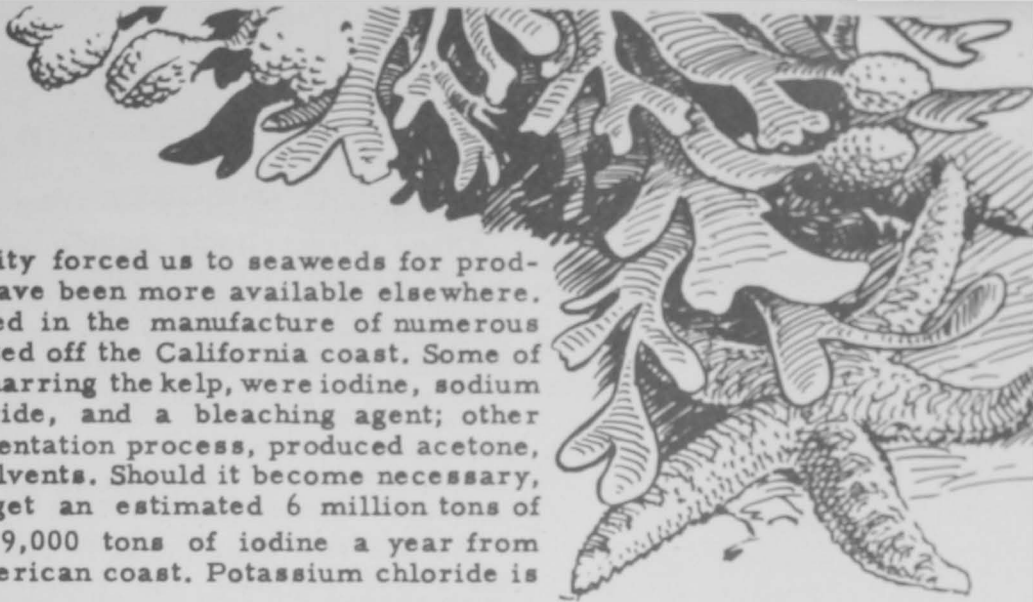
Another important base product is the colloid group, or the phycocolloids. A colloid is a glue-like or jelly-like substance similar in appearance to raw egg white. The word "phycocolloid" is derived from the Greek word "phykos", meaning seaweed. The phycocolloids are used in the development of many food and nonfood products. Since World War II, importance of the seaweed colloid industry has increased steadily.

Agar, algin, and carrageenin are important phycocolloid products. Agar and carrageenin are produced from red seaweeds; algin from the kelps, or big brown seaweeds. Carrageenin, obtained from Irish moss, is the thickening agent which "makes the pudding" when Irish moss is added to milk as previously explained.

Agar is used in canning jellied fowl, fish, and meat, for stabilizing sherbets and ices, in preparing cheeses and bakery products, and in making candy and preserves. It is a convenient jelling agent for home cooking. It is low in calories and since it is not derived from animal sources it is useful in diets limited by health or religious considerations. Agar is also used for bacteriological, medicinal, and dental purposes.

Algin is used in ice creams, dry ice cream mixes, chocolate milk, and in other dairy products; in puddings, fountain syrups, bakery icings, meringues, and candy. Its medical uses are in antacid tablets, calamine lotion, aspirin compound tablets, aureomycin tablets, and in numerous other compounds. It is used in the making of rubber, textile products, adhesives for wallboard, gummed tape, and decals; in the manufacture of various paper packages and acoustic tile; in paints, ceramic glazes, porcelain ware, leather finishes, auto polishes, welding-rod compounds, and beet sugar processing.

Carrageenin is used in stabilizing ice cream and whipped cream, in puddings, pie fillings, meringues, tooth pastes, hand lotions, cold-water paints, and various pharmaceutical items.



ROCKWEED, A SMALL BROWN ALGAE, IS OFTEN EXPOSED AT LOW TIDE

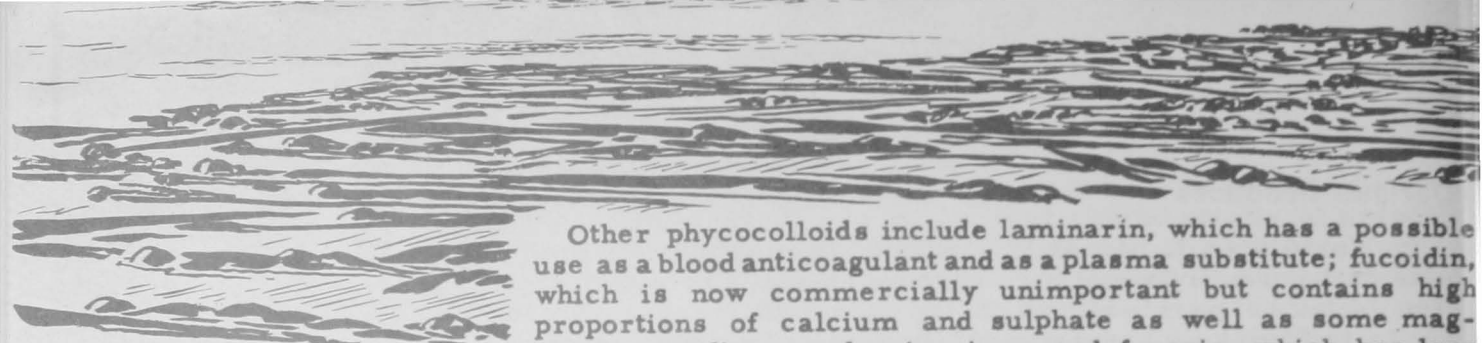


AGARWEED



AGARWEED DRYING ON WIRE FRAMES, AND ON THE GROUND





FRONDS OF BLADDER  
KELP FLOATING IN  
QUIET WATER

Other phycocolloids include laminarin, which has a possible use as a blood anticoagulant and as a plasma substitute; fucoidin, which is now commercially unimportant but contains high proportions of calcium and sulphate as well as some magnesium, sodium, and potassium; and funorin, which has long been used in the Orient for sizing textiles.

## Sources of Supply

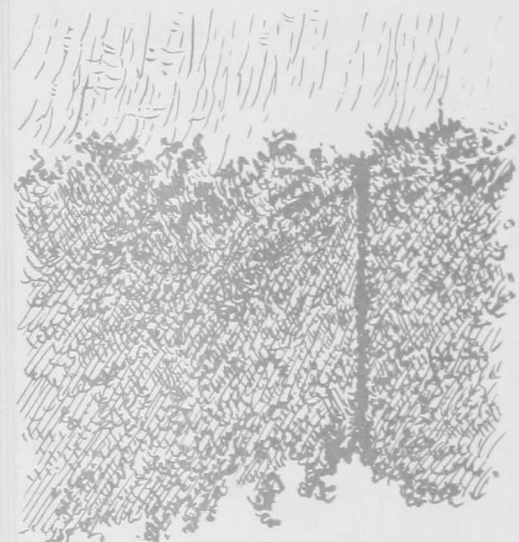
On our east coast, agar is obtained from red seaweed found off North Carolina and Florida. These seaweeds grow in shallow water and can be collected by raking them aboard a skiff.

There are big red seaweed producing areas in west coast waters off southern California and Lower California, where three forms occur: one red seaweed is found on rocks in fast-moving water; the other two species are found at depths of 80 feet, and are usually collected by skin divers or divers using diving suits.

Algin is extracted from the brown seaweeds. Most of the algin comes from the giant kelp found in beds off the Pacific coast from Lower California to Alaska and off the coast of Maine and Nova Scotia. The beds of giant kelp are of enormous size, some being as much as 2 square miles in extent. The kelp grows on rocky bottom outside the breaker area in water from 30 to 90 feet deep. Its attachment must be substantial enough to resist the pull of the floating leaflike bodies and buoyant air bladders.

Because of the habits of growth of the giant kelp, the harvesting can be done mechanically. A large mowing machine, with the cutting bar set about 4 feet below the surface of the water, is operated from the front end of a motor-driven barge. As the kelp is cut by the mowing machine, it is brought aboard the barge by means of a conveyor. As much as 300 tons of kelp can be harvested in a day in this manner.

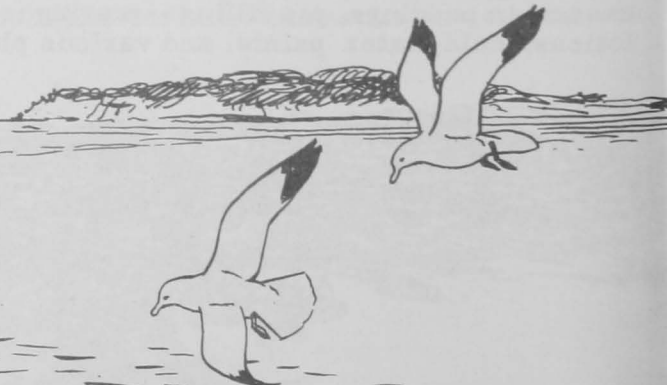
Harvesting along the California coast is done under the strict regulation of the California Fish and Game Commission, which governs the depth of cutting and other procedures. Only the mature beds of kelp are cut. The long fronds of the mature plants, if not harvested, would break loose from the parent plant and rot in the water or drift up on the beaches. Harvesting removes the dense mat of material on the surface, allowing light to reach the immature plants. Their growth is thus stimulated, and new fronds rapidly replace the harvested plants. Plants cut back in this way will grow new leafy stems 20 feet long within a few weeks. Thus, there is no danger of depletion.



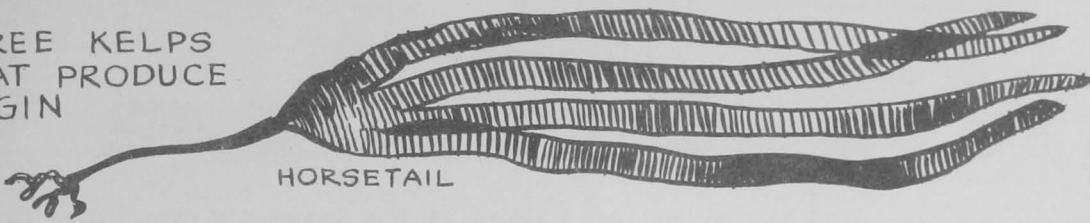
AERIAL VIEW OF  
CALIFORNIA KELP BED  
DARK LINE IS BOAT  
CHANNEL FROM THE PIER



KELP HARVESTING  
BARGE



## THREE KELPS THAT PRODUCE ALGIN



HORSETAIL



BROADTAIL



(FROND)

CALIFORNIA GIANT KELP



FISH,  
SHELLFISH,  
AND SEA  
MAMMALS  
ALL FIND  
SHELTER  
IN KELP BEDS

Carrageenin is produced from Irish moss, a red seaweed, which is obtained along the North Atlantic coast particularly from the western and central Maine coasts, Nova Scotia, and Prince Edward Island.

Irish moss is found growing from just above low-water level down to a depth of about 20 feet and is relatively easy to harvest. In some areas, it is often collected by the wagonload after it has been washed up on the shore during storms. Usually, however, it is picked by hand or raked. The rakes have close-set teeth and have handles from 15 to 20 feet long. An experienced man can obtain as much as 800 to 1,000 pounds on a tide. The plants are gathered in bags and sent to a central collection point for drying and baling.

## Problems of Harvesting

Although some seaweeds, such as the giant kelps, are easily harvested by mechanical means, many of the seaweeds must be collected by hand. Thus, the development of mechanical harvesters poses one of the fundamental problems of the seaweed industry. American producers are using mechanical harvesters with underwater cutters operated from power barges, but there is still need for more economical methods.

The Scottish workers have given much study to the development of a high-capacity mechanical harvester. One piece of equipment on which they have worked consists essentially of two side chains with steel mesh stretched between them to form a continuous belt. Short hooks are mounted at suitable intervals. The purposes of the steel mesh are (1) to compact the seaweed in front of the hooks and (2) to cause the trailing end of the gear to ride on the surface of the weed bed and thus prevent the hooks from fouling. The downward thrust of the trailing end on the seabed is reduced by means of floats. To prevent anchoring of the hooks or chains on obstructions on the seabed, the operators run the belt in the reverse direction to the travel of the boat.

## Monetary Values

The value of seaweed varies considerably, depending upon the chemical composition as shown by chemical analyses. Some seaweeds sell for \$350 a ton. Agar sells for \$3.50 to \$4.00 a pound, algin and carrageenin sell for \$1 to \$1.75 per pound. These prices change from time to time.

The seaweed-processing industry is not large, by American standards. The value of its products has jumped from \$2 million a year in 1945 to more than \$10 million in 1960 and is expected to reach \$20 million in a few years.



SEA  
TTER

## Scientific Names

For those interested in the scientific names of the seaweeds mentioned in this article, the following information is added.

The scientific names for the four groups of algae to which seaweeds belong:

Blue-green algae--Cyanophyceae

Green algae--Chlorophyceae

Brown algae--Phaeophyceae

Red algae--Rhodophyceae

Species sometimes used in natural form for human food:

Irish moss--*Chondrus crispus*

Dulse--*Rhodomenia palmata*

Purple laver--*Porphyra perforata*

Red seaweed found off North Carolina and Florida:

*Gracilaria confervoides*

*Gracilaria foliifera*

*Hypnea musciformis*

Red seaweed found off southern California and Lower California:

*Gelidium cartilagineum*

*Gelidium arborescens*

*Gelidium nudifrons*

Brown seaweed found off California coast:

Giant kelp--*Macrocystis pyrifera*

Brown seaweed found in North Atlantic:

Broadleaf kelp--*Laminaria saccharina*

Horsetail kelp--*Laminaria digitata*

For more complete information on seaweeds write to the Fish and Wildlife Service, Department of the Interior, Washington 25, D. C. Seaweeds and Their Uses, Fishery Leaflet 469, and any other available information will be sent to you.

Prepared in Office of Information, Fish and Wildlife Service  
United States Department of the Interior, Washington 25, D. C.

Circular 130, January 1962.

GPO 221630



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE  
WASHINGTON 25, D. C.  
OFFICIAL BUSINESS

POSTAGE AND FEES PAID  
U.S. DEPARTMENT OF THE INTERIOR