# Marine Plants:

# Commercial Opportunities in Alaska

Department of Commerce, Community and Economic Development

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## Alaska's Marine Plant Resources

There are many marine plants growing naturally in Alaska's coastal waters that can potentially be harvested in the wild or cultured on farms, and have potential to be developed as a high value product. Among these are seaweeds such as Macrocystis (giant kelp), Nereocystis (bull kelp) and Porphyra (nori). Alaska scientists have developed procedures for the successful mariculture of Macrocystis which has economic implications for the Alaska roe-on-kelp fishery.[1] Bull kelp is very similar to wakame (*Undaria pinnatifida*) used in traditional Asian cooking and may have potential as a culinary substitute. These same scientists have researched the methodology for the successful mariculture of Porphyra, marketed as nori for sushi, and harvested as black seaweed by Alaska's Native community.[2] Potential commercial development of this seaweed is excellent, however very little biological and economic research has been done to bring this resource to commercial levels.

More needs to be learned about the number, quantity, and types of marine plants in Alaska. Stock assessment work has focused mainly on Macrocystis, Nereocystis and Porphyra because of their present value in the marine plant marketplace. Much of what is currently known about marine plant biomass in Alaska is based on 100 year old surveys or site specific survey work undertaken in only a few areas of state coastal waters. For example, after a 1913 survey estimated approximately 45,000 acres of kelp in southeast Alaska, the next comprehensive survey to examine kelp bed area occurred in 1999 at Prince of Wales Island where 8,800 acres were identified. [3]

## Commercial Marine Plant Management in Alaska

Alaska's commercial fisheries regulatory jurisdiction extends three miles offshore. The Alaska Department of Fish & Game manages and regulates commercial use of aquatic plants through a process known as a "Commissioner's permit." Specifics of the marine / aquatic plant regulation permit are covered under Chapter 37 of the Alaska Administrative Code including: harvest provisions, seasons, harvest requirements, restrictions, and definitions. For example, Article 1 Harvest Provisions, 5 AAC 37.100.Permits (a) states:

> A processor, buyer, harvester of aquatic plants, aquatic plant farmer operating under a permit authorized by AS 16.40.100, or a person intending to collect and supply wild stock to such an aquatic farm must obtain a permit issued by the commissioner, or the commissioner's authorized representative, before operating.

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[1] Michael S. Stekoll & Page V. Else. *Cultivation of Macrocystis in southeastern Alaska waters. 1990*. Also by the same authors see: *The Feasibility of Macrocystis Mariculture in Southeast Alaska. 1992.*

[2] Michael S. Stekoll. *Porphyra cultivation in Alaska: growth of three indigenous species*. Also see: *Marine Plant mariculture in Alaska: Status and Research. 1999.*

[3] RIR No. 1J99-24: *Assessment of Macrocystis Biomass, Quality, and Harvesting Effects in Relation to Herring Roe-on-Kelp Fisheries in Alaska. 1999*

Under the Commissioner's permit process, an applicant intending to commercially harvest wild seaweed applies to an area biologist located in a coastal area where the marine plant harvest will occur. The applicant will work within the conservative guideline harvest levels described in the permit. Data obtained this way contributes to the management strategy followed by the applicant since no commercial management plans exist for wild marine plants. For applicants intending to farm marine plants there is a comprehensive land lease system and permit process available.[4]

**Marine Plants Market Value**

Coastal aboriginal people have for centuries included certain types of seaweeds in their traditional diets. Consumed from both wild and intensively farmed mariculture production sources, sea vegetables as they are known, are considered a delicacy from Alaska to Japan, China, the Republic of Korea, Malaysia and India. Increasingly, seafood consumers in such places as France, the United Kingdom, Canada, and the United States are developing a taste for sea vegetables for their unique appearance in special seafood dishes and as a natural or organically grown food originating from clean water sources around the world's oceans.

Total annual seaweed production is approximately 16 million metric tons wet weight with 90 percent of this supplied from nearshore mariculture operations, the rest from wild sources.[5] The marine plant industry consists of four main sectors: (1) food for human consumption; (2) phycocolloid; (3) phycosuppliment, and (4) botanical, nutraceutical, pharmaceutical and cosmetic.

Marine plants for human consumption as sea vegetables comprise a much greater amount of the marine plant industry both in terms of volume and value at 8.6 tons (76 percent) and US $5.3 billion (88 percent) respectively.[6] Three types of marine plants dominate the edible sea vegetable markets: Laminaria ("kombo"), Porphyra ("nori"), and Undaria ("wakame"). Within the phycocolloid sector, manufacturing of emulsifying, binding, thickening, gelling and clarifying agents such as carrageenans, alginates and agars occurs. As a percent of the total marine plant industry, current figures place the phycocolloid sector's value at ten percent (US $650 million), and 11 percent of volume (1.3 million wet tons) respectively. The so-called phycosuppliment sector is estimated at 1.2 million wet tons worth US $53 million worldwide. These products are used in agricultural applications such as feed and fertilizer. Finally, perhaps the fastest growing use of marine based plant materials is occurring in the botanical, nutraceutical, pharmaceutical and cosmetic sector. Current estimates place this sector's value at around US $ 3.5 million consuming some 3,000 wet tons of materials annually.

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[4] http://www.cf.adfg.state.ak.us/geninfo/enhance/maricult/maricult.php

[5] Roesijadi, G, A.E. Copping et al. Pacific NW National Laboratory. Techno-economic Feasibility Analysis of Offshore Seaweed Farming for Bioenergy and Biobased Products. March 2008.

[6] Chopin T, Sawhney M (2008) Seaweeds and their mariculture. In: Steele JH, Thorpe SA, Turekian KK (eds). The Encyclopedia of Ocean Sciences, Elsevier, Oxford.

## Supply

Wild seaweed harvest is about two million metric tons of wet weight. Farmed seaweeds represent about half of the biomass of the global mariculture industry (which would also include all finfish and bivalve production) and a quarter of the total value. Marine plant aquaculture production doubled between 1996 and 2004 and the Food Agriculture Organization of the United Nations estimates its volume at around 11.3 million wet tons. Industry analysts place the current world value of total marine plant aquaculture production at US $ 5.7 billion with 99.7 percent of the value originating in Asian countries.[7]

Large cultivation bay in north-east China of *Saccharina japonica* (formerly *Laminaria japonica)*

Globally, brown seaweeds comprise 63.8 percent of total commercial production. Red and green seaweeds account for the remaining 36 percent, and 0.2 percent respectively. Of the nearly 230 species of cultivated seaweeds, six genera supply approximately 95 percent of total global seaweed aquaculture production, and four comprise 96 percent of its value.[8]

[7] Ditto

[8] FAO. The six types include: Laminaria (40 percent); Undaria (22 percent); Porphyra (12 percent); Eucheuma (112 percent) and Gracilaria (eight percent) supplying volume. The four genera accounting for the most value include: Laminaria (48 percent); Porphyra (23 percent); Undaria (18 percent) and Gracilaria (seven percent). Note: No single source reports worldwide harvest and culturing of seaweeds. Industry estimates are collected from global aquaculture yields, and analysts then assign conversion ratios for biomass and weight.

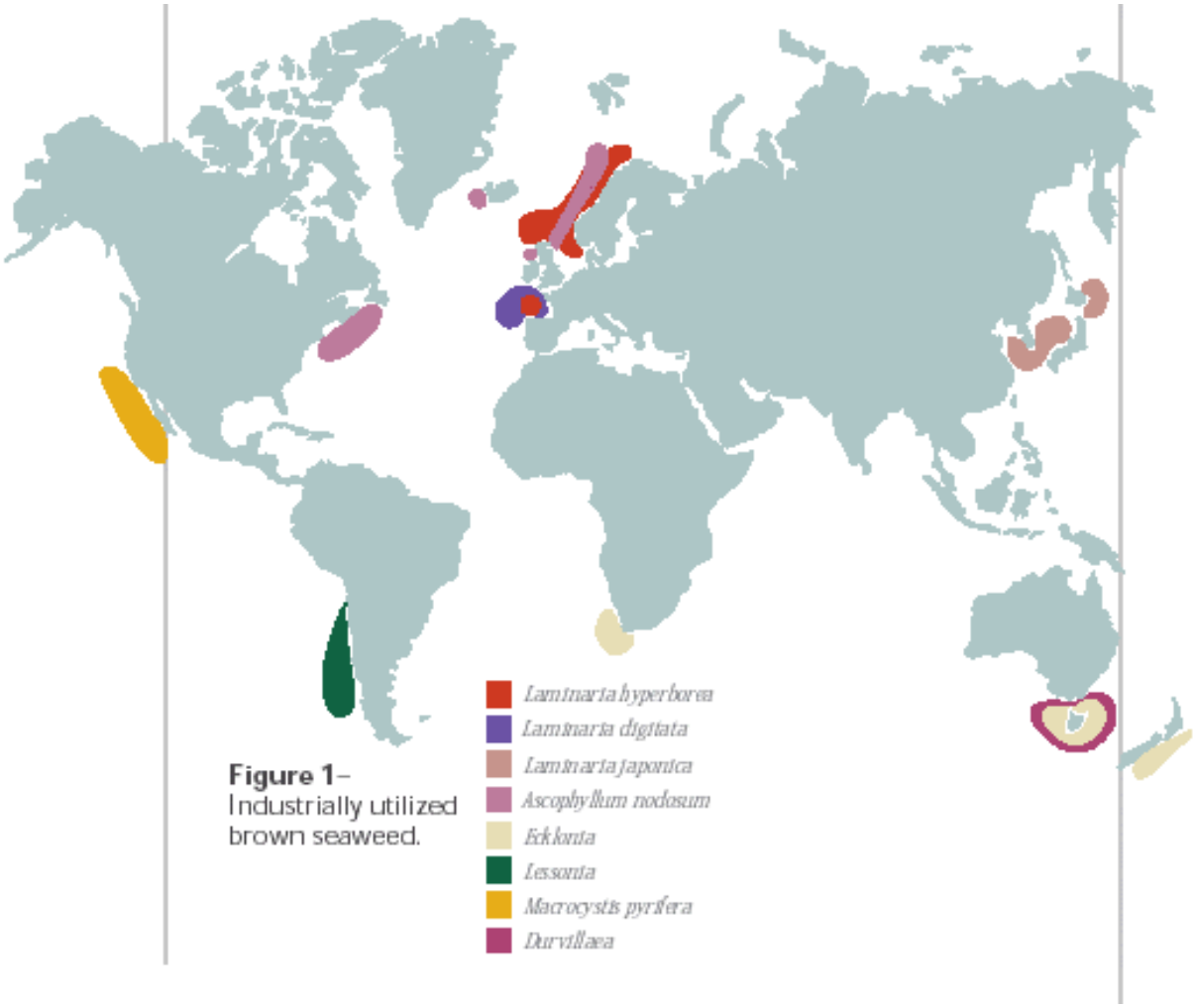


**Figure 1**– Industrially utilized brown seaweed.

**Source:** FMC BioPolymer (http://www.fmcbiopolymer.com/Food/Ingredients/AlginatesPGA/Origins.aspx)

World aquatic plant production in 2004 reached 13.9 million tons (US$6.8 billion), of which 10.7 million tons (US$5.1 billion) originated from China, 1.2 million tons from the Philippines, 0.55 million tons from the republic of Korea and 0.48 million tons from Japan. Japanese kelp (*Laminaria japonica* – 4.5 million tons) showed the highest production followed by Wakame (*Undaria pinnatifida* – 2.5 million tons) and Nori (*Porphya tenera* – 1.3 million tons). An additional 2.6 million tons were reported by countries as "aquatic plants" and not further specified. The production of aquatic plants increased rapidly from the 2002 total of 11.6 million tons, primarily as a result of large production increases in China.[9]

[9] FAO State of World Fisheries and Aquaculture, 2006.

## Commercial Marine Plant Harvesting in Alaska

Harvesting of wild Macrocystis or giant kelp in Alaska has been ongoing for many years to support the roe-on-kelp commercial herring fishery. Two key elements are required by management biologist to sustainably manage kelp harvests in Alaska: the amount of kelp available and needed for the harvest; and the effects of harvesting on kelp beds and nearby marine communities. Unfortunately, due to limited funding to conduct basic scientific research and more pressing department priorities, kelp harvests in Alaska are currently being managed conservatively do to incomplete knowledge of the biomass, growth, and recruitment data required to expand economic development. The total annual amount of wild kelp commercially collected is less than 100 tons or about 0.1 percent of the wild kelp biomass off the waters of Sitka alone. Since the early 1990's a mid-size private commercial wild kelp harvester has been operating in Southeast Alaska waters. Based in the State of Washington, the Alaska Kelp Company harvests wild bull kelp (Nereocystis) for use as a plant fertilizer supplement used in home gardens and large scale commercial agriculture operations alike.

A small amount of marine plants are currently harvested in state mariculture operations that focus primarily on oysters or geoducks. Aquatic farmers in Southcentral Alaska have approval to take various species of aquatic plants off their culture gear only and sell it. Due to the scale of the operations and number of businesses involved, harvest values /volumes are confidential.

## Commercial Marine Plant Opportunities in Alaska

Marine Plants as Human Food

According to FAO analysts, traditional sea vegetable markets found in Japan, Republic of Korea, and China appear to be at capacity. In fact, these nations are searching out new markets in places like the EU and U.S in order to export their oversupply of available sea vegetable products. Technology in these countries aimed at reducing harvesting costs as well as environmental and social issues associated with harvesting wild supplies is being used to cultivate wild species of seaweeds. For Alaska, innovation, and identifying high end niche markets could lead to success for potential businesses instead of trying to compete with the larger international suppliers of markets for nori, kombu, and wakame products.

Industrial Applications of Seaweeds

Industrial application methods reduce specific types of seaweeds into three categories of products: Agar, alginates, and carrageenans. Each form possesses its own production methods and specific applications over a broad spectrum of uses. For example, agar is used as a food additive and helps to improve the quality, texture, and stability of a food product, but its use as medium in the bacteriological/scientific field is even greater than its use as a food additive. Alginates and carrageenans excel as food additives (sauces, syrups and toppings) or in textile printing (ink thickeners). In the near term, annual growth is expected to be around two percent with the greatest profitability potential found in the pharmaceutical and medical applications.


Additional commercial uses of seaweeds in fertilizers, animal feeds, cosmetics, and water treatment while small in comparison to the aforementioned uses, represents the fastest growing commercial market.

**Summary**

Research undertaken in West Coast states and British Columbia suggests the best entry level markets for high quality seaweeds are in North America food markets.[10] These markets could be targeted by future Alaska marine plant businesses selling high-value specialty products. Long term, the experiences gained in domestic markets could then be directed at niche Asian marine plant markets.

Alaska has an excellent reputation as a source of high quality, sustainable seafood with outstanding brand recognition. Building on this international brand, economic opportunities in specialty food markets for Alaska sea vegetables and fertilizer concentrates holds the highest potential for success among entrepreneurs and coastal communities alike. However, before scaled up operations occur, state resource agencies still need to learn more about the number, quantity, and types of commercial marine plants in Alaska, establish total allowable harvest limits for sustainable wild seaweeds, and help to identify financing opportunities to assist an emerging wild aquatic plant and mariculture industry.

[10] Marine Plant Management and Opportunities in British Columbia, 2000.

ELECTRONIC RESOURCES

ALGAEBASE (www.algaebase.org)

SEAWEED AFRICA (www.seaweedafrica.org)

SEAWEED SITE (www.seaweed.ie)

MARINALG (www.marinalg.com)