



STATE *of the* STATES

Status of U.S. Seaweed Aquaculture

Compiled and updated by the following Sea Grant programs: Alaska, California, Connecticut, Hawai'i, Maine, New Hampshire, New York, Oregon, Rhode Island, Washington, Woods Hole (Massachusetts)

Presented at the 2023 National Seaweed Symposium by Jaclyn Robidoux (Maine Sea Grant) & Melissa Good (Alaska Sea Grant)
Updated in December 2023



STATE OF THE STATES OVERVIEW



- **Farms & Landings**
- **Permitting & Regulations**
 - Only the *lead regulatory agency* for permitting is listed for in each state. Operations will need to obtain multiple permits and authorizations to get their farms up and running.
- **Post-Harvest**

EAST COAST

Maine

New Hampshire

Massachusetts

Rhode Island

Connecticut

New York

WEST COAST

Alaska

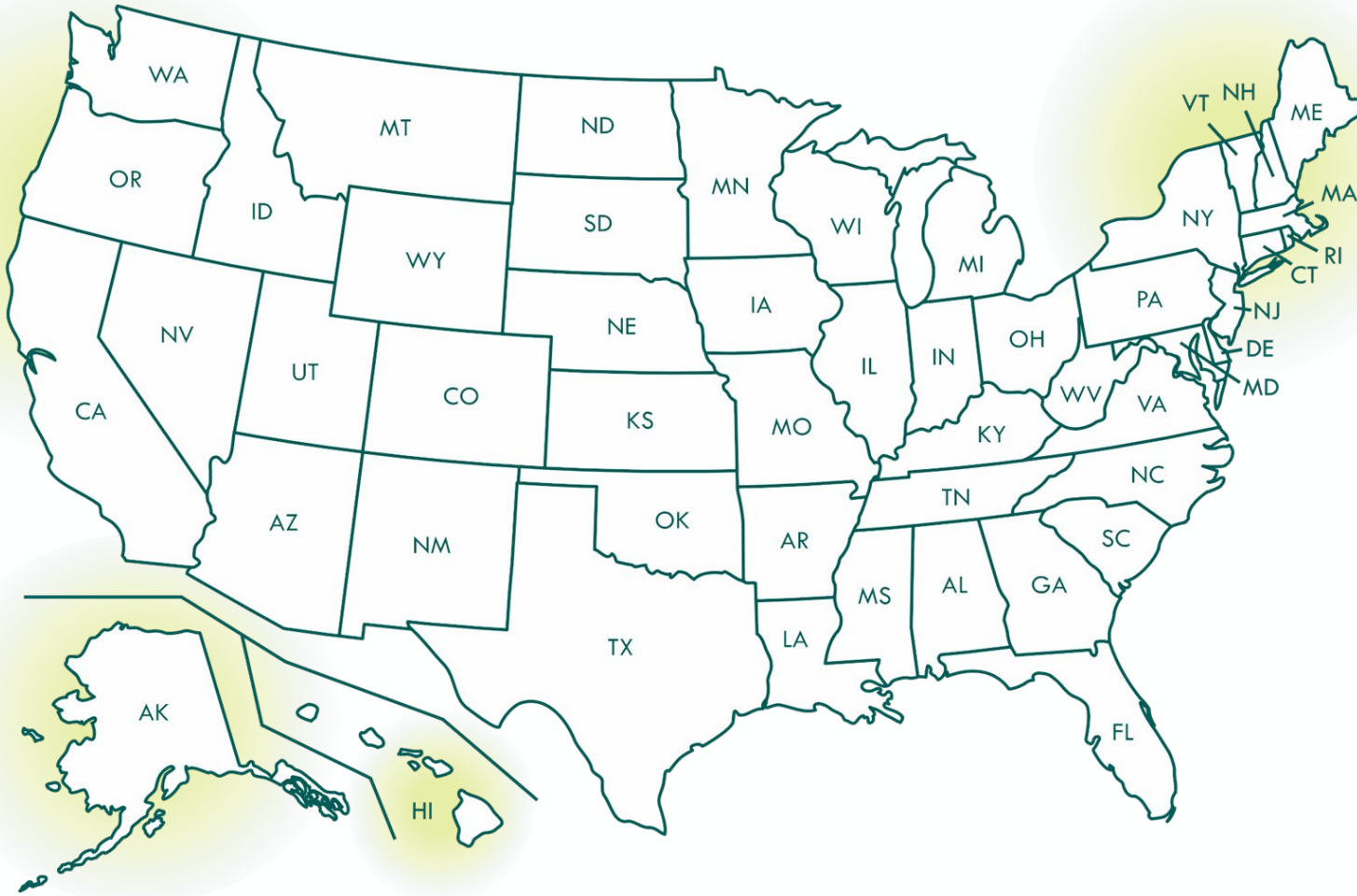
Washington

Oregon

California

Hawai'i

SEAWEED FARMING IN THE UNITED STATES



- A young industry emerging over the last decade
- Currently producing cold-water kelps and tank-cultured red algae
- Production primarily occurring in the Northeast and Northwest, as well as Hawai'i.
- For most operations - small scale with limited, seasonal production (winter)
- Largely reliant on pre-existing working waterfront/fisheries infrastructure
- Current markets are primarily human consumption/food
- Projected to grow alongside significant research and development efforts

SEAWEED FARMING IN THE UNITED STATES

Source: National Sea Grant Seaweed Hub State of the States Report, 2023

Region	East Coast						West Coast				
State	ME	NH	MA	RI	CT	NY	AK	WA	OR	CA	HI
Landings, wet pounds	1,000,000+ (2022)	N/A	9,500 (2022)	14,500 (2022)	3,800 (2022)	N/A	871,000+ (2022)	10,000 (2022)	N/A	N/A	250,000+ (2022)
Landings, wet MT	454+	N/A	4.3	6.6	1.7	N/A	395+	4.5	N/A	N/A	113+
Number of ocean farms and use	40+ active commercial farms (100+ permitted sites)	5 (2 active, 2 research)	5 commercial farms	10 farms (3 active)	15 farms (10 active in 2022)	1 permitted farm as of 2023	50 permitted farm sites (30 active)	3 farms (ocean and land-based farms)	3 land-based farms	4 farms (ocean and land-based farms)	7 farms (all tank cultivation)

EAST COAST



Maine

New Hampshire

Massachusetts

Rhode Island

Connecticut

New York

ME

NH

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MAINE

FARMS & LANDINGS

40+

Active commercial farms, with over 100 sites permitted to grow seaweed or seaweed alongside shellfish.

1,000,000+ lbs harvested in 2022

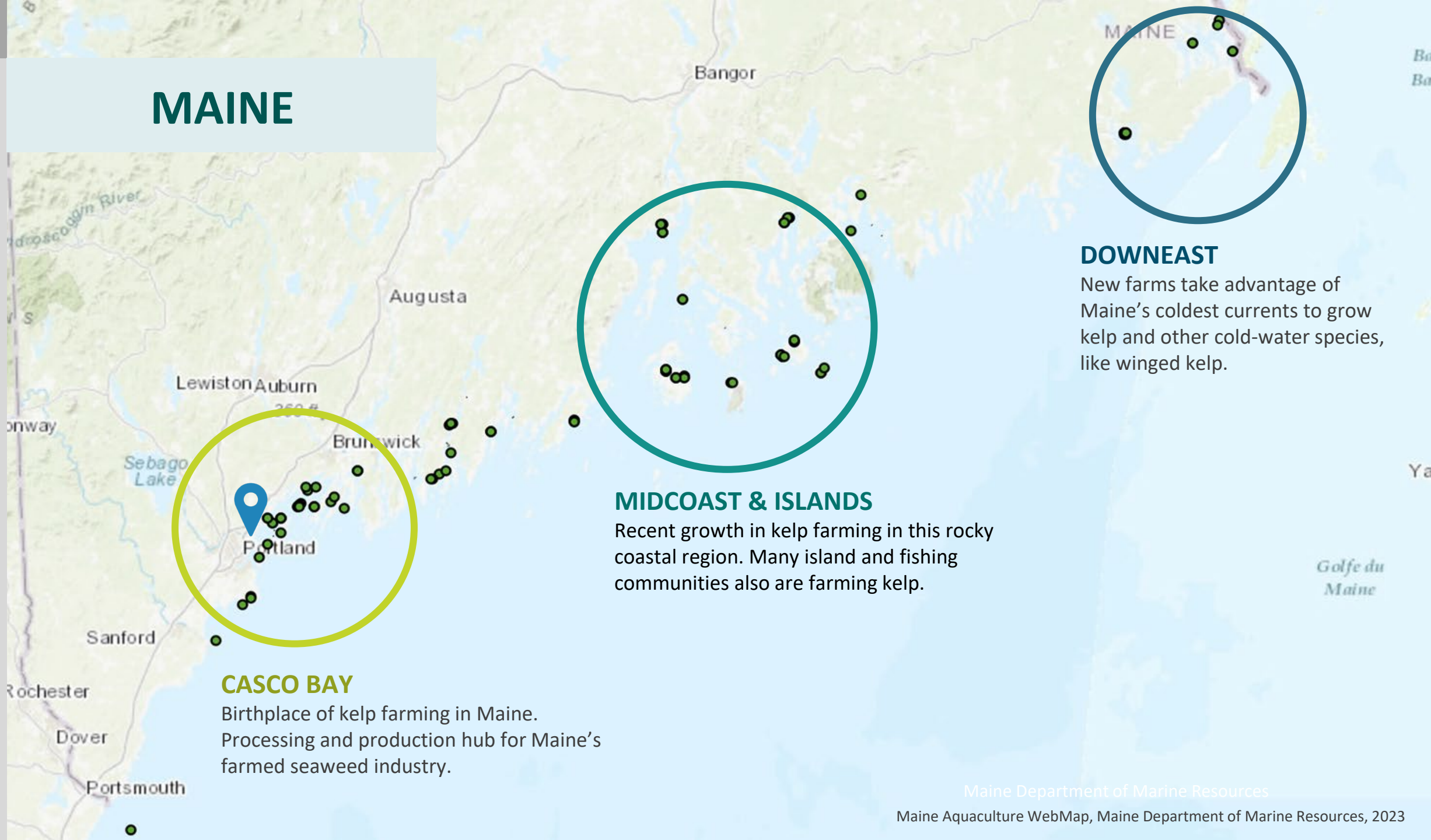
2023 landings expected to be over 1.2 million lbs. Landings reported through the state.

4 commercial seaweed nurseries with capacity to produce tens of thousands of seed spools.

Primary species under cultivation: **Sugar Kelp** (*Saccharina latissima*), **Skinny Kelp** (*Saccharina angustissima*), **Winged Kelp** (*Alaria esculenta*).

Maine also has a wild harvest seaweed industry, which landed approx. 15 million lbs in 2022 (mostly rockweed).

MAINE



CASCO BAY

Birthplace of kelp farming in Maine. Processing and production hub for Maine's farmed seaweed industry.

MIDCOAST & ISLANDS

Recent growth in kelp farming in this rocky coastal region. Many island and fishing communities also are farming kelp.

DOWNEAST

New farms take advantage of Maine's coldest currents to grow kelp and other cold-water species, like winged kelp.

MAINE

PERMITTING & REGULATIONS



Lead Agency:

Maine Department of Marine Resources (DMR)

<https://www.maine.gov/dmr/aquaculture/>

Maine DMR issues licenses and leases for conducting shellfish, seaweed, and finfish aquaculture.

- Licenses may have a lower barrier to entry but are limited in size (400 sq. ft.) and need to be renewed annually. \$100-\$400/year.
- Leases are larger sites and are granted for up to 20 years. Farms can be up to 100 acres. For seaweed, leases will have application fees (\$100 or \$1500) and annual rent (\$100/year/acre)

Seaweed cultivated in Maine must be sourced from/native to Maine waters.

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MAINE

POST HARVEST

The primary market for Maine seaweed is **value-added, consumer packaged goods and food products.**

Maine has both first-stage processing (ex. drying, blanching, freezing, etc.) and second- stage processing (creation of consumer-ready products)

Increases in processor-farming contracting, processing capacity, product development, distribution, and marketing have allowed for stabilization and growth in Maine’s kelp farming industry.

Examples of products produced in Maine include seaweed salads, kimchi, teas, smoothie cubes, snack bars, beverages, and spice blends, as well as dried whole leaf, flakes, powders.

NEW HAMPSHIRE

IMTA Site- Integrated Multi-Trophic Aquaculture

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NEW HAMPSHIRE

FARMS & LANDINGS

5 Commercial Farms.

2 commercial farms (UNH) deployed and sold sugar kelp
3 commercial farms that did not deploy

2 Experimental Farms.

These farms are submerged longlines, with 3 lines per farm.
One farm is located 9 miles offshore as part of a project funded by the **Department of Energy**

Primary species under cultivation: **Sugar Kelp**
(*Saccharina latissima*)

Landing not reported and there is no wild harvest industry.

NEW HAMPSHIRE

PERMITTING & REGULATIONS



Lead Agency:

New Hampshire Fish and Game (F&G)

<https://www.wildlife.state.nh.us/>

New Hampshire F&G issues leases for shellfish, seaweed, and finfish aquaculture.

- The fee for conducting aquaculture in NH is \$500/submerged acre/year.
- Size of seaweed leases: No minimum size limit on leases for seaweed

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NEW HAMPSHIRE

POST HARVEST

The primary market for New Hampshire seaweed is **culinary uses and food products.**

Seaweed is sold to local restaurants and breweries as well as processors in Maine.

Seaweed is seasonally available in fresh/raw forms.

Examples of products produced include kelp beer and fresh kelp in restaurant dishes, as well as value-added products produced in Maine.

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MASSACHUSETTS



Photo credit: Martino Seafood



Photo credit: Chatham Kelp & Edible Cape Cod

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MASSACHUSETTS

FARMS & LANDINGS

5 Commercial Farms

Two of these farms are standalone kelp farms and three farms are within an existing shellfish farm. These are all commercial sites.

< 10,000 lbs

Harvested in 2022 for both human consumption and use in fertilizer products.

Official landings are not reported (farmer reported)

Primary species under cultivation:

Sugar Kelp (*Saccharina latissima*)

There is no commercial wild harvest industry, though there was historically.

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MASSACHUSETTS

PERMITTING & REGULATIONS



Lead Agency:

Massachusetts Division of Marine Fisheries (DMF)

<https://www.mass.gov/service-details/aquaculture>

Massachusetts DMF works directly with the municipalities and issues a Class 4, Type 2 Commercial Aquaculture Permit for seaweed. ACOE is lead agency at federal level.

Largest site permitted currently is 27 acres.

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MASSACHUSETTS

POST HARVEST

The primary market for Massachusetts seaweed is
Food products, and fertilizers

Seaweed is sold: raw and fresh. Though has been dried and examined for use in food additives and skin care products.

In Massachusetts, sugar kelp must be sold directly to a wholesale seafood dealer to be a food product per Department of Public Health (DPH) food protection and DMF regulations.

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Juvenile Kelp

Photo: Humphries, 2017 / University of Rhode Island

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RHODE ISLAND

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FARMS & LANDINGS

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10 Permitted Farms

10 farms are permitted in Rhode Island, but only 3 are growing kelp this year.

2 new permits currently under review.

14,500 lbs

Sugar kelp landings for 2022

Official landings are not reported (farmer reported)

Primary species under cultivation:

Sugar Kelp (*Saccharina latissima*)

There is no commercial wild harvest industry.

Seed source: self-propagated, private supplier, and university

RHODE ISLAND

PERMITTING & REGULATIONS



Lead Regulator:

Rhode Island Coastal Resources Management Council (CRMC)

<http://www.crmc.ri.gov/aquaculture.html>

Rhode Island CRMC issues shellfish and seaweed leases on state submerged land.

- Leases can be for 15 years, with yearly lease fees.

Due to growth in shellfish aquaculture, the state caps the acreage of aquaculture activities in coastal ponds at 5% of the total open water surface area.

Size of permitted farms: 2.0 to 9.6 acres

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RHODE ISLAND

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POST HARVEST

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Farmed seaweed in Rhode Island primarily goes to:

Processors

Seaweed is sold: freshly harvested / raw to processors, chefs, and consumers

In Rhode Island, kelp processors ability to purchase fresh product is the limiting factor for kelp farms.

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CONNECTICUT

Gracilaria Research



Photo: Judy Benson / Connecticut Sea Grant

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CONNECTICUT

FARMS & LANDINGS

15 Permitted Sites.

Of these sites, 10 farms deployed sugar kelp seed-string in 2022. In addition, Connecticut has 13 companies and 1 nursery.

2022 Landings: 3,800 lbs

Landings reported by the state

Species under cultivation: **Sugar Kelp** (*Saccharina latissima*) and **Gracilaria** (*Gracilaria tikvahiae*), in tank cultures only.

There is no commercial wild harvest industry.

CONNECTICUT

PERMITTING & REGULATIONS



Lead Agency:

Connecticut Department of Agriculture, Bureau of Aquaculture

<https://portal.ct.gov/DOAG/Aquaculture1/Aquaculture/Seaweed/Seaweed>

Kelp-only licenses are issued and are good for 5 years.

- Cultivation for seaweed is based on the Connecticut shellfish model and can only occur in approved or conditionally-approved waters.
- Size of permitted farms: 2-9 acres

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CONNECTICUT

POST HARVEST

The primary market for CT seaweed is
Food and food products.

Seaweed is sold: raw, blanched, and cut

Seaweed in Connecticut is sold as a Raw Agricultural Commodity. In addition, seaweed is sold as kelp noodles. Some of the product is sold as fertilizer.

Connecticut is investigating **kelp powder** for use as a food additive and in cosmetics.



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CONNECTICUT

Blanched Kelp Stipes

Photo: Vellotti, 2018 / Connecticut
Sea Grant

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NEW YORK



Research Farm Site

Photo: Michael Doall, Stony Brook University

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NEW YORK

FARMS & LANDINGS

The first commercial farm in New York received their permit in August of 2023. Several other permits were being reviewed. Stony Brook University's School of Marine and Atmospheric Sciences completed their study testing various locations for suitability.

No official landings were reported in 2023 from research sites.

Major species under cultivation: **Sugar Kelp** (*Saccharina latissima*) and **Gracilaria** (*Gracilaria tikvahiae*).

New York has 4 hatcheries producing kelp spools.

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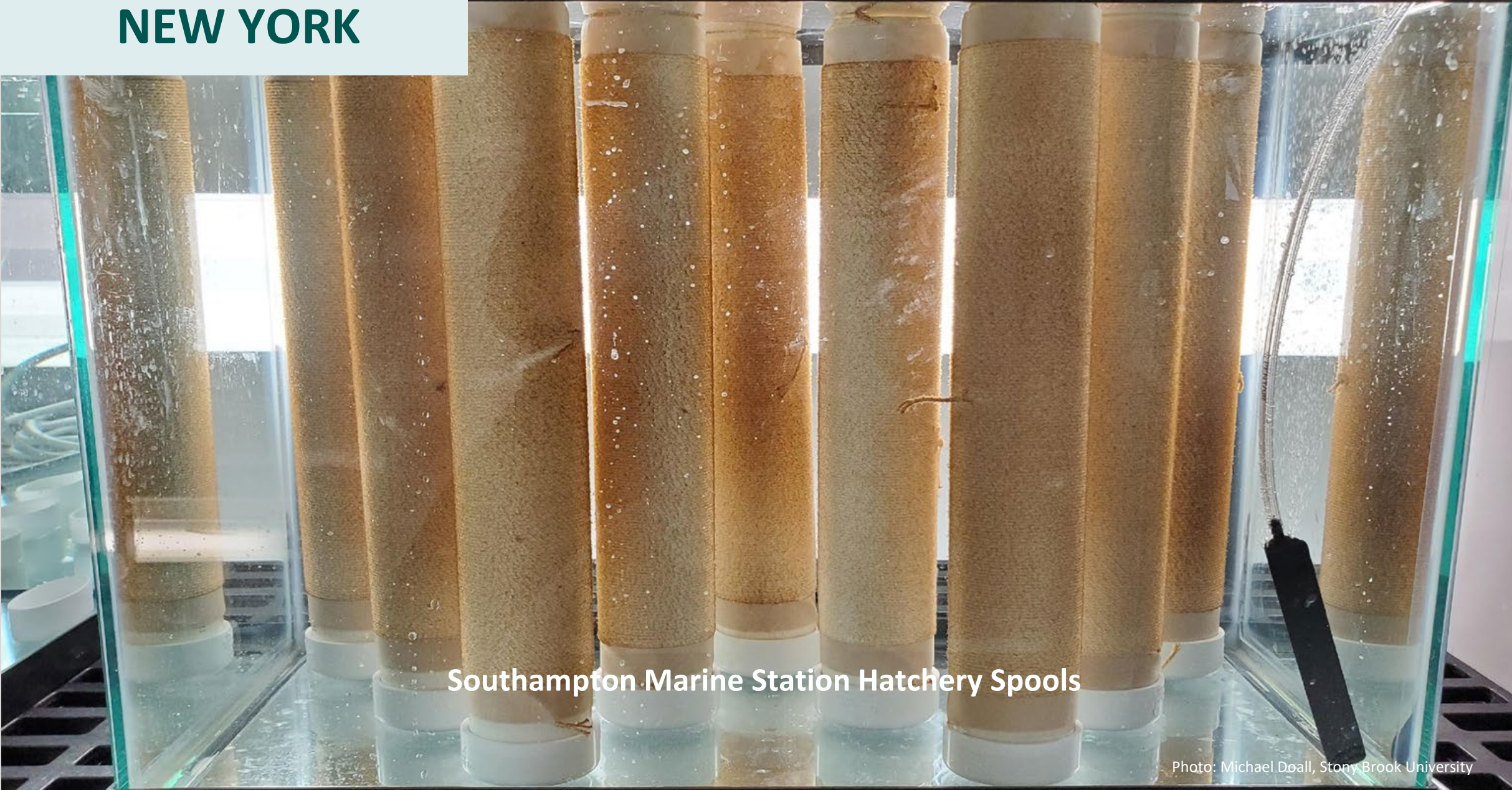
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NEW YORK



Southampton Marine Station Hatchery Spools

Photo: Michael Doall, Stony Brook University

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NEW YORK

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PERMITTING & REGULATIONS



CT

NY

New York will permit seaweed farms in certain waterbodies. Efforts are ongoing to survey and determine additional locations where farms can be permitted.

AK

Lead Regulator:

New York State Department of Environmental Conservation

<https://dec.ny.gov/things-to-do/saltwater-fishing/marine-permits-licenses>

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WEST COAST



Alaska

Washington

Oregon

California

Hawai'i

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ALASKA



Kelp Nursery

Photo: Gary Freitag

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ALASKA

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FARMS & LANDINGS

2022 Sales: 871,911 lbs of seaweed. Up from 591,711 in 2021

Landings reported by the state

Active Farms in 2022

- Seaweed only: 24 issued permits, 11 active
- Seaweed/Shellfish: 26 issued permits, 22 active
- Seaweed nurseries: 6 active (4 land-based; two floating)

New applications under review

- i. Shellfish only, Seaweed only, Seaweed/Shellfish: 40
 - a. Seaweed only: 16

Primary species under cultivation: **Sugar Kelp** (*Saccharina latissima*) and **Ribbon Kelp** (*Alaria marginata*), and **Bull Kelp** (*Nereocystis leutkeana*) to a lesser degree.

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Bull Kelp Farm

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ALASKA



Bull Kelp Farm

Photo: Gary Freitag

ALASKA

PERMITTING & REGULATIONS



Lead Agency:

Alaska Department of Natural Resources (DNR)

<http://dnr.alaska.gov/mlw/aquatic/>

Alaska DNR issues leases for aquatic farm sites in the state, including sites for aquatic plants.

- The lease terms is 10 years.
- Lease fee is \$450 for the first acre, \$125 for each additional acre.

Alaska Department of Fish and Game issues permits for commercial wild harvest of seaweeds.

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ALASKA

POST HARVEST

Food-use

The primary market for Alaska seaweed is for human consumption.

Companies produce

Value-added food products

like seaweed salsa, hot sauce, and dried kelp seasonings.

Seaweed is sold: dried, blanched, and frozen

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An aerial photograph of a salmon farm in the Hood Canal, Washington. The water is a deep blue-grey color. In the foreground, a long line of black buoys stretches from the left towards the center. Further out, a grid of buoys is visible, with some red and yellow buoys interspersed. A yellow boat with a ladder is in the middle ground, and another smaller yellow boat is further out. The background shows a forested shoreline under a cloudy sky.

Blue Dot Sea Farms, Hood Canal, WA

Photo: John Mickett

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FARMS & LANDINGS

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Open Water Cultivation: Blue Dot Sea Farms

In 2021, Blue Dot Sea Farms (formerly Hood Canal Mariculture) transitioned to become Washington’s first open water commercial seaweed farm in 30 years.

Primary species under cultivation: **Sugar Kelp** (*Saccharina latissima*) and Pacific oysters (marketed through Baywater Shellfish Farm).

Sugar Kelp landings: 10,000 (2022)

Official landings are not reported (farmer reported)

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Lummi Island Sea Greens



Photo: Larry Mellum / Lummi Island Sea Greens

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FARMS & LANDINGS

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Open Water Cultivation: Lummi Island Sea Greens

Newly-permitted sugar kelp farm in Legoe Bay, WA. Operators granted an experimental 1-year lease to cultivate kelp on the site of an existing salmon reefnet fishing operation during the off-season.

Primary species under cultivation: **Sugar Kelp** (*Saccharina latissima*).

Inaugural harvest April 16, 2023.

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WASHINGTON



SolSea LTD Tank Cultured Red Algae

Photo: Washington Sea Grant / SolSea

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FARMS & LANDINGS

Tank Culture: SolSea LTD

Combined propagation/research facility at NOAA's Manchester Research Station.

Primary species under cultivation: *Chondracanthus* (Turkish towel), Dulse, and *Ulva*. Research incubators recently dedicated to continuous seasonal culture of Sugar Kelp and Bull Whip (aka Bull Kelp).

Annual production capacity: 28 metric tons (*not verified*) of *Chondracanthus* and Dulse (reduced during pandemic). Over 2000 lbs (multiple species) harvested for NOAA research.

WASHINGTON

PERMITTING & REGULATIONS



Joint Aquatic Resources Permit Application (JARPA) - Permit applications are funneled to the various agencies and stakeholders through the state JARPA process. Permits are ultimately granted by the US Army Corps of Engineers.

www.epermitting.wa.gov/site/jarpa/9983/jarpa.aspx

Washington Department of Natural Resources - WDNR leases are required for all farms on state-owned aquatic lands. Leases may be granted for up to 30 years. Note that ~50% of Washington tidelands belong to Treaty Tribes or private landowners; prospective growers are advised to consult with local county planning offices about tideland ownership.

<https://www.dnr.wa.gov/programs-and-services/aquatics/leasing-and-land-transactions>

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POST HARVEST

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Blue Dot Sea Farms - 100% of Blue Dot' Sea Farms' sugar kelp harvest is currently utilized for *Seacharrones*, a new kelp snack produced by Blue Dot Kitchens (available through retail outlets in March 2022).

SolSea LTD - tank system produces seaweed for:

High-end skincare - proprietary face and body bars, gels and serums, moisturizer (SEAME brand)

Upmarket restaurant-quality food - including value-added products and snacks (limited to product development due to pandemic)

Research - fish feeds, high-end fertilizers, abalone and oyster cultivation.

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West Coast Dulse



Photo: Stephen Ward / Oregon State University

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FARMS & LANDINGS

Currently, there are no ocean-based seaweed farms permitted in Oregon.

3 Land-Based Farms

Since 2016, there has been significant growth in land-based dulse farming in Oregon.

Access to a consistent supply of high-quality seawater is the main limiting factor for these land-based systems.

Primary species under cultivation: **Dulse** (*Palmaria mollis*)

The Land-based farms consist of anywhere between 5 and 10 10,000 liter tanks.

Official landings are not reported (farmer reported)

OREGON

PERMITTING & REGULATIONS



Lead Agency:

Oregon Department of State Lands (DSL)

<https://www.oregon.gov/dsl/WW/Pages/Waterways.aspx>

Oregon DSL issues special use leases or licenses.

- Leases can be from 1-30 years.
- Licenses grant non-exclusive use of state lands. A license can only be granted for less than 3 years.

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OREGON

POST HARVEST

Seaweed grown in tank systems goes to primarily to

Local restaurants

And is shipped out of state.

Seaweed is sold: fresh/raw and dried

The seaweed is used as ingredients in restaurant dishes and in health food supplements.

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CALIFORNIA

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Red Ogo Produced in Tank System

Photo: Monterey Bay Seaweeds

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CALIFORNIA

FARMS & LANDINGS

4 Farms/Businesses

California has tank culture operations, like Monterey Bay Seaweeds and 2 pilot-scale open water farms.

Primary species under cultivation (tank culture): **Red Ogo** (*Gracilaria pacifica*), **Sea Lettuce** (*Ulva spp.*), **Dulse** (*Palmaria mollis*)

Giant Kelp:

Commercial wild kelp harvest exists for Giant Kelp (*Macrosystis pyrifera*). 25 metric tons of edible algae were wild harvested in 2015.

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CALIFORNIA

Bull kelp line from HSU-ProvidenSea



Photo credit: Rafael Cuevas Uribe, Cal Poly Humboldt

CALIFORNIA

PERMITTING & REGULATIONS



Lead Agency:

California Department of Fish and Wildlife (DFW)

<http://wildlife.ca.gov/aquaculture>

California DFW coordinates permits/approvals for farms in state waters. They work with the California Fish and Game Commission who issues bottom leases in most areas. In some cases, the harbor/port districts may administer leases.

- Maximum lease term is 25 years (10 for marine finfish aquaculture).
- Lease process triggers an environmental review under CA law.

California requires an Aquaculture Registration through the DFW for all aquaculture businesses. California DFW also regulates the harvest of kelp and other aquatic plants.

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POST HARVEST

Seaweed in California is a niche market; sold to **restaurants and direct to consumers.**

Seaweed sold for food purposes is mostly fresh/raw.

Some of California's wild harvest kelp is not used for food purpose/non-edible.

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HAWAI'I



***Gracilaria
coronofifolia***



***Asparagopsis
taxiformis***



***Halymenia
formosa***

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HAWAI'I

FARMS & LANDINGS

7 Farms/Businesses

Hawai'i has tank culture operations, including Royal Hawaiian Sea Farms, Olakai Hawaii, Blue Ocean Barns, OceanEra, and Symbrosia. No ocean farmed seaweed is available.

Primary species under cultivation: **Limu Manauea** (*Gracilaria spp.*), **Dulse** (*Palmaria mollis*), **Limu Kohu** (*Asparagopsis taxiformis*), and **Lepe`ula`ula** (*Halymenia formosa*)

Production:

Estimated production (farmer reported) for Gracilaria, "ogo": ~5,000 pounds per week, or ~260,000 pounds per year mostly for human consumption.

State Division of Aquatic Resources production includes seed for industry and as feedstock for urchin stock enhancement program: ~1,500 pounds per year

Estimated production ~500-600MT(500,000 -600,000kg) or 1.1-1.3 million pounds of red macroalgae per annum for animal feed.

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HAWAI'I



Tank Culture System

HAWAI'I

PERMITTING & REGULATIONS



Lead Agency:

Hawai'i Department of Land and Natural Resources (DLNR), Division of Aquatic Resources (DAR)

<https://dlnr.hawaii.gov/dar/>

Hawai'i DAR coordinates permits/approvals for farms and collection permits for aquatic plants in state waters.

Hawai'i requires an Aquaculture Facility License through the DLNR for all aquaculture businesses (<https://dlnr.hawaii.gov/dar/licenses-and-permits/aquaculture-facility-license/>)

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HAWAI'I

POST HARVEST

Edible seaweed in Hawai'i is a niche market; sold to **restaurants and direct to consumers.**

Seaweed sold for food purposes is mostly fresh/raw.

Mālama Maunalua removes ~ 70,000 pounds of invasive algae (*Avrainvillea lacerata*, *Gracilaria salicornia*, and *Acanthophora spicifera*) from Maunalua Bay on the island of Oahu each year. 100% of the algae removed is converted into soil amendment and compost at local farms, schools, and nursing homes.

Landings reported by farmers.



WANT TO LEARN MORE?



Reach out to your state's Sea Grant seaweed extension specialist or check out our National Seaweed Hub Website.

