

BIG ISLAND

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Mauna Kea's Time Machine

*Hawaii Grown: Diversified Ag
Comes of Age*

Big Isle's Finest: "Major Mom"

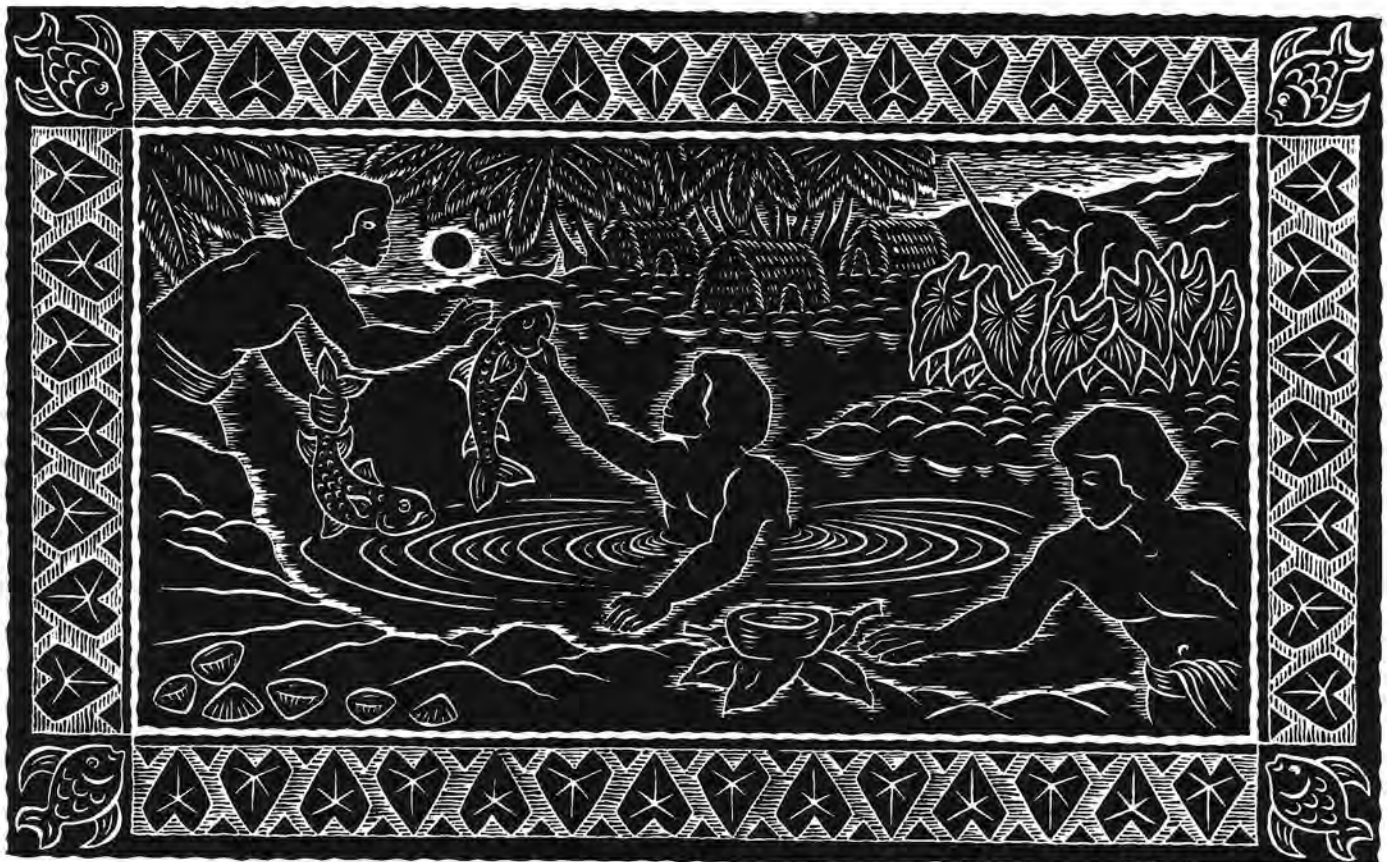


ILLUSTRATION: "KA LOKO", DIETRICH VAREZ

Hawaii's Fish Farms Combine Tradition and Technology

Aquaculture offers the ideal opportunity to produce food in an environmentally sustainable fashion.

by Shelley Hoose

At the soul of Hawaiian agriculture is aquaculture, where the *loko*, or fish pond, is the cultural equivalent of the *loi*, or wetland taro patch. Growing food, whether in soil or water, means nurturing the family, the culture, and completing the cycle of birth, life, and death.

Hawaiians have been involved in aquaculture, or fish farming, since at least 1300 A.D. With land ownership extending in *ahupua'a* from mountain to ocean, the upland hills would bear *ulu* or breadfruit, potato, and banana, descending in a natural progression to the makai regions which produced taro, and then to the sea where Hawaiians farmed the water in the

loko kuapa (salt water ponds), marvels of technological achievement.

"The *ahupua'a* was really a wonderful, integrated farming system with the salt-water fish pond at the bottom edge of the farm being just as important as any other element," says Dr. Kent Fleming, UH Manoa extension economist. "And ancient Hawaiian aquaculture was not only among the earliest in the world, but was also quite advanced. When Captain Cook arrived in 1778, there were 360 fish ponds producing more than 1,000 tons of fish a year. Only in the past few years has Hawaii again begun to produce anything close to that."

In the past decade, aquaculture has attracted much research and development interest, particularly on the Big Island, where the many diverse eco-systems offer aquaculture farmers a particularly rich "soil" for farming a remarkable variety of fish.

"The Big Island has the resources to raise a whole lot of species," says Howard Takata, Hilo's county extension agent with UH Manoa's Sea Grant/Cooperative Extension Services. "We have so many ecological niches here—from cool to warm water, from brackish to salt to fresh water. Who would have thought you could raise cold-water rainbow trout

right next to the balmy ocean?" But farmers in Hilo have been doing just that for more than a decade, taking advantage of the coastal pond areas where underground spring-fed water emerges at a cool temperature of 65 to 68 degrees.

"Trout grow faster and better here than anywhere on the Mainland because we have a year-round, constant, optimal temperature," says Takata. "The ice and cold temperatures of many Mainland ponds during the winter retard a trout's growth. Our trout grow and increase in size daily."

Yet aquaculture technology in Hawaii is still in its infancy. In the past decade, researchers have been conducting experiments of all kinds, aided especially by the availability of large amounts of cold, deep-sea water at the Natural Energy Lab of Hawaii Authority (NELHA) in Kona at Keahole Point. NELHA's experimental alternative energy program, Ocean Thermal Energy Conversion (OTEC) produces electricity by utilizing the temperature difference between solar-heated surface water and colder, deep seawater. The by-product is large amounts of nutrient-rich, clean, cold water. This water, and the ability to mix it with surface water to obtain any temperature from 45 to 75 degrees, offers the Big Island a unique opportunity to become a world center for aquaculture industry.

Research projects at NELHA have proven that it is technically feasible to grow a variety of finfish, shellfish, and sea vegetables. With nutritional studies consistently pointing to fish and ocean products as healthy, low-fat sources of protein, vitamins and minerals, interest in aquaculture has increased. The demand for fish by health-conscious consumers, combined with the decreasing supply from the world's over-exploited oceans, has contributed to opportunities for aquaculture on a large scale. Yet the high start-up capital investment required, high production costs, and competitive world market prices have prevented several products, such as salmon and abalone, from being economically feasible.

There are, however, some dramatic exceptions. Steven Katase, an early pioneer of NELHA aquaculture research, has expanded into successful commercial production.

ROYAL HAWAIIAN SEA FARMS.

Since 1987, Katase's Royal Hawaiian Sea Farms, Inc. (RHSE) has farmed and successfully marketed a variety of sea vegetables, or *limu*, including *nori* in

which sushi is wrapped, *ele ele*, and five varieties of *ogo*, an ingredient in Hawaii's popular dish *poki*. The firm also sells two kinds of fish, the salt water *tilapia* and *awa*, or milkfish.

RHSE's location next to NELHA is crucial, as its products need the nutrients and variable temperature of the seawater there which is purchased from the state facility. NELHA offers aquaculture a classic opportunity to produce food in an environmentally sustainable fashion. "Located on a lava flow next to the airport, we can use land unacceptable for almost any other use," Katase says. "And the water's temperature can be adjusted to anything you want, which is unique in the world for any aquaculture facility." In addition, Katase points out that the combination of Kona's sun and the nutrient-rich water create healthy, fast-growing crops which need little, if any, outside fertilizer, as well as ensure consumers a clean, chemical-free product. "It's really an exciting concept and a perfect balance of nature and development."

RHSE sells 90 percent of its commercial crop locally in Hawaii, and Big Island consumers can find its products in all local supermarkets and fish markets. The company also sells to distributors in San Francisco, Los Angeles, Seattle and Las Vegas.

While *limu* is particularly nutritious and is prized by Hawaii's local population, educating new consumers on its taste and use is essential to expand the market. (For some tips, see the recipes, left.) In addition, exporting out of the state is expensive due to airfreight costs. Export also entails competing with world markets, many of which can grow the product less expensively due to lower overhead, especially labor.

To compete in an export market, Katase believes that Hawaii's priority, as with any of Hawaii's diversified agricultural products, must be high quality. "We must sell quality and cleanliness." The clean, pathogen-free water at NELHA helps ensure this. "That we can grow thousands of pounds weekly of delicious food with just the sun and water is incredible—and a dream come true," says Katase.

In addition to marketing *limu*, *tilapia* and milkfish, RHSE is working on a num-



COOK IT, HAWAIIAN STYLE

KONA STYLE OGO KIM CHEE *Sam Choy's Kona Cuisine*

- 1 lb. *ogo*
- 3/4 cup vinegar
- 1/2 cup sugar
- 1/4 cup shoyu
- 1 tsp. salt
- 1 large Maui onion, sliced
- 3 green onions
- 1 cucumber, diced
- 1/2 cup roasted sesame seeds
- 1/2 tsp. sesame oil
- 1 cup dried shrimp, chopped
- 1 piece ginger, minced
- 1 clove garlic, minced
- 1 chile pepper, minced
- 2 tomatoes, diced

Combine ingredients for sauce in a bowl. Add *ogo*. Mix well.

CREAM OF ELE ELE SOUP

- 1/3 cup chopped onion
- 1/3 cup flour
- black pepper, salt, nutmeg to taste
- 4 cups skim milk
- 1 cup light cream
- 1 cup *Ele ele*, finely chopped

Melt margarine. Add onion and sauté until tender. Blend in flour and seasoning. Stir in milk and cream until smooth and heated through. Add *ele ele*. Bring to a boil and cook 1 minute.



BIG ISLAND AQUACULTURE

ber of research projects, including the feasibility of farming warm-water abalone, the local *opihi*, and edible sea cucumbers. The company's research on *opihi* and sea cucumbers is funded in part by federal grants from the USDA's Small Business Innovative Research program.

AQUATIC CULTURE & DESIGN.

Another early pioneer of aquaculture research now producing commercially on the Big Island is David Barclay, a marine zoologist who has worked in aquaculture research and consulting since the mid-'70s. Barclay and his wife, Christi, raise Asian Catfish on their eight-acre farm in Kokoiki, North Kohala, through their business Aquatic Culture & Design.

Barclay's background includes working with Dr. Arlo Fast, the pioneer in the state of Hawaii for aquaculture research. Fast holds the patent for the process of culturing cold water fish in fresh water by taking advantage of the upwelling of cold water from the lower depths. Ten years ago Barclay and Fast worked together on a research project to test the growth of salmon and *nori* at the NELHA facility, joined by Katase and others. Katase's successful cultivation of *nori* and other seaweeds is one result of their research, while Barclay and Fast began to

The NELHA grows cold-weather crops in the middle of the stark lava fields simply by running deep-sea, cold-water pipes through the garden and allowing the soil to be watered by the resulting condensation.



focus on the fresh-water Asian Catfish as a viable, marketable product.

Because Asian Catfish was already a 60-million-pound per year commodity in Thailand, and Hawaii's Southeast Asian population considers it a staple, the market was already established.

By the mid-'80s, much of the federal OTEC research and development monies which had driven research at NELHA had ended, and Barclay was ready to go into production himself. On family-owned land in North Kohala he built 16 27-foot diameter tanks with the help of an aquaculture loan. Using fresh water from the Kohala Ditch, Barclay began to grow catfish profitably. This year he has produced 15,000 pounds, all of which he sells to Honolulu markets. He harvests weekly, sending the fish by barge to Oahu. There they are emptied into tanks in Oahu's stores and sold live to consumers. The recent addition of four 50-foot tanks gives Barclay the production capacity of 30-50,000 pounds of fish per year.

One problem in aquaculture production is disposal: as new water circulates, where does the old water go? Barclay and other fish farmers are beginning to use this "waste" by-product as a source of fertilizer and nutrients for agriculture, creating an integrated aqua-agriculture system. Barclay's effluent now drains through his family's wetland taro patch and eventually into coconut trees at the lower end of his property.

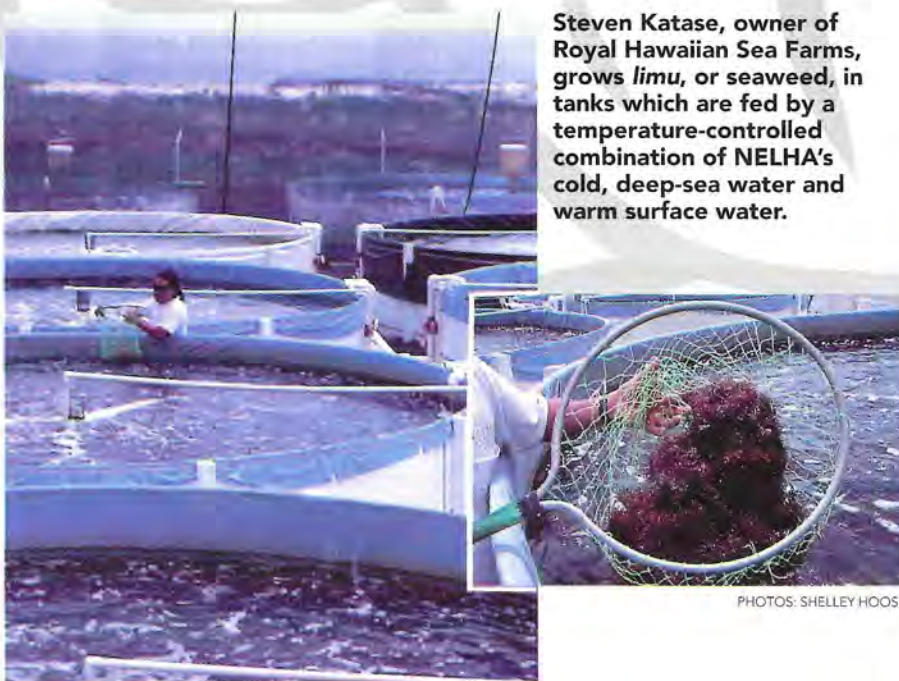
THE FUTURE OF AQUACULTURE ON THE BIG ISLAND.

With Hamakua Sugar ceasing production and the world's oceans fast depleting, Big Island aquaculture could be in a position to contribute to the state's economy. However, it is no simple panacea for Hawaii's economic troubles.

"It's farming, and it's not just glamour like some people seem to think," says extension agent Takata. "There's a lot of stuff you have to think about before you go out and buy fish for stocking ponds and tanks. What type will you grow? What will it eat? Where are you going to market it? Will you make a profit?"

Several large aquaculture endeavors started on the Big Island and statewide have failed, including Ocean Farms at NELHA and several corporate attempts on other islands. It is Barclay's opinion that successful aquaculture will remain in the realm of the family farm. "Costs are really high," Barclay says. "Aquaculture is labor-intensive, feed is expensive, things can go wrong, and if they go wrong on a large scale, you're in trouble."

Takata, however, believes that because of its unique properties, the Big Island has great potential for aquaculture expansion. "One example is the Hamakua lands which have a lot of water. If the water is used carefully, it can be used for all types of aquaculture and also for agriculture." Takata points out that the water from the Hamakua Ditch



Steven Katase, owner of Royal Hawaiian Sea Farms, grows *limu*, or seaweed, in tanks which are fed by a temperature-controlled combination of NELHA's cold, deep-sea water and warm surface water.

PHOTOS: SHELLEY HOOSE



**100% JUICE
TART & TASTY
GUAVA PINEAPPLE
PASSION FRUIT**

INGREDIENTS:
Pineapple Juice,
Guava Puree, and
Passion Fruit Juice

NO WATER, SWEETENERS,
PRESERVATIVES, COLORING,
OR FLAVORING ADDED

**100% JUICE
APRICOT-LIKE FLAVOR
PINEAPPLE
PAPAYA**

INGREDIENTS:
Pineapple Juice,
and Papaya Puree

NO WATER, SWEETENERS,
PRESERVATIVES, COLORING,
OR FLAVORING ADDED

**100% JUICE
LOTS OF LILIKOI
PINEAPPLE
PASSION FRUIT**

INGREDIENTS:
Pineapple Juice,
and Passion Fruit Juice
(Lilikoi)

NO WATER, SWEETENERS,
PRESERVATIVES, COLORING,
OR FLAVORING ADDED

**100% JUICE
WITH SPIRULINA
(8 grams (1 Tbs.) per pint)
GUAPIN
PAPULINA
(GUAVA, PINAPPLE, PAPAYA, spirULINA)**

INGREDIENTS:
Pineapple Juice,
Guava & Papaya Purees;
and Hawaiian Spirulina

NO WATER, SWEETENERS,
PRESERVATIVES, COLORING,
OR FLAVORING ADDED

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BIG ISLAND AQUACULTURE

surfaces at a temperature of about 65 degrees in which some cool-water species can grow. Then as the water moves through cool-water ponds, solar radiation will warm it to 70 or 72 degrees, which can then be used for another species. The waste effluent will be rich in nutrients and can be used to water and fertilize other agricultural crops.

This is known as integrated aquaculture-agriculture and is now being practiced on a small scale by several farmers, including Craig Emberson of Makuu Aquafarms in Puna. Emberson grows fresh-water Asian Catfish and golden tilapia, as well as salt-water shrimp, all of which he sells locally on the Big Island at the Hilo Farmers' Market, local restaurants, or direct from the farm. The waste water from the fresh-water tanks is then used to irrigate and fertilize green ti leaf, bananas, citrus, and cashew fruit trees.

UH Manoa's Sea Grant Extension

Service is seriously looking at another area which holds great promise for aquaculture expansion — ornamental tropical aquarium fish. "We can raise species of high value in Hawaii and can tap the international market, which is huge," says Takata. With Singapore, Thailand and Japan the main exporters of tropical aquarium fish, Hawaii will have to compete with those countries' inexpensive labor, feed, land, and other overhead. However, Takata believes, "we can compete if we can grow pathogen-free fish in high quantities."

The Big Island Aquarium Society, based in Hilo, meets once a month to share information on individuals' work with raising ornamentals, including fancy guppies, swordtails, angel fish, African cichlids, goldfish, and carp. "But to get this going large-scale, you need research and a long-term commitment to the project. Once you buy the tanks, you may

Early aquaculture pioneer David Barclay now grows Asian Catfish on his family farm in North Kohala.



PHOTOS: SHELLEY HOOSE

