Community-Based Naguabo Aquaculture Center in Puerto Rico

Centro Acuícola Comunitario Naguabo en Puerto Rico

Centre d'aquaculture communautaire de Naguabo à Porto Rico

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EXTENDED ABSTRACT

Stimulating the growth of a sustainable aquaculture industry is a top priority for Puerto Rico. This industry can help to take pressure off the fishery sector, augment livelihoods for fishers, advance aquaculture technology, offer training programs and workforce development, facilitate food and nutrition security, and provide economic resilience for coastal communities. In 2019, the community-based Naguabo Aquaculture Center was launched in Puerto Rico in collaboration with Florida Atlantic University, Conservación ConCiencia and the Naguabo Commercial Fishing Association. The Naguabo Aquaculture Center is located in the middle of the Naguabo Commercial Fishing Association on Húcares Beach.

The facility was designed and built to grow queen conch, *Aliger gigas*, for restoration and sustainable seafood. The majority of the queen conch (also known as 'carrucho' in Puerto Rico) fished in Puerto Rico are consumed locally with very little export. With the decline in conch populations in Puerto Rico's state and federal waters, closed seasons in state waters (August 1 to October 31), closed fishery in federal waters, and disruption of conch habitats from hurricanes, conch is a prime candidate for aquaculture in Puerto Rico. The facility was expanded in 2021 to grow various locally-sourced halophyte plants for coastal restoration and culinary dishes. These halophyte 'salt-loving' plants are an environmentally sustainable crop that are known to sequester carbon, remove excess nutrients from coastal ecosystems or aquaculture systems and can handle extreme conditions while requiring zero freshwater. In addition to these capabilities, their high salt content makes them more resistant to pests and diseases. These plants, also known as sea vegetables, were historically foraged and eaten in Puerto Rico, however, today they go largely unnoticed in Puerto Rican cuisine. Introducing them to the domestic food industry, targeting restaurants as well as households, could generate a market for a new aquaculture crop in Puerto Rico with many economic and nutritional benefits.

The project began culturing queen conch juveniles from egg stage in June 2021, and in October 2021, sea vegetable aquaponics were introduced to the facility. The Naguabo Aquaculture Center's infrastructure (also see Davis and Cassar 2020; Davis et al. 2021; Dones Ortiz 2022) includes: a saltwater system with two 2,000-gallon insulated, fiberglass reservoir tanks (6' diameter x 8' height), filtration, UV sterilization, and chillers (approx. area 200 ft^2) (Fig. 1). Every two to three weeks, water is pumped from the Húcares Bay adjacent to the Naguabo Fishing Association and into the reservoirs. For each reservoir, the seawater is continuously filtered through a polishing loop system and is maintained at 28 ^oC using a chiller. The queen conch temperature-controlled (26-28 ^oC) hatchery (approx. area 144 ft^2) consists of: five fiberglass conical bottom larval tanks that are each 18 gallons; an egg mass fiberglass incubation tank that allows for seawater to upwell through each egg incubator screened-bottom cylinder; two metamorphosis shallow tanks on a recirculating aquaculture system with screen trays to grow conch from 1 – 4 mm shell length; and a microalgae culture area to grow *Isochrysis galbana* and *Chaetoceros gracilis* for feeding the conch larvae. The hatchery is designed to produce 2,000 conch per year and each larval cycle is about 28 days long. The conch nursery and aquaponic sea vegetable area is approximately 500 ft^2. The conch nursery system consists of a recirculating aquaculture system with six 100-gallon fiberglass troughs (2' wide x 8' long x 1' deep) that are stacked in two racks, three tanks high. There is a sump with two submersible pumps that flows seawater to the conch nursery trays through individual spray bars. Each trough holds four sand-filled trays for growing the conch juveniles from 4 mm to 7-9 cm shell length. The conch are fed a seaweed-based gel diet. The next stage will include acclimation of the conch juveniles in the wild inside pens prior to release in seagrass nurseries and/or grow out in the pens for the seafood market.

The aquaponic sea vegetable system consists of two stacks of 4 fiberglass trough tanks each (Fig. 2). These tanks are the same size as those used in the conch nursery system. The bottom tank acts as a sump with a submersible pump, which circulates seawater to the other tanks. Using technology developed at Florida Atlantic University, indigenous Puerto Rican halophyte plants are being tested in these two aquaponic systems at the Naguabo Aquaculture Center. On each top-level tank is a nutrient film technique (NFT) system where sea purslane (*Sesuvium portulacastrum*) is growing from cuttings. The other aquaponic tanks include one of these species: queen conch; West Indian fighting conch (*Strombus pugilis*); or West

Indian top shell (*Cittarium pica*). Another tank includes cuttings from sea purslane (*Sesuvium portulacastrum*) and saltwort (*Batis maritima*). The sea asparagus (*Salicornia bigelovii*) is started from seeds germinated in fresh water and then switched to saltwater. These seedlings are grown in a shallow sand tray located in the vicinity of the aquaponic systems. The nutrients for the plants come from the waste stream from the queen and fighting conch and the top shells. For the *Salicornia* seedlings, hydroponic nutrients are used. In the future, additional species such as spiny lobsters and crabs will be added to the aquaponic system.

There have been many project successes thus far, including local job creation, research internships, and additional sources of income for fishers engaging and participating in different aspects of the operation including conch egg collection, infrastructure development, and seawater pumping. The Naguabo Aquaculture Center is supported through grants from Saltonstall-Kennedy NOAA Fisheries, USDA Agricultural Research Services, and Puerto Rico Sea Grant. This project serves as a model that can be transferred to other fishing communities in Puerto Rico and elsewhere in the Caribbean.

KEYWORDS: *Aliger gigas*, queen conch, sea vegetables, aquaculture, Puerto Rico, fishers, community

LITERATURE CITED

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Figure 1. Seawater reservoir system

Figure 2. Aquaponic seawater system for halophyte plants, queen conch, fighting conch and top shells.