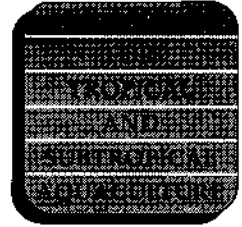




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# Abalone Culture in Hawaii

## Importation, Quarantine, and Seed Suppliers

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Abalone are a highly desired seafood throughout the world and have provided a source of food and shell ornaments since prehistoric times. Close to 90 different species of these herbivorous marine gastropods are found on rocky coastlines in both the northern and southern hemispheres. Intense fishing pressure has resulted in dramatic declines in abalone populations worldwide, giving impetus to programs for stock enhancement and aquaculture.

In Hawaii, historical interest in establishing a fishery, and more recent interest in abalone aquaculture, resulted in the introduction of a number of species. These species were selected based on the likelihood of their survival in the wild if the goal was to establish a fishery, or in the case of aquaculture, based on their growth rates and market demand.

### Historical Importations

The black abalone (*Haliotis cracherodii*) was first introduced to the wild in Hawaii during 1927 and 1928, when 35 individuals were brought from California. Subsequent monitoring found no evidence of survival in this group. In 1958 and 1959, a total of 895 black abalone were introduced to the waters off Rabbit Island and Pyramid Rock, Oahu. While subsequent observations indicated healthy survivors, there was no evidence of long-term survival. In 1968, 24 green abalone (*H. fulgens*),

and 24 pink abalone (*H. corrugata*) were released into the waters of Pokai Bay off Waianae, Oahu. These animals were monitored for a short period but later disappeared, possibly due to poaching. These species were imported to evaluate ocean introductions, and were undertaken prior to implementation of current regulations which require an import permit.

More recently, a number of introductions of abalone species have been permitted for aquaculture in land-based systems. These include the red abalone, *Haliotis rufescens*; green abalone, *H. fulgens*; pink abalone, *H. corrugata*; and the Japanese Ezo Awabi, *H. discus hannai*. In 1991, the entire genus *Haliotis* was placed on the conditionally approved list that allows import permit applications to be handled administratively by the Plant Quarantine Branch (PQB) of the Department of Agriculture without the need for public hearings or review by the state Board of Agriculture. Import permits for abalone can be issued following site approval and submission of a two-page import permit application. These applications can normally be processed within two weeks.

Additional species permitted for introduction include the Tokobushi abalone, *Haliotis diversicolor supertexta*; the green lip abalone, *H. laevigata*; and the black lip abalone, *H. rubra*.

## Import Quarantine Requirements

Permits are required for the importation of live organisms to Hawaii in order to monitor arrivals and ensure protection of native ecosystems from potentially harmful exotic species or pathogen introductions. To accomplish this, the PQB can impose quarantine requirements or other conditions that must be met prior to actual species importation. The PQB establishes these requirements based on individual species characteristics and knowledge of potential pathogens associated with each importation.

Quarantine is defined as a strict isolation that is imposed to prevent the spread of disease, or a system of measures maintained at ports of entry to prevent the spread of diseases. Quarantine requirements for introducing aquatic species into Hawaii range from complete isolation to direct stocking into production ponds. Abalone and most other species imported for aquaculture are generally allowed onto approved private or public facilities, with a series of safeguards to prevent the inadvertent introduction of pathogens.

In cases of concerns about specific pathogens, such as viruses in penaeid shrimp, animals are imported and held in closed systems where effluent discharge is chlorinated or pumped into a dispersion well. These shrimp are then used as broodstock, and the resulting offspring may be released to farms identified on the import permit after being checked for pathogens using state of the art methods.

The conditionally approved listing, under which species of the genus *Haliotis* are imported, allows import permits to be issued only after holding facilities have been approved by the Plant Quarantine Aquatic Animal Specialist. Criteria that must be met by these facilities include the following:

1. Facilities must be secure to prevent unauthorized access and the potential for removal or release of imported species.

2. Effluent water from culture facilities must be treated to prevent release of viable gametes, larvae or pathogens, or the effluent must be released into the ground via seepage pits or injection wells, with no direct contact to the ocean.

Additional conditions relating to the importation and culture of abalone include the following:

1. The transporting water shall be chlorinated and discharged into the city's sewer system, or other approved dispersion pit, pond, or well.
2. Abalone shall be limited to production in onshore tanks (closed system) with screened outlets to prevent escape.
3. On arrival in Hawaii, each group of abalone shall be inspected for attached organisms by a state Plant Quarantine Branch inspector.
4. The facility shall be made available for post entry inspection by the Plant Quarantine Branch.
5. An authorized disease specialist shall monitor the animals and facilities for diseases and parasites.

These conditions provide reasonable assurance that introduced species will not escape and that pathogens are not inadvertently introduced to the environment.

## Abalone Suppliers

Abalone are available from commercial hatcheries throughout the world. Juvenile abalone are priced according to size and are generally available between 10 mm and 15 mm at prices ranging from \$0.10 to \$0.50 each.

The Abalone Farm  
P.O. Box 136  
Cayucos, CA 93430  
Ph.: 805-995-2495/Fax: 805-995-0236

Bodega Farms  
1750 Montgomery Street  
San Francisco, CA 94111  
Ph.: 707-875-2273/Fax: 415-474-0529

The Cultured Abalone, Inc.  
9580 Dos Pueblos Canyon Road  
Goleta, CA 93117  
Ph.: 805-685-1956/Fax: 805-685-5757

Terminal Island Aquaculture  
712 Tuna Street  
Terminal Island, CA 90731  
Ph.: 310-833-9342/Fax: 310-831-8735

McCormick & Associates  
323 East Matilija Street #112-131  
Ojai, CA 93023  
Ph.: 805-640-1180/Fax: 805-640-0165

U.S. Abalone  
825 Shaffer Road  
Santa Cruz, CA 95060  
Ph.: 408-458-2832/Fax: 408-458-0433

Mr. Yu Yi Huang  
No. 8, Chung Hsiao East Road  
Taipei, Taiwan, R.O.C.  
Ph.: 3414830/Fax: 3218985

Mr. Chiu Wu-Yang  
72 Chung-Chen Road  
Pingtung, Taiwan, R.O.C.

Mr. Pan Ming-Hsiung, Associate Engineer  
Taipei County Fry Cultivation Farm  
No. 34 Shyung-Lan Street  
Kung-Liao, Taiwan, R.O.C.

Mr. Chang Fu-Ping  
1, Chung-Chen Road  
Tainan, Taiwan, R.O.C.

Marine Shellfish Hatcheries Pty. Ltd.  
P.O. Box 45, Harvey's Farm Road  
Bicheno, Tasmania, Australia 7215  
Ph.: 003-75-1412/Fax: 003-75-1488

Mr. Adrian Cuthbertson  
P.O. Box 96, Tas Univalve  
Swansea, Tasmania, Australia 7190  
Ph.: 002-57-8403/Fax: 002-57-8442

Mr. Lu Han-Sen  
Mr. Jackson Chao  
1 Jong-Jen Road  
Tainan, Taiwan, R.O.C.

Moun Po Enterprise Co., Ltd.  
Wei Cheng Liao, General Manager  
SFL No. 71, Sec. 1, Chung King S. Road  
Taipei, Taiwan, R.O.C.  
Ph.: 02-3319177/Fax: 02-3615235

Dr. Wu-Tien Wu, M.D.  
96 Ning Po W. Street  
Taipei, Taiwan, R.O.C.  
Ph.: 02-3031665(o)/Ph.: 02-3036971(h)

## Abalone Shipment

Abalone shipments should be scheduled to coincide with spawning seasons and to avoid seasons in which extremely warm or cold weather may induce handling stress in animals. Juvenile *H.d. supertexta* are generally available from Taiwanese suppliers from January through February, while green abalone are available from California hatcheries throughout the year.

Prior to arranging live abalone shipments, direct air connections should be secured, import permits obtained and provided to the shipper and attached to the outside of the shipping container. It is also important that the arrival of foreign shipments coincides with work hours for U.S. Fish and Wildlife and U.S. Customs inspectors, and that both domestic and international shipments are available for inspection by Hawaii state agriculture inspectors.

The most important considerations in transporting abalone seed are to provide adequate oxygen and to prevent desiccation. A number of commercial techniques are used to accomplish this. First, abalone should be taken off feed for a few days prior to shipping to empty their digestive tracts. They can then be packed in small mesh net bags, wrapped in moist towels, diapers, or foam, and placed inside a plastic bag filled with oxygen. It is important that the packing materials be moist, but not wet enough for standing water to collect in the shipping bag, as submerged animals often die from lack of oxygen or deteriorating water quality. Abalone can also be placed directly between layers of wet foam or other material and packed in plastic bags or rigid plastic boxes. Abalone thus packaged are then placed inside an insulated container containing ice or artificial "blue ice" to lower temperatures and reduce metabolism. Shipping temperatures around 10° C are good for most temperate species while *H.d. supertexta* transport best at a temperature of 20° C.

If culture temperatures differ from those in shipment containers, the newly arrived abalone should be allowed to slowly acclimate. Temperature changes in excess of 2° C/hour should be avoided whenever possible.

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