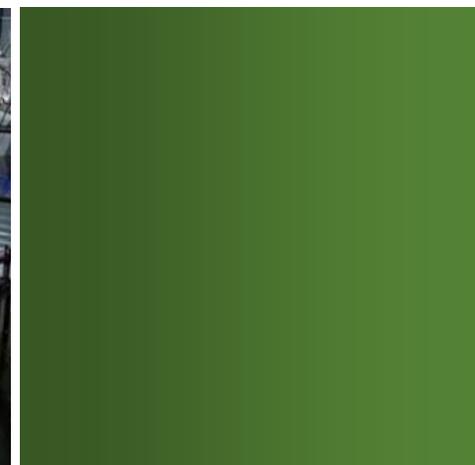


Abstract for Sea Cucumber Farming and Processing

This abstract reflects general technical and market aspects of sea cucumber farming/processing



INTRODUCTION OF SEA CUCUMBER FARMING

Tropical sea cucumber mariculture has potential to become a profitable industry and contribute towards natural population replenishment. The stagnating catches from our oceans cannot keep up with the seafood consumption of the world's growing population. To some extent this growing demand has been met by the rapid development of the aqua-



culture sector that now provides half of all fish destined for human consumption. Besides supplying people with nutritious foods aquaculture also generates jobs and income and its development has benefited from the domestication of new species. The farming of sea cucumbers (Echinodermata: Holothuroidea) is an example of a relatively new aquaculture activity in the tropics that provides high value products to the Asian dried seafood market. Commercially valuable sea cucumbers are generally conspicuous in their environment making them easy to find and consequently vulnerable to extensive collection. From the modern medical viewpoint, sea cucumber is a valuable source of several kinds of substances



that can serve as natural health products, and, perhaps, be developed as drugs. Since sea cucumber is consumed as a food by a very small segment of the population outside East Asia, most people do not have access to its beneficial components. Thus, extracts of desired sea cucumber materials are put into easy-to-consume formats, such as capsules (hard and soft gelatin) and tablets.

BASIC FACTS OF SEA CUCUMBERS

There are over 1,100 species of sea cucumbers under six orders. Aspidochirota Elapsozoa Pelagothurida Dendrochirota Molpadonia Apoda

There are about 20 edible species and the most preferred is *Stichopus japonicus*. Tube-shaped body, 20–40 cm in length and 3–6 cm in width. Quadriangular in transverse section. Flat ventral side, on which tube feet are lined in three irregular longitudinal rows. Dorsum slightly raised with irregular caruncles in 4–6 rows. Mouth anterior and inclined to dorsum. The environmental factors which have a close bearing on the habitat of *S. japonicus* are water temperature, salinity, tidal current, substratum, food, attachment and living spot of juveniles.

Among them, water temperature, salinity and substratum are the main limiting factors. Sea cucumbers are found in nearly every marine environment, but are most diverse on tropical shallow-water coral reefs. They range from the intertidal, where they may be exposed briefly at low tide, to the floor of the deepest oceanic trenches. They only avoid areas exposed to high wave action,

and are found on all types of bottom, from muddy sand to bedrock. Although sea cucumbers spread out in the marine environment, all sea cucumbers are ocean dwellers, though some inhabit the shallows and others live in the deep ocean. They live on or near the ocean floor—sometimes partially buried beneath it.



POPULAR SPECIES OF SEA CUCUMBERS

Type	Habitat	Characteristics	Appearance
Bêche-de-mer japonaise (<i>Apostichopus japonicus</i>)	<ul style="list-style-type: none"> <i>Apostichopus aponicus</i> occurs from the shallows of the intertidal zone to about 20 or 30 m depth. 	<ul style="list-style-type: none"> About 20cm Average fresh weight 200g 	<ul style="list-style-type: none"> Tentacles with curved, spiny rods. Dorsal surface variable in colour from brown to grey or olive green; ventral surface brown to grey. 
Lolly Fish (<i>Holothuria atra</i>)	<ul style="list-style-type: none"> Tropical Indo-Pacific region From the Red Sea and East Africa to Australia 	<ul style="list-style-type: none"> About 20cm Smooth, pliable, entirely black skin 	<ul style="list-style-type: none"> Uniformal black. Body is commonly covered with medium-grain sand, with characteristic bare circles in two rows along the dorsal surface. 
Sandfish (<i>Holothuira scabra</i>)	<ul style="list-style-type: none"> Found in shallow waters, but occasionally to about 20 m. Commonly found on inner flat reefs of fringing and lagoonal reefs of India and Australia 	<ul style="list-style-type: none"> About 30cm White-spotted, smooth skin 	<ul style="list-style-type: none"> Black to grey or light brownish green, sometimes with greyish black transverse lines 

FROM HATCHERY/FARMING TO PROCESSING

Farming and Processing of Sea Cucumbers includes several steps. The main procedures can be seen as follows:

- 1. Obtaining Sea Cucumber broodstock**
- 2. Larval Rearing**
- 3. Juvenile Production**
- 4. Growing of Sea Cucumbers**
- 5. Processing**

Broodstock for hatchery use are obtained from natural stocks. Fully matured broodstock in the spawning season can be used for gamete collection immediately. To induce maturation, broodstock are reared for several months at a density of 25-10/m³ and fed with powdered brown algae. Suitable sperm and egg densities are 10 000 sperms/ml and 10 eggs/ml, respectively.

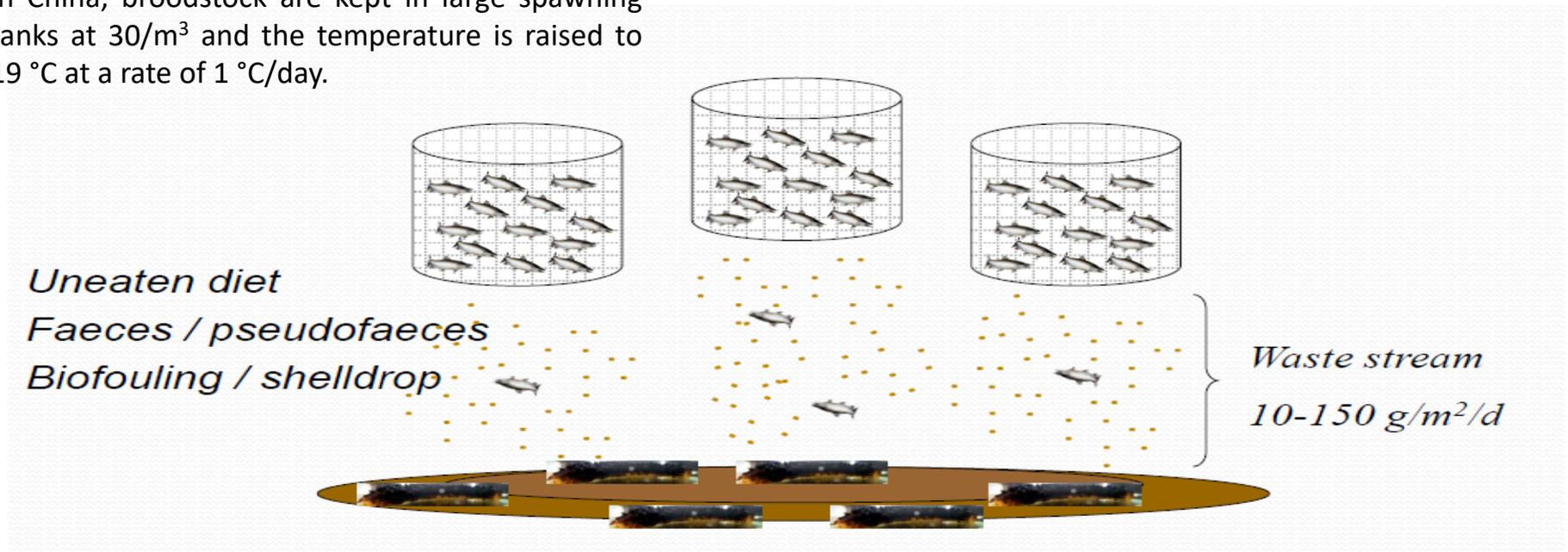
Maturation is judged by the egg diameter (>150 um) and sperm formation in the gonads. The broodstock are set individually in 15 litre containers and/or 20-30 broodstock are placed in 100 litre tanks filled with sea water and the temperature is raised to 5 °C higher than the normal rearing temperature. The released eggs are fertilized within 2 hours.



FROM HATCHERY/FARMING TO PROCESSING

The fertilized eggs are washed to remove excess sperm and left to hatch out for about 18 hours without aeration. The hatched blastulae swim to the surface and are transferred to larval rearing tanks at a density of 1-2/ml and fed microalgae (*Chaetoceros gracilis*) at ~10 000 cells/larvae/day until they are ready to set onto collectors (10-14). In China, broodstock are kept in large spawning tanks at 30/m³ and the temperature is raised to 19 °C at a rate of 1 °C/day.

After seven-ten days the broodstock will spawn at night. Eggs are carefully washed by draining the water and replacing it. The hatched larvae are transferred to larval rearing tanks, where they sit under already existing aquaculture systems to increase their growth until they are processed.



FROM HATCHERY/FARMING TO PROCESSING

Common processing techniques The Asian markets are now accepting new product forms of sea cucumbers, such as semi-dried vacuum packed, frozen whole or as separate body parts. Processing methods to achieve the dried form (*bêche-de-mer*) vary depending on the species, the final product to be achieved and the market to which the product will be sold. In general there are 5 methods to process harvested sea cucumbers, but here you can see the most common processing procedure:



A: Evisceration



B: Scrapping



C: Salting



D: 1st cooking



E: using ground papaya leaves



F: Cooking in brine



G: Rinsing



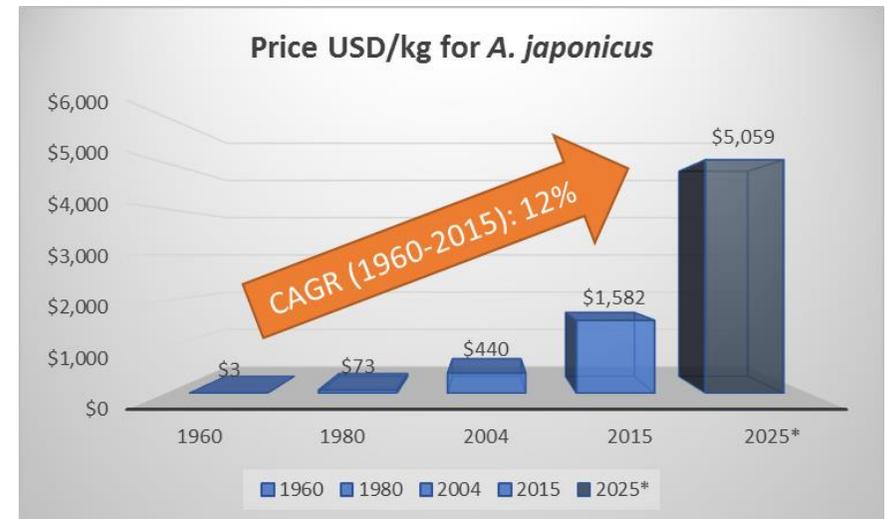
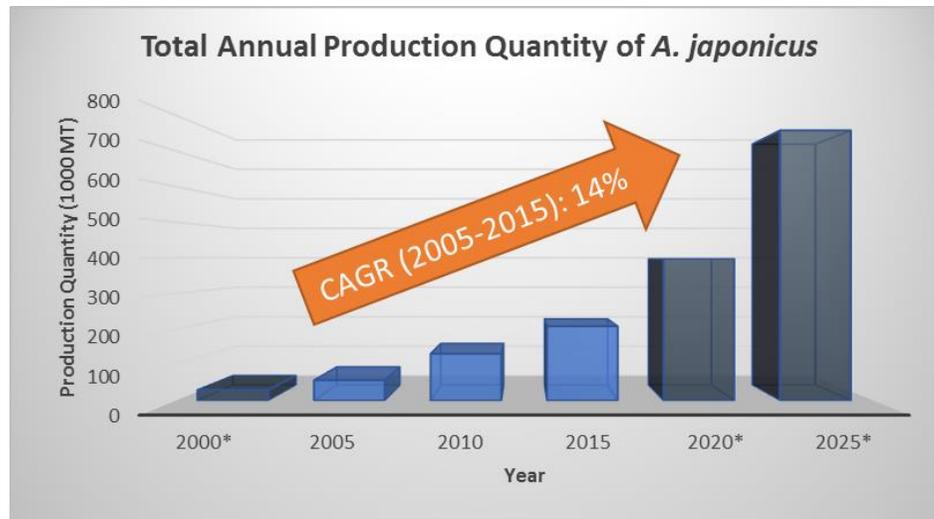
H: Sun drying

SEA CUCUMBER MARKET OVERVIEW

In the recent decades, invertebrate fisheries have expanded in catch and value worldwide. The major product in the sea cucumber is the boiled and dried body-wall, familiarly known as 'bêche-de-mer' or 'gamat', for which there is an increasing demand for food delicacy and folk medicine in the communities of Asia and Middle

East. There is also a trade in sea cucumbers for home aquaria and biomedical products. Sea cucumber fisheries had rapidly grown and expanded due to the growing bêche-de-mer-related international market, supported by continuing demand of these organisms for aquaculture and biomedical research programs.

They have high commercial value coupled with increasing global production and trade and therefore, commercially fished and heavily overexploited in some areas. Cultivation of these species increasingly becomes a necessity, both for stock enhancement programs and as a means to meet up market demand.



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