Potential culture of sea cucumber in Mexico

by Alexandra Gutiérrez-García[1]

Attempts to raise and produce sea cucumber from an aquaculture system in Mexico have been scarce, almost nil. Despite the increasing interest of this sea product in the world markets, the only approach has been an unregulated extracting fishery, which has led only to a serious depletion of natural populations of species *Isostichopus fuscus* in the sea of Cortez (Gulf of California), Mexico (Figure 1). To understand the scenario more thoroughly, we can review some main aspects.

Introduction to the species

The sea cucumber *Isostichopus fuscus* (Figure 2) belongs to the Phylum Echinodermata, Class Holothuroidea, Order Aspidochirota and Family Stichopodidae. It presents an elongated body, with soft texture, very vigorous, with thick borders. The body shape is convex at the dorsal surface and flat on the ventral side. The coloration of *I. fuscus* is dark brown, spotted with orange papillae, while ambulacral extensions are arranged in bands. It has a thick, spikeless dermis, which makes it a highly edible and valuable species. The market was open for dry and cooked product.

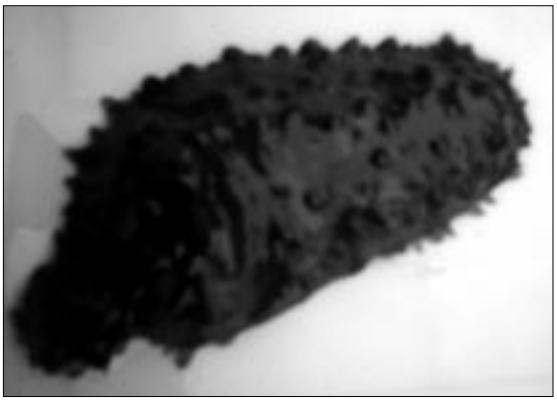

Figure 2: ***Isostichopus fuscus*, 'rock sea cucumber', native species from the Sea of Cortez, Mexico**

Sea cucumber fishery situation to date

The fishery started in 1988 on the eastern shorelines of the Peninsula of Baja California, where catch records reached 646 t in 1989, and a maximum of 1,230 t in 1991, but decreased to only 467 t in 1994 (Ministry of Fisheries, 1995, see Figure 3). However, these statistics must be interpreted with caution, since the last records may refer to dry product only.

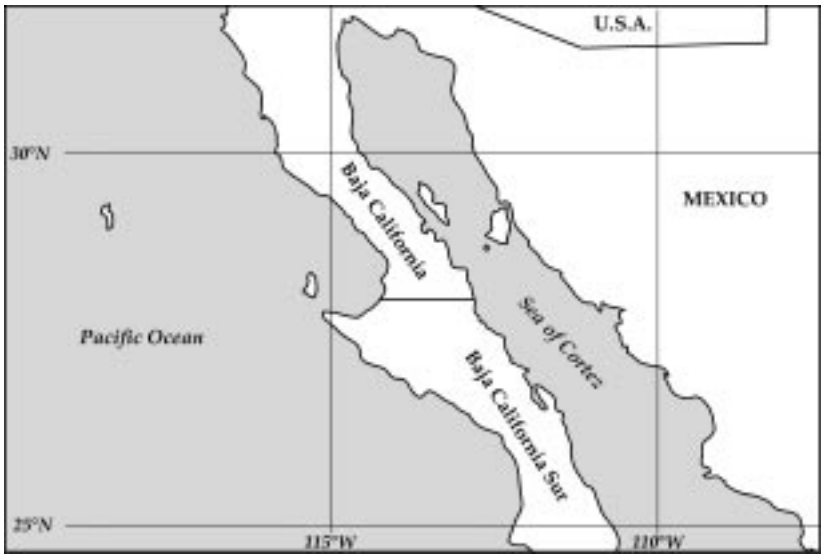

Figure 1: The Sea of Cortez (Gulf of California), Mexico, natural habitat of the species *Isostichopus fuscus*

The same trend in world landing records is reported by other analysts (SPC *Beche-de-Mer Information Bulletin* #6). Nevertheless, based on the figures alone and without any further consensus with the scientific community assessing the resource, Mexican authorities assumed a severe depletion of natural populations in the area due to overexploitation and, in 1994, established an indefinite ban on the fishery for the species, labelling its condition as *endangered.*

The National Fisheries Institute has observed that official catch records are different from those reported by its researchers. This highlights the need for the fishery sector to participate in the costs of protecting the resource and in the experimental design to assess natural stocks. To estimate the growth potential of this species, the National

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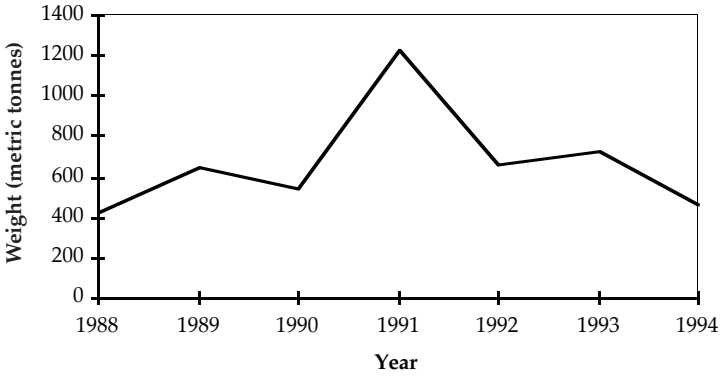

Figure 3: Annual production, 1988–1994, of sea cucumber *Isostichopus fuscus* on the eastern coast of Baja California, Mexico (Ministry of Fisheries, 1995)

Fisheries Institute proposes to place the species under a *special protection* condition, allowing a controlled fishery (Ministry of Environment, Natural Resources and Fisheries, 1998).

Consideration of aquaculture of the sea cucumber *Isostichopus fuscus*

All these conditions have led to much interest among the private sector in developing alternative methods of producing beche-de-mer. The development of an aquaculture system would provide a solution, making it possible both to enhance wild populations and to provide product to satisfy the increasing market demand for the species (Gutierrez-Garcia, 1995). The following considerations should be borne in mind in relation to the culture of this holothurian in Mexico.

Natural behaviour of the species

The Mexican sea cucumber *I. fuscus* occurs naturally along the coast of Baja California, Mexico. It is a native species from the Sea of Cortez and is distributed along the Mexican Pacific coast, reaching the Galapagos and Ecuador (Kerstitch, 1989). The natural habitat of this species can be a variety of substrates, including reefs, rocks, coralline algae, coral, sand and mud. It has been found in shallow waters at 20 m and as deep as 200 ft (61 m) (Kerstitch, op. cit; Salgado-Castro, 1993). Due to oceanographic dynamics in the area, there is a seasonal upwelling from January to June. *I. fuscus* then migrates to surface waters to feed on the rich nutrient medium. It is after this period, during July and August, that it reaches its seasonal maturity (Salgado-Castro, op. cit.; Herrero-Pérezrul, 1994; Fajardo-Leó, et al., 1995). The cucumbers consequently spawn during September and October (Ministry of Fisheries, 1995).

Juveniles (60–160 mm) are found within rocks and underneath them, whereas the biggest specimens (>170 mm) are distributed over rocks and stones (Fajardo-Leon et al., op. cit.). Gonadic development is in five stages: undifferentiated, gametogenesis, maturity, spawning and post-spawning (Herrero-Pérezrul, 1994). Gonadic development and the gonadosomatic index are related to temperature changes. This factor plays a significant role in synchronising the reproductive cycle, but it does not cause spawning (Fajardo-León & Vélez-Barajas, 1996).

Aquaculture alternatives for sea cucumber

It is necessary to promote the interest in aquaculture of the research media, as well as fishery authorities, not forgetting the participation of fishermen and investors. The culture of sea cucumber could be feasible if following elements were in place:

Review of and consensus on the regulation of the fishery: Fishery activity should be reactivated by means of reviewing up-to-date information on the species *I. fuscus* and assessing whether the permanent ban and classing it as an endangered species have been positive instruments for the natural stock since their establishment in 1994.

The evaluation can be carried out with different methods, such as visual observation of catching areas and density assessments with transects and quadrants (Conand, 1990). If results indicate no significant improvement, discussion between authorities, fishermen, entrepreneurs and researchers should be encouraged to identify feasible measures and actions for a suitable and participatory co-management of sea cucumber in the Sea of Cortez .

A biological research background that can provide the basis to establish an experimental culture. Regarding this point, previous studies on reproduction and development (Herrero-Pérezrul, 1994; Fajardo-León et al., 1995), and fishery parameters (Salgado, 1992, 1993) must be considered as supporting background for further studies.

In particular, the study should focus on broodstock management, controlled spawning, life-cycle description and larval development. We need to know optimum conditions for growth and survival, such as salinity, temperature, dissolved oxygen, food ratio and larval density.

Experimental systems must be designed to grow-out juvenile stages up to commercial size, probably with the use of partially-controlled natural areas or by integrated culture systems in shrimp ponds (Gutiérrez-García, 1995).

A stock enhancement programme should be designed by fishermen and authorities working together, in order to allocate harvest restrictions and recovery benefits fairly and equitably among all sectors of the fishing community.

The programme could use either harvest areas or artificial reefs; these have proved suitable as controlled systems to shelter and recover natural stocks in other areas of Mexico (Ministry of Fisheries, 1993), such as coastal areas of Manzanillo, in Colima State. The programme should be monitored and enforced with stock assessments in subsequent years to rebuild measures and regimes. These actions are recommended in a Strategic Plan for Fisheries (NOAA, 1997) to eliminate over-fishing and rebuilding of overfished stocks.

Results produced by these elements will provide information for the implementation of steps in the aquaculture process of the sea cucumber, beginning with an experimental system, upgraded to a pilot study and then leading finally to the commercial production of sea cucumber.

The time needed to achieve these goals is long, but the efforts made by many people so far must be spread to help to maintain the interest of authorities, researchers and fishermen in working together for the sustainable benefit of the sea cucumbers of Mexico.

The author wishes to express her interest in contacting expertise and financial organisations devoted to sea-cucumber culture and conservation, to explore the possibility of initiating a co-operative programme which could support a research project on sea-cucumber culture. Any feedback will be most welcome.

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Observations on fission and spawning

Communicated by Ram Mohan, Tuticorin RC CMFRI, Tamil Nadu. India 628 001.

1. Spawning observations

1. Date: 24.03.1998
Time: 09:45
Species: *Holothuria atra*
Moon phase: NM-3
Remarks: Two male specimens spawned one after the other in laboratory holding tanks at 30°C, for about 15–20 minutes. No peculiar spawning behaviour was noticed.

2. Date: 22.07.1998
Time: 08:30
Species: *Holothuria atra*
Moon phase: NM-1
Remarks: One male specimen spawned during transit in the container by slightly lifting its anterior end, for 12 minutes. The water temperature recorded was 27.5°C.

3. Date: 27.08.1998
Time: 11:45
Species: *Holothuria atra*
Moon phase: 1/4-3
Remarks: Four male specimens spawned in holding tanks by lifting their anterior end, but showed no swaying action. The spawning duration was 15–40 minutes. Later, two more male specimens spawned, but for a shorter duration. A single female specimen spawned in the same tank intermittently for about 4 hrs. No peculiar behaviour was observed. The water temperature recorded was 29.5–31°C.

4. Date: 15.09.1998
Time: 17:50
Species: *Holothuria atra*
Moon phase: 3/4+2
Remarks: One male specimen spawned for 30 minutes during transportation at 28°C water temperature. It erected its anterior end and showed swaying movements.

5. Date: 24.09.1998
Time: 09:30
Species: *Holothuria atra*
Moon phase: NM+3
Remarks: Two male specimens spawned in containers for 30 minutes to 1 hr. at 28°C by lifting their anterior end. One specimen had two gonopores; spawning time of 1 hour.

6. Date: 21.10.1998
Time: 14:10
Species: *Holothuria atra*
Moon phase: NM+1
Remarks: Three male specimens spawned in holding tanks, at about 29.0° to 29.5°C water temperature. The spawning duration extended from 45 minutes to 2 hrs. 15 min. One specimen had 3 gonopores. This particular animal lifted and swayed its anterior end.

2. Fission and regeneration observation

Species: *Holothuria atra*
Site: South Brezk Water, New Harbour, Tuticorin, Tamil Nadu, India.
Habit: Calm, loamy bay with beds of seagrass such as *Cymodicea* sp., and *Halophila* sp., along with some sea weeds and dead coral stones.
Date: November 1997 – October 1998.
State: Fissioned and regenerating anterior as well as posterior parts were observed. A maximum percentage of such specimens was noted during October, 1998 and minimum during April, 1998. The fission rate was higher at a temperature range of 25–27° C, at a steady salinity level of 34–45 ppt.
Behaviour variations: Not observed.