Sea Cucumber *(Cucumaria frondosa)*

Common Names: Northern sea cucumber, beche-de-mer and the orange footed sea cucumber.

Description, Distribution and Biology

Sea cucumber is a marine organism belonging to the phylum Enchinodermata, which also include sea urchin and sea star. There are several species of holothurians found in the northwest Atlantic but the most common in nearshore areas is *C. frondosa*. Similar to other sea cucumber species, *C. frondosa* has a tube-shaped elongated body with a mouth at one end and an anus at the other (Fig.1 and 2). The mouth is typically surrounded by one or two rows of branching tentacles used for feeding. During feeding, the sea cucumber will extend its tentacles, which are covered with sticky mucus, into the surrounding water until they are filled with food particles. The sea cucumber is classified as a suspension feeder, taking in small bits of detritus and microscopic organisms that float near the sea bottom. They are also known to take food particles from the seabed or burrow into the sediment in search of food. The sea cucumber has a green to brown leathery skin with five rows of tube feet used for locomotion and attachment. The body is extremely flexible and can tighten into a knot when stressed, often eviscerating (casting off) its internal body organs, which can be regenerated. This species can grow to a maximum length of 50 cm, a width of 10 cm and weigh 2 to 5 kg. The body wall, which has a moisture content of 80 %, makes up about 50 % of the total body weight of the organism.

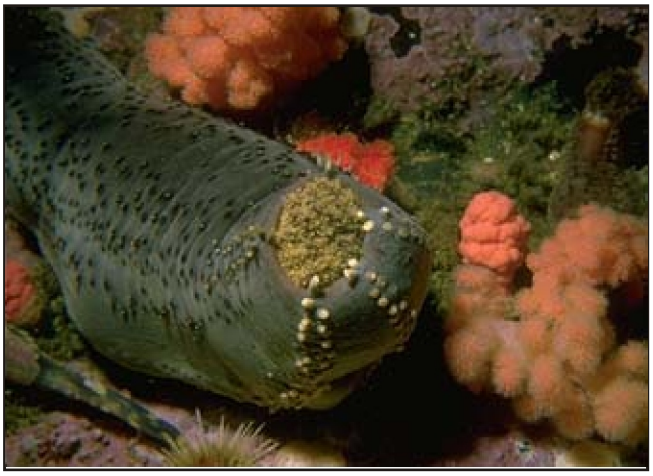

Figure 1. Sea Cumcumber. Source: Department of Fisheries and Oceans, Ottawa, Canada

Figure 2. Sea Cumcumber. Source: Department of Fisheries and Oceans, Ottawa, Canada

The sea cucumber is a bottom dwelling organism found worldwide. *C. frondosa* is distributed on both sides of the North Atlantic, ranging from northern Europe and Scandinavia to the Faeroe Islands and Iceland in the eastern Atlantic and from Greenland southward to the northern shore of Cape Cod, Massachusetts (USA) in the western Atlantic. This species prefers rocky or sandy substrates with strong currents and depths from 30 to 300 m or more. In Newfoundland and Labrador, C. frondosa is abundant in waters depths less than 30 m with currents that ensure an adequate and steady food supply.

C. frondosa typically reach sexual maturity between 2 ½ to 3 years of age and exhibits sexual dimorphism; a marked difference between males and females. The gonopore, which is located on the crown of the feeding tentacles (podia), is used to distinguish the sexes. The female gonopore is a single, large (4 mm), and long (7 mm) papilla with one genital pore. In comparison, the male gonopore is 8-10 mm wide and divided into a number of papillae (5-22). Spawning takes place annually between February and May in Newfoundland and Labrador waters. Studies indicate spawning in Newfoundland waters is closely related to spring phytoplankton blooms. During this time the eggs and sperm are released into the water column. After approximately 9 days, the fertilized eggs hatch into free swimming (planktonic) larvae and remain pelagic for 6 to 7 weeks prior to settling on rocky substrates or mussel beds. At 4 to 5 months, juvenile cucumber migrates to illuminated sheltered areas and then migrates again to exposed areas when growth exceeds 3.5 cm in length. The main predators for adult sea cucumber are sea star, lobster and snow crab.

Harvesting and Management

Sea cucumber has been harvested throughout the world for many years, particularly in the western Pacific and Indian Oceans. In these areas, sea cucumber was traditionally harvested by snorkel near reefs or atolls less then 200 m. With a decline in resource abundance in near shore areas, other methods of harvesting were introduced for deeper water. Eventually, many of the traditional sea cucumber fisheries became overexploited, resulting in the creation of new fisheries in other areas. In North America, commercial landings for sea cucumber species began in Washington State, in 1971, and quickly spread to California and British Columbia by the 1980s. By the latter part of this decade, resource abundance in these areas began to decline as a result of over fishing, inadequate management measures and fluctuating market prices. Since then, proper management measures including limited fishing season, individual quotas (IQs), limited entry, and restricted areas have been established in both countries.

In 1988, a small fishery for *C. frondosa* developed on the east coast of the United States. This fishery developed rapidly because of demand from foreign markets. Sea cucumber is harvested by similar gear employed in the scallop fishery and vessels are typically between 40 and 90 feet in length. Landings for Maine increased from 6, 300 lbs in 1990, to over 9.5 million lbs in 2000; dropping to3.3 million lbs in 2001(Fig. 3). The highest value attained in this fishery was in 2000 at $614, 937 (US). In Atlantic Canada, *C. frondosa* is mainly harvested as a result of by-catch in scallop dragging fisheries between May and November. In 1997, the Canada/Newfoundland Cooperation Agreement for Fishing Industry Development (CAFID) carried out an exploratory sea trial for sea cucumber in the province and concluded that a future fishery for this species was possible. In 2002, the Department of Fisheries and Aquaculture, under the Fisheries Diversification program, surveyed

potential sea cucumber fishing grounds and alternative harvesting methods. This study concluded that certain areas of the province could maintain a viable industry and recommended that alternative methods of harvest be used, such as a modified beam trawl, green sea urchin drag and modified scallop bucket.

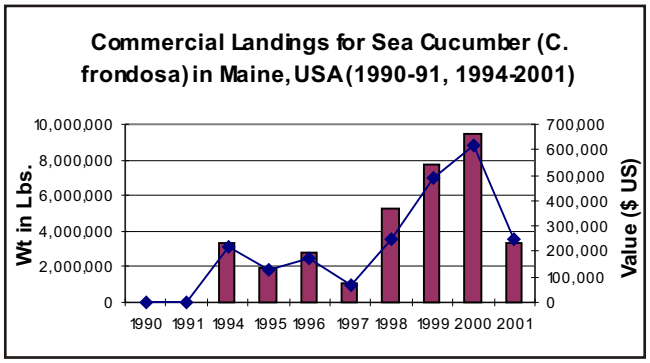

Figure 3. Commercial Landings for Sea Cucumber (C. frondosa) in Maine, USA (1990-91, 1994-2001). Source: DFO Statistics, Canada

Processing and Marketing

Handling and holding procedures on-board the vessel during transport and prior to processing is important to reduce losses and improve the market value of the product. After capture, sea cucumber should be eviscerated and immediately placed in seawater to prevent quality problems with the skin. The holding tubs should have smooth walls, be free of dirt and sand particles, which may become embedded into the body wall of the organism and include drainage holes approximately 2.5 cm or less in diameter. During transport to processing facilities, the catch should be held in seawater and changed every 8 to 12 hours. Processing of sea cucumber depends on the market demand for the final product. A limited amount of raw sea cucumber is eaten worldwide but the main markets are for processed products.

The most common product produced from sea cucumber is dried body walls, known as beche-de-mer or trepang, and is a traditional part of Chinese cuisine, particularly during the Chinese New Year (January and February) and the Hungry Ghost Festival (July and August). The process for producing beche-de-mer is eviscerating and gutting the cucumber, cleaning and cooking (30 minutes or less) in boiling water, and then sun drying. In Japan, Korea, Singapore, Hong Kong, and Taiwan the body wall (namako) and viscera is eaten raw, boiled or pickled in a mixture of vinegar and soya sauce. Japanese also consume dried ovaries (Konoko), salted and fermented intestines (Konowata), and respiratory trees (Minowata) as delicacy items, which are highly regarded and priced on the Japanese market. The longitudinal muscles, which taste like clam meat, are also extracted from the sea cucumber and prepared for a high-end market in the United States. The quality and value of sea cucumbers is dependent on the thickness of the body wall, odour, skin colouration and texture and the colour and viscosity of the mucus.

Constraints and Future Development

Traditional sea cucumber fisheries have become over exploited in many regions of the world causing an increase in market demand and value for *C. frondosa* in recent years. The sea cucumber fishery in Newfoundland and Labrador is in a developmental stage and further research is required to determine appropriate harvesting gear and potential markets. As with any emerging fishery, there are a number of constraints. First, there has been insufficient information collected on sea cucumber populations and distribution. Research into this species is limited in this province but studies have indicated that an abundant resource is available in both Notre Dame Bay and on the St. Pierre Bank. Second, there has to be sufficient harvest to make the industry economically viable. Third, processors have to be willing to invest in equipment and impose quality regulations. Currently, only two processing facilities are operational in this province, Woodpick Enterprises of Wareham and Fogo Island Co-op. Fourth, in developing unconventional fisheries, the main difficulty is finding and capturing markets. Finally, since no fishery exists, management measures have yet to be developed or implemented. Future development will require restrictions on gear, fishing season, area and entry.

ADDITIONAL READINGS:

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The $10 million Fisheries Diversification Program is part of the $81.5 million Canada-Newfoundland Agreement respecting the Economic Development Component of the Canadian Fisheries Adjustment and Restructuring Initiative, announced in August, 1999. The main thrust of the Fisheries Diversification Program is industry-wide research and development initiatives that reflect the economic development priorities of the Newfoundland and Labrador fishing industry.