

6. HARVESTING - PROCESSING - PRODUCT GRADING

6.1 Harvesting holothurians

While *Stichopus japonicus* in Japan and *S. parvimensis* in the United States can be harvested by trawling, the tropical species of sea cucumber are generally hand-gathered. Divers go out to the fishing grounds in small motorboats, or in some places still in sailing canoes, and collect the holothurians by skin diving. Scuba-diving equipment is too expensive and the constraints involved too great for it to be a viable method of hand collection. In the Solomon Islands, a weighted hook is sometimes used (Crean, 1977) to reach animals in deep waters with good visibility. A 2.5 kg weight attached to the end of a line bears a 32 mm hook which enables the catch to be brought up from depths of up to 30 m. However, these hooks are probably not to be recommended because of the wounds they cause to the body wall which detract from the quality of the processed product. Some species, such as *H. scabra*, can be harvested by hand at low tide on the reef flats.

The sea cucumber must be kept alive in sea water until processing, to prevent evisceration which tends to occur when they are handled or confined in tanks where the temperature rises rapidly.

6.2 Processing methods

Most processing methods were introduced into the Pacific islands by the Chinese who, in many islands, still run bêche-de-mer processing and trade.

The conventional method has not changed much over the years and many descriptions of it have been given : Saville-Kent (1893), Sella and Sella (1940), SPC (1979) and in booklets issued by fisheries departments in various countries.

6.2.1 General procedure

The processing stages are as follows, for all species except sandfish *H. scabra* and *H. scabra* var. *versicolor*.

- First boiling (Figure 44A)

This is done in boiling sea water, using large cast-iron pots or 200 litre drums, cut lengthwise. The holothurians are first cleaned and sorted by species and by size, then immersed in the boiling water, either directly or in wire-mesh baskets which make it easier to take them out when they are ready. They must be kept boiling for several minutes, and stirred continuously with a long flat utensil. Cooking time depends on the species and the size of the animals, which tend to swell up.

- Slitting (Figure 44B)

After they have been taken out and cooled off in sea water, the bodies are placed on a board belly-side down and cut down the middle of the back with a sharp knife. The cut must be clean and leave intact the last 3 cm to the mouth and the anus.

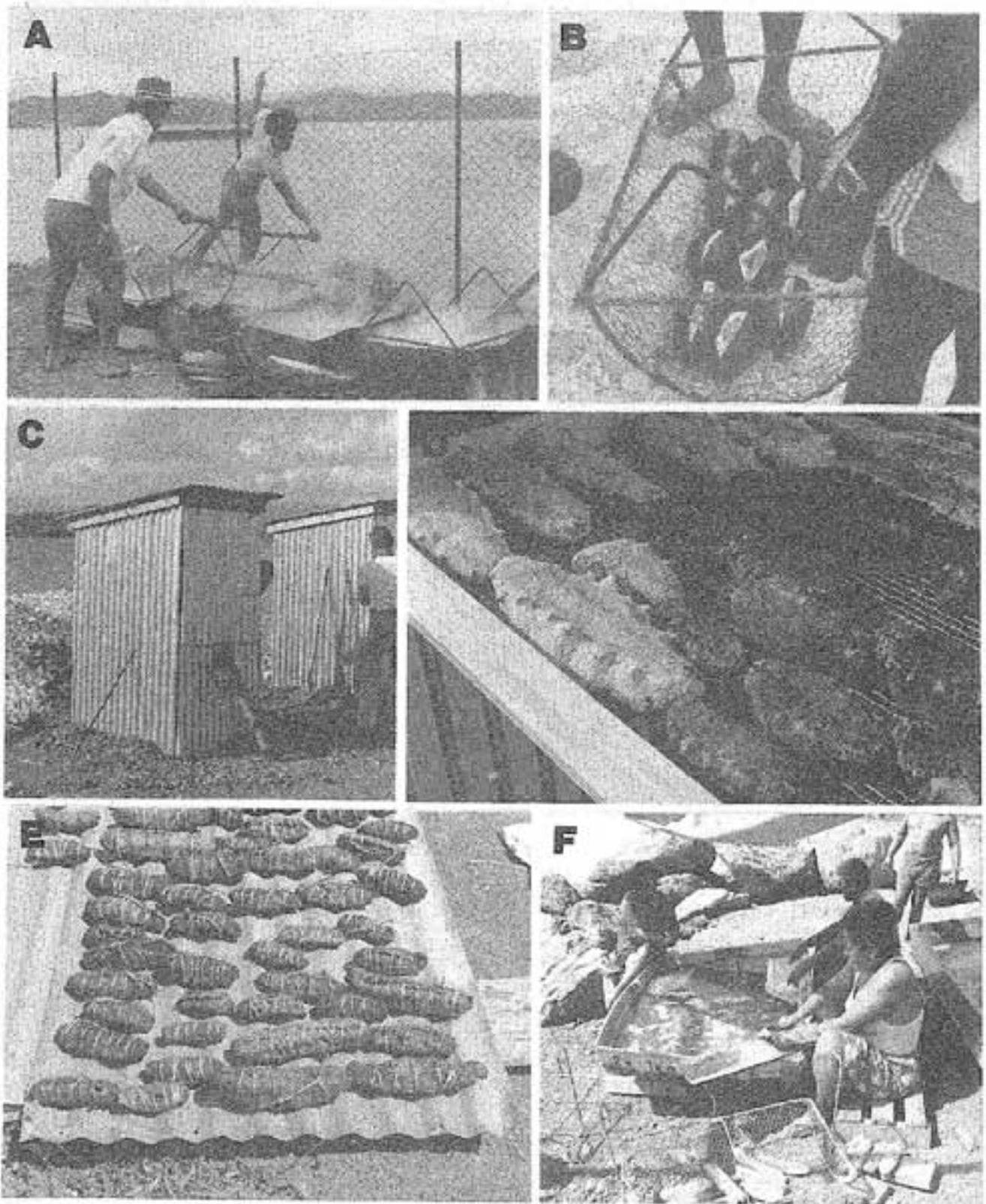


Figure 44: Processing sea cucumber. A: first boiling - B: mid-dorsal incision on *H. nobilis* - C: smokehouse - D: smoking trays containing teatfish - E: sun-drying - F: processing *H. scabra* var. *versicolor*; cleaning before second boiling (photos Conand)

- Second boiling
During the second boiling the body hardens slightly, taking on a rubbery consistency. After boiling for a few minutes, the animals are removed and put into sea water to cool off.
- Gutting
Depending on the method, gutting can be done either before or after the second boiling. All the internal organs must be removed and the body cavity is carefully rinsed to remove any debris or sand. Only the longitudinal muscles remain.
- Smoke drying (Figures 44C and D)
A bêche-de-mer dryer is similar to a copra dryer. A small but steady fire is maintained under the smoking trays. Mangrove leaves may be put on the fire to make more smoke. For teatfish, a small stick is sometimes inserted across the cut to keep the sides apart. The bêche-de-mer are arranged on the trays with the cut turned towards the heat source. The tray positions must be permutated regularly every few hours. The smoke-drying process may take several days. The sticks must be removed and the sides pressed together to close the cut; sometimes the whole body is tied closed with string to restore its uniform cylindrical shape.
- Sun drying (Figure 44E)
The bêche-de-mer are brushed to remove any ash, then put out in the sun and wind for a few days to dry out completely. The finished product must be as hard as wood. Should the bêche-de-mer become damp, the smoking and drying process has to be repeated. Once dry, the bêche-de-mer are sorted by species and size and stored in a dry, well-ventilated place until shipment. Depending on the market for which they are intended, there may be slight variations in procedure: e.g. length and position of the cut or omission of the second boiling or the smoking process. The procedure described is very suitable for teatfish and is used in Fiji and in many other countries of the region.

6.2.2 Processing of sandfish *H. scabra* and *H. scabra* var. *versicolor*

Processing of sandfish is slightly different because of the calcareous spicules contained in the body wall. The procedure described here was developed by Adithiya (1969) from the method traditionally used in India (Hornell, 1917).

- Gutting
Evisceration occurs spontaneously in this species (cf. Chapter 4.2.1) and the animals have usually already ejected their guts by the time they are landed. Evisceration can be hastened by pressing firmly on the body wall or by making little slits at the front and rear ends of the body or a small cut along the middle of the underside.
- First boiling
As for the other species, boiling time varies, according to country, from a few minutes, which seems sufficient, to over an hour. They are then cooled off.

- Burying
The sandfish are buried for about 18 hours in a pit of moist sand; this aids decomposition of the outer tegument, which contains many spicules.
- Cleaning (Figure 44F)
After being dug up and rinsed, the sandfish are cleaned either by brushing or by being trampled on in coconut baskets, or by means of a machine, the "descummer" (Sachithanathan, 1972).
- Second boiling
After being rinsed once more, the sandfish are thrown into boiling sea water a second time and cooked for about three-quarters of an hour.
- Smoke drying
This is sometimes done before sun drying, but is often omitted because not all markets appreciate the smoky taste.
- Sun drying
This is done on wire-mesh trays to allow good air circulation.

Processing must be carried out with the utmost care at every stage, so as to yield a product of consistently good quality. The defects that most commonly lead to down-grading of the product are an incorrect cut, body wall injuries, inadequate cleaning and cooking time unsuited to the size of the animal. If insufficient time was allowed for drying, or if the product absorbed moisture at a later stage, smoking and drying can always be repeated.

Sea cucumber collection and processing require very little equipment but a great deal of manpower. It is therefore rarely undertaken by individuals. Fishermen will find it profitable to pool their efforts either on a community basis or within a village cooperative. In New Caledonia, for example, holothurian fishermen sell their catch to traders who take care of processing and export. In the Solomon Islands, a Chinese-owned company was protected between 1966 and 1971. Established in Honiara and supplied with live holothurians by village fishermen, it encountered serious storage and transport problems. When the company lost its monopoly, bêche-de-mer production was gradually taken over at the village level, with the assistance of fisheries department officers.

6.2.3 Changes in size and weight during processing of the major species

Processing considerably reduces holothurian length and weight. It is important to know these parameters, since sampling of the processed product is one possible technique for monitoring bêche-de-mer operations and achieving rational management of the resource. Shrinking is mainly due to dehydration during smoking and drying. Loss of weight results from removal of guts as well as dehydration. These two parameters are related to the size of the specimens, the shape of the species and the thickness of the body wall.

Table 30 sums up the results obtained for the major species of commercial value during processing trials, and Figure 45 shows results for the species *H. scabra* var. *versicolor*.

Table 30: Changes in weight and length parameters of the various species during processing.
 1: initial condition - 2: after boiling - 3: smoking
 4: dried product - \bar{m} : mean value of parameter
 Percentages are expressed as a proportion of the parameter applicable to the species in its initial condition.

Species Author	LENGTH (cm)				WEIGHT (g)				
	1	2	3	4	1	2	3	4	
<i>Microthele fuscogilva</i> Conand (1979) (n = 13)	\bar{m}	52	33	24	23	4220	1230	340	320
	%	100	63	46	44	100	29	8	8
<i>Microthele nobilis</i> Conand (1979) (n = 70)	\bar{m}	37	20	19	19	1730	223	170	150
	%	100	54	51	51	100	13	10	9
Crean (1977) (n = 5)	\bar{m}					1276	404	176	87
	%	100	66	59	52	100	31	14	7
Parrish (1978) (n = 8)	\bar{m}					1520			632
	%					100			41
Harriot (1985) (n = 18)	\bar{m}					1900			163
	%					100			9
<i>Theleota ananas</i> Conand (1979) (n = 13)	\bar{m}	58	24	22	22	4000	290	186	184
	%	100	41	38	38	100	7	5	5
Parrish (1978) (n = 48)	\bar{m}					2850			238
	%					100			8
Harriot (1985) (n = 17)	\bar{m}					4300			128
	%					100			3
<i>Actinopyga echinites</i> Conand (1979) (n = 40)	\bar{m}	19			9	330			37
	%	100			47	100			11
Shelley (1981) (n = 100)	\bar{m}					470	111	74	75
	%					100	24	16	3
<i>Actinopyga miliaris</i> Harriot (1985) (N = 8)	\bar{m}					2500			76
	%					100			3
<i>Holothuria scabra</i> Shelley (1985) (n = 42)	\bar{m}					366	312	185	20
	%					100	85	51	5
<i>H. scabra</i> var. <i>versicolor</i> Conand (unpubl.) (n = 6)	\bar{m}	37	23	18	14	1530	325	182	98
	%	100	62	49	38	100	21	12	6

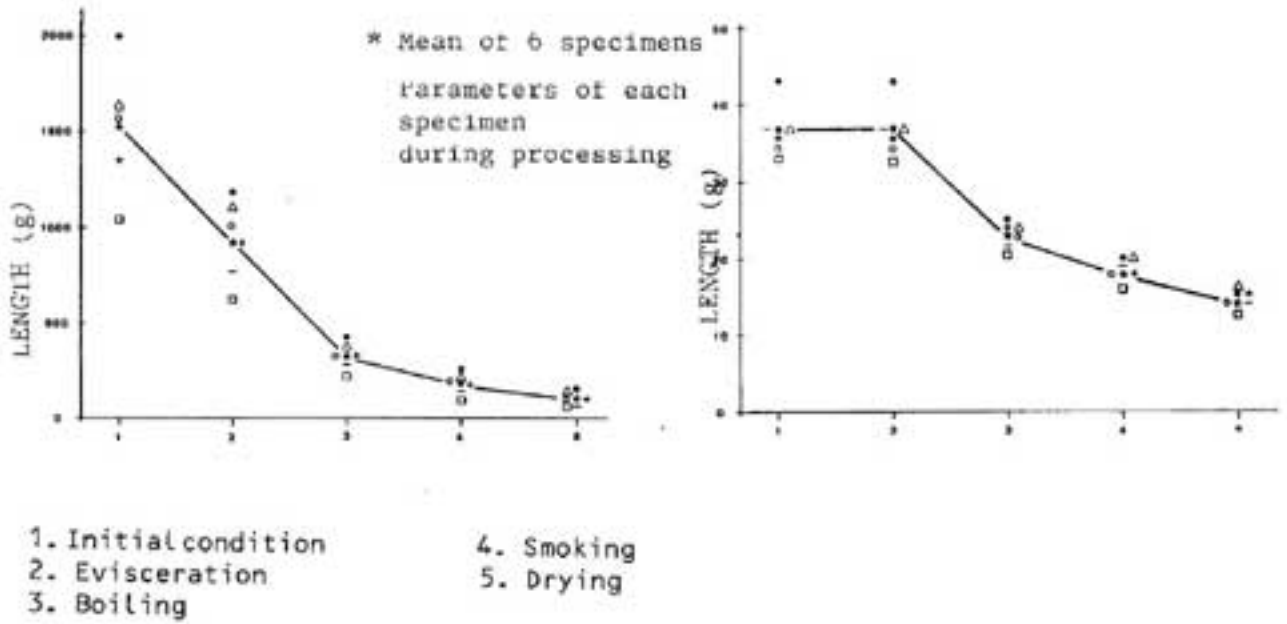


Figure 45: Changes in length and weight parameters during processing of *H. scabra* var. *versicolor*.

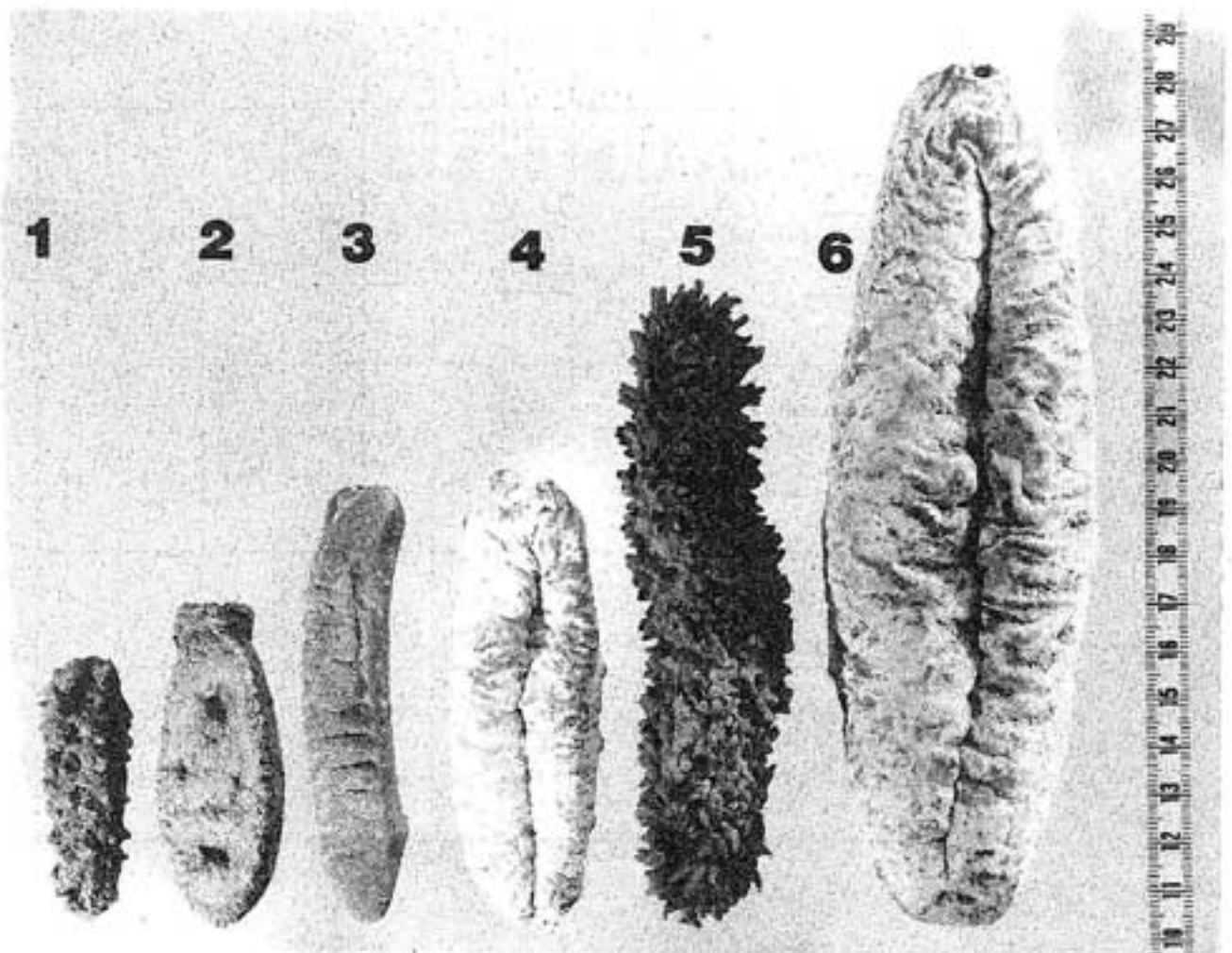


Figure 46: Béche-de-mer samples from the Hong Kong and Singapore markets. 1: *Stichopus japonicus*; 2: *Actinopyga echinites*, redfish; 3: *Holothuria scabra*, sandfish; 4: *H. nobilis*, cat.4, teatfish; 5: *Thelenota ananas*, prickly redfish; 6: *H. nobilis*, cat. 2 (Photos Conand).

The final result depends on the moisture content of the processed product, which accounts for the slight differences in the figures given by the various authors. The length of a processed *bêche-de-mer* is about half that of the live animal. Its weight after processing varies between 3 and 10 per cent of the fresh weight depending on the species. Parrish gives different figures, but they were obtained after only 48 hours of drying.

6.3 Product Grading

6.3.1 Quality rating

A number of criteria are used to grade processed *bêche-de-mer* into various commercial categories. Three major grades were defined in Chapter 4.1: high value, medium value and low value species. However, no standard species grading procedure exists (Van Eys, 1986) and the value assigned to a species can vary with the market considered and even sometimes, on the same market, from importer to importer.

If production involves several species, the products are first sorted by species.

Figure 46 shows samples of the species sold on the Hong Kong and Singapore markets. Only the first specimen, a processed *Stichopus japonicus*, is not from the tropical Indo-Pacific area.

The second grading criterion is size. Some markets grade by length, others by weight. Depending on the species, there may be from 2 to up to 7 size grades often defined as extra-large (XL), large (L), medium (M), small (S) and extra-small (XS). Each grade corresponds to a length or weight interval, and is expressed as number of animals per kilogram.

Other grading criteria are appearance, odour, colour and moisture content. Indeed, the product's general appearance also affects the grade and depends on the care that was taken in the various stages of processing. *Bêche-de-mer* that have been carelessly gutted, still contain sand, are over-cooked, not properly cut or not smoked and dried for long enough, or that have been stored in a damp place, are down-graded.

This variability in the grades can be illustrated by the following examples. In its early stages, *bêche-de-mer* production in New Caledonia (cf. Chapter 3, Table 7), involving mainly sandfish *H. scabra* and *H. scabra* var. *versicolor*, was monitored in two trading companies. The processed animals for export, to both Hong Kong and Singapore, were graded into six categories according to number of specimens per unit weight. The corresponding weight and length classes were calculated (Table 31). The data published regularly by INFOFISH (1985) generally concern the Singapore market for species from various origins. The commercial grades for the species *H. scabra*, as well as average prices per kilo in November 1985, are shown in Table 31.

The teatfish *H. nobilis* and *H. fuscogilva* are graded as "black stone" and "white stone" in Hong-Kong (Sachithanathan, 1972) depending on whether they are black or white. Grading according to length, in inches, is usually as shown in Table 32.

Despite the lower prices paid in recent years, demand for these species, generally from the Pacific islands, remains high.

6.3.2 Weight-length relationships in bêche-de-mer

In producing countries, statistics generally refer to exports of processed bêche-de-mer. Sea cucumber harvest data are in fact very difficult to obtain because the activity is often organised in a rudimentary way and its intensity varies greatly in both space and time. It thus seems easier to sample bêche-de-mer after processing. Because of the great variability of the grading criteria applied on the markets, it is necessary to know the weight-length relationships for the processed product from the different species concerned, in order to be able to make comparisons. These ratios were worked out for the species most commonly gathered at the present time (Figure 47) and enabled us to find the lengths corresponding to the weights of the various commercial grades (Table 31). They will be useful for deducing the approximate length (or weight) distributions of freshly-gathered holothurians, from samples ready for export, by applying available knowledge on how the parameters change in the course of processing (cf. Chapter 6.2.3).