Measurement of size in live sea cucumbers

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The need to devise a suitable and reliable measure of size in live sea cucumbers has been a consistent problem for researchers investigating the population ecology of this group. This was noted by Alex Bradbury (Washington State Department of Fisheries) in a recent issue of *Beche-de-mer Information Bulletin*. Any person faced with a sea cucumber deflating in one's hands will probably despair of ever getting a repeatable measure of size.

Measurement has usually been based on two variables — total length and total weight. However, there are problems with both these measures. Length is difficult to measure because of the morphology and elasticity of the body wall. Variation is also observed in total weight due to differences in the amount of food in the gut, seasonal changes in the size of the alimentary canal and respiratory tree (in some species of sea cucumber), and the quantity of water contained within the respiratory tree (Choe, 1963; Conand, 1981, 1989).

For research on the aspidochirote *Stichopus mollis*, a reliable measure of size was needed for calculation of gonad indices and size-frequency distributions. The method devised required that the animals be brought to the laboratory, but provided fairly reliable results. Although this method is described in a recent paper (Sewell, 1990), details of the methods are given here.

To get a reliable measure of size, the animals were placed in aquaria for 24 hours in order to clear the sediment from the alimentary canal. Each animal was put in a small mesh bag constructed from surplus onion sacks (mesh size 5 mm). The bags were approximately 20 x 20 cm square, just large enough to contain the animals. In the area studied, sexually mature *Stichopus mollis* were 13—24 centimetres in length. A large metal frame (a salvaged rectangular quadrat) was hung over a pool of running sea water (500 litres) as shown in Figure 1.

Then 'hangers' were constructed from two squeeze-type clothes pegs connected by string. The bag was closed by this hanger, and suspended from the metal frame so that the animal was totally immersed in the running sea water. Animals suspended in this fashion shed faeces to the bottom of the tank, and could not reconsume the sediments. After 24 hours, each animal was transferred to a small laboratory aquarium (15 l) of aerated sea water for 15 minutes. This allowed the animal to achieve a natural body form after being held in the mesh bags. Most animals started respiratory movements soon after entering the tank, and began moving tentacles after 5 —10 minutes.

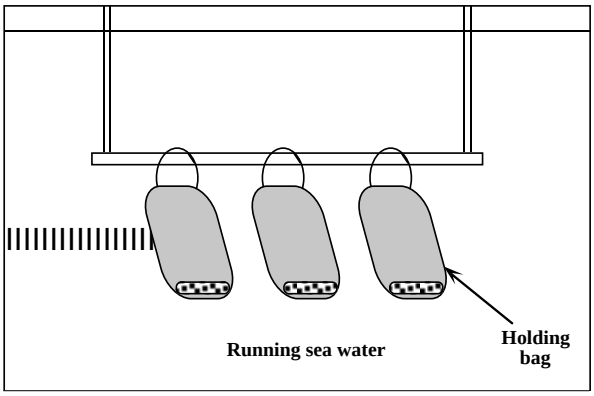

Figure 1. Side-view of aquarium showing position of holding bags. (Not to scale)

Two measures of size were made — total length and weight. Each sea cucumber was removed from the aquarium and its length measured dorsally from the anus to the centre of the tentactular crown with a dressmaker's tape to the nearest 0.5 cm. The animal was stimulated to expel the excess water remaining in the respiratory trees by gently squeezing the posterior half, and then quickly blotted dry and weighed.

To obtain an estimate of the errors associated with the total length and total weight measures used, ten sea cucumbers were measured ten times at 15-minute intervals. Details of the analysis and table of results are included in Sewell (1990). Raw data are included in Table 1.

The results showed that total length was not a very reliable measure of size (Sewell, 1990). Individual sea cucumbers varied up to 6 cm in length. In this study, however, there was no correlation between the size of animal measured in the field prior to collection (i.e. underwater), and the mean of the ten repeated measures in the laboratory. I, therefore, do not recommend the use of length to measure size.

Total weight appeared to be a reliable measure of size in *Stichopus mollis*, provided that sediments were removed from the gut and excess water squeezed from the respiratory trees. Analysis showed that a single measure had a reliability of approximately 95 per cent in estimating the mean

Table 1: Repeated measures analysis of total weight and total length in *Stichopus mollis*

Animal	Weight range (g)	Mean (g)	S.D. (g)	Length range (cm)	Mean (cm)	S.D. (cm)
1	178.1 - 205.0	189.4	8.3	17.5 - 20.5	18.5	1.0
2	178.2 - 206.1	198.3	8.8	17.0 - 21.5	19.4	1.3
3	138.6 - 156.9	145.6	6.1	16.5 - 19.5	17.9	0.9
4	146.4 - 159.0	154.7	6.2	14.5 - 20.0	16.9	1.9
5	173.6 - 194.4	183.9	7.1	16.0 - 22.0	18.1	1.9
6	183.2 - 193.1	188.1	3.4	18.0 - 19.5	18.9	0.5
7	103.8 - 115.6	107.1	3.4	12.5 - 17.0	14.8	1.4
8	148.6 - 166.1	156.8	5.7	16.0 - 19.5	18.1	0.9
9	154.7 - 163.8	158.7	3.1	15.5 - 19.0	17.7	1.1
10	175.9 - 203.7	191.6	7.5	18.5 - 20.0	19.4	0.5

of the ten measures (Sewell, 1990). A high correlation was also found between total weight and the drained weight used in the calculation of the gonad index (r=0.95, n=480), suggesting that total weight was a reasonably accurate and non-destructive measure of size in this species.

So in conclusion, a reasonable measure of weight could be obtained by the following protocol for *Stichopus mollis*

(i) Empty the alimentary canal in such a way that sea cucumbers cannot reconsume the sediments released as faeces;
(ii) Allow a relaxation period in the tank;
(iii) Squeeze excess water from the respiratory trees;
(iv) Blot quickly and weigh.

These methods were found to be suitable for calculation of gonad indices; however, if animals are to be reweighed for estimates of growth a number of measurements should be taken, and a mean calculated. The method described here reduces some of the variation, by at least ensuring that all the animals have empty guts before measurement.

References:

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Recent trends in sea cucumbers exploitation in New Caledonia

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The history of the sea cucumber fishery in New Caledonia has been traced back to the nineteenth century from various documents and statistics. The exports have shown wide fluctuations in connection with political and socio-economic events, as well as with the status of the biological resource (Conand, 1989, 1990).

Evolution of the exports

The most recent period of revival started in 1983, when a few New Caledonians of Chinese origin undertook to organise the fishing, processing and trade. As the catches in New Caledonia are all exported, the export statistics provide easily obtainable accurate data.

Table 1 shows the fluctuations in tonnage between 1983 and 1990. For this period, the mean annual export was 103 tons. Production was not constant but oscillated between years, giving peaks in landed volume during 1984, 1986, 1988 and 1990.

Table 1. Evolution of the recent beche-de-mer exports from New Caledonia

Year	1983	1984	1985	1986	1987	1988	1989	1990
Tonnage	15	150	89	180	77	135	55	126
exporters	2	4	7	6	4	3	3	4