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Studies on the sea cucumber fishery in the North Western coastal region of Sri Lanka

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Abstract

Present study was carried out at the major landing sites at Kalpitiya and Mannar in the North Western coastal region of Sri Lanka from October 2002 to April 2003. A total of 16 sea cucumber species belong to the Order Aspidochirotida were identified. Of these, 12 species belonged to Family Holothuridae and four to Family Stichopodidae. *Holothuria scabra* and *H. spinifera* were found to be restricted to the Mannar area whilst *H. fuscogilva, H. nobilis, Actinopyga echinites, Bohadschia argus, B. marmorata,* unidentified *Bohadschia sp, Thelenota ananas* and *T. anax* were recorded only in the Kalpitiya area *H. atra*, *H. edulis*, *A. miliaris*, *A. mauritiania* and *Stichopus chloronotus* were found in both areas but these species were not very frequent in catches. Sea cucumbers were harvested by fishers through diving and hand picking. Total catch and effort in the two areas showed marked differences. In Kalpitiya area *B. marmorata* was dominant in catches while in Mannar *H. scabra* was dominant. During the period of survey, the highest estimated catch was recorded in March 2003 in Kalpitiya area (22,692 Numbers) and January in Mannar area (16,269 Numbers). The fishing effort remained at a more or less steady level in Mannar area throughout the study period (7 – 9 boats day^{-1}). However in Kalpitiya area, fishing effort varied considerably (7 – 13 boats day^{-1}) and the maximum and minimum fishing efforts were reported in March 2003 and October 2002 respectively. Nevertheless there was no significant difference between the mean number of boats engaged in this fishery in the two areas. Significantly high catches per diver per day was noted in Kalpitiya area (22.6 Numbers day^{-1}) than in mannar (5.5 Numbers day^{-1}) ($p < 0.001$). The estimated total number of sea cucumbers caught in Mannar and Kalpitiya area during the present study was 102,280. Of these 47,507 individuals were caught from Kalpitiya area and 54,773 were caught from Mannar area. Estimated values

for asymptotic length (L_∞) of *A. echinites, A. miliaris, B. marmorata*, unidentified *Bohadschia. Sp.* and *H. scabra,* were 32 cm, 41.5 cm, 56.3 cm, 41.5 cm, and 34.4 cm and the growth coefficients were 1.9 year^{-1}, 2.3 year^{-1}, 1.35 year^{-1}, 1.8 year^{-1}, 0.8 year^{-1} respectively. The highest mortality estimated for *A. miliaris* while the lowest was for *H. scabra*. It appears that size regulation is the most important measure for sustainable exploitation of existing sea cucumber stocks in the North western coastal region of Sri Lanka.

Introduction

Sea cucumbers (Class: Holothuroidea) are found in many marine habitats of all latitudes, from the foreshore to greater depths. They are very common in the Indian Ocean and the South West Pacific (Conad 1990). According to James (1990), there are 650 species of sea cucumbers in the various parts of the world. They are usually benthic (Rowe 1969) and non-selective suspension feeders (Chenoweth and McGowan, 1994).

The consumption of holothurians either raw or after very simple preparation is very common specially in Japan and Korea (Conad 1979). Various commodities are reported to be prepared from sea cucumbers. The gutted body wall, named as 'namako' is consumed raw while the dry form of ovaries known as 'konoko' and salted, fermented respiratory trees known as 'minowata' are considered as delicacies (Conad 1994). The intestines are also eaten as it believed to be particularly good for pregnant women and new mothers (Duraira, 1982). Intestine of some holothurians such as *Stichopus variegates* are also used as bait. The muscles bands of some species are used as clam substitutes in Asia and the United States (Bruce, 1983). Further an extract of boiled skin is drunk as a tonic in Malaysia (Conad 1990). The toxins of sea cucumbers have antiviral, antitumoral, anticancerous and antifertility properties and are used in the pharmaceutical industry (Nagabhushanam et al. 1994). According to the traditional Chinese medicine, extracts of sea cucumbers are used to treat the weakness, impotence and debility of aged, constipation and frequent urination. From the western medical viewpoint, the sea cucumber is valuable because it serves as a rich source of the polysaccharide condroitoin sulfate, which is well-known for its ability to reduce arthritis pain. It is also credited with curative powers for ailments like high blood pressure and some muscular disorders (James and James 1994a).

Certain species of sea cucumbers are fished for the preparation of highly priced export product known *as beche-de-mer* which has high market demand (James and James 1994b). *Beche de-mer* industry has originated in China in the 18th century and this has been introduced subsequently to other countries including Sri Lanka by Chinese people (Conad 1990). According to Hornell (1917) *beche-de-mer* appear to be one of the commodities taken to China during the last one thousand years when trade existed between South India, Sri Lanka and China.

Though there was a well established fishery for sea cucumbers in the past, at present it has been restricted to certain areas of the country. Presently fishing is conducted in the Kalpitiya, Trincomalee, Kalmunai and Batitcalloa areas especially for *H. scabra.* Due to the high price of *beche-de-mer* in recent years, other species such as *Bohadschia marmorata* are also fished thus relieving the fishing pressure on*H. scabra* to some extent.

In Sri Lanka research on holothurians or any other Echinodermata species are at the very elementary level. Although sea cucumbers are fished in large numbers around the year from various parts of island, no data are available on their landings. Without data on catch and effort it is not possible to estimate the potential yield, maximum sustainable yield and the standing crop. Therefore present study was carried out to study the commercially important holothurian species, their catch, effort and some important population parameters of the sea cucumbers in the north western coastal region of Sri Lanka.

Materials and Methods

Collection of catch and effort data

Catch and effort data of the sea cucumber fishery in the North Western coastal waters of Sri Lanka were collected at the major landing sites in Kalpitiya and Mannar from October 2002 to April 2003. On each day more than 95% of the total number of boats operated were sampled randomly. Sampling was done as soon as the catch was landed. At the landing sites, sea cucumbers were grouped into the species and the total length of each individual was measured to the nearest 0.1 cm using a measuring board. At the time of measurement, these sea cucumbers were alive. Before taking length measurements slight pressure was applied to their bodies. Then they start to elongate and at one point no further elongation takes place. The total length was measured at this point. Total weight of each individual was also measured using a field balance.

The total catch, catch of different species and the number of divers engaged in the fishing operation were recorded for each boat sampled. Time of fishing and information about the fishing ground were obtained by interviewing the fishermen. The total number of boats operated in a particular day was also recorded to estimate the total catch for the day. All the species found were brought the laboratory for further identification.

Species identification

Identification was done using the key prepared by Conad (1998). Small pieces of body wall were removed from the bivium and the trivium, as well as from the oral tentacles and podia, and macerated in sodium hydroxide in order to dissolve the organic material. The spicules were then washed in distilled water, rinsed in alcohol and examined under the microscope to confirm identification.

Analysis of data

(A). Catch data

The monthly variation of the total catch, catch of most abundant species in the catches, effort and catch per unit effort (expressed as numbers per boat per day and numbers per diver per day) were determined using the data collected on each sampling day.

Total catches at the different landing sites were statistically compared using Student t test (Zar 1984).

(B). Population dynamics

The monthly length frequency data for Holothuria scabra, Bohadschia marmorata, unidentified Bohadschia*sp, Actinopyga miliaris* and *Actinopyga echinites* were analyzed using the FiSAT software programme (Gayaillo et al. 1994) to estimate the parameters of Von Bertalanffy growth equation. The fitting of the best growth curve was based on ELEFAN programme which allowed the curve to pass through the maximum number of peaks of the length frequency distribution. With the aid of the best growth curve the growth constant (K) and the asymptotic length (L_∞) were estimated following the methodology described by Amarasinghe and De Silva (1992).

The instantaneous total mortality coefficient (Z), fishing mortality coefficient (F) and the exploitation rate (E) were estimated using the length converted catch curve method which is incorporated in the FiSAT software package.

Instantaneous natural mortality coefficient (M) was estimated using the following multiple regression equation described by Pauly (1980).

$$\text{Log}_{10} M = -0.0066 - 0.279 \log_{10} L_\infty + 0.6543 \log_{10} K + 0.4634 \log_{10} T$$

where,
M - Instantaneous natural mortality coefficient
L∞ - Asymptotic total length
K - Growth constant per year
T – Temperature in degrees Celsius

The environmental temperature was used as 28°C as this is the value recorded for water temperature in this area by Anon. (1978). However the Pauly's equation is not recommended to be used for animals other than fish and crustaceans.

As such M was also estimated by plotting monthly Z values against monthly fishing effort as described by Gulland (1983). This method was thought to be more suitable as sea cucumbers are short lived species.

The Yield per recruit as functions of E and size at first capture incorporating probabilities of capture were also determined using the FiSAT software package (Gayaillo et al., 1994).

Results

The sea cucumber species present in the commercial catches

A total of 16 species of sea cucumbers were identified during the present study (Table 1). All these species belong to Order Aspidochirotida. Of these, 12 species belonged to Family Holothuriidae and 4 species belonged to Family Stichopodidae.

Fishing season

Fishing season for sea cucumbers along the north western coast of Sri Lanka starts in the middle of October and continues until the end of April of the following year. No fishing is carried out in other months as the sea is rough.

Fishing Method

Sea cucumbers in this region are mainly harvested through diving and hand picking. In the Kalpitiya area, scuba diving is carried out by all the divers while in Mannar area only skin diving is allowed. The fishing crafts used are FRP boats with outboard motors. Two fishermen, a diver and the boat operator go for a fishing trip in Kalpitiya area while 8 to 10 divers use one boat in Mannar area. The fishing crafts leave around 7.30 a.m. – 8.00 a.m. and return around 2.30 p.m. – 3.30 p.m. Night fishing for *Thelenota anax* is carried out in April in Kalpitiya area. When night fishing is done they leave around 9.00 p.m. and come back in the early morning around 2.00 a.m. – 3.00 a.m.

Catch and Effort

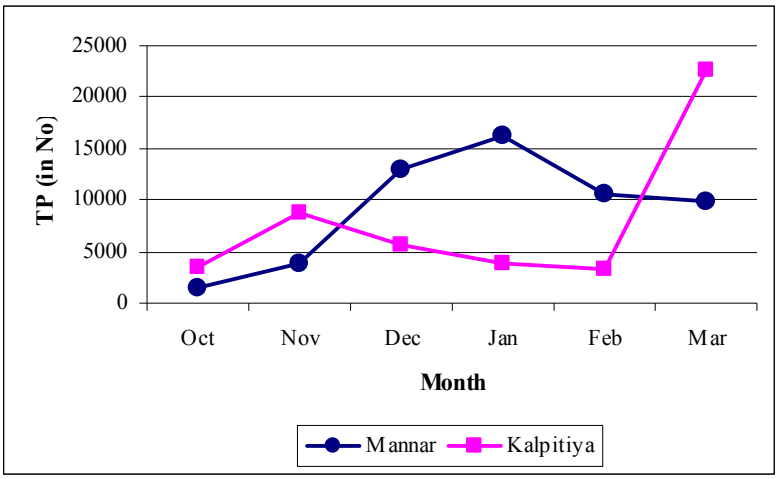
Figure 1(a) shows the variation of fishing effort (in number of boats operated per day) in the two different fishing areas studied. The number of boats operated per day ranged from 7 to 13 in in Kalpitiya area while in Mannar it was 7 to 9. The highest fishing effort was observed in March 2003 in Kalpitiya area and in February 2003 in Mannar area while the lowest fishing effort was reported in October 2002 in both areas. Fishing effort in Kalpitiya was higher than that of the Mannar area. However, there was no statistically significant difference between the monthly mean fishing effort in the two fishing areas ($t = 2.01$; $n=6$; $p > 0.05$).

Figure 1(b) shows the monthly variation of total catch in Kalpitiya and Mannar areas. In Kalpitiya area maximum total production (22,692 Nos per month) was observed in March 2003 while in Mannar area, it was in January 2003 (16,269 Nos per month). In both regions, the lowest production was observed in October 2002. Although the total production of sea cucumbers in Mannar area (54,773 Nos for the whole study period) was higher than that of Kalpitiya area (47,508 Nos for the whole study period), monthly mean production in the two areas were not significantly different from each other ($t =1.83$; $n = 6$; $p > 0.05$).

Table 1: The sea cucumber species recorded during the present survey, length, weight (mean values and ranges) and retail price (per piece) of the commercially exploited sea cucumbers in Mannar and Kalpitiya areas

Scientific name	English name	Local name	Length (cm)	Mean length (cm)	Weight (g)	Mean weight (g)	Price (Rs) (per piece)
Family : Holothuriidae							
Actinopyga echinites	Deep water redfish	Goma attaya	13.5 - 30.7	22.59	374 -1325	669.20	90.00
Actinopyga miliaris	Blackfish	Kalu attaya	17.2 - 41.3	27.56	220 - 4000	675.59	90.00
Actinopyga mauritiana	Surf redfish	Gal attaya	-	-	-	-	120.00
Bohadschia argus	Mummyfish		-	-	-	-	100.00
Bohadschia marmorata	Chalkyfish	Nool attaya	19.6 - 56.1	33.83	150– 3125	1148.42	150.00
Unidentified *Bohadschia sp.*			18.3 - 40.5	28.63	232– 1700	730.19	150.00
Holothuria atra	Lolly fish	Narri attaya	20.5 - 35.4	27.25	350– 1100	595.00	24.00
Holothuria edulis	Pinkfish	Rathu attaya	15.9 -28.5	18.30	275 – 450	310.50	15.00
Holothuria fuscogilva	White teatfish	Preema attaya	25.2 - 46.2	35.68	1000-4200	1892.19	500.00
Holothuria nobilis	Black teatfish	Polanga attaya	23.8 - 41.7	34.28	985– 2500	1719.32	500.00
Holothuria scabra	Sand fish	Jaffna attaya	11.1 - 29.5	18.20	107 – 720	271.95	90.00
Holoturia spinifera	Brown sand fish		-	-	-	-	60.00
Family : Stichopodidae							
Stichopus chloronotus	Greenfish	Dabalaya	25.2 – 38.7	31.30	285 – 950	565.70	35.00
Stichopus variegatus	Curryfish		30.5 – 48.2	37.55	855– 2100	1350.00	50.00
Thelenota ananas	Prickly redfish	Annasi attaya	30.3 – 50.9	39.80	1050-2900	1725.00	24.00
Thelenota anax	Amberfish	Poona attaya	19.3 -38.5	27.40	125 – 495	378.25	40.00

(a)



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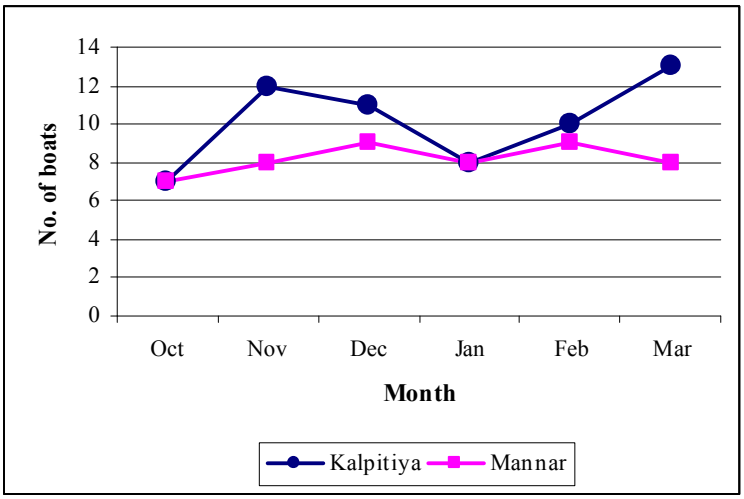


Figure 1. (a) Monthly variation of fishing effort (number of boats per day) in the two fishing areas studied (b) Monthly variation in catch of different species of the sea cucumber total production (TP, in numbers per month) in the two areas studied.

Among the 16 species listed in Table 1, 6 species namely, *Bohadschia marmorata*, unidentified *Bohadschia* sp, *Actinopyga miliaris, Actinopyga echinites*, *Holothuria fuscogilva* and *H. nobilis* were dominant in the catches in Kalpitiya area and *Holothuria scabra* and *H.spinifera* were dominant in Mannar area.

The highest catches for *B. marmorata*, *A. miliaris*, *A. echinites*, *H. fuscogilva* and *H. nobilis* were reported in November 2002 in Kalpitiya area. *B. marmorata* showed the highest total production in Kalpitiya area followed by *A. miliaris*. *H. nobilis* reported the lowest production and this fishery in Kalpitiya area and was restricted only for two months i.e., November and December. In Mannar area, both *H. scabra* and *H. spinifera* reported the highest total catches in the month of January 2003 and lowest catch in the October 2002 (Figure 2).

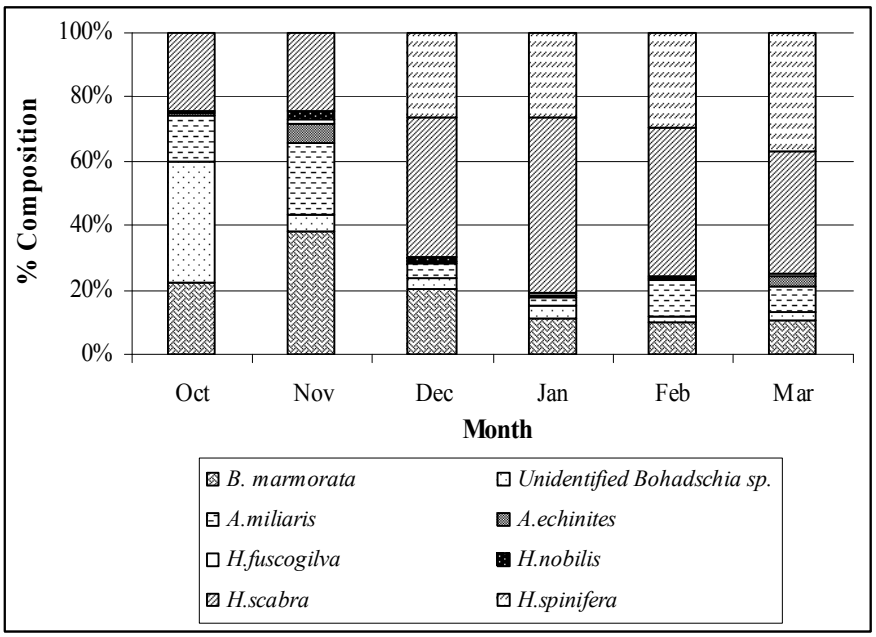
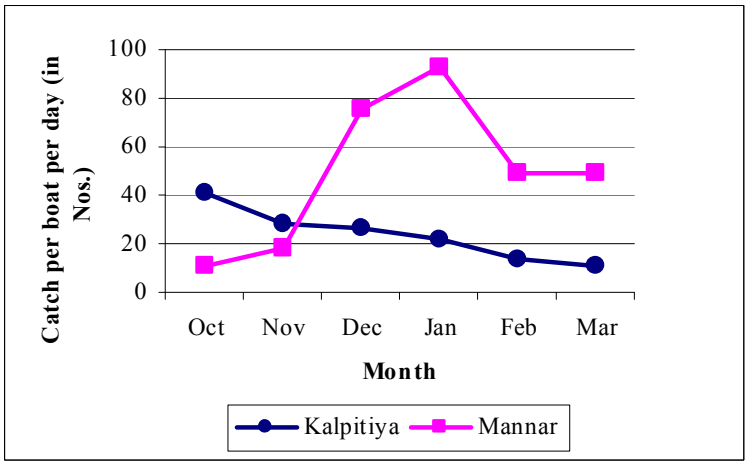


Figure 2: Percentage composition of major sea cucumber species in commercial landings

Figure 3(a) shows the monthly variation of catch per boat per day in two fishing areas. There is an increasing trend in daily catch per boat from October 2002 to January 2003 in Mannar area while in Kalpitiya area a gradual decrease from October 2002 to March 2003 was evident. The daily mean catch per boat in Mannar area (49 Nos/boatday) was not significantly different from that for Kalpitiya area (24 Nos./boatday) ($t = 1.88$; $n = 6$; $p > 0.05$).

(a)



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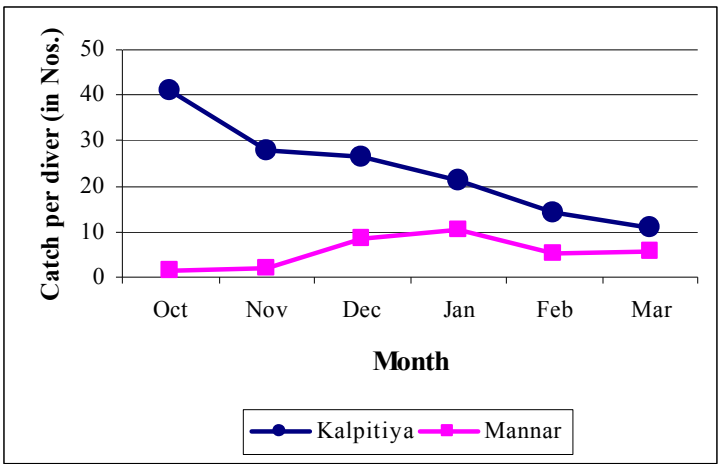


Figure 3. (a) Monthly variation of catch (in numbers) per boat per day in Kalpitiya and Mannar areas (b)Monthly variation of catch (in numbers) per diver per day (CPUE) in Kalpitiya and Mannar areas

Figure 3(b) shows the monthly variation of catch per unit effort expressed as catch per diver per day in the two areas. Decreasing trend of CPUE measured on catch per diver per day was observed from October 2002 to March 2003 in Kalpitiya area while there was a gradual increasing trend from October 2002 to January 2003 in Mannar area. The catch per diver per day in Kalpitiya (23.6 no/day) was significantly higher than that in Mannar (5.5 no/day) ($t = 3.94$; $n = 6$; $p < 0.001$).

Night diving for sea cucumbers was not carried out in the north western coast of until March 2003. For the first time, night diving for sea cucumbers was started in March 2003 in the Kalpitiya area for *Thelenota anax*. As this species is not efficiently caught during day time it is necessary to carry out night diving. The total number of sea cucumbers caught per boat per day during night was very high and varied between 378- 643. However due to unfavorable weather condition night diving was carried out only for about two weeks during the study period.

Length and Weight

The length and weight ranges of commercially exploited sea cucumbers in the Mannar and Kalpitiya areas are summarized in Table 1. The maximum length (56.1cm) was recorded for *B. marmorata* while maximum weight (4200g) was recorded in *H. fuscogilva.* The lowest values for length (11.1 cm) and weight (107 g) was recorded for *H. scabra*. All the species except *H. scabra* grows above the mean length (22 cm) and mean weight (660 g) of the catch. No length and weight data are available for *H. spinifera* as fishermen did not allow to measure them. As *Actinopyga mauritiana, Bohadschia argus* were very rarely recorded in the commercial catches, length and weight data could not be collected.

The Prices

The market value of the fresh sea cucumbers varies according to the species. Table 1 shows the selling prices of sea cucumber species caught in Mannar and Kalpitiya areas. The highest price was recorded for *H. nobilis* and *H. fuscogilva* while the lowest price was recorded for *H. edulis.*

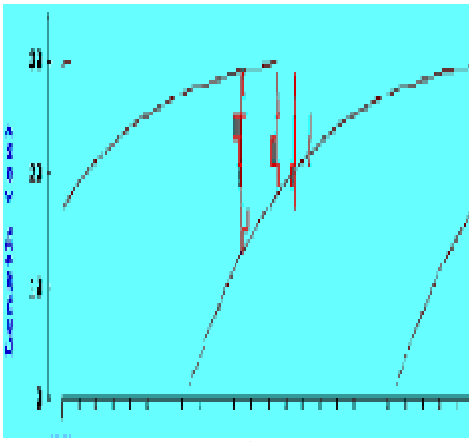
Population parameters

The population parameters were estimated only for five species out of the six most abundant species except *H. spinifera* using FISAT software package and results are presented in Table 2. Some important growth parameters are also summarized in Figures 4, 5, 6, 7 and 8. Although *H. spinifera* is highly abundant, these parameters could not be estimated for this species due to non-cooperation of the fishers.

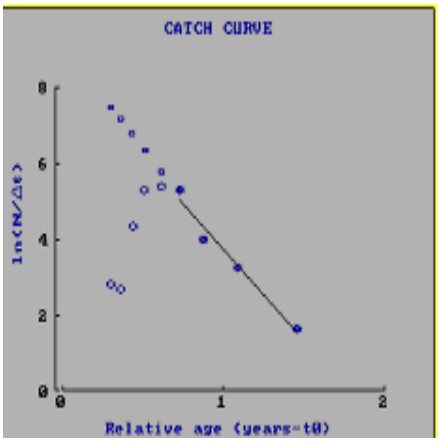
Table 2: Estimated population parameters for some important sea cucumber species

Species	L_∞	K	R_n	Z	M Pauly's method	M Gulland's method	F	E	E Opt.	L_{50}	L_{50} Opt.
A.echinites	32	1.9	0.145	4.83	2.67	2.62	2.21	0.45	0.55	20.8	17.6
A. miliaris	41.5	2.3	0.106	6.31	2.81	1.94	4.37	0.55	0.55	23.4	24.9
B. marmorata	56.3	1.35	0.198	4.74	1.82	1.01	3.73	0.62	0.5	26.8	22.8
Bohadschia sp 1	41.5	1.8	0.275	4.57	2.4	3.3	2.69	0.47	0.55	25.2	28.15
H. scabra	34.4	0.8	0.124	3.43	1.49	1.16	2.27	0.57	0.45	15.7	15.48

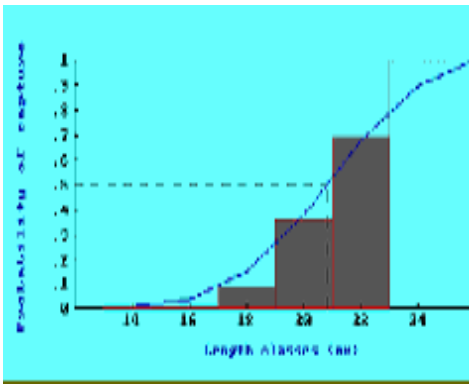
L_∞ - Asymptotic total length
K - Growth constant per year
R_n – Regression Value
Z – Total Mortality
$M_{\text{Pauly's method}}$ – Natural mortality (Pauly's method)
$M_{\text{Gulland's method}}$ - Natural mortality (Gulland's method)
F – Fishing Mortality
E – Exploitation Rate
E_{opt} – Optimum Exploitation Rate
L_{50} – Length at which 50% of the fish is retained
L_{50Opt} – Optimum length at which 50% of the fish is retained



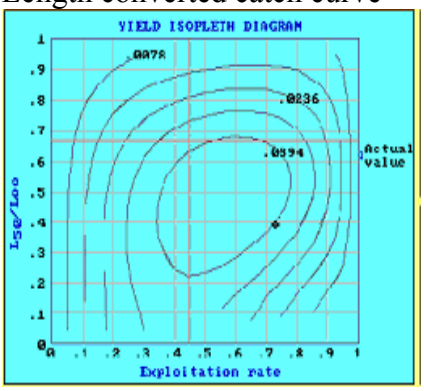
Growth curve



Length converted catch curve

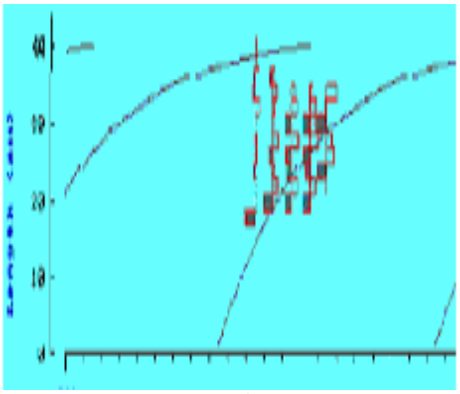


Probability of capture analysis



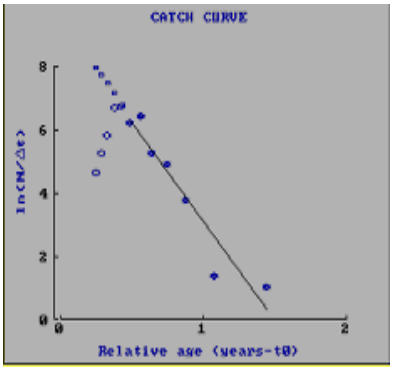
Yield isopleth curves

Figure 4. Estimated growth curve, length converted catch curve, probability of capture analysis and yield isopleth curve for *Actinopyga echinites.*

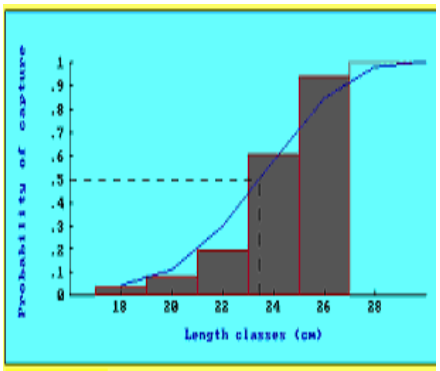


Months

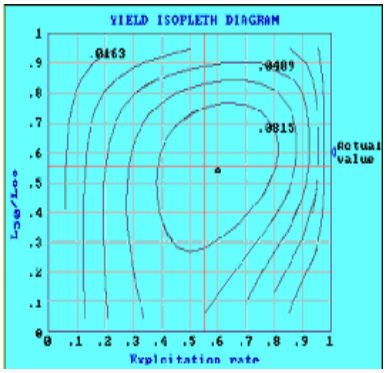
Growth curve



Length converted catch curve

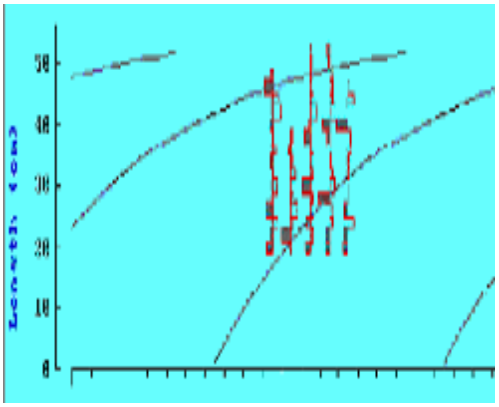


Probability of capture analysis

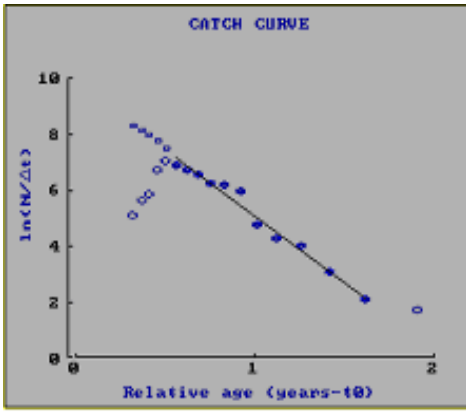


Yield isopleth curves

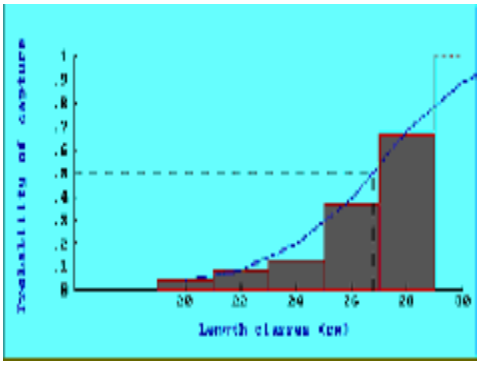
Figure 5. Estimated growth curve, length converted catch curve, probability of capture analysis and yield isopleth curve for *Actinopyga miliaris*



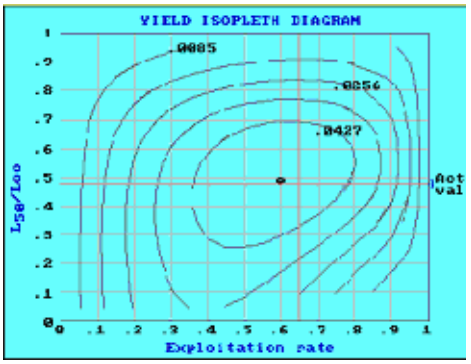
Growth curve



Length converted catch curve

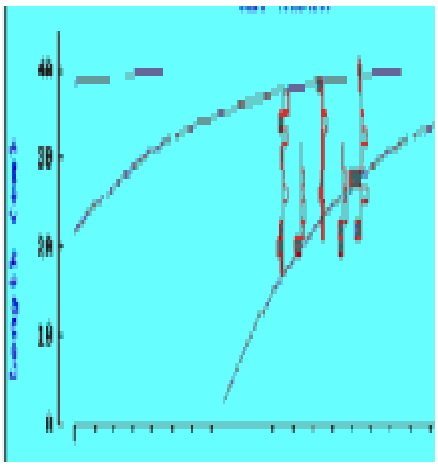


Probability of capture analysis



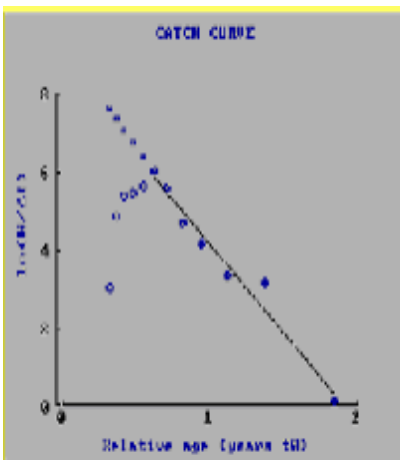
Yield isopleth curves

Figure 6. Estimated growth curve, length converted catch curve, probability of capture analysis and yield isopleth curve for*Bohadschia marmorata.*

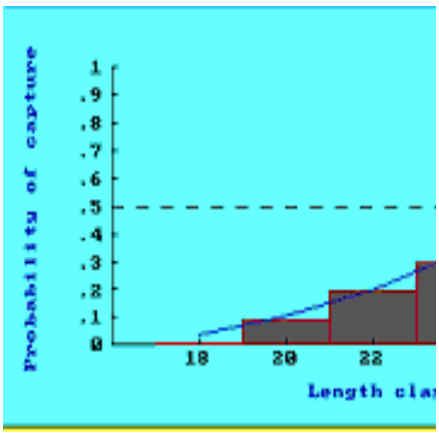


Months

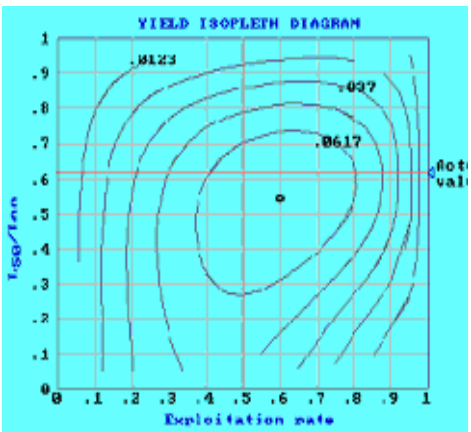
Growth curve



Length converted catch curve

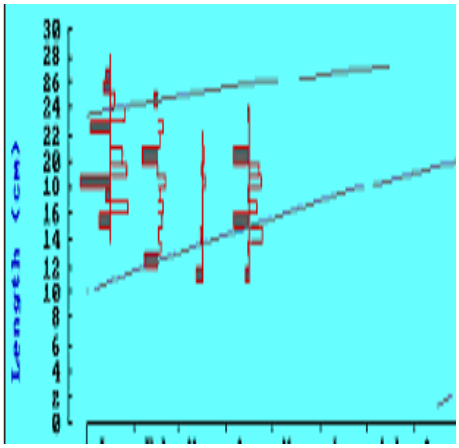


Probability of capture analysis

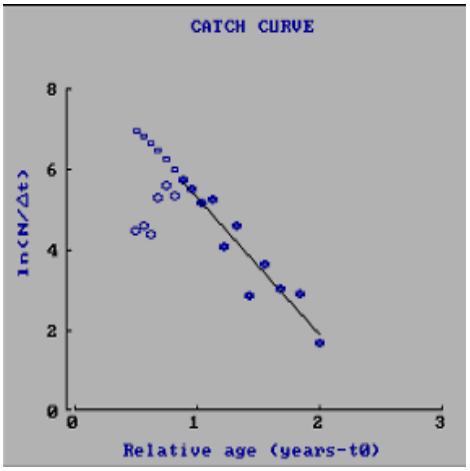


Yield isopleth curves

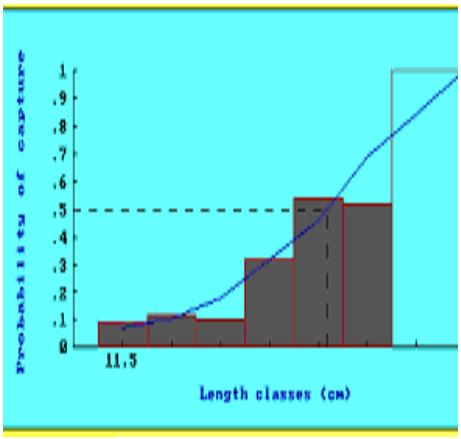
Figure 7. Estimated growth curve, length converted catch curve, probability of capture analysis and yield isopleth curve for unidentified *Bohadschia* sp



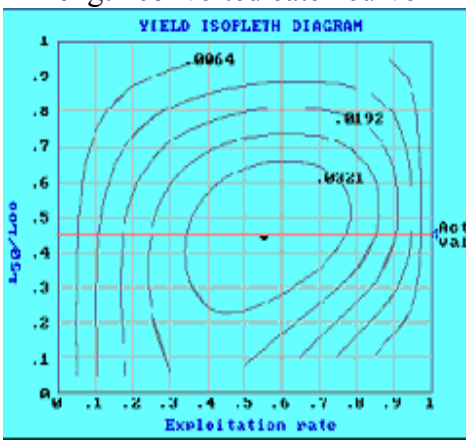
Growth curve



Length converted catch curve



Probability of capture analysis



Yield isopleth curves

Figure 8. Estimated growth curve, length converted catch curve, probability of capture analysis and yield isopleth curve for *Holothuria scabra*

Discussion

James (1994b) reported that there are 49 species of sea cucumbers in Indian Ocean and whereas only 24 species are reported from the coastal areas. The results of this study revealed that there are 16 commercially important sea cucumber species in the North western coast of Sri Lanka. Of these *H. scabra* and *H. spinifera* are the most abundant species in the Mannar area while the other 14 species are abundant in the Kalpitiya area. During this study no individuals of *H. scabra* and *H. spinefera* were recorded in Kalpitiya area and individuals of *H. fuscogilva, H. nobilis, A. echinites, B. argus, B. marmorata, T. ananas,* and *T. anax* were not recorded in the Mannar area

Despite the close proximity of India and Sri Lanka it has been reported that there is a marked difference in the species composition of holothurians along the coasts of these two countries (James 1994a). For example, although the genus *Actinopyga* is not recorded on the Indian side of the Gulf of Mannar and Palk Bay, five species of this genus had been recorded in Sri Lanka (James 1994a). Of these five species, three species, namely *A. echinites, A. mauritiana* and *A. miliaris* were reported during this study. All these species were predominant in the catches of Kalpitiya area and latter two species were found in the Mannar region in small numbers *B. marmorata* was not reported in Indian territory whereas four species of *Bohadschia* viz., *B. argus, B. marmorata, B. tenissima and B. vitiensis* were known in Sri Lankan territory (James 1994a). During the present study, *B. argus, B. marmorata* and another unidentified species of *Bohadschia* were present only in Kalpitiya area. Therefore the results of the present study indicate that there are differences in the holothurian communities in different areas of northwestern coastal region of Sri Lanka.

Four species of genus *Actinopyga* namely *A. mauritiana, A. echinites, A. lecanora* and *A. miliaris* are known from Indian seas (James 2001). Except *A. lecanora,* other three species were recorded in the north western coastal region of Sri Lanka during the present study. According to James (2001) both *A. miliaris* and *A. echinites* grow to a length of about 300 mm and reach a weight of 0.5 – 2 kg. However during the present study higher length and weight values recorded for these species. According to James (1994a), teatfish species specially *H. nobilis* and *H. fuscogilva* are abundant in some areas of Sri Lanka. The present study also supports this statement as both these species were found in catches from Kalpitiya area. James (1994a) has reported that teatfish grows to a length of 400 mm and attains a weight of 2 - 3 kg. The value reported in present study for length and weight are higher than the values reported by James (1994a).

James (1994a) had stated that free movements of holothurians from Sri Lanka to the Indian side are prevented due to ocean currents and resulting in differences in species diversity. Species diversity in Kalpitiya and Mannar may also be due to the some oceanographic factors as suggested by James (1994a). In addition, these differences in the species composition in the two

regions may be due to differences in ecological niches and microhabitat conditions coupled with their slow moving nature.

So far, the fishery for *T. anax* has been recorded only in the east coast of Sri Lanka (Personal observation) and there were no past records of the fishery for this species in Kalpitiya area. Catching of *T. anax* by diving at night has been a recent development in Kalpitiya area. The results of the present study also indicate that the species diversity is low in Mannar compared to Kalpitiya. However total production is higher in mannar area than in Kalpitiya area as 54, 773 and 47,507 individuals were caught from these two areas respectively.

Teatfish, specially *H. nobilis* and *H. fuscogilva* receive the highest price in the world market (James 2001). Present study reveals that these two species command the highest price in the local market too. As holothurians are caught in Sri Lanka mainly for export market, the local market values essentially reflect their export market value.

As holothurian growth parameters are rarely discussed in literature, it is difficult to make any comparisons with the past records. The value for natural mortality (M) was estimated using both the Pauly's equation (Pauly, 1980) and the method described by Gulland (1975). Since Pauly (1980) has stated that his equation is valid only for fishes and crustaceans the other method based on total mortality and fishing effort was used. As sea cucumbers are short lived species they have a high turnover rate. Therefore the use of the method described by Gulland (1975) appears to be suitable for sea cucumbers. On the other hand, when using Pauly's method, water temperature was assumed to be 28^0C. However, there are no records for sea water temperature in this region. Therefore, use of M values obtained from Gulland method appears to be justifiable.

The optimum fishing mortality of an exploited stock should be approximately equal to natural mortality and therefore exploitation ratio (E) be equal to 0.5 (Gulland 1975). As such, it appears that *H. scabra, B. marmorata* and *A. miliaris* are over exploited while unidentified *Bohadschia species* and *A. echinites* are under-exploited.

The results of the present study also give the optimum L_{50} values for each species. When these values are compared with the present L_{50} values, it can be concluded that size regulation is needed for sustainable utilization of existing sea cucumber stocks in the north western coastal regions of Sri Lanka. Holothurians are usually caught along with chanks when the sea is calm. Therefore it is easy to monitor and regulate the catches. Sea cucumbers live out of water for a long time and therefore if a minimum permissible size is declared, the undersized specimens that are landed could be released back into the sea for further growth and propagation.

Acknowledgement

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