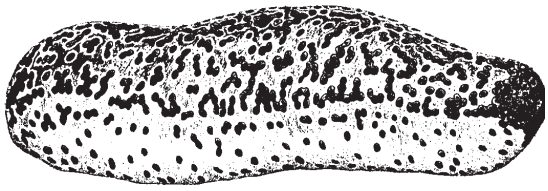
B E C H E - D E - M E R

Abstracts, Publications Workshops and Meetings



Recent publications on tropical holothurians

Chao, S.M., C.P. Chen and P.S. Alexander (1993). Fission and its effect on population structure of *Holothuria atra* (Echinodermata: Holothuroidea) in Taiwan. *Mar. Biol.* 116: 109–115.

Conand, C. (1993). Ecology and reproductive biology of *Stichopus variegatus* an Indo-Pacific coral reef sea cucumber (Echinodermata: Holothuroidea). *Bull. Mar. Sci.* 52 (3): 970-981.

Conand, C. (1993). Reproductive biology of the characteristic holothurians from the major communities of the New Caledonia lagoon. *Mar. Biol.* 116: 439–450.

Lane, D. (1992). Biogeographical notes on the northward extension of the known latitudinal range for the tropical stichopodid sea cucumber, *Thelenota anax* H.L. Clark (Echinodermata: Holothuroidea). *Raffles Bulletin of Zoology*, 40 (2): 175–178.

Kerr, A., E. Stoffel and R. Yoon (1993). Abundance distribution of Holothuroids on a windward and leeward fringing coral reef, Guam, Mariana Islands. *Bull. Mar. Sci.* 52 (2): 780-791.

The following text summarises the results of a German 'Diplomarbeit' with the original title 'Untersuchungen zurkologie zweier sedimentfressender Holothurien, *Holothuria (Halodeima) atra* und *Stichopus chloronotus*, im Riffbereich um Lizard Island, Australien' (Ecology of two sediment-feeding Holothurians, *Holothuria (Halodeima) atra* (Ger, 1833) and *Stichopus chloronotus* (Brand, 1835), on reefs near Lizard Island, Australia), by Sven Uthicke, Institut für Hydrobiologie und Fischereiwissenschaft, Zeiseweg 9, 2000 Hamburg 50, Germany.

Populations of the two holothurian species were monitored during six consecutive months (November 1992 – April 1993) in three permanent transects (10 x 100 m) across a reef flat near Lizard Island, Great Barrier Reef. Each transect was subdivided into five zones. *H. atra* and *S. chloronotus* were the most abundant shallow-water holothurian species on the reefs around Lizard Island. On the transects and in other observed areas they nearly always co-occurred, but mostly one of the species clearly dominated the other. Along the transects both species showed distinct heterogeneous distribution patterns in abundances and average body size.

Potential nutrients for holothurians (measured as bacterial numbers, protein and chlorophyll a content) were determined in sediments of each zone of the transects. Although the nutritional value of the sediments was found to differ significantly between single zones, no correlations were found between these values and the distribution patterns of the holothurians. This suggests that nutrients were not a major limiting factor for the distribution of *H. atra* and *S. chloronotus* on the reef flat under study.

The bottom coverage with different substrata (Scleractinia, Alcyonaria, dead hard coral, coral rubble, pavement and sediment) was estimated along the transects. The coverage with coral rubble showed a significant negative correlation with the mean body weight of both holothurian species. This suggests that zones with a high percentage of coral rubble are habitats for juvenile holothurians. These zones are generally in the middle of the reef flat and are probably best suitable for larval settlement. It appears that individuals migrate towards the reef margins as they become larger.

The intensity of water movement in the zones was measured by the erosion of plaster-of-Paris cubes

and showed a clear gradient along the transects as well as differences between the transects. The abundance and biomass of *S. chloronotus* decreased significantly in areas of high water-flow while *H. atra* appeared to be more adapted to these zones. Thus, the latter species was dominant in the more exposed zones while the former was more abundant in sheltered areas.

Temporal variations were observed in biomass and abundance of *H. atra* and *S. chloronotus*. The number of all *H. atra* in the transects increased from 296 to 345 during the observation period, while the biomass of this species was nearly constant. As no recruitment of juvenile *H. atra* could be observed, the increase of abundance is probably due to asexual reproduction by transverse fission. This assumption is supported by analyses of weight-frequency data. In contrast to *H. atra*, the abundance of *S.chloronotus* decreased from 279 in November to 227 in March; the biomass of this species showed a maximum in January. The decrease in abundance could be explained by a high mortality, probably due to strong winds and stronger current conditions which prevailed from the beginning of January until the end of the observation period. The overall mean abundance of *H. atra* on the transects was 10.7 individuals / 100m^2 (biomass: 128 g / 100m^2) the abundance of *S. chloronotus* had a mean of 9.0 individuals / 100m^2 (biomass: 141 g / m^2).

An average growth rate of 12g / month during the observation period was calculated for *S. chloronotus* employing Modal Progression Analyses (MPA). As this species is known to have two distinct spawning periods in November and March, the approximate age of each cohort could be assessed assuming all individuals resulted from one of these spawning periods. Plotting the weight of these cohorts against their assumed age resulted in an annual growth rate smaller (70 / 80 g / year) than the growth rate that could be extrapolated from data of the observation period (12 x 12 g = 144 g / year). This suggests a strong seasonal variation in the growth of *S. chloronotus*. MPA could not be applied to obtain growth rates for *H. atra*. This was probably due to asexual reproduction of this species, as the weight-frequency data showed no clear modes.

The daily activity rhythm of the two species under study was examined in two 24 h cycles in aquarium experiments. Faecal pellets were collected every two hours to determine their dry weight. *H. atra* was feeding day and night with the same intensity, whereas *S. chloronotus* stopped feeding at night. These findings were supported by field observations. During their nightly resting phase, individuals of *S. chloronotus* tended to hide under dead corals or larger rubble. During the daytime, *S.chloronotus* covered distances of about 27.2 cm per hour, which was significantly 'faster' than *H.atra* (12.9 cm / hour). Grain-size analyses of faeces of both species showed that *S. chloronotus* (median: 424 µm) selected for much finer sediments than *H.atra* (median: 1102 µm). The former species was frequently found feeding on pavement or between coral rubble while the latter fed in more open areas. Hence, micro-habitat and grain-size selection appear to be important means of niche separation between the two species.

An average-sized individual of *H. atra* (129-125 g) consumed about 67 g of sediment (dry weight) per day, an average *S. chloronotus* (in November: 144 g) 59 g. Assuming the determined densities on the reef flat, the populations of both species would rework about 4600 kg sediment / year per transect (1000m^2). This is approximately the weight of the upper 5 mm of sediment per 1000 m^2. Ten individuals of each species were sacrificed for analyses of gut contents. A sediment sample was taken directly in front of each specimen. No significant decrease in phycopigments (chlorophyll a and c, fucoxanthin) occurred during gut passage and the contents in the oesophagus were not higher than in the adjacent sediments. Pigment concentrations of sediments in front of *S. chloronotus* and in all gut segments of this species were significantly higher than the corresponding values in *H. atra*. From these observations I conclude that *S. chloronotus* is efficiently selecting for sediments rich in plant material. This selection does obviously not occur by taking up certain particles from a given sediment, but by carefully choosing the sediment spot to feed on. Meiofauna density in the ingested sediments of both holothurians species was significantly lower than in sediments near the holothurians. The ratio of living and dead diatoms was much smaller inside the intestines. This might indicate that at least a portion of the plant material ingested is digested as well.

Several aquarium experiments were conducted to examine the influence of holothurians on micro algae and bacteria in sediments. In a pilot experiment, bacterial concentrations in an aquarium with *S. chloronotus* and a control aquarium reached the same level (2,3-2,8 x 109 cells / ml) after 9 days. The bacterial population in an aquarium with *H. atra* reached this value after 14 days. A larger experiment showed that both species significantly reduced chlorophyll a concentrations in sediments compared to control aquaria. The reduction by *H.atra* was more distinct than by *S. chloronotus*. In further experiments both holothurian species were feeding intensively on sediments with cyano-bacterial mats, extinguishing these mats and preventing their development.

The review *New Scientist* of 11 December 1993 contained an article entitled 'The grub and the Galapagos', by Nigel Sitwell, on a clandestine fishery of *Isostichopus fuscus* that started in 1992. The exploitation was banned by the President of Ecuador, but there has been strong pressure by businessmen to revoke the ban. Scientists sent by IUCN reported that 'the sea cucumbers had been taken at a rate of 130,000 to 150,000 per day and predicted that if this continued, populations would be wiped out in the entire archipelago within three to four years'.

Sea cucumbers are still fished despite the ban. A new institution, 'The Presidential Advisory Commission of the Environment', has been created to examine the whole problem, take into account the conservationist opinion and the fishermen's interests and provide guidance. Charles Darwin Research Station is starting biological and ecological studies on holothurian populations.

Below is an abstract of a paper entitled ' Predictable and unpredictable spawning events: *in situ* behavioural data from free-spawning coral reef invertebrates', by Russ Babcock, Craig Mundy, John Keesing (Australian Institute of Marine Science, PMB No. 3, Townsville MC, QLD 4810, Australia) and Jamie Oliver (Great Barrier Reef Marine Park Authority, P.O. Box 1379, Townsville, QLD 4810, Australia), which was published in 1993 in *Invertebrate Reproduction and Development*.

We describe the spawning behaviour and some aspects of spawning periodicity in a diverse group of marine invertebrates, principally echinoderms, but including sponges, anthozoans, molluscs, and polychaetes. Our observations were made both opportunistically and on a systematic basis between 1978 and 1992 on the central and northern Great Barrier Reef.

Spawning was predictable in some of the species observed, for example *Bohadschia argus, Euapta godeffroyi,* and *Stichopus variegatus* (Holothuroidea), which exhibited regular lunar and diel periodicity. Others, such as *Holothuria coluber, Actinopyga lecanora,* and *Bohadschia graffei* (Holothuroidea), *Acanthaster planci* (Asteriodea), *Hyotissa hyotis* and *Arca* spp. (Bivalvia) exhibited no clear lunar or diel periodicity in spawning behaviours. Mass heterospecific spawnings which involved several species, often from different phyla, were commonly observed.

The species participating were usually those with unpredictable spawning patterns. While the species involved were diverse, there were also occasions when spawning involved species from the same genera. Fertilisation rates were measured *in situ* for the predictable spawner *Bohadschia argus* and were found to vary between 0 and 96 per cent depending on the circumstances of the spawnings. Fertilisation rates for the unpredictable spawners showed similar variability; *Holothuria coluber* and *Actinopyga lecanora* ranged from 9 to 83 per cent.

Eighth International Echinoderm Conference

The 8th International Conference was held in Dijon, France, from 6 to 10 September 1993, with several hundred participants from all over the world. Presented here are summaries of the communications on tropical sea cucumbers and the abstracts on sea cucumbers from other regions. They are presently with the referees and will soon be published, when accepted, by Balkema, Rotterdam.

1. Communications on tropical species

The fishery of the sea cucumbers *Isostichopus fuscus* and *Parastichopus parvimensis* in Baja California, Mexico, by L.R.S. Castro, National Institute of Fishery, Ensenada Baja California, Mexico

These species have been harvested along the east and west coast since 1988. The annual catch values in fresh weight from 1988 to 1992 were: 420, 703, 1000, 1783 and 1277 t.

The processed products: whole – gutted and dried, boiled skin, semi-frozen and raw fresh muscle, are totally exported to China (route L.A. Ca. USA). The maximum sizes measured were up 435mm in *I.fuscus* and 310mm in *P. parvimensis.*

The animals are hand-harvested by divers in shallow waters up to 30m deep on rock reefs. Both species are known to suddenly disappear or reappear in known fishing grounds in relation to seasonal changes in sea water temperatures. They are surface deposit feeders with mud, sand and remains of macroalgae, shells and sea urchin spines in their guts.

The animals eject their viscera but this behaviour is more drastic with *P. parvimensis* because it seems less tolerant to sun and air exposure. Sexes are separate, spawning in both species occurs in summer; in autumn–winter there are very few animals with gonads, very poorly developed. The adult size is 220-240mm (TL).

Through direct visual assessment of densities with quadrats drawn randomly we found: 1.46, 0.38 and 0.33 animals / m^2 and 720, 2115.5 gr / m^2 at west coast side. Average ranges of the measurements of the animals sampled were: TL, 217-263; GL, 210; BL, 100-109; DL, 64-57 (mm). TW,522-720; GW, 365-378; BW, 102-129; DW, 18-20 (grs).

These are data from samples of commercial catches for both coasts. The resource studies are for management regulations and continue.

Sediment utilization, niche breadth and niche overlap of Aspidochirotida (Holothuroidea: Echinodermata) in the lagoon and reef flat of Heron Island, Great Barrier Reef, by T.S. Klinger, C.R. Johnson & J. Jell, Department of Biological and Allied Health Sciences, Bloomsburg University, USA and Departments of Zoology and Earth Sciences, University of Queensland, Australia.

Aspidochirotida are abundant deposit-feeders in the lagoon (0.17±0.53 ind. / m^2; mean ± 1 SEM) and on the reef flat (0.68±0.06 ind. / m^2) of Heron Island. Granulometry of sediment and faeces indicates minimal feeding-niche separation between species. Electivity (*E*) for grain sizes ranges from -0.74±0.14 to 0.43±0.19. Coarser grain sizes (-1.5 to -0.5 phi) tend to be excluded, and finer grain sizes (3.0 to 4.5 phi) included disproportionately in the diet. However, each species ingests all available sediment grain sizes and all species ingest each grain size in roughly the same proportions.

Niche breadth (*FT*) for all species ranges from 0.97±0.00 to 0.99±0.01 and niche overlap (*L*) for each species pair ranges from 0.78 to 1.15. Some spatial separation of species occurs. *Holothuria atra* and *Holothuria leucospilota* have aggregated distributions, with *H. atra* more common on the inner and *H. leucospilota* more common on the outer reef flat. In the lagoon, *H. atra* and *H. leucospilota* forage at a distance from coral patch reefs (1.7 to 3.0 m) while *Holothuria edulis*, *Stichopus chloronotus* and *Stichopus variegatus* forage nearer (0.7 to 1.3 m).

However, active exclusion is unlikely. Coefficients of association (C_7) for these species indicate random co-occurrence. *Holothuria impatiens* and *Stichopus horrens* are positively associated (C_7=0.34) reflecting their shared cryptic habitat. Total consumption by Aspidochirotida in the lagoon and reef flat (3.93 and 12.76 g / m^2 / day, respectively) represents only a small fraction of the available surface sediment (0.06% and 0.22%, respectively). Available surface sediment is not a limiting resource and therefore competition between co-occurring deposit-feeding Holothuroidea is probably slight.

Echinoderms of the Houtman Abrolhos Islands, Western Australia and their relationship to the Leeuwin current, by L.M. Marsh, Western Australian Museum, Perth, Western Australia.

The Houtman Abrolhos Islands (28°18'-29°S, 113°36-114°E), lying 65-90km off the mid-west coast of Western Australia are the southernmost coral reefs in the Indian Ocean. They are influenced by the warm Leeuwin Current during autumn and winter and by cooler water during the summer, resulting in a juxtaposition of coral reefs and kelp beds which is reflected in the composition of the echinoderm fauna. Sixty-eight per cent of the 167 species of echinoderms are tropical species, 13 per cent are southern Australian temperate species and 15 per cent are endemic to the west coast of Australia, but no species are confined to the islands.

Population dynamics of two reef flat dwelling Holothurians, *Holothuria atra* and *Stichopus chloronotus*, by Sven Uthicke, Institüt für Hydrobiologie und Fischereiwissenschaften, Zeiseweg 9, 2000 Hamburg 50, Germany.

Population dynamics were studied in two species of aspidochirotes (*Holothuria (Halodeima) atra* Jaeger and *Stichopus chloronotus* Brandt) on a reef flat near Lizard Island, Great Barrier Reef. Populations of these species were monitored during six consecutive months (November 1992 – April 1993) in three permanent transects (10m x 100m). Each transect was subdivided into 10 quadrats. In these

quadrats species abundance was recorded each month, individual wet weight (ww) every second month. Additionally the following physical parameters were determined in every quadrat: type of bottom coverage, water movement and water depth. As sediment parameters, bacterial biomass, chlorophyll a and protein content were measured.

The obtained mean growth rates were 10g ww / month for *S. chloronotus* and 5g ww / month for *H. atra*. The mean body weight of both species decreased significantly in quadrats with high coral rubble cover. This suggests juvenile holothurians grow up in this type of habitat and that they migrate out of this zone as they become larger.

Although the species are sympatric on the reef flat under study they occupy different micro-habitats and exhibit different feeding rhythms. *H. atra* is found mainly on bare sand, ingesting coarse sediment, while *S. chloronotus* feeds on smaller particles selected from coral rubble covered with filamentous algae. The former species feeds 24 hours a day and the latter only between 11 am and 7 pm.

No correlations were found between chemical sediment parameters and the abundance of either species. This suggests that the distribution of these species on the reef flat is not limited by food. Their distribution is, however, greatly influenced by water movement. The biomass and abundance of *S.chloronotus* are lower in areas of high flow while *H. atra* is more adapted to these zones. Hence, *H.atra* dominates the more exposed quadrats and *S.chloronotus* is the dominant species in sheltered areas.

2. Communications on holothurians

G.G. Foster, A.N. Hodgson. The distribution and reproduction of three sympatric species of intertidal holothurians from South Africa.

H.M. Moore, D. Roberts. Feeding in deep-sea holothurians.

P.M. O'Loughlin, T.M. Bardsley. Diversity and density in Antarctic holothurians (Echinodermata, Holothuroidea).

A.V. Smirnov. Holothurians of the order *Apopida*: system and phylogeny.

A.S. Thandar. A new species of the holothuroid genus *Phyllophorus* from South Africa.

A. Tuwo, C. Conand. Fecundity of three temperate holothurians with pelagic development.

P.M. O'Loughlin, J.N. Ortenburg. Brood-protecting and fissiparous cucumariids (Echinodermata, Holothuroidea).

M.A. Sewell. Mortality of Pentactulae during intraovarian brooding in the apodid sea cucumber *Leptosynapta clarki*.

3. Posters on holothurians

J.-F. Hamel, G. Desrosiers. Larval fixation and small scale migration of the sea cucumber *Cucumaria frondosa*.

Y. Liao, A.M. Clark. An introduction to the echinoderms of southern China.

C. Massin. Calcareous deposit variations in holothurians illustrated by Antarctic dendrochirotes (Echinodermata).

J.B. McClintock, M. Slattery, B. Gaschen, J. Heine. Reproductive mode and population characteristics of the Antarctic sea cucumber *Cucumaria ferrari*.

A.S. Thandar. Character divergence and cladistic relationships of the Southern African genera and subgenera of the family Holothuriidae.

The contributions will be published by BALKEMA (Rotterdam).

Welcome to new members

by J.P. Gaudechoux, South Pacific Commission, Noumea, New Caledonia

The SPC Beche-de-mer Special Interest Group is growing. We have received additional completed questionnaires from the individuals listed below. The previous lists of members are available in the first four issues of *SPC Beche-de-mer Bulletin*.

If you are on the list and your name and address are wrong, please send us a correction. If you are not on the list and would like to be, fill in the form enclosed with the bulletin or write to us for a new one.