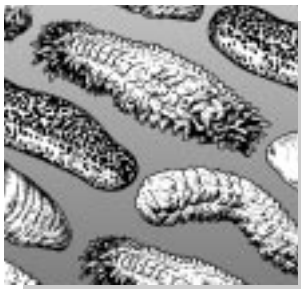

abstracts, publications, workshops & meetings
beche-de-mer

Are holothurian fisheries for export sustainable?

by C. Conand
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Source: Paper presented at the International Congress on Reefs, Panama, 2 : 2021–2026.

Holothurian fisheries have a very long history and the increase in the catches could be interpreted as a sign of sustainibility. A dozen Indo-Pacific coral reef species constitute the major part of world catches of these export fisheries, which are yet poorly documented and generally not rationally managed. From different sets of statistics (captures, processing, national exports by producers or imports by consumers, international markets in Hong Kong and Singapore) the main characteristics and the recent trends are analysed. The annual world captures are around 120 000 t, valued over US$ 60 million. It appears also that new fisheries have developed in many non-traditional fishing areas, such as Mexico and the Galapagos. The main life-history traits of the species, though showing variety, could explain that they constitute fragile stocks. With the increasing market demand, biological over-exploitation occurs well before economic over-exploitation. Effective collaborative management is needed. Development of information exchange is now in progress through the *Beche-de-mer Bulletin* published by the South Pacific Commission.

Potential of the tropical Indo-Pacific sea cucumber, *Holothuria scabra*, for stock enhancement

by Stephen C. Battaglene & Johann D. Bell
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Submitted to 'Proceedings first international Symposium on Stock Enhancement and Sea Ranching' Bergen, Norway 8–11 September.

Sea cucumbers processed into 'beche-de-mer' are a valuable source of income for many poor communities in the Indo-Pacific. Increasing demand from China has seen most stocks of high-value species over-fished. The ability to sustain or increase the yield of tropical sea cucumbers by stock enhancement is being assessed in a number of countries including, Ecuador, India, Maldives, Marshall Islands, and Solomon Islands. Sea cucumbers appear suitable for enhancement because they are: restricted to inshore habitats, low on the food chain, relatively sedentary and easy to harvest. Among the tropical sea cucumbers, sandfish, *Holothuria scabra*, appears to be an especially good candidate for stock enhancement because it is of high value, is easy to propagate, and grows rapidly at high densities on simple, low-cost diets. Our preliminary rearing trials indicate that the juveniles could be ready for release into the wild at two months of age and 20 mm in total length. However, before effective and responsible strategies for releasing sandfish can take place, we need to understand their ecology and population genetics. Methods also need to be developed to mark the juveniles so that the success of experimental releases can be assessed.

Induction of larval metamorphosis in the sea cucumber *Stichopus japonicus* by periphytic diatoms

by S. Ito & H. Kitamura.

Source: *Hydrobiologia* (in press).

The mass production of juvenile seeds of the sea cucumber, *Stichopus japonicus* has been recently developed by the Sea Farming Centre of Saga Prefecture. Methods for the culture of periphytic diatoms have been improved. There are three important steps in propagating the diatoms. The first step is the enrichment, with the addition of the nutrient salts, under controlled light intensity. The second step is washing with high pressure seawater and reversal of the plates. The last step is elimination of copepods, which feed on diatoms, using a pesticide. Small periphytic diatoms such as *Mavicula*, *Amphora*, *Achanthes*, and *Nitzschia* are easily cultured at a density of more than one million cells per cm^2, and these diatoms are able to include larval metamorphosis and serve as a food source for juvenile sea cucumbers.

Predation on holothurians: a literature review

by Patrice Francour
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Source: *Invertebrate Biology*, 116(1): 52–60.

In the literature, 69 references altogether have reported 76 predators on holothurians. In terms of the number of predatory species, the most important predators are fishes (26 species), seastars (19 species), and crustaceans (17 species). Seastars are the predators most often cited as regularly ingesting large quantities of holothurians. Toxicity seems to be an effective defence against a generalised predator but, against a specialist on holothurians, escape by swimming movements or shedding of a piece of body wall are the only behaviours that occasionally end with a successful escape. Escape behaviours may be a factor in providing the apparent size refuge from predators. Impacts of predators on holothurian populations have rarely been reported or evaluated, and predation on the earliest life stage is unknown.

Note on *Synaptula recta* Semper, 1868 (Echinodermata, Holothuroidea, Synptidae) new to Pakistan waters

Source: *Pakistan J. Zool.*, vol. 29(1), 92–94, 1997.

Synaptula recta Semper, 1868 is widely distributed in the Indo-West-Pacific region. It was previously not known from Pakistan (northern Arabian Sea). These specimens now recorded from the region fill the gap in the distribution of the species. The specimen is briefly described and illustrated.

Reproduction, spawning induction, development and larval rearing of the tropical sea cucumber sandfish, *Holothuria scabra*, Jaeger 1833

by Stephen C. Battaglene, Christain Ramofafia & J. Evizel Seymour
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Presented at the Third International Larval Biology meeting, Melbourne, Australia 13–16 Jan. 1998.

Sea cucumbers, processed into 'beche-de-mer', are a valuable source of income for many coastal communities in the developing nations of the Indo-Pacific. Increasing demand from China has caused overfishing of stocks of the high-value species. ICLARM is exploring the possibility of restoring depleted populations of tropical sea cucumbers by stock enhancement. Sandfish *Holothuria scabra*, is considered the best candidate for stock enhancement because it is of high value, widely distributed, relatively easy to culture, and grows rapidly at high densities on simple, low-cost diets. In the Solomon Islands, individual mature sandfish are present in the wild population year-round with peak reproduction in May and November. Approximately 10 per cent of mature sandfish can be induced to spawn by elevating sea water tempera-

ture 3 to 5°C. Four batches of sandfish eggs totalling 19 million fertilised eggs were produced from the Coastal Aquaculture Centre hatchery in the first 12 months of operation. Optimal egg densities for static incubation were 0.1 egg/ml. Larvae were cultured at densities of 0.1 to 4 larvae/ml using batch exchange of water. Larvae grew and developed better on *Chroomonas* sp. than other algae species tested. Although, large scale rearing is undertaken using combinations of *Chaetoceros muelleri* (*gracilis*), *Chaetoceros calcitrans, Chaetoceros simplex*, *Chroomonas* sp., Tahitian *Isochrysis* sp., and *Pavlova salina*. Feeding density started at 20 000 cells/ml at Day 2 and increased to 40 000 cells/ml by Day 14. Settlement of sandfish pentacula started from Day 10 to 14. A combination of fresh micro-algae and commercial dried micro-algal products 'Algamac 2000' and 'Livic' were fed from Day 10. Survival to settlement ranged between <1 and 35 per cent depending on initial stocking density and other husbandry factors. Larval survival and growth increased with successive batches as rearing protocols and rearing systems were refined. Experiments are continuing to establish the best combination of micro-algae for larval growth and survival. The batches of settled juveniles were detached from settlement plates using 1–0.5% KCl at Day 21 and transferred to outdoor concrete rearing tanks. Over 150 000 juveniles, some as large as 150 mm, have been produced.

Recruitment in the Holothurian *Cucumaria frondosa* in the Gulf of Maine

by Dorothy E. Medeiros-Bergen & Erika Miles

Source: *Invertebrate Reproduction and Development*, 31: 1–3 (1997). 123–133.

The sea cucumber *Cucumaria frondosa* spawns in the spring, in the Gulf of Maine, USA. The larvae remain pelagic for several weeks prior to recruitment to the benthos. In western Gulf of Maine, a previous study showed that juvenile *C. frondosa* occur exclusively inside mussel beds; adults are absent from the region. In the present investigation, recruitment and juvenile abundance in the field were examined from 1993–1995. A study conducted in the spring of 1993 in the Maine-New Hemishire coastal waters indicated that recruitment of *C. frondosa* to mussel beds was high. In the fall of 1994, no recuits were present on the benthos; juveniles were more abundant in coralline algae than in mussel beds or kelp holdfasts. In 1995, recruitment and juvenile abundance monitored over the recruitment season revealed that recruitment was highest in June. Toward the end of June and during early July, recruitment was significantly higher in mussel beds than in coralline algae and kelp holdfasts. In June, a 2 day intensive field study indicated that recruits were significantly more abundant in the mussel beds than coralline algae. Mussel beds may enhance early survival by providing a refuge from predation. A potential predator on new recruits are large nereid worms.

Seasonality of asexual reproduction in *Holothuria (Halodeima) atra*, *H. (H.) edulis* and *Stichopus chloronotus* (Holothuroidea:Aspidochirotida) on the Great Barrier Reef

by S.Uthicke

Source: *Marine Biology* (1997) 129: 435–441

Asexual reproduction by fission was monitored for 18 months in populations of *Holothuria (Halodeima) atra, H. (H.) edulis* and *Stichopus chloronotus* on three nearshore fringing reefs and one midshelf reef in the Great Barrier Reef. Fission in *S. chloronotus* occurred exclusively between March and October, with a peak value of 31 per cent recently divided individuals in one population in July. *H. atra* showed a similar pattern, with maxima of between 16 and 26 per cent from May to July. In *H. edulis*, asexual reproduction occurred only between March and July, with a maximum of 17 per cent recently divided individuals in March. Fission rates (43%) for *S. chloronotus* were found in a dense population on Great Palm Island. The lower-density midshelf reef population exhibited comparatively lower annual fission rates (19%). About 24 per cent of *H. edulis* undergo fission each year. Annual fission rate and population density were positively correlated in the four populations of *S. chloronotus* and *H. atra* studied rarely exhibit asexual reproduction, the major exception being the echinoderms (Emson & Wilkie, 1980). Transverse fission in aspidochirotide holothurians has been reported for six *Holothuria* species (Crozier, 1917; Deichmann, 1922; Bonham & Held, 1963; Harriott, 1980) and two *Stichopus* species (Harriott, 1980). On the southern section of the Great Barrier Reef (GBR), fission has been observed in *H. atra, H. edulis, S. chloronotus* and *S. horrens* on Heron Island (Harriot, 1980). Fission products of the first three species are frequently observed on nearshore fringing reefs and midshelf reefs in the central section of the GBR (Uthicke, 1997). *H. atra* and *S. chloronotus* are the most abundant holothurian species on the reef flats of the GBR (Harriot, 1980; Hammond et al., 1985; Uthicke, 1994), whereas *H. edulis*

is more abundant in deeper water of the fore-reef area (Uthicke, unpublished data). In several populations of *H. atra,* asexual reproduction is the main means of population size-maintenance (Ebert, 1978; Chao et al., 1993). Seasonal fluctuations in fission frequency were reported for *H. atra* (Harriot, 1982; Conand, 1989 and 1996) and *H. parvula* (Emson & Mladenov, 1987). Chao et al. (1993) were the first to demonstrate that *H. atra* has a distinct seasonal periodicity, with a peak activity between July and September in Taiwanese populations; no information on fission periodicity of *H. edulis* and *S. chloronotus* is available.

In this investigation, asexual reproduction of *Holothuria atra*, *H. edulis* and *Stichopus chloronotus* was monitored for 18 months on several reefs of the GBR to determine the seasonality of fission, spatial differences in fission frequency and the proportion of the populations reproducing by fission.

Results of the Rumphius Biohistorical Expedition to Ambon (1990). Part. 4. The Holothurioidea (Echinodermata) collected at Ambon during the Rumphius Biohistorical Expedition.

by C. Massin

Source: *Zool. Verh. Leiden* 307, 23-12-1996: 1–53, figs 1–35.

During the Rumphius Biohistorical Expedition (4 Nov. – 14 Dec. 1990) 52 specimens representing 27 holothurian species were collected. All the species are described, figured and discussed systematically. Six species are new to the fauna of Ambon; two of these are new to the fauna of Indonesia, and two are new species: *Afrocucumis stracki* and *Chiridota smirnovi*. The holothurian fauna of Ambon is now represented by 59 species.

Ammonium excretion by holothurians enhances production and turnover of benthic diatom communities

by S. Uthicke [1, 2] and D.W. Klumpp [2]
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2. Australian Institute of Marine Science, PMB No. 3, Townsville MC Qld 4810, Australia

Source: *Proc. 8th Int. Coral Reef Symp*. 1: 873–876. 1997

In this paper the effects of holothurian excretion products on microphytobenthos communities dominated by benthic diatoms are examined. Production and biomass of these communities was measured in treatments with elevated ammonium levels and compared to control aquaria with low nutrient levels. Elevation in ammonium level was produced by excretion of holothurians. Even slightly increased ammonium levels (1.1 mmol NH_4 above the background level) led to a 31 per cent increase in total pigment concentrations (chl. a + phaeopigment), but chlorophyll a as indicator for living biomass was not enhanced. Area specific production increased 34 per cent within 8 days in the enhanced treatments. The nutrient enhancement led to significantly higher maximum gross production (P_{max}), initial slope (a) and daily net-production, but did not alter the saturation point (I_k) and the compensation point (I_c).

Growth of juvenile *Actinopyga mauritiana* (Holothuroidea) in captivity

by Christain Ramofafia, Timothy P. Foyle & Johann D. Bell
International Centre for Living Aquatic Resources Management, Coastal Aquaculture Centre, P.O. Box 438, Honiara, Solomon Islands

The growth of juvenile (less than 10 g) *Actinopyga mauritiana* was examined at three different levels of stocking biomass; low (26 g/m^2), medium (130 g/m^2), high (260 g/m^2), and two 'feeding regimes' (removing or not removing faeces from grow-out tanks) for 12 months. Growth was monitored monthly using 'fresh weights', which were taken after maximum contraction and expulsion of cloacal water. Mean growth was highest at low stocking biomass (10.4 g fresh weight per month ± 1.49 S.E.), but ceased once total biomass reached 250–300 g/m^2. Growth at medium stocking biomass was much reduced compared to that at low biomass, and reduced growth at high levels, was due to overgrazing of suitable algal food. Leaving faeces in grow-out tanks increased growth significantly once algal food became limiting indicating that fae-

ces can provide supplementary nutrition for *A. mauritiana* in captivity, probably via greater availability of bacteria. We conclude that juvenile *A. mauritiana* caught from the wild have potential for culture if individuals are stocked initially at around 26 g/m^2.

Ovarian Development in the Class Holothuroidea: a Reassessment of the 'Tubule Recruitment Model'

By M.A. Sewell[1], P.A. Tyler[2], C.M. Young[1], and C. Conand[3]

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3. Laboratoire de Biologie Marine, Université de La Réunion, 97715 Saint-Denis Cedex, La Réunion, France

The 'tubule recruitment model' for the development of the holothurian gonad was proposed (a) to connect the stages of oogenesis with ovarian morphology in holothurians throughout the reproductive season and (b) to emphasise the potential for the holothurian ovary as a model system for cytological and biochemical study of echinoderm oogenesis. To reassess the evidence for this model, we have examined published accounts and unpublished observations on gonad development in holothurians from both temperate and tropical habitats, in shallow water and in the deep sea. A very limited number of species were found to conform to the predictions of the tubule recruitment model. The patterns of gonad development vary substantially in holothurians, even at the individual level, and with taxonomic position, geographical location, and habitat. The tubule recruitment model can be applied to only a small subset of holothurians, specifically those in the families Stichopodidae and Holothuridae that have gonad morphology similar to that of *Parastichopus californicus*. However, the tubule recruitment model is invalid for many other aspidochirotes, and does not have wider applicability within the class Holothuroidea. To recognise unifying patterns of reproduction and to assist in the development of robust theory (Giese et al., 1987). An example is the 'tubule recruitment model' proposed by Smiley (1988) to describe gonad development in the class Holothuroidea (phylum Echinodermata). This conceptual model, based on a careful and impressive study of ovarian development in the aspidochirote sea cucumber *Parastichopus californicus*, was proposed to connect the stages of oogenesis with the ovarian morphology of holothurians throughout the reproductive season (Smiley, 1988, 1994; Smiley et al., 1991), and to accentuate the usefulness of the holothurian ovary as a model system for cytological and biochemical study of echinoderm oogenesis (Smiley, 1988, 1990, 1994; Smiley et al., 1991).

Since the tubule recruitment model was first published, several studies have documented apparent exceptions to the model. Moreover, our own work with a variety of holothurians from throughout the world, and from depths ranging from the intertidal zone to the deep sea, casts additional doubt on the broad applicability of the model. Here we re-examine both the published literature and our own unpublished data to test the applicability of the tubule recruitment model to the class Holothuroidea in general, and particularly to the aspidochirote holothurians.

Other noteworthy publications

BALLMENT, E., S. UTHICKE, L. PEPLOW & J. BENZIE. (1997). Techniques for enzyme electrophoretic analysis of the holothurians, *Holothuria atra* and *Stichopus chloronotus* (Holothuroidea: Aspidochirotida). AIMS Report, Number 27, 1997.

BATTAGLENE, S.C. & J.E. SEYMOUR. (in press). Detachment and grading of the tropical sea cucumber sandfish, *Holothuria scabra*, juveniles from settlement substrates. Aquaculture.

CHAMBERS, M.R. (1989). A survey of the beche-de-mer of Vanuatu. **In:** T. Done & K.F. Navin (Eds), The marine resources of Vanuatu (165 p.), Australian Institute of Marine Science, Townsville: 107–114.

FORBES, R. & M. BAINE. (eds.) (1988). A Field Guide to the Sea Cucumbers of Malaysia (Working Document). Pub. Heriot-Watt University. 42 p. *(International Centre for Island Technology, Heriot-Watt University, Stromness, Orkney, Scotland, and Institut Penyelidikanan, Jobatan Perikanan Malaysia, Pulau Pinang, Malaysia. The final guide will be available soon. Orders to Mark Baine: Mark@icit.demon.co.uk; fax +44 1856 851349)*

GRIFFIN, N. (1997). Sea cucumbers in the frame, report on the uses for this Asian delicacy, now being caught off North America. Seafood International, September 1997. 75.

LAMBERT, P. (1996). *Psolidium bidiscum*, a new species of sea cucumber from the northeast Pacific Ocean (Echinodermata: Holothuroidea) . Can. J. Zool 74: 20–31.

LAMBERT, P. (in press). Sea cucumbers of British Columbia – Including southeastern Alaska and Puget Sound. University of B.C. Press. Vancouver.

RASOLOFONIRINA, R. (1997). Écologie, biologie et pêche de deux espèces d'holothuries aspidochirotes *Bohadschia vitiensis* et *Holothuria scabra versicolor* au Grand Récif de Toliara. DEA de l'Université de Toliara (Madagascar), 1997.

SEWELL, M.A. (1996). Mortality of pentactulae during intraovarian brooding in the apodid sea cucumber *Leptosynapta clarki*. Biol. Bull. 190: 188–194.

SEWELL, M.A., A.S. THANDAR & F.-S., CHIA. (1995). A redescription of *Leptosynapta clarki* Heding (Echinodermata: Holothuroidea) from the northeast Pacific, with notes on changes in spicule form and size with age. Canad. J. Zool. 73: 469–485.

Workshops and meetings

'Friends of the echinoderms'

Regional echinoderm meeting to be held at The Wallops Island Marine Science Consortium, Wallops Island, Virginia, USA, from 16–19 August 1998.

Contact:

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Fifth European Conference on Echinoderms

Milano, 7–12 September 1998
University of Milano, Department of Biology 'Luigi Gorini'

Contact:

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Chair: M. Daniela Candia Carnevali

Members: Francesco Andrietti
Francesco Bonasoro
Erminio Giavini
Giulio Lanzavecchia
Giulio Melone

Pre-registration form (To receive the Second Circular)

5th European Conference on Echinoderms
Milano, 7–12 September 1998

Name:
Address:
Telephone:
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E-mail:

For organisational reasons please answer the following questions (preliminary survey only):

- I plan to present a contribution in the form of:
  an oral contribution; a poster.
- My contribution relates to the following topic:
  Functional Biology; Physiology; Reproductive Biology; Developmental Biology; Paleontology; Ecology; Behaviour.
- If possible, I would like to stay in a:
  university residence; hotel.

Send your pre-registration form to:

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Date for next International Echinoderm Conference

Dear fellow echinodermologists

Those of you who were at the San Francisco meeting, and attended the general meeting at the end of the conference, will remember that we decided that the next international conference would be held at the University of Otago, Dunedin, New Zealand in late January or early February, 1999.

Although February is not ideal for those teaching in academic institutions in the Northern hemisphere, it is the best timing for a conference in New Zealand. As it is just before the start of our academic year, all the necessary University facilities, lecture theatres, halls of residence etc., will be open and available, and the weather is generally pleasant in southern New Zealand in February (I anticipate that most people travelling to New Zealand will wish to spend some time enjoying the spectacular scenery in this part of the world before or after the conference).

Since deciding on February 1999, however, I have had a letter from Maria Daniela Canadia Carnevali, the organiser of the next European echinoderm conference, to be held from 6–11 September 1998, in Milan. Daniela is very concerned that the European and New Zealand conferences have been scheduled so close together and feels that many people, especially those from Europe, will be unable to obtain the funding to attend both meetings.

Since receiving Daniela's letter I have consulted several members of the organising committee for the next IEC, and other potential participants from the USA, UK and Europe. All agree that it would be better to have a greater gap between the two meetings, and so I have decided to postpone the New Zealand conference for one year. The date of the next IEC therefore becomes early February of the year 2000. I apologise for this change of dates, however I would like as many people as possible to come to New Zealand and enjoy our southern hospitality.

I will send out further notices at least a year, or possibly longer, before the conference, and if there is sufficient interest I will set up an information page on the Web.

8 June 1997

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