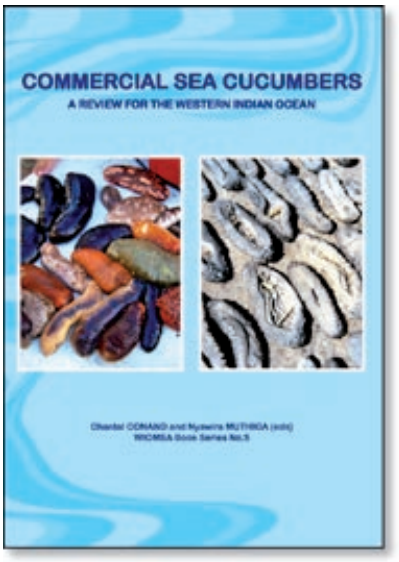
Abstracts & new publications...

Commercial sea cucumbers: A review for the Western Indian Ocean

Conand C. and Muthiga N. (eds)

Source: WIOMSA Book Series No. 5. 66 p.



Sea cucumbers (Holothurians) are a group of marine invertebrates that are harvested worldwide, mostly for human consumption in Asian countries. Over the past decades, a significant increase in the demand for sea cucumbers has led to an explosion in exploitation, which often results in population declines in many producing nations. Because of the importance of sea cucumbers as a source of livelihood for many artisanal fishers from developing countries, and as a globally traded product, there is considerable interest in information on their biology, ecology and fisheries management. Although management agencies and fishing communities recognize that sea cucumber fisheries are in trouble worldwide, attempts at management have been largely unsuccessful due to several factors including: 1) the vulnerability of sea cucumbers to harvesting, 2) the artisanal nature of the fishery, which prevents fishing communities from using alternative coping mechanisms, 3) the institutional and socioeconomic barriers to management. Sea cucumber production has been declining in nations of the Western Indian Ocean in the last 10 years. The reasons for the overexploitation include: 1) a lack of ecological information for understanding species life histories, 2) a lack of understanding of the socioeconomic realities of the fishery, and 3) inadequate monitoring and enforcement of fishery regulations.

The Western Indian Ocean Marine Science Association (WIOMSA) — as part of its aim to serve the information needs of resource managers and communities for the sustainable management of marine resources in the western Indian Ocean (WIO) — approved a "Regional Sea Cucumber Project" in 2006. This review was prepared as the baseline study of the project and aims to provide a comprehensive synthesis of the current state of knowledge on sea cucumbers in the WIO. The information used in the review comes from many sources including journal articles, theses and dissertations, and reports on all aspects of sea cucumbers in the region Although the report focuses on the five countries (Kenya, La Reunion, Madagascar, Seychelles, Tanzania) that are involved in the project, a brief description of the status of sea cucumbers in other countries of the WIO is also included.

It is hoped that this review contributes scientific information that will support management efforts of sea cucumbers in the WIO and will also serve as a useful reference for scientists and students interested in echinoderms in general and sea cucumbers in particular. The authors thank WIOMSA for financial support for the Regional Sea Cucumber Project and the publication of this review. Authors who contributed to the review are gratefully acknowledged.

Note: The book is available for free from the WIOMSA secretariat: secretariat@wiomsa.org

Abstracts from papers presented at the 5th WIOMSA Scientific Symposium, Durban, 22–26 October 2007

The reproductive biology of the commercial sea cucumbers *Holothuria fuscogilva* and *Holothuria scabra* along the Kenyan coast

N.A. Muthiga, J.A. Kawaka and S. Ndirangu

Email: nmuthiga@wcs.org

The tropical sea cucumbers *Holothuria fuscogilva* and *Holothuria scabra* are amongst the most highly valued sea cucumbers that are widely distributed across the Western Indian Ocean. Despite their fisheries value, their biology, ecology and population dynamics remain poorly understood. The reproductive biology and ecology of these species was investigated in order to provide information that contributes to the improved management of sea cucumbers along the Kenyan coast. Distribution and abundance surveys were carried out using belt transects (2 x 100 m) from Kiunga south to Shimoni. Standard measurements of size, observations of gonad condition and sex and calculations of gonad and gut indices were used to analyze reproductive patterns of both species collected monthly between 2006–2007 and compared with data from a previous study in 1998-1999. Both species occurred at low densities ~ 0.1 ind 200 m^{-2}, *H. scabra* was more widely distributed occurring at sites from Kiunga to Shimoni while *H. fuscogilva* was only recorded south of Diani. Mean monthly gonad indices were significantly correlated between males and females (r = 0.89 and 0.60 for *H. fuscogilva* and *H. scabra* respectively) indicating synchronous gonad development between sexes. The pattern of gonad growth was less correlated between years (r = 0.31 and 0.46 for *H. fuscogilva* and *H. scabra* respectively). Gametogenesis commenced between April and May and peaked in November for *H. fuscogilva*. Gonad growth in *H. scabra* showed two peaks in March–June and September–October in 1998–1999 and only one peak in November–January in 2006–2007. The sexes did not differ in size in either species although females had significantly higher gonad indices in *H. fuscogilva* than males. *H. scabra,* the smaller sea cucumber had significantly lower gonad index and higher gut index, and the sex ratio was skewered towards more males. The life history strategies of these species include spawning at the time favourable for larval growth and a high reproductive effort that may serve to increase reproductive success.

Reproductive biology of sea cucumbers from La Réunion: a contribution for a regional management of the fishery

S. Kohler, C. Conand and S. Gaudron

Email: conand@univ-reunion.fr

The sea cucumber fishery is important in several countries of the Western Indian ocean (WIO) but generally not adequately managed. A regional programme (Masma) granted by Wiomsa is bringing data on the reproduction of most important beche de mer species. In La Reunion the two target species are *Holothuria leucospilota* and *Actinopyga echinites*. They are very abundant on the fringing reefs and were sampled monthly in 2005–2006. Data on the morphology, the histology of the gonads and the Gonad-Index were analysed. The main results concern the following parameters: the size distribution of the individuals within the population, the sex ratio, the anatomy of the gonads, the annual reproductive cycle and the size at first sexual maturity. These results are compared with data on other holothurian species such as *H. atra* and *Stichopus chloronotus* previously studied in La Reunion. The importance of fission is also discussed for the population parameters. These results will be useful for the research on the reproductive biology of sea cucumbers conducted in the other countries of WIO. The spawning season and the size at maturity will be useful for a future regional management of the stocks.

Relation between nutrition of Holothurians and microbenthos of soft-bottoms in a shallow coral reef (Reunion Island)

Dorothée Taddei, Patrick Frouin, Jean Blanchot and Chantal Conand

Email: dorothee.taddei@univ-reunion.fr

Deposit feeding holothurians are among the most conspicuous invertebrates in marine benthic coral reef communities, particularly in La Saline reef (Reunion Island, Indian Ocean). Therefore nutrition of the two dominant species, *Holothuria atra* (Jaeger, 1883) and *Holothuria leucospilota* (Brandt, 1835), was studied during winter season. Chlorophyll *a*, bacteria, organic carbon and nitrogen contents were quantified in

four compartments: sediment under holothurian tentacles (Sed), the foregut (FG), the hindgut (HG) and the faeces (F). These two species selectively ingested chlorophyll *a* and bacteria as shown by significant increases (from 235 to 935 %) between Sed and FG. The digestion of microbenthos occurred between FG and HG (with 21 to 75 % decrease of the content). Conversely, bacteria and chlorophyll *a* did not vary significantly between HG and F. Despite microbenthos was not the main component of total organic carbon in sediment, it appeared as the main carbon source for these selective feeders: 55 % of ingested for *H. atra* and 30 % for *H. leucospilota*. A mixed population of both species at the study site (Planch'Alizés) removed 109 mgC m^{-2} j^{-1}, among which 57 mgC m^{-2} j^{-1} came from living microbenthos. Availability of microbenthos therefore appeared to be very important in regulating distribution and dynamics of these two holothurian species. With densities reaching 3.1 ind m^{-2}, these deposit feeders played an important role in the carbon cycling through soft-bottoms of the coral reef ecosystem.

Toxicity biomarkers responses in holothurians species (La Reunion, Indian Ocean)

J. Kolasinski

Email: joanna.kolasinski@univ-reunion.fr

The objective of this study was to assess toxicity biomarkers, acetylcholinesterase activity (AChE) and ethoxyrufin-O-deethylase activity (EROD), to elucidate any correlation with the eutrophication gradient. AChE is the functionnal target of insecticides, nematicides and chemical nerve agent. EROD activity is the main biotransformation process concerning the organic xenobiotics and then inform on any physiological induced stress. Significant variation was measured in AChE activity for *H. leucospilota*. The lowest value was found at the reference station (293,9 ± 72,4 nmoles mgP^{-1} min^{-1}) compared with the values in eutrophicated areas (548.0 ± 84.1 and 607.3 ± 72.2 nmoles mgP^{-1} min^{-1}), what represent a 48% inhibition in the reference station. The EROD activity was measured for the first time on *H. leucospilota* and *H. atra*, and showed no significant difference between stations with 27.73 ± 25.19 to 68.73 ± 52.20 pmoles mgP^{-1} min^{-1} for *H. leucospilota* and 10.78 ± 7.55 to 20.33 ± 24.56 pmoles mgP^{-1} min^{-1} for *H. atra*.

The social and economic features of the sea cucumber fishery in Kenya

Jacob Ochiewo and Maricela de la Torre-Castro

Email: jochiewo@kmfri.co.ke

This paper presents the results of part of the Socio-economics component of a MASMA funded three-year sea cucumber project in the Western Indian Ocean (WIO) region. The objectives of this component of the project are 1) to determine the national marine resource use patterns, the social and economic characteristics of the fisher communities and the contribution of sea cucumbers to the national economies and local livelihoods of the coastal areas, and 2) to analyze the management system present in the area. The study has been conducted at Vanga, Shimoni, Majoreni and Gazi villages in the Kenyan south coast. The results indicate that sea cucumber collectors (fishers) are mainly men who fish in the sub-tidal areas between 3 and 10 metres deep. These fishers do not use scuba-diving gear and fishing is heavily done during the northeast monsoon season when the sea is calm and water is clear. About 50% of the sea cucumber fishers also collect other marine products such as octopus. The sea cucumbers are sold fresh from the sea to local dealers (middlemen) who process them and sell to more prominent middlemen in Mombasa and Kaloleni in the neighborhood of Mombasa. The fishers occasionally borrow money from dealers especially when they fail to catch sea cucumbers. This in turn makes them loyal to the dealers who lend them money thus creating conditions for exploitation. Almost all sea cucumber fishers have stated that they are not willing to make sea cucumbers part of their daily diet. Sea cucumber fishing is regulated by the Fisheries Department that issues fishing licenses. According to this law, fishers pay Kenya shillings 100 for the fishing license annually. However, a part from the main Fisheries legislation, there is no special law or policy that is devoted specifically to govern the sea cucumber fishery.

Fate of sea cucumber populations and fisheries in the south-west coast of Madagascar

Richard Rasolofonirina and Thierry Lavitra

Emails: rrasolof@ulb.ac.be; aqua-lab@malagasy.com

Sea cucumber fisheries were investigated in 13 coastal villages in the south west coast of Madagascar, from Morombe to Androka in 1996 and 2006. Catch rates, trepang production and species abundance in the catches of each village were examined and compared. In addition, sea cucumber population structures were also investigated on two corals reefs, the Great Barrier Reef of Toliara and the Nosy-ve Reef, during the

two periods where population density, species biomass and distribution on the reefs were analysed. About 30 species of holothurian were recorded in the studied villages. Targeted species in each village changed with their availability on the field and with market prices. Moreover, in recent years, lower valuable species became the most targeted species in some villages. After ten years, sea cucumbers resources declined considerably and the number of harvested species decreased. In 1996, about 20 species formed usually the catches of fishermen villages. In 2006, the mean number of harvested species decreased to ten. *Holothuria notabilis*, *Holothuria scabra* and *Stichopus horrens* were the main collected species and *Holothuria notabilis* formed the major part of the catch in some villages. Decreasing catch rates were also observed in the villages and, in the same time, mean density and biomass of all species observed on both investigated reefs dropped between the two periods. At the opposite, sea cucumber prices increased from 5 to 30 times.

Effect of food quality and settling density on growth and survival of epibiotic juveniles of the sea cucumber *Holothuria scabra*

Thierry Lavitra, Richard Rasolofonirina, Michel Jangoux and Igor Eeckhaut

Emails: aqua-lab@malagasy.com; lavitra_thierry@yahoo.fr

Holothuria scabra is one of the most valuable commercial sea cucumber species in the world. It is also the first species farmed in Madagascar. Today, breeding, larval rearing and juvenile settlement are totally controlled in the Aqua-Lab hatchery of Toliara; juvenile farming optimisation is still in process. After larval metamorphosis, *H. scabra* individuals are firstly epibiotic for 6 to 8 weeks (they stand the whole day on the substrates) before becoming endobiotic for the rest of their life (they burrow into the muddy sand from sunrise to sunset). Here we report the effect of food quality and settling density on the growth and survival of epibiotic individuals.

Seven types of food were tested: extracts of *Thalassia hemprichii* with spiruline, *Thalassia hemprichii, Sargassum isoetifolium* with spiruline, *Sargassum isoetifolium, Thalassodendrom ciliatum, Siryngodium isoetifolium* and organic biofilm. Control consisted in epibionts kept in seawater without any biofilm. The results showed that the extracts of *Sargassum isoetifolium* with or without spiruline gave the best growth and high survival rate: the mean epibiotic volumes were of 118,9 and 83,7 mm^3 and the survival rates of 65 and 61% at the end of the experiments. In the control tests, epibionts had a mean volume of 1,27 mm^3, which is 65 times less important.

We tested epibiont densities of 150, 300, 450 and 600 juveniles m^{-2}. The best growth and survival rates were observed for densities less than 450 juveniles m^{-2}. The highest mortality rate in all experiments was observed during the two first weeks of rearing.

To reach adequate growth and survival rates, these experiments suggest the use of *Sargassum isoetifolium*-spiruline extracts and a settling density less than 450 juveniles m^{-2}. In case of *Sargassum* depletion, extracts of seaweed could also be used.

Annual reproduction in the Indo-Pacific sea cucumber *Holothuria leucospilota* as a response to variability in the environment

Joan Akoth Kawaka and Nyawira A. Muthiga

Email: jkawaka@wcs.org

The world-wide decline in wild stocks of holothurians or sea cucumbers has generated a great deal of interest for reproduction and fisheries biology information that could lead to the development of better management programs as well as aquaculture of this valuable resource. Sea cucumbers have been collected for export in the WIO since the early 1900s, however, reports of declining stocks has led to concerns about the better management of this fishery. This paper discusses the findings of a study on the distribution, abundance and reproduction of the sea cucumber *Holothuria leucospilota* a commercial species that is widely distributed throughout the Western Indian Ocean (WIO). The species was selected as an appropriate model as part of a broader program to assess the status, biology and ecology of sea cucumbers of the WIO funded by the Western Indian Ocean Marine Science Association. Our objective was to assess the status of this sea cucumber under different management regimes (protection vs. fishing), as well as study the reproductive strategy and how environmental factors influence this strategy. The population assessment was carried out along the Kenyan coast using belt transects (100 m x 2 m) and time searches. The Gonad Index (GI) method was used to investigate the changes associated with gonad development of individuals collected in the Mombasa Marine Reserve. Results indicated that *H. leucospilota* is distributed throughout the Kenyan coast and that the abundance and biomass of sea cucumbers is dependent on habitat (higher abundances in

coral reefs, and reef lagoons) as well as management regime (population densities were higher in protected than unprotected reefs). In addition, the pattern of reproduction indicated that *H. leucospilota* has a seasonal reproductive pattern, with gametogenesis beginning in November and spawning occurring in March. The estimated size at sexual maturity for this sea cucumber was 18 cm. The study provides information on stocks as well as sea cucumber biology that should contribute to the sustainable management of sea cucumbers as well as information for the development of mariculture in this region.

Poster presented at the WIOMSA Symposium

Spatial patterns of holothurian populations on the shallow reefs in Reunion Island

Patrick Frouin, Chantal Conand, Ariadna Burgos, Clémence Hollinger, Joanna Kolasinski

Email: frouin@univ-reunion.fr

In the scope of a MASMA programme dealing with sea cucumbers fisheries in the WIO, we investigated holothurians populations in shallow fringing reefs from Reunion Island. These small reefs (total of 12 km^2) can show extremely high densities of *Holothuria atra* populations that have formerly been studied, as well as the *Stichopus chloronotus* and *H. leucospilota* ones. However, no global survey of the shallow reefs from Reunion Island has been realised up to now. Southern reef (St Pierre) was particularly poorly known. This study was designed to bring such information at the island scale, covering all the holothurian populations present in back reefs and inner reef flats. From the west to the south coast, 9 sites and 16 stations were counted in rainy season with replicated belt transects (100 m^2 each). In each site back reefs and inner reef flats were sampled, when present. Mean grain size, total organic load and chlolophyll-a content were quantified concurrently and correlated with holothurian densities. Richness of holothurian communities was poor in all sites (10 species max.), with strongly dominant species in Etang Salé (*S. chloronotus*, up to 203.7 ± 2.5 ind 100 m^{-2}) and St Gilles sites (*H. atr*a). Large spatial variability was observed at the reef complex scale and between reefs along the west and south coasts. The difference pattern between reefs could not be related to the considered physical variables, despite some impact of nutrients could be hypothesized in Saint Gilles back reefs. Strong patchiness characterized these reefs from Reunion.

Abstracts from journals

Grow-out of sandfish *Holothuria scabra* in ponds shows that co-culture with shrimp *Litopenaeus stylirostris* is not viable

Johann D. Bell, Natacha N. Agudo, Steven W. Purcell, Pascal Blazer, Matéo Simutoga, Dominique Pham and Luc Della Patrona

Source: Aquaculture 273:509–519. (2007)

We examined the potential for producing the large numbers of sandfish (*Holothuria scabra*) needed for restocking programmes by co-culturing juveniles with the shrimp *Litopenaeus stylirostris* in earthen ponds. Our experiments in hapas within shrimp ponds were designed to detect any deleterious effects of sandfish on shrimp, and vice versa. These experiments showed that a high stocking density of juvenile sandfish had no significant effects on growth and survival of shrimp. However, survival and growth of sandfish reared with shrimp for 3 weeks were significantly lower than for sandfish reared alone. Increased stocking density of shrimp also had a significant negative effect on survival and/or growth of sandfish. A grow-out trial of juvenile sandfish in 0.2-ha earthen ponds stocked with 20 shrimp post-larvae m^{-2}, and densities of sandfish between 0.8 and 1.6 individuals m^{-2}, confirmed that co-culture is not viable. All sandfish reared in co-culture were dead or moribund after a month. However, sandfish stocked alone into 0.2-ha earthen ponds survived well and grew to mean weights of ~ 400 g within 12 months without addition of food. The grow-out trial demonstrated that there is potential for profitable pond farming of sandfish in monoculture. Further research is now needed to identify the optimal size of juveniles, stocking densities and pond management regimes.

A new era for restocking, stock enhancement and sea ranching of coastal fisheries resources

Johann D. Bell, Kenneth M. Leber, H. Lee Blankenship, Neil R. Loneragan and Reiji Masuda

Source: Reviews in Fisheries Science, 16(1):1–9. (2008)

The growing number of countries investigating the potential for releasing cultured juveniles to augment coastal fisheries resulted in the First International Symposium on Stock Enhancement and Sea Ranching (ISSESR) in Norway in 1997. The 1st and 2nd ISSESR, in Japan in 2002, were instrumental in developing methods for mass production of environmentally fit juveniles and for releasing them in responsible ways. The 3rd ISSESR, held in the U.S.A. in 2006 (www.SeaRanching.org), ushered the discipline into a new era. The major advances included: (1) definitions of the various objectives for releasing cultured juveniles (restocking, stock enhancement, and sea ranching); (2) a framework for integrating releases within their fisheries management context, including tools for quantitative assessment; (3) a systematic, transparent, and stakeholder participatory planning process to determine whether releases have a cost-effective role to play in managing a fishery; (4) a comprehensive case study (blue crabs in Chesapeake Bay) describing the multi-disciplinary approach needed to evaluate the potential benefits of releases; and (5) a suite of other lessons to guide stakeholders in evaluating the potential for and implementation of releases. The papers in this Special Issue of *Reviews in Fisheries Science* elaborate how restocking, stock enhancement and sea ranching programs can create synergies between aquaculture and some coastal fisheries to help meet the future demand for seafood and aid in restoring depleted stocks.

Spatio-temporal and size-dependent variation in the success of releasing cultured sea cucumbers in the wild

Steven W. Purcell and Matéo Simutoga

Source: Reviews in Fisheries Science 16:204–214. (2008)

Large-scale releases of cultured "sandfish," *Holothuria scabra*, were used to examine size- and density-dependent effects on survival among sites. Juveniles were marked by fluorochromes in 3 size classes and released into open 500-m^2 sea pens. A preliminary trial involved the release of 4,000 juveniles at two sites. In a subsequent large-scale experiment, we released 9,000 juveniles at 0.5, 1, or 3 individuals m^{-2} at 4 sites. Growth and survival up to 2 years post-release were estimated from successive recapture surveys and marker verification. Most of the surviving animals attained the size at first maturity (180 g) within 12 months in the preliminary trial but grew slower in the second experiment. Growth was density dependent, with carrying capacity at one site of 200–250 g sandfish m^{-2}. Survival varied greatly among sites, explained in part by microhabitat features, but site suitability was ephemeral; previous success at sites did not guarantee success later. Juvenile size at release significantly affected long-term survival, but survival was density-independent within the experimental range. Juveniles should be released at a minimum size of 3 g and at multiple sites and occasions to mitigate spatio-temporal variation in survival. We predict that 7–20% of sandfish released at a size of 3–10 g in optimum habitat could survive to market size, which gives qualified support for restocking. Our results also help to assess the viability of sea ranching, which will depend on sale price, harvest efficiency, and reduced costs of producing juveniles.

In vivo investigation of oocyte transit and maturation in a broadcast-spawning holothurian

Jean-François Hamel and Annie Mercier

Source: Invertebrate Biology 126(1):81–89. (2007)

A sequential in vivo approach was used to examine the transformations undergone by oocytes during transit in the gonoduct of the sea cucumber *Holothuria leucospilota*, from ovulation until fertilization competency. Spasms of the ovarian muscle bands, during the prespawning locomotor activity of the females, coincided with the extrusion of oocytes from the follicle cells (ovulation). No germinal vesicle breakdown (GVBD) was visible and the oocytes were not fertilizable. As the animal began to display the anterior sweeping movements characteristic of spawning, the oocytes streamed out of the gonad and were stored in the gonad basis. The oocytes, which were still non-fertilizable, were then pressed forward through the first (proximal) section of the gonoduct. GVBD was completed during this rapid transit, but oocytes could not be fertilized unless they had soaked ±20 min in seawater. In the second (distal) section of the gonoduct, most oocytes were readily fertilizable; fertilization rates increased noticeably after the formation of a bulge beneath the gonopore, which favored the entry of seawater. Hydration of the jelly coat was apparent (i.e., a 60% increase in oocyte surface area). Gamete release occurred in one powerful spurt B85 min after the onset of ovulation. This oocyte maturation sequence is expected to occur in holothurian species with similar anatomy and spawning behavior.

Exogonadal oogenesis in a temperate holothurian

Jean-François Hamel, Pierre Becker, Igor Eeckhaut and Annie Mercier

Source: The Biological Bulletin 213:101–109. (2007)

Unusual structures were detected on the visceral peritoneum of the ovarian tubules in about 5%–10% of female sea cucumbers (*Cucumaria frondosa*) collected off Newfoundland, eastern Canada. The condition varied from mild to severe, with localized castration observed in the most heavily affected tubule sections. Investigation of the structures using histology, transmission electron microscopy (TEM), and gene analysis revealed that they were oocytes at different stages of development, growing singly or in groups of up to six. Their size and composition were consistent with those of oocytes found in the lumen of the ovaries, although "exogonadal" oocytes were devoid of a vitelline coat and presented few cortical granules. TEM sections suggest that the atypical oocytes emerged from the peritoneum and grew toward the coelomic cavity, and that they were not in direct contact with the basal lamina or the inner germinal layers. Similar masses have been observed in *C. frondosa* from the Gulf of St. Lawrence (Québec, Canada) and the Barents Sea (Russia), and in *C. japonica* and *Psolus fabricii* from Canada and Russia. The possibility that exogonadal oogenesis is attributable to anthropogenic disturbances should be investigated even though some of the affected specimens originate from presumably pristine locations.

Diurnal observations of sheltering behaviour in the coral reef sea cucumber *Holothuria whitmaei*

Glenn Shiell and Brenton Knott

Source: Fish Research 2007

Management of commercial sea cucumber stocks relies, in part, on estimates of population densities which, in turn, depend on knowledge of habitat preferences, and of the influence of biological cues on sheltering and/or aggregation behaviour. Here, we document a diurnal shift in the sheltering behaviour of the Pacific and eastern Indian Ocean black teatfish, *Holothuria whitmaei*, and discuss the implication of this behaviour for surface based population density surveys. Diurnal studies of thirty black teat fish on Ningaloo Reef, Western Australia, found that the proportion of animals sheltered (and therefore hidden when viewed from directly above) was significantly greater in the morning (3–23%; 08:30–12:30) relative to the afternoon (0–6%; 12:30–17:30). As with sheltering behaviour, the straight-line distance between individual sea cucumber and the nearest shelter also showed marked diurnal variation, with animals observed at greater distances from shelter between 12:30 and 17:30 (PM: 4–22 cm; AM: 1–7 cm). Based on these results, we suggest that surfaced-based census techniques (e.g. manta tows) may underestimate population densities if conducted during times of reduced activity and increased incidence of sheltering behaviour. Appropriate calibration factors for daytime black teatfish surveys are proposed.

Reproductive biology of the commercial sea cucumber *Holothuria spinifera* (Echinodermata: Holothuroidea) from Tuticorin, Tamil Nadu, India

P.S. Asha and P. Muthiah

Source: Aquaculture, published online**:** 27 October 2007

The annual reproductive cycle of the commercial sea cucumber *Holothuria spinifera* was studied in Tuticorin, Tamil Nadu, India, from September 2000 to October 2001, by macroscopic and microscopic examination of gonad tubule, gonad index and histology of gametogenic stages, to determine the spawning pattern. The gonad consists of long tubules with uniform development. It does not confirm the progressive tubule recruitment model described for other holothurians. The maximum percentage of mature animals, gonad and fecundity indices, tubule length and diameter, with the observations on gonad histology, ascertained that *H. spinifera* had the peak gametogenic activity during September and October 2001 followed by a prolonged spawning period from November 2000–March 2001.

Redescription of *Stichopus naso* Semper, 1868 (Echinodermata, Holoturoidea, Stichopodidae)

C. Massin

Source: Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie 72:123–130. (2007).

Specimens from Japan, Thailand, Papua New Guinea and Madagascar have allowed a complete redescription of *Stichopus naso* Semper, 1868. The species, with a wide Indo-Pacific distribution, is new to the fauna of Papua New Guinea and Madagascar. Similar to several other shallow-water holothurians it has the poten-

tial to reproduce by transversal fission. When disturbed, the body undulates in a typical fashion and it is capable of limited swimming movements.

New cucumariid species from southern Australia (Echinodermata: Holothuroidea: Dendrochirotida: Cucumariidae)

P. Mark O'Loughlin

Source: Memoirs of Museum Victoria 64:23–34. (2007). [also available at: http://museumvictoria.com.au/pages/3660/64-o-loughlin.pdf]

Four cucumariid species, new to science, are described for the rocky shallows and off-shore sediments of southern Australia: *Apsolidium falconerae*, *Neoamphicyclus altoffi*, *Neoamphicyclus materiae*, *Neocucumella turnerae*. *Neocucumella turnerae* sp. nov. is unique within the genus in not having table ossicles. The five syntypes of *Cucumaria mutans* Joshua are reviewed, restricted to three, and a lectotype and two paralectotypes are designated. The genus *Neoamphicyclus* Hickman is reviewed. *Cucumaria mutans* is referred to *Neoamphicyclus* Hickman. One former syntype of *Cucumaria mutans* is assigned to *Neoamphicyclus materiae* sp. nov. One former syntype of *Cucumaria mutans* has lost all ossicles and is assigned to *Neoamphicyclus* sp. A key is provided for the species of *Neoamphicyclus* Hickman.

New *Holothuria* species from Australia (Echinodermata: Holothuroidea: Holothuriidae), with comments on the origin of deep and cool holothuriids

P. Mark O'Loughlin, Gustav Paulay, Didier Vandenspiegel and Yves Samyn

Source: Memoirs of Museum Victoria 64:35–52. (2007). [also available at: http://museumvictoria.com.au/pages/3660/64-o-loughlin-paulay-vandenspiegel-samyn.pdf]

Two aspidochirotid species, new to science, from the continental slope of southern Australia are described: *Holothuria (Panningothuria) austrinabassa* O'Loughlin sp. nov. and *Holothuria (Halodeima) nigralutea* O'Loughlin sp. nov. The first represents the southernmost documented holothuriid, and is the sister species of the northernmost holothuriid species *Holothuria (Panningothuria) forskali* Delle Chiaje. The second is a very recent offshoot of the wide-ranging Indo-west Pacific *Holothuria (Halodeima) edulis* Lesson. Morphological and molecular genetic differences between these species pairs are detailed. *Holothuria (Halodeima) signata* Ludwig is raised out of synonymy with *H. edulis*. A lectotype for *Holothuria (Halodeima) signata* Ludwig is designated. The status of the subgenera *Panningothuria* Rowe and *Halodeima* Pearson is discussed. The occurrence of multiple madreporites in *Halodeima* is discussed.

New apodid species from southern Australia (Echinodermata: Holothuroidea: Apodida)

P. Mark O'Loughlin and Didier VandenSpiegel

Source: Memoirs of Museum Victoria 64:53–70. (2007) [also available at: http://museumvictoria.com.au/pages/3660/64-o-loughlin-vandenspiegel.pdf].

A new chiridotid genus is erected: *Archedota* O'Loughlin gen. nov. In addition, seven apodid species, new to science, are described (O'Loughlin as author) for the rocky shallows, continental shelf and continental slope of southern Australia: chiridotids *Archedota lapidea, Taeniogyrus papillis, Taeniogyrus tantulus, Trochodota epiphyka*; myriotrochids *Prototrochus burni, Prototrochus staplesi, Prototrochus taniae*. *Taeniogyrus heterosigmus* Heding, *Taeniogyrus roebucki* (Joshua), *Trochodota allani* (Joshua) and *Trochodota shepherdi* Rowe are discussed. Keys are provided for southern Australian species of *Taeniogyrus* Semper and *Trochodota* Ludwig. A table is provided distinguishing Tasman Sea myriotrochid species.

Additions to the holothuroid fauna of the southern African temperate faunistic provinces, with descriptions of new species

A.S. Thandar

Source: Zootaxa 1697:1–57. (2008)

This paper is the third and the final one in the series reporting on the numerous lots of unidentified holothuroids received from the South African and Natal Museums. While the first two papers were limited to the fauna of the subtropical east coast, this paper is limited to the fauna of the temperate region of southern Africa, west of the Port St. Johns-East London area, encompassing the warm and cold temperate faunistic provinces, stretching into Namibia. It records and/or describes 23 nominal and four indeterminate spe-

cies of mostly dendrochirotid holothuroids. Altogether seven new species and three new records for the region under consideration are included and some new data presented for previously described but poorly known species, where this was lacking. The new species are *Sclerothyone unicolumnus*, *Ocnus rowei*, *Cladodactyla brunspicula*, *Panningia trispicula*, *Psolidium pulcherrimum*, *P. pseudopulcherrimum* and *Synallactes samyni* whereas the new records for South Africa are *Pannychia moseleyi* Théel; for the temperate region, *Pawsonellus africanus* Thandar; and for Namibia, *Pseudoaslia tetracentriophora* Heding.

Report on the survey of sea cucumbers conducted at St. Brandon, Mauritius

A. Laxminarayana, Adviser in Fisheries

A survey of sea cucumbers was made at St. Brandon during 6th to 10th November, 2006. In the Ille du Sud, the major species was *Actinopyga mauritiana* with a mean weight of 500 g and mean length of 8 cm. The total quantity present in the area was 7200 kg (un-processed wet weight). Fairly good numbers of *A. milaris* with a mean weight of 1 kg and mean length of 18 cm were present in the location. The chalkyfish, *Bohadschia marmorata* was also present in good numbers with a mean weight of 550 g and mean length of 20 cm. Three specimens of *Holothuria nobilis* with a mean weight of 1.5 kg and mean length of 20 cm were found. Good numbers of *A. echinites* were also found in the site. The dominant species found was *H. atra* with a mean weight of 250 g and mean length of 18.5 cm.

A survey was made around the Coco Island. In the east of the island, specimens of *Thelonota ananas* with a mean weight of 6.25 kg and mean length of 54 cm were found. *B. marmorata* was found in good concentration with a mean weight of 1 kg and mean length of 18 cm. The species found in fairly good numbers were *Stichopus chloronotus* (mean weight of 300 g and mean length 20 cm) and *A. milaris* (mean weight 1 kg and mean length 18 cm). In all the sites surveyed around Coco Island, the dominant species found was *H. atra*.

Fourteen sites were identified around Ille Rephael at various depths from 1.5 m to 19 m. The species found during the survey were *S. chloronotus*, *A. milaris*, *H. pervicax*, *H. fuscofunctata* and *H. atra*. Some of the sites were ideal locations for *H. scabra*, *H. scabra versicolor* and *H. fuscogilva* but no specimens were found during the survey.

A survey made around Ille Paul showed the presence of large quantities of *H. atra* and *S. chloronotus*.

Density and size distribution of the sea cucumber, *Holothuria scabra* (Jaeger 1935), at six exploited sites in Mahout Bay, Sultanate of Oman

Khalfan M. Al-Rashdi, Michel R. Claereboudt and Saud S. Al-Busaidi

Source: Agricultural and Marine Sciences, 12:43-51 (2007)

A rapid survey of the density and size distribution of recently exploited populations of *Holothuria scabra* in Mahout Bay (Ghubbat Hashish Bay) was carried out at six fishing sites. The results showed that population densities varied between 1170 and 4000 individuals ha^{-1} and biomass ranged between 393 and 2903 kg ha^{-1}. The mean size of sea cucumbers and population densities were much lower in populations closer to human settlements, suggestive of overfishing. The sex ratio was estimated to be 1:1 and the size distributions of males and females did not differ significantly. The length-weight relationship for both sexes was calculated as W (g) = 0.033 Length (mm) 2.178.

Stimuli-responsive polymer nanocomposites inspired by the sea cucumber dermis

Jeffrey R. Capadona, Kadhiravan Shanmuganathan, Dustin J. Tyler, Stuart J. Rowan, Christoph Weder

Source: Science 7 March 2008: Vol. 319(5868):1370–1374. [also available at: http://www.sciencemag.org/cgi/content/short/319/5868/1370]

Sea cucumbers, like other echinoderms, have the ability to rapidly and reversibly alter the stiffness of their inner dermis. It has been proposed that the modulus of this tissue is controlled by regulating the interactions among collagen fibrils, which reinforce a low-modulus matrix. We report on a family of polymer nanocomposites, which mimic this architecture and display similar chemoresponsive mechanic adaptability. Materials based on a rubbery host polymer and rigid cellulose nanofibers exhibit a reversible reduction by a factor of 40 of the tensile modulus, for example, from 800 to 20 megapascals (MPa), upon exposure to a chemical regulator that mediates nanofiber interactions. Using a host polymer with a thermal transition in the regime of interest, we demonstrated even larger modulus changes (4200 to 1.6 MPa) upon exposure to emulated physiological conditions.

Articles from the magazine *Fish for the People*

Conserving and managing the sea cucumber resources in Southeast Asia: SEAFDEC Initiative

R. Bumrasarinpai

Source: Fish for the People 5(2):8–9. (2007)

The present trend in the ASEAN towards overfishing of sea cucumbers in commercial species especially under the Families Holothuriidae and Stichopodidae to support international market demand, has become an urgent concern in the international community, particularly at the Convention on International Trade in Endangered Species (CITES). There have been very limited studies and collection of information on the biology and production of sea cucumbers in the ASEAN countries. Nonetheless, sea cucumbers clearly represent an economically important fisheries resource in the region but inadequate attention is given to the management of these species and its fisheries status is not very well known.

The ongoing global initiative to possibly include sea cucumber in commercial species in the CITES Appendices has alarmed the ASEAN countries as this would greatly affect the region's sea cucumber fisheries. In order to address such concern, ASEAN and SEAFDEC convened the Preparatory Meeting on Environmental Related Tasks in October 2005 in Bangkok, Thailand to discuss this issue. The outcome was submitted to the 8th Meeting of ASEAN- SEAFDEC Fisheries Consultative Group (FCG) and the 38th Meeting of SEAFDEC Council held in April 2006 in Brunei Darussalam, during which the following proposals were approved:

- Conduct of a regional comprehensive compilation of data and information on sea cucumbers; and
- The management of sea cucumber resources should be the purview of competent national fisheries agency

Subsequently, SEAFDEC organized the ASEAN-SEAFDEC Regional Technical Consultation on International Fisheries Related Issues in September 2006 in Phuket Thailand, where updated information on sea cucumber in commercial species proposed for listing under CITES and the relevant initiatives undertaken by FAO were provided. The Consultation reaffirmed the need to conduct a regional study on sea cucumber fisheries, utilization and trade and reiterated its recommendation that economically important sea cucumber species should not be listed under any of the CITES Appendices.

Efforts to conserve sea cucumber resource

L.L. Labe, L.K.C. Acera, N.A. Romena, V.V. Manlulu

Source: Fish for the People 5(2):10–12. (2007)

Reports from the University of Guam Marine Laboratory

The two following reports and others are available from: http://mangilao.uog.edu/marinelab/technical-reports.html

The shallow-water echinoderms of Yap – Results of a survey performed 27 July to 9 August 2007, including a stock assessment of commercially valuable species

A.M. Kerr, K.H. Netchy and S.M Hoffman

Source: University of Guam Marine Laboratory Technical Report 121. (2007).
[also available at: http://mangilao.uog.edu/marinelab/publications/uogmltechrep121.pdf]

Yap has an abundance of commercially valuable species of holothuroids (sea cucumbers) and is currently being targeted by at least three foreign buyers of the processed product, beche-de-mer. The Yap State government has realized the danger of overharvesting this valuable resource and is currently seeking to develop a management plan that will permit a sustainable level of harvesting. We performed a survey of holothuroids and other echinoderms around the main island to 1) assist in a stock assessment of commercially valuable species and 2) document Yap's echinoderms as part of a global survey of coral reef biodiversity. In a total of nine days of surveying, 19 sites were visited around the island. Several commercially valuable species of holothuroids inhabited Yap's waters, some in abundance. The most valuable species seen were *Holothuria* (*Microthele*) *whitmaei* (trade name: black teatfish), *Holothuria* (*Metriatyla*) *scabra* (sandfish) and *Thelenota ananas* (prickly redfish). A total of 66 taxonomic units attributable to species have now been identified

from Yap's waters: 33 holothuroids, 14 echinoids, 14 asteroids and 5 crinoids. At least four (12%) of the holothuroids are in all likelihood new to science and formally undescribed. Based on our brief survey, our preliminary recommendations for a beche-de-mer management plan include: 1) Institute a moratorium on fishing until a management plan is in place. 2) Conduct an inventory of the island's commercially valuable species. 3) Institute minimum harvestable lengths for each species. 4) Institute temporary closures to increase stock size and value. 5) Increase public awareness and teach monitoring methods to villages. 6) Continually assess the effectiveness of the management plan and modify it when necessary. We discuss all these measures at greater length in the report.

Survey of the shallow-water sea cucumbers of the central Philippines

A.M. Kerr, K. Netchy and A.M Gawel

Source: Unversity of Guam Marine Laboratory Technical Report 119 (2006) [also available at: http://mangilao.uog.edu/marinelab/publications/uogmltechrep119.pdf]

Announcement:

4th Workshop of German & Austrian Echinoderm Research, 24–26 October 2008

Location:
Naturhistorisches Museum Wien, Burgring 7, Vienna, Austria

Organisation and contact:
Andreas Kroh and Brigitta Schmid
Naturhistorisches Museum Wien
Geologisch-Paläontologische Abteilung / Abteilung für Ausstellung und Bildung
Burgring 7, 1010 Wien, Austria

Phone: 0043-1-52177-576 (A. Kroh) or 564 (B. Schmid)
Fax: 0043-1-52177-459
Emails: andreas.kroh@nhm-wien.ac.at ; brigitta.schmid@nhm-wien.ac.at

Please consult the circular for registration and further information:
http://www.nhm-wien.ac.at/Content.Node/forschung/geologie/mitarbeiter/pdfs/Zirkular1_EN.pdf

Original text: English

Secretariat of the Pacific Community, Marine Resources Division, Information Section
BP D5, 98848 Noumea Cedex, New Caledonia
Telephone: +687 262000; Fax: +687 263818; cfpinfo@spc.int; http://www.spc.int/coastfish