



**CMFRI SPECIAL PUBLICATION**  
**Number 58**

**AN ANNOTATED BIBLIOGRAPHY  
ON SEA-CUCUMBERS**

**CENTRAL MARINE FISHERIES RESEARCH INSTITUTE**  
Indian Council of Agricultural Research  
DR. SALIM ALI ROAD, POST BOX NO. 1603, TATAPURAM P.O.  
ERNAKULAM, COCHIN 682 014

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# AN ANNOTATED BIBLIOGRAPHY ON SEA-CUCUMBERS

*Compiled by*

**DR. D. B. JAMES**

*Central Marine Fisheries Research Institute,  
Cochin 682 014*



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**DR. SALIM ALI ROAD, POST BOX NO. 1603, TATAPURAM P.O.**  
**ERNAKULAM, COCHIN 682 014, INDIA**

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**Front Cover : *Holothuria pardalis* (Photo by Mr. P. Emmanuel Vijay Anand).**

**Back Cover : *Thelenota ananas* (Photo by Dr. D. B. James).**

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## INTRODUCTION

*Beche-de-mer* is a little known subject with references widely scattered and not readily available for an average worker. Therefore it was felt essential to bring in all the scattered references at one place with a brief summary of each reference. A few references collected through cross reference are simply listed without annotations as it was not readily possible to the correct summary. The subject matter with 398 references is arranged under different headings such as General, Taxonomy, Morphology, Anatomy, Biology, Ecology, Reproduction, Hatchery and Culture, Conservation and Management, Resource and Fishery, Processing and Quality Control, and Marketing and Export. Many of the papers particularly the valuable reports of the FAO and the these approved by various Universities are also included to make the Bibliography comprehensive. Valuable information has been collected from the Administrative Reports of the Madras State Fisheries Department. Maximum references are under the heading Taxonomy. Though hatchery and culture techniques in sea-cucumbers are of recent origin, more than 30 references have been collected on the subject and included. Every effort is made to make the Bibliography wide-based and complete.

The compiler is most grateful to Dr. P. S. B. R. James, Director, Central Marine Fisheries Research Institute, Cochin for kindly suggesting to take up this work and also for his interest and encouragement. He particularly thanks Miss. A. M. Clark formerly of the British Museum (Natural History) for generously providing some of the references on Reproduction, Hatchery and Culture from the Far Eastern Seas. He is also thankful to his colleague Shri P. Thirumilu for collecting some information from the Administrative Reports of the Madras State Fisheries Department. He sincerely thanks Dr. K. Rengarajan for critically scrutinising, editing and printing this Bibliography nicely and in time.

## GENERAL

1. ADITHIYA, L. 1967. *Beche-de-mer* : The Sea slug. *Loris.*, 11 (12) : 87 - 90

The *beche-de-mer* industry of Sri Lanka is described.

2. ——— 1969. The *beche-de-mer* in Ceylon. *Spolia Zeylan.* 31(2) : 405 - 412

3. ANONYMOUS 1917. Report on the Administration of Madras during the year 1916 - 1917. *Government of Madras Publication*; 57.

Sir Frederick Nicholson mentions that *beche-de-mer* cultivation was done during 1916 - '17. It is also stated that *Beche-de-mer* yielded profit.

4. ——— 1969. Revived interest in *beche-de-mer*. *Aust. Fish.*, 28 : 11.

*Beche-de-mer* industry in Australia is described.

5. ——— 1975. *Beche-de-mer* : a new export. *World Fishing*, 24 (11) : 61.

*Beche-de-mer* industry in Sri Lanka Processing methods for *Holothuria scabra* are given. In Sri Lanka three more *beche-de-mer* factories proposed to engage 1000 - 4000 families. A figure is given about the collection of sea cucumber.

6. ——— 1978. Rupee a slug in Sri Lanka. *Fish News. Inst.*, 17 (6) : 9.

In Sri Lanka *Holothuria scabra* is collected from 3-20 m depth. During 1977-'78, 800 and 500 lbs. were collected. There are two seasons for fishing one from January to May and the other

from August to October. Collection is made by steel-pronged fork mounted on a long handle.

7. — 1979. Over sea prospects for Australian *beche-de-mer*. *Aust. Fish.*, 38 (9) : 45 - 47.

The prospects for the Australian *beche-de-mer* are given.

8. — 1985. *National Workshop on beche-de-mer. Regional Project for the Development and Management of Fisheries in the Southwest Indian Ocean*. Ministry of Tourism, Marine and Forestry, United Republic of Tanzania during July 29th to August 2nd 1985. pp.17.

Probably the first workshop on *beche-de-mer*. Conducted classes on commercially important holothurians, processing, grading, packing, storage and market trends and marketing. Conducted practical classes for the preparation of processing site, fishing for holothurians, cleaning, handling, degutting, boiling, drying and smoking.

9. — 1987. Sea cucumbers or *Beche-de-mer. Near Shore*, 12 pp.

A popular article describes commercial holothurians, their habits, methods of catching and processing.

10. — 1987. Preparing *beche-de-mer* for export. *Ibid.*, pp. 13 - 15.

A popular article on the processing, packing, storing, grading and finally marketing of *beche-de-mer*.

11. AYYANGAR, S. R. 1922. Notes on the fauna and fishing industries of the Laccadives. *Madras Fish. Bull.*, 15 : 45 - 69.

*Beche-de-mer* industry which existed once in Lakshadweep is now closed.



12. BEARDSLY, A. J. 1971. *Beche-de-mer* fishing. *Comm. Fish. Revi.*, 33 (7 & 8) : 64 - 68.

Gives a few remarks on *beche-de-mer* fishery.

13. BRADBURY, A. 1990. Sea-cucumber research in Washington State. *Beche-de-mer Information Bulletin*, 2 : 11 - 12.

The only commercially exploited holothurian in Washington State is *Stichopus californicus*. Underwater surveys made by taking 12 transects each measuring 83.61 sq.m. Tagging was also done using Floy tags.

14. BRUCE, C. 1983. Sea-cucumbers - extraordinary, but edible all the same. *Infofish.*, 6 : 19 - 21.

Economically important holothurians in different languages with processing and marketing methods are mentioned. Recipes for *beche-de-mer* preparation are also given.

15. CHARI, S. T. 1964. The Indian *beche-de-mer* industry. *Indian Seafoods*, 1 (14) : 11 - 13.

Some remarks on the Indian *beche-de-mer* industry are given.

16. CHOPRA, B. 1931. On some decapod Crustacea found in the cloaca of Holothurians. *Rec. Indian Mus.*, 33 : 303 - 324.

The pea-crab *Pinnotheres decanensis* is reported from the cloaca of the commercially important holothurian *Holothuria scabra* from the Andamans.

17. CLARK, A. M. 1976 Echinoderms of coral reefs. In : O. A. Jones and R. E. Endean (Ed.) *Biology and Geology of Coral Reefs*. Academic Press, New York, 3 (2) : 95 - 123.

Gives very interesting information on the habits of reef

dwelling echinoderms. Some of the species listed as useful for *beche-de-mer* are strictly not used for *beche-de-mer*.

18. COLLIER, C. 1830. On the *Trepang* or *Biche-de-Mer* or Sea slug of India the *Holothuria tubulosa* of naturalists. *Edinburgh New Phil. J.*, 8 : 46 - 52.

A very old paper which described the processing of *beche-de-mer*. First account on *beche-de-mer* from India.

19. CONAND, C. AND N. A. SLOAN 1988. World fisheries for echinoderms. In : J. F. Caddy (Ed.) *Scientific approaches to management of shellfish resources*. Wiley, New York. pp. 647 - 663.

History of *beche-de-mer* fisheries, harvesting, trade, life-history of commercial species, resource assessment, fisheries regulation and future of sea-cucumber management are given.

20. ——— AND ——— 1988. *Les holothuries espidochirotes du lagoon de nouvelle-Caledonie*. These de Doctorat es Sciences, 288 p.

Detailed work on the reproductive biology of some holothurians from New Caledonia.

21. CUENOT, L. 1948. Anatomie, ethologie et systematique des echinoderms. In : Grasse (Ed.) *Traite de Zoologie*. Masson Paris, 2 : 3 - 363.

22. CURTTS, V. A. 1980. *Queensland beche-de-mer fishery summary : 1880 - 1980*. Brisbane, Queensland Fisheries Service, p. 6.

Unpublished report on the *beche-de-mer* fishery of Queensland for one hundred years.

23. DAVIDSON, A. 1977. *Seafood of Southeast Asia*. Federal Publications Pvt. Ltd, Singapore.

A recipe for *beche-de-mer* preparation is given.

24. FAO, B. 1990. Pollution problems. *Beche-de-mer Information Bulletin*, 2 : 12.

In New Caledonia is caused by the fluids that come out during degutting and also by throwing the water in which they are boiled. A number of bivalves and thousands of sardines died due to the pollution. This toxin is tested against small fish by using fresh juice and cooking stock.

25. GENTLE, M. T. 1979. The fisheries biology of *beche-de-mer*. *South Pacific Bull.*, 29 : 25 - 27.

26. HORNELL, J. 1917. The Indian *beche-de-mer* industry : its history and recent revival. *Madras Fish. Bull.*, 11, (4) : 119 - 150.

A classical paper on Indian *beche-de-mer*, its history and revival. The history of the industry in India is traced back to the Chinese method of curing in earlier days. Defects in curing and trade are pointed out. The setting up of a Government factory at Tirupalakkudi is mentioned. Finally the prospects for the industry in India including Lakshadweep are given.

27. HYMAN, L. H. 1955. *The Invertebrates : Echinodermata. The Coelomate bilateria*, 4 : 1 - 763. McGraw - Hill. New York

Brief mention of *beche-de-mer* is mentioned in general manner.

28. JACOB, P. J. 1973. Sea-cucumbers. *Seafood Export J.*, 5 (11) : 21 - 26.

A popular article on sea-cucumbers. Some information is given on the *beche-de-mer* industry in the Gulf of Mannar and Palk Bay. Processing method is also briefly described.

29. JAMES, D. B. 1983. Research on Indian echinoderms - A review. *J. mar. biol. Ass. India.*, **25** (1 & 2) : 91 - 108.

All the papers published on *beche-de-mer* from India are reviewed. Thorough survey of the sea-cucumber resources in the Gulf of Kutch is suggested. Detailed study on the resources and biology of commercially important holothurians is suggested.

30. ——— 1986. The holothurian resources. *Marine fishery resources and management. CMFRI, Cochin, R & D Series*, **10** pp. 4.

The importance of *beche-de-mer*, its utilization, present status of the industry and future prospects are given. Commercially important species of holothurians *Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria) spinifera* (Gulf of Mannar and Palk Bay), *Holothuria (Microthele) nobilis*, *Actinopyga mauritiana*, *A. echinites*, *A. miliaris*, *A. lecanora* and *Holothuria (Metriatyla) scabra* (all species from Andamans), *Thekenota ananas* and *A. mauritiana* from Lakshadweep are given.

31. ——— 1988. The enigmatic echninoderms. *Biology Education.*, **5** (2) : 84 - 86.

General remarks on *Beche-de-mer* from India are given.

32. ——— 1989. A Handbook on *beche-de-mer*. Issued on the occasion of National Workshop on *beche-de-mer* held at Mandapam Camp during Feb. 23-25, 1989. Central Marine Fisheries Research Institute, Cochin. pp. 27 (In Tamil with English Summary).

This is the first Handbook in Tamil on sea-cucumbers with beautiful colour plates. It deals with all information needed for the fishermen and industry. Field key is given for commercially important species with brief notes on each species. Information on processing, packing, marketing, conservation and management are given. The recent breakthrough made by CMFRI in inducing *H. scabra* to spawn in the laboratory for the first time is given. At the end, export figures of the last ten years with full addresses of *beche-de-mer* importers in Hong Kong, Singapore and Malaysia are given.

33. \_\_\_\_\_ 1993. Sea-cucumber. *Technical paper presented at the Business Session of INDAQUA, Madras.* pp. 3.

General account of sea-cucumbers is presented along with information on new resources for the Indian *beche-de-mer* industry, potential species for processing, technology for seed production and sea-ranching programme are given.

34. \_\_\_\_\_ AND P. S. B. R. JAMES 1994. A hand-book on Indian Sea-cucumbers. *CMFRI Spl. Publ.*, 59 : 1 - 48.

Field identification characters of commercially important species of holothurians from Indian waters with key, fishery, resources, processing, marketing, trade, recipes of *beche-de-mer*, prospective buyers in international markets, etc. have been given.

35. JAMES, P. S. B. R. 1990. The status of sea farming development in South Asia and options for India. *Souvenir*. A special issue of AFSIB Newsletter. Issued on the occasion of the Second Indian Fisheries Forum.

Controlled breeding of sea-cucumber in China and recent success in breeding sea-cucumbers in India are mentioned.

36. JAMES, R. H. 1977. *Beche-de-mer* in the Solomon Islands. S.P.C. 9th Regional Technical Meeting on Fisheries. Nowmea, WP 17 : 12 p.
37. LIVINGSTONE, A. A. 1935. The life and uses of *beche-de-mer*. *Aust. Mus. Mag.*, 5.
- A popular article on the life of holothurians and also uses of *beche-de-mer*.
38. LOKANI, P. 1990. *Beche-de-mer* research and development in Papua New Guinea. *Beche-de-mer Information Bulletin*, 2 : 8-11.
- Commercially important species : *Holothuria nobilis*, *Actinopyga miliaris*, *A. echinites*, *A. mauritiana*, *H. scabra*. Maximum price is paid to *H. scabra* and this accounts for 70% of the total *beche-de-mer* export.
39. MEYER, W. G. 1992. Sea-cucumbers. *Baja Explorer*. Sept-Oct. 1992.
- The cost of processed sea-cucumbers is US \$ 20.00 per kg in Japan and US \$ 17.00 elsewhere. The species endemic to sea of Cortez is *Isostichopus fuscus*. This is preferred to the Pacific Ocean counterpart and it accounts for 80% of the sea-cucumber export from Mexico.
40. MOTTET, M. G. 1976. The fishery biology and market preparation of sea-cucumbers. *Tech. Rep. Wash. Dep. Fish.*, 22 : 1 - 48.
- Some observations on the *beche-de-mer* preparation.
41. PIETERSZ, V. L. C. 1974. *Beche-de-mer* : valuable foreign exchange earner. *A souvenir to mark the opening of the beche-de-mer processing factory, Mannar*.

History of *beche-de-mer* trade in Sri Lanka and export figures of *beche-de-mer* in terms of quantity and value in recent years are given.

42. PITA, E. 1979. Tuvalu *beche-de-mer* Project : Quarterly report. *SPC Fish. Newsl.*, 18 : 15 - 17.

A brief report on the *beche-de-mer* project of Tuvalu.

43. RADHAKRISHNAN, N. 1989. The role of fisherwomen in the *beche-de-mer* industry. Paper presented at the National Workshop on *beche-de-mer* at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin, Abstract. p. 15.

Presents some remarks on the role of women in *beche-de-mer* industry.

44. SACHITHANANTHAN, K. 1971. *Beche-de-mer* industry in the South Pacific Islands. Interim report to the Food and Agriculture Organisation of the United Nations. 12 p. (Report).

Identification of commercially important species of holothurians, their collection, processing, packing and marketing to promote efficient exploitation of the existing resources in the South Pacific are given.

45. \_\_\_\_\_. 1972. *South Pacific Islands Beche-de-mer fishery*. A report prepared for the South Pacific Islands Development Agency, Rome. FAO, FI : DP/RAS/69/102/11.

Exploitable holothurians, non-commercial holothurians, processing methods, market information, organising the fishery in various areas such as Territory of Papua and New Guinea, British Solomon Islands Protectorate, New Hebrides, Fiji Islands and Micronesia surveyed are given.

46. ——— 1974. *Beche-de-mer of the South Pacific Islands : A handbook for fishermen*. South Pacific Commission, Noumea, New Caledonia, 30 pp.

A small handbook with colour photographs of commercially important holothurians such as *Microthele nobilis*, *Actinopyga miliaris*, *A. echinites*, *A. mauritiana*, *A. leconora*, *Thelenota ananas*, *Holothuria scabra*, *Bohadschia argus*, *B. marmorata*, *B. marmorata vitiensis*, *Halodeima atra* and *Stichopus variegatus* taken *in situ*. Some remarks on the size and habits of the holothurians are also given. *Halodeima edulis* and *Stichopus chloronotus* are mentioned as non-commercial holothurians. Processing methods are given briefly. A new dryer known as Jaffna dryer is described in detail. Grading, packing and storing methods are also given.

47. ——— 1979. *Beche-de-mer of the Tropical Pacific. Handbook for fishermen*. South Pacific Commission, Noumea, New Caledonia. *Handbook*, 18 : 1 - 29.

This is a revision of the earlier work published in 1974. Colour photographs of commercially important holothurians like *Microthele nobilis*, *Actinopyga* sp., *Actinopyga ecchinites*, *A. lecanora*, *A. mauritiana*, *Thelenota ananas*, *Metriatyla scabra*, *Halodeima atra*, *Stichopus variegatus*, *Microthele axiologa*, *Thelenota anax*, *Stichopus chloronotus*, *Bohadschia argus* and *B. marmorata vitiensis* are given with more details for each species. The names for each holothurian in other languages are given. Information on size, shape, colour, habits and value are given for each species. More details on equipment, processing method for Teatfish, packing, storing and grading are given. At the end, full addresses of *beche-de-mer* buyers are given. A very useful and informative booklet.

48. SAVILLE-KENT, W. 1893. In : W. H. Allen (Ed), *The Great Barrier Reef of Australia - its products and potentialities*. 387 pp.



Though this is an old publication it gives lot of information on *beche-de-mer* of Australia.

49. SHENOY, A. S. 1977. Holothurians and its commercial utility. *Seafood Export J.*, 9 (12) : 17 - 23.

A popular article which gives an account on availability, mode of collection, processing and exports of sea-cucumbers.

50. SIME, F. 1992. Tongan gold (sea-cucumbers) exported to Asia, France and Canada. *Tonga Chronicle*.

Processed sea-cucumbers are sent not only to Asian destinations such as Hong Kong and Korea, but also to France and Canada. Only sea-cucumbers more than nine inches are collected. Sea-cucumbers have 43% protein, 2% fat and 21% minerals.

51. VEILAWALAV, M. AND M. IZUMI 1987. *Beche-de-mer* Fishing and Processing. Training Course, 12-13 January 1987. Kavieng, Papua, New Guinea. UNDP/FAO/SPC. (Report).

Processing of *beche-de-mer* is give in detail.

52. VILLANI, S. 1981. Sul consumo alimentare umano di anemoni marine ed oloturie. *Atti Soc. ital. Sci. ver.*, 35 : 661 - 662.

Gives historical and dietary account.

### TAXANOMY

53. APPLGATE, A. L. 1984. Echinoderms of Southern Taiwan. *Bull. Inst. Zool. Academia Sinica*, 23 (1) : 93 - 118.

*Actinopyga echinites* and *A. mauritiana* can be used for processing.

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*Actinopyga echinites* and *A. mauritiana* can be used for processing.

54. BELL, F. J. 1887 a. Report on a collection of Echinodermata from the Andaman Islands. *Proc. Zool. Soc. Lond.*, 1887 : 139 - 145.

Fortyfive species of echinoderms are listed for the first time from Andamans, of which sixteen are holothurians. *Holothuria cadelei* is a synonym of *Holothuria (Metriatyla) scabra* which is commercially important. Other species of commercial value are *Actinopyga mauritiana* and *A. miliaris*.

55. ——— 1887 b. The echinoderm fauna of the Island of Ceylon. *Scient. Trans. R. Publ. Soc.*, 2 : 643 - 658.

Fortythree species of echinoderms belonging to 33 genera are reported. Of these *Actinopyga mauritiana* and *A. miliaris* are economically important. One new species *Holothuria ondaatiei* appears to be a synonym of *Holothuria (Thymioscygia) hilla*.

56. CANNON, L. R. G. AND H. SILVER 1986. *Sea-cucumbers of Northern Australia*. Queensland Museum (Queensland Cultural Centre), P.O. Box 300, South Brisbane, Queensland 4101, Australia.

79 species are described with an indication where they are found. Figures of the body and spicules are given for some species. Picture keys (morphology and spicules) are given for the families and genera. Coloured illustrations for 34 species are given. A brief treatment of holothurian biology, *beche-de-mer* fishery and three Chinese recipes are given at the end.

57. CHAO, S. M. AND K. H. CHARW 1989. The shallow-water holothurians (Echinodermata : Holothurioidea) of Southern Taiwan. *Bull. Inst. Zool. Academia Sinica*, 28 (2) : 107 - 137.

Commercially important holothurians are *Thelenota ananas*, *Actinopyga echinites*, *A. mauritiana*, *Holothuria atra* and *Holothuria nobilis*.

58. ——— 1990. First records of two holothurians (Echino-  
dermata : Holothurioidea) from Taiwan. *Ibid*, **29** (1) :  
65 - 69.

*Bohadschia argus* and *B. graeffi* are recorded for the  
first time from Taiwan. They can be tried for *beche-de-mer*.

59. CHERBONNIER, G. 1951. Holothuries de l' Institut Royal des  
Sciences Naturelles de Belgique. *Mem. Inst. r. Sci. nat.*  
*Belg.*, **44** (2) : 1 - 65.

A very important paper on holothurians with good  
spicule drawings. Commercially important holothurians are  
*Holothuria (Metriatyla) scabra* (Banda Sea), *Actinopyga*  
*mauritiana* (Hawai).

60. ——— 1952. Le Holothuries de Quoy et Gaimard. *Ibid.*, **44**  
(2) : 1 - 50.

A very important paper which has reproduced the  
original colour paintings of Quoy and Gaimard. Good spicule  
diagrams are also given. Commercially important holothurians :  
*Thelenota ananas*, *Actinopyga miliaris*, *A. mauritiana* and  
*Holothuria (Microthele) nobilis*.

61. ——— 1954. Holothuries recoltes en Oceanie Francaise par G.  
Ranson en 1952. *Bulletin du Museum.*, **26** (6) :  
685 - 690.

Only four species of holothurians are listed. *Actinopyga*  
*mauritiana* which is commercially important is listed from  
Tahiti.

62. ——— 1955. Resultats scientifiques des campagnes de la  
'Calypso' Les Holothuries de la Mer Rouge. *Annls. Inst.*  
*Oceanography., Monaco*, **30** : 29 - 183.

A very good contribution on the holothurians from the Red Sea with good spicule diagrams. Commercially important holothurians : *Actinopyga echinites*, *A. bannwarthi*, *A. serratidens*, *A. crassa*, *A. mauritiana*, *Theelothuria spinifera*.

63. — 1963. Contributions to the knowledge of the Red Sea. No. 27. Les Holothuries de la Mer Rouge de L' Universite Hebraique de Jerusalem. *Sea Fish Res. Stat. Bull.*, 34 : 5 - 10.

On the holothurians collected from Eylath (Gulf of Aqaba). Eight species of holothurians are listed, of which *Actinopyga bannwarthi* and *Holothuria (Microthele) nobilis* are commercially important.

64. — 1967. Deuxieme contribution a l' etude des holothuries de la Mer Rouge collectees par des Israeliens. *Israel South Red Sea Expedition. Reports Sea Fisheries Research Station Bulletin*, 43 : 55 - 68.
65. — 1979. Description d' *Actinopyga flammea* nov. sp. et donnees nouvelles sur deux especes connues d' Holothuries Aspidochirotés (Echinodermes). *Bull. Mus. natl. Hist. nat., Paris, 4e ser.*, 1 (1) : 3 - 12.
66. — 1980. Holothuries de Nouvelle-Caledonie. *Ibid.*, 4e ser., 2 (3) : 615 - 667.
67. — AND J. P. FERAL 1984. Les holothuries de Nouvelle-Caledonie, deuxieme contribution (Premiere partie : Synallactidae et Holothuriidae). *Ibid.*, 4e ser., 6 (3) : 659 - 700.
68. — 1984. Les holothuries de Nouvelle-Caledonie, deuxieme contribution (Deuxieme partie : Stichopodidae, Cucumariidae, Phyllophoridae, Synaptidae). *Ibid.*, 4e ser., 6 (4) : 827 - 851.

69. ——— 1988. Echinoderms : Holothurides. *Fauna de Madagascar*, 70 : 1 - 293.

A recent work on the holothurians of Madagascar in which 122 species, two genera and one new subgenus are described. Some of the species are economically important.

70. CLARK, A. M. 1952. The 'Manihine' Expedition to the Gulf of Aqaba 1948-1949. VII. Echinodermata. *Bull. Brit. Mus. nat. Hist. (Zool)*, 1 : 203 - 214.

On echinoderms from the Red Sea. Commercially important holothurian is *Holothuria (Microthele) nobilis* from the Gulf of Aqaba.

71. ——— AND P. S. DAVIES 1966. Echinoderms of the Maldiv Islands. *Ann. Mag. nat. Hist.*, 8 (13) : 599 - 612.

Second paper from Maldives after the survey of Dr. Stanley Gardiner. Earlier misidentifications have been corrected. Twelve species of holothurians are listed from Maldives. Of these the commercially important species are *Actinopyga mauritiana* and *Holothuria (Microthele) nobilis* which is mentioned as common.

72. ——— 1971. Echinoderms from Diego Garcia. *Atoll. Res. Bull.*, 149 : 89 - 92.

Echinoderms collected from Diego Garcia are listed. Of the holothurians listed *Actinopyga mauritiana*, *A. echinites* and *Holothuria (Microthele) nobilis* are economically important.

73. ——— 1980. Echinoderms of Hong Kong. In : B. S. Morten and C. K. Tseng (Ed.) *Proceedings of the First International Marine Biological Workshop. The Marine flora and fauna of Hong Kong and Southern China*. Hong Kong University Press, pp. 485 - 501.

Annotated echinoderm fauna list is given upto 30 metres depth. Economically important holothurians like *Actinopyga obesa*, *Holothuria (Metriatyla) scabra* are listed. Interesting notes on zoogeography are given. The faunal composition shows similarity to the fauna of the Gulf of Mannar and Palk Bay.

74. ——— 1984. Echinodermate of the Seychelles. In : D. R. Stodart (Ed.) *Biogeography and ecology of Seychelles Islands*. Dr. W. Jenk Publishers. The Jagus, Boston, Lancaster, pp. 83-103.

A number of species of echinoderms from the Seychelles with general accounts of various groups. Photographs are given with notes on zoogeography. Commercially important holothurians : *Actinopyga mauritiana* most common mainly at the seaward edges of reef platforms, *Holothuria (Microthele) nobilis* common on the lagoon grass flats at Aldabra.

75. CLARK, H. L. 1921. The Echinoderm fauna of Torres Strait. *Pap. Dep. mar. biol. Carnegie Instn. Wash.*, 10 : 1 - 223.

A very important work on the echinoderms of Torres Strait with beautiful colour paintings and good photographs. Some of the Families and Genera are revised. A small account on the *beche-de-mer* industry of Torres Strait region is given. Commercially important species of holothurians : *Holothuria (Microthele) nobilis*, *Holothuria (Metriatyla) scabra*, *Actinopyga mauritiana*, *A. lecanora*, *A. echinites*, *A. miliaris* and *Thelenota ananas*.

76. ——— 1932. Echinodermata (other than Asteroides) of the Great Barrier Reef Expedition 1928 - 1929. *Scient. Rep. Gt. Barrier Reef Exped.*, 4 : 197 - 239.

Notable contribution on the echinoderms of the Great Barrier Reef with good photographs. Commercial species like

*Holothuria (Metriatyla) scabra* and *Actinopyga miliaris* are described.

77. \_\_\_\_\_ 1983. Echinoderms of Australia. *Mem. Mus. Comp. Zool. Harv.*, **55** : 1 - 596.

Most comprehensive work on the echinoderms of Australia with colour paintings and good photographs. Commercially important species like *Holothuria (Metriatyla) scabra* and *Actinopyga lecanora* are given.

78. \_\_\_\_\_ 1946. The echinoderm fauna of Australia. *Publis. Carnegie Instn.*, **566** : 1 - 567.

A comprehensive work summarises all the living and extinct echinoderms of Australia. Keys to various taxa are given. Flourishing *beche-de-mer* trade between Australia and China existed before the first World war. Commercially important species of holothurians : *Holothuria (Microthele) nobilis*, *Holothuria (Metriatyla) scabra*, *Actinopyga mauritiana*, *A. lecanora*, *A. echinites*, *A. miliaris*, *Thelenota ananas*, *Holothuria (Theclothuria) spinifera*. At the end the relationships of the Australian echinoderms with surrounding areas are given. *Beche-de-mer* industry of Torres Strait is given.

79. CONAND, C. AND P. CHARDY 1985. Les holothuries aspidochirotes du lagon de Nouvelle-Caledonie sont-elles de bons indicateurs des structures recifales ? *Proc. 5th Int. Coral Reef Congress, Tahiti*, **5** : 291 - 296.

80. \_\_\_\_\_ 1986. Les ressources halieutiques des pays insulaires du Pacific. Deuxieme partie : Les holothuries. *FAO Doc. Tech. Paper*, **272 (2)** : 1 - 108.

A very important document on the commercially important holothurians and *beche-de-mer*. Methods for the estimation of resource are given. Information on reproduction



on commercially important species of holothurians, classification of *beche-de-mer* and export figures are given.

81. ——— 1989. *Aspidochirote holothurians of the New Caledonian lagoon : Biology, ecology and exploitation*. ORSTOM, Paris.

From the New Cale lagoon, 48 species of holothurians are collected. Population biology of nine species, their biometry, reproduction, growth and mortality have been studied. They have annual sexual cycle, late sexual maturity and high fecundity. Several options for fishery management are discussed.

82. DANIEL, A. AND B. P. HALDER 1974. Holothuroidea of the Indian Ocean with resources and their distribution. *J. mar. biol. Ass. India.*, 16 (2) : 412 - 436.

Area and regionwise distribution of holothurians in the Indian Ocean is given.

83. DOMANTAY, J. S. 1933. Littoral Holothuroidea of Port Galera Bay and adjacent waters. *Nat. appl. Sci. Univ., Philipp.*, 3 : 41 - 101.

Shallow water holothurians of Port Galera Bay and surrounding waters are given with figures. Some of the species are of commercial importance.

84. ——— 1934. Philippine commercial holothurians. *Philippine Jour. Com.*, 10.

All the holothurians of commercial value from philippines are listed.

85. ——— 1936. Philippine edible holothurians. *The Searchlight*, 1.

Lists all the edible holothurians from Philippines.

86. ——— 1953. Littoral holothurians of Zamboanga and vicinity. *Philipp. J. Sci.*, **82** : 109 - 131.

Shallow water holothurians of Zamboanga and vicinity are mentioned. Some of the holothurians are of commercial value.

87. ——— 1954. Some holothurians of Guam and vicinity. *Natl. appl. Sci. Bull. Univ. Philipp.*, pp. 336 - 357.

On the holothurians of Guam and vicinity. Some of the holothurians are of commercial value.

88. ——— 1961. Littoral Holothurioidea of Hundred Islands and vicinity. *Philipp. J. Sci.*, **89** (1) : 79 - 108.

On the shallow water holothurians of Philippines. Commercially important holothurians : *Holothuria (Microthele) nobilis*, *Actinopyga lecanora*, *A. echinites*, *A. mauritiana*, *A. miliaris*. Spicule diagrams are given for the species.

89. ENDEAN, R. 1953. Queensland faunistic records III, Echinodermata (excluding Crinoidea). *Pan. Dep. Zool. Univ. Cd.*, **1** (3) : 51 - 60.

From Queensland, echinoderms belonging to all the five classes are listed with some notes on their habitat. *Holothuria (Metriatyla) scabra* is stated to be the most common holothurian found throughout the year. Another economically important holothurian *Actinopyga mauritiana* is also recorded.

90. EKMAN, S. 1918. Results of Dr. E. Mjobergs Swedish Scientific Expedition to Australia 1910 - 1913. XIX. Holothurioidea. *K. svenska Vetensk Akad. Handl.*, **58** (6) : 1 - 70.

91. ELANGANAYAGAM, P., V. K. GANESALINGAM AND K. SACHITHANANTHAN 1981. Studies on taxonomy and

ecology of holothurians in the Jaffna Lagoon. *Proc. Southern Ass. Advt. Sci.*, **37** (1) : 44.

Ten species are identified. *Holothuria scabra* is most abundant and *H. impatiens* is rare. *H. spinifera* and *H. impatiens* are found in deep waters.

92. ——— 1983. *Studies on ecology and some aspects on biology of Sri Lankan holothurians (Echinodermata : Holothurioidea)*. M. Phil. Thesis, University of Jaffna.

21 species of holothurians are described. Commercially important species : *B. marmorata*, *B. vitiensis*, *Actinopyga echinites*, *A. serratidens*, *Holothuria scabra*, *H. nobilis*, *H. spinifera*, *Thelenota ananas*. Some remarks are given on saponins.

93. ERWE, W. 1919. Holothurien aus dem Roten Meer. *Mitt. Zool. Mus. Ber.*, **9** : 177 - 189.

A small paper on the holothurians of the Red Sea. Some of the holothurians mentioned are economically important.

94. FERAL, J. P. AND G. CHERBONNIER 1986. Les holothurides. In : Guille, Laboute and Menou (Ed.) *Guide des étoiles de mer, oursins et autres échinodermes du lagon de Nouvelle-Calédonie*. ORSTOM, Paris, pp. 56 - 107.

95. FISHER, W. K. 1907. The Holothurians of the Hawaiian Islands. *Proc. U.S. natn. Mus.*, **32** : 637 - 744.

A very important document on the holothurians from Hawaii which gives several interesting details. Commercially important holothurians : *Holothuria (Microthele) nobilis*, *Actinopyga mauritiana*.

96. GIBBS, P. E., A. M. CLARK AND C. M. CLARK 1976. Echinoderms from the northern region of the Great

Barrier, Australia. *Bull. Brit. Mus. nat. Hist. (Zool.)*,  
30 : 102 - 144.

A recent paper on the echinoderms of the Great Barrier Reef with some notes on their habits. Economically important holothurians : *Holothuria (Metriatyla) scabra*, *Actinopyga miliaris*.

97. GRAVELY, F. H. 1927. The littoral fauna of Krusadai Island in the Gulf of Mannar : Echinodermata. *Bull. Madras Govt. Mus. (Nat. Hist.)*, 1 (1) : 163 - 173.

Twentyeight species of echinoderms belonging to 22 genera are reported. *Holothuria (Metriatyla) scabra* the most commercially important holothurian from the Gulf of Mannar and Palk Bay is reported.

98. HAACKE, W. 1880. Holothurien. In : K. Mobius (Ed.) *Beitrag zur Meeresfauna der Insel Mauritius und der Seychelles*, Berlin, pp. 46 - 48.

One of the oldest papers on holothurians of Mauritius and Seychelles. Some of the holothurians listed are economically important.

99. HEADING, S. G. 1940. Echinoderms from the Iranian Gulf : Holothuroidea. *Danish Scient. Invest. Iran*, Part 2: 113-137.

One of the earliest papers on holothurians from the Persian Gulf. Fourteen species of holothurians are listed. *Holothuria (Theelothuria) spinifera* is the only commercially important holothurian listed.

100. JAEGER, C. F. 1833. *De Holothuriis*. Turici : 1 - 40.

101. JAMES, D. B. 1969. Catalogue of echinoderms in the reference collection of the Central Marine Fisheries Research Institute. *Bull. Cent. Mar. Fish. Res. Inst.*, 7 : 51 - 62.

*Actinopyga mauritiana* (Andaman and Nicobar Islands, Lakshadweep, the Red Sea), *A. echinies* (Andamans), *A. miliaris* (Lakshadweep), *Microthele nobilis* (Lakshadweep and the Red Sea), *Holothuria spinifera* (Gulf of Mannar and Palk Bay), *H. scabra* (Gulf of Mannar, Gulf of Kutch) the commercially important holothurians are listed.

102. \_\_\_\_\_ AND J. S. PEARSE 1971. Echinoderms from the Gulf of Suez and northern Red Sea. *J. mar. biol. Ass. India*, **11** (1 & 2) : 78 - 125.

Fortythree species of echinoderms are reported. Commercially important holothurians : *Actinopyga mauritiana*, *Microthele nobilis*. Comparison of the echinoderms of the Gulf of Suez and the Gulf of Aqaba and the migration of echinoderms into and through the Suez Canal are given.

103. \_\_\_\_\_ 1978 a. Studies on Indian Echinoderms - 6. Redescription of little known holothurians with a note on an early juvenile of *Holothuria scabra* Jaeger from Indian Seas. *Ibid.*, **18** : 55 - 61.

A single juvenile specimen of *Holothuria scabra* of 30 mm collected along with algae from Palk Bay is described with spicule diagrams.

104. \_\_\_\_\_ 1978 b. *Studies on the systematics of some shallow water asteroidea, ophiuroidea and holothuroidea of the Indian Seas*. Ph.D. Thesis, Andhra University.

Commercially important holothurians : *Holothuria (Theelothuria) spinifera* (Gulf of Mannar and Palk Bay), *Holothuria (Metriatyla) scabra* (Gulf of Mannar and Palk Bay, Gulf of Kutch, Andamans), *Holothuria (Microthele) nobilis* (Andamans, Lakshadweep), *Actinopyga mauritiana*, (Andamans, Lakshadweep), *A. lecanora*, (Andamans) *A. echinites* (Andamans), *A. miliaris* (Lakshadweep, Andamans), *Bohadschia marmorata* (Andamans, Lakshadweep), *Bohadschia argus*

(Andamans), *Bohadschia vitiensis* (Andamans), *Thelenota ananas* (Lakshadweep). Some notes on their habitats along with their zoogeography are given.

105. \_\_\_\_ 1985. Echinoderm fauna of the proposed National Marine Park in the Gulf of Mannar. *Proc. Sym. Endangered Marine Animals and Marine Parks*, MBI, 1 : 403 - 406.

Comments on *Holothuria scabra* and *Holothuria spinifera* which are likely to be endangered, are given.

106. \_\_\_\_ 1986. Studies on Indian Echinoderms-12. *Holothuria (Acanthotrapeza) pyxis* Selenka, an interesting holothurian from the Andamans. *J. Andaman Sci. Ass.*, 2 (1) : 34 - 36.

The possibility of using *Holothuria (Acanthotrapeza) pyxis* for *beche-de-mer* due to its large size and thick body wall is pointed out.

107. \_\_\_\_ 1989 a. Zoogeography and systematics of commercially important species of holothurians used for *beche-de-mer*. Paper presented for the National Workshop on *beche-de-mer* at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin. February, 1989. Abstract, p. 6.

Detailed account of taxonomy of the commercially important species of holothurians and their zoogeography are given.

108. \_\_\_\_ 1989 b. Echinoderms of Lakshadweep and their zoogeography. *Bull. Cent. mar. Fish. Res. Inst.*, 43:97-144.

Five commercially important holothurians are described.

109. \_\_\_\_ 1991. Echinoderms of the Marine National Park, South Andaman. *J. Andaman Sci. Ass.*, 7 (2): 19 - 25.

Commercially important species : *Actinopyga mauritiana*, *A. miliaris*, *Bohadschia argus*, *B. vitiensis*, *Holothuria atra* *H. pyxis*, *H. scabra*, *Stichopus* sp., *S. chloronotus*.

110. JAYASREE, V. 1988. *Some aspects of eco-biology and chemistry of Holothuria leucospilota (Brandt) from Central West Coast of India*. Ph. D. Thesis, Andhra University.

111. KOEHLER, R. AND C. VANEY 1905. *Echinodermata of the Indian Museum*. Part IV. An account of the littoral Holothurioidea collected by the R.I.M.S. Investigator. 55 pp.

A very important document on the shallow water holothurians of India. Some of the species collected from Andamans are economically important. Good spicule diagrams are given.

112. LAMPERT, K. 1885. Die Seewalzen (Holothurioidea). In: C. Semper (Ed.) *Reisen in Archipel der Philippinen*. Wiesbaden, 4 (3) : 1 - 312.

Some of the holothurians mentioned are commercially important.

113. LAMPERT, P. 1984. British Columbia marine faunistic survey report : Holothurians from the Northeast Pacific. *Can. Tech. Rep. Fish. Aquat. Sci.*, 1234: 1 - 33.

Holothurians of the Northeast Pacific are given.

114. LESSON, R. P. 1830. *Centurie zoologique on choix d' animaux rares, nouveaux on imparfaitement connues*. Paris, pp. 1 - 244.

Some of the holothurians are described as new species.  
Some of the species are used in *beche-de-mer* processing.

115. LEVIN, V. S. 1979. Aspidochirote holothurians of the upper sublittoral zone of Indo-West Pacific : Species composition and distribution. *Biol. Morva Vladivost.*, **5** : 17 - 23 (In Russian).

The shallow water holothurians belonging to Aspidochirotea from the Indo-West Pacific are given. Some of them are commercially important.

116. \_\_\_\_ 1982. Japanese sea-cucumber. *U.S.S.R. Acad. Sci., Viadovostock* 191 pp. (In Russian).
117. \_\_\_\_ , V. I. KALININ AND V. A. STONIK 1984. Chemical characters and taxonomic revision of the holothurian *Bohadschia graeffei* (Semper) as refer to erection of a new genus. *Biol. Morva Vladivostok*, pp. 33 - 38 (In Russian).
118. LIAO, Y. 1975. The Echinoderms of Xisha Islands. I. Holothuroidea Guangdong Province, Oshima. *Studia Marina Sinica*, **10** : 199 - 228.

One of the very few papers on the holothurians of China. All descriptions given in Chinese except for the new species which is given in English. Spicule diagrams are given. Commercially important holothurians : *Thelenota ananas*, *T. anax*, *Actinopyga lecanora*, *A. mauritiana*, *A. miliaris*, *A. echinites*, *Holothuria (Microthele) nobilis*.

119. \_\_\_\_ 1984. The aspidochirote holothurians of China. *Ibid.*, **23**: 221 - 248.
120. LUDWIG, H. 1887. Drei mitheilungen uber alte and neue Holothurienarten. *Ab. preuss. Akad. Wise.*, **54** : 1 - 28.



Seventeen species of holothurians are reported from Sri Lanka. Commercially important holothurians : *Holothuria (Metriatyla) scabra*, *Holothuria (Theelothuria) spinifera*, *Actinopyga echinites*, *A. miliaris*, *A. lecanora*.

121. MARSH, L. H. 1986. Part VI. Echinoderms. *Rec. West. Aust. Mus., Suppl.*, 25 : 63 - 74.

The echinoderms of the Northwestern Australia Coast are listed. Commercially important holothurians : *Holothuria (Microthele) nobilis*, *Actinopyga mauritiana*.

122. MARY BAI, M. 1980. Monograph on *Holothuria (Metriatyla) scabra* Jaeger. *Mem. Zool. Surv. India*, 16 (2) : 1 - 75.

In two parts. The first part deals with the holothurians from the Indian seas with keys to genera and species and with spicule diagrams. The second part deals with the anatomy of *Holothuria (Metriatyla) scabra* in detail with sections of various organs. Directions for practical work are given with notes on evisceration and regeneration.

123. MITSUKURI, K. 1912. Studies on Actinopodus Holothuroidea. *J. Coll. Sci. imp. Univ. Tokyo.*, 29 (2) : 1 - 284.

A very important paper on the holothurians of Japan. Commercially important holothurians : *Holothuria (Microthele) nobilis*, *Actinopyga mauritiana*, *A. echinites* and *Theleota ananas*.

124. MORTENSEN, T. 1926. Cambridge Expedition to the Suez Canal in 1924. VI. Echinoderms. *Trans. zool. soc. Lond.*, 22 : 117 - 131.

On the echinoderms of Suez Canal. The migration of echinoderms from the Gulf of Suez into Suez Canal is described. *Actinopyga miliaris* is the only commercially important holothurian.

125. MUKHOPADHYAY, S. K. AND T. K. SAMANTHA 1983. On a collection of shallow water holothurians from the Lakshadweep. *Rec. Zool. Surv. India*, **81** : 299 - 314.

Twelve species of holothurians collected from the Lakshadweep are listed with brief description, habitat and spicule diagrams, commercially important holothurians : *Actinopyga mauritiana*, *Thelenota ananas*. A list of holothurians known from the Lakshadweep is given.

126. \_\_\_\_ 1988. On some holothurians from the Gulf of Mannar. *Ibid.*, **85** (1) : 1 - 17.

Ten species of holothurians are described. Descriptions of *Holothuria ocellata* and *H. rigida* appear to be based as *Holothuria Scabra*.

127. \_\_\_\_ 1991. Echinodermata : Holothurioidea. *State Fauna Series 2. Fauna of Lakshadweep*. pp. 399 - 413.

Commercially important species : *Actinopyga mauritiana*, *A. miliaris*, *Bohadschia marmorata*, *Holothuria atra*, *H. nobilis*, *Stichopus chloronotus*, *S. variegatus*, *Thelenota ananas*.

128. PANNING, A. 1929-1935. Die Gattung *Holothuria*. *Mitt. zool. St. Inst. Hamb.*, **44** (1929) : 91 - 138; **45** (1934) : 24 - 50; (93) : 65 - 85; (1935) : 85 - 107 : **46** (1935) : 1 -18.

A very important work on the genus *Holothuria*. The author has brought out all the published information on the genus *Holothuria* at one place and attempted revision. Unfortunately the revision proved to be artificial since closely related species were separated and unrelated species were grouped together. Good spicules drawings are reproduced. Many commercially important species are described.

129. PEARSON, J. 1903. Holothurioidea. In : W.A. Herdman (Ed.) *Report to the Government of Ceylon on the Pearl oyster*

*Fisheries of the Gulf of Mannar. London (Royal Society). suppl. rep., 5 : 181 - 208.*

A very important paper on the holothurians of Sri Lanka though some of the new species proved to be synonymous with others. Commercially important holothurians : *Holothuria scabra*, *Actinopyga mauritiana*, *A. serratidens*.

130. \_\_\_\_ 1910 a. Littoral marine fauna of Kerimba Archipelago. Portuguese East Africa. Holothuroidea. *Proc. zool. Soc. Lond.*, 1910 : 167 - 182.

Some of the species reported are economically important.

131. \_\_\_\_ 1910 b. Marine fauna of the Mergui Archipelago : Holothuroidea. *Ibid.*, 1910 : 183 - 194.

On the holothurians of the Mergui Archipelago. Commercially important holothurians : *Actinopyga lecanora*, *A. echinites*.

132. \_\_\_\_ 1913. Notes on the Holothuroidea of the Indian Ocean. *Spolia Zeylan*, 9 (34) : 49 - 101.

Twentyfive species of holothurians belonging to the genus *Holothuria* are reported from various localities such as Suez Bay, Sri Lanka, Amboina, Maldives, Japan and Seychelles. *Holothuria (Theelothuria) spinifera* is reported from Sri Lanka.

133. \_\_\_\_ 1914 a. Proposed re-classification of the genera *Mulleria* and *Holothuria*. *Ibid.*, 9 (35) : 163 - 172.

Re-classification of the commercially important genera *Mulleria* (= *Actinopyga*) and *Holothuria* is suggested.

134. \_\_\_\_ 1914 b. Notes on the Holothuroidea of the Indian Ocean. *Ibid.*, 9 (35) : 163 - 172.

Eight species of holothurians are recorded from Sri Lanka, Seychelles, Red Sea, Durban and Maldives. Commercially important species of holothurians : *Actinopyga mauritiana*, *A. miliaris*, *A. lecanora*, *A. echinites* and *A. serratindens*.

135. POPE, E. C. 1967. Lesser known echinoderms of the Great Barrier Reef. *Aust. nat. hist.*, 15 : 310 - 314.

A small, but interesting popular article with good photographs. A passing reference is made to *beche-de-mer*.

136. PRICE, A. R. G. 1982. Echinoderms of Saudi Arabia : Comparison between Echinoderm fauna of the Arabian Gulf, SE Arabia, Red Sea, Gulf of Aqaba and Gulf of Suez. *Fauna Saudi Arabia*, 4 : 3 - 21.

Commercially important species of holothurians : *Actinopyga bannwarthi*, *A. crassa*, *A. echinites*, *A. lecanora*, *A. plebeia*, *A. mauritiana*, *A. miliaris*, *A. serratindens*, *Holothuria (Metriatyla) scabra*, *Holothuria (Theelothuria) spinifera*. Distribution Table is given.

137. \_\_\_\_\_ 1983. Echinoderms of Saudi Arabia. Echinoderms of the Arabian Gulf; coast of Saudi Arabia. *Ibid.*, 5 : 28 - 108.

A good contribution on echinoderms of the Arabian Gulf Coast in which keys and information on various species with good figures are given.

138. \_\_\_\_\_ AND C. E. REID 1985. Indian Ocean echinoderms collected during the Sindbad Voyage (1980-81) : 1. Holothurioidea. *Bull. Brit. Mus. nat. Hist. (Zool.)*, 48 (1) : 1 - 9.

Commercially important species : *Actinopyga echinites*, *A. mauritiana*, *Holothuria atra*, *H. nobilis*, *Stichopus chloronotus*.

139. RAO, G. C. 1991. Distribution of plants and animals on rocky sea shores of Andaman and Nicobar Islands. *J. Andaman Sci. Ass.*, **7** (2) : 30 - 42.

Commercially important species : *Holothuria atra*, *Actinopyga echinitis*, *Stichopus variegatus*.

140. ROWE, F. W. E. 1969. A review of the Family Holothuroidea (Holothuroidea; Aspidochirotida). *Bull. Brit. nat. Hist. (Zool.)*, **18** (4) : 119 - 170.

Genus *Holothuria* is divided into several manageable sub-genera. Several economically important species are dealt with.

141. ——— AND J. E. DOTY 1977. The shallow water holothurians of Guam. *Micronesica*, **13** (2) : 217 - 250.

Contribution on the holothurians of Guam with colour plates, spicule diagrams and keys to various taxa. Commercially important holothurians : *Thelenota ananas*, *T. anax*, *Actinopyga mauritiana*, *A. echinites*.

142. SATYAMURTI, S. T. 1976. The Echinodermate in the collection of the Madras Government Museum. *Bull. Madras Govt. Mus. nat. Hist., New Series*, **7** (3) : 1 - 284.

A compilation on the echinoderms labelled and deposited in the Madras Museum. Some of the holothurians like *Holothuria scabra* are economically important.

143. SELENKA, E. 1867. Beitrage zur Anatomie und Systematik der Holothurie. *Z. wiss. Zool.*, **17** : 281 - 374.

On holothurians with several new species. Some of them are economically important.

144. SEMPER, C. 1868. Holothurien. *Reisen im Archipel der Philippines*. 2. Wissenschaftliche Resultate. Weisbaden. 288 pp.

A very important work on the holothurians published more than one hundred years back with beautiful colour plates and remarkable resemblance to live specimens. Some of the species are new. Commercially important species: *Actinopyga miliaris* (Mozambique), *Holothuria (Microthele) nobilis* (Philippines).

145. SLOAN, N. A., A. M. CLARK AND J. D. TYLOR 1979. The echinoderms of Aldabra and their habits. *Bull. Brit. Mus. Nat. Hist., (Zool.)*, **37** (2) : 81 - 128

Echinoderms belonging to all the classes are listed with notes on their habits. Commercially important holothurians: *Actinopyga echinites*, *A. mauritiana*, *A. miliaris*, *Thelenota ananas*, *Holothuria (Microthele) nobilis*.

146. SLUTTER, C. P. 1901. Die Holothurien der Siboga Expedition. *Siboga Exped.*, **44** : 1 - 142.

A standard work on the holothurians of East Indies with colour plates. Commercially important holothurians: *Holothuria (Metriatyla) scabra*, *Actinopyga echinites*, *A. miliaris*, *Thelenota ananas*.

147. SOOTA, T. D., S. K. MUKHOPADHYAY AND T. K. SAMANTA 1983. On some holothurians from the Andaman and Nicobar Islands. *Rec. Zool. Survey India*, **80** : 507 - 524.

Eighteen species of holothurians are listed with brief description, distribution and remarks. Commercially important holothurians: *Actinopyga mauritiana*, *Holothuria (Metriatyla) scabra*, *Holothuria (Lessonothuria) pardalis* and *Halodeima (Thumiosycia) impatiens* are not commercially important, but mentioned as being extensively used for *beche-de-mer* preparation.

148. TIKADER, B. K. AND A. K. DAS 1985. *Glimpses of animal life in Andaman and Nicobar Islands*. Zoological Survey of India, Calcutta. 170 pp.

Seven species of holothurians are mentioned of which *Actinopyga mauritiana* and *Holothuria scabra* are commercially important.

149. \_\_\_\_\_, A. DANIEL AND N. V. SUBBA RAO 1986. *Sea shore animals of Andaman and Nicobar Islands*. Zoological Survey of India, Calcutta. 188 pp.

Eight species of sea-cucumbers are mentioned. *Actinopyga echinites* is commercially important.

150. THEEL, H. 1886. Holothurioidea. Part 2. *Rep. Scient. Results Voy. HMS Challenger (Zool.)*, 39 : 1 - 290.

A report on the shallow water holothurians collected by H.M.S. *Challenger*. Summarised all the work done upto that time with good spicule figures. Commercially important holothurians : *Actinopyga mauritiana* (Fiji Islands), *Holothuria (Metriatyla) scabra* (Mauritius, Torres Strait, Gulf of Siam, Fiji Islands, Singapore, Java, Port Natal), *Actinopyga mauritiana* (Navigator Islands, Fiji Island, Tahiti), *Actinopyga lecanora* (Mauritius), *A. echinites*, *A. miliaris* (Fiji Islands), *Thelenota ananas*.

151. TOKUHICA, S. 1915. On *Stichopus japonicus* in Nanao Bay. *Suisan Kenkyushi*, 10 (2) : 33 - 37.

152. TORTONESE, E. 1979. Echinoderms collected along the eastern shore of Red Sea (Saudi Arabia). *Atti Soc. ital. Sci. nat. Museo Oiv. Stor. nat. Milano*, 120 (3 & 4) : 314 - 319.

Fiftythree species of echinoderms collected near Jiddah are listed. Commercially important holothurians : *Actinopyga mauritiana*, *A. serratidens*, *Holothuria (Metriatyla) scabra*, *Holothuria (Microthele) nobilis*.

153. WAINIYA, W. 1988. On the taxonomy of commercial sea-cucumbers from Prachuap Khiri Khan-Surat Thani Provinces. *Technical Paper No. 1/2531 Marine Fisheries Laboratory, Marine Fisheries Division, Department of Fisheries*, pp. 1 - 28.

Taxonomic studies on commercial sea-cucumbers collected by research vessels from two coastal areas. Two commercial species are *Holothuria atra* and *H. scabra*. Description and illustration of commercial sea-cucumbers for the benefit of further studies are provided.

154. WALTER, A. 1885. Ceylon's echinoderms. *Z. Naturw.*, **18** : 365 - 384.

Sixteen species of echinoderms belonging to 13 genera with only two holothurians are listed. *Actinopyga* sp. recorded as *Mulleria* sp. is of economic value.

### MORPHOLOGY

155. LAMBERTSON, J. O. 1978. Notes on morphology, ecology and distribution of *Thelenota anax* H. L. Clark (Holothuroidea, Stichopodidae). *Micronesica*, **14** (1) : 115 - 122.
156. MOSS, W. L. AND E. MURCHISON 1966. Calcified anal teeth and pharyngeal ring in the holothurian *Actinopyga mauritiana*. *Acta Anot.*, **64** : 446 - 461.
157. MUKHERJEE, S. K. AND T. K. SAMANTA 1977. Morphological variation of the genetic character in *Actinopyga mauritiana* (Quoy & Gaimard) (Holothuridae : Echinodermata). *Rec. Indian. Mus.*, **3** (4) : 177 - 178.

*Actinopyga mauritiana* reported here is an economically important species.



153. WAINIYA, W. 1988. On the taxonomy of commercial sea-cucumbers from Prachuap Khiri Khan-Surat Thani Provinces. *Technical Paper No. 1/2531 Marine Fisheries Laboratory, Marine Fisheries Division, Department of Fisheries*, pp. 1 - 28.

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*Actinopyga mauritiana* reported here is an economically important species.

158. SPIEGEL, V. AND M. JANGOUX 1993. Fine structure and behaviour of the so-called Cuvierian organs in holothuroid genus *Actinopyga* (Echinodermata). *Acta Zoologica*, 74 : 43 - 50.

In *Actinopyga* sp. the Cuvierian tubules are few in number. They cannot elongate and become sticky and are not expelled.

### ANATOMY

159. MARY BAI, M. 1978. The anatomy and histology of *Holothuria scabra* Jaeger. *J. mar. biol. Ass. India.*, 20 (1 & 2) : 22 - 31.

The anatomy and histology of the common holothurian *Holothuria scabra* used for *beche-de-mer* is given.

### BIOLOGY

160. ARAKAWA, K. Y. 1990. *A handbook on the Japanese Sea-cucumber - Its Biology, Propagation and Utilization*. Japanese Publisher, 118 pp.

This recent book gives detailed information on the biology of the Japanese sea-cucumber, feeding habits and digestion, movement, propagation, larval rearing and juvenile rearing are given in detail.

161. BASKER, B. K. 1989. Some observations on the biology of the holothurians *Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria) spinifera*. Paper presented at the National Workshop on *beche-de-mer* at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin. February 1989. Abstract p. 7.

158. SPIEGEL, V. AND M. JANGOUX 1993. Fine structure and behaviour of the so-called Cuvierian organs in holothuroid genus *Actinopyga* (Echinodermata). *Acta Zoologica*, **74** : 43 - 50.

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A preliminary report on the biology of the holothurians  
*Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria)*  
*spinifera*.

162. BAKUS, G. J. 1973. The biology and ecology of tropical holothurians. In : O. A. Jones and R. Endean (Ed.) *Biology and Geology of Coral Reefs*. Academic Press, New York. Vol. 2 : 325 - 389.

General information regarding the species used for *beche-de-mer* with some references are also given.

163. BERTOLINI, F. 1930 a. Regenera Zione dell' apparato digerente nelle oloturie. *Rend. R. Acc. Lincer. cl. Sci. Fis. Mat. and nat. S.*, 6 : 600 - 601.
164. \_\_\_\_\_. 1930 b. Regenerazione dell' apparato digerente nelle *Stichopus regalis*. *Publ. Staz. Zool. Napoli*, 10 : 439 - 447.
165. \_\_\_\_\_. 1932. La autotomia dell' apparato digerente e la sur regenerazione nella oloturie. *Att. Accad Nazion, Lincei. Ser. 6, Rendiconti cl. sci. Pis.*, 15 : 893 - 896.
166. BUCKLEY, R. M. AND M. C. G. BUCKLEY 1992. Internal micro-tag identification systems for teleosts, holothurians and decapods. *Paper presented at the 7th International Coral Reef Symposium in Guam*. Abstract. p. 27.

Studies showed that fluorescent polymer (FP) tag retained in one sea-cucumber for 50 days.

167. CHOE, S. 1963. *Biology of the Japanese common sea-cucumber Stichopus japonicus* Selenka. Pusan National University, Pusan.

A very detailed paper with biology and propagation of the species.

168. CONAND, C. 1983. Methods of studying growth in holothurians (*beche-de-mer*) and preliminary results from a *beche-de-mer* and tagging experiment in New Caledonia. *Fish. Newsletter*, **26** : 31 - 38.

Some observations on tagging of holothurians *Actinopyga mauritiana*, *A. echinites*, *Holothuria scabra*, *Stichopus variegatus*, *Holothuria nobilis* and *Thelenota ananas* in the aquarium and the sea.

169. \_\_\_\_ 1988. Biologie et exploitation des holothuries en Nouvelle-Caledonie. *Colloque sur les Ressources halieutiques cotieres du Pacifique, C.P.S., Noumea*, WP **5** : 11 p.
170. CROZIER, W. J. 1918. The amount of bottom material ingested by holothurians (*Stichopus*). *J. Exp. Zool.*, **20** : 297 - 356.
171. DAWBIN, W. H. 1949. Autoevisceration and the regeneration of the viscera in the holothurian *Stichopus mollis* (Button). *Trans. Roy. Soc. New-Zealand*, **77** : 497 - 523.
172. EBERT, T. A. 1978. Growth and size of the Tropical Sea-cucumber *Holothuria (Halodeima) atra* Jaeger at Enewetak Atoll, Marshall Islands. *Pacific Sci.*, **32** (2) : 183 - 191.
173. FISH, J. D. 1967. The biology of *Cucumaria elongata*. *J. Mar. Biol. Ass. U.K.*, **47** : 129 - 143.
174. GENTLE, M. T. 1979. The fisheries biology of *Beche-de-mer*. *S. Pac. Comm. Bull.*, **29** : 25 - 27.
175. JAMES, D. B. 1988. Boring and fouling echinoderms of Indian waters. In : *Marine Biodeterioration*. Oxford and IBH Publishing Co. Pvt. Ltd., pp. 227 - 238.

A small specimen of *Holothuria scabra* of 30 mm length is reported from algal scrapings.

176. KILLE, F. R. 1931. Induced autotomy in *Thyone*. *Science*, **74** : 396 pp.
177. \_\_\_\_\_. 1935. Regeneration in *Thyone briareus* Lesueur following induced autotomy. *Biol. Bull. mar. biol. lab. Woods Hole*, **69** : 82 - 208.
178. \_\_\_\_\_. 1936. Regeneration in Holothurians. *Year Book Carnegie Inst. Wash.*, **35** : 85 - 86.
179. LOKANI, P. 1992. First results of an internal tag retention experiment on sea-cucumber. *Beche-de-mer information Bulletin*, **4** : 9 - 12.
- In this paper the sites of tagging, methods of tagging and effects of tagging on *Actinopyga echinites*, *Thelenota ananas* and *Holothuria nobilis* are described.
180. MARY BAI, M. 1971. Regeneration in the holothurian *Holothuria scabra* Jaeger, *Indian J. Exp. Biol.*, **9** : 467 - 471.
- Regeneration in the holothurian *Holothuria scabra* after evisceration is given.
181. MOSHER, C. 1956. Observations on evisceration and visceral regeneration in the sea-cucumber *Actinopyga agassizi* Selenka. *Zoologica, New York*, **41** : 17 - 26.
182. \_\_\_\_\_. 1965. Notes on natural evisceration of the sea-cucumber *Actinopyga agassizi* Selenka. *Bull. mar. sci.*, **15** : 255 - 258.
183. \_\_\_\_\_. 1989. Studies on regeneration in the holothurian *Holothuria scabra* Jaeger. *Paper presented at the National Workshop on beche-de-mer at Mandapam Camp*. Central Marine Fisheries Research Institute, Cochin, February 1989. Abstract, p. 8.
184. MITSUKURI, K. 1903. Notes on the habits and life-history of *Stichopus japonicus* Selenka. *Annot. Zool Jpn.*, **5** : 1 - 22.

185. NAGABHUSHANAM, R., B. ASHOK KUMAR AND R. SAROJINI 1989. Toxicity evaluation of the holothurian (*Holothuria leucospilota*) toxin on the prawn *Cardina rajadhari*. Paper presented for the National Workshop on beche-de-mer at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin. February 1989. Abstract, pp. 8 - 9.

The size and sex dependent toxicity indicated that LC50 values decreased. Juveniles had the highest LC50 values followed by immature male, immature female, mature male and mature female. The males were found to be more tolerant than females in both immature and mature stages. Mature females were the most susceptible and the juveniles more tolerant among the test animals.

186. RAO, D. S., D. B. JAMES, K. G. GIRIJAVALLABHAN, S. MUTHUSWAMY AND M. NAJMUDDIN 1985. Bioactivity in echinoderms. *Mar. Fish. Infor. serv. T & E. Ser.*, **63** : 10 - 12.

The toxicity of ten species of echinoderms including *Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria) spinifera* used for beche-de-mer were tested against fish fingerlings, white mice and rabbit blood and they are found to be less toxic. The toxin broke down during boiling and therefore not harmful.

187. \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_ AND \_\_\_\_\_ 1985 b. Biotoxicity in echinoderms. *J. mar. biol. Ass. India*, **27** (1 & 2) : 88 - 96.

A detailed work on the toxicity of ten species of echinoderms. *Holothuria (Theelothuria) spinifera* exhibited high degree of toxicity to fish fingerlings and mice, and also showed strong action on the erythrocytes. In the case of fish bioassay all organs of *Holothuria (Metriatyla) scabra* and *Holothuria (Theelothuria) spinifera* were found to be less toxic.



188. ROLLEFSEN, S. 1965. Studies on the mast cell like morula cells of the holothurian *Stichopus tremulus* (Gun.). *Arb. Univ. Bergen, Mali - Mat - Naturv., Serie 8* : 1 - 12.
189. RUTHERFORD, J. C. 1973. Reproduction, growth and mortality of the holothurian *Cucumaria pseudocurata*. *Mar. Biol.*, **22** : 167 - 176.
190. SARMA, N. S., A. S. R. ANJANEYULU, C. B. S. RAO AND Y. VENKATESWARLU 1987. Triterpene Glycosides and Aglycones of sea-cucumbers *Holothuria atra* and *Holothuria scabra* (Holothuridae). *Ind. Jour. Chem.*, **260** : 715 - 721.
- Triterpene Glycosides and Aglycones of the commercially most important *Holothurian scabra* are discussed.
191. SCOTT, J. W. 1914. Regeneration, variation and correlation in Thyone. *Am. Nat.*, **48** : 280 pp.
192. SEWELL, M. A. 1991. Measurement of size in live sea-cucumbers. *Beche-de-mer Information Bulletin.*, **3** : 4 - 5.
- After a series of experiments the use of length to measure size is not recommended. Reasonable measure of weight can be obtained by emptying the alimentary canal, by allowing the animal in relaxation tank, by squeezing excess water and by blotting the water quickly.
193. SHELLEY, C. C. 1981. *Aspects of the distribution, reproduction growth and fishery potential of holothurians beche-de-mer in the Papuan coastal lagoon*. M.S. Thesis, University of Papua, New Guinea, 165 p.
- Fishery potential of holothurians along with distribution, reproduction and growth from Papuan coastal lagoon is given.
194. \_\_\_\_ 1985. Growth of *Actinopyga echinites* and *Holothuria scabra* (Holothuroidea : Echinodermata) and their potential (as *beche-de-mer*) from Papua New Guinea.

*In: Proceedings of the Fifth International Coral Reef Congress, Tahiti, 5 : 297 - 302.*

Growth and fishery potential in case of *Actinopyga echinites* and *Holothuria scabra* are given.

195. SMITH, G. N. 1971. Regeneration in the sea-cucumber *Leptosynapta* I. The process of regeneration. *Jour. Expt. Zool.*, **177** (3) : 319 - 329.
196. SWAN, E. F. 1961. Seasonal evisceration in the sea-cucumber *Parastichopus californicus* (Stimpson). *Science*, **133** (3458) : 1078 - 1079.
197. \_\_\_\_ 1966. Growth, Autotomy and Regeneration. *In: Physiology of Echinodermata*. John Wiley and Sons. Inc. New York, pp. 397 - 434.
198. TORELLE, E. 1909. Regeneration in *Holothuria*. *Zool. Anz.*, **35** : 15 : 22.
199. WIEDEMEYER, W. L. 1992. Feeding behaviour of two tropical holothurians *Holothuria (Metriatyla) scabra* (Jaeger 1833) and *H. (Halodeima) atra* (Jager 1833) from Okinawa, Japan. *Paper presented at the 7th International Coral Reef Symposium in Guam. Abstract*, p. 27.

*Holothuria scabra* and *H. atra* showed different feeding strategies and behaviour which were specific for seasons and habitats. *H. scabra* fed during the night when burrowed.

200. \_\_\_\_ 1992. *The biology and behavioural ecology of small juveniles of the holothurian species Actinopyga echinites (Jaeger 1833)*. Thesis submitted to the University of Ryukyus, Okinawa, Japan.

The natural mortality of the animals (excluding predation effects) was low 0.6% during the first three months of the field experiments. The daily amount of sediment ingested

by the juveniles was estimated as 58.25% of their individual drained body weight. The author concludes that outdoor rearing of *A. echinites* juveniles and releasing of the specimens to the field might be feasible.

## ECOLOGY

201. GENTLE, M. T. 1979 a. Population ecology of commercial *beche-de-mer* (Echinodermata : Holothuroidea) in Fiji. *SPC Fish. Newsl.*, **18** : 13 - 15.

Survey was conducted on Barrier Reef near Suva to study the habitat requirement of commercial species of *beche-de-mer*. Juveniles of *M. nobilis* were found in association with a pink coloured turtle grass stems. It is suggested that the larvae of *M. nobilis* have a specific settling response to turtle grass or alga.

202. HARRIOTT, V. J. 1980. *The ecology of holothurian fauna of Heron Reef and Moreton Bay*. M.Sc. Thesis. University of Queensland, Australia, 153 pp.

203. JAMES, D. B. 1982. Ecology of intertidal echinoderms of the Indian Seas. *J. mar. biol. Ass. India*, **24** (1 & 2) : 124 - 129.

Echinoderms characteristic of coral reefs, rocky coasts, sandy shores, muddy flats, algal beds and epizoic forms are given. Commercially important holothurians : *Holothuria scabra*, *Actinopyga mauritiana*, *A. miliaris*, *A. lecanora*, *A. echinites*.

204. \_\_\_\_\_ 1986. Zoogeography of shallow water echinoderms of Indian Seas. In : P. S. B. R. James (Ed.) *Recent Advances in Marine Biology*. Today and Tommorrow Printers and Publishers, New Delhi, pp. 569 - 591.

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204. \_\_\_\_\_. 1986. Zoogeography of shallow water echinoderms of Indian Seas. In : P. S. B. R. James (Ed.) *Recent Advances in Marine Biology*. Today and Tomorrow Printers and Publishers, New Delhi, pp. 569 - 591.

Commercially important species of holothurians :  
*Actinopyga echinites* (Sri Lanka, Andaman & Nicobar Islands),  
*A. lecanora*, *A. mauritiana* (Lakshadweep and Maldives, Sri Lanka, Andaman and Nicobar Islands), *A. miliaris* (Lakshadweep and Maldives, Sri Lanka, Andaman and Nicobar Islands), *A. serratidens* (Lakshadweep and Maldives, Sri Lanka), *Bohadschia argus* (Sri Lanka, Andaman and Nicobar Islands), *B. graeffei* (Lakshadweep and Maldives), *B. marmorata* (Lakshadweep and Maldives, Gulf of Mannar and Palk Bay on Indian side, Sri Lanka, Andaman and Nicobar Islands), *B. tenuissin* (Lakshadweep and Maldives, Sri Lanka), *B. vitiensis* (Sri Lanka, Andaman and Nicobar Islands), *Holothuria (Microthele) nobilis* (Lakshadweep and Maldives, Sri Lanka, Andaman and Nicobar Islands), *Holothuria (Metriatyla) scabra* (Gulf of Mannar and Palk Bay on Indian side, Sri Lanka, Andaman Nicobar Islands), *Holothuria (Theelothuria) spinifera* (Gulf of Mannar and Palk Bay on Indian side, Sri Lanka), *Thelenota ananas* (Lakshadweep and Maldives). The above mentioned species are listed in the Distributional Tables and some remarks are given on their zoogeography.

205. \_\_\_\_ 1987. Animal Association in Echinoderms. *All India Symposium on Aquatic Organisms*. A. V. V. M. Sri Pushpam College, Poondi, p. 13.

The association of the commercially important holothurians *Holothuria (Metriatyla) scabra* and species of *Actinopyga* with the crabs *Pinnotheres decanensis* and *Lissocarcinus orbicularis* respectively are given.

206. \_\_\_\_ 1989. Ecology of commercially important species of holothurians from India. *Paper presented for the National Workshop on Beche-de-mer at Mandapam Camp*. Abstract, p. 6.

Ecology is important for proper exploitation of the species. Notes on the habitats of commercially important species of holothurians given.

207. JESPERSEN, A. AND Y. LUTZEN 1971. On the ecology of the aspidochirote sea-cucumber *Stichopus tremulus* (Gunnerus). *Norw. J. Zool.*, **19** : 117 - 132.

208. JONES, S. AND S. MAHADEVAN 1966. Notes on Animal Association - 5. The pea-crab *Pinnotheres decanensis* Chopra inside the respiratory tree of the sea-cucumber *Holothuria scabra* Jaeger *J. mar. biol., Ass. India.*, **7** (2) : 377 - 380.

Female specimens of the crab *Pinnotheres decanensis* collected from *Holothuria scabra* are described.

209. KERR, A. M. 1992. Effects of typhoon - generated waves on windward and leeward assemblages of holothuroids. *Paper presented at the 7th International Coral Reef Symposium in Guam.* (Abstract) : 27 - 28.

*Holothuria atra* and *Actinopyga echinites* live on the open unsheltered substrata and diurnally cryptic species were greatly reduced on the other reef flat of the windward side. No species decreased on the leeward outer and inner reefs.

210. \_\_\_\_\_, E. M. STOFFEL AND R. L. YOON 1993. Abundance and distribution of holothuroids (Echinodermata : Holothuroidea) on a windward and leeward fringing coral reef, Guam, Mariana Islands. *Bull. Mar. Sci.*, **52** (2) : 28.

During the survey 19 species were recorded. *Holothuria atra* was the most common species and comprised of 92% of the holothurians collected. The next two most abundant species were *Actinopyga ethinites* (3%) and *H. leucospilota* (2%). Significant inverse correlation exists between *Holothuria atra* and three holothurians viz., *A. mauritiana*, *H. nobilis* and *Stichopus chloronotus*.

211. MITSUKURI, K. 1903. Notes on the habits and life history of *Stichopus japonicus*. *Annot. Zool. Jap.*, **5** : 1 - 22.

212. MUKHERJI, D. D. 1932. Ecological observations and instances of commensalism of an Ophioid fish with echinoderms from Andaman Islands. *Rec. Indian Mus.*, **34** : 567 - 569.

Female crab of the genus *Pinnotheres* are reported from *Holothuria scabra*. Some Carapid fish are also reported from other holothurians.

213. MONDY, E. O. AND M. E. COWAN 1980. Observations on the behaviour and symbiotic relationship of the Pearlfish *Encheliophis vermicularis* (Osteichthys : Carapidae). *Kalikasan*, **9** (2-3) : 309 - 312.

Pearlfish recorded for the first time from *Holothuria scabra*.

214. NAGABHUSHANAM, A. K. AND G. C. RAO 1972. An ecological survey of the marine fauna of Minicoy Atoll (Laccadive Archipelago, Arabian Sea). *Mitt. zool. Mus. Berlin*, **48** (2) : 265 - 324.

Marine fauna belonging to all groups from sponges to marine mammals are listed with their habitat. Sixteen species of holothurians are listed. Commercially important holothurians : *Holothuria (Microthele) nobilis*, *Actinopyga mauritiana*, *A. miliaris* and *Thelenota ananas*.

215. TYLER, P. A., D. S. M. BILLET AND J. D. GAGE 1987. The ecology and reproductive biology of *Cherbonniera utriculus* and *Molpadia blakei* from the Northeast Atlantic. *J. Mar. Biol. Ass. U.K.*, **67** : 385 - 397.

## REPRODUCTION

216. CAMERON, J. L. AND P. V. FANKBONER 1986. Reproductive biology of the commercial sea-cucumber *Parastichopus californicus* (Stimpson) (Echinodermata : Holothuroidea), I. Reproductive periodicity and spawning behaviour. *Can. J. Zool.*, **64** : 168 - 175.

212. MUKHERJI, D. D. 1932. Ecological observations and instances of commensalism of an Ophiod fish with echinoderms from Andaman Islands. *Rec. Indian Mus.*, **34** : 567 - 569.

Female crab of the genus *Pinnotheres* are reported from *Holothuria scabra*. Some Carapid fish are also reported from other holothurians.

213. MONDY, E. O. AND M. E. COWAN 1980. Observations on the behaviour and symbiotic relationship of the Pearlfish *Encheliophis vermicularis* (Osteichthys : Carapidae). *Kalikasan*, **9** (2-3) : 309 - 312.

Pearlfish recorded for the first time from *Holothuria scabra*.

214. NAGABHUSHANAM, A. K. AND G. C. RAO 1972. An ecological survey of the marine fauna of Minicoy Atoll (Laccadive Archipelago, Arabian Sea). *Mitt. zool. Mus. Berlin*, **48** (2) : 265 - 324.

Marine fauna belonging to all groups from sponges to marine mammals are listed with their habitat. Sixteen species of holothurians are listed. Commercially important holothurians : *Holothuria (Microthele) nobilis*, *Actinopyga mauritiana*, *A. miliaris* and *Thelenota ananas*.

215. TYLER, P. A., D. S. M. BILLETT AND J. D. GAGE 1987. The ecology and reproductive biology of *Cherbonniera utriculus* and *Molpadia blakei* from the Northeast Atlantic. *J. Mar. Biol. Ass. U.K.*, **67** : 385 - 397.

## REPRODUCTION

216. CAMERON, J. L. AND P. V. FANKBONER 1986. Reproductive biology of the commercial sea-cucumber *Parastichopus californicus* (Stimpson) (Echinodermata : Holothuroidea), I. Reproductive periodicity and spawning behaviour. *Can. J. Zool.*, **64** : 168 - 175.



217. CONAND, C. 1982. Reproductive cycle and biometric relations in a population of *Actinopyga echinites* (Echinodermata : Holothuroidea) from the lagoon of New Caledonia, Western Tropical Pacific. In : J. M. Lawrence (Ed.) *Echinoderms. Proceedings of the International Conference, Tampa Bay, Balkema*, pp. 437 - 442.

Distribution, abundance, biometry, reproduction and stages of maturity, size at first maturity of *Actinopyga echinites* from New Caledonia are given.

218. \_\_\_\_ 1981. Sexual cycle of three commercially important holothurian species (Echinodermata) from the lagoon of New Caledonia. *Bull. Mar. Sci.*, **31** (3) : 523 - 544.

Detailed studies on reproduction have been conducted on stages of maturity and fecundity of holothurians for the first time.

219. FRANKLIN, S. E. 1980. *The reproductive biology and some aspects of the population ecology of the holothurians *Holothuria leucospilota* (Brandt) and *Stichopus chloronotus* (Brandt)*. Ph.D. Thesis, Univ. of Sydney pp. 253.

220. JAYASREE, V. AND P. V. BHAVANARAYANA 1989. Reproduction in *Holothuria leucospilota* (Brandt) from Anjuna, Goa. *Paper presented at the National Workshop on beche-de-mer at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin, February 1989. Abstract, p. 9.*

*Holothuria leucospilota* spawns during October to January and from June to September. The reproductive tubules are found to be longer in males when compared to the females. The spawning appears to be influenced by low temperature and salinity.

221. KISHIMOTO, T. AND H. KANATANI 1980. Induction of oocyte maturation by disulfide reducing agent in the sea-cucumber *Stichopus japonicus*. *Dev. Growth Differ.*, **22** (2) : 163 - 167.
222. KRISHNAN, S. 1967. Biochemical and cytochemical observations of the nucleic acids in the gonads of *Holothuria scabra*. *Acta Biol. Med. Soc. Sci. Cedan.*, **11** : 307 - 313.
- Some observations on the biochemical and cytochemical nature of the nucleic acids in the gonads of *Holothuria scabra* are given.
223. \_\_\_\_ 1968. Histochemical studies on reproductive and nutritional cycles of the holothurian *Holothuria scabra*. *Mar. Biol.*, **2** (1) : 54 - 65.
- Histochemical studies on the reproductive and nutritional cycles of the holothurian *Holothuria scabra* are given.
224. \_\_\_\_ 1970. Studies on reproductive and nutritional cycles of the *Holothuria scabra* Jaeger. *Ph.D. Thesis, University of Madras*, pp. 96.
225. \_\_\_\_ AND S. KRISHNASWAMY 1970. Studies on the transport of sugars in holothurian *Holothuria scabra*. *Mar. Biol.*, **5** : 303 - 307.
226. \_\_\_\_ 1971. Autoradiograph studies on the sugar transport in the sea-cucumber *Holothuria scabra*. *Ibid.*, **10** : 189 - 191.
227. \_\_\_\_ 1989. Studies on reproductive and nutritional cycles of the holothurian *Holothuria (Metriatyla) scabra* Jaeger. *Paper presented at the National Workshop on beche-de-mer at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin. February 1989. Abstract, p. 7.*

Holothurian breeds twice in an year. Seasonal changes in the organic components such as proteins, carbohydrates, lipids and nucleic acids from the gonads are given.

228. KRISHNASWAMY, S. AND S. KRISHNAN 1967. A report on the reproductive cycle of holothurian *Holothuria scabra* Jaeger. *Curr. Sci.*, **36** (6) : 155 - 156.

*Holothuria scabra* breeds in July and October. Greater breeding activity is seen in July.

228. LEVIN, V. S. 1984. Protection and reproduction of *Stichopus japonicus* in Far Eastern Reserve. pp. 58 - 65. In : T. S. Beniaminson et al. (Ed.) *Animal Kingdom of the Soviet Far-East Marine Reserve. Coll. pap. Accad. Sci. USSR Far-E Sci. Centre, Vladivostok.* (In Russian).

230. MARUYAMA, Y. K. 1980. Artificial induction of oocyte maturation and development in the sea cucumbers *Holothuria leucospilota* and *Holothuria pardalis*. *Biol. Bull.*, **158** : 339 - 348.

Mature eggs were obtained by using dithiotheritol (DTT) a maturation inducing hormone of starfish. After insemination mature eggs obtained with DTT treatment developed into typical auricularia larvae.

231. \_\_\_\_ 1985. *Holothuria* oocyte maturation induced by radial nerve. *Biol. Bull.*, **168** : 249 - 262.

Water extracts of radial nerves from five species of sea-cucumbers induced oocyte maturation. The radial nerve factor stimulates the follicle cells to produce a secondary factor and later in turn directly induces oocyte maturation.

232. \_\_\_\_ 1986. Induction of sea-cucumber oocyte maturation by starfish radial nerve extracts. *Jour. Exptl. Zoology*, pp. 238 - 248.

233. MARY BAI, M. 1971. Studies on *Holothuria scabra* Jaeger. Ph. D. Thesis, University of Madurai. pp. 68.

Detailed work on the anatomy and reproductive biology of *Holothuria scabra*. Information on the histology of various organs is also given.

234. MOKRETSOVA, N. D. 1978. Biologie de la reproduction du trepang *Stichopus japonicus* Selenka comme base de la biotechnique de son élevage. *Compte-rendu de these Vladivostok DVNT, Acad. Sc., U.R.S.S.* (In Russian).
235. MORTENSEN, T. 1921. *Studies on the development and larval forms of echinoderms*. 266 pp. Copenhagen.
236. \_\_\_\_\_. 1931. Contributions to the study of the development and larval forms of Echinoderms I & II. *K. dansk Vidensk. Skr. (naturv. math)*. (9) 4 (1) : 1 - 39.
237. \_\_\_\_\_. 1937. Contributions to the study of the development and larval forms of Echinoderms III. *Ibid.*, (9) 7 (1) : 1 - 65.
238. ORGCHER, R. G. AND E. D. GOMEZ 1985. Reproductive periodicity of *Holothuria scabra* Jaeger at Calatagen, Batazens, Philippines. *Asian Mar. Biol.*, 2 : 21 - 29.
239. SHUI, X. AND CO-WORKERS 1985. Effects on the sperm density of sea-cucumber *Apostichopus japonicus* (Selenka) and the duration of fertility of spawned eggs on the fertilization. *Mar. Sci.*, 9 (5).
240. TANAKA, Y. 1958. Seasonal changes occurring in the gonad of *Stichopus japonicus*. *Bull. Fac. Fish. Hokkaido Univ.*, 9 : 29 - 36.

## HATCHERY AND CULTURE

241. ANONYMOUS 1976. A study of the artificial breeding and cultivation of *Stichopus japonicus* (Selenka). *Stud. Mar. Sinica.*, **11** : 173 - 181.

During 1972-'73 *Stichopus japonicus* was induced to spawn by thermal stimulation. 1.7 lakh juveniles were produced, reared in concrete ponds and fed with dried powder of various algae like *Enteromorpha*, *Sargassum*, *Rhodomela*, etc. Green mud scraped from the surface of rocks which is rich in diatoms and organic debris was also given. Sexual maturity reached within two years.

242. \_\_\_\_ 1977. Raising sea-cucumbers. *China Pictorial*, **6** : 2.

Settlement of Pentactula stage is given in detail. A two year old sea-cucumber could reach a length of 230 mm and a weight of 248 g.

243. \_\_\_\_ 1978. Culture of sea-cucumber at Andaman. *CMFRI Newsletter*, **8** : 1 - 2.

Experiments conducted at Port Blair in 1978 are described. About 500 juveniles of *Holothuria* (*Metriatyla*) *scabra* varying from 65 to 160 mm were stocked in an closed area of 1500 sq.m. In seven months the sea-cucumbers were found to grow to 190-290 mm in length.

244. \_\_\_\_ 1983. Takarao morise Kawamura namako (Artificial Production of Holothurian Larvae). *Rep.*, **12** : 200 - 204 (In Japanese).

245. \_\_\_\_ 1989. Indians try breeding sea-cucumbers. *Fish Farming International*, **16** (7) : 93.

A general article giving some information on the *beche-de-mer* industry in India. Some details are given on the attempts

made by Indian Scientists to produce seed of *Holothuria (Metriatyla) scabra* at Tuticorin.

246. \_\_\_\_ 1991. Training manual on breeding and culture of scallop and sea-cucumber in China. Prepared for the Scallop and Sea-cucumber Breeding and Culture Training Course conducted by the Yellow Sea Fisheries Research Institute in Qingdao, People's Republic of China and organised by the Regional Seafarming Development and Demonstration Project (RAS/90/002). *Training Manual*, 9 : 1 - 84.

The manual describes and discusses on taxonomy, biology, morphology, ecology, artificial breeding, rearing of postlarvae and juveniles of *Stichopus japonicus* and predator control, etc. with emphasis on culture aspects.

247. BURKE, R. D., D. G. BRAND AND B. W. BISGROVE, 1986. Structure of the nervous system of the auricularia larva of *Parastichopus californicus*. *Biol. Bull.*, 170 : 450 - 460.
248. BYRNE, M. AND C. CONAND 1992. Request for information on spawning behaviour of tropical holothurians. *Beche-de-mer Information Bulletin*, 4 : 4 - 5.

Information is sought on the following aspects of spawning behaviour of holothurians : name of the species, number of species, locality, time, stage of lunar cycle, tide, depth and other echinoderms spawning.

249. CHANG, F. AND OTHERS 1957. A preliminary report on the artificial rearing and propagation of *Stichopus japonicus* Selenka. *Zool. Mag.*, 2 (2) : 65 - 73.
250. CHEN, Z. AND OTHERS 1978. A study on the artificial rearing and cultivated technique of *Stichopus japonicus*. *Ibid.*, 120 (2) : 9 - 13.

251. CHEN, C. P. AND C. S. CHIAN 1990. Larval development of the sea-cucumber *Actinopyga echinites* (Echinodermata: Holothuroidea). *Bull. Inst. Zool. Academic Sinica*, **29** (2) : 127 - 133.

Gonad-matured adults of *A. echinites* were induced to spawn by ultra-violet (UV) irradiated warm seawater. The embryos hatched at 14 h after semination when reared at 25-28°C under continuous lighting of fluorescent light (100 lux). The larvae were fed with the alga *Isochrysis galbana* at  $10^4$  to  $10^5$  cells/ml. The larvae grew to the auricularia with hydrocoel at 10 days, to the doliolaria at 15 days and to the pentactula with one podium at 16 days. The pentactula settled on the substratum and became juveniles.

252. HUILIN, S. 1988. The effect of some factors on survival and growth of juvenile sea-cucumber. *Jour. Fish. Res.*, **12** (3) : 259 - 267.

253. IMAI, T., D. INABA, R. SATO AND M. HATANAKA 1950. The artificial rearing of the transparent flagellate larvae of *Stichopus japonicus*. *Tohoku Daigaku Nogakubu Kenkyo Iho*, **2** (2) : 269 - 277. (In Japanese with English Summary).

The duration for various larval stages is given. The survival rate of Auricularia larvae was found to be 5-25%. The mortality in Doliolaria, Pentactula and young stages is found to be very low. The young ones grow to 3-4 mm length in two months. Densely covered eel grass was found to be a favourable ground for the natural propagation of the sea cucumber.

254. INABA, D. 1937. Artificial rearing of sea-cucumbers. *Suisan Kenkyushi*, **35** (2) : 241 - 246 (In Japanese).

Artificial fertilization in *Stichopus japonicus* is given. Mature testis is yellowish white and 300 mm in length. Mature ovary is semi-transparent and orange yellow in colour and of

the same size as testis. Ova are distinguished into four types. First cleavage took place after two hours of fertilization.

255. \_\_\_\_\_ AND Y. K. MARAYAMA 1988. Holothuroidea. In : *Developmental biology of invertebrates*. Baifuken, Tokyo. pp. 399 - 409.

Development of the holothurian *Labidoplax digitata* is given with beautiful figures. *Auricularia nudibranchiata* and *A. paradoxa* are figured. This species is not used for *beche-de-mer*.

256. ISHIDA, M. 1979. Studies on production of juvenile sea-cucumbers. *Susan Shikenjo*, pp. 1 - 17, 1977. (In Japanese).

Temperature stimulation gave good results to induce spawning. Larvae were fed on *Monochrysis* or *Phytocerus*. For mass production in one tonne tank five lakh *Auricularia* were fed with *Monochrysis*. Eightyfive thousand sea-cucumbers were produced. Dried green algae were used to feed juvenile sea-cucumbers. The juvenile sea-cucumber changes body colour and shape according to feeding condition.

257. JAMES, D. B. 1989. A review of the hatchery and culture practices in Japan and China with special reference to the possibilities of culture of holothurians in India. *Paper presented at National Workshop on beche-de-mer at Mandapam Camp, CMFRI, Cochin*. Abstract, pp. 10-11.

Japanese are the pioneers in the hatchery and culture of holothurians. The holothurian *Stichopus japonicus* is cultured in Japan and China. Their methods of work and their relevance to Indian conditions are described.

258. \_\_\_\_\_ , M. E. RAJAPANDIAN, B. K. BASKER AND C. P. GOPINATHAN 1989. Breakthrough in the hatchery of the holothurian *Holothuria (Metriatyla) scabra*. *Ibid.*, p. 11.



For the first time success is achieved in India by inducing the holothurian *Holothuria (Metriatyla) scabra* in the laboratory. The methods of rearing the different stages of larvae till they settle to the bottom are given.

259. \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, AND \_\_\_\_\_ 1988. Successful induced spawning and rearing of the holothurian *Holothuria (Metriatyla) scabra* Jaeger at Tuticorin. *Mar. Fish. Infor. Serv., T & E. Ser.*, **87** : 30 - 33.

The breakthrough achieved in inducing *Holothuria (Metriatyla) scabra* to spawn in the laboratory for the first time in India is reported. The various types of larvae have been reared till they settled down to the bottom.

260. \_\_\_\_\_ 1993. Sea-cucumber Culture. *In : Sea-weed, Sea-urchin and Sea-cucumber. Handbook on Aquafarming.* The Marine Products Export Development Authority, Kochi, pp. 33 - 47.

Techniques for the production of seeds in *Holothuria scabra* are given. Some experiments on the culture of the same species are given.

261. \_\_\_\_\_, A. D. GANDHI, N. PALANISWAMY AND J. X. RODRIGO 1994. Hatchery techniques and culture of sea-cucumber *Holothuria scabra*. *CMFRI Spl. Publ.*, **57** : 1 - 40.

The laboratory and hatchery techniques to induce spawning, rearing of larvae, production of seeds, culture of sea-cucumbers, feeding of larvae and juveniles, maintenance of culture pens and farms, site selection, farm management, economics, etc. are given.

262. KOBAYASHI, S. AND S. USHIMA 1983. Research on the propagation of Japanese common sea-cucumber. III. *Sukoka Prefectural, Buzen Fisheries Experimental Station Report*, **3** : 81 - 86.

Research efforts on the propagation of *Stichopus japonicus* is given.

263. ODA AND Y. USHIMA 1984. Research and propagation of the Japanese common sea-cucumber. *Ibid.*, 4.

Research on the propagation of *Stichopus japonicus* is given.

264. LALMOHAN, R. S., D. B. JAMES AND S. KALIMUTHU 1989. Mariculture potential in Lakshadweep. In : *Survey of Fisheries Potential of Lakshadweep. Bull. Cent. Mar. Fish. Res. Inst.*, 43 : 243 - 247.

Culture possibilities of holothurians from Lakshadweep indicated. *Holothuria (Microthele) nobilis* appears to be the best for culture.

265. LI, F. 1983. The artificial breeding and cultivation of *Apostichopus japonicus* (Selenka). *Zool. Mar. Drugs*, 6 (2) : 103 - 105.

266. LIAO, Y. 1986. Prospects for the artificial culture of sea-cucumber *Apostichopus japonicus* (Selenka). *Mar. Sci.*, 10 (6) : 55 - 57.

267. MOKRETSOVA, N. D. 1973. Artificial rearing in Peter, the Great Bay. *Rybone. Khoz., Moskva*, 11 : 7 - 8. (In Russian).

268. MU, S. AND OTHERS 1986. Releasing propagation for the artificial seeding of *Apostichopus japonicus* (Selenka). *Trans. Oceanol.*, 2 (3) : 44 - 49.

269. PRESTON, G. 1990. *Beche-de-mer* resource management studies in Guam. *Beche-de-mer Information Bulletin*, 1.

*Holothuria nobilis*, *Actinopyga mauritiana* and *Thelenota ananas* are induced to spawn by thermal stimulation, but development of the larvae to juveniles is not achieved.

270. QIAO, J. 1988. Pond culture study of the sea-cucumber *Stichopus japonicus* (Selenka). *Mar. Sci.*, 4 : 1 - 5.

271. SHUI, X. AND OTHER 1984. A study on artificial culturing of sea-cucumber seed. The effect of artificially prepared feed for larval sea-cucumber. *Fish. Sci.*, 3 (3) : 18 - 23 (In Chinese).

The juvenile sea-cucumbers were fed with powder prepared from *Sargassum thunbergii*.

272. \_\_\_\_ 1985. Preliminary report on the artificial ripening of parental sea-cucumber. *Ibid.*, 4 (3) : 28 - 32 (In Chinese).

Artificial ripening of *Apostichopus japonicus* is given.

273. \_\_\_\_ , Q. HU AND Y. CHEN 1986. A study on technology for rearing of postlarvae and juveniles of sea-cucumbers in high density tanks. *Oceanol. Limnol. Sin.*, 17 (6) : 513 - 520.

Methods to rear postlarvae and juveniles of sea-cucumbers in high density tanks are discussed.

274. SHUXU, X. AND G. GONGCHAO 1981. Experiments on southward transplantation and artificial breeding of the sea-cucumber (*Stichopus japonicus*). *J. Fish. China.*, 5 (2) : 147 - 155 (In Chinese).

*Stichopus japonicus* was transplanted from Northern China to Southern China for the purpose of artificial breeding and culture. Both adults and juveniles developed well in indoor concrete tanks at temperature 27-29° C in summer. After four months the adults attained sexual maturity. They spawned twice in April. More than twenty thousand juveniles were produced. In four months time they reached a size of 20 mm. Food of the larvae mainly consisted species of *Dicrateria*, *Platymonas*,

*Nitzschia*, *Dumaleilla* and *Terulopsis* among them *Dicratera shanjiamgensis* is the most preferred diet.

275. SHUI, X. L. AND OTHERS 1985. Preliminary report on artificial ripening of parental sea-cucumber. *Fish. Sci.*, 4 (3) : 28 - 32 (In Chinese).
276. XILLIN, S., H. QINGMING AND C. YUAN 1986. *Oceanologia and limnologia Sinica*, 17 (6) : 520 p.
277. YANAGIBASHI, S. T. YANAGISAWA AND K. KAWASAKI 1984. A study on the rearing procedure for the newly settled young of a sea-cucumber *Stichopus japonicus* with special reference to the supplied food items. *Aquaculture*, pp. 6 - 14.

Settlement of pelagic larvae is influenced by the presence of their foods : epibenthic diatoms. Those fed on frozen epibenthic diatoms grow two times faster than those fed on epibenthic diatoms adhered to the plates. When they attain 0.1 g weight two species of *Sargassum* were dried and given. The young ones attained 1 g weight in six months after fertilization.

278. ZHANG, Y., M. ZHIZHEN, L. YONGHONG AND L. FUXIN 1982. Experiment in propagation of sea-cucumber *Stichopus japonicus* (Selenka) in Gangdong coastal water. *Mar. Fish. Res.*, 4 : 52 - 53.

For propagation of sea-cucumber 30,000 m<sup>2</sup> area was marked. In this area 600 m<sup>3</sup> of stone and 1,158 bundles of twigs were sunk and also 14,178 adult sea-cucumbers from another area were transported. Prior to the experiment in 1976 sea-cucumber caught was 0.5/mt and in 1980 average number of sea-cucumber caught increased to 8. Semi enclosed fertile water abundant in phytoplankton and large algae is the best site for propagating sea-cucumbers.

## CONSERVATION AND MANAGEMENT

279. JAMES, D. B. 1991. Research, conservation and management of edible holothurians and their impact on the *Beche-de-mer* industry. *Bull. cent. mar. Fish. Res. Inst.* **44** (3) : 648 - 661.

It is suggested to collect data on catch and effort, length composition, age and growth, longevity, length at first maturity, spawning fecundity, development and culture to take up necessary conservation methods to monitor the resources of economically important holothurians. The relevance of these studies on the *beche-de-mer* industry is discussed.

280. JAMES, P. S. B. R. AND D. B. JAMES 1989 a. Management of the *beche-de-mer* industry in India. *Paper presented at National Workshop on Beche-de-mer, CMFRI, Cochin.* Abstract, p. 3.

The *beche-de-mer* industry is now facing crisis due to the shortage of holothurians and also due to ban imposed by the Government to export material less than 3" size. Under these circumstances the management strategies for the *beche-de-mer* industry are given.

281. \_\_\_\_ AND \_\_\_\_ 1989 b. Conservation and management of sea-cucumber resources in India. *Ibid.*, Abstract, p. 3.

Due to over exploitation of the holothurians there is need to conserve the resource. Methods of conservation and rational management are given.

282. SILAS, E. G., S. MAHADEVAN AND K. NAGAPPAN NAYAR 1985. Existing and proposed Marine Parks and Reserves in India - A review. *Proc. Symp. Endangered Marine Animals and Marine Parks.* Marine Biological Association of India. pp. 414 - 425.

Depletion of the holothurian *Holothuria scabra* is indicated.

## RESOURCES AND FISHERY

283. ADAMS, T. 1992. Resource aspects of the Fiji *beche-de-mer*. *Beche-de-mer Information Bulletin*, 4 : 13 - 16.
- Deals with resources, conservation and socio-economic problems in Fiji.
284. \_\_\_\_ 1993. Management of *beche-de-mer* (sea-cucumber) fisheries. *Ibid.*, 5 : 15 - 17.
- Recommendations for the management of *beche-de-mer* fishery in Fiji and Tonga are given in detail.
285. AMIR, A. A. 1985. Democratic Yemen fisheries : Cuttlefish and sea-cucumber. *ICLARM NEWSL.*, 8 (4) : 15 - 16.
- Holothuria scabra* is abundant in the coastal waters of the Gulf of Aden. Details of the fishery and marketing aspects are indicated. *H. scabra* is available in the Gulf of Aden and Socotra.
286. ANONYMOUS 1918. Administration Report of the Madras Fisheries Department for 1917 - 1918. *Government of Madras Publication.*, 9 (2) : 187 - 188.
- Statistics of different quality of *beche-de-mer* are given.
287. \_\_\_\_ 1920. Administration Report of Madras Fisheries Department for the year 1918-1919. *Ibid.*, 12 (1) : 15 - 16.
- The bulk of III size was obtained in April, May and June. All were immature and were under one year and should have been left on the beds to grow to adult size. In 1919 three tonnes of excellent *beche-de-mer* was ready for export to Singapore. It was noted that the holothurians fished in Sri Lanka were larger and heavier than those fished from the southwest coast of Palk Bay. The divers of Tirupalakkudi got nearly Rs. 1000/- from sea-cucumbers.

288. \_\_\_\_ 1922. Administration report of Madras Fisheries Department for the year 1920-'21. *Ibid.*, 15 (1) : 17 - 18.

*Beche-de-mer* fishery was a complete failure since only 163 lbs were cured. The scarcity is attributed to heavy mortality due to an influx of fresh water from the River Vaigai during the previous rainy season.

289. \_\_\_\_ 1923. Administration report of Madras Fisheries Department for the year 1921-'22. *Ibid.*, 17 (1) : 17 - 18.

During the year, 1008 lbs of the product were shipped to Singapore and Rs. 439/- was realised giving a net profit Rs. 41/-.

290. \_\_\_\_ 1924. Administration report of Madras Fisheries Department for the year 1922-'23. *Ibid.*, 18 (1) : 22.

Only 850 lbs were cured partly due to adverse weather conditions and partly due to poor attention given by divers.

291. \_\_\_\_ 1925. Administration report of Madras Fisheries Department for the year 1923-'24. *Ibid.*, 19 (1) : 19.

During the season only 1926 lbs were cured and exported to fetch Rs. 896/- with a net profit of Rs. 286/-.

292. \_\_\_\_ 1926. Administration report of Madras Fisheries Department for the year 1924-'25. *Ibid.*, 20 (1) : 19.

During the season 1900 lbs were cured. the charges incurred for the fishery came to Rs. 619/- and the cured product was exported to fetch Rs. 700/- giving an estimated profit of Rs. 80/-.

293. \_\_\_\_ 1927. Administration report of Madras Fisheries Department for the year 1925-'26. *Ibid.*, 21 (1) : 26.

During the season 1,187 lbs were cured. The charges incurred on account of this experimental industry was Rs. 466/- and the receipts amounted to Rs. 470/-.

294. \_\_\_\_ 1928. Administration report of the Madras Fisheries Department for the year 1926-'27. *Ibid.*, 22 (1) : 27.

During the year 1474 lbs were cured. The expenditure incurred was Rs. 434/- and the sale proceeds was Rs. 708/-.

295. \_\_\_\_ 1929. Administration report of the Madras Fisheries Department for the year 1927-'28. *Ibid.*, 23 (1) : 17.

During the year 3063 lbs were cured at the Government curing station at Tirupalakkudi. Plenty of raw material was available all along the coast. A local merchant proposed to start a private curing yard at Tirupalakkudi on the lines of Government yard. No more *beche-de-mer* will be cured from 1st July, 1928.

296. \_\_\_\_ 1984. *Marine Small-scale Fisheries of Sri Lanka. General description.* BOBP/INF/6.

Main species *Holothuria scabra* is found to be distributed in 6-20 m. Production is estimated to be about 100-150 tonnes per annum from Palk Bay, Gulf of Mannar and Kalpitiya.

297. \_\_\_\_ 1989. *Beche-de-mer resources of India.* CMFRI Newsletter, 43 : 2.

Some general remarks on the *beche-de-mer* industry of the Gulf of Mannar and Palk Bay are given. Some remarks on the history, distribution, hatchery and culture are given.

298. \_\_\_\_ 1993. *Beche-de-mer harvesting in the northern Province of New Caledonia.* *Beche-de-mer Information Bulletin*, 5 : 7 - 8.



In New Caledonia 48 species of sea-cucumber have been identified. Of these four species viz., *Actinopyga miliaris*, *Holothuria scabra*, *H. nobilis* and *H. atra* are processed. *A. miliaris* forms 68% and *H. scabra* forms 28% of the total catch. As conservation measure fishing is suspended during January to April and also size limit is imposed by the fishermen. Export figures are given countrywise from 1987-1991.

299. BRADBURY, A. AND C. CONAND 1991. The dive fishery of sea-cucumbers in Washington State. *Beche-de-mer Information Bulletin* 3 : 2 - 3.

The longitudinal muscles of *Parastichopus californicus* are stripped, frozen and exported to Taiwan. The body was is also processed. Each area goes unfished for 3½ years after six month harvest. Value had doubled during the last four years.

300. CONAND, C. 1987. Exploitation des holothuries L. historique en Nouvelle-Caledonie et marche mondial, *Bull. Soc. Sci. nat. ouest France*. Suppl. H.S. pp. 169 - 174.
301. \_\_\_\_\_ AND N. A. SLOAN 1989. *World fisheries for echinoderms. In: Marine invertebrate fisheries : their assessment and management.* John Wiley & Sons, Inc.

A review paper on *beche-de-mer* and sea urchin roe industry on a global basis.

302. \_\_\_\_\_ 1990. The fishery resources of Pacific Island countries. Part.2. Holothurians. *FAO Fisheries Technical Paper*, 272. 2. Rome, FAO. 143 p.

The main species of holothurian exploited in the South Pacific are *Holothuria scabra*, *H. fuscogilva* and *H. nobilis* of high commercial value, *Actinopyga echinites*, *A. miliaris* and *Thelenota ananas* of medium commercial value and *Holothuria atra*, *H. fuscopunctata* and *A. mauritiana* whose commercial value is low.

Knowledge of the biology of these species is reviewed in detail, as are resource assessment methods. An example of the possible use of remote sensing for estimating potential is given.

Harvesting and processing techniques and commodity grading are also discussed, while a chapter focussing on the principal markets for *beche-de-mer*, Hong Kong and Singapore, concludes that an increase in exports from the countries and territories of the South Pacific is possible. They can supply a consistently good quality product on a regular basis.

303. — AND C. HÖFFSCHIR 1991. Recent trends in sea-cucumbers exploitation in New Caledonia. *Beche-de-mer Information Bulletin*, 3 : 5 - 7.

*H. scabra* forms 25% and *A. miliaris* 75% of the catch.

304. DALZELL, P. 1990. *Beche-de-mer* production from three Papua New Guinean atolls between 1982 and 1983. *Beche-de-mer Information Bulletin*, 1 : 6.

The average production of *beche-de-mer* is low being 5.5 tonnes. They chiefly fished for white and black teat-fish. No information is available on the size of the harvesting grounds and the effort expended.

305. GENTLE, M. T. 1985. Report of a consultancy on the commercial sea-cucumber resources of the Peoples Democratic Republic of Yemen. 23 January - 6 April 1985 (Phase II). FAO FI/TCP/PDY/4401 (Mar) Cop. FAO, Rome (Italy).

In two areas west of Aden fishery for *H. scabra* exists. Production has totaled approximately 12 tonnes of dried product with a value of US \$ 20,000. Diving was conducted at whole mainland coast of Socatra. Results indicate no potential areas in addition to the ones already mentioned.

306. GRONEN, D. 1881. Die Trepang fisherei in Nord-Australian. *Zool. Garten.*, **22**.

The *beche-de-mer* fishery in North Australia discussed.

307. HARRIOT, V. J. 1985. The potential for a *beche-de-mer* fishery. *Aust. Fish.*, **44** (6) : 18 - 21.

The *beche-de-mer* potential of Australian waters is given.

308. ISARANEURA, A. P. 1976. Conventional and unconventional fisheries resources in Southeast Asia. In : K. Tiews (Ed.) *Proceedings of the International Seminar on Fisheries Resources and their Management in Southeast Asia, Berlin, 19 November to 6 December 1974*. German Foundation for International Development, Bonn (GPR) 552 pp.

Demersal resources in Southeast Asia in the Bay of Manila and the Gulf of Thailand. It is worthwhile looking at the possibility of developing the fisheries of sea-cucumber.

309. JAMES, D. B. 1973. *Beche-de-mer* resources of India. *Proc. Symp. Living Resources of the seas around India. CMFRI Spl. Publ.* pp. 706 - 711.

Probably the first paper in recent times on *beche-de-mer* resources from India. The fishing season for *Holothuria scabra* is given. The other valuable species from the Andamans and the Lakshadweep are pointed out.

310. \_\_\_\_\_. 1983. Sea-cucumber and sea-urchin resources. *Bull. cent. mar. Fish. Res. Inst.*, **34** : 85 - 93.

The *beche-de-mer* resource of Andaman and Nicobar Islands is given with field key and good photographs. Processing of *Holothura scabra* is briefly described. Some

experiments conducted to grow juveniles of *Holothuria scabra* are given.

311. — 1988. A review of the holothurian resources of India : their exploitation and utilization. *Symposium on Tropical Marine Living Resources*. Marine Biological Association of India, Cochin, Abstract p. 8.

Mode of exploitation and utilization of commercially important species of holothurians are mentioned.

312. — 1989 a. *Beche-de-mer* : its resources, fishery and industry. *Mar. Fish. Infor. Serv. T & E. Ser.*, 92 : 1 - 35.

Detailed information on the taxonomy of the commercial species of holothurians, their biology, ecology, anatomy, zoogeography, hatchery, culture, resources, conservation and management, *beche-de-mer* industry, processing, quality control, export figures, market and market trends, uses of *beche-de-mer*, recipes for the preparation of *beche-de-mer* are given.

313. — 1989 b. *Beche-de-mer* resources from India and their exploitation. National Workshop on *Beche-de-mer*, Mandapam camp, CMFRI, Cochin, Abstract, p. 4.

An account of the *beche-de-mer* resources of India and their mode of exploitation is given.

314. — 1989 c. *Beche-de-mer* resources of Lakshadweep. In : Marine Living Resources of the Union Territory of Lakshadweep - An indicative survey with suggestions for Development. *Bull. cent. mar. Fish. Res. Inst.*, 43 : 97 - 144.

*Beche-de-mer* resources of Lakshadweep are given. Future prospects for the industry are indicated.

315. JAMESON 1830. *Über den Trepang- Handel im Indien. Frorieps Notizen*, 29.

The trepang fishery of India in olden days is described.

316. JOSEPH, L. AND SHAKEEL 1991. The *beche-de-mer* fishery in the Maldives only a few years old, but already in need of management. *BOBP Newsletter*. pp. 2 - 5.

Background information, fishing methods and processing of *beche-de-mer* are given from the Maldives for the first time.

317. \_\_\_\_ 1992. Review of the *beche-de-mer* (Sea-cucumber) fishery in the Maldives. *BOBP/WP/79*. pp.34.

Resources, fishing methods, areas and seasons, processing, marketing and export, income and expenditure and production trends of *beche-de-mer* fishery from Maldives are given with good colour photographs.

318. KONINGSBERGER, J. C. 1904. Tripang en tripang-visecherij in Nederlandsc-India. *Meded. Plantentuin Batavia*, 712 : 1 - 72.

An old publication in which the *beche-de-mer* industry of India is given.

319. KRISHNAMOORTHY, B. 1957. Fishery resources of the Rameswaram Island. *Indian J. Fish.*, 41 (2) : 229 - 253.

Some observations on the *beche-de-mer* industry of Rameswaram Island are given.

320. LEVIN, V. S. AND E. I. SKALETSKANYA 1984. Dynamics of utilization of the resources of a foreging area by Japanese sea-cucumber. *Can. Transl. Fish. Aquat. Sci.*, 5075 : 1 - 20.

321. MATTHES, H. 1983. *Beche-de-mer* resources of the People Democratic Republic of Yemen. *Beche-de-mer* resources of PDRY. A report prepared for the *beche-de-mer* Fishery Development Project, FAO, Rome, Italy, May, 1983. 32 pp. FAO/FI/TCP/PDY/2204. Field Document. 1 : 25 p (mimeo).

The report describes the activities undertaken to investigate the possibility of extending the sea-cucumber *Holothuria scabra* fishery to the Peoples Democratic Republic. Findings indicate the resource to be small. Recommendations concerning the development of fishery and exploitation of the stocks are listed.

322. PANNING, A. 1944. Die Trepang fisherei. *Mitt. Zool. St. Inst. Hamb.*, 49 : 1 - 76.

Though old, a very important document on *beche-de-mer*. All the commercially important species are mentioned and spicule diagrams are given. The *beche-de-mer* industry of southeast coast of India and various parts of the world are mentioned.

323. PRESTON, G. 1990. Mass *Beche-de-mer* production in Fiji. *Beche-de-mer Information Bulletin*, 1 : 4 - 5.

*Beche-de-mer* production was only 20-30 tonnes in 1984, but it shot up to 665 t in 1988. In 1988, 95% of the material was only *A. miliaris* which has low value. In 1989 *H. scabra* was banned by Fiji Government.

324. \_\_\_\_ 1990. Recent *beche-de-mer* surveys in the Pacific Islands. *Beche-de-mer Information Bulletin*, 1 : 10.

Commercially important species : *Holothuria nobilis*, *Thelenota ananas* and *Actinopyga mauritiana*.

325. \_\_\_\_\_ 1990. *Beche-de-mer* survey in Tonga. *Beche-de-mer Information Bulletin*, 2 : 7.

Six species were found to be commercially useful. The total standing stock of exploitable sea-cucumbers in less than 30 m was estimated to be about 1.01 million. It was recommended that the harvests do not exceed the total standing stock per year. It was also recommended that SCUBA gear should not be used.

326. SANDERS, M. J. AND G. R. MORGAN 1989. Review of the fisheries resources of the Red Sea and Gulf of Aden. *FAO Fisheries Technical Paper*, 304 : 1 - 138.

A potential yield of 55 t of dried product was estimated based mainly on *Holothuria scabra* and various *Actinopyga* species. Some commercial exploitation of these species was reported during 1981-1984 when 12 t of dried product was taken during 19 months fishig.

327. SAVVATEEA, L. YU 1987. Prospects for the combined use of holothurians of Far-Eastern Seas. *Rynee Khoz., Moskya*, 1 : 72 - 74 (In Russian).

328. SEALE, A. 1911. The fishery resources of the Philippine Islands. Part 4. Miscellaneous marine products. *Philipp. J. Sci.*, 6 (6) : 283 - 289.

The *beche-de-mer* resources of the philippins are described.

329. SHELLEY, C. 1985. Potential for reintroduction of a *beche-de-mer* fishery in the Torres Strait. In : *Proceedings of the Torres Strait Fisheries Conference, Port-Moresby*, 140 - 150.

330. SLOAN, N. A. 1985. Echinoderm fisheries of the world : A

review. In : B. F. Keegan and B. D. S. O' Connor (Ed.)  
*Proceedings of the Fifth International Echinoderm  
Conference*. A. Balkems, Rotterdam; pp. 109 - 124.

331. SWAN, J. G. 1986. The Trepang fishery. *Miscellaneous Documents*.

Some information on *beche-de-mer* is given.

332. TENAKANAI, C. 1988. The status of *beche-de-mer* resource and exploitation in Papua New-Guinea. *Colloque sur les Ressources halieutiques Cotieres due Pacifique, C.P.S., Noumea, B.P. 108* : 4 p.

333. TRINIDAD - ROA, 1987. *Beche-de-mer* fishery in the Philippines. *Marine Science Institute Contribution*, 151 : 15 - 17.

A very informative paper on the *beche-de-mer* fisheries of philippines. The uses of *beche-de-mer*, processing methods, different grades of holothurians and their rates of *beche-de-mer* are given. Some remarks on conservation and management of holothurians are also given.

334. TUWO, A. AND C. CONAND 1992. Developments in *beche-de-mer* production in Indonesia during the last decade. *Beche-de-mer Information Bulletin*, 4: 2 - 3.

Indonesia is now the main world *beche-de-mer* producer and exporter. The major part of the production is exported to Hong Kong. About ten species are processed.

335. WINCKLER 1870. Die Trepang visscherji (Holothuria trepang) kennis en Kunst.

Some details on *beche-de-mer* fishery are given.

336. ZAKARIA, Ez AND EL. DIN 1983. *Field experiment on Beche-de-mer Project for the development of fisheries in areas*



*of the Red Sea and Gulf of Aden*. Cairo, Egypt. 13 pp. (Report).

Survey was conducted in the Egyptian Red Sea area. Processing methods are given for Surf Red-fish and Black Stone-fish. Percentage of weight loss during processing and percentage of moisture content of Surf Red-fish are given.

### PROCESSING AND QUALITY CONTROL

337. ANONYMOUS 1930. Administration report of the Madras Fisheries Department for the year 1928-'29. *Government of Madras Publication*, 2 (1) : 23.

During the period 1927-'28, 3,360 lbs were cured and shipped to Singapore for Rs. 1518/-. Since the termination of the Ramnad Chank fishery lease from 1st July, 1928 the curing under departmental agency ceased. A private yard existed and conducted processing in a satisfactory manner on the lines of the Government Factory. The Departmental chank fishing investigations for the first time on the Tanjore Coast has brought to light the existence of suitable holothurians all along the Tanjore Coast for conversion to *beche-de-mer*.

338. \_\_\_\_ 1979. *La Beche-de-mer dans le Pacifique Tropical Manuel a l'usage des fecheurs*. Manuel, 18: 1 - 31. C. P. S. Publication.
339. \_\_\_\_ 1982. *Government of India Notifications and Export Inspection Council Instructions on pre-shipment inspection of dried fish, dried shark fins and fish maws, fish meal and beche-de-mer. Pre-shipment Inspection and quality control manual*. Export Inspection Agency Training and Documentation Centre, Madras. pp. 6.

*Beche-de-mer* is subjected to quality control and inspection before export. The size should be above 76 mm and

*of the Red Sea and Gulf of Aden.* Cairo, Egypt. 13 pp. (Report).

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338. \_\_\_\_ 1979. *La Beche-de-mer dans le Pacifique Tropical Manuel a l' usage des fecheurs.* Manuel, 18: 1 - 31. C. P. S. Publication.
339. \_\_\_\_ 1982. *Government of India Notifications and Export Inspection Council Instructions on pre-shipment inspection of dried fish, dried shark fins and fish maws, fish meal and beche-de-mer. Pre-shipment Inspection and quality control manual.* Export Inspection Agency Training and Documentation Centre, Madras. pp. 6.

*Beche-de-mer* is subjected to quality control and inspection before export. The size should be above 76 mm and

the colour on the dorsal side is dark brown and pale white on the ventral side. It should be free from any off colour.

340. \_\_\_\_ 1985. *Beche-de-mer processing traits along with Egyptian Red Sea Coast*. Presented at FAO Expert Consultancy on Fish Technology in Africa, Lusaka (Zambia). 21 - 25 Jan. 1985.

Three species of sea-cucumbers from the Egyptian Red Sea Coast were test-fish (*Microthele nobilis*), black-fish (*Actinopyga* sp.) and surf red-fish (*Actinopyga mauritiana*). Test fish are large, whereas the black-fish and red surf-fish are small. The yield of the product after processing varied between 8 - 12% of the initial weight, the moisture content of the product on wet weight basis varied between 14 - 24%.

341. \_\_\_\_ 1990 a. *Thirty years of Fisheries Developments in Lakshadweep*. Dept. of Fisheries, U.T. of Lakshadweep, Kavarathi. 89 p.

General introduction to *beche-de-mer* is given. During 1975-76 permission was accorded to a private firm to process *beche-de-mer* on trial basis. This firm processed 3.8 tonnes of *beche-de-mer*.

342. \_\_\_\_ 1990 b. Papua New Guinea. An action plan for small scale fish processing. CFTC/IDU/PNG/23. pp. 248.

Sea-cucumber potential is 10,000 tonnes, but present harvest is only 1,200 t (12%). *Holothuria scabra* is the major species exported. Sand-fish forms 95 to 99%, Test-fish is negligible. Good production during January and February. During March, April and September production is poor. Major supply is to Singapore and Hong Kong. Species available at Papua New Guinea : *Holothuria fuscogilva*, *Holothuria radilus*, *Actinopyga echinites*, *Holothuria scabra*, *Thelenota ananas*, *Actinopyga militaris*, *Holothuria fuscopunctata*.

343. BASKER, B. K. AND P. S. B. R. JAMES 1989. Size and weight reduction in *Holothuria scabra* processed as *beche-de-mer*. *Mar. Fish. Infor. Serv. T & E. Ser.*, **100** : 13 - 16.

Size reduces 42.65 - 43.13% and weight 91.34 to 91.79% on processing. Average spawning size is 220 mm when reduces to 76 mm on processing. Size range of *H. scabra* exploited is 130 - 340 mm and maximum percentage 61.81% falls below 230 mm. There is no justification to reconsider the earlier decision banning export of material less than 75 mm.

344. CARLATON, C. 1985. Development of miscellaneous marine products in the South Pacific. *Infofish.*, **31** : 18 - 21.

Considerable scope exists for expansion of the Pacific *beche-de-mer* industry. There is need to improve and standardise the quality of the product.

345. CLUCAS, I. J. 1985. *Fish handling, preservation and processing in the tropics*. Part 2. Tropical Development and Research Institute, London. p. 54.

346. CONAND, C. 1973. *Beche-de-mer* in New Caledonia : Weight loss and shrinkage during processing in three species of holothurians. *SPC Fish. Newslett.*, **19**: 14 - 17.

*Beche-de-mer* industry in New Caledonia is described. Loss of weight and shrinkage during processing in three species of holothurians are described.

347. CREAN, K. 1977. Some aspects of the *beche-de-mer* industry in Ongtong Java, Solomon Islands. *SPC Fish Newsl.*, **15** : 36 - 48.

348. DERANIYAGALA, P. E. P. 1933. Cured marine products of Ceylon. *Bull. Ceylon Fish.*, **5** : 1 - 68.

349. DURAIRAJ, S. 1982. Evolving quality standards for *beche-de-mer*. *Seafood Export J.*, **14** (3) : 19 - 22.

A general article on *beche-de-mer* processing, chemical composition, exports and prospects are given. Chief defects such as faulty evisceration, imperfect removal of external chalky coat and careless drying are highlighted to improve the quality of the product.

350. \_\_\_\_\_, M. M. NAINAR, M. K. LAINE, R. R. SUDHAKARAN AND S. INBARAJ 1984. Study on the quality of *beche-de-mer* in trade and shrinkage of specimens during processing. *Fish. Tech.*, **21** : 19 - 24.

Chemical quality of 180 trade samples of *beche-de-mer* of four sizes were studied. The percentage of shrinkage of the samples ranged from 56 - 60% for dried *beche-de-mer* of 7.5 cm size and above.

351. GOPAKUMAR, K. 1978. Diversified Fish Products. *Summer Institute on Fish Processing Technology*. p. 13.
352. HOWELL, R. M. AND M. HENRY 1977. Dried sea-cucumber processing. *Report. Marine Resources and Development Truk District, Trust Territory of Pacific Islands* : 15 p.
353. JAMES, D. B. 1986. Quality improvement in *beche-de-mer*. *Seafood Export Jour.*, **18** (3) : 3 - 10.

Factor such as species, size appearance, shape, colour, odour, control the quality of *beche-de-mer*. Improvement in handling, precautions to be taken during processing, quality control and the malpractices to be checked during processing are mentioned.

354. \_\_\_\_\_ 1987. Prospects and problems of *beche-de-mer* industry in Andaman and Nicobar Islands. *Proc. Sym. Management of Coastal Ecosystems and Oceanic Resources of Andamans*. 110 - 113. Andaman Science Association, Port Blair.

The availability of holothurian resources, their distribution, farming, processing, problems and solutions pertaining to the Andaman and Nicobar Islands are presented.

355. \_\_\_\_\_ 1988. Problems of *beche-de-mer* industry in Tamil Nadu and recent development in breeding of sea-cucumbers. *Paper presented in Workshop on Research and Development in Marine Fisheries in Tamil Nadu, Madras. September 13-14, 1988. 5 p.*

Problems and solutions for the *beche-de-mer* industry in Tamil Nadu are discussed.

356. \_\_\_\_\_ 1989. Improved methods of processing holothurians for *beche-de-mer*. *Paper presented at the National Workshop on Beche-de-mer, CMFRI, Cochin. Abstract, p. 11.*

There is lot of scope to improve the quality of the *beche-de-mer*. Many suggestions are given to improve the quality to fetch higher prices in the export market.

357. \_\_\_\_\_ AND B. K. BASKER 1989. Present status of the *beche-de-mer* industry in the Palk Bay and Gulf of Mannar. *Ibid.*, Abstract, p. 13.

A survey is conducted along the Palk Bay from Adiraampatinam to Rameswaram and along the Gulf of Mannar from Mandapam to Cape Comorin. all the processing centres have been visited and the present status of the industry is reported.

358. \_\_\_\_\_ AND ALI MANIKFAN 1989. Some remarks on the present status of *beche-de-mer* industry of Maldives and its lessons for the Lakshadweep. *Paper presentd at the National Workshop on beche-de-mer at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin, February, 1989. Abstract. p. 15.*

Recent observations made on the *beche-de-mer* industry of Maldives are given along with suggestions to extend the industry to the Lakshadweep.

359. McELROY, S. 1973. *The beche-de-mer industry: its exploitation and conservation. Findings of an exploratory beche-de-mer resource survey at Ontong Java atoll.* Honiara, British Solomon Islands, Dept. Agriculture, Fish. Div. 15 p.
360. MOTTET, M. G. 1976. The fishery biology and market preparation of sea-cucumbers. *Tech. Rep. Wash. Dept. Fish.*, 22 : 1 - 57.
361. PARAMANANTHAN, S. 1974. *Processing of beche-de-mer in factory. Souvenir to mark the opening of the beche-de-mer factory, Mannar.*

The advantages of processing *beche-de-mer* in a factory established under a co-operative basis are given. The cost analysis is also given.

362. PARRISH, P. 1978. Processing guidelines for *beche-de-mer*. *Aust. fish.*, 10 (17) : 26 - 27.

Processing of *beche-de-mer* is briefly mentioned.

363. PRESTON, G. 1990. *Beche-de-mer* recovery rates. *Beche-de-mer Information Bulletin*, 1 : 7.

On processing 2.7% to 11.2% weight is retained. *Stichopus chloronotus* may yield as little as 3%. For most of the species the length of the dried product is between 30 and 50% of the live length. For these studies 11 species are tested.

364. ROBERTSON, G. W., C. HOTTEN AND J. H. MERRITT 1987. Drying Atlantic Sea-cucumber. *Infofish*, 3 : 36 - 38.

For the first time an Atlantic holothurian *Cucumaria frondosa* is processed with a view to export to the Orient. After stormy weather substantial quantities can be collected from the Bay of Fundy from shallow water to 200 m depth. Processing method is simple. Handling and drying tests are also described.

365. SACHITHANANTHAN, K., P. NATESAN, C. ALGARATNAM, A. THEVATHASAN AND L. B. PHILIP 1975. De-Scummer for *Beche-de-mer* processing. *Bull. Fish. Res. Stn. Sri Lanka*, 26 (1 & 2) : 11 - 15.

A new devise to remove the white chalky deposits from the body wall during processing of *Holothuria scabra* is described in detail with drawings. About one hundred holothurians can be cleaned in five minutes by this devise.

366. \_\_\_\_ 1986. Artisanal handling and processing of sea-cucumbers (sandfish). *Infofish*, 2 : 35 - 36.

Handling, processing and packing of *Holothuria (Metriatyla) scabra* are given. The processing is dealt in a detailed manner.

367. SEALE, A. 1917. Sea products of Mindanao and Sulu. III. Sponges, tortoise shell, corals and *Trepang*. *Philipp. J. Sci.*, 12.

The *beche-de-mer* resources of Mindanao and Sulu are described.

368. SIDDEEK, M. S. M. AND K. SACHITHANANTHAN 1979. Use of length-weight relationship in grading processed *beche-de-mer*. *Bull. Fish Stn. Sri Lank.* 29 : 115 - 116.

369. SIMMONDS P. L. 1879. *The commercial products of the sea*. London, Griffthe and Farran.

Some information on the commercial product of *beche-de-mer* is given.



370. SIVAGURUNATHAN, P. 1986. Fish processing and preservation with reference to Tamil Nadu. *Information Brochure*, 8. Dept. of Fisheries. Tamil Nadu.
371. \_\_\_\_\_ AND S. DURAIRAJ 1986. Exportable fish and fishery products in Tamil Nadu. *Ibid.*, 7.
372. TANIKAWA, E. 1971. Marine Products in Japan. *Science, Technology and Research*. Koseisha Kosaikaka, Tokyo. 507 pp.

Information on boiled dried and graded sea-cucumber is given.

373. VELAYUDHAN, P. AND R. SANTHANAM 1990. Fish by-products of commerce. *Fishing Chimes*, 9 (10) : 44 - 47.

Processing method for *H. scabra* is given.

374. YEN, S. AND W. NEAGLE 1985. Sea-food processing in French Polynesia. *SPC Fish. Newsl.* 32 : 30 - 33.

Some information is given on *beche-de-mer* processing in French Polynesia.

#### MARKETING AND EXPORT

375. ALU, R. AND D. COOK 1987. *Beche-de-mer market survey*. Department of Fisheries and Marine Resources, Konedobu, Pua New Guinea. 16 pp.
376. ANONYMOUS 1978. *Export potential survey of Marine Products in Tamil Nadu, 1978*. The Marine Products Export Development Authority, Cochin-16.

The export potential *beche-de-mer* from Tamil Nadu is given.

370. SIVAGURUNATHAN, P. 1986. Fish processing and preservation with reference to Tamil Nadu. *Information Brochure*, 8. Dept. of Fisheries. Tamil Nadu.
371. \_\_\_\_\_ AND S. DURAIRAJ 1986. Exportable fish and fishery products in Tamil Nadu. *Ibid.*, 7.
372. TANIKAWA, E. 1971. Marine Products in Japan. *Science, Technology and Research*. Koseisha Kosaikaka, Tokyo. 507 pp.

Information on boiled dried and graded sea-cucumber is given.

373. VELAYUDHAN, P. AND R. SANTHANAM 1990. Fish by-products of commerce. *Fishing Chimes*, 9 (10) : 44 - 47.

Processing method for *H. scabra* is given.

374. YEN, S. AND W. NEAGLE 1985. Sea-food processing in French Polynesia. *SPC Fish. Newsl.* 32 : 30 - 33.

Some information is given on *beche-de-mer* processing in French Polynesia.

#### MARKETING AND EXPORT

375. ALU, R. AND D. COOK 1987. *Beche-de-mer market survey*. Department of Fisheries and Marine Resources, Konedobu, Pua New Guinea. 16 pp.
376. ANONYMOUS 1978. *Export potential survey of Marine Products in Tamil Nadu, 1978*. The Marine Products Export Development Authority, Cochin-16.

The export potential *beche-de-mer* from Tamil Nadu is given.

377. — 1980. *Marine Products Export Review*. The Marine Products Export Development Authority, Cochin.

Some information on *beche-de-mer* exported from India is given.

378. — 1983. *Export potential survey of marine products, Tamil Nadu*. The marine Products Export Development Authority, Cochin.

Information is given on the Export potential of *beche-de-mer* from Tamil Nadu.

379. — 1986. *Report of Indian dried fish delegation to Malaysia and Hong Kong*. Marine Products Export Development Authority, Cochin-16.

*Beche-de-mer* import to Malaysia for 1978-'83 is given. Imports to Singapore are also given. Of the 500 tonnes imported, only 100 tonnes were locally consumed and the rest was re-exported to Peninsular Malaysia, Taiwan, Hong Kong, Thailand and Sarawak. The import figures by Hong Kong for 1981-'85 are given.

380. CONAND, C. 1988. Dried Sea-cucumber - major markets update. *Infofish.*, 6 : 21 - 22.

Present market trend in Hong Kong, Singapore and Malaysia are given. Sea-cucumber consumption trials throughout the year are given. Some remarks on product preference are also given.

381. — 1993. Recent evolution of Hong Kong and Singapore sea-cucumber markets. *Beche-de-mer Information Bulletin*, 5 : 4 - 7.

Hong Kong is the world major market followed by Singapore. They also serve as re-exporting centres. Hong Kong imports from Indonesia, Singapore, Philippines, Fiji, China,

Maldives, Solomon Island, Papua New Guinea, Madagascar and New Caledonia. Products from the Western Indian Ocean (Madagascar, Tanzania and Mozambique) fetch good prices, but the highest are from the temperate Pacific countries. Three fourths of the cheaper material is re-exported to China. The major suppliers for Singapore are the Maldives, the Pacific Islands, Tanzania and Malaysia. Until a few years the main exporters were Sri Lanka, India and the Philippines. More than half the material is re-exported to Hong Kong. High grade *Beche-de-mer* goes to Taiwan and the low grade material goes to Malaysia. Generally higher grade are imported to Singapore and lower grades to Hong Kong.

382. DOUGLAS, B. 1971. The export trade in tropical products in New Caledonia 1841-1872. *J. Soc. Ocean. Paris*, 31 (27) : 157 - 169.

The *beche-de-mer* trade in New Caledonia during the years 1841-1872 are given.

383. GAUDECHOUX, J. P. 1993. Statistics on *Beche-de-mer* production. *Beche-de-mer Information Bulletin*, 5: 9 - 10.

Export figures are given for Fiji (1987-1992), Papua New Guinea (1991-1993) and for Solomon Islands (1983-1991).

384. JEGANATHAN, R. 1974. *Beche-de-mer* production and marketing. *A souvenir to mark the opening of the beche-de-mer processing factory, Mannar.*

The quantity of exports by the Mannar fishermen Co-operative Fishing Society during 1971-1974 is given.

385. KWKRETI, C. B. 1983. *Export of beche-de-mer (Inspection) amendment Rules 1983*. The Gazette of India Part II. Sec. 3, Sec. (ii) dated 15-10-83. P. 3978 - 3979.

386. MANINARAYANASWAMY 1982. Export policy of Marine Products.

*beche-de-mer* 1982. Delhi Circular E (C) : 1977/Am (248) dated, 16-8-1982.

387. McELROY, S. 1990. *Beche-de-mer* species of commercial value - update. *Beche-de-mer Information Bulletin*, 2 : 2 - 7.

The rates for 18 species and their grading according to size is done. Hong Kong offers better price than other markets.

388. MOTTET, M. G. 1976. Marketing of sea-cucumbers in the United States. *Comp. Rep. Wash. Dep. Fish.*, p. 59.

The possibilities of marketing *beche-de-mer* in United States is discussed.

389. NAIR, M. R., T. S. G. IYER AND K. GOPAKUMAR 1989. Processing and quality requirements of *beche-de-mer*. Paper presented at the National Workshop on *beche-de-mer* at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin. February, '89. Abstract, p. 12.

Export figures of *beche-de-mer* from 1972-'86, processing, common quality defects, export specifications, suggestions for improvement and precautions to be taken during processing are given.

390. RUSSEL, P. J. 1970. *The Papuan beche-de-mer trade*. M.A. Thesis, University of Papua New guinea, 64 p.

The history of *beche-de-mer* industry of Papua New Guinea is given from 1900 to 1970 in the thesis.

391. SACHITHANANTHAN, K. 1974. Efforts to diversify exports of *beche-de-mer*. A souvenir to mark the opening of the *beche-de-mer* processing factory, Mannar.

Information regarding *beche-de-mer* such as countries that process, consume, export and import are given. Also

figures regarding annual percentage of export to each country from Singapore during the years 1962-'70, price index to determine countrywise quality in the Singapore market during 1962-70 are given. Information regarding different species of holothurians, their specific name, trade name, size range, purchasing and selling prices in the Hong Kong market are given.

392. SAKTHIVEL, M. AND P. K. SWAMY 1989. International trade in sea-cucumbers. *Paper presented at the National Workshop on beche-de-mer at Mandapam Camp. Central Marine Fisheries Research Institute, Cochin. February, 1989. Abstract, p. 14.*

Singapore, Hong Kong and Malaysia are the principal trade centres for sea-cucumbers. Indonesia, Philippines, Japan, Korea (DPR), Sri Lanka, India, Africa and Oceania are the major suppliers. The contribution of India is very little due to the ban on the export of material below 3" size which formed around 70% of our export. good scope exists for culture and sea-ranching to boost exports.

393. SELLA, A. AND M. SELLA 1940. L' industries del trepang. *Thalassia*, 4 (1) : 1 - 116.

Detailed account of the *beche-de-mer* industry is given.

394. SOMMERVILLE, W. S. 1993. Marketing of *Beche-de-mer*. *Beche-de-mer Information Bulletin*, 5 : 2 - 4.

Early part of February when the Chinese Lunar New Year is celebratd, the prices of *Beche-de-mer* shoot up. Most of *beche-de-mer* is consumed in the restaurants rather than at homes. China will not take any *beche-de-mer* which is more than ten U.S. dollars in value. List of grades and values for May 1993 are given.

395. VAIL, L. AND B. RUSSEL 1990. Indonesian fishermen of

Australia's North-West. *Australian Natural History*,  
24 : 211 - 220.

The authors conclude that the pressure on the marine resources of Indonesia have increased during the last 10-15 years and some conservation measures are called for.

396. VAN EYS, S. 1986. The international market for sea-cucumber. *Infofish*, 5 : 41 - 44.

Economically important holothurians are listed. Hong Kong is a major centre for worldwide holothurian trade. Imports made by Hong Kong and Singapore during 1981-1985 from different countries are given along with value per kg in Hong Kong dollar. the re-exports from Hong Kong to various countries during 1981-'85 are also given.

397. WARD, G. 1972. The Pacific *beche-de-mer* trade with special reference to Fiji. In: G. Ward (Ed.) *Man in the Pacific Islands*. Oxford, Clarendon Press, pp. 91 - 123.

The *beche-de-mer* trade in the Pacific Ocean with special reference to Fiji Islands is given.

398. ZOUTENDYK, D. 1990. Potential market for frozen *beche-de-mer* in New Zealand. *Beche-de-mer Information Bulletin*, 1 : 8.

Pro-Marketing claims to have located a market for frozen *beche-de-mer*. The animals have to be simply gutted or gutted and boiled and then frozen. Market is found for gutted and frozen leopard-fish (*Bohadschia argus*) which is traditionally not a commercial species. It is interesting to note that price for gutted/frozen *B. argus* is of same value like *Thelenota ananas* and *Holothuria nobilis* which are highly valuable when boiled and dried.

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