

fission or that are in the process of internal regeneration. The Ap category includes all anterior specimens that have begun regeneration of the integument; category P includes all posterior specimens that have recently undergone fission and have not regenerated any of their organs; and, finally, category Pa includes all posterior specimens that have regenerated the oral portion and begun regeneration of internal organs.

Sexual and asexual reproduction

The presence of gonads both in some subjects showing recent fission and in some that are in the process of regeneration suggests that sexual and asexual reproduction can occur in the same specimen.

Anatomical study has thrown light on the ways in which fission and regeneration take place in *Holothuria atra*. Study of regeneration and fission rates will be carried out over an entire year-long cycle for full understanding of these events. Finally, numerous other parameters, such as fission stimuli, energy requirements, etc. will have to be considered in order to understand the place of this strategy in population dynamics.

Acknowledgements

We thank Mrs C. Conand and the team at the Marine Ecology Laboratory who assisted us in carrying out this research.



Request for information on fission and regeneration of tropical holothurians

by Chantal Conand

Asexual reproduction by fissiparity and regeneration is displayed by some marine animals. It can occur in populations also reproducing sexually, but the evolutionary and ecological significances of this strategy are still a subject of debate (Ghiselin, 1987; Mladenov & Emson, 1988; Gouyon et al., 1993).

Although holothurians are noted for their ability to reproduce asexually by fission, there have been relatively few reviews on the subject and specific data are still very limited (Emson & Wilkie, 1980; Lawrence, 1987; Smiley et al., 1991; Mladenov & Burke, 1994). Approximately ten species, amongst

Dendrochiotes and Aspidochiotes, have been reported, from field and laboratory observations, to reproduce asexually. Most of these observations are still anecdotal, and refer to very low fission rates in the field; they are therefore not significant at the population level.

Two tropical Aspidochiotes have attracted more attention: *Holothuria parvula*, in the Atlantic Ocean (Crozier, 1917; Deichmann, 1922; Emson & Mladenov, 1987) and *Holothuria atra* in the Indo-Pacific (Bonham & Held, 1963; Pearse, 1968; Doty, 1977; Harriot, 1982; Conand & De Ridder, 1990; Conand, 1993; Chao et al., 1993). As this species is

widely distributed in the Indo-Pacific tropical region (Guille et al., 1986), it offers a good example of this particular life strategy.

The request for spawning informations (Byrne & Conand in BDMIB #4) has brought many new observations, some being the first for some species. If any reader has observed fission or more commonly regenerating individuals, please supply us with the following details:

1. Species, locality, habitat, date;
2. State of regeneration or fission;
3. Number of regenerating and not regenerating;
4. Variations in behaviour.

Please send the observations to C. Conand (see address on cover); they will be published in the next issue of this bulletin.



References

- Bonham, K. & E. E. Held (1963). Ecological observations on the sea cucumbers *Holothuria atra* and *Holothuria leucospilota* at Rongelap Atoll, Marshall Islands. *Pacif. Sci.*, 17: 305-314.
- Chao, S. M., C. P. Chen & P. S. Alexander (1993). Fission and its effect on population structure of *Holothuria atra* (Echinodermata: Holothuroidea) in Taiwan. *Mar. Biol.*, 116: 109-115.
- Conand, C. (1993). Reproductive biology of the characteristic holothurians from the major communities of the New Caledonia lagoon. *Mar. Biol.*, 116: 439-450.
- Conand, C. & C. De Ridder (1990). Reproduction asexuée par scission chez *Holothuria atra* (Holothuroidea) dans des populations de platiers récifaux. In: *Echinoderm research*, De Ridder et al. (eds). Balkema, Rotterdam, 71-76.
- Crozier, W. J. (1917). Multiplication by fission in holothurians. *Am. Nat.*, 51 (609): 560-566.
- Deichmann, E. (1922). On some cases of multiplication by fission and coalescence in holothurians. *Vidensk. Medd. Dansk. Naturhist. Foren.*, 73: 199-206.
- Doty, J. E. (1977). Fission in *Holothuria atra* and holothurian population growth. M.Sc. Thesis, Univ. of Guam: 54 p.
- Ebert, T. A. (1983). Recruitment in echinoderms. *Echin. Stud.* 1: 169-203.
- Emson, R.H. & P. V. Mladenov (1987). Studies of the fissiparous holothurian *Holothuria parvula* (Selenka) (Echinodermata: Holothuroidea). *J. Exp. Mar. Biol. Ecol.*, 111: 195-211.
- Emson, R. H. & I. C. Wilkie (1980). Fission and autotomy in echinoderms. *Oceanogr. Mar. Biol., Ann. Rev.*, 18: 155-250.
- Ghiselin, M. T. (1987). Evolutionary aspects of marine invertebrate reproduction. In: *Reproduction of marine invertebrates, general aspects*, Giese A.C., Pearse J. & Pearse V. (eds.), Boxwood Press, California, 609-665.
- Guille, A., P. Laboute & J. L. Menou (1986). Guide des étoiles de mer, oursins et autres échinodermes du lagon de Nouvelle-Calédonie, ORSTOM (ed.), *Coll. Faune tropicale*, Paris, 25, 238 p.
- Gouyon, P. H., S. Maurice, X. Reboud & I. Till-Bottraud (1993). Le sexe pour quoi faire? *La Recherche*, 250: 70-76.
- Harriot, V.J. (1982). Sexual and asexual reproduction of *Holothuria atra* Jaeger at Heron Island Reef, Great Barrier Reef. *Australian Museum Memoirs*, 16: 53-66.
- Lawrence, J. M. (1987). *A functional biology of echinoderms*. Croom Held (ed.), London, 340p.