This year, a new sea cucumber season was included in the fishing calendar, from May to July. On the basis of past experience, many efforts have been made to conduct this fishery with a better management and control system. A fixed quota and a zoning plan with "no take" areas have been established. However, just a few days before the sea cucumber season started, a group of fishermen revolted in protest against the rules established by the authorities. They took by force the National Park and Charles Darwin Research Station offices on Isabela Island, and removed tortoises from the rearing center as ransom in an attempt to get the rights to fish more sea cucumbers. Fortunately, the government kept to the rules established by the management authorities and the threat was unsuccessful. The tortoises were recuperated and actions have been taken against those responsible for this criminal act.

Although, this type of event caused instability and raised questions about the management process, not all the fishermen support this kind of deed. The leader of the fisheries cooperative of Santa Cruz Island declared his rejection to this action and expressed his total support to the participatory management process. There is a long way to go in this slow process but a basis for conservation has been established in the Galapagos.

It is hoped that this new strategy of conservation based on participatory management will not be another human experiment with nature, but the beginning of a solid basis for protection of the Galapagos as a whole.

The process of asexual reproduction by transverse fission in *Stichopus chloronotus* (greenfish)

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Introduction

Stichopus chloronotus (greenfish) is generally considered a low value beche-de-mer species. However, due to overfishing of high commercial species worldwide (Conand and Jacquemet 2000) it is likely to become more important in tropical fisheries. This species is one of eight aspidochirotide species known to have asexual reproduction by transverse fission in addition to sexual reproduction by broadcast spawning (Harriott 1980; Conand et al. 1998; Uthicke 1997; Uthicke et al. 1999). Asexual reproduction is a seasonal event mainly occurring in winter and is an important means of population size maintenance in this species (Uthicke 1997; Uthicke et al. 1998). Therefore, information on this reproductive mode is important for the sustainable management of the fishery for this species.

Most holothurian species with asexual reproduction follow the "twisting-and-stretching" mode (Emson and Wilkie 1980): the anterior and posterior sections slowly rotate in opposite directions, resulting in a constriction in the holothurian. In a second step, the two halves slowly move in opposite directions, until the bodywall tears at the constriction and the two halves become completely separated. This process had not been previously observed in *S. chloronotus*. Observations on this process are reported here.

Observations

During routine surveys of holothurian populations on Lizard Island (Great Barrier Reef) on 8 June 2000 at 14h00, I observed on the shallow reef flat a specimen of *S. chloronotus* that appeared constricted slightly anterior to the middle and showed some white tissue at the constriction (Fig. 1A). I carefully collected this individual and transported it to a nearby aquarium with running seawater. After some initial activity, this specimen remained nearly stationary on the wall of the aquarium for about four hours. At 19h30, the constriction became slightly more distinct, and the animal started to move (Fig. 1B). Shortly after, the posterior half of the individual remained stationary, while the anterior end continued to move forward. This resulted in a more distinct constriction (Fig. 1C). At this point, the bodywall at the fission site was nearly liquid, and the two body parts separated apparently without effort, remaining connected only with a string of mucus for about 30 seconds (Fig. 1D). The entire process of fission lasted only for about five minutes. The bodywall at the fission

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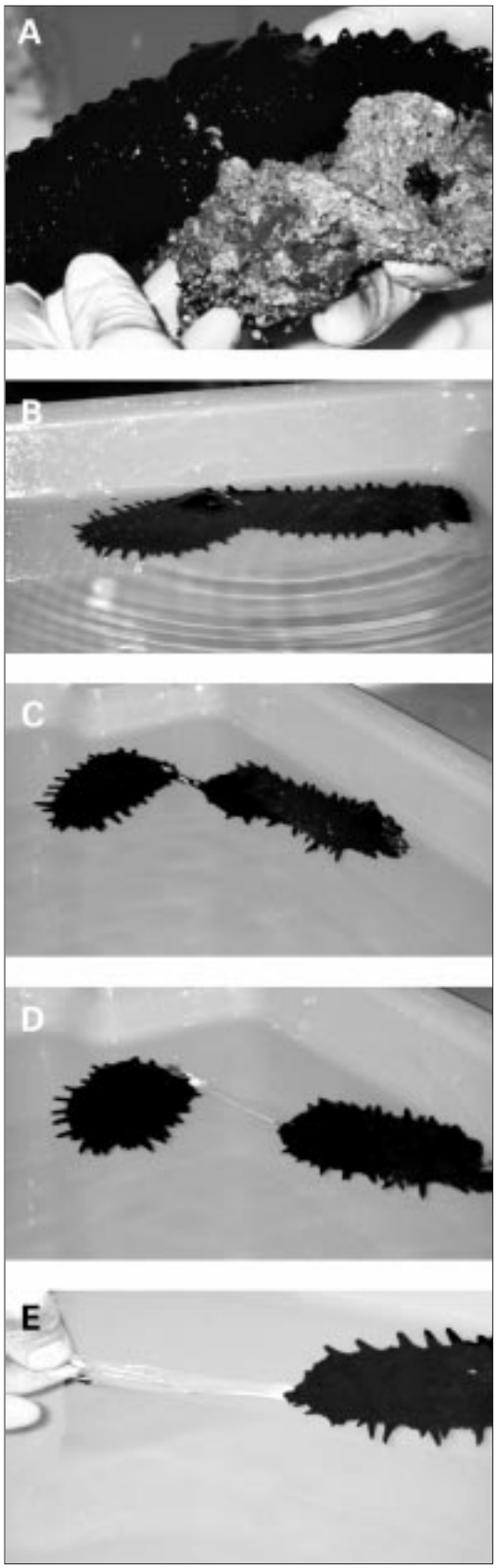
site remained a liquid or mucus like consistency (Fig. 1E) for at least two more hours. The following morning, the bodywall had its normal consistency and the wounds at both ends were nearly entirely closed.



This process took place during a period of intense asexual reproduction in the field. In a nearby population of *S. chloronotus* I observed 15.5% of all specimens being products of asexual reproduction just three days before the animal described here was collected (Table 1). Only four days later, this percentage had increased to 23.2 (Table 1). Most of these individuals appeared recently devided, and only one animal was in the process of regenerating (one anterior section with regenerating posterior end; sensu Conand et al. 1998).

Discussion

To my knowledge, this is the first description of the process of asexual reproduction in *S. chloronotus*. However, the observations are based on only one individual and were done in an aquarium, and should thus not be over interpreted.

Asexual reproduction in the individual *S. chloronotus* did not follow the twisting-and-stretching mode, as described for species of the genus *Holothuria* (Emson and Wilkie 1980), which may take up to several hours (personal observations). Instead, the mechanical properties of the body wall allow this organ to become semi-fluid, and the sections may separate rapidly, apparently with minor effort simply by forward movement of the anterior section.

The mechanical properties of the bodywall of many holothurians have fascinated physiologists for a long time, and are well described for *S. chloronotus* (Motokawa 1982, 1984). Connective tissue in holothurians (and other echinoderms) is named "catch-connective-tissue" (Motokawa 1984) or

Table 1: Observations on the frequency of fission products ("post-fission") in a population of *Stichopus chloronotus* on Lizard Island, Great Barrier Reef.

	05 June 2000		09 June 2000	
	N	%	N	%
Total observed	110		112	
Intact individuals	93	84.5%	86	76.8%
Post-Fission	17	15.5%	26	23.2%

Figure 1: Process of asexual reproduction in *S. chloronotus*. An individual shows a slight constraint in the body wall and some tissue damage (A). Once the animal becomes active (B), the anterior section moves away from the posterior section (B), until they are only connected by a thin string of mucus (C, D) and finally separate after about five minutes. The bodywall at the fresh "wounds" remains liquid for several hours (E).

"mutable collagenous tissue" (Wilkie 1984). These tissues may contract or expand nearly instantaneously without the action of muscles, probably under control of the nervous system (Wilkie 1984). *S. chloronotus* is a primary example for these properties. When rubbing animals of this species, the whole bodywall may disintegrate within minutes, and handling therefore often poses a problem for beche-de-mer fishermen.

The function of the catch connective tissue may mainly be associated with locomotion. *S. chloronotus* was shown to escape through shedding of a fraction of the bodywall when attacked by gastropods (Kropp 1982), which may also be facilitated by the connective tissue. It appears that, at least in *S. chloronotus*, another important function of the catch connective tissue is to aide in asexual reproduction by transverse fission and to warrant rapid wound healing.

The main fission period for *S. chloronotus* on the Great Barrier Reef (Uthicke 1997) and on La Réunion Island (Conand et al 1998) is in winter. The findings presented here confirm that fission activity in June is very high. In fact, the very small number of individuals in the process of regeneration suggest that fission may have commenced just prior to the beginning of the observations. I previously inferred that asexual reproduction in *S. chloronotus* occurs mainly at night (Uthicke 1997). Although I observed the first indications in the early afternoon, the observations presented here seem to corroborate this. However, due to the rapid speed of the process, and the fact that I only observed one individual, it cannot be excluded that some fission during daytime may have been overlooked.

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