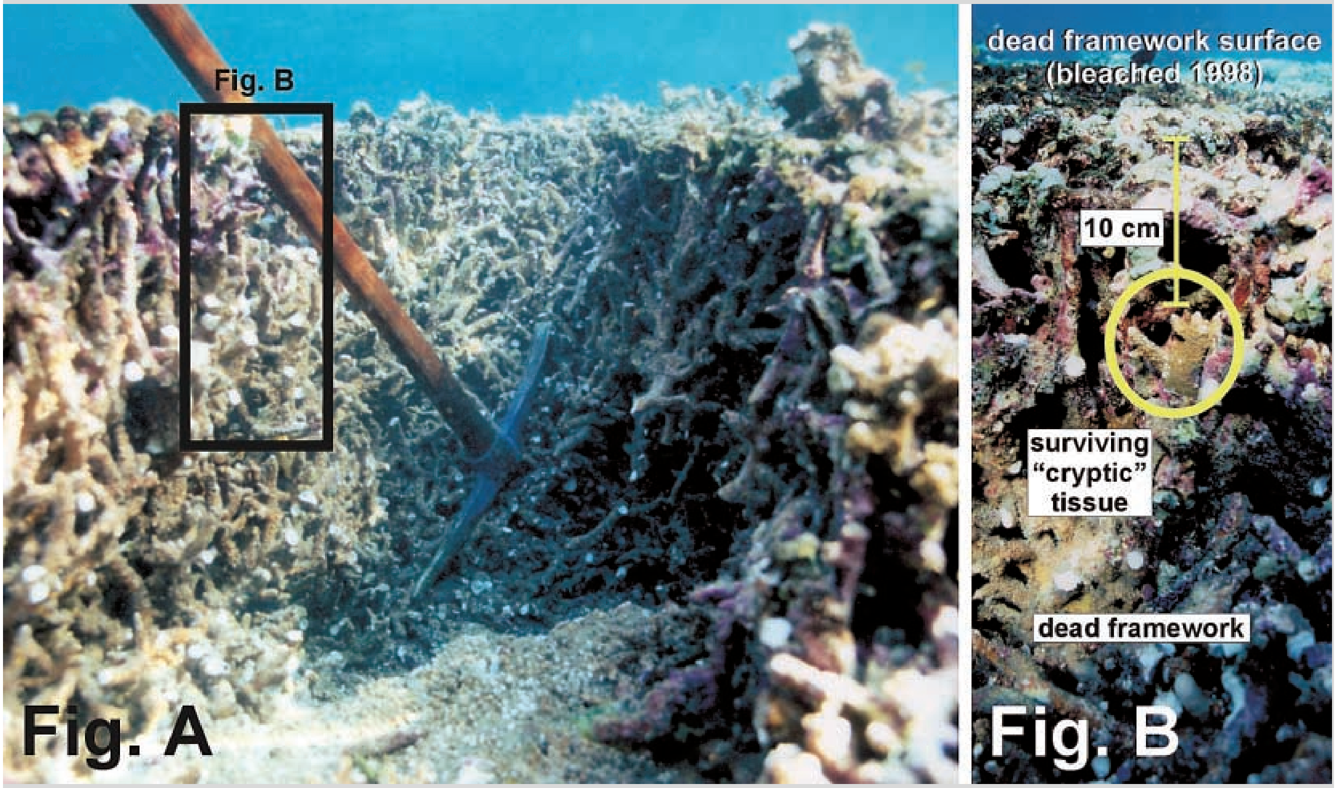

Fig. 1

"Cryptic" tissues inside Acropora *frameworks (Indonesia): a mechanism to enhance tissue survival in hard times while also increasing framework density*

Published online: 27 April 2001

The colonial nature of corals allows them to counter environmental perturbances by partial mortality and subsequent regrowth from surviving tissues (Hughes 1984). Tissues exposed to predators or environmental stresses are likely to be damaged, while those that can retract deeply into the skeleton or are sheltered otherwise are more likely to escape damage. Acroporids have a dense skeleton and, although the spongy coenosteal parts are occupied by a canal system which aids in directed fluid transports (Wallace 1999), the outer tissues, which form the contact with the environment, cannot retract very far into the skeleton (like in *Porites*, for example) and therefore have no way to escape environmental vicissitudes in times of crisis. This may be one of the many reasons that makes *Acropora* one of the genera more vulnerable to bleaching and other temperature-related mortality (Coles and Fadlallah 1991; Marshall and Baird 2000), and this genus suffered extensively during the 1998 bleaching episode (Marshall and Baird 2000).

Investigations in dense but dead frameworks of open arborescent *Acropora* in Indonesia (Tulamben, Bali) provided insight into a possible refuge mechanism for tissues in times of crisis – the maintenance of “cryptic” tissues. Inside an outwardly apparently totally dead framework of *Acropora* cf. *vaughani*, a victim of the 1998 bleaching episode (Schaffelner, personal communication) which was excavated to reveal the initiation sequence (Fig. 1A), we found several live branch tips (Fig. 1B). These live tissues usually occurred in depths of about 10 cm inside the approximately 80-cm-thick frame and were of normal color and vitality (visual assessment only). The illustrated branch tip (Fig. 1B) shows three branchlets, primarily laterally oriented, since the way up was blocked by competing branches of the same colony. This indicates three strategies followed by this *Acropora*:

1. While most live tissue is concentrated in the uppermost layers of the framework, closest to the light, apparently at least some tissue remains active closer to the base inside the framework, even if strongly shaded.
2. When surface tissues bleach and die, these shaded, “cryptic” tissues remain intact and provide a nucleus for recovery of the lost “colony surface” tissues by regrowth from below.
3. Also, as a result of “cryptic” branch tips remaining active, framework density caused by branch spacing is not only defined by the uppermost layer of tips, but apparently also by the active branch tips further down which continue to fill free spaces inside the framework by producing new branchlets. This may help to increase the mechanical stability and longevity of the framework.

Mechanisms such as the one suggested by our observations may provide further insight into why a coral genus, which is apparently very vulnerable to environmental perturbances and suffers repeated severe mortality, has been able to dominate many reefs worldwide over much of the Pleistocene and virtually the entire Holocene.

Acknowledgements Research was funded by Austrian Science Foundation project P13165-GEO. We thank J. Schaffelner (Tulamben, Bali, and Vienna, Austria) for local guidance.

References

Coles SL, Fadlallah YH (1991) Reef coral survival and mortality at low temperatures in the Arabian Gulf: new species-specific lower temperature limits. Coral Reefs 9:231–237

Hughes TP (1984) Population dynamics based on individual size rather than age: a general model with a coral reef example. Am Nat 123:778–795

Marshall PA, Baird AH (2000) Bleaching of corals on the Great Barrier Reef: differential susceptibilities among taxa. Coral Reefs 19:155–163

Wallace CC (1999) Staghorn corals of the world. A revision of the coral genus *Acropora* (Scleractinia; Astrocoeniina; Acroporida) worldwide, with emphasis on morphology, phylogeny and biogeography. CSIRO, Collingwood

B. Riegl (✉)
National Coral Reef Institute, Oceanographic Center, Nova Southeastern University, 8000 N. Ocean Drive, Dania Beach, Florida 33004, USA. E-mail: rieglb@nova.edu

W.E. Piller · B. Riegl
Institut für Geologie und Paläontologie, Karl-Franzens-Universität Graz, Heinrichstrasse 26, 8010 Graz, Austria