

**NOTA:**

## **JUVENILE SCLERACTINIAN CORAL MORTALITY AT NUESTRA SEÑORA DEL ROSARIO ARCHIPELAGO, COLOMBIAN CARIBBEAN\***

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### **RESUMEN**

**Mortalidad de corales escleractinios juveniles en el archipiélago Nuestra Señora del Rosario, Caribe colombiano.** En la estación de monitoreo de arrecifes coralinos del SIMAC en isla Tesoro, archipiélago Nuestra Señora del Rosario, se evaluó la mortalidad y se identificaron algunos signos de deterioro en corales escleractinios juveniles (colonias < 2-4 cm). Se marcaron y evaluaron 41 colonias por un período de seis meses (abril-octubre de 2006), de las cuales 31 pertenecieron a especies incubadoras de plánulas (con dominancia de *Porites astreoides* y *Agaricia* spp.) y 10 a especies liberadoras de gametos (con mayor abundancia de *Montastraea cavernosa*). La tasa de mortalidad encontrada (0.1) fue baja comparada con otras registradas, condición posiblemente relacionada con una presión moderada de los tensores presentes en el área durante la época del estudio. La abundancia de corales juveniles en los diferentes taxones y los signos de deterioro registrados son reflejo de las estrategias de vida, en las que especies incubadoras de plánulas son usualmente más abundantes y vulnerables.

**PALABRAS CLAVES:** Corales juveniles, Tasas de mortalidad, Incubadores de plánulas, Liberadores de gametos, Caribe colombiano.

Early mortality of scleractinian corals, soon after successful processes of reproduction and recruitment, is an important factor in the composition of coral communities (Bak and Engel, 1979). Post-settlement survival of juvenile corals is controlled by species-specific characteristics (e.g. growth rates and size of the colonies: Babcock, 1985; Vermeij, 2006), interaction with other reef organisms (e.g. competition and predation: Box and Mumby, 2007; Venera-Ponton *et al.*, 2011) and environmental conditions (e.g. seawater temperature, sedimentation rates and pollution: Wittemberg

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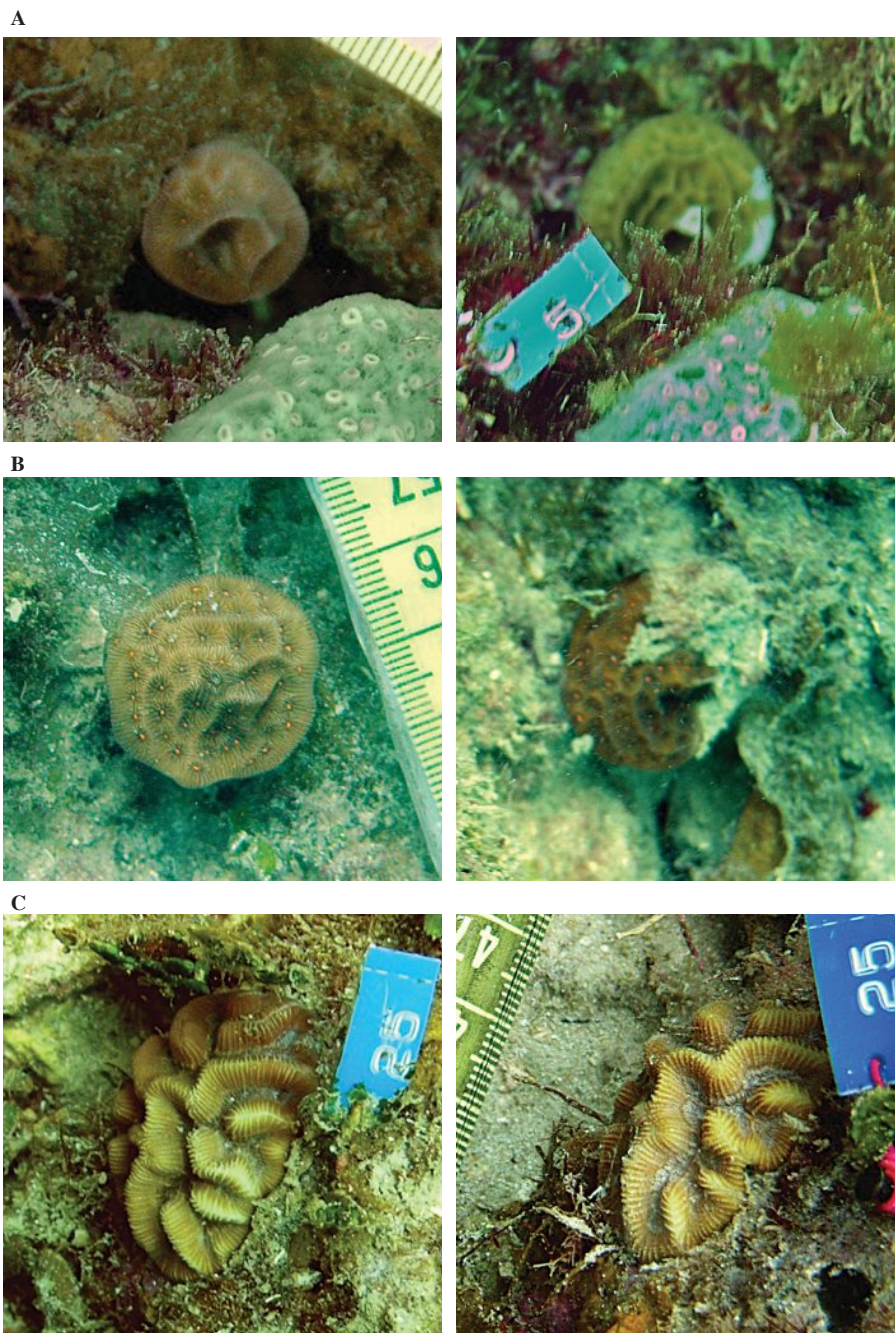
and Hunte, 1992; Richmond, 1997; Edmunds, 2004). Life-history strategies of species also play a fundamental role in the abundance and survival of juvenile corals (Bak and Engel, 1979; Van Moorsel, 1983; Hughes, 1985; Vermeij, 2006). In this research, an approach to the rates of mortality and some damage conditions of juvenile scleractinian corals was done in the Nuestra Señora del Rosario Archipelago (NSRA), an area in the Colombian Caribbean affected by natural and anthropogenic disturbances that have led to a continuous reef degradation (Alvarado *et al.*, 1986; Solano *et al.*, 1993; Gil-Agudelo *et al.*, 2006; Pineda *et al.*, 2006).

Two surveys within a six months interval (April-October 2006) were carried out in SIMAC's (National Monitoring System for the Coral Reefs of Colombia) monitoring site of Tesoro Island, northern zone of NSRA (10°14'3.1''N - 75°44'47.2''W). Juvenile scleractinian corals were located on each survey in six band transects (10 x 2 m), at 5-12 m depth. Similar to Vidal *et al.* (2005), the juvenile corals were defined as the sexual produced colonies with a maximum diameter of 2 cm for small-fast growing species (e.g. *Agaricia* spp. and *Porites astreoides*) and 4 cm for massive-slow growing species (e.g. *Montastraea* spp. and *Colpophyllia natans*).

In the initial survey, a total of 41 juvenile corals of eight taxa were tagged, 31 of which were brooder species and 10 were spawners (Table 1). Most of these colonies were identified as *Agaricia* spp. (n= 14) and *Porites astreoides* (n= 16). On the last survey, 34 of the colonies initially tagged were found healthy, three with damage conditions (one partially smothered by algae, one broken and one partially bleached on a pattern resembling a white plague disease), and four colonies were found dead (Figure 1, Table 1).

**Table 1.** Taxa and number of colonies found in permanent transects during the study period (n<sub>0</sub>: beginning and n<sub>r</sub>: end) in Tesoro Island. Damage conditions: (a) partially smothered by algae, (b) partially bleached, (c) broken.

TAXA	n <sub>0</sub>	n <sub>r</sub>		
		Healthy	Deteriorated	Death
<i>Agaricia</i> spp.*	14	9	1(a), 1(b), 1(c)	2
<i>Eusmilia fastigiata</i> *	1	1	0	0
<i>Porites astreoides</i> *	16	15	0	1
<i>Diploria strigosa</i> **	1	1	0	0
<i>Montastraea cavernosa</i> **	5	4	0	1
<i>Siderastrea siderea</i> **	3	3	0	0
<i>Colpophyllia natans</i> **	1	1	0	0
<b>Total brooders(*)</b>	<b>31</b>	<b>25</b>	<b>3</b>	<b>3</b>
<b>Total spawners (**)</b>	<b>10</b>	<b>9</b>	<b>0</b>	<b>1</b>
<b>Total n</b>	<b>41</b>	<b>34</b>	<b>3</b>	<b>4</b>



**Figure 1.** Initial (left) and final condition (right) of some of the juvenile corals surveyed in Tesoro Island. (A) *Agaricia agaricites* found partially bleached, (B) *A. agaricites* found partially smothered by algae, and (C) *Diploria strigosa* found healthy.

Mortality rate of juvenile corals ( $M_f$ ) was calculated following the mathematical expression [ $M_f = (n_0 - n_f) / n_0$ ], with  $n_0$  as the total number of colonies initially tagged, and  $n_f$  as the total number of colonies found alive at the end of the study period (including those with damage conditions). Thus, the mortality rate of juvenile corals for this study was 0.10.

It is difficult to compare the mortality rate found here, with other reports due to methodological differences in the species and period assessed. However, a discreet review suggested that the value obtained in this study (0.10) was considerably lower than reports from other studies in the Caribbean ( $\approx 0.33$ : Bak and Engel, 1979;  $\approx 0.72$ : Hughes, 1985;  $\approx 0.20$ : Smith, 1997;  $\approx 0.47$ : Vermeij, 2006;  $\approx 0.45$ : Irizarry-Soto and Weil, 2009). In the NSRA, there is a high influence of natural and anthropogenic disturbances that have led to coral reefs degradation, such as: high sedimentation rates and pollution (Alvarado *et al.*, 1986; Pineda *et al.*, 2006), and sporadic anomalies in sea surface temperature (Solano *et al.*, 1993; Gil-Agudelo *et al.*, 2006). Despite the special susceptibility of juvenile corals to some of these stressors (Wittemberg and Hunte, 1991; Edmunds, 2004), the low mortality rate found in this study could be a sign of a moderate pressure during the study period. Furthermore, the special degree of protection of Tesoro Island as “*área intangible*” (equivalent degree to a No-entry area) (Pineda *et al.*, 2006), could be a management strategy promoting the survival of juvenile corals.

Life history strategies influence the abundance and survival of corals during their life cycles. For example, most massive species are spawners with low recruitment (low abundance as juveniles) and high survival rates; whereas small sized species are usually brooders with high recruitment (high abundance as juveniles) but low survival (Bak and Engel, 1979; Hughes, 1985; Knowlton, 2001). These life history traits are partially reflected in this analysis, even when this study was not intended to determine the abundance and composition of juvenile corals in the area. Most of the juvenile corals surveyed were identified as brooder species ( $\approx 75\%$ ), while massive spawners corals were sparse (Table 1). Furthermore, the special vulnerability of brooder juvenile corals was also noticed, as just the taxon *Agaricia* spp. was found with damage conditions (Table 1, Figure 1).

The evidence of several studies suggests that a phase shift process may be taking place in Caribbean coral reefs, in which brooding species, like *Agaricia* spp. and *P. astreoides*, have become dominant over major reef building species following disturbances of the last decades (Done, 1999; Aronson and Pritch, 2001; Knowlton, 2001; Aronson *et al.*, 2004). Further studies, including a wider range of species and periods of time, are necessary to a better understanding of the survivorship of juvenile corals and its role in the coral community structure. In response to current

and oncoming environmental changes, it is important to focus these studies on the mortality of key species to elucidate if a phase shift process is taking place.

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