Feeding activity of the corallivorous gastropod
Quoyula monodonta (Blainville)

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Abstract: The predatory behavior of the gastropod *Quoyula monodonta*, a selective corallivore that feeds upon *Pocillopora* spp, is reported for the first time from the eastern Pacific. On average an individual eats tissue from 0.64 cm² of coral per day. Larger individuals cause more damage. The high densities of *Q. monodonta* and two species of hermit crab, make it likely that all of these corallivores are acting together to increase the mortality of pocilloporid corals and thus limit the growth, abundance and distribution of *Pocillopora* on the Caño Island coral reefs (Costa Rica).

The effect of different corallivorous organisms on coral reefs along the eastern Pacific has been well documented (Glynn *et al.* 1972, Glynn & Wellington 1983). Four species of gastropods are known to feed upon *Pocillopora* spp: *Jenneria pustulata* (Lightfoot), *Muricopsis zeteki* Hertlein & Strong, *Latiaxis hindsii* (Sowerby) and *Quoyula monodonta* (Blainville) (Glynn & Wellington 1983). *J. pustulata* reaches densities of 20-40 individuals/m² and is responsible for almost 79% of the reef destruction in Panamá (Glynn *et al.* 1972). *M. zeteki* and *L. hindsii* feed on live coral in Galápagos and occur in groups of up to five individuals per colony. No more than 10% of the colony's surface was destroyed (Glynn & Wellington 1983). Although *Quoyula monodonta* is common in the eastern Pacific, its impact on corals has not been measured. *Q. monodonta* may be potentially more damaging than other gastropods because it tends to restrict its feeding to the bases of *Pocillopora* colonies resulting in the breakage of branches (Robertson 1970, Glynn & Wellington 1983).

A mean density of 10.2 *Q. monodonta*/m² (range 1-36 ind/m²) has been reported in Costa Rica and it has been suggested that these snails strongly affect the growth and distribution of pocilloporid corals (Guzmán 1986). This study describes the predatory behavior of *Q. monodonta* including rates of *Pocillopora* tissue destruction, and discusses its effects on the coral reef structure at one site in Costa Rica, Central America.

METHODS

At Caño Island (8° 43'N, 83° 52'W), I surveyed 245 colonies of *Pocillopora elegans* along the reef slope and base. I recorded the colony diameter, the total number of *Q. monodonta* and their distribution on each colony.

Nine pairs of snails put in small plastic containers (12 cm high x 15 cm diameter) with two healthy fragments of *Pocillopora elegans* Dana (8 cm maximum length) were inmersed in an aquarium (0.7 x 1.4 x 0.5 m) with running sea water and continous aeration for between 13 and 34 days. I measured the area of tissue destroyed by each pair of snail every two days. Areas were measured to the nearest 0.5 mm using a magnifying glass.

The daily activity of 9 individuals (distance covered) during both feeding and non-feeding periods was observed, every 6 hours for 7 consecutive days.
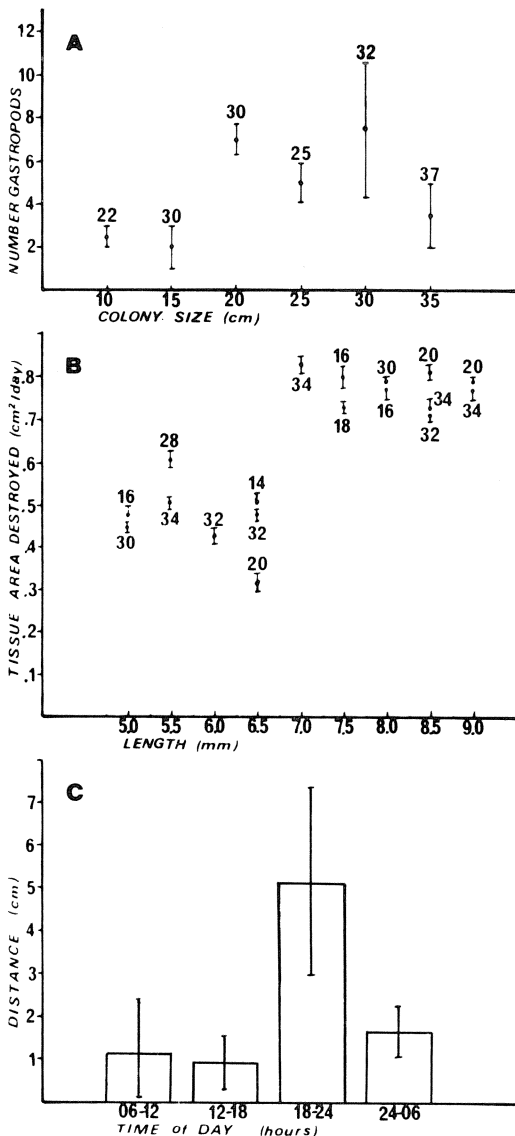
Fig. 1. Mean and Standard Error of: A. number of *Quoyula monodonta* as a function of colony diameter (values above standard error represent colonies counted); B, area of coral tissue destroyed by each individual (n = 18) (values above represent days of observations); and C. diurnal and nocturnal activity (24 hours) of nine individuals, based on the mean distance recorded during a 10 day period.

At the end of the experiment, 11 coral fragments damaged by *Q. monodonta*, were fixed to nails and returned to the reef so as to follow the fate of the damaged tissue.

RESULTS

Quoyula monodonta was found on 72% of the 245 colonies observed, and in 92.65% of the cases the individuals were located beneath the branches at the bases of the colonies. Robertson (1970), observed that *Quoyula* and *Coralliophila*, create marks (scars) on the coral and appear not to move from these scars. Of 31 individuals removed from the substrate only 61.29% (19 individuals) were observed resting on "scars". Scar material seems to be secreted by *Quoyula*. No relation was found between colony size and the number of *Quoyula* present on each colony (Fig. 1a). The maximum number of individuals (17) was found on a colony only 27 cm in diameter. Twenty seven percent of all the colonies surveyed (91 colonies) had completely dead areas covered by crustose coralline algae on the base of the branches. *Q. monodonta* was found on all damaged colonies.

The mean area of live tissue removed or damaged by individual *Quoyula* was 0.64 cm^2/day ± 0.16 (range 0.32-0.83 cm^2/day). Shell sizes ranged from 5 to 9 mm (mean 7.11 mm ± 1.36 mm). Larger individuals destroy more tissue area (P ~ 0.001; Kendall's Coefficient of Correlation, Fig. 1b).

The daily activity of *Q. monodonta* varied significantly (P < 0.01; One-Way Anova), and it seemed to be limited to nocturnal hours (Fig. 1c), mainly between 1800 and 2400 (SNK Multiple Comparison test).

Alter 43 days of observations, 82% of the fragments, previously damaged by *Quoyula*, were totally coated by crustose coralline algae. After 71 days, only 3.67% showed signs of tissue recovery.

DISCUSSION

The damage caused by gastropod corallivores in Caribbean and Pacific reefs has been documented (Knowlton *et al.* 1981; Moyer *et al.* 1982). In most cases the damage has been related to an increase in local snail populations after some alteration of the environment (e. g. sedimentation, hurricanes). Multiple severe perturbations in the environment (*e.g.* high sea surface temperatures, red tides) have ocurred in the last five years in the eastern Pacific. Contrary to expectations, the gastropod corallivore populations have decreased or disappeared

(Glynn 1985: Guzmán 1986). The only census of *Quoyula* known for the region is from Caño Island, but it was made after the natural disturbances of El Niño 1982/83 and the red-tides in 1985 (Guzmán 1986). Population studies for this species probably have been avoided because of difficulties encountered when censusing their populations. In most cases coral colonies (*Pocillopora* spp.) have to be broken due to the behaviour of the species which prefers to aggregate at the base of corals. At Caño Island, the most abundant pocilloporid species is *Pocillopora elegans*. Its branches grow in a more widely branched pattern than those of *Pocillopora damicornis* (Linnaeus), which makes counting these snails easier than in other reefs, where the latter coral species dominates. The densities reported here and in Guzmán (1986) may nevertheless underestimate the local population of this snail species.

At Caño Island, 37% of coral colonies had bases which were dead and covered by coralline algae, suggesting that *Quoyula* might be feeding on those colonies. A mean number of 7.6 individuals found in colonies with 30 cm in diameter and an average of 0.64 cm^2/day of tissue destruction by each individual *Quoyula*, would result in predation rates of 4.86 cm^2/day/colony. At Caño Island, the mean lineal growth rate for *Pocillopora elegans* is 3.39 cm/year (Guzmán & Cortés, in rev.), so it could grow about 0.01 cm/day (assuming 365 days/year). The rate of tissue destruction is about five times the lineal growth of *Pocillopora*. Thus, colonies with bases of 10 cm diameter (aprox. 157 cm^2), would have no live tissue remaining at the colony base after 30 days. Due to the low tissue recovery of *Pocillopora* and the great number of boring sponges observed at the base of affected colonies, a weakening and proximal fracture of several colony branches might be expected. However, most of the fragments produced by those means may survive and disperse across the slope and to the base of the reef producing new colonies. The survival of fragments is higher on rocky bottom than on sand.

What effect would *Q. monodonta* have on the reef structure at Caño Island? The species seems to be a selective corallivore in all over the eastern Pacific. Its effect on the coral community must be strong on *Pocillopora* species, which at the same time are affected by numerous other corallivores. The hermit crabs *Aniculus elegans* Stimpson and *Trizopagurus magnifi-cus* (Bouvier), are considered important predators of pocilloporid corals in the eastern Pacific (Glynn *et al.* 1972). Both species are present in Caño Island, usually in the peripheral areas of colonies, with densities of 8.95 ind./m^2 and 12.69 ind./m^2 respectively (Guzmán 1986). These densities are similar or slightly greater than those reported for other reefs in the eastern Pacific. One individual of *T. magnificus* can destroy 1.8 cm^2/day of coral (Gilchrist 1985), which is about twice the area that could be destroyed by one individual of *Q. monodonta*.

The main reef-building coral at Caño Island is *Porites lobata* Dana. This species dominates the reefs from the reef flat to the base, while pocilloporid corals are found in small patches in the various zones of the reef (Guzmán 1986). I suggest that the low abundance and patchy distribution of *Pocillopora* spp on the reef slope and base could be related, in part, to the action of selective corallivores with high densities and feeding rates which combine to limit the growth of the species.

RESUMEN

Se informa por vez primera para el Pacífico Oriental del comportamiento depredatorio del gastrópodo *Quoyula monodonta*. Dicho gastrópodo se alimenta selectivamente del coral *Pocillopora*. La tasa de destrucción por individuo es de 0.64 cm^2/día, y esta aumenta en individuos de mayor tamaño. Debido a las altas densidades del gastrópodo y de dos especies de cangrejos ermitaños encontradas en la Isla del Caño, se podrá esperar que las tres especies en conjunto estén afectando el crecimiento, abundancia y distribución de corales pocillopóridos localmente.

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Addendum:
Recently, S. Kosuge and M. Suzuki (1985. Illustrated catalogue of *Latiaxis* and its related groups. Institute of Malacology of Tokio, Special Publication 1: 1-83) established the synonymy of *Coralliophila madreporara* (Sowerby, 1820-1824) with *Quoyula monodonta* (Blainville, 1832).