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NOTA CIENTÍFICA

Recruitment of *Pocillopora* coral on experimental tiles in the Mexican Pacific

Reclutamiento del coral *Pocillopora* en placas experimentales en el Pacífico mexicano

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ABSTRACT

Background. The recruitment of branching corals in the eastern Pacific is poorly understood despite being of paramount importance to the dynamics of coral populations. Experimental studies provide a non-destructive means to evaluate recruitment and compare settlement materials. **Goals.** To study *Pocillopora* recruitment on PVC and terracotta tiles in Bahía Ixtapa-Zihuatanejo (Mexican Pacific). **Methods.** We deployed 40 square (10 x 10 x 0.5 cm) experimental (20 PVC and 20 unglazed terracotta) tiles arranged as Calcification/Accretion Units at the Islote Zacatoso reef. **Results.** We observed two coral recruits at the edges of terracotta tiles, presumably due to light availability, and no recruits on horizontal sides, which may have been due to siltation stress, predation, or biofouling. No recruits were found on PVC tiles. **Conclusions.** Our findings indicate that the coral recruitment is low in the study area and that the terracotta tiles may be a better experimental substrate than PVC tiles to assess pocilloporid coral recruitment in the Mexican Pacific; however, further studies are needed to clarify this assumption.

Keywords: Coral recruitment, experimental substrate, terracotta tiles, Mexican Pacific.

RESUMEN

Antecedentes. El reclutamiento de corales ramificados en el Pacífico oriental tropical está poco documentado, a pesar de la importancia que tiene para entender su dinámica poblacional. Los estudios experimentales proporcionan un medio no destructivo para evaluar el reclutamiento y comparar diferentes materiales. **Objetivo**. Estudiar el reclutamiento de *Pocillopora* en placas de PVC y de terracota en Bahía Ixtapa–Zihuatanejo, en el Pacífico mexicano. **Métodos**. Colocamos 40 placas cuadradas (10 x 10 x 0.5 cm), 20 de PVC y 20 de terracota armadas como Unidades de Calcificación/Acreción en el arrecife Islote Zacatoso. **Resultados**. Observamos dos reclutas de coral en la orilla de las placas de terracota pero ninguno en los lados horizontales, posiblemente debido a la disponibilidad de luz, el estrés por sedimentación, la depredación, o el sobrecrecimiento por biota incrustante. No encontramos reclutas en ninguna de las placas de PVC. **Conclusiones**. Nuestros hallazgos indican que el reclutamiento coralino es bajo en la zona de estudio y que las placas de terracota pueden ser un mejor sustrato experimental que las de PVC para evaluar el reclutamiento de corales pociloporidos en el Pacífico mexicano; sin embargo, se necesitan más estudios para corroborar esta suposición.

Palabras clave: Reclutamiento de corales, sustrato experimental, placas de terracota, Pacífico mexicano.

Larval dispersal and recruitment are crucial to the persistence of existing coral populations and the establishment of populations in new areas. In the eastern tropical Pacific, branching corals such as *Pocillopora* are the primary reef builders (Glynn *et al*., 2017), and fragmentation is the predominant mechanism of asexual reproduction and dispersal (Highsmith, 1982; Richmond, 1997). Although *Pocillopora damicornis* (Linnaeus, 1758) was thought to be sexually sterile in the eastern Pacific (Richmond, 1987), it can reproduce asexually and sexually (Chávez-Romo & Reyes-Bonilla, 2007; Carpizo-Ituarte *et al*., 2011).

Coral recruitment is indicative of sexual reproduction. In the face of anthropogenic and environmental disturbances, genetic diversity due to sexual reproduction is of paramount importance for the persistence of populations to adapt and persist over time (Glynn *et al.*, 1991; Richmond, 1997). Despite the importance of coral recruits, they are often difficult to detect *in situ* because of their small size, and live scans may underestimate overall recruitment compared to artificial substrate-based census methods (Harper *et al.*, 2021). Although artificial settlement tiles are a non-destructive means to study coral recruitment, both the material and orientation of the tiles may influence coral settlement and recruitment (Field *et al.*, 2007).

Herein, we provide evidence of the successful recruitment of *Pocillopora* branching corals at the Islote Zacatoso reef (Ixtapa-Zihuatanejo, Guerrero, Mexican Pacific; 17° 39' 14.5" N, 101° 37' 18.7" W). We deployed 40 square experimental (10 x 10 x 0.5 cm) tiles composed of two frequently used materials: polyvinyl chloride (PVC; 20 tiles) and unglazed terracotta (20 tiles). Tiles were arranged as Calcification/Accretion Units (CAUs) parallel to the sea floor to mimic horizontal exposed and natural cryptic substrates (Price *et al.*, 2012; Johnson *et al.*, 2022). All CAUs were deployed near healthy coral colonies within the reef in April 2019, with approximately 1 m between each one, at a 6 m depth (~ 30 cm above the seabed; Fig. 1A). After 15 months, the CAUs were recovered, and each tile was stored in a plastic bag and frozen until further processing. In the laboratory, each tile was rinsed to remove sediments and soaked in sodium hypochlorite for 24–48 h to degrade organic matter. The tiles were then oven-dried at 70 °C for 48 h, and coral recruits on the tiles were identified with a stereoscopic microscope.

We found two *Pocillopora* sp. recruits attached at the edges of terracotta tiles that were growing over encrusts such as bryozoans and barnacles (Fig. 1B). Corals did not settle on horizontally positioned tiles, which may have been due to siltation stress (Babcock & Davies, 1991; Te, 1992) or to avoid predation (Jokiel *et al.*, 2014; Doropoulos *et al.*, 2016). No recruits were observed on PVC tiles. These findings suggest that terracotta tiles facilitate coral recruitment (Harriott & Fisk, 1987) possibly because of their microstructure and similarity to reef substrata (López-Pérez *et al.*, 2007). Moreover, these results support the presence of active coral reproduction in the region (Carpizo-Ituarte *et al.*, 2011).

The recruitment of *Pocillopora* sp. is reportedly low in the Mexican Pacific. López-Pérez *et al.* (2007) observed only one *Pocillopora* recruit in 305 terracotta tiles, which were deployed at 45 degrees concerning the ocean floor over 12 months in Bahías de Huatulco, Oaxaca. In Bahía de La Paz, Baja California Sur, Cabral-Tena *et al.* (2018) recorded six *Pocillopora* recruits in 30 terracotta tiles deployed for ~ 3 months. Furthermore, other studies with terracotta tiles have not recorded pocilloporid recruits in the region (e.g., Medina-Rosas *et al.*, 2005 in Jalisco and Nayarit; Santiago-Valentín *et al.*, 2020 in the Islas Marias Biosphere Reserve).

In this study, Pocilloporid corals settled on the sides (i.e., vertical) of terracotta tiles but not in PVC tiles, even though the CCA, which is known to act as a preferential settlement substrate for reef-building coral larvae (Morse *et al.*, 1988; Heyward & Negry, 1999; Tebben *et al.*, 2015; Elmer *et al.*, 2018; Jorissen *et al.*, 2021; Tanvet *et al.*, 2022;), grew in both materials. Competent coral larvae can explore for a suitable substrate that maximizes their fitness (Morse & Morse, 1996). Moreover, perhaps coral spats settled on terracotta tiles because their texture resembles natural substrate conditions (López-Pérez *et al.*, 2007), and avoid predation and siltation stress on vertical sides (Babcock & Davies, 1991). PVC tiles might not be an attractive substrate for larvae of this coral branching, or if settlement occurs, we do not know which factors eliminate spats from tiles. Factors such as predation and competition for space with others encrusting organisms might be a possible response, but this question is beyond the objectives of the present work.

Although in other parts of the world PVC tiles appear to be a stable substrate for the recruitment of corals (e.g., Vargas-Ángel *et al.*, 2015; dos Reis *et al.*, 2016; Price *et al.*, 2019), to our knowledge, *Pocillopora* sp. recruits on PVC tiles has never been observed in the Mexican Pacific (Alvarado-Rodríguez *et al.*, 2019, 2021, 2022; Nava *et al.*, 2022; Orran-

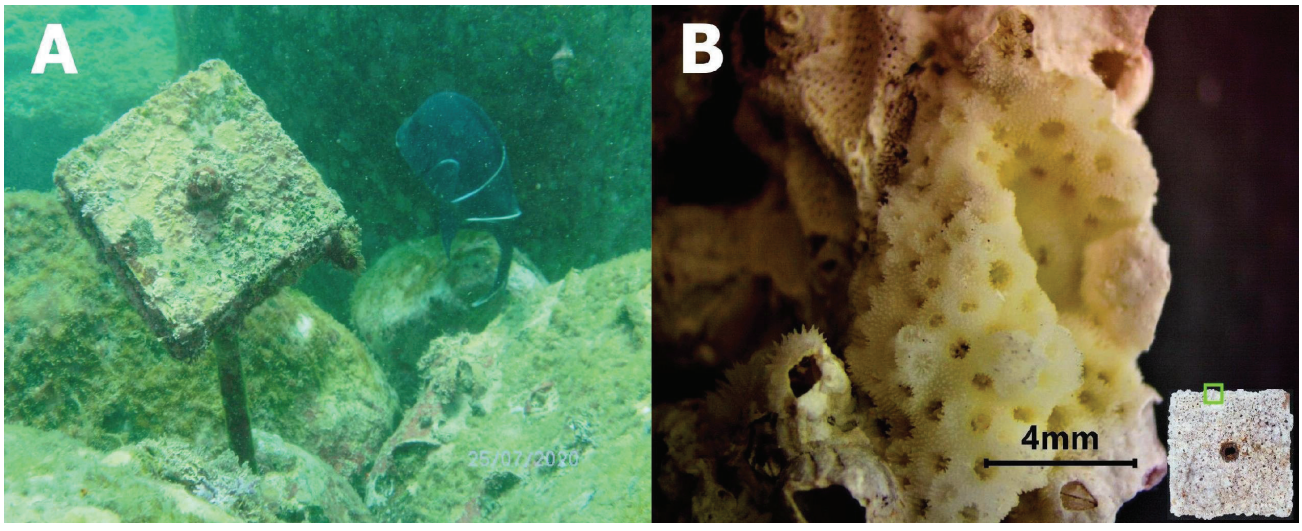

Figure 1. A) Photograph of a CAU (Calcification/Accretion Unit) after 15 months of deployment at Islote Zacatoso reef and B) *Pocillopora* sp. recruits overgrowing encrusting organisms; inset is a terracotta tile (lower right) showing the edge where the recruit attached (green square).

te *et al*., 2023; Medellín-Maldonado pers. comm. 2023 in Huatulco, Oaxaca; Pareja-Ortega pers. comm. 2023 in La Paz, Baja California Sur). We encourage terracotta tiles over PVC tiles in future studies of recruitment of branching corals in reefs of the Mexican Pacific because we have never observed coral recruitment in PVC tiles throughout several years of using this material while we found two recruits of *Pocillopora* coral for the first time using terracotta tiles.

It is also essential to evaluate multiple settlement tile orientations (e.g., 45 or 90 degrees concerning the ocean floor) because no scientific consensus exists that substrate orientation increases the chances of encountering coral recruits. For example, English *et al*. (1997) described the general procedure to study coral recruitment on terracotta tiles inclined to 45 degrees concerning seafloor, but no discussion about it is provided. In this regard, Glassom *et al*. (2004) argued that this orientation positively correlates with coral recruitment. However, horizontally deployed experimental substrates are common in coral recruitment studies (e.g., Doropoulos *et al*., 2016; Gallagher & Doropoulos, 2017; Elmer *et al*., 2018). More specifically, Harper *et al*. (2021) recommend including both sides (top and bottom) of horizontally deployed tiles and ensuring homogeneous rugosity due to coral recruits settling on both sides.

Like in this work, coral recruitment has occurred on lateral sides of the experimental substrates in other studies (e.g., Tomascik, 1991; Melo-Merino, 2009; Cameron & Harrison, 2020). These works conclude that predation and siltation effects are the main factors controlling larva settlement and argue that coral recruitment is proportionally greater on vertical or under surfaces than on upper surfaces (Babcock & Davies, 1991 and references therein). In particular, the recruitment of *Pocillopora* corals is so scarce that some works have adopted both material orientation strategies to increase chances for coral recruits encountering (e.g., Soong *et al*., 2003). In conclusion, more comparative studies in the Mexican Pacific are needed to clarify this issue.

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