6.4 Genus *Dichocoenia*

6.4.1 *Dichocoenia stokesi* Milne Edwards and Haime, 1848

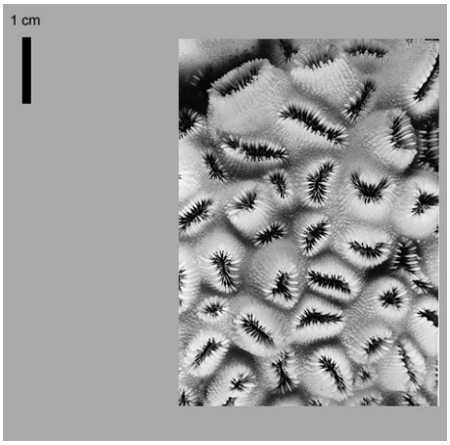

Figure 6.4.1. *Dichocoenia stokesi* photos and corallite plan copied from Veron and Stafford-Smith (2002).

Figure 6.4.2. *Dichocoenia stokesi* colony with partial mortality characteristic of white plague disease. Photo from NOAA Southeast Fisheries Science Center.

Characteristics

Dichocoenia stokesi colonies are either massive and spherical or form thick, submassive plates (Veron, 2000). The corallites of this species are evenly spaced and either plocoid or ploco-meandroid, and the septocostae are usually in two neatly alternating orders (Veron, 2000). Although sometimes green, they are usually orange-brown with white septo-costae.

Taxonomy

Taxonomic issues: Colonies of *Dichocoenia stokesi* from lower reef slopes or shaded habitats have markedly smaller corallites than those from more exposed environments and are usually identified as *Dichocoenia stellaris* (Wells, 1973). The petition cites the IUCN species account in differentiating these two species; hence, this Status Review Report addresses *Dichocoenia stokesi*.

Family: Meandrinidae.

Evolutionary and geologic history: The genus *Dichocoenia* dates from at least the Oligocene Era in the Caribbean region (Edinger and Risk, 1995).

Global Distribution

Dichocoenia stokesi is restricted to the west Atlantic where it occurs throughout the Caribbean, the Gulf of Mexico, Florida (including the Florida Middle Grounds), the Bahamas, and Bermuda (IUCN Species account). S. dePutron (Bermuda Institute of Ocean Sciences, St. George's. pers. comm., May 2010) confirmed the presence of *Dichocoenia stokesi* in Bermuda and categorized its abundance as rare. T. Murdoch (Bermuda Zoological Society, Flatts. pers. comm.. May 2010) also confirmed its occurrence as rare and added that it is mainly found on forereefs at depths of 10–27 m where he noticed it being partially-to-fully bleached.

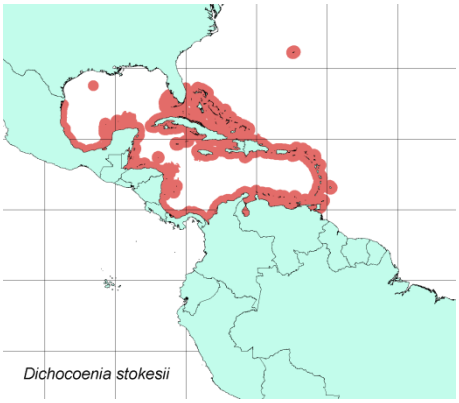

Figure 6.4.3. *Dichocoenia stokesi* distribution from IUCN copied from http://www.iucnredlist.org


Figure 6.4.4. *Dichocoenia stokesi* distribution from Veron and Stafford-Smith (2002).

U.S. Distribution

Dichocoenia stokesi occurs throughout U.S. waters in the western Atlantic, including the Gulf of Mexico, Florida, Puerto Rico, and the Virgin Islands. Within federally protected U.S. waters, the species has been recorded from the following areas:

- Florida Keys National Marine Sanctuary
- Flower Garden Banks National Marine Sanctuary
- Navassa National Wildlife Refuge
- Dry Tortugas National Park
- Biscayne National Park
- Virgin Islands National Park/Monument
- Buck Island National Monument

Habitat

Habitat: *Dichocoenia stokesi* is found in most reef environments within its range (Veron, 2000), including both backreef and forereef environments, rocky reefs, lagoons, spur-and-groove formations, channels, and occasionally at the

base of reefs (IUCN Species Account). When found in exposed reefs at depths less than 20 m, its hemispherical heads are more abundant than usual (IUCN, 2010).

Depth range: *Dichocoenia stokesi* has been reported in water depths ranging from 2 to 72 m (Carpenter et al., 2008). This considerable depth range suggests the potential for deep refugia, but it is not likely that it attains high abundance at deeper depths.

Abundance

Dichocoenia stokesi is usually uncommon (Veron, 2000). The overall colony density of *Dichocoenia stokesi* averaged across all habitat types in the south Florida region was ~ 1.6 colonies per 10 m^2, making it the ninth most abundant coral species in this region (Wagner et al., 2010). Substantial population declines have been reported from a bay in Curaçao (80% decline between 1961 and 1992; Debrot et al., 1998) and the upper Florida Keys (see disease description below). There have been no obvious trends in the abundance of *Dichocoenia stokesi* in monitoring of randomized stations at La Parguera, Puerto Rico, St. John, nor St Croix USVI with less than 1.5% cover at most sites (NOAA-Center for Coastal Monitoring and Assessment; http://www8.nos.noaa.gov/biogeo_public/query_habitat.aspx)

Life History

Reproductive characteristics of *Dichocoenia stokesi* have been described from a histological study of populations in southeast Florida (Hoke, 2007). This species is predominantly a gonochoric spawner with an overall sex ratio of 2:1 (male:female), but a small portion of hermaphroditic colonies (~ 18%) were observed in this population. Mean egg size is reported at 312.2 μm (SD 40) and fecundity as 1138 eggs per cm^2 per year. Minimum colony size at reproduction was found to be 160 cm^2 in this population and two potential spawning events per annum were inferred: one in late August/early September and a second in October.

Bak and Engel (1979) reported very low densities of *Dichocoenia* juveniles (approximately 1% of total juvenile colonies). However, reports of juveniles of *Dichocoenia stokesi* have been relatively common compared to most other scleractinian corals in the Florida Keys with mean juvenile densities among 566 sites surveyed during 1999–2009 averaging 0.11 per m^2, but reaching densities as high as 1 juvenile per m^2 in certain habitats (Chiappone, 2010).

The annual growth rate of *Dichocoenia stokesi* has been reported to increase 2–7 mm per year in diameter and increase 2–5.2 mm per year in height (Vaughn, 1915).

The mounding morphology and large corallite diameter of *Dichocoenia stokesi* enhance turbulence near the surface of colonies (Gardella and Edmunds, 2001). This should, in turn, enhance mass transfer, which affects photosynthesis and respiration in *Dichocoenia stokesi* (Gardella and Edmunds, 1999) as well as prey capture and nutrient uptake. Thresholds for uptake of inorganic nitrogen in *Dichocoenia stokesii* have been reported to be fairly low (150 nM; Davis and Jones, 1997), giving it a potential advantage in nutrient-poor conditions.

Threats

Thermal stress: Although *Dichocoenia stokesi* is susceptible to bleaching (loss of zooxanthellae), it showed the lowest bleaching response (of species observed to bleach) in the south Florida region (Wagner et al., 2010), and in Barbados it ranked 16th of 21 species in bleaching prevalence (Oxenford et al., 2008) during the 2005 Caribbean mass-bleaching event. It was also observed to be bleaching-tolerant in the U.S. Virgin Islands during the same event (Clark et al., 2009). Hence, this species is regarded to be at relatively low threat from temperature-induced bleaching. *Dichocoenia stokesi* hosts clade B zooxanthellae (Correa et al., 2009; LaJeunesse, 2002). Zooxanthellae in clade B do not grow well at high temperatures (Kinzie et al., 2001), but in the field corals with this clade may be relatively bleaching-resistant (McField, 1999). Experimental studies suggest clade B is more bleaching-resistant than clade C, but less resistant than clade A (Warner et al., 2006).

Acidification: No specific research has addressed the effects of acidification on the genus *Dichocoenia*. However, most corals studied have shown negative relationships between acidification and growth (Table 3.2.2), and acidification is likely to contribute to reef destruction in the future (Hoegh-Guldberg et al. 2007, Silverman et al. 2009). While ocean acidification has not been demonstrated to have caused appreciable declines in coral populations so far, the BRT considers it to be a significant threat to corals by 2100 (Albright et al., 2010; Hoegh-Guldberg et al., 2007; Langdon and Atkinson, 2005; Manzello, 2010; Silverman et al., 2009).

Disease: *Dichocoenia stokesi* has been reported to be highly susceptible to white plague (see Fig. 6.4.2), with infection increasing with temperature (Borger and Steiner, 2005). An outbreak event for this disease in the Florida Keys had demonstrable impact at the local population level, yielding mortality of 75% of colonies across several reef sites, substantial shifts in population structure, and essentially no recovery over a 7-year follow-up period (Richardson and Voss, 2005). This species has also been reported to be susceptible to black-band disease (Sutherland et al., 2004), ciliate infection (Croquer et al., 2006), and dark-spot syndrome (Borger and Steiner, 2005). However, disease susceptibility appears to be variable (Borger and Steiner, 2005); for example, *Dichocoenia stokesi* was minimally affected during a 1998 outbreak in St. Lucia that caused widespread mortality in *Montastraea faveolata* and other species (Nugues, 2002).

Predation: *Dichocoenia stokesi* is minimally affected by predation. It can be heavily bioeroded, particularly by bivalves (Highsmith, 1981), and lose substantial amounts of tissue to sponge overgrowth (Hill, 1998).

Land-based sources of pollution (LBSP): One laboratory study has shown that *Dichocoenia stokesi* displays physiological stress at turbidity levels that are within allowable levels as regulated by the State of Florida for coastal construction projects. While light levels and photosynthesis were not affected, respiration levels and mucous production were significantly higher at turbidity levels as low as 14–16 NTU, and P:R fell below 1 at 28–30 NTU (Telesnicki and Goldberg, 1995). An earlier laboratory study examining oil/sediment rejection indicated that *Dichocoenia stokesi* was intermediate (of 19 Caribbean coral species examined) in the rate of sediment removal from its tissues (Bak and Elgershuizen, 1976).

LBSP-related stresses (nutrients, sediment, toxins, and salinity) often act in concert rather than individually and are influenced by other biological (e.g., herbivory) and hydrological factors. Collectively, LBSP stresses are unlikely to produce extinction at a global scale; however, they may pose significant threats at local scales and reduce the resilience of corals to bleaching (Carilli et al., 2009a; Wooldridge, 2009b).

Collection/Trade: Collection and trade are not considered a threat to Dichocoenia stokesi (CITES, 2010).