

Diversity of gorgonians and influence of cutting on their growth in the upper Gulf of Thailand

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Abstract. Diversity of gorgonians was investigated in the upper Gulf of Thailand and 15 genera were found. A field experiments determined the influence of cutting of branches on their growth rate. In *Menella*, non-cut colonies grew faster than cut colonies while in *Dichotella*, non-cut colonies grew slower than cut colonies.

Key words: *Menella*, *Dichotella*, gorgonian, diversity, physical disturbance

Introduction

The Indo-Pacific region has a high diversity of gorgonian corals (Goh and Chou 1996; Fabricius and Alderslade 2001; Dautova 2007). Their distribution and abundance are influenced by environmental factors such as light, temperature, water flows, currents, and substrates (Russo 1985; Weinbauer and Velimirov 1996; Zeevi and Benayahu 1999). Azooxanthellate gorgonians usually occur in mid-depth reefs and deep windward fore-reef terrace areas with high currents and sedimentation (Goh and Chou 1995; Goh et al. 1997; Sánchez et al. 1998). Gorgonians also act as refuge habitats for many small invertebrates such as crabs, snails, and brittle stars (Goh et al. 1999; Buhl-Mortensen and Mortensen 2005; Gili et al. 2006). Their shape and their complexity have an influence on diversity and abundance of associated animals (Buhl-Mortensen and Mortensen 2005).

In Southeast Asia, few studies exist on diversity of gorgonians (Alderslade et al. 1989; Goh and Chou 1996; Goh et al. 1997; Ofwegen et al. 2000; Ofwegen and Alderslade, 2007). In Singapore, 12 genera of gorgonians were found (Goh and Chou 1996). In Thailand, gorgonians are common and from previous records 28 genera are known (Alderslade et al. 1989; Worachananant 2000).

In this study, we investigated the diversity of gorgonians in the upper Gulf of Thailand. In addition, the influence of physical disturbance such as cutting on the growth was investigated.

Methods

The surveys were conducted to investigate the diversity of gorgonians at 10 study sites of Mu Ko Samae San, Sattahip, Chonburi Province, the upper Gulf of Thailand (Fig.1). Gorgonians were sampled

by scuba diving from 1-20 m depth. Since gorgonians taxonomy needs revision, specimens were only identified to genus level. The density of gorgonians at Laem Pu Chao, western part of Sattahip Bay was investigated with 3 belt transect lines (50 m each) at 6 m depth, where majority of colonies occurred. A diver swam along the line counting gorgonian within 2.5 m on either side.

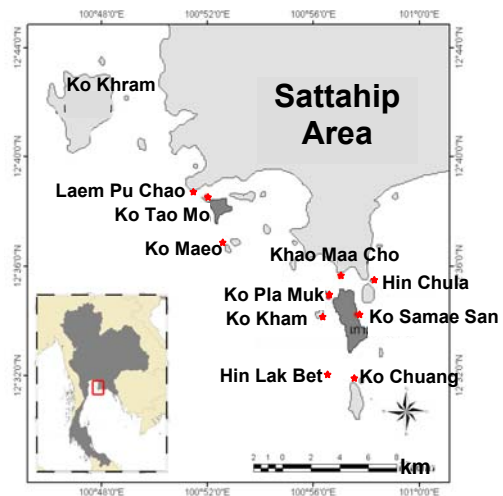


Figure 1: Ten study sites of gorgonians at Mu Ko Samae San, Sattahip, Chonburi Province.

To determine whether physical disturbance such as cutting would influence the growth of gorgonians, field experiments were conducted at Laem Pu Chao. Two genera, *Menella* and *Dichotella* were chosen. *Dichotella* was a dominant genus at Sattahip and *Menella*, although its density was not high in the study area, is a common genus throughout the Gulf of Thailand. Ten colonies of each genus were tagged at 6 m depth. Five of them were control with no

disturbance (normal colony group) while the other five were disturbed by cutting (cut colony group). In each disturbed colony, 5 branches were chosen. Two branches were cut to approx. 5 cm remaining in length (cut branch group) while another 3 branches were left without cutting (normal branch group). For undisturbed colonies, 5 branches of each colony were also selected. Each month, the growth of each branch in both disturbed and non-disturbed colonies were measured. The experiments continued for 16 months.

Results

A total of 15 genera of gorgonians were found at Mu Ko Samae San, Sattahip, Chonburi Province. These included *Subergorgia*, *Melithaea*, *Mopsella*, *Acabaria*, *Euplexaura*, *Echinomuricea*, *Echinogorgia*, *Menella*, *Paraplexaura*, *Astrogorgia*, *Rumphella*, *Guaiagorgia*, *Ctenocella*, *Junceella* and *Dichotella*. Two genera (*Paraplexaura* and *Guaiagorgia*) were the first record found in Thai waters, while three genera (*Echinomuricea*, *Menella* and *Dichotella*) were the first record in the Gulf of Thailand.

Table 1: Diversity of gorgonians found at Mu Ko Samae San, Sattahip, Chonburi Province.

Suborder Family Genus spp.	Laem Pu Chao	Ko Tao Mo	Ko Maeo	Khao Maa Cho	Hin Chula	Ko Pla Muk	Ko Kham	Ko Samae San	Hin Lak Bet	Ko Chuang	Total
The Scleraxonia Group											
Subergorgiidae Gray, 1859											
<i>Subergorgia</i>	x		x				x				3
Melithaeidae Gray, 1870											
<i>Melithaea</i>	x	x	x	x	x	x	x	x			10
<i>Mopsella</i>								x		x	3
<i>Acabaria</i>		x									1
Suborder Holaxonia											
Plexauridae Gray, 1859											
<i>Euplexaura</i>	x		x					x			3
<i>Echinomuricea</i>	x	x			x		x	x			5
<i>Echinogorgia</i>	x	x			x		x	x		x	6
<i>Menella</i>	x	x	x	x	x		x	x	x	x	9
<i>Paraplexaura</i>		x	x				x	x	x		5
<i>Astrogorgia</i>										x	1
Gorgoniidae Lamouroux, 1812											
<i>Rumphella</i>	x	x	x	x							4
<i>Guaiagorgia</i>		x									1
Suborder Calcaxonia											
Ellisellidae Gray, 1859											
<i>Ctenocella</i>	x	x		x				x			4
<i>Junceella</i>	x	x		x	x		x		x	x	8
<i>Dichotella</i>	x	x	x	x	x		x			x	8
Total (15 genera)	10	11	6	7	6	1	10	6	4	5	

The highest diversity of gorgonians (11 genera) was found at Ko Tao Mo, followed by 10 genera at Laem Pu Chao and Ko Kham (Table 1). The density surveys at Laem Pu Chao showed that *Dichotella* was the dominant genus (59.1% of total gorgonian colonies found) followed by *Ctenocella* (18.4%). *Melithaea*, *Euplexaura* and *Rumphella* had the lowest densities (0.5%) (Fig. 2).

The field experiment on cutting showed that in normal colonies (control group), the percents of monthly relative growth rates of *Menella* and *Dichotella* were 4.7% and 0.6% respectively (Fig. 3). When comparing between cut and non-cut colonies of *Menella*, there was a significant difference in the growth rate ($p < 0.05$). Non-cut colonies had higher percent relative growth rate per month than cut colonies (Fig. 3). However, in *Dichotella*, cut colonies had higher relative growth rate per month than non-cut ones ($p < 0.05$) (Fig. 3). In cut colonies of *Menella*, even though cut branches seemed to grow faster than non-cut branches, there was no significant difference (Fig. 4). In contrast, there was significant difference in the growth rates between cut branches and non-cut branches in the cut colonies of *Dichotella* ($p < 0.05$) (Fig. 4).

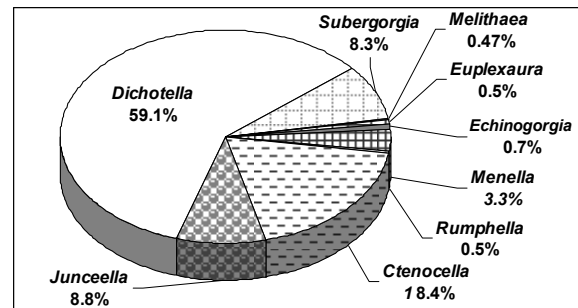


Figure 2: Density of gorgonians in each genus at Laem Pu Chao.

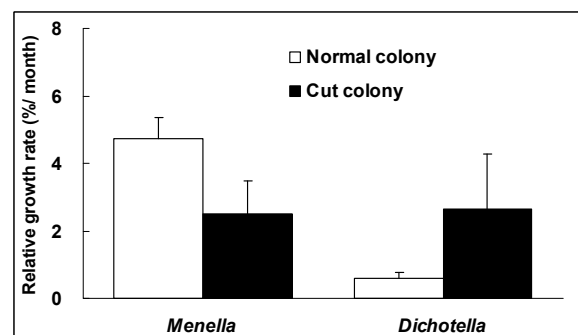


Figure 3: Percent relative growth rate per month of normal and cut colonies in *Menella* and *Dichotella*.

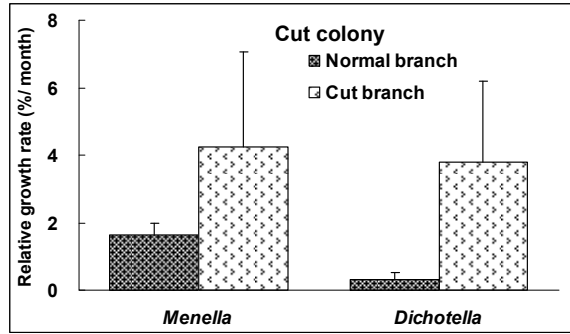


Figure 4: Percent relative growth rate per month of cut and non-cut branches in *Menella* and *Dichotella*.

Discussion

In Chonburi Province, upper Gulf of Thailand, 15 genera of gorgonians were found, a low diversity in comparison with other countries in Southeast Asia. In Indonesia, 225 species of gorgonians were recorded and in the Philippines, 36 genera (Mai-Bao-Thu and Domantay 1970; Grigg and Bayer 1976). Ko Tao Mo had the highest diversity (11 genera). Scleractinian coral species diversity was also high in this area (our observations). This may be due to high currents, one of the major factors influencing the diversity and distribution of gorgonians (Zeevi and Benayahu 1999; Fabricius and Alderslade 2001).

The field experiments showed that reaction to cutting differed between gorgonian genera. In *Menella*, energy needed for the regrowth of the cut branches lowered average growth in comparison to non-cut colonies. In *Dichotella*, cutting stimulated overall growth. More studies are needed for a better understanding of how those factors influence the abundance and growth of gorgonians populations.

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References

Alderslade P, Muzik K, Benayahu Y (1989) Report on the Unesco/Comar 1st Octocoral Research Workshop and Advanced

Training Course, Phuket, Thailand, 30 November – 13 December, 1987. Marinf. 1989 (Unesco Division of Marine Sciences, reports) 71:1-27

- Buhl-Mortensen L, Mortensen PB (2005) Distribution and diversity of species associated with deep-sea gorgonian corals off Atlantic Canada. In Freiwald A, Roberts JM (eds) Cold-water Corals and Ecosystems. Springer-Verlag, Berlin, pp 849–879
- Dautova TN (2007) Gorgonians (Anthozoa: Octocorallia) of the northwestern Sea of Japan. Russian J Mar Biol 33:297–304
- Fabricius K, Alderslade P (2001) Soft corals and sea fans: a comprehensive guide to the tropical shallow-water genera of the central-west Pacific, the Indian Ocean and the Red Sea, Australian Institute of Marine Science, Townsville, p 264
- Gili JM, López-González PJ, Bouillon J (2006) A new Antarctic association: the case of the hydroid *Sarsia medelae* (new sp.) associated with gorgonians. Polar Biol 29:624–631
- Goh NKC, Chou LM (1995) Growth of five species of gorgonians (sub-class Octocorallia) in the sedimented waters of Singapore. Mar Ecol 16:337–346
- Goh NKC, Chou LM (1996) An annotated checklist of the gorgonians (Anthozoa: Octocorallia) of Singapore, with a discussion of gorgonian diversity in the Indo-West Pacific. Raff Bull Zool 44:435–459
- Goh NKC, Loo MGK, Chou LM (1997) An analysis of gorgonian (Anthozoa: Octocorallia) zonation on Singapore reefs with respect to depth. Environ Monit Assess 44:81–89
- Goh NKC, Ng PKL, Chou LM (1999) Notes on the shallow water gorgonian-associated fauna on coral reefs in Singapore. Bull Mar Sci 65:259–282
- Grigg RW, Bayer FM (1976) Present knowledge of the systematic and zoogeography of Order Gorgonacea in Hawaii. Pac Sci 30:167–175
- Mai-Bao-Thu F, Domantay JS (1970) Taxonomic studies of the Philippine gorgonaceans in the collections of the University of Santo Tomas, Manila. Acta Manilana 6:25–78, pls 1–18
- Ofwegen LP van, Alderslade P (2007) A new species of *Alertigorgia* (Coelenterata: Octocorallia: Anthothelidae) from the Indo Malayan region. Zool Med Leiden 81:241–249
- Ofwegen LP van, Goh NKC, Chou LM (2000) The Melithaeidae (Coelenterata: Octocorallia) of Singapore. Zool Med Leiden 73:285–304
- Russo AR (1985) Ecological observations on the gorgonian sea fan *Eunicella cavolinii* in the Bay of Naples. Mar Ecol Prog Ser 24:155–159
- Sánchez JA, Zea S, Díaz JM (1998) Patterns of octocoral and black coral distribution in the oceanic barrier reef-complex of Providencia Island, Southwestern Caribbean. Caribbean J Sci 34:250–264
- Weinbauer GW, Velimirov B (1996) Population dynamics and overgrowth of the sea fan *Eunicella cavolinii* (Coelenterata: Octocorallia). Estuar coastl Shelf Sci 42:583–595
- Worachananant S (2000) Study of soft corals and gorgonians distribution in Thai seas. M.Sc. Thesis, Graduate School of Kasetsart University, Bangkok, 210pp (in Thai with English Abstract)
- Zeevi BYD, Benayahu Y (1999) The gorgonian coral *Acabaria biserialis*: life history of a successful colonizer of artificial substrata. Mar Biol 135:473–481