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Coral disease prevalence in Samui Island and the adjacent islands, southern part of the Gulf of Thailand

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Abstract

Preliminary surveys for coral disease were conducted in April 2012 at shallow water reefs of Samui Island (Bang Po Bay and Thong Krud Bay) and four adjacent islands (Katen Island, Jatamoon Island, Mud Sum Island and Hin La Lek rock patch). Results showed that a total of 6 coral diseases were found consisting of White Plague (WP), Pink Line Syndrome (PLS), *Porites* White Patch Syndrome (WPS), *Porites* Trematodiasis (PTR), White Syndrome (WS) and Pacific Yellow Band Disease (YBD). *Porites lutea* was the dominant species for all study sites and it contained the highest disease infection by Pink Line Syndrome (PLS) for all study areas. *P. lutea* in shallow water reef of Samui Island group, (Baan Bang Po Bay and Thong krud Bay), Hin La Lek, and Katen Island had higher disease prevalence (14.70 - 17.16%) than those of Mud Sum Island and Jetamun Island (6.20 - 9.40%). The most significant syndrome detected was Pink Line Syndrome, which affected 6 different coral genera. The reefs at Samui Island (Baan Bang Po Bay and Thong Krrud Bay), Hin La Lek, and Katen Island had higher prevalence of Pink Line Syndrome (12.86 - 14.24%) than those of Mud Sum Island and Jetamun Island (6.20 - 8.67%). This study provides preliminary baseline data on the impact of coral disease within the shallow water reefs of Samui Island and the adjacent islands.

Introduction

Coral reef ecosystems are now being degraded at an accelerated rate. The underlying causes of reef decline are diverse, and include pollution, sedimentation, fishing impacts, habitat destruction, invasive species, bleaching, disease, global climate change, and other factors. In recent years, disease outbreaks have caused widespread mortalities to scleractinian corals, gorgonians, sea urchins, reef fish, sponges, algae and associated coral reef organisms (Bruckner 2000).

Coral disease caused by both biotic and abiotic stressors. Biotic stressors are those caused by a living organism (e.g., pathogen, parasite) and abiotic stressors are environmental stressors (e.g., changes in salinity, temperature, light). Research suggests that important drivers of coral disease include climate warming and other anthropogenic stressors such as land-based pollution, sedimentation, overfishing, and human use (Mohamed *et al.,* 2012) stated that coral reefs are among the most heavily degraded marine ecosystems. Over the last two decades, coral reef communities have experienced increasingly stressful conditions due to a combination of natural and anthropogenic factors. Coral disease potentially acts as a bioindicator of reef health and recent increases in coral disease events have been linked to environmental stress and climate change.

Coral disease diagnosis is primarily macroscopic, taking into account characteristics such as the extent of tissue loss, tissue color and exposure of coral skeleton. Up to date, very little is currently known about the prevalence, distribution and pathology of coral disease in Gulf of Thailand (Kenkel 2007, Putchim *et al.* 2012). To understand the role of coral diseases in effecting change in coral communities, the aims of this study were to provide baseline knowledge of coral health and disease prevalence in the Samui Island group, Southern Gulf of Thailand, Thailand and to identify coral species that were the most susceptible to each specific disease.

Materials and methods

Study sites and field survey

Surveys were carried out during the summer months of April 2012 using SCUBA diving and snorkeling at shallow water reefs of Samui Island. Two study sites of Samui Island (Bang Po Bay and Ban Thong Krud Bay) and four adjacent islands (Katen Island, Jatamoon Island, Mud Sum Island and Hin La Lek rock patch) were chosen for diseases assessment (Fig 1). At each site, three replicate 20 m long and 2m wide belt transects (English *et al.* 1997) were surveyed at the reef flat of a uniform depth of 3-5 m. All coral colonies within each transect were identified, counted, photographed, and checked for signs of disease, bleaching, predation and compromised health. Coral species and diseases were identified *in situ* and underwater photographs of corals and diseases were used confirmation of *in situ* identification. Hard corals were identified to species level using the identification guides of Veron (2000).

Fig. 1. Study sites of Samui Island and the adjacent islands, Southern part of the Gulf of Thailand, Thailand; 1) Bang Po Bay 2) Ban Thong Krud Bay 3) Katen Island 4) Mud Sum Island 5) Hin La Lek rock patch and 6) Jatamoon Island.

Disease identification

Coral disease, bleaching, predation and other signs of compromised health (pigmentation response, sediment damage, algae and sponge overgrowth) were identified by the characteristics of lesions using the guides of Beeden *et al.* (2008), Weil and Hooten (2008), Bruckner, A. 2004 and Raymundo *et al.* (2008).

The prevalence of coral disease, bleaching, predation and other signs of compromised health was expressed as a percentage of the total number of coral colonies surveyed per transect.

Data analysis

Mean prevalence and standard errors were calculated from all three replicate transects per site. Differences in the prevalence of disease and compromised health signs among affected hard coral species and sites were tested using one-way analyses of variance (ANOVA). Water samples were collected at surface and bottom from all study sites.

Results

Coral coverage

Species composition and coverage of corals found that *Porites lutea* was the dominant species in all shallow water reefs of Samui Island (Bang Po Bay and Thong Krud Bay) and four adjacent islands (Katen Island, Jatamoon Island, Mud Sum Island and Hin La Lek rock patch). The highest coral coverage was Jatamoon Island (68.0%), followed by Katen Island (54.0%), Hin La Lek rock patch (58.0%) and Mud Sum Island (40.0%), while the reefs of Samui Island (Bang Po Bay and Ban Thong Krud Bay) showed the lowest coral coverage (20%). In addition, all reefs studied were covered with 3 main seaweeds (*Padina* spp., *Turbinaria* spp. and *Sargussum* spp.

Occurrence of coral diseases

The occurrence of coral diseases showed that a total of 6 coral diseases were found consisting of White Plague (WP), Pink Line Syndrome (PLS), *Porites* White Patch Syndrome (WPS), *Porites* Trematodiasis (PTR), White Syndrome (WS) and Pacific Yellow Band Disease (YBD) (Fig 2). The highest coral diseases was found at reef of Katen Island (5), followed by Bang Po Bay (4), Thong Krud Bay (4), Hin La Lek (4), while Jatamoon Island and Mud Sum Island were found only 1 coral disease (Pink Line Syndrome). The dominant diseases are Pink Line Syndrome (PLS) and White Plague (WP) occurring in all study sites (Table 1).

Table 1. Occurrence of coral diseases at shallow water reefs of Samui Island and the adjacent islands.

Study site	Coral diseases					
	PLS	WP	PTR	PWPS	YBD	WS
Samui Island (Bang Po Bay)	X	X	X	X		
Samui Island (Ban Thong Krud Bay)	X	X		X		X
Hin La Lek rock patch	X	X	X	X		
Katen Island	X	X	X	X	X	
Mudsum Island	X			X		
Jetamoon Island	X					

Remarks: Pink Line Syndrome (PLS), White Plague (WP), *Porites* Trematodiasis, (PTR) *Porites* White Patch Syndrome, (PWPS) Pacific Yellow Band Disease (YBD), White Syndrome (WS).

Table 2. Infected corals at shallow water reefs of Samui Island and the adjacent islands.

Coral species	Coral diseases					
	PLS	WP	PTR	PWPS	YBD	WS
Porites lutea	X	X	X	X		
Pavona sp.						X
Goniastrea sp.						X
Favia sp.						X
Fungia sp.					X	
Diploria sp.						X

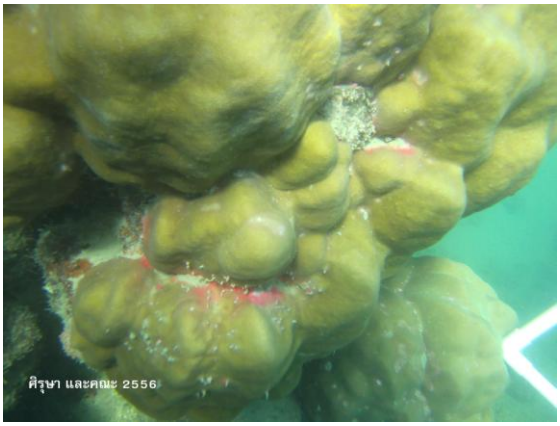
Remarks: Pink Line Syndrome (PLS), White Plague (WP), *Porites* Trematodiasis, (PTR) *Porites* White Patch Syndrome, (PWPS) Pacific Yellow Band Disease (YBD), White Syndrome (WS)

Variation of diseases and sites

Variation of coral diseases among survey sites showed that the prevalence of coral diseases varied significantly among sites ($p<0.05$). Prevalence was higher Samui island both Ban Po Bay and Thong Krud Bay than in the adjacent island. The highest diseases prevalence (17.43%) was recorded at both study sites

of Samui island, followed by Katen island (16.84%) and Hin La Lek (15.28%), while the lowest prevalence was recorded at Jetamoon island (6.20%) and Mudsum island (9.94%) (Table 3).

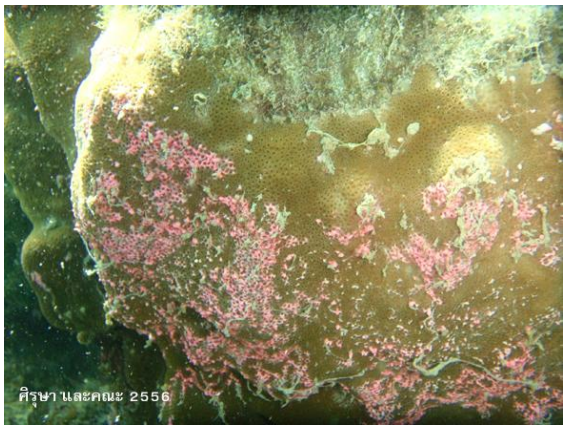
(a) White plaque disease (WP)



(b) Pink line syndrome disease (PLS)

(c) White patch syndrome (WPS)

(d) Pacific yellow band disease (YBD)



(e) Porites trematodiasis (PTR)

(f) White syndrome (WS)

Fig. 2. Occurrence of coral diseases at Samui Island and the adjacent islands.

Variation of diseases and corals

Variation in coral diseases among hard coral species showed that overall 6 infected corals were ound *Porites lutea*, *Pavona* sp., *Goniastrea* sp., *Favia* sp., *Fungia* sp. and *Diploria* sp. The highest infected coral was *Porites lutea* with Pink Line Syndrome (PLS), White Plague (WP), *Porites* trematodiasis (PTR) and *Porites* White Patch Syndrome (PWPS), while other corals were found only one disease (White Syndrome (WS) or Pacific Yellow Band Disease (YBD) (Table 2).

The dominant coral *Porites lutea* showed the highest disease prevalence among other corals in all study sites ranged 6.20 - 14.14%, followed by *Porites* White Patch Syndrome (0.82 – 1.34%) and White Plague (0.49 – 1.01%) (Table 3).

Table 3. Disease prevalence of *Porites lutea* at shallow water reefs of Samui Island and the adjacent islands.

Study sites	Total colony	Normal colony (%)	Infected colony (%)				Total (%)
			PLS	WP	PTR	PWPS	
Samui Island (Bang Po Bay)	297	82.82	14.14	1.01	0.67	1.34	17.16
Samui Island (Ban Thong Krud Bay)	272	85.29	15.86	1.10	-	0.74	17.70
Hin La Lek rock patch	202	83.16	13.86	0.49	0.48	0.99	15.28
Katen Island	267	83.14	14.24	0.74	1.12	0.74	16.84
Mudsum Island	242	90.49	8.67			0.82	9.49
Jetamoon Island	274	93.79	6.20				6.20

Remarks: Pink Line Syndrome (PLS), White Plague (WP), *Porites* Trematodiasis, (PTR) and *Porites* White Patch Syndrome, (PWPS)

Discussion

Our preliminary surveys for coral disease in shallow water reefs of Samui Island and four adjacent islands showed that a total of 6 coral diseases were found consisting of White Plague, Pink Line Syndrome, *Porites* White Patch Syndrome, *Porites* Trematodiasis, White Syndrome and Pacific Yellow Band Disease. The most significant syndrome detected was Pink Line Syndrome, which affected 6 different coral genera. Genus Porites in shallow water reefs of Samui Island and the adjacent areas is a dominant host of coral diseases particularly Pink Line Syndrome. This study showed low prevalence of coral diseases as various reefs in Indonesia waters. This study showed that *Porites lutea* was the dominant species for all study sites and it contained the highest disease infection by Pink Line Syndrome for all study areas. This result agreed with the study in Indian coral reef (Thinesh *et al.* 2009) but not for the study of coral diseases in Indonesia reefs (Erinn *et al.* 2012) and Red Sea reefs (Mohamed 2012). Thinesh *et al.* (2009) reported that most common coral host for disease was *Porites* sp. and the most common disease was pink spot, followed by black band. Erinn *et al.* (2012) reported that the most significant syndrome detected was white syndromes, which affected 13 different coral genera in Indonesia reefs. The most significant syndromes detected were white syndromes, black band disease, and a yellow tissue discoloration syndrome that was similar macroscopically to Caribbean yellow band disease. Although overall coral disease prevalence was low, there is the potential for greater impacts of coral disease as anthropogenic influences increase and the oceans continue to warm. In addition, this study showed that all parameters of seawater quality of seawater were under the standard natural seawater of during the study period. However, although overall coral disease prevalence was low in all reefs surveyed, there is the potential for greater impacts of coral disease as anthropogenic influences increase and the oceans continue to warm. Mohamed (2012) showed that the highest prevalence of coral diseases in northern Red Sea, Egypt was recorded on the coral *Favia stelligera*, followed by *Porites lutea*, and *Goniastrea edwardsi.* Enhanced local anthropogenic stresses and increasing sea surface temperature due to global warming are the suggested potential factors responsible for the initiation and the persistence of some coral diseases in the studied reefs.

In addition, this study showed that *P. lutea* in shallow water reef of Samui Island group, (Baan Bang Po Bay and Baan Thongkrut Bay), Hin La Lek, and Katen Island had higher disease prevalence (14.70 - 17.16%) than those of Mudsum Island and Jetamun Island (6.20 - 9.40%). This result may due to the location of high disease prevalence areas were nearer Samui

main land than those areas of low prevalence. Various factors both natural and human impacts from the main land may cause in infection of coral diseases such as climate changes (Sokolow 2009, Looney *et al.* 2010), rainfall and freshwater runoff (Haapkyla *et al.* 2011), nutrient loading (Vega *et al.* 2014, Bruno *et al.* 2003), physical contacts, ballast water (Macedo *et al.* 2008), physical contact of seaweeds (Maggy *et al.* 2004) and human impacts (Bruno *et al.* 2003). Haapkyla *et al.* (2011) suggest that rainfall and associated runoff may facilitate seasonal disease outbreaks, potentially by reducing host fitness or by increasing pathogen virulence due to higher availability of nutrients and organic matter. In the future, rainfall and seawater temperatures are likely to increase due to climate change which may lead to decreased health of inshore reefs. Thurber *et al.* (2014) provide that coastal nutrient loading is one of the major factors contributing to the increasing levels of both coral disease and coral bleaching these data also suggest that simple improvements to water quality may be an effective way to mitigate some coral disease epizootics and the corresponding loss of coral cover in the future. Maggy *et al.* (2004) also showed that physical contact with the macroalga *Halimeda opuntia* can trigger a virulent disease known as white plague type II that has caused widespread mortality in most Caribbean coral species. Colonies of the dominant coral *Montastraea faveolata* exposed to algal transplants developed the disease whereas unexposed colonies did not. Bruno *et al.* (2003) indicated that changes in the environment caused by human activities have impaired host resistance and/or have increased pathogen virulence. Nutrient enrichment can significantly increase the severity of two important Caribbean coral epizootics: aspergillosis of the common gorgonian sea fan *Gorgonia ventalina* and yellow band disease of the reef-building corals *Montastraea annularis* and *M. franksii*. The climate variables likely alter coral epidemiology through effects on pathogen growth rates, transmission, virulence, and susceptibility. The causes of coral disease emergence at large spatial and temporal scales has been hindered by several factors including (1) the inability to rely on Koch's postulates for diseases with multifactorial etiologies, (2) the paucity of long-term, coordinated, coral disease data, and (3) the difficulty in detecting correlations in inherently non-linear, dynamic disease systems. In a rapidly changing global environment, the consequences of increasing coral disease may be severe, leading to elevated extinction risk and loss of critical reef habitat (Sokolow 2009).

Most of the causative factors of emerging diseases contributing to their occurrence and spread, and consequences on coral populations remain incompletely understood, however. A long-term, multi-disciplinary research and monitoring program for coral diseases is necessary to assist resource managers in identifying and responding to emerging coral diseases. These efforts should involve management-driven strategies that include 1) an early warning system to predict and identify disease outbreaks; 2) documentation of spatial distribution and temporal variations of coral diseases and other syndromes at local to global scales; 3) elucidation of relationships of environmental stressors, localized anthropogenic impacts, and widespread phenomena such as global warming and El Niño on coral health, disease, degradation and recovery; 4) development of standardized terminology for diseases and other syndromes through a characterization of the visual appearance, pathology and etiology, and the development of molecular probes and other tools to identify and verify diseases in the field; 5) identification of factors that facilitate the introduction, spread and transmission of pathogens; 6) research on the effects of disease on coral species and populations, associated species, and ecosystem structure and function; and 7) implementation of measures to mitigate disease impacts, including strategies that reduce anthropogenic stressors responsible for the proliferation or spread of diseases and the development of novel techniques to treat affected corals and improve habitat quality (Bruckner 2000). This study provides preliminary baseline data on the impact of coral disease within the shallow

water reefs of Samui Island and the adjacent islands. Further prediction of disease outbreak, appropriate monitoring of physical and chemical parameters of seawater should be done in relation with diseaseprevalence at all sites which affected by natural and human impacts.

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References

APHA, AWWA, WPCF. 2009. Standard Methods for the Examination of Water and Wastewater. Washington: American Public Health Association. 83 pp. Boney, A.D. (1975)

Bruckner AW. 2000. Priorities for effective management of coral diseases. NOAA Fisheries Office of Protected Resources, 1315 East West Highway Silver Spring, MD 20910. 47 p. 49.

Beeden R, Willis BL, Raymundo LJ, Page CA, Weil E. 2008. Underwater Cards for Assessing Coral Health on Indo-Pacific Reefs. CRTR Program. The University of Queensland, Australia. 26 p.

Bruckner A. 2004. Field guide to Western Atlantic coral diseases and other causes of coral mortality. UNEP-World Conservation Monitoring Centre; Cambridge - UK.

Bruno JF, L.E. Petes LE, Harvell CD, Hettinger A. 2003. Nutrient enrichment can increase the severity of coral diseases. Ecology Letters **6**, 1056-1061.

Erinn M, Muller EM, Laurie J, Raymundo LJ, Willis BL, Haapkylä J, Yusuf S, Wilson JR, Harvell DC. 2012. Coral Health and Disease in the Spermonde Archipelago and Wakatobi, Sulawesi Journal of Indonesia Coral Reefs **1(3)**, 147-159

English S, Wilkinson C, Baker V. 1997. Survey manual for tropical marine resources. ASEAN Australia Marine Science Project. Australian Institute of Marine Science. 368 pp.

Haapkyla J, Unsworth RKF, Flavell M, Bourne DG, Schaffelke B. 2011. Seasonal Rainfall and Runoff Promote Coral Disease on an Inshore Reef. PLoS ONE **6(2**), e16893. doi:10.1371/journal.pone.0016893

Kenkel C. 2007. Coral Disease on the Reefs of Southern Thailand. [Online]. Phuket Marine Biological Centre, Ministry of Natural Resources and Environment. From: http://www.pmbc.go.th/webpmbc/nipon/disease_greenfins.pdf [February 10, 2011]

Looney EE, Sutherland KP, Lipp EK. 2010. Effects of temperature, nutrients, organic matter and coral mucus on the survival of the coral pathogen, Serratia marcescens PDL100. Environmental microbiology **12(9),** 2479-2485.

Macedo MLA, Matinez VMV, Silveira JAH, Lozano DSV, Rodriguez MHR, Novoa MAO. 2008. Ballast water as a vector of coral phatogens in the Gulf of Maxico: The case of the Cayo Arcas coral reef. Marine pollution Bulletein **56**, 1570-1577.

Mohamed AR, Ali AAM, Abdel-Salam HA. 2012. Status of coral reef health in the northern Red Sea, Egypt. Proceedings of the 12th International Coral Reef Symposium, Cairns, Australia, 9-13 July 2012, 9A Coral bleaching and climate change. P. 5.

Maggy M, Nugues MM, Garriet W, Smith GW, Hooidonk RJ, Seabra MI, Bak RP. 2004. Algal contact as a trigger for coral disease. Ecology Letters, *7*, 919–923

Putchim L, Yamarunpattana C, Pongsuwan N. 2012. Observations of coral diseases in *Porites lutea* in the Andaman Sea following the 2012 bleaching. Phuket marine biological center research bulletin. **71**, 57-62.

Raymundo L, Couch C, Harvell CD. 2008. Coral disease handbook: guidelines for assessment, monitoring and management. Currie Communications, Melbourne

Sokolow S. 2009. Effects of a changing climate on the dynamics of coral infectious disease: a review of the evidence. DISEASES OF AQUATIC ORGANISMS, Vol. **87**: 5–18, doi: 10.3354/dao02099

Thinesh T, Mathews G, Edward JKP. 2009. Coral disease prevalence in Mandapan group of island, Gulf of Mannar, Southern India. Indian Journal of Marine Science **38**, 444-450.

Veron J. 2000a. Coral of the world (vol. 1). Australian Institute of Marine Science, Queensland, Australia. 463 p.

Veron J. 2000b. Coral of the world (vol. 2). Australian Institute of Marine Science, Queensland, Australia. 429 p.

Veron J. 2000c. Coral of the world (vol. 3). Australian Institute of Marine Science, Queensland, Australia. 490 p.

Thurber RLT, Burkepile DE, Fuchs C, Shantz AA, Mcminds R, Zaneveld JR. 2014. Chronic nutrient enrichment increases prevalence and severity of coral disease and bleaching. Global Change Biology (2014) 20, 544–554, doi: 10.1111/gcb.12450

Weil E, Hooten AJ. 2008. Underwater cards for assessing coral health on Caribbean reefs. CRTR Program Project Executing Agency, Centre for Marine Studies. The University of Queensland. Australia.