



An introductory study on composition and abundance of corals using an imaging survey technology in the South China Sea (Sanya, China)

Xiaojuan Xu¹, Bo Yuan¹, Yuemin Liu¹, Weidong Li², Zhihao Wang³, Lian Ming Wang¹, Pei-Zheng Wang⁴, Farnaz Mahmoudi Shikhsarmast^{*1}

¹College of Marine Science and Technology, Hainan Tropical Ocean University, Sanya, China

²College of Ecology and Environment, Hainan University, Haikou, China

³College of Fisheries and Life Sciences, Hainan Tropical Ocean University, Sanya, China

⁴College of Ecology and Environment, Hainan Tropical Ocean University, Sanya, China

Article published on July 18, 2021

Key words: Distribution, Diversity, Soft Corals, Stony Corals, South China Sea

Abstract

Coral reefs are one of the important marine ecosystem in the oceans. This study evidenced the composition and abundance of coral communities in protected and non-protected areas in Sanya (Hainan, China). Our results showed that different localities have different communities of soft and/or stony corals. Regarding to our findings, Yalong Bay that it is under protection program represented high coverage of corals, especially soft corals. It is documented that protection program can be introduced as one of the major methods to preserve coral reefs.

***Corresponding Author:** Farnaz Mahmoudi Shikhsarmast ✉ farnaz_mahmoudi@ymail.com

Introduction

Coral reefs are one of the unique and much important ecosystem in the oceans (Knowlton, 2001), supporting crucial aquatic habitats for many marine organisms (McClanahan *et al.*, 2002; Hughes *et al.*, 2003). Despite their importance, due to global warming, the frequency and extent of corals bleaching around the world have been increased, and the coverage of coral reefs has been decreased significantly (Brown, 1997; Chou and Loo, 1994; Chou 2002; Seah *et al.* 2015; Lu *et al.* 2021ab). The growing risk of coral reefs destruction can confirm the importance of constantly monitoring of composition and abundance of corals.

Coral reefs are distributed widely in South China Sea and have importance ecological roles in local economic development (Seah *et al.* 2015, Benayahu *et al.* 2012; 2018). There is a lack of information on ecological status and communities' structure of coral reefs in Hainan Province (China) especially in the territory of the Sanya city, due to the lack of sequential taxonomic studies. It has caused that our knowledge on coral diversity and communities be much limited. Although over the last few years, scientific evidences have documented the potential of corals in modern medicine (Hildemann *et al.*, 1977; Reina *et al.*, 2011; Cooper *et al.*, 2014; Elkhawas *et al.*, 2020), corals have had a special position in traditional Chinese medicine (Huang *et al.*, 2012; Lin *et al.*, 2013; Liang *et al.*, 2018). Therefore, this has caused that corals being threatened by humans for medical usage. Additionally, the development of tourism industry and ocean transportation have risen the hazard of corals damage (Fong *et al.*, 1995; Madin *et al.*, 2006, 2014). Recently, Administration of Hainan-Sanya National Coral Reef Nature Reserve has been administering protection program to conserve Sanya coral reefs against of human activities. Human activities are one of the most important factors that can damage and alter composition and abundance of coral reefs.

In the present study, we aim to provide a preliminary landscape of corals distribution and abundance in

Sanya to support effect of local protection program on preserving coral reefs. The purpose of this investigation was to determine the composition and abundances of soft and stony corals to compare the communities' structure between protected and non-protected regions in Sanya.

Materials and methods

Study area

Surveys were conducted in October 2019. Study locations were in three geographic regions in east part of Sanya including Sun Bay (SB), Baifu Bay (BB) and Yalong Bay (YB) which shown in Fig. 1. Information of localities was summarized in Table 1.

Table 1. Information of studied areas in South China Sea.

Locality	Abb.	Geographic Coordinates	Depth (m)	Protection status
Sun Bay	SB	18° 11' 30.94" N 109° 36' 40.00" E	7-8	non-protected
Baifu Bay	BB	18° 10' 28.71" N 109° 37' 22.02" E	4-5	non-protected
Yalong Bay	YB	18° 12' 44.47" N 109° 37' 50.76" E	4-5	protected

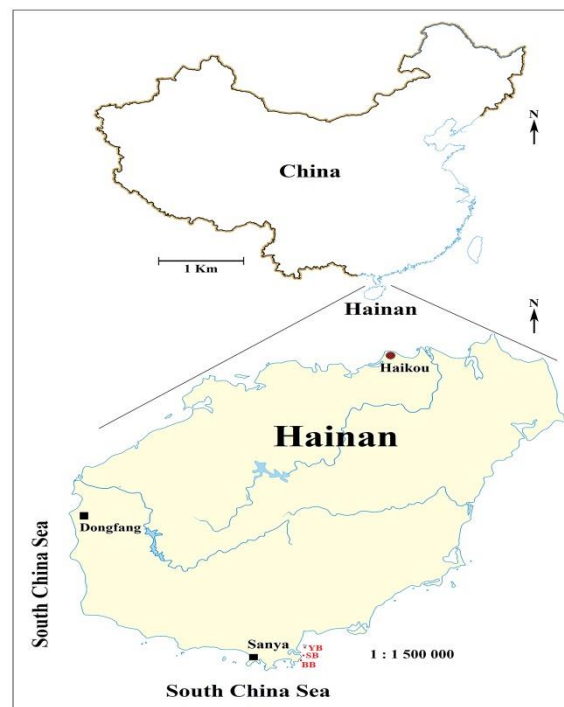


Fig. 1. Geographical position of studied areas (SB: Sun Bay, BB: Baifu Bay, YB: Yalong Bay).

Survey method

At each study locality, a 30m belt was established along coastal shore. A quadrat (1m²) sequentially was used along belt and for each quadrat. A Photo was separately taken to calculate the coverage of soft and stony corals in each quadrat (Fig. 2). Finally, coverage of soft corals, stony corals and empty place were calculate for 30 m² in each locality. AutoCAD 2020 software was utilized to calculate coverage of soft corals, stony corals and empty place (Fig. 3).

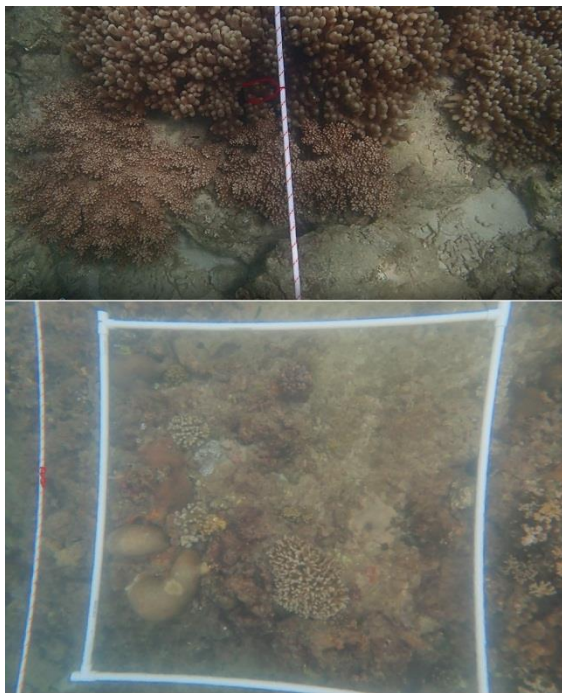


Fig. 2. Using 30m belt along the coral reefs as reference line (up), using the quadrat (1m²) along the belt (down) to calculate coverage of corals.

Our finding showed that highest average and total coverage belonged to Yalong Bay with 0.44m²/quadrat and 13.32m²/30m², respectively. On the other hand, Sun Bay shoed the lowest average and total coverage with 0.11 m²/quadrat and 3.50m²/30m². Yalong Bay exhibited high coverage of soft corals (0.44m²/quadrat) while it had the lowest stony corals coverage (0.62m²/quadrat). Although Baifu Bay and Yalong Bay represented same average coverage of stony corals in each quadrat (0.02m²/quadrat), Sun Bay had poor stony corals (0.1m²/quadrat). The highest stony corals coverage was belonged to Sun Bay with 3.27m²/30m².

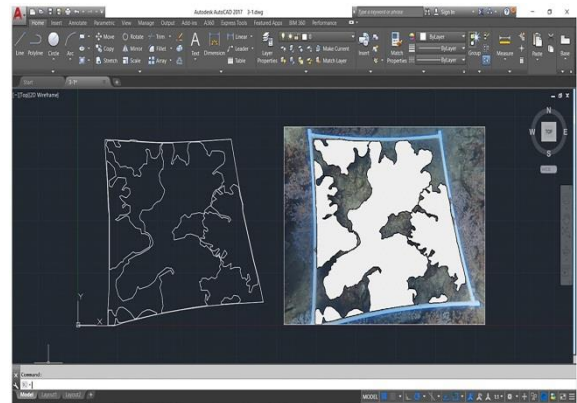


Fig. 3. The screen of Auto CAD software to show calculation method of corals coverage.

Results

The results of average coverage in each quadrat (1m²) and total coverage in 30 m² are separately summarized for each localities in Table 2 and Fig. 4.

Table 2. Average and total coverage of soft and stony corals in studied areas.

Location	Ave. in a quadrat (1 m ²)			Total coverage in 30 m ²		
	Total	Soft Coral	Stony Coral	Total	Soft Coral	Stony Coral
Sun Bay	0.11	0.01	0.10	3.50	0.23	3.27
Baifu Bay	0.16	0.14	0.02	5.52	4.75	0.77
Yalong Bay	0.44	0.42	0.02	13.32	12.70	0.62

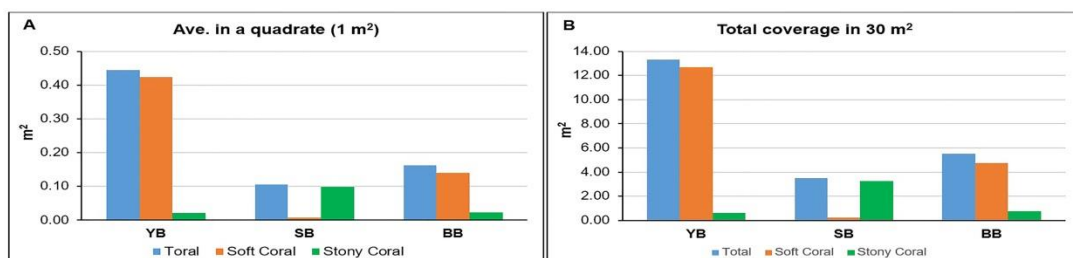


Fig. 4. value of Average and total coverage of soft and stony corals in studied areas.

Discussion

Our results showed that Sun Bay is the habitat of stony corals while the Baifu Bay is the host of soft corals. These two location are non-protected area and total coral coverage significantly lower than Yalong Bay, which it is a protected area.

Successive Study on abundance and composition of coral can help to get knowledge about effect of regional environmental conditions on coral communities and help to improve taxonomic information about local coral reefs (Seah, *et al.*, 2015). Current investigation studied the coral communities at fringing reefs of three eastern islands, including Sun Bay, Baifu Bay and Yalong Bay of Sanya (Hainan, China). Lirman *et al.* (2007) utilized a video-mosaic method to survey the coral reefs abundance and composition and showed this method can be used to construct two-dimensional.

In this study, we used the imaging survey technology to get coverage for each 1 m². Seah, *et al.* (2015) reported that soft corals abundance at Kusu Island reefs were significantly higher than two other islands including P. Hantu and P. Semakau in Singapore. Chanmethakul *et al.* (2010) documented that different localities could host different communities.

We have gotten the highest coverage and distribution of corals at Yalong Bay. This place is under protection program by local government that diving and fishing are forbidden. Our results can document that protection program that has been carried out by government was a successful project to protect coral reef at Yalong Bay. With regards to our finding there is no positive relationship between neighbor localities and diversity and composition of corals.

To nearby Baifu Bay and Sun Bay show different composition of coral, while Sun Bay is the host of stony corals, but in Baifu Bay the highest abundance belong to soft corals. It is suggested in further studies, ecological parameters of localities with different coral composition and abundance to find the effect of ecological condition on coral diversity.

Overall, in this time the most survey project on coverage of coral reefs have been done using video recording technology, here our finding clearly represented the ability of imaging survey technology to get the exact results for coverage quantity in coral reef. It is recommended that imaging survey technology utilize for future studies on survey of coral reefs.

Conclusion

In conclusion, the abundance and distribution soft and stony corals are not identical in different localities that it might be attributed to special ecological and environmental conditions in each localities. Additionally in close localities also composition and density of coral are different that can be referred to regional environmental situations (generally water pollution) or fishery activities. Government protection programs can be one of the most effective governmental plans to protect coral reefs. Generally implementation of conservation program by Administration of Hainan-Sanya National Coral Reef Nature Reserve had a major impact on the protection of coral reefs in Yalong Bay.

Acknowledgements

This study was supported by 2020 Provincial Undergraduate Innovation and Entrepreneurship Program (S202011100013) of Hainan Tropical Ocean University and cooperative agreement provided by Hainan Province Science and Technology Department Key Research and Development Programme (ZDYF2019154).

References

- Benayahu Y, Ofwegen LV, Dai CF, Jeng MS, Soong K, Shlagman A, Du SW, Hong P, Imam NH, Chung A, Wu T, mc Fadden CS.** 2018. The Octocorals of Dongsha Atoll (South China Sea): An Iterative Approach to Species Identification Using Classical Taxonomy and Molecular Barcodes. *Zoological Studies* **57**, 50-77.
- Benayahu Y, Ofwegen LV, Dai CF, Jeng MS, Soong K, Shlagman A, Hsieh HJ, mc Fadden CS.** 2012. Diversity, Distribution, and Molecular Systematics of Octocorals (Coelenterata: Anthozoa) of the Penghu Archipelago, Taiwan. *Zoological Studies* **51**, 1529-1548.

- Brown BE.** 1997. Coral bleaching: causes and consequences. *Coral Reefs* **16**, 129-138.
- Chanmethakul T, Chansang H, Watanasit S.** 2010. Soft Coral (Cnidaria: Alcyonacea) Distribution Patterns in Thai Waters. *Zoological Studies* **49**, 72-84.
- Chou LM, Loomg K.** 1994. A review of marine soft-bottom benthic community studies from Singapore. In: Wilkinson CR, Sudara S, Chou, L. M. (Eds) Proceedings of the third ASEAN-Australia symposium on living costal resources, Vol 1, Status Reviews. Australia Institute of Marine Science, Townsville p 365-371.
- Chou LM.** 2002. Singapore reefs report. In: Report of the Global Coral Reef Monitoring Network (GCRMN) Regional workshop for the East Asian Seas. Ministry of the Environment, Japan 85-95.
- Cooper EL, Hirabayashi K, Strychar KB, Sammarco PW.** 2014. Corals and Their Potential Applications to Integrative Medicine. *Evidence-Based Complementary and Alternative Medicine* **59**, 1-9.
- Elkhawas YA, Elissawy AM, Elnaggar MS, Mostafa NM, Kamal EM, Bishrmm, Singab ANB, Salama OM.** 2020. Chemical Diversity in Species Belonging to Soft Coral Genus *Sarcophyton* and Its Impact on Biological Activity: A Review. *Marine Drugs* **18**, 41-58.
- Fong P, Lirman D.** 1995. Hurricanes cause population expansion of the branching coral *Acropora palmata* (Scleractinia): wound healing and growth patterns of asexual recruits. *Marine Ecology* **16**, 317-335.
- Hildemann WH, Raison RL, Cheung G.** 1977. Immunological specificity and memory in a scleractinian coral. *Nature* **270**, 219-223.
- Huang SY, Chen NF, Chen WF, Hung HC, Lee HP, Lin YY, Wang HM, Sung PJ, Sheu JH, Wen ZH.** 2012. Sinularin from indigenous soft coral attenuates nociceptive responses and spinal Neuroinflammation in carrageenan-induced inflammatory rat model. *Marine Drugs* **10**, 1899-1919.
- Hughes TP, Baird AH, Bellwood DR, Card M, Connolly SR, Folke C, Grosberg R, Hoegh-Guldberg O, Jackson JBC, Kleypas J, Lough JM, Marshall P, Nyström M, Palumbi SR, Pandolfi JM, Rosen B, Roughgarden J.** 2003. Climate Change, Human Impacts, and the Resilience of Coral Reefs. *Science* **301**, 929-933.
- Knowlton N.** 2001. The future of coral reefs. *Proceedings of the National Academy of Sciences* **98**, 5419-5428.
- Liang LF, Kurtan T, Mandi A, Yao LG, Li J, Lan LF, Guo YW.** 2018. Structural, stereochemical, and bioactive studies of cembranoids from Chinese soft coral *Sarcophyton trocheliophorum*. *Tetrahedron* **74**, 1933-1941.
- Lin YY, Jean YH, Lee HP, Chen WF, Sun YM, Su JH, Lu Y, Huang SY, Hung HC, Sung PJ, Sheu JH, Wen ZH.** 2013. A soft coral-derived compound, 11-epi-sinulariolide acetate suppresses inflammatory response and bone destruction in adjuvant-induced arthritis. *PLoS One* **8**, 1-15.
- Lu H, Asem A, Han Y, Li M, Li W, Wang PZ.** 2021a. Diversity and Abundance of Symbiodiniaceae and Bacteria in Corals *Sarcophyton trocheliophorum* and *Euphyllia ancora* under Thermal Stimulation. *Journal of genetic Recourses* **7**, 1-14.
- Lu H, Asem A, Wang L, Li W, Wang PZ.** 2021b. Comparison of Symbiotic Bacterial Community of Soft Corals *Sarcophyton* and *Sinularia* of the Hainan Province, (South China Sea, China). *Genetics of Aquatic Organisms* **5**, 19-28.
- Madin JS, Baird AH, Dornelas M, Connolly SR.** 2014. Mechanical vulnerability explains size-dependent mortality of reef corals. *Ecology Letters* **17**, 1008-1015.
- Madin JS, Connolly S.** 2006. Ecological consequences of major hydrodynamic disturbances on coral reefs. *Nature* **444**, 477-480.

McClanahan T, Polunin N, Done T. 2002.

Ecological states and the resilience of coral reefs. *Conservation Ecology* **6**, 1-28.

Reina E, Puentes C, Rojas J, Garcia J, Romas FA, Castellanos L, Aragon M, Ospina LF. 2011.

Fuscoid E: a strong anti-inflammatory diterpene from Caribbean octocoral *Eunicea fusca*. *Bioorganic and Medicinal Chemistry Letters* **21**, 5888-5891.

Seah JZS, Yap NWL, Tan LT, Goh BPL. 2015.

Distribution and abundance of octocoral (*Octocorallia, alcyonacea*) communities at three Southern Islands of Singapore. *Ocean Science Journal* **50**, 299-306.