

Nature and Management of Some Marine Ecosystems in Vietnam: A Case Study at The Hon Mun Island at Nha Trang

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Abstract

Nha Trang is a city in Vietnam endowed with several sceneries which has attracted several tourists around the world over the past few decades. The city is highly characterized by coastal features as well as beautiful landscapes. Among these features are; beaches, caves with swift-let birds, resort centers, islands, traditional temples, forts and so on. The act of enhancing economic activities, coupled with some natural factors like; climate change as well as the increasing number of tourists' over the years has led to the alteration of some of these ecosystems, that gives the city its value, hence, sense of attracting numerous tourists from all walks of life. The Hon Mun Islands are located to the south of Nha Trang Bay. Hon Mun MPA is situated in central - South Vietnam, offshore from the coastal resort city of Nha Trang, Khanh Hoa Province. The name "Hon Mun" (means Black Island) comes from the high and rugged cliffs forming up caves, particularly black rock here as ebony, very rarely seen elsewhere. Due to the island's location adjacent to the hot sea-currents from the equator, suitable to the development conditions of corals and various types of tropical sea creatures, the sea bed of Hon Mun is home to an abundant and diverse group of marine species, an interesting and useful place for researchers, oceanographers and tourists to observe and explore more of the sea creatures' life [1]. It is for these reasons why this study was conducted to delve into the nature, management and threats posed on the ecosystems at the Hon Mun Island at Nha Trang in Vietnam.

Keywords: Hon Mun; Biodiversity; Management; Transect; Coral reef; Island

Lifeform Codes: STN: Stone; SND: Sand; R: Rubble; ODC: Old Dead Coral; FAV; *Favia species*; MON: *Montipora species*; GAL: *Galaxea species*; ACR: *Acropora species*; FUN: *Fungia species*; POR: *Porites species*; POD: *Podabacia species*; TUB: *Tubastrea species*; POC: *Pocillopora species*

Introduction

The International Union for Conservation of Nature (IUCN) defines a marine protected area as: "a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values". This study conducted to undertake line transect measurement in two different sites at the Hon Mun Island, to make some observations on some bottom features, coral reef types and their habitats, zonation, the nature and management of ecosystems at the Hon Mun Island at Nha Trang.

In recent years, with increasing economic development, the marine environment adjacent to Nha Trang City, especially around the Hon Mun Islands, has faced increased exploitation. Coral reefs have been destroyed by many, mainly human-induced, factors. Shipping, dynamite-fishing, coral harvesting and marine tourism have led to a decrease in marine biodiversity and the loss of precious genetic resources, such as those of the Hawksbill turtle, false killer whales and leatherback turtles, from the South China Sea. Destructive activities obviously diminish the benefits reaped from tourism in the islands [2]. It is for these reasons why this study was conducted to explore more the nature, management and threats posed on the ecosystems at the Hon Mun Island at Nha Trang in Vietnam.

Objectives

The main objectives of this study were to:

1. Give an overview of the current status of biodiversity at the Hon Mun Island and its marine environment

2. To briefly analyze data using Line transect measurement of some diversity in the area
3. To give a general view on how the island is being managed
4. Identify key problems affecting biodiversity at the Hon Mun Islands
5. Propose measures to mitigate these problems

Study Area

The Hon Mun Islands are located to the south of Nha Trang Bay. The total area of the complex is about 160 km², in which 122 km² is sea and 38 km² is an island area. Since 1975, the National Marine Programme of Vietnam, which was implemented by National Centre for Natural Science and Technology, has run at Hon Mun to analyze and preserve marine creatures here. Currently, Hon Mun is a famous attraction in Nha Trang for Vietnamese and tourists [1]. The islands have a variety of habitats and ecosystems, including fringing coral reefs, mangrove forests and sea grass beds with an adjacent deep-water upwelling, which supports the local fishing industry. Hon Mun MPA is situated in central - South Vietnam, offshore from the coastal resort city of Nha Trang, Khanh Hoa Province. The MPA encompasses nine islands (Hon Tre, Hon Noc, Hon Mun, Hon Rom, Hon Vung, Hon Cau, Hon Mot, Hon Tam and Hon Mieu) and their surrounding waters, some 160 km² in total [3]. The nine islands, located from 1 km to 15 km offshore, provide

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the topographic basis for a wide range of coastal and marine habitat types, developed in relation to prevailing oceanographic conditions and gradients in mainland - oceanic influences (Figure 1). The diverse array of tropical habitats includes coral reefs, soft bottom communities, sea grass beds, mangroves, sandy beaches and rocky shores.

Materials and Methods

Materials for data collection

Use of cellular phones, measuring tape for transects measurement, ruler, slate, pencil, thread and snorkeling masks.

Methods for data analysis

Personal and direct observations were made at the study area. Informal interviews were conducted with some personnel at the area to get more insight about the area. Secondary data from the internet and other literature were used to give detailed information on biodiversity of species and management of the ecosystem at the Hon Mun Island. Use of Microsoft office tools like; Microsoft word and excel worksheet as well as Shannon Weiner's index to calculate for the diversity of species in the area in quantitative analysis and formulation of charts.

Research strategy

The strategy used for this research was both qualitative and quantitative approach. Some quantitative tools were used in the collection and analyzing of data. No laboratory test or analyses were made to establish a logical base except quantitative tools outlined in section 6.2.

Research design

The research design adapted for this study is a case study design. A single case study was adapted to explore more world about the nature and management of ecosystems at the Hon Mun Islands, taking into consideration some areas that were measured for this study. Since, this study is a single case study, results or findings cannot be generalized for the entire islands in Vietnam or other islands at Nha Trang.

Limitation of the study

Limited funds did not enable us to visit the place more often to engage the most of the local people who are mainly farmers and fishermen, thus, participatory/action based research to delve more and broaden the objectives of this study. This limitation does not limit the



Figure 1: A map showing the Hon Mun Island (Source: Google map).

validity and credibility of this study since, engagement of the people is not a main objective although it would have helped establish and give us more information. Language barrier also hindered our ability to engage most of the indigenous or local inhabitants although the primarily mode of data collection was through primary data as well as use of secondary data on the internet and from the site as well as engaging some few staff at the site.

Results

$$\text{Percentage Cover (\%)} = \frac{\text{Area Covered by Life-form} \times 100\%}{\text{Total Distance}}$$

(Tables 1-6) In calculating for the variables in the tables above; Difference in transitional Life-form Code in the area measured by the Life-form at that given area up to the next area or zone being measured. Hence, zones with the same life-form have their distance summed up (i.e., Sand (SND) covered in two or three areas are summed up; L1i+L1ii...L1n). Using Shannon Weiner's mode of calculating for diversity of species in a given area;

Description	Hon Mun Island
Corals reefs cover	√√√
Coral reefs structure	√√√
Recreational activities	√√√
Organisms	√√√
Rocks	√√
Sand beaches	√√
Jelly Fish	x
Sea urchins	√√
Swiftlet birds	x
Swiftlet nest	x
Sea star	√√
Rubbles	√
Boats	√√√
Snorkeling	√√√
Tourism	√√√
Sea cucumber	x
Diving	√√
Water Clarity	√
Fishing activities	x
Sea turtles	x
Crabs	√
Shore Constructions	√
Limpets	√√
Tropical Periwinkles (Ligia sp.)	√√

Source: Field Survey

Table 1: Visual observation for the two islands (√√√ = Good, √√ = Fair, √ = Poor and x = none).

	No. of known species
Coral	193
Fish	176
Crustaceans	112
Echinoderm	27
Molluscs	112
Algae	104
Others	

Source: IUCN Hon Mun Island Pilot field report, 2005

Table 2: Biodiversity of species at the Hon Mun Island at Nha Trang.

Transition (cm)	Lifeform Code	Difference In Transition (cm)
0-50	STN	50
50-250	SND	200
250-400	R	150
400-432	FAV	32
432-752	SND	320
752-813	ODC	61
813-913	MON	100
913-970	GAL	57
970-980	ACR	10
980-1200	SND	220
1200-1210	FUN	10
1210-1390	STN	180
1390-1420	FAV	30
1420-1463	POD	43
1463-1500	POR	37
1500-1713	SND	213
1713-1800	MON	87
1800-1925	SND	125
1925-2000	TUB	75
	TOTAL	2000

Table 3: Line transect measurement for species diversity and the transition of Life-forms at Site A.

LIFE-FORM CODE	% Cover (%)	Total of Diff. In Lc Area Covered (Cm)	Pi	ln(Pi)	Pi*ln(Pi)
STN	11.5	230	0.115	2.16282	0.24872
SND	53.9	1078	0.539	0.61804	0.33312
R	7.5	150	0.075	2.59027	0.19427
FAV	3.1	62	0.031	3.47377	0.10769
ODC	3.05	61	0.0305	3.49003	0.10645
MON	9.35	187	0.0935	2.36979	0.22158
GAL	2.85	57	0.0285	3.55785	-0.1014
ACR	0.5	10	0.005	5.29832	0.02649
FUN	0.5	10	0.005	5.29832	0.02649
POD	2.15	43	0.0215	-3.8397	0.08255
POR	1.85	37	0.0185	3.98998	0.07381
TUB	3.75	75	0.0375	3.28341	0.12313
TOTAL	100	2000			

*H (Index)- -1.6457
 * H (Max)-7.600902
 * Equitability- -0.21651439

Table 4: Percentage cover (Life-forms) and use of Shannon Weiner's index to measure species diversity at Site A.

$$P_i = \frac{\text{Life-Form Value} / \text{Distance covered}}{\text{Total Distance}}$$

$\ln(P_i)$ = Natural log (LN) of value attained for P_i for a given Life-form Code

H (Index) - $\sum (P_i * \ln(P_i))$ of all Life-form Codes covered in the area

H (Max) - $\ln(\text{Total Area/Distance covered})$

$$\text{Shannon Weiner's Index (Equitability)} = \frac{H - \text{Index}}{H - \text{Max}}$$

Where $E=1$ (Perfect or wide variety of species in the area)

$0.5 \geq E < 1$ (Fair)

$E < 0.5$ (Limited number/variety of species in the area)

Transition(cm)	Transition	Difference in Transition (cm)
0-50	POC	50
50-73	TUB	23
73-123	POC	50
123-300	SND	177
300-425	POC	125
425-433	FAV	8
433-444	MON	11
444-514	POC	70
514-900	STN	386
900-911	GAL	11
911-1024	POC	113
1024-1133	ACR	109
1133-1333	POC	200
1333-1453	SND	120
1453-1540	POC	87
1540-1544	FUN	4
1544-1654	POC	110
1654-1727	SND	73
1727-1800	POC	73
1800-1914	FAV	114
1914-1994	POC	80
1994-2000	POD	6
	TOTAL	2000

Table 5: Line transects measurement for species diversity and the transition of Life-forms at Site B.

LIFEFORM CODE	% Cover (%)	Total of diff. in Lc area covered	Pi	ln(Pi)	Pi*ln(Pi)
POC	47.9	958	0.479	0.73605	0.35257
TUB	1.15	23	0.0115	4.46541	0.05135
SND	18.5	370	0.185	-1.6874	0.31217
FAV	6.1	122	0.061	2.79688	0.17061
MON	0.55	11	0.0055	5.20301	0.02862
STN	19.3	386	0.193	1.64507	-0.3175
GAL	0.55	11	0.0055	5.20301	0.02862
ACR	5.45	109	0.0545	2.90955	0.15857
FUN	0.2	4	0.002	6.21461	0.01243
POD	0.3	6	0.003	5.80914	0.01743
TOTAL	100	2000			

*H (Index)- -1.44986 *H (Max)- 7.600902 *Equitability- -0.190748279

Table 6: Percentage cover (Life-forms) and use of Shannon Weiner's index to measure species diversity at Site B.

Management of ecosystem at the Mun Island

In an interview with a tourist guide at the Hon Mun Island, we were meant to understand that the site is being managed by the Government of Vietnam with sole responsibility given to the Ministry of Fisheries as the responsible agency. Khan Hoa PPC and the committees in some allocated communities or villages around the Hon Mun Island.

There are some forms of international support for management of Hon Mun Island from the World Conservation Union supporting the Marine Protected Area, funded by Global Environmental Facility (GEF) through the World Bank as well as the Royal Danish Government through DANIDA [4].

Objectives of Hon Mun marine protected area

- To conserve a representative example of internationally significant and threatened marine biodiversity.

- To enable local island communities to improve their livelihoods and in partnership with other stakeholders to effectively protect and manage the marine biodiversity at Hon Mun as a model for collaborative marine protected area management.

Enforcement plan: The enforcement plan is aimed at eliminating illegal fishing in the area which destroys fish larvae and coral reefs, as well as enforcement of gear and no fishing restricted zones. Some zones have been demarcated for snorkeling, diving, boat settlement and so on, basically recreational activities [5] in the area. Marine protected areas village committees liaising with personnel from the government.

All stakeholders have been brought on deck to help manage the Hon Mun Island. Village committees have been set up in each village to represent the interest of their people, teaming up with Mun Island MPA Authority as well as provincial agencies in management of this zone.

Discussion

Line transects measurement of species at Site A and Site B

The survey was conducted to measure diversity of species at the bottom zone at the Mun Island as well as to enable students to describe reef habitats. Per direct observation, some features which were found in the area can be classified into these (Table 7).

Per the tables, thus, Tables 3-6 outlined in the results of this study for the two given sites, it can be concluded that, both sites have limited variety of species in this ecosystem. Per Shannon Weiner's index of measuring species diversity in a given area, thus, equitability (E^*), when E^* is 1, means there are wide range of species in that area. Half this value means there are fair or moderate variety of species in the area. Before this value ($E^* < 0.5$) means limited diversity of species in an area. At site A, E^* was calculated to be 0.2165 whereas at Site B, E^* was calculated to be 0.19075 [6]. Hence, per these two given values which were being calculated from the data gathered from these two sites, we can logically state that, there are limited diversity of species, specifically, the life-forms in those two given areas or sites as well as other species which may be in the same group or family with these life forms outlined in Tables 4 and 5 but may not be available in these two areas.

Biodiversity of species at the Hon Mun Island

With reference to the tables illustrated above, it can be observed that, there is a wide range of species at the Mun Island from site report and per direct observations made ranging from fishes, crustaceans, echinoderms, molluscs, algae and corals as well as vegetative cover around the ocean with variety of birds and other terrestrial insects and animals.

The main objective of this study was to expose students to biodiversity of species at the site and to take transect measurement in shallow zones of the ocean where there are coral reefs, sand and rocky zones coupled with other species.

Living biotic features	Substrata	Others
Lively hard corals	Sand	Geomorphology
Soft corals	Bedrock	Visibility
Macro algae	Rubble	Depth
Sponge	Dead coral	
Some fish species Echinoderms like; sea urchins, star fish and so on		

Source: Field Survey

Table 7: Biotic and abiotic features at these two sites.

Coral reefs at the Mun Island

There were wide ranges of coral reef forms ranging from encrusting, columnar, plate-like, mushroom (*Fungia sp.*), free living, massive, semi-massive and branching corals. These coral forms had several polyp growth forms like; *plocoids*, *phaceloid*, *ceroid*, meandering and flabello-meandroid growth forms embedded around them when observed from above (Figure 2).

Coral reefs as a base for protection and habitat for some fishes, echinoderms, crustaceans and molluscs

Per direct observation, some dead corals, broken (fragmented) corals in a state of bleach with some still growing as well as a coral with half of its section being dead and half being alive in the images below (Figures 3 and 4).

Threats/Problems the Hon Mun Island is faced with:

- Over-harvesting of resources:** Overfishing may cause algae bloom since some of these fishes feed on algae and when harvested excessively may increase the accumulation of algae. In addition is harvesting corals for making jewelries and other ornaments.
- Illegal fishing**
- Tourism and other recreational activities** like; diving, snorkeling and trampling, touching or walking on coral reefs by some tourist as well as anchor damage from boats especially during low tide zones (Figure 5).
- Pollution:** Some forms of solid waste like; clothes, baskets, old fishing nets and polythene bags were found beneath the ocean where there are coral reef platforms from direct observation. This goes a long way to breed algae and compete for space with corals (Figure 6).
- Inputs from land like; nutrients and sediment run off** from agricultural lands around the island or from mountainous farmlands. This causes smothering and growth of algae competing with the corals (Figure 7).
- Invasion of some species thereby causing some corals to die off or bleach:** e.g. Crown-of-thorn on some corals with some images captured from field study (Figure 8).

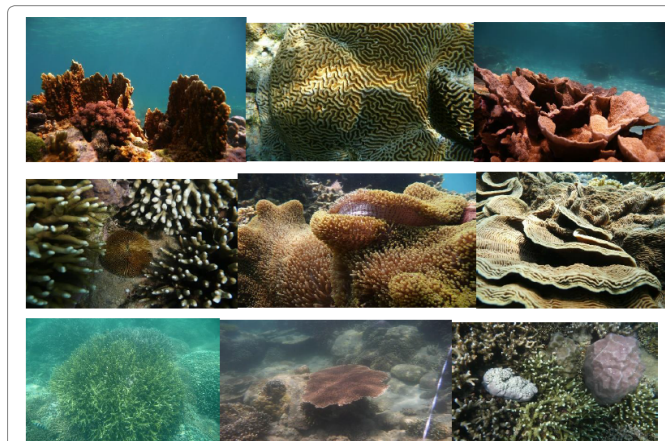


Figure 2: Coral reefs at the Mun Island (Source: Field Data/Survey).

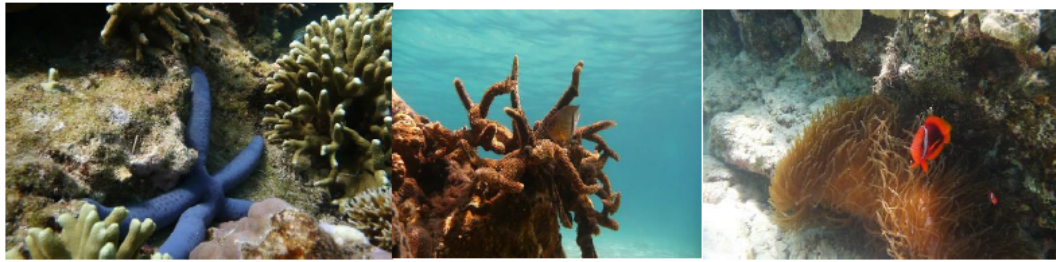


Figure 3: Coral reefs as a base for protection and habitat for some fishes, echinoderms, crustaceans and molluscs (Source: Field Data/Survey).

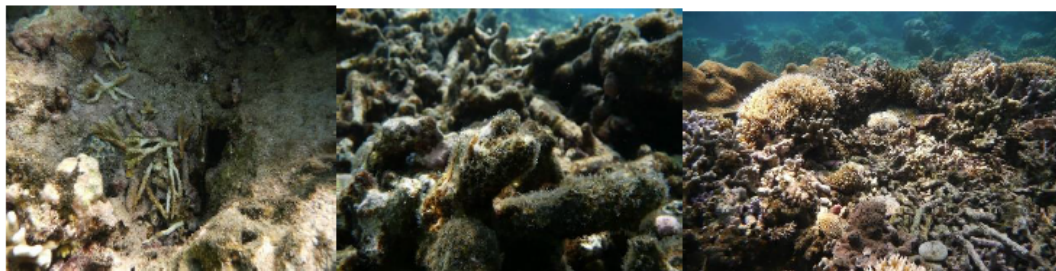


Figure 4: Observation of some dead corals, broken (fragmented) corals in a state of bleach with some still growing as well as a coral with half of its section being dead and half being alive (Source: Field Data/Survey).

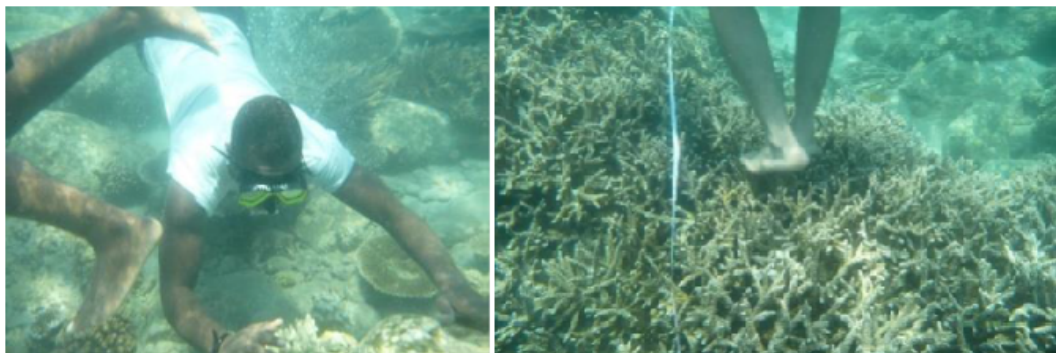


Figure 5: Threats/Problems the Hon Mun Island is faced with.

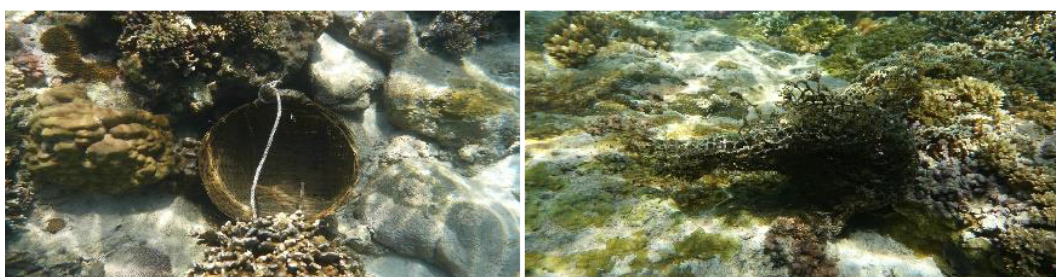


Figure 6: Observation of solid waste like; clothes, baskets, old fishing nets and polythene bags were found beneath the ocean (Source: Field Data/Survey).

Recommendations

These are some measures which when effectively taken into consideration, can ensure sustainable use of resources at the Hon Mun Island:

1. Participatory planning and management by relevant stakeholders.
2. Development of alternative income generating activities to

draw people away from activities associated with excessive resource use.

3. Capacity building through management training and public education. A tourist who visits this site are being sensitized, fishermen, local people in the area are being educated about the need to conserve the resource and how their actions can significantly impact upon the resources in the area.
4. Monitoring and evaluation of how effective policies, plans and



Figure 7: Observation of inputs from land like; nutrients and sediment run off (Source: Field Data/Survey).



Figure 8: Invasion of some species thereby causing some corals to die off or bleach.

programs which have been implemented are meant to conserve or keep the resources in its pristine nature.

5. Support community involvement through; Collection of user fees of which a percentage is returned to local communities. Local people are involved in monitoring the change in biodiversity. Local people are rewarded for improvements in the local marine environment.

Conclusion

In nut-shell, participatory or action based approach as well as conservation, are two main approaches, which can be adhered to ensure sustainable use of resources if the right policy framework and monitoring mechanisms are properly structured through institutional capacity [7]. The factors spelt above delves into biodiversity of species at the Hon Mun Island, who manages the site, support, threats which degrade the site's pristine ecosystem and proposed measures which can be adapted to ensure sustainability of resources in that marine environment.

Acknowledgement

We would like to express our profound gratitude to God Almighty for giving us strength to embark on this study thereby making this study fruitful. We would also like to thank the management at the Hon Mun Island for their time and information they gave to us as well as Norhed and management of Nha Trang University for the resources they provided in making this study a success.

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