

Coral Cay Conservation 2013

Using biological indicators to assess the conservation value of coral reefs around Koh Rong and Koh Rong Samloem, Cambodia

Presented to the Fisheries Administration, Ministry of Agriculture,
Forestry and Fisheries



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In Partnership With:



**Fisheries Administration,
Ministry of Agriculture, Forestry and Fisheries**

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Coral Cay Conservation

Founded in 1986, CCC is dedicated to 'providing resources to protect livelihoods and alleviate poverty through the protection, restoration and sustainable use of coral reefs and tropical forests'. CCC works in collaboration with government and non-governmental organisations within a host country and does not charge that country for the services provided. CCC is primarily self-financed through a pioneering volunteer participatory scheme whereby international volunteers are given the opportunity to join a phase of each project in return for a financial contribution towards the project costs. Upon arrival at a project site, volunteers undergo a training programme in marine life identification and underwater survey techniques, under the guidance of qualified marine scientists, prior to assisting in the acquisition of data. Finances generated from the volunteer programme allow CCC to provide a range of services, including data acquisition, assimilation and synthesis, conservation education, technical skills training and other capacity building programmes.

CCC has been successfully operating volunteer based conservation programmes in developing countries over the past 27 years with several internationally notable accomplishments, including the establishment of several Marine Protected Areas around the world. Examples of CCC action include the creation of the UNESCO World Heritage Site in Belize, the Danjugan Marine Reserve and Wildlife Sanctuary for Negros in Philippines, and the development of 12 no-take marine parks around Sogod Bay in the Philippines.

1. Introduction

Cambodia has a rich abundance of fringing reef, but the overall status of these reefs is poorly researched and documented (Kim et al., 2004). At the invitation of the Fisheries Administration (FiA) of the Cambodian Ministry of Agriculture, Forestry and Fisheries (MAFF), Coral Cay Conservation (CCC), a British NGO, has conducted research on the state of the coral reefs around the islands of Koh Rong, Koh Koun and Koh Rong Samloem, Phreah Sihanouk Province. With anthropogenic pressure likely to increase in the next decade as a result of large scale tourism development on Koh Rong and Koh Rong Samloem, among other pressures, there is a need to establish effective protection and management systems for the marine resources in the area. In light of this, the FiA is currently working with local stakeholders and NGOs to implement a multiple-use marine protected area (MPA), known locally as a marine fisheries management area (MFMA) to reflect the national Fisheries Law and a multiple-use approach that allows tourism, fishing biodiversity and conservation.

1.1 Report Aim

The vision for the MFMA around Koh Rong and Koh Rong Samloem islands has been identified as: *“A model marine fisheries management area for conservation of marine biodiversity, sustainable fishing and tourism, contributing to poverty reduction.”* (FiA, *in litt.*). Thus, in order to be successful, the MFMA must balance a number of ecosystem protection goals incorporating both ecological and economic considerations. Multiple-use zoning provides a means of balancing these, often conflicting, considerations and accommodating a wide range of stakeholders (IUCN-WCPA, 2008). A zoning scheme generally includes areas under strict protection and areas with increasing fewer restrictions (IUCN, 2008). This approach identifies different zones within the MPA and defines what uses are limited, to what extent, and by what means in each of these.



“A model marine fisheries management area for conservation of marine biodiversity, sustainable fishing and tourism, contributing to poverty reduction”

To achieve the goals of biodiversity conservation and supporting sustainable fishing practices, the MFMA must effectively protect sufficient habitats to support key ecological processes such as spawning and food webs (Secretariat of the Convention on Biological Diversity, 2004). In order to determine which areas are most deserving of this protection, we can estimate the conservation value of different areas. Assessment of the conservation value of coral reefs incorporates a number of factors which can include biodiversity of coral, fish and invertebrates, fisheries potential, habitat for rare or endangered species, aesthetic value and economic potential from tourism (Edinger and Risk, 1998). This report aims to support the zonation process around Koh Rong and Koh Rong Samloem by summarising key biological findings in order to highlight areas of particular biological interest which should be protected within the MFMA.

2. Methods

2.1 Ecological Surveys

Ecological data was collected from the reefs around Koh Rong and Koh Rong Samloem islands by trained CCC staff and volunteers, using the Reef Check methodology (van Bochove et al, 2012). Surveys were conducted at 156 locations around the two islands (Figure 1). Data collected included:

1. Site description
2. Fish abundance, size and diversity
3. Invertebrate abundance and diversity
4. Benthic composition (substrate)
5. Coral disease, impacts and anthropogenic impacts

Appendix A lists the target substrates, fish and invertebrates that were recorded.

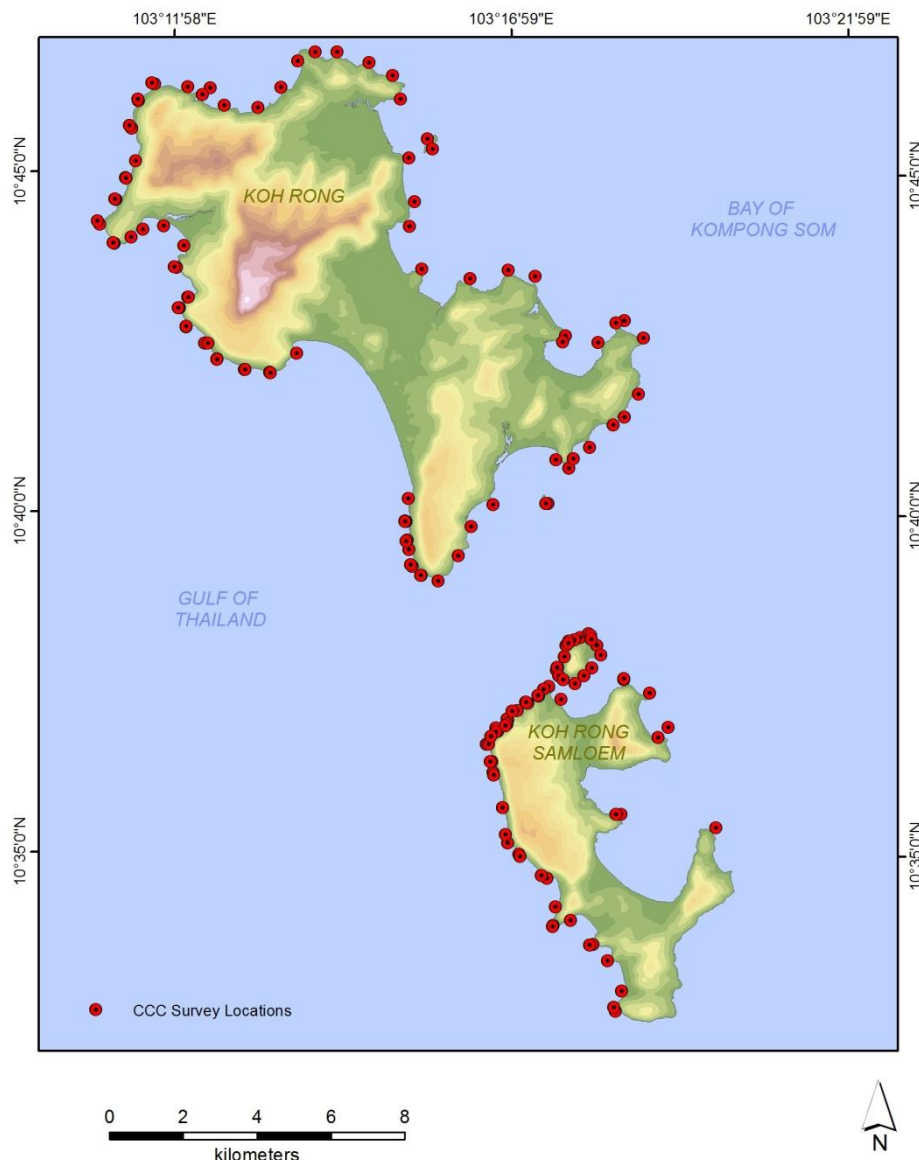


Figure 1 – CCC survey locations around Koh Rong and Koh Rong Samloem

2.2 Conservation Value Analysis

In order to provide a general overview highlighting areas of particular biological interest, data from these surveys was analysed to produce the following ‘conservation indices’:

- Fish target species abundance (total number of individuals recorded)
- Fish target species diversity (Fishers α)
- Food fish* abundance (total number of individuals recorded)
- Invertebrate target species abundance (total number of individuals recorded)
- Invertebrate target species diversity (Fishers α)
- Hard coral percentage cover
- Coral target species diversity (Fishers α)

* *Rabbitfish (Siganidae), Snappers (Lutjanidae), Barracuda (Sphyraenidae), Emperors (Lethrinidae), Jacks/Trevally (Carangidae), Sweetlips (Haemulidae), Parrotfish (Scaridae), Groupers (Serranidae).*

The value of an index for each site was assigned to an abundance class (very low, low, medium, high or very high) whose boundaries were determined by the overall index values of all of the sites. Thus the results presented represent a relative assessment, based on all of the sites surveyed in the area. This means that the values presented in this report are site specific and do not provide a mechanism for wider regional or national comparisons.

To summarise this information into a single output, a ‘conservation management value’ (CMV) was determined. This value was calculated by comparing the value of each index at a site with the mean value of that index. Sites that were above average were allocated a score of 1, while those below average were given a score of 0. Overall CMV was calculated by adding together the score for each individual index, thus producing a total score between 0 and 7.

ArcGIS (ERSI Software) was used to facilitate data analysis and display survey results onto Geographic Information System (GIS) maps. The Fishers α diversity index used to calculate coral, fish and invertebrate diversity was generated in PRIMER-5 software.

3. Results

Figures 2-9 on the following pages present the individual conservation indices calculated, in addition to the overall conservation management value for each site. Each index is presented in two figures, one showing values for every site and one showing only high or very high values for clarity. These figures highlight a number of sites of particular biological interest, predominantly on the northern and western areas of both Koh Rong and Koh Rong Samloem islands, and around Koh Koun (a small island just north of Koh Rong Samloem).

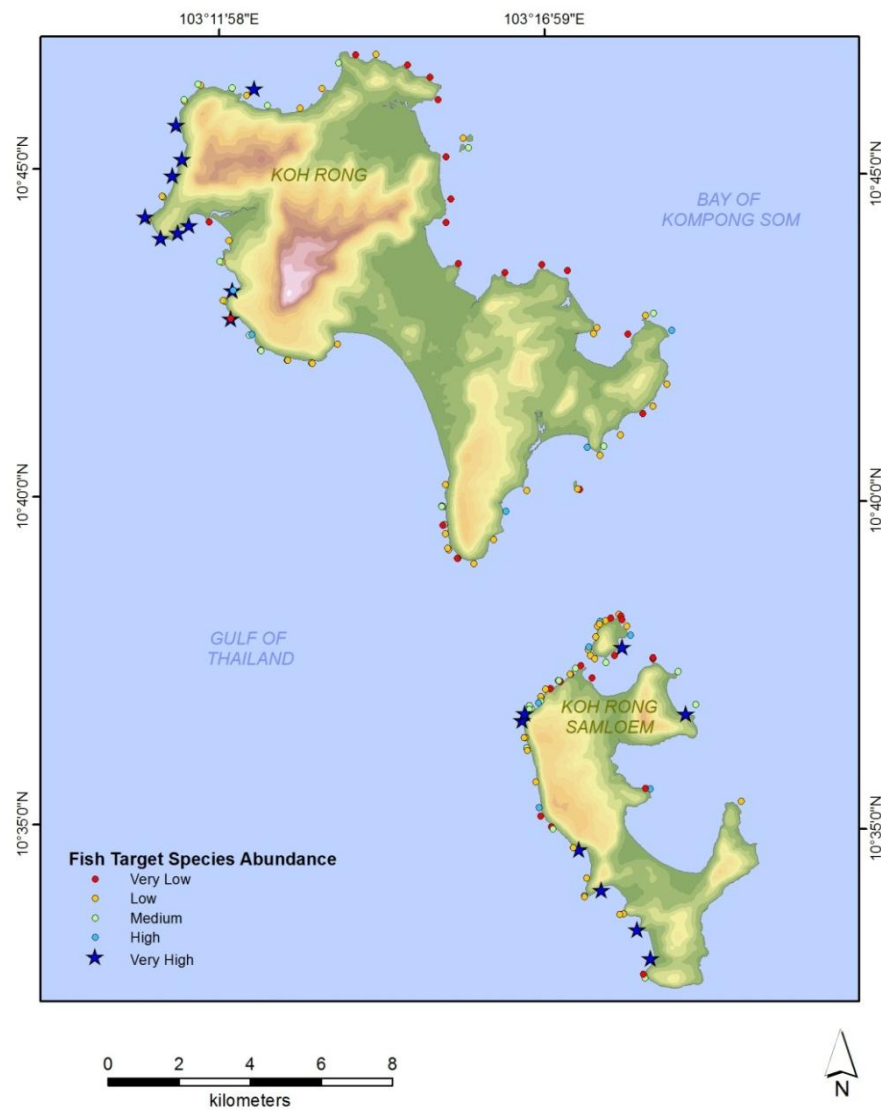


Figure 2a – Fish target species abundance at all CCC survey sites

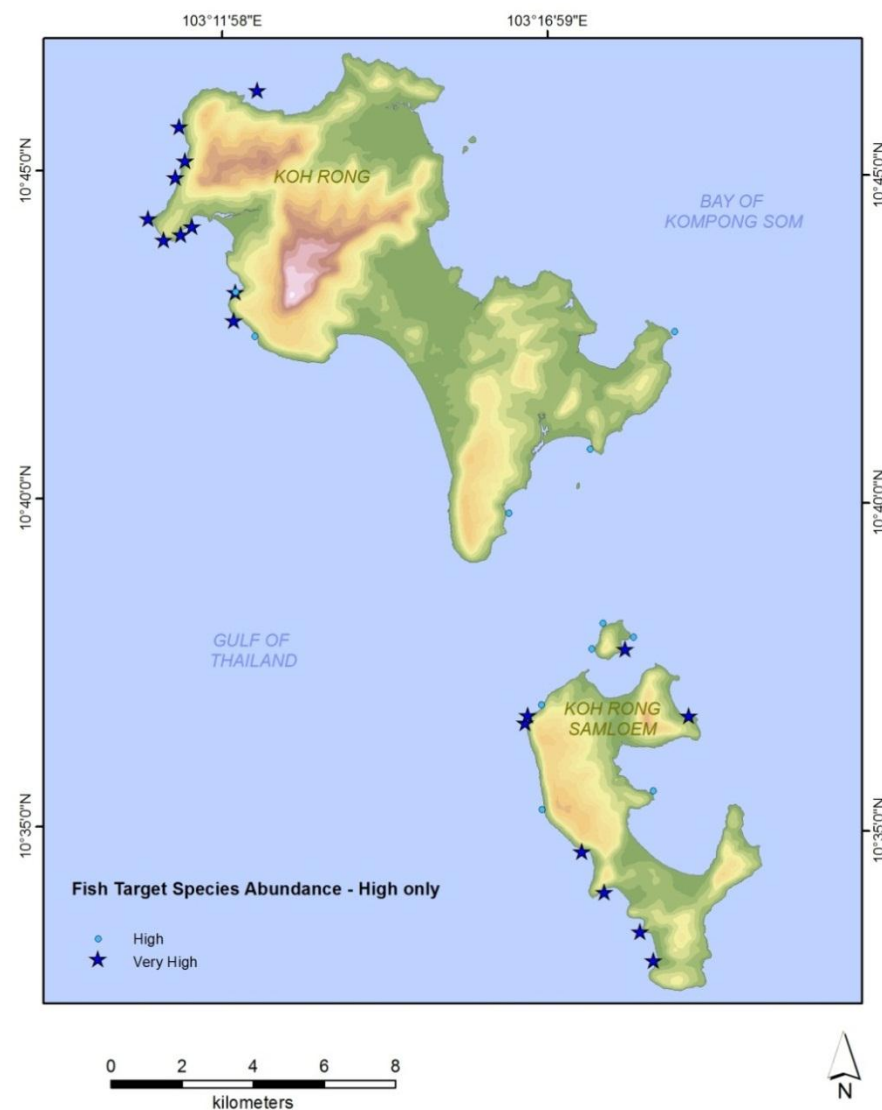


Figure 2b – Fish target species abundance at sites with high or very high values

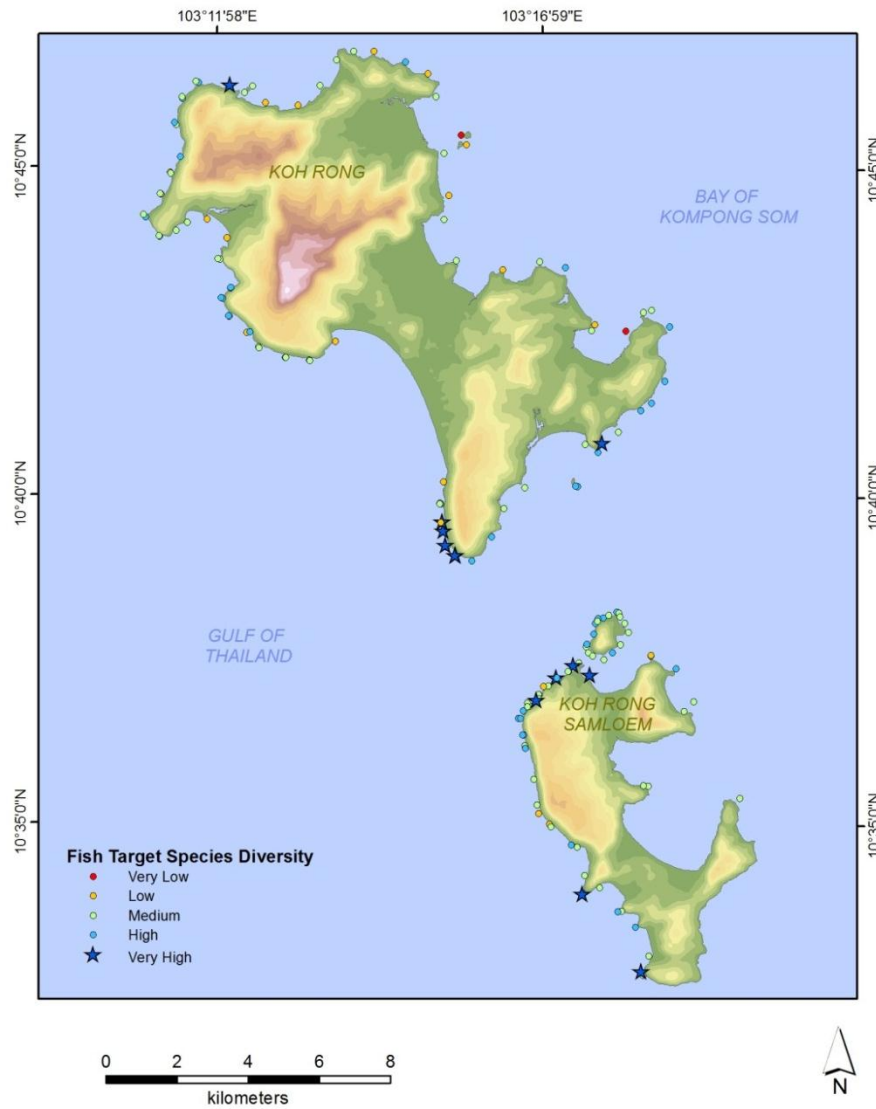


Figure 3a – Fish target species diversity at all CCC survey sites

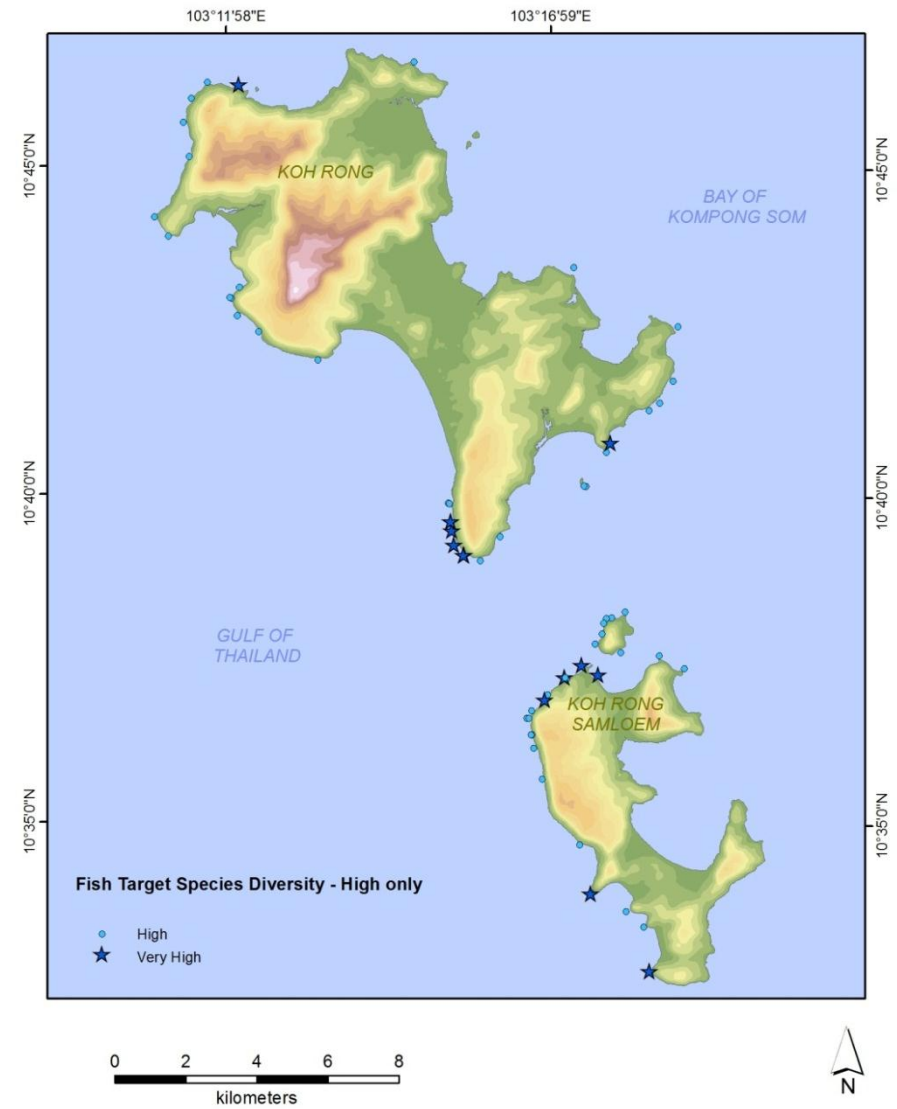


Figure 3b – Fish target species diversity at sites with high and very high values

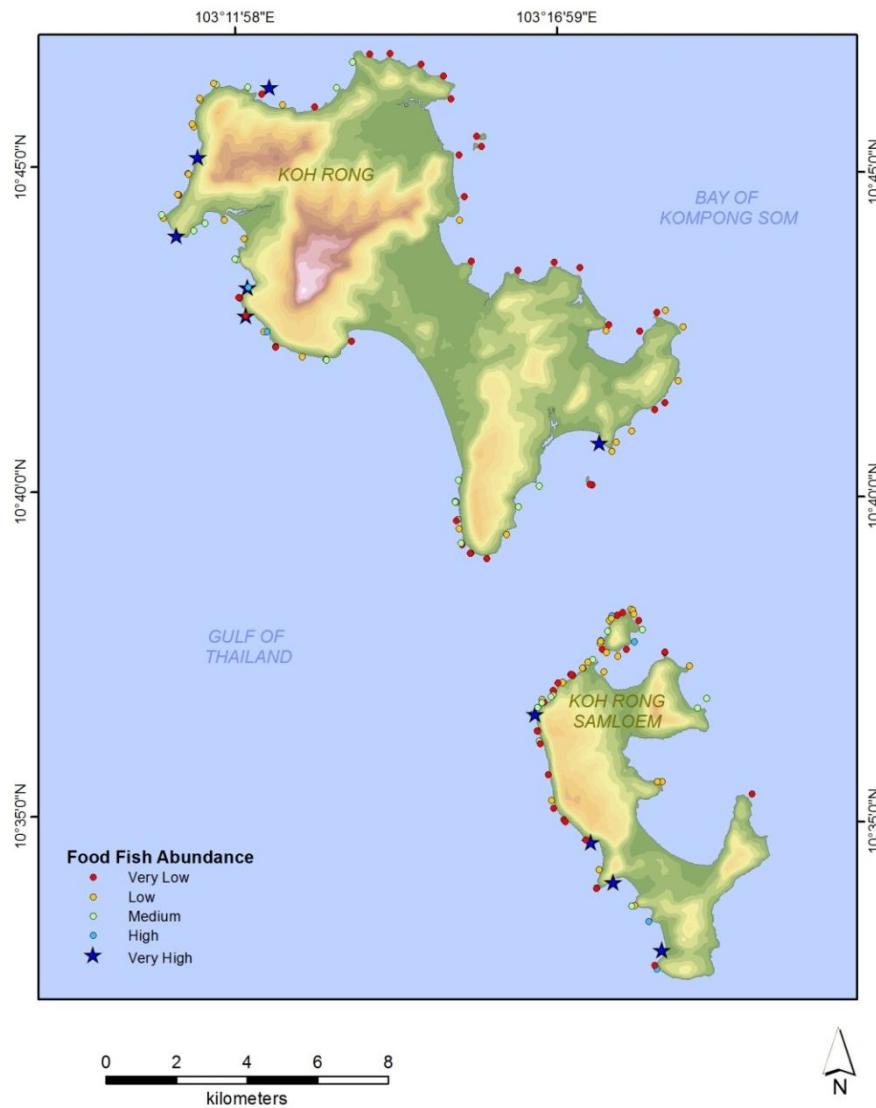


Figure 4a – Food fish abundance at all CCC survey sites

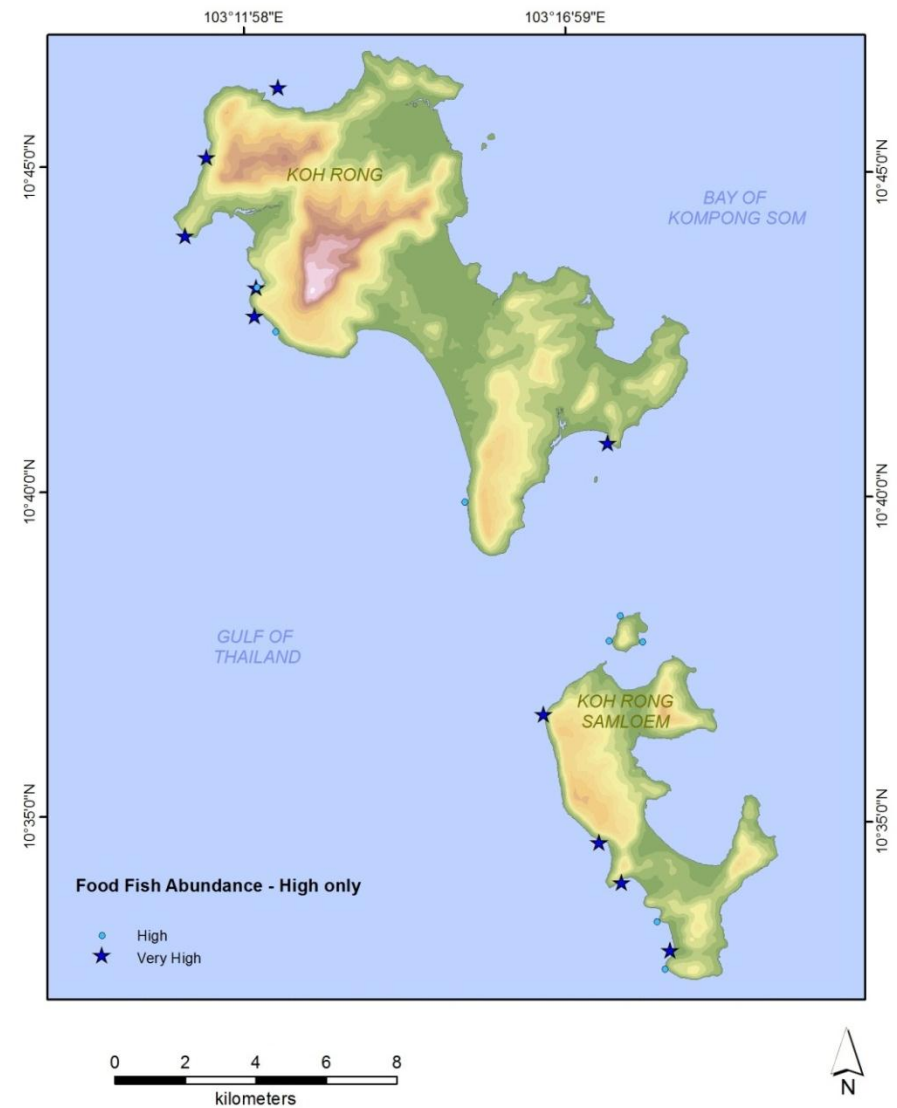


Figure 4b – Food fish abundance at sites with high and very high values

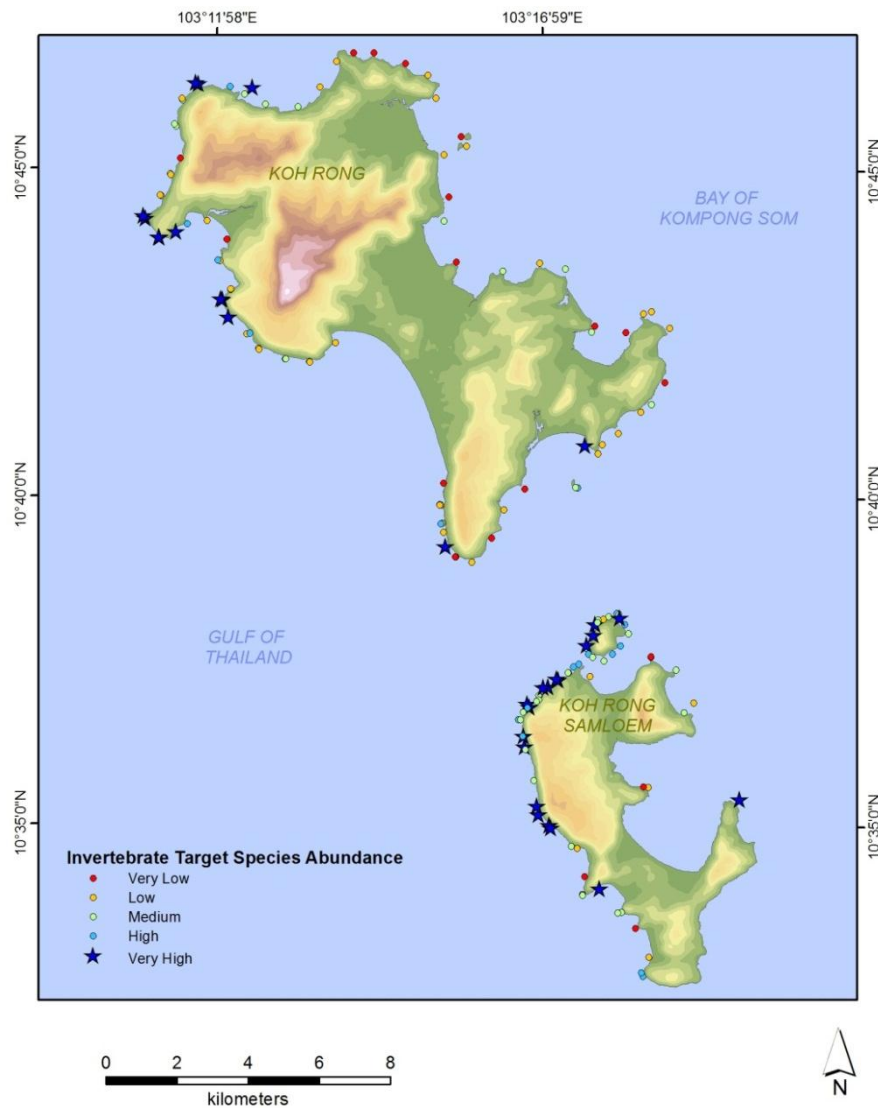


Figure 5a – Invertebrate target species abundance at all CCC sites

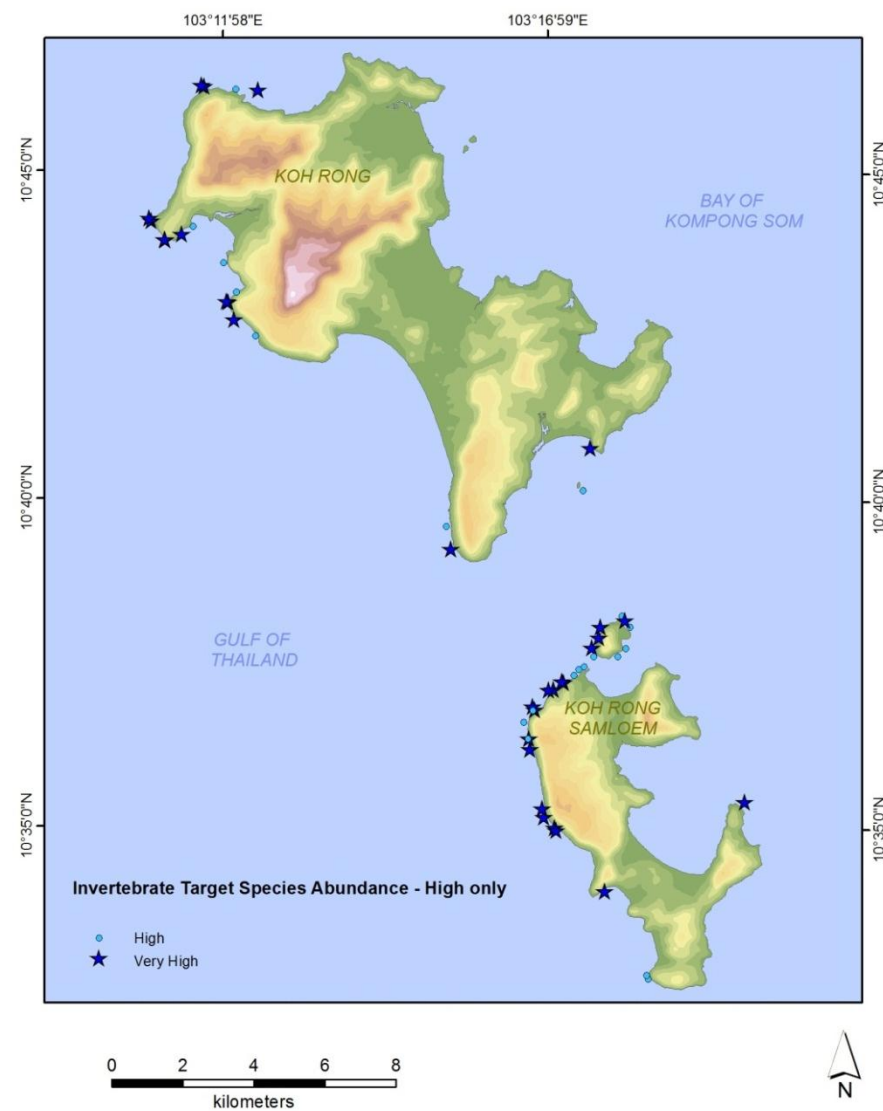


Figure 5b - Invertebrate species abundance at sites with high and very high values

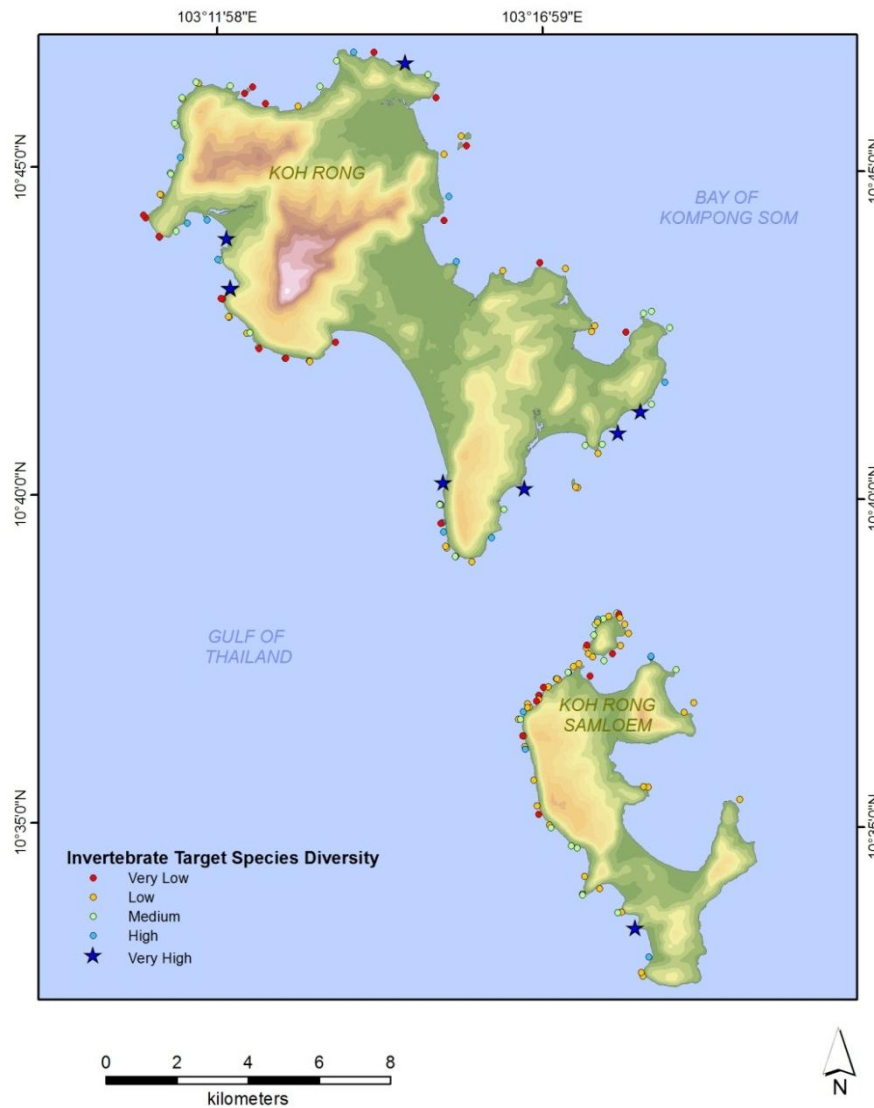


Figure 6a – Invertebrate target species diversity at all CCC survey sites

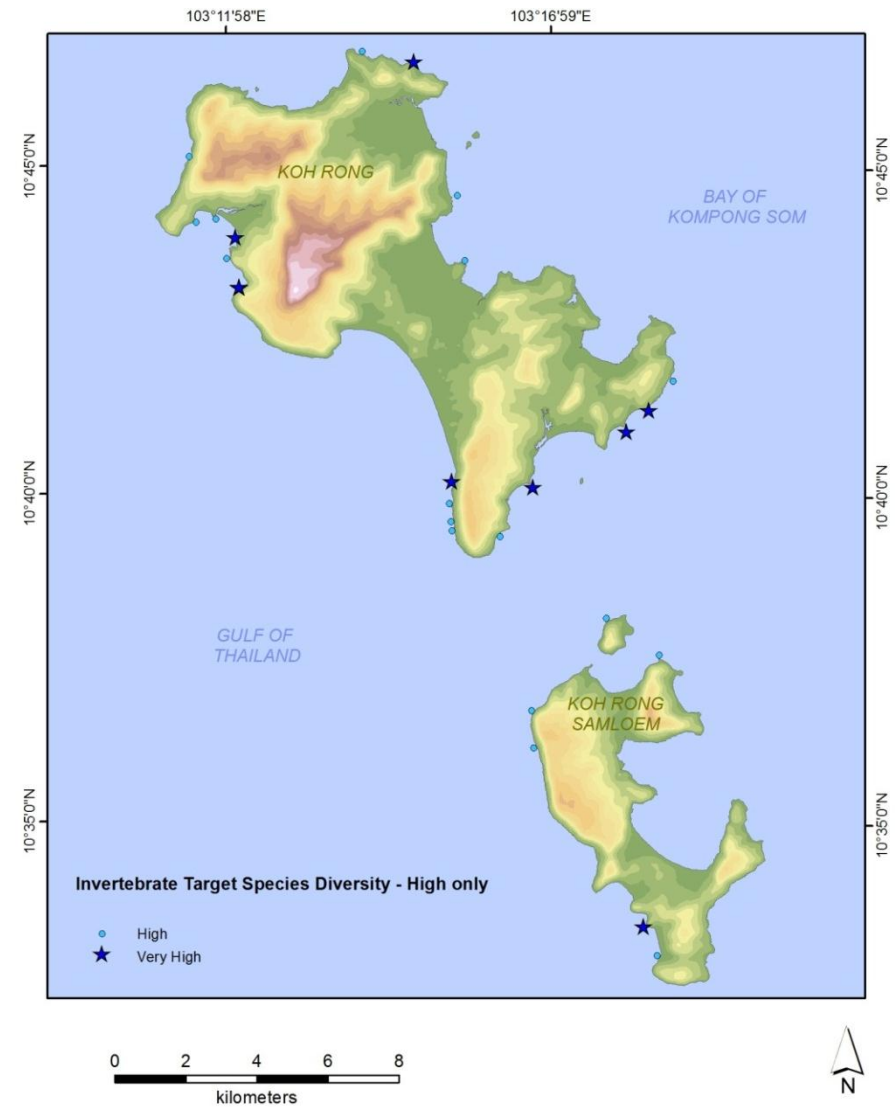


Figure 6b – Invertebrate target species diversity at sites with high and very high values

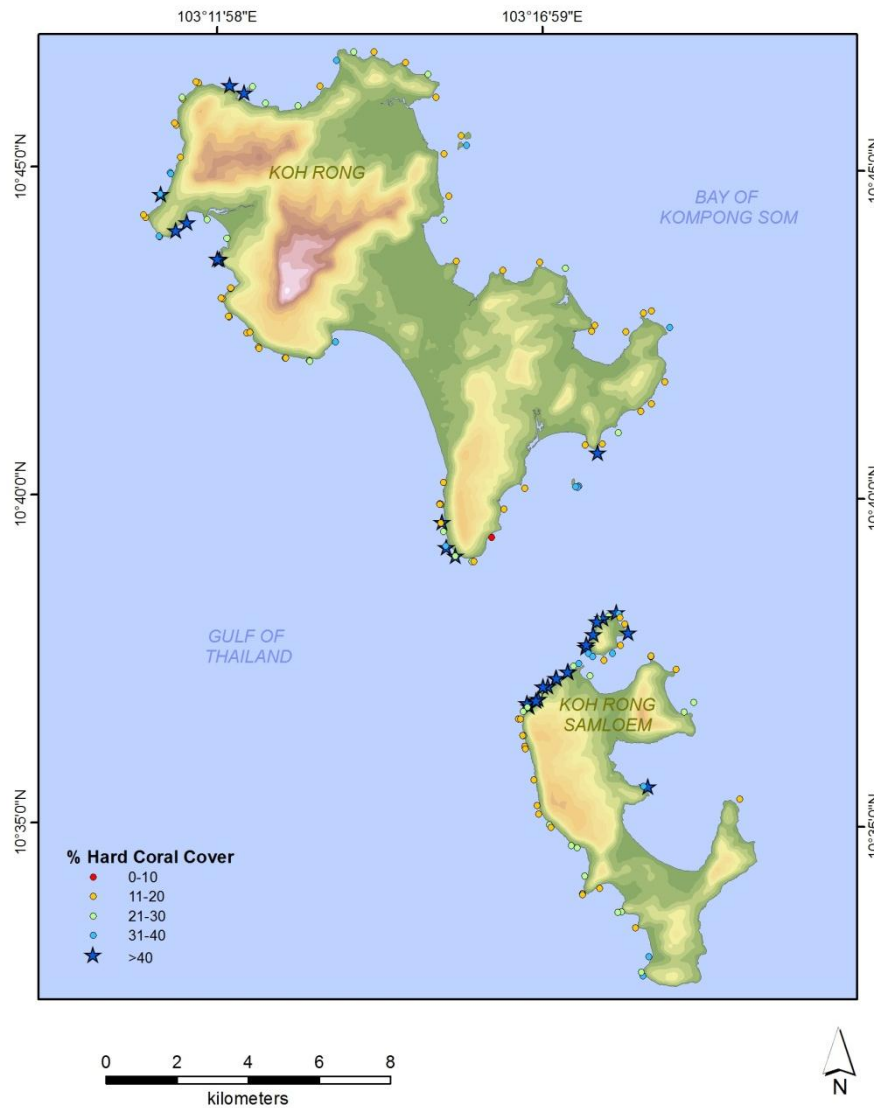


Figure 7a – Hard coral percentage cover at all CCC survey sites

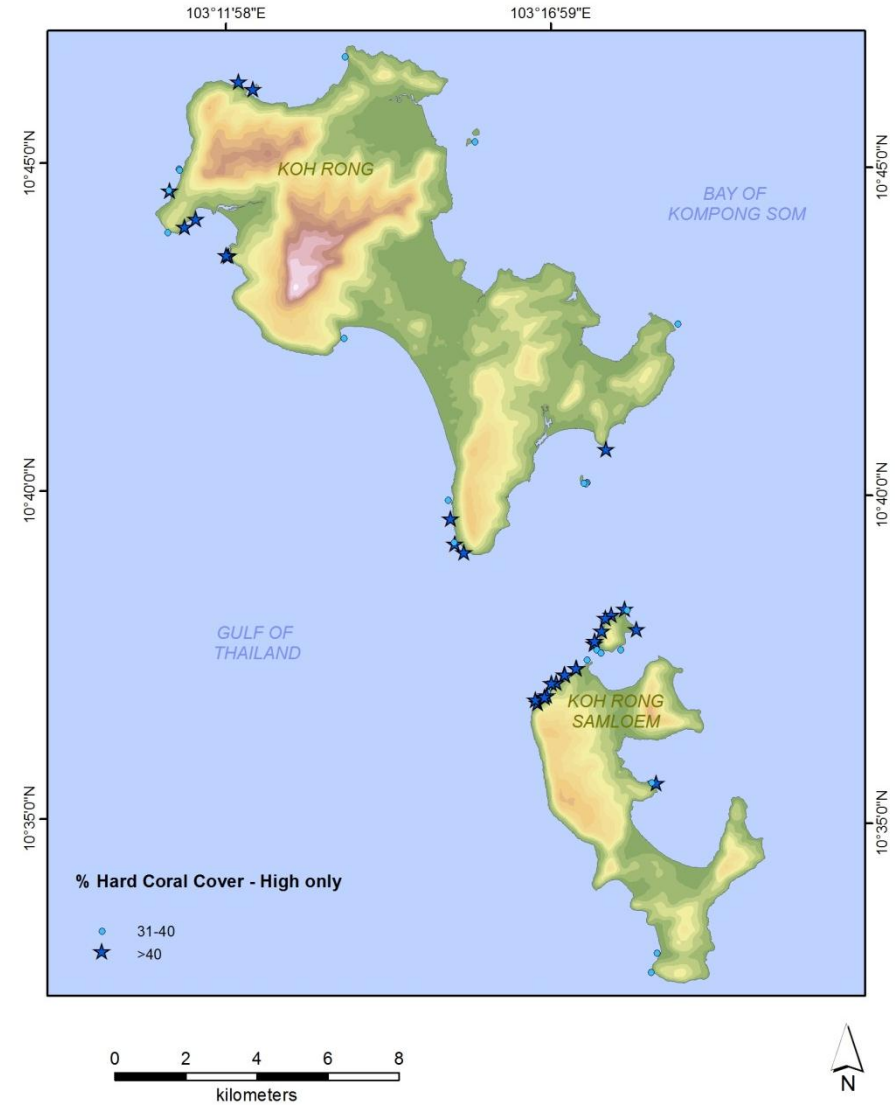


Figure 7b – Hard coral percentage cover at sites with high and very high values

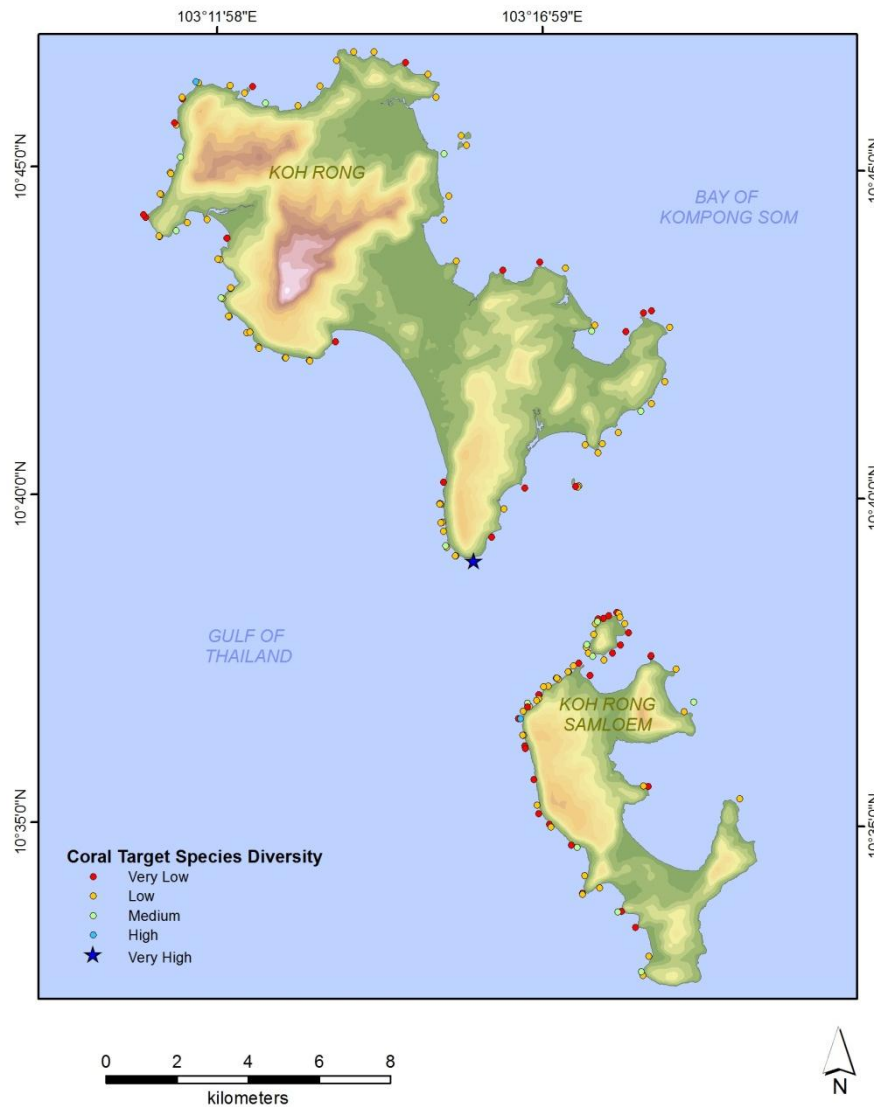


Figure 8a – Hard coral target species diversity at all CCC survey sites

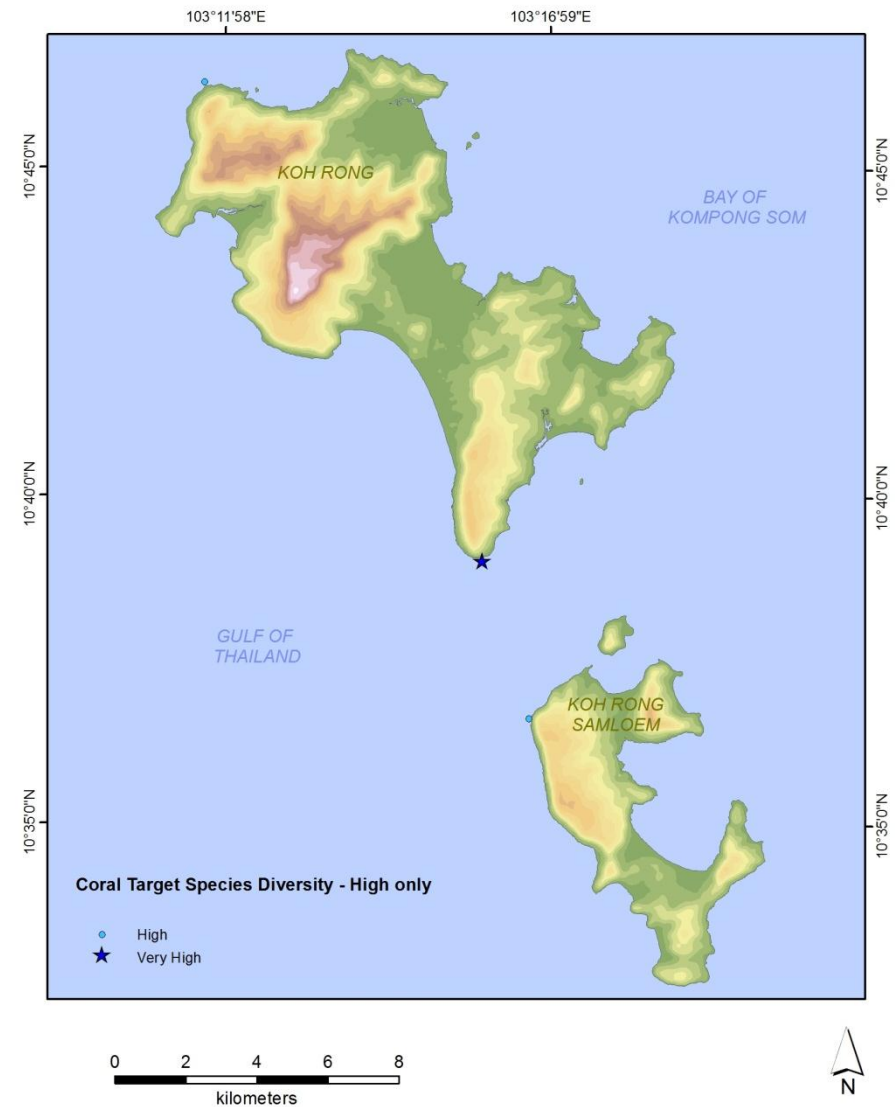


Figure 8b – Hard coral target species diversity at sites with high and very high values

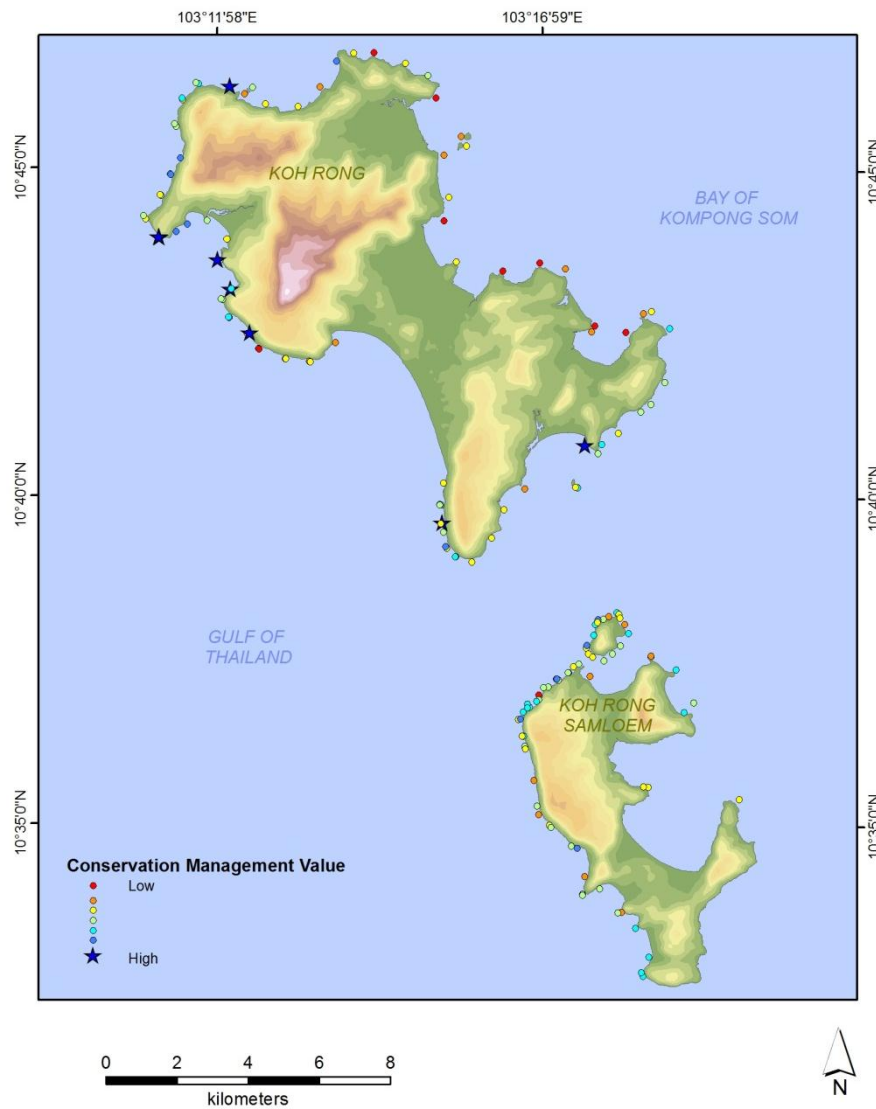


Figure 9a – Conservation management value at all CCC survey sites

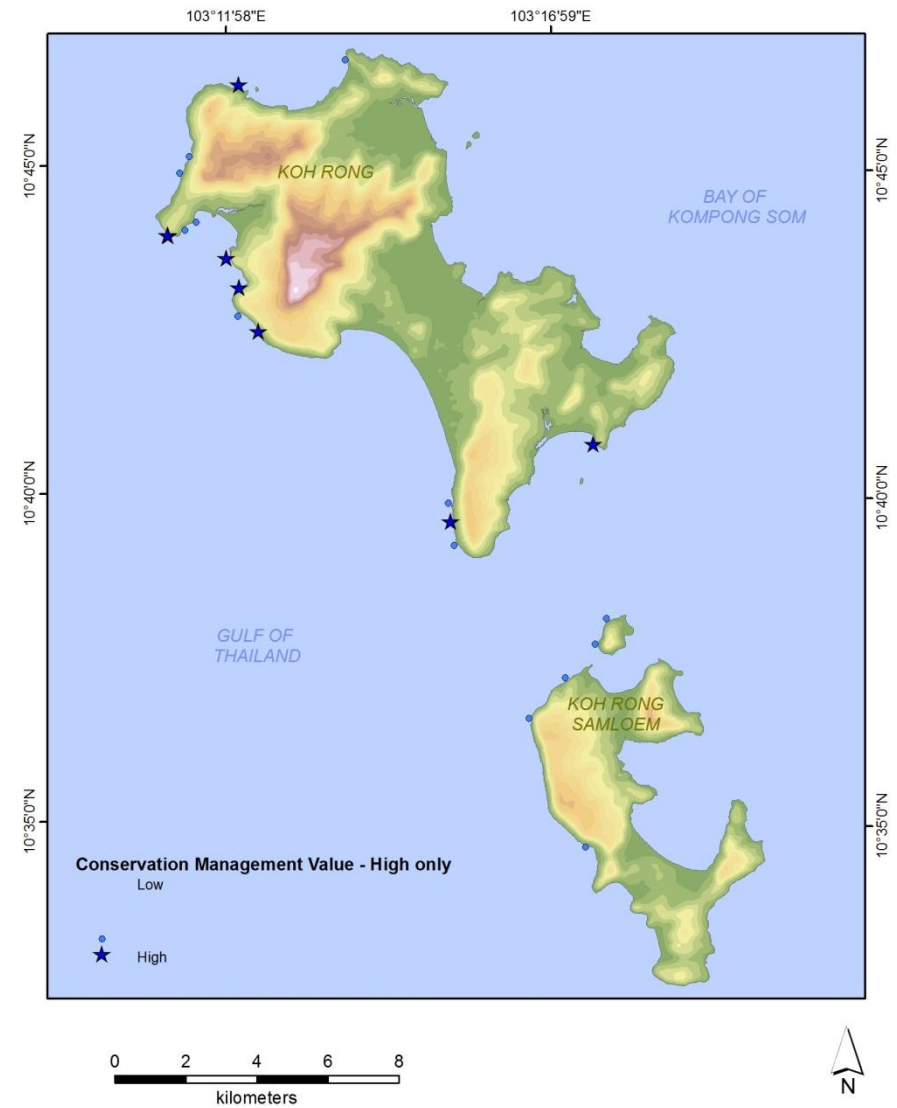


Figure 9b – Conservation management value at sites with high and very high values

4. Conclusion

The figures presented above highlight key areas which should be considered for protection within the MFMA around Koh Rong and Koh Rong Samloem islands. While the CMV summarises all the indices, it should not be taken as the sole indicator for high priority sites. Since, by comparing the mean values for each index, a high CMV highlights sites that are above average in several indicators but does not necessarily take into account sites which have an especially high value for only one or two indices. As such, an evaluation of high priority sites for protection within the MFMA should take into account all of the information presented in this report. Figure 10 shows a summary of the key areas of conservation interest, incorporating both sites with high CMVs and particularly high values for individual indices.

It is important to bear in mind that the data presented in this report relate to coral reef habitats only. However, it is essential that all marine habitat types present in the area are protected within the MFMA to protect the full range of biodiversity, maximise connectivity and minimise the impact of large-scale effects, such as climate change (Secretariat of the Convention on Biological Diversity (2004)). It is therefore recommended that Figure 10 serves as a foundation to which additional biological data can be added for other habitats of interest such as sea grass beds and mangroves.

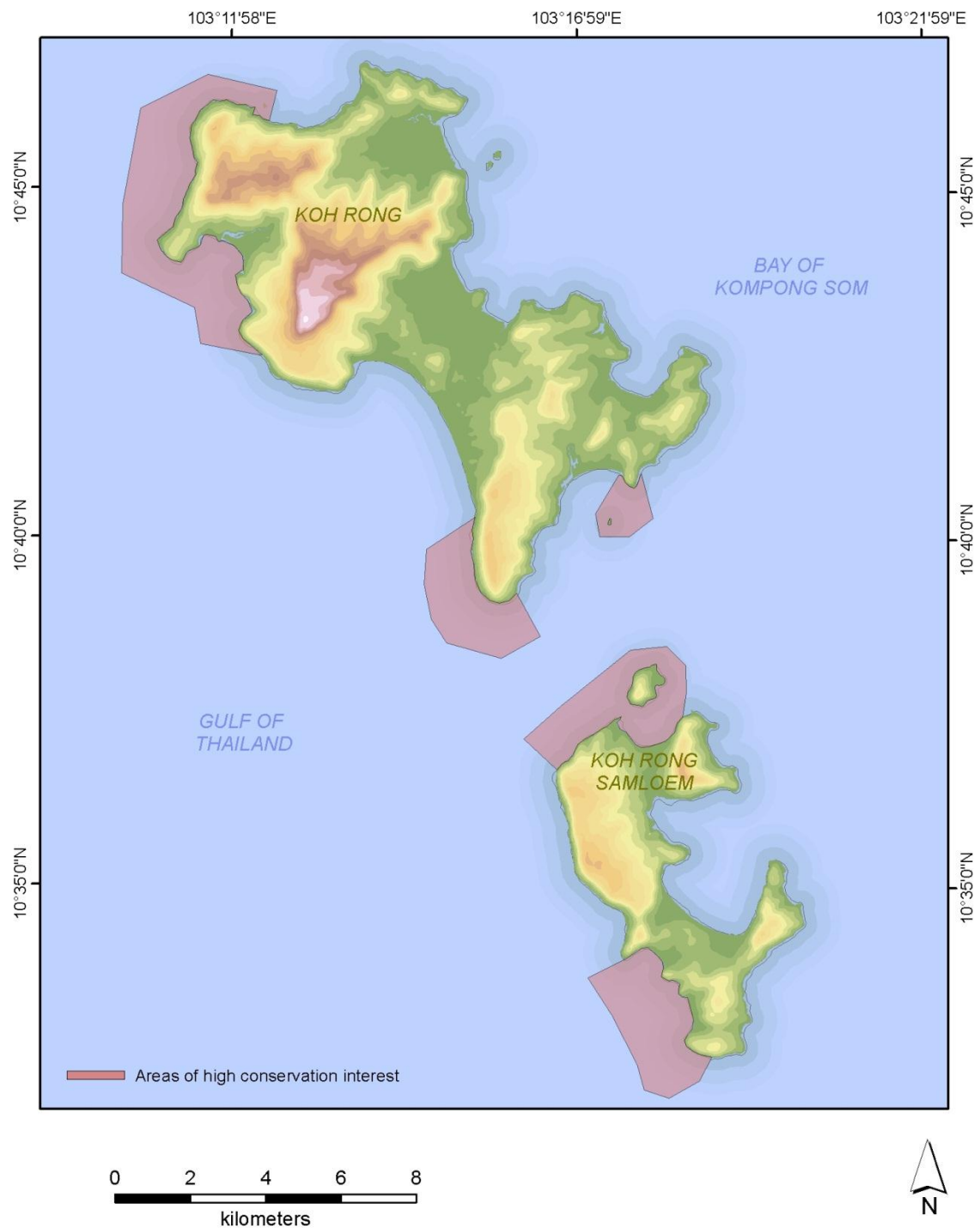


Figure 10 – Map showing areas of high conservation interest, based on CMVs and individual index values. Seaward boundaries were defined to ensure encapsulation of associated reef habitats.

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Appendix – Target Species Lists

FISH

Butterflyfish (Chaetodontidae)	Fusiliers (Caesionidae)
<i>Eight-Banded Butterflyfish (Chaetodon octofasciatus)</i>	Emperors (Lethrinidae)
<i>Longfin Bannerfish (Heniochus acuminatus)</i>	Jacks/Trevally (Carangidae)
<i>Long-beaked Coralfish (Chelmon rostratus)</i>	Squirrel/Soldierfish (Holocentridae)
Angelfish (Pomacanthidae)	Cardinal (Apogonidae)
<i>Blueringed Angelfish (Pomacanthus annularis)</i>	Lizardfish/Sandperch (Synodontidae/Pinguipedidae)
Rabbitfish (Siganidae)	Goby (Gobiidae)
<i>Golden Rabbitfish (Siganus guttatus)</i>	Blenny (Blenniidae)
<i>Coral Rabbitfish (Siganus corallinus)</i>	Scorpionfish (Scorpaenidae)
<i>Virgate Rabbitfish (Siganus virgatus)</i>	Boxfish (Ostraciidae)
<i>Java Rabbitfish (Siganus javus)</i>	Goatfish (Mullidae)
Damselfish (Pomacentridae)	Sweepers (Pempheridae)
<i>Sergeant Damselfish</i>	Pufferfish (Tetradontidae)
<i>Anemonefish (Amphiprion sp.)</i>	Porcupinefish (Diodontidae)
Snapper (Lutjanidae)	Seahorse/Pipefish (Syngnathidae)
<i>Checkered Snapper (Lutjanus decussatus)</i>	Moray eel (Muraenidae)
<i>Red Snapper (Lutjanus bohar)</i>	Sweetlips (Haemulidae)
<i>Blacktail Snapper (Lutjanus fulvus)</i>	Bamboo Sharks (Hemiscylliidae)
Monocle Breems (Nemipteridae)	Blue-spotted Ribbontail Ray (<i>Taeniura lymma</i>)
<i>Bridled Monocle Bream (Scolopsis bilineatus)</i>	Spadefish/Batfish (Ephippidae)
<i>Whitestreak Monocle Bream (Scolopsis ciliatus)</i>	Parrotfish (Scaridae)
Barracuda (Sphyraenidae)	<i>Bumphead Parrotfish (Bulbometopon muricatum)</i>
<i>Yellowtail Barracuda (Sphyraena flavicauda)</i>	Barramundi Cod (<i>Cromileptes altivelis</i>)
<i>Great Barracuda (Sphyraena barracuda)</i>	Double-banded Soapfish (<i>Diploprion bifasciatum</i>)
Wrasse (Labridae)	Groupers (Serranidae)
<i>Humphead Wrasse (Cheilinus undulates)</i>	<i>Honeycomb Grouper</i>
<i>Red-breasted Wrasse (Cheilinus fasciatus)</i>	<i>Blue-lined Grouper (Cephalopholis formosa)</i>
<i>Crescent Wrasse (Thalassoma lunare)</i>	<i>Chocolate Grouper (Cephalopholis boenak)</i>
<i>Tripletail Wrasse (Cheilinus trilobatus)</i>	<i>Peacock Grouper (Cephalopolis argus)</i>
	<i>Squaretail Grouper (Plectropomus areolatus)</i>

INVERTEBRATES

Worms	<i>Drupella</i>	<i>Culcita novaeguineae</i>
Feather Duster Worms	Topshell	Feather Star
Christmas Tree Worms	Nudibranch	Urchins
Flatworms	Other	<i>Diadema</i> spp. Urchin
Crustacea	Cephalopods	Pencil Urchin
Banded Coral Shrimp	Octopus	Collector Urchin
Lobster	Cuttlefish	Sea Cucumber
Gastropods	Squid	Prickly Redfish Sea Cucumber
Cowries	Sea Stars	Greenfish Sea Cucumber
Triton's Trumpet	<i>Acanthaster planci</i> (COTS)	Pinkfish Sea Cucumber
Cone Shell	<i>Protoreaster nodosus</i>	Giant Clams

SUBSTRATES

Coral Lifeforms	Non-Acropora branching	Non-Acropora mushroom
<i>Acropora</i> branching	Non-Acropora encrusting	<i>Heliopora</i> (blue coral)
<i>Acropora</i> encrusting	Non-Acropora foliose	<i>Millepora</i> (fire coral)
<i>Acropora</i> submassive	Non-Acropora massive	<i>Tubipora</i> (organ pipe)
<i>Acropora</i> digitate	Non-Acropora submassive	
<i>Acropora</i> tabulate		
Target Hard Corals		
Brain Small	<i>Porites</i> <i>rus</i>	<i>Tubastrea micrantha</i>
Brain Medium	<i>Turbinaria</i>	<i>Astreopora</i>
Brain Large	<i>Lobophyllia</i>	<i>Pectinia</i>
Massive <i>Porites</i>	<i>Plerogyra</i>	<i>Herpolitha limax</i>
<i>Echinopora</i>	<i>Favia</i>	<i>Ctenactis echinata</i>
<i>Galaxea</i>	<i>Favites</i>	<i>Polyphyllia talpina</i>
<i>Goniopora/Alveopora</i>	<i>Diploastrea heliopora</i>	<i>Pseudosiderastrea</i>
<i>Pavona decussata</i>	<i>Podabocia</i>	<i>Euphyllia</i>
Other Substrates		
Soft coral	Rock	Sand
Sponge	Silt/mud	Nutrient indicator algae
Recently killed coral	Rubble	Other