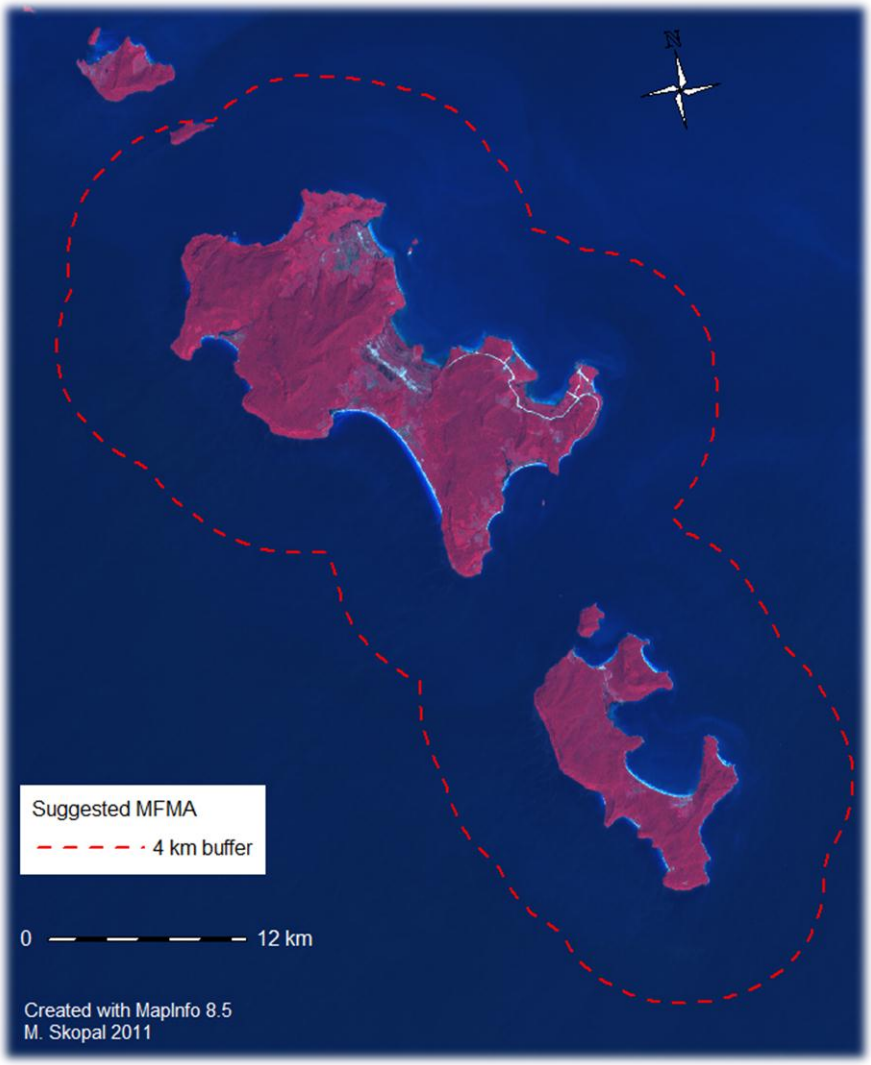
Koh Rong, Koh Rong Samloem and Koh Koun

Marine Fisheries Management Area

3nd Draft for Zoning Proposal



For

- Fisheries Administration –

Fisheries Conservation Department

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Photo 1 - Aerial shot of Koh Rong Island (garrisonphoto.com)

Report By:

Marine Skopal-Papin – MA Integrated Coastal Management

With Complementary Inputs From:

Julia Herbolsheimer – MA Fisheries Sciences
Jacqueline Dodd – Dive Master, Marine Survey Coordinator

ABSTRACT

Along with a rapid increase in tourism, Cambodia's marine resources, including coral reefs, fisheries and mangrove, turn out to be ever more threatened by development. This document constitutes a very first Zoning Draft Proposal relating to the creation of a Marine Fisheries Management Area around the islands of Koh Rong Samloem and Koh Rong, Preah Sihanouk Province. First providing the reader with basic notions of zoning, it then reviews and combines socio-economic and environmental data collected on-site, thus allowing the creation of a very first Draft Zoning Map. The aim of this Proposal is to bring useful information and appropriate recommendations based on actual and recent data in order to assist the Cambodian Fisheries Administration in the creation and management of the future Marine Fisheries Management Area.

Marine Skopal-Papin
MA – Integrated Coastal Management
maskop@hotmail.com

Table of Contents

Tables and figures

Photographies

All photographies taken by MCC team and volunteers except Photo 1.

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H.E. Mr. Nao Thuok	Director General of the Fisheries Administration
Mr. Ing Try	Deputy Director General of the Fisheries Administration
Ms. Kaing Khim	Deputy Director of the Fisheries Administration
Mr. Ouk Vibol	Director of Fisheries Conservation Department
Mr. Va Longdy	Researcher for Marine Working Group of the Fisheries Administration
Mr. Prak Visal	Project Coordinator of Integrated Coastal Management (ICM) – Provincial Hall of Preah Sihanouk Province
Miss. Nay Sally	Project Management Office (PMO) – Sihanoukville ICM Program – Provincial Hall of Preah Sihanouk Province
Mr. Thay Somony	National Project Coordinator of Regional Fisheries Livelihoods Program (RFLP), FAO
Mr. Yos Chanthana	Consultant for Fisheries Co-Management, RFLP/FAO
Mr. Nen Chamreun	Deputy Director of Community Fisheries Department, FiA
Mr. Daich Sokhom	Koh Rong Sangkat Chief
Mr. Lay Thay	Koh Rong Samloem Community (Village 23) Chief

Koh Rong Samloem Community Fishery (Village 23)

List of Abbreviations and Acronyms

FAO	Food and Agriculture Organization of the United Nations
FiA	Fisheries Administration
FiACD	Fisheries Administration Conservation Department
GIS	Geographic Information System
ICM	Integrated Coastal Management
KRS	Koh Rong Samloem
MFMA	Marine Fisheries Management Area
MPA	Marine Protected Area
RFLP	Regional Fisheries Livelihoods Programme
RGC	Royal Government of Cambodia

INTRODUCTION

Each year, the tourism industry becomes more important in Cambodia's economy and at the same time its precious marine resources, including coral reefs, fisheries and wetlands turn out to be more threatened by development. The team is constantly looking at ways to help rehabilitate marine ecosystems and increase potential for marine ecotourism in Cambodia. In doing so, we are also hoping to assist the FiA in the creation of Marine Fisheries Management Areas (MFMAs), Cambodia's equivalent to Marine Protected Areas (MPAs).

This document constitutes a 1st draft proposal relating to the future creation of a MFMA around the islands of Koh Rong Samloem and Koh Rong in the shape of a 4 km buffer zone around the islands. It is meant to be read along with the latest marine assessment on Koh Rong Samloem and Koh Kon, as well as socio-demographic reports on Koh Rong Samloem Community Fishery (CFi), Daem Thkov CFi, Prek Svay CFi and Koh Toch Community (*see References*).

By combining socio-economic and environmental data collected on-site, we are hoping to bring useful information and appropriate recommendations for the creation of a Zoning Plan that will be associated to the future MFMA. A 2nd draft, including proper GIS maps with clear definitions of zone boundaries, will be the next step to follow.

I. About Protected Areas and Zoning: generalities

a. Background: why protecting?

Cambodia has rich marine resources and habitats such as coral reefs, sea grass beds, mangroves, wetlands, salt marshes, sensitive benthic habitats and sandy beaches. These marine resources and habitats present an important part of the marine ecosystem and livelihoods of local communities. Rapid socio-economic changes and an exponential growth in the marine tourism sector increase pressure and threats on marine resources. Therefore, they must be urgently protected and conserved through the establishment of protected area or in Cambodia's case Marine Fisheries Management Areas.

With a good elaborated dataset of the defined area it is possible to create a Management Plan including a well-defined Zoning Plan which fits the interests all stakeholders while ensuring a sustainable use of the marine ecosystem and its resources.

b. MPA/MFMA zoning

i. Generalities

A "zonation" is a spatial or temporal allocation of specific uses and activities to well-defined areas within a larger area: it is a key management tool for multiple-use MFMAs. It allows areas to be set aside for particular activities such as protection of key habitats or nursery areas and breeding sites, research, education, anchoring, fishing and tourism. The zoning of a MFMA appears to have two major purposes: first, to reduce conflicts between users (professional and recreational fishers, fishers and divers, etc.); second, to protect critical stocks and nursery areas for the purpose of replenishing the surrounding areas ("spill-over" effect).

A zoning scheme generally includes areas under strict protection and areas with increasingly fewer restrictions. There may also be sub-zones, which might be modified on a seasonal or temporal basis (e.g. for boat access or because of breeding cycles of organisms), but this differ and is dependent on the characteristics of the area. In general the scheme should aim to provide a balance between conservation and resource use, and should be as simple as possible. If it is too complex, it will be difficult to enforce as stakeholders may have difficulty distinguishing the different zones.

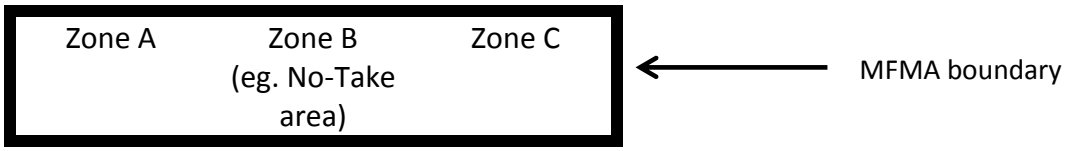
The Zoning Plan is typically part of the Management Plan of the area, or a separate document. In some cases, the zone types are laid out in the MFMA legislation. This is extremely important because if a Zoning Plan is not officially recognized, it may significantly delay management decisions. The plan should ***clearly identify the boundaries of the different zones using GIS (mapping)*** and explain ***how each area can be used***. As with the outer boundaries of the MFMA, ***it is essential that the different***

zones are identified on-site by floating buoys or other relevant system once the plan is agreed and approved.

An MFMA could be of two kinds: a type of management zone in one larger area, or an area in which activities may be zoned and managed. These two scenarios are illustrated below:

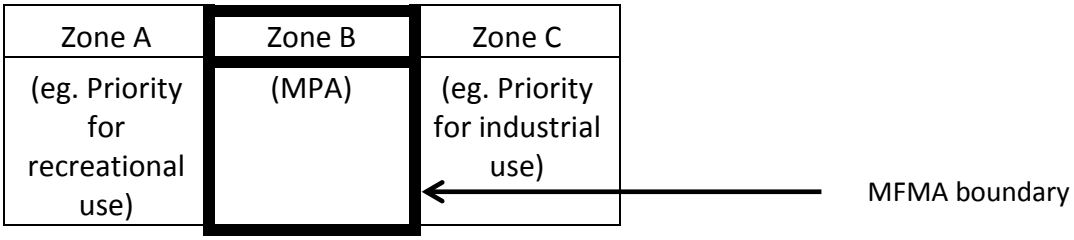
Scenario A:

MFMAs are areas in which activities are zoned. Zoning of activities takes place within the MPA and the management measures in these zones are driven by biodiversity conservation objectives.



Scenario B:

MFMAs are one of a number of types of management zone. Management measures within the MFMA will support biodiversity conservation and have been specifically designed with this objective in mind. The management regime in other "zones" may support biodiversity conservation but are not introduced with this objective in mind.



In our case, scenario A would seem to be the most appropriate.

ii. Data collection

In order to conserve marine resources on a long-term scale, biodiversity approach and socio-economic approach need to be fully integrated within the creation and management of the MPA/MFMA (Marine Protected Area / Marine Fisheries Management Area) and its associated Zoning Plan.

Besides assessing the marine environment, it is essential to collect all necessary information on the communities that will be directly affected by the creation of the MFMA and Zoning Plan, that is to

say the communities residing on Koh Rong and Koh Rong Samloem. Knowing the local socio-demographic context is an essential initial steps in the MFMA creation process and success. By conducting surveys in Koh Rong and Koh Rong Samloem, the social and economic data collected during the socio-demographic surveys will allow:

- Integrating requirements of marine ecosystems with the need of the people who depend upon fisheries resources. If these social and economic criteria are not taken into account, the MFMA and its Zoning Plan will be created from a single sector management view and will eventually lead to a significant number of resource use conflicts.

- Collecting all necessary data, including information on fishing gears, techniques and target species, in order to establish a clear and well-defined Zoning Plan. A multiple-use zoning scheme will allow reducing competition and conflicts between human uses of the area while still allowing for conservation.

- Getting a clear picture of people's needs, expectations and perceived issues related to fisheries resource management in their area. This will allow exploring possibilities of alternative sources of income that would contribute decreasing anthropogenic pressure on fisheries resources, especially through marine ecotourism.

II. Local socio-demographic context

a. Background

The registered local communities living on Koh Rong Samloem and Koh Rong, namely Koh Rong Samloem CFi, Koh Toch, Prek Svay CFi and Daem Thkov CFi (*Figure 1*), depend heavily upon marine resources. The introduction of Koh Rong Samloem Community Fishing Area (CFA) in 2009 has had a great influence on the protection of reefs and surrounding habitats with an ongoing and active protection by Koh Rong Samloem Community Fishery.

A MFMA is planned to intensify the effectiveness of conservation, of sustainable fishing and anticipate further socio-economic changes along with an increase in marine tourism in Cambodia. The area would cover ***a 5 kilometer buffer around the island of Koh Rong, Koh Rong Samloem and Koh Kon***, which will greatly affect at least three of the four communities previously mentioned, since Koh Rong Samloem Community Fishery is already managing its area the same way a MFMA would require.

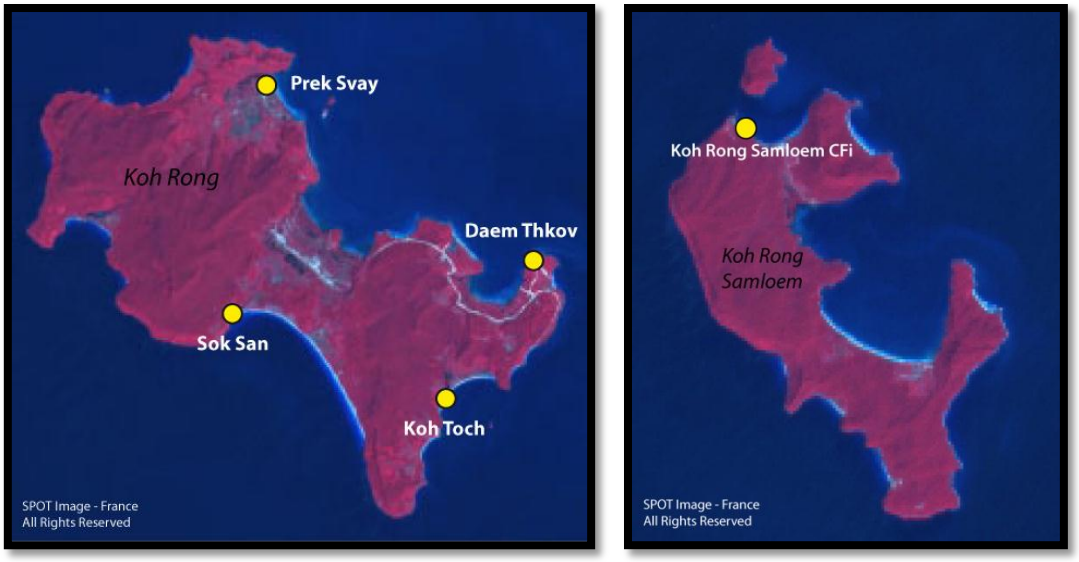


Figure 1 – Location of the communities living on Koh Rong and Koh Rong Samloem

b. Koh Rong Samloem Community Fishery

An updated socio-economic has recently been conducted in Koh Rong Samloem Community Fishery (KRS CFi) or "Village 23". The data were compiled in a specific report[1]. Among other results, it was found that:

- A total of 220 inhabitants (43 households) were recorded.
- 33 households (almost 78%) are involved in fishing-related activities thus depend heavily upon the availability of fisheries resources.
- 53 of the people surveyed being fishermen on long-tail boats, with the dominant catch being squid.
- Kids, teenagers and sometimes adults fish on small polystyrene "paddle-boats" in order to avoid gasoline expenses.

Regarding fishing techniques, KRS Community Fishery promotes the use of sustainable gears within the CFA, thus prohibiting destructives techniques such as bottom gillnets (crab nets) and making sure that the traps are not lying on corals by patrolling the area daily. As such, fishermen of the community only squid troll lines, traditional fish lines, fish traps, collapsible crab traps and octopus lines (one household only).

Besides, KRS Community depends heavily on marine ecotourism which constitutes a vital alternative revenue to fishing, with 20% of the community members employed by MCC and 3% by other tourism operators. Around 10% of the inhabitants are involved in commerce (bars, food seller) which benefit from the daily average of 25 volunteers staying at MCC's facilities.

[1] M. Skopal. *Koh Rong Samloem CFi, Socio-Demographic Survey – April 2011 update*. MCC July 2011.

Thus, KRS CFi depends heavily upon marine resources, upon the health of the marine ecosystems, habitats and fish stocks. The community is currently seen as a model of Community-Based Marine Resource Management with an ongoing successful experience in Marine Conservation, Sustainable Fishing and Marine Eco-Tourism. The creation of a MFMA will be supported by and could largely use the experience of the community members in managing such an area.

c. Koh Toch

Koh Toch Community, located in the south of Koh Rong, has been surveyed in April 2011[2]. A sample of 32 households, out of 81 in total, was interviewed (more than 1/3 of the total number of households). 134 inhabitants were recorded, which bring the statistics to a total of 339. Koh Toch is a very interesting case study illustrating the impact of rapid tourism development occuring in a small, traditional and until recently remote island fishing community.

Indeed, Koh Toch seems to be the community where tourism is the most developed with around 5 businesses, all based in Sihanoukville (one dive center, and at least 4 guest houses/bungalows). At first, the general impression given by the people was positive: tourism means jobs opportunities and increase in revenue for local people. However, after further discussion, several issues were raised:

- Tourists are discouraged by operators to consume in the village for sanitary reasons. As such, there is a noticeable gap between the community on one side, and the "tourist area" on the other side. Tourists are rarely seen wandering in the village thus do not seem to benefit local commerce.
- The community itself does not seem to benefit from the incomes brought by tourism as it can be illustrated by an incredibly poor waste management. According to the persons interviewed, no one is aware neither of the benefit made by the business nor of what part of their benefit is redirected to the community through education or health care improvement, for instance.
- Cultural issues: people mentioned inappropriate ways of dressing and sexual behaviors from the visitors. Serious concerns were raised regarding the loss of cultural identity and changes in sexual behaviors from local teenagers ("I don't want my daughter to work in the bungalows because I am scared").

In conclusion, Koh Toch seems to present several issues that could affect the creation of a MFMA:

- The predominant use of unsustainable and destructive fishing techniques (crab nets) that will not be compatible with the MFMA regulations.
- A rapid increase in marine tourism that is not well-managed, both by the village and by the companies themselves. Such a thing as an absence of proper waste-management or logging

[2] M. Skopal. *Koh Toch Community, Koh Rong, Preah Sihanouk Province – Socio-dem. Survey*. MCC July 2011.

(e.g. to build bungalows) could quickly affect the quality of the marine environment and near-by coral reefs by increase water pollution and terrestrial runoff.

d. Prek Svay Community Fishery

A socio-economic survey[3] was conducted in Prek Svay in March 2010 by the Fisheries Action Coalition Team in March 2010. Located on the northeast end of Koh Rong, Prek Svay counts a total population of 677 persons for 122 households at the time of the survey.

Fishing:

- 17,29% of the households listed fishing as their primary occupation while 7,25% listed it as secondary occupation. Overall, almost 24% of the total number of households depends upon fishing.
- 5 households (2,34%) work in fish trading (middleman).
- 3 households (1,40%) listed boat and house building/repairing as their primary activity and 3 others as their secondary activity.
- Crab is the main targeted species (32,6% response) followed by fish (20,9%) and squid (7%).

The types of gears used are (Table 1):

- Crab traps and crab nets: 28,9% (blue swimmer crab)
- Gillnet, hook and line (pushnet and trawler): 25,6% (fish)
- Squid traps, hook and line: 7% (squid)

Thus, we can observe a predominance of unsustainable and destructive fishing gears (crab nets and other bottom gillnets, pushnets and trawlers). Alternative solutions shall be discussed with the Community if the MFMA is to be created as such gears could not be allowed within the area.

Coastal and Marine Activities	Goods and Services	% response	Types of Use	% response
Fishery	Crab	32.6	Crab trap, gillnet	28.9
	Fish	20.9	Gillnet, hook and line (pushnet and trawler)	25.6
	Squid	7.0	Squid trap, hook and line	7.0
	Sea cucumbers and earthworm	0.0	Manual (Vietnamese fishers)	

Table 1 - Fishing gears and targeted species observed in Prek Svay Community

[3] Seak Sophat, Hoy Sereivathanak Reasey. *Socio-economic Monitoring of Coral Reef in Koh Rong Island, Preah Sihanouk Province, Cambodia*. FACT April 2010

Conflicts between users of the area, more precisely between different types of fishing was raised as being a serious issue: "As the current capacity of community fishery's executive committee is weak and lacking of patrolling resources, they were unable to carry out regular patrols over large areas of community fishing ground. As such there have been frequent encroachments by outside fishermen. For instance, buoyant deployed in order to mark the boundary of community fishery area are frequently devastated by outsiders, above all for those who operated push net and trawler gears." (FACT 2010)

Aquaculture was not taken either as primary or secondary occupation as it was at the demonstration phase at that time. Two different types of aquaculture were observed: cage culture of snapper and crab bank "which are being collectively done by committee members of Phumi Prek Svay Community Fishery as communal property" (FACT 2010).

Tourism seems to be well-undeveloped as only 2 households (1,04%) listed tourism as their secondary occupation.

Finally, concerns were raised about the future development of the island and the environmental impacts of "conversion of forest land into hotel, resort and leisure grounds [is] likely to cause large scale deforestation which subsequently accelerates soil erosion and finally suffocates corals leading to widespread bleaching" (FACT 2010). This constitutes a major apprehension for local people whose livelihoods are entirely reliant upon marine fishery resources.

a) Daem Thkov Community Fishery

Daem Thkov CFi is located east of the island of Koh Rong. A socio-demographic survey was conducted by the FiA-FCD in collaboration with MCC in May 2011 and the results are compiled in a specific report[4]. Observations so far revealed that crab traps are largely used, with people complaining about the dramatic decrease in catches related to the high number of trawling boats from Kampong Som (Stung Hav) operating in the area.

Indeed, dozens of trawling boats were seen using Daem Thkov pier to clean their net or refill fuel; knowing that most of them trawl within 5 km of the island, the creation of a MFMA will most likely face reluctance among those fishermen.

Unlike KRS CFi, Prek Svay or Koh Toch, Daem Thkov has not yet been affected by tourism development. The community is a perfect illustration of the challenges and issues faced by small coastal communities. Threats to fisheries resources and marine habitats such as inshore trawling, sand dredging and foreign poaching affect both marine ecosystems and community members whom livelihood depend upon the health of fisheries stocks. Realizing the damage caused by illegal and destructive fishing, community members would most likely willingly take part in the creation of a Marine Fisheries Management Area that would protect them from large-scale fishing and offer them alternative source of revenue through ecotourism. Discussions with groups of inhabitants show that

[4] S. Kim, M. Skopal. *Daem Thkov Community Fishery, Socio-Demographic Survey*. FiA-FCD / MCC June 2011.

people were willing to open to sustainable tourism, focusing on cultural and marine assets that they community could offer, yet expressed concerns about tourism impacts on culture and traditions, especially on younger generations, quoting the case of Koh Toch community: "we want ecotourism the same way as Koh Rong Samloem because now Koh Toch has too many problems".

Along with proper training in capacity building, sustainable development concepts and incentives to widespread the use of traditional non-destructive fishing gears such as traps and squid lines, Daem Thkov CFi could be a major asset in a future MFMA co-management process.

e. Koh Koun

This island is in private property and until now is inhabited. Hence socio-demographic data are inexistent.

III. Environmental context: Assessment of the marine habitats and resources

a. Habitats

The tropical reefs around Koh Rong Samloem and Koh Rong are mainly fringing reefs, located along the shoreline of the islands. These reefs are ecosystems with high biodiversity, providing habitats for a wide variety of fish families and invertebrates. Their value is not only ecological, but also socio-economic, as fishing and marine ecotourism contribute to the livelihoods of local communities. Based on collected data around Koh Rong Samloem and Koh Koun, the small, uninhabited island located just North of Koh Rong Samloem, it is possible to classify six main habitats: coral reef, rock and coral reef, seagrass, mangrove area as well as seahorse breeding grounds. (*See maps, Appendix 1 to 6*).

i. Coral Reef

Tropical coral reefs are one of the most diverse ecosystems in the world. Their depth distribution is highly dependent on sunlight penetration, because algae cells called zooxanthellae, which live in symbiosis with the corals, provide high amounts of essential nutrients (products of photosynthesis) to the coral polyps. The shallow fringing reefs around the coastline consist mainly of massive hard coral, the reef-builder, whose limestone skeletons constitute the foundation of the reef. Their complex structure provides many different ecological niches, not only for fish, but also for a high variety of benthic marine organisms, ranging from sessile creatures like sponges, soft corals, anemones and bivalves, to other invertebrates, including several crustaceans, echinoderms (sea stars, sea cucumbers, sea urchins etc.), and molluscs (octopuses, cuttlefish, nudibranchs, etc.).

ii. Rock and Coral Reef

Much of Koh Rong and Koh Rong Samloem is fringed by a mixture of coral reef and rocks. In many instances, these rocks are the limestone remains of hard corals that have died, often due to bleaching events or anthropogenic disturbances like anchor damage, destructive fishing methods (e.g. dynamite fishing), or high sedimentation rates mostly caused by local trawling. These habitats generally present a high density of rocky substrate interspersed with small to medium sized patches of different coral types. In marine areas, the distribution of sessile organisms is dependent on the availability of hard substrate, which functions as a settling ground, especially for coral polyps. Therefore, these rocky areas are important habitats for the rejuvenation of entire reef ecosystems from the bottom up, i.e. the settling of young coral polyps, even as they are indicators of how those same ecosystems were damaged.

iii. Mangroves

Mangroves constitute a transitional zone between land and sea in tropical and subtropical marine tidal areas. Mangrove plants are adapted to the extremity of the abiotic factors that define this special environment. Water temperature, salinity and oxygen concentration vary dramatically with tidal changes in water level, requiring a broad tolerance range from the mangrove trees.

Like many other transitional ecosystems, mangroves provide important habitats for both marine and terrestrial species. The complex root system of the mangrove trees serve as important breeding and nursery grounds for several fish and crustacean families, and are also often used as a hiding place in predator avoidance. Furthermore, these unique intertidal ecosystems play an important role in coastal protection against erosion, storm surges and tidal inundation.

iv. Seagrass

The complex marine habitat of seagrass meadows offers a rich food supply for herbivores, and serves as a shelter and nursery for commercial fish species, recreational fish species, and countless invertebrate organisms. The leaves of seagrass give juvenile fish and benthic invertebrates, such as crustaceans, bivalves, and echinoderms, a place to hide from predators, and provide a settling substrate for sessile organisms. Furthermore, seagrass meadows also help to mitigate the effects of strong currents, preventing the scouring of bottom areas from extreme water movement.

v. Seahorse Area / Seahorse Breeding Grounds

Seahorse breeding grounds are highly fragile habitats for one of the most endangered animals in Cambodia. So far, seven different species of seahorses have been sighted and identified within the area. Most seahorses are found in coastal waters, generally at depths between 10 and 30 meters, in both relatively sheltered environments such as seagrass, kelp beds, or mangroves, and on sandy bottoms. Unfortunately, these are some of the most vulnerable habitats in the area, highly

susceptible to disturbance caused by human activities like trawling boats, Vietnamese air-supplied boats, crab nets, and crab traps. The main threats to the marine ecosystems are listed in the following part; a detailed version can be consulted in *Koh Rong Samloem and Koh Kon Marine Environmental Assessment*[5].

b. Threats & Resource-Use Conflicts

Based on data collected through survey dives[6], it can be said that the health of the marine ecosystem around Koh Rong Samloem, Koh Koun and Koh Rong is generally in fragile condition, threatened by various legal and illegal anthropogenic activities. Nevertheless, it has been observed that the creation of Koh Rong Samloem CFA, by tackling on illegal and destructive fishing, has allowed a progressive regeneration of the most damaged areas where some rarely seen species, such as bamboo sharks, seem to return. The main threats for the habitats are listed below:

- Destructive fishing methods and overharvesting
- Sedimentation from trawling activities
- Coastal development: sewage, terrestrial runoff
- Tourism-associated damages (coral and shell "souvenir" collecting, coral breaking from snorkelers and divers, etc.)
- Anchoring on the reef: dive centers operating in the area (**Photo 2 and 3)** as well as fishing boats sheltering in the bay, especially during rainy season.

[5] *Koh Rong Samloem and Koh Kon Marine Environmental Assessment, Preah Sihanouk Province: Report on Marine Resources and Habitats.* MCC May 2011.

[6] *Koh Rong Samloem and Koh Kon Marine Environmental Assessment, Preah Sihanouk Province: Report on Marine Resources and Habitats,* May 2011.

Photo 2 and Photo 3 – Sihanoukville based dive operators anchoring on the reef off Koh Kon Island, 2011.

Climate change constitutes a natural threat that can lead to episode of coral bleaching. Climate change-related coral disease need to be closely monitored.

IV. Zoning Draft Proposal

a. A Zoning adapted to local context

Zoning of an MFMA appears to have two major purposes: first, to reduce conflicts, particularly between fishers and recreational users such as divers; second, to protect critical stocks and nursery areas for the purpose of replenishing the surrounding areas.

The Zoning Plan should be designed with basic conservation criteria principally emphasizing on fishing practice and specific gear restriction, fishing period regulations, as well as control of tourism activities.

The goals should be set for the long term and should illustrate an area used in a sustainable manner with abundant biodiversity and proper community protection. A top priority is the conservation of the ecosystems and the services it provides for the local communities in term of fisheries resources and alternative source of income from marine ecotourism.

Creating many zones within the MFMA would lead to confusion and would eventually be ineffective. Being the first MFMA of its kind in Cambodia, it should follow a framework that would be as simple as possible in order to make it understandable to stakeholders with a great diversity of backgrounds. In this case the area would be divided into 3 zones: a Conservation Zone, a Multi-use zone and a Buffer Zone. These 3 zones are simple enough for local communities to manage their area at local level, following the example of the ongoing management occurring within Koh Rong Samloem Community Fishery Area.

Moreover, by providing a gradation of restrictions, a balance of uses of the marine environment that satisfy the requirements of many resources-users, a multiple-use zoning plan could be easier to

implement and enforce than to manage large restricted areas.

The basic principle of multiple zoning is to have areas within the MFA that are strictly protected, buffered by areas with fewer restrictions. For example the core consists of a sanctuary with high ecological importance (vulnerable habitats with endangered species like the seahorse breeding ground) where only diving and research/scientific activities are allowed. The inner core is surrounded by a multiple use zone where no fishing techniques and gears are allowed in order to increase the biodiversity in the surrounding areas ("spillover effect") but diving and snorkeling are permitted as ecotourism activities. The Buffer Zone, where only specific fishing techniques and gear are allowed, acts as a buffer zone between the Conservation/Multiple-Use Zone and the outside of the MFMA where all regular fishing activities are allowed.

Although it is difficult to deal simultaneously, all in one area, with the needs and interests of the local community, the increase of tourism development and the needs and objectives of species and habitat conservation, many examples around the world have proved that a well-planned and implemented "zonation" area can work. Also, many examples show that the best scenarios of protected area management have been driven by local communities which led to the conclusion that local communities should be greatly involved in the MFMA co-management process, under the direction of the FiA, to assist in monitoring and controlling the area. CFAs boundaries should be kept and left to the communities to manage; however they should not form an independent entity but be included in the general MFMA zoning process.

b. Defining the zones (Figure 2)

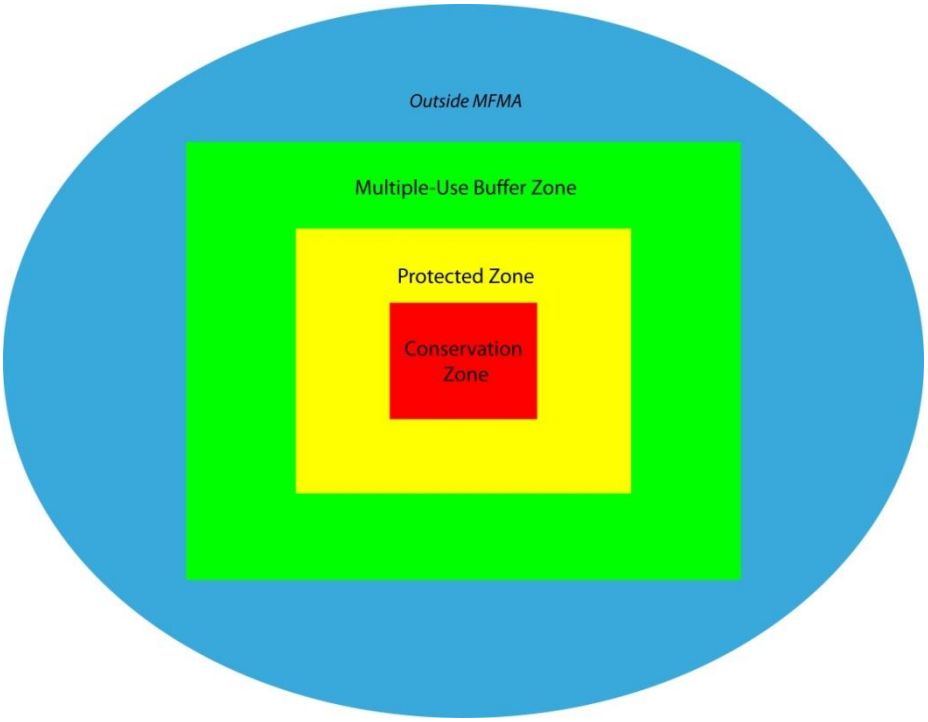


Figure 2 – Basic scheme of Zoning Plan including 3 main zones.

i. "No-Take" Conservation Zone (also called "Sanctuary") (red)

***Total area**:* [size to be determined on final draft via GIS]

Generalities: The Conservation Zone is comprised of areas with high ecological importance. Vulnerable habitats like breeding grounds and endangered species concentrations will remain undisturbed by tourism activities or fishing, except for scientific research activities licensed by the Fisheries Administration. Well-defined and complex fish sanctuaries need to be reviewed and re-established to ensure that the reproduction cycle of aquatic animals, especially seahorses and other such animals attractive to tourists, will be understood and well protected by all stakeholders, especially by the FiA and the wardens from local communities.

Local context: The Conservation Zone includes vulnerable habitats of high ecological importance, especially seahorse breeding grounds. Seahorses are very fragile marine animals, and small brood size limits their potential reproductive rate.

E.g.: The Corral (Appendix 5)

- Average depth: 10m; minimum depth: 5 m; maximum depth: 23 m.
- Predominant substrate: sand.
- Species composition:
  - sessile organisms: different types of bivalves, sponges, soft corals, anemones
  - mobile benthic organisms: crustaceans, nudibranches, echinoderms (the pencil urchin as main habitat for seahorses)
- Seahorses: *Hippocampus spinossisimus* (predominant species)*,H.comes, H.kuda, H.trimaculatus, H.kelloggi*
- Threats: trawling, bottom weighted nets (crab nets), trap fishing.
- Comments: most important breeding ground for seahorses.

ii. Protected Zone (yellow)

***Total area**:* [size to be determined on final draft via GIS]

Generalities: Fishing activities within the Protected Zone are limited and rigorously monitored to attract marine ecotourism, snorkelers, and divers who appreciate a rich ecosystem undisturbed by human activities. Anchoring is strictly forbidden (use of mooring buoys only), and tourism-related damage shall be closely monitored. A speed limit will be enforced due to safety concerns (e.g.: divers surfacing), and certain types of boats will be forbidden (e.g.: jet skis).

This level of protection allows fish in the protected zone to grow older and bigger. The subsequent

increase in eggs and juveniles will increase the local fish density, and through time, the fish density of other zones as well. In this "spillover effect," the movement of larvae and adults to the Multiple-Use Zone (and beyond) will benefit the greater community relying on Cambodian fisheries.

Local context: In our case, the creation of such zones also aims to anticipate and avoid potential conflict between subsistence fishing (traditional fishing with lines) and small-scale commercial fishing (crab traps, especially). Indeed, it has been noticed that at peak periods of crab fishing, lines of subsistence fisher people get tangled or caught at the bottom by the traps. This results in the loss of many lines, hooks and weights, sometimes forcing people to lift up the traps. Damage to and even theft of traps (catch or equipment) have to be considered, anticipated, and avoided by the use of a Protected Zone. Squid fishing at night (troll lines) is allowed because there is no conflict with divers at that time.

The priority in this area is to protect coral reefs and other sensitive habitats such as seagrass beds and mangroves, while still allowing for family-scale fishing and tourism.

E.g.: Secret Reef (Appendix 2)

- Average depth: 9 m.
- Predominant substrate: very healthy, massive hard corals.
- Most likely an important fish nursery ground.

E.g.: Boatman's Bay (Appendix 4)

- Fringing, sheltered reef
- Average Depth: 2.5m, max.: 4 m , min: 1m
- Substrate: mainly very healthy hard coral
- Special: high density of healthy foliose hard coral
- Comments: very high level of anchor damage mostly caused by fishing boats sheltering in the bay (especially during rainy season). Mooring buoys would be urgently needed.

E.g.: Beach Bar (Appendix 4)

- Fringing reef
- Average depth: 6 m min. Depth: 2.5m ; max Depth: 10m
- Predominant substrate: massive hard coral and rock
- Comments: very high level of anchor damage mostly caused by fishing boats sheltering in the bay (especially during rainy season). Mooring buoys would be urgently needed.

E.g.: Corner Bar (Appendix 4)

- Fringing reef

- Average depth 7m ; min.Depth: 3 m; max.Depth: 14 m
- Predominant substrate: hard coral and in deeper areas different families of soft corals
- Special: relatively high fish abundance with big schools of Trevallys and Spadefish
- Comment: increase of anchor damage from dive operators observed during the last high season.

E.g.: Back Door (Appendix 4)

- Fringing reef
- Average Depth: 6m , min.Depth: 3 m , max.Depth: 13 m
- Predominant substrate: massive hard coral mixed with rocks, deeper: soft coral beds
- Comment: increase of anchor damage from dive operators observed during the last high season.

E.g.: Vietnamese Bay (Appendix 4)

- Patchy Reef
- Average Depth: 8 m, min.Depth: 4m , max.Depth: 18 m
- Predominant substrate:
    - Shallower part: hard coral
    - Deeper part: soft corals, mainly whip soft corals and sea fans

E.g.: KC's Reef (Appendix 4)

- Deep Reef
- Average Depth: 20 m; max.Depth: 24 m; min.Depth: 18 m
- Predominant substrate: soft corals
- Special: deep sea reef

E.g.: House Reef (Appendix 4)

- Fringing, sheltered Reef
- Average depth: 2.5m ; max.Depth: 4.5m, min.Depth: 1 m
- Predominant substrate: hard corals, rocks
- Special: nursery area for fish
- Comment: area set up as no-fishing zone by Koh Rong Samloem CFi, unofficial but agreed by all community members. A spill-over effect starts to be observed along with an increase in species diversity and size of individuals.

iii. Multiple-Use Zone/Buffer Zone (light green)

***Total area**:* [size to be determined on final draft with GIS]

Generalities: The Multiple-Use Buffer Zone aims to provide a transition space between a highly protected area (Conservation & Protected Zones) and the outside of the MFMA, where heavier activities are allowed. The Multiple-Use Zone is a family-scale fishing and ecotourism zone. Carefully considered guidelines are necessary to avoid potential conflicts between fishers and tourists. Snorkeling is prohibited due to safety concerns, while diving is still allowed but at one's own risk.

Local context: Fishing activities are less limited than in the previous zones. Anchoring is allowed, as it does not significantly impact the habitats in these areas.

iv. Special Purpose Zone (dark green)

***Total area**:* [size to be determined on final draft with GIS]

Generalities: The Special Purpose Zone aims to provide an area for transportation facilities (piers) and all activities related to fishing (fisheries landings, boat fixing, etc.)

Local context: Special Purpose Zones should be provided to the fishing villages and Community Fisheries of Koh Rong and Koh Rong Samloem.

Based on the elaborated environmental and socio-economic data of the area Zoning draft and associated regulations could be worked out on the model presented below (Table 1, *Figure 2*):

ACTIVITY		Conservation Zone *Human activities strictly limited*	Protected Zone *A limited number of activities may be undertaken*	Multiple-Use Buffer Zone *A limited number of allowed activities can be undertaken*
Squid lines (troll line)	Day time	✗	✗	✓
	Night time	✗	✓	✓
Traditional line fishing ①		✗	✓	✓
Bottom long lines		✗	✗	✗
Paddle-boat fishing ②		✗	✓	✓
Traps ③	Fish traps	✗	✓	✓
	Squid traps	✗	✗	✓
	Crab traps	✗	✗	✓
Shell harvesting		✗	✗	✗
Bottom weighted net fishing		✗	✗	✗

Surface net fishing ④	✗	✗	✓
Anchoring[1]	✗	✗	✓
Diving[2]	✓	✓	✓
Snorkeling[3]	✗	✓	✗
Research and scientific activities[4]	✓	✓	✓
Speed limit > 2 nods	✗	✗	✓

ACTIVITY		Special Purpose Area *Transporation facilities (piers), fisheries landings, boat fixing,etc.*
Squid lines (troll line)	Day time	✗
	Night time	✗
Traditional line fishing ①		✗
Bottom long lines		✗
Paddle-boat fishing ②		✗
Traps ③	Fish traps	✗
	Squid traps	✗
	Crab traps	✗
Shell harvesting		✗
Bottom weighted net fishing		✗
Surface net fishing ④		✗
Anchoring[1]		✓
Diving[2]		✗
Snorkeling[3]		✗
Research and scientific activities[4]		✗
Speed limit > 2 nods		✗

Table 2 – Draft regulation table for future MFMA zones

✓ : Allowed

✗ : Not Allowed

① Traditional line fishing stands for lines with hooks and baited.

② Paddle-boats (small polystyrene rafts) are allowed for subsistence fishing only (family scale).

③ A limited number of traps per boat should be applied.

④ A limited number and lenght of net (per boat) should be applied.

[1] On mooring buoys only. Exception made in case of emergency / safety reasons and in Special Purpose areas.

[2] May require special permit

[3] Risk must be evaluated by the user/tourism operator, especially in area of important boat traffic; the FiA or local communities shall not be held responsible for any accident.

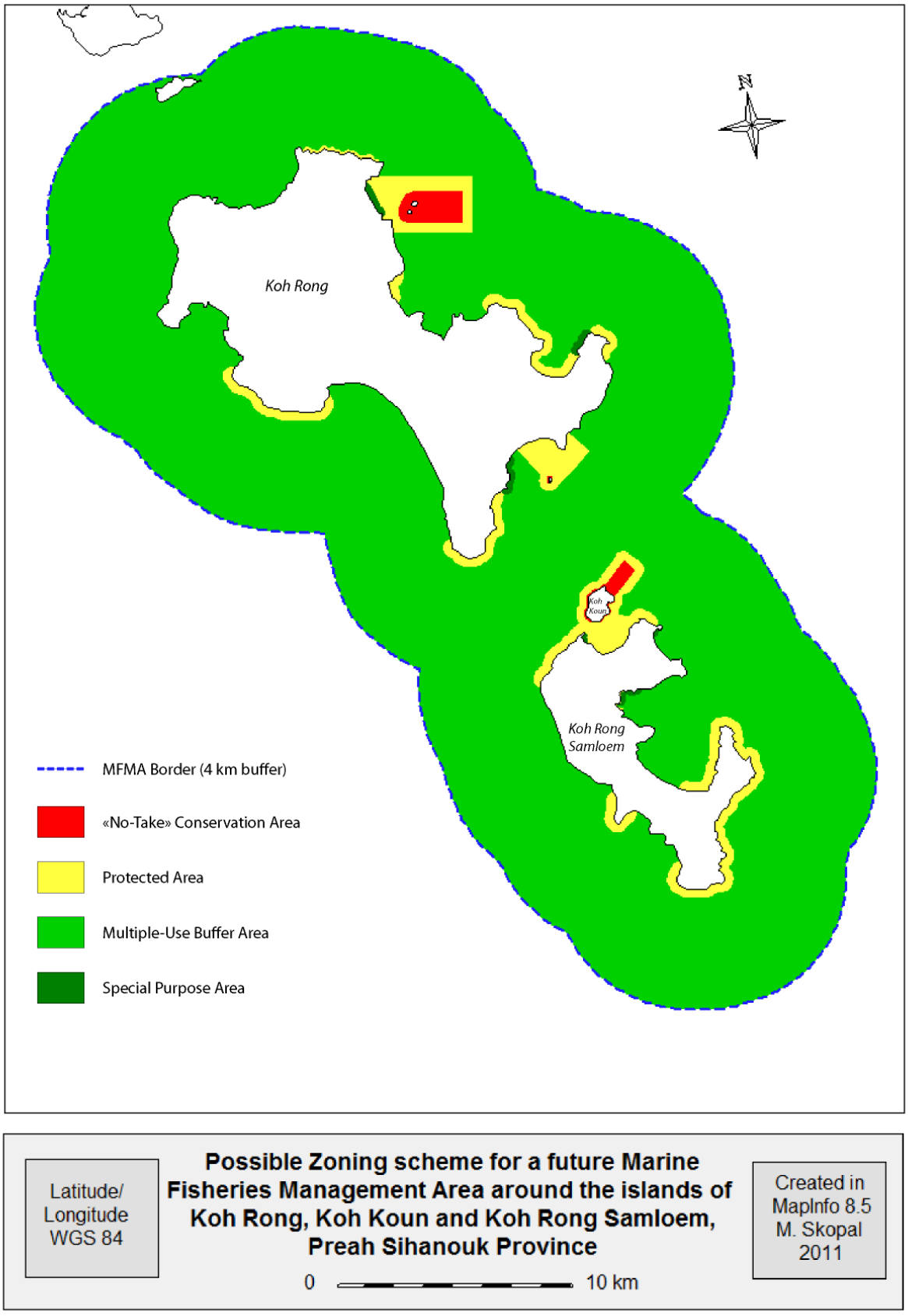


Figure 3 – Possible Zoning scheme for a future MFMA around the islands of Koh Rong, Koh Kon and KRS

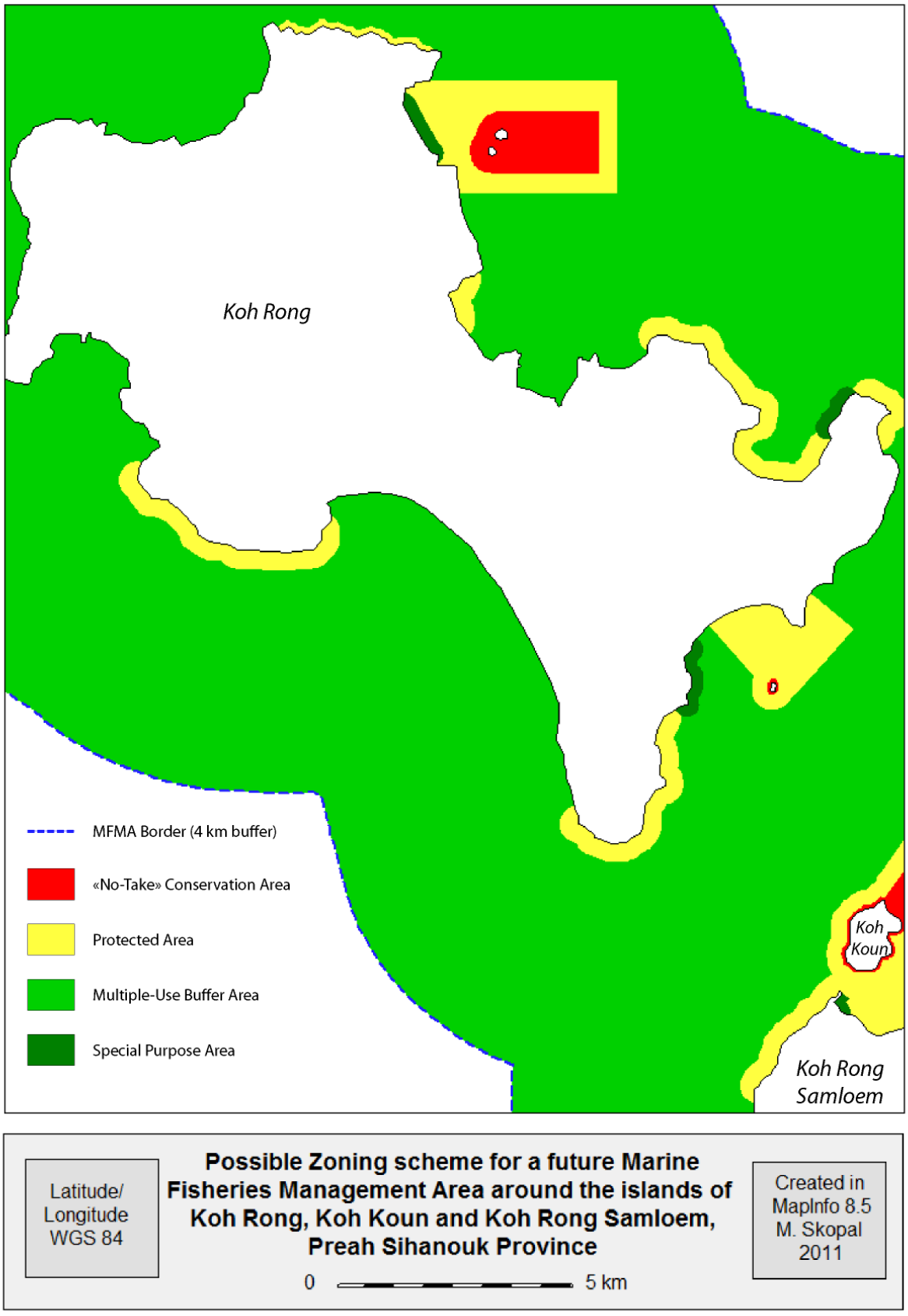


Figure 4 - Possible Zoning scheme for a future MFMA around Koh Rong, Koh Kon and KRS: close-up on Koh Rong

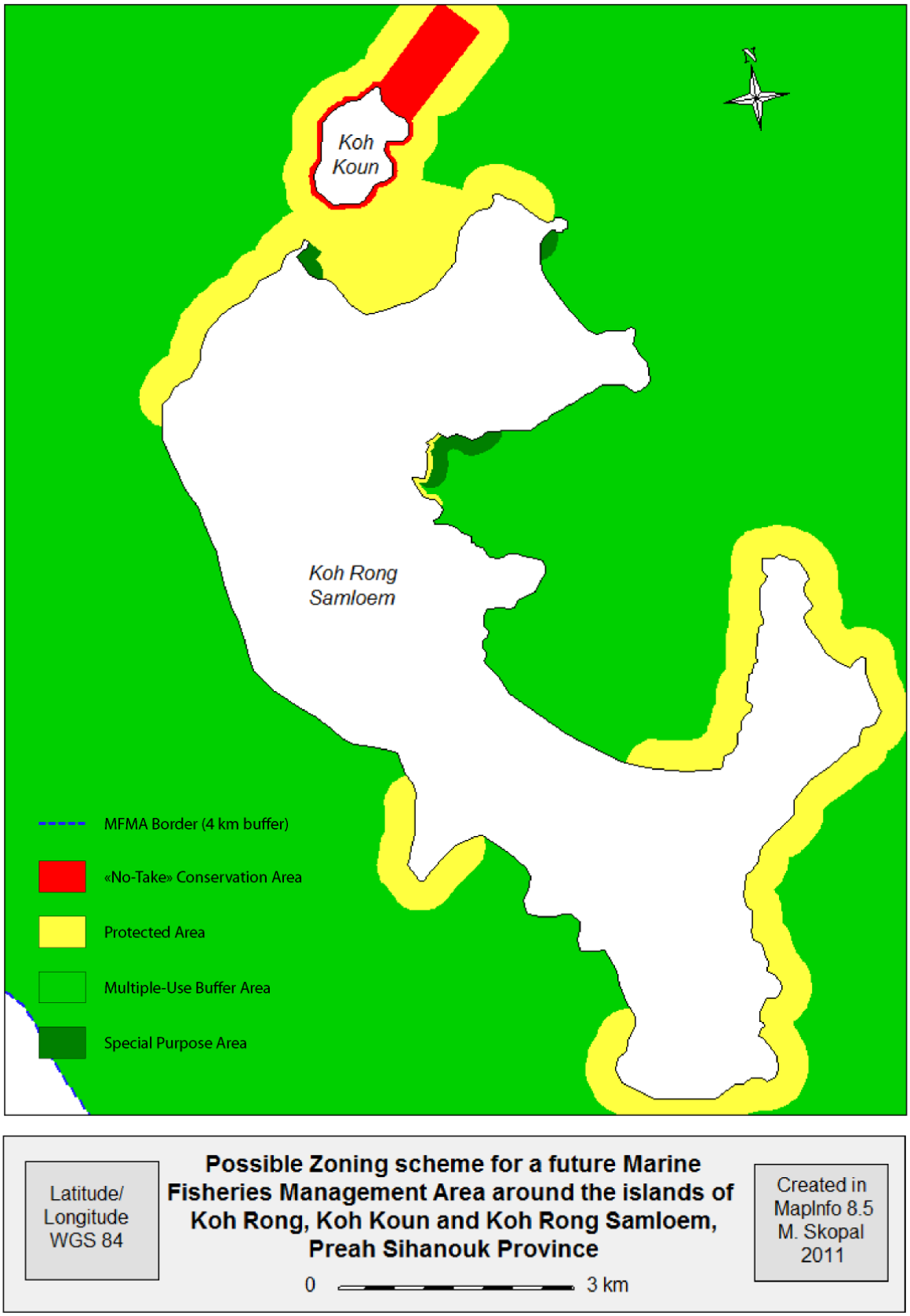


Figure 5 - Possible Zoning scheme for a future MFMA around Koh Rong, Koh Kon and KRS: close-up on KRS

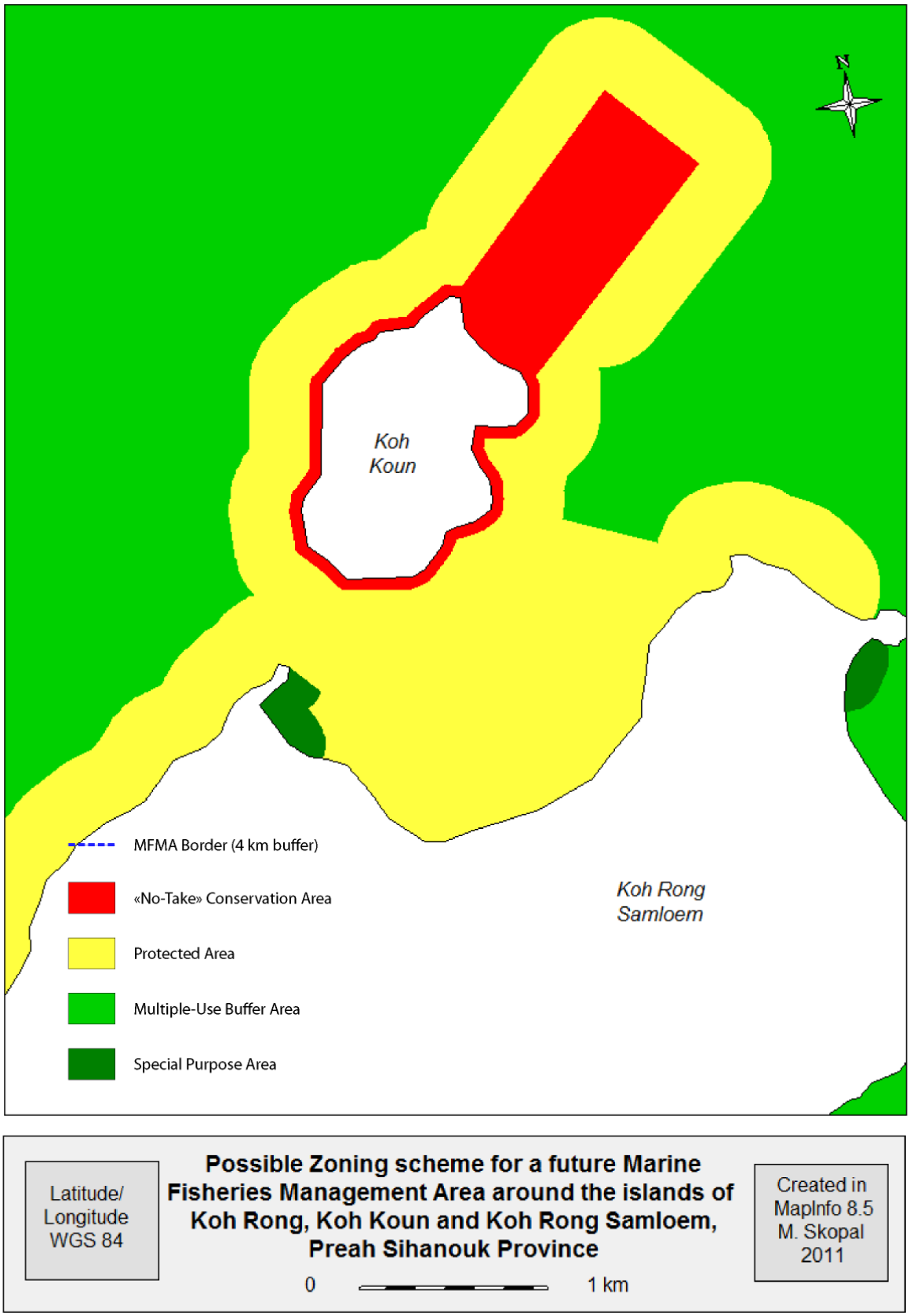


Figure 6 - Possible Zoning scheme for a future MFMA around Koh Rong, Koh Kon and KRS: close-up on Koh Koun

V. Conclusion

With all necessary data now collected, the creation of the Marine Fisheries Management Area and associated Zoning Plan could be finalized soon enough and efficiently protect the fragile habitats and fisheries resources surrounding the islands of Koh Rong and Koh Rong Samloem.

The introduction of Ecotourism-Based User Fees, along with an increase in Marine Tourism already observed over the past few years, could then subsidize the management of the MFMA in a sustainable way and guarantee the participation of all stakeholders in the protection of an area from which they get benefit from.

Local communities who depend on fisheries for their livelihoods shall be well involved in the MFMA creation process as they will constitute the key element in the success of its management.

Finally, land development and associated environmental impacts (waste-management, terrestrial runoff, etc.) as well as an increase in recreational activities (diving, recreational fishing, sailing…) shall be anticipated in order to avoid irreparable environmental impact on the marine environment and future resource-use conflicts.

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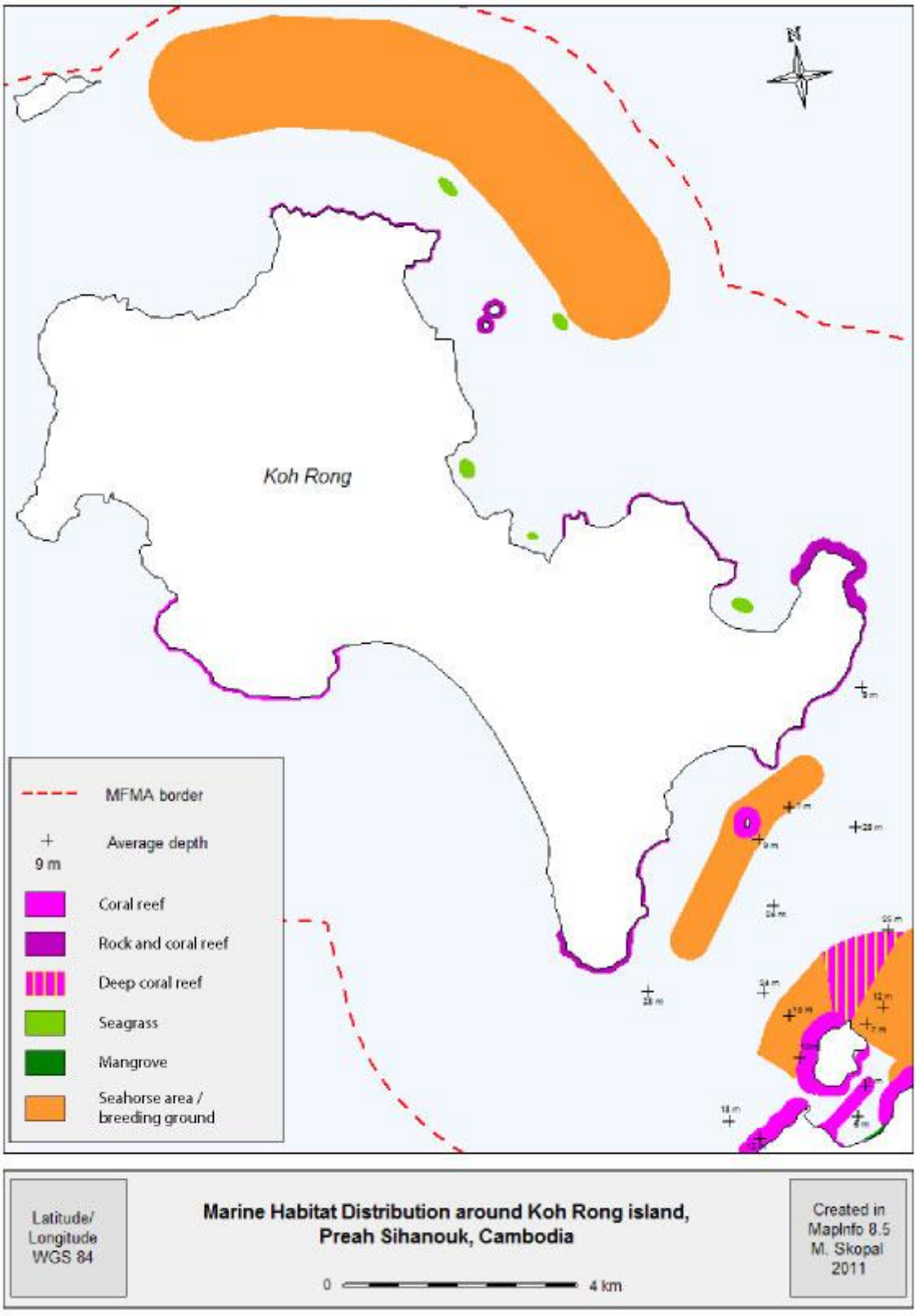
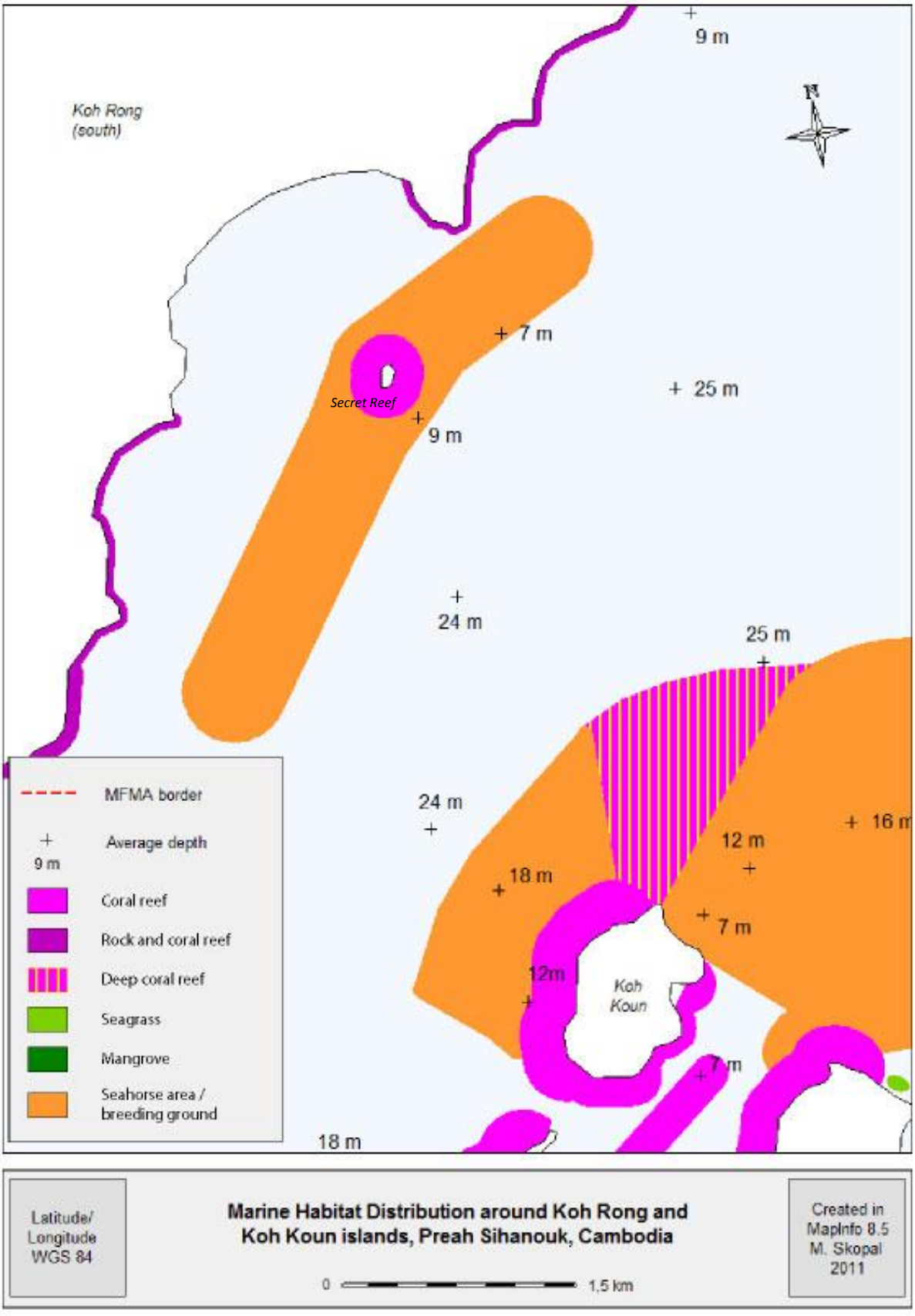
Appendix

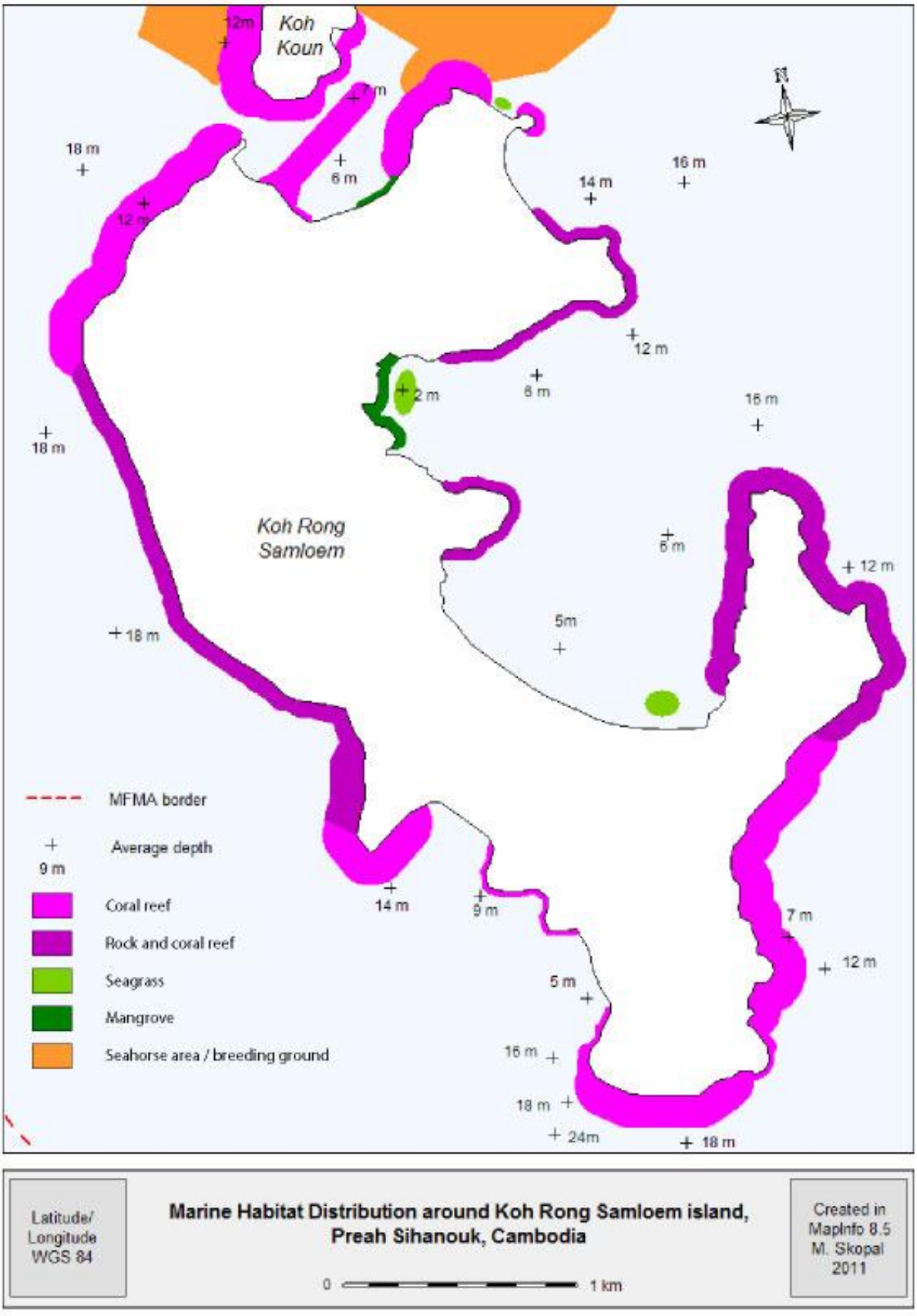
Appendix 1 – Marine Habitat Distribution around Koh Rong



Appendix 2 - Marine Habitat Distribution around Koh Rong (South)



Appendix 3 –Marine Habitat Distribution around Koh Rong Samloem



Appendix 4 - Marine Habitat Distribution around Koh Kon