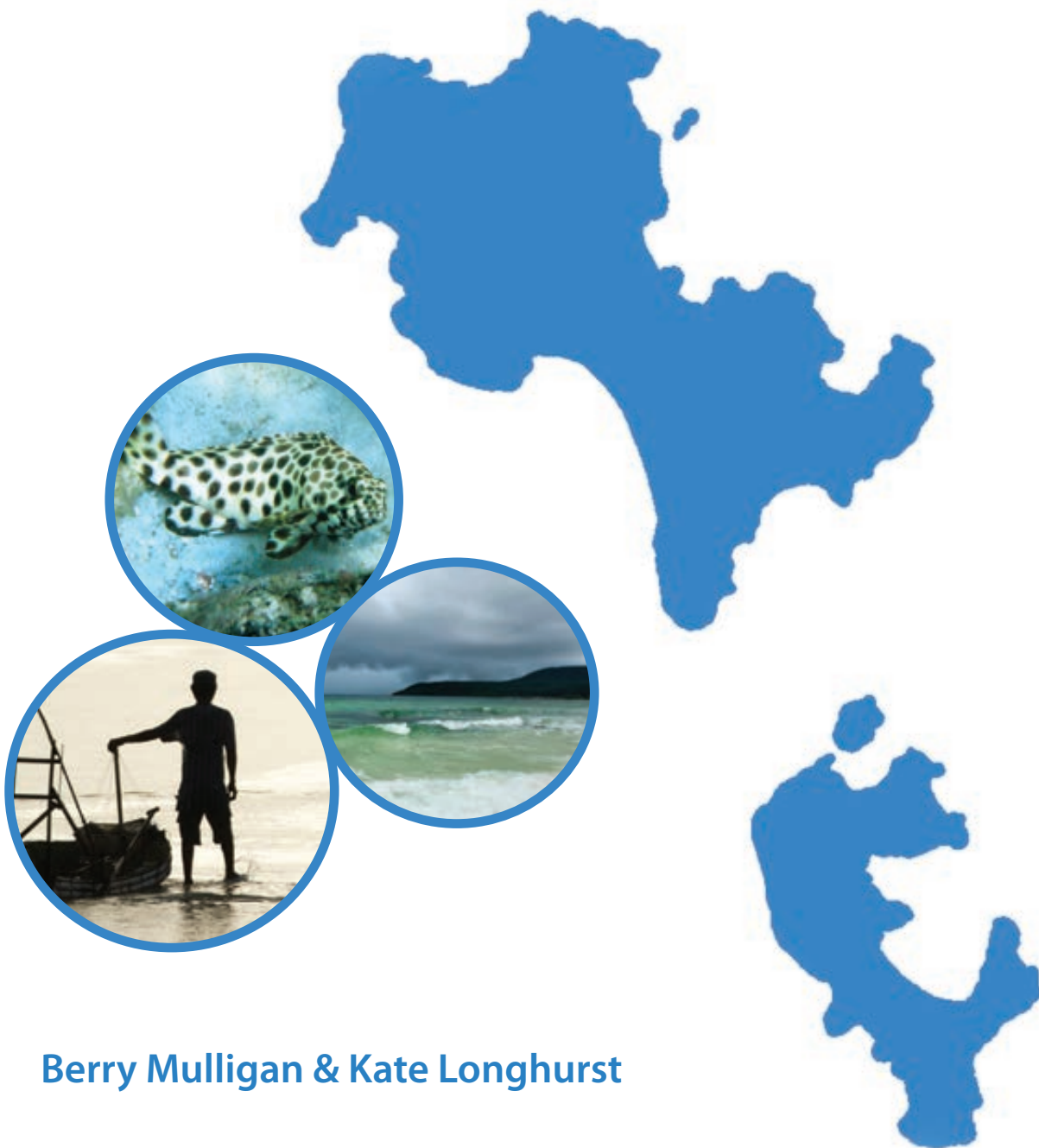




Research & Recommendations for a Proposed Marine Fisheries Management Area in the Koh Rong Archipelago



Berry Mulligan & Kate Longhurst



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PRINCE ALBERT II
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TABLE OF CONTENTS

Acknowledgements	6
Disclaimer	6
Recommended Citation	6
Abbreviations	7
I. Summary Khmer Text	9
Summary English Text	17
II. Introduction	25
1. Cambodia's Coastal Resources	25
2. Marine Fisheries in Cambodia	26
3. Marine Fisheries Domain	27
4. Report Aims and Overview	27
III. Study Area and Methods	33
1. Site Overview	33
2. Biodiversity Data Collection, Observation and Analysis	34
3. Socio-economic Data Collection, Observation and Analysis	34
IV. Results	39
1. Biodiversity	39
a. Coral Reef	39
b. Mangrove and Coastal Forests	43
c. Seagrasses	50
d. Endangered Species	52
2. Human	63
a. Demography	63
b. Community Infrastructure and Transport	65
c. Livelihood Strategies	65
d. Perceptions	67
3. Threats	68
4. Management and Uses	70
a. Community Fisheries	70
b. MFMA Management Structures	73
c. Tourism	73
d. Developers	75
V. Conclusion and Recommendations	79
a. MFMA Establishment	79
b. Creating Effective MPAs	79
c. Initial Recommendations for the Koh Rong Archipelago MFMA	81
d. MFMA Zoning	82
VI. References	89
Appendices	96

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ABBREVIATIONS

CBC	Centre for Biodiversity Conservation
CC	Conservation Cambodia
CCC	Coral Cay Conservation
CFi	Community Fishery
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMV	Conservation Management Value
CORDIO	Coral Reef Degradation in the Indian Ocean
DANIDA	Danish International Development Agency
DD	Data Deficient
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EN	Endangered
FACT	Fisheries Action Coalition Team
FAO – RFLP	Food and Agriculture Organization - Regional Fisheries Livelihoods Programme
FFI	Fauna & Flora International
FiA	Fisheries Administration
FiAC	Fisheries Administration Cantonment
GIS	Geographic Information System
ICRAN	International Coral Reef Action Network
IUCN	International Union for Conservation of Nature
JICA	Japan International Cooperation Agency
MAFF	Ministry of Agriculture, Forestry & Fisheries
MCC	Marine Conservation Cambodia
MFMA	Marine Fisheries Management Area
MoE	Ministry of Environment
MoT	Ministry of Tourism
MPA	Marine Protected Area
NCCD	National Committee for Sub-national Democratic Development
NGO	Non-Governmental Organisation
NT	Near Threatened
PMC	Management Committee for MFMA within Preah Sihanouk Province
RGC	Royal Government of Cambodia
RUPP	Royal University Phnom Penh
SEAFDEC	Southeast Asian Fisheries Development Centre
SocMon	Global Socioeconomic Monitoring Initiative for Coastal Management
SSPI	Song Saa Private Island
SSF	Song Saa Foundation
TM	Traditional Medicine
TCM	Traditional Chinese Medicine
TWG-MFMA	Technical Working Group for the Koh Rong Archipelago MFMA
UNEP	United Nations Environment Programme
VU	Vulnerable

I. SUMMARY - KHMER

១. សេចក្តីសង្ខេប៖

ទិដ្ឋភាពទូទៅ

ដែននេសាទសមុទ្រដែលស្ថិតនៅជុំវិញកោះរ៉ុងនិងកោះរ៉ុងសន្លឹម ត្រូវបានគ្រោងដាក់ទៅជាតំបន់គ្រប់គ្រង ជលផលសមុទ្រទីមួយនៅក្នុងប្រទេសកម្ពុជា (Marine Fisheries Management Area-MFMA)។ របាយការណ៍នេះ ត្រូវបានចងក្រងឡើងដោយអង្គការអភិរក្សក្បាល (Coral Cay Conservation-CCC) និងអង្គការសត្វព្រៃនិងរុក្ខជាតិអន្តរជាតិ (Fauna & Flora International-FFI) តាមរយៈសំណើរបស់រដ្ឋបាលជលផល (FiA) ដែលរួមទាំងអនុសាសន៍ ក្នុងការរៀបចំបង្កើតនិងការអនុវត្តសកម្មភាពក្នុងតំបន់គ្រប់គ្រងជលផលសមុទ្រនៅប្រជុំកោះរ៉ុងនិងប្រជុំកោះរ៉ុងសន្លឹម។ របាយការណ៍នេះ ជាលទ្ធផលនៃការស្រាវជ្រាវរួមគ្នារវាងរដ្ឋបាលជលផល CCC, FFI និងផ្នែកឯកជនពាក់ព័ន្ធ ដូចជា ក្រុមអភិរក្សសមុទ្រ (Marine Conservation Cambodia-MCC) និងមជ្ឈមណ្ឌលសង្គមចាប់ពីឆ្នាំ២០១០ ដោយ សង្កត់ធ្ងន់លើស្ថានភាពទីជម្រក ប្រភេទភាវសាស្ត្រ និងលក្ខណៈសេដ្ឋកិច្ចសង្គមរបស់សហគមន៍មូលដ្ឋាន។ របាយ- ការណ៍នេះក៏មានគោលបំណងផ្តល់នូវព័ត៌មានទូទៅពីតំបន់និងសារៈប្រយោជន៍តំបន់ការពារសមុទ្រ ព្រមទាំងយុទ្ធសាស្ត្រសម្រាប់រៀបចំនិងបង្កើតតំបន់ការពារសមុទ្រប្រកបដោយប្រសិទ្ធភាព។

ផ្ដាច់និងទីជម្រកសមុទ្រសំខាន់ៗផ្សេងទៀត ដូចជាស្មៅសមុទ្រនិងព្រៃកោងកាង មានវត្តមានជាច្រើននៅ ក្បែរកោះទាំង៦៩ របស់ប្រទេសកម្ពុជា និងជាទីជម្រកដ៏សម្បូរបែបរបស់ជីវចម្រុះសមុទ្រ។ តំបន់ឆ្នេរនិងសមុទ្រកម្ពុជា ដើរតួនាទីមួយដ៏សំខាន់ក្នុងការអភិវឌ្ឍប្រទេសជាតិ ការគាំទ្រដល់វិស័យជលផល ទេសចរណ៍ ព្រមទាំងវិស័យកសិកម្ម និងដឹកជញ្ជូនផងដែរ។ ក្នុងចន្លោះពីឆ្នាំ២០០៩ដល់ឆ្នាំ២០១២ ផលិតផលជលផលសមុទ្រជាមធ្យមស្មើនឹង១៥ភាគ រយ នៃផលិតផលជលផលសរុបទូទាំងប្រទេស ហើយវារីវប្បកម្មសមុទ្រត្រូវបានប៉ាន់ប្រមាណថាមានការកើនឡើង។ នៅក្នុងប្រទេសកម្ពុជា ការគំរាមកំហែងជាចម្បងទៅលើផលិតផលជលផលសមុទ្ររួមមាន ការនេសាទខុសច្បាប់ ការ បំផ្លាញទីជម្រក ការនេសាទហួសកំរិត និងការបំពុលសមុទ្រ។ និន្នាការជាទូទៅគឺដោយសារមានការកើនឡើងនូវការ បំផ្លិចបំផ្លាញ និងការធ្វើអាជីវកម្មហួសកម្រិតនៅតាមតំបន់ឆ្នេរ ដែលនេះបង្ហាញពីតម្រូវការសម្រាប់ចាត់វិធានការកែ លម្អការគ្រប់គ្រងប្រភេទជីវសាស្ត្រសមុទ្រ និងទីជម្រកដែលមានតំលៃពាណិជ្ជកម្មខ្ពស់។ របាយការណ៍នេះផ្តល់អនុ- សាសន៍ថា ការបង្កើតតំបន់គ្រប់គ្រងជលផលសមុទ្រនៅក្នុងប្រជុំកោះរ៉ុងនិងប្រជុំកោះរ៉ុងសន្លឹមជាផ្លូវការ គឺជាការចាំ បាច់និងគួរតែអនុម័តជាបន្ទាន់ ដើម្បីធានាបាននិរន្តរភាពធនធានជលផល។ យន្តការគ្រប់គ្រងត្រូវបានបង្កើតឡើងជា ចាំបាច់ សម្រាប់គាំទ្រដល់ការគ្រប់គ្រងនិងវឌ្ឍនៈភាពប្រកបដោយប្រសិទ្ធភាពដើម្បីឆ្លើយតបទៅនឹងទស្សនៈវិស័យ៖ តំបន់គ្រប់គ្រងជលផលសមុទ្រទីមួយ សម្រាប់ការអភិរក្សជីវចម្រុះសមុទ្រ និរន្តរភាពនៃការនេសាទ និងទេសចរណ៍ ដើម្បីរួមចំណែកកាត់បន្ថយភាពក្រីក្រ។

ប្រភេទតាមវិស័យនិងទីជម្រកជលផល

ការស្រាវជ្រាវក្នុងអំឡុងដើមសតវត្សរ៍ថ្មីនេះបានសន្និដ្ឋានថា ផ្ដាច់នៅក្នុងប្រទេសកម្ពុជាផ្តល់នូវអត្ថប្រយោជន៍ ទាំងសេដ្ឋកិច្ច សង្គម និងជីវចម្រុះ ហើយការស្រាវជ្រាវនេះបានផ្តល់អនុសាសន៍ថា ការអភិរក្សធនធានសមុទ្ររយៈពេល វែងគួរតែត្រូវបានអនុវត្ត។ កម្រិតនៃហានិភ័យផ្ដាច់នៅក្នុងប្រទេសកម្ពុជាត្រូវបានគេគិតថាស្ថិតនៅចន្លោះខ្ពស់ទៅ ខ្ពស់ខ្លាំង ដោយសារមិនមានតំបន់ផ្ដាច់ភាគច្រើនណាស្ថិតនៅក្នុងប្រព័ន្ធតំបន់ការពារនោះទេ។

FIA CCC និងMCC បានធ្វើការសិក្សាស្រាវជ្រាវនៅក្នុងតំបន់ប្រជុំកោះរ៉ុងនិងប្រជុំកោះរ៉ុងសន្លឹមចាប់តាំងពី ឆ្នាំ២០១០ ដល់ឆ្នាំ២០១៣ ដោយប្រើប្រាស់វិធីសាស្ត្រស្រាវជ្រាវពិនិត្យផ្ទាល់ (Reef Check) ដើម្បីកំណត់បរិមាណ របាយផ្ដាច់ នានាភាព សមាសភាពត្រីសំខាន់ៗ សត្វឥតឆ្អឹងកង និងប្រភេទសត្វស្រទាប់បាត។ CCC ថែមទាំងបាន

កំណត់នូវទីតាំង សំខាន់ៗនិងជាក់លាក់មួយចំនួនដើម្បីដាក់ជាតំបន់ការអភិរក្ស ដោយប្រើប្រាស់សូចនាករចម្រុះក្នុង ការគណនាពីគុណតម្លៃនៃតំបន់នីមួយៗសម្រាប់ការគ្រប់គ្រង។ គម្របផ្ទៃដីក្នុងតំបន់សម្រាប់ការគ្រប់គ្រង ២០% នៅជុំវិញកោះរ៉ុង និង១៣%នៅជុំវិញកោះរ៉ុងសន្លឹម។ ភាពចម្រុះនៃផ្កាថ្មហាក់ដូចជាមានកម្រិតទាបនៅទូទាំងតំបន់ ប្រជុំកោះ ជាមួយនឹងជីវិតដ៏ច្រើនដូចជា ប្រភេទ *Porites* និងភាពលំបរបស់ *Diploastrea heliopora* ។ កង្វះជីវិត ពពួក tabulate និង branching អាចជាសូចនាករបញ្ជាក់ពីផលប៉ះពាល់ពីកករលាប់។ ឥទ្ធិពលរបស់មនុស្ស ដូចជា ការបោះចោលកាកសំណល់នៅមានកម្រិតទាប ប៉ុន្តែផលប៉ះពាល់ពីសកម្មភាពនេសាទ ដូចជាការបោះចោលកំទិច មង ត្រូវបានឃើញស្ទើរគ្រប់ទីតាំងស្រាវជ្រាវទាំងអស់នៅជុំវិញកោះរ៉ុងសន្លឹម។

ជាទូទៅ ភាពចម្រុះរបស់ប្រភេទត្រីមានតិច ហើយចំនួនប្រភេទត្រីដែលរស់នៅក្នុងផ្កាថ្មដែលមានតម្លៃ ពាណិជ្ជកម្មក៏ហាក់ដូចជាមានតិចផងដែរ។ តាមការស្រាវជ្រាវនៅជុំវិញប្រជុំកោះរ៉ុងសន្លឹមបានបញ្ជាក់ថា ពពួកត្រីអាំង ក៊ីយ (Snappers) គឺមានចំនួនច្រើនជាងគេ ដែលរួមចំណែករហូតដល់៤១% នៃភាពចម្រុះរបស់ត្រី បន្ទាប់មកគឺពពួកត្រី មេអំបៅ (*Chaetodontidae*) ៣៣% ត្រីសេក (*Scaridae*) ១៨% និងត្រីតុកកែ (*Serranidae*) ៧% ចំណែកឯត្រីកាដី (*Haemulidae*) មានត្រឹមតែ១%ប៉ុណ្ណោះ។ វាស្ទើរតែគ្មានវត្តមានត្រីតុកកែធំៗនៅក្នុងតំបន់នេះ។ ទីតាំងដែលសម្បូរ ត្រីបំផុត ស្ថិតនៅភាគខាងលិច និងនិរតី នៃកោះរ៉ុង។ ទីតាំងនោះ ក៏ជាតំបន់ដែលត្រូវបានកំណត់ជាកន្លែងអភិរក្ស ដែលមានគុណតម្លៃខ្ពស់សម្រាប់ការគ្រប់គ្រង រួមទាំងកោះតូចដែលស្ថិតនៅខាងលិចកោះរ៉ុង។ យោងតាមទិន្នន័យផ្កាថ្ម តំបន់ដែលមានការចាប់អារម្មណ៍ខ្ពស់សម្រាប់ការអភិរក្សស្ថិតនៅភាគនិរតី និងភាគខាងជើងកោះរ៉ុងសន្លឹម ដោយរាប់ បញ្ចូលទាំងកោះកូនផងដែរ។

ប្រព័ន្ធដីវចម្រុះព្រៃកោងកាង គឺមានផលិតភាពខ្ពស់ និងដើរតួនាទីយ៉ាងសំខាន់ក្នុងវដ្តរបស់ភាវៈមានជីវិត សមុទ្រជាច្រើន។ យោងតាមរូបភាពពីលើអាកាស (Satellite) នាខែមករា ឆ្នាំ២០១៣ បង្ហាញថា ផ្ទៃព្រៃកោងកាង សរុបមានទំហំប្រហែល១១២ហិកតា ស្ថិតនៅកោះរ៉ុង និង១៥ហិកតា នៅកោះរ៉ុងសន្លឹម ដែលជុះរាយប៉ាយតាមឆ្នេរ និងសងខាងព្រែក។ តំបន់ដែលមានវត្តមានព្រៃកោងកាងតភ្ជាប់គ្នាយ៉ាងក្រាស់ ស្ថិតនៅប៉ែកខាងកើតនៃកោះរ៉ុង។ សមាសភាពនៃព្រៃកោងកាងផ្តុំគ្នារក្សាបាននូវទិដ្ឋភាពធម្មជាតិយ៉ាងសំខាន់។ ការគំរាមកំហែងធំបំផុតដោយសារតែ កង្វះខាតផែនការអភិវឌ្ឍន៍តំបន់ឆ្នេរ ជាហេតុបណ្តាលឲ្យព្រៃកោងកាងនៅបន្តការកាប់បំផ្លាញនៅក្នុងតំបន់មួយចំនួនផង ដែរ។

ស្មៅសមុទ្រដែលនៅក្នុងប្រជុំកោះមានដុះភាគច្រើននៅតាមតំបន់ក្បែរព្រៃកោងកាង។ តាមការស្រាវជ្រាវ ពិន្ទុកាត់ទទឹង (transect) កាលពីខែមេសានិងឧសភា ឆ្នាំ២០១៣ បានបង្ហាញឲ្យឃើញថា មានស្មៅសមុទ្រ ប្រមាណ១៨ហិកតានៅក្នុងប្រជុំកោះនេះ។ លទ្ធផលនៃការស្រាវជ្រាវបង្ហាញឲ្យឃើញថា មានវត្តមានប្រភេទស្មៅល្អិត (*Halodule pinifolia*) ខ្យងបាត(*Thalassia hemprichii*) ខ្យងគុម្ព (*Enhalus acoroides*) និងស្មៅស្លាបមាន់ (*Halophila minor*) ត្រូវបានកត់ត្រាថ្មី ហើយប្រភេទស្មៅល្អិតសម្បូរជាងគេ។ ប្រភេទពីរផ្សេងទៀតត្រូវបានកត់ត្រាពី អតីតកាល គឺខ្យងរនងបង្កង់ (*Cymodocea serrulata*) និងស្មៅកាត់សមុទ្រ (*Halophila ovalis*) ប៉ុន្តែពុំឃើញមាន វត្តមានទេ។ មនុស្សបានបង្កផលប៉ះពាល់រីករាលដាលនៅបរិវេណដែលមានវត្តមានស្មៅសមុទ្រ រួមទាំងផលប៉ះពាល់ ពីការនេសាទ និងអាចបង្កពីការបំពុលពីលើដីផងដែរ។ ទាំងអស់នេះជាហេតុផលនៃការធ្លាក់ចុះវិសាលភាពជម្រក ស្មៅសមុទ្រ។ ជម្រកស្មៅសមុទ្រដែលមានវត្តមានដ៏ធំបំផុតទំហំប្រហែល១០ហិកតា ស្ថិតនៅក្បែរភូមិដើមថ្កូវ ដែលជា តំបន់មួយត្រូវបានផ្តល់អនុសាសន៍ឲ្យដាក់បញ្ចូលទៅជាកន្លែងអភិរក្ស នៅក្នុងតំបន់គ្រប់គ្រងផលផលសមុទ្រ។

ប្រភេទព្រៃដែលមានដុះច្រើននៅលើប្រជុំកោះនេះ គឺជាប្រភេទព្រៃបៃតង មានទំហំប្រមាណ៧.៧៣៦ហិកតា ហើយគ្របដណ្តប់៧៥% នៃផ្ទៃប្រជុំកោះទាំងមូល ដោយរួមបញ្ចូលទាំងកោះកូន គឺត្រឹមខែមករាឆ្នាំ២០១៣។ ព្រៃ

ឈើត្រូវបានកាប់នៅក្នុងអំឡុងទសវត្សរ៍ឆ្នាំ១៩៨០ និង១៩៩០។ ចំណាត់ថ្នាក់ដ៏មានដូចជា តំបន់ដីវាលភក់ ដីព្រៃ គុម្ពោត ដីវាលស្មៅ ដីព្រៃស្មៅ និងដីកសិកម្ម ជាពិសេសនៅលើកោះរ៉ុង។ នៅទសវត្សរ៍ចុងក្រោយនេះ ទំហំព្រៃកោង- កាងមិនមានការធ្លាក់ចុះគួរឲ្យកត់សំគាល់នោះទេ ប៉ុន្តែយោងតាមផែនទីគម្របព្រៃឆ្នាំ១៩៩៧ និងទិន្នន័យពីលើ អាកាសក្នុងឆ្នាំ២០១៣ មានការធ្លាក់ចុះប្រភេទព្រៃបៃតងប្រមាណ២០% នៅលើកោះរ៉ុង ក្នុងអំឡុងពេលជាង១៦ឆ្នាំ ចុងក្រោយនេះ។ ការគ្រប់គ្រងតំបន់ឆ្នេរ និងព្រៃកោងកាងនឹងមានសារៈសំខាន់ដល់ទីជម្រកក្បែរច្រាំងសមុទ្រ។

អនុក្រឹត្យលេខ១២៣ បានផ្តល់ការការពារផ្លូវច្បាប់ដល់ប្រភេទរ៉ាវីសត្វដែលកំពុងរងគ្រោះថ្នាក់ចំនួន៥៨ ប្រភេទ ហើយយ៉ាងហោចណាស់១០ប្រភេទ ក្នុងចំណោមប្រភេទទាំងនេះត្រូវបានកត់ត្រាថាមានវត្តមាននៅក្នុងតំបន់ ដែលគ្រោងដាក់ជាតំបន់គ្រប់គ្រងជលផលសមុទ្រ។ ប្រភេទរ៉ាវីសសមុទ្រដែលបានកត់ត្រាមាន ១ប្រភេទជិតផុតពូជ ២ប្រភេទកំពុងរងគ្រោះ និងចំនួន១០ប្រភេទងាយរងគ្រោះ ជាពិសេសពពួកសេះសមុទ្រ។ មានករណីមួយចំនួន ជា ពិសេសស្ថានភាពនៃប្រភេទរ៉ាវីសត្វដែលកំពុងរងគ្រោះថ្នាក់ណាមួយដែលសម្បូរជាងគេនៅក្នុងតំបន់នេះ ហាក់ដូចជា បានដឹងតិចតួចប៉ុណ្ណោះក្នុងពេលស្រាវជ្រាវកន្លងមក។

ការអនុវត្តលើការគ្រប់គ្រងប្រភេទសំខាន់ៗមានការចាំបាច់ដើម្បីធានាប្រភេទងាយរងគ្រោះ អាចបន្តវត្តមាន នៅក្នុងតំបន់គ្រប់គ្រងជលផលសមុទ្រ។ ការសិក្សាថ្មីបង្ហាញថា ផ្ទៃទឹកនៅជុំវិញប្រជុំកោះនៅតែមានវត្តមានល្អិត (*Chelonia mydas*) និងក្រាស់ (*Eretmochelys imbricata*) ជាញឹកញាប់ ហើយឆ្នេរកោះរ៉ុងអាចនឹងឃើញមាន សំបុកពួកវាម្តងម្កាល។ ការគំរាមកំហែងជាចម្បង គឺដោយសារការចាប់ដោយចៃដន្យ ជាពិសេសជាប់នឹងមង អូនអូស និងសន្ទូចរង/សន្ទូចបែល។ ការរុំជាប់នឹងសំណល់ផ្លាស្ទិក និងឧបករណ៍នេសាទ ដែលបានបោះចោលក៏ជាមូល ហេតុនាំឲ្យប៉ះពាល់ដល់អណ្តើកសមុទ្រផងដែរ។ មានសេះសមុទ្រ០៦ប្រភេទត្រូវបានកត់ត្រា រួមមាន *Hippocampus kuda*, *H. trimaculatus*, *H. spinosissimus*, *H. comes*, *H. kelloggi* និង *H. histrix* ដែលមានវត្តមានច្រើនទៅ តាមតំបន់នីមួយៗ។ កត្តាគំរាមកំហែងដ៏ចម្បងទៅលើប្រភេទសេះសមុទ្រនៅតំបន់ឆ្នេរ គឺអូនអូស រួមទាំងការចាប់ ដោយចៃដន្យ និងការអូសបំផ្លាញស្រទាប់បាតសមុទ្រ។ ការសិក្សាដំបូងដោយ MCC បានកំណត់ទីតាំងជម្រកសេះ សមុទ្រ៥កន្លែងផ្សេងគ្នា ហើយការសិក្សាអង្កេតចាប់តាំងពីឆ្នាំ២០០៧ បានបង្ហាញថា ជីវចម្រុះជាច្រើនមានការធ្លាក់ ចុះ ជាពិសេសប្រភេទ *H. spinosissimus* ។ ការសិក្សាថ្មីបានកំណត់ផ្ទៃទឹកប៉ែកខាងលិច និងខាងត្បូងកោះរ៉ុង និង កោះរ៉ុងសន្លឹម ពីទ្វីបវិញកោះតាង និងកោះប៉ូឡូរី ជាចំនុចដ៏សំខាន់ សម្រាប់ចំណីសត្វសមុទ្រ។ របាយការណ៍ពីមូល ដ្ឋានបង្ហាញថា មានវត្តមានសត្វផ្សោត ប៉ុន្តែមិនមានការឆ្លើយតបជាក់លាក់ណាមួយនោះទេ។ ការកត់ត្រាចុងក្រោយ បំផុតអំពីជ្រូកទឹក (*Dugong dugon*) មាននៅក្នុងតំបន់គ្រប់គ្រងជលផលសមុទ្រចាប់ពីឆ្នាំ២០០៥។

ប្រជាសាស្ត្រ

ការប្រមូលទិន្នន័យសេដ្ឋកិច្ចសង្គមត្រូវបានធ្វើឡើងយ៉ាងទូលំទូលាយក្នុងប្រជុំកោះរ៉ុងនិងកោះរ៉ុងសន្លឹម។ វិធី សាស្ត្រប្រមូលទិន្នន័យ រួមមានការសម្ភាសន៍ជាមួយអ្នកពាក់ព័ន្ធសំខាន់ៗ ពិភាក្សាជាក្រុម និងការអង្កេតអំពីប្រជា សាស្ត្រ សកម្មភាពនេសាទ ព្រមទាំងទស្សនៈរបស់មូលដ្ឋានអំពីធនធានជលផលនិងការគំរាមកំហែង ព្រមទាំងឱកាស ការងារទទួលបានតាមរយៈការអភិវឌ្ឍន៍សេចក្តី។ គោលការណ៍ណែនាំអំពីការផ្តួចផ្តើមលើការត្រួតពិនិត្យសេដ្ឋកិច្ច សង្គមសម្រាប់ការគ្រប់គ្រងតំបន់ឆ្នេរ (SocMon) ត្រូវបានអនុវត្តនៅភូមិមួយក្នុងចំណោមភូមិទាំងប្រាំខាងលើ។

កោះរ៉ុងនិងកោះរ៉ុងសន្លឹមមានភូមិចំនួន០៤ ដែលបានចុះបញ្ជីទទួលស្គាល់ និងមានភូមិមួយទៀតមិនទាន់ បានចុះបញ្ជីទទួលស្គាល់ដោយក្រសួងមហាផ្ទៃ ព្រមទាំងមានប្រជាពលរដ្ឋយ៉ាងហោចណាស់៤៤៣គ្រួសារ (១៩៣៧ នាក់) កំពុងរស់នៅលើកោះទាំងនេះ។ សហគមន៍រស់នៅទីនេះមានទំនាក់ទំនងទាំងជាតិ ភាសា និងសាសនា រួមទាំង សមភាពយេឡែ។ អក្ខរកម្មនិងកំរិតអប់រំមូលដ្ឋានហាក់ដូចជាមានកម្រិតខ្ពស់ ជាមធ្យមពួកគាត់ទទួលបានការអប់រំពី៤

ទៅ៥ឆ្នាំ ដោយឡែកអ្នកភូមិកោះតូចមានភាពខុសប្លែកគួរឲ្យកត់សម្គាល់ ដោយប្រមាណ៥០% ជាអ្នកមិនចេះអក្សរប្រមាណ ១០០% ទទួលការអប់រំបានតិចតួចឬមិនបានទទួលការអប់រំទាល់តែសោះ នេះបើយោងតាមរបាយការណ៍ឆ្នាំ២០១១។ ប្រជាពលរដ្ឋគ្រប់ភូមិទាំងអស់មានសមាមាត្រអត្រាកុមារខ្ពស់។ យ៉ាងហោចណាស់ ពាក់កណ្តាលនៃពលរដ្ឋសរុបជាអ្នកពេញវ័យធ្វើការ (អាយុ១៩ ទៅ៥០ឆ្នាំ) ប៉ុន្តែភូមិព្រែកស្វាយជាភូមិដែលធំបំផុតនិងមានមនុស្សចាស់ៗច្រើន។ ចំនួនប្រជាពលរដ្ឋដែលរស់នៅទីនេះហាក់មានលំនឹងខ្ពស់។ យោងលើរបាយការណ៍បង្ហាញថា មានការធ្វើចំណាកស្រុកទៅបណ្តាខេត្តផ្សេងៗទៀត ដោយសារផលចាប់ត្រីធ្លាក់ចុះ ប៉ុន្តែមានការរំពឹងថា ចំនួនប្រជាពលរដ្ឋនឹងកើនឡើងម្តងទៀតដោយសារឱកាសការងារវិស័យទេសចរណ៍នៅក្នុងតំបន់នេះ។

តាមការអង្កេតជាទូទៅបានបង្ហាញថា ប្រាក់ចំណូលរបស់អ្នកនេសាទបានថយចុះជាបន្តបន្ទាប់ក្នុងរយៈពេលកន្លងមក។ ទោះជាយ៉ាងនេះក្តី ការនេសាទនៅតែជាប្រភពចំណូលដ៏ចម្បង ដែលនេះបង្ហាញពីសារៈប្រយោជន៍នៃទីជម្រកជលផលសម្រាប់ប្រជាពលរដ្ឋក្នុងតំបន់។ គ្រួសារជាច្រើនមានមុខរបរចម្រុះសម្រាប់ទ្រទ្រង់គ្រួសារ។ ក្នុងឆ្នាំ២០១១ ប្រជាពលរដ្ឋនៅសហគមន៍កោះរ៉ុងសន្លឹមប្រមាណ៥៦% មានមុខរបរពាក់ព័ន្ធនឹងវិស័យជលផល ហើយ២៣% មានសកម្មភាពពាក់ព័ន្ធដោយផ្ទាល់ជាមួយវិស័យទេសចរណ៍។ សកម្មភាពនេសាទជាចម្បងគឺការនេសាទមីកវីងអ្នកភូមិភូមិកោះតូច និងព្រែកស្វាយបានផ្តោតលើការនេសាទក្តាម។ នៅភូមិដើមថ្កូវ ការនេសាទក្តាមត្រូវបានធ្វើជាចម្បង តែការនេសាទមីកវីងត្រីក៏សំខាន់ផងដែរ។ ក្នុងឆ្នាំ២០១៣ អ្នកនេសាទ៥៥នាក់នៅលើប្រជុំកោះរ៉ុងនិងកោះរ៉ុងសន្លឹមត្រូវបានសម្ភាសន៍ ជាលទ្ធផល ប្រជាពលរដ្ឋ ១៦%ធ្វើការក្នុងវិស័យទេសចរណ៍ ៩%ធ្វើស្រែចំការ និង២០%ប្រកបរបរផ្សេងៗទៀត។ នៅភូមិព្រែកស្វាយប្រមាណជាងពាក់កណ្តាលនៃគ្រួសារដែលបានធ្វើសម្ភាសន៍ រកចំណូលពីការធ្វើនេសាទ ក្នុងនោះ៣៦%ពឹងអាស្រ័យជាចម្បងលើការនេសាទតែមួយមុខគត់ ហើយ១៥% អាស្រ័យលើការនេសាទរួមផ្សំនឹងស្រែចំការ។ កសិកម្មមានសារៈសំខាន់នៅក្នុងតំបន់នេះដោយអ្នកភូមិខ្លះធ្វើស្រែចំការ និងនេសាទអាស្រ័យលើអាសាសនាតុរ្យរដូវកាល និងផលចាប់។

មានដំណើរការផ្លាស់ប្តូរជាចម្បងនៃប្រភពប្រាក់ចំណូល ដោយសារការកើនឡើងយ៉ាងឆាប់រហ័សក្នុងវិស័យទេសចរណ៍ ពិសេសនៅភូមិកោះតូច។ តាមរយៈការធ្វើសម្ភាសន៍និងការពិភាក្សាជាក្រុមនៅឆ្នាំ២០១៣ បានរកឃើញថា ប្រជាពលរដ្ឋក្នុងភូមិកោះតូចទាំងអស់បានឈប់ធ្វើនេសាទ ហើយពួកគាត់បានផ្លាស់ប្តូរមុខរបរទាំងស្រុងទៅជាអ្នកផ្តល់សេវាកម្មទេសចរណ៍។ នៅប្រជុំកោះទាំងមូល យោងតាមលទ្ធផលជារួម អ្នកនេសាទខ្នាតតូចប្រមាណ២៨% បានឈប់ធ្វើនេសាទដោយសារគាត់មានមុខរបរផ្សេងទៀត។ ជាការឆ្លើយតប អ្នកនេសាទបានផ្លាស់ប្តូរប្រភេទធនធានជលផលដែលត្រូវចាប់ តាមរយៈការផ្លាស់ប្តូរឧបករណ៍នេសាទ ដោយសារប្រភេទដែលធ្លាប់ចាប់មានការធ្លាក់ចុះ (ជាពិសេសក្តាម) ។ សន្ទុះមីកវីងបានក្លាយជាឧបករណ៍នេសាទដ៏សាមញ្ញ ដែលត្រូវបានគេប្រើប្រាស់ជាទូទៅបំផុត រីឯលបក្តាម និងមងត្រូវបានថយចុះ។ ផលចាប់សរុបហាក់មានលក្ខណៈថេរ ដែលក្នុងនោះ ១ភាគ៣ នៃផលចាប់សរុបគឺជាពពួកត្រី រីឯមីកវីងត្រូវបានប៉ាន់ស្មានថាកើនរហូតដល់៥១% នៃផលចាប់សរុបរបស់អ្នកនេសាទក្នុងតំបន់ប្រជុំកោះ។ នៅពេលដែលមីកវីងជាប្រភេទសត្វដែលកំពុងពេញនិយមចាប់ក៏ដោយ ក៏ការនេសាទដោយឧបករណ៍ខ្នាតតូចផ្សេងៗរហូតដល់០៨ប្រភេទ ត្រូវបានប្រើប្រាស់ក្នុងតំបន់ប្រជុំកោះរ៉ុង និងប្រជុំកោះរ៉ុងសន្លឹម ដើម្បីចាប់ក្តាម បង្កា និងត្រី។

ការគំរាមកំហែងនិងការប្រើប្រាស់

ការគំរាមកំហែងខ្លាំងបំផុតទៅលើជម្រកជលផលសមុទ្រក្នុងប្រជុំកោះរ៉ុងនិងកោះរ៉ុងសន្លឹម គឺកករណ៍ ការនេសាទហួសកម្រិត និងការនេសាទខុសច្បាប់។ កង្វះខាតនៃផែនការអភិវឌ្ឍន៍តំបន់ឆ្នេរគឺជារូបភាពមួយនៃការគំរាមកំហែងផងដែរ។ ទោះជាផលប៉ះពាល់ជាអវិជ្ជមានអំពីសកម្មភាពរស់នៅរបស់មនុស្សត្រូវបានប៉ាន់ស្មានថានៅមានកម្រិតទាបនៅឡើយ ក៏ប៉ុន្តែ ការបំពុលបានកើតឡើងដែលបណ្តាលឲ្យមានផលប៉ះពាល់នៅទីតាំងដែលរស់នៅនោះ។

តាមការអង្កេតរបស់អ្នកនេសាទក្នុងប្រជុំកោះបានឲ្យដឹងថា ការគំរាមកំហែងទៅលើធនធានជលផលគឺ ការប្រើប្រាស់ ឧបករណ៍នេសាទខុសច្បាប់ ការនេសាទដោយទូកនេសាទបរទេស និងការនេសាទហួសកម្រិត។ ការនេសាទដោយ ប្រើខ្យល់ អូនអូស និងការនេសាទដោយប្រើថ្នាំបំពុល ជាកត្តាគំរាមកំហែងដ៏ខ្លាំងបំផុត។ ឧបសគ្គដែលបង្កឲ្យប៉ះពាល់ ដល់ប្រសិទ្ធភាពនៃការគ្រប់គ្រងត្រូវបានកំណត់ឡើង ដូចជា ខ្វះការពង្រឹងអនុវត្តច្បាប់ និងខ្វះការគាំទ្រថវិកាធនធាន និងបច្ចេកទេស។

សកម្មភាពទេសចរណ៍បានបង្កើតឱកាសនិងការគំរាមកំហែងផងទៅលើមុខរបរចិញ្ចឹមជីវិតក្នុងមូលដ្ឋាន។ ឧស្សាហកម្មទេសចរណ៍ក្នុងតំបន់នេះ គឺអាស្រ័យយ៉ាងខ្លាំងលើការមុជទឹក និងសកម្មភាពកំសាន្តផ្សេងៗទៀតដែល ពឹងអាស្រ័យលើ បរិស្ថានសមុទ្រដ៏ស្រស់ស្អាត។ ចំនួនភ្ញៀវទេសចរដែលទៅកំសាន្តនៅលើប្រជុំកោះទាំងនេះ មាន ការកើនឡើងយ៉ាងឆាប់រហ័ស ពីចំនួន៣៦.០០០នាក់ នៅឆ្នាំ២០១១ ទៅចំនួន៧២.០០០នាក់ នៅឆ្នាំ២០១២ និង ចំនួន៩០.០០០នាក់ នៅឆ្នាំ២០១៣ ហើយមានផ្ទះសំណាក់និងបារប្រមាណចំនួន៤៧ និងមានរមណីយដ្ឋានដ៏ប្រណិត មួយ ព្រមទាំងមានក្រុមហ៊ុនមុជទឹកនិងអ្នកផ្តល់សេវាកម្មមុជទឹកចំនួនប្រហាក់ប្រហែល១០ នៅក្នុងតំបន់នេះ។ កន្លែង មុជទឹកសំខាន់ៗគឺត្រូវបានគេផ្ដោតសំខាន់នៅប៉ែកខាងជើងកោះរ៉ុងសន្លឹម និងជាពិសេសនៅជុំវិញកោះកូន។ ចំពោះ សកម្មភាពទេសចរណ៍សមុទ្រដទៃទៀតនឹងក្លាយជាសកម្មភាពទាក់ទាញជាទូទៅ ដូចជាការនេសាទជាលក្ខណៈកំសាន្ត ទេសចរណ៍តាមនាវា និងកីឡាលើទឹក។ ក្រុមហ៊ុនសម្បទានអភិវឌ្ឍន៍ធំៗចំនួន៣នៅលើកោះ ក្នុងនោះមានក្រុមហ៊ុន១ អភិវឌ្ឍន៍លើកោះរ៉ុង និង២ក្រុមហ៊ុនផ្សេងទៀតអភិវឌ្ឍនៅលើកោះរ៉ុងសន្លឹម។ បរិស្ថានសមុទ្រនិងដីគោកមានអន្តរ អំពើរវាងគ្នានឹងគ្នា ជាហេតុធ្វើឲ្យអាជ្ញាធរ និងក្រុមហ៊ុនឯកជនសម្រេចចិត្តអនុវត្តតាមច្បាប់ឬបទដ្ឋានដែលមានស្រាប់ ជាមួយនឹងឆន្ទៈរបស់ពួកគេក្នុងការអនុវត្តតាមបទពិសោធន៍ល្អៗរបស់អន្តរជាតិក្នុងការអភិវឌ្ឍតំបន់ឆ្នេរ ដែលនឹងកំណត់ ថាតើមានផលប៉ះពាល់យ៉ាងណាដល់ជម្រកធនធានជលផលតាមឆ្នេរសមុទ្រ ដោយសារការអភិវឌ្ឍទ្រង់ទ្រាយធំ។

គណៈកម្មការគ្រប់គ្រងតំបន់គ្រប់គ្រងជលផលសមុទ្រខេត្តព្រះសីហនុ និងក្រុមការងារបច្ចេកទេសសម្រាប់ តំបន់គ្រប់គ្រងជលផលសមុទ្រនៅប្រជុំកោះរ៉ុងនិងកោះរ៉ុងសន្លឹមត្រូវបានបង្កើតឡើង។ សហគមន៍នេសាទចំនួន០៣ ត្រូវបានបង្កើតឡើង និងចុះបញ្ជីជាមួយក្រសួងកសិកម្ម រុក្ខាប្រមាញ់ និងនេសាទ ក្នុងទំហំសរុប ១៨.៦៧២ហិកតា ស្មើនឹងជិតពាក់កណ្តាលផ្ទៃសរុបនៃតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរ៉ុងនិងកោះរ៉ុងសន្លឹម ដែលបានស្នើឡើង ហើយគ្របដណ្តប់ទាំងទីជម្រកផ្កាថ្មក្បែរច្រាំង ព្រៃកោងកាង និងស្មៅសមុទ្រ។ ចរិតលក្ខណៈជាមូលដ្ឋាននៃសហគមន៍ នេសាទនីមួយៗខុសគ្នាគួរឲ្យកត់សម្គាល់ ជាពិសេសតាមកម្រិតនៃការគាំទ្រ ដូចជាសហគមន៍នេសាទភូមិដើមថ្កូវទទួល បានការគាំទ្រពីខាងក្រៅតិចតួចបំផុត។ គណៈកម្មការសហគមន៍នេសាទថ្មីត្រូវបានបោះឆ្នោតជ្រើសរើសនៅអំឡុងខែ តុលា ឆ្នាំ២០១៣ ដែលរួមមាន៦៣% ជាសមាជិកគណៈកម្មការថ្មី។ អ្នកនេសាទក្នុងតំបន់នេះជាទូទៅបានយល់ដឹងពី គោលបំណងនៃសហគមន៍នេសាទ ខណៈដែលអ្នកនេសាទប្រហែលជាពាក់កណ្តាលយល់ថា សហគមន៍នេសាទជា យន្តការគ្រប់គ្រងមួយដ៏ល្អប្រសើរ តែពួកគាត់ក៏ទទួលស្គាល់ផងដែរថា សហគមន៍នេសាទមិនមានលទ្ធភាពគ្រប់គ្រាន់ ដើម្បីគ្រប់គ្រងសកម្មភាពនេសាទបានទេ ព្រោះថាពួកគាត់នៅសង្កេតឃើញមានការនេសាទខុសច្បាប់ធ្វើសកម្មភាព ក្នុងតំបន់ ហើយបំផ្លាញឧបករណ៍នេសាទរបស់ពួកគាត់ទៀតផង។

អនុសាសន៍

អនុសាសន៍សំខាន់ៗសម្រាប់ការគ្រប់គ្រងតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរ៉ុងនិងកោះរ៉ុងសន្លឹម ប្រកបដោយប្រសិទ្ធភាព ៖

១. បង្កើតតំបន់គ្រប់គ្រងជលផលគំរូនៅប្រជុំកោះទាំងពីរនេះ និងបែងចែកកន្លែងគ្រប់គ្រងជលផលឲ្យបាន ច្បាស់លាស់ តាមរយៈការពិគ្រោះយោបល់ជាមួយអ្នកពាក់ព័ន្ធទាំងអស់និងលទ្ធផលនៃការស្រាវជ្រាវ។

២. បង្កើតនិងអនុវត្តផែនការគ្រប់គ្រងតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុងនិងកោះរុងសន្លឹម។
៣. ប្រើប្រាស់សហគមន៍នេសាទដែលមានស្រាប់ ជាបង្គោលការពារតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុង និងកោះរុងសន្លឹមប្រកបដោយប្រសិទ្ធភាព។
៤. ប្រើប្រាស់រចនាសម្ព័ន្ធច្បាស់លាស់ ដោយមានអ្នកពាក់ព័ន្ធចូលរួម ដើម្បីគាំទ្រការគ្រប់គ្រងតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុង និងកោះរុងសន្លឹម។
៥. ហាមឃាត់អ្ននអូសនិងឧបករណ៍នេសាទដទៃទៀតដែលបំផ្លិចបំផ្លាញដល់ធនធានជលផលក្នុងតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុងនិងកោះរុងសន្លឹម។
៦. បង្កើតប្រព័ន្ធការពារសុវត្ថិភាពទប់ទល់នឹងផលប៉ះពាល់ជាអវិជ្ជមានលើជីវភាពរស់នៅនិងធានាសន្តិសុខស្បៀង ព្រមទាំងយុទ្ធសាស្ត្រមុខរបរចិញ្ចឹមជីវិតចម្រុះ។
៧. ធានាការបែងចែកថវិកានិងធ្វើការអនុវត្តយន្តការហិរញ្ញប្បទានសម្រាប់ការគ្រប់គ្រងចំណាយនៃតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុងនិងកោះរុងសន្លឹម។
៨. បង្កើតនិងអនុវត្តនូវក្របខណ្ឌការងារត្រួតពិនិត្យតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុងនិងកោះរុងសន្លឹម ដើម្បីផ្តល់ព័ត៌មានដល់ការធ្វើសេចក្តីសម្រេចចិត្តក្នុងការគ្រប់គ្រងនិងវាយតម្លៃពីវឌ្ឍនភាពនៃការសម្រេចបាននូវគោលដៅរយៈពេលវែងរបស់តំបន់គ្រប់គ្រងជលផលសមុទ្រ។
៩. ផ្សារភ្ជាប់ផែនការប្រើប្រាស់ដីនិងអភិវឌ្ឍកោះប្រកបដោយសក្តានុពលទៅក្នុងផែនការរៀបចំនិងអនុវត្តការគ្រប់គ្រងតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុងនិងកោះរុងសន្លឹម។
១០. អនុវត្តយុទ្ធនាការអប់រំផ្សព្វផ្សាយពីសារៈសំខាន់តំបន់គ្រប់គ្រងជលផលសមុទ្រនេះ។

ការកំណត់បែងចែកកន្លែងគ្រប់គ្រងនៅក្នុងតំបន់គ្រប់គ្រងជលផល គឺជាឧបករណ៍ឬវិធីសាស្ត្រគ្រប់គ្រងដ៏សំខាន់សម្រាប់តំបន់ដែលមានការប្រើប្រាស់ច្រើនយ៉ាង។ កន្លែងពិសេសៗអាចជួយជ្រោមជ្រែងដល់ទីជម្រកជលផលដ៏រឹងមាំ ដើម្បីរួចផុតពីសកម្មភាពបំផ្លិចបំផ្លាញ ព្រមទាំងជួយការពារនិងបង្កើនស្តុកត្រី ពីព្រោះយើងអាចបែងចែកសកម្មភាពប្រើប្រាស់កន្លែងពិសេសៗទាំងនេះផ្សេងៗគ្នា ដើម្បីកាត់បន្ថយផលប៉ះពាល់និងជម្លោះដែលកំពុងកើតឡើង។ ទម្រង់នៃការបែងចែកកន្លែងគ្រប់គ្រង ជាទូទៅមានកន្លែងដែលត្រូវការការពារដោយតឹងរឹង និងកាន់តែដាច់ខាតបំផុត។ កិច្ចប្រជុំពិគ្រោះយោបល់លើការកំណត់និងបែងចែកកន្លែងគ្រប់គ្រងក្នុងតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុងនិងកោះរុងសន្លឹម ត្រូវបានពិភាក្សាតាំងពីខែធ្នូ ឆ្នាំ២០១២ មកម្ល៉េះ ហើយគម្រោងនេះក៏ត្រូវបានលើកនៅក្នុងរបាយការណ៍នេះដែរ។ ជាអនុសាសន៍ការបង្កើតតំបន់គ្រប់គ្រងជលផលសមុទ្រ និងផែនទីកំណត់បែងចែកកន្លែងគ្រប់គ្រង ព្រមទាំងផែនការគ្រប់គ្រងរយៈពេល៥ឆ្នាំ គួរត្រូវបានអនុម័តជាផ្លូវការយ៉ាងឆាប់ដែលអាចធ្វើទៅបាន សម្រាប់គ្រប់គ្រងតំបន់គ្រប់គ្រងជលផលនេះ។

អនុសាសន៍ជាក់លាក់សម្រាប់ការកំណត់បែងចែកកន្លែងគ្រប់គ្រងជលផល គឺដើម្បី ៖

១. ធានាថា រាល់ទីជម្រកជលផលសំខាន់ៗក្នុងតំបន់ប្រជុំកោះរុងនិងកោះរុងសន្លឹមត្រូវបានបញ្ចូលជាកន្លែងអភិរក្ស។ កន្លែងអភិរក្សជលផលគួរត្រូវកំណត់ឲ្យដល់ទំហំមួយដែលអាចទទួលយកបានពីសហគមន៍មូលដ្ឋានផ្ទាល់ ជាពិសេស អ្នកនេសាទក្នុងមូលដ្ឋាននិងអ្នកដែលពឹងអាស្រ័យលើផែននេសាទទាំងនេះ។
២. បង្កើតកន្លែងមុជទឹកកំសាន្តក្នុងតំបន់គ្រប់គ្រងជលផលសមុទ្រប្រជុំកោះរុងនិងប្រជុំកោះរុងសន្លឹម។

ប្រសិនបើការរៀបចំនិងត្រួតពិនិត្យបានល្អប្រសើរ កន្លែងទាំងនេះនឹងមានសារៈប្រយោជន៍ដល់តំបន់ គ្រប់គ្រងជលផល ដូចជាការអប់រំ ស្រាវជ្រាវវិទ្យាសាស្ត្រ គាំទ្រវិស័យទេសចរណ៍ និងជួយរកចំណូល សម្រាប់ការគ្រប់គ្រងតំបន់គ្រប់គ្រងជលផលសមុទ្រនេះ ព្រមទាំងជួយដល់ការការពារទីជម្រកជលផល បានល្អប្រសើរ។

I. SUMMARY - ENGLISH

Overview

The waters around the islands of Koh Rong and Koh Rong Sanloem have been proposed to become Cambodia's first Marine Fisheries Management Area (MFMA). This report, compiled by Coral Cay Conservation (CCC) and Fauna & Flora International (FFI) at the request of the Fisheries Administration (FiA), contains initial recommendations on the design and implementation of the Koh Rong Archipelago MFMA. Recommendations are based on the compilation of information from multiple sources on the state of habitats, species and the socio-economic characteristics of local communities. The report is intended to provide an overview of available information for the area, while providing background on the benefits of Marine Protected Areas (MPAs) and strategies for effective MPA design.

Coral reefs and other marine habitats such as seagrass beds and mangroves fringe many of Cambodia's 69 islands and shelter a rich diversity of marine life. Cambodia's marine and coastal zone plays an increasingly important role in the country's development, supporting fisheries, tourism and sectors such as agriculture and transport. The average marine fisheries production has been a steady 15% of the total national fish production between 2009-2012, and marine aquaculture is projected to increase. The primary threats to marine fisheries production nationally are habitat destruction, over fishing, pollution and increasing fishing effort. The overall trend is of increasing degradation and overexploitation of the coastal zone, which highlights the need for measures to improve management of commercially important marine species and their habitats. This report recommends that the formal proclamation of the Koh Rong Archipelago Marine Fisheries Management Area be approved as a matter of urgency. Mechanisms need to be established to support effective management and progress towards the MFMA vision of *a model marine fisheries management area for conservation of marine biodiversity, sustainable fishing and tourism, contributing to poverty reduction*.

Species and habitats

Early research at the turn of the century concluded that coral reefs in Cambodia provide both socio-economic and biological benefits, and recommended that long-term marine conservation schemes should be implemented. The level of risk to Cambodia's reefs is thought to be high to very high, yet coral reefs remain underrepresented in the protected area system.

Research in the Koh Rong Archipelago between 2010-2012 by CCC and Marine Conservation Cambodia (MCC) used Reef Check survey methods to quantify the abundance, diversity and composition of selected fish, invertebrate and benthic species. CCC also applied an approach to highlight particular areas of conservation interest using multiple indices to calculate a composite Conservation Management Value (CMV) for each survey site. Hard coral cover was around 20% on average around Koh Rong and around 13% for Koh Rong Sanloem. Coral diversity was relatively low throughout the archipelago, with massive life-forms such as *Porites* species and *Diploastrea heliopora* dominating. A lack of more sensitive tabulate and branching life-forms could be an indicator of the effects of sedimentation. Anthropogenic influences such as trash were relatively low, although the effects of fishing in the form of discarded nets were found at most survey sites around Koh Rong Sanloem.

In general, fish abundance was low, with numbers of commercially valuable reef fish species appearing to be low. Snappers (Lutjanidae) contributed the most to the composition of indicator fishes observed around Koh Rong Sanloem (41%), followed by butterflyfish (Chaetodontidae), parrotfish (Scaridae) and grouper (Serranidae) (33%, 18% and 7%, respectively), with sweetlips (Haemulidae) contributing just 1%. There was an almost complete lack of large groupers.

The highest fish abundances were on the south-western tip and west of Koh Rong. These were also identified as areas of high conservation interest based on CMVs and individual indices, along with Koh Touch on the south of Koh Rong. South western and northern sections of Koh Rong Sanloem, incorporating Koh Koun, were also highlighted as areas of high conservation interest based on coral reef data.

Mangrove ecosystems are also highly productive and play an essential role in the lifecycle of many marine organisms. Satellite imagery from January 2013 suggests a current total area of approximately 112ha of standing mangrove on Koh Rong and 15ha on Koh Rong Sanloem, distributed in small stands or lining creeks. The largest continuous block of habitat can be found on the east of Koh Rong. The composition of mangrove assemblages remains essentially unstudied. While it is likely that localised cutting of mangroves continues in some areas, the largest threat is expected to be from poorly planned coastal development.

Seagrass beds in the archipelago are predominantly associated with fringing mangroves. Recent transect surveys suggest that the total seagrass area in the archipelago in April-May 2013 was approximately 18ha. *Halodule pinifolia*, *Thalassia hemprichii*, *Enhalus acoroides* and *Halophila minor* have all recently been recorded, with *H. pinifolia* being the commonest species. Two further species have been reported historically; *Cymodocea serrulata* and *Halophila ovalis*. Human impacts appear to be widespread in the remaining seagrass habitat, including fishing impacts and possibly land-based pollution. There is evidence of general decline in the extent of seagrass habitat. The largest remaining seagrass bed, approximately 10ha, is close to Daem Thkov and it is recommended that it should be designated as a Conservation Area within the MFMA.

The dominant island vegetation is broadleaved evergreen forest, which covered approximately 7,736ha in January 2013, 75% of the total area of the major islands of the archipelago, including Koh Koun. The forest appears to have been selectively logged in the 1980s and 1990s. Areas of marshland, shrubland, grasslands, *Melaleuca* forest and agricultural land can be found across the archipelago, particularly on Koh Rong. The extent of mangrove does not appear to have declined significantly in the last decade. Comparison between 1997 land-cover maps and 2013 satellite data, however, suggest a decrease in evergreen forest cover on Koh Rong of approximately 20% over 16 years. Coastal and mangrove forest management will have an important impact on nearshore marine habitats.

Sub-decree 123 afforded increased legal protection to 58 aquatic species. Of the species, genera and the one class of marine organisms listed, at least 10 have been reliably recorded within the proposed MFMA boundaries. Of marine species that have been recorded, 1 is Critically Endangered, 2 are Endangered, and at least 10 Vulnerable, which are predominantly seahorses. With a few exceptions where targeted research has been undertaken, relatively little is known about the current status of the majority of endangered species in the area.

Species focused management practices will be necessary to ensure that endangered species are able to persist within and around the MFMA. Recent studies indicate that the waters of the archipelago are still frequented by the green turtle *Chelonia mydas* and hawksbill turtle *Eretmochelys imbricata* and Koh Rong's beaches may still see occasional nesting attempts. The primary threat is perceived to be from by-catch, particularly from net fishing/trawling and stingray hooks. There have also been multiple recent cases of turtle entanglement in plastic waste or discarded fishing gear. Six species of seahorse have been recorded, including *Hippocampus kuda*, *H. trimaculatus*, *H. spinosissimus*, *H. comes*, *H. kelloggi* and *H. histrix*, which represents relatively high seahorse species diversity for an individual site. Inshore trawling is noted as a major threat to seahorses, both due to incidental by-catch as well as trawl induced changes to benthic habitats. Previous studies by MCC have identified 5 separate areas as seahorse habitat, and field observations from 2007 suggested higher diversity that has since decreased to strongly favour *H. spinosissimus*. Early surveys identified the waters west and south of Koh Rong and Koh Rong Sanloem, encompassing Koh Tang and Koh Polou Wai as a 'hotspot' for marine mammals. Local reports of dolphins suggest that they are present but the species are unconfirmed.

The last known record of live dugong *Dugong dugon* from the proposed MFMA is from 2005.

People

A wide range of socio-economic data has been collected in the Koh Rong Archipelago. Key informant interviews, focus group discussions and observations have been used to gather data on basic household demographics, fishing practices, as well as local perceptions about fisheries resources and threats and opportunities afforded by tourism development. In one village the guidelines of the Global Socioeconomic Monitoring Initiative for Coastal Management (SocMon) have been applied.

Koh Rong and Koh Rong Sanloem host 4 registered villages and one additional unregistered village, and there are at least 443 households (1937 people) living on these islands. There appears to be no significant gender imbalance and the communities are relatively homogenous with regard to ethnicity, language and religion. Literacy/basic education levels appear to be relatively high with an average of 4-5 years' education, with a notable difference in Koh Touch where in 2011 approximately 50% of the population were reported to be illiterate or with little or no formal education. All communities have high proportions of children. At least half of the population are of working age (19-50 years old), although the largest village of Prek Svay has an older age profile. Population size is largely stable. There are reports of emigration to other provinces due to perceived decline in fisheries catch, but also the expectation that population will rise again due to employment opportunities in tourism.

While fishermen overall perceive that their income has decreased over time, fishing remains the primary income source, highlighting the importance of fisheries habitats to local men and women. Many households pursue multiple livelihoods strategies. In 2011 56% of the community on Koh Rong Sanloem relied on fishing-related activities, while tourism-related activities directly involved 23% of the population. The primary activity there was squid fishing, while in Koh Touch and Prek Svay the focus was on crab fishing. In Daem Thkov crab fishing was dominant but squid and fish also important. Of 55 fishers interviewed across the archipelago in 2013, 16% also work in tourism, 9% on farms and 20% have other jobs. Of families interviewed in Prek Svay over half derived some or all of their income from fishing, with 36% relying primarily on fishing alone, and 15% depending on a combination of fishing and farming. Agriculture appears to be important, in this area at least, with households engaging in farming and fishing depending on weather, seasonality and catch.

There are major shifts in income sources underway due at least in part to rapid growth in tourism in certain communities, namely Koh Touch. 2013 focus group discussions and interviews found that there were no fishermen remaining in the village – local people had switched entirely to provision of tourism services. Across the archipelago 28% of small-scale fishermen have stopped fishing because they have other jobs to do. Fishermen have also responded to changes in target species and declining catches (particularly of crab) by changing fishing gear. Squid hooks have become more prevalent and are the most commonly used gear, and crab traps and gillnets have decreased in prevalence. Fish catch as a proportion of total catch appears to remain relatively stable at an estimated one third of the total catch, with squid estimated to make up 51% of total catch of local fishers. While squid is now the most common catch, the small-scale fishery in the Koh Rong Archipelago remains diverse, including 8 basic gear types targeting crab, squid, shrimp and fish.

Threats and Uses

The most pervasive threats to marine habitats in the Koh Rong Archipelago are overfishing, destructive fishing techniques and sedimentation. Poorly planned coastal development is an emerging threat. While anthropogenic impacts that have been measured are generally considered low, pollution does appear to be having an impact at specific sites. Perceived threats from local fishers are use of illegal gears, generally associated with foreign fishing vessels, and an increase in fishing pressure. Surface-supplied diving, trawling and fishing with poison are the main perceived threats. Barriers to effective

management have been identified as a lack of/poor enforcement and a lack of funding, resources and technical support.

Tourism presents both a threat and an opportunity to local livelihoods. The tourism industry in the area relies heavily on diving and other recreational activities that depend on high quality marine environments. Visitor numbers to the whole archipelago are rapidly rising, from 36,000 in 2011 to 72,000 in 2012 and 90,000 in 2013. As of December 2013 there were 47 guest houses/bungalows and 1 luxury resort, and there are approximately 10 dive companies and businesses offering dive trips in the area. The key dive sites are concentrated around the north of Koh Rong Sanloem and particularly around Koh Koun. Other marine based tourism activities are becoming commonplace, such as recreational fishing, cruises and watersports. There are 3 large concessions for island development, one which covers Koh Rong in its entirety and two which divide Koh Rong Sanloem. As terrestrial and marine environments interact, the decisions of authorities and companies to enforce or comply with existing legislation, as well as their willingness to implement international best practice in coastal development, will determine how large-scale development affects nearshore habitats in future.

An MFMA Provincial Management Committee (PMC) and a Technical Working Group for the Koh Rong Archipelago MFMA (TWG-MFMA) have been formed. Three Community Fisheries (CFi) are established and registered and their combined area of 18,672ha is nearly half of the total area of the proposed MFMA, and includes the majority of fringing reef, mangrove and seagrass habitat. The basic characteristics of each CFi varies considerably, as does the level of support provided historically, with Daem Thkov CFi receiving the least external support. New CFi committees were elected in October 2013, with 65% of the committee members being new. Local fishers are generally aware of and understand the purpose of the CFis. While around half of fishers view CFis as a good management mechanism, they also acknowledge that CFi do not have sufficient ability to manage fishing practices because they still observe illegal fishermen coming to their areas destroying their fishing gear.

Recommendations

Initial recommendations for the establishment and management of the Koh Rong Archipelago MFMA:

1. Implement an effective zonation plan following consultation with all island stakeholders.
2. Establish and implement an adaptive MFMA management plan.
3. Use existing CFis as the building blocks of an effective MFMA.
4. Use existing structures to support MFMA management.
5. Prohibit trawling and other destructive fishing methods within the MFMA.
6. Safeguard against negative livelihoods impacts and ensure food security and diversified livelihoods strategies.
7. Secure domestic budget allocations and implement sustainable financing mechanisms for MFMA management costs.
8. Establish an overarching MFMA monitoring framework to inform management decisions and assess progress towards long-term MFMA goals.
9. Incorporate potential terrestrial land-use change and island development plans in MFMA design and implementation.
10. Implement an MFMA awareness campaign.

Zoning is a key management tool for multiple-use MPAs. A zoning scheme generally includes areas under strict protection and areas with increasingly fewer restrictions. Consultation has been underway since December 2012, and a proposed zone map is included in this report. It is recommended that the MFMA zoning map is approved as soon as possible and implemented as an integral part of a 5 year management plan for the MFMA. It is important that the zoning scheme is as simple as possible, and ideally the zoning map will be included in the MFMA proclamation. Specific zoning recommendations are to:

- A. Ensure that a range of habitats are included in no-take zones distributed throughout the Koh Rong Archipelago. The size of no-take zones should be maximised whilst ensuring that they are acceptable to local stakeholders, particularly local fishing households.
- B. Establish no-take Recreational Areas throughout the MFMA. Such areas can be significant assets to the MFMA by facilitating education, scientific research, supporting tourism and assisting in generating revenue for MFMA management, whilst protecting sensitive habitats.





II. INTRODUCTION

2.1. Cambodia's Coastal Resources

Cambodia's coastline is 435 kilometres long and includes 69 islands within the Gulf of Thailand (Touch, 1995, Kim *et al.*, 2004). Coral reefs and other marine habitats such as seagrass beds and mangroves, fringe many of these islands providing a unique coastal environment that shelters a rich diversity of marine life (Kim *et al.*, 2004). Moreover, coral reefs promote fisheries and ecotourism practices, and provide a variety of goods and services including coastal protection to thousands of people depending on them and they therefore support local economies (Ouk & Kluskens, 2008). Although it is difficult to put a monetary value on coral reef resources, a recent study conducted by The Economics of Ecosystems and Biodiversity estimated that the value per hectare of healthy coral reef to be anywhere between \$130,000 to \$1.2 million/hectare/year (www.diversitas-international.org). The services provided by these reefs include food, raw materials, ornamental resources, climate regulation, moderation of extreme events, waste treatment, biological control, cultural services and maintenance of genetic diversity. If Cambodia's reefs are effectively protected, they have the best possible chance of coping with local, anthropogenic impacts and recovering from regional ones. If, however, they are not properly managed, it is quite likely they will disappear within the next few decades.

Information about Cambodia's reef ecosystems has until recently been sparse and poorly documented and there has been an urgent need for accurate data on the status of these critical habitats (Chou, 2003; Wilkinson, 2008). The first surveys on Cambodia's reefs were completed between 1997 and 1999 (Nelson, 1999a), followed by further surveys conducted in 2001 by Wetlands International (Mam, 2001) and the Department of Fisheries and the United Nations Environment Programme in 2002 and 2003 (UNEP, 2003). A team of scientists from the National University of Singapore conducted assessments of coral reefs around the Koh Sdach archipelago in Koh Kong Province in 2002 and 2003 (Chou *et al.*, 2002; Chou *et al.*, 2003). These surveys concluded that coral reefs in Cambodia provide both biological and socio-economic benefits to the area, and recommended that long term marine conservation schemes should be implemented (Kim *et al.*, 2004). Our knowledge on extent and location of vulnerable ecosystems such as coral reefs, seagrass and mangroves has improved and the body of information about marine resources is growing (Jensen & Ing, 2014). For example, status reviews for coral reefs have recently been produced of the Koh Rong Archipelago (Van Bochove *et al.*, 2011b; Thorne *et al.*, in prep.) and Koh Sdach Archipelago (Savage *et al.*, 2014). Research efforts, however, have been largely supported by international organisations and foreign volunteers, as there is currently not enough in-country capacity to support such scientific studies.

Although many cities in South East Asia are developing very rapidly, many people in Cambodia remain highly dependent on coastal resources for their livelihoods, inducing pressure on the marine environment (Wilkinson, 2008). Anthropogenic impacts on Cambodia's coral reefs such as overfishing, coral extraction, coastal development and marine based pollution can cause significant and often, irreversible damage to the reefs (Gillet, 2004; Sheppard, 2006). These impacts, when coupled with the current global increase in temperatures, induce a severe threat to the survival of coral reefs (Wilkinson 2008). Future projections made by the Global Coral Reef Monitoring Network estimate that the level of risk in Cambodia's reefs range from 'high' (90% of reefs) to 'very high' (10% of reefs) (Wilkinson, 2008). Coral reefs remain, however, underrepresented in the protected area system. Cambodia has five nationally protected areas in the coastal zone: four National Parks (Bokor, Botum Sakor, Kep and Ream) and one Wildlife Sanctuary (Peam Krasop, which incorporates a Ramsar Wetland of International Importance), plus one Multiple Use Area (Dang Peng). These are all land-based with a minor marine component in some cases, the most significant being within Ream National Park and the extensive mangrove forest within Peam Krasop Wildlife Sanctuary. While they have been discussed, a real MPA has yet to be formally established in Cambodia (Jensen & Try, 2014).

2.2. Marine Fisheries in Cambodia

Cambodia's marine and coastal zone plays an increasingly important role in the country's development, supporting the industrial, agriculture, fisheries and transport sectors and offering growing attraction for recreation and tourism (Johnsen & Munford, 2012). Marine capture fisheries remain significant for Cambodians, with catches growing steadily year on year according to government statistics (FiA, 2013). Marine production appears to have grown by between 6,000-10,000 tons annually since 2009 (FiA, 2013) but remains small in comparison to inland capture fisheries. The inland and marine catches totalled 509,000 tons and 99,000 tons respectively in 2012, with marine production contributing 15% of total national fish production (including aquaculture) that year (FiA, 2013). The trends indicate relatively little change over time in the proportions of wild caught fish (2009-2012), with the period average contribution from inland production being 73%, consistent with >70% reported by Ing (2007). The average marine production was stable at 15% of the total national fish production during the same 4 year period (FiA, 2013).

Marine and brackish water aquaculture is still relatively little developed (European Union, 2014). While aquaculture cannot replace the large volumes of fish harvested from wild sources (The WorldFish Centre, 2011), aquaculture development in Cambodia is now showing signs of more rapid growth (European Union, 2014). Marine aquaculture production (mostly snapper and grouper) is projected to increase by approximately 8% per year between 2009 (est. 2,880 tonnes) and 2030 (est. 15,000 tonnes) (The WorldFish Centre, 2011 in Johnsen & Munford, 2012).

Resource management in Cambodian coastal fishing communities might have been boosted following the signing of 15 Community Fishing Area Management Plans in Preah Sihanouk Province in 2011 (Johnsen & Munford, 2012). There were 39 CFIs established in marine waters (FiA, 2013), rising to 45 in 2014 (FFI, in litt.), and ambitious national targets to both strengthen existing and establish new CFIs. This reflects a broader national shift towards local management following the process of 'deep fisheries reform' that was completed in 2012 when the remaining inland commercial fishing lots were abolished and turned over to community-use (as CFIs) and Conservation Areas (Cooperman *et al.*, 2012).

The effectiveness of new and existing marine CFIs within the four coastal provinces is not currently well understood. Published figures on fisheries' yields are generally not reliable, and estimates of marine fisheries production do not take account of the substantial catch made by Thai and Vietnamese vessels which normally land elsewhere (European Union, 2014). The fact that fish are not landed at central locations, together with direct exports by foreign vessels, continues to contribute to inaccuracies in fisheries statistics. Fish caught by subsistence fishers are often not included in the official numbers, and while this important component of the Cambodian marine fishing sector is still poorly monitored, reports suggest that small-scale fishers are witnessing dwindling catches in some areas. For example, 95% of small-scale fishers interviewed in the Koh Rong Archipelago reported that their catch had declined (Leng, 2013) and coral reef surveys in the same area find that commercially valuable fish and invertebrates such as groupers and lobsters are rarely recorded, indicating overharvesting (Van Bochove *et al.*, 2011b).

The main threats to fisheries production in Cambodia persist: habitat destruction, overfishing, pollution, and, most probably, increasing fishing effort. A rapidly emerging threat that may lead to further degradation of the marine environment and coastal habitats is poorly planned or unregulated development in the coastal zone, fuelled by growing visitor numbers and investment in resorts and other large infrastructure. There remains a paucity of information regarding the status of Cambodia's marine fisheries resources, for example, the location of spawning grounds, or data on temporal changes in resource condition and endangered species populations. The overall trend is of increasing overexploitation of the coastal zone (Johnsen & Munford, 2012), highlighting the urgent need for efforts to improve management of commercially valuable marine species and their habitats.

2.3. Marine Fisheries Domain

The 2006 Law on Fisheries defines ‘fishery domains’ as state property (Article 9), and stipulates that fishery management shall be under the jurisdiction of Ministry of Agriculture Forestry & Fisheries (MAFF) (Article 3). The FiA is a Government authority, under MAFF, responsible for the management of fisheries and fishery resources based on the National Fishery Policies and the Law on Fisheries (Article 6). The marine fishery domain refers to marine water or brackish water that extends from the coastline at the highest high tide of the coastal lines to the outer limits of the Exclusive Economic Zone [EEZ, 200 nautical miles] of the Kingdom of Cambodia (FiA, in litt.). The Marine fishery domain is divided into:

- Inshore fishing areas, which extends from the coastline at higher high tide to the 20 meter deep line.
- Offshore fishing area, which extends from the 20 meter deep line to the outer limits of the EEZ of the Kingdom of Cambodia.
- Fishery conservation area, sea grass area, and coral reef area which are habitats for marine aquatic animals and plants.
- Mangrove forest area including mangrove and forests zone, which are important feeding and breeding habitats for aquatic animals, and protected inundated areas (Article 11).

2.4 Report Aims

This report, compiled by Coral Cay Conservation and Fauna & Flora International at the request of the Fisheries Administration, contains initial recommendations on the design and implementation of a multiple-use MPA in the Koh Rong Archipelago. This is known within Cambodia as the Marine Fisheries Management Area (MFMA), to reflect the definition within the Cambodian Law on Fisheries and the multiple-use approach which aims to ensure that fishery resources are managed sustainably while also encouraging tourism, reducing poverty and maintaining biodiversity¹. For the purpose of this report, the terms MPA and MFMA are synonymous.

This report aims to:

- Present the methods and results from biological and socio-economic survey work conducted in the Koh Rong Archipelago.
- Summarise the current status and state of knowledge of biological resources in the Koh Rong Archipelago.
- Provide background on the small-scale fisheries operating in the area.
- Outline the benefits of MPAs, and highlight strategies for designing and managing them effectively.
- Provide initial recommendations for the management and zonation of the Koh Rong Archipelago MFMA.

¹ Under globally applied IUCN protected area management categories (Day *et al.*, 2012), the proposed Koh Rong Archipelago MFMA is expected to best fit the Category VI definition (Protected Area with sustainable use of natural resources), although this needs to be confirmed in consultation with the Cambodian Government.

The recommendations herein are based on ecological and socio-demographic surveys carried out by CCC, FFI as well as a wide range of organisations who have conducted research in the area in the last 5-6 years, particularly MCC and the FiA itself. We compile information from the published and grey literature, as well as anecdotal records and observations. This report is not intended to be a comprehensive scientific analysis nor in-depth summary of the research carried out to date, but rather a simple overview of available information. We make general observations that can be drawn from the significant knowledge base that now exists for the marine habitats and fishing communities living around Koh Rong and Koh Rong Sanloem - related research and suggested reading are summarised in Appendix A. It is hoped that the growing body of information produced by multiple organisations in the area will be used to inform effective strategies to protect marine resources for the benefit of all island stakeholders.

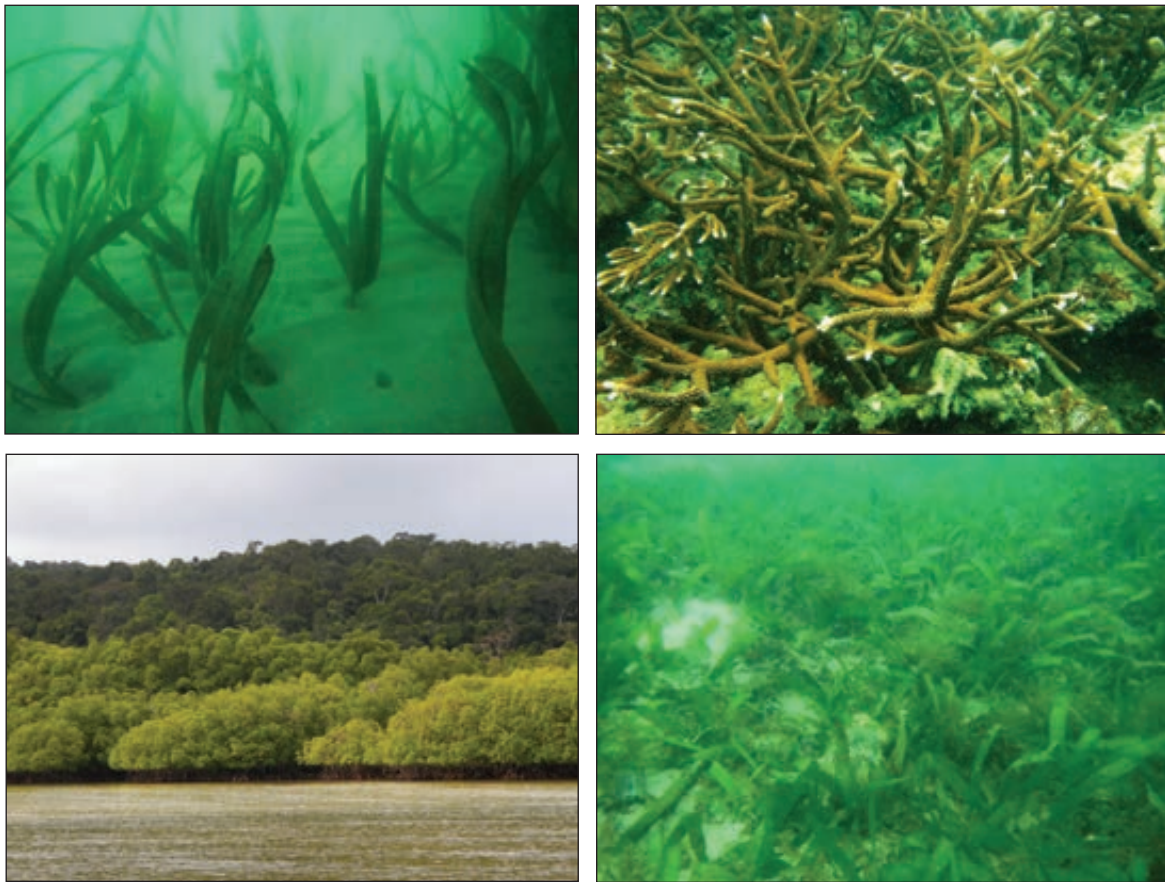


Figure 1-4 (clockwise). Habitat types within the proposed management area: Sea grass *Enhalus acoroides* © Leng Phalla/FFI; *Acropora formosa* branching coral, Koh Rong © CCC; Seagrass *Thalassia hemprichii* © Leng Phalla/FFI; Fringing mangroves Koh Rong Sanloem © Berry Mulligan/FFI.



Figure 5. Forest stream on Koh Rong Sanloem. Although island forests have been selectively logged since the 1980s, forest cover remained approximately 75% of total land-area in 2013 © Jeremy Holden/FFI.





III. STUDY AREA & METHODS

3.1 Site Overview

Koh Rong and Koh Rong Sanloem are the two major islands of the Koh Rong Archipelago, located in Preah Sihanouk Province, approximately 20km from the coastal town of Sihanoukville (Fig. 6). Several much smaller islands neighbour Koh Rong and Koh Rong Sanloem². The proposed MFMA encircles these islands, including fringing coral reefs, seagrass beds and mangroves, covering a total area of ocean of approximately 40,000ha (400km²). There are 5 villages in the area.

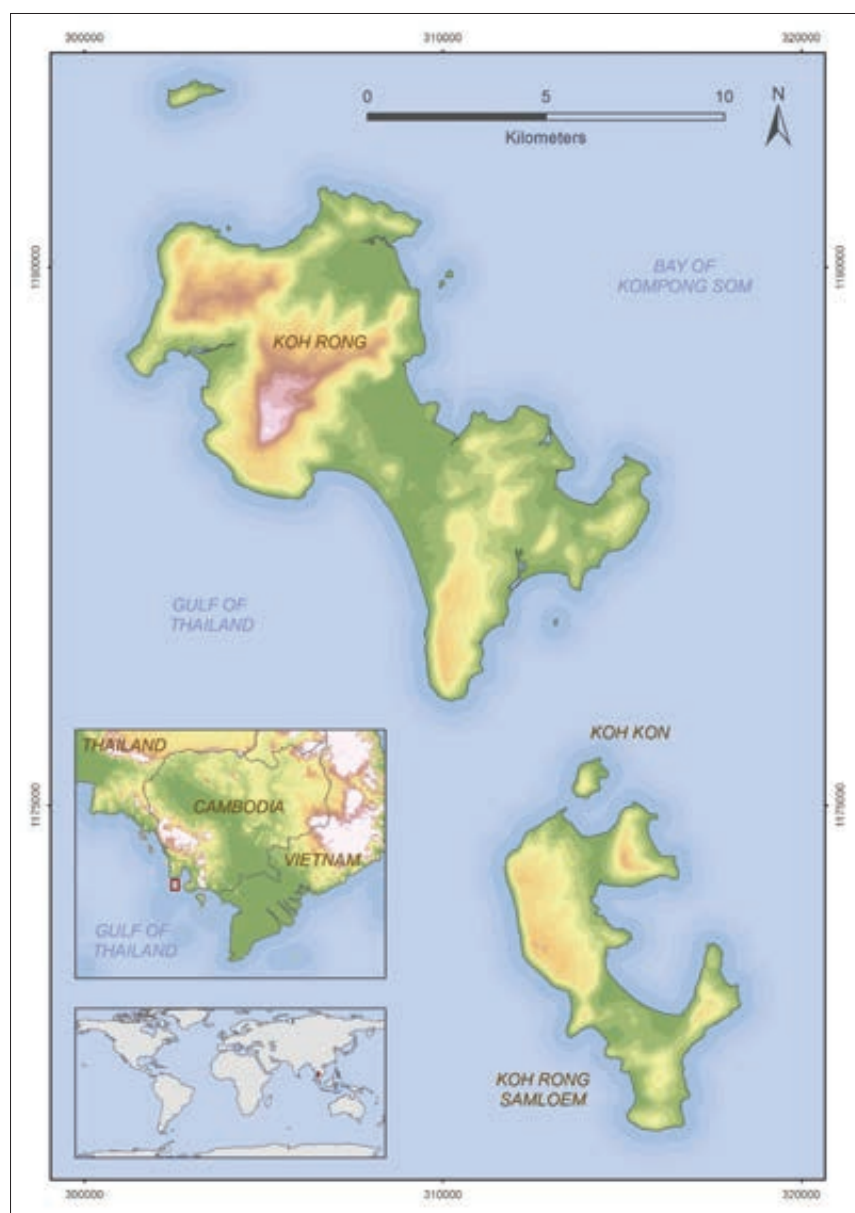


Figure 6: The islands of Koh Rong, Koh Koun and Koh Rong Sanloem (N 10°39.962' E 103°16.386').

² For the purpose of this report the Koh Rong Archipelago includes: Koh Rong, Koh Rong Sanloem, Koh Koun, Koh Touch, Koh Bong, Koh Ouen and Koh Doung, which are referred to using their Khmer names, although spellings of these vary considerably depending on source. It appears that there is no clear legal or accepted definition of the geographic extent of the Koh Rong Archipelago, and what is included tends to follow jurisdictional boundaries rather than geology. For example, Koh Tor Tueng (also called Koh Ta Team) and Koh Mnors approximately 5km from Koh Rong on the northern boundary of the proposed MFMA might arguably also be included, but are in Koh Kong Province.

3.2 Biodiversity Data Collection, Observation and Analysis

Reef Check methodology (Hodgson *et al.*, 2006) was used to survey reef sites around Koh Rong and Koh Rong Sanloem in order to quantify the abundance, diversity and composition of selected fish, invertebrate and benthic species. Biological data were collected between February 2010 and April 2012. Reef Check is a method for monitoring the general health status of a reef and provides a synoptic view of the health of a particular reef site. Specific indicator species were selected to provide more comprehensive information on the diversity of reef sites. Data were gathered by volunteer divers, trained and led by scientists on site, to assess the biological and physiological characteristics of reef communities. Data were collected from Koh Rong and Koh Rong Sanloem by teams from CCC (Van Bochove *et al.*, 2012) and from Koh Rong Sanloem by teams from MCC (Krell *et al.*, 2011).

In order to provide a general overview highlighting areas of particular biological interest, data from CCC's surveys of Koh Rong and Koh Rong Sanloem was analysed to produce the following 'conservation indices' (Longhurst & Clay, 2013):

- Fish target species abundance (total number of individuals recorded);
- Fish target species diversity (Fishers α);
- Food fish³ 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).

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. 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. Thus the results presented represent a relative assessment, based on all of the sites surveyed by CCC in the area. This means that the values presented are specific to the Koh Rong Archipelago and do not provide a mechanism for wider regional or national comparisons. This scoring approach to marine spatial planning is further discussed in Boon *et al.* (2014).

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.

A transect and quadrat method adapted from Ouk *et al.* (2010) was used to gather data on seagrass percentage cover (Leng *et al.*, 2014). Five metre resolution RapidEye satellite imagery from 30th January 2013 was ground-truthed by the FFI GIS Coordinator, and used to estimate extent of mangrove and other forest cover in the Koh Rong Archipelago. For species records this report also compiles incidental records gathered by the authors during site visits, as well as numerous observations shared by organisations, local authorities, businesses and individuals who live in or frequent the area.

3.3 Socio-economic Data Collection, Observation and Analysis

Experience from around the world has shown that socio-economic conditions (including cultural and governance factors) significantly affect the development, management and success of MPAs. Understanding the socio-economic context of the different groups that make up coastal or island

³ Rabbitfish (Siganidae), snappers (Lutjanidae), barracuda (Sphyraenidae), emperors (Lethrinidae), jacks/trevally (Carangidae), sweetlips (Haemulidae), parrotfish (Scaridae), groupers (Serranidae).

communities dependent on marine resources is an essential part of MPA planning and management. Use of socio-economic data enables MPA managers to incorporate local people's interests and perspectives into MPA management. This in turn usually results in high levels of local compliance with rules and regulations and minimises the need for, and potential conflict associated with, costly intensive enforcement measures. Analysis of socio-economic data also enables assessment of the impacts – both positive and negative – of management decisions on different stakeholders and can therefore inform adaptive management and demonstrate the benefits of MPAs.

A wide range of socio-economic data has been collected in the Koh Rong Archipelago which should inform MFMA design and assist implementation. In April 2011, socio-economic surveys were carried out in Koh Touch community on Koh Rong (Skopal, 2011) and Koh Rong Sanloem village⁴ (Skopal & Ferber, 2011), which are the two villages within the Koh Rong Sanloem CFI. A similar survey was carried in Daem Thkov on Koh Rong (Ouk *et al.*, 2011a). All 3 surveys combined key informant interviews with community heads, household surveys and observations carried out over 2 days spent in each community. Teams included two CFI trainees from Koh Rong Sanloem. Data were collected on basic household demographics, fishing practices (including gear, techniques and target species) as well as residents' perceptions of main threats to fisheries resources and of the threats and opportunities afforded by tourism development. In addition, note was made of community infrastructure and building materials used for housing in order to gain an impression of degree of overall development and the relative prosperity of different community members. Ouk *et al.* (2011b) then summarised the results of socio-demographic surveys in Koh Rong Sanloem CFI, Koh Touch, Prek Svay and Daem Thkov.

A survey was also carried out in February-March 2010 in the largest settlement of Prek Svay on Koh Rong using slightly different methods following SocMon guidelines, including a wider range of key informants, focus group discussions and participatory resource mapping, plus on-site observation (Seak & Hoy, 2010). The primary purpose of the assessment was to collect baseline information about the socio-economic situation of the local community involved marine resource conservation. This survey also incorporated attitudes towards marine resource management (including both use and non-use values), as well as governance indicators such as awareness of rules and regulations, compliance and enforcement, and participation in governance structures and processes.

In 2013, further socio-economic survey work was conducted in Prek Svay in conjunction with the relocation of CCC to the village. A series of informal interviews were conducted with groups of individuals within households in the village (Longhurst *et al.*, 2013). Questionnaires were developed to gather background demographic information on households. In addition, information was gathered to identify current skills present in the community, areas of training or capacity building previously received (if any), potential areas in which to develop training and skills delivery, and aspirations of individuals in terms of development. Basic data were gathered to identify the prevalence and importance of fishing in the community. Information was also collected on the current levels of environmental awareness including: awareness of environmental problems or challenges within the village; knowledge of the marine environment and perceptions of the proposed MFMA.

Several students and researchers have undertaken thesis research projects relating to local perceptions about fisheries, which can inform potential socio-economic impacts of the MFMA. Hamilton (2012) interviewed 29 individuals in July – August 2011 in Koh Touch to investigate the acceptance to and perceptions of MPAs amongst artisanal fishers operating around coral reef areas. An archipelago-wide study aimed to understand community fishing practices within the proposed MFMA, and identify the strengths and weaknesses of the CFIs (Leng, 2013). This used 55 individual household interviews and 5 focus groups involving 60 participants from across the 5 villages in the Koh Rong Archipelago. The study investigated current fishing practices, including any changes over time in terms of contributions to local livelihoods, as well as the degree understanding about and local support for CFIs. An ongoing study (On, in prep.) aims to understand the resource use patterns of local people in Koh Rong and Koh Rong Sanloem and to establish their perception of socio-economic impacts of proposed no-take zones within the MFMA, using participatory mapping and questionnaires, which specifically target finfish fishers and gleaners.

⁴ Also known as M'Pei Bei/Village 23.





IV. RESULTS

4.1. Biodiversity

4.1.a Coral Reef

Koh Rong

Coral cover was around 20% on average for all sites surveyed around Koh Rong. The highest live hard coral cover was located on the south western peninsular of the island. Cover was also high along the western side of the island. The lowest coral cover was found along the eastern side of the island with figures ranging from ~7 – 20%. The eastern side of the island contained no deep sites as the area is comprised largely of shallow sandy bottom. This may be a factor affecting the percentage cover as there is less suitable habitat for coral to colonise. In addition, the Cambodian mainland is located to the east of the island. Sediment run off from the main land could play a role in limiting coral cover by smothering coral and limiting growth.

The results show that coral species diversity was fairly low across all sites, with most corals being more robust massive or encrusting life-forms. Massive life-form corals such as *Porites* species and *Diploastrea heliopora* dominated most sites and were the most commonly seen, comprising around 40% of coral cover across all sites. Their dominance and the lack of more sensitive life-forms could be an indicator of the effects of sedimentation in the area. Tabulate and branching life-forms which are important habitat for many juvenile fish species were rarely observed on the survey dives. The highest abundance of these life-forms (Fig. 2) was found along the south western edge of the southern peninsular where the highest diversity and coral cover were also located.

Anthropogenic impacts were relatively low across most sites surveyed. There were however several sites where damage caused by fishing nets and other general trash was high. As these observations were fairly uncommon it is unlikely that these anthropogenic impacts are a major factor in reef degradation.

In general, abundances of fish species were not high, the highest abundances of all species were located on the south-western side of the southern peninsular and around the western point of the island. The results are in line with the highest values for coral diversity and cover and indicate that these areas may be the healthiest sections of reef around the island. Furthermore these areas are fairly isolated in terms of their distance to local fishing villages. Despite fishing being on a small-scale around the island, this relative isolation may be a factor in maintaining higher fish diversity and abundance.

Koh Rong Sanloem⁵

The dominant substrate cover encountered on surveys was sand (36%). The average hard coral cover within the area, was found to be 13%. Rock was one of the dominant substrates with an average cover of 28%. In general, the percentage of recently killed coral was low (< 5%). Nutrient Indicator Algae was found on few sites, generally not representing more than 5% of the substrate of the survey sites. This is to be expected as there is no terrestrial runoff or other nutrient enriching activities on these islands. However, future development, if not well managed, will most likely affect sediment runoff to the sea thus impacting the health of coral reefs.

Coral diversity was quite low, with massive *Porites* and *Diploastrea heliopora* dominating. These types of corals are slow-growing and generally more robust being able to withstand higher levels of

⁵ Results presented for Koh Rong Sanloem are compiled from Krell *et al.*, 2011.

sedimentation. Sedimentation can smother the coral when it is too heavy. Foliose coral such as *Turbinaria* sp. and *Montipora* sp. were relatively rare.

When assessed individually, each coral damage category (boat damage, dynamite damage and 'other') was found to be low with exception for dynamite damage in one area that reached the medium damage category. Even when the coral damage categories are summed together, the damage was low to moderate at most of the sites with the exception of one site around Koh Koun where the impact was high. The effects of fishing in the form of discarded nets or other trash were found on most sites, however, when present, it was relatively limited. Measures of other trash such as cans and plastic were generally low on all survey sites. Analysis showed that 46% of coral damage resulted from trash due to fishing activities, followed by general trash with 25%. 13% of the total damage resulted from boats anchoring on the coral reef while 11% resulted from inappropriate fishing methods with dynamite. Other coral damage, including predation by *Drupella* snails, was responsible for 5% of the total damage.



Figure 7. Groupers are rarely recorded on transects, and tend to relatively small, indicating overharvesting © CCC.

Humphead wrasse, bumphead parrotfish, baramundi cod and moray eel, were completely absent from all sites. In general, fish diversity was quite low, rarely more than four indicator species/families were recorded. The numbers of groupers recorded during the survey dives was very low on all sites (less than 2 individuals per ha) and with an almost complete lack of large individuals (Fig. 7). The numbers of snappers presented a greater variability ranging from 38 to 0 individuals per 100m². Snappers (Lutjanidae), contributed the most to the composition of indicator fishes observed at the study area (41%), followed by the family of butterflyfish (Chaetodontidae), parrotfish (Scaridae) and grouper (Serranidae) (33%, 18% and 7%, respectively). Individuals of sweetlips (Haemulidae) were found contributing less (1%) to the present fish composition.

Conservation Management Values

Figure 8 shows CMVs calculated for all survey sites around the Koh Rong Archipelago. Sites with high CMVs, representing sites with above average values for several conservation indices, were highlighted in western and southern areas of Koh Rong and northern and western areas of Koh Rong Sanloem. However, while highlighting areas with above average values for several indices, CMV analysis was unable to take into account sites with particularly high values for one specific index. Figure 9 shows key areas of conservation interest identified by CCC, based on both CMVs and individual index values.

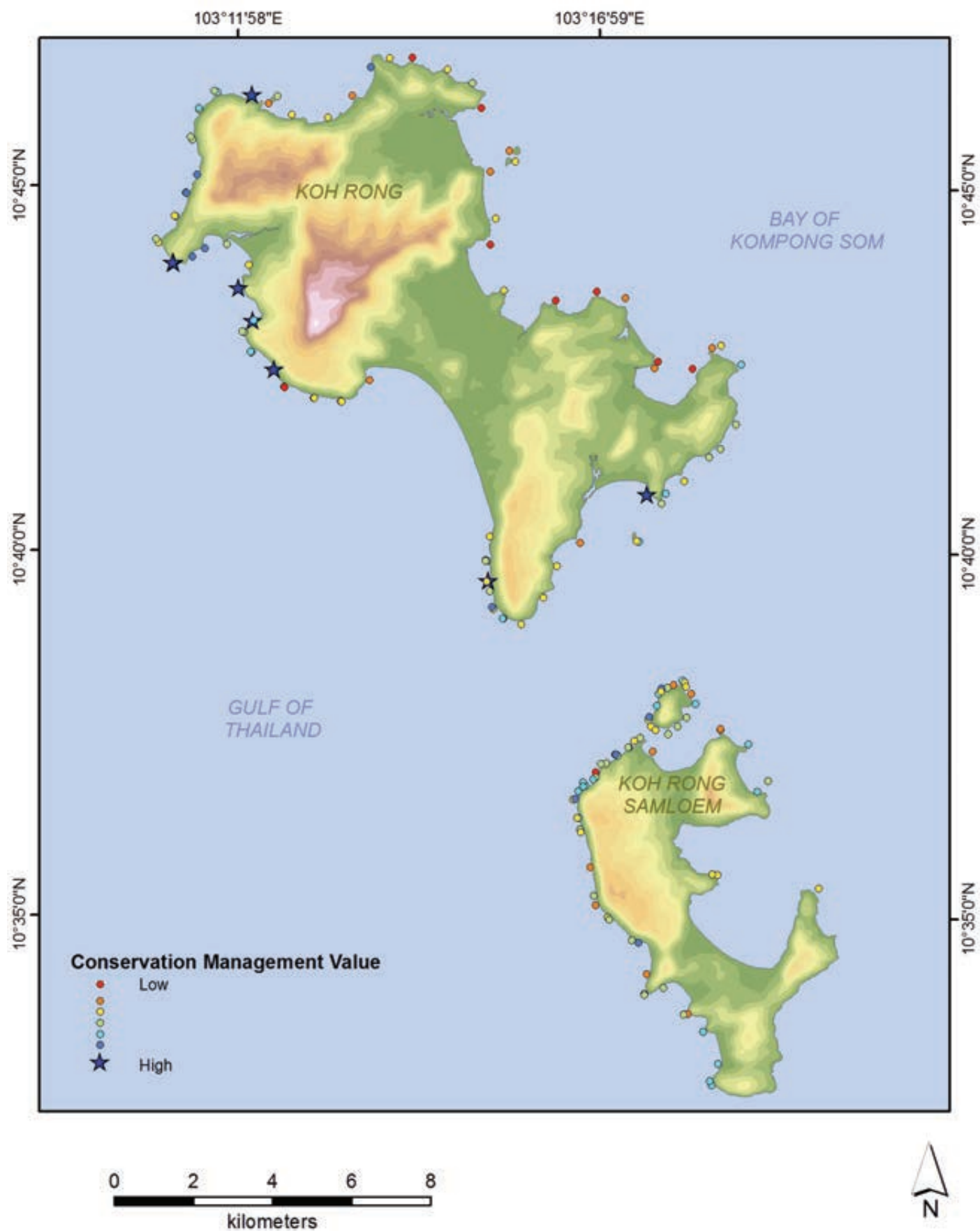


Figure 8. Conservation Management Values at all CCC survey sites (after Longhurst & Clay, 2013).

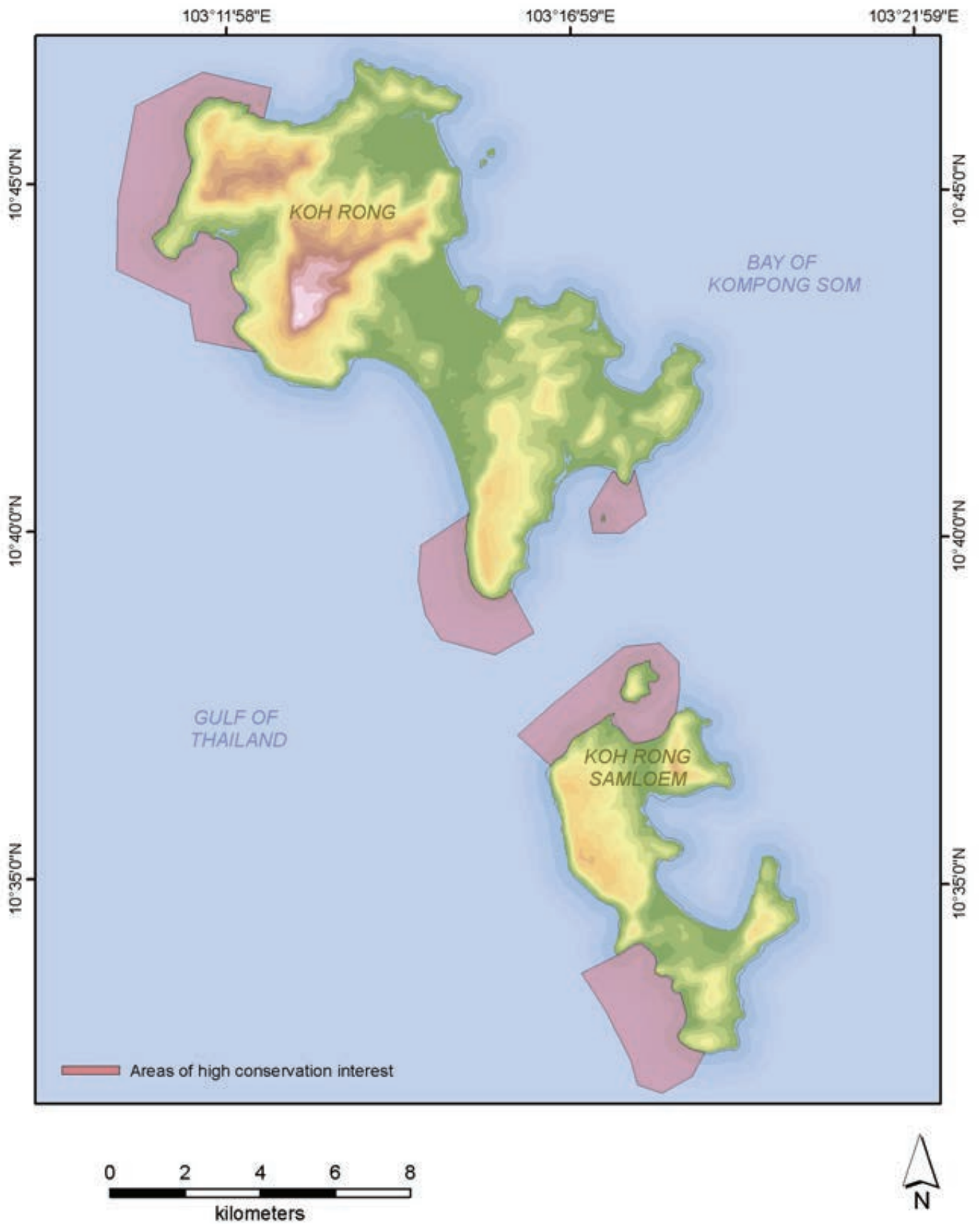


Figure 9. Areas of high conservation interest based on Conservation Management Values and individual index values (after Longhurst & Clay, 2013).

4.1.b Mangrove and Coastal Forest

Mangrove ecosystems are highly productive and play an essential role in the lifecycle of many marine organisms. For example, they serve as spawning or nursery grounds for several commercially critical fish species (Johnsen & Munford, 2012). Mangrove forests are considered vital for providing food sources, shelter and nursery areas for both culture and capture fisheries in the coastal zone (Rizvi & Singer, 2011). They also act as a buffer against storms, strong winds and currents and therefore help reduce coastal erosion (Save Cambodia's Wildlife, 2014).

Three different types of mangroves are found in Cambodia: riverine, basin and fringing mangroves (FAO, 2005), and 16 true mangrove species have been recorded (FAO, 2007). The most common species are *Rhizophora apiculata* (syn. *R. conjugata*), *R. mucronata*, *Bruguiera gymnorhiza*, *B. sexangula*, *Ceriops tagal*, *C. decandra*, *Sonneratia alba*, *Lumnitzera littorea*, *L. racemosa* and *Xylocarpus granatum* (syn. *Carapa obovata*) (FAO, 2007). Rates of mangrove loss in Cambodia have accelerated from 1.6% between 1990 and 2000 to 1.9% between 2000 and 2010 (Johnsen & Munford, 2012). Preah Sihanouk Province is second only to Koh Kong Province in terms of the extent of standing mangrove forests – it holds 13,500 ha of mangrove, which is 17% of the total mangrove area in Cambodia (FiA 2010 in Mangroves for the Future, 2013).

Previous JICA (1997, 2005) land use maps which include land cover for Koh Rong (but not Koh Rong Sanloem) indicate areas of degraded mangrove on the east of Koh Rong of between 91 ha and 104 ha. Seak & Hoy (2010) reported an area of about 57 ha in the Prek Svay community on Koh Rong, and Skopal-Papin (2011) maps approximately 14 ha of mangrove on Koh Rong Sanloem. The Atlas of Cambodia (Save Cambodia's Wildlife, 2006) recorded a total of 90 ha from both Koh Rong and Koh Rong Sanloem. Observations suggest that there are some important patches of mangrove missing from these previously available land-cover maps as well as mis-classification of village areas and plantations close to Prek Svay as degraded mangrove on the JICA national land use maps.

This lack of clarity and recent observations on-site demonstrate the need for detailed mangrove mapping, including both major islands of the archipelago. Current mangrove distribution and species composition remains poorly documented in the archipelago, although good, healthy mangroves reportedly exist on Koh Rong, including along creeks on the north west of the island (B. Olsen, in litt.). Social surveys by Seak & Hoy (2010) found that local people could easily recognise 6 dominant mangrove species, and when the local names were cross referenced with scientific names these were identified as *R. apiculata*, *R. mucronata*, *Avicennia marina*, *B. gymnorhiza*, *B. sexangula* and *Ceriops* spp. The study also found that local people on Koh Rong tend to perceive that mangrove resources are in good or very good condition, and have relatively high awareness of the rules protecting mangroves. Rapid ecological surveys of Koh Ouen and Koh Bong, islets adjacent and to the east of Koh Rong, found that they are surrounded with mangrove in good health (FFI, 2010), although this is not extensive mangrove cover. Large-leaved mangrove *B. gymnorhiza* was the dominant species, and the 'red mangrove' also observed (FFI, 2010), assumed to be *R. mucronata*. On the north of Koh Rong Sanloem, small sparse fringing mangrove stands have been observed (Fig. 10, BM, pers. obs.).

Ground-truthed 5m resolution RapidEye satellite imagery from 30th January 2013 suggests a current total area of approximately 112 ha of standing mangrove on Koh Rong and 15 ha on Koh Rong Sanloem, distributed in small stands on the east of both islands (Fig. 4), and lining several creeks around Koh Rong, including the west coast. Existing seagrass beds in the archipelago are predominantly associated with fringing mangroves (Leng *et al.*, 2014). While the overall mangrove area within the proposed MFMA is relatively small when compared to mainland mangrove forests, it is assumed to play an important role in the local island fishery.

The largest continuous block of habitat can be found fringing the bay close to the Navy base on the east of Koh Rong (see Fig.11). This backs on to a sizeable low lying area dominated by *Melaleuca* sp.. *Melaleuca leucadendron* can reach as far as the sea but grows best in the hinterland of the mangrove swamps, where the water is almost always fresh, with salt water penetrating only at spring tides, where it grows mixed with some mangrove species like *Bruguiera gymnorhiza* and *Excoecaria agallocha* and species that can tolerate very slightly salt water (FAO, 2005). The recent building of a road through this area may have had some effect on local hydrology and therefore the vegetation community, but this has not been assessed, nor a botanical survey yet carried out to confirm the species composition of this *Melaleuca* assemblage.



Figure 10. Sparse fringing mangrove on the north of Koh Rong Sanloem. While the extent of mangroves has now been mapped, the species composition of mangrove assemblages is essentially unstudied in the archipelgo © Berry Mulligan/FFI.

At a national level mangrove clearing is being undertaken illegally for firewood, charcoal production, saltpan investments, land reclamations and intensive shrimp aquaculture. Mangroves are reported to be further damaged and degraded by offshore and estuarine sand dredging (Johnsen & Munford, 2012). There has been some past selective logging of mangrove species on Koh Rong Sanloem (e.g. *Lumnitzera* sp. BM, pers. obs.), potentially for charcoal production, which was previously common on the island to supply domestic charcoal consumption (FFI, 2009), or for building. There appears to have been past clearing of small patches of mangrove forest within the largest mangrove area on the east of Koh Rong (B. Olsen, in litt.) and reports that charcoal in Prek Svay was made not only from upland forest but also mangroves (Seak & Hoy, 2010), as well as more recent evidence of mangrove cutting potentially for charcoal production near Koh Touch (K. Gavard, pers. comm.).

Local usage or dependence on mangroves in the archipelago is not well understood, but clear-cutting or harvest of timber does not appear to be causing significant habitat loss at present, with 2013 mangrove extent as least as high as that recorded in the 2006 Atlas of Cambodia. To better understand the distribution of any habitat degradation further research is required. The Law on Fisheries protects mangroves and prohibits cutting of mangrove trees, due to their importance as nursery areas (FAO, 2007) and it includes heavy penalties for burning mangroves or otherwise cutting and clearing areas to claim land in mangrove forests. The law also bans commercial collection and transportation of mangrove forest species, and the building of kilns and processing plants for charcoaling or trading mangrove timber. While it is likely that localised cutting continues in some areas, the largest threat to mangroves in the Koh Rong Archipelago is expected to be from poorly planned coastal development.

Land cover in the wider Cambodian coastal zone is dominated by coastal forests. Between 1993 and 2005, coastal forest cover declined nationally from 84% to 71%, largely as a result of deforestation to aid agricultural expansion (Johnsen & Munford, 2012). The vegetation of the archipelago is classified as broadleaved evergreen forest (e.g. by JICA in 2005), which covered approximately 7,736 ha of the islands as of January 2013 based on ground-truthed RapidEye satellite imagery - this represents 75% of the total area of Koh Rong and Koh Rong Sanloem (Figs. 11 and 12). Directly behind the beaches on sandy soils open *Casuarina* woodland can be found, with scrub and degraded forest distributed in low lying areas, transitioning to evergreen forest cover on the slopes on Koh Rong Sanloem (FFI, 2009). The evergreen forest on Koh Rong Sanloem is mainly dominated by *Hopea pierrei* and *Shorea hypochra* of the family Dipterocarpaceae, *Gacinia ferrea*, *Calophyllum* sp. of the family Guttiferae, *Syzygium zeylanica*, *Urgenia* sp., *Parinaria annamensis* (Chrysobalanaceae), *Irvingia malayana* (Simaroubaceae), Sapotaceae, *Aglaia spectabilis* (Meliaceae), *Parkia sumatrana* (Leguminosae) and *Knema corticosa* (Myristicaceae) (FFI, 2009). Small islets such as Koh Bong have been found to support sub-evergreen forest dominated by *Syzygium* sp. and *Thespesia populnea* with a canopy of *Peltophorum dasyrrhachis*, *Fucus hispida* and *Murria* sp. (FFI, 2010). The changes in island forest cover and quality have not been examined in detail, but local reports suggest selective logging of valuable timber species occurred during the 1980s on Koh Rong (Seak & Hoy, 2010) and late 1980s and early 1990s on Koh Rong Sanloem (FFI, 2009). Seak & Hoy (2010) reported that many parts of forested areas on Koh Rong have been clear-cut for agricultural purposes including rain fed rice and upland crop farming which takes place mostly on the eastern part of island. While the evergreen forest has been selectively logged across the whole of Koh Rong Sanloem for many years, clear-cutting has only occurred in the lowland areas (FFI, 2009). Low levels of opportunistic selective logging currently occur on Koh Rong Sanloem, primarily for local usage such as pier and bungalow building or repairs (BM, pers. obs.), and the same is expected on Koh Rong.

Coastal and mangrove forest management within the archipelago will have an important impact on nearshore marine habitats. Mangroves absorb excess nitrates and phosphates, for example, and in doing so they play a vital role in protecting coral reefs and seagrasses from siltation and eutrophication (Mangroves for the Future, 2013). Sedimentation from coastal development is a threat to seagrass beds. Sedimentation is also considered a direct threat to coral reefs in Cambodia, while coastal development and deforestation in upland areas are cited as indirect threats (UNEP, 2008 in Mangroves for the Future, 2013).

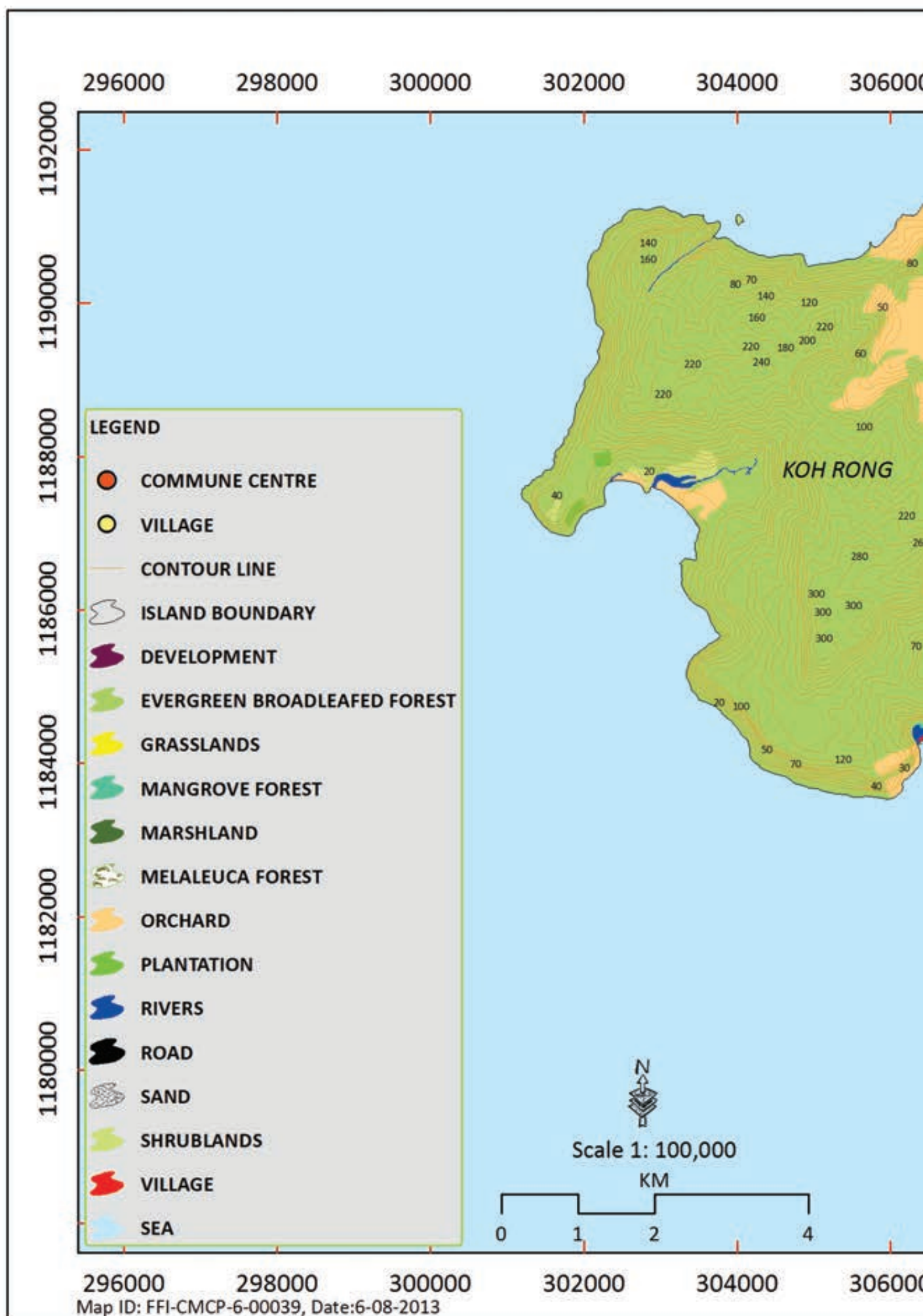
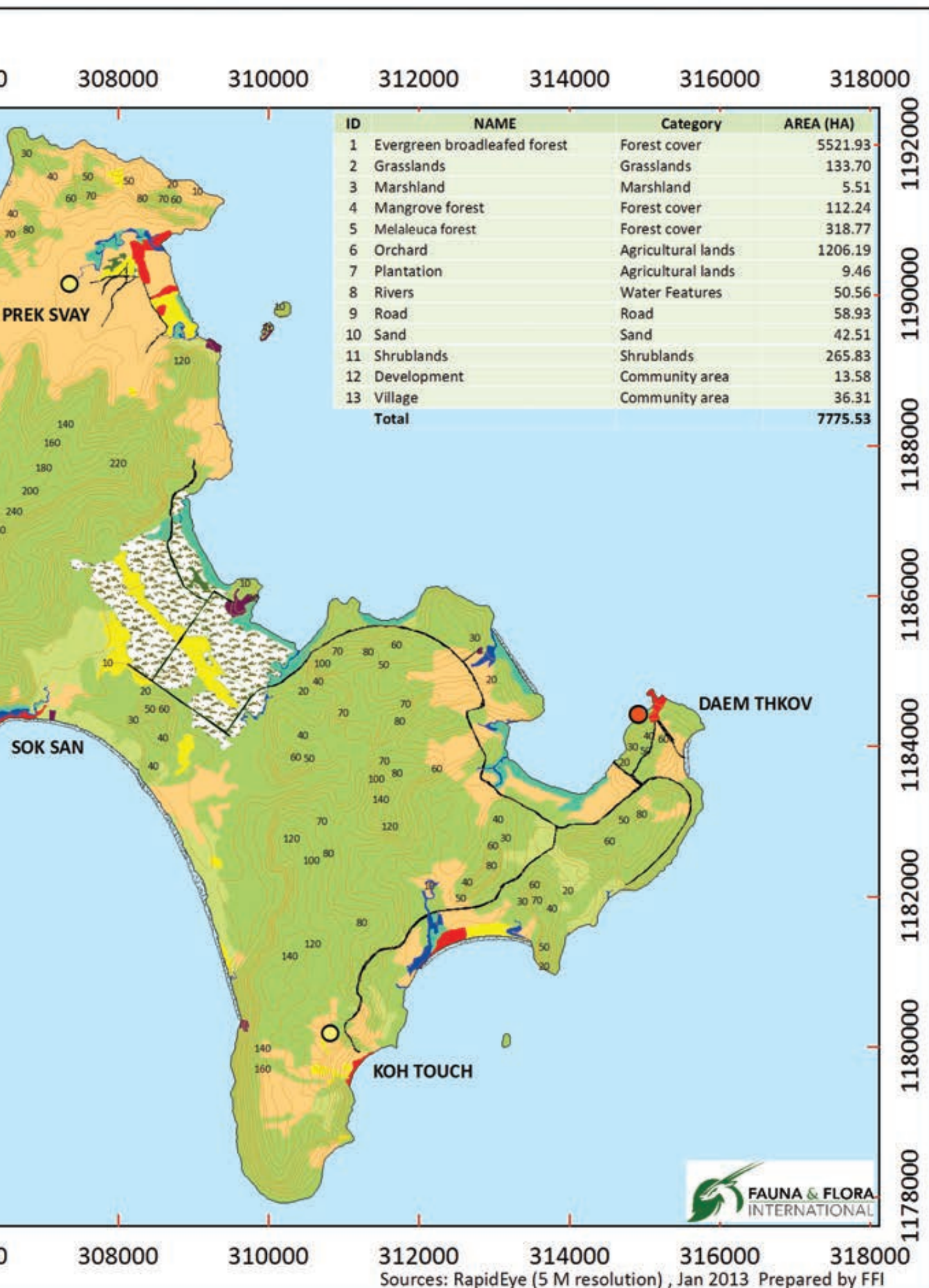


Figure 11. Koh Rong land use map derived from ground-truthed satellite imagery from 30th January 2013.



Although the overall area of mangrove does not initially appear to have declined significantly in the last decade in the Koh Rong Archipelago, comparison between JICA 1997 land-cover maps and January 2013 data suggest a c.20% decrease in evergreen forest cover during the 16 year period on Koh Rong. This and development plans for both Koh Rong and Koh Rong Sanloem highlight the importance of designing an MFMA which takes in to account potential terrestrial land-use change, including conversion of forest. Despite some rapid and localised surveys (e.g. FFI, 2009; FFI, 2010; Hudson *et al.*, in prep.) there is also a paucity of information on coastal forest fauna and flora, and further research is urgently required to better understand the biological and socio-economic significance and value of island forests, including mangroves.

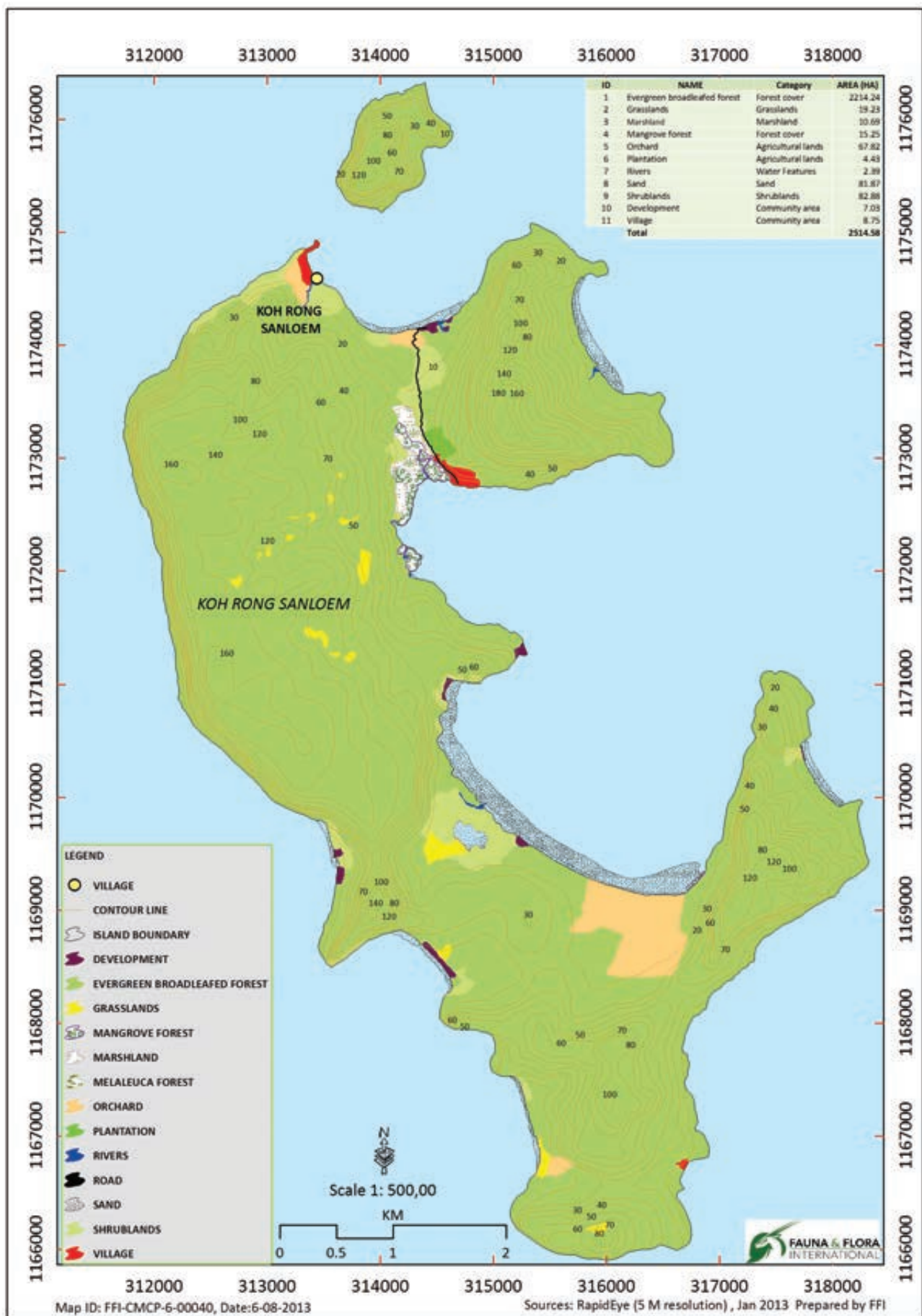


Figure 12. Land-cover map for Koh Rong Sanloem derived from ground-truthed satellite imagery from 30th January 2013.

4.1.c Seagrass

Cambodia's coastal zone houses one of the world's largest seagrass areas (Johnson & Munford, 2012). Seagrasses can be found in most shallow water areas (Department of Fisheries, 2005) and provide important habitat essential in sustaining the marine fisheries of Cambodia (Ouk *et al.*, 2010). Seagrass fishes, and especially shrimp, are highly valuable in both domestic and international markets (Department of Fisheries, 2005; UNEP, 2008). An economic analysis in Kampot found that seagrass provides fish catch worth 1,000 USD/ha/year, excluding collection of seaweed and invertebrates (Ouk V., in litt.). Seagrass beds are critical habitats that support a diverse range of resident and migratory species (UNEP, 2008).

Until relatively recently, little was known about seagrasses in Cambodia. Early studies and reports (e.g. Ethirmannasingam, 1996; Nelson, 1999b; Department of Fisheries, 2005) provided information on distribution and species diversity in some coastal areas, and aerial surveys (e.g. Hines *et al.*, 2008) helped identify new seagrass beds. Generally, seagrass habitats in Cambodia can be divided into two main types: extensive seagrass meadows along the mainland, and patches of seagrasses intermingled with corals around islands (Ethirmannasingam, 1996 in Nelson, 1999b). Inshore seagrass beds are mixed stands of several species, while offshore, *Enhalus acoroides* occurs in extensive beds (Department of Fisheries, 2005). Hines *et al.* (2008) recorded eight species of seagrass during intertidal surveys in eastern Cambodia around Kep and Kampot in 2002, and highlighted the need for further research on coastal seagrasses. Ouk *et al.* (2010) report 12 species belonging to 7 genera from Kampot Province, which appears to hold Cambodia's most extensive seagrass beds and the nation's highest seagrass species diversity.

Large areas of seagrass reportedly once occurred in Kampong Saom Bay, although as a result of high intensity trawling and push netting, seagrass distribution and abundance has diminished significantly in this area (Department of Fisheries, 2005; UNEP, 2008). Mangroves for the Future (2013) report known extent in Preah Sihanouk Province to be 1,468 ha, with 600 ha of that area under some form of management. Small seagrass beds have been observed in waters adjacent to Koh Rong and Koh Rong Sanloem (Nelson & Carson, 1999) and previous distribution maps suggests areas of between 92 ha (Save Cambodia's Wildlife, 2006; Seak, & Hoy, 2010) and 47 ha (Skopal-Papin, 2011) within the proposed MFMA. Recent transect and quadrat surveys in 2013 and 2014 to establish a more detailed baseline for seagrasses (Leng *et al.*, 2014) suggest that the total area in the late dry season of 2013 was approximately 18 ha (Fig. 13).

There is little published information on seagrass species composition in the area. MCC (2011) recorded *Cymodocea serrulata* and *Halophila ovalis* within the Koh Rong Sanloem CFI. The presence of both is potentially indicative of the prevailing conditions and threats – the former is more resilient to sedimentation compared to other coastal seagrass species (Short *et al.*, 2010a) and the latter is well adapted to high levels of disturbance (Short *et al.*, 2010b), although there is little historical data on seagrass species distribution, composition or sediment monitoring and benthic disturbance that might corroborate this assertion. Leng *et al.* (2014) did not record *C. serrulata* or *H. ovalis*, but found a further 4 species in the archipelago: *Halodule pinifolia*, *Thalassia hemprichii*, *Enhalus acoroides* and *Halophila minor*. *Halodule pinifolia* was the most common species and the highest seagrass percentage cover was found in areas where the benthos was composed of coarse sand. The largest and potentially most significant remaining seagrass bed is close to Daem Thkov, where all 4 seagrass species were recorded in 2013, and 3 species recorded in 2014. It is recommended that this area of around 10 ha, dominated by *H. pinifolia*, should be considered as a Conservation Area (no-take zone) within the MFMA.

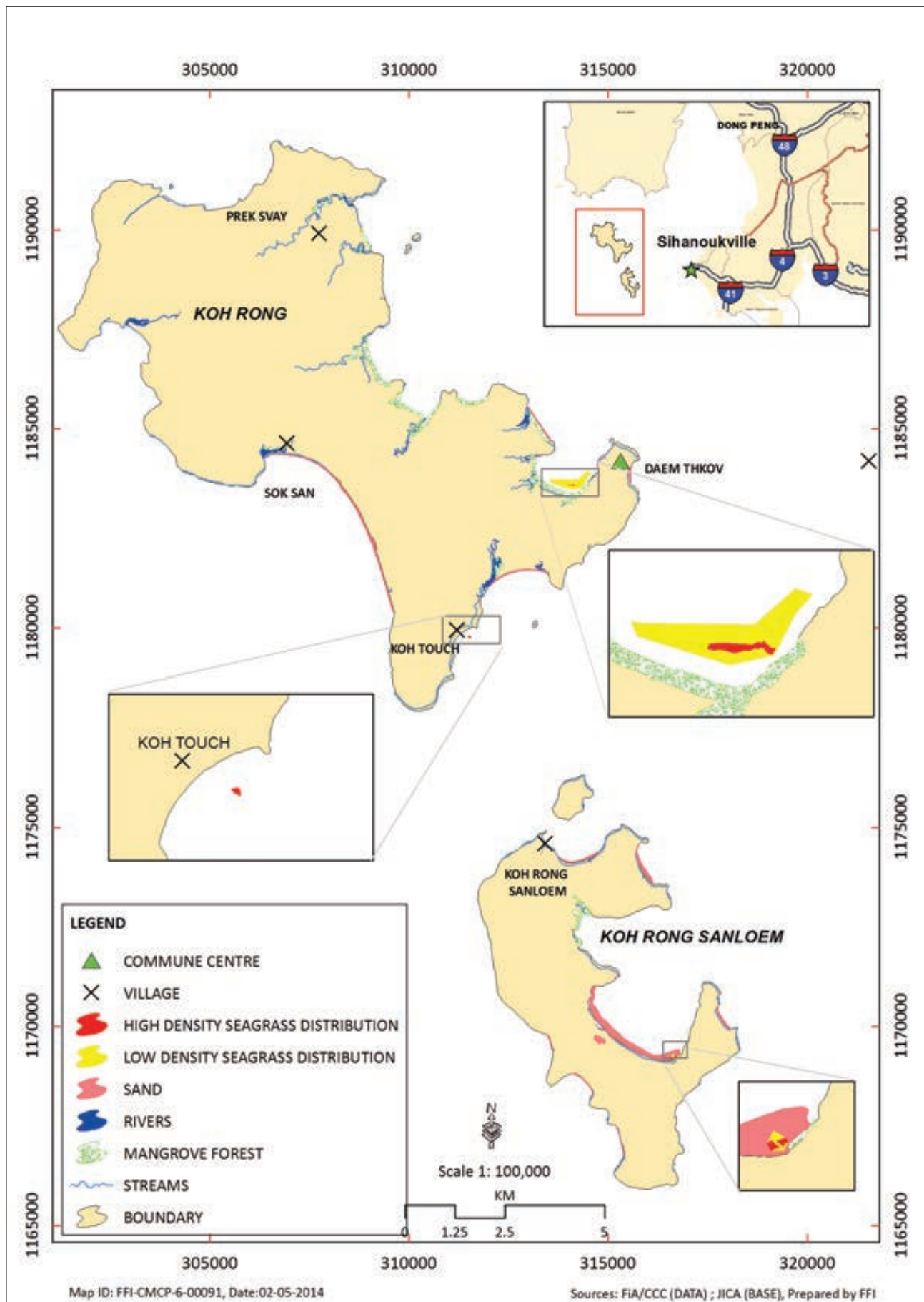


Figure 13. Seagrass distribution in the Koh Rong Archipelago in April-May 2013 (after Leng *et al.*, 2014).

There is evidence of general decline in the extent of seagrass coverage over time in the Koh Rong Archipelago (Leng *et al.*, 2014), although the speed of the decline cannot be accurately determined. This highlights the need for prioritising protection of remnant seagrass habitat within the zoning scheme for the MFMA. In addition to the function of seagrass in supporting fisheries, they provide a crucial habitat for several endangered and vulnerable (UNEP, 2008; Johnson & Munford, 2012) species in Cambodia, such as green turtles (Hep & Pich, 2003), seahorses (Skopal-Papin, 2011) and probably, historically, dugong (Hines *et al.*, 2008). They also maintain water quality by absorbing nutrients and stabilising sediments, as well as reducing wave and current energy (Nelson & Carson, 1999).

Seagrasses are threatened nationally by destructive fishing practices as well as declines in water quality associated with agricultural use of fertilizers and pesticides and increased erosion from unsustainable logging practices and poor land use (Department of Fisheries, 2005; UNEP, 2008). Seagrass dependent fish and shrimp species are subject to high levels of legal and illegal fishing effort (Department of Fisheries, 2005; UNEP, 2008). Demersal trawling and other active fishing gears can damage seagrasses by ripping them up (Tana, 1995 in Nelson & Carson, 1999), and trawling and pushnetting are thought to be the most damaging (Department of Fisheries, 2005; UNEP, 2008). The collection of invertebrates by fishers using snorkel and mask is also popular in inshore waters (Department of Fisheries, 2005). Human impacts appear to be widespread in the remaining seagrass habitat in the Koh Rong Archipelago, including fishing impacts, such as degradation due to inshore trawling (Leng *et al.*, 2014). Land based pollution may also be an issue at some sites, for example, near rapidly developing Koh Touch, and a fuel pier previously operating on the eastern side of Koh Rong Sanloem.

The Law on Fisheries determines seagrass areas to be one of the places for sheltering fish and aquatic animals, and the government aims to secure at least 7,000ha of seagrass under an appropriate form of sustainable management by the end of 2019 (FiA, 2011). While the total area of seagrass in the proposed MFMA is relatively small, it has the potential to contribute to these national targets through improved protection of remaining seagrass areas, which are thought to be important in sustaining local fisheries.

4.1.d Endangered Species

Relatively little is known about endangered marine species nationally. The FiA developed Anukrat 123, a sub-decree (approved by the Prime Minister on 12th August 2009) which identifies 58 aquatic species, genera and a class of organism as endangered nationally, affording them an increased level of legal protection. Twenty nine of those species are considered marine organisms (Ouk V., in litt.). Relatively few (~10) aquatic species on the list, such as the Irrawaddy dolphin (*Orcaella brevirostris*), are systematically monitored, with 3 marine endangered species populations receiving regular surveys to determine population increases or decreases (Ouk V., in litt.). The FiA has ambitious targets to reduce the number of endangered aquatic species nationally (marine and freshwater) from 58 to 43 by 2019 (FiA, 2011).

Of the species, genera and the one class of marine organisms listed on Anukrat 123, at least 10 have been reliably recorded (see Table 1) within the proposed MFMA boundaries. Given that the legislation in some cases includes genera and whole classes, the number of species that are present or have historically been recorded in the area is actually higher. Anthozoa, for example, are generally not identified to species level using the reef survey methods applied in the Koh Rong Archipelago. CCC data confirms 15 genera and 6 species within the class Anthozoa (see Appendix B) with at least one coral species recorded on the site listed as globally Near Threatened and another Vulnerable.

Of all the marine species that have been recorded within the proposed MFMA, 2 are globally Endangered, and 1, the hawksbill turtle, Critically Endangered, with at least 10 Vulnerable species observed, which are predominantly seahorses. It is likely that there are also globally significant Red Listed species amongst the Anthozoa recorded on the site identified to Genus, Family (e.g. Faviidae) and Order (e.g. Corallimorpharia, Actiniaria, Zoantharia, Alcyonacea), and several Near Threatened shark species.

With a few exceptions where targeted research has been undertaken relatively little is known about the status, including population trends, of the majority of species listed in Anukrat 123 which occur in the area. Of four *Tridacna* clam spp. listed, *Tridacna gigas* is globally Vulnerable, and has been recorded in the area (Savage *et al.*, 2013). CCC recorded 1359 clams on transects between 2010-2014 (CCC unpublished data), although these are not identified to species using the Reef Check method (Fig. 14). Recent research by Frontier has mapped distribution and sizes of *Tridacna* spp. around the north of Koh Rong Sanloem (J. Reitz, pers. comm.), and they are reportedly under threat from illegal harvest (e.g. Fig. 15). Little is known of other commercially valuable shells such as *Turbo marmoratus* and *Trochus niloticus*. Mangrove horseshoe crabs (*Carcinoscorpius rotundicauda*) have been observed near fringing mangroves close to the village of Prek Svay (Fig.19), including mating individuals (R. Mag Aiodh, pers. comm.), but almost nothing is known about local distribution, threats and population trends. Collection and trade might be assumed to be a significant threat given that horseshoe crab species are openly sold and consumed in restaurants in nearby Sihanoukville (BM, pers. obs.). There is an example from Koh Rong Sanloem of horseshoe crabs reportedly captured using cyanide (Krell *et al.*, 2011) and possibly also in trawler discards (Fig. 17, BM, pers. obs.). Further research is urgently required to understand their status in the area.

Targeted conservation measures will be necessary for species with specific requirements facing specific threats. For example, the MFMA hosts the globally Near Threatened Malaysian plover (*Charadrius peronei*), which was the Important Bird Area (IBA) trigger species for the Koh Rong IBA (BirdLife International, 2014) and a rare coastal resident restricted to undisturbed sandy beaches. The species was first recorded for Cambodia on Koh Rong in 1995, with subsequent records in 2001, and in 2002, 2010, 2011 on Koh Rong Sanloem (Goes, 2013). While not defined as an aquatic species within Cambodian legislation, it is likely under threat due to increasing disturbance on the beaches of the archipelago, and is thought to have a small population size nationally, presumably due to the relatively limited availability of suitable coastal habitat (Goes, 2013). While not thought to be particularly common or widespread, several shark species are reportedly caught, traded or consumed in the area, including bamboo sharks (*Chiloscyllium* spp.) (BM, pers. obs.). All 4 bamboo sharks listed for Cambodia in Ing *et al.*, (2004) are globally near threatened. Cat sharks are also traded and consumed (BM, pers. obs.), most probably the Near Threatened coral catshark *Atelomycterus marmoratus*. Blacktip reef sharks *Carcharhinus melanopterus*, also Near Threatened, have recently been caught in nets off of Koh Rong Sanloem and reportedly traded through the village (Fig. 16). Despite early calls for improved data on species composition, habitats and status of individual shark species in Cambodia (e.g. Ing *et al.*, 2004), the growing popularity of fresh shark soup in Sihanoukville and sporadic records of shark caught in the area, little up to date information is available on the presence and threats to sharks in the Koh Rong Archipelago.

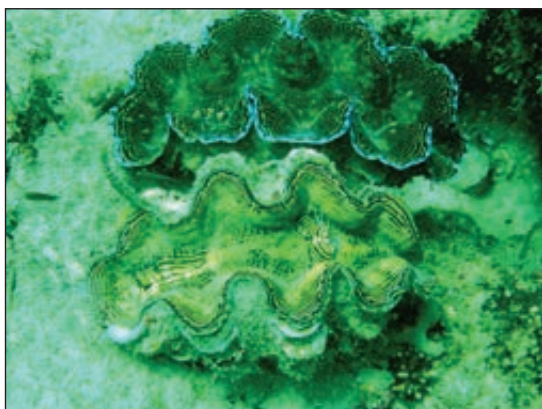


Figure 14 & 15. *Tridacna* spp. are protected under Cambodian law (Anukrat 123), and are found on reefs around the archipelago © CCC; Clams harvested illegally in November 2013 were placed back on the reef by the Daem Thkov CFI and collaborators © Kylie Gavard/CC.

Species focused management practices factoring in specific life histories and behaviour will be necessary to ensure endangered species persist within and around the MFMA. Seahorses, for example, change depths with the seasons, which is important to understand when protecting them as the full picture of any seasonal variations and changes in behaviour is required (N. Garrick-Maidment, pers. comm.). MPAs can fail to meet species specific conservation goals if their size and design is not calibrated to match with species home ranges, or the MPA fails to meet the ecological requirements of a given species through different life history stages (Agardy *et al.*, 2011).



Figures 16-19 (clockwise). Posing with three blacktip reef sharks *Carcharhinus melanopterus*, which were reportedly caught together near Koh Rong Sanloem in one net in April 2014. Fresh shark soup is sold in restaurants in Sihanoukville © *Koh Rong Sanloem CFi*; Horseshoe crabs in fishing discards, most probably from trawling, observed on Koh Rong Sanloem in February 2013 © Berry Mulligan/FFI; A dugong caught in December 2005 in the vicinity of Daem Thkov using an encircling seine net © Nhem Vanna/FiA. Horseshoe crabs are globally Data Deficient, and their status in the area is unknown. This individual, found near Prek Svay in February 2014, was identified as mangrove horseshoe crab *Carcinoscorpius rotundicauda* © Berry Mulligan/FFI.

Table 1: Endangered aquatic species or genera listed on Anukrat 123 recorded within the boundaries of the proposed MFMA.

Anukrat 123 #	Anukrat 123 categorisation	Species records	IUCN category	Year of last sp. record	Source of last known sp. record
31	Dugong <i>Dugong dugon</i>		VU	2005	Nhem V., in litt.
32	Humphead Wrasse <i>Cheilinus undulatus</i>		EN	2011	CCC, unpublished data
33	False killer whale <i>Pseudorca crassidens</i>		DD	2001	Beasley & Davidson, 2007
36	Irrawaddy dolphin <i>Orcaella brevirostris</i>		VU	2009	FFI, 2009 (skeleton)
43	Green turtle <i>Chelonia mydas</i>		EN	2013	FFI, 2013.
44	Hawksbill turtle <i>Eretmochelys imbricate</i>		CR	2014	D. Funke, in litt.
51	Giant clam <i>Tridacna gigas</i>		VU	2013	Savage <i>et al.</i> , 2013
54	<i>Hippocampus</i> spp. Seahorse	<i>H. kuda</i>	VU	unknown	MCC, 2012
		<i>H. trimaculatus</i>	VU	unknown	MCC, 2012
		<i>H. spinosissimus</i>	VU	2013	MCC, 2012, MCC 2013a
		<i>H. comes</i>	VU	unknown	Skopal-Papin, 2011
		<i>H. kelloggi</i>	VU	2013	Skopal-Papin, 2011; MCC 2013a
		<i>H. histrix</i>	VU	unknown	MCC, 2013a
57	Mangrove horseshoe crab <i>Carcinoscorpius rotundicauda</i>		DD	2014	BM, pers. obs.
55	Anthozoa spp.* Corals and sea anemones	<i>Pavona decussata</i>	VU	2014	CCC, unpublished data
		<i>Porites rus</i>	LC	2014	CCC, unpublished data
		<i>Diploastrea heliopora</i>	NT	2014	CCC, unpublished data
		<i>Herpolitha limax</i>	LC	2014	CCC, unpublished data
		<i>Ctenactis echinata</i>	LC	2014	CCC, unpublished data
		<i>Polyphyllia talpina</i>	LC	2014	CCC, unpublished data

* This includes multiple records not identified to species - see Appendix B for all genera within Anthozoa recorded by CCC.

Below we briefly outline available information or observations for certain species that have received at least some targeted research or survey, or where incidental records are available. It is important to recognise that this is not comprehensive and there remains a dearth of data for the majority of taxa, underlining the need for ongoing and additional research.

Marine turtles

Five species of marine turtle have been recorded in Cambodia; olive ridley turtle (*Lepidochelys olivacea*), loggerhead turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*) and Leatherback turtle (*Dermochelys coriacea*) (Ing & Pich, 2003). At the turn of the century researchers found three species: green, hawksbill and loggerhead turtles, the latter being considered as rare (Ing, 1999; Ing & Pich, 2003). Leatherbacks are rarely recorded from the Gulf of Thailand and the only known contemporary record of a leatherback turtle in Cambodian waters is of an individual captured in a shrimp net near Kampong Saom in 2001 (Stuart & Van Dijk, 2002).

More recent studies using semi-structured interviews with local people (FFI, 2011; Diamond *et al.*, 2012) indicate that the waters around the Koh Rong Archipelago are still frequented by Endangered green turtles and Critically Endangered hawksbill turtles. This is supported by direct incidental records of both species by divers (e.g. Fig. 21) and other observers from 2008 to present (e.g. MCC, in litt.; P. Ferber pers. comm.; T. Eastoe, pers. comm.; J. Vukosavljevic, in litt.; K. Gavard, in litt.; Leng P., pers. comm.; FFI, 2013), as well as records of six hawksbill turtle carapaces collected by villagers in Prek Svay (Fig. 20, FFI, 2011), a juvenile hawksbill turtle carapace confiscated from a fishermen in the same village in 2013 (Leng P., pers. comm.) and a green turtle carapace washed up on a beach on Koh Ouen (B. Kluskens, in litt.). Records from 2014 include a hawksbill turtle washed ashore entangled in rubbish on the west of Koh Rong Sanloem (D. Funke, in litt.), multiple turtles reported by divers in the same area (E. Burger-Gohl, in litt.), and an adult green turtle observed by divers to the north of Koh Rong (Leng P., pers. comm.). Recently a hawksbill turtle captured near Koh Mnors on the boundary of the proposed MFMA was released following the intervention of a member of the Prek Svay CFI Committee (Chea P., in litt.). Although there are relatively regular records, there is an overall perception from local people that the turtle population in the archipelago has decreased in the past 20 years (Diamond *et al.*, 2012).



Figure 20. Six hawksbill shells had been collected over a 2-3 year period by a local fisherman on Koh Rong © Jeremy Holden/FFI.

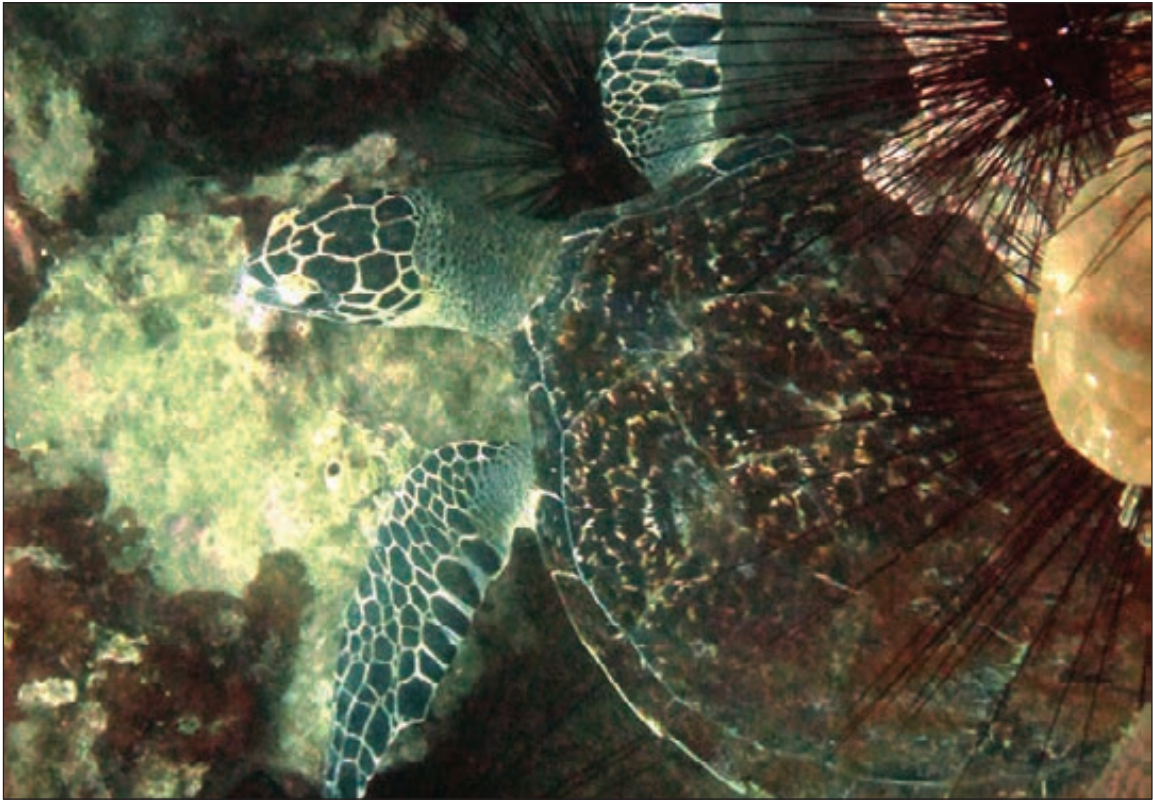


Figure 21. Hawksbill turtles *Eretmochelys imbricata* are not regularly encountered by divers, but have been observed on the fringing reefs of the Koh Rong Archipelago © Jelena Vukosavljevic/SSPI.



Figure 22. By-catch incidents are the primary threats to sea turtles in the area, and crab nets, trawling and stingray hooks seem to be the most threatening gear types © FFI/FIA/USFWS/Darwin Initiative.

Reliable historical information on nesting within the proposed MFMA is scant, but nesting of green turtles has previously been recorded on Koh Rong (Ing *et al.*, 2002) and reports from interviews with old fishermen suggest that before 1988 there were 12 sea turtle nests per year on the island (Va, 2002). Tana (1997) also identified sandy beaches on Koh Rong Sanloem as sea turtle nesting grounds. There are more recent unconfirmed reports from island inhabitants of female turtles hauling out in late 2010 (FFI, 2011) and nesting on Koh Rong between 2010 and 2012 (Leng P., pers. comm.). While solid data is lacking, it is assumed that current nesting densities are significantly reduced when compared to historical numbers in the Koh Rong Archipelago. Recent village interviews suggest that Koh Rong beaches still see occasional nesting attempts, for example, three nests were mentioned by locals during the 2012/13 nesting season, at least one of which was reportedly predated by dogs (Leng P., in litt.). Any confirmed nesting beaches would be significant, given that very few have been located elsewhere in Cambodia despite some effort to identify nationally important nesting beaches (FFI, 2011), with only Koh Tang and Koh Prins known to have recent nesting attempts.

Pich & Hep (2003) highlighted the importance of seagrass meadows for green turtles in Cambodia, and suggested that the species is mostly found in areas dominated by *Thalassia hemprichii* in Kep and Kampot Provinces, which is in line with previous studies elsewhere (e.g. Garnett *et al.*, 1985; Fuentes *et al.*, 2006). Turtles have relatively recently been reported by local people in seagrass meadows along the coast of the mainland (e.g. in Kampot and Koh Kong Province) (FFI, 2011) but the extent to which species use or depend on foraging grounds in the future MFMA requires further research. *T. hemprichii* is found at 3 sites in the Koh Rong Archipelago, dominating in 2 small seagrass beds (Fig. 13), next to Koh Touch and on the east of Koh Rong Sanloem (Leng *et al.*, 2014).

In line with findings from a rapid assessment of the entire Cambodian coastline (FFI, 2011), Diamond *et al.* (2012) found that turtle products are not an important component of the diet of people living in the Koh Rong Archipelago. The primary threat to turtles is perceived to be from by-catch, particularly from net fishing/trawling and stingray hooks. While turtles are occasionally accidentally caught and eaten, it seems that they are rarely a target species for fishermen, with the notable exception of Vietnamese divers who in the past (about 5-10 years ago) would apparently target turtles at night (Diamond *et al.*, 2012) in the area. Results of research designed to document small-scale fishing practices highlights the continued threat of by-catch in the proposed MFMA - crab nets and trawling remain the primary fishing gears implicated in turtle by-catch incidents in the area (Leng P., 2013). There have also been multiple cases of entanglement in plastic waste or discarded fishing gear, including a juvenile green turtle on Koh Rong entangled in discarded fishing net in 2013 (Gavard, K., in litt.), a green turtle in a net which was released on Koh Rong Sanloem and a hawksbill turtle washed ashore on the west of Koh Rong Sanloem in June 2014 (D. Funke, in litt.).

Turtles are sometimes considered to bring good luck, and the merit release of sea turtles is not uncommon in Cambodia (Stuart & Van Dijk, 2002; FFI, 2011). In the Koh Rong Archipelago the practice appears to have been conducted by fishermen (Diamond *et al.*, 2012). There is some evidence to suggest that measures to promote safe release of incidentally captured turtles may gain traction – during 2013 there were three known sea turtle releases within the proposed MFMA, and two to date in September 2014. Both dive operators and CFIs have coordinated several successful turtle releases. Locals interviewed by Diamond *et al.*, (2012) recognised that improved conditions for sea turtles could also be beneficial for the human population and economic development in the area, particularly through tourism.

Cambodia has ratified several international conventions and Memoranda of Understanding that relate to sea turtle conservation and management (Try *et al.*, 2002), including the Indian Ocean - South-East Asian Marine Turtle Memorandum of Understanding⁶. The five previously recorded sea turtle species are all protected under Anukrat 123.

⁶ <http://www.ioseaturtles.org/>

Seahorses

Seahorses (genus *Hippocampus*) are in the family Syngnathidae, which also includes pipefish, pipehorses, and seadragons (Panithanarak *et al.*, 2010). Until relatively recently, little was known about seahorse distribution and ecology within Cambodian waters.

During a seahorse population assessment adjacent to Koh Koun in June 2011, 62 seahorses were observed at 35 visual transects (MCC, 2012). Six species have been recorded from the Koh Rong Archipelago, including *Hippocampus kuda*, *H. trimaculatus*, *H. spinosissimus* (MCC, 2012) *H. comes*, *H. kelloggi* (Skopal-Papin, 2011; MCC, 2012) and *H. hystrix* (MCC, 2013a). Previous studies have identified 5 geographically separated coastal areas as seahorse habitat, and field observations from 2007 suggest that seahorse species diversity was previously higher, and has decreased over time to strongly favour *H. spinosissimus* (MCC, 2012). All 6 species known from the proposed MFMA are listed globally as Vulnerable due to inferred population declines, primarily caused by incidental capture, targeted catch and habitat degradation (IUCN, 2012).

MCC suggest that there could be as many as 8-9 different *Hippocampus* spp. in Cambodia (Skopal *et al.*, 2010; Z. Calef, in litt.) with *H. hystrix* and *H. mohnikei* confirmed (P. Ferber, in litt.) and *H. barbouri* suspected (Z. Calef, in litt.; MCC, 2013a). There are 7 recorded species in Thailand (Panithanarak *et al.*, 2010), 10 from Malaysian waters (Lim *et al.*, 2011), and at least 14 species in Australia, which is considered to have remarkably high syngnathid biodiversity (Martin-Smith & Vincent, 2006). Six recorded seahorse species within the proposed MFMA therefore represents relatively high seahorse species diversity for an individual site. For example, the entire coast of Sabah - the easternmost state of Malaysia that falls within the 'Coral Triangle' and is known for its rich marine biodiversity (Choo & Liew, 2004) - holds 10 seahorse species, the highest seahorse species diversity in all of Malaysia (Lim *et al.*, 2011).



Figures 23 & 24. Drying seahorses, caught as bycatch on a trawler in July 2014, photographed near Koh Touch © Koh Rong Sanloem CFI & Dried seahorses being transported from Prek Svay to Sihanoukville on the local supply boat © Chea Phallin/FFI.

A specialised life-history coupled with a dependence on shallow habitats that are subject to extremely high fishing pressure, and the fact that seahorses do not move very much and are thus easily captured, means they are very vulnerable to over-exploitation (IUCN, 2012). Inshore trawling within the proposed MFMA is noted as a major threat to seahorses (Fig. 23), both due to incidental by-catch as well as trawl-induced changes to their benthic habitats (Krell *et al.*, 2011). The few available studies within the Gulf of Thailand suggest that capture of seahorses is primarily as trawl by-catch (Giles *et al.*, 2005; Perry *et al.*, 2010), with some targeted fishing (Vincent, 1996; Perry *et al.*, 2010). Seahorse entanglement in bottom-weighted gillnets and 'seahorse collecting' has been directly observed in the proposed MFMA (Krell *et al.*, 2011; Chea P, pers. comm.). Air-supplied fishing has also been recorded in the area and poses a threat to seahorses and other organisms such as abalone or pen shells (Krell *et al.*, 2011). In neighbouring Vietnam, seahorses are collected by divers or swimmers seeking a wide range of animals (Vincent, 1996).

Any trade within Cambodia is assumed to be in dried seahorses (Fig. 24) for Traditional Chinese Medicine (TCM) and Traditional Medicine (TM), rather than for the live seahorse trade for aquaria. Whether there is any local seahorse consumption for TCM/TM is unknown, and trade routes poorly understood. MCC (2013b) report that most of Cambodia's illegal trade in seahorses goes through the beach market in Kep and is directly transported to Vietnam. Perry *et al.* (2010) note that Thai trawlers captured seahorses in foreign waters of various countries, including Cambodia. Early trade surveys in Vietnam (Vicent, 1996) indicated that the southern province of Kien Giang, bordering Cambodia, traded more than half of the Vietnam's seahorse caught by fishers. Fishers from the province were travelling widely, including to Phu Quoc Island and in one case a trader was sourcing seahorses directly from Cambodia.

Supply of seahorses is decreasing in parts of Southeast and Southern Asia, in some cases populations are thought to have declined in the order of 15–50% over 5 years (Vincent, 1996). Fishers and buyers surveyed in Malaysia, Thailand and Vietnam have reported that seahorse catches have declined over time (Giles *et al.*, 2005; Perry *et al.*, 2010). While it was not possible to quantify changes in effort, trawl vessels numbers are either stable (Malaysia) or have fallen in recent years (Thailand) and the trend may indicate population declines (Perry *et al.*, 2010). This raises conservation concern regionally, and highlights the importance of any Cambodian seahorse populations.

While there is no available data on trade, it may be reasonable to expect that population decline has also occurred within Cambodia and the proposed MFMA. For example, seahorse habitat adjacent to Koh Koun was observed to be in excellent condition in 2007, but damage from trawling activity has greatly impacted the habitat since (MCC, 2012). Diver observations suggest that it is harder to find certain seahorse species within recent years, due to declines driven by habitat loss and destructive fishing techniques (MCC, 2013b). Pre-trawling, 6 species of seahorse were recorded in large numbers at a survey site [adjacent to Koh Koun] yet only *H. spinosissimus* was present in any significant numbers during 2012 and the first quarter of 2013, leading to the conclusion that this species is best adapted to the fragmented and disturbed habitat [in the area] (MCC, 2013a). Researchers have suggested that the destruction of the seabed in the area has even led to behavioural changes, with seahorses becoming free ranging and non-monogamous, rather than forming territories and partnerships (The Seahorse Trust, in litt.). The destructive nature of trawling can affect benthic habitat to the extent that it impacts on the ability of seahorses to hold territories (Z. Calef, in litt.). During MCC surveys in 2012 it was found that 85% of seahorses observed were attached to pencil urchins rather than solid non-motile holdfasts such as seafans, coral, seapens and sponges, which, based on studies and observation of other species, are used as holdfasts in a prime undamaged seahorse habitat (Z. Calef, in litt.). It is assumed that the removal of holdfast and the drastic altering of habitats due to trawling has been a driving force behind seahorse decline (MCC, 2013a).

The conservation and management of seahorse populations are of great international concern (Panithanarak *et al.*, 2010). Conservation activities by MCC and others have sought to identify and protect key seahorse habitats in Cambodia. Skopal-Papin (2011) maps the most important habitats and breeding grounds for seahorses within the proposed MFMA in order to assist with zoning. All *Hippocampus* spp. are listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES signatories, including Cambodia (Nao *et al.*, 2013), are required to provide permits for all exports of seahorses (IUCN, 2012). Under the 2004 CITES Appendix II listing, Parties are required to ensure exports are not damaging to wild populations (Perry *et al.*, 2010) and that all international trade in seahorses is monitored and managed for sustainability (Giles *et al.*, 2006). All *Hippocampus* spp. are protected under Anukrat 123.

Marine Mammals

The first boat-based marine mammal surveys in 2001 (Beasley & Davidson, 2007) suggested that Cambodian waters at the time supported regionally if not globally significant populations, and confirmed the presence of ten marine mammal species. Surveys specifically for marine mammals have included parts of the Koh Rong Archipelago, but coverage of the area, particularly in the last 10 years, has been

essentially non-existent. The few marine mammal records available are from incidental encounters.

Dugongs *Dugong dugon* were reportedly abundant on parts of the Cambodian coast until 1975 (Nelson, 1999b). Four days of aerial survey for dugong by Hines *et al.* (2008) in Cambodia, including the eastern side of Koh Rong on 16th January 2004, located none. A dugong carcass was recorded drifting off the north of Koh Rong in April 2011 (B. Olsen, in litt.). The last known record of live dugong from the proposed MFMA is from December 2005, when an individual was reportedly caught by fishermen from the mainland (Sangkat Tumnob Rolok) using thick gauge encircling seine net in an area with abundant seagrass on the east of Koh Rong near Daem Thkov. The captured individual was killed (Fig. 18), and a second individual escaped (Nhem V., in litt.). While direct hunting of dugongs is uncommon in Cambodia, interviews in fishing communities in 2002 and 2004 in Kep, Kampot and Koh Kong revealed that dugongs are sporadically found in fishing nets and their body parts are sold for a relatively large profit (Hines *et al.*, 2008). Informal interviews in 2001 along the Cambodian coastline found that fishers believed it was very “lucky” to catch a dugong due to the high price paid for the bones and tusks for medicinal purposes and for the meat for consumption (Beasley & Davidson, 2007).

There are no other known dugong records from the proposed MFMA, and no interview or other historical data available, therefore presence and the historical significance of the area to dugong remains poorly understood. During 2001 marine mammal surveys dugong had been convincingly reported as occurring around Koh Rong and Koh Rong Sanloem, although probably only persisting in that area occasionally and in very low numbers (Beasley & Davidson, 2007). Dugongs were also reportedly found near Stoeng Hav in Kampong Saom Bay, but have disappeared, supposedly because of increased motor boat traffic (Tana, 1995 in Nelson, 1999b). Nelson (1999b) suggested that the disappearance is more likely related to the loss of seagrass beds due to trawling and push netting, in addition to the abundance of floating and fixed gillnets in Kampong Saom Bay, which pose a serious threat to the species.

The possible decline in the total area of seagrass in the Koh Rong Archipelago (Leng *et al.*, 2014) will certainly not have improved conditions for dugongs, as they rely on seagrass beds for foraging. As a species with specialised foraging needs that keeps close to the shore (Hines *et al.*, 2008) the ongoing degradation of seagrass beds and risk of incidental capture poses a significant threat to the persistence on dugongs in Cambodia as a whole. The dugong is almost certainly the most threatened marine mammal in the region (Beasley & Davidson, 2007). FiA apparently currently receives around 2-3 reports of dugongs annually from the eastern coastal provinces, although these are predominantly reports to FiAC officers of captured or dead individuals (Ouk V., pers. comm.). A dugong was reported dead in Kep sometime in early 2014 (Head of Kep FiAC) but details of the cause of death are unknown.

Boat-based surveys (line transects) targeting cetaceans between April-July 2001 criss-crossed the area of the now proposed MFMA multiple times, yielding 4 records, including a pod of 45 false killer whales (*Pseudorca crassidens*), a first record of occurrence for Cambodia. A rapid assessment focusing predominantly on terrestrial biodiversity between 31st December 2008 and 3rd January 2009 yielded no cetacean records, but reports were received of two species of ‘dolphin’ being present (FFI, 2009). On Koh Rong Sanloem what was originally thought to be the partial skeleton of an Indo-Pacific finless porpoise *Neophocaena phocaenoides* was observed (Fig. 25, FFI, 2009), but was later confirmed to be from an Irrawaddy dolphin *Orcaella brevirostris*. More recently individuals inhabiting or spending a lot of time on the islands have reported dolphin sightings both close to Koh Rong Sanloem (P. Ferber, pers. comm) and the east of Koh Rong (B. Olsen, pers. comm.), but the species sighted are unknown.

The proposed MFMA has relatively shallow water to the east (generally <15m depth) towards the shallow Kampong Saom Bay, and deeper water on the west (generally >20m depth) sloping gently away westward from the islands. It is possible that the MFMA may fall on the boundary of inshore water specialists - such as Irrawaddy dolphin and finless porpoise - and the more oceanic species. The Kampong Saom Bay north of Kampong Saom itself was at least in the past important for Irrawaddy dolphin and finless porpoise, and potentially also the Indo-Pacific humpback dolphin in the vicinity of Tmor Sor village (Beasley & Davidson, 2007), Botum Sakor District. By contrast, the only known reliable

oceanic species records from the area are of the 'blackfish', or false killer whale, sighted on the north-west of Koh Rong Sanloem. Beasley & Davidson (2007) identified the waters west and south of Koh Rong and Koh Rong Sanloem, encompassing the Koh Tang and Koh Polou Wai island group as a 'hotspot' for marine mammals as all their survey records of the more oceanic cetacean species came from that area. Our understanding of cetacean species distribution in Cambodian waters, with the exception of the Irrawaddy dolphin, remains limited.

Informal interviews with fishers or traders in 2001 suggest that they were familiar with the fact that dolphins were at least occasionally by-caught, particularly in monofilament line gillnets (set for crab and prawn) and stronger nylon Spanish Mackerel nets, the former being particularly prevalent in Kampong Saom Bay (Beasley & Davidson, 2007). While the figures should be treated with caution, the interviews suggested that on average at least one dolphin was caught in fishing nets in the Kompong Saom Bay area every 1 to 3 months, and perhaps up to 50 per year according to one informant. Interviewees did however hold a very strong belief that it was very unlucky to catch dolphins in their fishing nets and that they would release any dolphins caught if they were still alive. There are apparently quite strictly observed taboos concerning catching, killing, and consuming cetaceans in Khmer culture, but these don't extend to dugong (Beasley & Davidson, 2007).

Anukrat 123 lists 10 cetaceans and the dugong, which appears to represent all marine mammal species that have been recorded in Cambodian waters. Based on studies from neighbouring countries, Beasley & Davidson (2007) suggested that it is highly likely that further cetacean species remain unrecorded for Cambodian coastal waters. Cambodia's shallow seas and gentle seabed gradient, which lacks marked "shelving" or other prominent underwater features, may constitute a limiting factor to marine mammal species diversity (Beasley & Davidson, 2007). With the exception of the Irrawaddy dolphin, which has received recent 2014 survey effort in nearshore and estuarine habitats in Koh Kong Province (Kong S., pers. comm.), the national status of the remaining species remains unknown and the significance of the water of the proposed MFMA for cetacean populations in the Gulf of Thailand remains uncertain and merits further research. It is also important to highlight that ongoing degradation of the marine environment and escalating threats to marine mammals since the 2001 surveys has likely had a negative impact on populations of those species that frequent or frequented Cambodian waters.



Figure 25. Irrawaddy dolphin *Orcaella brevirostris* remains recovered from Koh Rong Sanloem, now stored at RUPP © Jeremy Holden/FFI.

4.2. Socio-economic Surveys⁷

4.2.a Demography

While Koh Koun is uninhabited, Koh Rong and Koh Rong Sanloem host 4 registered communities: Koh Rong Sanloem village on Koh Rong Sanloem and Daem Thkov, Prek Svay and Koh Touch villages on Koh Rong, along with naval/military outposts on both islands. The four officially registered communities comprise an estimated total of 1633 inhabitants, with a further 303 in the unregistered village of Sok San on the west of Koh Rong (Table 2). Prek Svay is the largest community with 148 registered households and an estimated population of 697. Koh Touch and Daem Thkov are similar in size, each with approximately half the population of Prek Svay. Koh Rong Sanloem village appears to be the smallest community with 43 registered households, although it is worth noting that while generally the island population estimates agree across several sources, Diamond *et al.* (2012) record a much higher number of households in this village (94 'families', 404 people), which is consistent with National Committee for Sub-national Democratic Development (NCCD) figures from 2010 (429 people). The NCCD commune profile puts the total population of the archipelago at 2,016 (NCCD, 2010). There appears to be no significant gender imbalance in any of the communities. Approximately 17% of households in the commune are female headed (NCCD, 2010).

Table 2: Approximate population of 5 villages within the proposed MFMA.

Village	Koh Rong Sanloem*	Koh Touch*	Daem Thkov*	Prek Svay*	Sok San**	TOTAL
Households	43	81	89	148	82	443
Women	106	177	209	319		
Men	144	162	188	359		
TOTAL	220	339	397	678	303	1937

* after Ouk *et al.* (2011b)

** after Diamond *et al.* (2012)

The communities are relatively homogenous with regard to ethnicity and language (vast majority Khmer) and religion (Buddhist) with a very small number of Muslims and people of Thai or Vietnamese origin. In 3 out of 4 communities literacy/basic education levels are relatively high (over 70%) with an average of 4-5 years' (presumed primary) education. Gender differences in literacy were not recorded in the survey reports, with the exception of Prek Svay where of 212 students attending school in 2013, 90 were female and 122 male. Koh Touch was significantly different to other communities – in 2011 approximately 50% of the population were reported to be illiterate or with little or no formal education.

All communities have high proportions of children (under 18 years old) with Daem Thkov having the highest proportion (45%) in this age group, followed by Koh Rong Sanloem village and Koh Touch (both around 40%) and Prek Svay (25%). In all communities, at least half of the population are of working age (19-50 years old) but Prek Svay appears to have an older age profile than the other settlements with a lower percentage of 19-30 year olds (15% cf c. 30%) and a higher percentage of both 31-50 year olds (45% cf 20-26%) and people over 50 years old (15% cf 5-10%). All communities have experienced similar in-migration patterns from 1989-2006 with people either returning from displacement under the Pol Pot regime (particularly mentioned by respondents in Prek Svay) or migrating from other provinces (predominately Preah Sihanouk and Kampot) in search of better livelihood opportunities, predominately through fishing.

⁷ Results presented in this section are compiled from Seak & Hoy (2010); Skopal (2011); Skopal & Ferber (2011); Ouk *et al.* (2011a); Ouk *et al.* (2011b), Longhurst *et al.* (2013); Leng (2013); Hamilton (2012). Where additional references or sources were used they are cited within the text.

NCCD (2010) report a 32% increase in population size between 2007 and 2008, and a subsequent plateau. Population size seems to be largely stable, although some people reported some emigration to other provinces due to perceived decline in fisheries catch. Others thought the population would rise again with expected increase in employment opportunities related to tourism in the future. Immigration in the near-term may be particularly acute in Koh Touch and Koh Rong Sanloem village where backpacker tourism and associated infrastructure is rapidly developing.



Figures 26 & 27. Above: Prek Svay is the largest village in the proposed MFMA, with approximately 150 households © CCC; Koh Touch has turned rapidly from a small fishing village to a busy centre of tourism in the archipelago © Jeremy Holden/FFI.

4.2.b Community Infrastructure and Transport

Surveys to date do not generally document household buildings, with the exception of the 2010 Prek Svay survey. Zinc is the most popular material for roofing in the area followed by thatch, and wood is common material for external walls - 77% of household buildings in Prek Svay used zinc roofing and the same number used wood for the outside structural walls. Over 85% of houses in Prek Svay use wood and plastic as floors, apparently due to their resistance to salinity. Houses in Koh Touch use similar materials. There is no regular electricity supply on the islands. Generators are run by community members, mostly by people owning businesses, normally from nightfall to approximately 11pm.

Infrastructure is still relatively limited on both Koh Rong and Koh Rong Sanloem. Each island has a network of minor forest trails and tracks linking villages and military (navy) bases. The road network and resorts are under planning and/or construction by concessionaires. The only significant road construction was initiated by Royal Group in early 2010 on Koh Rong, with a currently unpaved road now in place linking Koh Touch to Daem Thkov, and extending along the east coast of Koh Rong, towards but not reaching Prek Svay (see Fig. 11). This is used along with other trails to navigate by motorbike. Boat nonetheless remain the most important means of transportation for people within the archipelago (Fig. 28). Each village has at least one pier used to unload fisheries products, commodities and as well as tourists visiting the island, and several villages (e.g. Koh Touch, Koh Rong Sanloem village) have as many as 3 piers, which are used and managed for a variety of private and/or public purposes.



Figure 28. Boats remain the most important means of transportation for people within the archipelago © Jeremy Holden/FFI.

4.2.c Livelihoods Strategies

Survey results highlight the critical importance of coral reefs and their associated habitats and species to the local communities, although it should be noted that many households pursue multiple livelihoods strategies. Analysis of livelihoods activities in 2011 showed that 56% of the community on Koh Rong Sanloem relied on fishing-related activities, while tourism related activities directly involved 23% of the population. It was also noted that activities related to commerce (e.g. running shops, bars etc.), which supported 10% of the population, have been increasing with tourism on the island. Diving and other aquatic activities, such as snorkelling, are key draws to tourists coming to the area and depend on having high quality marine ecosystems for visitors to observe. Daem Thkov reported the highest percentage involved in fishing activities (67%) while Koh Touch reported 35% and Prek Svay only 26%.

Of 55 fishers interviewed across the archipelago in 2013, 16% also work in tourism, 9% on farms and 20% have other jobs. Of the families interviewed by CCC in Prek Svay in 2013 over half derived some or all of their income from fishing, with 36% relying primarily on fishing alone, and 15% depending on a combination of fishing and farming. Other sources of income and employment include sale of groceries in local stores, trading, casual labouring and working for the government. Agriculture appears to be important in Prek Svay at least, alongside fishing, with households engaging in both depending on weather, seasonality and catch. Within the village, fishing and farming is carried out predominantly by men and groceries or fish trading predominantly by women. The secondary income source for fishermen in Sok San is also farming. In Koh Rong Sanloem village secondary income is generated by working as staff at bungalows, although there are also a growing number of bars, food sellers and small stores selling groceries catering to tourists. In Daem Thkov some people also work as bungalow staff in nearby Koh Touch, although Daem Thkov villagers also have work on farms.

Fishing activities varies between the communities on each island, based on socio-economic surveys carried out in 2010 and 2011. On Koh Rong Sanloem the primary activity was squid fishing (77% of fishermen practising), while in Koh Touch and Prek Svay the focus was on crab fishing (79 and 54% respectively). In Daem Thkov crab fishing was dominant (45%) but squid and fish are also important (26 and 29% respectively). In accordance with this, the gears used for fishing vary between the communities, with squid lines predominating on Koh Rong Sanloem (86.5%), while in Koh Touch bottom-weighted crab nets were most common (79%) and crab traps dominated in Daem Thkov (48%). In Prek Svay the survey did not distinguish between crab nets and traps, but 47% of fishermen used one of these two methods. A small sample of fishers in a study in Koh Touch in 2011 also suggest that seine nets were widely used there, with jacks/trevallies, 'red snapper' and fusiliers the most prevalent in catch. Mean boat length for respondents was 12m. In Koh Rong Sanloem, Koh Touch and Daem Thkov long-tail boats were the dominant type of fishing boat, but paddle boats are important in Koh Rong Sanloem (38%) (Fig. 36) and Ko Yon boats were recorded in Daem Thkov fishing crab (9%).

There are major shifts in income sources underway due at least in part to rapid growth in tourism in certain communities, namely Koh Touch, but also Koh Rong Sanloem village. For example, majority of fishers questioned in Koh Touch in 2011 reportedly did not have another source of income (c. 90% of respondents), whereas 2013 focus group discussions and interviews found that there were no fishermen remaining in the village, and that they had switched entirely to provision of tourism services, primarily work in bungalows and restaurants (the income source for 70% of villagers). The reasons cited for stopping fishing were a sharp decline in marine animal abundance, an oversupply of fishermen, trawler boats coming and ruining their gear, and an increase in the price of fishing materials. Any fishing in Koh Touch is now carried out by local children targeting squid with hooks for their own consumption or sale to tourists. Across the archipelago 28% of fishermen have stopped fishing because that have other jobs to do. Employment opportunities in the tourism industry are being perceived as a solution to many economic challenges, including within areas currently without rapid growth in tourism numbers, such as Prek Svay. Some women have expressed an interest in expanding small-scale agricultural activities to supply a future tourist market, although land availability is a constraint (FFI, in litt.). While fishermen overall perceive that their income has decreased over time, fishing remains the primary income source.

2013 surveys suggest that fishermen have responded to changes in target species and declining catches (particularly of crab) by changing gears. Squid hooks have become more prevalent (36% of gear used now compared to 22% previously across the whole archipelago) and are the most commonly used gear, and crab traps and gillnets have decreased in prevalence. Hooks targeting fish have also become more common (6% of all gears before, 17% now). Fish catch as a proportion of total catch appears to remain relatively stable at an estimated one third of the total catch, with squid estimated to make up 51% of total catch of local fishers. While squid is now the most common catch, the small-scale fishery in the Koh Rong Archipelago remains diverse, including 8 basic gear types (variations of hooks, traps and gillnets) targeting crab, squid, shrimp and fish (e.g. Figs. 29-32).



Figure 29-32 (clockwise). Various methods (squid trap, crab gillnet, squid hooks, crab trap) used to catch squid and crab. Squid hooks have become more common in the area, as have fish hooks, while crab traps and gillnets have reportedly decreased in prevalence amongst small-scale fishers
© Leng Phalla/RUPP/FFI.

Improved documentation of small-scale fisheries is needed to gauge trends, identify the threats to their sustainability, and assess management options (Lunn & Dearden, 2006). The wide ranging information gathered to date should provide a reference point for quantifying further changes in local fisheries, and inform the development of a more comprehensive and cohesive fisheries and coastal livelihoods monitoring programme in the Kog Rong Archipelago MFMA. Better understanding fishing practices, patterns and perceptions relating to the squid fishery is required, given the local significance of squid for income and food. A study of small-scale fishers in Ko Chang National Park, Thailand, found that small-scale squid fishers did not report any changes to their catch volumes over time, in contrast to other fishers such as finfish fishers who generally reported declines (Lunn & Dearden, 2006). It has been suggested (e.g. in Hamilton, 2012) that squid fishers may not therefore be as severely affected by fishery development (e.g. introduction of large-scale trawling) and do not notice declines in catches over time, implying that squid species may be better able to support small-scale fisheries than some long-lived finfish species (e.g. grouper) for which stocks take longer to recover. Whether this is the case in the Koh Rong Archipelago remains to be determined, but is supported by the recent increase in the proportions of gears targeting squid amongst artisanal fishers and a smaller perceived decrease in squid catch over time, relative to perceived decreases in crab and shrimp catch.

4.2.d Perceptions

Here we present some local perceptions on catch, and on existing (i.e. CFis) and proposed (i.e. MFMA) management measures. Fishing behaviour, practice and the success of future management interventions is influenced by perceptions about the fishery, as well as community involvement in planning (Hansen *et al.*, 2011). Social acceptance of MPAs is necessary if they are to be effective, and 2011 surveys

in Koh Touch suggest that local fishers at the time would accept MPAs as a management tool. Of 29 respondents, 62% felt that MPAs are a good thing. Fishers felt the state of marine resources had worsened in the past decade in the area (with regards to the number of fish, the size of fish and the number of species present in their catch). Older fishers showed greater acceptance of MPAs, while mobile gear users were more willing to be involved in MPA management. Respondents did not feel that an MPA would increase conflicts between fishers, although the survey was conducted when MPAs were a relatively novel concept in Cambodia and less than half (41%) of fishers were aware of plans to establish an MPA in the area. 2013 surveys in Prek Svay suggest that there is very little understanding of marine issues and challenges, but in general there was support for the role of the CFI and also of the MFMA, including support for greater regulation of marine resources.

Local fishers are generally aware of and understand the purpose of the already established CFIs in the Koh Rong Archipelago, because they were either present when CFIs were established or because they join village meetings. Justification given for supporting the CFIs vary, but the fact that they can protect marine habitats and animals living around villages, and can protect fishing gears from large boats, feature heavily (75% of all respondents). While around half of fishers interviewed across the archipelago in 2013 appear to view CFIs as a good management mechanism, they also acknowledge that CFI do not have enough ability to manage fishing practices in the area (55% of respondents), because they still observe illegal fishermen destroying fishing gear in their areas. Eight percent of respondents said they have stopped believing in their CFI. CFI Committee members and patrol teams surveyed in January 2014 themselves acknowledge that CFI management could improve, that CFI capacity seems to be limited to perform all the activities to manage their area, and that they are not strong enough to catch illegal fishing activities throughout their area. About 53% of respondents from newly elected CFI committees and newly appointed patrol teams felt that the CFI did not have enough capacity to catch illegal fishing activities in the CFI boundaries (2014 FFI/FiA, unpublished data). There appears to be little in-depth understanding, within the Prek Svay community at least, as to why and how management measures can benefit them.

Although the composition of the species caught has not changed over time, local fishers perceive an ongoing decline in fisheries resources across the archipelago. This includes decline in estimated catch weights across multiple gear types used by small-scale fishers (crab trap, crab gillnet, fish trap, fish gillnet, fish hook, squid trap, squid hook, shrimp gillnet), with the largest relative declines in catch weight perceived to be within the crab fishery. Of 33 interviewees conducted in Prek Svay in 2013, 67% of respondents has observed a decrease in quantity of fishing catch in the last 5 years. Fishermen may adapt to perceived declines by increasing fishing area and time spent, changing their gear and overlapping in fishing zones (Karnad *et al.*, 2013), and gear changes appear to be occurring in the proposed MFMA due in part to declining crab catch. Changes in spatial patterns of resource use are not particularly well-understood, although research is underway to determine preferred fishing sites amongst artisanal gleaners and finfish fishers (On, in prep.), which could provide a basis to monitor changes upon establishment of the MFMA, including the socio-economic impacts of no-take zones.

4.3. Threats

Coral reefs are threatened by a number of natural and anthropogenic impacts. The effects of these impacts are interlinked since chronically stressed reefs are far less likely to recover from an acute stress (Kinsey, 1988). Global and regional threats to Cambodia's reefs, including those located around Koh Rong and Koh Rong Sanloem, have been identified as:

- Climate change
- Coral bleaching
- Ocean acidification
- Coral disease outbreaks
- Precipitation and storm damage

At least some of these threats are impacting on the reefs around Koh Rong and Koh Rong Sanloem. During May of 2010, sea surface temperatures in Cambodia rose by 2°C above the average temperatures, causing significant stress to the corals and inducing the onset of a mass bleaching event in the area. This event was recorded by international agencies such as the National Oceanic and Atmospheric Administration, and affected the Gulf of Thailand (Van Bochove *et al.*, 2011b). During May, coral bleaching levels were between 90-100% at all sites surveyed around Koh Rong. Bleaching levels remained above 50% in June and July and then slowly declined between August and November 2010.

While it is difficult to control such global or regional impacts on a local scale, managing local threats can ensure that the reef system remains resilient. Threats do not just affect coral reefs, but also seagrass, mangrove and other intertidal or subtidal habitats in the area. A variety of research and reports indicate that major threats to marine habitats in the Koh Rong Archipelago persist, including several which feature frequently across multiple studies as pervasive threats:

- Overfishing (e.g. Krell *et al.*, 2011; Van Bochove *et al.*, 2011b; Leng, 2013)
- Destructive fishing techniques (e.g. Krell *et al.*, 2011; Ouk *et al.*, 2011b; Leng, 2013)
- Sedimentation (e.g. Van Bochove *et al.*, 2011b; Thorne *et al.*, in prep.; Yim, in prep.)

While anthropogenic impacts that have been measured on reefs in the area are generally considered low, pollution does appear to be having an impact at specific sites, including seagrass beds (e.g. Leng *et al.*, 2014), and coral reefs have variable and localised damage from anchors, general waste and discarded fishing gear (Krell *et al.*, 2011; Van Bochove *et al.*, 2011b). Poorly planned and/or large-scale coastal development for tourism are emerging threats to remnant marine habitats, particularly to fringing reefs (Van Bochove *et al.*, 2011b; Thorne *et al.*, in prep.), mangroves and associated seagrass beds. If not carefully planned and managed, large-scale land-use change, increased pollution, increased disturbance and growing demand for terrestrial and marine natural resources could all negatively impact on marine life in the Koh Rong Archipelago and lead to further resource degradation.

During social surveys and consultations in 2010 and 2011, a large perceived decline in fish catch was recorded and a number of perceived threats to fishing activities and/or management were identified both in Krell *et al.* (2011) and Ouk *et al.* (2011b) and are listed in order of prevalence in community responses:

1. Trawling boats
2. Illegal Vietnamese boats
3. Increase in fishermen from outside
4. 'Boats with big lamps' (light fishing)
5. Conflicts with foreigners [interpreted to mean divers damaging fish traps]
6. Sand dredgers (cited particularly in Daem Thkov)
7. Changes in weather patterns

The use of destructive fishing methods (bottom weighted gill nets/crab nets) which cause a large amount of damage to marine habitats was also identified as a major threat to the coral reefs and endangered species in the area, and an increase in anchor damage was noted, particularly around popular dive sites (Krell *et al.*, 2011). It was mentioned by some Koh Touch fishers interviewed in Hamilton (2012) that larger boats, often foreign, operated in shallow waters and caused conflict with smaller boats. More recent surveys are consistent with the top three threats listed above, and suggest that the major current perceived threats from local fishers are i) use of illegal gears, generally associated with foreign fishing vessels, and ii) an increase in fishing pressure due to outsiders entering the local fishery/CFi. In surveys in Prek Svay (Longhurst *et al.*, 2013) the most commonly reported threat by far was the increase in boats from outside the CFi collecting resources from within it. A small proportion of respondents also raised the issue of encroachment by larger illegal commercial vessels generally associated with Vietnamese fishers, and 'corruption', though interviewees were unwilling to expand upon this. In a survey of fishers

across a range of gear types and the entire archipelago (Leng, 2013) illegal fishing activities, particularly use of surface-supplied diving, ‘fast trawls’ (*mong hors*) and poisons were perceived threats to local fishermen’s livelihoods and marine resources. Respondents reported that illegal fishing still occurs in their CFis, mostly at night and mainly by boats from Vietnam, but also Thailand, and a small proportion of interviewees thought boats came from Sihanoukville port to fish in the area. Barriers to effective coastal resources management have been identified as lack of/poor law enforcement, as well as lack of funding, resources and technical support (Ouk *et al.*, 2011b).

4.4. Management and Uses

4.4.a Community Fisheries

Fisheries management in the fisheries domain is under jurisdiction of MAFF, and FiA is the authority under MAFF responsible for fisheries and fisheries resources. The Minister of Agriculture, Forestry & Fisheries is entitled to allocate part of the fisheries domain of the state to communities or groups of citizens living in or around the fisheries domain, who form a CFI. A CFI is essentially a cooperative arrangement between the government and a group of local people of one or more villages [who] voluntarily join together [to] establish a CFI – it may be regarded as a co-management approach (FiA, in litt.). The Law on Fisheries states that all Cambodian citizens have the rights to form CFis in their own areas on a voluntary basis to take part in the sustainable management, conservation, development and use of fishery resources (Article 59).

Each CFI is led by an elected committee called the “Community Fisheries Management Committee”. The committee is generally composed of one chief, two deputy chiefs, a secretary, a patrol leader, education and extension member, and a cashier (Fig. 33). The detail of roles and responsibilities of each committee member are further defined in the CFI internal rules/regulations (Yeang, 2014) of individual CFis.

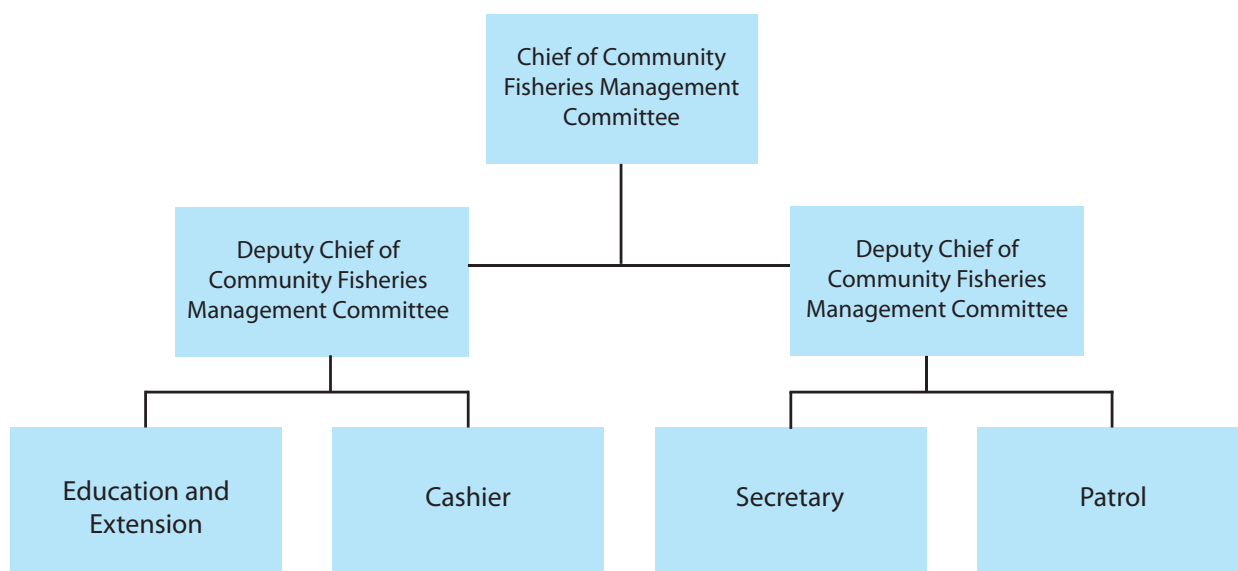


Figure 33. General structure of a Community Fisheries Management Committee (after Yeang, 2014).

Three CFis have been established in the Koh Rong Archipelago, and their combined Community Fishing Areas cover 18,672ha, incorporating nearly half of the total area of the proposed MFMA, including the majority of fringing coral reefs and mangrove, and all of the known seagrass beds within the archipelago. According to the CFI by-laws, the main purpose of establishing these CFis is to “*protect, conserve and use fisheries resources in sustainable ways*”.

The basic characteristics of each CFI varies considerably, and the level of support provided to them has historically also varied. To date there have been multiple organisations and projects from both private sector (e.g. MCC, SSPI) and development partners (e.g. FAO-RFLP, DANIDA) that have assisted. Each CFI has received differing levels of equipment and training (Table 3) and Daem Thkov CFI had, until recently, received the least support. As well as material support, the Koh Rong Sanloem CFI has in the past benefited from community catch monitoring and training in patrolling/boat handling, book keeping, family planning, chicken rearing (through FAO-RFLP) and fuel, use of equipment and in-kind meeting space (from MCC). Prek Svay CFI also benefited from a CFI office, plus a crab bank (now defunct) and boat (provided by DANIDA), a speedboat (provided by FAO-RFLP), and some equipment, training and operational costs such as fuel (from SSPI). More recent training (2013 - 2014 by FiA and FFI) for the three CFIs has focused on patrolling, GPS use, CFI administration, management planning and bookkeeping. New CFI committees were elected in October 2013, with 65% of the committee members being new to the positions, which highlights the need for ongoing training and support towards the CFIs committees and members to improve their institutional capacity and effectiveness.

The effectiveness of the three CFIs has not been carefully studied, but the fact 95% of small-scale fishers interviewed in the Koh Rong Archipelago reported that their catch had declined (Leng, 2013) suggests that they are struggling to sustain local fisheries resources. In addition, and comparative study of coral reefs using CCC data (Thuang, 2013) found that there was no statistically significant difference in reef fish or invertebrate abundance and composition between inside CFIs and outside (i.e. the reefs around Sok San).



Figures 34-37 (clockwise). Local fishers report a decline in crab catch, although it remains an important component of the catch in several villages in the Koh Rong Archipelago © Gurveena Ghataure/FFI; CFI and FiA conduct a joint patrol to stop illegal fishers © FiA; Small polystyrene paddle boats in Koh Rong Sanloem for squid fishing by local children © Leng Phalla/RUPP/FFI; Signage to raise awareness of the need to protect mangroves to support local fisheries © Prek Svay CFI.

Table 3. Summary of basic characteristics of existing CFIs in the Koh Rong Archipelago.

CFI background	Prek Svay CFI	Daem Thkov CFI	Koh Rong Sanloem CFI
Size	7,447ha	1,734ha	9,491ha
Year Established	2003	2010	2008
# committee members	11	9	11
Total # CFI members	384 (incl. 76 women)	223 (incl. 85 women)	185 (incl. 89 women)
Last committee election	October 2013	October 2013	October 2013
Internal regulations/ bylaws	Yes, updated 2014	Yes, updated 2014	Yes, updated 2014
Registered* (Year)	Yes (2010)	Yes (2011)	Yes (2010)
Management Plan**	Yes, approved Sept. 2014	Yes, approved Sept. 2014	Yes, approved Sept. 2014
Key habitats, in order of relative significance within the MFMA***	1. Coral reef 2. Mangrove 3. Seagrass	1. Seagrass/Mangrove 2. Coral reef	1. Coral reef 2. Mangrove 3. Seagrass
Prior support	Seila Program, DANIDA, FAO, SSPI	Seila Program, FiAC, FAO	Seila Program, FAO, RFLP, MCC
Current support	SSF, FFI	FFI, CC	FFI
Basic equipment/ infrastructure ⁸	CFI Office x 1 Speed boat x 1 Outboard engine x 1 Uniforms x 11 Camera x 1 GPS x 1 Radios x 3 Binoculars x 1 Raincoats/lifejackets x 10/10 Boundary poles x 5	Speed boat x 1 40 hp outboard x 1 Uniforms x 15 Camera x 1 GPS x 1 Radios x 3 Binoculars x 1 Raincoats/lifejackets x 10/10 Boundary poles x 6 (1 broken)	Longtail boat x 1 Engine x 2 Uniforms x 33 Cameras x 2 GPS x 2 Radios x 4 Binoculars x 2 Raincoats/lifejackets x 15/15 Boundary poles x 7 (1 broken) Trawler blocks x 40

* Registered and recognised by MAFF, step 8 in CFI establishment.

** Step 9, final step in CFI Establishment. KRS had a previous 1 Year Management Plan, which has been updated.

*** Based on habitat extent and quality in the Koh Rong Archipelago, for 3 habitat types only.

⁸ This describes equipment that CFIs have in-hand at the time of writing, or where there is some evidence or documentation on the whereabouts of the equipment/infrastructure. Reports from FiAC suggest additional items that were provided historically, including: 1) Prek Svay: Boundary poles x 7 (of which 3 are located in Sok San, 2 in Daem Thkov and 2 broken), trawler blocks x 38, Mooring buoys x 30, buoys to demarcate the Song Saa Marine Reserve x 150, concrete poles for protect coral x 30, concrete poles for protect seagrass x 39, crab bank (now defunct); Daem Thkov: trawler blocks x 45 and Koh Rong Sanloem: Buoys x 35, trawler blocks x 55.

4.4.b MFMA Management Structures

A management platform for the proposed MFMA have been put in place at the provincial level, and initiated meetings in 2014. The structure is comprised of a Management Committee for Marine Fisheries Management Areas within Preah Sihanouk Province⁹ (PMC) and a site specific Technical Working Group for the Koh Rong Archipelago Marine Fisheries Management Area,¹⁰ Preah Sihanouk Province (TWG-MFMA) (Fig. 38). The former is made up of 16 provincial and national government members and was formed 'in order to coordinate the management tasks, protect fisheries ecosystems and fisheries resources in Preah Sihanouk province in order to enhance livelihoods of people living along the coast, ensure the sustainability of fishery resources, protect fisheries ecology and promote eco-tourism through utilization and conservation of Marine Fisheries Management Areas in Cambodia.' The TWG-MFMA is multi-sectoral, with 6 private sector members, 3 CFI members, 2 Non-Governmental Organisation (NGO) representatives, alongside 15 local and national government members. Its roles and responsibilities are varied, and include the protection and conservation of the marine fisheries resources and habitats in the Koh Rong Archipelago, awareness raising, the preparation and drafting of reports, maps and supporting legislation, plus the design and implementation of a site management plan and subsequent monitoring and evaluation of activities.

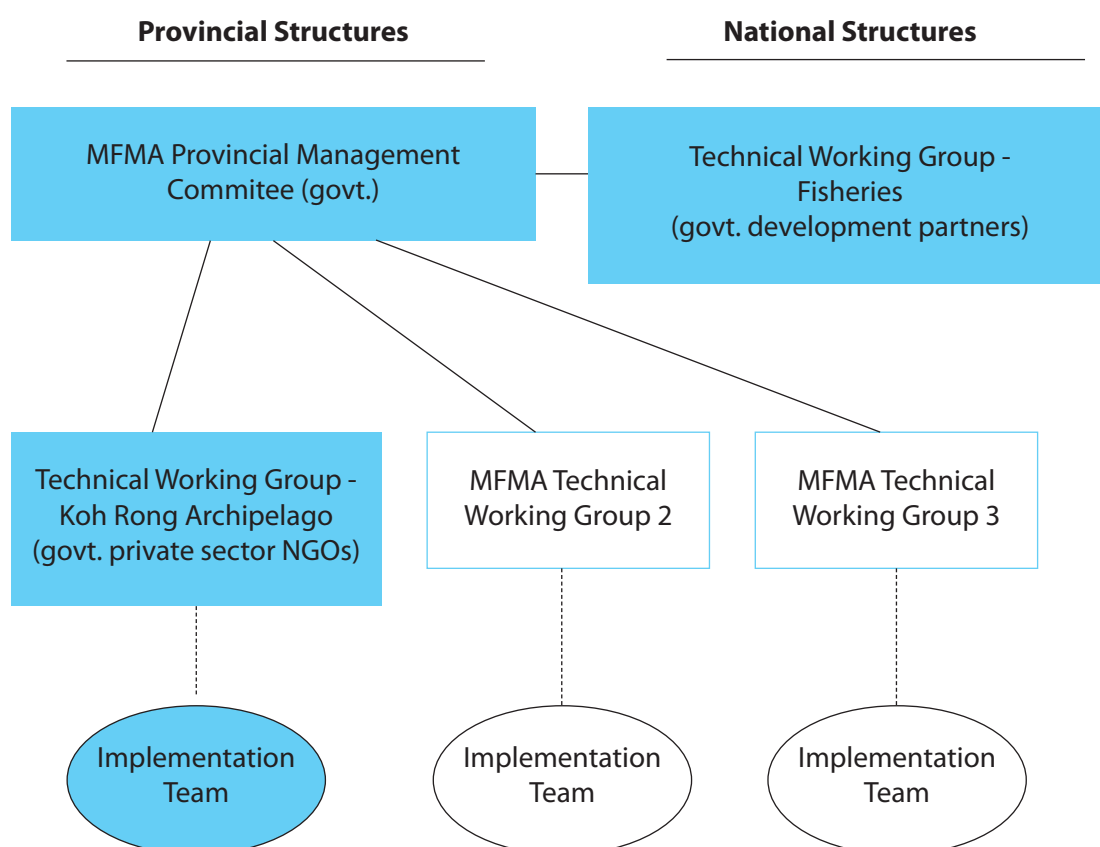


Figure 38. Schematic of the MFMA management structures, including possible additional TWGs for future MFMA in Preah Sihanouk Province.

4.4.c Tourism

The Royal Government of Cambodia (RGC) is promoting tourism as a key pillar for economic growth, stating that the long-term vision is 'to push for the sustainable development along the Cambodian

⁹ Provincial Decision [Deika] no. 134SSR signed 25th November 2013, updated with Provincial Decision no. 251SSR signed 12th June 2014.

¹⁰ Provincial Decision [Deika] no. 009SSR dated 17th January 2014.

coastal area.' The coastal zone is known as the 'Dragons' Head' of the national economy and tourism is a growth area as government seeks to encourage visitors to look beyond the Angkorean temples. Visitors to coastal areas increased by 45.3% between 2011 and 2012 (MoT, 2013), and the Ministry of Tourism is expecting to reach 1 million foreign visitors to the 4 coastal provinces in 2015.

In Preah Sihanouk Province international tourist visits increased by 38.8% between 2011 and 2012 (MoT, 2013). Rapid growth of visitors to the Koh Rong Archipelago is causing significant changes within local villages, notably in Koh Rong Sanloem village and especially in Koh Touch (Ouk *et al.*, 2011b), where fishing has essentially stopped and local fishermen have switched to tourism related work (Leng, 2013). Skopal *et al.* (2010) estimated that the highest average visitation rate to the Koh Rong Sanloem CFI at the time would be 19,912 per year, with peak visitation occurring Feb-April. While the reliability of figures is somewhat uncertain¹¹, the provincial Department of Tourism report that visitor numbers to the whole archipelago were 36,000 in 2011, 72,000 in 2012 and 90,000 in 2013.

Infrastructure for tourism has rapidly expanded. Skopal *et al.* (2010), for example, counted just 4 businesses offering bungalow accommodation within the Koh Rong Sanloem CFI, whereas there are now approximately 36 guest houses/bungalows in the same area (Department of Tourism, Preah Sihanouk Province, unpublished data). According to figures provided by the provincial authorities in December 2013 there are now 47 guest houses/bungalows in the Koh Rong Archipelago: 27 in Koh Touch, 9 on Koh Rong Sanloem (including Koh Rong Sanloem Village), 8 in Sok San and 3 in Prek Svay. These predominantly cater for backpackers, and are centred on Koh Touch and Koh Rong Sanloem village, with a growing number of bungalows in Saracen Bay, on the east of Koh Rong Sanloem, and also on '5 mile beach' on the west of Koh Rong. One additional luxury resort, Song Saa Private Island, is located on the islets of Koh Bong and Koh Ouen, a short distance from the village of Prek Svay on the northeast of Koh Rong.

There are approximately 10 dive companies and businesses offering dive trips within the proposed MFMA, approximately half of which are well established. These businesses mainly operate from Sihanoukville, or the islands themselves, and many offer snorkelling trips as well as diving. The Koh Rong Archipelago is the most frequented area in Cambodia for SCUBA diving, and snorkelling trips running from Sihanoukville are becoming established. The most important dive sites for the recreational dive industry are concentrated around the north of Koh Rong Sanloem and particularly around Koh Koun (Unofficial notes from the TWG-MFMA inception meeting, FFI in litt.). There are important sites on the southern tip of Koh Rong, around Koh Touch, and also on the western side of Koh Rong Sanloem. Koh Rong Sanloem CFI contains nearly all of the most frequently used dive sites, with some from Sok San south to 'Stingray Point' (the southern tip of Koh Rong) outside any existing management regime. A small number of dive sites are within Prek Svay CFI, used predominantly by Song Saa Private Island. Other marine based tourism activities are becoming commonplace, such as recreational fishing, cruises (Skopal *et al.*, 2010) and watersports, including kayaking to visit mangrove creeks at various sites around Koh Rong (SSPI/SSF, 2013). Some illegal activities, for example spear fishing, have recently been observed as advertised activities for tourists (Chea P., pers comm.).

A survey of tourists in Sihanoukville in 2010 found that 'marine activities' (SCUBA diving and snorkelling, boating, swimming, relaxing on the beach, recreational fishing) were most frequently selected as a favourite activities by respondents, followed by volunteering, resort vacations, then 'other' generally nature oriented activities, such as walking/hiking, visiting nature parks, backpacking and sightseeing (Skopal *et al.*, 2010). The study highlighted that the primary reason tourists dive and snorkel the reefs around Koh Rong Sanloem and the nearby islands is the delicate and diverse combination of sea life and ecosystems, both accessible and affordable to the vast majority of tourists visiting the province.

¹¹These are estimates based on reports from the ferry operators, and are likely to be unverified by spot checks. The split between Cambodian and foreign visitors is unknown.

While concerns have been raised about the potential detrimental effects of burgeoning tourism on local culture, Ouk *et al.* (2011b) also highlight that the area shows great potential for livelihoods improvements through marine and cultural ecotourism. It is important to recognise that the local tourism industry is based on diving and other recreational activities that depend on high quality marine environments (Skopal *et al.*, 2010).

4.4.d Developers

Cambodia's coastal zone is being targeted by national and international investors, attracted by the tourism potential of the coastline and nearby islands (Savage *et al.*, 2013). The vast majority of the 69 islands in Cambodia are leased to private concessionaires for the development of resorts. In the Koh Rong Archipelago there are three major concessionaires. Koh Rong Sanloem Island Resorts Co., Ltd signed a 99 year concession agreement with the RGC in October 2008 for 1,120ha¹² on the north of Koh Rong Sanloem, with 1,200ha, the southern half of the island, leased to Emario Shonan Marine Corporation Ltd.¹³ Millennium Group and its Cambodian partner, Royal Group, have a circa 7,800ha concession with 99 year lease and plan to develop Koh Rong¹⁴.

To date, individual construction projects have been on a relatively small-scale, with the exception of the road initiated in 2010 on Koh Rong. Bungalows and other small businesses are proliferating in the archipelago, generally around coastal villages and beaches (Fig. 27). It should be assumed however that the archipelago, and particularly Koh Rong and Koh Rong Sanloem, will be further developed on a larger-scale than the existing bungalow and backpacker infrastructure that is currently in place. The resulting changes may have a direct effect on coastal and marine habitats. Skopal *et al.* (2010) predicted several potential environmental impacts of the development of large concessions on coral reefs:

- i) *Increased terrestrial runoff* due to logging, soil compaction and surface sealing. Increased run-off of sediment and nutrients will have a direct detrimental effect on hard corals and associated species;
- ii) *Waste management issues* due to increased visitation and discharge of waste to the sea;
- iii) *Increased divers and boat numbers*, resulting in a breach of the carrying capacity of the area and excessive direct reef damage by careless divers, plus associated impacts such as increased pollution, anchor damage and noise.

Environmental Impact Assessments (EIAs) would highlight the full range of potential impacts of individual infrastructure projects, and should be conducted prior to development activities. The level of threat to marine habitats from large-scale island development will ultimately hinge on the decisions of authorities and companies to enforce and/or comply with existing legislation (e.g. set-back regulations), as well as their willingness to implement international best practice in coastal development, including the use of comprehensive EIAs.

In 2007 Song Saa Private Island established a 5.5ha no-take marine reserve around their resort. While the biological benefits of this increased protection in terms of species abundance and diversity are taking time to show (Savage *et al.*, 2013), the Song Saa marine reserve sets an important precedent for Cambodia in terms of active private sector engagement in marine management. It can also be viewed as a positive initial step for the management of the larger MFMA that several concessionaires and resorts (SSPI, Royal Group, Koh Rong Sanloem Island Resorts Co., Ltd) are members of the TWG-MFMA and have actively engaged in the zoning consultation process to date.

¹² <http://kohrongsamloemconservation.org>

¹³ <http://www.emario-resort.com/project.html>

¹⁴ <http://www.millenniumgroup.net>





V. CONCLUSIONS AND RECOMMENDATIONS

5.1.a MFMA Establishment

Early studies in the Koh Rong Archipelago (e.g. Krell *et al.*, 2011; Van Bochove *et al.*, 2011b) found clear indications that the condition of coral reef was deteriorating, that the reefs were stressed, and that local factors such as overfishing, sedimentation and pollution were continuing to threaten the reef systems. Seagrasses and several endangered species also appear to be suffering ongoing declines. Moreover, the experiences and observations of local people highlight the worsening condition of small-scale fisheries, consistent with the national pattern of increasing overexploitation of the coastal zone.

There is an urgent need to improve marine resource management in archipelago and increase the area of coral reef under effective management. The 2006 Law on Fisheries allows for the creation or nullification of fishery management areas by proclamation of the Minister of Agriculture, Forestry and Fisheries (Article 12). The proposal to increase protection through an MFMA around Koh Rong and Koh Rong Sanloem is not new (see, for example: Ouk *et al.*, 2011b; Skopal-Papin, 2011; Van Bochove *et al.*, 2011b; Hamilton, 2012), and there has been an ongoing effort by multiple organisations, government and private sector stakeholders to move towards implementation through development of management structures, support to CFIs and data collection to inform MFMA design. While not covered in detail in this report, MFMA establishment also closely aligns with and supports national targets and international commitments by the RGC (See Appendix C). We recommend that the formal proclamation of the Koh Rong Archipelago Marine Fisheries Management Area should therefore be approved as a matter of urgency. Mechanisms need to be established to support effective management and progress towards the proposed MFMA vision of:

*A model marine fisheries management area for conservation of marine biodiversity, sustainable fishing and tourism, contributing to poverty reduction.*²⁵

5.1.b Creating Effective MPAs

Scientific assessments of biodiversity and socio-economic conditions can provide the information needed to guide the conservation and sustainable use of coral reefs and associated habitats. Together with stakeholders, a consensus can be reached to implement a zonation scheme as part of the MPA in line with the relevant national legislation, thereby helping to protect critical habitats. Community participation is widely accepted to be an integral part of management planning. Participation encourages stakeholders to collaborate in both planning and management and has been shown to be effective in coordinating both top-down and bottom-up governance of MPAs – finding a balance between central and local institutions in MPA governance is important. Co-management involves a partnership between local resource users and governments, NGOs and/or private sector actors. It has been found to be a viable approach to marine resource governance particularly for less migratory fisheries on which local coastal communities often depend. Co-management combines context-specific local experience and traditional knowledge, the legitimacy of rules and regulations developed through consensus, and the strength of local institutions together with the powers and resources of centralised government (McCay & Jones, 2011). An analysis of 42 co-managed fisheries areas across 5 countries illustrates generally positive perceived outcomes for livelihoods, high degree of compliance with rules and greater fish biomass than areas without local management (Cinner *et al.*, 2012). Some general background on MPAs as management tools, including economic benefits, are presented in Appendix D.

¹⁵ The MFMA vision was drafted in consultation between FiA, FFI, CCC and was reviewed by stakeholders at the inception meeting of the TWG-MFMA on 24th February 2014.

An MPA that receives wider support has a much better chance of being effectively managed and protected. Without this participation, MPAs risk becoming 'paper parks', where the legislation is in place but there is no actual compliance or enforcement. Once this happens, it is very difficult to turn the tide. MPAs may then inadvertently create the illusion of protection when in fact no protection is occurring (Agardy *et al.*, 2011). The steps preceding MPA establishment are therefore crucial for successful implementation and sustainability.

In 2005 the International Coral Reef Alliance listed a number of strategies that should be considered for incorporation in order for MPAs to be effective in meeting their goals. Those relevant to the Koh Rong and Koh Rong Sanloem Islands have been summarised here:

- Set goals for coastal zone management. Determine, through stakeholder consultations, the long and short-term goals required to create strategies that help ensure protection of coral reefs and related habitats, and formalise these goals through a management planning process.
- Develop a strong coastal management constituency. This will require partnerships and an MPA steering committee at a local, regional and national level.
- Involve local stakeholders and take into account their socio-economic needs and rights. MPAs are more successful when local communities are able to effectively participate in the decision-making process. When they understand the financial and fisheries costs and benefits of the designation of an MPA in local waters, they are more likely to play an active role in contributing to its design and management to achieve both wellbeing and conservation outcomes.
- Incorporate local knowledge and experience by learning and sharing alongside local communities, using traditional knowledge to support marine conservation and sustainable fisheries.
- Develop a zonation plan including several no-take and restricted use zones to help protect and sustainably manage the coastal resources of the islands.
- Develop a legal and institutional framework to support the MPA. Good governance practices and structures, alongside economic incentives, help ensure high levels of compliance with locally agreed rules and regulations to support conservation and sustainable fisheries management.
- Establish diversified financing streams for the MPA, which may include a user fee system and/or government subsidies.
- Assess and monitor the effectiveness of the MPA management plan once implemented. This would include monitoring the health of coral reefs at several permanent monitoring stations within the MPA. Assessments of pollutants and sedimentation will allow for the development of control measures. Ongoing monitoring of socio-economic and governance indicators enables adaptive management which can help ensure net positive benefits for local communities and marine ecosystems.

5.1.c. Initial Recommendations for the Koh Rong Archipelago MFMA

1. **Implement an effective zonation plan following consultation with all island stakeholders,** including the island concession holders, tourism industry, local and national authorities, enforcement agencies and island communities. Several consultation rounds need to be conducted, drawing on local knowledge and experience, in order to reach a general consensus for the implementation of a zonation plan that balances different needs and goals. The zone map should be included in the MFMA proclamation [Prakas], to maximise support for its' implementation. See further comments on zoning in section 5.1.d. below.
2. **Establish and implement an adaptive MFMA management plan,** which is designed to contribute to long-term biophysical, socio-economic and governance goals and objectives of the MFMA and can be monitored using verifiable indicators. This plan should complement and support already established individual management plans of the three CFIs and align with targets and timing of the Strategic Planning Framework for Fisheries 2010-2019 (FiA, 2011). Planning should be carried out with the participation of multiple sectors. The TWG – MFMA is already mandated to develop and update management plans and should coordinate this process.
3. **Use existing CFIs as the building blocks of an effective MFMA.** The MFMA should strengthen not replace the CFIs, embedding them in the broader management of the seascape. The presence of CFIs provides an opportunity to enhance the rights of local resource users at village level, which in turn will improve MFMA effectiveness. The mandate of CFIs to manage their own areas should be fully acknowledged and they should be encouraged to develop and implement their own internal by-laws within the scope of the existing Law on Fisheries and national CFI legislation.
4. **Use existing structures to support MFMA management,** particularly the PMC and TWG - MFMA. Ensure clear guidelines on the roles, responsibility, contributions of each stakeholder group, and clarity on decision making processes so as to expedite management responses.
5. **Prohibit trawling and other destructive fishing methods within the MFMA.** Law enforcement and increased capacity through materials and manpower are needed to ensure illegal activities and encroachment by foreign vessels are not threatening fisheries resources, local livelihoods and marine biodiversity. Approaches should also seek to incentivise compliance by local stakeholders to MFMA rules and the zoning plan.
6. **Safeguard against negative livelihoods impacts and ensure food security and diversified livelihoods strategies.** Poor users of marine resources must have viable options for diversifying away from the use of protected fisheries resources. Recognise that biological benefits of no-take zones will take time to accrue, and that the MFMA should create an opportunity to enhance livelihoods and build capacity to take advantage of new opportunities that the MFMA might create, for example, involvement in the tourism sector. The time for this process should not be underestimated.
7. **Secure domestic budget allocations and implement sustainable financing mechanisms for MFMA management costs.** While government allocations may remain initially quite small, tangible and early contributions will demonstrate willingness and commitment to island stakeholders, engendering further support and collaboration for MFMA implementation. As a minimum, funds are required for education and outreach, demarcation, surveillance and monitoring, enforcement, and performance monitoring and evaluation. A diversified financing portfolio should be developed to support such costs, incorporating market-based funding sources and a benefit sharing mechanism with island communities. *Hastings (2013) provides an*

assessment of 15 possible financing options for the MFMA and Yeang (2014) investigates possible benefit sharing mechanisms.

8. **Establish an overarching MFMA monitoring framework to inform management decisions and assess progress towards long-term MFMA goals.** This should include several permanent monitoring stations around the islands that will allow assessment of coral reef health pre and post MFMA establishment. Monitoring socio-economic indicators within the communities which populate the islands will help assess the impacts – both positive and negative - that the MFMA is having on the women, men and children who depend on marine resources for their livelihoods and well-being. Results from these assessments can ensure accountable governance, inform adaptations to management and zonation plans if needed, and the framework should increase efficiency by promoting research efforts in the MFMA that contribute to monitoring management effectiveness and directing researchers to data gaps.
9. **Incorporate potential terrestrial land-use change and island development plans in MFMA design and implementation.** Terrestrial and marine environments interact. Both Koh Rong and Koh Rong Sanloem are expected to see ongoing tourism related development and MFMA managers and stakeholders should continue to engage with private sector stakeholders and input to EIAs where new developments may affect marine habitats. Although the MFMA will provide some level of protection within the fisheries domain, in itself it cannot mitigate potential land-based impacts such as increased terrestrial runoff, associated sedimentation, and sewage outflow. These issues will need to be carefully considered and integrated into the management plan, in coordination with the relevant government authorities and companies.
10. **Implement an MFMA awareness campaign,** targeting island residents, local authorities, private sector, tourists, and fishers in Preah Sihanouk Province. This should be guided by a concise MFMA communications strategy. Various environmental awareness activities are underway in the area, and could be expanded to reinforce messaging on MFMA establishment, MFMA goals and to disseminate information on the location and function of zones, and the permitted and prohibited activities within zones. A targeted campaign should be in multiple languages, aligned with the timing of the legal establishment of the MFMA, and be additional to ongoing environmental education and outreach built in to the MFMA management plan and communications strategy. Expectations about the speed and scale of potential benefits from habitat recovery need to be considered and managed (see for example Savage *et al.*, 2013).

5.1.d MFMA Zoning

The zonation of MPAs is often recommended as an effective management procedure whereby different zones within an MPA define what uses are allowed or prohibited, to what extent they are prohibited, and by what means. Zoning is a key management tool for multiple-use MPAs (IUCN, CORDIO and ICRAN, 2008). Particular zones help protect sensitive habitats from damaging activities, confine intensive use such as fishing to sites that can sustain it, and separate incompatible activities to reduce existing and potential conflicts. A zoning scheme generally includes areas under strict protection and areas with increasingly fewer restrictions (IUCN, CORDIO and ICRAN, 2008).

Existing Cambodian legislation does not appear to have been written with the zoning and management of marine space in mind, and does not readily support MPA design. Efforts have been made, however, to implement integrated coastal zone management on a provincial scale, and the terrestrial area of Preah Sihanouk Province to a seaward boundary of 20m water depth¹⁷ has been classified in to different zones based on levels of development and 'functional characteristics' (e.g. fisheries, tourism, coastal industry, transport, low-intensity use, restoration, preservation). The resulting plan was officially adopted, although apparently is still not legislated for by sub-decree. *The 2005 Coastal Use Zoning Plan in*

¹⁷ To the edge of the inshore fishing area defined under the Law on Fisheries.

Sihanoukville identified the waters of the Koh Rong Archipelago as a 'Protection Zone', and the area is also mentioned in the plan as a 'Preservation Zone' for conservation purposes. The coastal use zoning plan includes a small embedded Aquaculture/Mariculture Zone on the east of Koh Rong, although it seems that this has never been put in to practice. Skopal-Papin (2011) compiled the very first draft zoning proposal for the Koh Rong Archipelago MFMA itself, explaining the general principles of MPA zoning, suggesting an outer boundary of 4km from Koh Rong and Koh Rong Sanloem while putting forward the following possible zone types: i) no-take Conservation Zone, ii) Protected Zone, iii) Multiple-Use/Buffer Zone and iv) Special Use Zone.

Review of the Law on Fisheries and related FiA guidelines (FiA in litt.) and initiatives provide possible zone types as follows:

- Fisheries Conservation Area ¹⁸
- Community Fishing Area ¹⁹
- Fisheries Protected Area ²⁰
- Multiple Use Area ²⁰
- Fisheries Refugia²¹

According to Skopal-Papin (2011) zoning of the MFMA has two major purposes: firstly to reduce conflicts, particularly between fishers and recreational users such as divers, and secondly, to protect critical fish stocks and nursery areas for the purpose of replenishing surrounding areas. Private sector stakeholders have advocated for a no-take zone where recreational activities such as diving are allowed. Such a zone does not exist within the Law on Fisheries nor FiA guidelines, but has been suggested on the basis of global norms for MPAs and particularly to ensure access to quality dive sites thereby encouraging rather than negatively impacting on the local tourism industry (e.g. SSPI/SSF, 2013; Unofficial notes on TWG-MFMA inception meeting, FFI in litt.).

The zoning of the Koh Rong Archipelago MFMA has been under consultation since December 2012. This has followed a stepwise process that can be broadly summarised as i) on-site community consultation, ii) compilation and incorporation of biophysical data, iii) provincial and private sector consultation and iv) national consultation through FiA and MAFF (see also Boon *et al.*, 2014; Chea *et al.*, 2014). FiA have pushed this process with support from partners and in collaboration with the TWG-MFMA since its inception meeting in February 2014, allowing for the elaboration of a proposed zone map (Fig. 39) for consideration by MAFF. We recommended that the MFMA zoning map is approved as soon as possible and implemented as an integral part of a 5 year management plan for the MFMA. Specific recommendations from this report related to MFMA zoning are:

- A. **Establish no-take Recreational Areas throughout the MFMA.** If properly designed and controlled, such areas will be significant assets to the MFMA by facilitating education, scientific research, supporting tourism and assisting in generating revenue for MFMA management, whilst protecting sensitive habitats and buffering Fisheries Conservation Areas.
- B. **Ensure that a range of habitats are included in no-take zones (Fisheries Conservation Areas and Recreational Areas) distributed throughout the Koh Rong Archipelago,** and maximise the size of no-take zones whilst ensuring that they are acceptable to local stakeholders, particularly local fishing households and those dependent on access to fishing grounds. The potential benefits of no-take zones are highlighted in Appendix D. Van Bochove *et al.* (2011b) suggested no-take zones of at least 20ha at the best reef sites in the area, to allow fish population to increase.

¹⁸ Law on Fisheries

¹⁹ Law on Fisheries - commonly referred to as Community Fisheries, of which 3 are already established.

²⁰ *Guidelines for the establishment and management of coral reef ecosystems in the Kingdom of Cambodia.*

²¹ SEAFDEC introduced concept, see for example Ing *et al.*, 2010 and Pernetta *et al.*, 2010.

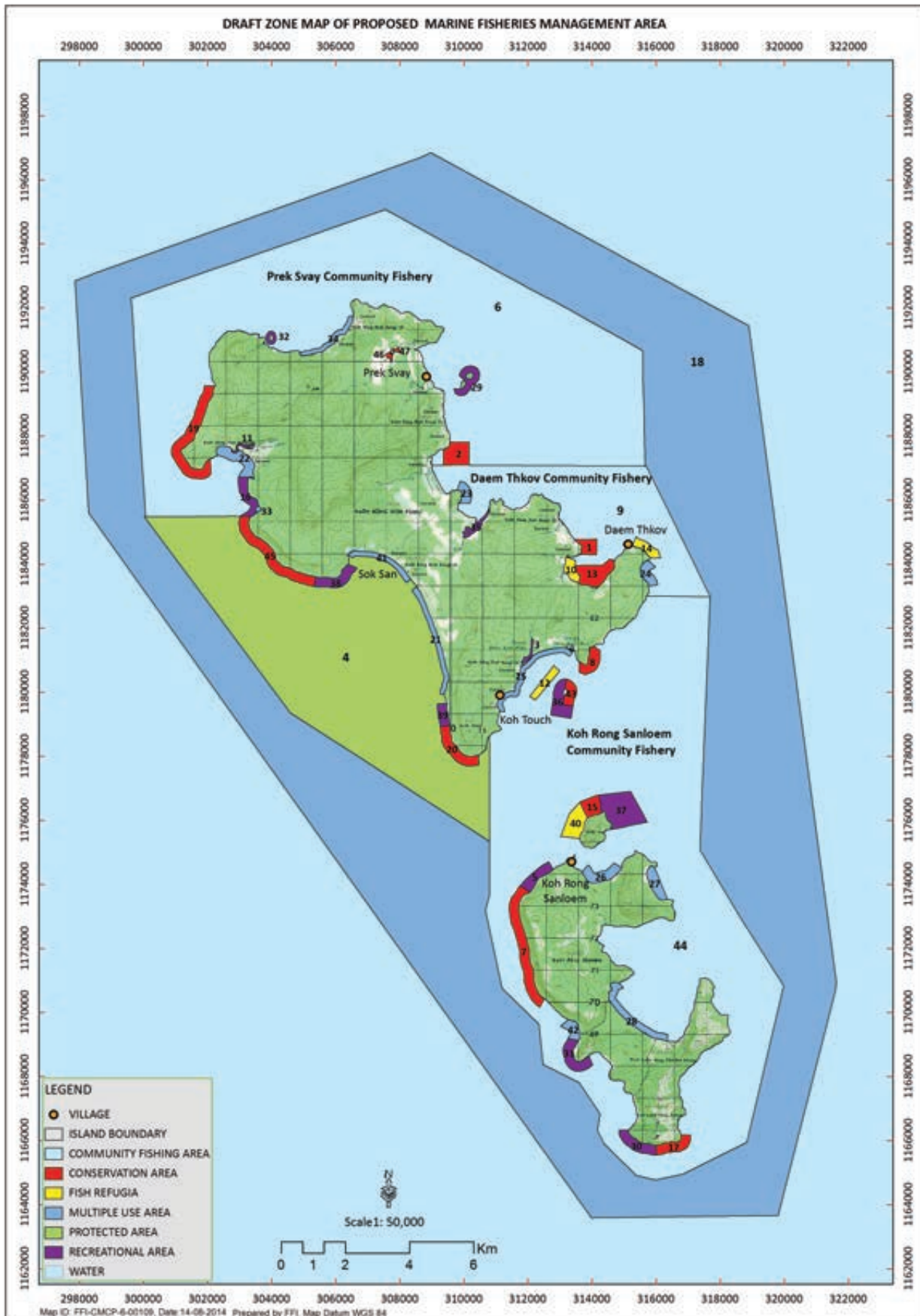


Figure 39. Proposed zoning map for the Koh Rong Archipelago MFMA based on community, government and private sector consultation since December 2012. Zone names correspond with the zone types identified in the Law on Fisheries and FiA Guidelines.²²

²² Conservation Area = Fisheries Conservation Area, Protected Area = Fisheries Protected Area; Community Fishing Area = Community Fishing Area (commonly referred to as Community Fisheries); Multiple Use Area = Multiple Use Area, Fish Refugia = Fisheries Refugia; Recreational Area is a new proposed zone type.

General observations relating to the Koh Rong Archipelago MFMA zoning scheme:

- The zoning scheme should be as simple as possible – if too complex it will be difficult to enforce (IUCN, CORDIO and ICRAN, 2008) and the current number of proposed zone types is already high and the draft zoning map relatively complex. We recommend that, where the zone restrictions are the same (i.e. Fisheries Protected Area and Community Fisheries Area) that once the zoning map is officially approved, the zones are communicated to stakeholders on site with one name and one description, even if the legal basis and management mechanism of the zone types is slightly different.
- In some MPAs zone types are laid out in the legislation, which is important as lack of official recognition can delay management decisions (IUCN, CORDIO and ICRAN, 2008) and may affect the buy-in to the zoning scheme at the local level. Ideally the zoning map will be included in the proclamation of the MFMA, including Recreational Areas and Multiple Use Areas. This would set an important precedent for the establishment of future MFMA/MPAs.
- A multiple-use zoning scheme will enable reduced competition and conflict between human uses of the area while still allowing for conservation (Skopal-Papin, 2011). It is expected that zoning will impact spatial distribution of resource use as no-take zones will limit access to fishing resources – this can result in displacement and intensification of fishing efforts in adjacent areas (Pernetta *et al.*, 2010). Spatial distribution of fishing effort is increasingly recognised as an important consideration for fisheries management as it can affect trends in catch rates and be incorporated into planning of spatial management tools such as MPAs (Daw, 2008). Changes in local fishing patterns and preferences should be monitored, not least to ensure that impacts are not disproportionately affecting certain user groups within the MFMA. Research underway (On, in prep.) may provide a basis for monitoring changes amongst gleaners and small-scale finfish fishers.
- Incorporation of temporary closures has the potential to bring conservation and sustainable management closer together, and may be more acceptable to local fishing communities. Fisheries Refugia provide an important tool in this regard, and are in the process of being written in to national legislation. CFI bylaws may also provide an opportunity to adjust rules and gear restrictions within smaller areas and shorter timeframes based on local decision making and needs, providing any changes aren't contra the proclamation on family scale fishing gear (Prakas 630).
- Adjustment of zones may be necessary within the MFMA, not least relating to proposed refugia, as these are based on more limited data than the currently proposed Conservation and Recreational Areas. With any future adjustments to zone distribution or rules, a balance needs to be struck between adaptability and practicality, not least as it will initially take time to raise awareness about rules and to demarcate zones across the site. Any changes in the zonation scheme should be based on data and thorough review by the TWG - MFMA.





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Appendix A: Selected reading on socio-economic, environmental and MFMA focused research for the Koh Rong Archipelago.²³

Biophysical:

- Krell *et al.* (2011) *Koh Rong Samloem and Koh Kon Marine Environment Assessment*, MCC.
- Van Bochove *et al.* (2011a) *Cambodia Reef Conservation Project Year 1 Report: February 2010-February 2011*, CCC.
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Copies of CCC reports are available at: <http://www.coralcay.org/science-research/scientific-reports/>

Articles from the Cambodian Journal of Natural History can be downloaded at: <http://www.fauna-flora.org/publications/cambodian-journal-of-natural-history/>

²³ Full references available in Section 6

Appendix B: Table of Anthozoa genera and species recorded by CCC surveys in the Koh Rong Archipelago.

Anukrat 123 #	Anukrat 12 categorisation	Site records	IUCN category*	Last Record	Source
55	Anthozoa spp.	Massive <i>Porites</i> (Incl. <i>Porites lutea</i> , <i>Porites lobata</i> , <i>Porites solida</i> , <i>Porites australiensis</i>)	LC – <i>lutea</i> NT – <i>lobata</i> LC – <i>solida</i> LC – <i>australiensis</i>	2014	CCC, unpublished data
		<i>Echinopora</i> (genus)	VU – 2 NT – 6 LC – 3 DD – 3	2014	CCC, unpublished data
		<i>Galaxea</i> (genus)	VU – 3 NT – 3 LC – 1	2014	CCC, unpublished data
		<i>Goniopora/Alveopora</i> (genus)	EN – 2 VU – 12 NT – 8 LC – 14	2014	CCC, unpublished data
		<i>Pavona decussata</i> (species)	VU	2014	CCC, unpublished data
		<i>Porites rus</i> (species)	LC	2014	CCC, unpublished data
		<i>Turbinaria</i> (genus)	VU – 7 NT – 1 LC – 3	2014	CCC, unpublished data
		<i>Lobophyllia</i> (genus)	EN – 1 VU – 3 NT – 1 LC – 4	2014	CCC, unpublished data
		<i>Plerogyra</i> (genus)	VU – 1 NT – 2 DD – 3	2013	CCC, unpublished data
		<i>Favia</i> (genus)	VU – 1 NT – 13 LC – 7 DD – 1	2014	CCC, unpublished data

<i>Favites</i> (genus)	VU – 1 NT – 12 LC – 1	2014	CCC, unpublished data
<i>Diploastrea heliopora</i> (species)	NT	2014	CCC, unpublished data
<i>Podabocia</i> (genus)	NT – 1 LC – 1 DD – 1	2014	CCC, unpublished data
<i>Astreopora</i> (genus)	VU – 3 NT – 2 LC – 7 DD – 1	2014	CCC, unpublished data
<i>Pectinia</i> (genus)	EN – 1 VU – 3 NT – 5 DD – 1	2014	CCC, unpublished data
<i>Herpolitha limax</i> (species)	LC	2014	CCC, unpublished data
<i>Ctenactis echinata</i> (species)	LC	2014	CCC, unpublished data
<i>Polyphyllia talpina</i> (species)	LC	2014	CCC, unpublished data
<i>Pseudosiderastrea</i> (genus)	NT – 1	2014	CCC, unpublished data
<i>Euphyllia</i> (genus)	VU – 5	2014	CCC, unpublished data
<i>Tubipora</i> (organ pipe)	NT	2013	CCC, unpublished data

* Where multiple redlist categories are presented, this column shows the number of species listed within the genus on the IUCN redlist. This table only indicates that the genus has been recorded, not that all those red listed species are necessarily found or confirmed within the MFMA.

Appendix C: Related National Fisheries Policy and Strategy

Below are some of the international and national targets and indicators relevant to the proposed MFMA, and to MPAs more broadly:

Convention on Biological Diversity, Aichi Target 11: By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes.

Strategic Planning Framework for Fisheries (2010-2019), Goal 3: The fisheries domain and associated resources are in a healthy and resilient condition and sustainably managed.

Relevant Strategic Planning Framework Indicators:

- 3.1. The number of endangered aquatic species in Cambodia.
- 3.2. The protection and management of critical fisheries habitats.²⁴
- 3.6. The area of critical fisheries habitats under sustainable management.
- 3.8. The strengthening of Community Fisheries to conduct effective Natural Resource Management.²⁵

National Action Plan for Coral reef and Seagrass, Target: to put at least 8.4 km² of coral reefs and 90 km² of seagrass under an appropriate form of sustainable management by 2016.

Joint Monitoring Indicators 2014-2018 for the Fisheries Sector:

Immediate Outcome: Management, conservation, and development of sustainable fisheries resources to contribute to ensuring people's food security and to socioeconomic development in order to enhance people's livelihoods and the nation's prosperity.²⁶

Output: The availability of fresh water and marine fisheries production remains stable through sustainable management and conservation of natural resources, applying sound environmental principles.

Output Indicator 1.1: Wild-harvested fish (and other aquatic animals) production remains sustained at no more than 500,000 tonnes per year and production from rice fields is increased by 15% per year to reach 184,000 tonnes end of 2015.

Output Indicator 1.4: 288 registered Community Fisheries are fully strengthened and operational by 2015.

Output Indicator 1.5: 800 Communes have a sustainable and effective fish refuge by 2015.

²⁴ Including rivers, lakes, floodplains and flooded forests, estuaries, mudflats and coastal zones.

²⁵ Strengthening consists of demarcation, establishment and maintenance of fish sanctuaries, patrolling and networking. Should other natural resource co-management processes and/or systems then CFIs be created, new targets for them will be set.

²⁶ Derived from the Strategic Planning Framework for Fisheries 2010-2019, the Agriculture Sector Strategic Development Plan and the National Strategic Development Plan.

Appendix D: Marine Protected Area benefits

The term marine protected area (MPA) broadly describes an area where natural and/or cultural resources are given greater protection and management than the surrounding waters. The variety of uses for MPAs has led to confusion over what the term actually means. Some people interpret marine protected areas to mean areas closed to all human activities. This is not the case. MPAs can incorporate special areas established for conservation, but may also include recreational and limited fisheries areas. MPAs therefore create a framework for sustainable use and resource management that are designated to protect marine ecosystems. The most effective MPAs are those that are part of a holistic approach where MPAs protect marine habitats from a series of stressors, so they can recover faster from any single disturbance.

MPAs can be an effective management tool for protecting biodiversity as well as replenishing fish stocks from within 'no-take' zones to surrounding waters through a spillover of fish. By allowing fish to grow to an adult size, their reproductive capacity is increased, sometimes exponentially, providing a sustainable source of fish from the MPA.

A well-managed MPA can benefit a wide range of stakeholders. Local fisheries can benefit from no-take zones through increased fish catches. Communities benefit through improved quality of life and preservation of their customs and cultural heritage, increasing local income and providing food. Tourism can also benefit from MPAs, particularly the sustainable tourism industry, worth US\$105 billion to the Caribbean economy annually.

The no-take areas within MPAs can be attractive dive sites, with healthy reefs and large fish. Divers are usually willing to pay to be able to visit these areas, generating income and increasing tourism numbers. This income can in turn be used to keep the MPA functioning effectively. The total potential sustainable annual economic net benefits per km² of healthy coral reef in Southeast Asia is estimated to range from US\$23,100 to US\$270,000 arising from fisheries, shoreline protection, tourism, recreation, and aesthetic value (Burke *et al.*, 2002).

Economic Valuation of MPAs - Case Studies

A study conducted by Dr Alan White, concluded that coral reefs, seagrass, mangroves and mudflats around Olango Island in the Philippines provided goods and services from fisheries, seaweed farming, bird habitat and tourism with a revenue estimated to be US\$38,300 to US\$63,400 per km², or US\$1.5 to US\$2.5 million for the entire 40 km² reef area (White *et al.*, 2000).

In Hon Mun Marine Protected Area in Vietnam, total recreational was estimated at US\$4.2 million. Domestic visitors' Willingness To Pay per visit was US\$3.90. Given visitation patterns, the total conservation value of Hon Mun's coral reefs was estimated to be approximately US\$128,245 for domestic visitors and US\$144,945 for foreign visitors (Pham *et al.*, 2005).

A study conducted on the Leuser National Park, Indonesia, from 2000-2034, found the accumulated value for the ecosystem over 30-year period was between US\$7-9.5 billion. Water supply, flood prevention, tourism and agriculture contributed the most in the conservation and selective utilisation scenarios (Van Beukering *et al.*, 2003).

