



SINGAPORE'S **INTEGRATED URBAN COASTAL MANAGEMENT**

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Agri-Food & Veterinary Authority of Singapore (AVA)

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Ministry of the Environment and Water Resources (MEWR)

Ministry of Foreign Affairs (MFA)

Ministry of Transport (MOT)

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National University of Singapore (NUS)

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A clownfish nestled in a sea anemone: An example of Singapore's marine biodiversity.

Singapore is an island city state that is heavily dependent on its coastal and marine environment (CME), as well as its strategic location along a major sea lane. Singapore is a major transshipment hub for commercial shipping and is also one of the world's busiest ports. The Singapore maritime industry is one of the fastest growing economic sectors, contributing to 7% of Singapore's GDP and employing over 170,000 people. It is home to more than 5,000 maritime-related establishments engaged in shipping, port-related activities, and offshore and maritime engineering services¹.

Singapore's limited coastal and marine² area is densely populated and heavily utilised by various industries including shipping, transport, petroleum, petrochemical manufacturing, as well as non-industrial uses such as residential development and recreation. These demands have placed Singapore's CME under constant pressure. To achieve sustainable development, this fragile environment needs to be carefully planned and managed in a holistic and integrated manner.

¹ http://www.mpa.gov.sg/sites/maritime_singapore/what_is_maritime_singapore/gateway_to_asia.page

² Singapore's marine territory is about 600km². In Chou Loke Ming, 2006. Marine habitats in one of the world's busiest harbours. In E. Wolanski (ed.), The Environment in Asia Pacific Harbours, pp.377–391)

Background

“Singapore recognizes the need to further enhance the management of her coastal and marine environment. In view of this, Singapore has adopted an Integrated Coastal Management strategy this year”.³

ICM is recognised internationally as fundamental to good coastal and ocean governance, and has been espoused in numerous international conventions as key to environmental sustainability. ICM is a management framework that utilises the capacity of local governments to work across economic sectors through sound planning and better management of human behaviour in all sectors (Chua, 2006)⁴. It provides a mechanism for the management of competing issues in the CME through effective governance, active partnerships, efficient coordinating mechanisms, sustainable financing and enhanced capacities to achieve the sustainable use of coastal resources. This also ensures that their functional integrity is preserved. ICM has been currently practised by more than 100 countries in the world in various forms.

Singapore has no hinterland, hence our coastline is practically inseparable from the urban surroundings. In this context, issues pertaining to Singapore’s CME are closely tied to urban development. As such, we have developed a more specific form of ICM, known as **Integrated Urban Coastal Management (IUCM)**. Singapore’s IUCM is adapted from the internationally recognised ICM framework developed by

the Partnerships in Environmental Management for the Seas of East Asia (PEMSEA). IUCM facilitates Singapore’s coastal management by enhancing coordination of governmental stakeholders and coherence in governance, policies and processes. It uses governing structures, such as administrative processes, legislation and institutions to allocate and coordinate the use of resources. This approach enhances flexibility and ability to cope with constant changes in the CME. Singapore’s IUCM is a dynamic, reiterative process as it is based on establishing continuous baselines and feedback loops to address the inherent complexity of CME issues in an

“In Singapore, for instance, an Inter-Ministry Integrated Urban Coastal Management (IUCM) committee takes a whole-of-government approach to ensure that in creating urban pressures on the limited land in Singapore are balanced against our international obligations to protect the marine environment and preserve biodiversity around our coasts”.⁵

urban environment.

This document describes the structures and processes underpinning IUCM, its implementation progress, and highlights some IUCM initiatives. Through this, we would like to share our successes and challenges in coastal management.

³ Ambassador-At-Large Professor Tommy Koh, 2009. Keynote speech on Coastal and Ocean Governance at the East Asian Seas Congress.

⁴ Chua Thia-Eng, 2006. The Dynamics of Integrated Coastal Management: Practical Applications in the Sustainable Coastal Development in East Asia. 468p. Philippines: PEMSEA.

⁵ Deputy Prime Minister Teo Chee Hean, 2012. Opening remark at the Global Oceans Summit.



Singapore has adapted PEMSEA's ICM principles to fit our unique physical, political and socio-economic context. The guiding principles for IUCM implementation in Singapore are as follows:

- (1) Proactive Planning and Management:** Singapore carries out adaptive and forward-looking planning by reviewing our various land-use, management and action plans periodically while taking into account the needs of the present. This aims to make the best use of Singapore's limited natural resources and to prepare for uncertainty.
- (2) Whole-of-Government Approach:** This principle is widely used to address public issues that are complex and multi-dimensional in nature. Public sector agencies work together through participatory planning, inter-agency platforms and administrative processes without having to create a specialised coastal management agency.
- (3) Active Partnerships:** Through collaborations with academic institutions, non-governmental organisations, the private sector, and regional and international organisations such as PEMSEA, the Secretariat for Convention on Biological Diversity (CBD), and the International Maritime Organisation (IMO), greater synergies are created to achieve sustainability.
- (4) Science-Based Management:** IUCM adopts a holistic approach to planning and management of Singapore's coastal space which is supported by comprehensive data-gathering, the creation of dedicated databases, reiterative reviews, long-term monitoring regimes, and capacity-building activities.

Objectives

Enhance coordination between all stakeholders in coastal and marine land use and planning

Conserve sensitive coastal habitats and biodiversity/natural resources amidst coastal development

Optimise the use of coastal resources, including coastal space in a sustainable manner



A knobby sea-star (Protoreaster Nodosa) on one of Singapore's several seagrass meadows.

IUCM Instruments

While there is no overarching legislation for IUCM, there are existing administrative processes, a legal framework for coastal management, coordinating mechanisms, and supporting structures in place to achieve IUCM's objectives. IUCM is thus an adaptive model which has been developed by synergising existing administrative processes, governing structures and mechanisms that facilitate integrated management. The model seeks to be as efficient as possible as it does not require broad changes in the current administrative system and seeks opportunities to increase integration amongst stakeholders of the CME.

Administrative processes

Administrative processes are utilised in conjunction with existing legislative powers to manage the CME. The relevant government agencies draw upon their given mandates as governing authorities to create processes to complement, and in some instances, replace the use of legislation. Administrative processes that involve various agencies rely on the regulatory authority, technical expertise and resources of other relevant agencies to address issues holistically. These processes allow for communication, information-sharing and decision-making among these stakeholders. The following elaborates on the main processes that are related to the CME.

Master Planning

The Master Plan⁶ is the statutory land use plan that guides Singapore's development in the medium term over the next 10 to 15 years. It is reviewed every five years and translates the

broad long-term strategies (40 to 50 years) of the Concept Plan into detailed blueprints to guide development. The Master Plan shows the permissible land-use and density for developments in Singapore, including coastal land. The master planning process is a collaborative effort between agencies to ensure that plans meet immediate economic and social needs while maintaining a good quality living environment.

Environmental Impact Assessment (EIA)

An inter-agency administrative process governs development projects to safeguard the environment. In this process, relevant technical agencies will assess potential impacts of these developments and may require that an EIA be carried out before the works. Prior to this current process, EIAs were conducted on an ad-hoc basis. From the latter half of the 1990s however, major development projects in the CME have been accompanied by EIAs, which have identified impacts as well as necessary mitigation measures.⁷

Committee for Marine Projects (COMET)

Foreshore and marine development projects in Singapore come under the charge of various governmental agencies, including the National Environment Agency (NEA), the Urban Redevelopment Authority (URA) and the Maritime and Port Authority of Singapore (MPA). All project proposals involving foreshore or marine development must obtain approval from MPA's Committee for Marine Projects (COMET). COMET seeks to ensure that foreshore and marine development projects do not affect the navigational safety of vessels at the fairways, shipping channels, shipyards, or terminals.



The bustling cityscape along the Marina Bay waterfront made possible through Singapore's long-term Master Planning process.

⁶ Singapore Master Plan 2008 <http://www.ura.gov.sg/MP2008/intro.htm>

⁷ Chou Loke Ming, 2008. Nature and sustainability of the marine environment. Ch. 10 in Wong T.C., Yuen B. and Goldblum C. (eds), Spatial Planning for a Sustainable Singapore, Springer and Singapore Inst. Planners, Singapore, pp. 169-182.

Table 1: Key regulations for IUCM in Singapore

Legislation	Authority	Subjects related to the CME
Biodiversity conservation and protection of the CME		
Control of Plants Act	AVA	Controls the introduction of pests into Singapore, and the use of pesticides in the commercial cultivation of plants in Singapore.
Endangered Species Act	AVA	Gives effect to the Convention on International Trade in Endangered Species of Wild Fauna and Flora. The Act prohibits trade in endangered animals and plants, and their parts and derivatives (including coastal and marine flora and fauna which are endangered) without a permit from AVA.
Wild Animals and Birds Act	AVA	General prohibition against the killing, taking or keeping of any wild animal or bird without a license. Also regulates the import and export of fauna.
Sand and Granite Quarries Act	BCA	The licensing and control of sand and granite quarries and for matters incidental thereto.
Control of Vectors and Pesticides Act	NEA	Prevents pollution from hazardous pesticides and vector repellents in the coastal and marine environment.
National Parks Board Act	NParks	Establishes the National Parks Board e.g. function, powers of the Board etc.
Parks and Trees Act	NParks	Provides for the planting, maintenance and conservation/protection of flora and fauna within coastal areas managed by NParks. Also regulates the use of such areas.
Foreshores Act	URA	Provides the legal basis for land reclamation and validates as well as facilitates leases or grants of foreshores and submerged lands.
Resource management		
Fisheries Act	AVA	Protects and conserves fisheries, including those in estuarine and marine waters. Promotes sustainable fisheries.
Public Utilities (Reservoirs and Catchment Areas) Regulations	PUB	Provides for the protection of fauna, flora, and soil in catchment areas, and regulates pollution and activities within reservoirs, and the central catchment areas.
Sentosa Development Corporation Act	SDC	Protects flora and fauna, as well as soil, on Sentosa Island, as well as on other islands managed by SDC.
State Lands Encroachment Act	SLA	Prevents encroachment upon State lands. The Act gives protection to coastal and marine-related resources on State lands, such as minerals, corals, shell and sand.
State Lands Act	SLA	Governs the sale, lease, or licensing of State land within the coastal areas.
Planning Act and Rules	URA	Provides for the planning and improvement of Singapore and for the imposition of development charges on the development of land. Requires mandatory adherence to the Master Plan – which consists of detailed land use plans for the different planning areas. The Master Plan makes provisions to guide physical development through development control, conservation and preservation requirements in the coastal area. It is mandatory for URA to review this plan once every 5 years.
Pollution control and waste management		
Maritime and Port Authority of Singapore (Port) Regulations	MPA	Regulates and manages activities within the port, which includes prohibition against pollution of port waters (regulation 65) and prohibition against emission of smoke, ash, soot or grit in such quantity or density as to cause nuisance or annoyance (regulation 66).
Prevention of Pollution of the Sea Act and the regulations made under the Act	MPA	Prohibits and/or regulates the discharge of various pollutants, including oil, garbage, harmful emissions, sewage, harmful anti-fouling systems, and noxious liquid substances carried in bulk, into any part of the sea by Singapore ships or into Singapore waters by any ship or person.

Merchant Shipping (Civil Liability and Compensation for Oil Pollution) Act	MPA	Regulates issues relating to civil liability for bunker oil pollution by any ship in Singapore waters, including but not limited to limitation of liability for bunker oil pollution in Singapore waters by ship-owners, and the requirement for Singapore ships to take up compulsory insurance against liability for bunker oil pollution.
Environmental Protection and Management Act	NEA	Provides for the protection and management of the environment through controlling the discharge of trade effluent, oil, chemical, sewage or other polluting matters into drains or land, as well as hazardous substances into inland waters and resource conservation. Empowers Director-General of Environmental Protection (DGEP) to require anyone intending to carry out any activity that, in the opinion of the Director-General, is likely to cause substantial pollution to the environment or increase the level of such pollution, to carry out a study on environmental pollution control and related matters.
Hazardous Waste (Control of Export, Import and Transit) Act	NEA	Regulates the export, import, and transit of hazardous waste as classified under the Basel Convention. Under the framework of the Basel Convention, the consent of importing countries is required before hazardous wastes are allowed to enter these countries.
Control of Vectors and Pesticides Act	NEA	Provides for the control and use of pesticides for the purposes of destroying vectors that threaten public health.
Sewerage and Drainage Act and Regulations	PUB	Regulates the discharge of trade effluent into public sewers, and the discharge of silt into the drains.
Marine activities		
Fisheries Act and Rules	AVA	Regulates fishing and aquaculture activities in the marine environment.
Maritime and Port Authority of Singapore Act, and Maritime and Port Authority of Singapore (Port) Regulations	MPA	Regulates activities within the port, including but not limited to the provision of port and marine services and facilities, matters relating to removal of sunk, stranded or abandoned vessels and aircraft, pilotage, all works and operations carried out in the Singapore waters, including inter alia the laying of submarine cables and pipelines, hydrographic and hydrologic surveys, dredging, salvage etc.
Merchant Shipping Act	MPA	Regulates all matters relating to all Singapore ships and all ships in Singapore waters, including but not limited to manning and certification, crewing, apportionment and limitation of liability in maritime claims by ship-owners.
National Parks Board Act	NParks	Regulates, amongst other things, recreational activities in coastal parks.
Public Utilities Regulations	PUB	Regulates recreational activities in the coastal catchments and reservoirs.
Sentosa Development Corporation Regulations	SDC	Provides specific provisions to manage activities, including tourism and recreation, on Sentosa Island and other islands managed by SDC.
Singapore Tourism Board Act	STB	Provides STB with powers to license tourism enterprises in the coastal area.
Coastal hazards management		
Building Control Act	BCA	Regulates buildings and building works as defined under the Building Control Act.
Civil Defence Act	SCDF	Establishes special powers to carry out civil defence measures for the preservation of human life or property during a state of civil defence emergency (which includes oil spills, floods, storms or other events).
Foreshore Act	URA	Regulates the construction and maintenance of coastal defence systems.
Heritage conservation		
National Heritage Board Act	NHB	Establishes and constitutes the National Heritage Board (NHB). The NHB facilitates the preservation of historic sites.
Preservation of Monuments Act	NHB	Provides for the preservation and protection of national monuments by the NHB, including those by the coast.
Parks and Trees Act	NParks	Provides for the planting, maintenance and conservation of trees and plants in tree conservation areas and heritage road green buffers, as well as the conservation of natural heritage within Nature Reserves and other areas managed by NParks.
Planning Act	URA	Identifies conservation areas in the Master Plan. Conservation entails preservation, enhancement or restoration of the built environment.

Marine Emergency Action Procedure (MEAP)

The MPA has developed the Marine Emergency Action Procedure (MEAP) to deal with maritime emergencies such as collisions, groundings, fire, and oil and chemical spills. The MEAP contains detailed procedures on reporting, control, co-ordination and rescue in the event of a maritime emergency and establishes clear channels of authority for effective assembly of resources. It enables MPA to tap on a large pool of resources for assistance in the event of a maritime emergency⁸. These include resources and personnel from government agencies as well as anti-pollution vessels and equipment operated by private organisations. MPA conducts regular emergency exercises with other agencies, port facility operators and ship-owners to test the effectiveness of the MEAP.

Legal framework for coastal management

A legal framework, comprising various legislation that facilitate the management and regulation of the CME, forms the backbone of the IUCM effort in Singapore. This legal framework covers biodiversity conservation and the protection of the CME, resource management, pollution control and waste management, marine activities, coastal hazards management, tourism and recreation, and heritage conservation. Table 1 summarises key legislation pertaining to the IUCM issues mentioned above.



Marine invertebrates such as this cowry and gorgonian are frequently encountered in our Southern Islands.



Singapore's CME against a backdrop of her maritime industry.

⁸ Maritime and Ports Authority website: http://www.mpa.gov.sg/sites/pdf/singapore_nautilus_issue2.pdf

Coordinating mechanisms

Consultative Planning

Singapore has taken a holistic approach to urban planning, beginning with a long-term Concept Plan that is reviewed every 10 years, to a finer resolution of planning in the Master Plan that is reviewed every five years⁹. This allows Singapore to adapt to the changing socio-economic trends of the population. A key success factor of the planning framework is the high level of consultation and integration amongst stakeholder agencies in drawing up the Concept and Master Plans. Previous Concept Plans have also incorporated recommendations from NGOs in the safeguarding of sensitive habitats with high biodiversity.

Coordinated Policy Formulation

The Coastal and Marine Environment Policy Committee (CMEPC) is an inter-ministerial committee that was formed in 2007 to provide coordinated, holistic and strategic policy direction for CME-related issues. The CMEPC's main

task is to coordinate a balanced approach towards coastal management, focusing on strategic issues such as development activities, port and shipping activities, navigational freedom, and environmental sustainability. The CMEPC endorses the adoption and implementation of Singapore's IUCM framework. The Committee also seeks to establish local and international networks of experts that can be tapped on to strengthen Singapore's capacity in IUCM.

Whole-of-Government (WOG) Approach

Singapore's government agencies adopt a WOG approach to tap on and synergise diverse knowledge, viewpoints and ideas to enhance policy development. A WOG approach requires agencies to facilitate communication, learning, analysis and decision-making across organisations, and can lead to greater outcomes than the most competent agencies working in silo. A well known example is the Singapore River Clean-up, where the approach was used to address a pollution problem that could not be solved by a single agency (Box 1).



Coordination at work:
Discussion at an interagency
working on IUCM.

Box 1 - Singapore River Clean-up

In the 1970s, urbanisation, industrial growth and population growth resulted in the pollution of Singapore's rivers. The Singapore River was heavily polluted due to discharges brought about by farms, un-sewered premises, street hawkers, markets, and riverine activities. The cleaning up of Singapore River and Kallang Basin is a project that best illustrates Singapore's coordinated effort in combating water pollution caused by human activities. An action plan was drawn up with the primary aim to remove filth and stench permanently from the rivers and canals, allowing clean water to flow and aquatic life to return. The plan called for a coordinated, comprehensive approach with active participation and commitment of many agencies such as the Housing & Development Board, Primary Production Department*, Urban Redevelopment Authority, Sewerage Department*, Hawkers Department*, Port of Singapore Authority*, Environmental Health Department*, and Parks & Recreation Department*. The task started in 1977 and took ten years to complete. With the successful completion of the clean-up, the Singapore and Kallang rivers have been transformed from polluted, smelly water bodies devoid of aquatic life to clean habitats where fish and other aquatic life have returned. The rivers are now used for recreation by Singaporeans and tourists. The water quality has been sufficiently restored such that a man-made reservoir was created at the river's mouth (in 2007) to augment Singapore's freshwater needs.

* As they were known then.

Supporting structures

A key element in IUCM is the existence of supporting structures that help decision-makers formulate effective policies and management solutions. These exist in the form of institutional structures, knowledge platforms and data-collection programmes. Singapore's IUCM is supported by the following: the Technical Committee on Coastal and Marine Environment (TCCME), a comprehensive Biodiversity and Environment Database System (a.k.a. BIOME), a long term Survey and Monitoring regime, and other plans and strategies.

The Technical Committee on Coastal and Marine Environment (TCCME)

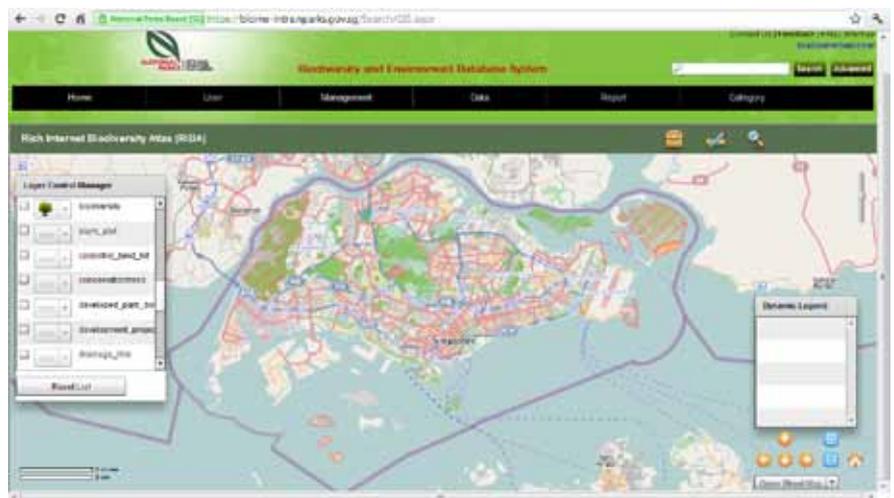
The TCCME was formed in 2007 with technical experts from various agencies such as NParks, NEA, BCA, MPA, AVA, MEWR, MFA, together with academics and researchers. Co-chaired by NParks and NEA, the TCCME supports the CMEPC by providing technical inputs, undertaking studies, and building capacity in CME-related issues. The TCCME's role is based on the recognition that sound scientific knowledge and good data are key to ensuring better management of Singapore's coast. By driving research on the CME and identifying local and overseas experts to spearhead projects, the TCCME bridges and complements policy and management with science.



A TCCME meeting discussing research projects.

The Biodiversity and Environment Database System (BIOME)

As an essential component of Singapore's IUCM programme, the development of an integrated information system called BIOME began in 2009 with a survey of data availability and projected needs across many stakeholders. BIOME serves as a one-stop repository for biodiversity and environment-related data which are contributed by government agencies, educational institutions and NGOs. One of its key aims is to facilitate government decision-making by providing easy access to information via a comprehensive and user-friendly database. It also includes a GIS interface for visualisation of the CME and tools for simple data analysis. Since January 2011, members of the public have been able to access BIOME at this URL: <https://biome.nparks.gov.sg>



The GIS interface of BIOME.

Survey and Monitoring Programmes

IUCM is supported by data collected from comprehensive surveys and monitoring programmes. Long-term monitoring of Singapore's seagrass, coral reefs, and mangroves have been initiated to keep track of our biodiversity and gather information for environmental and biodiversity impact assessments. One notable example is the five-year Comprehensive Biodiversity Survey (CMBS). The CMBS is a five-year national initiative that began in 2010 to take stock of our marine ecosystems, species diversity and distribution of marine life and is organised by NParks in collaboration with taxon experts from tertiary institutions, NGOs and individual enthusiasts (See Box 2). It is estimated that the surveys and expeditions in the Johor Straits and Singapore Strait have discovered more than 50 species that might possibly be new to science, more than 200 new records and about 10 rediscoveries for Singapore since the beginning of the CMBS.

To ensure continuous protection of the intertidal area a group of volunteers known as TeamSeagrass, conducts frequent seagrass monitoring at six different locations – Chek Jawa, Pulau Semakau, Cyrene Reef, Sentosa, Labrador Beach and Tuas. The information collected is shared with Seagrass-Watch, an international monitoring programme for seagrasses.

The Intertidal Watch is another programme to document and monitor the biodiversity of intertidal habitats in Singapore. The objective is to collect quantitative data over the long term to facilitate science-based decision-making and management of Singapore's coastal areas.



More examples of Singapore's rich marine biodiversity

- a) Hawkbills hatchlings release at East Coast Park
- b) Coral goby resting on a *Diploastrea heliopora* coral
- c) A nudibranch, one of many colourful sea slugs
- d) Fiddler crabs

Supporting Plans and Strategies

The IUCM framework is supported by many existing plans and strategies for resource management, environmental protection, conservation, and sustainable development. Below are some of the supporting plans and strategies.

- The **Master Plan 2014**, which is the latest statutory land use plan that guides Singapore's land use development in the medium-term.
- The **Parks and Waterbodies Plan**, which represents existing and proposed green spaces and waterbodies.
- The **National Biodiversity Strategy and Action Plan** (adopted in 2009), develop key strategies for biodiversity conservation in Singapore.
- The **Nature Conservation Master Plan (NCMP)** is a framework that aims to consolidate, coordinate, strengthen and intensify all the current biodiversity conservation efforts over a five-year period from 2015 – 2020. NCMP comprises of four thrusts – physical, programmatic, research and community stewardship
- The **Marine Conservation Action Plan (MCAP)**, which guides our efforts at conserving Singapore's marine habitats and biodiversity. The MCAP include the following key activities: (1) Physical safeguarding; (2) Species Recovery; (3) Habitat Enhancement; and (4) Community Stewardship
- The **National Climate Change Strategy**, which sets out present and future efforts to address Singapore's susceptibility to climate change and contribute to the reduction of greenhouse gas emission. The strategy also layout Singapore's local capacity-building efforts and participation in international climate change discussions.
- The **Climate Action Plan: Take Action Today, for a Sustainable Future**, comprises two documents containing information on how Singapore intends to reduce greenhouse gas emissions and increases energy efficiency to meet our 2030 climate pledge and how Singapore may be affected by climate change and our strategy to prepare for them.
- **Clean and Green Singapore**, which is a continuous programme that aims to motivate Singaporeans to care for and protect their living environment by adopting on environmentally-friendly lifestyle.
- The **Singapore Blue Plan 2018**, which is a proposal from NGOs and academics for the integration and balanced conservation and rehabilitation of Singapore's marine heritage.
- The **Sustainable Development Blueprint**, which supersedes the Singapore Green Plan -established in 1992 to tackle environmental issues- and is jointly produced by the people, private and public sectors in Singapore. It contains strategies and initiatives for Singapore to achieve both economic growth and maintain a quality living environment over the next two decades.

Partnerships

IUCM recognises and encourages meaningful partnerships amongst stakeholders and interested parties. In Singapore, close partnership through a 3P (people, private and public) approach has been identified as crucial to building a nation that is environmentally aware and responsible.

The public sector

The government plays a pivotal role in the management of Singapore's coastal areas as it owns almost all of the coastal land on the main and offshore islands, and has jurisdiction over Singapore's territorial waters. Different government agencies are responsible for the management of specific aspects of the CME such as coastal protection, pollution control, shipping activities, coastal land use planning and habitat protection.

Many agencies have established communication strategies and activities to educate and engage the public. These range from implementing educational programmes, establishing volunteer programmes, publishing lifestyle magazines, scientific journals and annual reports, and organising workshops. Common to all agencies is the creation of web-based information portals that provide the public with easy access to information on the relevant agency websites.

Some campaigns spearheaded by government agencies have become nation-wide annual features to educate the public. These events involve several agencies and are parts of international campaigns to which Singapore participates. Examples include World Wetland Day, World Environment Day and World Maritime Day.

The private sector

Within the business sector, the multi-national corporation (MNC) community in Singapore has played an important role by bringing their environmental management standards to Singapore and imposing these standards on their suppliers. As part of their Corporate Social Responsibility (CSR) programmes, many private organisations have collaborated with government agencies and provided funding for environmental initiatives and infrastructure. Examples include the setting up of an outdoor classroom at Sungei Buloh Wetland Reserve with sponsorship from Toyota Motor Corporation, and funding for the Comprehensive Marine Biodiversity Survey from Asia Pacific Breweries, Care-For-Nature Trust Fund, Shell and Air Liquide Group.

Various environmental consulting firms have also established themselves in Singapore. Their services are often engaged to assess potential development impacts, and propose mitigation measures and management options to minimise these impacts to the CME. These firms are also engaged in various government projects that involve the formulation of environmental policy and quality standards.



Joggers at a park overlooking the coast.



A clownfish seeking refuge in a host anemone.



Urban development surrounded by green areas.

The people sector

Government agencies such as NParks, NEA and MPA collaborate with various academics on CME-related projects. This is an important partnership as academia provides crucial technical expertise that complements agencies' capabilities. Information collected by these institutions are used to aid management of the CME.

Non-governmental organizations (NGOs), such as the Nature Society (Singapore), Waterways Watch Society and Blue Water Volunteers, as well as key individuals in marine conservation, help nurture environmental consciousness through guided reef walks and educational programmes. This is complemented by the use of the Internet and social media. *WildSingapore* and *Habitatnews* are two examples of web portals for biodiversity-related news in Singapore.

An example of a partnership between the public-people-private sectors is the Comprehensive Marine Biodiversity Survey (Box 2).



Volunteers surveying the mangroves for animals that live in the mud.



A coral reef, off Singapore's Southern islands, exposed during low tide.



Volunteers of the CMBS sorting survey specimens.



Box 2 - The Comprehensive Marine Biodiversity Survey

Launched in 2010, the Comprehensive Marine Biodiversity Survey is a national initiative that aims to take stock of our marine ecosystem, species diversity and distribution. Led by NParks, with partners from tertiary institutions, NGOs and individual enthusiasts, the survey will be carried out over five years and will include habitats such as mudflats, coral reefs and the seabed.

The Survey has received support from the local and international community, including sponsorships through NUS and NParks' Garden City Fund, a registered charity and IPC. Corporate sponsors include Asia Pacific Breweries, Care-for-Nature Trust Fund, Shell Companies in Singapore and the Air Liquide Group. Some 300 local volunteers have also contributed to various aspects of the survey, including photography, field sampling and collection, specimen processing, database support as well as the organization of outreach programs.

Apart from corporate sponsors and volunteers, renowned scientists from various countries also contribute their expertise to enrich our knowledge of Singapore's marine heritage.

The ICM Strategy and Implementation Plan

IUCM commenced in 2009 with the drafting of the "ICM Strategy and Implementation Plan", which was a technical document to: a) introduce the ICM framework, b) provide a review of Singapore's status in relation to the ideals of ICM, and c) chart out the course for ICM implementation in the immediate and medium-term future. The document recommended four measures, which have been implemented as described below.

Coastal profile

The coastal profile is essentially a current snapshot of the state of the coast, and it includes the compilation of pertinent information such as economic conditions, coastal and marine resource use and its ecological and socio-economic impacts on the CME. The coastal profile thus serves as an information baseline for government agencies to implement IUCM.

Legislative and administrative regulations review

An effective legislative framework, amongst other things, is a pre-condition for policy to be successfully implemented. A review of the existing coastal and marine-related legislation and administrative regulations was undertaken by the Centre for International Law, National University of Singapore in collaboration with NParks. The review assessed the legal mandate regulating activities in the CME and identified potential improvements in the existing legislative framework.

Establishing key institutional arrangements

The CME is a shared space governed by a myriad of government agencies, each with different mandates and objectives (Fig. 1). Therefore, it is imperative to establish institutional arrangements that enhance the synergy between these agencies. The pre-existence of the CMEPC and the TCCME eliminates the need to create new arrangements. As such, the CMEPC serves as the high-level, inter-ministerial IUCM coordinating committee to provide strategic and coherent policy directions, while the TCCME has been designated as its implementing arm. This arrangement is also in line with PEMSEA's recommendation of creating a high-level Policy Coordination Committee to maximize the success of IUCM implementation.

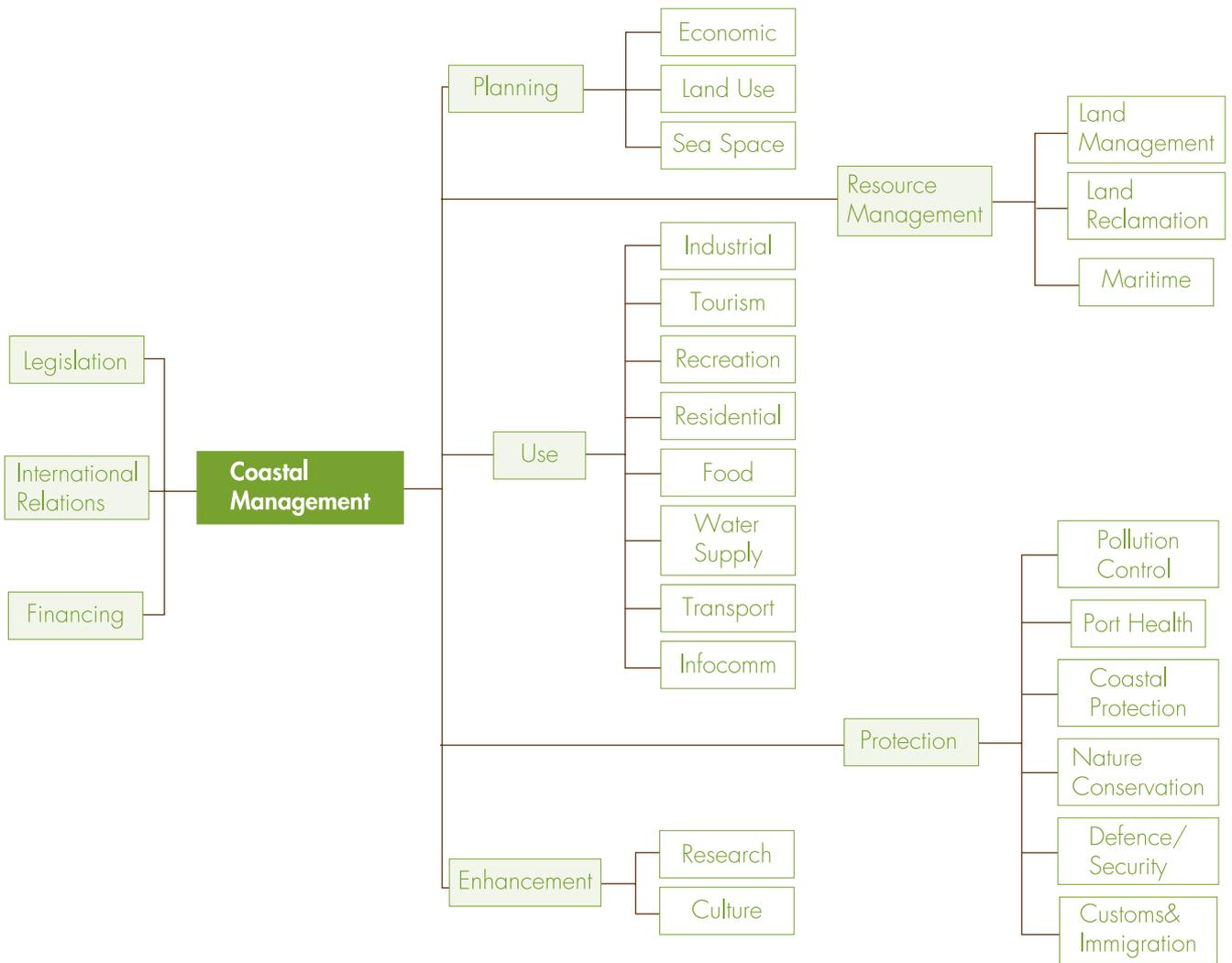
IUCM expertise and capacity development in government

To build technical and policy formulation expertise amongst coastal managers, NParks has invested in capacity-building activities of various forms. These include organizing IUCM-related courses, workshops, and seminars such as Biodiversity Impact Assessment courses, and an ASEAN-level workshop on the United Nations Convention on the Law of the Sea and Marine Biodiversity Conservation. Others are conducted in collaboration with PEMSEA specialists such as Dr Chua Thia-Eng and Professor Raphael Lotilla.



A satellite image of Marina Bay area.

Figure 1: Uses and management of the coast in Singapore

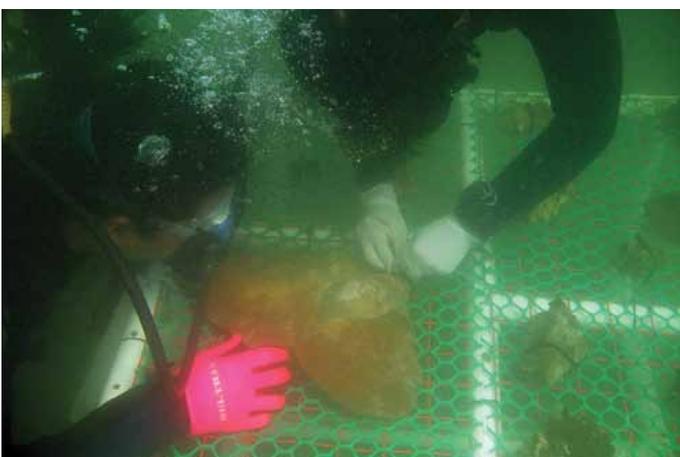




Building with nature: growing mangroves to strengthen rock walls.



A coastal mangrove forest during night tide.



Divers securing coral fragments.

Some ongoing initiatives

Under the auspices of the TCCME, NParks has initiated a number of projects with the aim of conserving, enhancing and rehabilitating the CME as well as addressing anthropogenic and trans-boundary impacts. These initiatives seek to develop a knowledge-base of Singapore's CME and best practices for IUCM. Examples are given below.

Coastal protection and mangrove restoration

The north eastern coastline of Pulau Tekong comprises approximately 90 hectares of pristine mangroves. Studies have shown that coastal erosion and scouring of the mangroves had led to habitat degradation. To address this problem, NParks and its collaborators developed novel engineering solutions that used combined traditional "hard engineering" and "soft engineering techniques.

The project team conducted studies to assess the extent of the erosion and to provide possible solutions. Coastal erosion was halted by filling the undercut with stone and biodegradable sacks of marine clay. These measures were complemented by the construction of stone revetments along the coast to reduce wave impacts. Parallel to such traditional engineering methods, the team planted mangrove saplings on the fortified coast. Mangrove saplings of multiple species, collected locally, were used to conserve our native gene pool. To ensure minimal impact to the existing environment for this project, an EIA and *ex post* environmental monitoring were carried out.

Coastal habitat rehabilitation

Singapore has embarked on a series of projects to enhance and restore coral reef habitats. In particular, a coral nursery was established in 2007 – the first in the region – that uses naturally fragmented coral pieces as seed stock for growth and transplantation. This project was supplemented by efforts to rear corals *in situ* and to transplant sexually reared corals back into our waters. Giant clams (family Tridacnidae), the largest of all bivalve molluscs, are also being cultured and re-introduced to improve the coral habitat.

Sisters Islands Marine Park – A Marine Park for All

Consisting of two islands – Pulau Subar Laut (Big Sister) and Pulau Subar Darat (Little Sister) islands which are separated by a narrow channel - Sisters' Islands were declared Singapore's first Marine Park in 2014. Located 9km from the mainland, and spanning an area of about 40ha, it encompasses the western reefs of both St John's Island and Pulau Tekukor. The marine park was established as a platform for outreach, educational, conservation and research activities related to Singapore's native marine biodiversity. The location was chosen due to its variety of habitats including coral reefs, sandy shores and seagrass areas.

The marine park enables Singaporeans to have a first-hand experience of the rich biodiversity which are usually submerged and inaccessible to most people. The Marine Park Public Gallery on St John's Island opened in 2015 to complement outreach programmes like the intertidal guided walks conducted at SIMP. The public gallery showcases the rich coral reefs, which support an ecosystem inhabited by rare and endangered species of seahorses, clams, sponges and other marine life in Singapore's waters and includes a 3D diorama of its dive trails.

Turtle Hatchery

Singapore's first sea turtle hatchery has been set up at the southern lagoon on Small Sister's Island in 2018 through a \$500,000 donation from HSBC. The Green Turtles and Hawksbill Turtles will be the key species covered under the project.

Turtles visit Singapore's shores throughout the year to lay eggs on the sandy beaches. Since 2012, there have been ten reported sightings of turtles on the shores of East Coast Park and Changi Beach. Members of the public can call the NParks hotline or the Animal Concerns Research and Education Society (ACRES) to report sightings of turtles on Singapore's shores. The organisations will follow up on the reported sightings, in consultation with each other to ensure the safety of these turtles. If eggs are found and assessed to be at risk, they will be collected and transferred to the turtle hatchery at the Sisters' Islands Marine Park where they will be monitored and cared for until they hatch and are released into the sea.

The hatchery would also provide research opportunities to study local sea turtle populations. Education and outreach programmes will be developed to create awareness of our local marine biodiversity. These include visits to the turtle hatchery, involvement in egg collection and transfer to the hatchery, and habitat maintenance.

The donation from HSBC will support the building of a facility for receiving rescued eggs and where outreach programmes are conducted on the island, over a period of five years. Educational signs and materials will also be developed for the outreach facility.

Artificial Reef

By the end of 2018 SIMP will become home to the Republic's largest artificial reef and is the result of a joint project launched by Jurong Town Council (JTC) and NParks, in partnership with local marine research and interest group communities. In support of Singapore's Year of Climate Action 2018, the initiative will see an extra 500 m² of reef area at SIMP, to supplement the existing habitat enhancement and reef restoration efforts to conserve biodiversity in our waters. By 2030, the hope is to double the artificial reef areas created at Sisters' Islands to 1000m².

Artificial reef structures are pre-fabricated off-site, will then be sunk in the waters off Small Sister's Island; each artificial reef structure is conceptualised to minimise impact to the existing marine environment, utilising materials that promote attachment and growth of corals, and recruitment of fish species. The structures would sit on the seabed without piling or major works that would otherwise disturb the underwater environment. The structures would also occupy the entire water column from sub-surface to the seafloor, hence providing numerous and unique habitat niches for a wide variety of marine life.

The artificial reef project will complement ongoing reef enhancement efforts and expand the habitat restoration and enhancement programme in both scope and scale. At the same time, the artificial reefs will provide opportunities for various research initiatives to be implemented and serve as test beds for new technologies to study coral reef resilience. This will contribute to expanding knowledge and understanding of Singapore's marine habitats and the biodiversity they support.



Disk-shaped corals (Turbinaria sp.) commonly seen in our waters.



Volunteers sorting specimens collected during biodiversity surveys.



One of the large reef fish that populate Singapore's reefs.

Improving the coastal environment

The high sedimentation load found in Singapore's waters stresses our coastal and marine habitats. Improved water clarity would increase light penetration, which leads to a more conducive environment for the survival and growth of corals and seagrass. The appearance of our waters would also be enhanced. To achieve this, NParks is collaborating with research institutions to develop technologies that reduce suspended sediments, at varying scales and depths, and remove settled sediments from the seabed.

The National Environment Agency conducts regular water quality monitoring of Singapore's marine waters. Monitoring efforts will be augmented by the planned implementation of Project Neptune, in early 2014, which will enable real-time continuous monitoring of coastal water quality. An inter-agency workgroup has also been formed to develop and to test the implementation of water quality standards for Singapore's marine waters.

Monitoring and Evaluation

Singapore's IUCM implementation has covered all the stages of the ICM Development and Implementation Cycle¹⁰; it is also constantly refined through continuous monitoring and evaluation in response to changing conditions. A State of the Coasts Report has also been planned to monitor and assess conditions, responses and trends in the CME. The Report aims to evaluate the components of the IUCM framework and the stages of the implementation cycle. The evaluation will include other assessment tools such as the Singapore Index on Cities' Biodiversity to assess Singapore's progress in reducing the rate of biodiversity loss in urban ecosystems.¹¹

¹⁰<http://beta.pemsea.org/icm-cycle>

¹¹User's manual for City Biodiversity Index. <http://www.cbd.int/authorities/doc/User%20ManualfortheCityBiodiversityIndex27Sept2010.pdf>

Box 3 - Semakau Landfill

Semakau Landfill was commissioned in April 1999 and is Singapore's only landfill for waste disposal. Ash from incineration plants and non-incinerable waste are disposed of at the landfill. Semakau Landfill covers a total area of 350 hectares and has a landfill capacity of 63 million m³. To create the required landfill space, a 7-km perimeter bund was built to enclose a part of the sea off two islands, Pulau Semakau and Pulau Sakeng. The bund is lined with impermeable membrane and a layer of marine clay to ensure that the waste is contained within the landfill area. Other ancillary facilities were also built on the island to ensure self-sustainability of the landfill operation.

On 16 July 2005, Semakau Landfill was officially opened for recreation. The main habitats found on the island and the intertidal zone are grassland, mangroves, seagrass, intertidal reef flat and coral reefs. Since 2005, Semakau Landfill has become increasingly popular and, to date, has received more than 62,500 visitors who come for a wide range of activities included educational tours, intertidal walks, bird watching, stargazing and sport fishing.

The Semakau Landfill is expected to meet Singapore's needs beyond 2045. To add to Singapore's sustainable strategies, NEA educates the public, and collaborates with industry to further increase recycling rates and minimise waste generation at source.



Volunteers from an NGO, Team Seagrass, recording their findings during a seagrass monitoring trip.



A young coral grown in a coral nursery at Semakau.



The vast expanse of mud flat at Chek Jawa.

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