



CLIMATE CHANGE ADAPTATION AND NATURAL RESOURCES

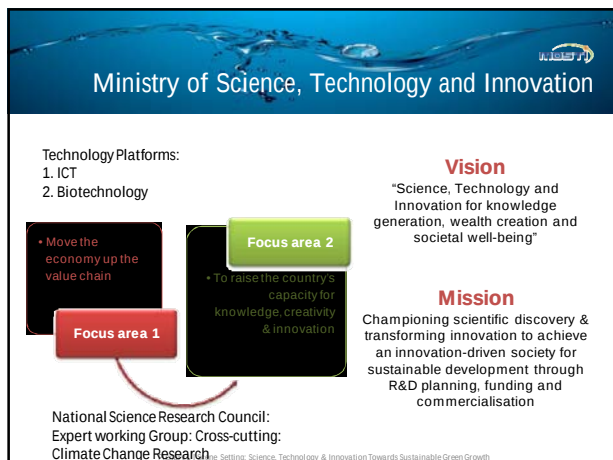
Climate change and marine life

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 Ministry of Science, Technology and Innovation (MOSTI), MALAYSIA

CLIMATE CHANGE ADAPTATION-Goals and Aspirations for Climate Resilient Development
 16 November 2011, Pullman Hotel, Putrajaya

Presentation Outline

- Introduction
- Goals – Aligning to the 5 principles of National Climate Change Policy (2009)
 - (KA-ST1: Policy Harmonisation & Review,
 - KA26-ST6: Integrate, apply tools, assessment,
 - KA27-ST7: R & D Agenda including **coastal and marine** areas,
 - KA30-ST7: Institutionalise Climate friendly technology,
 - KA40-ST10: Establish a pool of Climate Change experts
- Strategic Plans – Bali Action Plan-UNFCCC, mainstream CCA in Climate and Ocean Science Program
- Program and activities
- The way forward for innovative solutions



National Oceanography Directorate (NOD)

NOD is also the **National Focal Point** for R&D&C Oceanography and Marine Science and coordinator for related Oceanographic activities

-**National CTI Secretariat** Malaysia

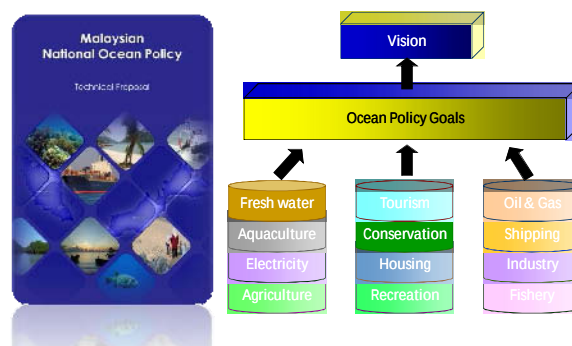


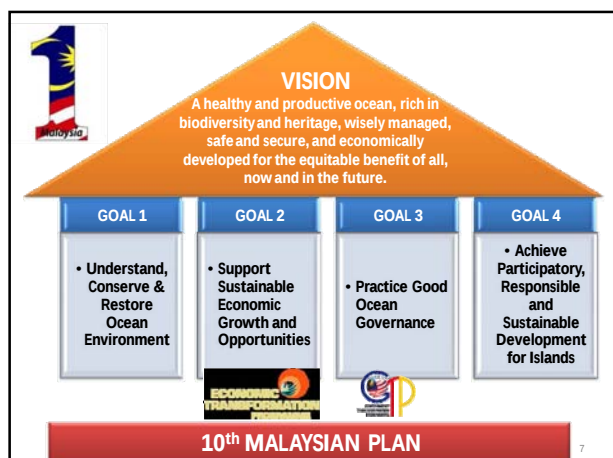
Committed to Excellence in the Marine Sciences

THE ECONOMIC VALUE OF THE OCEAN SECTOR: ~ 25% of Malaysia's GDP

Maritime Shipping & Trade	• 11,200,000 DWT of shipping (~ RM29.1 billion)
Energy – Oil & Gas	• 68 oil and 36 gas fields (4 billion barrels and 83 trillion cubic feet (Tcf) of proven natural gas reserves as of January 2009)
Marine Fisheries	• 99,600 registered fishers working on 39,221 licensed vessels (~ RM6,083,846,176 – year 2007)
Marine Tourism	• estimated revenue of around RM25 billion
Marine Engineering	• a total of 105 landing facilities ranging from major ports to landing jetties
Marine Education	• RM2 billion per year annually on students going overseas for tertiary education (esp. Oil & gas)
Marine Biotechnology	• agriculture, healthcare and industrial biotechnology with total approved investment of RM1.4 billion

A NATIONAL OCEAN POLICY FRAMEWORK



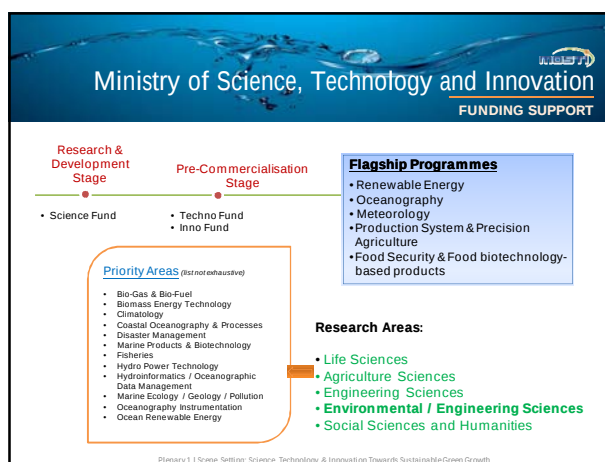


A Healthy Ocean Sector is Essential for a High-Income Nation

The move to a **GREEN FUTURE**

RMK10 - Chapter 6
- Building environment that enhances quality of life
- Valuing the nation's environmental endowments

Blue Carbon Economy



Malaysia – a member of IOC/UNESCO Executive Council, Vice Chair to IOC/WESTPAC Chair to CTI-COM and CTI-SOM and a member of ASEAN-COST/SCMSAT

IOC High Level Objectives

- Prevention and reduction of the impacts of **Natural hazards**
- Mitigation of the impacts and adaptation to **climate change and variability**
- Safeguarding the **health of ocean ecosystems**
- **Management procedures and policies** leading to the sustainability of coastal and ocean environment and resources

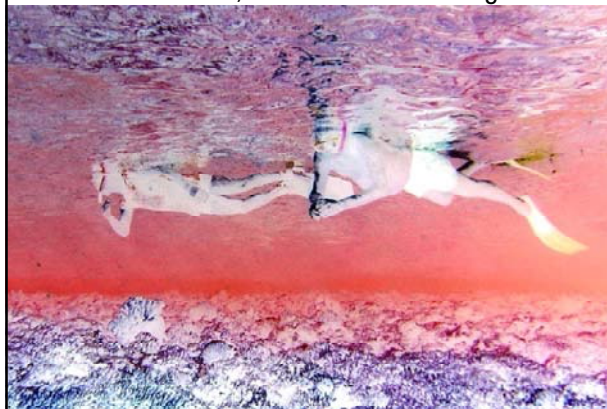
Areas of Activities

- Ocean Observations and Service
- Ocean Science
- Disaster Warning and Mitigation
- Capacity Development

Questions

- Do we have enough data with regards to the interpretation for carbon cycle, source and sinks, changing seas and ocean circulation influencing climate variability around us, data and infra-structure to support the measurement, management and monitoring the status of ecosystem health and future viability of fish stocks and other high valued marine resources?
- How do we forecast and adapt to climate change and conserve biodiversity, alleviate poverty, improve income, provide sustainable and alternative livelihoods and food security in an increasingly number of poor coastal communities across the region?
- How do we use science to make assessment and provide better decision for policy makers?

The state of marine environment and ecosystem health

3 Ms: **M**easure, **M**onitor and **M**anage

Climate Change Scenario

- Equatorial region- Constant temperature, high humidity and high rainfall
- Land topography, sea breeze, wind speed varied based on seasonal winds
- Climate Simulation models (GCM) increased in temperature and rainfall
- El Nino dan La Nina, Temperature rise 0.5-1.5 °C (1961-2007), forecast in 2028, 2048, 2061 and 2079, higher impact in Sabah and Sarawak
- Climate variability, NE Monsoon, increased SST, Salinity, rise in sea-level, tropical storms, floods, drought, Salt water intrusion, epidemic, diseases. Coastal erosion in Western Pacific will affect ocean productivities and aquaculture industries.

Marine natural resources

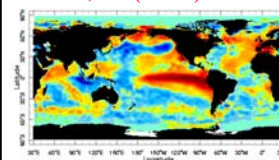
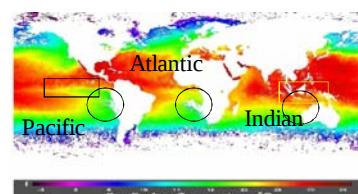
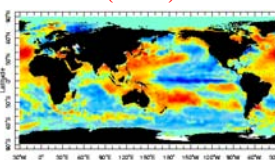
- Coral reefs
- Seagrass
- Seaweeds
- Mangroves
- Mudflats
- Sandy beaches and rocks
- Rivers and Estuaries
- Fish stocks
- Turtles
- Marine mammals

Malaysian Marine Ecosystem

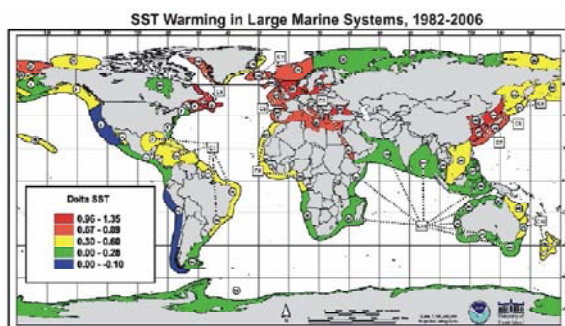
Biotechnology has the potential to derive value from any of the thousands of species of marine flora and fauna found in the Malaysian marine ecosystems, through bio-prospecting including:

- 36 mangrove species,
- 9 seagrass species,
- 72 genera of coral (more than 500 species of coral),
- 5 species of marine turtle,
- 300 species of algae,
- 22 species of marine mammal,
- 16 or more species of marine sea snakes,
- 1,200 species of reef fish,
- more than 100 species of demersal and pelagic fish,
- and more than 35 species of crustacean and cephalopods.

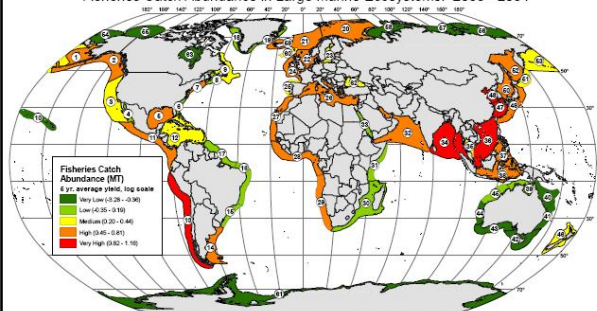
Malaysia aspires to create a vibrant and productive biotechnology sector by 2020.

SST
Oct 8, 1997 (El Nino)SST
Nov 1998 (La Nina)

Warming Clusters of LMEs in Relation to SSTs, 1982-2006
(Sherman et al. 2008)



Fisheries Catch Abundance in Large Marine Ecosystems: 2000 - 2004



Climate Change Impacts

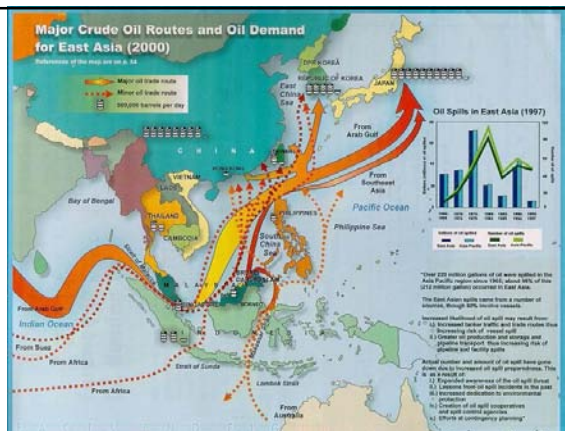
- Increased CO₂, Ocean Acidification – affecting the productivities of mollusc, crustaceans, etc.
- Increased Sea Surface Temperature (SST) – Change in Plankton distribution, species migration affecting biodiversity resource especially brood stock for aquaculture, Increased in harmful Algal Bloom episodes, reduced in Dissolved Oxygen, increased in diseases, alien and invasive species. Change in Zooplankton composition, destruction to coral reefs
- Change in sea temperature offshore, leading to reduced fish stocks, coral bleaching, reduced reef fish.
- Change in Current pattern, El Nino and La Nina affecting change of time and location of upwelling-changes in pelagic distribution.
- Sea level Rise- Storms, Changes to beach profile, exposed coastal areas, sediment loss, damage to properties, reduce fresh water fish, spawning and juveniles
- Increased frequency of storms, poor water quality
- Unpredictable drought or increased in drought or floods.

has it happened before?

- The Paleocene Eocene Thermal Maximum (PETM) about 55 million years ago, temperatures soared +5°C. The cause: a massive release of carbon over thousands years
- (= the expected total now over only 400 years with “business as usual” scenario)
- PETM = “a sharp reduction in marine biodiversity”

Source: 'Past Greenhouse Warming Provides Clues To What The Future May Hold' Science Daily 26 Feb 2008

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Source: Captain Mat Taib, Overview of Malaysia's Maritime Strategy, A Presentation to the Visiting Western Australian Maritime and Defence Trade Mission, 15th August 2005, Shangri-La Hotel, Kuala Lumpur.



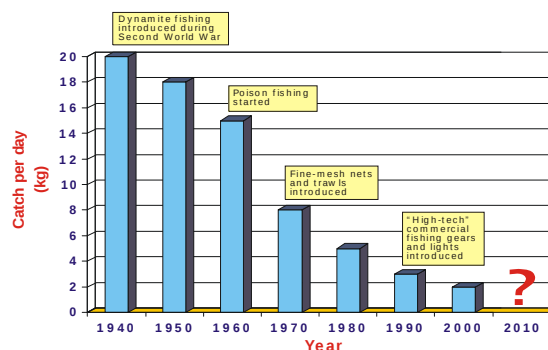
Malaysian seas covering part of Andaman, Straits of Malacca, South China Sea, Sulu and Sulawesi (Celebes) Seas

Threats

- Overfishing creates growth of certain fish and organisms that can be damaging to the reef if they appear in great numbers.



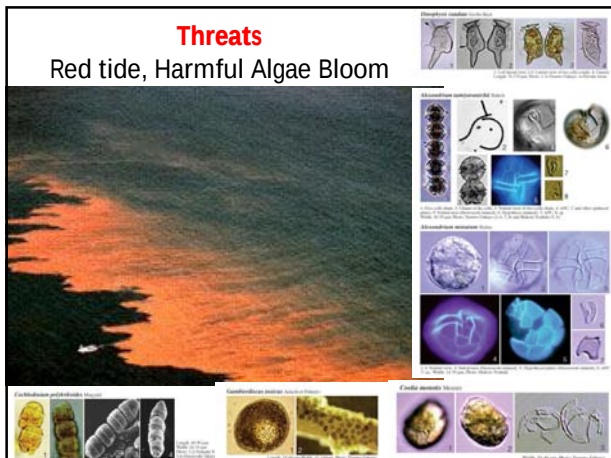
Declining fish catch of fishers



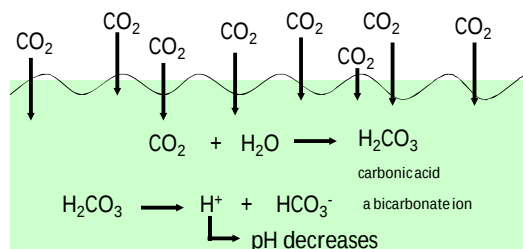
Source: CTI -CTSP

Threats

Red tide, Harmful Algae Bloom



- The oceans are absorbing CO₂ from the atmosphere and this is causing chemical changes by making them more acidic



Source: 'Ocean Acidification due to increasing atmospheric carbon dioxide' The Royal Society Policy Doc 12/05, p. vi & Annex 1

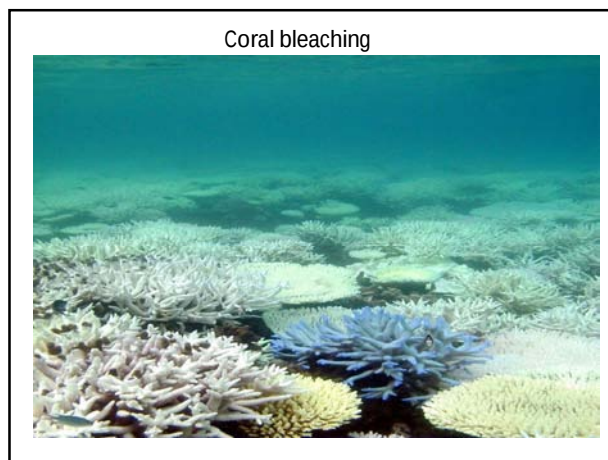
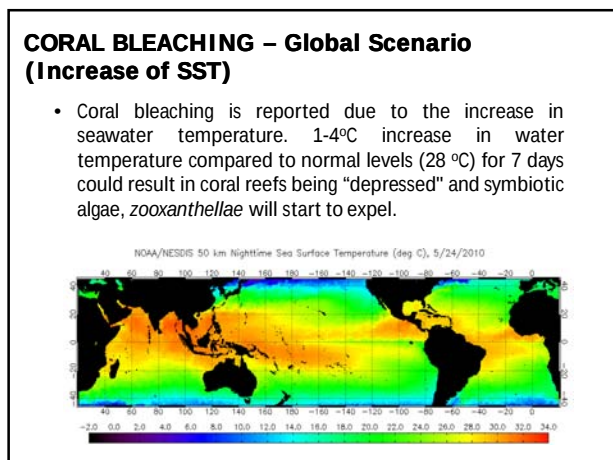
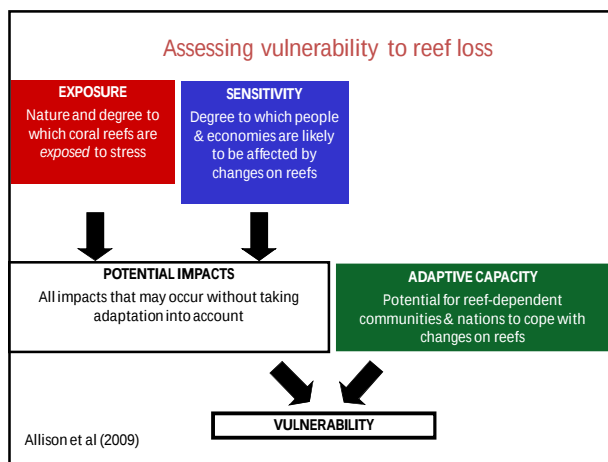
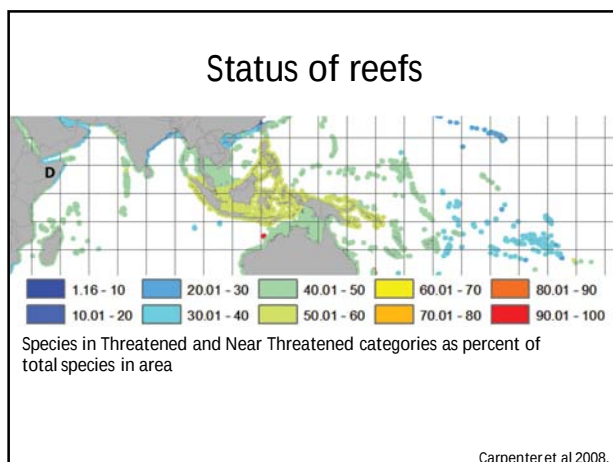
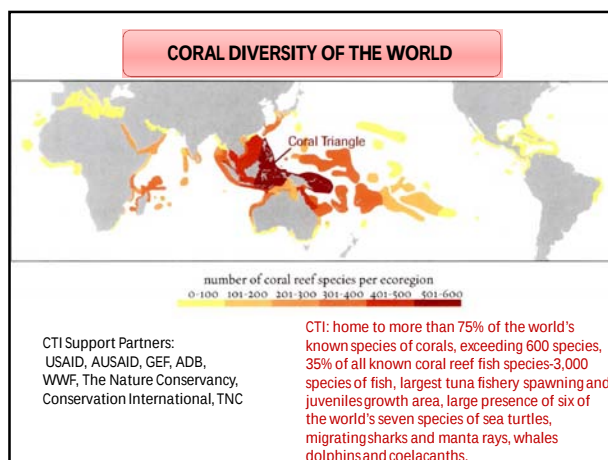
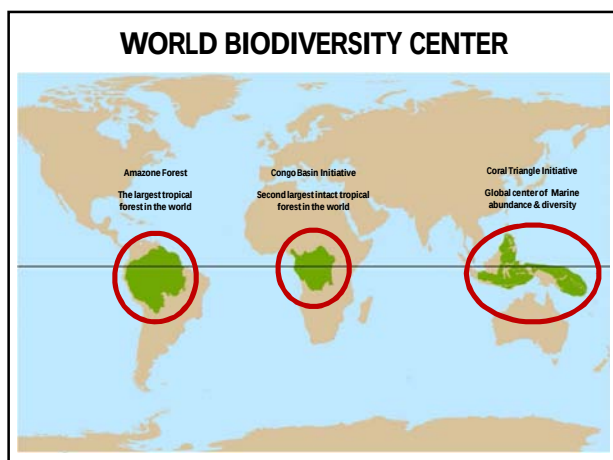
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Research and Data/Info management

- Oceanography- Bio-Physical-Chemical and Geographical
- Climate and Ocean modelling
- Hydrological/hydrodynamic modelling
- Remote Sensing-Satellite oceanography
- Fish forecasting
- Climate change, resilience, water quality and pollution studies
- Spatial data infrastructure- Central repository, Data accessibility
- Integrated Coastal Zone Management
- Monitoring and Evaluation
- Knowledge Management

Marine Biodiversity protection

- Comprehensive scientific studies on climate change impact in fisheries and special sensitive areas, Marine and Coastal Biodiversity and its Management
- Research and conservation programs for mangroves, coral reefs and seagrasses
- Development and conservation of seaweeds.
- Eco-system based approach, seascapes, marine protected areas
- Taxonomy, Breeding and Genetic studies, endangered, alien species
- Co-Management, community-based, Partnerships-private sectors and NGOs.
- Sustainable financing – Blue Carbon and Payment for Ecosystem Services, PPP, Foundations and Trust Funds, Endowments



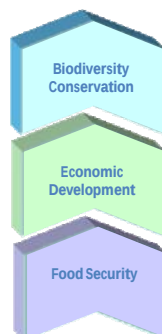
What is Coral Triangle Initiative (CTI)?



The Coral Triangle Initiative (CTI) involves high-level political commitments and proactive implementation by governments of the Coral Triangle area - supported and carried forward by private sector, international agencies and civil society (NGO) partners. This collaboration provides major undertakings toward safeguarding the region's marine and coastal biological resources for the sustainable growth and prosperity of current and future generations.

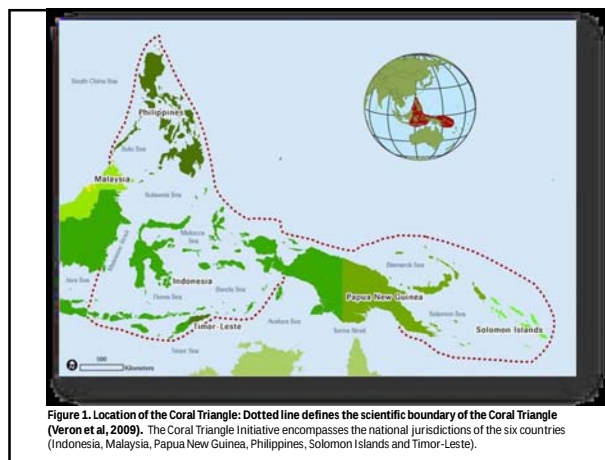
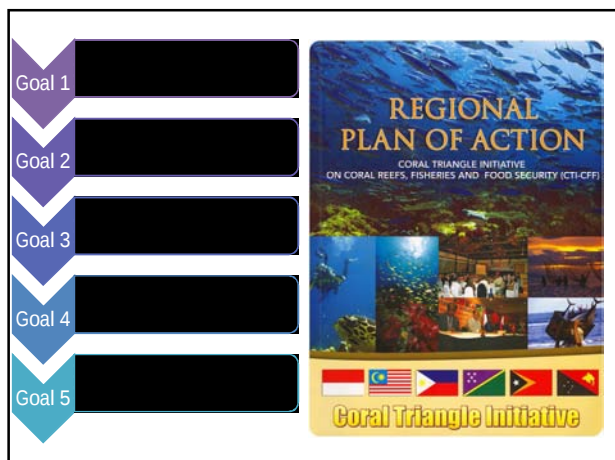
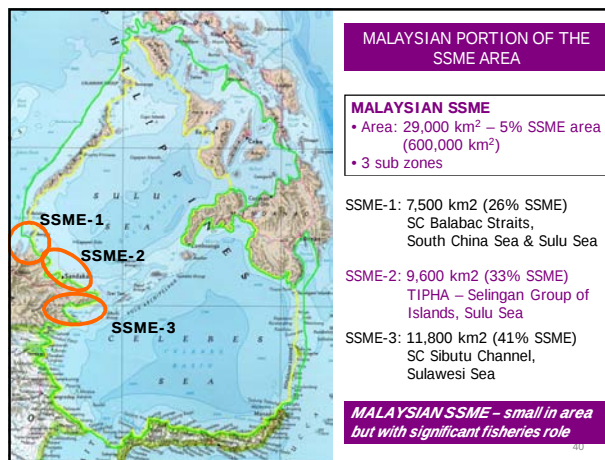
The Coral Triangle, known as the centre of the world's marine biodiversity (Hoeksema, 2007), covers portions of water and coastal region on all or part of six countries: Indonesia, Malaysia, Philippines, Papua New Guinea, Solomon Islands, and Timor-Leste

Why save the Coral Triangle?



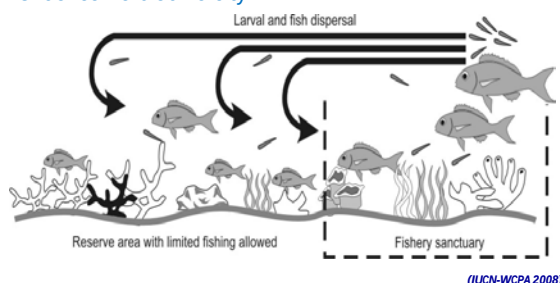
- Ecosystem Resiliency
- Pharmaceuticals Potential?
- Livelihoods : 120 million people
- Habitats: \$2.3 Billion /yr
- Tourism: \$12 Billion /yr
- Live Reef Fish: \$1 Bill / yr
- 50% of World Tuna stocks
- 60% of their protein from the sea

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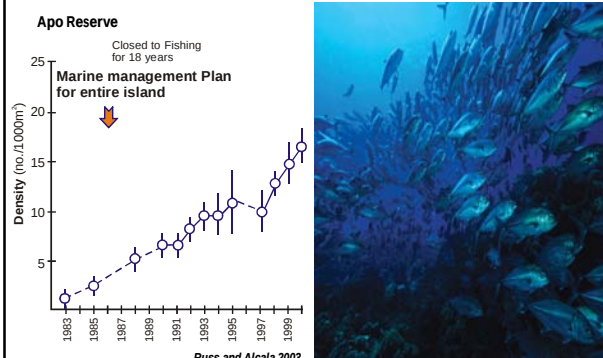


Most MPAs are created to:

1. Enhance fisheries production
2. Generate income for communities
3. Conserve biodiversity



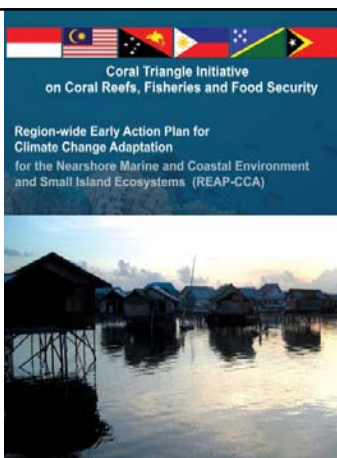
Why focus on MPAs? Biophysical results provide incentives for EBM--more fish in/out of MPAs



4th Goal of CTI-CFF

Climate Change Adaptation Measures Achieved

www.cti-secretariat.net



The REAP-CCA serves as a major step toward implementing climate change adaptation under the UN Framework Convention on Climate Change for the six Coral Triangle countries. Two overall **objectives** of the REAP-CCA are to:

1. **Maintain marine and coastal ecosystem structure, function, and services critical to livelihoods and food security of coastal communities; and**
2. **Support diversification strategies that build coastal community resilience to climate change**

The REAP-CCA draws on ecological and social resilience models to define priority climate adaptation.

measures that need to be taken in the *short-term*, by 2015, and over *medium- and long-term* time horizons to address climate change even in the face of scientific uncertainties associated with future climate change impacts. Building both ecological and social resilience is vital to **building community** resilience to climate change in the Coral Triangle.

Regional collaborative actions and country-specific actions identified by the Coral Triangle countries cover a range of **management scales and frameworks** including **transboundary seascape management and integrated coastal zone management plans** for districts, provinces, and single country seascapes.

Coral Reef Actions

- A. Conduct baseline studies and monitor the condition of coral reefs, especially the incidence of coral bleaching
- B. Protect coral reef habitats, including associated mangrove and seagrass beds through effective management of a resilient network of Marine Protected Areas (MPAs)
- C. Prohibit coral harvesting
- D. Develop and promote use of alternatives to coral for lime production
- E. Strengthen enforcement of fisheries laws and regulations to minimize impacts on habitats and to maintain key species (herbivores)
- F. Establish special courts for fisheries enforcement
- G. Develop alternative livelihood to collecting coral
- H. Strengthen enforcement of habitat protection laws and regulations
- I. Develop sustainable coral farming
- J. Rehabilitate coral reef areas by establishing a coral nursery and re-planting corals

CTI ON CORAL REEFS, FISHERIES, AND FOOD SECURITY REGIONAL PLAN OF ACTION

Goal 4: Climate Change Adaptation Measures Achieved

Target #1: Region-wide Early Action Plan for Climate Change Adaptation for the Nearshore Marine and Coastal Environment and Small Island Ecosystems developed and implemented by 2015

Regional Action 1: Identify the most important and immediate adaptation measures that should be taken across all Coral Triangle countries, based primarily on analyses using existing model by 2011

Regional Action 2: Identify the most important and immediate adaptation measures that could be taken in each CT country by 2011

Regional Action 3: Complete and implement a Region-wide Early Action Plan for Climate Change Adaptation by 2015

Regional Action 4: Conduct capacity-needs assessments and develop capacity building programs on climate change adaptation measures by 2011

Regional Action 5: Mobilize financial resources to implement Region wide Early Action Plan for Climate Change Adaptation by 2011

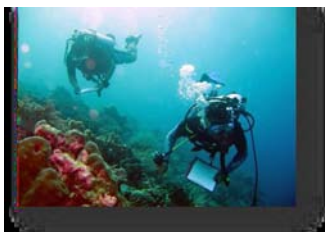
Target #2: Networked national centers of excellence on climate change adaptation for marine and coastal environments are established and in full operation

Regional Action 1: Collaborate around the design and implementation of a Pilot Phase for National Centers of Excellence

(CTI-CFF RPOA 2009)

Coral Triangle Country Priorities for Climate Change Adaptation

Country-specific priorities for climate change adaptation are embodied in National Plans of Action (NPOA) and Climate Change National Adaptation Programs of Action (NAPA). Early actions in the REAP-CCA are aligned with these national plans and programs.

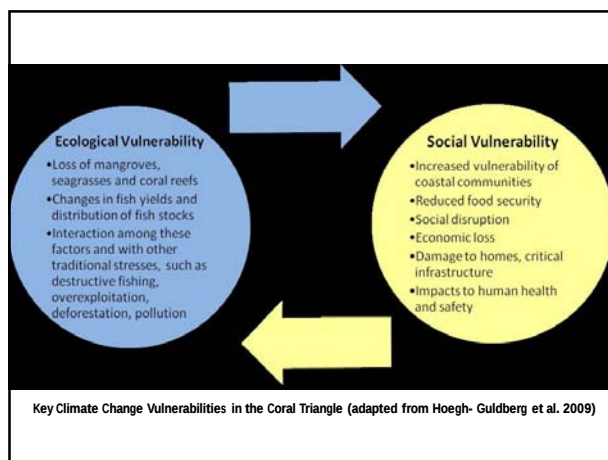


Malaysia

1. Contribute to the development of a fully functional Region-wide Coral Triangle MPA System. (Inventory for the EPI).
2. Strengthen coordination amongst the Sabah Environment Education Network (SEEN) (comprising policy-makers, practitioners, planners, and trainers from government agencies, NGOs, and private sector) to undertake Environmental Education efforts in Sabah.
3. Complete the Malaysian Climate Change Coastal Adaptation Plan, with a focus on sustainable management of fisheries and livelihood diversification.
4. Protect multiple representatives of **resilient habitats** covering a range of physiographic conditions within the Malaysian CTI area, with priority given to areas that have physiographic characteristics that make them inherently resilient to climate change.



Integrating framework for implementing CTI-CFF



TOOLS

- ▣ Risk & Vulnerability Assessment
- ▣ Benefit-cost Analysis
- ▣ Land Use Analysis, Marine Spatial Planning
- ▣ Data and Information Management and Sharing
- ▣ Research & Technology
- ▣ Legislation/Policy Development and Enforcement
- ▣ Capacity Building and Training
- ▣ Education, Outreach, and Communication Tools
- ▣ Monitoring, Evaluation & Reporting

Fisheries Actions

- A. Conduct fisheries and habitat baseline assessment
- B. Develop and adopt comprehensive fisheries management plan including gear-specific management measures and zoning
- C. Establish registration and licensing system for fishers, boats, and fishing gears
- D. Improve coastal law enforcement
- E. Protect habitats, including mangroves, seagrass beds, and coral reefs through effective management of a resilient network of MPAs

Strategy and Action Plan for Climate change in Fisheries in Malaysia (2011-2020) –SEAFDEC-MFRDMD

Mangrove Actions

- A. Assess vulnerability of mangrove forests to sea level rise and other climate hazards
- B. Monitor sea level rise especially in mangrove forests where some changes are already occurring
- C. Establish landward buffer areas to allow retreat of mangrove ecosystems based on sea level rise projections
- D. Support good engineering designs (e.g. culverts and trestle bridges) which would have minimal impact on the tidal hydrology of coastal ecosystems.
- E. Preserve pristine mangrove forests to maintain ecological balance in the coastal ecosystem, for educational and research purposes and as genetic reservoirs
- F. Strengthen community-based natural resource management to sustainably manage mangroves and other natural resources
- G. Rehabilitate mangrove areas to buffer coastal communities from storm surge and other hazards, serve as nursery grounds to increase fishery production, protect coral reefs from sedimentation from upland sources, and sequester carbon to support climate mitigation
- H. Establish mangrove protection zones on the banks of river mouths fronting the sea.
- I. Protect mangrove mother trees as sources of seed and propagules for planting

J. Establish a minimum protective zone of mangrove forest of greater than 100m along open coast, greater than 25m along river banks and lagoons, and greater than 10m along inland banks, creeks and channels

K. Protect mangroves areas near or adjacent to known areas of abundant fish, mollusk, and crustacean fishing to ensure life history stages are connected.

L. Provide alternative fuel sources for communities to minimize loss of mangroves

M. Provide environmentally friendly alternative livelihoods for communities associated with mangroves such as bee-keeping, crab fattening, and other non- extractive livelihoods

N. Conduct environmental impact analysis for all activities that would change coastal land use, and build capacity for environmental impact assessment and monitoring with local government and communities

Capacity Development

- Local governments
- CT Atlas and Data Sharing
- Climate Change Adaptation and Learning networks –community of practice
- Climate Change Adaptation Centres of Excellence

Coral Triangle Atlas and Data Sharing



3-levels benchmarking for local implementation

- **Level 1 (Short Term)-getting started**
Awareness of Climate hazards and vulnerability with early adaptation actions initiated.
- **Level2 (Medium Term)-laying a solid foundation**
Climate adaptation measures integrated into plans and programs with regular funding allocated to sustain implementation of early adaptation actions with monitoring
- **Level 3-(Long Term)-Responding to Changing Conditions**
Climate adaptation mainstreamed into policies, plans, programs and decision making processes across all sectors with monitoring, measured results and positive returns

Indicators to monitor Regional Early Action Program-CCA Implementation

- Hectares of mangroves restored
- Hectares of mangroves protected
- Number of climate risk and vulnerability assessments conducted
- Number of national and sub-national plans integrating climate risk reduction
- Number of early adaptation actions initiated, implemented and monitored
- Number of regional, national and local institutions with strengthened capacity to address new and emerging climate issues

State of Marine Environment Report

- Under the framework of the National Ocean Policy being formulated by MOSTI and other relevant ministries and agencies, concerted effort in Oceanographic, Marine Science and Maritime Research in Climate change and Biodiversity is mandatory, particularly for areas in Physical Oceanography including: Biological, Chemical, Geological, Geo-Political, Policy, Governance and legal framework.

Ocean Data Management, Modelling and forecasting,
Climate–Ocean Interaction and Climate Change Adaptation,
Development of tools, models, state-of-the-art technologies, Marine Engineering, Instrumentation and Innovations,
Scientific expeditions and explorations in territorial waters and uncharted waters,
Sub-Sea/Deep Sea research and applications, Sustainable Marine Fisheries and Aquaculture, Marine Biodiversity/Marine Biotechnology and Eco-Resource Management, Integrated Coastal Zone Management, Marine-Managed Areas,
Marine Spatial Planning and Investment Plans as well as Renewable Energy from Ocean are also necessary towards creating new sources of growth in marine/maritime industry including education, tourism, transport, oil and gas.

A New 'Era of the Oceans'

Preliminary research indicates that marine industries already contribute almost one quarter of Malaysia's gross domestic product (GDP) .

Emerging technology is poised to open up new ocean-based industries such as: renewable energy from tides, waves, currents, and temperature gradients; sea-bed mining; very-rapid sea transportation; marine bio-technology; extended-range and prolonged-duration marine tourism; and the "farming" of marine living-resources.

Thus, the combination of: improved knowledge of our vast ocean resources, greater economic and human capacity to conduct operations at sea, and emerging technology, promises to herald a new "Era of the Oceans". The importance of the marine sector to national well-being requires that we revisit approaches that largely have been inherited from the past, and establish anticipatory, coordinated, adaptive and directed responses to new challenges and opportunities at sea. The National Ocean Policy will provide an essential framework for such efforts.

With declaration of an exclusive economic zone (EEZ), and near universal acceptance of the EEZ regime under the *United Nations Convention on the Law of the Sea, 1982 (LOSC)*, the geographic extent of Malaysia's maritime estate increased significantly over the last three decades.

The marine area in which Malaysia has jurisdiction, sovereignty or sovereign rights is now larger than our land territory.

Moreover, greater understanding of genetic and ecosystem biodiversity, and enhanced technology, have raised awareness of marine resources and the potential wealth to be derived from the oceans.

Accompanying this awareness has been a realisation that human impact on the oceans is causing, amongst other outcomes, sea warming, acidification, pollution, habitat destruction and depletion of living resources at levels that are unprecedented in human history.

The response of the community of nations to these threats has been to put in place a regime of international marine and environmental law that has exploded over the past twenty years or so in a manner that is also unprecedented.

As a responsible nation, Malaysia has agreed through ratification or acquiescence to observe much of this new body of International law.

Equally, in recent years, concerning data have become available that suggest an unwelcome status for certain aspects of the Malaysian marine environment.

For example, far too many marine water quality measurements are above the maximum concentration levels stipulated in the Interim National Marine Water Quality Standards;

Certain fish species appear to have declined significantly, with some no longer a commercially viable resource; large areas of coastal forest and other important habitat have been degraded or altered completely; too many coastal and fishing families remain below the poverty line, and more so with Climate Change...

However, as with most coastal States, Malaysia is yet to explore or exploit the full extent of our territorial sea, EEZ and continental shelf. We also do not yet have sufficient data for scientific determination of whether certain practices and industries at sea are sustainable or indeed under-developed.

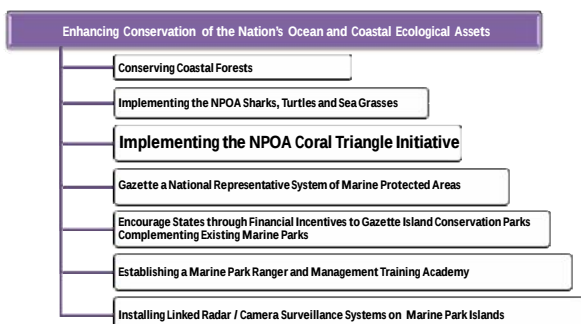
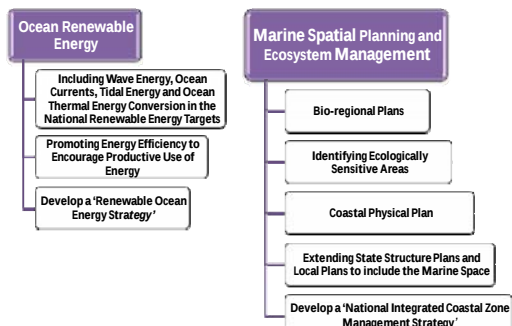
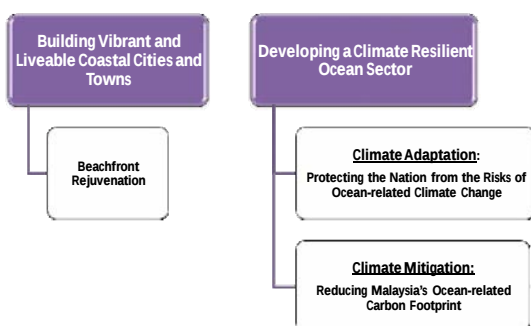
Our current level of oceanographic research and oceans observation may not be sufficient to alert us early enough to undesirable trends in environmental health or threats to marine resource based industries. Whilst impressive efforts have been made discretely by universities, research institutions and some private-sector companies to conduct marine research and development, these efforts remain largely uncoordinated and do not enjoy the guidance of a national strategy. The need for an active, well-resourced ocean science program is especially acute in light of international evidence of ocean change associated with global warming.

Improved Coordination and Directed Effort

At present, Malaysia's marine-related institutions and much of the legislation that govern activities at sea reflect earlier standards and traditional approaches to oceans management rather than a consciously **optimised governance** regime.

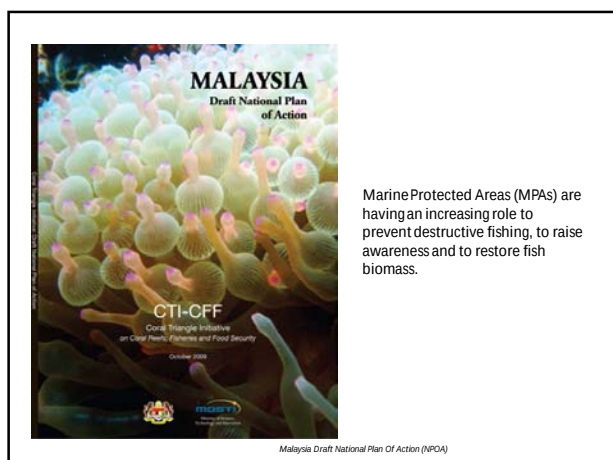
The National Ocean Policy will assist Government decision-makers, sectoral agencies and key non-government policy actors to address gaps and harmonise initiatives towards an agreed vision and common goals.

The National Ocean Policy will also guide determination of those activities at sea that are to be encouraged through measures such as financial allocations, technology deployment, human capacity development and incentives, etc.; along with those that are to be discouraged or prohibited through regulations, sanctions and disincentives, etc.



Our complex coastal environment - must be managed in integrated manner using EBM systems with interventions tailored to local needs and conditions





COUNTRY REPORT: MALAYSIA

NPOA Prioritisation List

Goals and Targets	List of Prioritised Actions
G1 T1	Jointly develop investment plans with seascape partners for all identified Priority Seascapes (including the existing SME seascape)
G1 T2	Strengthen coordination amongst the Sabah Environment Education Network (SEEN) (comprising policy-makers, practitioners, planners, and trainers from government agencies, NGOs, and private sector) to undertake Environmental Education efforts in Sabah.
G2 T1	Establish a national policy on EAFM.
G2 T2	Undertake education and public awareness programs to foster better understanding among the general public of the multiple values of mangrove forests.
G2 T3	As a SME initiative, share information on existing legislation and policies for the management of tuna and small pelagic.
G2 T4	Implement seasonal closure of spawning aggregation areas.
G3 T1	Establish and enforce additional marine sanctuaries (no-take zones).
G4 T1	Strengthen coordination amongst the Sabah Environment Education Network (SEEN) (comprising policy-makers, practitioners, planners, and trainers from government agencies, NGOs, and private sector) to undertake Environmental Education efforts in Sabah.
G5 T1	Identify cultural and economic uses of endangered species (both consumptive and non-consumptive), and assess the level and impact of traditional harvest, with particular attention to shark fins and turtle eggs.



Relevant projects under CTI

- Sulu Sulawesi Marine Ecoregion (SSME)
- MPA-Tun Mustapha Park
- Eco-Resource Management and Investment Opportunities for Eco-Tourism Marudu Bay
- Marine turtle conservation
- Collaborative scientific expedition in the Sulu-Sulawesi Seas
- Mayors Round Table



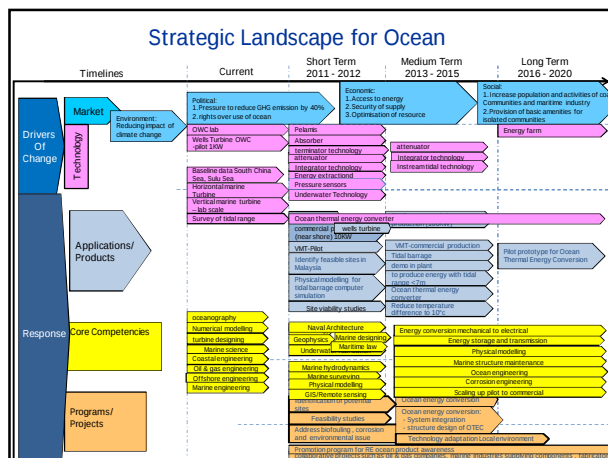
Biomass Technology Roadmap – Business

	Short Term 2011 - 2012	Mid Term 2013 - 2015	Long Term 2016 - 2020
Vision	• Value Creation of biomass from marine algae. • Development of RE from marine algae as a potential resource in moving towards carbon neutral by 2020		
Business	• Commercial farming of algae	• Commercial biofuel production from algae source in Malaysia • Zero waste processes • Integration of algae cultivation with CO₂ sequestration.	• Development of high value products from algae source.

IP DEVELOPMENT

Biomass Technology Roadmap – Programs/ Projects

Project	Short Term 2011 - 2012	Mid Term 2013 - 2015	Long Term 2016 - 2020
	- Strain improvement (e.g. Genetic modification of algae for high lipid content) - To find the most optimum cultivation and harvesting techniques/methodologies in Malaysian context. - Applied research e.g. Lab scale cultivation of algae. - Pilot scale cultivation of algae. - Review biodiesel policy to benefit algae usage. - Improvement on the techniques extraction of the lipids (biodiesel) or other high value properties (by products)	- Downstream processing (pilot scale) to convert Algae oil into bio fuel (bio ethanol, biodiesel or bio jet fuel) - Scaling up to commercial scale. - Economic feasibility study on commercialisation. - Get investors into converting algae oil into bio fuel in Malaysia - Improvement on Harvesting techniques (Cost-effective) e.g. - - Centrifugation technology - Flocculation techniques - Encapsulation - Spray drying	- Cosmeceutical - Pharmaceutical - Bio polymer - Anti aging supplements



MALYSIAN OCEAN RENEWABLE ENERGY ROAD MAP 2010-2020

