Building Resilience to Climate Change Impacts – Coastal Southeast Asia

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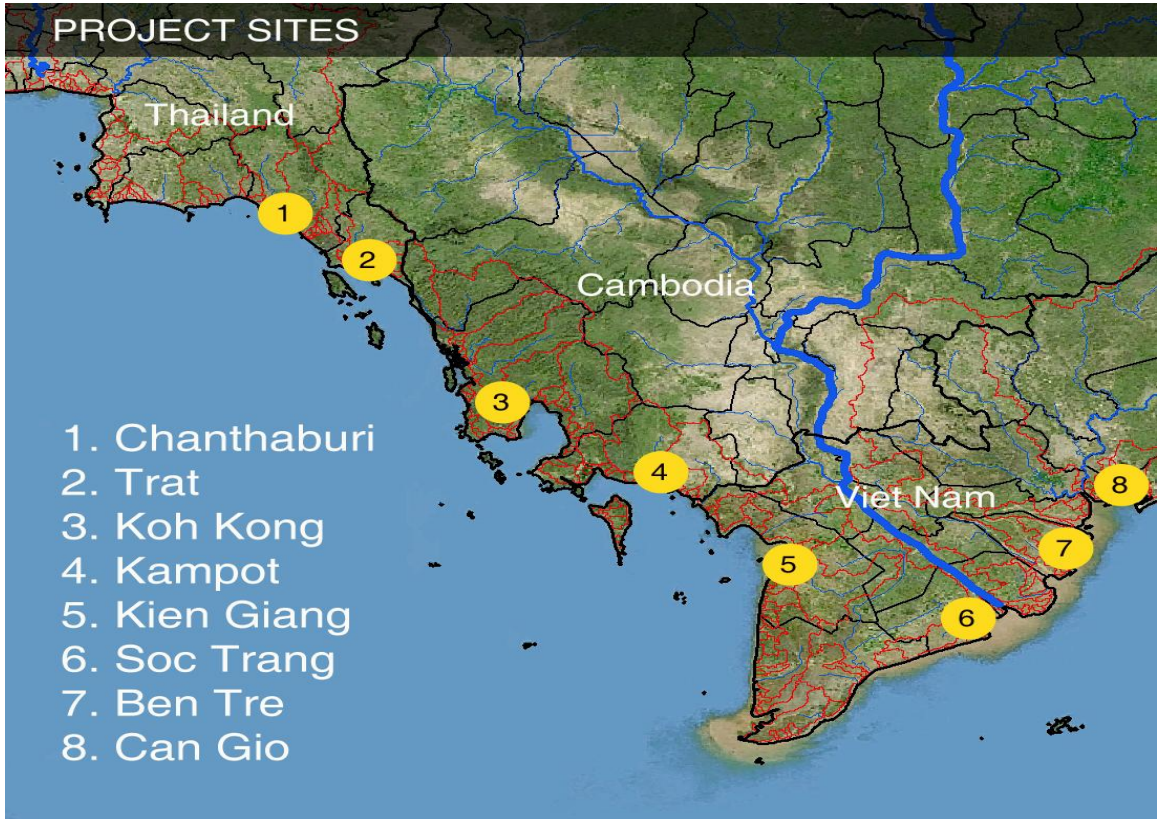
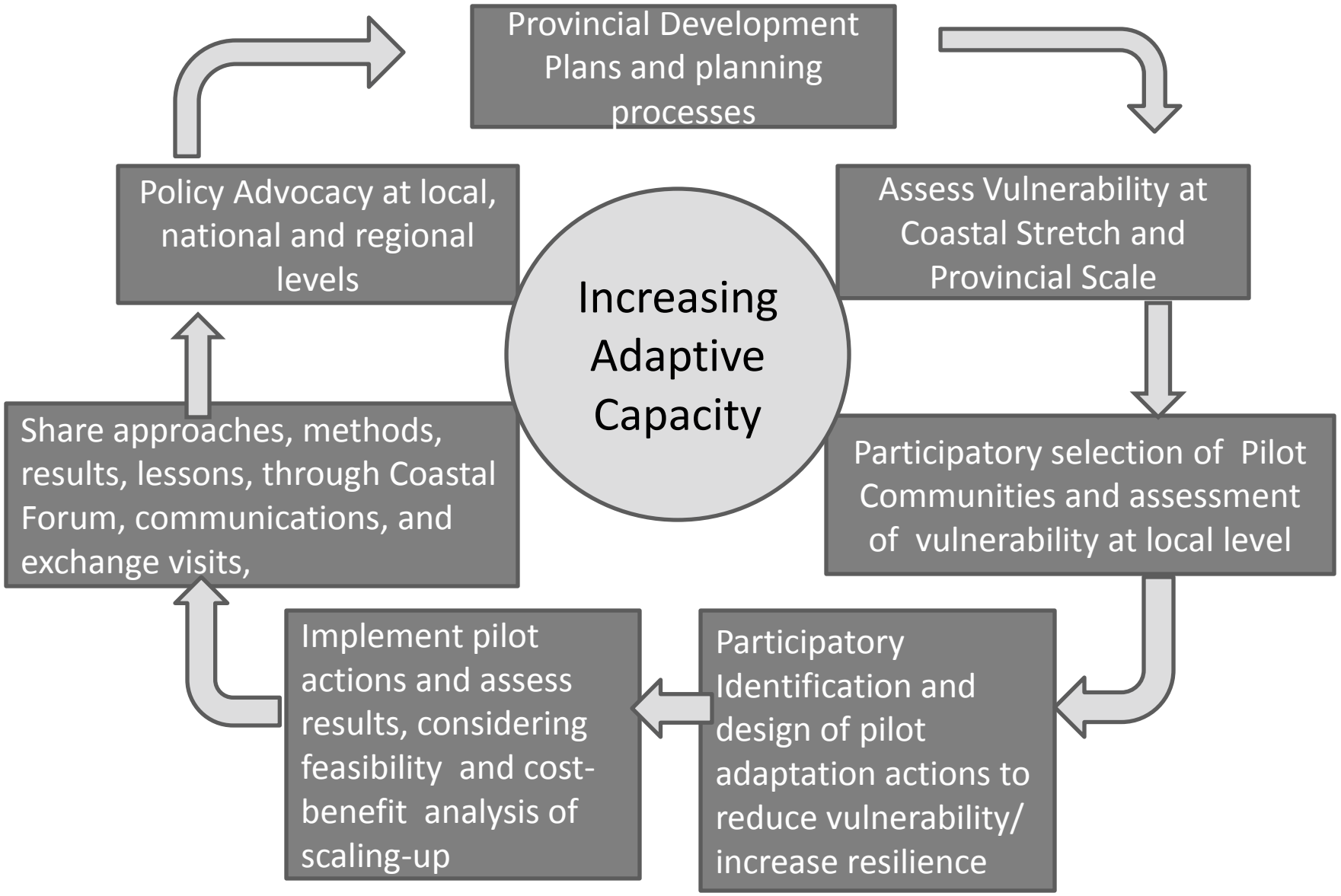
Content of Presentation

- Introducing the BCR Project
- General climate change effects in the coastal zone
- Vulnerability (Exposure, Sensitivity, Adaptive Capacity)
- Vulnerability of key coastal habitats
- Vulnerability of some important species
- Next Steps

Introduction to the BCR Project

This project aims to Increase adaptive capacity of people and ecosystems on which they depend to cope with the anticipated impacts of climate change and plan for DRR, through sound governance and planning




Provincial Development Plans and planning processes
Assess Vulnerability at Coastal Stretch and Provincial Scale
Participatory selection of Pilot Communities and assessment of vulnerability at local level
Participatory Identification and design of pilot adaptation actions to reduce vulnerability/ increase resilience
Implement pilot actions and assess results, considering feasibility and cost-benefit analysis of scaling-up
Share approaches, methods, results, lessons, through Coastal Forum, communications, and exchange visits,
Policy Advocacy at local, national and regional levels
Increasing Adaptive Capacity

What impact will climate change have on the coastal zone?

- Sea level rise
- Higher sea temperatures
- Changes in precipitation patterns and run off (water flow)
- Changed oceanic conditions; pH, warming upper layers, changes in ocean currents
- Changes in storm tracks, frequencies & intensities of storms

What will this lead to?

- Displacement of coastal lowlands & wetlands
- Impacts on habitats & species; coral bleaching, niche areas, breeding patterns/ sex ratios, food webs
- Increased coastal erosion
- Increased flooding & drought conditions
- Salinisation of surface & ground waters
- Livelihood activities unpredictable – increased vulnerability

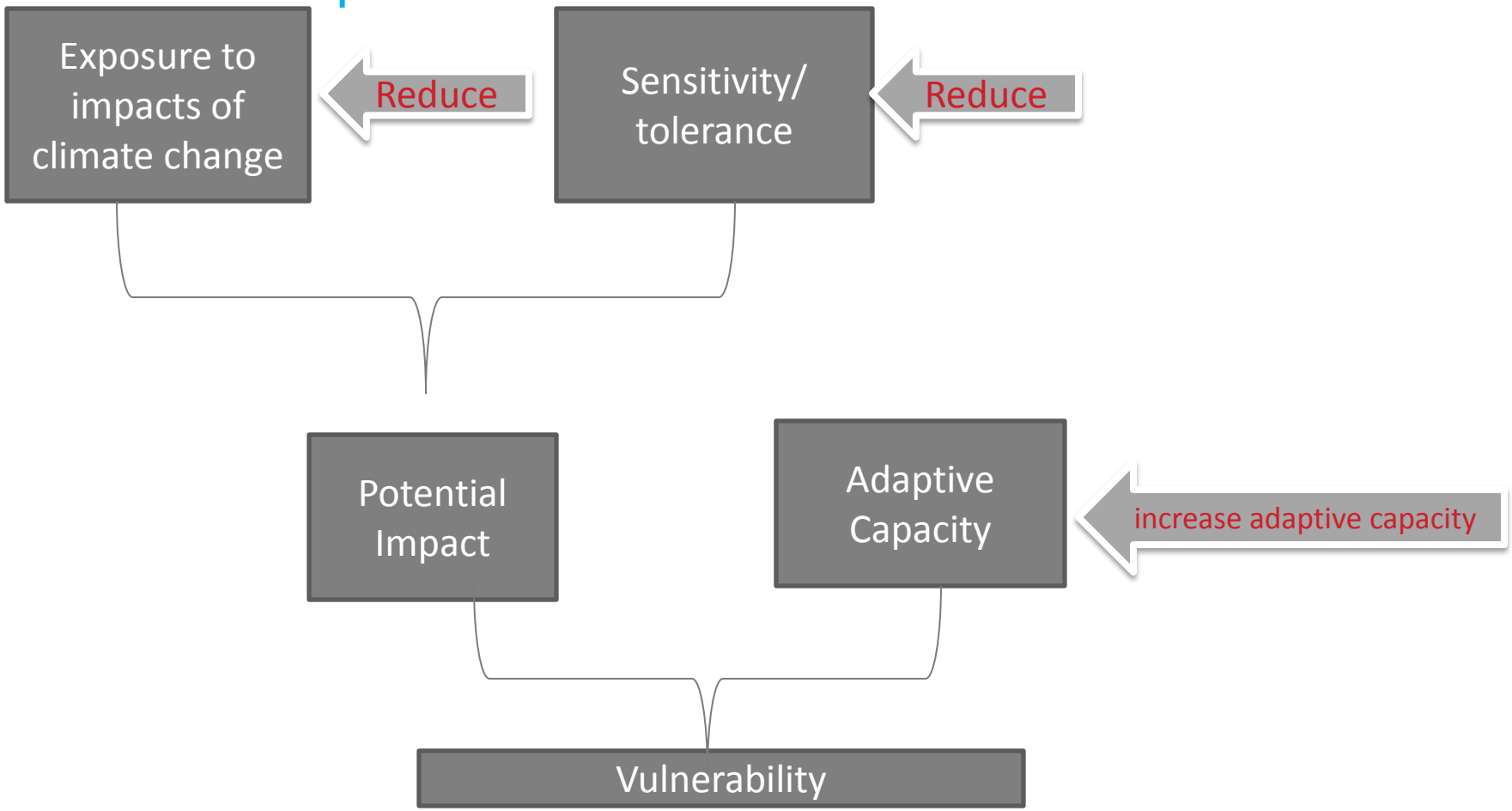
Vulnerability Assessments

- Vulnerability assessments provide information about the nature and magnitudes of impacts expected from climate change, and inform decisions about the form and urgency of adaptation activities

- Vulnerability to climate change can be assessed using knowledge of the three components - **exposure, sensitivity** and **adaptive capacity**

- Assessments should consider vulnerability at a variety of scales

Climate change, vulnerability & social adaptation



Resilience to climate change is the ability of human or ecological systems to cope and adapt to changes in the environment
Building resilience is analogous to reducing vulnerability – decreasing exposure, reducing sensitivity, increasing adaptive capacity

EXPOSURE

- Exposure is the extent to which a region, a habitat, a community, household or individual experiences climate.

- It is characterised by the magnitude, frequency, duration and/or spatial extent of a weather event or pattern.

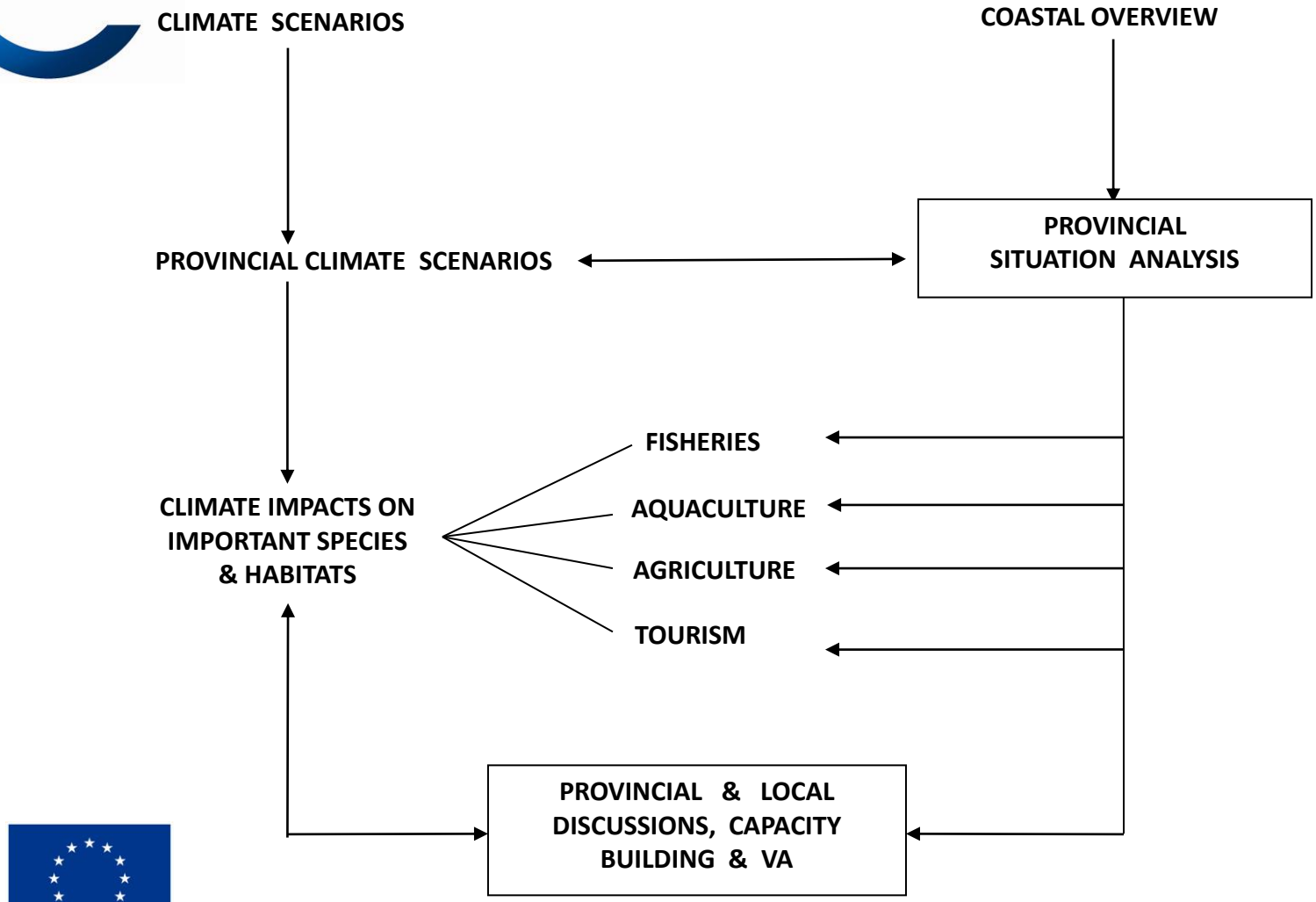
SENSITIVITY

- Sensitivity is the degree to which a system is affected by, or responsive to, climate changes.
- The sensitivity of ecological systems described in terms of physiological tolerances to change and/or variability in physical and chemical conditions (e.g. temperature, pH, salinity, etc.)
- Sensitivity of human social systems depends on a wide range of socio-economic, political, cultural institutional and governance factors

ADAPTIVE CAPACITY

- Adaptive capacity is ability to respond to challenges through learning, managing risk and impacts, developing new knowledge and devising effective approaches

- In ecosystems, adaptive capacity is related to genetic diversity, species diversity, and heterogeneity within landscapes, as well as life-cycle strategies, dispersal capacity, etc.


CLIMATE SCENARIOS
COASTAL OVERVIEW
PROVINCIAL CLIMATE SCENARIOS
PROVINCIAL SITUATION ANALYSIS
FISHERIES
AQUACULTURE
AGRICULTURE
TOURISM
CLIMATE IMPACTS ON IMPORTANT SPECIES & HABITATS
PROVINCIAL & LOCAL DISCUSSIONS, CAPACITY BUILDING & VA

CRITICAL HABITATS AND CLIMATE CHANGE

Mangroves

Sensitivity:

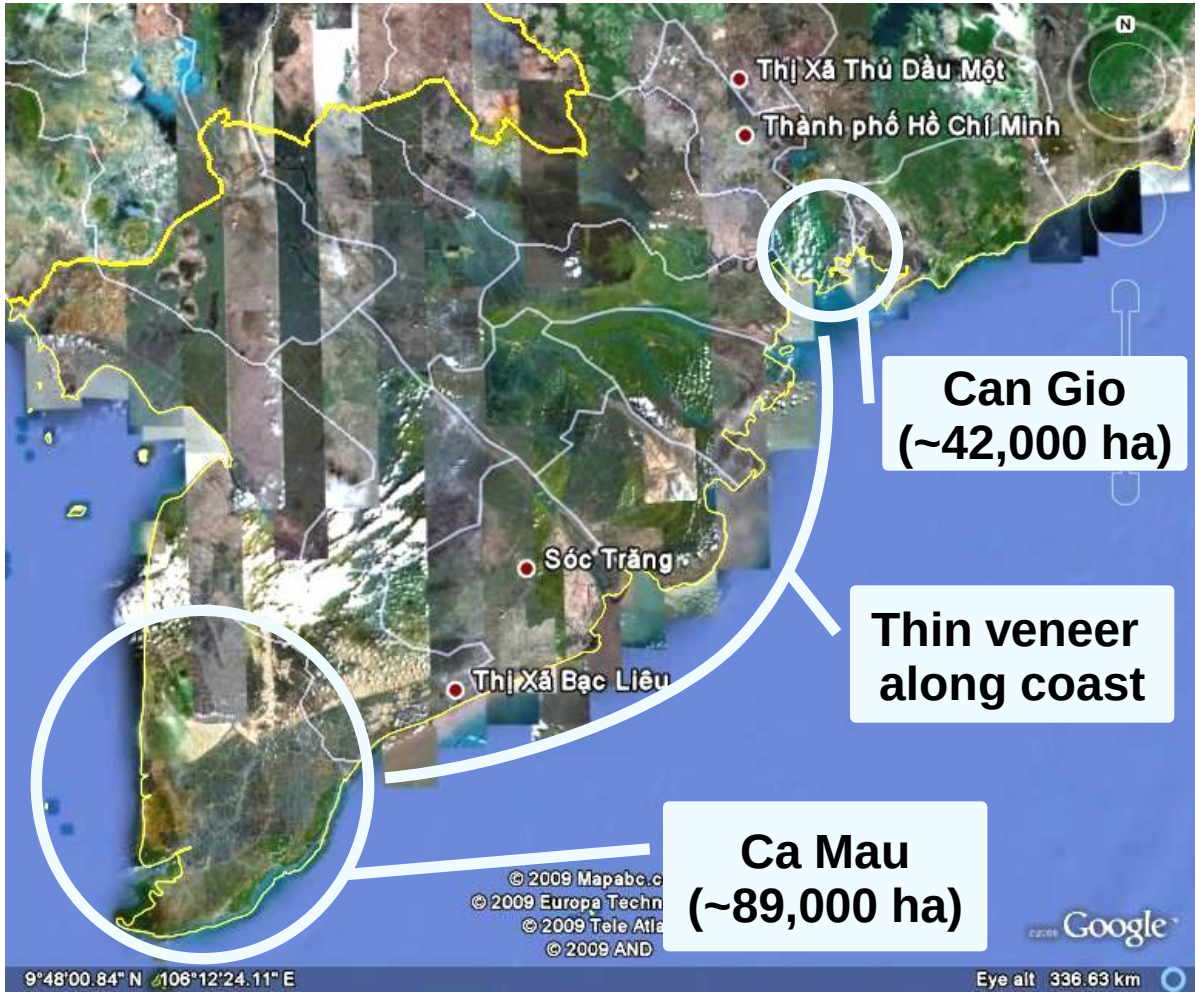
- Mangroves have the potential to be affected by both rising sea and air temperatures
- Processes such as respiration, photosynthesis and productivity will be affected by changes in both water and air temperature
- Mangrove systems particularly vulnerable to rising sea levels

CRITICAL HABITATS AND CLIMATE CHANGE

Adaptive capacity of Mangrove systems:

- Mangroves likely to retreat landward to maintain their preferred hyrdoperiod
- Presence of barriers behind mangroves is largest limitation to adaptation
- Filling sizable knowledge gaps in our understanding of how these environments change with rising sea level and other environmental changes should be made priority

Mangroves in the Mekong Delta



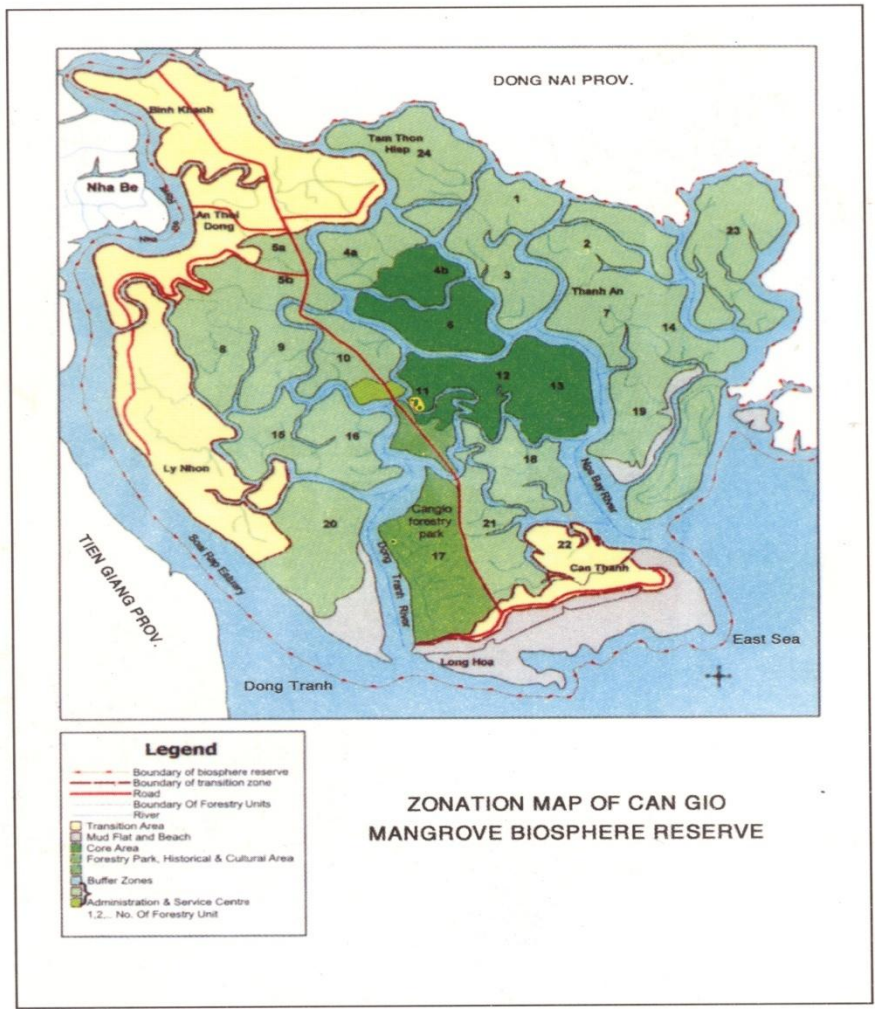
- Low species diversity
- Mainly monocultures of *Rhizophora apiculata*
- No trees of more than about 50 y of age.
- Most areas are variously disturbed or affected by human activities,

Le Tan Loi, Nguyen Van Be, Barry Clough

Dragon Institute

Can Tho University

Can Gio



- No seaward dikes
- Elevation mostly 0.5-1.5m above MSL, with small areas up to 10m above MSL.
- Average tidal amplitude 3 – 3.5 m.
- Estimated recent rate of SLR 3-6mm y^{-1}.
- Sedimentation rate less than 3mm y^{-1}.
- Limited opportunity for landward migration due to urban development & other human activities.
- A SLR of 0.5m likely to reduce area by 20-30% (but no detailed topographic data yet available).

CRITICAL HABITATS AND CLIMATE CHANGE

Coral reef systems

Sensitivity:

- Corals are extremely sensitive to temperature change- Small increases (1-2 C) in sea temperature above the long-term summer maxima destabilises the relationship between host corals and their symbiotic dinoflagellate algae (zooxanthellae), on which they rely for energy and growth
- ‘bleaching’ is a stress response by corals experiencing unfavourable conditions such as high or low irradiance high or low temperatures reduced salinity and the presence of toxins such as herbicides and bacterial infections

CRITICAL HABITATS AND CLIMATE CHANGE

Sensitivity cont.

- Coral reef systems also highly vulnerable to severe weather such as cyclones, which cause extensive physical destruction as well as reduced light conditions which affect coral ability to photosynthesize
- Corals will also very likely be severely affected by low pH by severely impacting their ability to accrete calcium carbonate

CRITICAL HABITATS AND CLIMATE CHANGE

Adaptive capacity of coral reef systems:

- Three potential responses
- **to acclimatise** (a phenotypic change within the individual)- possible as corals can acclimatise to changes in their environment including seasonal temperature fluctuations
- **to adapt** (a genetic response at the population level)- very little evidence has been shown to prove this is possible and it is thought the rate of change is too quick for it to happen
- **to shift latitudes -** geographic differences in temperature tolerances have evolved over much longer time frames than the decadal scale of current changes in climate

CRITICAL HABITATS AND CLIMATE CHANGE

Seagrass habitats

- **Sensitivity:**

- Vulnerable to any climate change factor which limits light availability (e.g. storms, rain, flooding events, flood plumes from coastal run off, sedimentation, algal blooms) as they are photosynthesizing plants
- Also highly sensitive to decreased water quality as a result of pollutants, with a significant sensitivity to herbicides

CRITICAL HABITATS AND CLIMATE CHANGE

Adaptive capacity of seagrass species:

- Many examples of seagass recovering from tropical cyclones/storm damage
- Some studies suggest that seagrasses respond and recover at different rates when exposed to herbicides both in laboratory and natural settings- so lab studies cannot be taken as a completely accurate prediction of what seagrasses will do in situ
- all seagrasses are capable of adapting by altering their physiological capacity and morphological structure however whether they can adapt fast enough to climate change is unknown

RESULTS – HABITATS

HIGHEST IMPACTS (POSSIBLY COMPLETE LOSS) OF CLIMATE CHANGE ALONE ARE TO:

- Inter-tidal mudflats in Ben Tre, Can Gio, Soc Trang
- Melaleuca forest in Kien Gang

HIGHEST IMPACTS (POSSIBLY COMPLETE LOSS) OF CLIMATE CHANGE + EXISTING THREATS ARE TO:

- Seagrass beds – Kampot, Koh Kong, Chanthaburi, Trad, Kien Gang
- Mangroves – Ben Tre, Can Gio, Kien Gang, Soc Trang
- Mudflats – Ben Tre, Can Gio, Soc Trang
- Melaleuca forest/seasonally flooded grassland - Kien Gang

WILD CAPTURE FISHERIES- MACKEREL

Indo-Pacific Mackerel (*Rastrelliger brachysoma*) occurs off the coast of Thailand Cambodia and Vietnam

- **Sensitivity:**

- Temperature can influence physiological condition, developmental rate, growth rate, swimming ability, reproductive performance and behaviour in Mackerel
- Eggs, larvae and juveniles are the most sensitive
- Young individuals vulnerable to sea level rise as they come onshore to mangrove environments during these life stages

WILD CAPTURE FISHERIES- MACKEREL

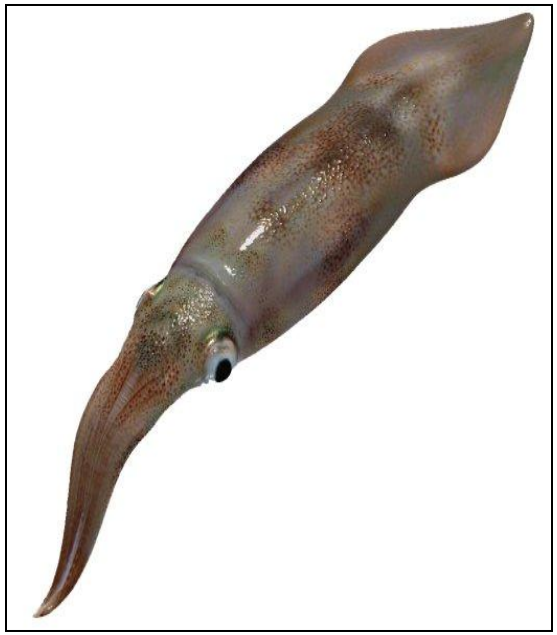
Sensitivity cont:

- Low pH shown to have detrimental affect to fish eggs predominantly
- Altered ocean circulation could have far-reaching consequences for the growth, survival, and dispersal patterns of larval fishes however extent unknown in Mackerel populations of S. China Sea

Adaptive capacity:

- Range shifting higher latitudes to more favourable conditions may be a response to rising SST
- Range shifting will depend on the availability of suitable habitat, food and conditions for breeding

WILD CAPTURE FISHERIES- SQUID



- Thirty species of cephalopods from ten families and 17 genera are found in the waters off the coast of Thailand, Cambodia and Vietnam, with the most important species within the fishery being *Loligo chinensis*
- **Sensitivity:**
- Increased temperatures within thermal tolerance results in substantially faster growth, metabolism and reproduction
- Highly sensitive to salinity in early life stages

WILD CAPTURE FISHERIES- SQUID

Sensitivity cont:

- Sensitive to lowered pH which results in a decreased ability to bind oxygen for transport to the tissues which may have implications for growth, reproduction and other physiological processes at different life stages
- Sensitive to changes in ocean circulation which may affect primary production, and therefore their food supply

WILD CAPTURE FISHERIES- SQUID

Adaptive capacity:

- As short-lived species with plastic growth and reproduction and high mobility, squid have a higher potential adaptive capacity than most other species
- Shifting latitudes towards thermal optimum already witnessed in some species elsewhere
- As they are trophic opportunists, diet shifting may be possible in times of low productivity
- Little information available on measuring adaptive capacity of squid species in South China Sea- which may have important fisheries implications

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SHRIMP/PRAWN AQUACULTURE

- Shrimp/prawn farming represents a sizable economic activity providing considerable livelihood opportunities in the BCR target regions
- Thailand is the leading global cultured shrimp producer. The giant tiger prawn (*Penaeus monodon*) and whiteleg shrimp (*Litopenaeus vannamei*) constitute the main species farmed

Sensitivity:

- Increase in temperature may cause increased metabolic rate and therefore growth but must be within thermal tolerances which are largely unknown
- Temperature rise in culture systems presents threat via increase in algal blooms, disease and reduced water quality

SHRIMP/PRAWN AQUACULTURE

Sensitivity:

- SLR/increase in extreme weather may cause severe operational impacts to shrimp ponds whilst water stress due to drought may make species more susceptible to disease
- Shrimp sensitive to changes in salinity therefore potentially vulnerable under intense water stress scenarios
- Shrimp vulnerable to synergistic impacts of poor water quality, habitat destruction, increased water stress (temperature, salinity and disease)

SHRIMP/PRAWN AQUACULTURE

Adaptive capacity:

- Even through shrimp are vulnerable to high and low salinity levels they can be acclimatised to total freshwater immersion using a gradual introduction technique which has implications for the adaptive capacity of the industry, which has the potential to move inland and away from the effects of other climate change impacts (extreme weather, sea level rise) provided water supply is adequate

MUD CRAB (SCYLLA SERRATA)

These crustaceans are both wild caught and cultured in Thailand, Cambodia and Vietnam

- **Sensitivity:**

- Mud crab larvae have been shown to suffer mortality above 32^0 C
- lowering pH has particularly negative implications for calcifying organisms via shell formation processes and weakening of existing skeletons
- Cultured crab are vulnerable to secondary impacts on their food supply from climate change

MUD CRAB (SCYLLA SERRATA)

Sensitivity cont:

- Eggs particularly vulnerable to fungal infections and disease in culture systems
- Habitat (mangrove) destruction is biggest threat to this species due to the strong ecological links between species and environment
- **Adaptive capacity:**
- Wild populations have been shown to extend their ranges by 1000s of kms to more favourable conditions
- Adaptive capacity of cultured species largely unknown

MARINE AND BRACKISH CAGE CULTURE

Major species cultured along the coastal areas of Thailand, Cambodia and Vietnam are grouper species (*Epinephelus.spp), snapper (*Lutjanus spp) *and Seabass (Lates* calcarifer)

Sensitivity:

- Temperature has been shown to be the most important factor dictating development of finfish
- Cultured groupers can tolerate temperatures from 22-28 C, whereby under 15 C they will not feed. Upper limits not clear.
- Seabass appear to thrive in warmer waters, however thermal limit is thought to be over 34-5 C
- All species sensitive to salinity, esp. at larval stages

MARINE AND BRACKISH CAGE CULTURE

Sensitivity cont.

- Seabass less sensitive to turbidity than most other fish and as such increased precipitation/extreme events may not impact this species as much as others
- All species vulnerable to changes in food supply bought about by climate change impacts (e.g. seabass and crustacean diet)
- Disease of great concern; may increase as water conditions deteriorate as a result of climate impacts (such as increased temperatures

MARINE AND BRACKISH CAGE CULTURE

Adaptation:

- Temperature will prove hardest to adapt to as fish are unable to shift latitudes unlike their wild counterparts
- Extent to which caged teleosts can adapt to climate change largely unknown
- Farmers are potentially capable of shifting culture species to more resistant species, for example grouper to seabass, seabass to shrimp

SOME VERTEBRATE SPECIES

HIGHEST IMPACTS (POSSIBLY COMPLETE LOSS) OF CLIMATE CHANGE ALONE ARE TO:

- River Terrapin – Koh Kong

HIGHEST IMPACTS (POSSIBLY COMPLETE LOSS) OF CLIMATE CHANGE + EXISTING THREATS ARE TO:

- Dugong – Chanthaburi, Trad, Koh Kong, Kampot, Kien Gang
- Sarus Crane – Kampot, Koh Kong, Kien Gang
- Hawksbill Turtle – all provinces
- 'Very High' impacts – to most other species + assemblages

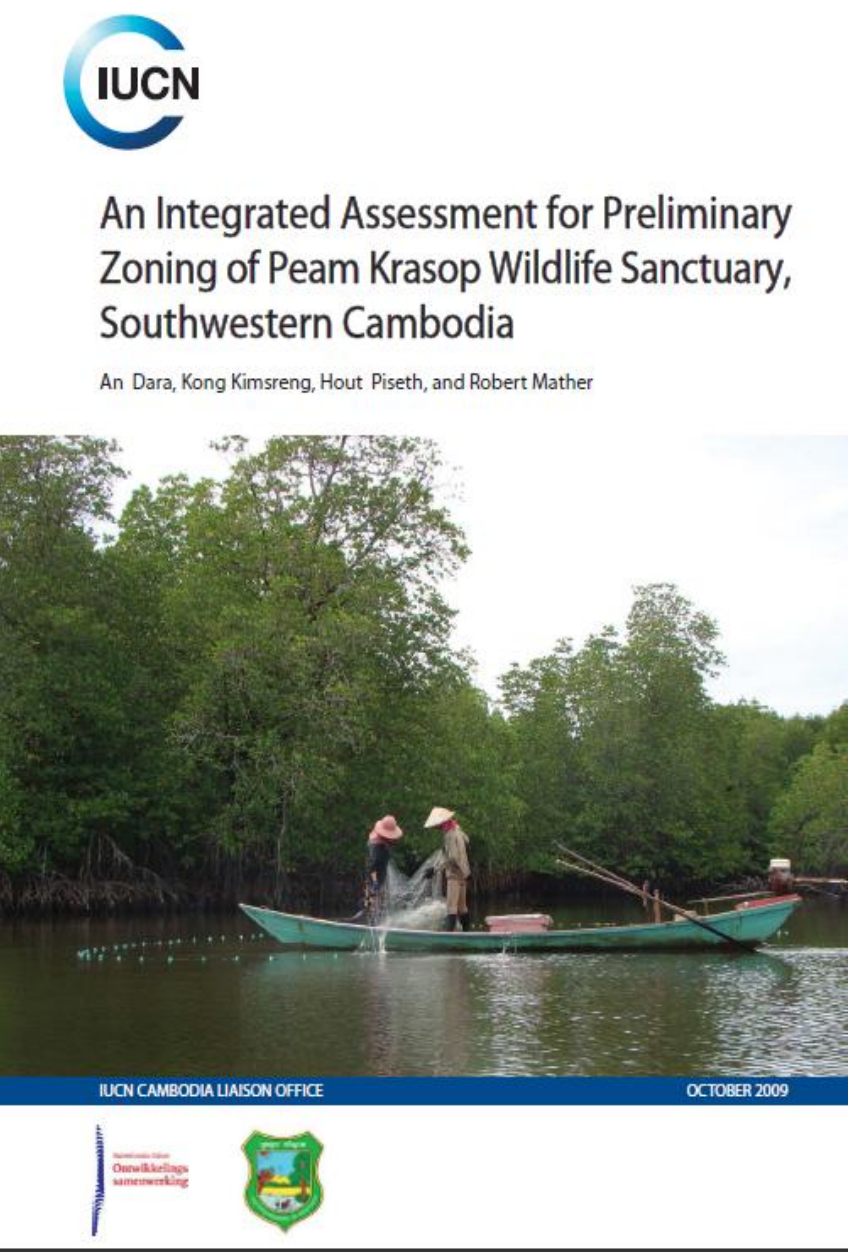
PROTECTED AREAS & IBAS

FEATURES WHICH WEAKEN RESILIENCE TO CC

- Marine protected areas are under-represented
- Little overlap between some IBAs / PAs - Ben Tre, Kien Gang
- Sites in Mekong Delta are low elevation, small, isolated – high edge effects; few options to shift to new climate spaces
- Mangroves in Chanthaburi & Trad are fragmented + linear – similar impacts as above

FEATURES WHICH STRENGTHEN RESILIENCE TO CC

- Large protected network, range of elevations + latitudes – species can shift north or to higher elevations – Koh Kong, Kampot
- Rivers oriented north-south – allows species to move north – all provinces



NO REGRETS ADAPTATION ACTION

- PKWS Established 1993, protecting one of the most important mangrove areas in Cambodia.
- About 9,000 people living in/around this sanctuary depend on ecological services to sustain their fisheries-based livelihood
- Zoning for effective management


Let’s go!