



Stakeholder Workshop Singapore Report - Digging into Sediments and Microbes for Nature Conservation (DiSeMiNation)

Date: May 18th-19th, 2017
Venue: Department of Geography, National University
Singapore (NUS), Earth Lab (#AS2 02-03)
Participants: see attendance list in annex

Workshop organisation and report author: Bevis Fedder
(bevis.fedder@leibniz-zmt.de)

Table of Content

Background.....	1
1. Introductory talks	1
2. Workshop Sessions.....	2
3. Excursion	4
4. Major Outcomes.....	5
Annex1: Attendance List	6
Annex 2: Agenda	7
Annex 3: PowerPoint Presentations.....	8

Background

Many mangrove ecosystem services – such as provision of food and material, coastal protection, and climate change mitigation – are controlled by microorganisms in the mangrove sediment. By combining modern methods of biology, chemistry, and social sciences, the research project DiSeMiNation conducted by the Leibniz Centre for Tropical Marine Research (ZMT) and partners aims to investigate how the flora and fauna as well as their uses by humans affect microorganisms in the sediment and thus how microbially-controlled ecosystem processes and services will change over time and space. In close cooperation with stakeholders in the partner countries, the project will suggest measures for the protection and sustainable management of these important and vulnerable ecosystems. Through a series of stakeholder workshops in the partner countries, the project initiates the cooperation with representatives from the government, civil society, and business sectors. Those workshops pursue the goals of building stakeholder relationships, evaluating ecosystem services, and developing ideas for the cooperation between the research project and the stakeholders. The first stakeholder workshop took place in Singapore, in collaboration with the Department of Geography at the National University of Singapore, and brought together representatives from national authorities, NGOs, and research (see attendance list in annex).

1. Introductory talks

Two plenary talks introduced the research project to the stakeholders and outlined the status and value of the mangroves in Singapore.

“DiSeMiNation” by Prof. Dr. Martin Zimmer

Martin Zimmer introduced the research project DiSeMiNation (Digging into Sediments and Microbes for Nature Conservation) to the workshop participants. DiSeMiNation aims at unravelling how the floral (e.g. mangroves) and faunal (e.g. worms, crabs, snails) communities, environmental conditions (e.g. salinity, tides, hydrology), and human resource-uses govern service-relevant microbial processes in mangrove sediments (e.g. organic matter turnover, carbon and nitrogen dynamics) and how the services that arise from these processes create benefits for users. The results will indicate the interrelation between flora, fauna, microbial composition and activity, and sediment processes. In combination with mapping and evaluating relevant services and threats, the project can serve as a basis for planning networks of protected areas, based on ecosystem function, service provision, and carbon/nitrogen fixation. The project has a global scope, integrating different research sites from Singapore, Colombia, Brazil, South Africa, Oman, and Australia. Project partners in Germany are the ZMT, the *Leibniz Institute of Ecological, Urban and Regional Development* (IÖR), the *Leibniz Institute German Collection of Microorganisms and Cell Cultures* (DSMZ), and the *Leibniz Institute for Plant Biochemistry* (IPB). More information about the project can be found here: <http://www.leibniz-zmt.de/en/research/research-projects/disemination.html>.

“Singapore’s mangroves – status and value” by Dr. Dan Friess

Singapore has 35 species of ‘true’ mangroves covering an overall area of between 650 and 950 ha, with single mangrove patches not exceeding 100 ha. The mangrove area in Singapore has been declining from ca. 4000 ha in 1958 mostly due to land reclamation, reservoir construction and changing hydrology, but also potentially due to pollution, pests, sediment starvation, storms, and sea level rise. Currently, however, the mangrove status is stable. Singapore’s mangroves provide a multitude of services for the country. These include enhancing food security; reducing wave energy that protects shoreline assets; trapping sediments and consolidating shorelines; attenuating heat regimes (reducing temperature up to 3°C compared with surrounding urban areas); enhancing economic re-

turns through recreational, aesthetic, and educational activities; and removing carbon dioxide from the atmosphere. Especially for carbon storage, Singapore's mangroves play an important role. They save up to 500 Mg carbon per ha (40-50% more than primary/secondary forest per ha). Important national carbon storage sites include mangrove areas at Sungei Buloh, Mandai, Pulau Semakau, and Pulau Ubin. Singapore's mangroves store over 1.5 million tonnes of carbon dioxide, which equals annual emissions of ca. 350.000 cars or of 630.000 Singaporeans. Finally, Dan Friess highlighted the potential of social media, such as flickr, for a rapid assessment of cultural ecosystem service usage.

2. Workshop Sessions

Two workshop sessions have evaluated ecosystem services and developed ideas for research-stakeholder cooperation.

Ecosystem Service Evaluation (moderation: Dr. Ralf-Uwe Syrbe, Dr. Karsten Grunewald)

Prior to the workshop, a survey was sent to all participants containing the later discussed issues. The workshop session should enhance the understanding of ecosystem services, scrutinise and discuss the preliminary survey results. The session started with a talk by Karsten Grunewald introducing the conception of ecosystem services to the invited stakeholders for mangrove areas. The slides of this presentation are attached as in Annex 3.

Main topics were

- a short introduction of the IOER ecosystem services research including our two new books about ecosystem services framework and about green cities in the European-Asian context
- a motivation why one should assess ecosystem services and the introduction of international initiatives that recently strengthen the concept
- a presentation of the framework for ecosystem services' assessment and how to apply them within the DiSeMiNation project
- a transfer concept that explains how the benefit reaches potential users.



Fig. 1: Workshop session „Ecosystem Service Evaluation“ with Dr. Ralf-Uwe Syrbe and Dr. Karsten Grunewald.

After that, Ralf-Uwe Syrbe presented the results of the already completed surveys. The main slides of the presentation are attached in Annex 3. Main topics were

- an overview of the concerned mangrove areas in Singapore (where answers relate to)
- the relevance and ranking of specific ecosystem services for stakeholders in Singapore
- the benefitting and threatening stakeholder groups of Singapore's mangrove ecosystems
- the scientist-stakeholder relations, i.e. what should be provided by science for a better maintenance of mangroves in Singapore
- potential knowledge gaps.

The subsequent discussion involved the following questions:

- How large are mangrove areas in Singapore now, how much can be maintained and should them even be enlarged?
- What must be done to avoid further pressures to mangrove areas?
- What do we know about the state of mangrove areas?
- What are the values and benefits of mangroves regarding different ecosystem services?

The discussion showed that mangrove areas of Singapore will probably continue to shrink due to the extension of water catchment structure around the entire coastline of Singapore, the need for more land reclamation also along the coastline, and sea-level rise. All the more, one should claim to conserve all remaining mangrove areas and to develop new mangrove habitat in abandoned shrimp ponds at Pulau Ubin. To preserve the mangroves, the project shall collect international experiences and design guidelines for architects and nature conservationists. In particular, a legal comparison with other countries having mangroves and recommendations how the local situation can be improved would be a great help.

Stakeholders were invited to complete their questionnaires unless already done after the workshop session.

DiSeMiNation-stakeholder cooperation (moderation: Dr. Bevis Fedder)

Stakeholders from the authority, NGO, and research sector (see participant list), together with the DiSeMiNation scientists, developed ideas on connecting the research project with mangrove management. For this purpose, selected stakeholders held short briefings from their perspectives on how they see the project fit within practical contexts. The two speakers were Yang Shufen (Deputy Director for Sungei Buloh Wetland Reserve at the National Parks Board) and Sivasothi N (Lecturer at the Department of Biological Sciences, National University of Singapore). After the briefings, two working groups further elaborated the ideas forwarded by the speakers. The overall results are summarized as follows.

Group I (Yang Shufen): Sediment microbes enhance habitat quality and improve ecosystem health (range, resilience, adaptation). However, it is a challenge to link microbes and mangroves in a way that is suitable for planning, design, management, and education. The most important challenge is to get people excited for this “invisible” topic. The group has therefore thought about two ways to make the project useful in practical contexts: A) practical questions for the research projects and B) outreach opportunities.

A) There exist several **practical knowledge questions** to which the project could provide answers. These include

- considering “functional guilds” of microbes in the sediment
- designing guidelines for habitat restoration and creation
- identifying sets of conditions to restore underground ecosystem services (not just microbial)
- identifying cultural ecosystem services

B) Although microbes are difficult to grasp by public audiences, the topic has considerable **outreach**



Fig. 2: Workshop session „DiSeMiNation-stakeholder cooperation. Group I headed by Yang Shufen.

potential. Through illustrating how microbes store carbon in sediments, the public can be educated on another important ecosystem service of mangroves. At the same time, the public increases its awareness on the major role of the “invisible” environment within mangroves. This creates the opportunity to draw further attention to the ecosystem services provided by mangrove wetlands and their global importance. Potential outreach material could be signposts within mangrove boardwalks. Additional material need to be developed in due time.



Fig. 3: Workshop session „DiSeMiNation-stakeholder cooperation. Group II headed by Sivasothi N.

Group II (Sivasothi N): Research may contribute to the education of different stakeholder groups. This includes the public, students, ecosystem managers, NGOs – all of which in turn influence government actions for conservation matters. There exist several tools to convey the information for educational purposes. These tools include symposia in the partner country, blogs and webpages, online PDFs, and technical workshops. Especially **technical workshops** have been described as a promising tool to make the project useful in practical contexts. The project would generate a lot of data useful for specialists, such as information on diversity of infauna and macrofauna, microbial diversity and activity (for baseline comparison,

maps), organic components and substrate types, etc. Through a technical workshop, this data can be transferred to, and used/processed by, specialists from authorities (e.g. NParks and its National Biodiversity Centre), the university, NGOs, etc. The technical workshop could convene at the end of the project’s runtime (e.g. 2019). NUS is planning a large international mangrove symposium that could integrate such a technical workshop. Independent funding needs to be sought for organising the workshop.

3. Excursion

On the second day, the project team visited several mangrove sites in Singapore, with a focus on those sites that harbour important biodiversity and are critical for management and future use. These sites were also some of the priority sites for the scientific sampling within the project. In the morning the team received an excellently guided tour through the different parts of the Sungei Buloh Wetland Reserve by Benjamin Lee (NParks Manager Projects/Conservation at the Sungei Buloh Wetland Reserve). In the afternoon, the team took the boat to Pulau Ubin, where the team enjoyed a great tour to different mangrove areas on the island, including Check Jawa and Puaka East, organised by Germaine Leng (NParks Manager/Conservation at Pulau Ubin Branch).



Fig. 4: Group excursion to Pulau Ubin.

4. Major Outcomes

- Scientific-practice exchange about the research project and Singapore's mangroves.
- An assessment of Singapore's mangrove ecosystem services via questionnaires and discussions (scientific analyses in progress).
- Interests of stakeholders identified in research questions relevant for practice.
- Idea for developing outreach material to raise public awareness on the importance of mangrove microbes.
- Idea for organising a technical workshop with stakeholders, which is integrated into the international mangrove symposium in Singapore in 2019.
- Identification of alternative sampling sites.



Annex1: Attendance List

Last name	First name	Position	Institution	e-mail
Beng	Stephen	Coastal Group	Nature Society Singapore	conserve.seahounds@gmail.com
Carrasco	Gonzalo	Research Fellow	National University Singapore	gonzalo.carrasco@smart.mit.edu
Chua	Siew Chin	Research Fellow	National University Singapore	siewchin@nus.edu.sg
Cormier	Nicole			
Fedder	Bevis	Officer for Knowledge Exchange	Leibniz Centre for Tropical Marine Research (ZMT)	bevis.fedder@leibniz-zmt.de
Friess	Dan	Research fellow	National University Singapore	dan.friess@nus.edu.sg
Grunewald	Karsten	Research fellow	Leibniz Institute for Ecological, Urban and Regional Development (IÖR)	k.grunewald@ioer.de
Bin Abdul Hamid	Abdul Rahim	Research Fellow	National University Singapore	
Helfer	Véronique	Research Fellow	Leibniz Centre for Tropical Marine Research (ZMT)	veronique.helfer@leibniz-zmt.de
Heng	Lye Lin	Professor for Law	National University Singapore	lawlyelh@nus.edu.sg
Kohler	Manon	Research Fellow	National University Singapore	1kohlerm@gmail.com
Lee	Benjamin	Manager Projects/Conservation Sungei Buloh	National Parks Board	benjamin_cf_lee@nparks.gov.sg
Leng	Germaine	Manager Conservation Pulau Ubin	National Parks Board	germaine_leng@nparks.gov.sg
Lin	Joseph		National Parks Board	joseph_lin@nparks.gov.sg
Ooi	SK	Research fellow	National University Singapore	sk.ooi@nus.edu.sg
Siong	Koh Kwan	Manager Biodiversity	National Parks Board	koh_kwan_siong@nparks.gov.sg
	Sivasothi	Lecturer	National University Singapore	sivasothi@nus.edu.sg
Syrbe	Ralf-Uwe	Research Fellow	Leibniz Institute for Ecological, Urban and Regional Development (IÖR)	r.syrbe@ioer.de
Yang	Shufen	Deputy Director Sungei Buloh	National Parks Board	yang_shufen@nparks.gov.sg
Zimmer	Martin	Workgroupleader mangrove ecology	Leibniz Centre for Tropical Marine Research (ZMT)	martin.zimmer@leibniz-zmt.de

Annex 2: Agenda

Thursday, May 18 th , 2017 @NUS, Department of Geography, 1 Arts Link, Room number: AS2 02-03	
09:15-09:30	Introduction Dr. Bevis Fedder on goals and structure of workshop
09:30-10:00	Plenary talk Prof. Dr. Martin Zimmer (ZMT) on the <i>DiSeMiNation</i> research project
10:00-10:30	Plenary talk Dr. Dan Friess (NUS) on the <i>Singapore's mangroves – status and value</i>
10:30-11:00	coffee break
11:00-13:00	Workshop session: ecosystem service evaluation [chair: Dr. Ralf-Uwe Syrbe, Karsten Grunewald]
13:00-14:00	lunch break
14:00-16:00	Workshop session: DiSeMiNation-stakeholder cooperation [chair: Dr. Bevis Fedder]
16:00-16:30	coffee break
16:30-17:00	Plenary: final discussion, wrap-up, feedback, outlook, intro excursion
Friday, May 19 th , 2017	
Excursion to mangrove sites (german research team, interested participants)	
9am	arrive at Sungei Buloh (Visitor Centre), have guided tour
11:30am	leave Sungei Buloh (taxi)
12:30pm	arrive Changi Ferry Terminal
12:45pm	arrive Pulau Ubin, have lunch @Cheong Lian Yuen
2pm	meet at ferry terminal, start guided tour at Pulau Ubin (Chek Jawa and Puaka East)
5:30pm	excursion end, leave Pulau Ubin
6:30pm	arrive at hotel/home

Annex 3: PowerPoint Presentations

1. Intro to the stakeholder workshop [Bevis Fedder]

29. September 2017

LEIBNIZ CENTRE
for Tropical Marine Research

ZMT

DiSeMiNation
stakeholder workshop
in Singapore

Leibniz-Institut für Ökologische Raumentwicklung DSMZ Leibniz-Institut für Plant Biochemistry NUS

Leibniz Association



29. September 2017

ZMT LEIBNIZ CENTRE
for Tropical Marine Research

The Leibniz Centre for Tropical Marine Research (ZMT)
Strong global network: long-term partnerships in the tropics



- 76 projects in 30 countries worldwide
- Over 740 alumni worldwide

29. September 2017

ZMT LEIBNIZ CENTRE
for Tropical Marine Research

The Leibniz Centre for Tropical Marine Research (ZMT)
Mission and cooperation

The objectives of the ZMT are

- to analyse tropical coastal ecosystems in their complexity and to establish the necessary scientific base that contributes to Integrated Coastal Zone Management.
- through research, capacity development and **cooperation/consultation**

Cooperation

- Continuous and problem-oriented exchange with scientific and **practical partners (government, civil society, business)** from partner countries and Germany
- develop & implement concrete activities and products for sustainable coastal management



29. September
2017

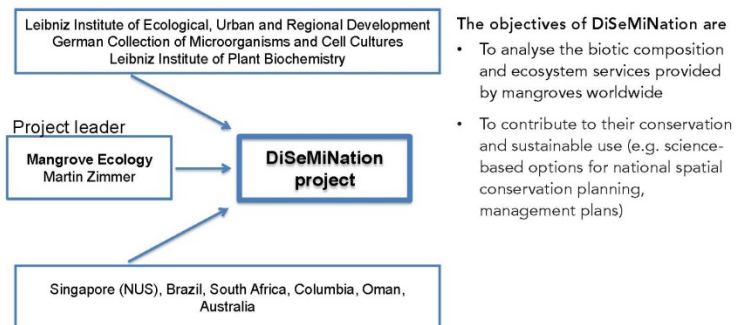
The Leibniz Centre for Tropical Marine Research (ZMT)

Organisation

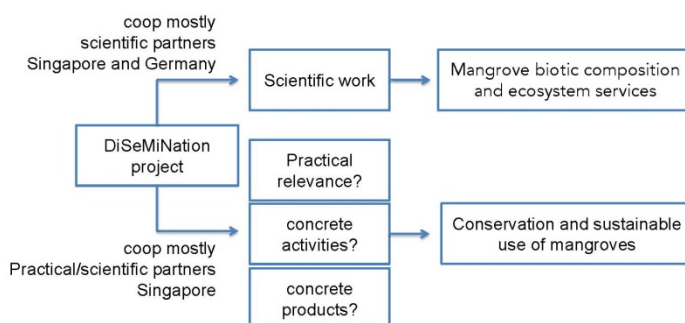
Biogeochemistry and Geology Hildegard Westphal	Ecology Werner Eklav	Social Sciences Anna-Katharina Hornidge	Theoretical Ecology and Modelling Matthias Wollf	Infrastructure Nicolas Dittart
Carbon and Nutrient Cycling Tim Rixen	Reef Studies N.N.	Development and Knowledge Sociology Anna-Katharina Hornidge	Resource Management Matthias Wollf	Administration
Ecological Biogeochemistry Tim Jennerjahn	Ecophysiology Andreas Kunzmann	Institutional & Behavioural Economics Achim Schüller	Spatial Ecology and Interactions Hauke Reuter	Biology Laboratory
Marine Ecotoxicology N.N.	Fisheries Biology Werner Eklav	Social-Ecological Systems Analysis Marion Glaser	Systems Ecology Agostino Merica	Chemistry Laboratory
Geocology & Carbonate Sedimentology Hildegard Westphal	Mangrove Ecology Martin Zimmer	Leibniz Chair Ecosystem Valuation Douglas MacMillan		Facility Management
Junior Research Groups	Junior Research Groups			IT Unit
Sea Level and Coastal Changes Alessio Rovere	Algae and Seagrass Ecology Mirja Teichberg			Library (MEDIA Unit)
Submarine Groundwater Discharge Nils Moussier	Human Agency, Resilience and Diversity in Coral Reefs Sebastian Ferra			Marine Experimental Ecology (MAREE)
Tropical Marine Microbiology Astrid Girdes				Scientific Diving Center
				Thin Sections and SEM Laboratory

29. September
2017

Goals, structure of DiSeMiNation

29. September
2017

Goals, structure of DiSeMiNation

29. September
2017

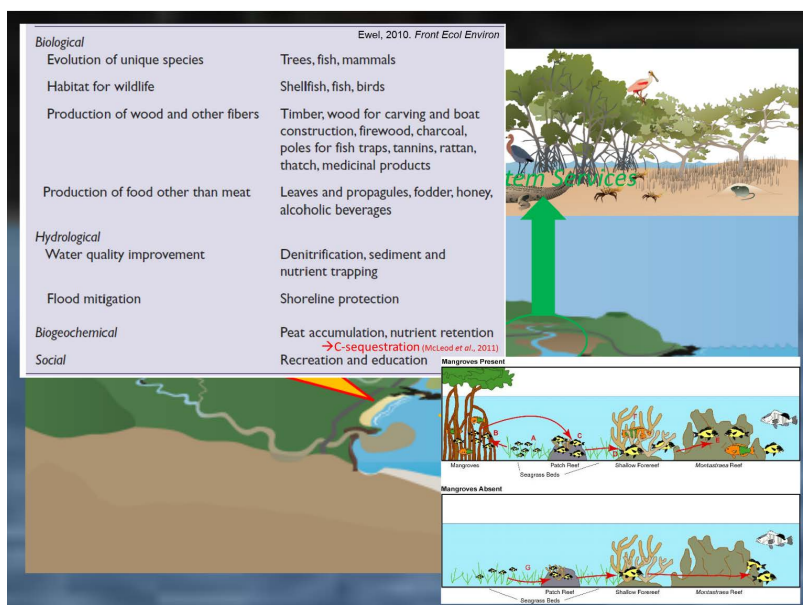
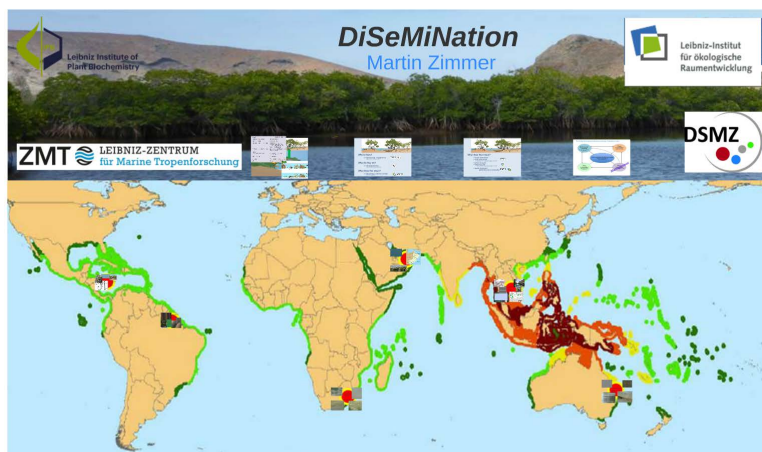
Goals of the workshop

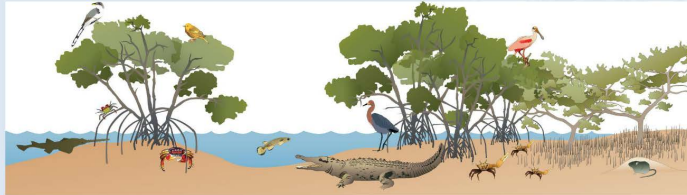
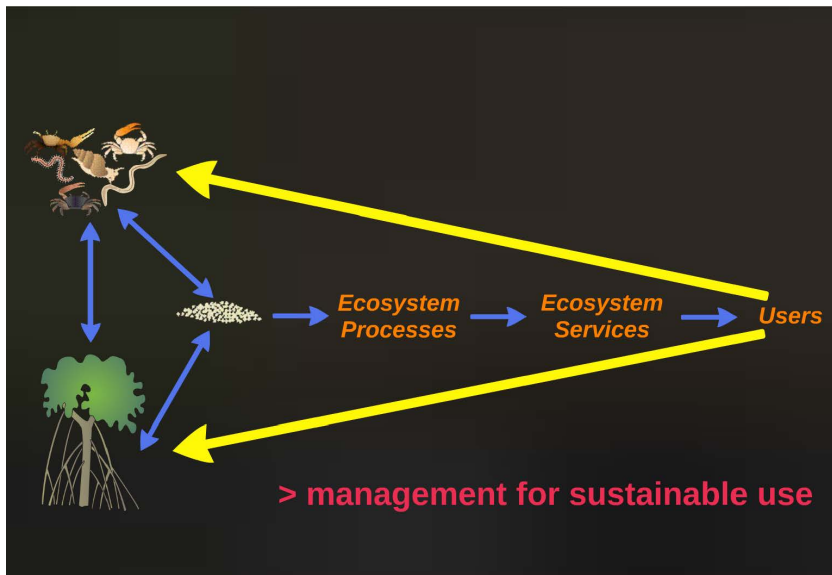
The goals of this workshop are

1. Introduce the research project (questions, approach, results) to stakeholders in Singapore
2. Identify potential interest for the research project from management perspectives
3. Assess, refine, and evaluate mangrove ecosystem services from stakeholder perspectives for research purposes (Workshop Session I)
4. Develop ideas for joint activities between stakeholders and DiSeMiNation to create products that benefit conservation and sustainable management of mangrove ecosystems in Singapore (Workshop Session II)

29. September
2017

2. Intro into the DiSeMiNation research project [Martin Zimmer]





Who is there?

→ metabarcoding / metagenomics
(taxonomic & functional diversity)



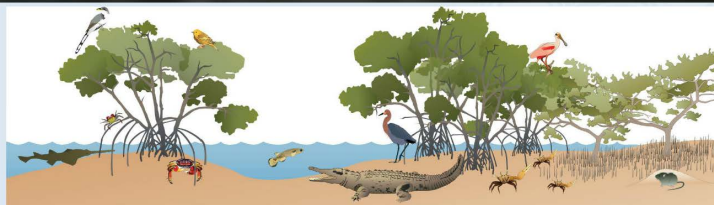
What do they do?

→ metatranscriptomics
(potential & actual microbial activity)



What does that mean?

→ metabolomics / sediment chemistry
(sediment processes)



What does that mean?

→ abiotic environment
→ biotic environment
(drivers of sediment processes & ecosystem services)

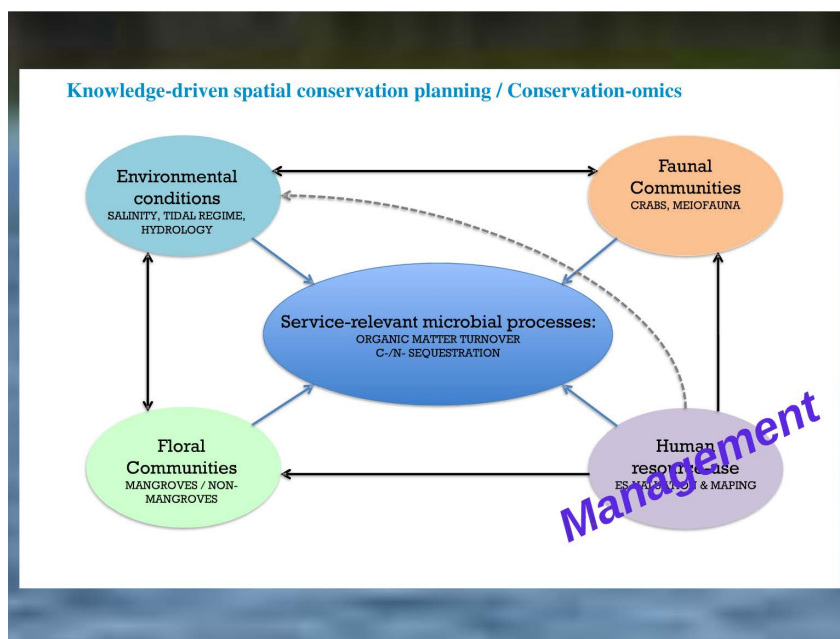


→ service-mapping
→ threat-mapping
(threats on sediment processes & ecosystem services)



→ spatial planning for
sustainable use vs conservation

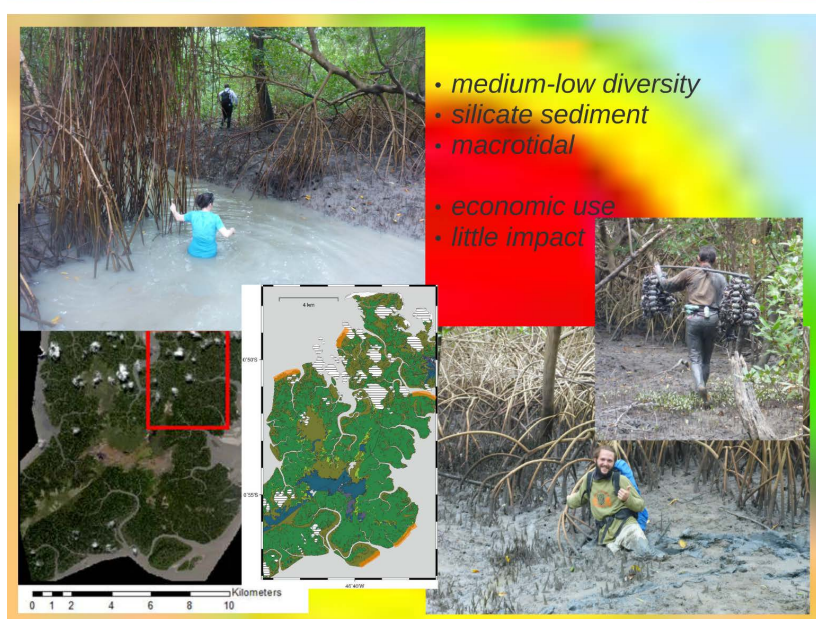
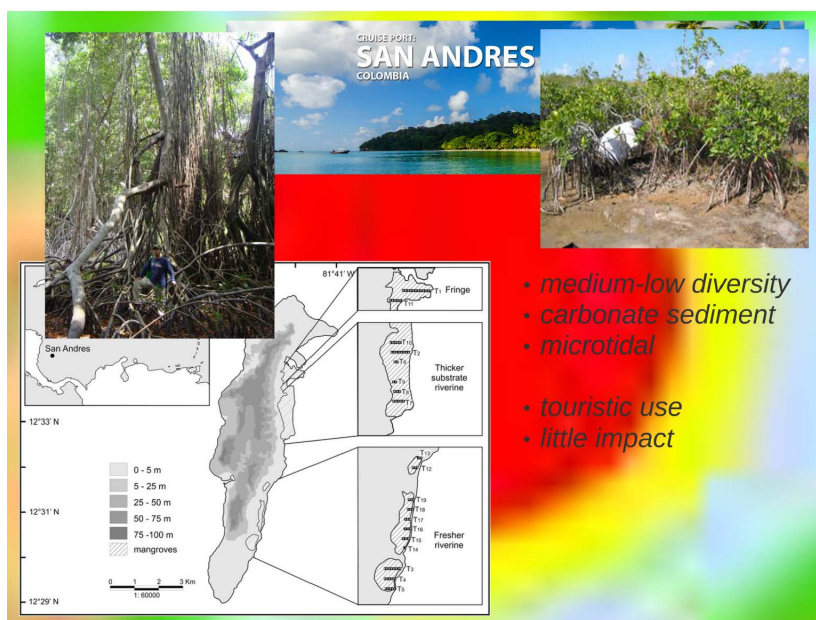
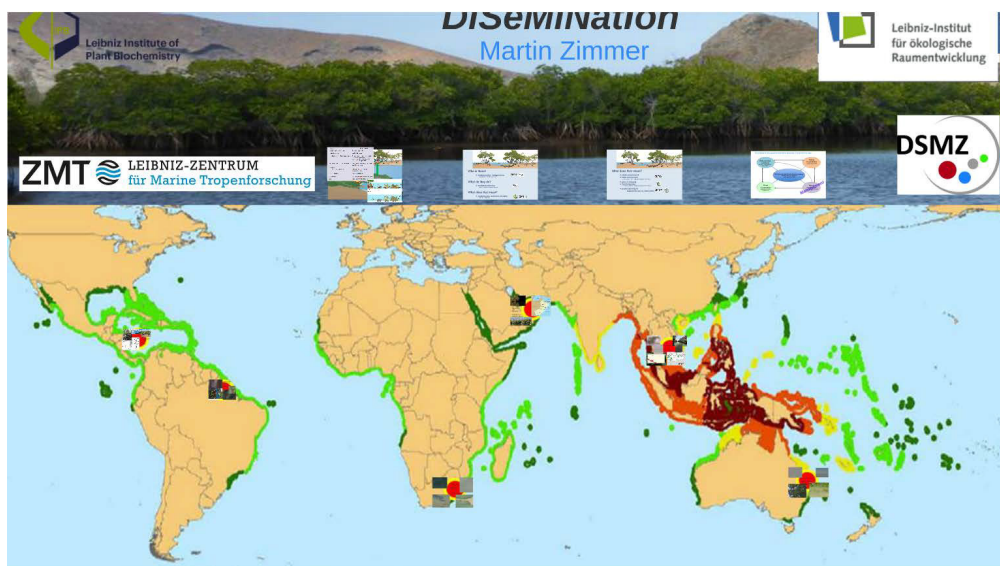




-what do you need from us?

-question-driven research!

- stakeholders
- managers
- decision-makers





- *low diversity*
- *Northern limit*
- *arid*
- *microtidal*
- *moderate use*
- *moderate impact*



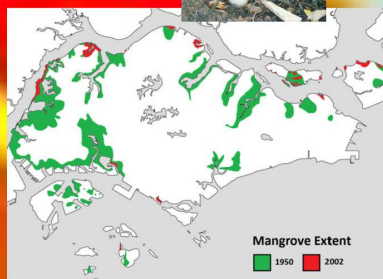
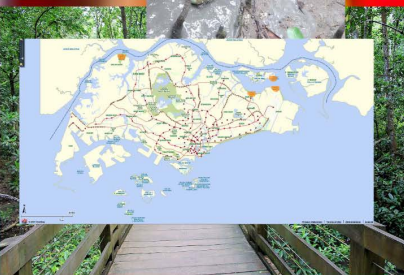
- *low diversity*
- *Southern limit*
- *(semi-)arid*
- *macrotidal*

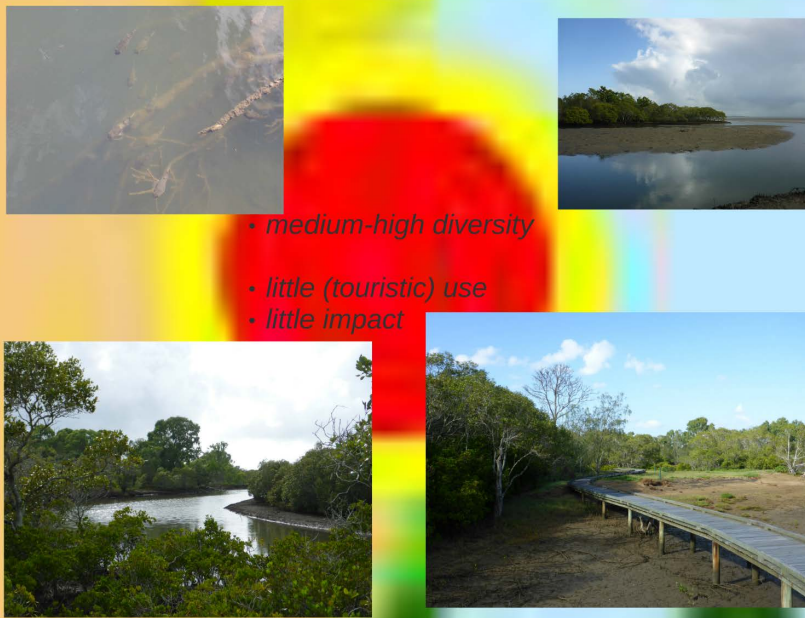
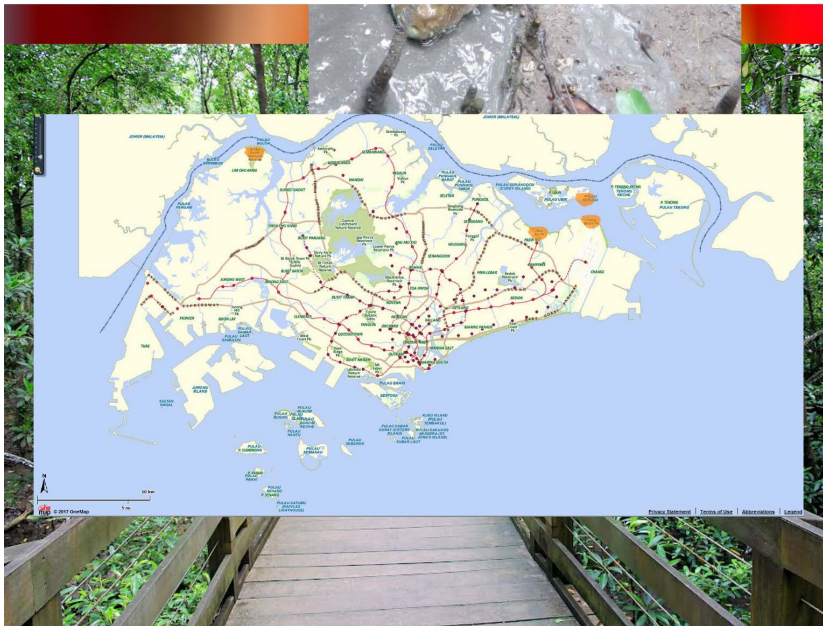


- *economic use*
- *moderate impact*



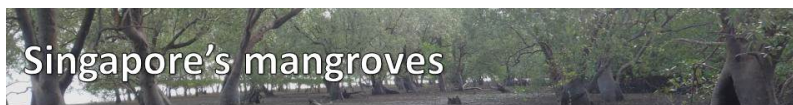
- *high diversity*
- *little use*
- *huge impact*





- medium-high diversity
- little (touristic) use
- little impact

3. Intro into the mangrove status in Singapore [Dan Friess]



Species: 35 species of 'true' mangroves (Yang et al., 2013)

Historical area: 7500 ha 200 years ago? (Corlett, 1992)

Current area: 650 ha (Yee et al. 2010) to 950 ha (NParks)

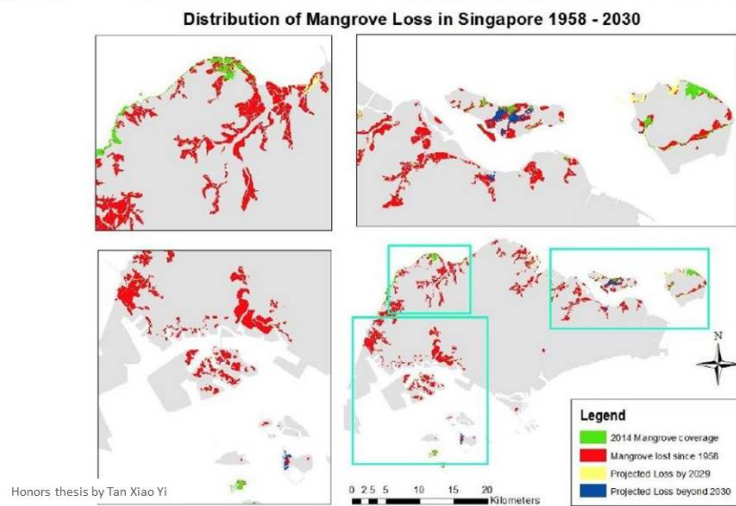
Current mangrove status: small fragments (max. ~100 ha), mostly in the northwest and northeast

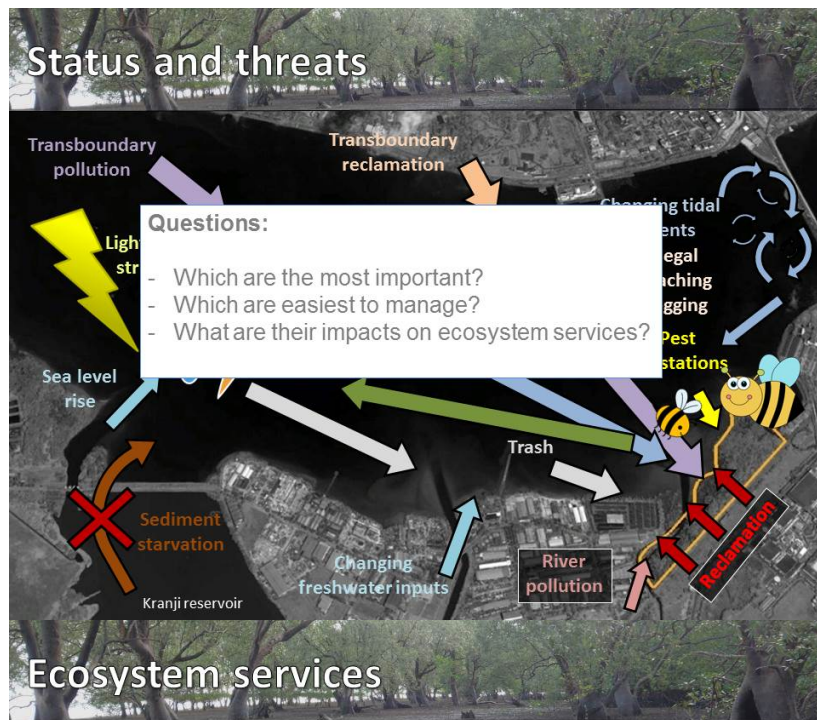
Status and threats

See also Hilton and Manning 1995; Lai et al. 2015



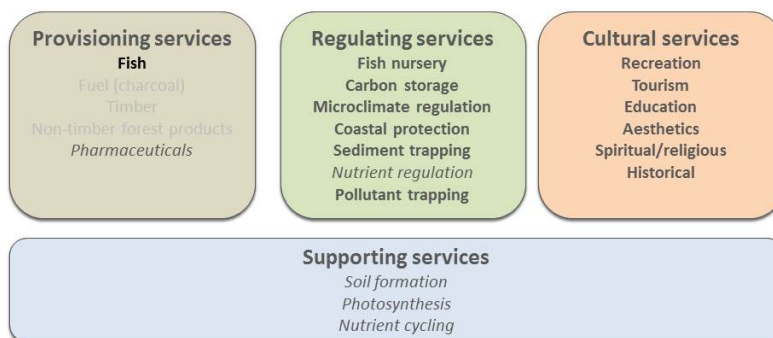
Status and threats





Ecosystem services

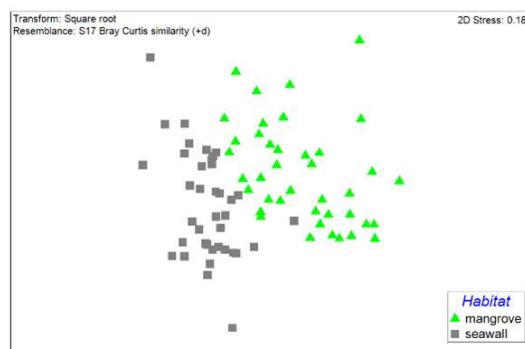
The direct and indirect benefits that ecosystems provide to human populations (e.g., not just biodiversity)



Fisheries

Why important?

Food security, key component of the food web

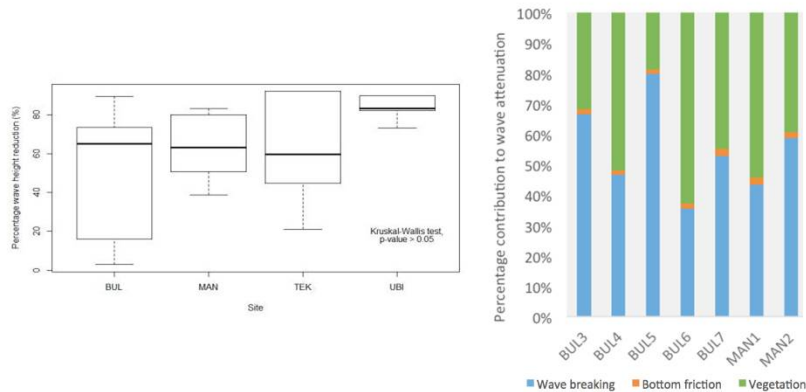


Benzeev et al. *in revision*. Fisheries ecosystem services value of an urban mangrove. *Hydrobiologia*

Coastal protection

Why important?

Reduce wave energy, protect shoreline assets

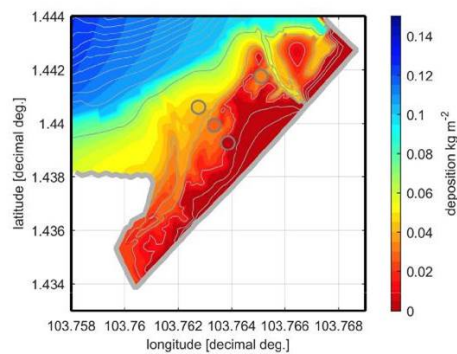


Masters thesis by Lee Wei Kit

Sediment trapping

Why important?

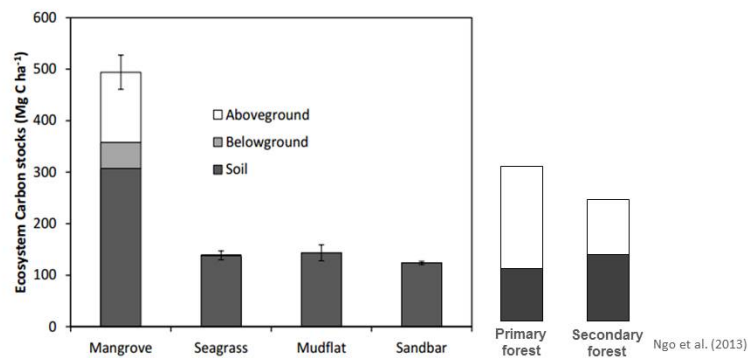
Consolidate shorelines, reduce erosion, keep pace with sea level rise.



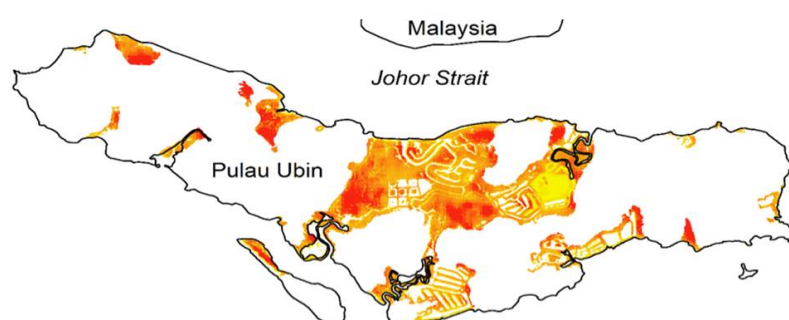
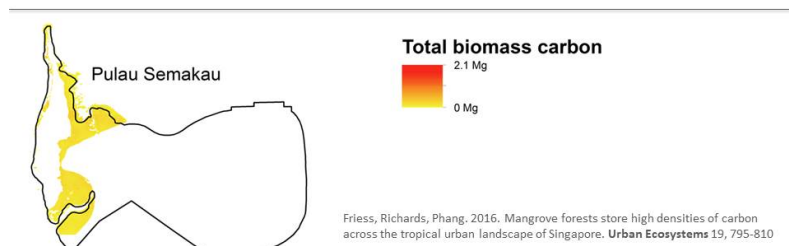
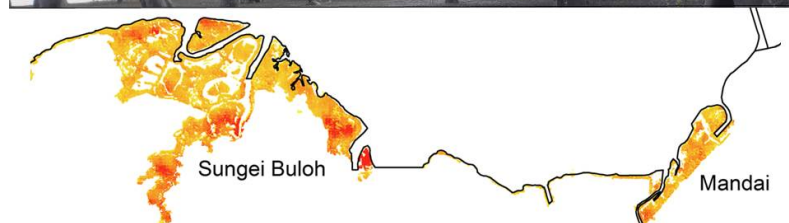
Carbon storage

Why important?

Mangroves take CO₂ out of the atmosphere, reduce our national carbon footprint and contribution to climate change



Phang et al. 2015. Ecosystem carbon stocks across a tropical intertidal habitat mosaic of mangrove forest, seagrass meadow, mudflat and sandbar. *Earth Surface Processes and Landforms* 40, 1387-1400.



Friess, Richards, Phang, 2016. Mangrove forests store high densities of carbon across the tropical urban landscape of Singapore. *Urban Ecosystems* 19, 795-810



= 450 000 tonnes of carbon = 1 652 096 tonnes of CO₂-e
 = annual emissions of 347 810 cars
 = annual emissions of 621 089 Singaporeans

An important component of our reporting to the UNFCCC and the NParks biomass carbon project

Ecosystem	MgC ha ⁻¹	Area (ha)	Total carbon MgC
Mangrove	469.3	960	450,571.7
Secondary forest	274.2 ^{a, b}	15,283.2 ^c	4,190,653.4
Primary forest	336.7 ^{a, b}	118.34 ^c	39,831.6
Roadside trees	not reported	not reported	83,540 ^{d, e}
Parkland trees	not reported	not reported	13,850 ^{d, e}

Mangroves contain 10% of the carbon of secondary forests, but only 6% of the area

Cultural values

Why important?

Bring money into the economy, green spaces for health and relaxation, contributes to the "City in a Garden"

How to measure?

Traditionally by questionnaires and interviews

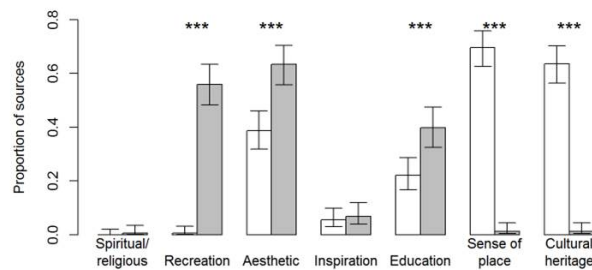
Could also use historical and contemporary photographs



Quantifying cultural value

How have mangrove cultural values changed from the 1980s to today?

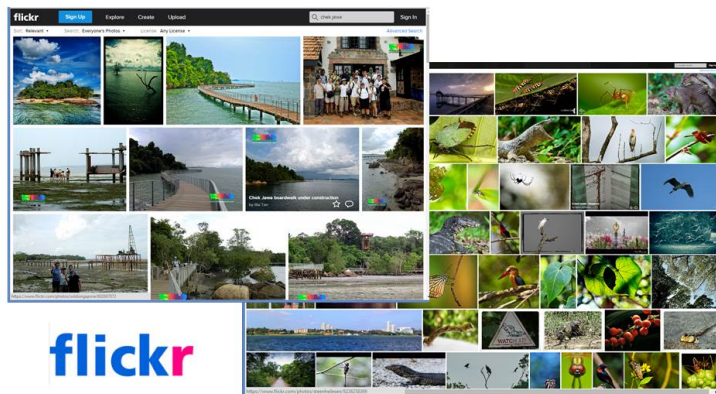
- Increase in instrumental uses – recreation, aesthetic, education
- Decrease in intrinsic appreciation – sense of place, cultural heritage



Thiagarajah et al. 2015. Historical and contemporary cultural ecosystem service values in the rapidly urbanizing city state of Singapore. *Ambio* 44, 666-677.

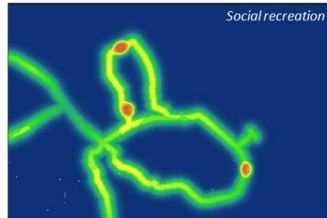
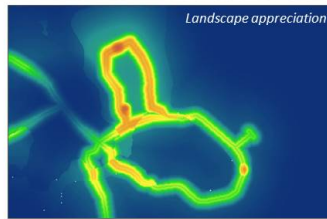
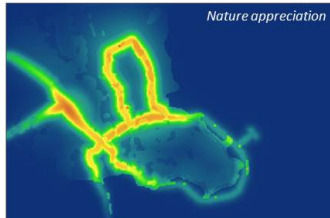
Quantifying cultural value

Rapid assessment of cultural ecosystem service usage using social media



Cultural value

Richards & Friess, 2015. A rapid indicator of cultural ecosystem service usage at a fine spatial scale: content analysis of social media photographs. *Ecological Indicators* 53, 187-195.



Summary and next steps

- Mangroves in Singapore provide crucial ecosystem services
- Mangrove status has reduced historically, but is currently stable
- Multiple threats, some easy to manage, others maybe not...
- How to reconcile development and mangrove protection in the future?

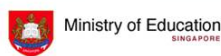
Next steps

- What ecosystem services are we missing?
- Should we convert these ecosystem services to financial values?
- NRF/CREATE proposal to upscale this to a National Ecosystem Services Assessment

Acknowledgements



The Mangrove Lab, Department of Geography, National University of Singapore



For more information: www.themangrovelab.com or dan.friess@nus.edu.sg

4. Introduction into the ecosystem evaluation research part of DiSeMiNation [Karsten Grunewald]

Evaluation of Mangrove Ecosystems and their Services (Project DiSeMiNation)

Stakeholder Workshop, NUS
Singapore, 18.05.2017



K. Grunewald, R.-U. Syrbe
www.ioer.de



IOER - Leibniz Institute of Ecological Urban and Regional Development, Dresden (Germany)

- Non-university spatial development research institute, interdisciplinary approach
- Member of the Leibniz Association
- Founded in 1992
- Ca. 120 employees
- Budget: ca. 8 Mio. Euro, including ca. 2 Mio. Euros of third-party funding (2014)
- Close cooperation with the TU Dresden
- Cooperation with partners in over 20 Countries

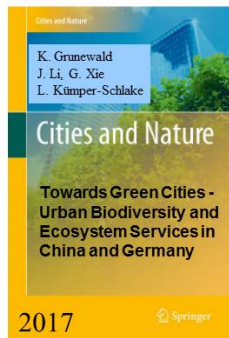
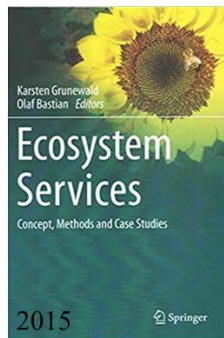


K. Grunewald, R.-U. S.
www.ioer.de



Our Research Area

- ▀ Landscape Change and Management
- ▀ Assessment of Ecosystems and their Services

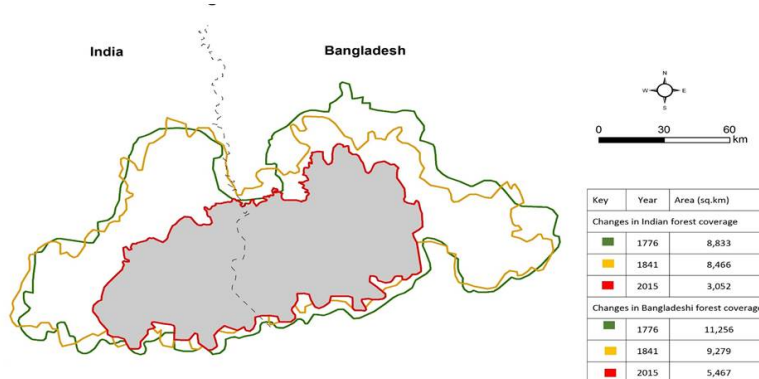


K. Grunewald, R.-U. Syrbe
www.ioer.de



The Problem - Loss of Ecosystems/Biodiversity (MEA 2005)

The areas of the Sundarbans in Bangladesh has reduced from 11,256 km² in 1776 to 5467 km² in 2015

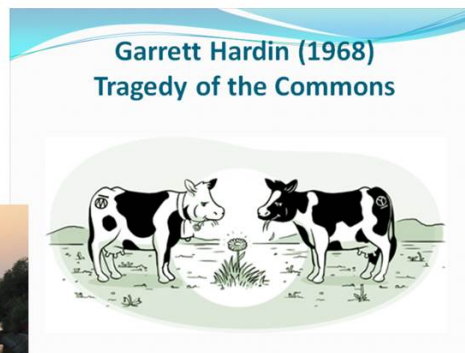


Why ES Assessments?

Market and policy failure in dealing with public goods

Market rules promote the overuse

The policy would have to counter-control, but how?





Global initiatives, strategies, e.g. TEEB, NEA, MAES



GREEN economy



ES concept (integrative, systematic...)

At the interface ecosystem services–land use an integrative management is necessary, which aims at the balance between the conservation, the sustainable use and the fair allocation of benefits from the utilization of the land.

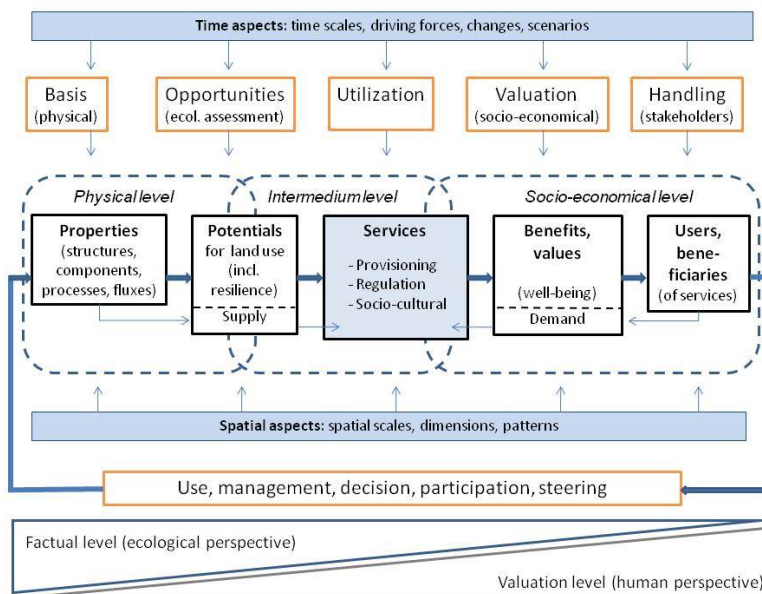
EPPS framework

- Step-wise analysis and valuation from **ecological** properties via **potentials** (supply) to **services** and benefits (values, demand, beneficiaries)
- Explicite consideration of space and time scales

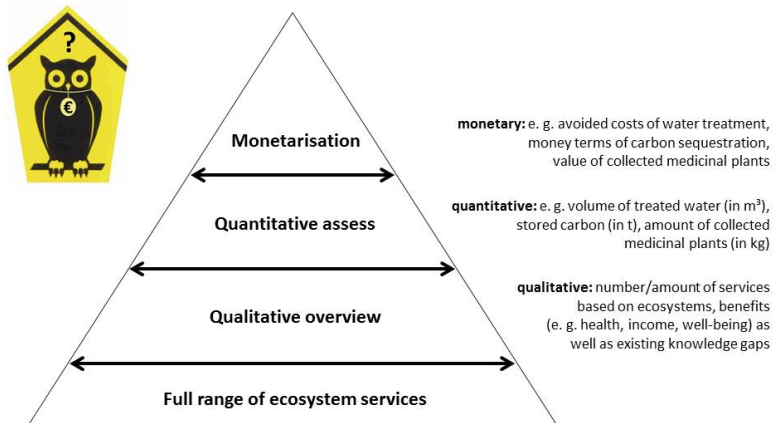
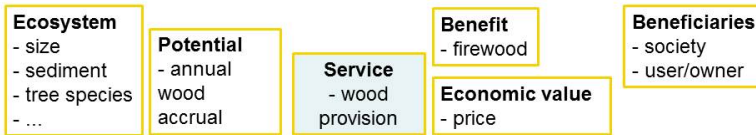
K. Grunewald, R.-U. Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung



Example: Valuation of „wood usage“



Basic approaches to ES evaluation (ten Brink 2008)

K. Grunewald, R.-U. Syrbe
www.ioer.de



Assessment methods

- **Participatory approaches**
 (Interviews with stakeholders, workshops, citizens' jury)

Further:

- **Expert evaluations**
 (utility analysis, ecological assessments)
- **Modelling / GIS**
- **Economical procedures**
 (Market or shadow prices, Benefit transfer)



K. Grunewald, R.-U. Syrbe
www.ioer.de



Benefit Transfer

Results from other primary studies in which ES-values have already been collected are transferred to the study area and to the services to be tested.

Value of ES per biome in monetary units (de Groot et al. 2012): Most value data points were found for inland wetlands (25%), coastal wetlands (especially mangroves)(21%), tropical forests (14%) and coral reefs (14%).

TEV (coastal wetland): 193,845 \$/ha/year

K. Grunewald, R.-U. Syrbe
www.ioer.de

DRESDEN
concept

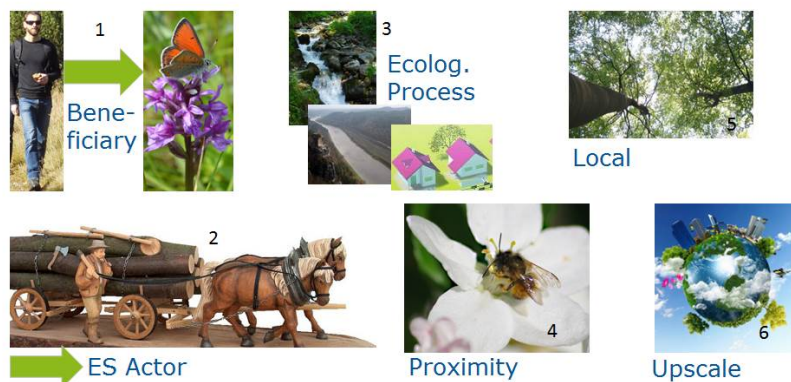
Leibniz-Institut
für ökologische
Raumentwicklung

Table All.3 Monetary value of services provided by mangroves & tidal marshes
Int.\$/ha/year – 2007 values

Russi et al. 2013

Mangroves & tidal marshes		No. of used estimates	Minimum values (Int.\$/ha/y)	Maximum values (Int.\$/ha/y)
TOTAL:		112	1995	215,349
PROVISIONING SERVICES		35	44	8289
1	Food	12	0	2600
2	(Fresh) water supply	3	41	4240
3	Raw materials	18	1	1414
4	Genetic resources	?		
5	Medicinal resources	2	2	35
HABITAT SERVICES		38	27	68,795
16	Lifecycle maintenance (esp. nursery service)	33	2	59,645
17	Gene pool protection (conservation)	5	25	9150
CULTURAL SERVICES		13	10	2904
18	Aesthetic information	?		
19	Opportunities for recreation and tourism	13	10	2904
20	Inspiration for culture, art and design	?		
21	Spiritual experience	?		

Spatial types of ecosystem services' transfer



K. Grunewald, R.-U. Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung

Challenge DiSeMiNation



ES of Singapore (in comparison to other Mangrove areas)
(Characteristics, values, specifics)

Linkage between samples/genetic part of biodiversity to
stakeholder benefits (nature-society)

K. Grunewald, R.-U. Syrbe
www.ioer.de



Questionnaire: account for the diversity of ES, stakeholder
operation, and mangrove area governance

Objectives:

- (1) identify key ES in Mangrove areas,
- (2) map-relevant stakeholders, the threats they make to and benefits they receive from ES, and the (dis)-similarities in the way they operate, and
- (3) assess governance challenges that need to be addressed to enhance sustainability



- 
- Photo: Karimon Nesha

Ralf-Uwe Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für
Raumbezogene
Raumentwicklung

Pre-workshop questionnaire: First results

First results

Please return the filled questionnaire by 15 April 2017 to Ralf-Uwe Syrbe, Email: r.syrbe@joer.de

Ralf-Uwe Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung

[illegible]

Ralf-Uwe Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung

Pre-workshop questionnaire: Relevant Ecosystem Services (ranked)

ES Regulating, Cultural, Provisioning	Importance	Range	Comment
R Nursery	Very high	4-5	Project contributions
R Seed dispersal + pollination	High	2-5	
C Heritage	High	3-5	Project contributions
C Education, aesthetic	High	2-5	
C Scientific	High	4-5	Project contributions
C Entertainment	Medium	2-4	
R Local-regional climate regulation	Medium	1-4	
R Sequestration + fixing GHG	Medium	3-4	Project contributions
R Mediation + filtering waste / pollut., storm protection, water flow	Medium	1-4	Project contributions
R Flood protection	Medium	1-4	?
P Use of wild plants / animals	Medium	1-5	Project contributions
C Spiritual / existence	Medium	2-4	Project contributions
P Use of genes, water resources	Low	1-4	
R Pest / disease control	Low	2-3	?

Ralf-Uwe Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung

Pre-workshop questionnaire: Benefitting and threatening stakeholder groups (ranked)

Stakeholder group	Benefit	Range	Threat
Scientists	High	4-5	Low
Wildlife / bird watchers	High	2-5	Medium
NGOs	High	3-5	Low
Education for schools or groups	High	1-5	Low
Conservation experts	High	1-5	Low
Nature-based tourism entrepreneurs	High	1-4	Low
Visitors (other)	Medium	1-4	Medium
Touristic operators	Medium	3	Low
Canoeists	Medium	1-3	Medium
Resort business workers	Low	1-4	Low
Small tourism entr. (bed+breakfast)	Low	1-3	Low
Fisherman, Shrimpers	Low	1-2	Low

Ralf-Uwe Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung

Pre-workshop questionnaire: Governance

Positions	Agree	Range	Improvement?
Scientific knowledge plays a role for decision-making	High	3-5	
Governance is adaptive and flexible	High	3-5	
Governance appears mainly top-down	High	2-5	
Lokal stakeholder can influence decisions	High	4	
Governance instruments consider mangroves	High	4	
Land-use planning has effect on mangroves	Medium	3-4	
Land use planning is transparent	Medium	2-4	
Too many overlapping gov. instruments	Medium	3	
Governance is balanced top-down/bottom-up	Medium	2-4	
Gov. enables two-way knowledge exchange	Medium	3	
Holistic ecological network approach needed	Single	Stated	

Ralf-Uwe Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung

Pre-workshop questionnaire: Scientist-stakeholder relations

Positions	Agree	Range
Stakeholders can influence study questions	Very high	5
Research enable two-way knowlegde exchange	Very high	5
Research projects include stakeholders	High	4-5
Stakeholders to be included additionally:		
Knowledge needs are addressed by research	High	4-5
Research meets decision-makers' questions	High	4
Your questions to DiSeMiNation:		
Research projects include dissemination efforts	High	4-5
Research projects examine consequences of management decisions	High	4
Scenarios that should be checked:		

Ralf-Uwe Syrbe
www.ioer.de



Pre-workshop questionnaire: Scientist-stakeholder relations

Positions	Agree
Additional stakeholders to be included. (please specify)	
DiSeMiNation should answer our questions. (please specify)	
Projet should deal also with future scenarios. (please specify)	
The interaction between science and decision-making did lead to concrete social-ecological outcomes in the past	
Research-stakeholder exchange and outcomes should be evaluated systematically	
There exist standard exchange measures between science and decision-making	
The exchange between science and stakeholders leads regularly to conflicts	
There are stakeholder groups that do not want to be engaged with research processes	
Research and stakeholders exchange early and in a continuous way	

Ralf-Uwe Syrbe
www.ioer.de



Pre-workshop questionnaire: Knowledge gaps

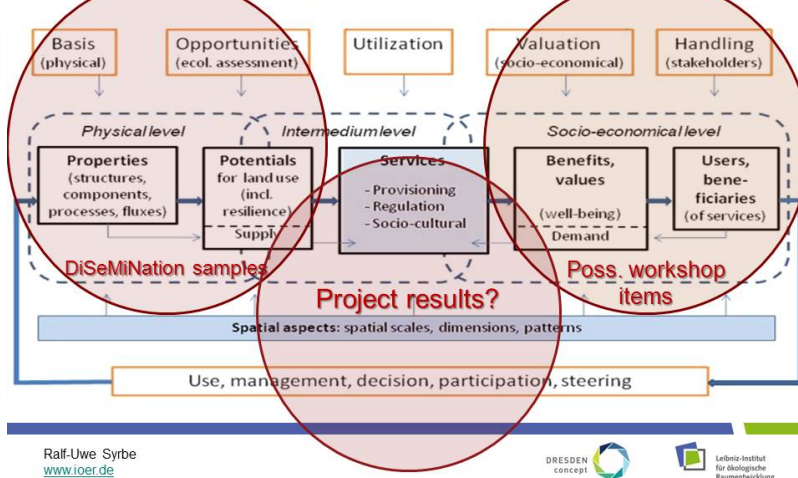
Suggestions	Your vote
Urbanization impacts on mangrove ecosystems	
Biodiversity inventory of animal species	
Hydrology and its impact on sedimentation	
Distribution of surrogate species	
Perceptions of mangrove biodiversity	
Role of mangroves in overall ecological network	
Values of mangroves' ES in urban context	
How to rehabilitate mangrove ecosystems	
More:	

Ralf-Uwe Syrbe
www.ioer.de



Values: Following the EPPS-Framework

(Grunewald & Bastian 2012)



Values: 1. Area

What do we know?

Singapore had 7500 ha mangrove forest in the past (1819), i.e. 10% of Singapore's area. Today, there are 659 ha left, resp. 1 % of Singapore's area (Yee et al. 2010).

What can you tell us?

How many area must be protected at least?
Do we need more mangrove forests as well in Singapore?
If so, how many?

What should be contributed by DiSeMiNation project?

Values: 2. Pressures to mangrove areas

What do we know?

Dam construction for freshwater provision

Continued development pressure e.g. Pulau Ubin

What can you tell us?

What should be contributed by DiSeMiNation project?

Values: 3. State of mangrove ecosystems

What do we know?

cf. presentation of Dan Friess

What can you tell us?

What do you expect for the next two decades?

What should be contributed by DiSeMiNation project?
Deeper insights into genetic and functional biodiversity?

Values / benefits of cultural ecosystem services

What do we know?

Qualitative valuation (4 sites)
- Mainly: recreational, touristic, educational
- To be raised awareness: sense of place, inspiration, (spiritual)

What can you tell us?

Access allowed – where?
Number of visitors
Touristic infrastructure (trails etc.)
Education facilities (particularly biodiversity/ecosystem services)

What should be contributed by DiSeMiNation project?

Values and benefits of regulating ES

What do we know?

Nursery: 500-2500 \$/ha*a
(TEEB, MA)
Carbon sequestration:
190 (stock) + 307 (sediment) tC/ha
(Check Jawa, Phang et al. 2015)
Matter mediation / filtering:
Flood/storm protection: 2400 \$/ha*a
(Barbier et al. 2003, Thailand)

What can you tell us?

Values known for Singapore?
Existing carbon market, prices?
Mangroves needed for climate regulation / air purification?
Situation of coast protection (flooding / sea level rise)

What should be contributed by DiSeMiNation project?

Values and benefits of provisioning ES

What do we know?

No direct use since mangroves are protection areas

What can you tell us?

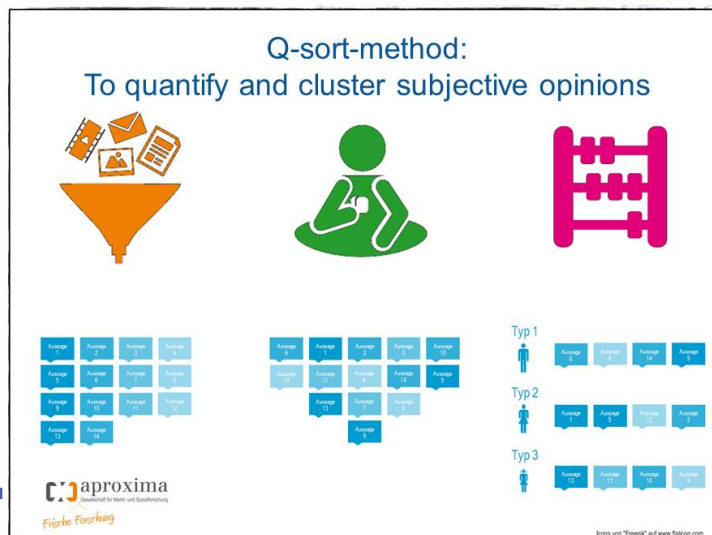
Where is protection lacking?
Fish / seafood catch
Firewood / charcoal use and accrual

What should be contributed by DiSeMiNation project?

Ralf-Uwe Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung



Q: Please stick the statements on the raster

1. People benefit from mangrove areas by provisioning of jobs, work and ecotourism opportunities.
2. Inevitable damage to environment appears owing to human presence.
3. We need a better understanding of the hydrology ... and its impact on sedimentation ...
4. Urbanization impacts on mangrove ecosystems is to be examined from urban ecology view.
5. There should be made a biodiversity inventory of mangroves and the effect of urbanization ...
6. A knowledge gap is the distribution of surrogate species of conservation in mangrove forests.
7. We should better know the perceptions of mangrove ecosystems and biodiversity...
8. The valuation of ecosystem services of mangroves in a city/urban context ... is still needed.
9. Concepts are required for revegetating and rehabilitating mangroves ...
10. "Turning the tide" requires to recover considerable areas of mangrove also in Singapore.
11. Different stakeholder groups from government, civil society, business, and science need to cooperate better for sustainable mangrove management
12. Mangrove areas under military control are well-protected and preserved.

Ralf-Uwe Syrbe
www.ioer.de

DRESDEN
concept

Leibniz-Institut
für ökologische
Raumentwicklung

6. Stakeholder engagement session [Bevis Fedder]

LEIBNIZ CENTRE
for Tropical Marine Research

Workshop Session II

DiSeMiNation-stakeholder cooperation

29. September 2017

LEIBNIZ CENTRE
for Tropical Marine Research

2

National mangrove
management Singapore

DiSeMiNation project

Joint activities?
Joint products?

Mangrove
conservation/
sustainable use

29. September
2017

ZMT LEIBNIZ CENTRE
for Tropical Marine Research

3

DiSeMiNation-stakeholder interaction

Objectives and agenda of workshop session

Objectives

- Develop 2-4 concrete ideas for *joint activities* between stakeholders and DiSeMiNation to *develop products* that benefit conservation and sustainable management of mangrove ecosystems in Singapore

Agenda (2 hrs):

- *Two briefings for ideas and inspiration* (max. 30 minutes)
 - Yang Shufen: Deputy Director Conservation @Nparks
 - Sivasothi N: senior lecturer Dept Biological Sciences @NUS
- *Working phase* (ca. 60 minutes)
 - split into same-size groups, one idea per group, 2-4 ideas = 2-4 groups
 - Material: poster paper, cards, pens, etc. or flip chart
 - World Café: group swap after 20 minutes, one fixed moderator per table
- *Plenary presentation and discussion* (ca. 20-30 minutes)

29. September
2017

DiSeMiNation-stakeholder interaction

Poster elements

1. **What is the outcome:** e.g. raise awareness, enhance skills, contribute to political/societal debate or environmental decision-making, data sharing, developing research questions...?
2. **What aspects of DiSeMiNation are relevant for mangrove management:** expertise, data, results, knowledge, ...?
3. **What is the joint activity:** e.g. cooperate, involve, consult, inform?
4. **What is the joint product:** e.g. awareness material, trained people, policy briefs, database data, adapted research, ...?
5. **Who are the target groups/partners:** e.g. specific groups from the government, civil society, business sectors.
6. **Who is our cooperation partner:** specific person for follow-up actions
7. **What are the next steps:** What has to be done next to put the measure into practice?