INTERNATIONAL SYMPOSIUM
ON THE BIODIVERSITY ASSOCIATED WITH MANGROVE ECOSYSTEMS IN SOUTHEAST ASIA

Ha Noi, Viet Nam, 17-19 May 2010

PROGRAMME & ABSTRACTS

Hanoi, May 2010

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SYMPOSIUM SCHEDULE

17th May, 2010			
8:30-9:00		Registration	
9:00-9:10		Opening Address by Prof. Dr. Nguyen Ngoc Chau	
9:10-9:20		Welcome Address by Prof. Dr. Le Xuan Canh, Director of Institute of Ecology and Biological Resources, VAST.	
9:20-9:30		Keynote for the Symposium by Prof. Dr. Ann Vanreusel	
9:30-10:00		Group Photo & coffee break	
Session 1. General problems of Mangrove Ecosystems Chair-man Prof. Dr. **Ulrich Saint-Paul** and Dr. **Vien Ngoc Nam**			
No	Time	Contents	Authors
1	10:00-10:25	Biodiversity of mangrove flora in Can Gio Biosphere Reserve, Ho Chi Minh City, Vietnam	Vien Ngoc Nam
2	10:25-11:50	Biodiversity and Value of Can Gio Mangrove Forest	Huynh Duc Hoan
3	11:50-12:15	Mangroves of Singapore: Botanical updates and current status	Yong, J.W.H., Yang,S.F., Lim, L.F., Sheue, C.R.
12:15-13:30		Lunch	
4	13:30-13:55	Outcome and perspectives of Education in Nematology related to Natural ecosystems	Nicole Smol
5	13:55-14:20	Diversity of fish in Can Gio mangrove ecosystem, Ho Chi Minh City, Vietnam	Nguyen Xuan Dong, Ngo Van Tri
6	14:20-14:55	Macrobenthic biodiversity in Can Gio mangrove forest	Pham Dinh Trong, Nguyen Xuan Duc
7	14:55-15:20	Rapid assessment of terrestrial vertebrata fauna at Dat Mui National Park, Ca Mau province	Nguyen Xuan Dang *et. al.*
15:20-15:50		Coffee break	
8	15:50-16:15	The loss of species: mangrove extinction risk and geographic areas of global concern	Beth A. Polidoro *et. al*.

9	16:15-16:40	The relationship between species, structural and functional diversity in mangrove ecosystems	Barry Clough
10	16:40-17:05	Mangrove habitat dynamics and rapid sea-level rise	Toyohiko MIYAGI
18:30-20:30		**Welcome Party** Hosted by Assoc. Prof Dr. Le Xuan Canh, IEBR Director Venue: Conference Hall, 3rd Floor, Army Hotel	
18th May, 2010			
Session 2. Meiofauna and Nematodes in Mangrove Ecosystems Chair-man Prof. Dr. **Ann Vanreusel,** Prof. Dr. **Zhinan Zhang** and Prof. Dr. **Nguyen Vu Thanh**			
10	8:30-8:55	The use of meiofauna in monitoring the quality of mangrove ecosystems	Ann Vanreusel
11	8:55-9:20	Biodiversity of Meiofauna community and used Nematodes as bioindicator in the Can Gio mangrove forest, Ho Chi Minh city	Nguyen Dinh Tu, Nguyen Vu Thanh and Ann Vanreusels
12	9:20-9:45	Nematode communities in Durian storm impacted area, Can Gio mangrove forest, HCM city	Ngo Xuan Quang *et. al*.
13	9:45-10:10	A study on nematode species composition of the family Comesomatidae Filipjev, 1918 (Nematoda) reconized in some coastal areas of Vietnam	Nguyen Vu Thanh, Gagarin and Nguyen Dinh Tu
10:10-10:40		Coffee break	
14	10:40-11.05	Meiobenthic communities in coastal mangrove area of the inner gulf of Thailand	Chawaporn Jittanoon and Chittima Aryuthaka
15	11:05-11:20	Functional adaptations of nematode assemblages to the mangrove habitat: a comparative study	Hong Zhou and Zhinan Zhang
16	11:20-11:45	Nematodes of the 'lesser' mangroves of Tamil Nadu, Southeast coast of India	Olivia J.Fernando
17	11:45-12:15	Can traditional taxonomy in nematology retain its place as a science in an automated world of barcoding, digital images and scaled-up biodiversity informatics?	Wilfrida Decraemer
12:15-13:30		Lunch	

Session 3. . **Ecological tools for Mangrove Management** Chair-man Prof. Dr. **Ulrich Saint-Paul** and Prof. Dr. **Yoshiaki Kitaya**			
18	13:30-13:55	Photosynthesis in pneumatophores and hypocotyls of mangroves for supplying oxygen to their underground parts	Yoshiaki KITAYA
19	13:55-14:10	Bioaccumulation, depuration of heavy metals (As, Cd, Pb) and metabolism of these metals in body of mussels (*Meretrix lyrata*) during 20 days in artificial media of culture	Pham Kim Phuong *et. al.*
20	14:10-14:35	Contribution to understanding the physical environment of the mangrove in the Ca Mau cap and surrounding area	Le Xuan Thuyen
21	14:35-15:00	The impact of indirect effects of climate change on mangrove associated biodiversity	Elisha M'rabu *et. al.*
15:00-15:30		Coffee break	
22	15:30-15:55	Sustainable development of mangrove resources- combining the best practices	Tan Kim Hooi
23	15:55-16:20	Estimates of benthic secondary production In Yellow river estuary and it's adjacent waters in the Bohai sea China	Zhinan Zhang and Hong Zhou
24	16:20-16:45	Lessons learnt from Can Gio for mangrove rehabilitation in Gujarat, India	Ulrich Saint-Paul
25	16:45-17:10	Land covers change analysis of mangrove in Viet Nam using Remote Sensing and Geographic Information System technology (The case study of Can Gio district of Ho Chi Minh city, Viet Nam)	Nguyen Viet Luong
17:10-17:45		Round Table Discussion on the Global cooperation in sustainable development of Mangrove Ecosystems	
Closing Remarks by Prof. Dr. Ann Vanreusel			
18:00-20:30		**Farewell Party** Hosted by Prof. Dr. **Ann Vanreusel**, IMABE Director Venue: West Lake, Tay Long Cruise, Adjacent back Chu Van An High School	

19th May 2010	
Excursion to the Oldest capital of Vietnam Supervision by Dr. Nguyen Dinh Tu and Drs. Nic Smol	
6:30	Departure at the Army and Ma May Hotel bus trip to Ninh Binh
12:30	Lunch at Ninh Binh City
17:30	Departure from Ninh Binh for return trip to Hanoi, arrival to the Army and Ma May Hotel

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Biodiversity of mangrove flora in Can Gio Biosphere Reserve, Ho Chi Minh City, Vietnam

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Can Gio mangrove forest play important role and significant meaning for local communities, the city and adjacent areas. During the war, the Can Gio mangrove forest has been devastated. The efforts of the government and people of Ho Chi Minh City in the rehabilitation of mangrove forests have been successful in the country as well as in the world and are recognized as a UNESCO Biosphere Reserve area of the world and is the first Biosphere Reserve in Vietnam. To have a scientific basis for the management of natural resources and proposed measures to conserve biodiversity in the future, the study referred to this approach to quantitative research methods biodiversity of plant communities in the Can Gio Mangrove Biosphere Reserve as the basis for the selection of measures to conserve biodiversity.

The results of study on mangrove flora biodiversity of 10 Forestry Compartments in Can Gio Biosphere Reserve with three hundred plots of 100 m^2 (10 x 10 m) were set up. There are 40 species belongs to 13 family with 30,124 individual trees in which there are 9 associated species and 31 true mangrove species. The Importance Value Index of *Ceriops zippeliana* is 22.52 %), *Acanthus ilicifolius* (20.91 %), *Rhizophora apiculata* (11.96 %), *Avicennia alba* (8.58%)*, Avicennia officinalis* (8.37 %), *Excoecaria agallocha* (7.77%) and the remaining species is 20%. The species and families have low abundance values are *Cordia cochinchinnensis, Aegiceras floridum, Sonneratia caseolaris, Boraginaceae*, *Malvaceae*, *Salvadoraceae*. The average of biodiversity index in each compartment is Species Richness (S = 21.30 ± 1.97), N = 3012 ± 472, Piejou (J' = 0.70 ± 0.03), Shannon (H' = 1.24 ± 0.09), Simpson Dominance (D = 0.39 ± 0.04). The quantity study of biodiversity together GIS were applied for temporal, spacial monitoring and planning in the Forestry Compartment. A set of digital pictures of mangrove species was established. The results provide the data base for conservation and managenment in future.

Keywords: Mangrove, Diversity of Mangrove Flora, Biodiversity Index, Can Gio.

Biodiversity and Value of Can Gio Mangrove Forest

HUYNH DUC HOAN

Can Gio Protection Forest Management Board, Ho Chi Minh City, Vietnam

The Can Gio Mangrove Forest was recognized as Biosphere Reserve by UNESCO in 2000. It is located in Can Gio district, Ho Chi Minh City with total area of 75,740 ha (core zone: 4,721 ha; buffer zone: 41,139 ha; transition zone: 29,880ha). Can Gio mangrove plays important roles in environmental protection, climate regulation, erosion control, and specially in responding to climate change and sea level rise, the problem world attention.

Can Gio mangrove forest is a forest known as the fastest recovery was devastated by the war. After 32 years of planting, maintenance and protection, mangrove ecosystem has fully recovered and developed the quality and quantity, the animals come back, with high biodiversity: About 36 true mangrove species, 90 associated mangrove species, 130 species of algae, 100 species of invertebrates, 137 species of fish, 9 species of amphibians; 31 species of reptiles; 130 species of birds, and 19 species of mammals.

Can Gio mangrove forest is located east of Ho Chi Minh City and adjacent to the four provinces of Dong Nai, Ba Ria - Vung Tau, Long An and Tien Giang, have contributed greatly in providing a rich source of seafood, provide economic resources for the people, create jobs, especially residents of adjacent neighborhoods. With the functions of mangrove forests has brought tremendous value in providing oxygen and absorbing carbon to reduce the temperature rise of the region, climate control, reduction of environmental pollution...

Mangrove forests have increased ability to sedimentation, sea and land expansion is critical to avoid the effects of sea level rise and climate change. Can Gio mangrove forest is a forest 25 km in width direction from the coast in to Ho Chi Minh City; this is a very solid wall of green to reduce strong winds and waves. Besides, Can Gio is ecotourism place, live laboratory for students, scientists as well as tourist.

Mangroves of Singapore: Botanical updates and current status

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The struggle to maintain or even to restore mangrove forest coverage is a challenging task facing all countries with mangrove forests, in view of the conflicting needs for urban and coastal developments to support economic growth. As a result of industrial and urban development, Singapore's total mangrove area has shrunk from 6400 ha in 1953 to about 500 to 600 ha at present. Despite this uphill battle for mangrove conservation, we are working strategically towards reversing this decline in mangrove forest coverage through careful land use planning. Even in a small and highly urbanized country like Singapore, we are still able to find new plant records in our mangrove forest that have never been documented before. A rare mangrove species, *Bruguiera hainesii* C. G. Rogers, was added to the mangrove flora of Singapore in 2003. In 1999, an uncertain taxon of *Ceriops* was discovered at Pasir Ris Park, which was morphologically different from *C. tagal* (Perr.) C. B. Rob. in Singapore. At first, this taxon was identified as the so-called *C. decandra* (Griff.) Ding Hou according to Flora Malesiana. However, it was later noted that the local *Ceriops* sp. collected from Singapore was morphologically and anatomically different from the *C. decandra* collected from India in 2000. Thus, it was therefore considered as an uncertain species awaiting further taxonomic research. Recently, we ascertained that the uncertain *Ceriops* species should be *C. zippeliana* Blume, and this species also occurs in areas of south-eastern Asia as well. Through several successful international collaborative research efforts, the elucidation of the true taxonomic identity of *Kandelia obovata* Sheue, Liu & Yong, an important East Asian species (China, Japan, Taiwan, Vietnam) in 2003, was greatly assisted by our own local research and conservation efforts towards understanding and preserving our own *Kandelia candel* (L.) Druce in Singapore. Moving forward, the solution to restore our mangroves and coastal vegetation in Singapore to its pristine condition is straightforward: conserve existing habitats, scientific studies to better understand mangrove plant growth, re-introduction of extinct species, and an active programme to propagate endangered species.

Outcome and perspectives of Education in Nematology related to Natural ecosystems

NICOLE SMOL

Since the start in 1992 of the Postgraduate International Nematology Course (PINC) master course at Ghent University, Belgium more than 200 nematologists have been trained at Ghent University. Most students originated from developing countries and their interest was mainly focused to agricultural problems and the plant parasitic nematodes. Nevertheless some showed interest in the free-living forms and specialized in either free-living marine or freshwater or soil nematodes. An overview is given of the importance of studying free-living nematodes and the geographical location of new centres for free-living nematode research. The scientific output and future perspectives are listed and reasons for success or failure are discussed. A PhD-level together with good managing capacity and international contacts are key factors for success. Geographic isolation, lack of infrastructure and access to literature are some factors hampering positive results.

Magrove of Sembilang National Park South Sumatra, Indonesia

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Sembilang National Park is the largest extent of mangrove area in South Sumatera and included in the ten areas with the largest extent of Indonesia's mangrove. Mangrove is known to be a highly productive ecosystem and estimated that a large proportion of fish use mangrove systems as its habitat. However, human pressure on this area and increasing demand for land represent increasing threats to mangrove. The aims of this research were to investigate the changing of mangrove coverage in 2003 – 2009 periods while this area was opened becoming National Park and also studied the fish community. The Landsat-7 ETM+ and SPOT 2 images was used and analyzed by using NDVI (Normalized Differencce Vegetation Index) to find information about mangrove coverage. Sample of fish were collected using encircling gillnet. The results showed that the composition of true mangrove were consisted of 4 families and 12 species that dominated by *Avicennia, Rhizophora, Sonneratia, Bruguierra* and *Cerips*. The mangrove coverage decreased from 89,874.00 ha in 2003 become 75,715.56 ha in 2009. A total of 657 individuals of fish belonging to 42 species and 27 families were collected from the mangrove waters area. Fish abundance ranged from 13.56 ind. ha^{-1} (Station I) to 103.60 ind. ha^{-1} (Station III). It was the positive correlation between mangrove density with fish abundance (Y=0.1031X-26.921; r=0.95; n=8).

Keywords : Mangrove, Fish, Image Analysis, encircling gillnet, Sembilang National Park

Diversity of fish in Can Gio mangrove ecosystem, Ho Chi Minh City, Vietnam

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A field survey on fish in Can Gio Mangrove forest, the suburban of Ho Chi Minh City has been conducted from in 2005 to now. More than several hundred of specimens was collected by many types of fishing tools in different habitats such as fishing, surrounding net, gift net, bottom net and housed in the Zoological collection of Institute of Tropical Biology. More than ninety species of fish belonged to 48 families, 13 orders were identified, recorded and photographed. There are 10 species were recorded in the Red data book of Vietnam (2007). And 44 species were recognized as economic species. Beside those species, many species were migratory fishes from sea and upper stream migrated into Can Gio Mangrove forest.

Macrobenthic biodiversity in Can Gio mangrove forest, Vietnam

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In framework of the project “Impact of mangrove exploitation on the benthic ecosystem and the assessment of ecological quality objectives” (IMABE), four sampling times of benthic invertebrates were carried out in November 2004, April 2005, November 2005 and April 2006 at Can Gio Mangrove Biosphere Reserve. In three previous surveys, only Meiobenthic fauna (Meiobenthos) was collected using tube corer (76 mm in diameter). In the last one, addition to sampling method, a quadrate tool (25 x 25 cm) as sampling method for Macrobenthos was used.

According to the collected data, a diverse benthic invertebrates fauna was recorded including 116 species, 88 genus, 46 families belong to major groups. Among those, class Polychaeta with 46 species, occupied 39.7% of total species; phylum Mollusca with 38 species - 32.8%; class Crustacea, 29 species - 25% and others (Peanut worm and insects) with only 3 species - 2.6%.

Relating to sampling method of benthic invertebrates, if only tube corer was used, 65 meiobenthic species were recorded while more 51 species were added to the species composition if a quadrate tool was used. Remarkably, almost of these species are economic ones.

So in order to investigate biodiversity in detail in a soft bottom ecosystem, more surveys with integrated sampling methods are recommended.

Rapid assessment of terrestrial vertebrate fauna in Mui Ca Mau National Park, Ca Mau Province, Vietnam

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Mui Ca Mau NP was established in 2003, located in Ngoc Hien and Nam Can Districts of Ca Mau Province, coordinates $8^0$32'- $8^0$49' N and $104^0$40'- $104^0$55' E. The National Park has total area of 41,862 ha, which consists of 15.262 ha of mainland and 26.600 ha of sea. Having large area of mangrove forest and tidal beaches, the National Park can offer good habitats for a rich and diverse fauna, however, this fauna was poorly studied. In framework of FFI sub-Project as a part of the World Bank and DANIDA funded Coastal Wetlands Protection and Development Project (CWPDP), we have conducted rapid assessment of terrestrial vertebrate fauna of Mui Ca Mau NP with following specific objectives:

- Inventory of species diversity of terrestrial mammals, birds, reptile and amphibians in the NP
- Identification of current threats to the fauna and habitats
- Providing recommendation on further study, monitoring and management of the faunas

The study was conducted in August 2007 including review of existing related literature and field survey in the National Park, by a group of scientists from Institute of Ecology and Biological Resources Hanoi University of Education with support by local staff of Mui Ca Mau NP. Survey methods include semi-structured interview of local residents and Park's staff; transect survey for direct sighting of wild animals and indirect observation of their signs (tracks, dropping, dens, vocalization, etc.) and collecting specimens by live traps (box live traps and mist-net). All captured specimens were released back to the wild after taking photos, basic measurement and species identification. The studies have obtained following main results:

- The faunal records include 26 mammal species of 11 families and 8 orders; 93 bird species of 33 families, 9 orders; 43 reptile species of 12 families, 2 orders; and 9 amphibian species of 5 families, 2 orders.
- The National Park offers an important feeding ground for large number of costal migrant birds. Two areas in the Park (Bai Boi and Dat Mui) were identified as Important Bird Areas under Birdlife International criteria
- The study fauna contains large number of nationally and globally threatened species, including 16 mammal species, 7 bird species, 13 reptile species and 1 amphibian species enlisted in Vietnam Red Data Book include; and 6 mammal species, 7 bird species and 6 reptile species enlisted in 2006 IUCN Red List.
- Mui Ca Mau NP plays special important role in conservation of some endangered species such as: Small-clawed Otter (*Aonyx cinerea)*, Smooth-coated Otter (*Lutra perspicillata*), Large-spotted Civet (*Viverra megaspila*), Fishing Cat (*Prionailurus viverrinus),* Grey Pelican (*Pelecanus philippensis*), Painted Stork (*Mycteria leucocephala),* Swinhoe Egret (*Egretta eulophotes),* Asian Box Turtle (*Cuora amboinensis),* Yellow-headed Temple Turtle (*Hieremys annandalii),* Malayan Snail-

eating Turtle (*Malayemys subtrijuga),* Black March Turtle *(Siebenrockiella crassicollis),* Asiatic Soft-shell Turtle (*Amyda cartilaginea).*

- Main current threats to study faunas and their habitat are:
    - Widespread illegal harvest of wildlife inside NP, including its Strict protection Zone
    - Illegal wildlife trade is common in surrounding area of the NP
    - Harvest of aquatic resources and tree plantation in tidal beaches causing much disturbance to feeding areas of wildlife, especially migrant seabirds
    - Habitat loss by land conversion for agriculture and aquaculture
    - Environmental pollution by chemicals used for agriculture and aquaculture, garbage and oil from large number of motorboats

Results of this study show that Mui Ca Mau NP contains high faunal biodiversity with large number of nationally and globally threatened species. However, this fauna and its habitat are under risk of loss and degradation while management capacity of National Park is weak. A number of measures were recommended to mitigate current threats and improvement of National Park Management.

The loss of species: mangrove extinction risk and geographic areas of global concern

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Mangrove species are uniquely adapted to tropical and subtropical coasts, and although relatively low in number of species, mangrove forests provide at least US $1.6 billion each year in ecosystem services and support coastal live hoods worldwide. Globally, mangrove areas are declining rapidly as they are cleared for coastal development and aquaculture and logged for Timber and fuel production. Little is known about the effects of mangrove area loss on individual mangrove species and local or regional populations. To address this gap, species-specific information on global distribution, population status, life History traits, and major threats were compiled for each of the 70 known species of mangroves. Each species probability of extinction was assessed under the Categories and Criteria of the IUCN Red List of Threatened Species. Eleven of the 70 Mangrove species (16%) area elevated threat of extinction. Particular areas of geographical concern in clued the Atlantic and Pacific coasts of Central America, whereas many as 40% of mangroves species present are threatened with extinction. Across the globe, mangrove species found primarily in the high intertidal and upstream estuarine zones, which of ten have specific fresh water requirements and patchy distributions, are the most threatened because they are often the first cleared for development of aquaculture and agriculture. The losses of mangrove species will have devastating economic and environmental consequences for coastal communities, especially in those areas with low mangrove diversity and high mangrove area or species loss. Several species at high risk of extinction may disappear well before the next decade if existing protective measures are not enforced.

Mangrove habitat dynamics and rapid sea-level rise

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The mangrove forest is very important as a buffer zone between land and ocean. The habitats located at the upper half of the tidal zone. This means that the ecosystem might be controlled by the sea-level changes. It is feared that the extent of mangrove ecosystems will be diminished by the rapid sea-level rise due to global worming.

The aim of the research is making the scenario how response the mangrove habitat against the rapid sea-level rise.

The scenario of the future dynamics will construct by the evidence of historical habitat dynamics in the past. The clarification of the bio-geomorphological mechanism of habitat development is also useful for construction the scenario. Consequently, the research team revealed the structure of habitat dynamics and has clarified the habitat development process with the sea-level change in last several thousand years. The field investigation had carried in Micronesia, Philippines and Thailand.

The habitat dynamics with the sea-level change is clarified by field study by geomorphic approach. Mangrove develops organic rich sediment. Mangrove organic sediment is a good evidence not only the existence of mangrove forest but also the sea-level at the time.

The threshold of the habitat existence with the sea-level rise that is able to deduce the tangent of the sea-level curve. It is 5 mm / year. Such stage of rapid sea-level rise the

organic sediment is luck. The IPCC (2005) reports the forecasting scenario of rapid sea-level rise by global worming will mark 65 cm rise by 22 century.

Although, the direct influence of the forecasted rapid sea-level rise will vary with the tidal situation. Actually, the ground level of the almost habitat is located at the higher part of the tide. This is reason of long term sedimentation during the stable sea-level in last 1000 years. In macro tidal area, such as Andaman Sea coast mangroves, the actual habitat is located at 0.5 to 2 meter above the mean sea-level. It is needless to say that the mangrove forest can survive between the mean water and the highest high water level. As the result, the mangrove habitats located in macro-tidal area have preserved in spite of great change in the inner structure of mangrove forest through a 50 cm rise in sea-level in 100 yrs. In contrast, the effects of rapid sea-level rise are relatively severe in micro-tidal area such as Thailand bay side mangrove.
Three factors which play a great role in the estimation of habitat change are as follows; 1) the rate of sea-level rise, 2) the tidal amplitude and 3) the rate of sedimentation.

The relationship between species, structural and functional diversity in mangrove ecosystems

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The term 'biodiversity' is most often used in relation to the number of species existing in a given area or ecosystem. Species diversity is important because it reflects the diversity of genetic resources that are available to mankind for a range of goods and services. However, structural and functional diversity are also important, especially in mangrove ecosystems, for their contribution to the stability of the ecosystem, to coastal protection and to the livelihoods of coastal communities. This paper examines the importance of structural diversity in mangrove ecosystems and the links between species, structure and function that may be useful in adaptive management of mangroves in response to climate change.

Carbon burial, storage and metabolism in mangrove systems

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Mangrove systems have potential to produce and store large amounts of carbon, both as living woody biomass and as peat or other organic detritus below ground. This paper summarises data on carbon buial and storage from a number recent studies on the carbon balance of mangrove ecosystems in the Asia-Pacific region, in order to assess the importance of mangroves as carbon sinks and as an energy source for benthic organisms.

Key words: mangrove, carbon storage, productivity, decomposition

The use of meiofauna in monitoring the quality of mangrove ecosystems

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Mangrove forests develop on the boundary between marine and terrestrial environments, being key ecosystems along many tropical and subtropical coastlines. They are apparently simple in their structure on a macro-scale, harbouring different tree species but lacking an understory of shrubs different from the tree layer species, whereas their stems and especially their aerial roots create a particular complex environment on a meso- and microscale for a variety of organisms, including the benthos. The associated benthic biodiversity is important from a functional point of view since mangroves may provide food for different organisms including socio-economically important macro-invertebrate and fish species. Unfortunately mangroves are also the subject of coastal development being cut for local subsistence use or cleared over extensive areas for large land reclaiming projects, or being impacted by increasing input of organic and inorganic pollutants. Being closely linked with the mangrove habitat, the benthos are an important tool to identify the quality of a mangrove habitat. Providing information on the substrate quality the benthos can be used as early warning indicators for changes (both recovery and deterioration) in a mangrove ecosystem. In this presentation I will illustrate through different case studies the value of meiobenthos to monitor the ecological quality of a mangrove ecosystem

Biodiversity of meiofauna community and used nematodes as bioindicator in the Can Gio mangrove forest, Ho Chi Minh City

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The Can Gio mangrove is the first Biosphere Reserve of Vietnam created since 2000, with a total area of 75,740ha in the coastal zone of Ho Chi Minh City. The area is situated in a recently formed estuary complex of tidal flats, where the Vam Co, Sai Gon and Dong Nai rivers discharge into the sea. Meiofaunal communities were investigated from 20 stations covering 3 buffer zones (Transfer, Aquaculture, and Industrial) and 2 core zones (Core 1, Core 2) in the Can Gio mangrove during both dry and rainy seasons from 2004 to 2006.

The meiofauna composition was investigated. From 20 stations and five zones, on the average, meiofaunal densities decreased from core zone 1 to the industrial zone the aquaculture zone core zone 2 and the transfer zone.

Nematodes were most abundant in all stations and zones. Nematode percentages were the highest in the rainy season (97.3 % and 97.4% in Nov. 2004 and Nov. 2005 respectively) and decreased in the dry season (97.2% and 94.5% in Apr. 05 and Apr.06 respectively). The second most abundant taxon was harpacticoid-copepods, followed by the oligochaetes, ostracods and turbellarians.

Nematodes can be used as bio-indicator by calculating the correlation between nematode community parameters such as densities, N/C ratio, MI index and diversity indices and different measures of inorganic and organic pollution. Most correlation coefficients were low and not significant, only the Maturity index showed significant negative correlation with Hg

and Cr, whereas the diversity index Shannon-Wiener had significant negative correlation with organic pollution measures (COD, BOD, Oil & grease and Coliforms).

Key word: Cangio mangrove, meiofaunal, Nematodes and Bioindicator.

Nematode communities in Durian storm impacted area, Can Gio mangrove forest, HCM city

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Nematode communities in the Durian impacted area during December 2007 in the core zone of Cangio Mangrove forest was researched in community structure, composition, densities and biodiversity aspect. There were 98 genera, 25 families belonging to 6 orders: Enoplia, Chromadorida, Desmodorida, Plectida, Monhysterida and Araeolaimida of phylum Nematoda recorded. No significant differences of number of genera and densities found between the area of original Rhizophora tree and Durian destroyed area. However, biodiversity indices in both area are quite high ($H'(\log_2)$ =3,12-4,49 and d=4,48 -8,32) and the Mature Index range from 2.06 -2.53. Research on impacted area of Durian storm still continue but it could show high diversity scenario of nematode communities in the area even that the plant cover being completely destroyed.

A study on nematode species composition of the family Comesomatidae Filipjev, 1918 (Nematoda) reconized in some coastal areas of Vietnam

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During 10 years recently, the species composition of free-living marine nematodes belonging to the family Comesomatidae in an estuaries, mangroves and coastal zones of Vietnamese sea such as Tra Co (Quang Ninh), Halong Bay (Quang Ninh), Ba Lat (Thai Binh), Thi Nai Pond (Binh Dinh), Bays of Khanh Hoa province, Can Gio mangrove forest (Ho Chi Minh City) and Thi Vai estuary (Ba Ria-Vung Tau) had been investigated.

Results showed that the species composition of the family Comesomatide consists of 41 nematode species; belong to 15 genera and 3 subfamilies. The higher density of the comesomatids was recognized at the Can Gio Mangrove forest with 31 species occupied 73,1%. The density of comesomatids in Thi Vai Estuary was recognized with 30 species, occupied 73,1%, in Tra Co beach were recognized 28 species, occupied 68,29%, then Ha Long Bay recognized 27 species, occupied 65,85% respectively. The density of comecomatids was lower in the Ba Lat, where the density was recognized 20 species, occupied 48,78% of the total recognized nematode species in Vietnam sea.

Among 15 genera which were recognized in Vietnam sea, the genus *Paracomesoma* and *Hopperia* were widly distributed and predominated in the each collected sample. Thus, 6 species belong to genus *Paracomesoma* were recognized in the Vietnamese fauna, and occupied 85,71 % of the total genus species. The new genus *Asymmelaimus* Nguyen D. T. *et al*., 2006 belonging

to the subfamily Sabatieriinae was described for the world science and 13 others nematode species were recognized as a new species for world science.

Meiobenthic communities in coastal mangrove area of the inner gulf of Thailand.

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Meiobenthic communities in mangrove area were investigated in Samut Songkhram Provinces on the Coast of Inner Gulf of Thailand. The samples were taken from natural mangrove forest, dominated by *Avicennia alba*, transplanted mangroves and adjacent mudflat. Meiobenthos densities were significantly different among samples. Highest densities (701±59.24 ind.10 cm^{-2}) occurred in the natural mangrove forest while lowest densities (168±20.94 ind.10 cm^{-2}) occurred in the mudflat. A total of 8 taxon of meiobenthos were found. Free-living marine nematode is the most dominant group, with average abundance 149±19.31 to 650±55.38 ind.10 cm^{-2}, accounting for 89-94% of the total abundance. Other important groups are harpacticoid copepods (5 - 8%) and polychaete (1 - 5%). Results of multivariate analysis on meiobenthic community structure showed differences among sampling sites. Their communities in mudflat were clearly different from those in the natural and transplanted mangrove forests. Transplanted mangrove tended to shift meiobenthic community in mudflat. Related environmental factors on meiobenthic communities were discussed.
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Functional adaptations of nematode assemblages to the mangrove habitat: a comparative study

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The ecological success of nematodes in the benthos relies on their morphological and functional adaptations to a highly heterogeneous environment. The functional approach provides the framework within which spatial and temporal patterns of heterogeneity can be addressed mechanistically. The mangrove-vegetated habitat differed from the foreshore

unvegetated sandflat not only in terms of hydrodynamics and substratum properties but also in terms of the quality and quantity of organic resources. The former is more heterogeneous and provides more niches with its developed root systems and rich pool of particulate and dissolved organic matter. This habitat is, however, also usually sulphide-rich and constantly anaerobic.

In this study we compare functional structures (trophic structure, age structure and size spectrum) and to estimate the functional parameters (biomass, respiration, production and maturity index) of nematode assemblages from mangrove-vegetated and unvegetated habitats and microhabitats (vertical sediment layers). Temporal fluctuations were also taken into account to further test the functional group hypotheses proposed by other studies and to investigate the interrelationships between functional features, e.g., trophic guilds and morphotypes.

The mangrove habitat, as compared to the foreshore sandflat, supported more abundant, trophically diverse and productive nematode assemblages. Based on the biomass spectrum and annual temperature regime, nematode annual production was estimated to be between 2.77-9.32 g $C \cdot m^{-2} \cdot yr^{-1}$ in the mangrove and 1.54-3.84 g $C \cdot m^{-2} \cdot yr^{-1}$ in the foreshore sandflat, with a corresponding annual P/B of between 17-51.

Subsurface mangrove sediment layers, in contrast to the surface and the foreshore, offered fairly stable microhabitats where nematode assemblages were characterized by random temporal oscillations and species with elongate body shapes, conservative life history traits and low colonizing abilities. These are best represented by the mouthless *Parastomonema* sp. and linhomoeids, implying the existence of a distinct thiobios which is adapted morphologically and functionally to the anaerobic/sulphidic and organic-rich (POC, DOC and sulphur bacteria) mangrove milieu.

Key words: Nematode assemblage; functional feature; secondary production; mangrove; sandflat

Nematodes of the ‘lesser’ mangroves of Tamil Nadu, Southeast coast of India

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Pichavaram and Muthupettai are the only two extensive mangroves along the 1000 km stretch of Tamil Nadu coast line, southeast coast of India, both of which are under the protection of the Ministry of Environment of Forest, Government of India. Pichavaram mangrove has both *Avicennia* and *Rhizophora* co-inhabiting, while Muthupettai mangrove has an extensive coverage of *Avicennia* with only an occasional *Rhizophora* amidst them. However patches of mangroves may be encountered throughout the stretch of Tamil Nadu coast under varying physicochemical conditions, extend of cover, composition and stage of development. In the present study a survey of these smaller patches, designated as the ‘lesser’ mangroves, has been undertaken to evaluate the presence of meiofauna with special emphasis on nematodes. It was observed that the 11 stations studied varied in its meiofaunal composition as well as in the abundance and composition of its nematode fauna reflecting the influence of the type of plant cover, distance from the marine environment, frequency and period of inundation and the sediment characteristics. Most stations had only a cover of *Avicennia* that appeared short and stunted with few *Rhizophora* in between. However on closer examination it was observed that these *Avicennia* were not young but appeared stunted due to constant felling by the local population for firewood, fodder and for fencing of nearby aquaculture farms. Inspite of these drawbacks it was observed that these

'lesser' mangroves harboured a diverse nematode fauna compared to the total meiofauna that was meager and exhibited considerable variation in composition.

Can traditional taxonomy in nematology retain its place as a science in an automated world of barcoding, digital images and scaled-up biodiversity informatics?

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In the era of biodiversity, taxonomy is the most comprehensive and reliable source of information, essential for environmental science and applied users. It is a broad field that has been hampered by the time consuming approach, the information impediment and fragmentation of taxonomic research. These constraints push taxonomy to advance its working routines. Therefore, it is critical to make the right decisions and to balance the emphasis researchers, stakeholders and society place on new technologies and research tools on the one hand and the maintenance of core taxonomic research and expertise necessary to study species diversity on the other hand. Because of the catching up, funds appear to go mainly to information and technology initiatives also in nematology. So there is money to serve taxonomy but rarely to perform taxonomy. To find the right connection between all partners, nematode taxonomists have to think about the fundamental questions on what information is needed, at what depth and how core nematode taxonomists can contribute. Because of the speed with which technology develops (meta-databases, automated digital data-gathering, next generation sequencing) the gap between traditional taxonomists and DNA-taxonomists and between laboratories with or without advanced infrastructure becomes steadily wider. However, nematode taxonomists can retain their place in science but need to develop more extensive collaborative research, going beyond their own discipline. Institutional integration, involving developing countries, is a possible way forward to avoid a two level nematological society.

Photosynthesis in pneumatophores and hypocotyls of mangroves for supplying oxygen to their underground parts

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Mangrove sediments are anaerobic in general and the diversity and functions of microorganisms living there are considered to be strongly affected by micro-environment with the presence of oxygen. Many mangrove species have well developed pneumatophores and young seedlings of many mangrove species have well developed hypocotyls. In this study, photosynthesis and ventilation actions of pneumatophores and hypocotyls were determined to asses the possibility of their contribution to the diversity and functions of microorganisms living in the sediments in mangrove ecosystems. Photosynthetic and ventilation rates were measured in the pneumatophores of *Sonneratia alba*, *Avicennia officinalis* and *Rhizophora apiculata*, and hypocotyls of young seedlings of *R. apiculata*, *R. mucronata*, *R. stylosa*, *Bruguiera cylindrica and B. gymnorrhiza* by a modified system with a

commercial photosynthetic measurement equipment. Oxygen concentrations in the pneumatophores and hypocotyls were also measured. The results showed that the photosynthetic rates of pneumatophores and hypocotyls increased with increasing the photosynthetic photon flux density (PPFD) and became mol m□saturated at 300-500 $^{-2}$ s^{-1} PPFD. The pneumatophores of *S. alba*, for example, converted 50% of respiratory carbon dioxide to oxygen by the photosynthesis. The hypocotyls of *R. mucronata*, also converted 80% of respiratory carbon dioxide to oxygen. The oxygen concentrations in an inner tissue system of the pneumatophores and hypocotyls were higher in order of the conditions when they were exposed to the air in the light, submerged in the light, and submerged in the darkness. In conclusion, the pneumatophores and hypocotyls were photosynthetic organs to generate oxygen diffusing through aerenchyma to the buried root system during daytime even when submerged and also ventilation organs to discharge carbon dioxide from the root system. They would supply oxygen to their root zones and make the micro-environment surrounding roots favorable for aerobic microorganisms.

Bioaccumulation, depuration of heavy metals (As, Cd, Pb) and metabolism of these metals in body of mussels *(Meretrix lyrata*) during 20 days in artificial media of culture

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The purpose of this work is to try to estimate for the first five days the extent of As, Pb, Cd bioaccumulation by *Meretrix Lyrata* mussels in artificial media of culture contaminated by heavy metals (As at 1.5 and 2.5ppm, Pb at 1.5 and 2.5ppm, Cd at 0.1, 0.5, 1ppm) and that of release in clean water during the following 15 days. Quantization was performed by ICP and AAS with Hydride System. Bioaccumulation increased with heavy metal concentrations in water and in the odder Pb>Cd>As. Release was also observed to increase with the amounts of absorbed metals. After 20 days of experiments, following figures of metal release were obtained(As ~100%, Pb~ 68.9%, and Cd~39.65%). In the case of Cd contamination, no mussel survived after 10 days of experiments even at low Cd concentration of 0.1ppm.

Residue of heavy metals in the body of mussels was metabolited to another chemical form. Inogranic Cd was metabolited to Cd-metallothionein and detected by LC/MS ESI(+). As was metabolited to monomethyl arsonic acid (MMA), dimethylarsinic acid (DMA) and detected by HPLC-UV- AAS- HG, and Pb was metabolited to photsphat hydroxyt lead ($Pb_5(OH)(PO_4)_3$) - which was detected by XRD.

Keywords: As, Cd, Pb, MMA, DMA, Cd7- MT, phosphate lead.

Contribution to understanding the physical environment of the mangrove in the Ca Mau cap and surrounding area

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Mangrove trees extend along the coast of the Mekong River delta and they are widespread largely around the Camau cape where the mangrove forest is considered the biggest in Vietnam. And there is a main part of the Mui Ca Mau Biosphere Reserve approved by UNESCO, May 26 2009. A high annual average rainfall of 2300mm maintains a relatively stable salinity of surface water, around 20-32 g/l. The interaction variable between diurnal tide in the western side (gulf of Thailand) and the semiduirnal tide in the eastern side (South China Sea) and coastal hydrodynamics induce the several specific features of physical environment such as great flow (max 8867 – 11835 m^3/s) exchanged daily between the mangrove and adjacent sea environment by the main tidal channel named Cualon. Moreover, the existence of different tidal regime (tidal range, types of tide) induces consequently a great water volume exchanged daily between the eastern and western coast by a reverse flow which encloses the deep part of the prodelta slope around the Camau cape. The predominance of hydrodynamic condition under the eastern side during a maximum NE monsoon enhances also the strong erosion along the eastern coast and the materials eroded from this sector are transported to the western side by longshore current and by flow through the Cualon tidal channel. In consequence, a continuous progradation, at least more than one century, occurs along the western coast where the mangrove forest is dense and extends rapidly under a large tidal flat, a few kilometers in width. However, the results of geological studies demonstrate that this hydro-sedimentation process follow discontinuous episodes (9-12 yrs).
In conclusion, there is a specific coastal process very dynamic and variable in temporal and spatial scale among the coastal environments in Vietnam and these characteristics support probably a high richness of the Camau mangrove and surrounding area.

The impact of indirect effects of climate change on mangrove associated biodiversity

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Periodic episodes arising out of global climate changes seem to pose a reasonable threat to the integrity of mangrove ecosystem. Mangrove macrofauna, which are residents of mangrove areas throughout their adult life, stand to be highly affected by the Periodic episodes arising out of global climate changes. During the 1997/8 El Nino event, massive sedimentation due to erosion of terrigenous sediments caused mangrove dieback in many areas along the Kenyan coast. Mwache Creek a peri-urban mangrove forest in Mombasa was the most affected resulting in mangrove death covering about 200ha. Functional biodiversity in El Nino impacted sites was compared to reference (natural forests) sites in order to assess the impact of climate change to mangrove associated biodiversity. Transects (sea-landward transect) were laid in both impacted and reference sites where relevant

physico-chemical variables were measured and mangrove biodiversity determined as an indicator of ecosystem change. Molluscs densities and diversity were found not to be significantly different between treatments (impacted and reference sites) while crabs diversities was significantly higher in reference sites than impacted sites. Faunal diversity of Molluscs in impacted sites was found to be sustained by invasive shrubs while crab densities and diversity was highly reduced by the mangrove die back.

Sustainable development of mangrove resources- combining the best practices

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Mangroves continue to disappear at an alarming rate at global as well as national level. This trend happens despite the introduction of new policies, regulations, and management approaches. This paper gives a quick overview of the present status of mangroves, deals with the issues and problems, reviews selected sustainable utilization of mangrove resources, and highlights the importance of combining the best practices for sustainable development of mangrove resources to meet the current and future challenges.

Key words: Mangrove, biodiversity, forestry, fisheries, ecotorism, sustainable development

Estimates of benthic secondary production In Yellow river estuary and it's adjacent waters in the Bohai sea China

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The whole metazoan community inhabitating Yellow River Estuary and adjacent Bohai Sea waters were sampled in late autumn, 2006. Secondary production estimates for macrofauna and meiofauna were made separately. Total benthic secondary production was as high as 8.38 ± 4.08 g ash-free dry weight (AFDW) m^{-2} a^{-1}, which represented autumn production level. In general, macrofaunal secondary production in this sea area was much lower than that of adjacent Bohai Sea areas, while meiofaunal secondary production distributed in contrast. Macrofauna contributed 61% to benthic secondary production (5.09 ± 3.26 g AFDW m^{-2} a^{-1}). It was lower than previous studies in the Bohai Sea. Secondary production of benthos was predicted by normalized biomass size spectra (NBSS) model. The secondary production of macrofauna was 4. 509 g $DW{\cdot}m^{-2}{\cdot}a^{-1}$, and that of meiofauna was 2. 208 g $DW{\cdot}m^{-2}{\cdot}a^{-1}$. A comparison of NBSS model with other empirical models suggested that the result s were much same. NBSS model can estimate benthic secondary production accurately.Sediment granulometric characterization, bottom-water salinity could explain the substantial variability in the marcrofauna biomass and production. Meiofuanal production was the important component of benthic production and exceeded that of macrofauna under exceptional conditions, e.g. in Yellow River Estuary where macrofauna was restricted. Chlorophyll pigments (Chl-a) concentrations in sediment explained the generally meiofaunal biomass and production distribution well here.

Key words benthic secondary production; meiofauna; macrofauna; Yellow River Estuary; the Bohai Sea; Biomass size spectra

Lessons learnt from Can Gio for mangrove rehabilitation in Gujarat, India

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Over the past 50 years, approximately one-third of the world's mangrove forests have been lost, but most data show very variable loss rates and there is considerable margin of error in most estimates. Mangroves are a valuable ecological and economic resource, being important nursery grounds and breeding sites; a renewable source of wood; accumulation sites for sediment, contaminants, carbon and nutrients; and offer protection against coastal erosion. The destruction of mangroves is usually positively related to human population density. Major reasons for destruction are urban development, aquaculture, mining and overexploitation for timber, fish, crustaceans and shellfish. Over the next 25 years, unrestricted clear felling, aquaculture, and overexploitation of fisheries will be the greatest threats, with lesser problems being alteration of hydrology, pollution and global warming. Loss of biodiversity is, and will continue to be, a severe problem as even pristine mangroves are species-poor compared with other tropical ecosystems.

The Gujarat Forestry Development Project aims at an integrated management of natural resources that include an appropriate mix of forest and non-forest lands and biodiversity objectives. In Gujarat, a state with inadequate forest cover and quality, the urgency to continue to strengthen these efforts is obvious. 15,000 ha of mangroves are planned to be planted in the Gulf of Kutchch, using mainly *Avicennia marina*. Planting is performed with the application of the raise bed technique, with about 800 seedling/m^2 and no subsequent thinning. The result of not thinning can be seen in an example from the Can Gio Region, Vietnam, where any human interference were prohibited after it became a UNESCO MAB reserve. The consequences of this lack of forest management on mangrove rehabilitation will be discussed.

Land covers change analysis of mangrove in Viet Nam using Remote Sensing and Geographic Information System technology (The case study of Can Gio district of Ho Chi Minh city, Viet Nam)

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Due to human activity land cover and land use give different patterns over the times, and also because of their strong influence on how land could be used in future. The land cover and land use period use patterns because a crucial factor in deciding as to how land development, management and planning activities should be taken. Most of environmental phenomenons are directly or indirectly related to the surface cover in a given locality. Such as management of environmental, we have to maintain among sustainable resources and socio-economic need, land cover studies should be dealt with care. Land cover change is perhaps the most prominent form of global environmental change since it occurs at spatial and temporal scales immediately relevant to human activity.

In the present study raw digital data of SPOT 1996 (time 1) and SPOT 2004 (time 2), ancillary maps and data were used. The data were loaded, rectified and registered to each to other used. Various digital images processing techniques like radiometric correction, enhancement techniques etc., were used to enhance quality of the images. To detect the change in land covers different change detection schemes, such as Post-classification comparison (based supervised classification and unsupervised classification), Principal component analysis, Normalized difference vegetation index were used. The contents of this report will present methods; Post-classification Comparison (based supervised classification).

The result of the project is the various statistics, diagrams, maps and show change land covers of the study area.