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STATUS OF SEAGRASS BEDS IN ASEAN

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ABSTRACT

The seagrass ecosystems of ASEAN are the most neglected comparatively - both as objects of scientific research and as marine resources. While the region is characterised by a near-maximum variety of seagrass species and habitats, these are increasingly being degraded at an alarming rate by both natural and man-induced stresses.

In the last 50 years, research on seagrass ecosystems in the region focused primarily on the structural aspects of the resident and associated communities. Despite the upsurge of interest and activities addressing the management of ASEAN coastal resources and environments, studies on seagrass dynamics, environmental variables affecting its ecology and applied extensions of the information are virtually non-existent. This unfortunate scenario is an offshoot of biophysical impacts on the habitat, political interference and mismanagement, and certain misguided perceptions which are deeply rooted in the socio-cultural psyche of the people governing the decision-making process, which is tailored towards industrialisation with little regard to environmental protection.

The primary goals of seagrass research and development in ASEAN should be to determine the role the ecosystem plays in the maintenance of the integrity of the coastal zone, its responses to environmental forcing factors, and how these changes affect the habitation and resource use by coastal dwellers. These goals are attainable through intensive process studies, extensive data gathering for key parameters, simulation and prognostic modelling, inter-habitat connectivity studies, application of acquired knowledge, and introduction of information technology and data handling.

INTRODUCTION

The Indo-West Pacific region is the center of generic richness and diversity of seagrasses in the world (Heck & McCoy 1978). The highest number of species is found in the coastal waters of Malesia bounded by Indonesia, Borneo, Papua New Guinea and northern Australia (Mukai 1993). The 16 seagrass taxa reported (Fortes 1988) from the ASEAN region (i. e. Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore and Thailand) and to which at least two more could be added (John Kuo, personal communication), make its marine submerged angiosperm flora second in species diversity to Western Australia, which has the highest in the world. However, seagrass distribution and ecology in ASEAN remain very poorly known. An elucidation of the species composition, biogeography, and distributional affinities of the plants in the region have been made (den Hartog 1970; IUCN/UNEP 1985; Fortes 1988,1989; Mukai 1993). Due to the incomplete understanding of the region's seagrasses, the resources are considered as being only marginally useful when

compared to the other resources that abound along its coasts. The high percentage of species overlap in the seagrass floras of the countries in the region and the comparable values obtained on their biomass and productivity imply the prevalence of equally similar patterns of climate and coastal conditions (Fortes 1992). In view of management, this would suggest similar patterns and strategies for regional utilisation of the resource. On the other hand, the high diversity and abundance of seagrass habitats and their resources in ASEAN make them highly vulnerable and susceptible to both man-induced and natural perturbations (Fortes 1991). While a growing awareness on the fundamental ecological and economic potential of seagrass ecosystems has recently occurred, there are indications that natural recovery of a significant percentage of the habitats in the region is impossible within this generation.

This paper aims to assess the state-of-the-art in seagrass research and development in the ASEAN region. It provides an opportunity for practitioners in tropical coastal science to rethink their priorities and help direct more support towards activities directly relevant to the development of national goals. It is envisioned that future efforts addressing the conservation and sustained multiple use of the seagrass resources in the ASEAN would build upon the results of the assessment.

CURRENT RESEARCH ACTIVITIES IN ASEAN SEAGRASS SYSTEMS

Current research activities in seagrass ecosystems in the ASEAN fall under five categories (Fortes 1994): structure, dynamics, fisheries, environmental factors, and applied aspects. The specific activities under each category are given in Table 1.

These activities are largely concentrated on the structural aspects (species composition and distribution) of the seagrass plants and their associated fisheries (finfishes and invertebrates), indicating, among others, the relative novelty of the subject. Even in the more basic aspects, only the Philippines (Fortes 1986), Malaysia (Phang 1989; Japar 1994) and Thailand (Ogawa, personal communication) have more comprehensive and updated records on the taxonomy and distribution of the local seagrasses. With the exception of the Philippines, much less research interest was focused on the dynamic and applied aspects. In recent years, and for valid reasons, fields of marine science have undergone a revolution in approach, with greater emphasis being placed on dynamic processes rather than static description. Among the countries, the Philippines has undertaken 44 of the 46 parameters so far under study on seagrasses in the region (Table 1), emphasising structural (seagrass and fisheries), dynamic, and applied aspects of its seagrass resources. To a lesser degree, activities in Thailand and Indonesia focus on similar concerns, although the former has marked emphasis on the applied aspects. Less intensely, research activities on seagrass systems occur in Malaysia, Singapore, and much less intensely, in Brunei Darussalam. Chou *et al.* (1987) reported the unfavourability for extensive seagrass growth of the coasts of Brunei.

The countries in the region have placed varying degrees of emphasis on their seagrass research and development efforts. This is largely a function of the following interrelated factors: (1) presence/absence of sizeable seagrass habitats associated with the length and nature of the coastlines; (2) available expertise; and (3) current state of knowledge on the ecosystem. A strong correlation exists between the intensity of research effort and the length of coastline in each country. Initially, a similar degree of affinity existed in relation to the number of seagrass species present (with Philippines and Indonesia having the highest number, Singapore and Brunei, the lowest; Fortes 1992), but this could be an artefact and a result of the varying degrees in the intensity of collection. The islandic nature of Indonesia and the Philippines has endowed the countries with a high diversity of seagrass habitats. Thailand has sizeable grass beds in Chantaburi and Trat (Suvaluck and Sudara 1992) at the east and around the islands of the west coast of the Gulf of Thailand. Seagrasses are also reported from Phan-nga southward in the Andaman Sea where the beds were classified into coastal fringe grass beds, beds on shallow sandy bottom, and beds associated with reef flats (Chansang and Poovachiranon 1992). On the other hand, the small size and limited coastlines in Singapore and Brunei allowed only patchily distributed seagrass communities. Isolated patches of seagrasses are found in many parts around the coasts of Peninsular (Japar 1994) and East Malaysia (Ismail 1993). However, the water and substrate conditions are generally unfavourable for extensive seagrass growth around the peninsula.

Table 1. Extent and intensity of seagrass research being undertaken within ASEAN countries.
PHIL-Philippines; INDO-Indonesia; THAI-Thailand; SIN-Singapore; MAL-Malaysia; BRU-Brunei Darussalam.

	PHIL	INDO	THAI	SIN	MAL	BRU
STRUCTURE						
species composition	**	*	*	*	*	*
distribution	**	**	**	*	*	*
biomass	**	**	**	*	*	
density	**	**	*		*	
cover	**	*	**			
diversity	*	*	*			
leaf height	*	*				
affinity	*	*				
zonation	**	**	*	*	*	
epiphytes	**	*	*			
leaf area index	*					
associated fauna	**	*	*			
DYNAMICS						
productivity - plant	**	**		*		
- animal	**					
- bacterial	*					
decomposition	*	**				
growth rates	**	**				
turnover	**	*				
recruitment	**					
mortality	**					
litter transport	*	*				
interaction	**	*	*			
nutrient budget		*				
mineralisation		*				
reproduction	**					
feeding	**					
FISHERIES						
species composition	**	**	**	*	*	
distribution	**	**	**			
abundance/biomass	**	*	*			
residence pattern	*	*				
diel variation	*	**	*			
interactions	*	*	*			
ENVIRONMENTAL FACTORS						
substratum	*	*	*		*	
depth	*	*	*			
water clarity	*	*	*	*		
light regime	**	*	*			
water movement	*	*				
temperature	*	*	*			
quality criteria	*	*	*	*		
APPLIED ASPECTS						
seagrass as feed	*	*	*			
remote sensing	**	*	*	*		
artificial sg	*		*	*		
transplantation	**	*	*			
pollution	**	*				
socio-economics	*	*	*	*		
endangered species	**	**	*			
Total (percent)	**44 (96)**	**38 (83)**	**27 (59)**	**11 (24)**	**7 (15)**	**2 (04)**

(**, done or being done more intensively; *, less intensively)

Expertise in seagrass research and development in ASEAN is extremely limited. This is due partly to the nature and status of the seagrass ecosystems present along its coasts. In the last ten years, the Philippines has advanced substantially in its effort to understand the basic ecology, trophic dynamics, and broad-scale distribution of its seagrass resources. It has initiated a program of research that investigated the role of seagrasses in protected areas, their usefulness in the rehabilitation of degraded coasts, and in monitoring impacts from environmental stresses imposed by industrial activities. In Indonesia, emphasis on seagrass research is focused on the structure of the communities and the fisheries they support. In collaboration with the Dutch government, the country has initiated a study on the role of seagrasses in marine pollution monitoring.

The taxonomy and phenology of seagrasses in Thailand is being investigated with help from Japan (Ogawa, personal communication). Largely through the ASEAN-Australia Living Coastal Resources project, seagrass role in fisheries and habitat interconnection are currently in focus. The role of seagrass resources in coastal socio-economy is under investigation by a non-governmental organisation in the western part of the country.

Very recently, Malaysia has intensified its research efforts on seagrasses. This is largely a result of its realisation of the threats to the ecosystem mainly through industrial development and the role the plants play in coastal economy and conservation (Japar 1994).

In Singapore, the contribution and value of seagrasses has not been assessed due principally to their patchiness and scant distribution. However, a realisation of the critical role of the plants in coastal ecology helped convinced policy-makers to protect the island of Semakau (Chou 1992). The Department of Primary Industry used artificial seagrasses to improve water quality in Singapore River.

PROBLEMS OF COASTAL RESOURCE MANAGEMENT IN ASEAN

Countries of ASEAN face the problem of how to maintain and improve the integrity of coastal resources for sustainable use. This problem arises from: (1) biophysical impacts on the environment; (2) political interference and mismanagement; and (3) psychosocial perceptions. Biophysical impacts are brought about either by human activities or by natural stresses. In the assessment of seagrass environmental quality, criteria were developed during the LCR project to assess the degree of impacts on seagrass ecosystems in the region. The impacts brought about by human activities include blastfishing, boat scour, dredging, eutrophication, fishing damage, fish poisoning, gleaning, mariculture, oil spill, pollution, population pressure, reclamation, sedimentation, trampling, and poor management status. On the other hand, the natural stresses and factors include substrate type, association with coral reefs or mangroves, presence/absence of dugong, topography, epiphytism, grazing intensity, monsoon exposure, salinity, temperature, depth, tidal exposure, diseases, cyclones, and volcanic eruption.

Political interference and mismanagement is a 'normal' ingredient in developing countries. This results from misguided priorities arising from a meagre information base, lack of expertise, political favouritism and inefficient bureaucracy in the face of a dire lack of financial resources. The much needed but least felt political will to support the new movement of coastal environmental protection is locked in the traditional bureaucracy and political elite in the region. This determines the role seagrass resource management plays in more open decision-making procedures. In the case of Environmental Impact Assessment (EIA) requirements for major development activities, its adoption as a planning tool is influenced largely by pressure from the funding agencies. This pressure is manifested in at least two ways: review of environmental impact reports to ensure that projects receiving development assistance do not cause undesirable environmental effects; and support, by way of funds and technical assistance, for environmental protection policies and environmental enhancement programs in recipient countries.

Some psychosocial misperceptions underlie most resource and environmental management efforts in Southeast Asia. Its people generally have an anthropocentric, not a naturalistic nor a sociocentric perception of the environment. Hence, everything that surrounds humans must conform to their specifications. Humans are not perceived as a simple player in a community of ecological equals but a dominating organism that dictates the nature and course of development. When the basic needs for food, shelter and security are under stress in

developing countries, people do not perceive human actions as posing a threat to the environment; it is the latter which poses a threat to life and survival. Development itself is perceived solely as industrial and infrastructural development and a precondition towards the improvement of the quality of life. Hence, the latter is predicated on environmental exploitation, not on environmental protection. In addition, protection of the environment is not a perceived social need but a marginally relevant and time-consuming exercise.

GOALS OF SEAGRASS RESEARCH IN THE REGION

The goals of seagrass research and development in the ASEAN region should be formulated within an environment framework with the following realisations (Yong 1989):

- There is severe environmental degradation in the coastal zone of the region;
- Most renewable resources are already heavily exploited and the coastal ecosystems are under stress;
- There is a lack of public appreciation of renewable resources and sustainable development;
- There is a lack of integrated management approaches and capabilities;
- Most coastal people are living in poverty;
- There are inadequate institutional frameworks in place; and
- There is poor law enforcement in most areas.

It is therefore imperative that any research effort on seagrass systems in the region address the above concerns. However, it should be a part of any such activity to consider the role played by direct or basic research as the lack of sufficient basic floristic, ecological and socioeconomic information remains the most serious limitation towards any effort to manage the resources in the region.

The goals of seagrass research and development in ASEAN should be to determine, at the national and regional levels:

- The external forcing conditions and how changes in them affect the structure and dynamics of the ecosystem;
- Material fluxes between the seagrass ecosystem, land and atmosphere;
- How land use patterns and human activities affect the morphodynamics of the ecosystem;
- How the responses of the ecosystem to environmental change will affect the habitation and usage by coastal dwellers; and
- Indices useful in developing scientific and socioeconomic bases for the integrated management of the coastal environment.

In specific terms, the goals of seagrass research and development in ASEAN could be addressed more effectively if substantial and sustained effort is committed and, together with the initial parameters currently under study, systematised and redirected towards the following (modified from Holligan & de Boois 1993):

- *Intensive process studies* in order to understand how the ecosystem and its components behave with respect to environmental perturbations. This would provide a better basis for understanding, thus allowing more confident prediction;
- *Extensive observational data gathering* for key resource and environmental parameters in order to establish their significance in maintaining and improving the ecological and economic status of the ecosystem;
- *Simulation and prognostic modelling* of the seagrass ecosystem for predictive management of target components over a wide range of space and time scales (e. g. seagrass-dependent fish and prawn fisheries; endangered sea cows, sea turtles);
- *Direct and careful application of acquired and established principles and insights* with active participation from the affected populace (e. g. restoration ecology);
- *Integration of activities* with those on mangroves, coral reefs and associated land-based ecosystems; and
- *Widespread introduction of information technology* and attendant data acquisition and handling methods.

CONCLUSIONS

In ASEAN countries, the last ten years have provided three times more information on local seagrasses and their resources than the last 100. This is because of the recent realisation and renewed interest on the part of the academia, governments and private sectors on the important ecological and economic roles seagrass ecosystems play in coastal and marine environmental protection and use. Despite this upsurge of interest, very few published accounts are yet available, and largely through the ASEAN-Australia Living Coastal Resources project do we now find data on dynamics, population biology, faunal relationship and rehabilitation potential. The seagrasses of the region are now the focus of an intensive study to look at their phenology and life history patterns as useful indices in environmental impact analysis in ASEAN coasts.

In the next decade, one of the challenges critical for seagrass research in ASEAN is its understanding and application in the management of the environment in the face of environmental change. Seagrass beds are a major life support ecosystem of tropical coasts and they are a common target of impacts from coastal and land-based developmental activities. Our current knowledge about the ecosystem and its resiliency to impacts are yet so meagre and the rate we acquire information about them cannot cope with the rate the habitat is being degraded. Put simply, if the seagrass environment is not protected, the basic cycles (food, water and air) and alternative uses of the resources upon which a great majority of coastal inhabitants and their socioeconomic development are largely dependent would be placed in jeopardy.

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