Introduction to Mangroves

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- Mangrove Environment
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Definition of Mangroves

Mangroves are defined as woody trees and shrubs which flourish in mangrove habitats or mangals

True mangroves: trees that occur only in such habitats, rarely elsewhere

54 species in 20 genera in 10 families

(Hogarth, P. 1999)

Avicenniaceae

Avicennia officinalis L.

Avicennia marina (Forsk.) Vierh.

Avicennia alba Bl.

Rhizophoraceae

Bruguiera cylindrica (L.) Bl.

Bruguiera gymnorrhiza (L.) Lamk.

Bruguiera hainesii C. G. Rogers

Bruguiera parviflora Wight and Arnold ex Griffith

Bruguiera sexangula (Lour.) Poir.

Ceriops tagal (Pen.) C. B. Robinson

Ceriops candolleana Arn.

Rhizophora apiculata BL.

Rhizophora mucronata Lamk.

Sonneratiaceae

Sonneratia caseolaris (L.) Engler

Sonneratia alba Smith

Acanthaceae

***Acanthus ilicifolius* L.**

Euphorbiaceae

***Excoecaria agallocha* L.**

Leguminosae

***Derris uliginosa* Benth.**

Meliaceae

***Xylocarpus granatum* Konig**

***Xylocarpus moluccensis* (Lamk.)Roem.**

Myrsinaceae

***Aegiceras corniculatum* (L.) Blanco**

Palmae

***Nypa fruticans* (Thunb.) Wurmb.**

***Calamus erinaceus* (Becc.) Dransfield**

***Daemonorops leptopus* Mart.**

Pteridaceae

***Acrostichum speciosum* Willdenow**

***Acrostichum aureum* L.**

Rubiaceae

***Scyphiphora hydrophyllacea* Gaertn. F.**

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Where Mangroves Occur

Tropical (and sub-trop) Coasts

No frost

Sediments

Low energy waves

Mangrove Environment

Soft substrate

Low oxygen content (water logged soil)

Range of Salinity

Terrestrial and aquatic components

Soft Substrate

Prop/Stilt Roots	***Rhizophora***
Buttress Roots	***Bruguiera***
	Xylocarpus
Cable Roots	***Avicennia***
	Sonneratia

Soft Substrate

Propagules ready to establish (vivipary – germinate on parent tree)

Marked in *Rhizophoraceae*

Rhizophora

Bruguiera

Rhizophora apiculata **propagules**

Low Oxygen Content

Pneumatophores

Avicennia

Sonneratia

Lenticels on Bark

Bruguiera

Saline Water

Plants occur at different salinity ranges

e.g. *Nypa fruticans* at freshwater end

Exclude salt at root level

e.g. *Rhizophora*

Exclude salt from leaves

e.g. *Acanthus*

To reduce water loss

Waxy Leaves - *Rhizophora*

Tomentose leaves - *Avicennia lanata*

Stomata on abaxial side only - *Rhizphora*

Common Mangrove Animals
Invertebrates

Crustaceans:

Marine Prawns: ***Penaeus*** **spp. (*P. monodon*), *Metapenaeus* spp.**

Mangrove Snapping Prawn: ***Alpheus*** **spp.**

Mud crabs: ***Scylla*** **spp. (*S. serrata*)**

Sesarmine crabs: ***Chiromanthes eumolpe*** **(blue face band)**

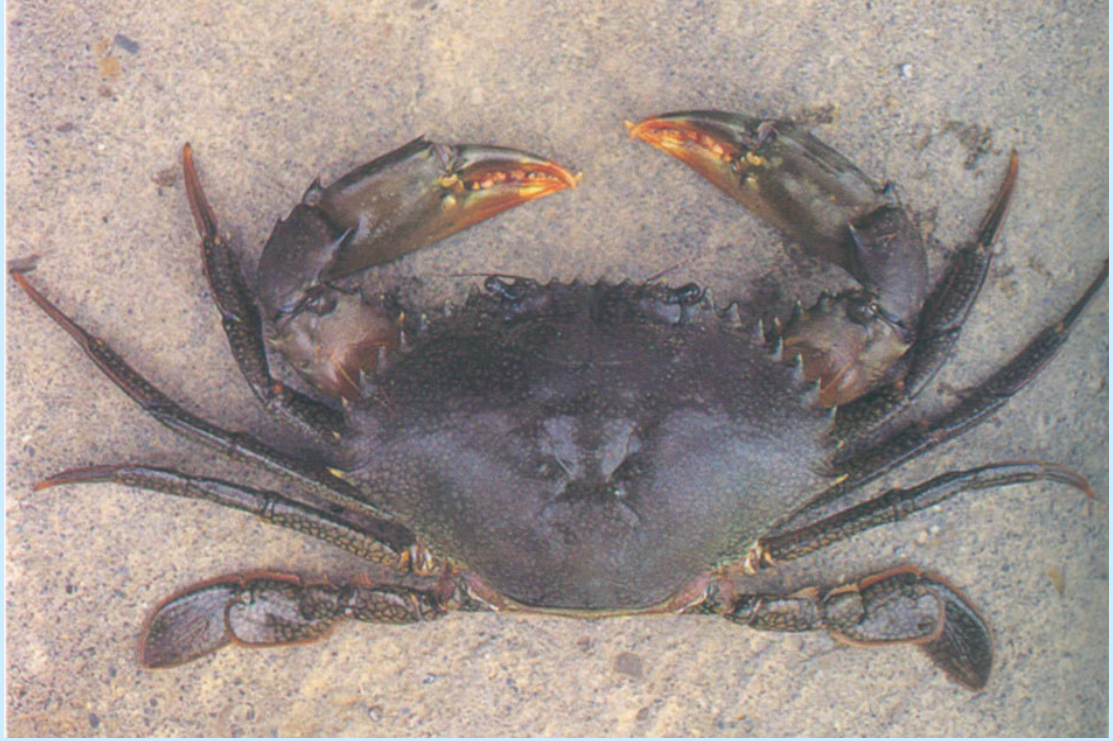
Fiddler crabs: ***Uca*** **spp. (*U. rosea*)**

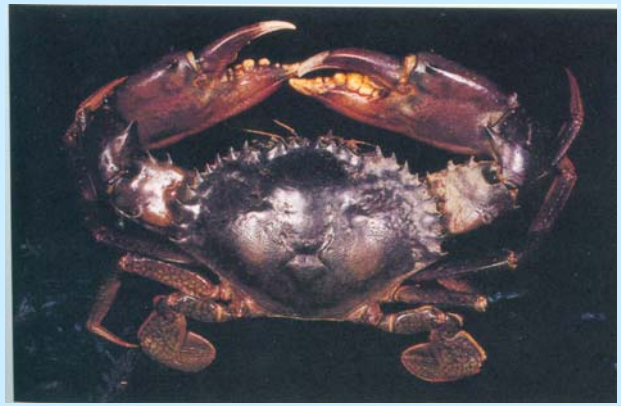
Mud lobster: ***Thalassina anomala***

Molluscs

Nerita, Littoraria, Cerithidea, Ellobium

Oysters, clams, cockles ***(Anadara granosa)***

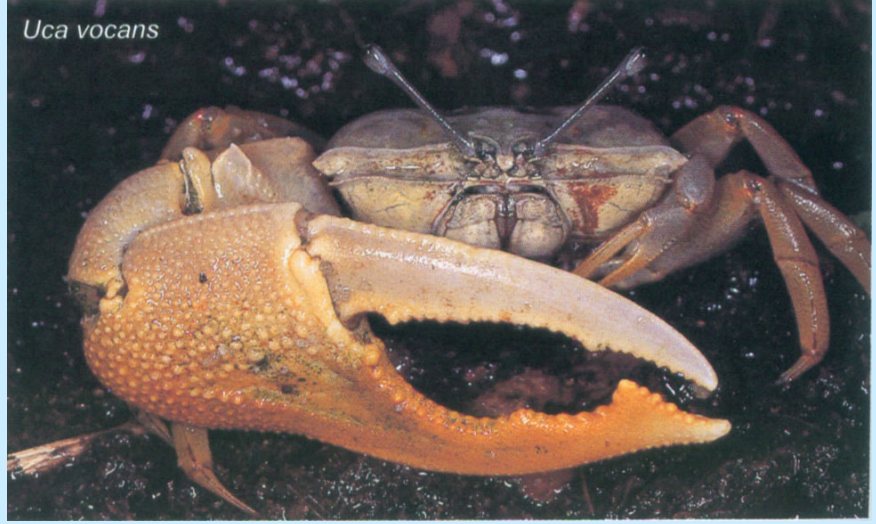




***Scylla* spp.: *S. serrata* (mud-crab) at top**

Photos from: Ng, P.K.L. & Sivasothi,N. (1999). A Guide to the Mangroves of Singapore II (Animal Diversity), Singapore Science Centre

Uca rosea



Uca vocans

Uca paradussumieri

Photos from: Ng, P.K.L. & Sivasothi,N. (1999). A Guide to the Mangroves of Singapore II (Animal Diversity), Singapore Science Centre

Common Mangrove Animals
Vertebrates

Fishes:

Commercial: Sea bass, grouper

Mudskippers, mangrove archer fish

Amphibians & Reptiles

Snakes: Water snakes, mangrove pit-viper, mangrove cat snake

Malayan water monitor, Estuarine crocodile

Birds

Brahminy kite, kingfishers, woodpeckers, herons, egrets

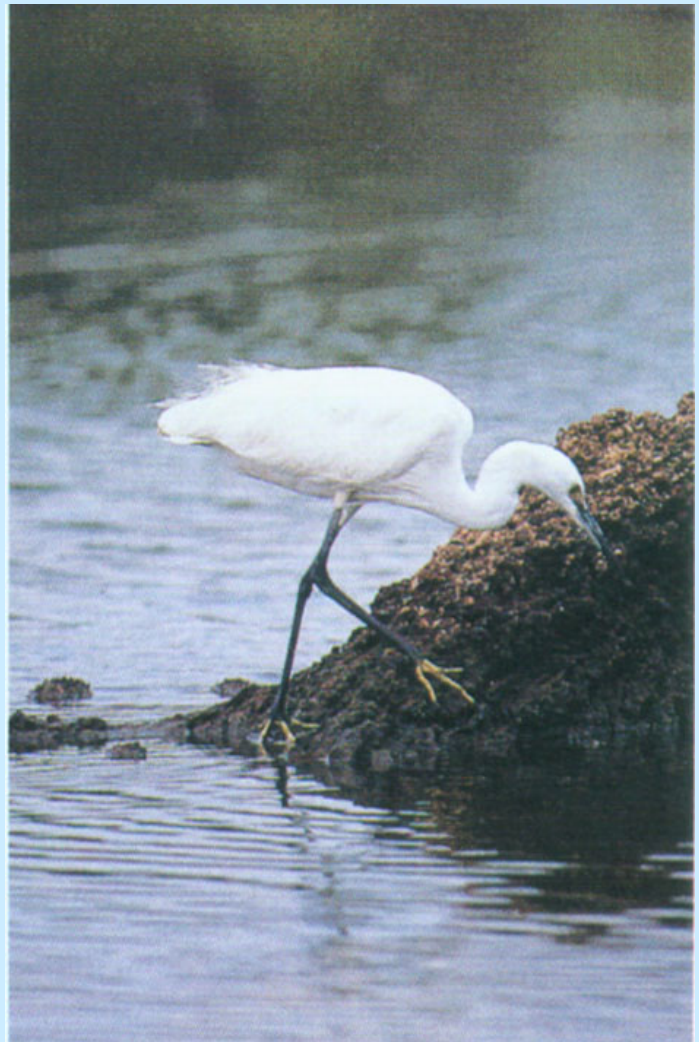
Mammals

Long-tailed macaques, bats, otters

Shore (Mangrove) Pit Viper VENOMOUS

Photos from: Ng, P.K.L. & Sivasothi,N. (1999). A Guide to the Mangroves of Singapore II (Animal Diversity), Singapore Science Centre

Brahminy Kite:
Haliastur indicus



Little Egret:
Egretta garzetta

Photos from: Ng, P.K.L. & Sivasothi,N. (1999). A Guide to the Mangroves of Singapore II (Animal Diversity), Singapore Science Centre

Long-tailed Macaque: ***Macaca fascicularis***

Adaptations in Animals

Dessication/dehydration

Anaerobic conditions

- Mechanisms to wet gills with reoxygenated water (sesarmid crabs, mudskippers)

- Breathe on land (mudskippers - through skin)

- Digs burrows which reaches water table (mud lobster)

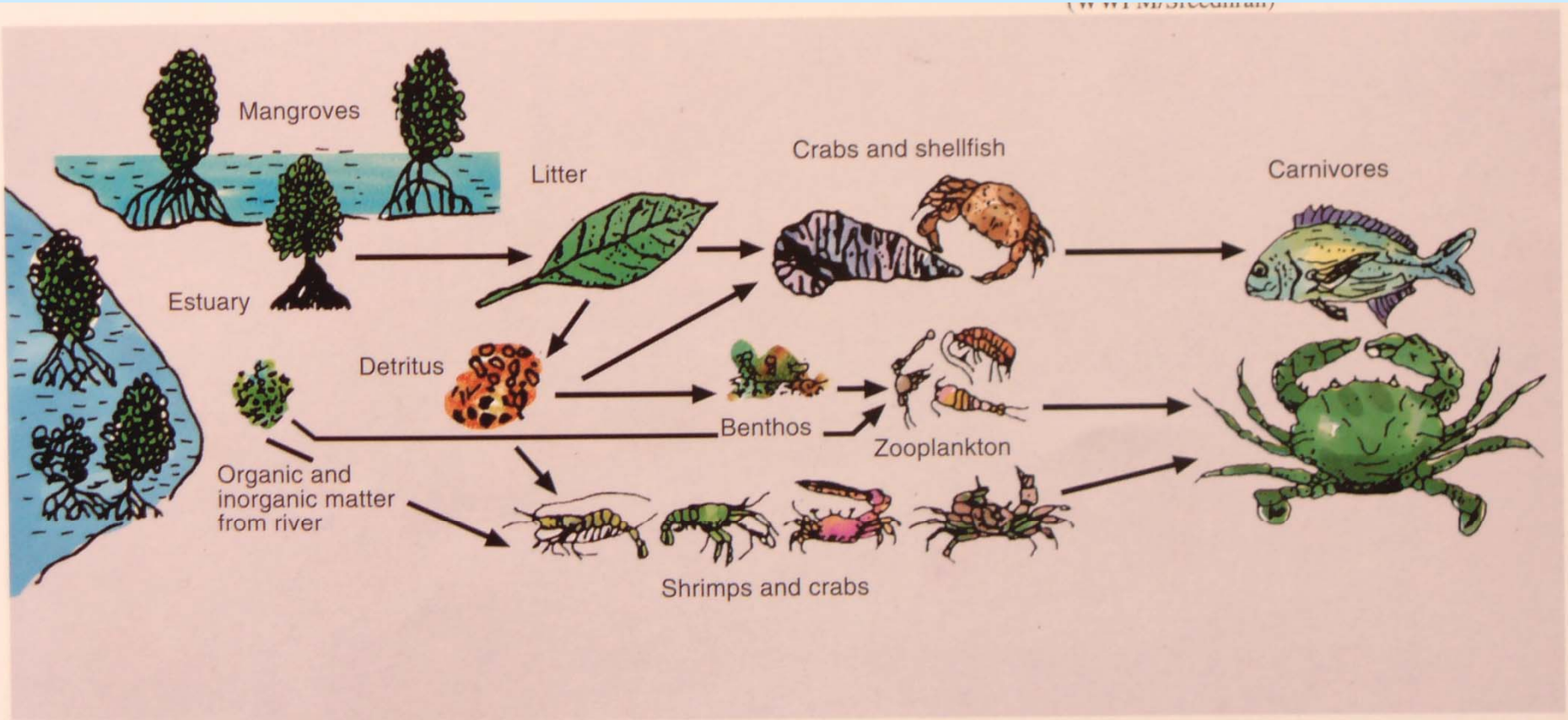
Plant/Animal Interactions

Food Web – Detrital/Herbivory

Pollination/Dispersal

From: Gong & Wazir (2001). Encyclopedia of Malaysia, Vol. 6: The Seas. EDM

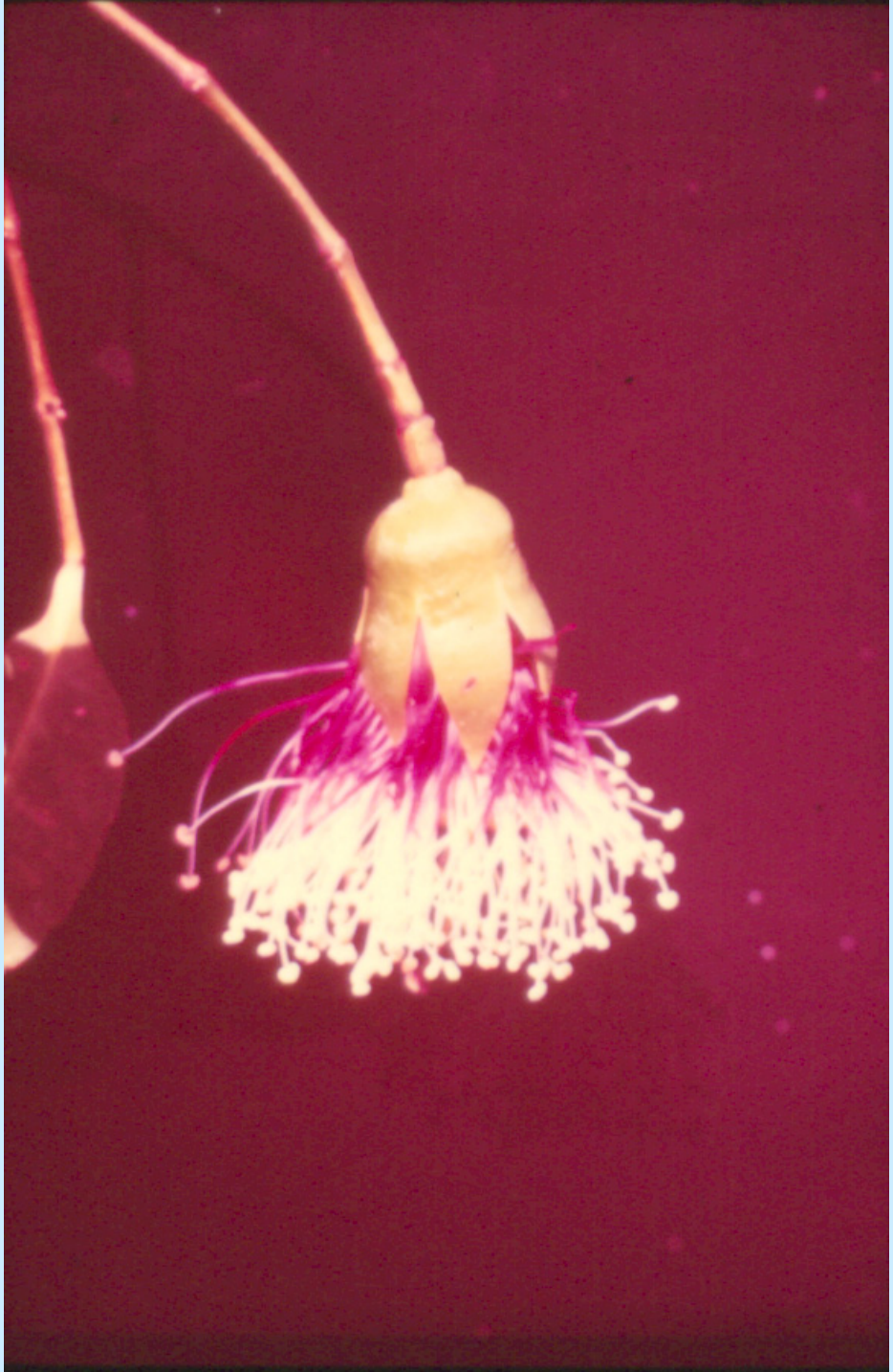
Simplified diagram of a food web in the mangroves



A simplified diagram of a food web in the mangroves

From: IPT-AWB (1994) : Glimpses of Malaysia's Mangroves

Fruit Bats: ***Macroglossus minimus, Eonycteris spelaea***



No mangroves,

No durians?

Importance of Mangroves
Extractive Use

- **Forestry**
  - **Timber**
  - **Minor products**

- **Fisheries**

Reference: UNEP/GEF/SCS Regional Task Force on Economic Valuation, 2003

Importance of Mangroves
Non-extractive Use

- **Tourism**
- **Research & Education**
- **Aesthetic**

Reference: UNEP/GEF/SCS Regional Task Force on Economic Valuation, 2003

Importance of Mangroves
Environmental Services

- Carbon sequestration
- Coastal protection
- Water purification
- Aquaculture (pearl)
- Nursery area

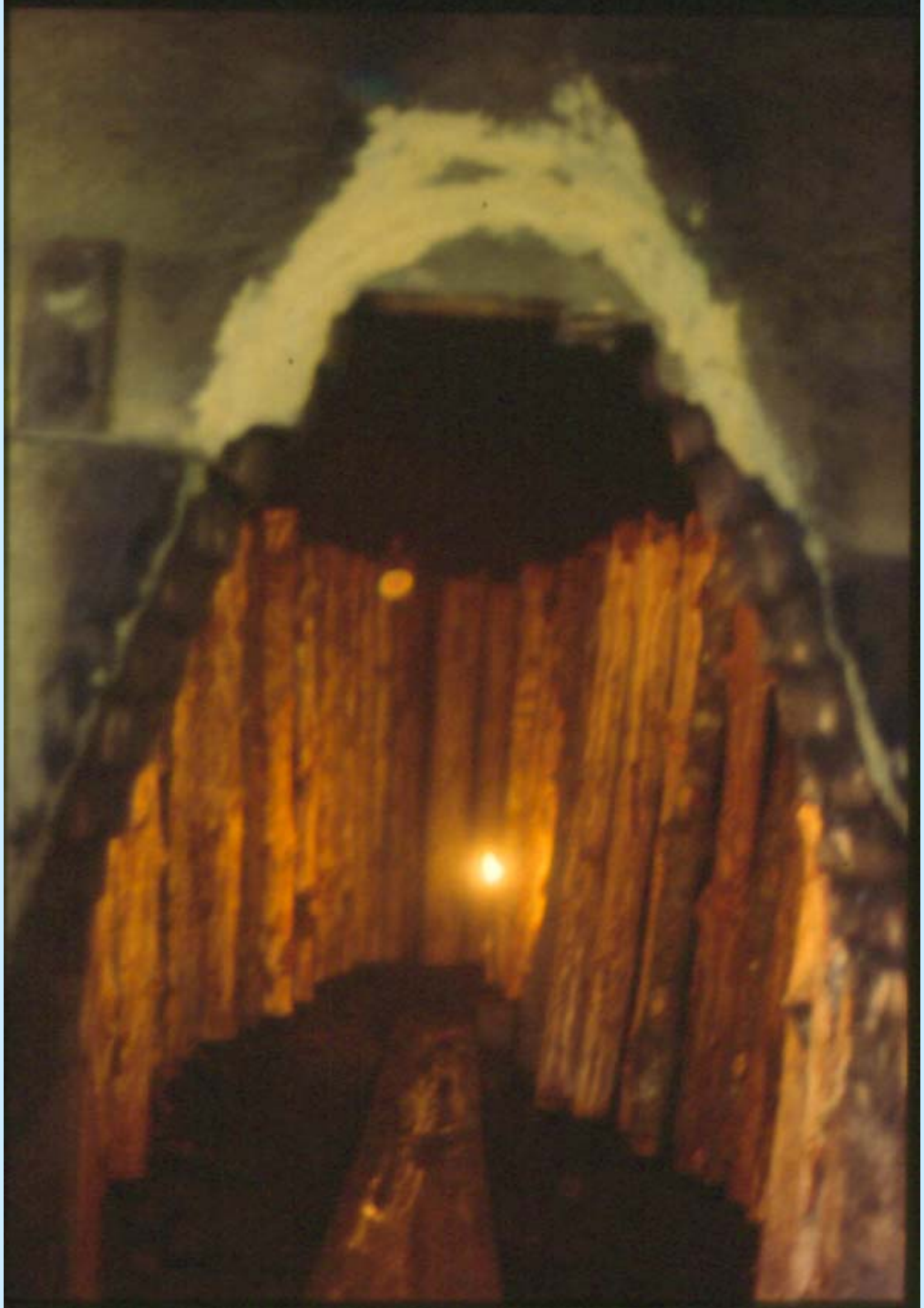
Reference: UNEP/GEF/SCS Regional Task Force on Economic Valuation, 2003

Mangrove productivity

High productivity of

20-30 tonnes OM ha^{-1} yr^{-1}

Mangrove Productivity
Charcoal



Mangrove productivity
Poles

Mangroves as Nursery/Refuge

- **High primary productivity - abundant and varied food resources**
- **Turbidity – increases chance of hiding & escape from predators**
- **Diversity & structural complexity of roots – multiple spatial & trophic niches**
- **Shallowness – escape predators**

Mangroves as Source of Food: Within Estuary

- **Chong *et al.* (2001) :**

  Primary food source in the upper estuaries (mangrove carbon up to 84% of prawn tissues)

- **Loneragan *et al.* (1997) :**

  Limited to very small spatial scale – within the mangrove fringe of small creeks

Mangroves as Source of Food: Offshore

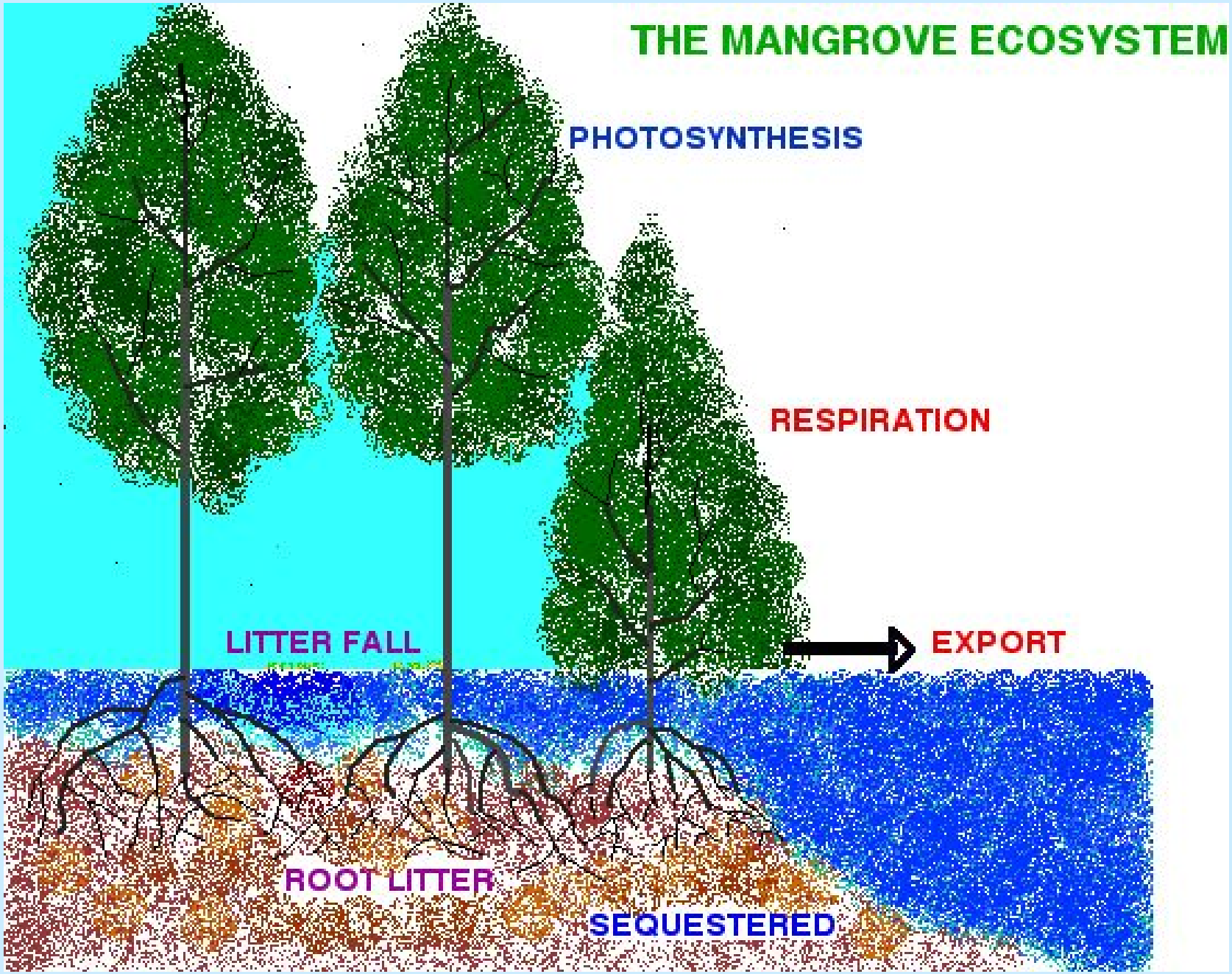
- **Loneragan *et al.* (1997) :**

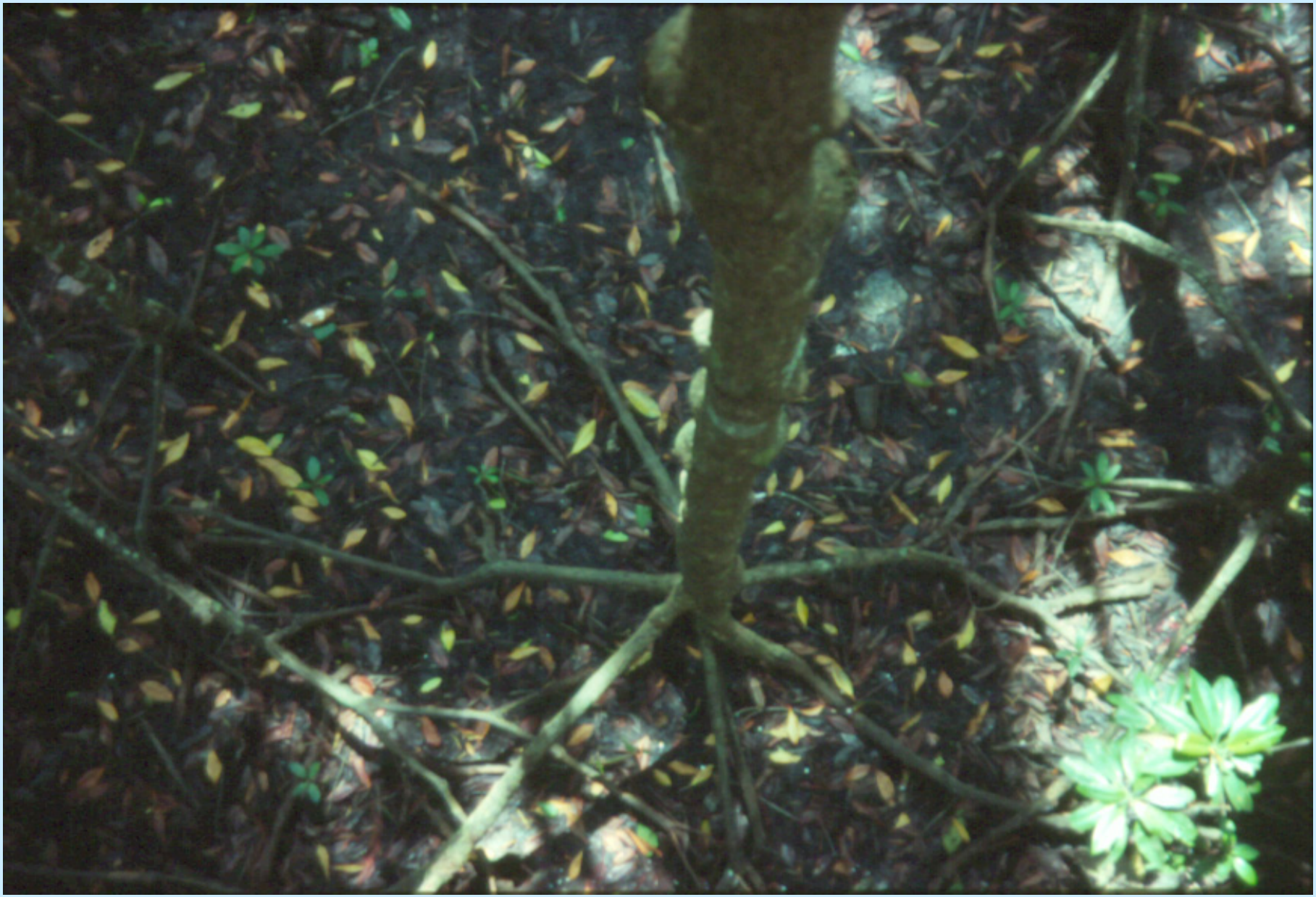
  Very little of exported mangrove carbon assimilated by prawns in habitats away from mangrove creeks

- **Chong *et al.* (2001) :**

  2 km offshore: 15-25% dependency on mangrove carbon

  7-10 km offshore (shallow waters) : mainly phytoplankton & benthic microalgae


THE MANGROVE ECOSYSTEM
PHOTOSYNTHESIS
RESPIRATION
LITTER FALL
EXPORT
ROOT LITTER
SEQUESTERED



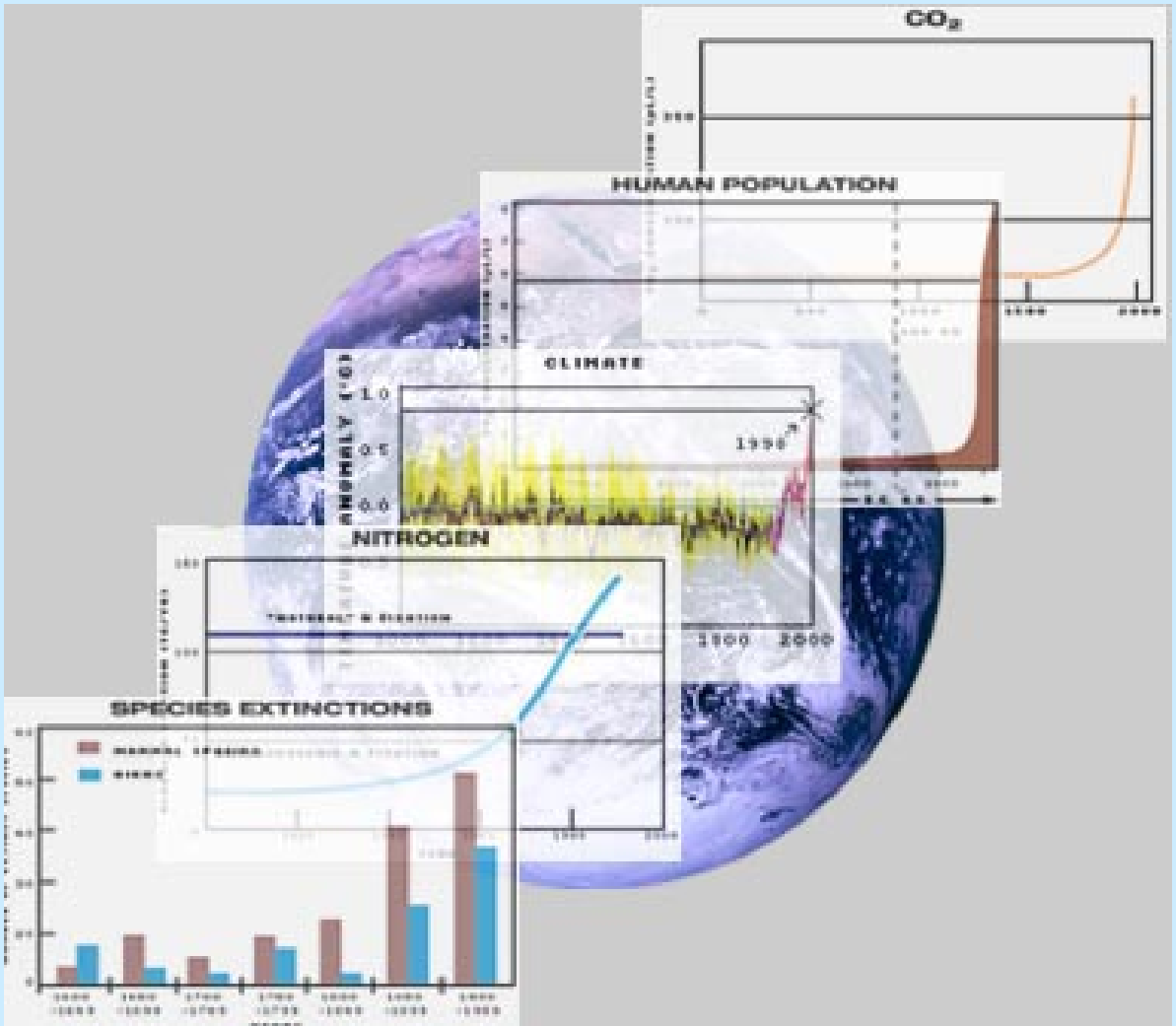
Carbon sequestration

Carbon Sequestration - comparison

	Mangrove	Oil Palm (20 yrs) **(Chan '02)**	TRForest **(Henson '99)**
Standing Biomass (tC/ha)	114	45	200
Net C fixed (tC/ha/yr)	17	9	12

International Geosphere- Biosphere Programme (IGBP)

A study of global change



Global Change & Mangroves

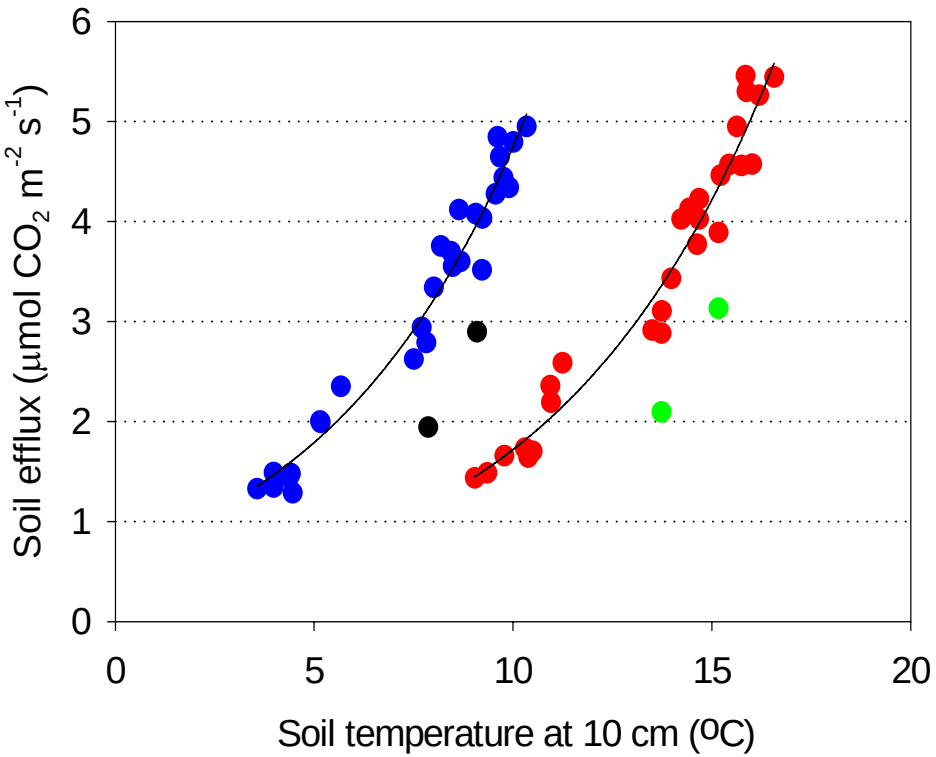
Inrease in CO_2 levels

Global Warming

Sea Level Rise

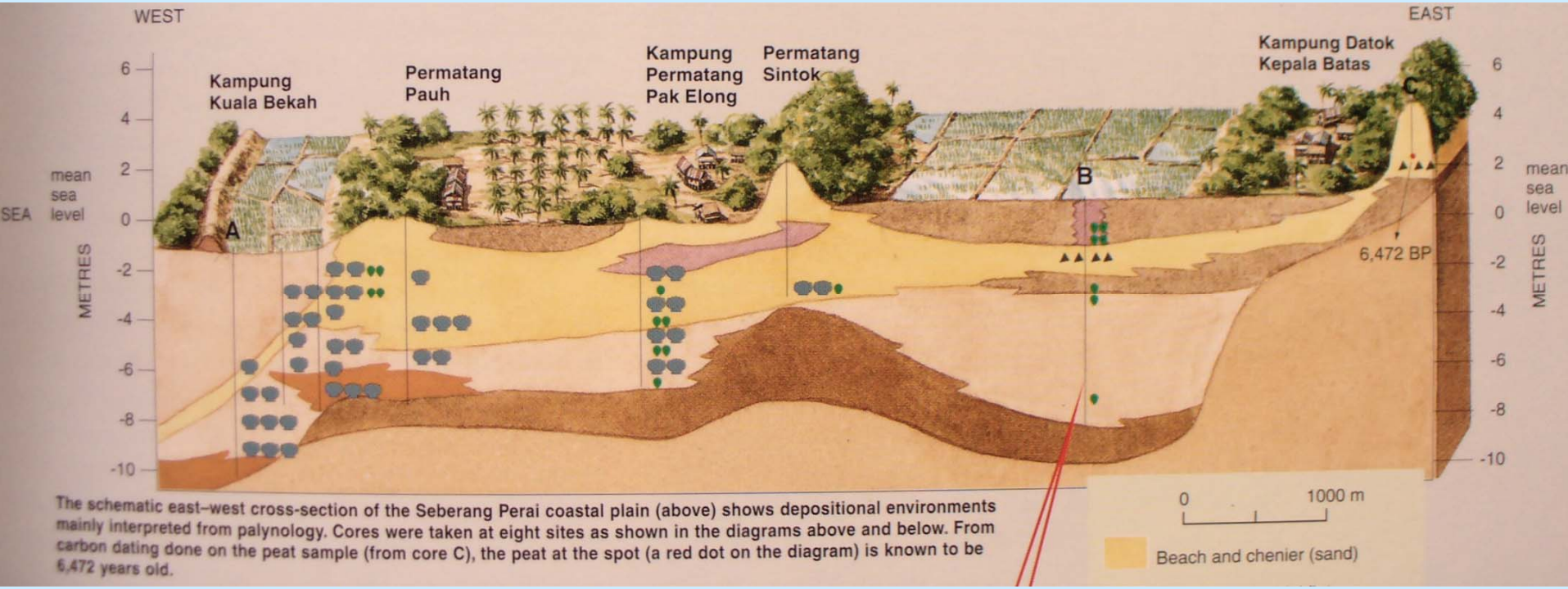
Land Use Change

Photo courtesy of
E. Farnsworth



The Flakaliden soil warming experiment of 5 years

Sea level rise: where can mangroves go?



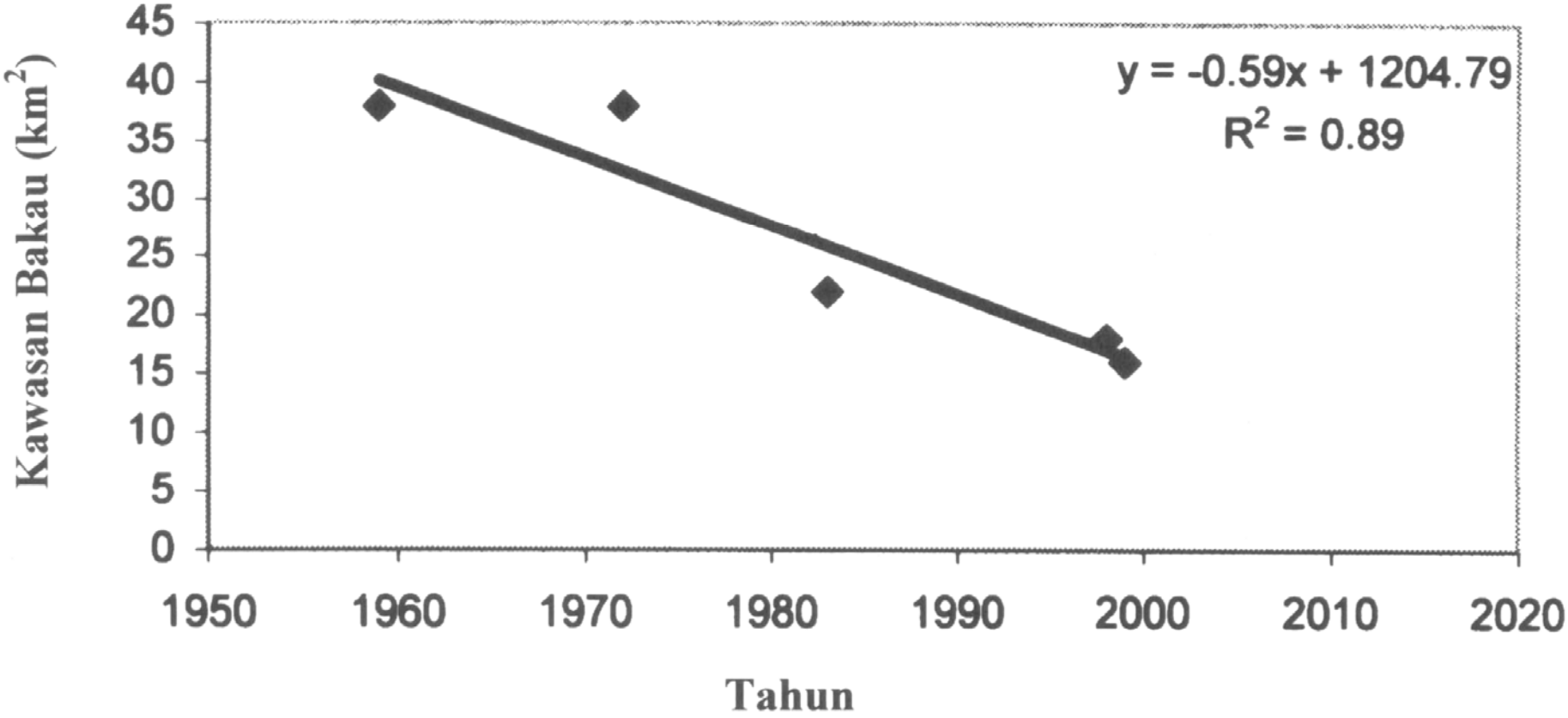
The schematic east–west cross-section of the Seberang Perai coastal plain (above) shows depositional environments mainly interpreted from palynology. Cores were taken at eight sites as shown in the diagrams above and below. From carbon dating done on the peat sample (from core C), the peat at the spot (a red dot on the diagram) is known to be 6,472 years old.

From: Kamaludin (2001). Encyclopedia of Malaysia. Vo. 6: the Seas. EDM

able 1 Estimates of area (Ha) and rates of loss of mangrove habitat in seven countries bordering the South China Sea, compared with the world totals. [Data from FAO, 2003]

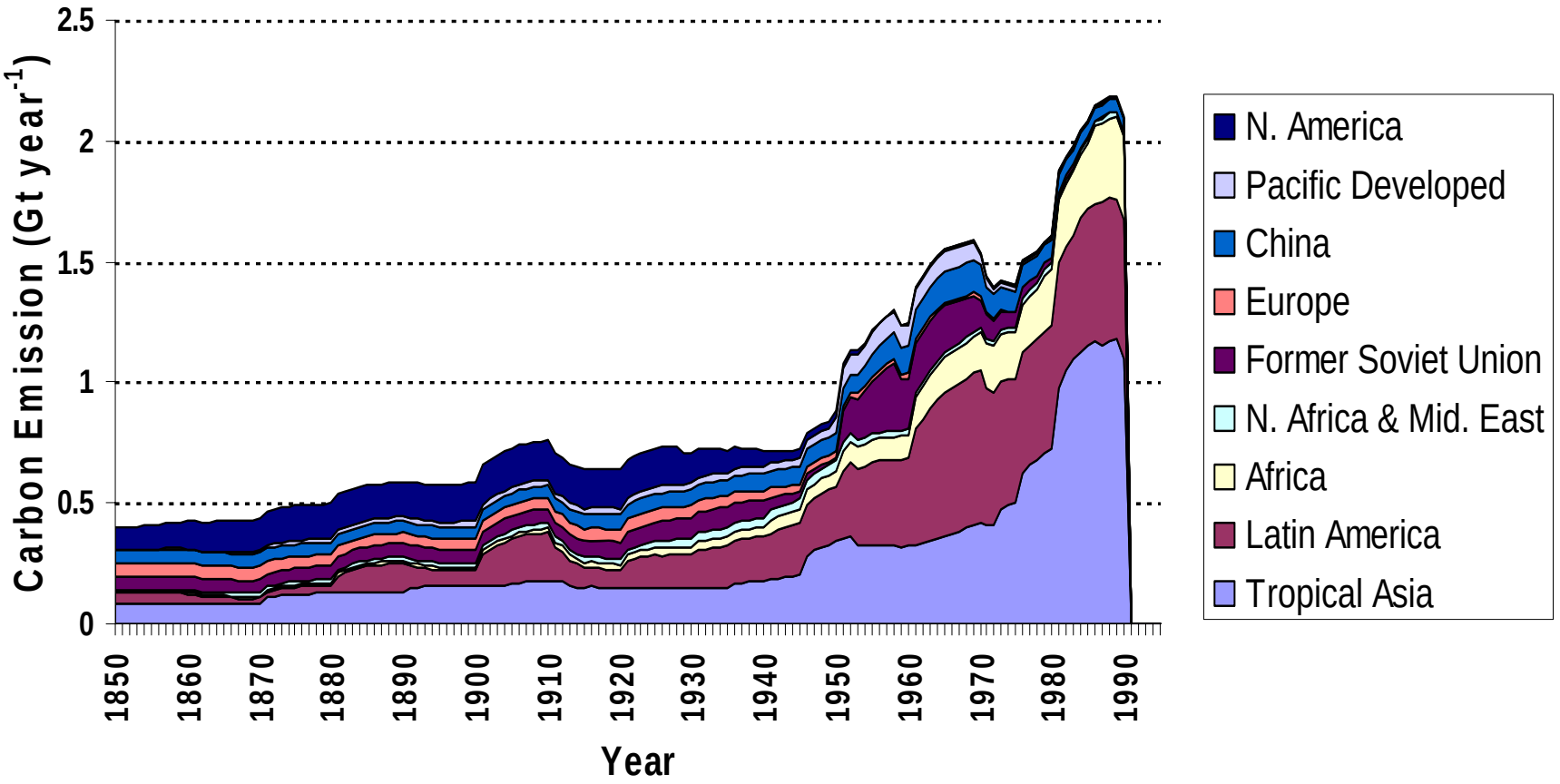
	Estimates of mangrove area in Ha					Rates of loss	
	Most recent	Date	1980	1990	2000	1980 - 1990	1990-2000
Cambodia	72,835	1997	83,000	74,600	63,700	-1.1	-1.6
China	36,882	1994	65,900	44,800	23,700	-3.8	-6.2
Indonesia	3,493,110	1988	4,254,000	3,530,700	2,930,000	-1.8	-1.8
Malaysia	587,269	1995	669,000	620,500	572,100	-0.7	-0.8
Philippines	127,610	1990	206,500	123,400	109,700	-5	-1.2
Thailand	244,085	2000	285,500	262,000	244,000	-0.9	-0.7
Viet Nam	252,500	1983	227,000	165,000	104,000	-3.1	-4.5
Total	4,814,291		5,790,900	4,821,000	4,047,200	average -1.8	average -1.7
World	15,763,000	1992	19,809,000	16,361,000	14,653,000	-1.9	-1.1
% world total	30.5		29.2	29.5	27.6		

From: UNEP/GEF/SCS (2004), Mangroves in the South China Sea



(From: Ong, 2003)

Carbon Emissions from Land Use Change



Source: R.A. Houghton, unpublished

Selected References

Chong,V.C., Sasekumar,A. & Wolanski,E. (1996). The role of mangroves in retaining penaied prawn larvae in Klang Strait, Malaysia. **Mangroves and Salt Marshes 1:**11-22.

Hogarth, P.J. (1999**). The Biology of Mangroves.** Oxford University Press.

Ng, P. K. L.& Sivashothi, N. (1999**). A Guide to the Mangroves of Singapore II (Animal Diversity).** Singapore Science Centre**.**

UNEP (2004**). Mangroves in the South China Sea.** UNEP/GEF/SCS Technical Publication No. 1

UNEP (2006). **Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand.** Report of the Fourth Meeting of the Regional Task Force on Economic Valuation.

UNEP/GEF/SCS/RTF-E.4/3.

Thank You