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Measuring Mangrove (Blue) Carbon Fluxes

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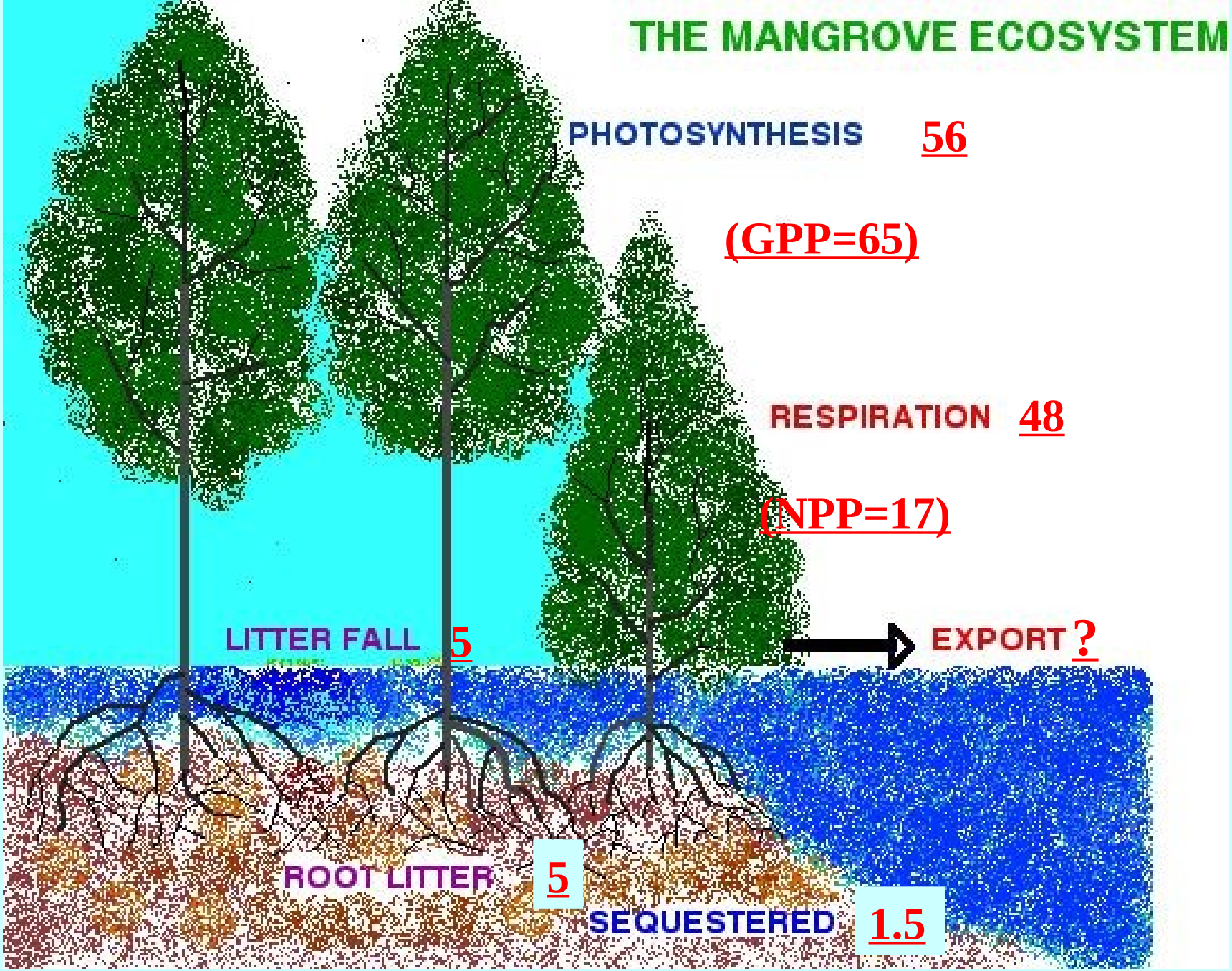
OUTLINE

1. **Background**
2. (Blue?) Carbon Trading
3. **Standing Biomass &Productivity**
4. **Carbon Sequestration**
5. **Mangrove “Outwelling”**
6. **Moving Forward, Sustainably.**

1. BACKGROUND

- **Ong, Gong, Wong *et al* Team at USM**
- **Long-term study on Carbon,** *Nitrogen and Phosphorus* **Budgets:**
  - Biomass and Productivity (Vertical Fluxes)
  - Sequestration in soil
  - “Outwelling” (Horizontal Hydrodynamics Fluxes)



Unit: t C ha $^{-1}$ y^{-1}

2. BLUE CARBON TRADING . . .

3. STANDING BIOMASS & PRODUCTIVITY

- **STANDING BIOMASS**
  - **Allometric equations**
- **PRODUCTIVITY**
  - **Is a rate (i.e. per unit time)**
  - **Leaf Litter fall / Root litter**
  - **Photosynthesis (and Respiration)**

Allometric Regressions

(Ong *et al*., 2004)

Rhizophora apiculata

log Above-ground Biomass(kg) = 2.523 log GBH(cm) -1.943

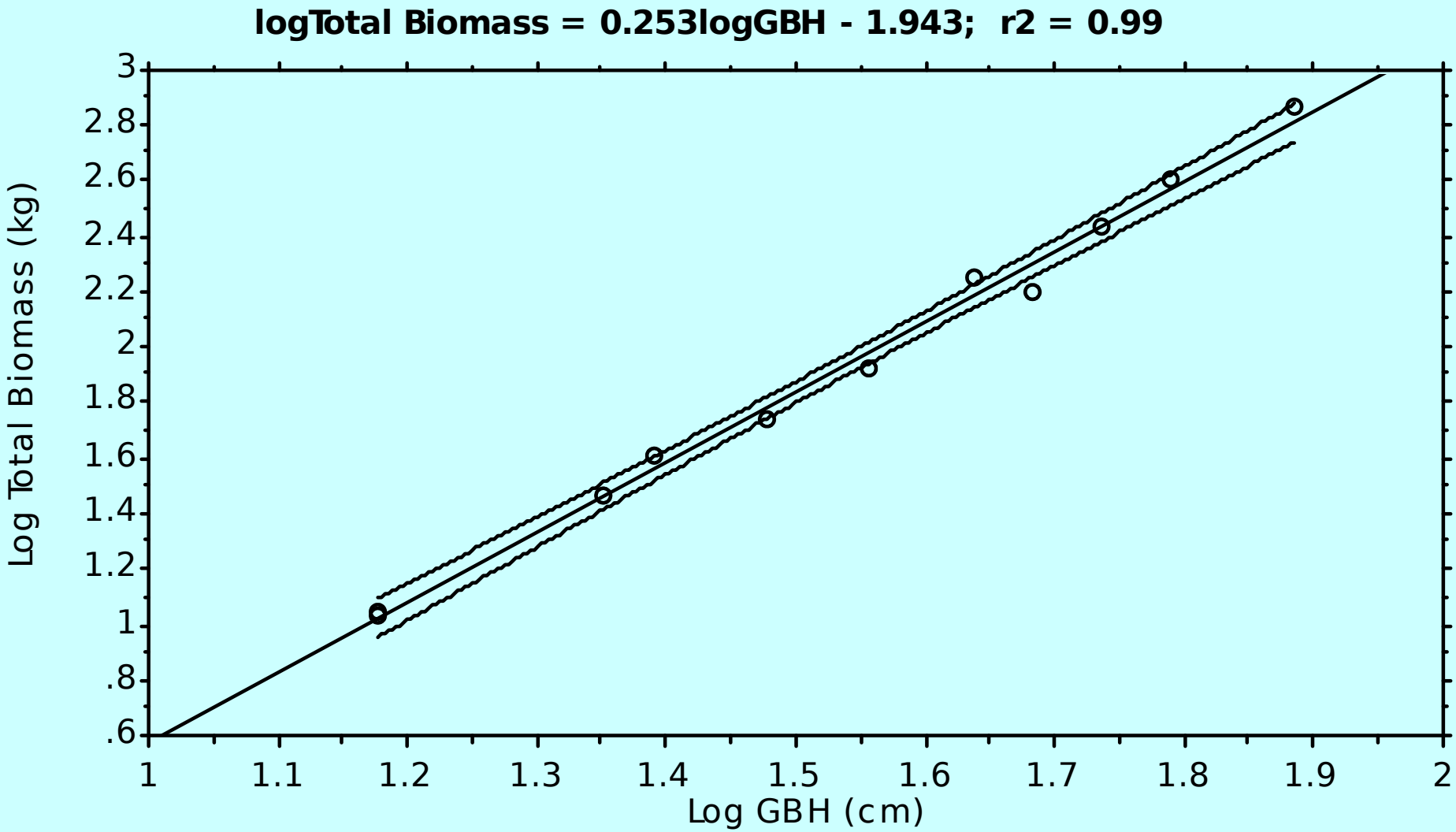
$r^2 = 0.98$

LESSONS LEARNT

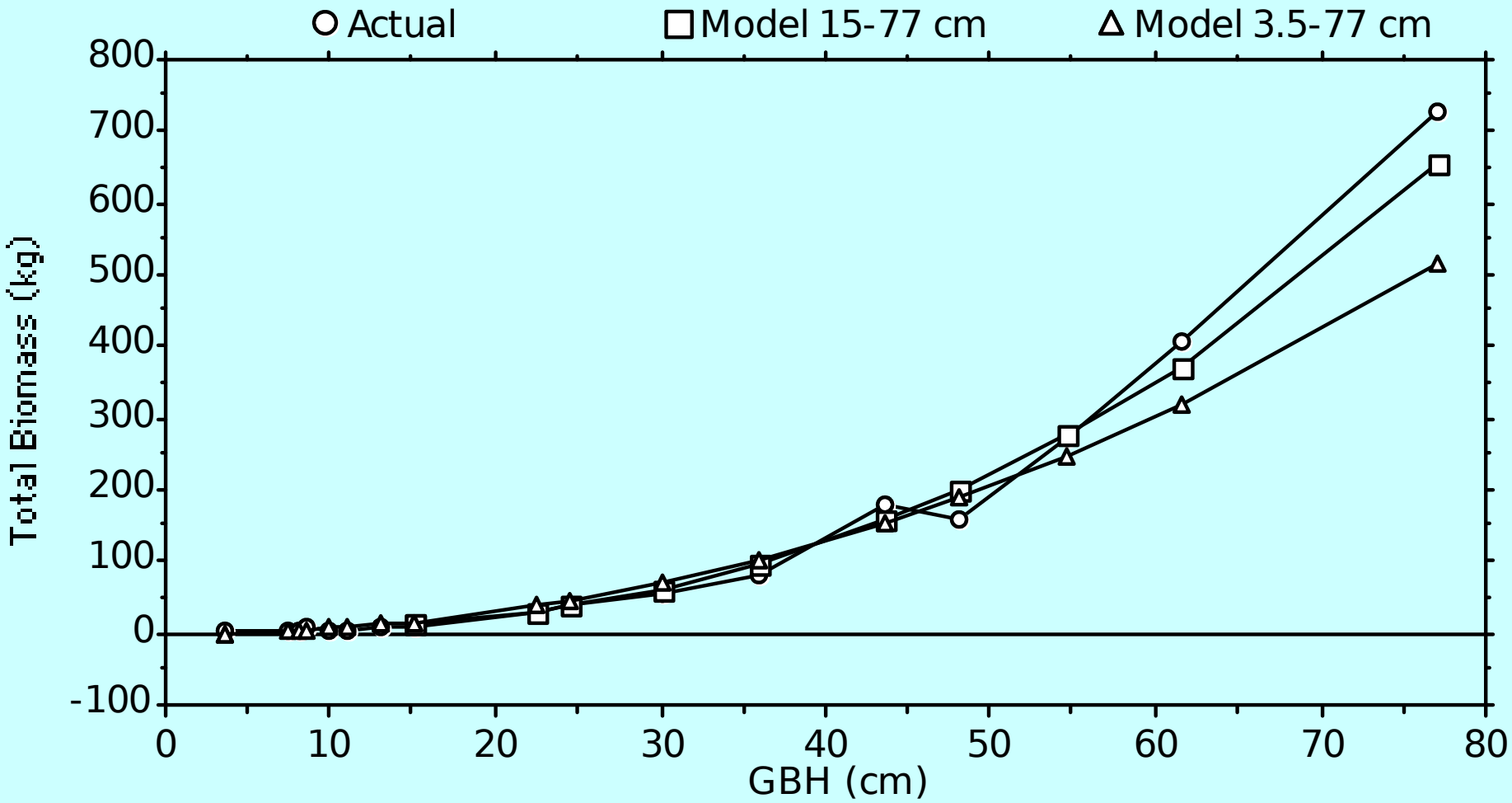
Have Fun

Rhizophora apiculata Allometric Regression

Which is the best equation to use?



Allometric Regression
is just a Model with associated errors



Productivity / litter-fall are RATES

PRODUCTIVITY

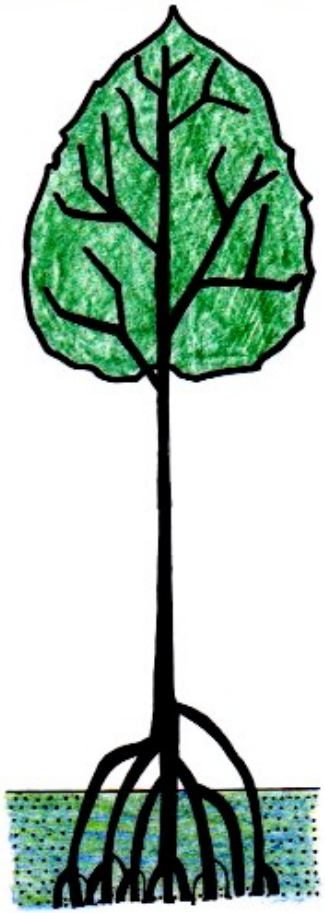
Nett (above-ground)

Lesson Learnt; Account for Dead Trees

Age (yrs.)	Biomass (t/ha)	MAI (t/ha)	Litter (t/ha/yr)	Nett Productivity (t/ha/yr)
5	16	3	7	10
10	180	18	10	28
15	200	13	10	23
25	300	12	11	23

Ong *et al*. (1984)

Biomass Partitioning & Growth



	% BIOMASS	PRODUCTIVITY ($tC\ ha^{-1}\ year^{-1}$)
LEAVES	2.6	0.08 ± 4.0
CANOPY		
BRANCHES	8.0	0.44 ± 1.1
TRUNK	74.0	5.56 ± -
STILT ROOTS	10.0	0.64 ± -
ROOTS	5.1	0.42 ± ?
TOTAL	100.0	7.14 ± 5.1 ± ?

Source : Ong, Gong & Clough (1995)

Photosynthesis & Respiration
(Gas Exchange)

Extreme Science?

Lesson Learnt:

Build Twin Towers

4. CARBON SEQUESTRATION

SOIL CORE MEASUREMENTS

- **Soil carbon: 15 %**
- **Soil density: 0.7**
- **Depth: about 10 metres**
- **Total Carbon: 10,500 t ha^{-1}**
- **Age: approx. 7000 years**
- **Sequestration: 1.5 t ha^{-1} yr^{-1}**

From: Ong (1993) in *Chemosphere*


Mangrove Shrimp Ponds have
Massive Carbon Footprints

SHRIMP PONDS IN MANGROVE: A HUGE CARBON FOOTPRINT

50-75 t C ha^{-1} yr^{-1}

(over a 10-year period)

released to the atmosphere

i.e 50 times the sequestration

5. MANGROVE OUTWELLING

No mangroves, no prawns?

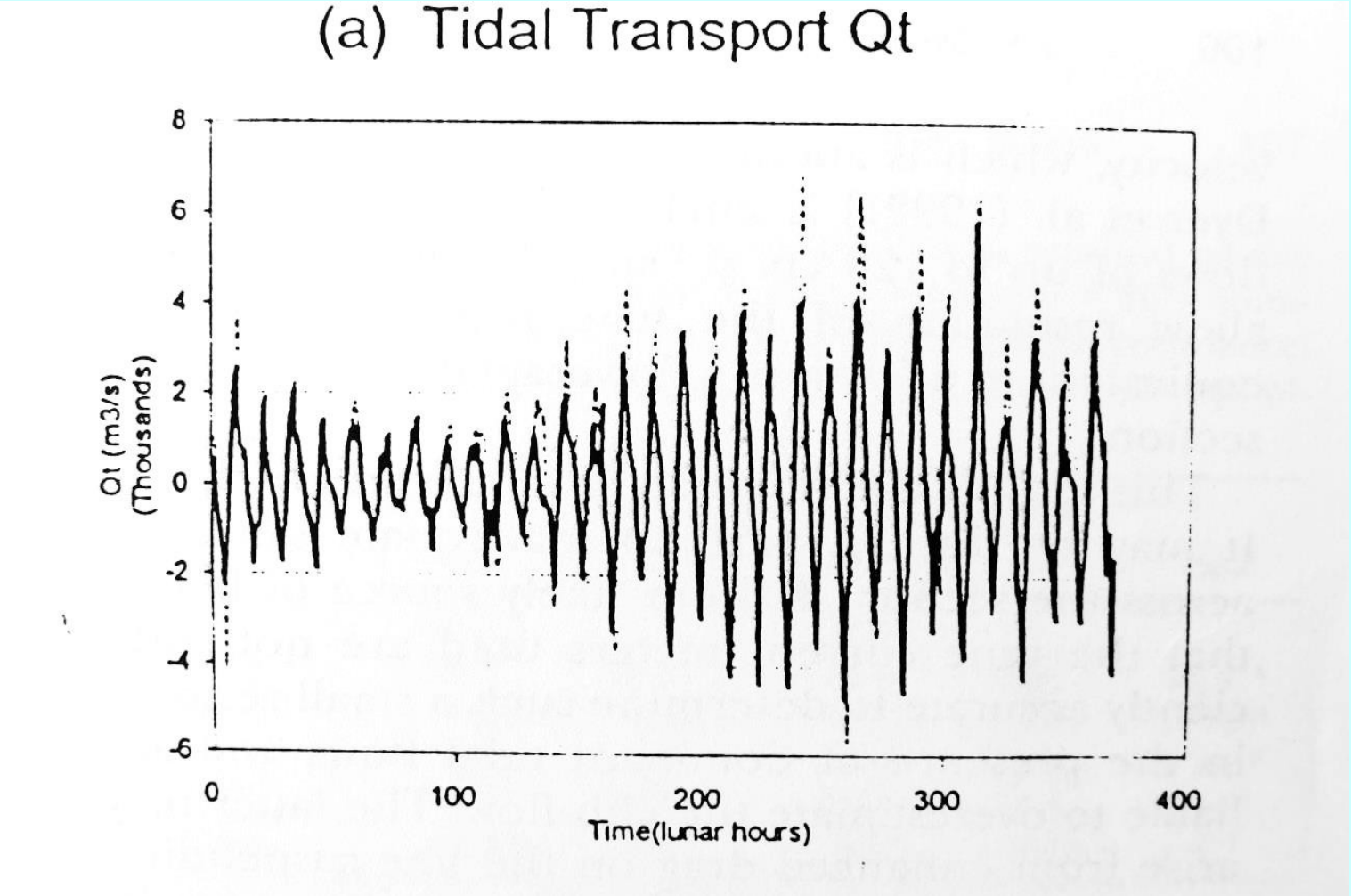
- **Golley,F., Odum, H.T. & Wilson, R.F. (1962)**
- **Odum, E.P. (1968)**
- **Macnae, W. (1974)**
- **Martosobroto P. & Naamin, N, (1977)**
- **Nixon, S. (1980)**
- **Kjerfve, B. et al. (1981)**

High technology self-recording current meters

Low-tech deployment of high-tech current meters

Simpson, J.H., Gong, W.K. & Ong, J.E. (1997)

Lesson Learnt: a low Signal / high Noise problem?
Possible Solution: use of ADCP?



Scott Nixon's, (1980) critique on "Outwelling"

A relatively few researchers, however well-meaning and able, failed to make and maintain a firm distinction between what they thought was happening, or what they thought 'ought' to be happening and that they had good data to show was happening. Because they told their story so often (and at times so eloquently), because at least some of them were very well-known and respected, because the credibility of the printed scientific literature was so strong, **perhaps because it sounded like such a good story, too many of us failed for too long to examine the concept critically**. Instead, we passed it on eagerly as one of the accomplishments of marine ecological research. And we passed it on very effectively to students, to managers, to legislatures, to funding agencies and to each other. It occurs to me that **if the early papers had clearly presented 'outwelling' as an exciting hypothesis, it might not have taken so long for the data necessary to evaluate it to become available**. It is reassuring that the scientific process has prevailed, and that we have begun to obtain some of the data necessary to evaluate the hypothesis, but it is humbling to realize how quickly and completely an idea becomes implanted in the literature, and in our minds, with so few data to support it.

It is a bad bargain to trade our credibility for political advantage. Science is a social enterprise, we communicate through the scientific literature, and we must do nothing to undermine the integrity of that communication. Both in sending and receiving information, **we must remain skeptical**. Reading . . .

6. Going Forward, Sustainably

- **For carbon trading to be sustainable**, the measurements of carbon fluxes must be under pinned by science. This, together with attaining SDG No.14, has to be driven by adequate scientific research funding:

A mechanism (e.g. a Research Cess Fund) must be established so that a small part of the gains from carbon trading can be used to fund the under pining science.

I thank the International Tropical Timber Organization, ISME & MoEF, Indonesia for so generously sponsoring me..

Thank you all and
Have a Very Good Day.

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