Forest Ecology & Management

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Scope

- Hydrology
- Forest structure
- Biomass
- Growth
- Phenology

Hydrology

Apart from temperature which affects the latitudinal range of mangroves, hydrology is the most important factor affecting where mangroves will grow, and which species will grow.

- Understanding hydrology is critical for restoration.
- Poor survival in most cases is due to unsuitable hydrologic conditions or a mis-match of species to the hydrologic conditions.

Diameter increments

Location	Age (y)	MADI (cm y^{-1})	Source
Matang, Malaysia	10 - 20	0.6	Chan (1996)
	20 - 40	0.4	Chan (1996)
Can Gio, Vietnam	3 - 15	0.5 - 0.6	Phan Nguyen Hong (1996)
Ca Mau, Vietnam	5 - 50	0.65	Clough et al. (unpublished)
Pattani, Thailand	5 - 18	0.45 - 0.61	Aksornkoae (1996)
Daintree R. Australia	NA	0.13 - 0.51	Clough (1992)

Forest structure

- Most published quantitative studies are for plantations of *Rhizophora*.
- There is almost no published information for mixed species stands.
- Relationships between species composition, stand density, tree size, canopy structure and growth rates can provide important inputs into management.

Self-thinning

There appears to be a fairly robust empirical relationship between the maximum size of an individual and the population density, of the form:

$$W = k\, N^{-1.5}$$

or

$$\log_e W = \log_e k - 1.5 \log_e N$$

or

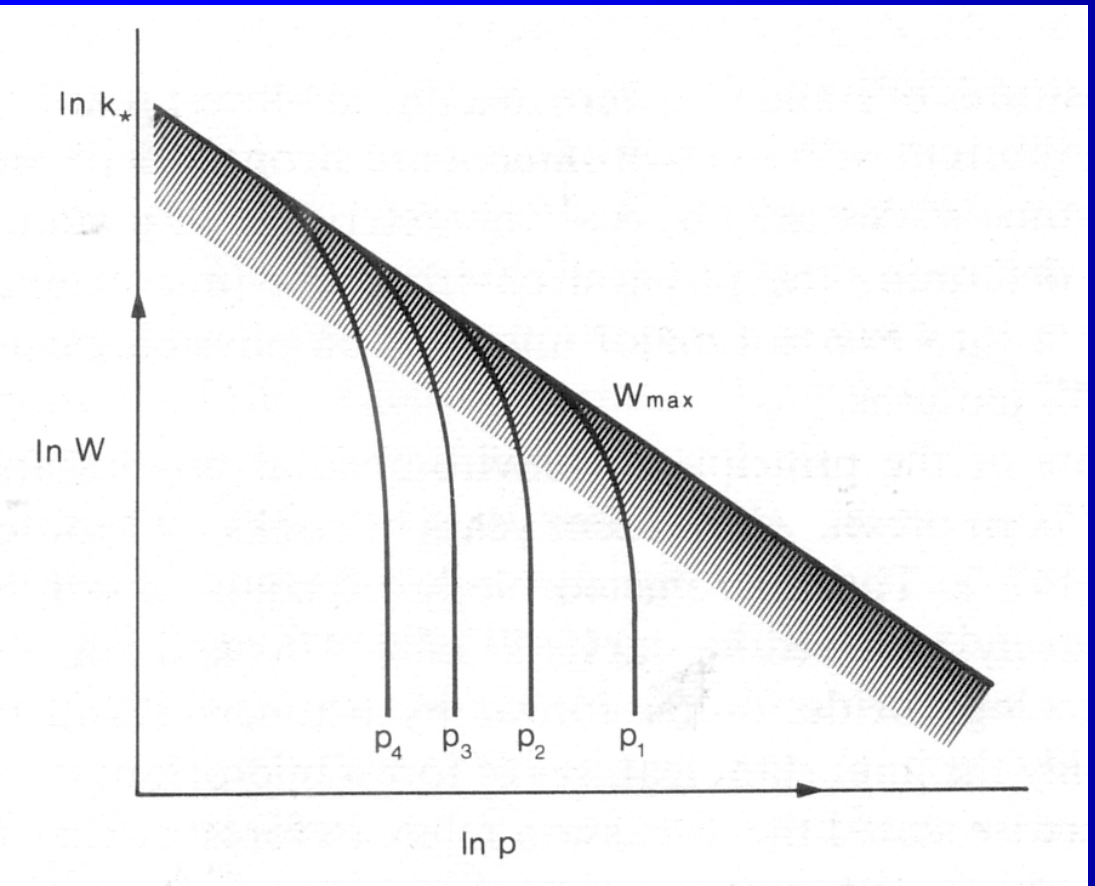
$$W = \exp(k - 1.5 \log_e N)$$

where W is the average weight of an individual, N is the population density (no. per unit area) and k is a constant.

The value of –1.5 seems to be a fairly good average value for many forest stands.

Self-thinning

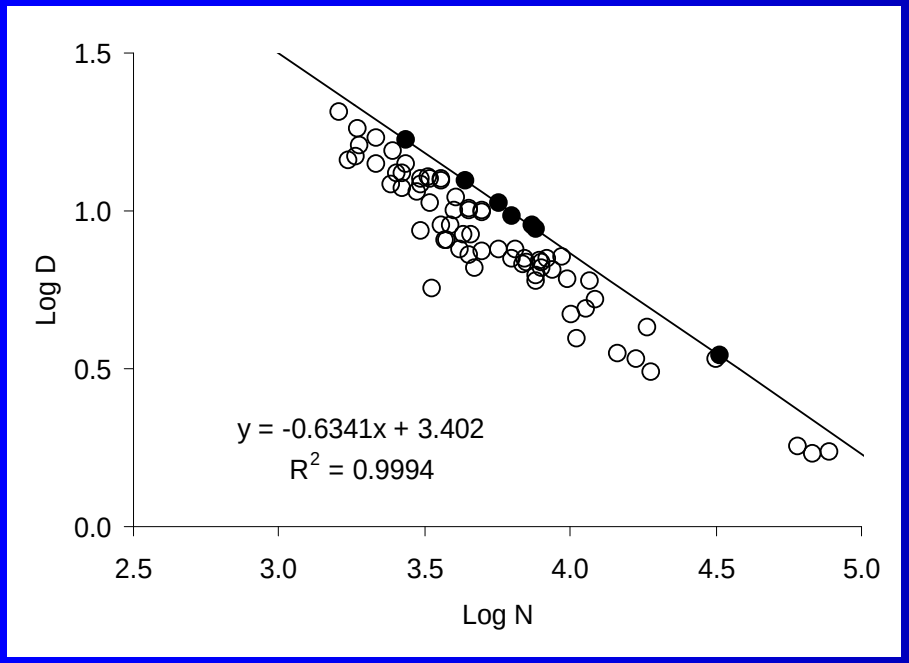
Diagrammatic illustration of the self-thinning rule, showing the trajectory of the increase in the total weight of the population (and the average weight of an individual) as a function of population density.



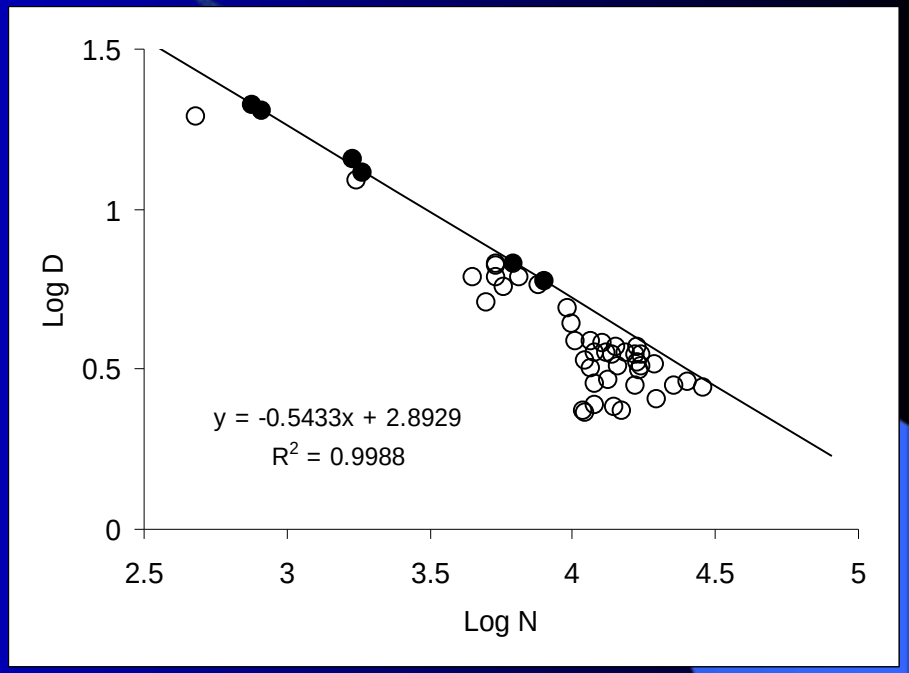
- The shaded area shows the region where competition becomes increasingly more severe.
- No increase in the population weight can occur above W_{max}, until some individuals in the population die, thereby reducing population density.

An example for mangrove forests

Here the dependent variable is average stem diameter, a measure of the size of a tree.



North-eastern Australia (76 plots in 5 estuaries or bays – mixed species forests)



Southern Vietnam (46 plots – planted monocultures of *R. apiculata*)

Silvicultural application

Parameter	First thinning	Second thinning	Final Harvest
Age (y)	8	14	20
DBH (cm)	4.6	9	13.4
Thin to a spacing of (m)	3.1	5.5	
Stems ha^{-1} after thinning	3200	1800	
Volume harvested (m^3 ha^{-1})	32.2	47.5	164.5
Total harvest (m^3 ha^{-1})			244.1

Tsunami protection

- The degree of protection depends on the volume of vegetation (a function of stand density, individual size and the width of the the protective barrier.
- Relationships based on rates of growth and the self-thinning rule appear to have potential in developing bioshields for tsunami and storm protection for coastal communities.
- Selection of seed sources for higher growth rates will be important for developing green belts for coastal protection.

Coastal erosion protection

- Different species have different root architectures
- Which is most effective in holding the soil together and reducing erosion? No comparative studies are available.

Phenology

- At Ranong there is a high abortion rate of among flower buds, which can affect natural regeneration.
- Reproductive phenology has not been widely studied, and there is very little information for species other than *Rhizophora* spp.
- Factors controlling phenology are not well understood.
- Changes in temperature and weather patterns is very likely to change reproductive phenology.