BDC223
SA:V

SA:V

The ratio of:

* surface area (cm^2)

to

* volume (cm^3)

i.e. SA/V

The ‘body plan’

Plants require that the following ‘functions’ are accomplished: they must capture photons, acquire water and nutrients, distribute these between parts; they must exchange O_2 and CO_2, metabolic wastes, etc.. These operations rely on chemical, physical and biological principles

A limited number of options are available for doing this, and the plant body plan is thus constrained to operate within these limits

The result is a recurring set of themes within which all plant body plans can be organised

General plant structure (organs) – ‘higher’ plants

- Roots: apical meristem, secondary or lateral roots, anchorage, water & mineral uptake. Fixed position, can’t avoid problems – cope.
- Stems: apical meristem, nodes and internodes, transport, support leaves, flowers & fruits.
- Leaves: attached at nodes, production.

General plant structure (organs) – algae

- holdfast or hapteron (pl. haptera)
- stipe
- fronds

- together it is called the thallus (pl. thalli)

The macroalgal body plan: the functional-form model

- An hypothesis that links the morphology of a macroalgal thallus to its photosynthetic performance:
  - The functional form model by Litter and Littler (1980);
  - Also explains many other physiological and ecological characteristics ('function') of macroalgae as a function of thallus morphology ('form').

J. Phycol. **18,** 307–311 (1982)

PRIMARY PRODUCTIVITY OF MARINE MACROALGAL FUNCTIONAL-FORM GROUPS FROM SOUTHWESTERN NORTH AMERICA'

Mark M. Littler[2] *and Keith E. Arnold*[3]

Littler. Bot. Mar. 22: 161-165 (1980).
Littler and Littler. Am. Nat. 116: 25-44 (1980).

Table 1.1. *Functional-form groups of macroalgae*

Functional-form group	External morphology	Internal anatomy	Texture	Sample genera
Sheet group	Thin, tubular, and sheetlike (foliose)	Uncorticated, one to several cells thick	Soft	*Ulva, Enteromorpha, Dictyota*
Filamentous group	Delicately branched (filamentous)	Uniseriate, multiseriate, or lightly corticated	Soft	*Centroceras, Polysiphonia, Chaetomorpha, Microcoleus*
Coarsely branched group	Coarsely branched, upright	Corticated	Fleshy-wiry	*Laurencia, Chordaria, Caulerpa, Penicillus, Gracilaria*
Thick, leathery group	Thick blades and branches	Differentiated, heavily corticated, thick-walled	Leather, rubbery	*Laminaria, Fucus, Udotea, Chondrus*
Jointed calcareous group	Articulated, calcareous, upright	Calcified genicula, flexible intergenicula with parallel cell rows	Stony	*Corallina, Halimeda, Galaxaura*
Crustose group	Prostrate, encrusting	Calcified or uncalcified parallel rows of cells	Stony or tough	*Lithothamnion, Ralfsia, Hildenbrandia*

Source: Littler et al. (1983b), with permission of *Journal of Phycology.*

Ulva lactuca

Porphyra umbilicalis

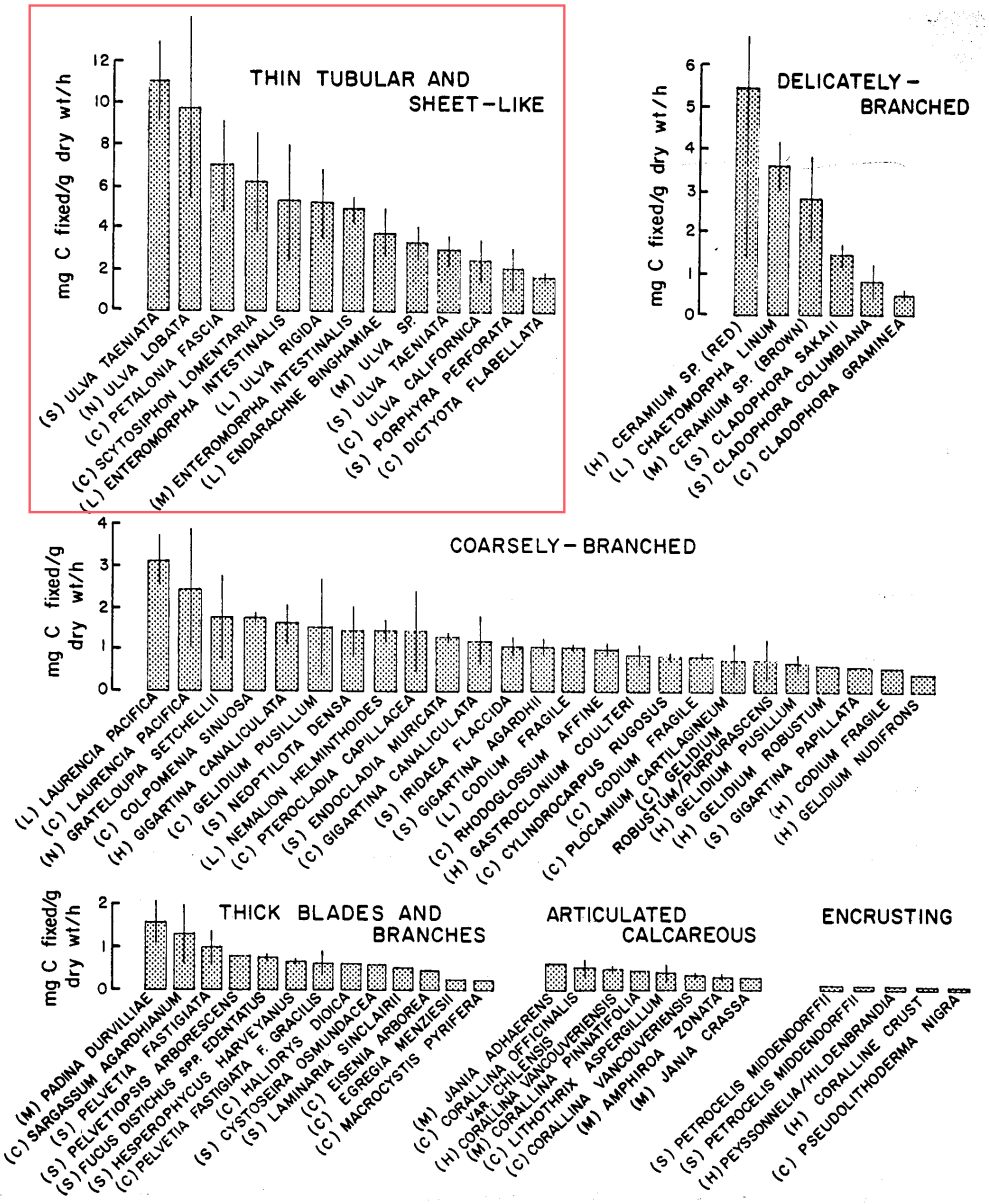
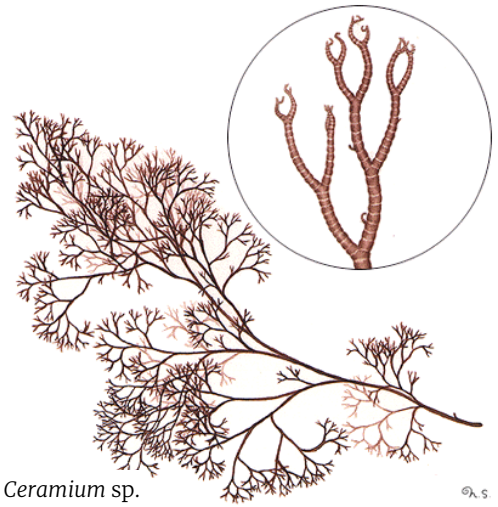


FIG. 2. Net apparent photosynthetic performances (±95% CI) of the six functional-form groups measured at San Simeon (S), Newport Beach (N), Laguna Beach (L), San Clemente Island (C), Punta Hipolito (H) and Punta Marquez (M).



Ceramium sp.

Chaetomorpha sp.

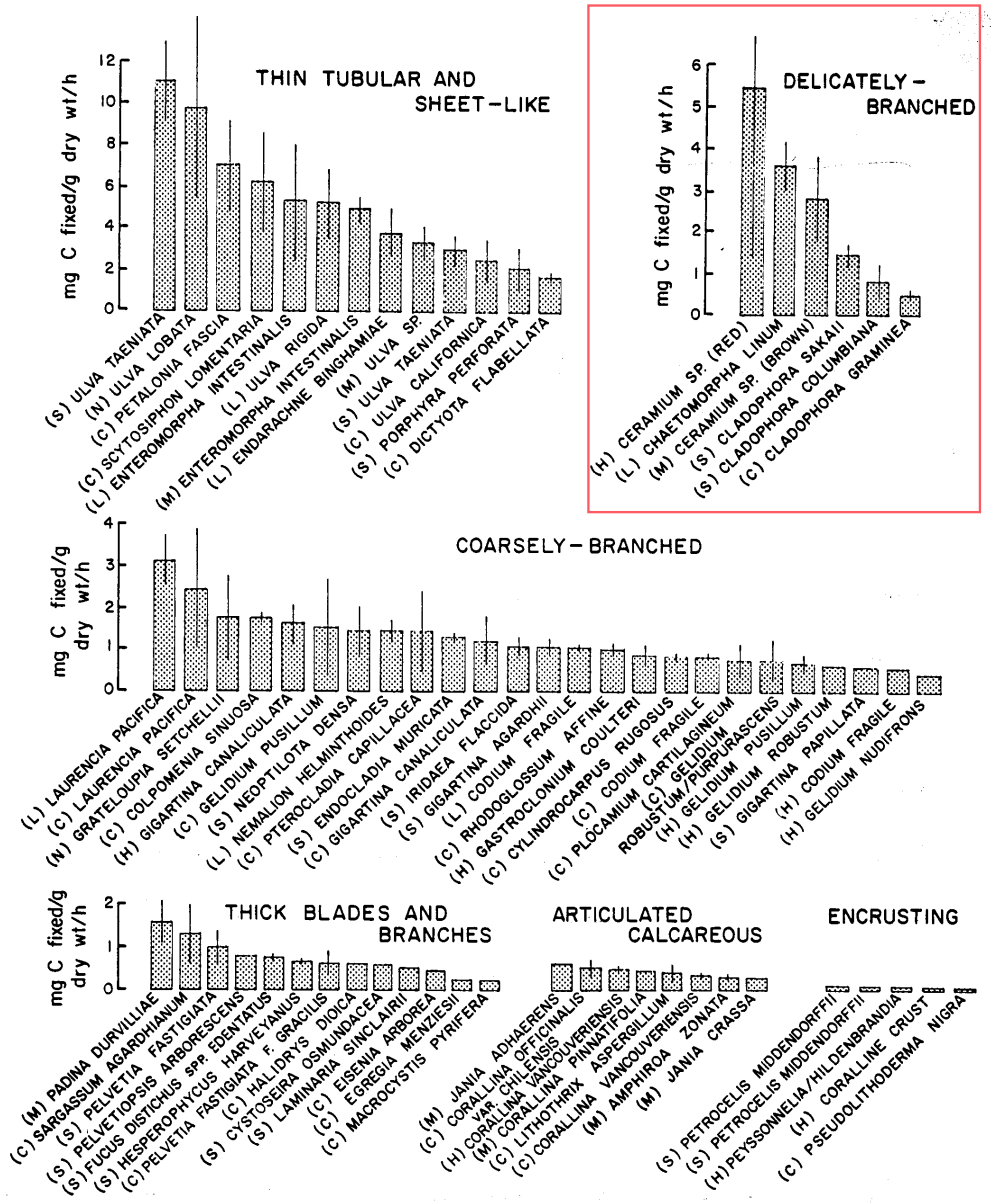
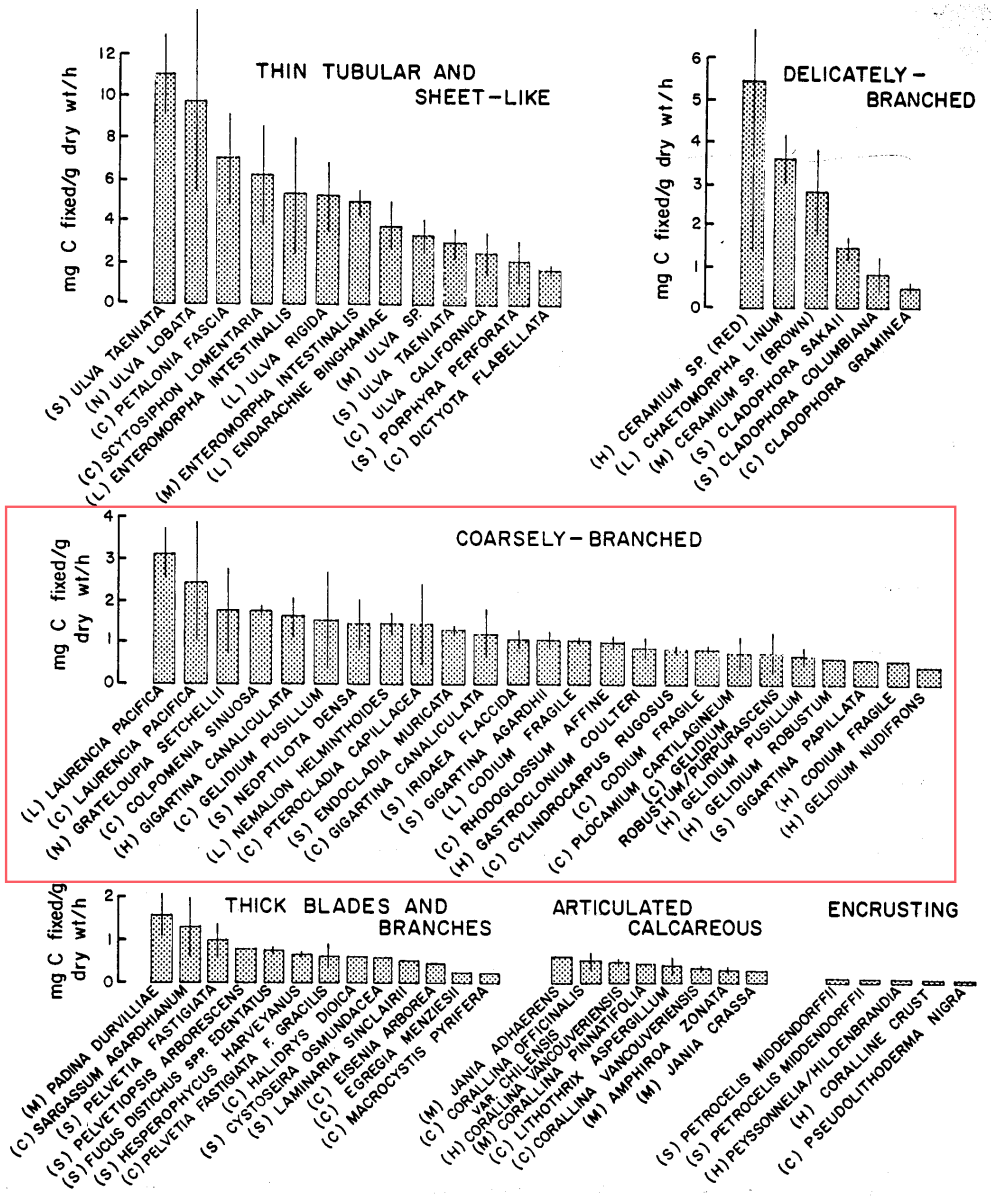


FIG. 2. Net apparent photosynthetic performances (±95% CI) of the six functional-form groups measured at San Simeon (S), Newport Beach (N), Laguna Beach (L), San Clemente Island (C), Punta Hipolito (H) and Punta Marquez (M).

Laurencia sp.

Gelidium sp.



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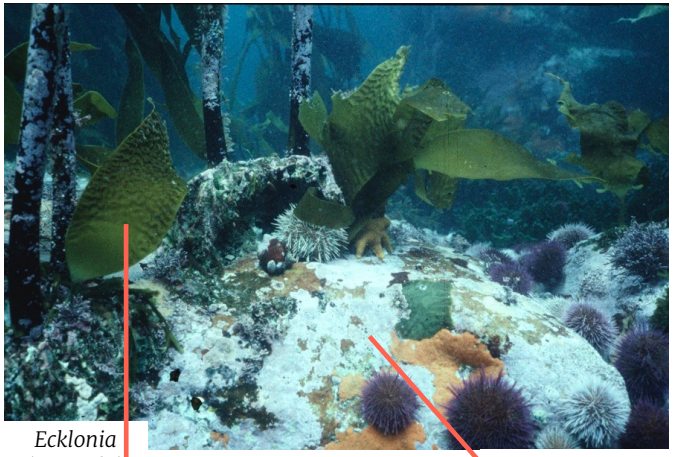

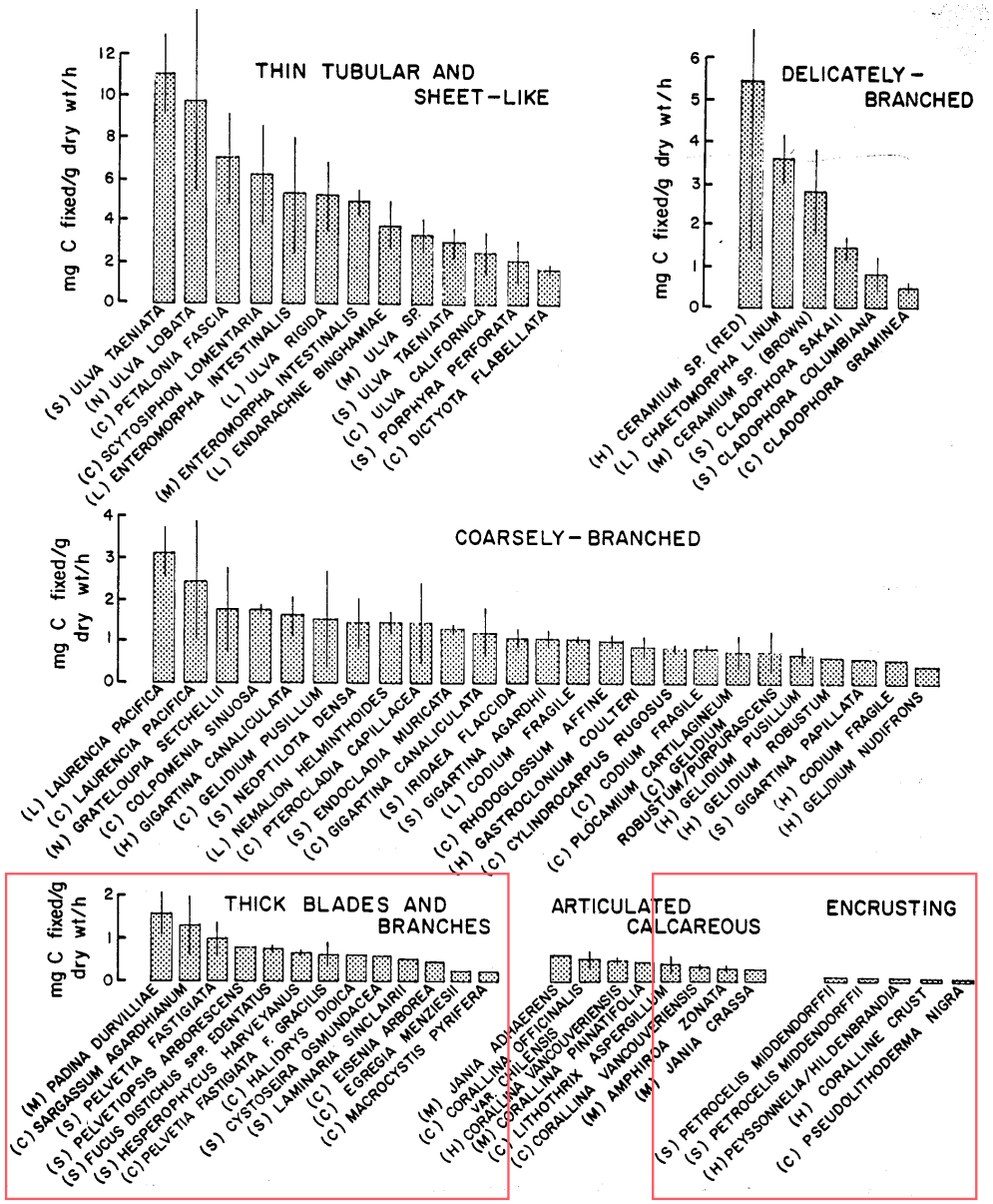

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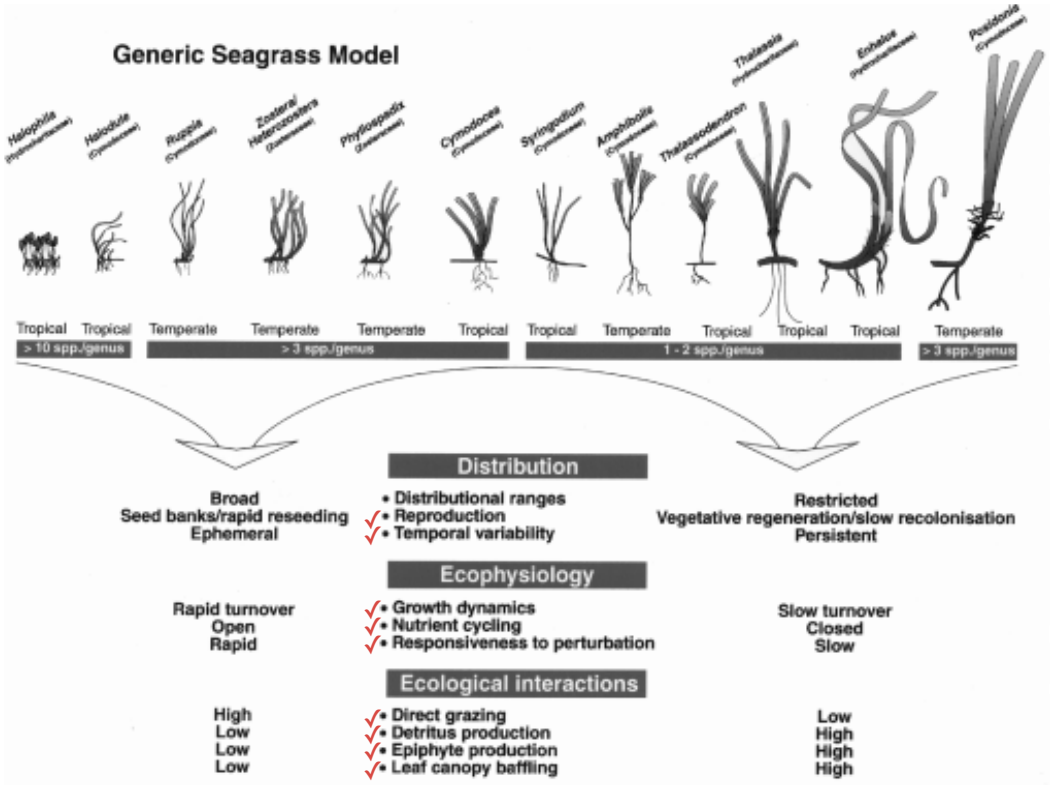
Seagrasses: the functional-form model



Walker, D., Dennison, W., Edgar, G., 1999. Status of Australian seagrass research and knowledge. In: Butler, A.J., Jernakoff, P. (Eds.), Seagrass in Australia: Strategic Review and Development of an R&D plan. CSIRO Publishing, Collingwood, Victoria, pp. 1–24.

Seagrasses

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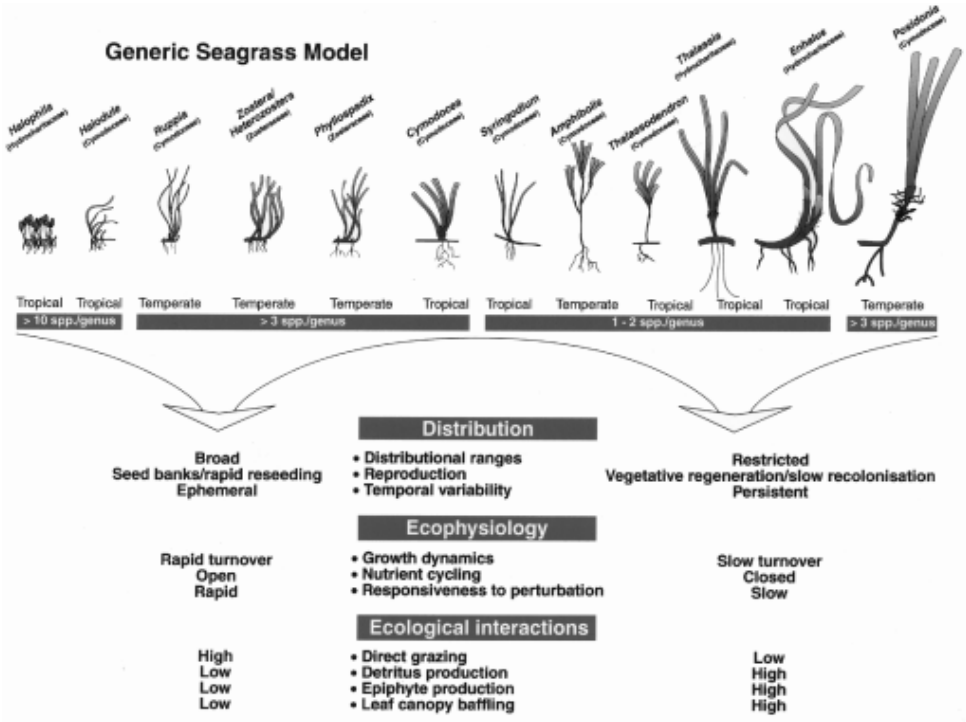
1.2 Seagrass plants

Seagrasses are highly specialised marine flowering plants adapted to soft sediments of nearshore environments. Although there are relatively few species of seagrasses globally (< 70 species), these plants have evolved from several lineages of land plants and are adapted to a totally submersed life. Seagrasses are productive, widespread and ecologically significant features of nearshore environments (Phillips and McRoy, 1980; Larkum *et al.*, 1989). Seagrasses indirectly support various coastal fisheries, largely through provision of a nursery habitat for juvenile animals (e.g. Klumpp *et al.*, 1989; Bell and Pollard, 1989). These connections are more fully explored in Chapter 2. Tropical seagrass meadows directly support dugong (*Dugong dugon*) and green sea turtles (*Chelonia mydas*) (Lanyon *et al.*, 1989).

Seagrasses are not a monophyletic group of plants; they are not even true grasses (Poaceae). Rather, 'seagrass' is a functional grouping referring to marine flowering plants living entirely submersed and sharing numerous convergent morphological and physiological characteristics (Larkum and den Hartog, 1989). Recent evolutionary studies using DNA sequences of the chloroplast genome have revealed that the present seagrass diversity probably arose from three separate evolutionary events (Waycott and Les, 1996). Thus, convergence of various characteristics of seagrasses has occurred within and between these three groupings (Cymodoceaceae complex, Zosteraceae, Hydrocharitaceae). The outcome of this convergence is a suite of common morphological and physiological characteristics (including internal gas spaces or lacunae, epidermal chloroplasts, lack of stomata, rapid leaf turnover, reduced respiratory tissue, and salt excretion through the plasmalemma).

Seagrasses

http://www.epa.qld.gov.au/nature_conservation/habitats/ marine_habitats/seagrass/ © Paul Kay


Generic Seagrass Model
Halophila (Hydrocharitaceae)
Halodule (Cymodoceae)
Ruppia (Cymodoceae)
Zostera/ Heterozostera (Zosteraceae)
Phyllospadix (Zosteraceae)
Cymodocea (Cymodoceae)
Syringodium (Cymodoceae)
Amphibolis (Cymodoceae)
Thalassodendron (Cymodoceae)
Thalassia (Hydrocharitaceae)
Enhalus (Hydrocharitaceae)
Posidonia (Cymodoceae)
Tropical
Tropical
Temperate
Temperate
Temperate
Tropical
Tropical
Temperate
Tropical
Tropical
Tropical
Temperate
> 10 spp./genus
> 3 spp./genus
1 - 2 spp./genus
> 3 spp./genus
Distribution
Broad
Seed banks/rapid reseeding
Ephemeral
• Distributional ranges
• Reproduction
• Temporal variability
Restricted
Vegetative regeneration/slow recolonisation
Persistent
Ecophysiology
Rapid turnover
Open
Rapid
• Growth dynamics
• Nutrient cycling
• Responsiveness to perturbation
Slow turnover
Closed
Slow
Ecological interactions
High
Low
Low
Low
• Direct grazing
• Detritus production
• Epiphyte production
• Leaf canopy baffling
Low
High
High
High

The next lecture:
Plants Stresses