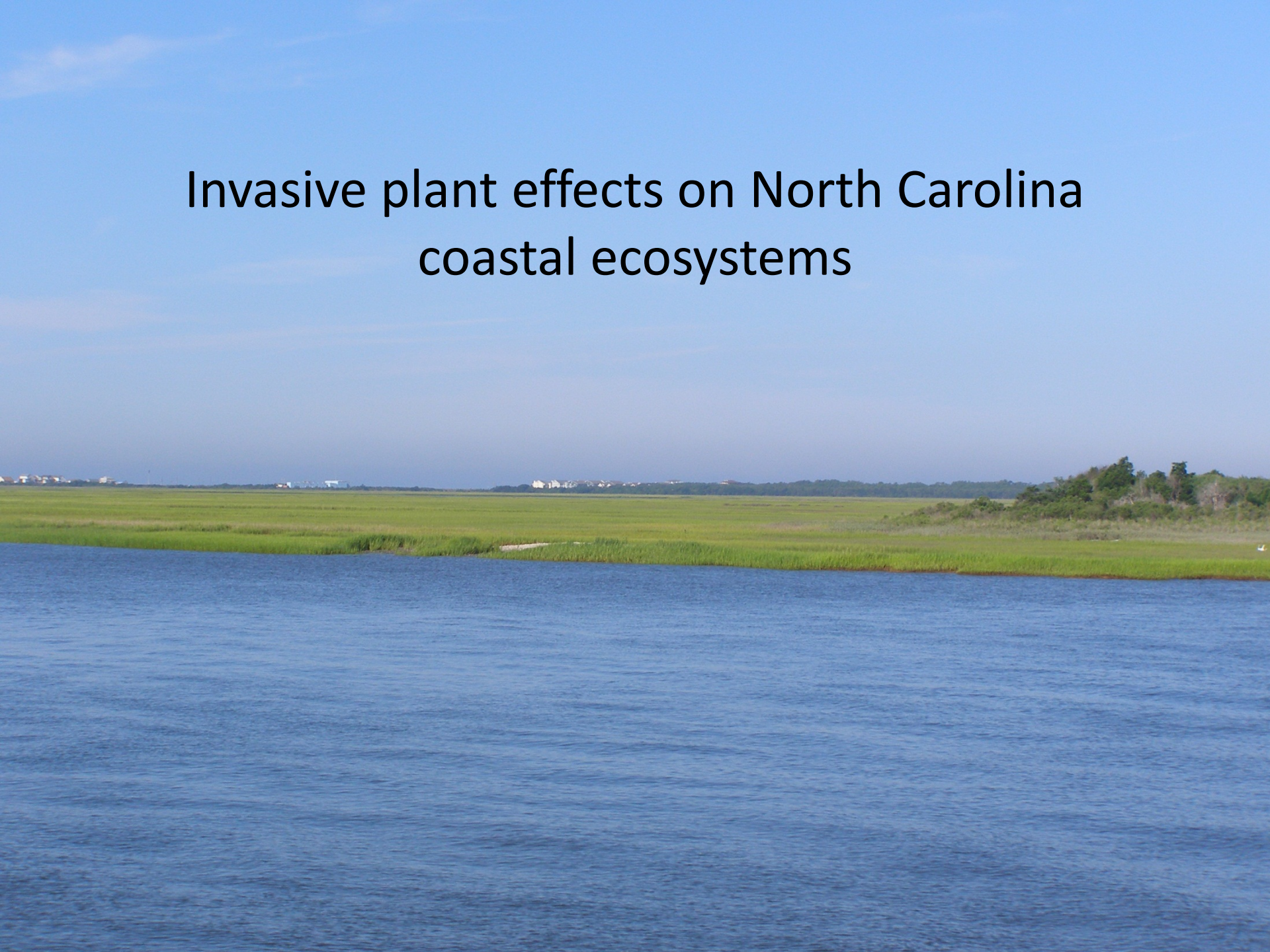
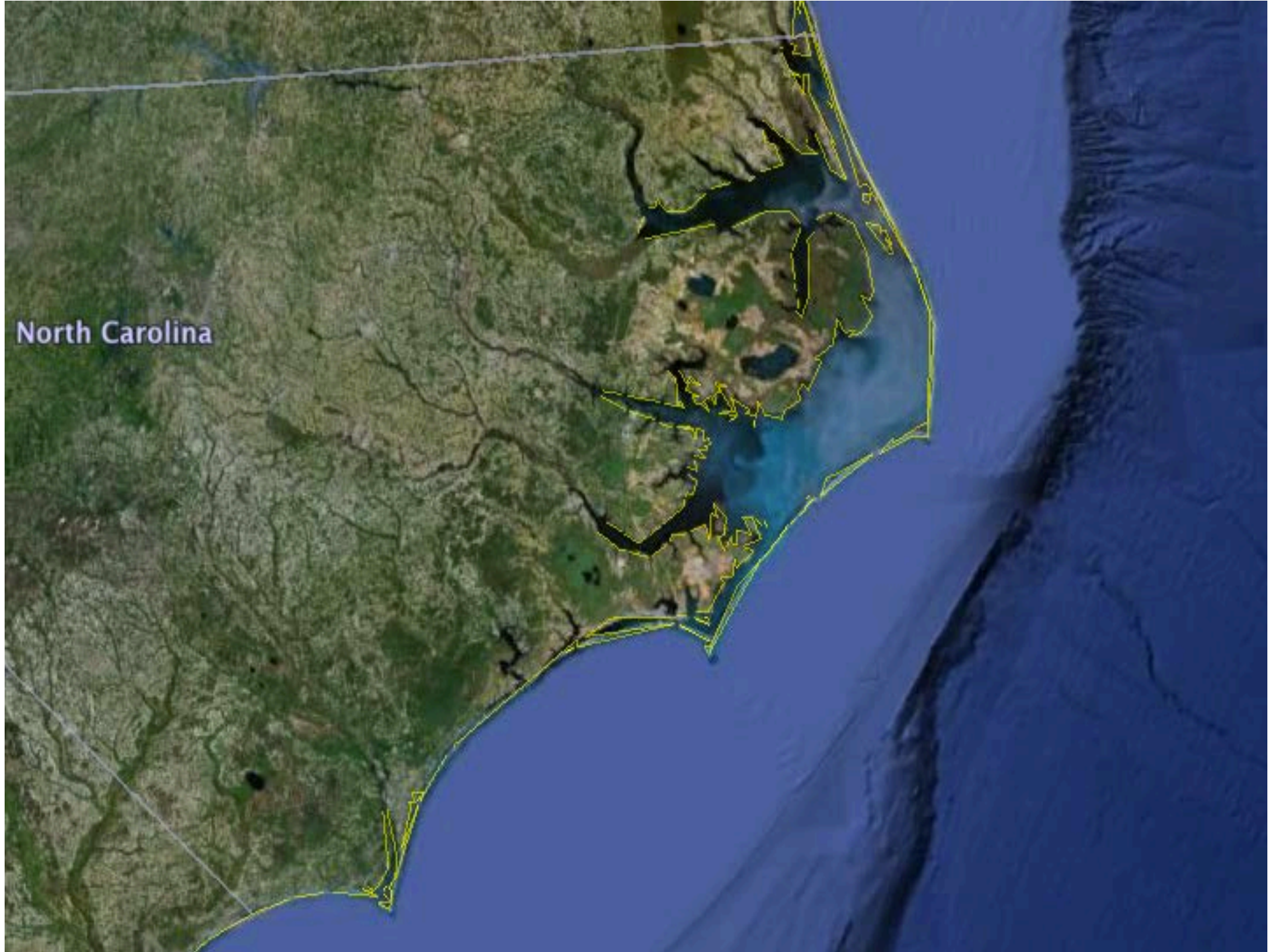
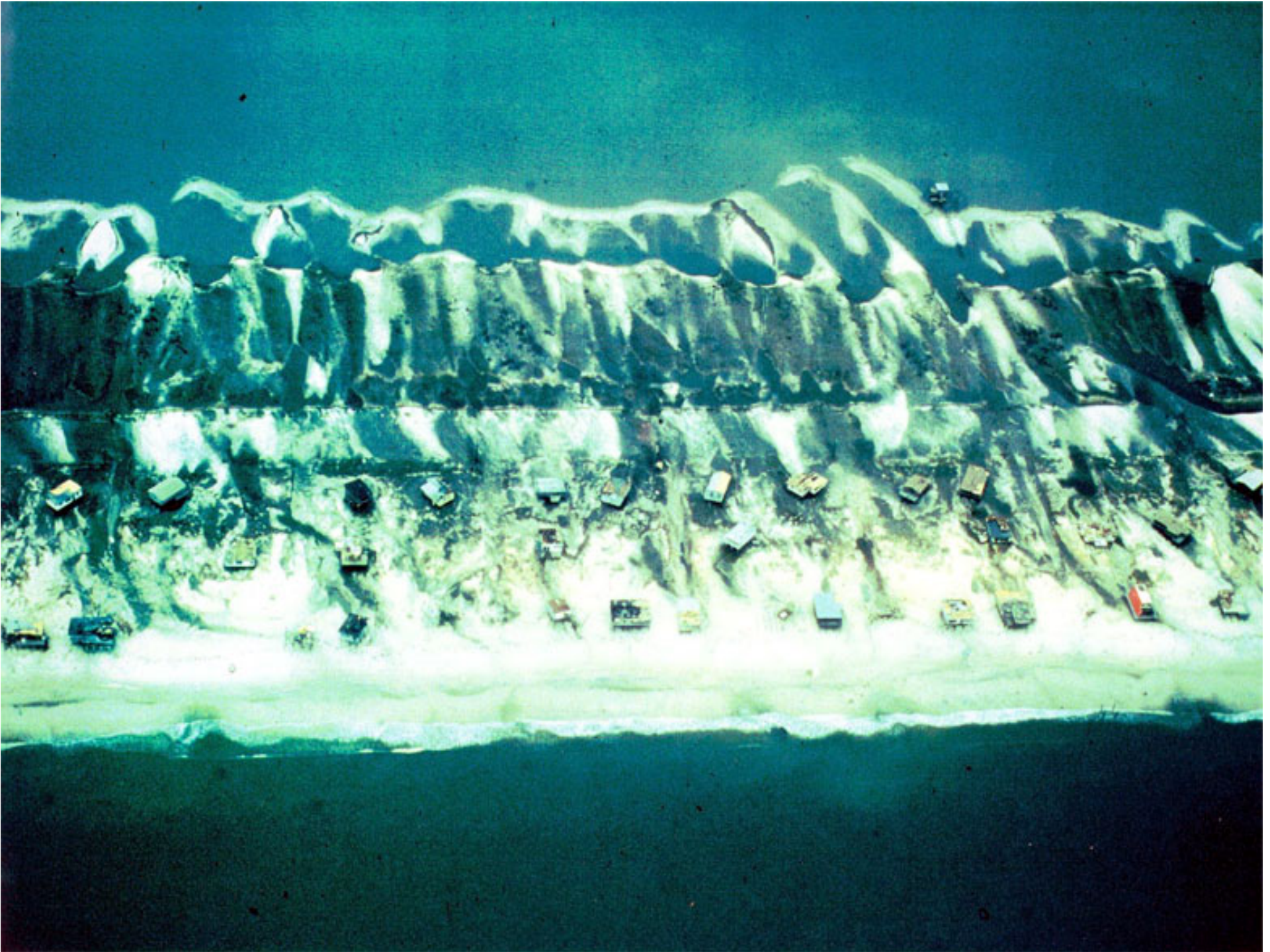
# Invasive plant effects on North Carolina coastal ecosystems




North Carolina



native – pre-industrial record of inhabiting an area

nonnative (exotic) – do not naturally occur in an ecosystem

invasive - aggressively establish themselves in an ecosystem at the expense of its native species and natural functions

pest plant – interfere with agriculture or natural areas management and the maintenance of biological diversity

noxious weeds – plants in any stage of development whose presence is detrimental to crops or other desirable plants, livestock and land or injurious to public health

- introduced species are responsible for about 40% of historic extinctions
- one of the most serious conservation problems today
- introduce disease
- damage to forests and crops
- may support less wildlife, or at least different wildlife
- the flora of most regions within the US are comprised of 25% or more nonnative species

# Biotic Invasions of Vascular Plants

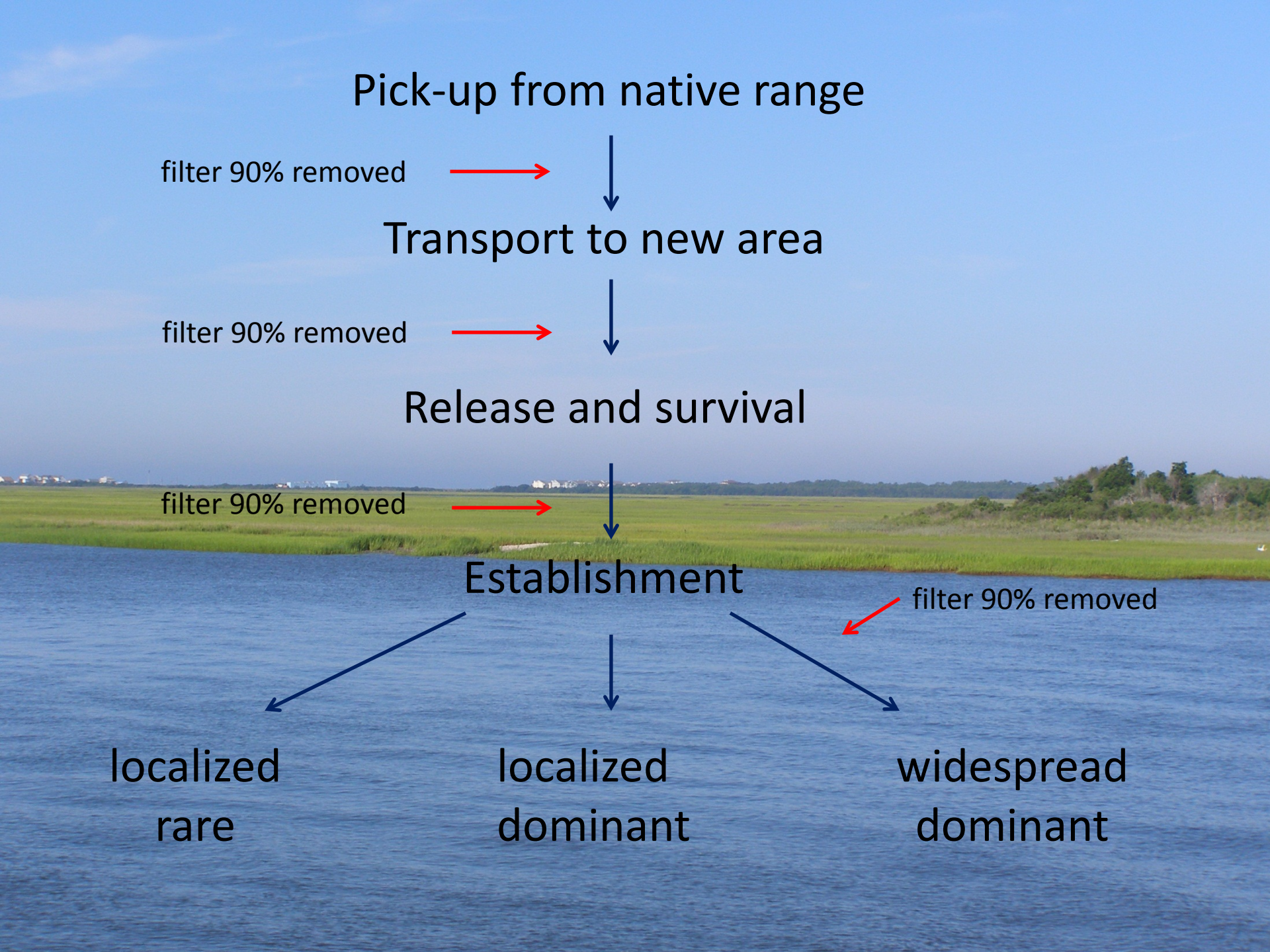
| Location | # of native species | # of nonnative species | % of nonnative species |
|---|---|---|---|
| Germany | 1718 | 429 | 20 |
| Finland | 1006 | 221 | 18 |
| Canada | 9028 | 2840 | 24 |
| California | 4844 | 1025 | 18 |
| Bermuda | 165 | 303 | 65 |
| Hawaii | 956 | 861 | 47 |

Krebs (2009)

# Invasive species management includes good quarantine practices and rapid response teams

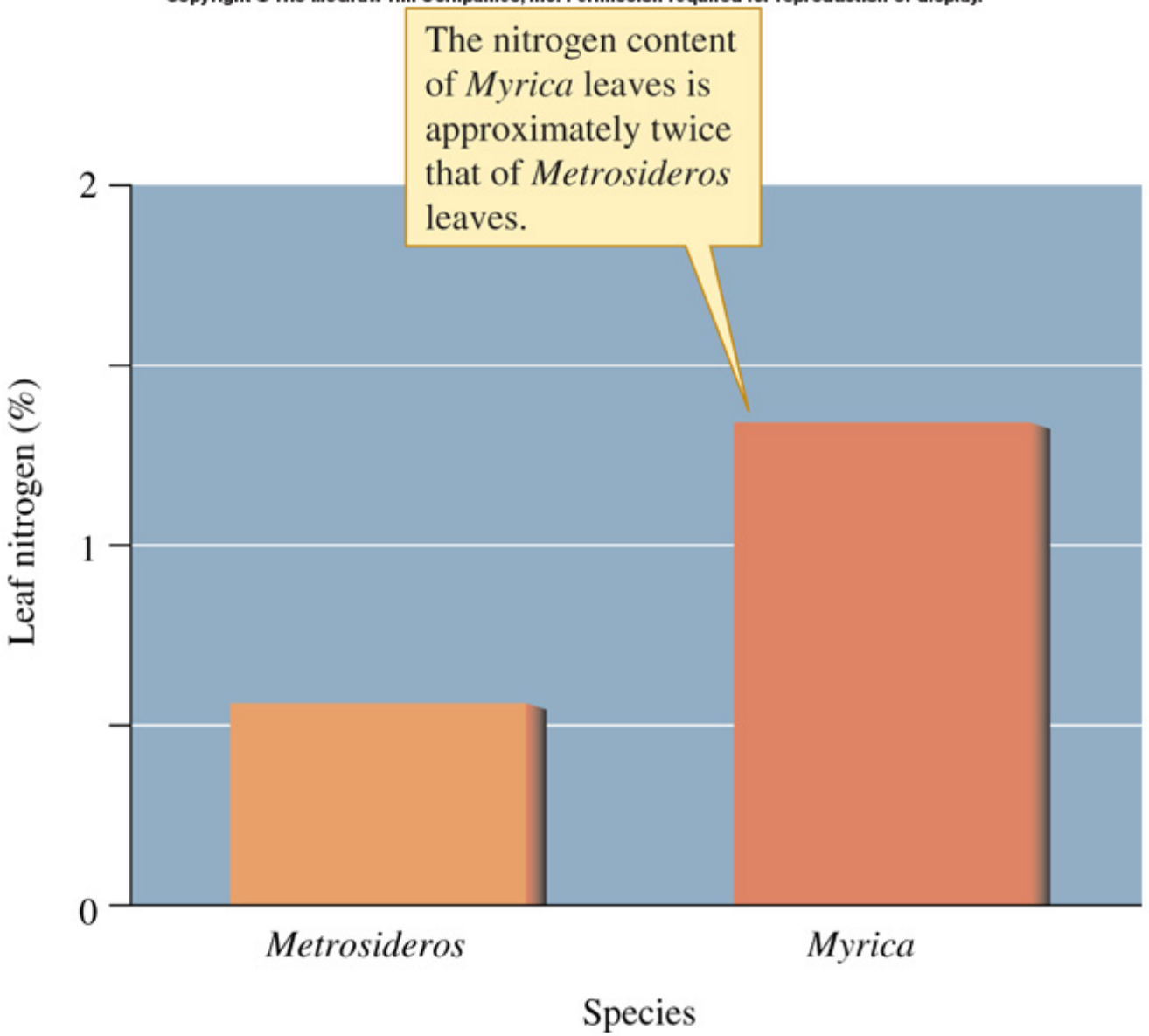
# Characteristics of some invasive species

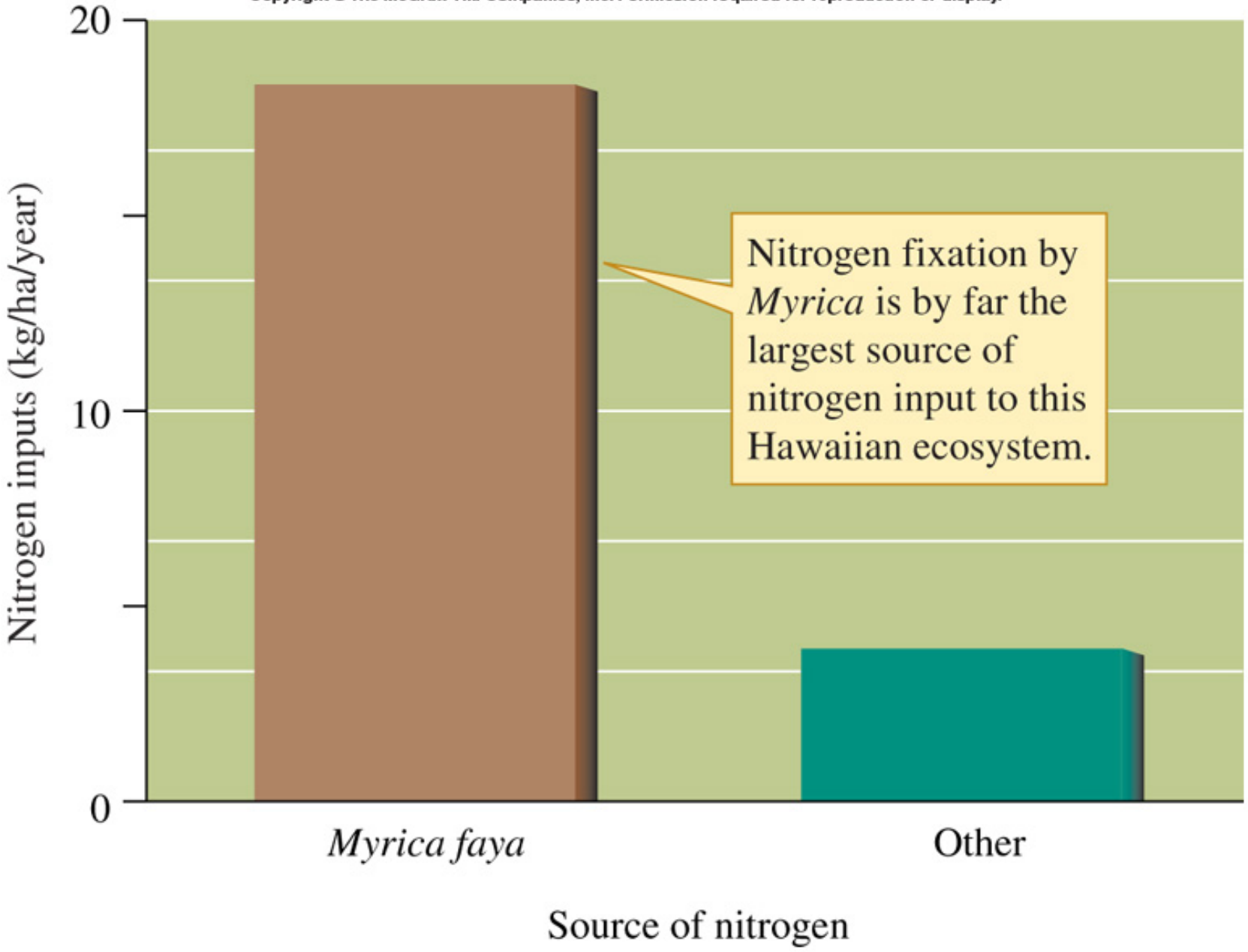
- superior competitive ability
- efficient photosynthesis
- efficient conversion to biomass
- adapted to poor soils
- drought tolerant
- adapted to low light levels
- allelopathy
- short juvenile period
- small seed mass
- early age of reproduction
- vegetative reproduction
- no pretreatment for seed germination
- mycorrhizal associations

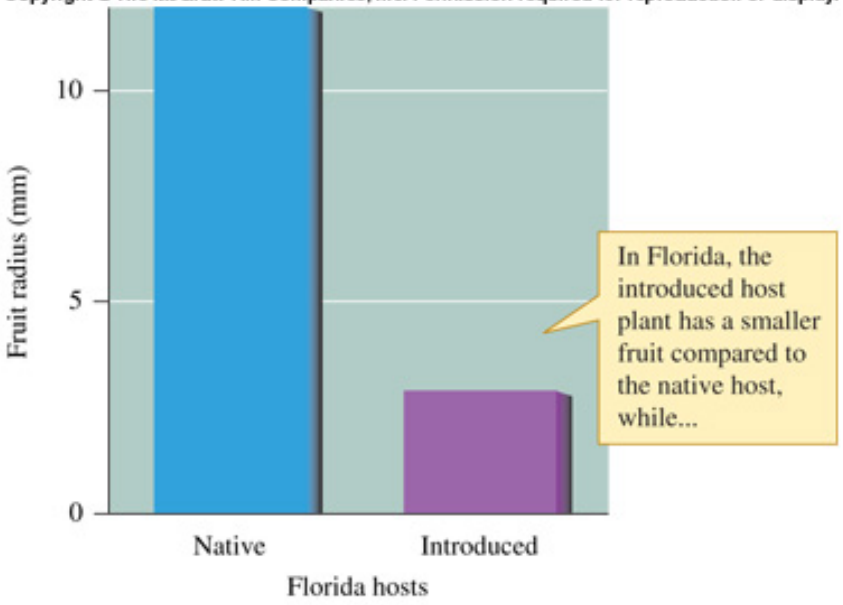

Pick-up from native range
filter 90% removed
Transport to new area
filter 90% removed
Release and survival
filter 90% removed
Establishment
filter 90% removed
localized rare
localized dominant
widespread dominant

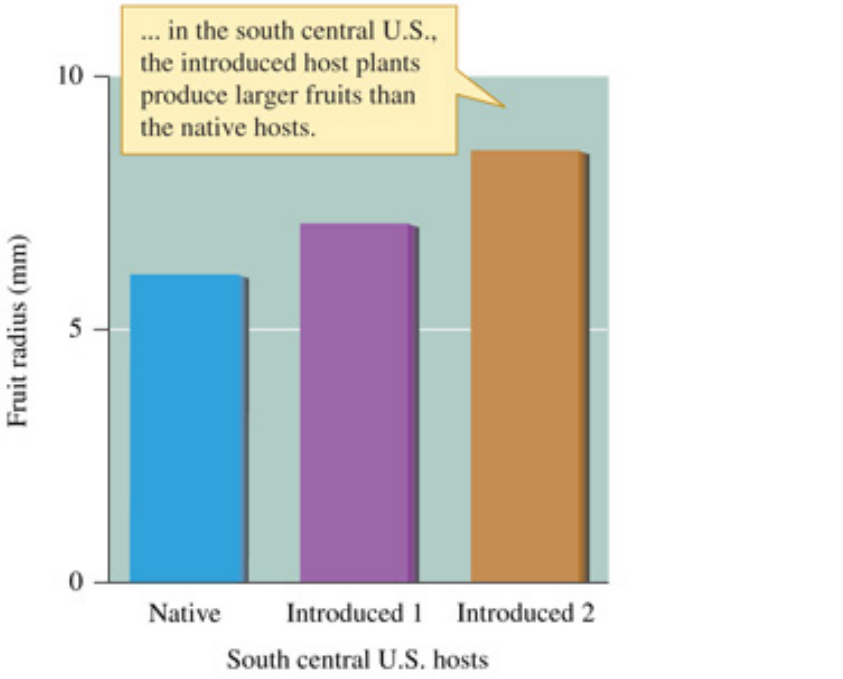
# Introduced species can alter ecosystem properties

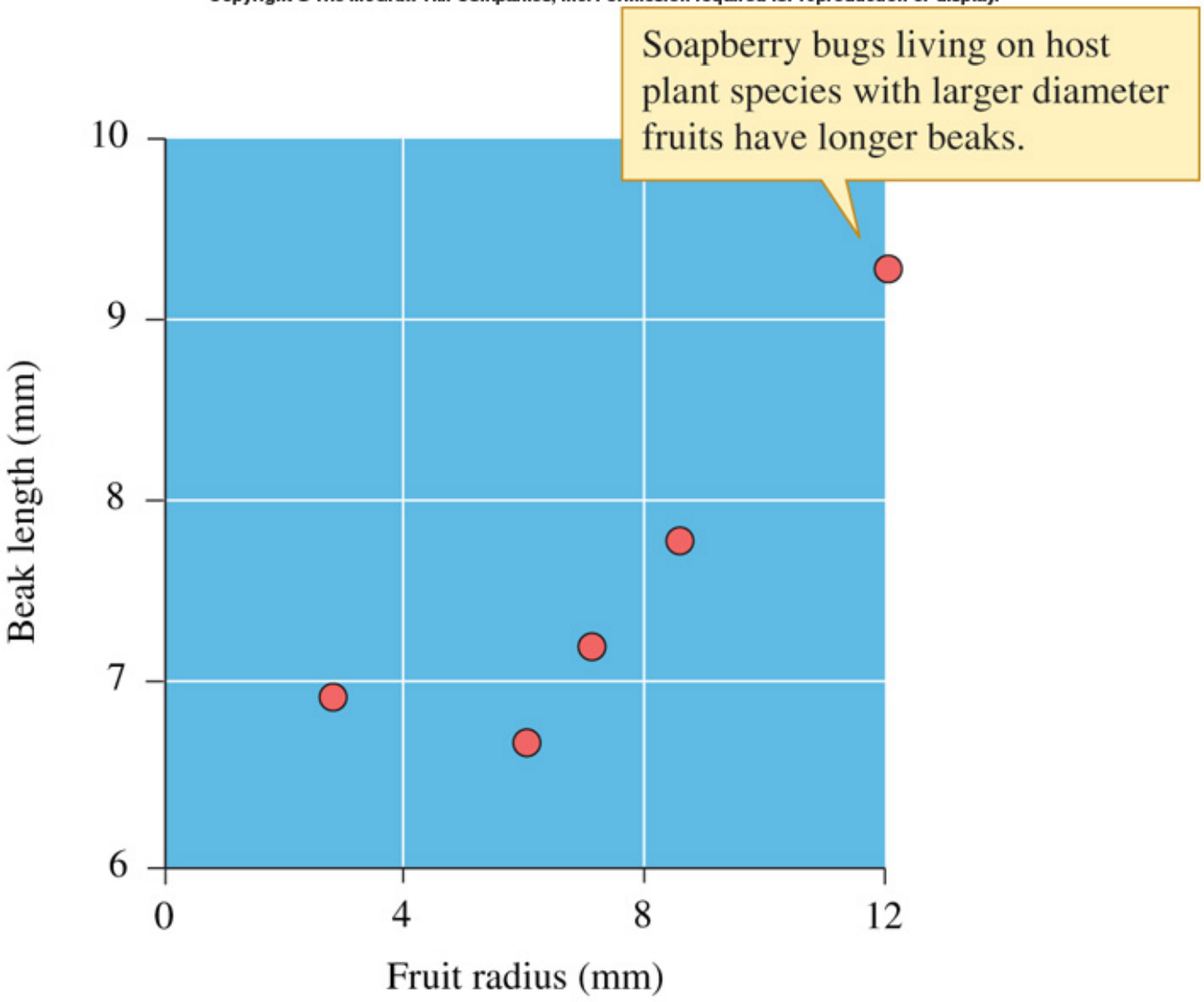











Ecology
'01 8 6

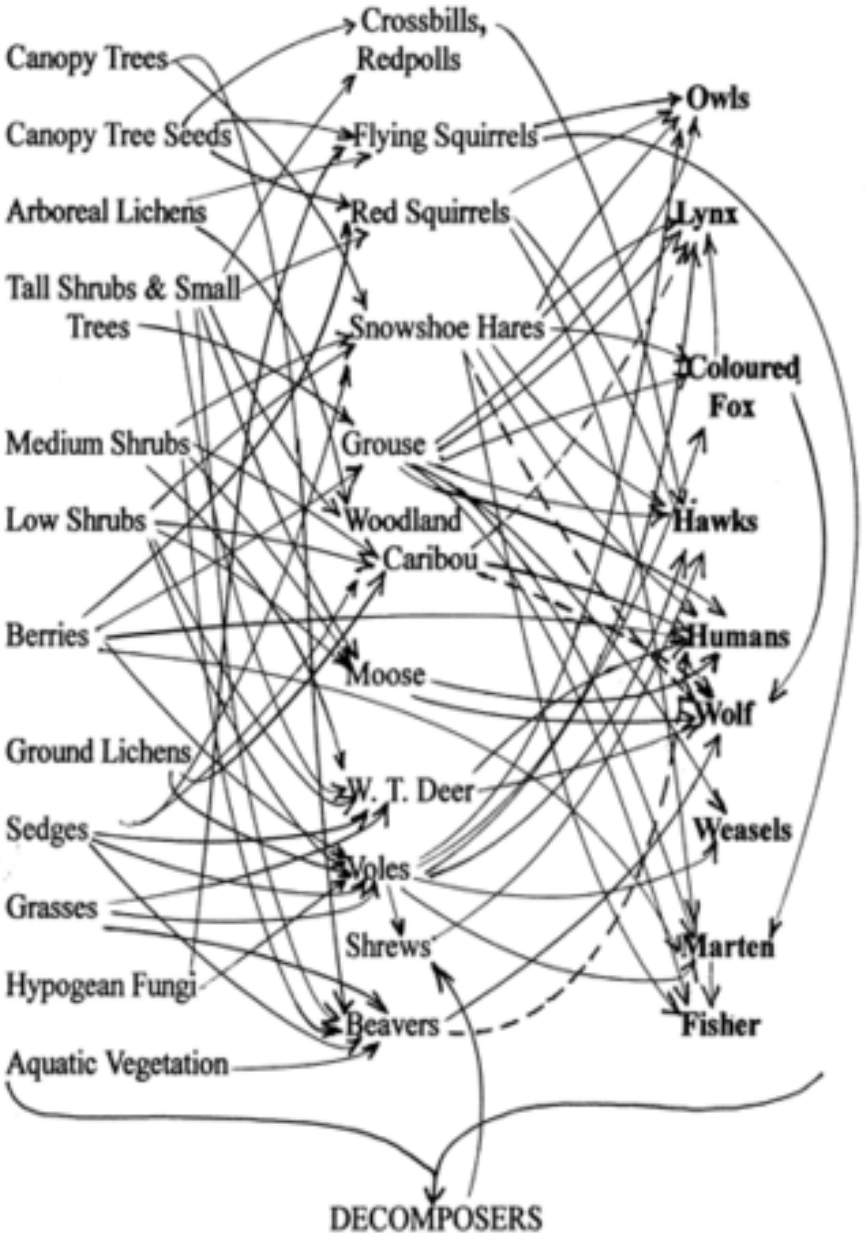
organism

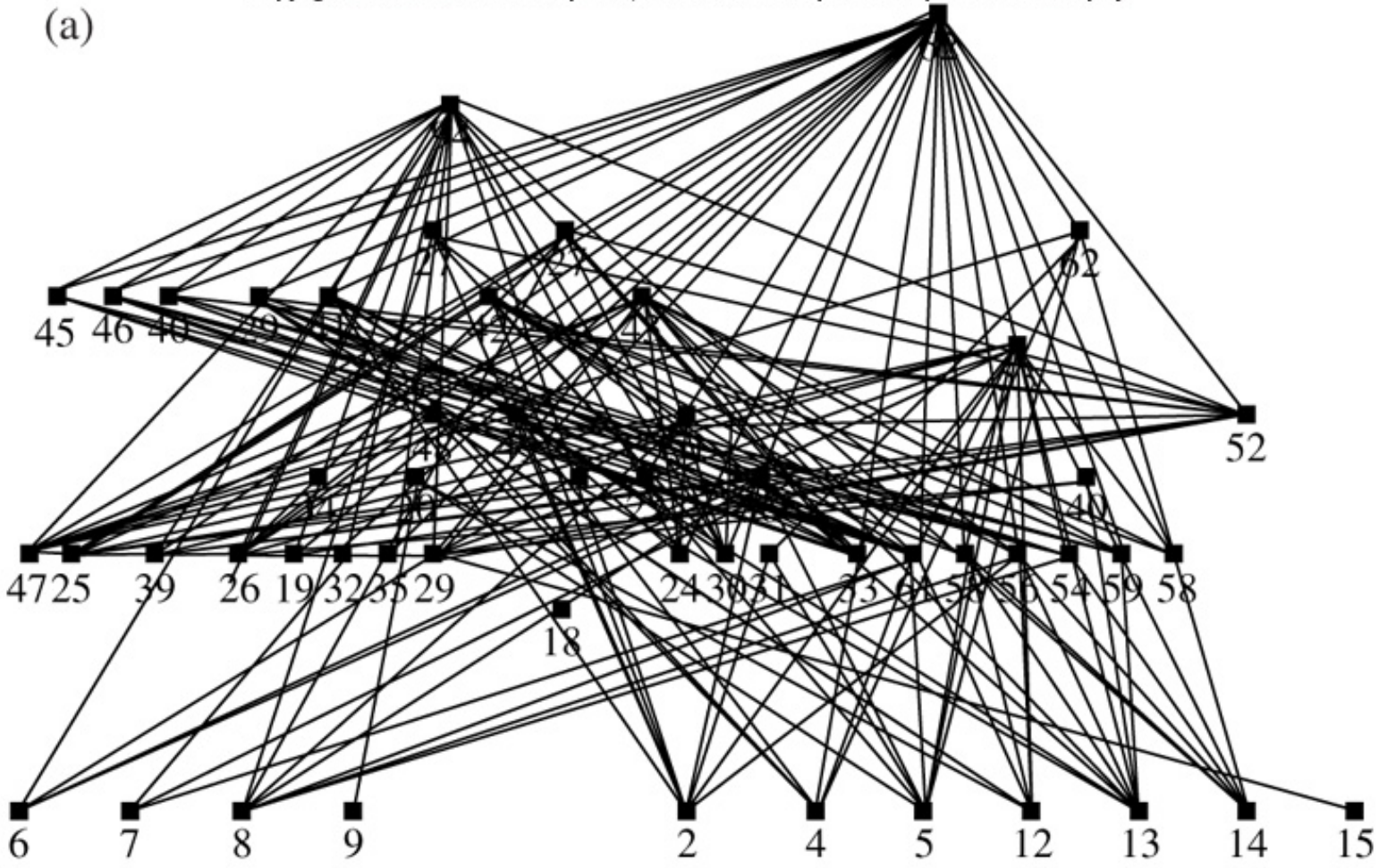
population

community

ecosystem

*Outline of* ***Terrestrial Vertebrate Food Web*** *of the*
***Taiga Biological Station Research Area***






Even a food web with only 10 fish species and their foods can be very complex.

# Life History Classification

MacArthur and Wilson (1967) proposed the terms r and K selection

<u>r selected individuals</u>

- high population growth rates
- colonize new or disturbed habitats

<u>K selected individuals</u>

- efficiently utilize resources
- prominent in more stable habitats

# TABLE 6.1

## Reproductive Strategies

| *r*-Selected Species | *K*-Selected Species |
|---|---|
| 1. Short life | 1. Long life |
| 2. Rapid growth | 2. Slower growth |
| 3. Early maturity | 3. Late maturity |
| 4. Many, small offspring | 4. Few, large offspring |
| 5. Little parental care and protection | 5. High parental care or protection |
| 6. Little investment in individual offspring | 6. High investment in individual offspring |
| 7. Adapted to unstable environment | 7. Adapted to stable environment |
| 8. Pioneers, colonizers | 8. Later stages of succession |
| 9. Niche generalists | 9. Niche specialists |
| 10. Prey | 10. Predators |
| 11. Regulated mainly by intrinsic factors | 11. Regulated mainly by extrinsic factors |
| 12. Low trophic level | 12. High trophic level |

# Plant Life Histories

Grime (1977, 1979) stated that the two most important selective pressure on plants were:

- intensity of disturbance
- intensity of stress

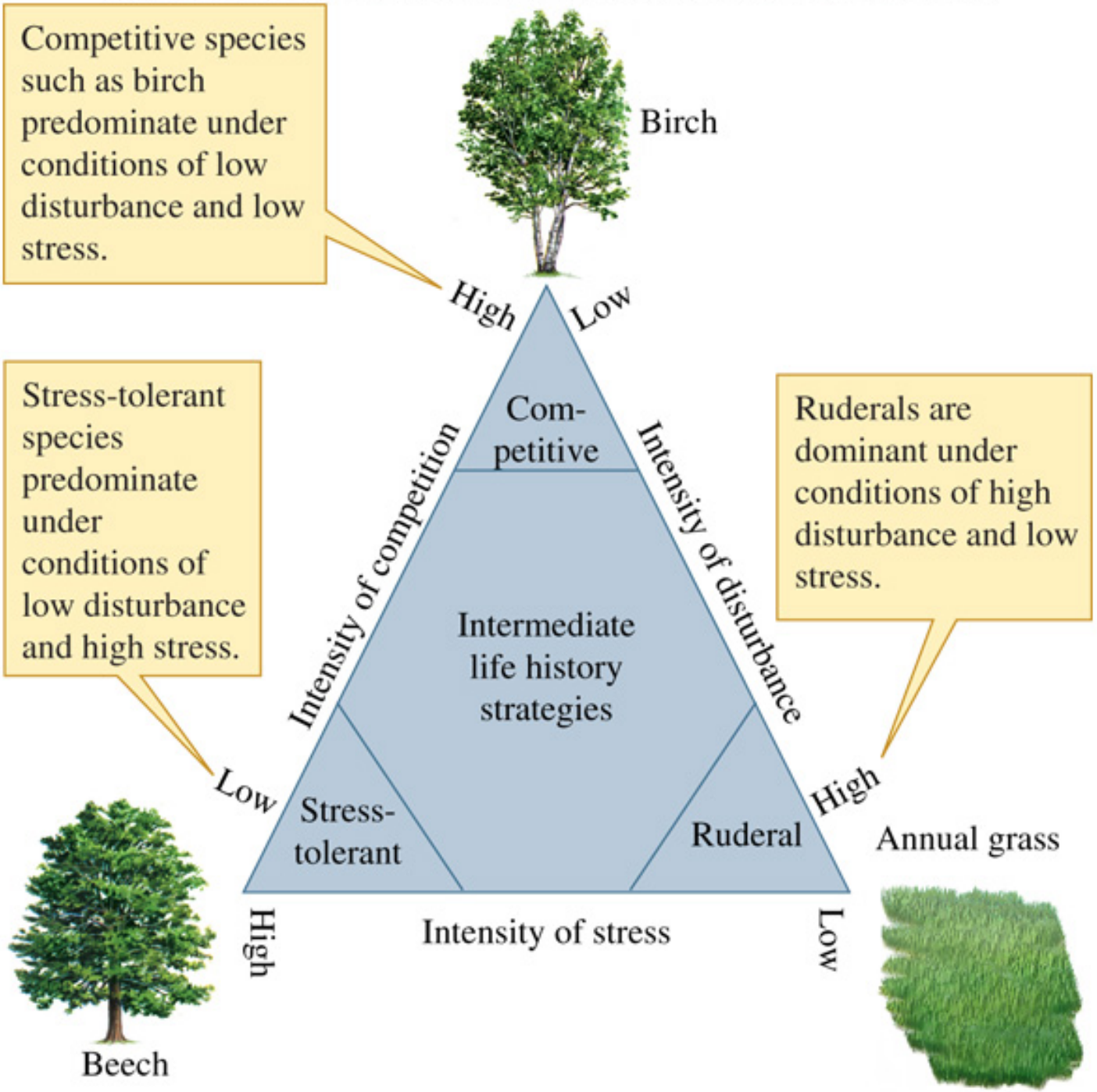
Grime proposed four environments:

low disturbance, low stress

low disturbance, high stress

high disturbance, low stress

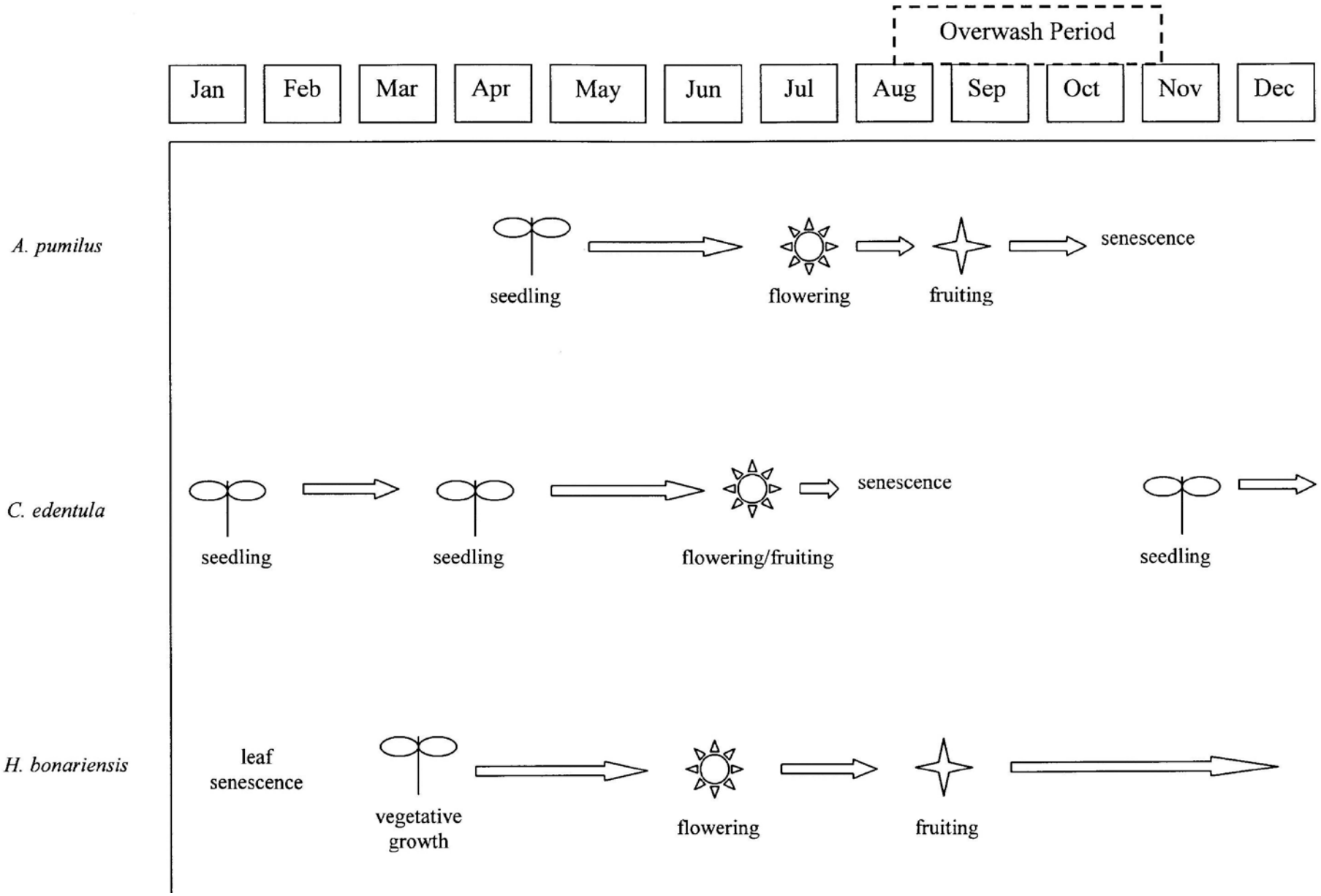
high disturbance, high stress



Timing of events in the life cycle can be critical:

- germination
- unfolding of cotyledons
- growth rates
- reproductive age

# Life Histories



# H.T. Odum (University of Florida)
# *Systems Ecology* (1983)

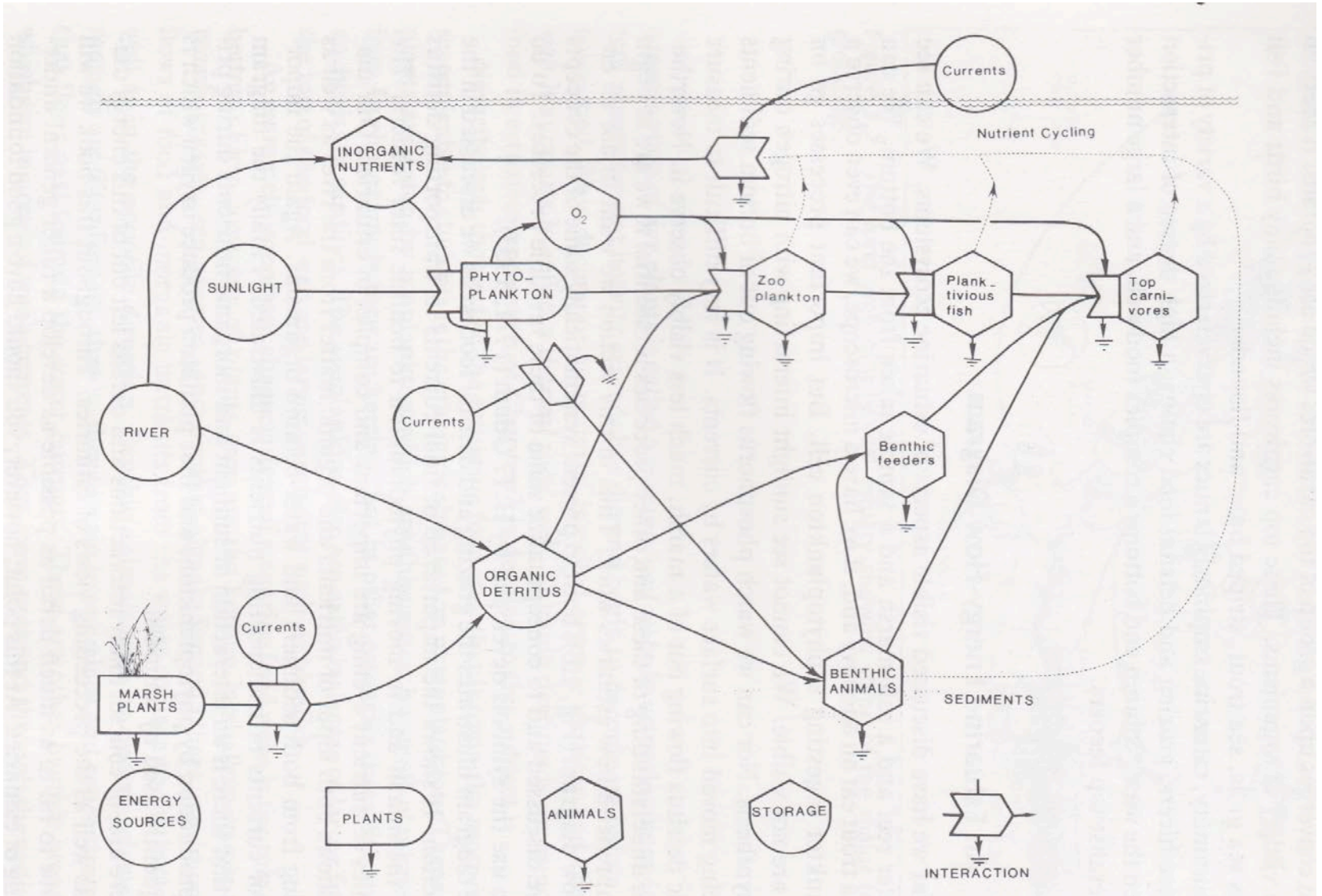
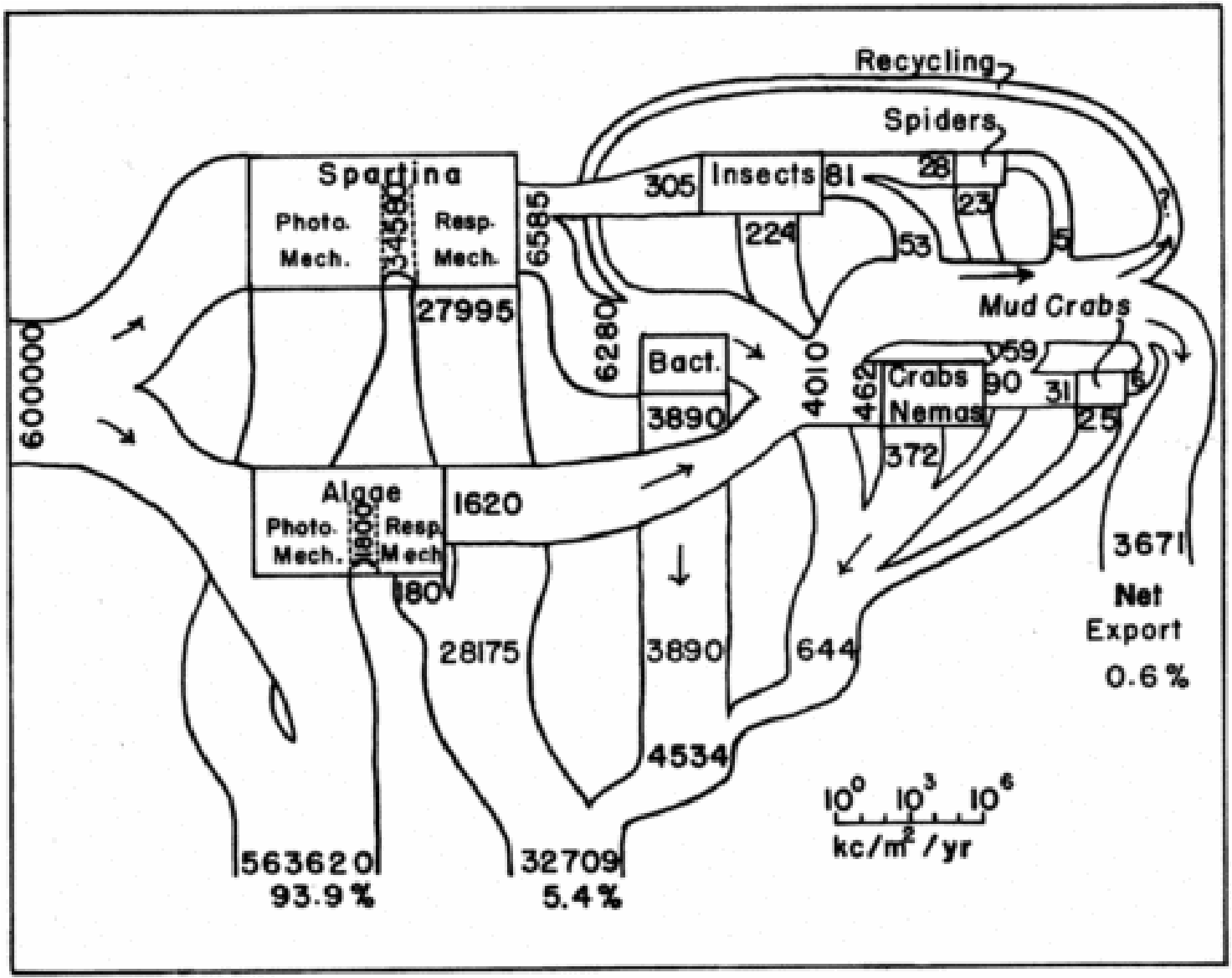


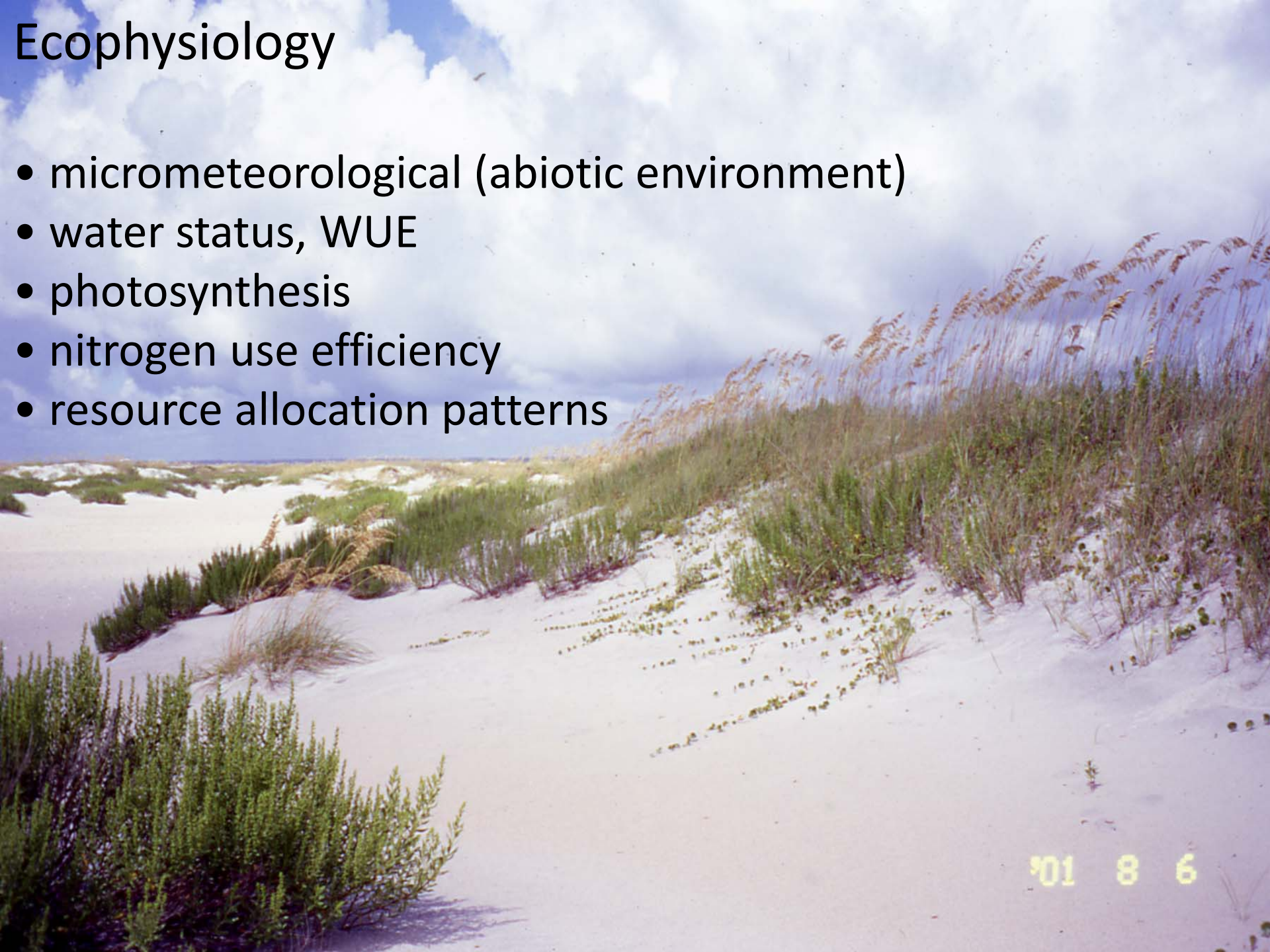

***Figure 1.8*** An energy-flow diagram illustrating some major structural and functional attributes of estuaries.

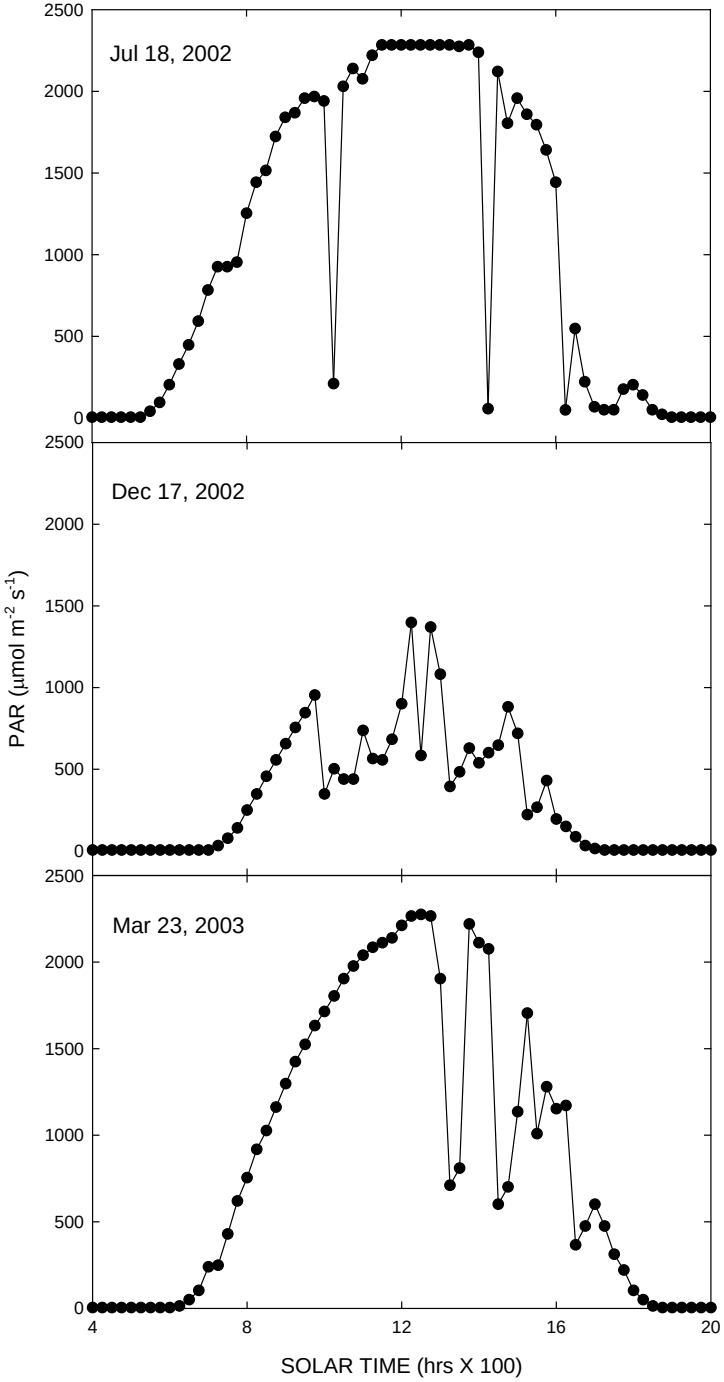
# J.M. Teal (Woods Hole Oceanographic Institution) ‘Energy flow in the salt marsh ecosystem of Georgia’ (1962)

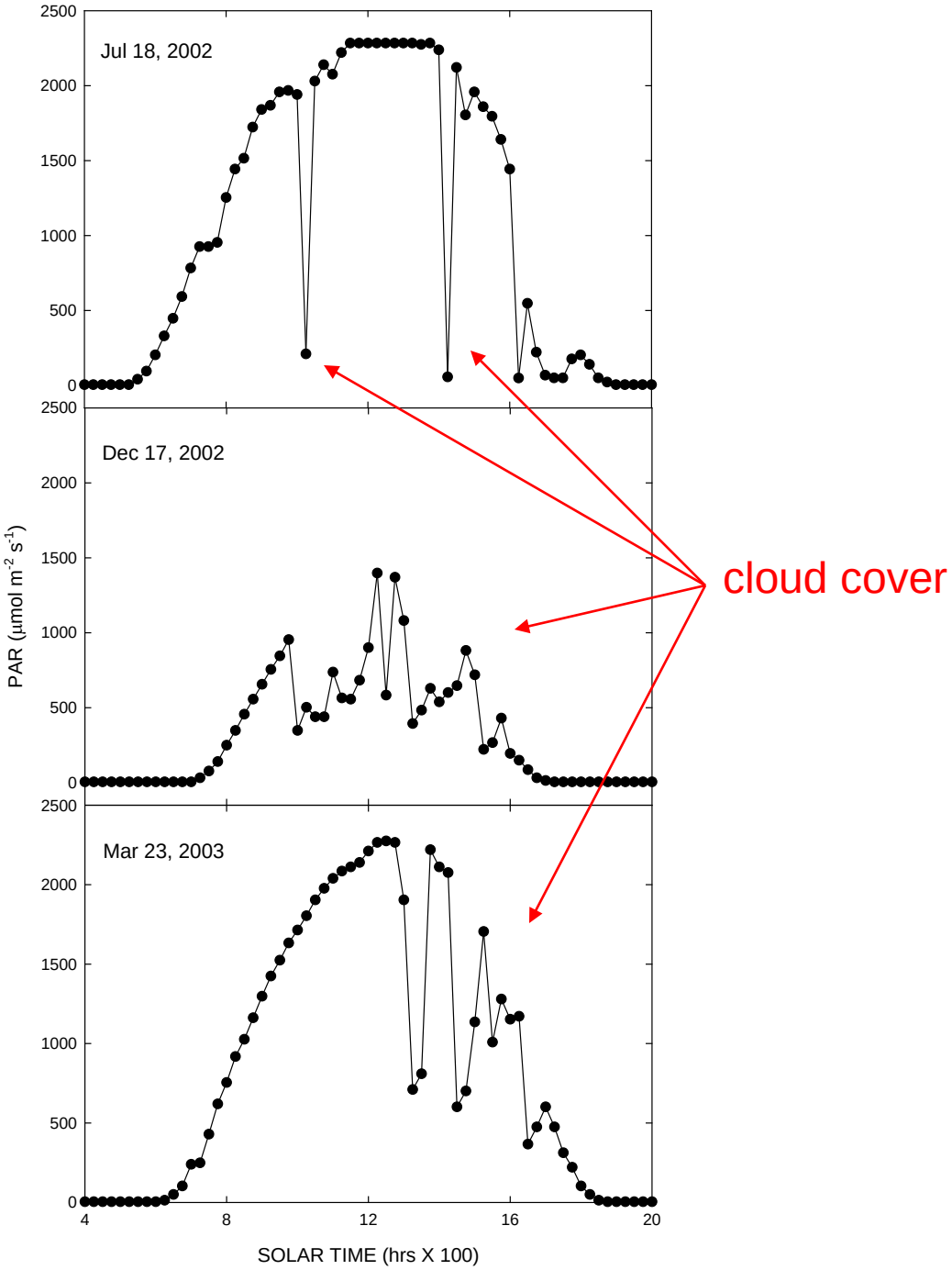


# Ecophysiology

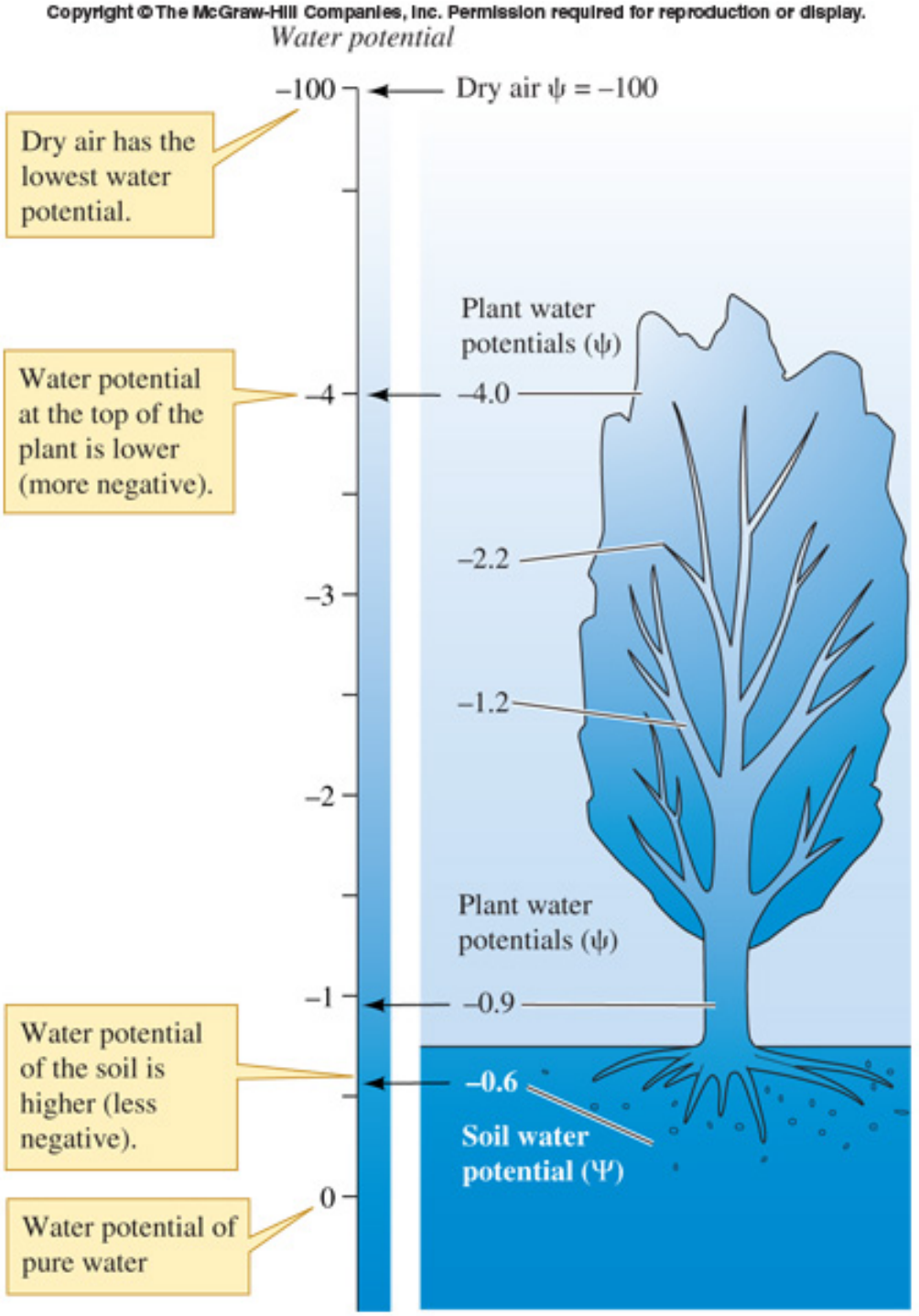
- micrometeorological (abiotic environment)
- water status, WUE
- photosynthesis
- nitrogen use efficiency
- resource allocation patterns




Jul 18, 2002
Dec 17, 2002
Mar 23, 2003
PAR (µmol m-2 s-1)
SOLAR TIME (hrs X 100)
0
500
1000
1500
2000
2500
4
8
12
16
20

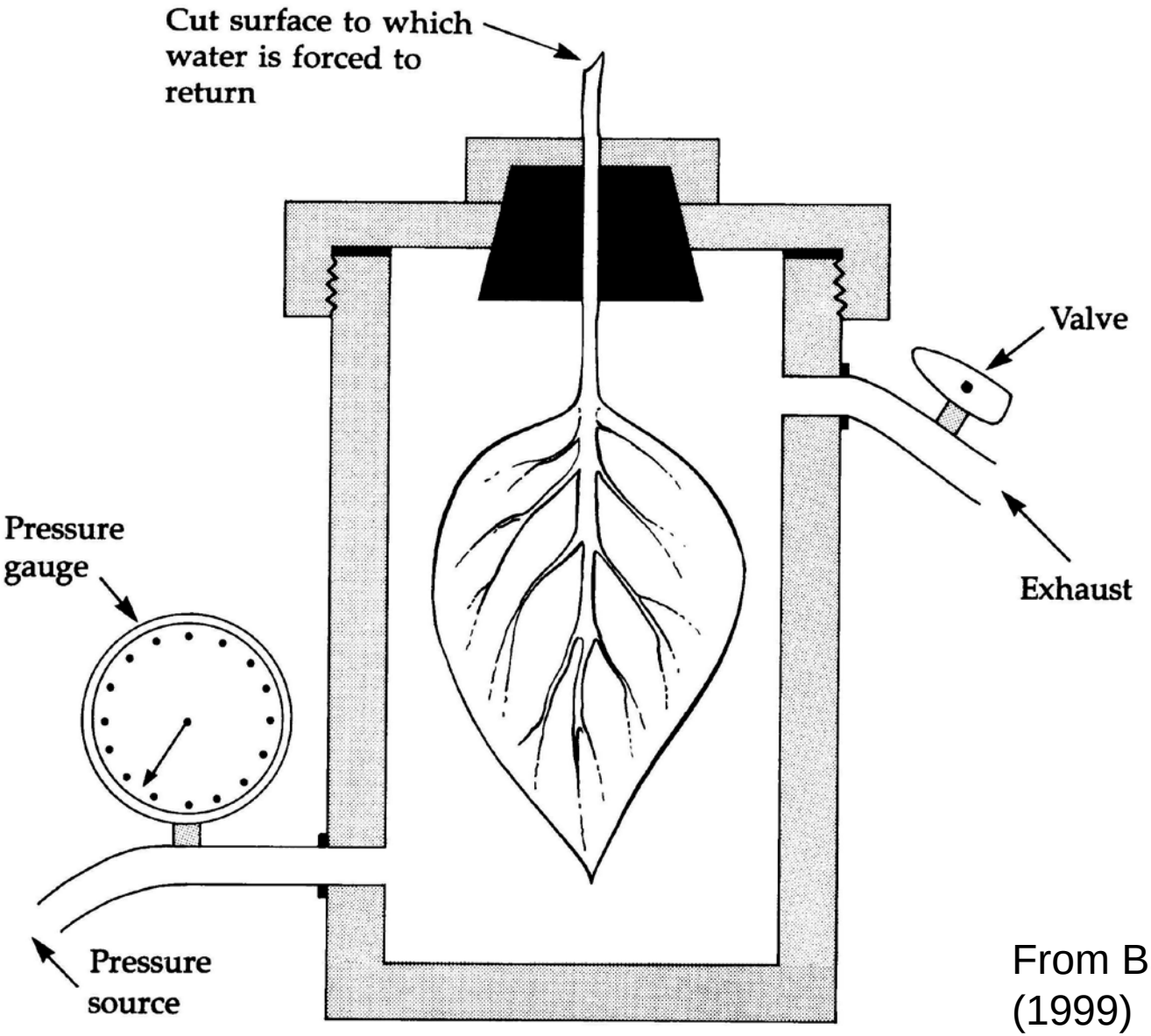

Jul 18, 2002
Dec 17, 2002
Mar 23, 2003
PAR (µmol m-2 s-1)
SOLAR TIME (hrs X 100)
cloud cover

# Soil Plant Atmosphere Continuum (SPAC)




From Moles (2008)

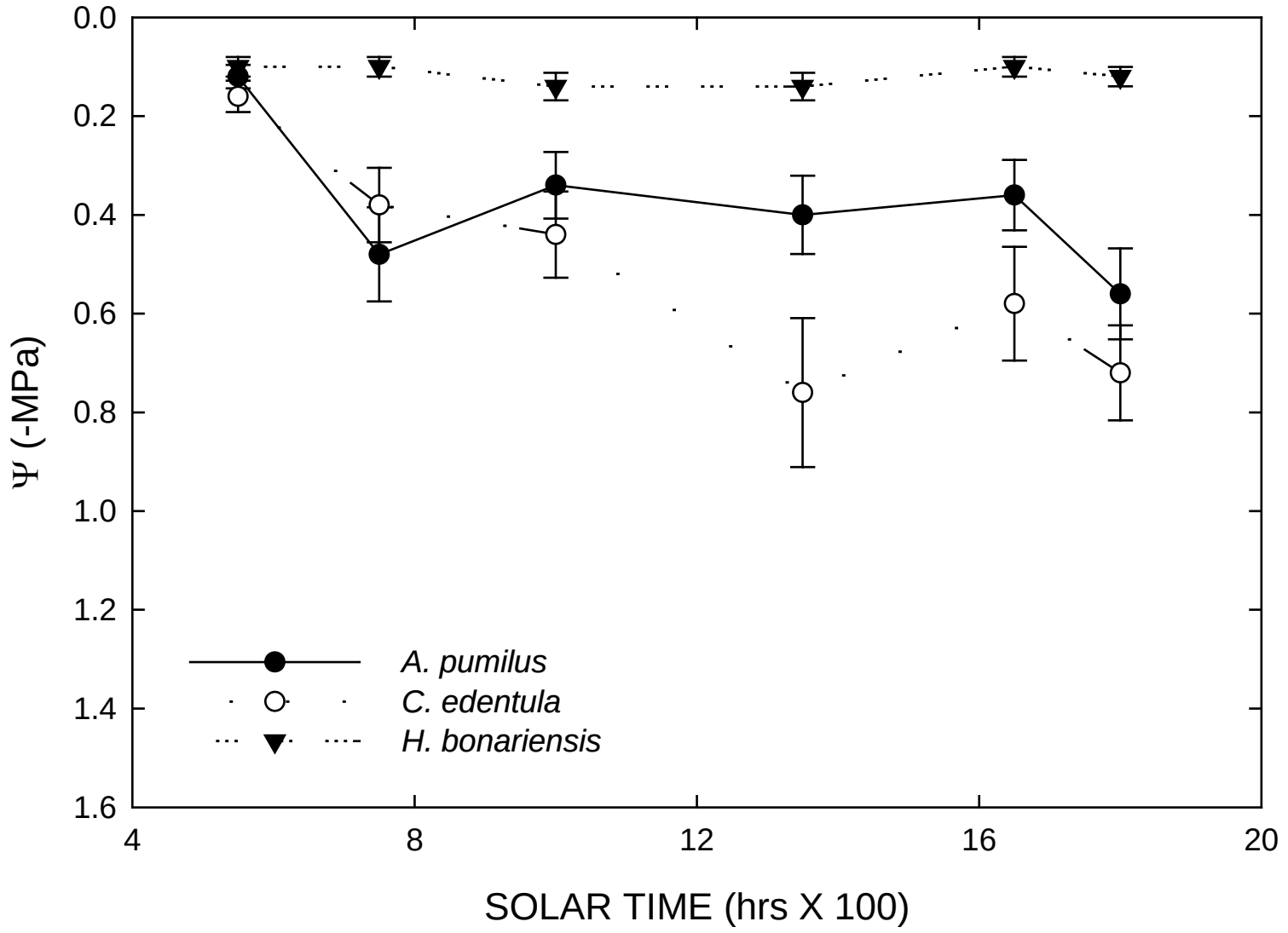
# Scholander type pressure chamber




From Barbour et. al. (1999)


PMS
OFF

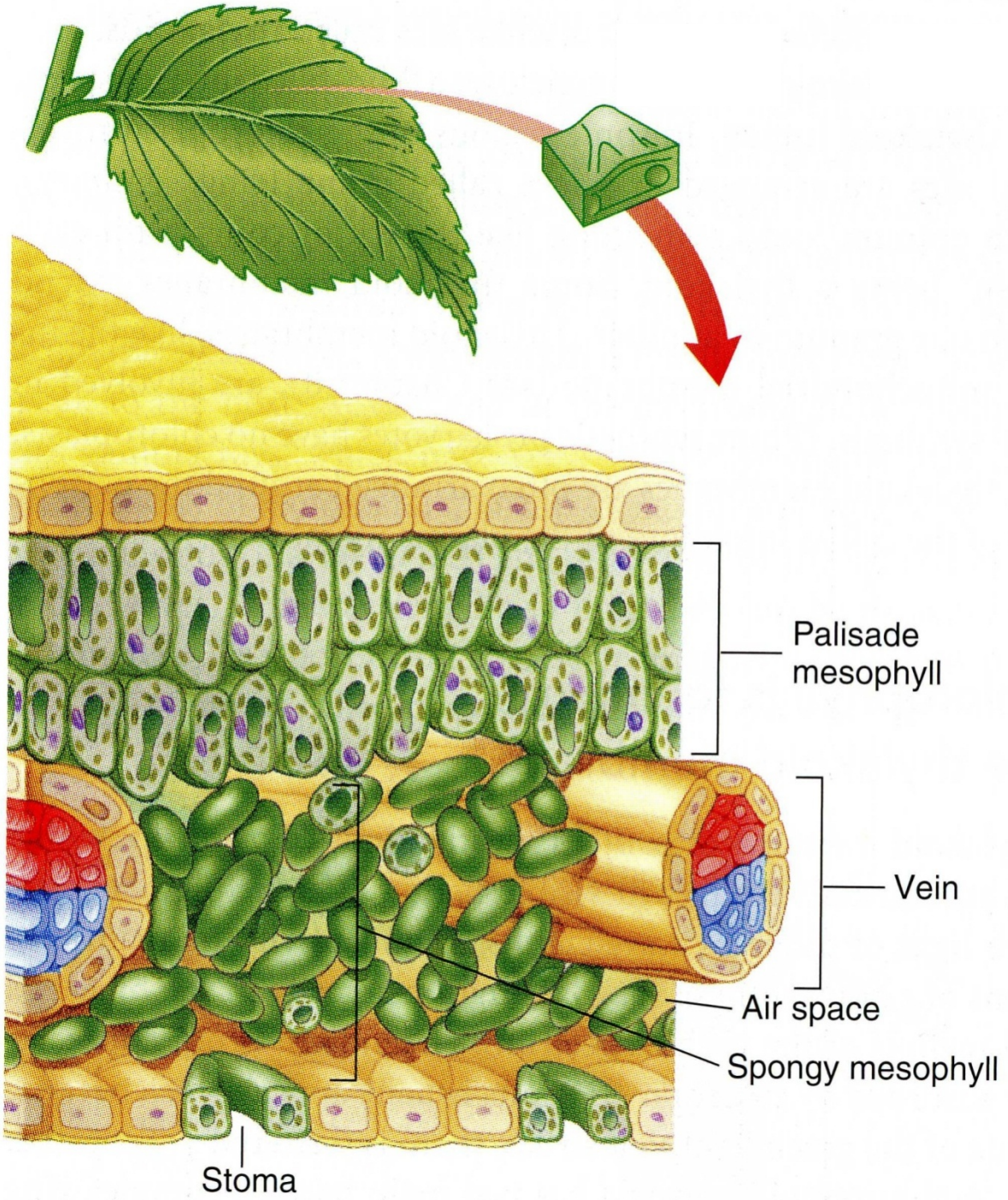
# Diurnal xylem water potential measured on Jul 18, 2002



A = photosynthesis
(μmol $CO_2$ $m^{-2}$ $s^{-1}$)

g = stomatal cond.
(mmol $H_2O$ $m^{-2}$ $s^{-1}$)

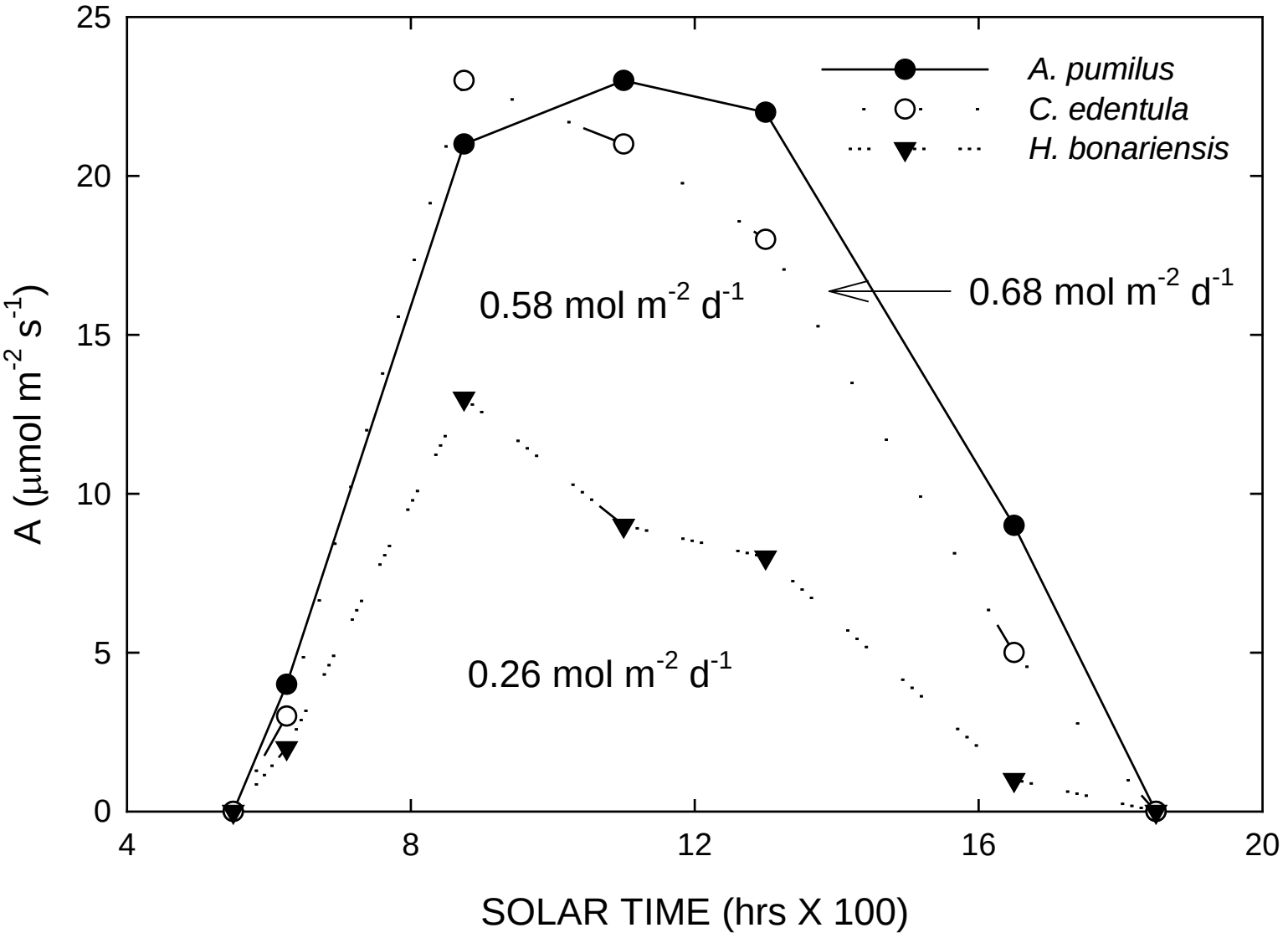
E = transpiration
(mmol $H_2O$ $m^{-2}$ $s^{-1}$)




from Solomon et. al. (2008)

# Photosynthesis

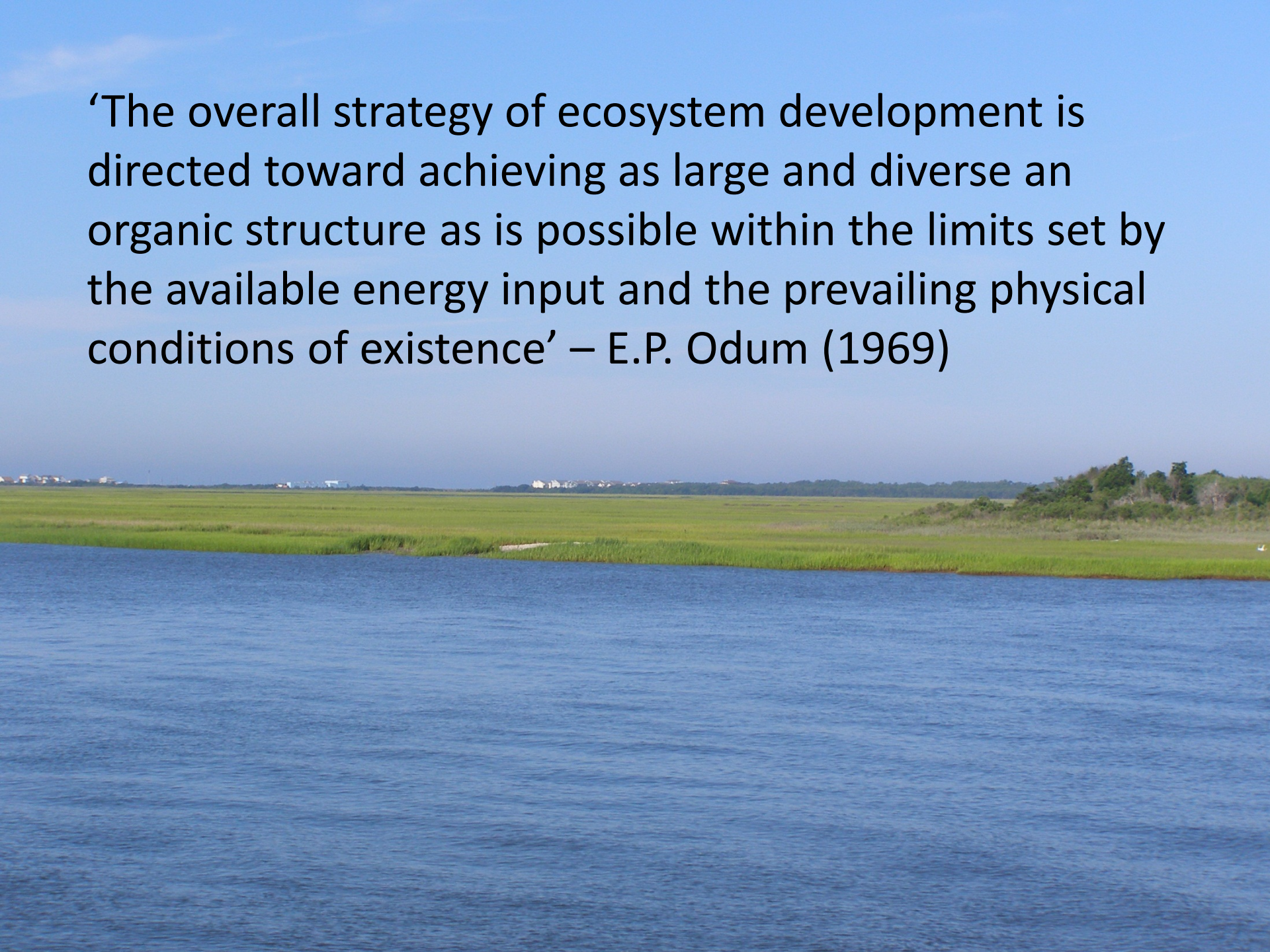
# Photosynthetic Carbon Gain (PCG) calculated for Sep 8, 2001



**Ecosystem services** - all the processes through which natural ecosystems and the biodiversity they contain help sustain human life

- purification of air and water
- mitigation of drought and floods
- generation and preservation of soils and soil fertility
- pollination of crops and natural vegetation
- nutrient cycling
- maintenance of biodiversity
- stabilization of shorelines
- partial stabilization of climate
- moderation of weather extremes
- provision of aesthetic beauty

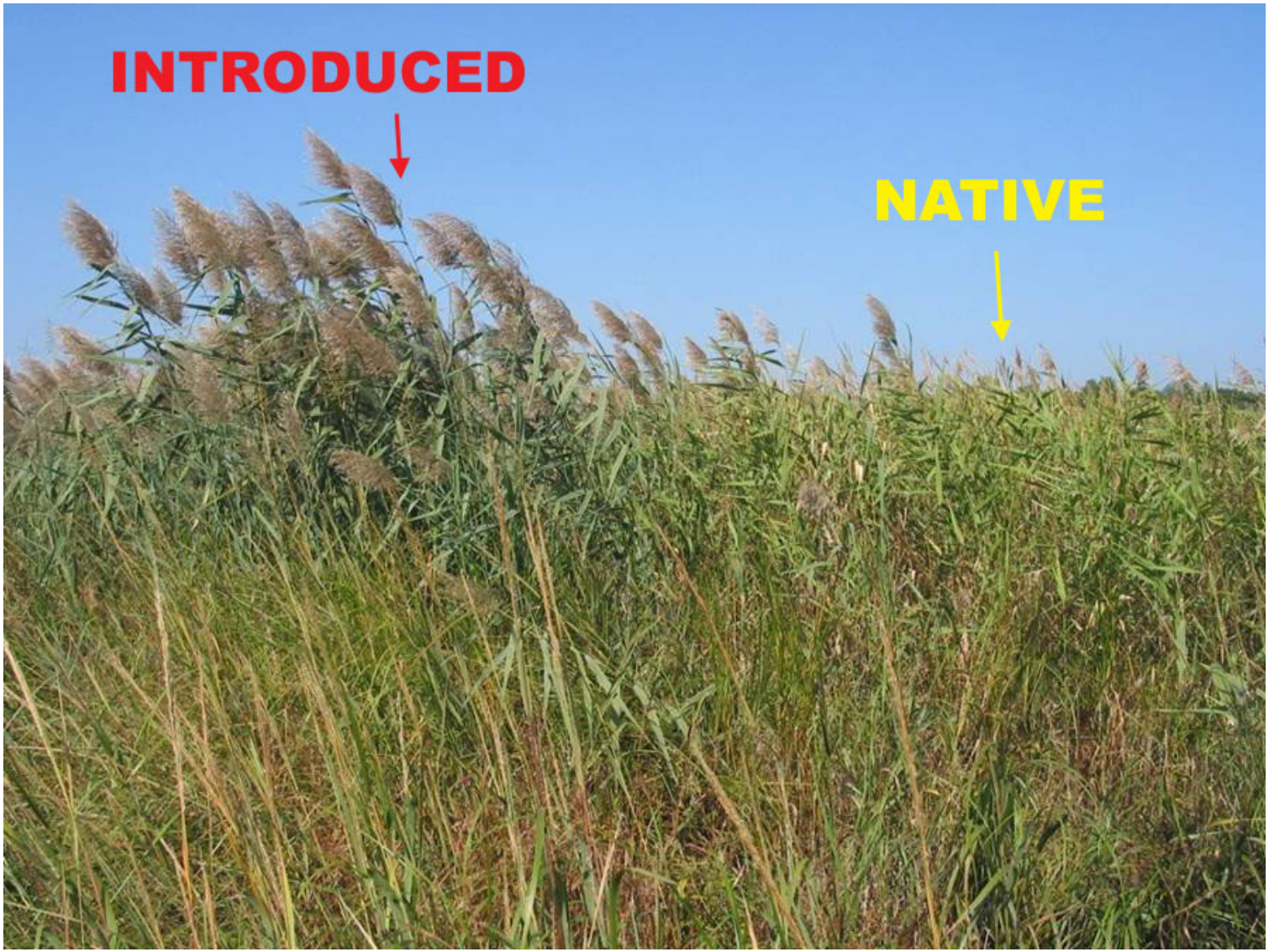
**Robert McArthur** (1955) proposed that more complex and interconnected communities are more resistant to disturbance.



‘The overall strategy of ecosystem development is directed toward achieving as large and diverse an organic structure as is possible within the limits set by the available energy input and the prevailing physical conditions of existence’ – E.P. Odum (1969)

# Hydrilla (*Hydrilla verticillata*)

# Phragmites (*Phragmites australis*)



# Cogongrass (*Imperata cylindrica*)

# Beach Vitex (*Vitex rontundifolia*)

# References


Barbour, M.G., J.H. Burk, W.D. Pitts, F.S. Gilliam and M.W. Schwartz. 1999. Terrestrial Plant Ecology (3rd edition). Benjamin Cummings Publishers, Menlo Park, CA (USA).

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Odum, E.P. 1969. The strategy of ecosystem development. Science. 164:262-270.

http://www.ncwildflower.org/

http://nceppc.weebly.com/

http://www.dnr.state.md.us/mydnr/askanexpert/nonnative_exotic.asp