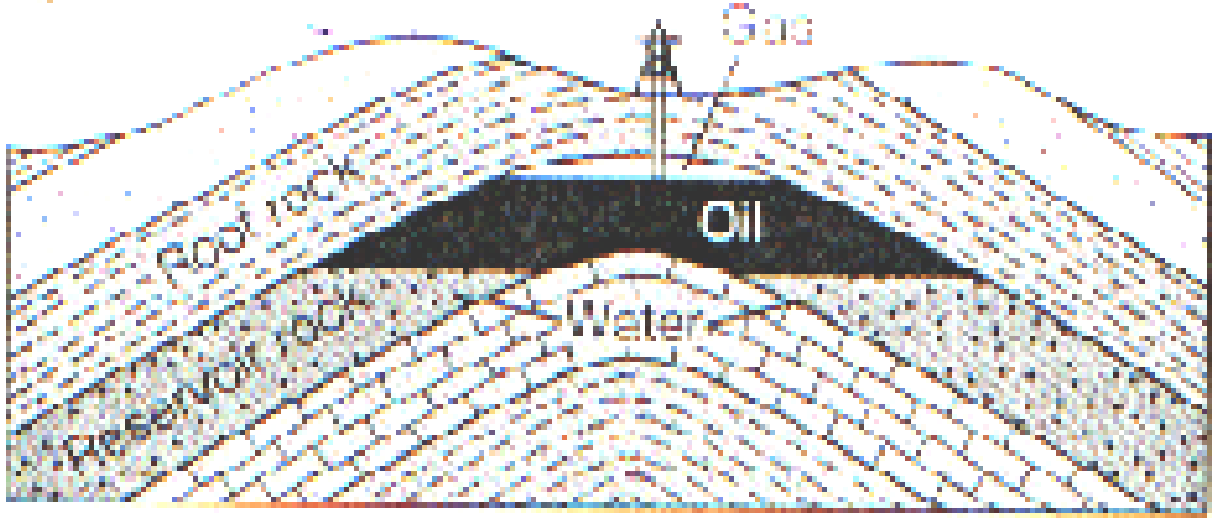
Origin of petroleum

- **Petroleum** is defined as gaseous, liquid, and semisolid naturally occurring substance that consist chiefly of **hydrocarbons.** Petroleum is therefore a term that includes both **oil** and **natural gas**.
- Petroleum is nearly always found in marine sedimentary rocks, in the ocean, microscopic **phytoplankton**(tiny floating plants) and **bacteria**(simple, single-celled organisms) are the principal sources of organic matter that is trapped and buried in sediment.

A.



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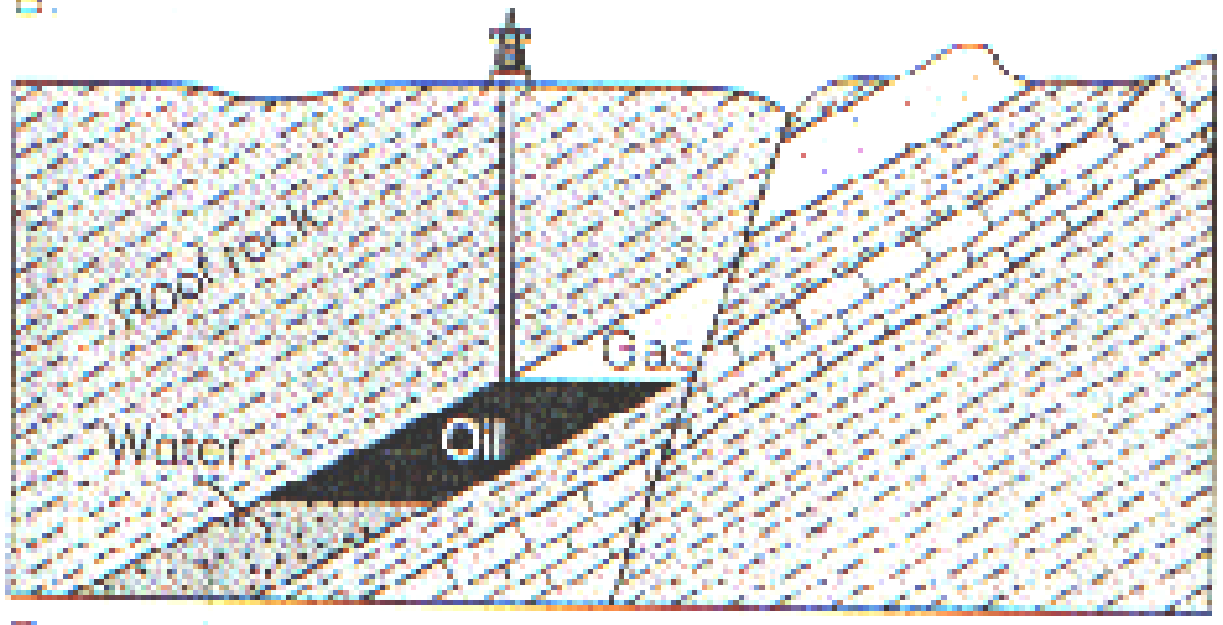
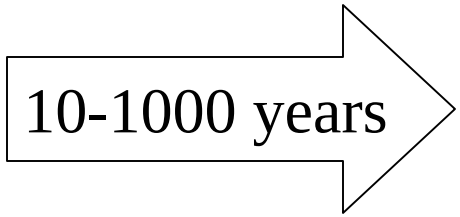


Sucession 消長

- Pioneer community 

climax community
- seral stage:
annual herb ⇨ perennial herb ⇨ shrub ⇨
pioneer forest ⇨ climax forest
- hydrosere and xerosere
- primary sucession初級消長(prisere) and secondary sucession次級消長(subsere)

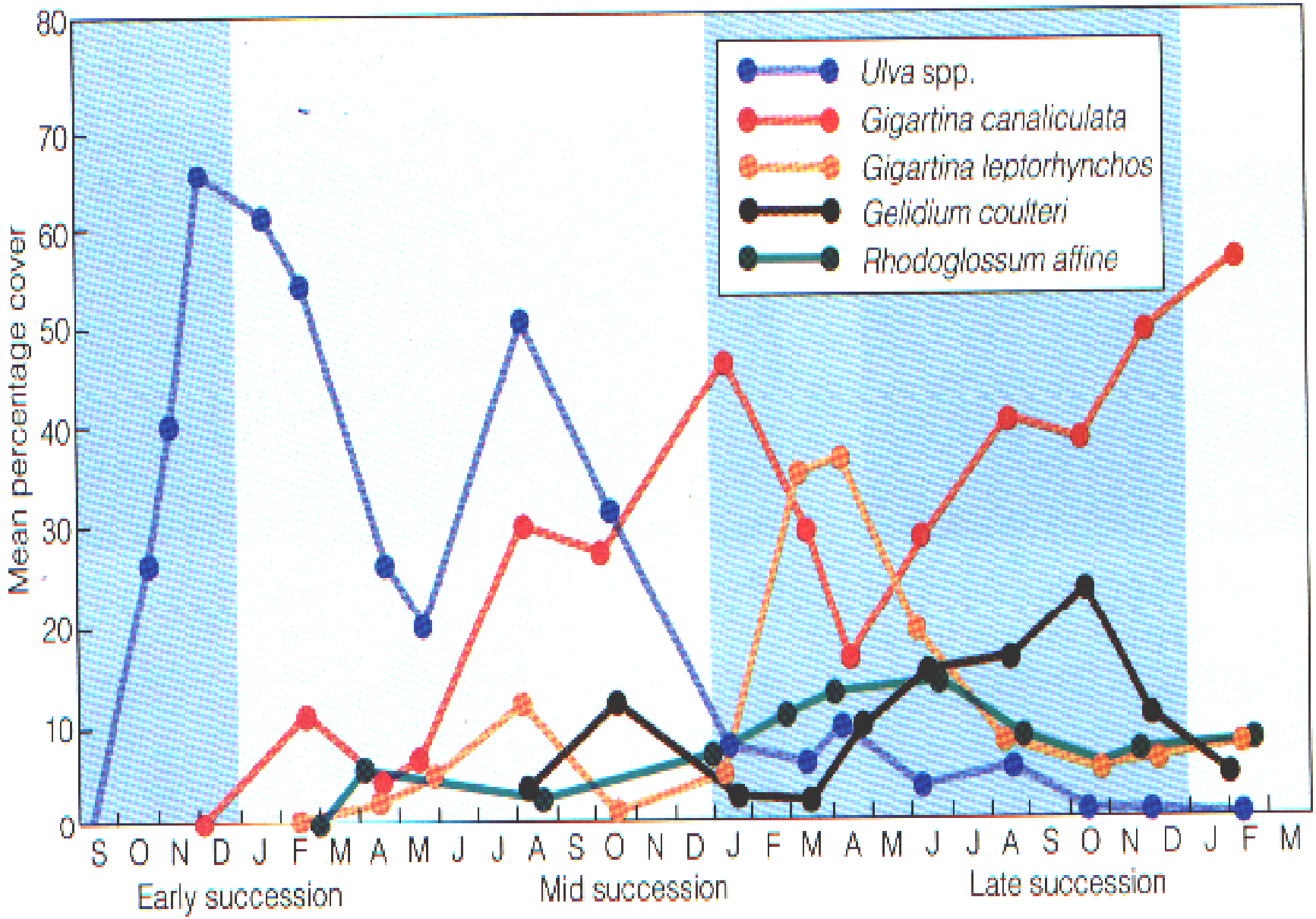


Figure 21.14 Mean percentage of five algal species that colonized concrete blocks introduced into the intertidal zone in September 1974. Note the change in species dominance over time.

Cause of sucession

- Allogenic factor(allogenic succession: ecological change or development of species structure and community composition brought about by some external force, such as fire or storms)
- autogenic factor: ex: 生物引起之土石崩解

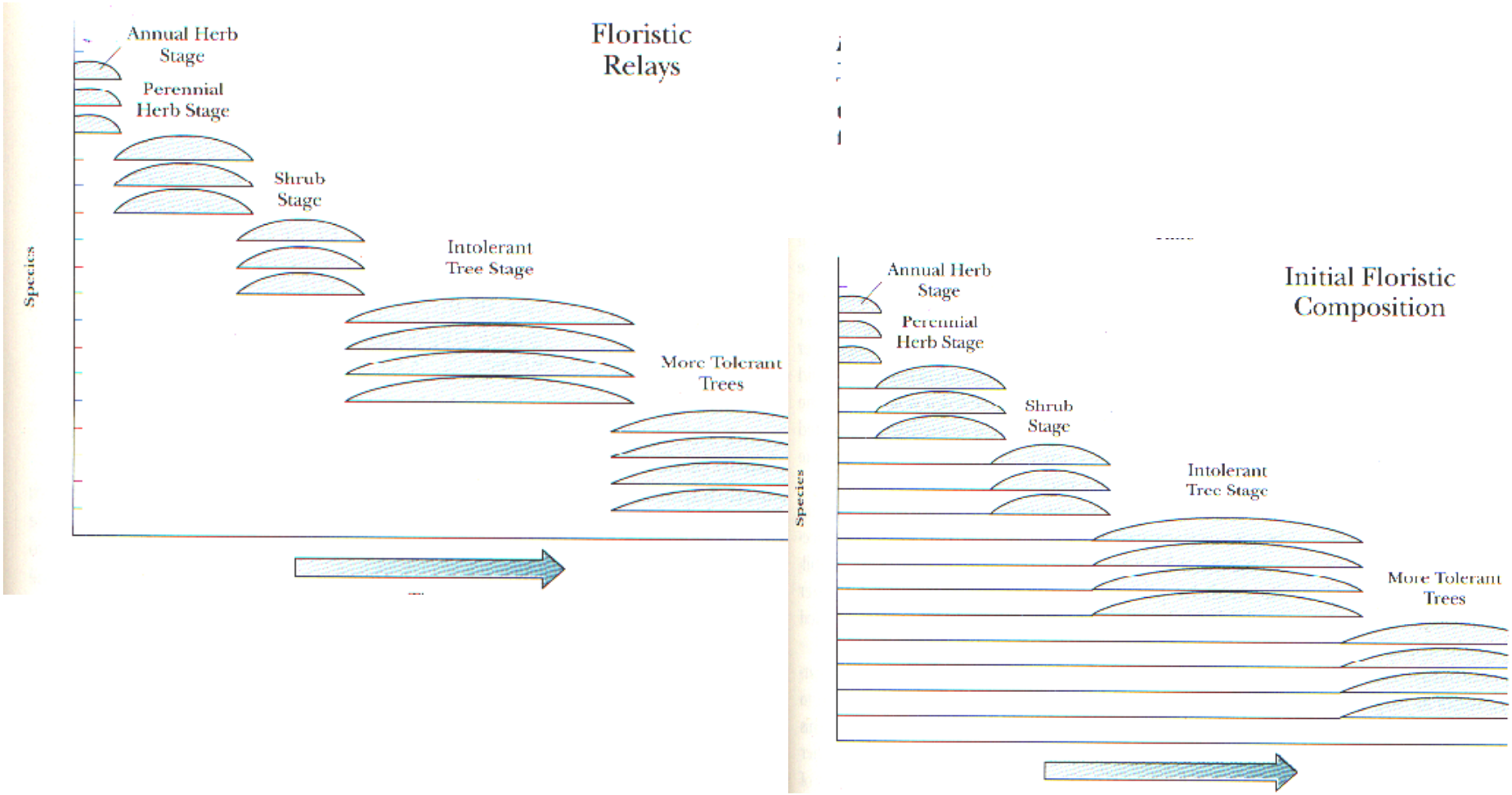
  原因: 1.遷入 2.生長 3. 作用 4. 交互作用(autogenic succession: succession driven by environmental changes brought about by the organism themselves)

The models for the relationship between the early and later successional species

- Facilitation model:reactions of the earlier species make the environment more suitable for later successional species
- tolerance model: reactions or the earlier species have little or no effect on the growth of the later species
- inhibition model: reactions of the earlier species make the environment less suitable for later species

Sucession models

- Floristic relays and initial floristic composition

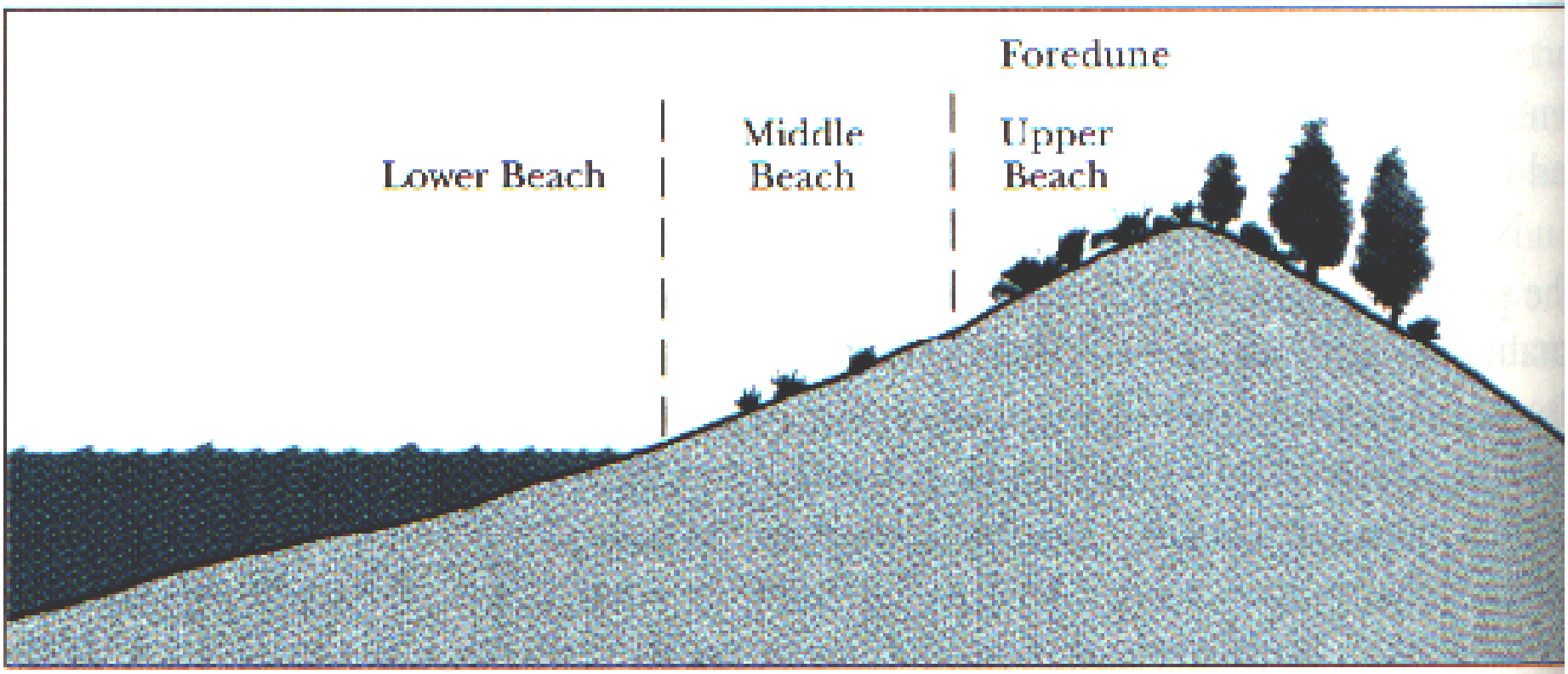


The role of coaction

- Coaction { competition / non-competition }
- in competition coaction: plants for the habitat and energy catching, animals for the habitat
- the non-competition coaction is also important

Sand dune sucession

- lower beach: the waves arrive in summer
  middle beach: the waves arrive in winter
  upper beach: no waves
- the biota of the lower and middle beach depend on the lake
- the sand dune forms in the upper beach


Foredune
Lower Beach
Middle Beach
Upper Beach

The climax community

- 1. 忍受群落中各物種之作用
- 2.氣候相對中央(pioneer community is xeric or hydric)
- 3. 高組織性
- 4. High biodiversity(fire increase the biodiversity)
- 5. The volume of organism is lager, the life-span is longer, and lower biotic potential)
- 6. net community production = 0
- 7. Climax ecosystem is more stable

演替巔峰理論 --Monoclimax hypothesis

- Cowles and Clement
- 演替途徑: 遷移 → 定居 → 群聚 → 競爭 → 反應 → 穩定
- climate climax
- proclimax前巔峰(原頂級群落)
- subclimax亞巔峰
- disturbance climax偏途巔峰
- preclimax預巔峰
- postclimax後巔峰(超巔峰)
- Clement suggest the direction is progressive succession (not regressive sucession)

演替巔峰理論--polyclimax hypothesis

- Climax: 群落自行繁衍並結束演替過程
- 群落演替之結果並不一定皆為共同之climatic climax終點, 只要一種或數種因子共同作用而使群落長期保持穩定
- 與monoclimax hypothesis 之差異: 演替之決定因素, 同一氣候區內群落是否趨同發展?

演替巔峰理論-- climax-pattern hypothesis 巔峰格局假說, population pattern climax theory 族群格局巔峰理論

- 各類型之巔峰群落如: 氣候 土壤 地形火山等巔峰不截然離散, 而呈連續變化, 構成連續變化之格局

Energy flow in community and ecosystem

太陽光用於光合作用效率低之原因

- 1. 只有4%之光之頻率在可用範圍(red and blue light)
- 2. 強光不利光合作用(light saturation point)
- 3. 地球大多地區整年皆無法行光合作用
- 4. 生長季節之光合作用仍受溫濕礦物之限制
- 5. 植物光合作用之極限(LAI=4)
- 6. 水中環境 產量被溫度 光度 營養鹽所限制 水中每20m 光強減一半 海洋 10m 一般湖泊1-2m

Trophic level

- Producer
- consumer-
  - primary
    - berbivore
  - secondary
    - carnivore
  - tertiary
    - omnivore
- decomposer
- scavengers

- scavengers are animals that eat dead plant and animal material.
- food chain and food web

QUANTIFYING ECOLOGY 24.1

ECOLOGICAL EFFICIENCIES

Assimilation efficiency (within a trophic level) =

$$\frac{\text{Assimilation}}{\text{Ingestion}} \quad \frac{A}{I}$$

Growth efficiency =

$$\frac{\text{Production}}{\text{Ingestion}} \quad \frac{P}{I}$$

Production efficiency =

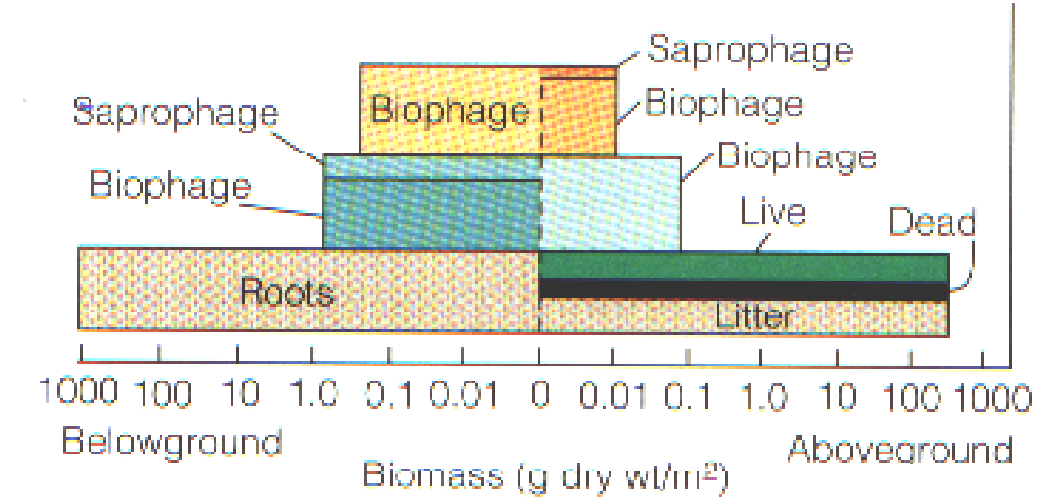
$$\frac{\text{Production}}{\text{Assimilation}} \quad \frac{P}{A}$$

Consumption efficiency =

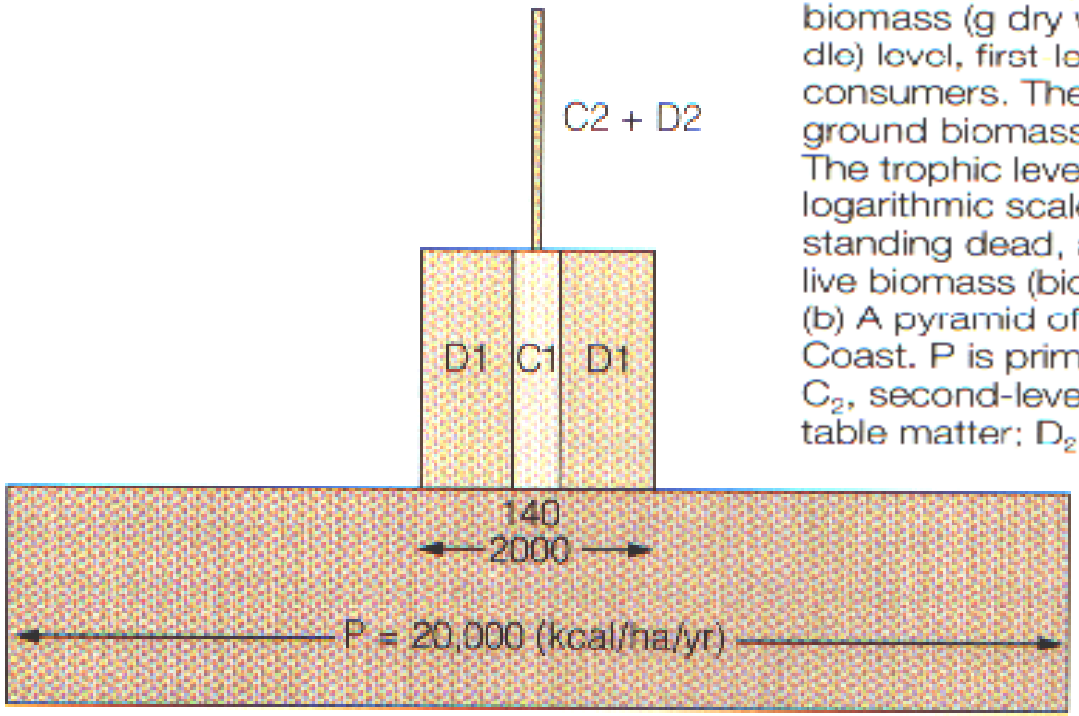
$$\frac{\text{Consumption at trophic level } n}{\text{Production at trophic level } n-1} \quad \frac{I_n}{P_n - 1}$$

pyramid

- Pyramid of biomass: diagrammatic representation of biomass at different trophic levels in an ecosystem.
- Pyramid of energy: diagrammatic representation of the flow of energy through different trophic levels.
- Pyramid of numbers: diagrammatic representation of the number of individual organisms present at each trophic level in an ecosystem; the least useful pyramid



(a)



(b)

Figure 24.8 Examples of ecological pyramids. The detrital and grazing food chains have been collapsed into the same trophic levels. (a) A pyramid of biomass for a northern shortgrass prairie. The base of the pyramid represents biomass (g dry weight/m^2) of producers; the second (middle) level, first level consumers; and the top, second-level consumers. The dashed vertical line separates aboveground biomass (right) and belowground biomass (left). The trophic level magnitudes are plotted on a horizontal logarithmic scale. The compartments are divided into live, standing dead, and litter biomass; and into consumers of live biomass (biophages) and dead biomass (saprophages). (b) A pyramid of energy for the Lamto Savanna, Ivory Coast. P is primary production; C_1, first-level consumers; C_2, second-level consumers; D_1, decomposers of vegetable matter; D_2, decomposers of animal matter.

ecosystem

- A. G. Tansley 1935 in the journal *Ecology*
- Ecosystem is the bioitic community and its abiotic environment functioning as a system.
- The primary focus of ecosystem ecology is the exchange of **energy and matter**.
- An ecosystem with no **inputs** is called a **closed ecosystem**; one with **inputs** is an **open ecosystem.**

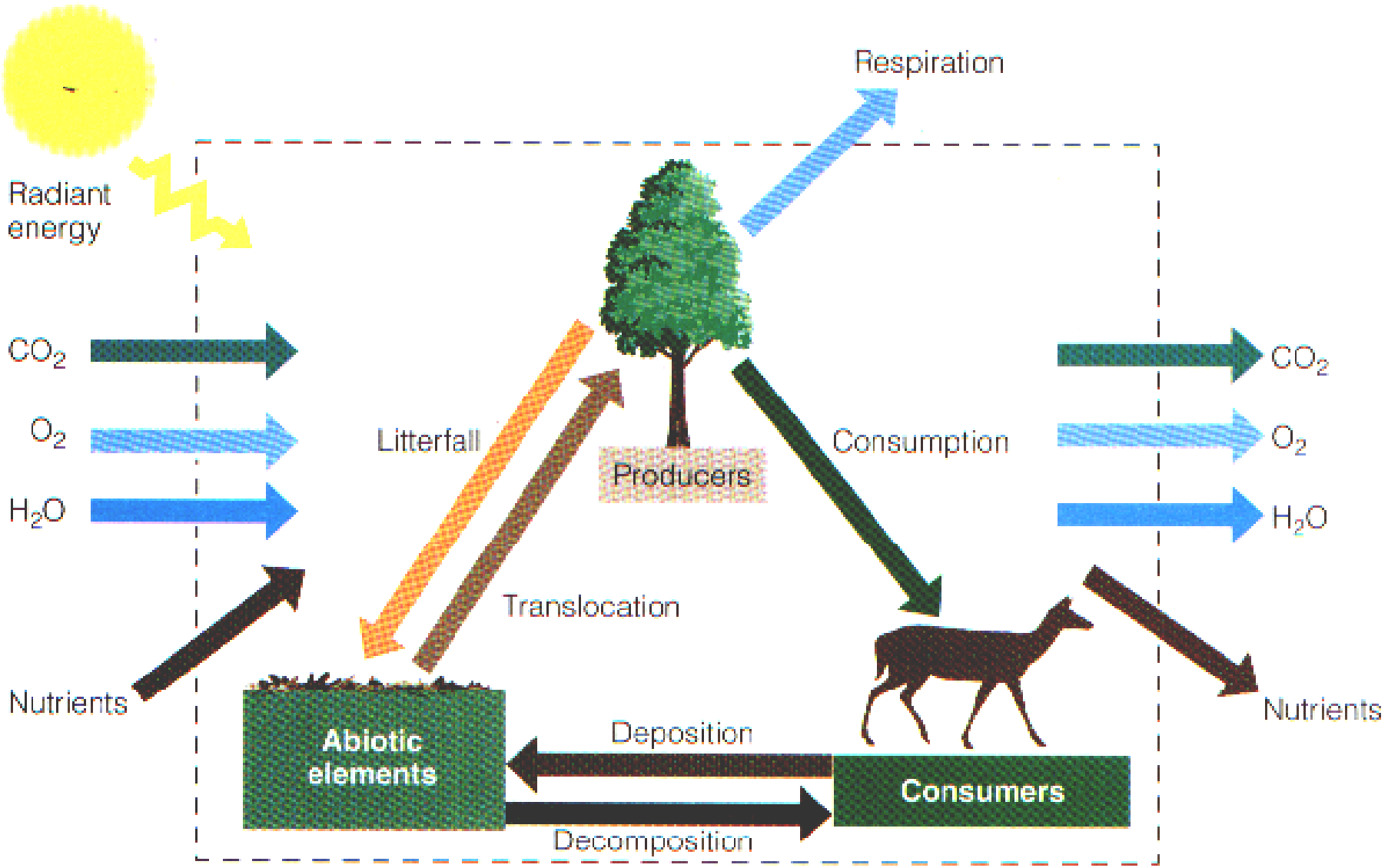


Figure 23.1 Schematic diagram of an ecosystem. The dashed lines represent the boundary of the system. The three major components are the producers, the consumers, and the abiotic elements: inactive or dead organic matter, the soil matrix, nutrients in solution in aquatic ecosystems, sediments, and so on. The arrows indicate interactions within the system and with the environment.

Measurement of energy

- 能量=水體積 X 水溫之上升(bomb calorimeter)
- unit of energy: cal, BTU(british thermal unit)(一磅水升高華氏一度)(1BTU=252 cal), Joule(1 Joule= 0.24 cal)

biomass

- Organism 之重量(dry weight)
- standing crop 現有量
- biomass 無法被正確估量之原因

  1. 植物各部分無法全部收集(落葉 地下部分)
  2. 無法估計被取食量
  3. 寄生性之消費者存在則更難估計

productivity

- Primary productivity:
  gross primary productivity(GPP) and
  net primary productivity(NPP)
  NPP=GPP-R
- net community productivity(NCP)
  NCP=GPP-R-consumption by other consumers
- the ecosystem is stable if GPP= the total respiration of all organisms in the community(P/R=1)

- P/R >1 : autotrophic community

  P/R <1 : heterotrophic community
- efficiency(生態效率)= output/ input (of energy)

  GPP/solar radiation（photosynthetic efficiency）

  GPP/light adsorbed（assimilation efficiency）

  NPP/GPP（effective primary production）
- ecological growth efficiency（P/I）= assimilation efficiency（A/I）X Production efficiency(P/A)（p325）

ecological growth efficiency

- Herbivores homoiotherms 0.1-1.5%
  poikolotherms 9-25%
- carnivores homoiotherms 0.6-1.8%
  poikolotherms 12-35%

Productivity increasing

- Increasing the efficiency of photosynthesis
- consumer control

subsidize energy

- solar energy
- tide
- wind

Measurements of PP

- Harvest measurement
- CO_2 measurement
- O_2 measurement\ BOD(biochemical oxygen demanding) measurement\ light-dark method

  BOD bottle → 350ml water sample → fill O_2 to saturation → 33^0C 5 days after measurement the concentration of O_2

Method: GP= NP+R

NP=LB-IB

R=IB-DB

then: GP=LB-DB

- pH measurement
- Chlorophyll measurement 海藻: 3.9g carbonhydrate/g chl hr
- isotope measurement: C^{14}/C^{12}

為何食物鍊無法太長

- Lindemann’s efficiency:
  in lake, no secondary consumer if the NPP< 10g/ m^2 year
- inhibition of evolution
- optimal foraging
- dynamic inhibition

NPP and plant biomass comparison in ecosystem

- 珊瑚礁, 熱帶雨林,沼澤(swamp), 河口(estuaries),耕地(cultivated land) 之NPP高
- 岩石,冰原,高山寒原,沙漠 NPP低
- 海洋NPP低(有 upwelling則NPP高)

影響ecosystem NPP 之因素

- 緯度
- Nutrient
- 雨量/ 濕度

	<250mm/year	250-750	>750
ecosystem	desert	grass	forest
producer	few	middle	many
productivity	low	middle	high

- Grazing
- water depth
- canopy structure
- wind

Energy allocation

- Plant photosynthesis for leaf, stem, bark, root, flower, fruit, seeds
- phytoplankton for cell division
- annual plants for leaf, in reproductive season for flower
- annual plants in desert for roots
- perennial plants depend on the seasons and latitude:

Food chain and food web analysis (feeding habitats analysis)

- Observation
- stomach content analysis
- fecal analysis