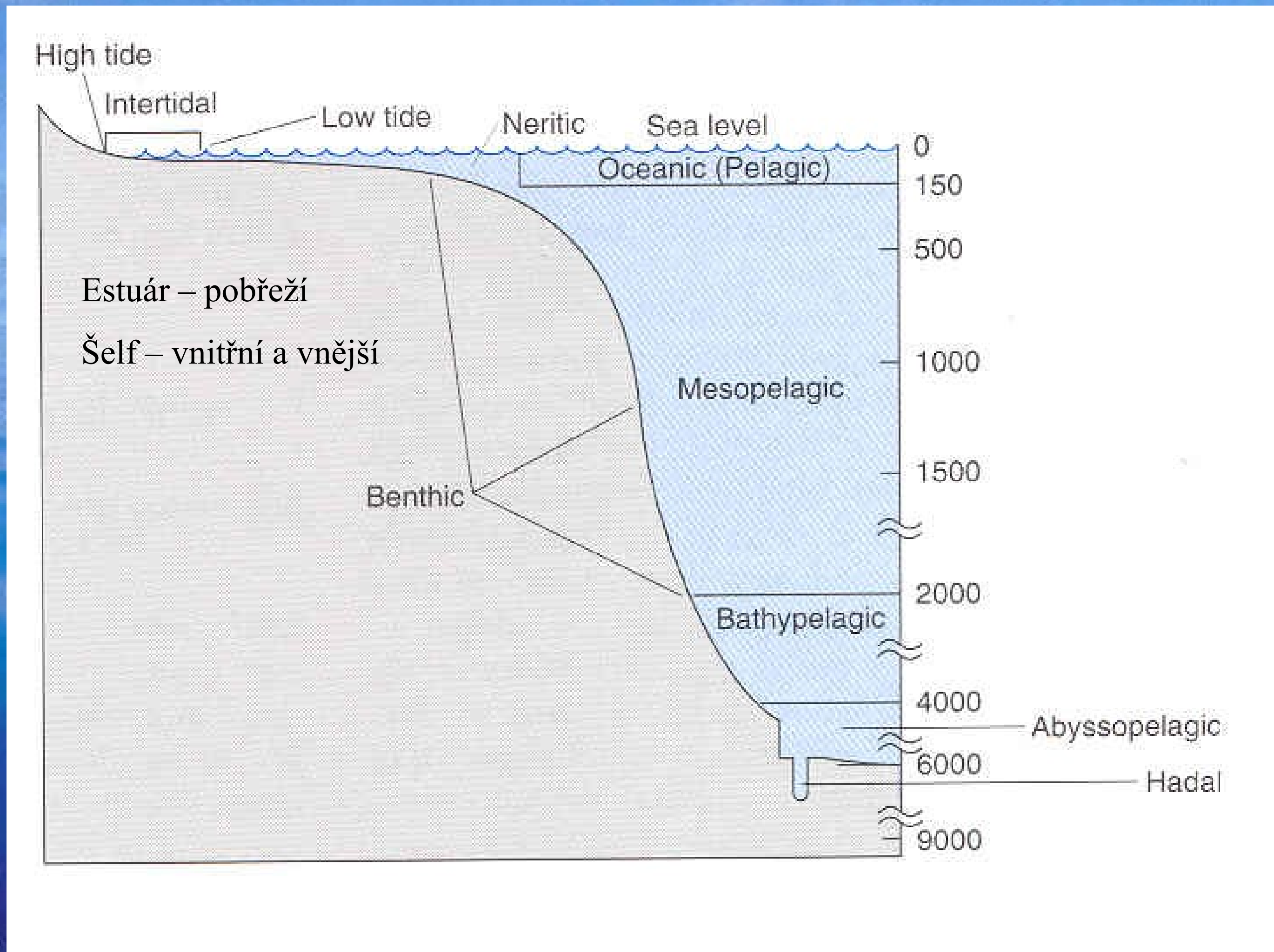
Ekologie moří, oceánů a oceánobiologie

II. Část

Ekosystém, funkce a biologie

Popis systému



Estuár – pobřeží

Šelf – vnitřní a vnější

Ekologické skupiny organismů

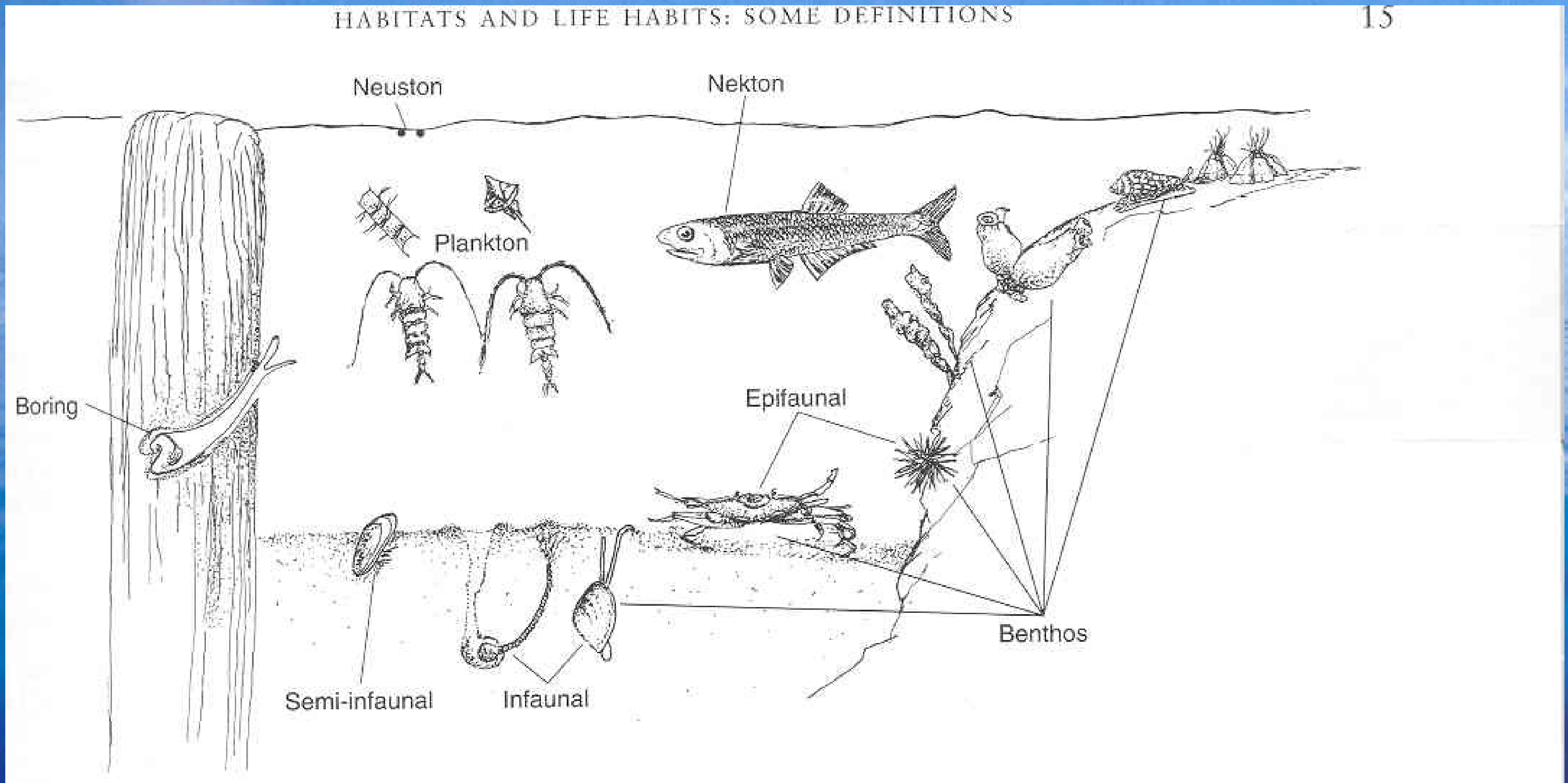
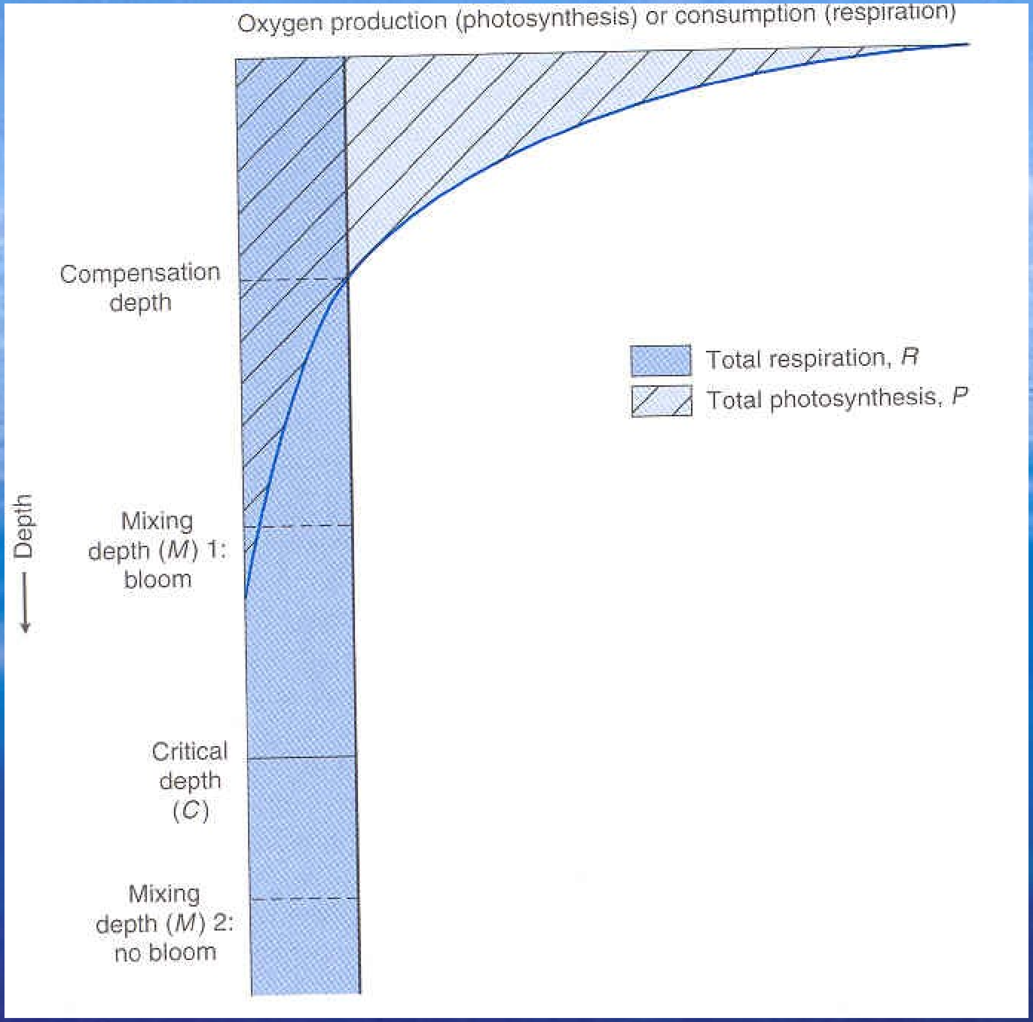
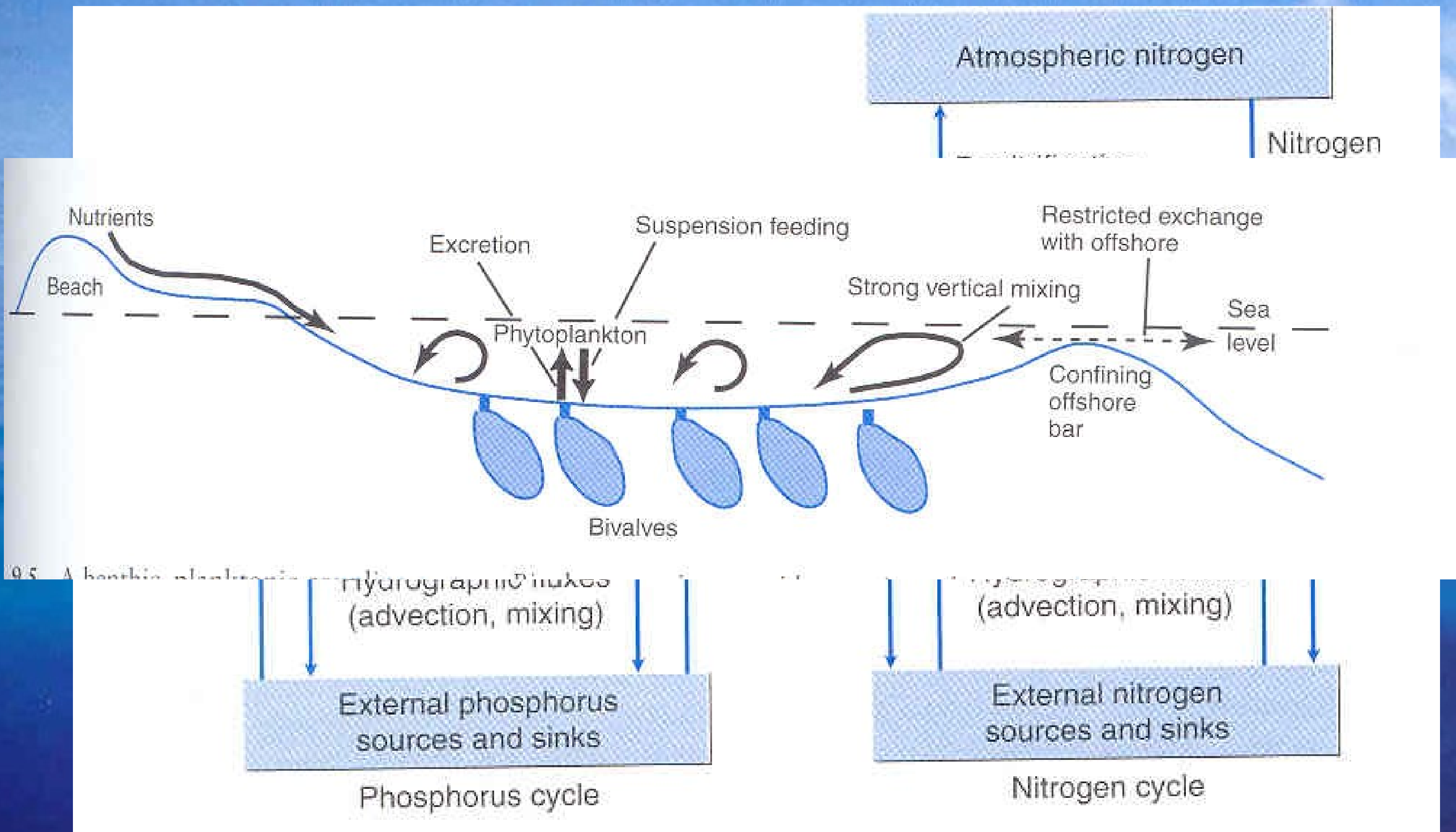


Fig. 1.10 General habits of marine organisms.

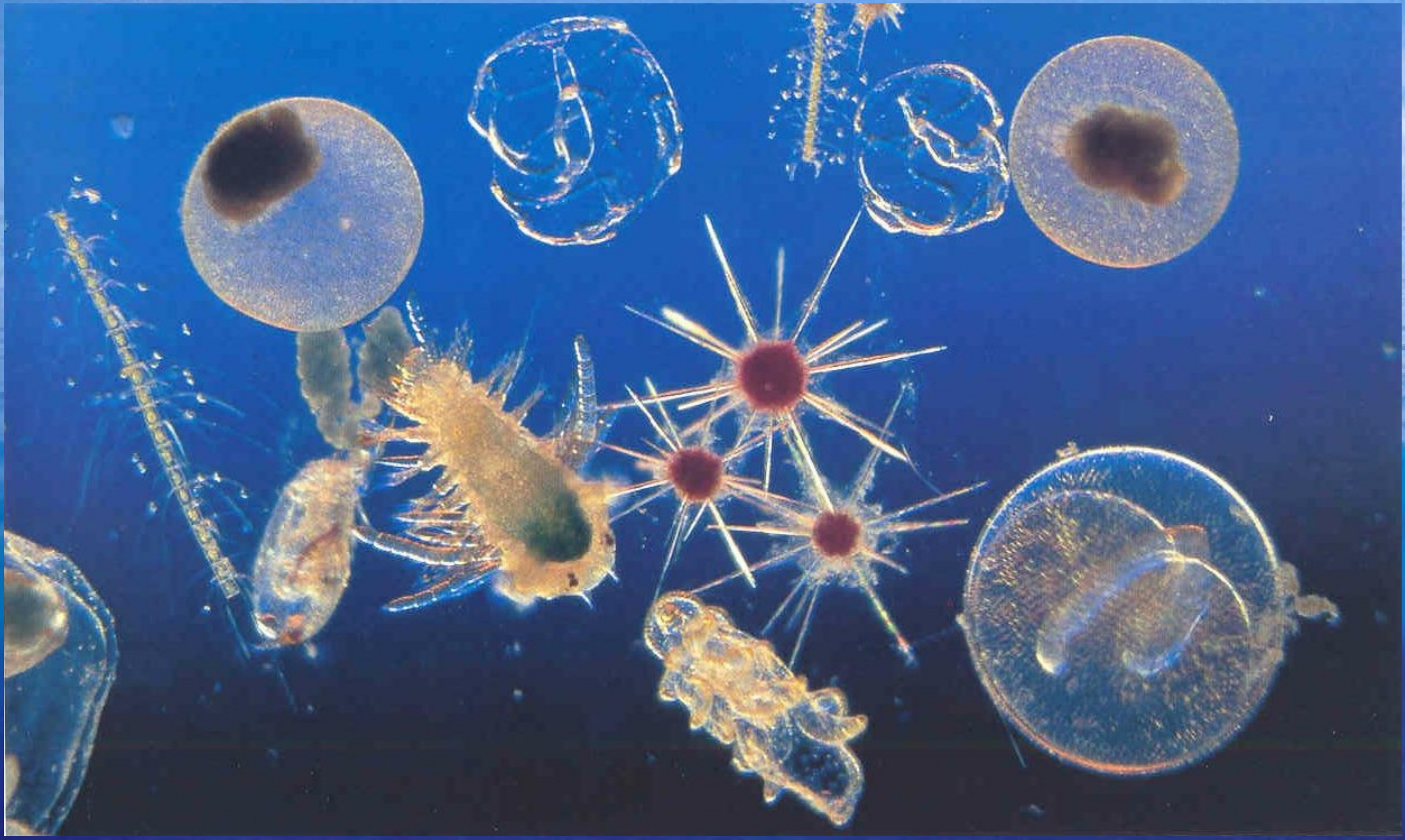
Širý oceán - pelagiál



Širý oceán - pelagiál

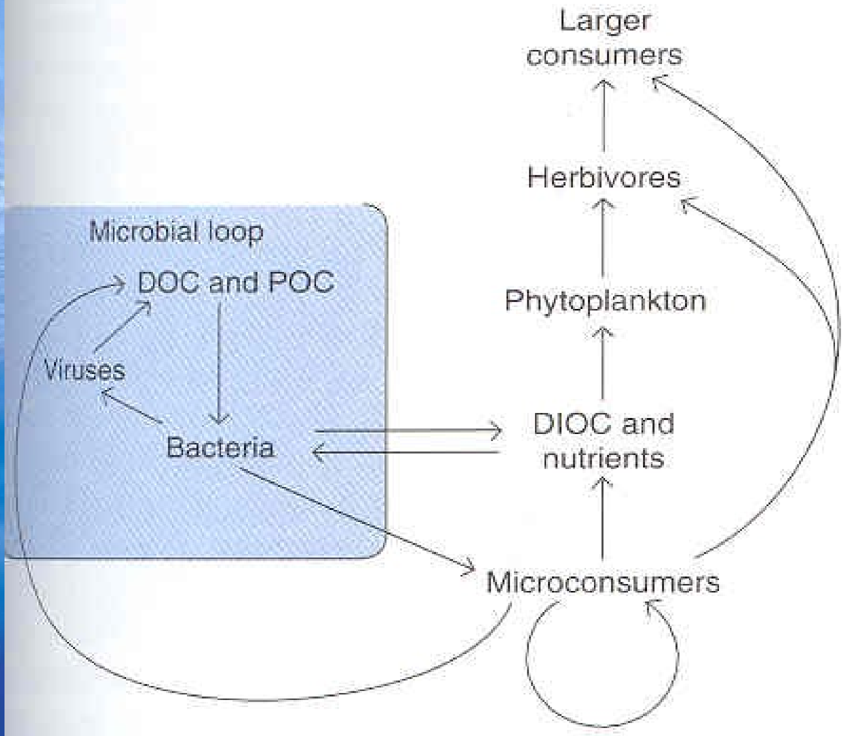


Plankton

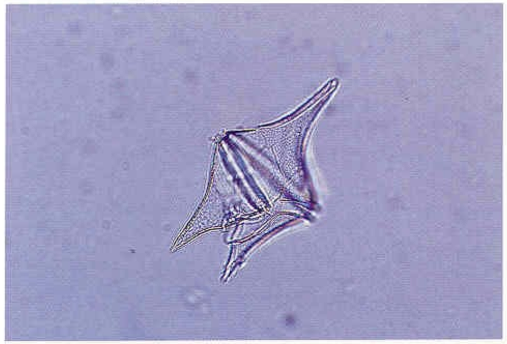


Bakteriální smyčka

Koloběh živin cestou heterotrofů a chemoautotrofů



ig. 9.11 Diagram of the cycling of organic material and utrients through the phytoplankton and through the mi-robial loop (shaded box): DOC, dissolved organic carbon; OC, particulate organic carbon; DIOC, dissolved inor-anic carbon.



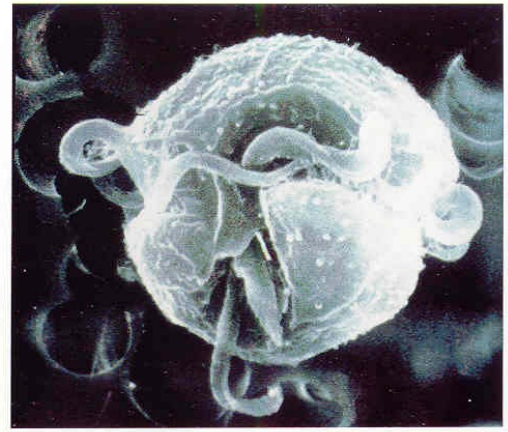


Plate IV. Plankton

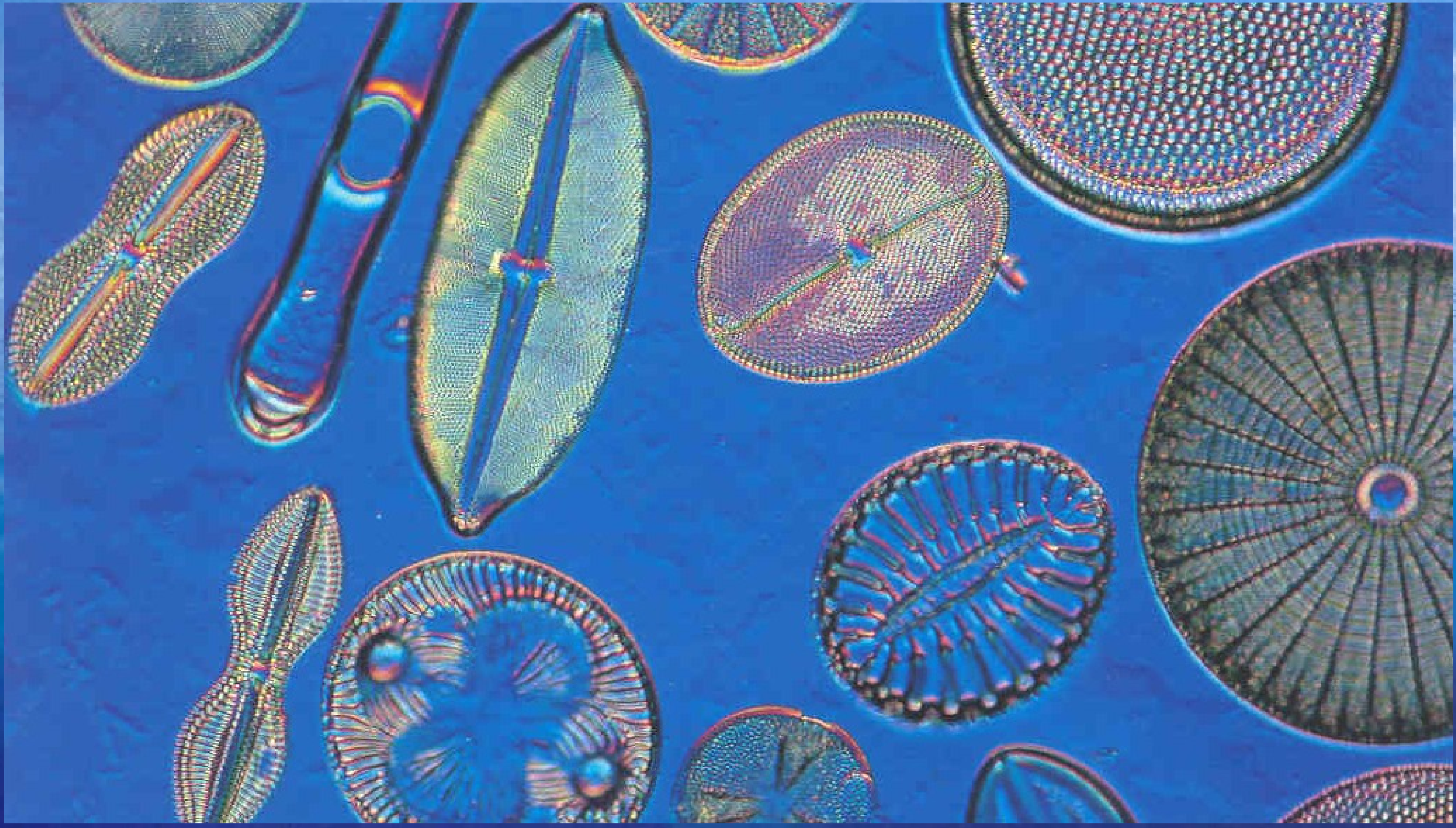
IV.1. *Top left, Peridinium* sp. This is a dinoflagellate common in estuarine and shelf waters. It is about 50 μm across. (Photograph by George Rowland)

IV.2. *Top right, Pfiesteria piscicida.* This dinoflagellate has become famous for its many life history stages (greater than 20) and its implication in many fish kills in east coast United States estuaries. It is highly toxic. (Photograph courtesy of Joann Burkholder)

IV.3. *Bottom right,* Ciliate *Strombidium conicum.* This common oligotrich ciliate feeds on algae and retains chloroplasts and also feeds on smaller protists by means of the ciliary tufts on top. (Scanning electron micrograph by Diane Stoecker)

IV.4. *Bottom left,* Ciliate *Strombidium capitatum.* This ciliate, about 30 μm in size, is common in shelf and estuarine environments and is one of the protistans important in the microbial loop. (Photograph by Diane Stoecker)

Producenti - fytoplankton

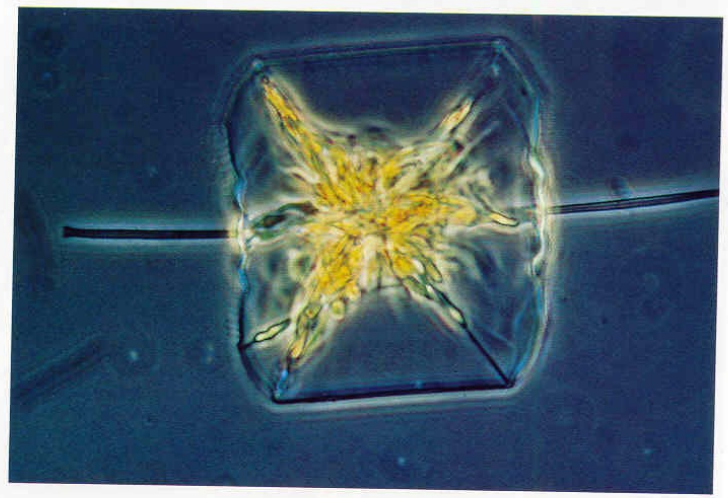


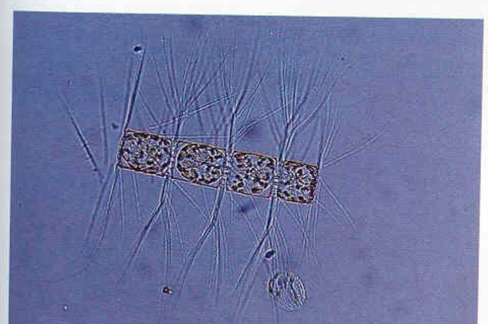
III.1. *Top*, Paired "Bongo" plankton nets are cast off the side of the R.V. *New Horizon*, principally to collect zooplankton. Note the sampler at the lower left, who is holding a protractor that enables her to estimate the angle of entry of the wire holding the nets. (Courtesy of Scripps Institute of Oceanography)

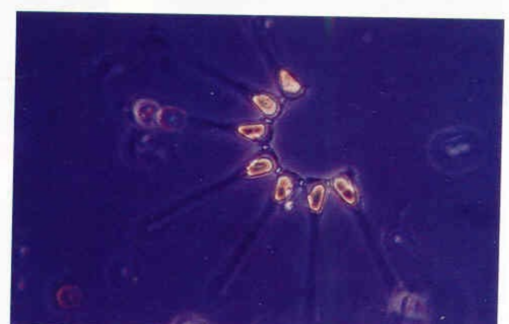
III.2. *Middle, Thalassiosira* sp. A common diatom in the spring phytoplankton bloom of temperate–boreal waters, usually occurring in chains of a few cells. (Photograph by George Rowland)

III.3. *Bottom left, Chaetoceros* sp. This diatom occurs in chains of cells armed with spines and is not preferred by suspension-feeding bivalve mollusks; often irritates the gills of fishes. (Photograph by George Rowland)

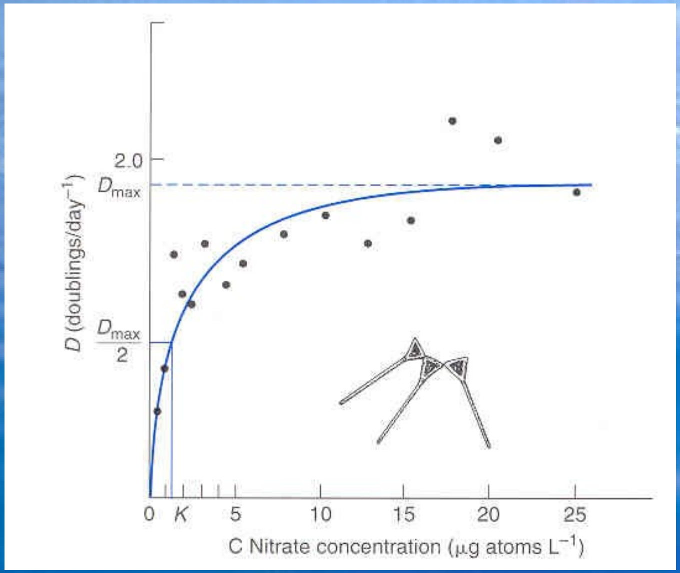
III.4. *Bottom right,* The diatom *Asterionella japonica,* often a dominant form of the phytoplankton. (Photograph by George Rowland)

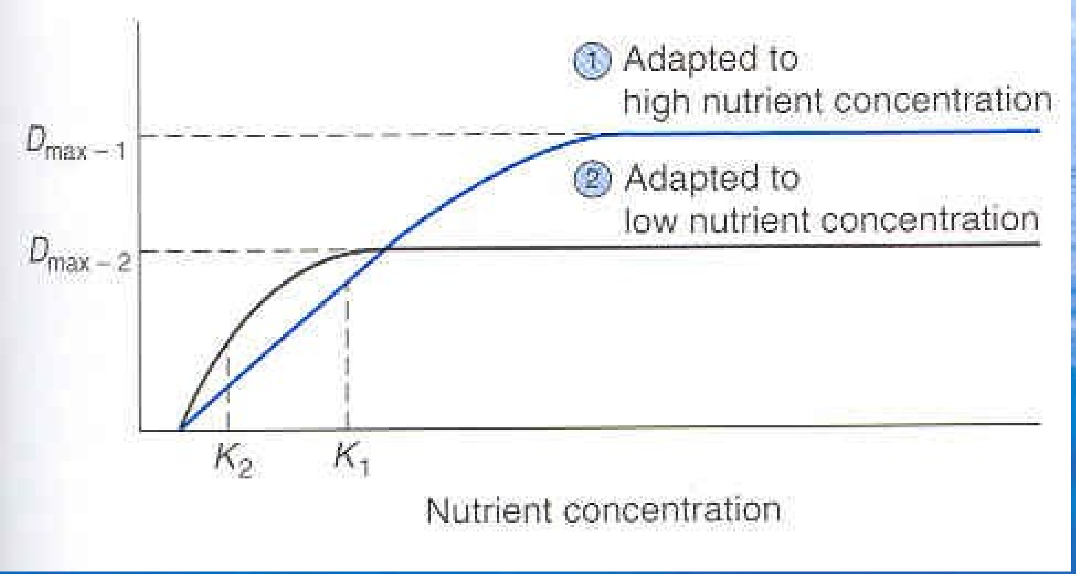




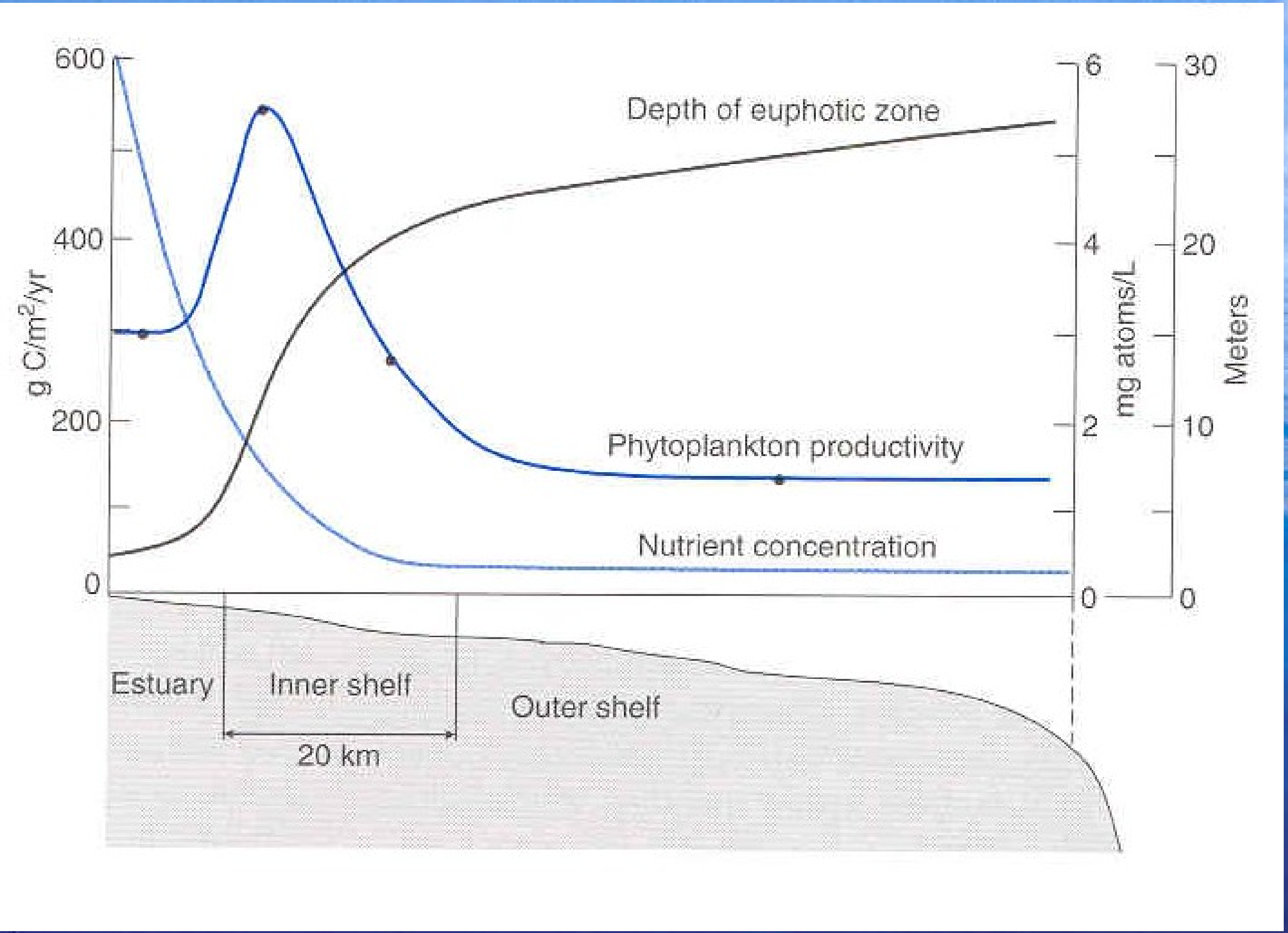


Podmínky rozvoje fytoplanktonu





Podmínky rozvoje fytoplanktonu



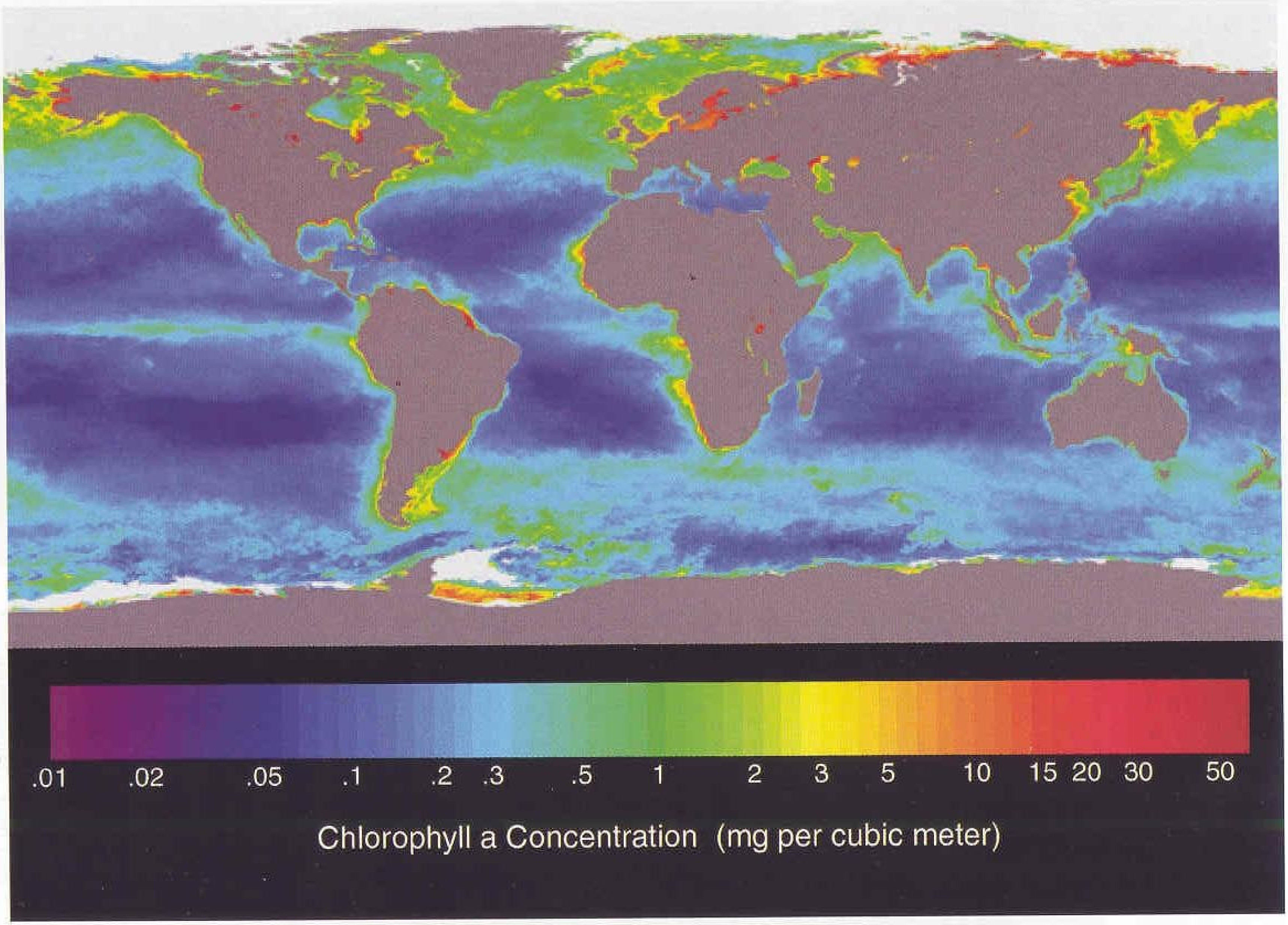
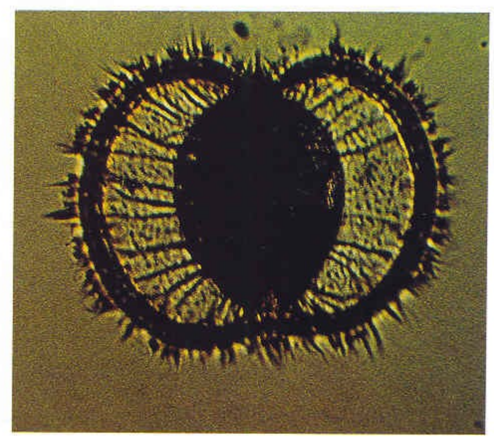


Plate VIII. Satellite Image of World Productivity

Konzumenti

- Zooplankton
  - planktoní larvy - meroplankton
  - gelový plankton
  - krustaceoplankton
- Nekton
  - hlavonožci
  - paryby a ryby
  - plazi a ptáci
  - savci

Plate I. Marine Invertebrate Planktonic Larvae



I.1. *Left,* Planula larva of the coral *Pocillopora damicornis.* Note the rows of zooxanthellae. (Photograph by Robert Richmond)

I.2. *Middle,* Sempers (Zoanthina) larva (Order Zoanthidea, Phylum Cnidaria). (Photograph by Rudolph Scheltema)

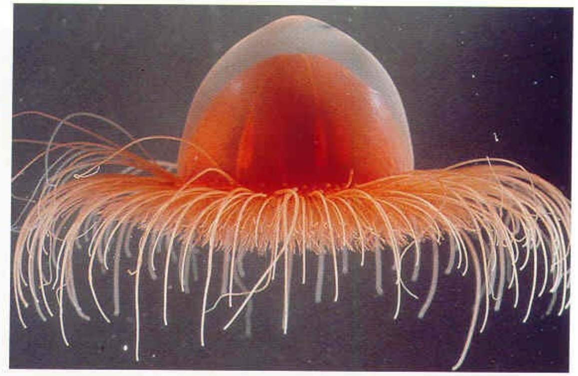
I.3. *Bottom left,* Planktotrophic larva of the hairy triton, *Cymatium parthenopetum,* a teleplanic larva found in the tropical Atlantic. (Photograph by Rudolph Scheltema)

I.4. *Bottom right,* Veliger larva of the gastropod *Xylophaga atlantica.* (Photograph by Rudolph Scheltema)

Plate V. Some Gelatinous Zooplankton

V.1. *Top left,* The jellyfish *Aequorea victoria,* Puget Sound region. (Photograph by Claudia Mills)

V.2. *Below,* The trachymedusan jellyfish *Benthocodon pedunculata,* collected at a depth of ca. 900 m offshore of the Bahamas. (Photograph by Claudia Mills)



V.3. *Bottom,* The anthomedusan *Pandea conica,* common in continental slope waters of the western Atlantic. A predator of other gelatinous zooplankton, it can be found up to 30 mm high. (Photograph by Laurence P. Madin)

V.4. *Right,* The siphonophore *Physophora hydrostatica* can be found up to about 50 mm high. (Photograph by Laurence P. Madin)

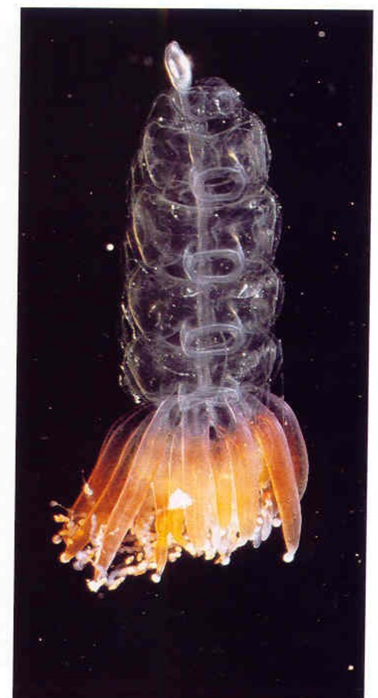
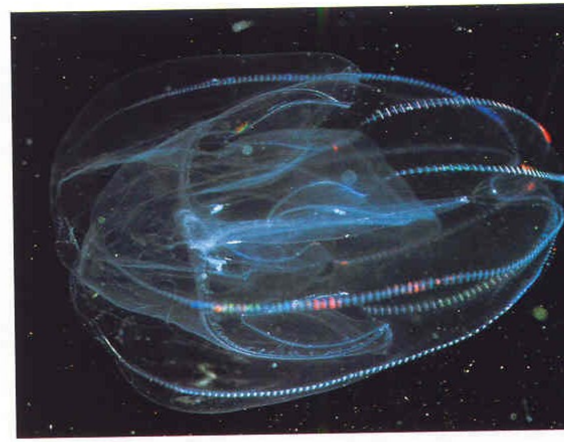
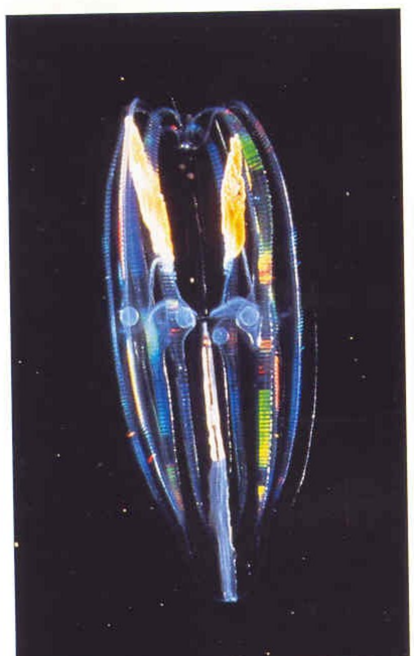


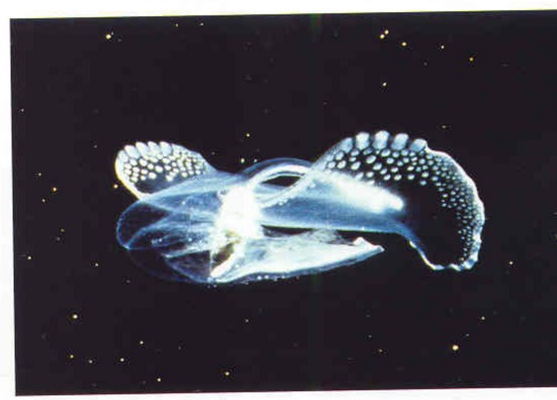
Plate VI. Zooplankton

VI.1. *Left,* An undescribed oceanic ctenophore. (Photograph by Marsh Youngbluth)

VI.2. *Below, Bolinopsis vitrea,* a lobate ctenophore, common in the Caribbean and other subtropical regions can be found up to 60 mm high; preys on copepods and other small crustaceans. (Photograph by Laurence P. Madin)





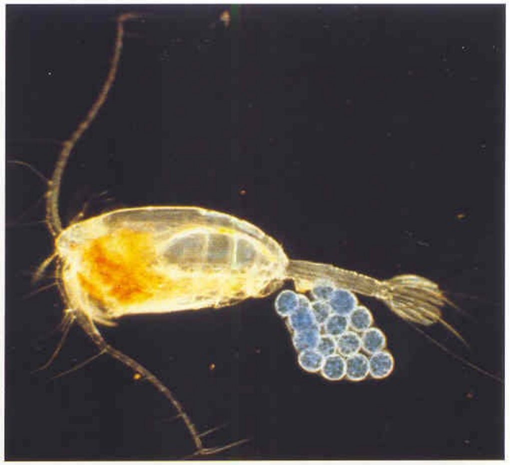


VI.3. *Left,* An undescribed ctenophore. (Photograph by Marsh Youngbluth)

VI.4. *Above, Gleba cordata,* a sea butterfly. (Photograph b Marsh Youngbluth)

Plate VII. Crustacean Zooplankton

VII.1. *Right,* An egg-bearing female of the copepod *Euchaeta elongata,* taken from Dabob Bay, Washington. (Photograph by Steve Bollens)

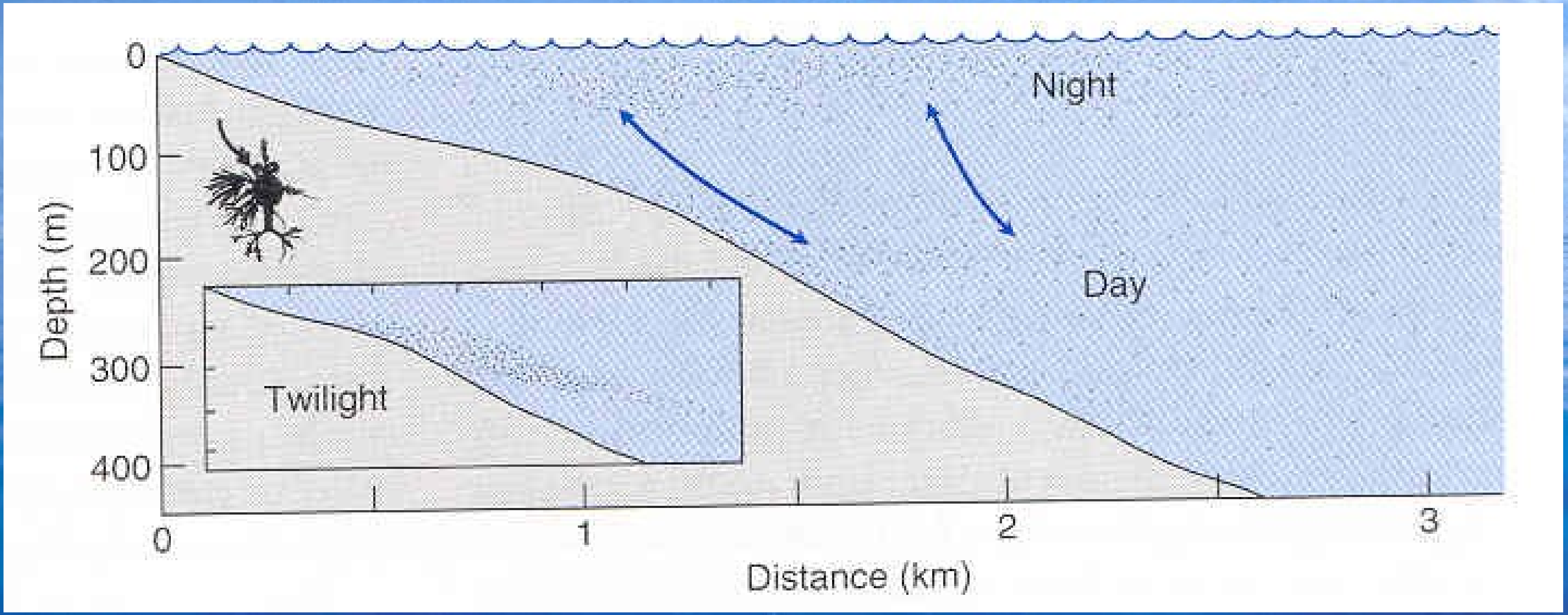


VII.2. *Above,* The copepod *Euchaeta norvegica.* Note the long mechanosensory hairs on the first antennae, which allow detection of approaching prey. (Photograph by Jeannette Yen)

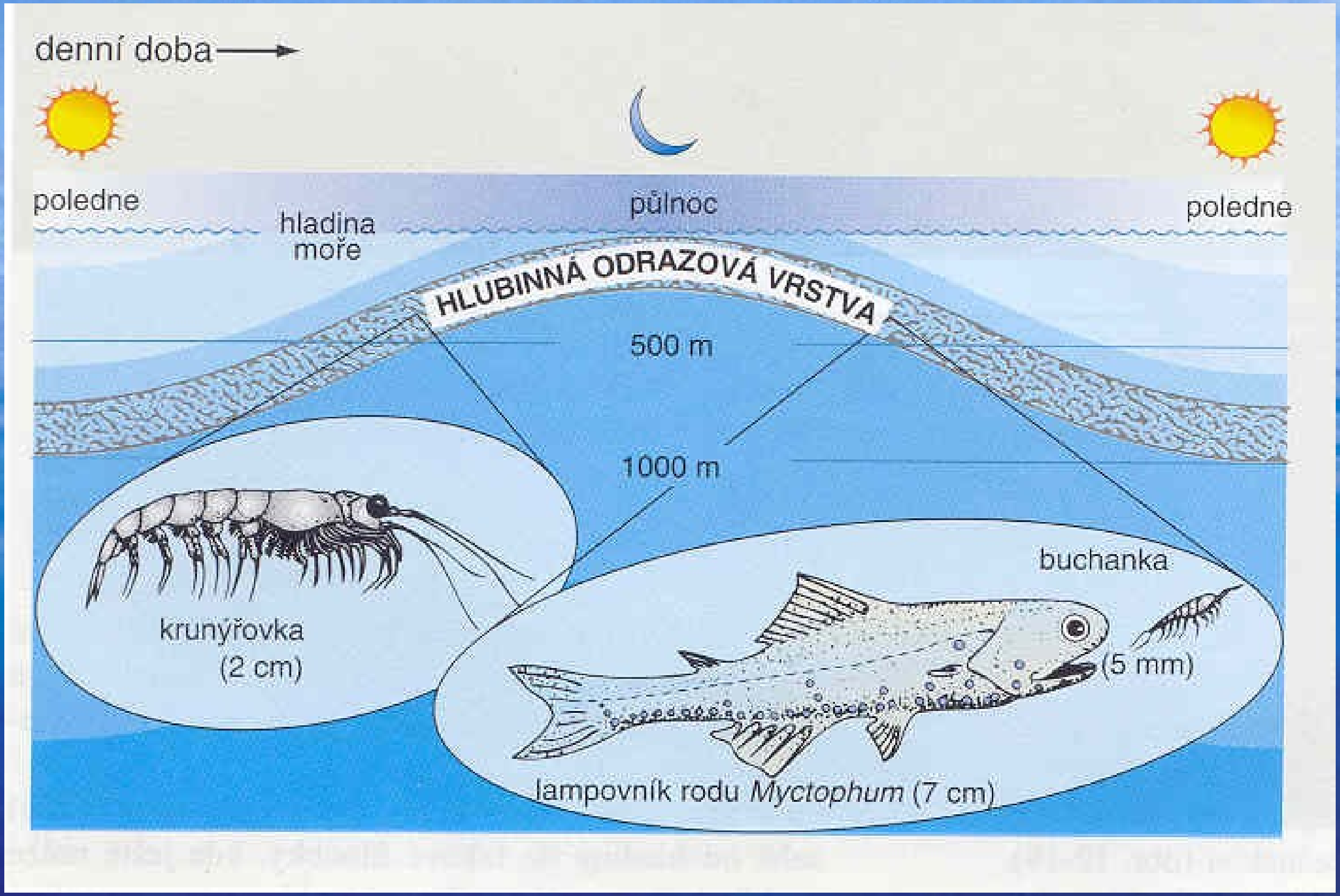
VII.3. *Middle,* The planktonic amphipod *Themisto compressa,* about 25 mm long. (Photograph by Marsh Youngbluth)

VII.4. *Right,* The krill *Meganyctiphanes norvegica,* about 35 mm long. (Photograph by Marsh Youngbluth)

Ekologie zooplanktonu



Falešné dno – hlubinná odrazová vrstva (DSL)



Sezónní změny

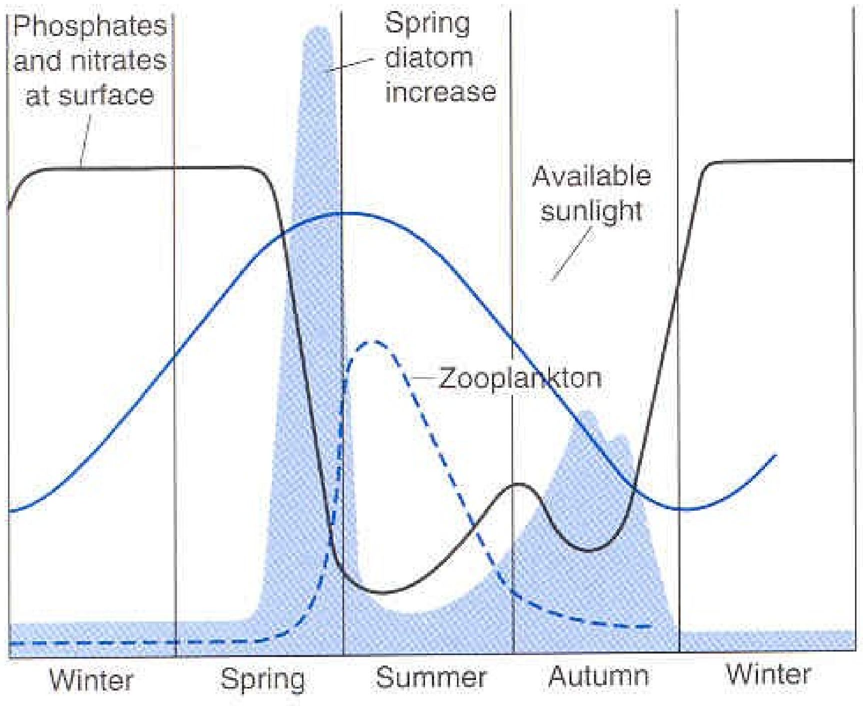


Fig. 9.1 Idealized diagram tracing changes in phytoplankton, zooplankton, light, and nutrients during the year in a temperate–boreal inshore body of water. (Modified after Russell-Hunter, 1970.)

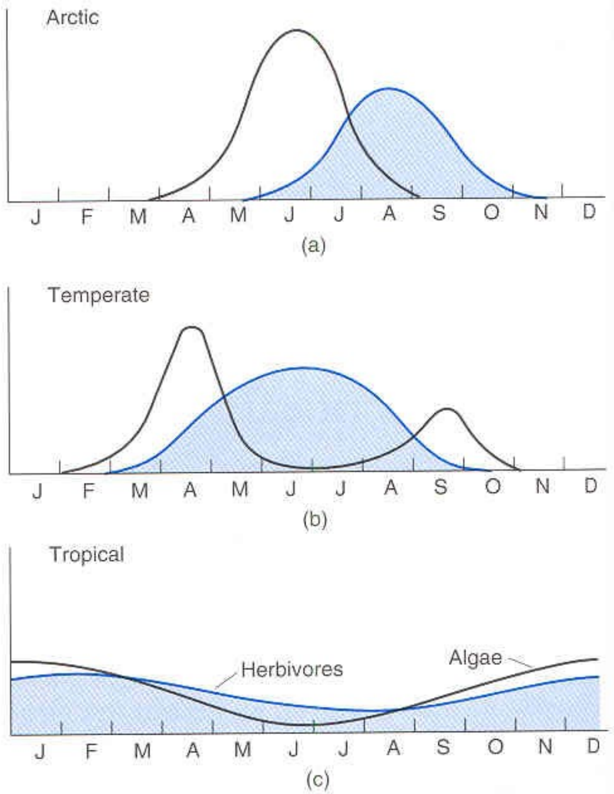


Fig. 9.2 Phytoplankton and zooplankton in a seasonal cycle: (a) Arctic, (b) temperate–boreal, and (c) tropical. (After Cushing, 1975.)

Spásání - vyžírání

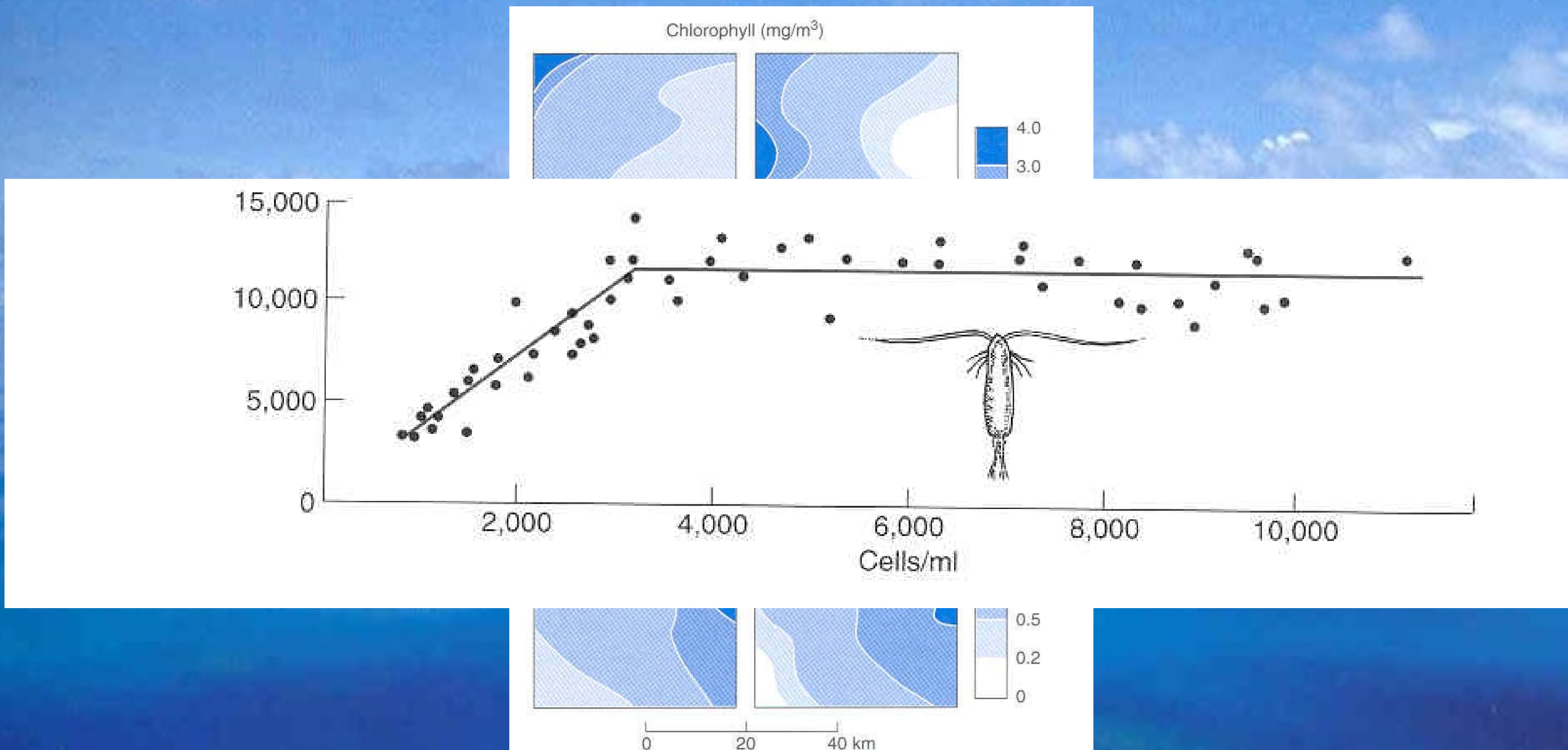


Fig. 9.15 Distribution of chlorophyll *a* and copepod carbon on a survey in the North Sea, showing an inverse relationship between phytoplankton and zooplankton standing stock. Phytoplankton are most abundant toward the left, whereas zooplankton are most abundant toward the right. (Modified from Steele, 1974.)

Nekton

Fig. 8.1 Some cephalopo
squid *Rossia pacifica*, (b) t
octopus *Octopus dofleini*
the western Pacific cuttle
ella japonica.

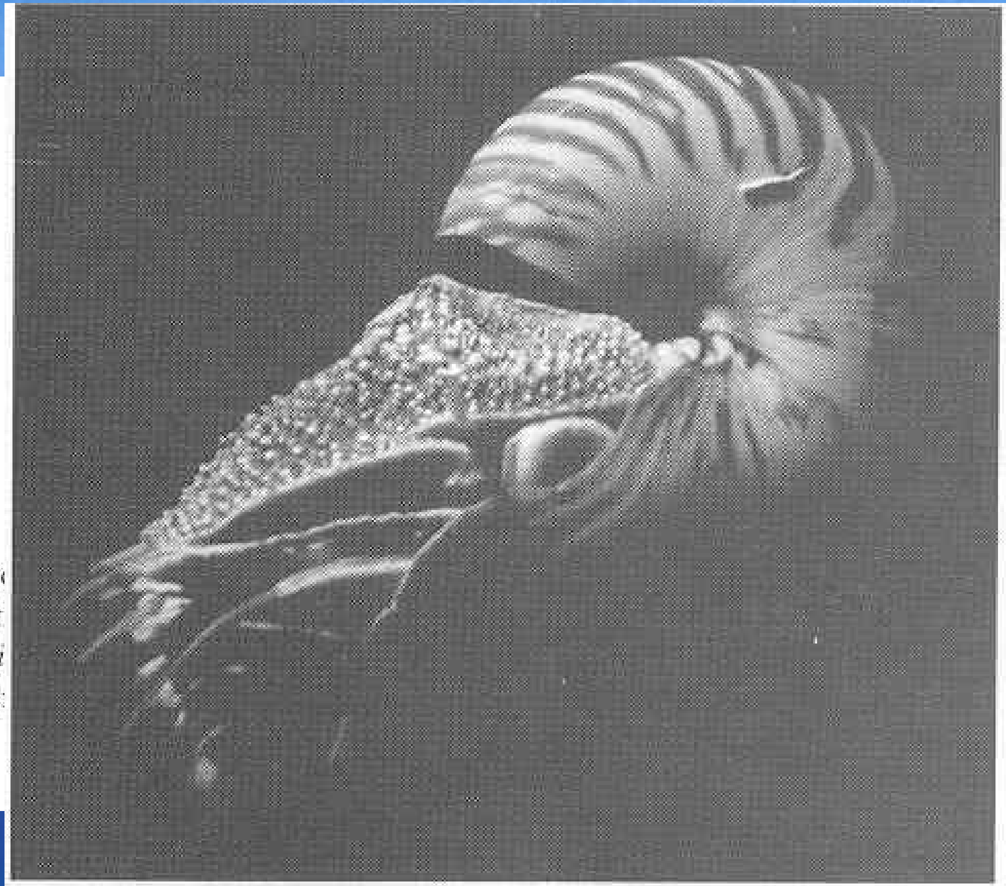
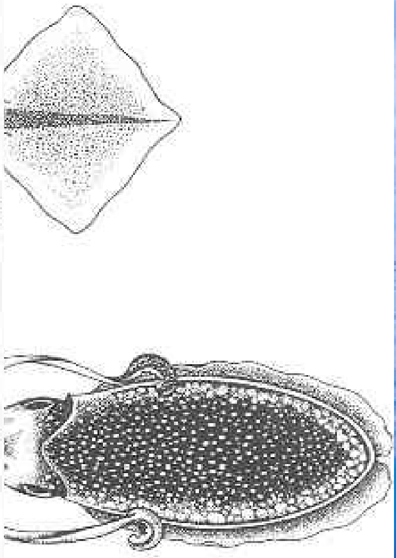


Fig. 8.2 The pearly nautilus in its natural midwater habitat. (Courtesy of Peter Ward.)



(c)

Nekton

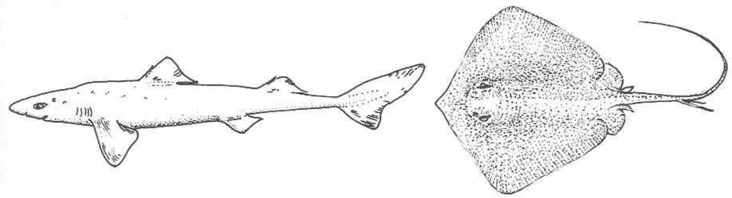


Fig. 8.4 Cartilaginous fishes: the shark *Squalus acanthias* and the ray *Dasyiatis akajei*.

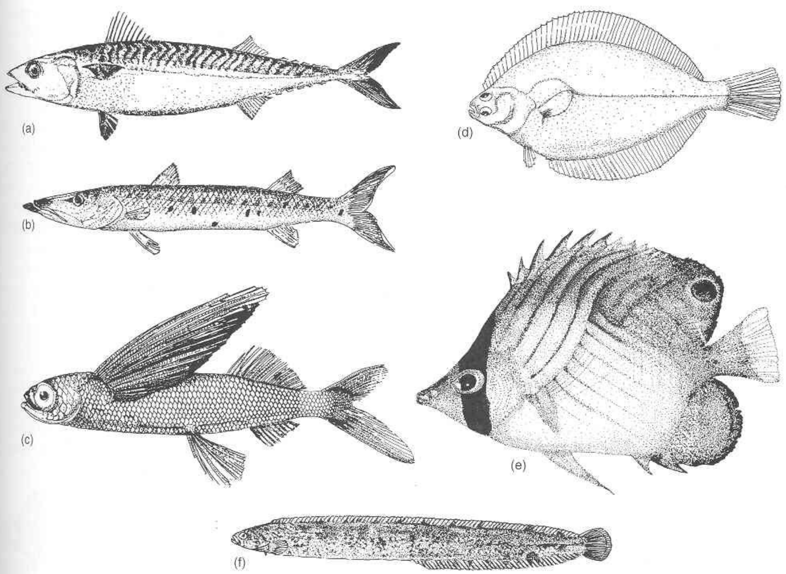


Fig. 8.5 Variation in the form of bony fishes: (a) rover predator, (b) lie-in-wait predator, (c) surface-oriented fish, (d) bottom-feeding flatfish, (e) deep-bodied fish, and (f) eel-like fish.

Plate X. Marine Mammals: Cetacea

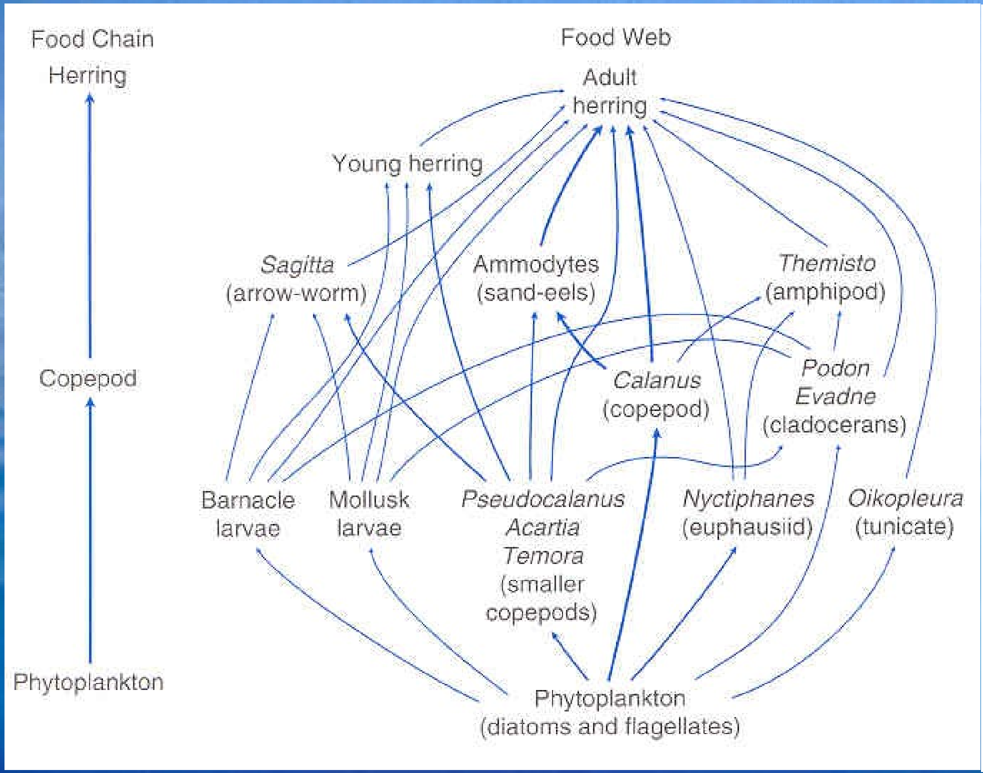
X.1. *Left,* A humpback whale breaching, near Montauk Point, Long Island, New York. (Photograph by Sam Sadove)

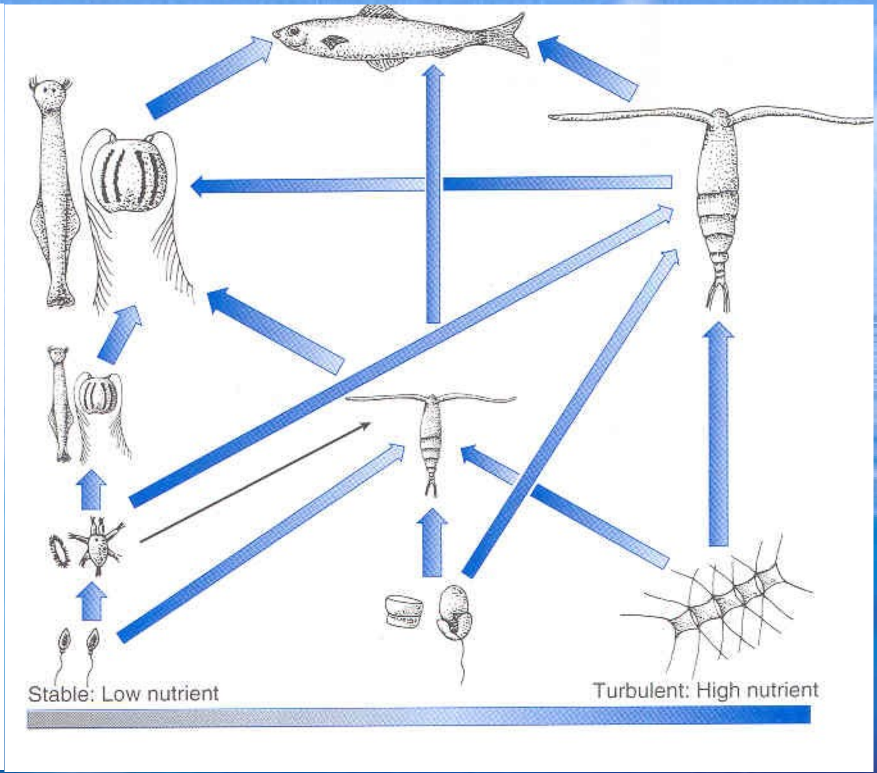
X.2. *Middle,* Fluke of a humpback whale that is "lobtailing." (Photograph by Sam Sadove)

X.3. *Below,* The bottlenose dolphin, *Tursiops truncatus.* (Photograph by Sam Sadove)

X.4. *Above,* Hauling and butchering of a fin whale, *Balaenoptera physalus,* at a whaling station in the 1980s. (Photograph by Sam Sadove)

Potravní sítě

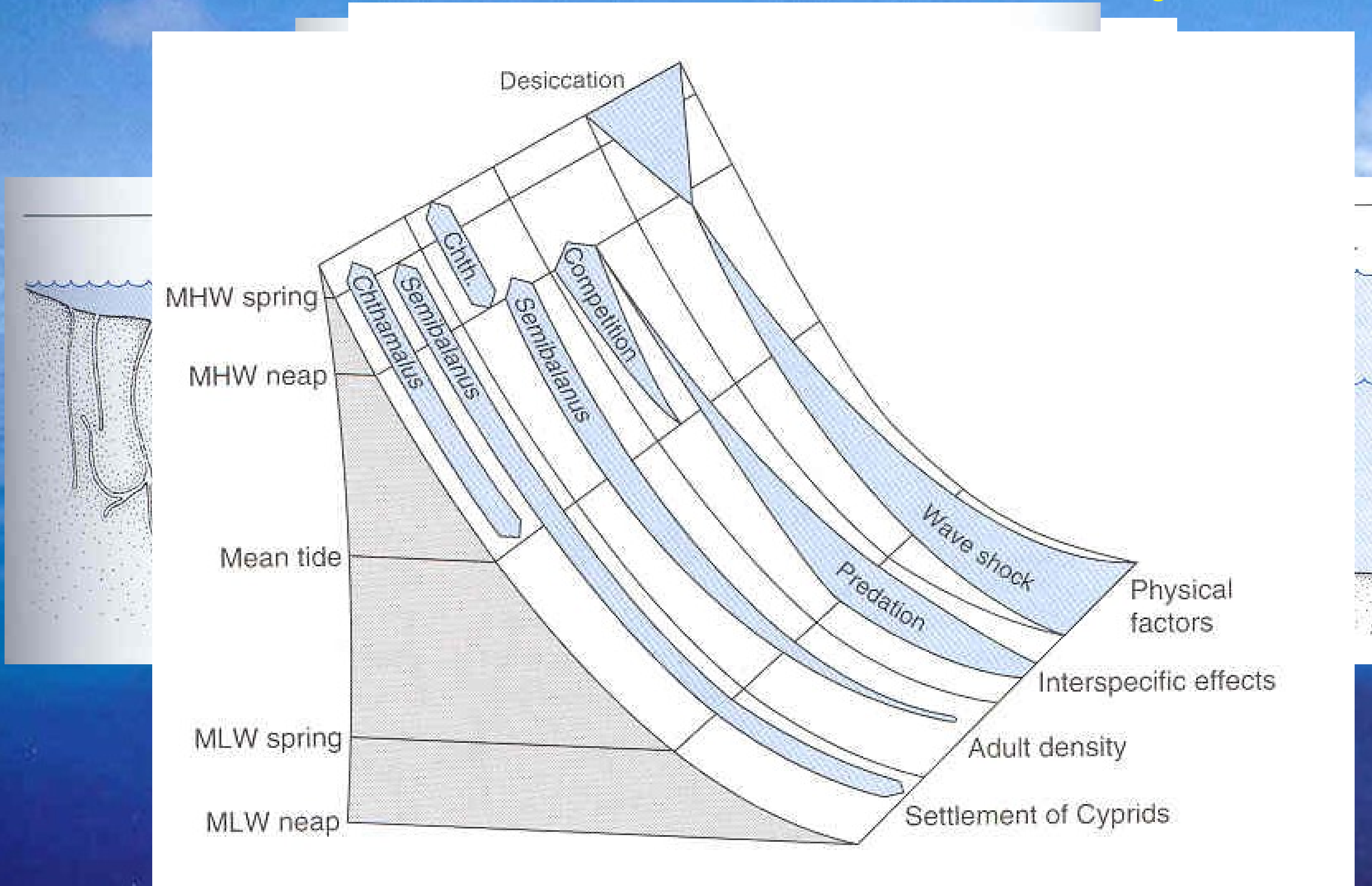




Bentál – koastál mořské dno

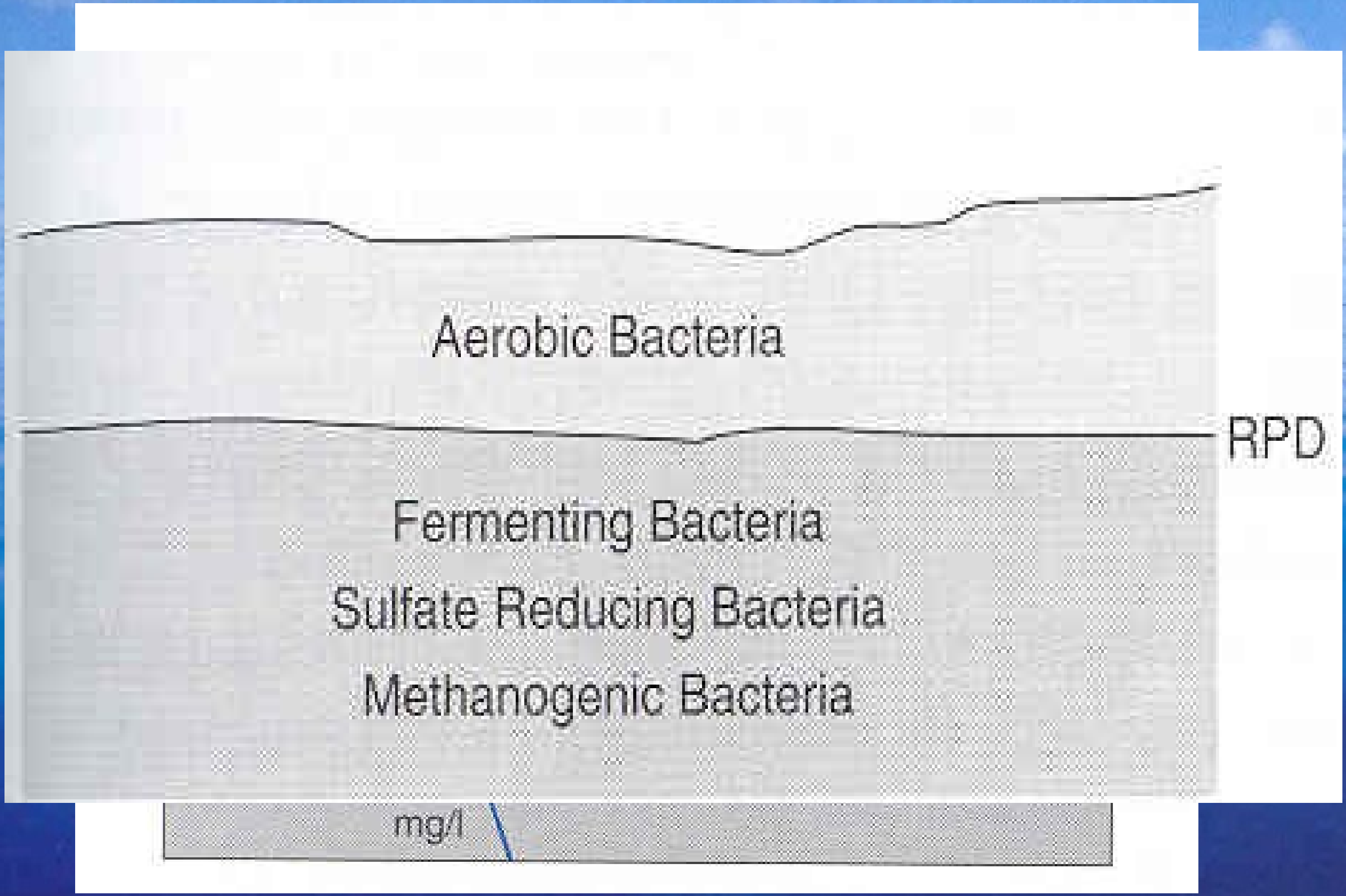
- Pobřeží – tidelands (přílivová zóna)
  - Beach – písčité a bahnité pláže
  - Seaweeds (kelp forests) – porosty řas
  - Seagrasses – mořské louky
  - Mangrovy
  - Estuár – ústí řek
  - Salt marhes – pobřežní mokřady
  - Reefs - útesy
    - Coral reefs – korálové útesy
- Mořské dno
- Mořské dno v abysálu a hadálu

Vertikální zonace a vlny



Newell, 1979.)

Podmínky v sedimentech



Organizmy - bentos

- Biotopová (habitatová) klasifikace
  - Epibentické organismy
  - Hrabavé organismy (borrowers)
  - Semi-infaunal org. – trvale v sedimetu žijící o.
  - Plavci (swimmers)
  - Interstidial org. – o. žijící v mikroprostorech
- Velikostní klasifikace
  - Mikro-, meio -, makrobentos

Organizmy - bentos

- Produkční klasifikace
  - Autotrofní organismy
    - Fotolitoautotrofní
    - Chemolitoautotrofní
  - Heterotrofní organismy
    - Dekompozitoři
    - Konzumenti
      - Různé úrovně až vrcholoví k. - predatoři

Organizmy - bentos

- Potravní specializace konzumentů
  - Suspension feeders – filtrátoři
    - Pasivní (mořské houby) a aktivní (mlži)
  - Deposit feeders – sběrači
    - Polychaeta, Gastropoda, Crustacea, Pisces
  - Herbivoři
    - Echinodermata, Polychaeta, Pisces
  - Mikroalgal (mikrobial) grazers – spásači nárostů
    - Gastropoda, Polychaeta,
  - Kranivorní org. – predátoři
    - ……………………….

Meiobentos

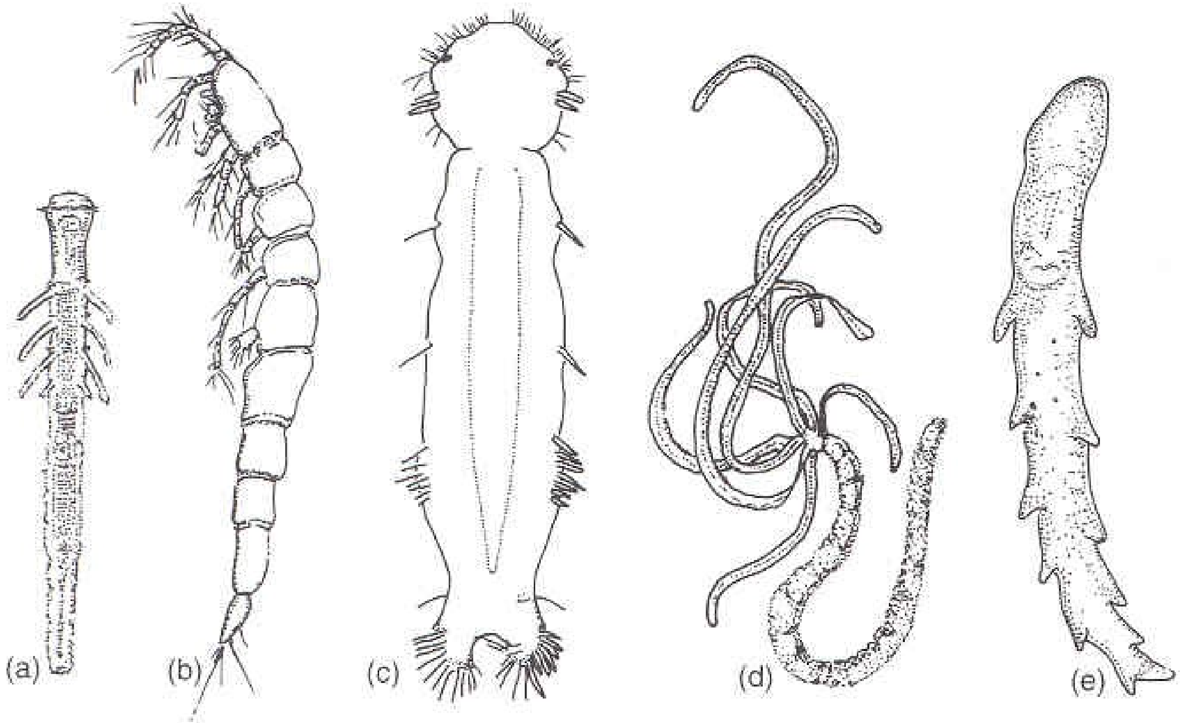


Fig. 13.4 The wormlike shape of meiobenthic animals of diverse phyla: (a) polychaete, (b) harpacticoid copepod, (c) gastrotrich, (d) hydroid, and (e) opisthobranch gastropod. (After Swedmark, 1964.)

Sběrači

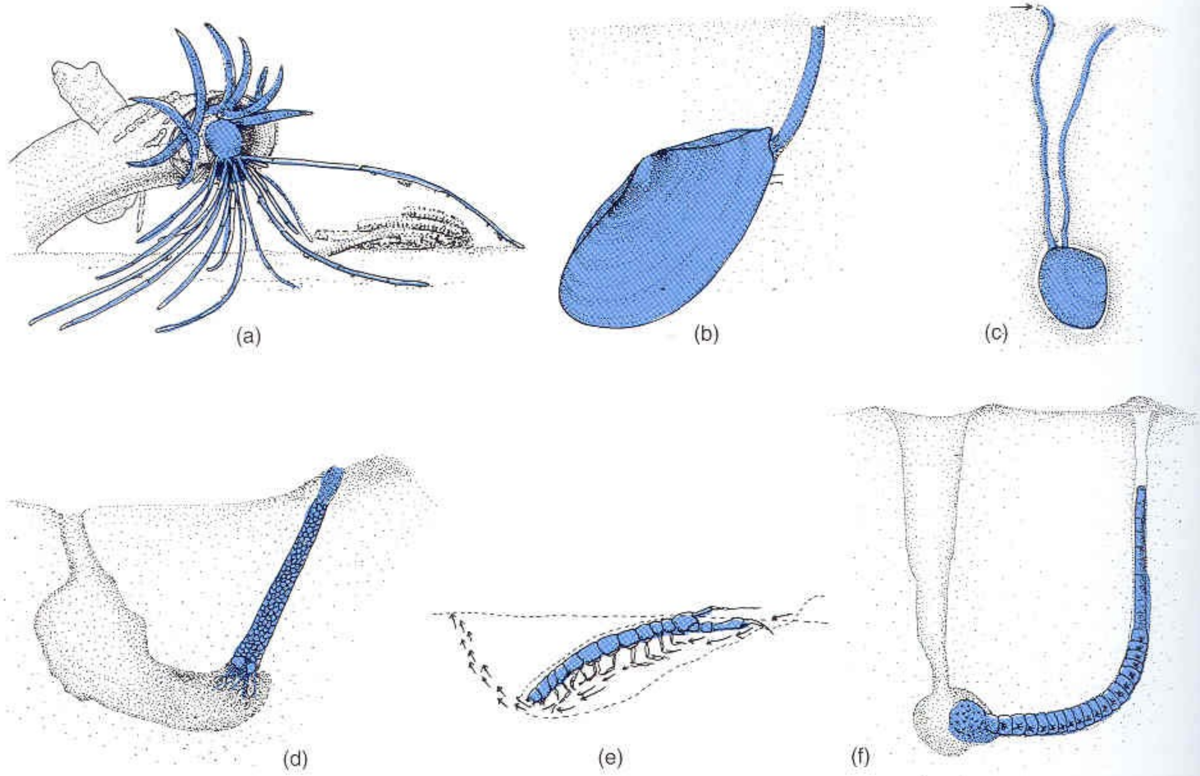


Fig. 13.7 Some deposit-feeding animals: (a) the surface tentacle-feeder *Hobsonia*, (b) the within-sediment tentacle-feeding bivalve *Yoldia limatula*, (c) the surface deposit-feeding siphonate bivalve *Macoma*, (d) the within-sediment feeding Atlantic polychaete *Pectinaria gouldii*, (e) the surface-feeding *Corophium volutator*, and (f) the deep-feeding *Arenicola marina*. (Drawing of *Hobsonia* copied with permission from an original by P. A. Jumars.)

Filtrátoři

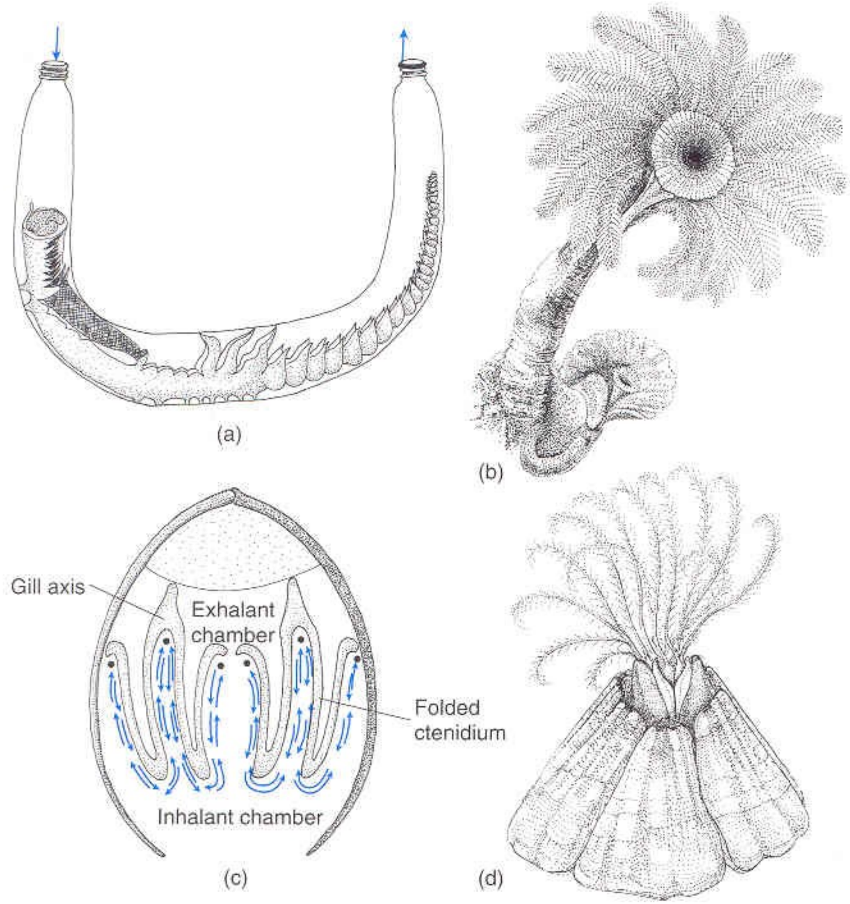


Fig. 13.12 Some suspension-feeding invertebrates. (a) The active suspension-feeding parchment worm *Chaetopterus*. (b) The suspension-feeding polychaete *Serpula*, which uses ciliary currents to draw particles to tentacles. (c) Cross section of a bivalve mollusk, an active suspension feeder (arrows denote ciliated tracts transporting particles). (d) The acorn barnacle *Semibalanus balanoides* with cirri protruded like a basket, the concave side pointing into the flow, and particles trapped on feeding appendages, which are then withdrawn. If the flow increases beyond a point, the basket is reversed, to maintain stability in the flow.

Spásači

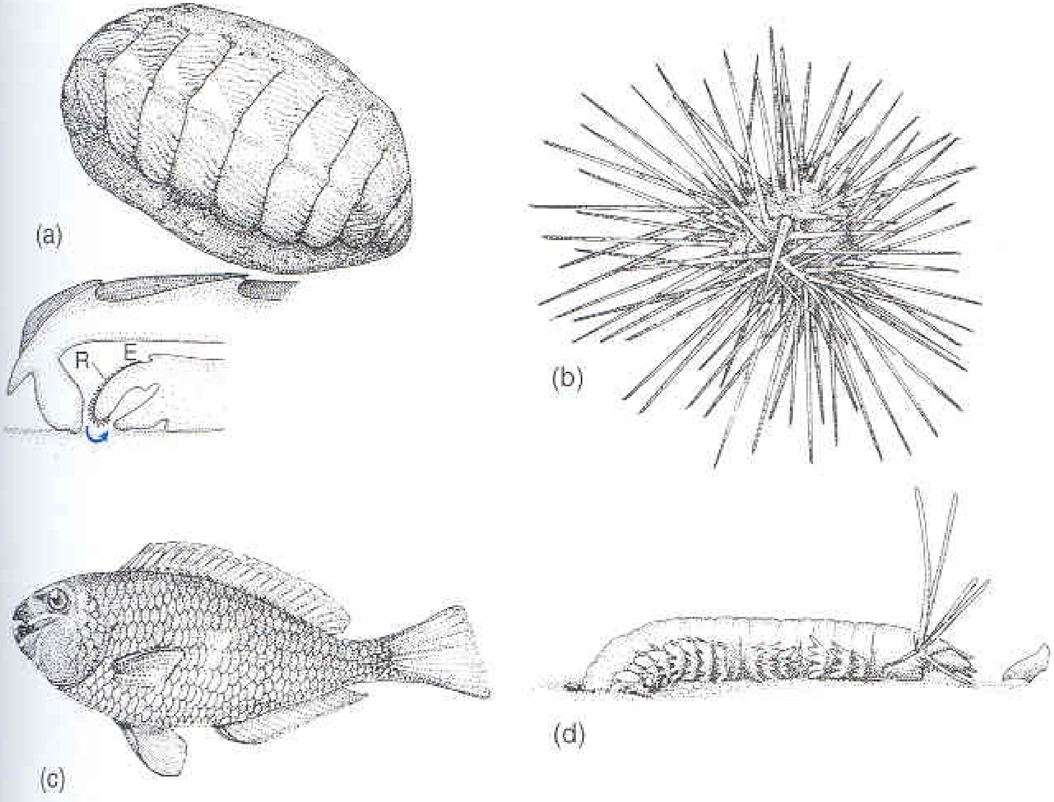


Fig. 13.18 Some benthic herbivores. (a) The chiton *Tonicella*, a scraper of microalgae; inset shows anterior sagittal cross section, indicating the action of the radular tooth belt in scraping algae from the substratum (R, radula; E, esophagus). (b) The sea urchin *Arbacia*, which uses a toothed Aristotle's lantern to scrape microalgae or to tear apart seaweeds. (c) A parrot fish, which uses a specialized mouth to scrape algae from coral surfaces. (d) The nereid polychaete *Nereis vexillosa*, which tears apart sea lettuce. (Copied from an original by K. Fauchald.)

Kranivoři

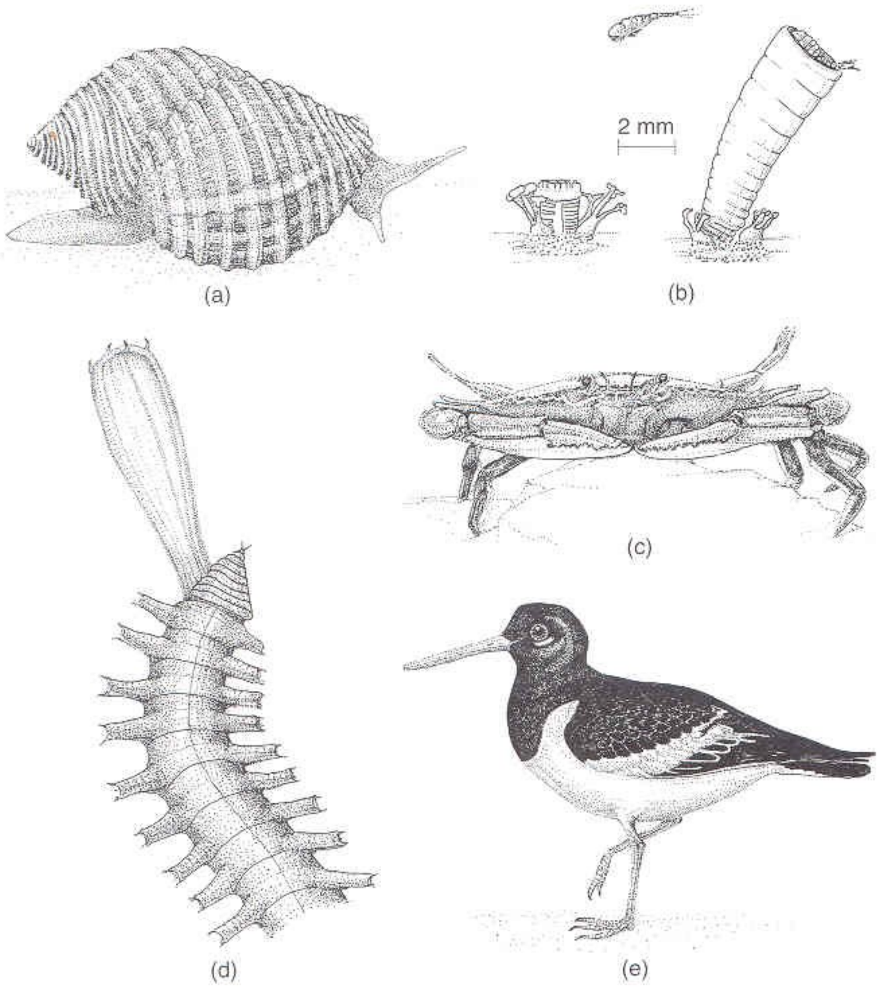


Fig. 13.17 Some marine benthic carnivores. (a) Gastropod *Nucella*, which uses a specialized radula and buccal mass to drill holes in barnacles and bivalve mollusks. (b) Bivalve mollusk *Cuspidaria*, which uses a pumping septum to suck up small prey. (c) Decapod crab *Callinectes sapidus*, whose strong claw can crush mollusks. (d) Polychaete *Glycera*, which has a proboscis armed with hooks, used in seizing and tearing prey. (e) The oystercatcher, *Haematopus ostralegus*, a predator on intertidal bivalve mollusks.

Funkce organismů

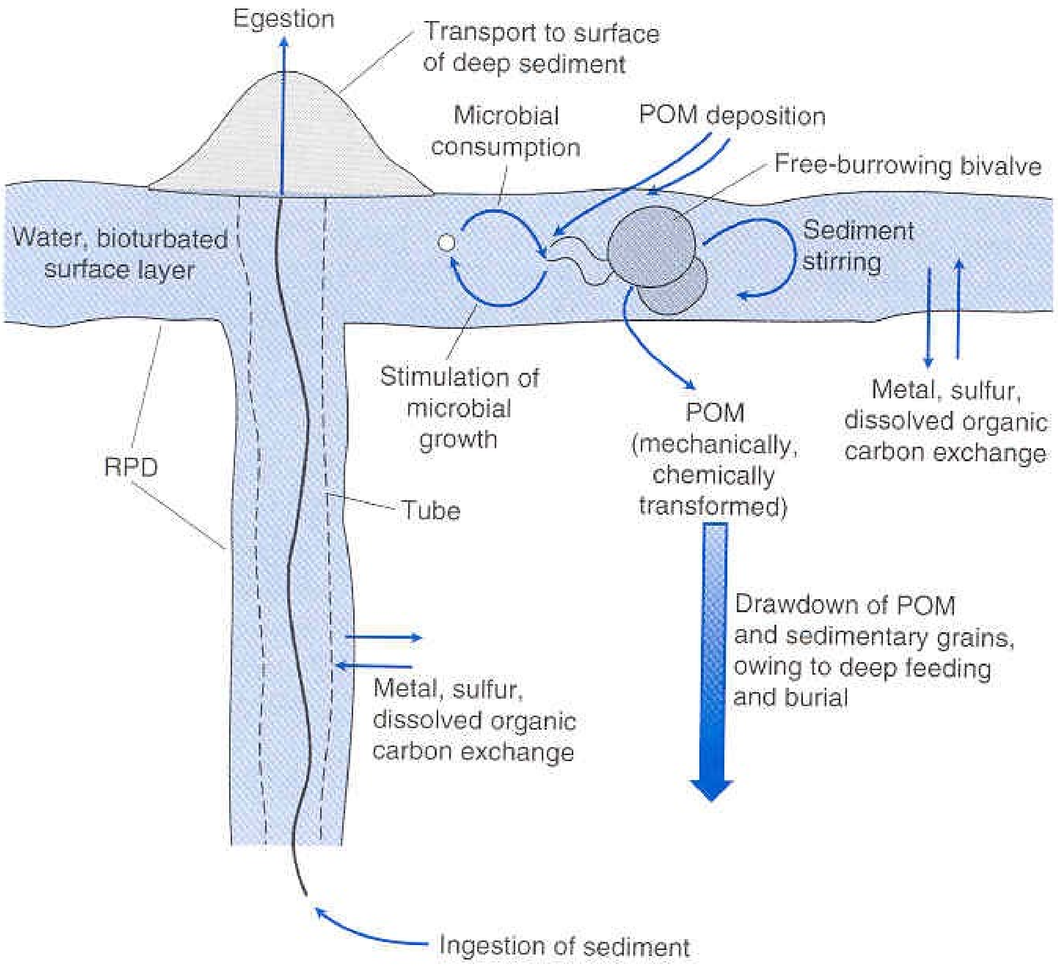


Fig. 13.10 General processes occurring within a sediment dominated by deposit feeders, including various transport processes. In deposit feeding, particles are taken up by a feeding organ, and some of them may be rejected before entering the gut. Particles may be packaged in fecal pellets, which are egested. As the pellets break down, the sedimentary grains are recolonized by microbes, which may be ingested and assimilated as the particles are ingested once again.

Úživnost pobřežních systému

Table 3.6 Ranges of net primary production by phytoplankton and macrophytes in various coastal environments. From Malone (1980) and Mann *et al.* (1980)

	Net primary production ($g\ C\ m^{-2}\ day^{-1}$)
Phytoplankton	
Estuaries	0.2–1.5
Bays	0.1–1.0
Lagoons	0.2–0.7
Fjords	0.1–1.2
Shelf	0.4–0.9
Upwelling	0.3–1.0
Macrophytes	
Seagrasses	0.2–18.5
Mangroves	0.0–5.7
Salt marshes	0.2–36.5
Kelp forests	0.4–9
Rockweeds	<12

Bentál – Koastál mořské dno

- Pobřeží – tidelands (přílivová zóna)
  - Beach – písčité a bahnité pláže
  - Seaweeds (kelp forests) – porosty řas
  - Seagrasses – mořské louky
  - Mangrovy
  - Estuár – ústí řek
  - Salt marhes – pobřežní mokřady
  - Reefs - útesy
    - Coral reefs – korálové útesy
- Mořské dno
- Mořské dno v abysálu a hadálu

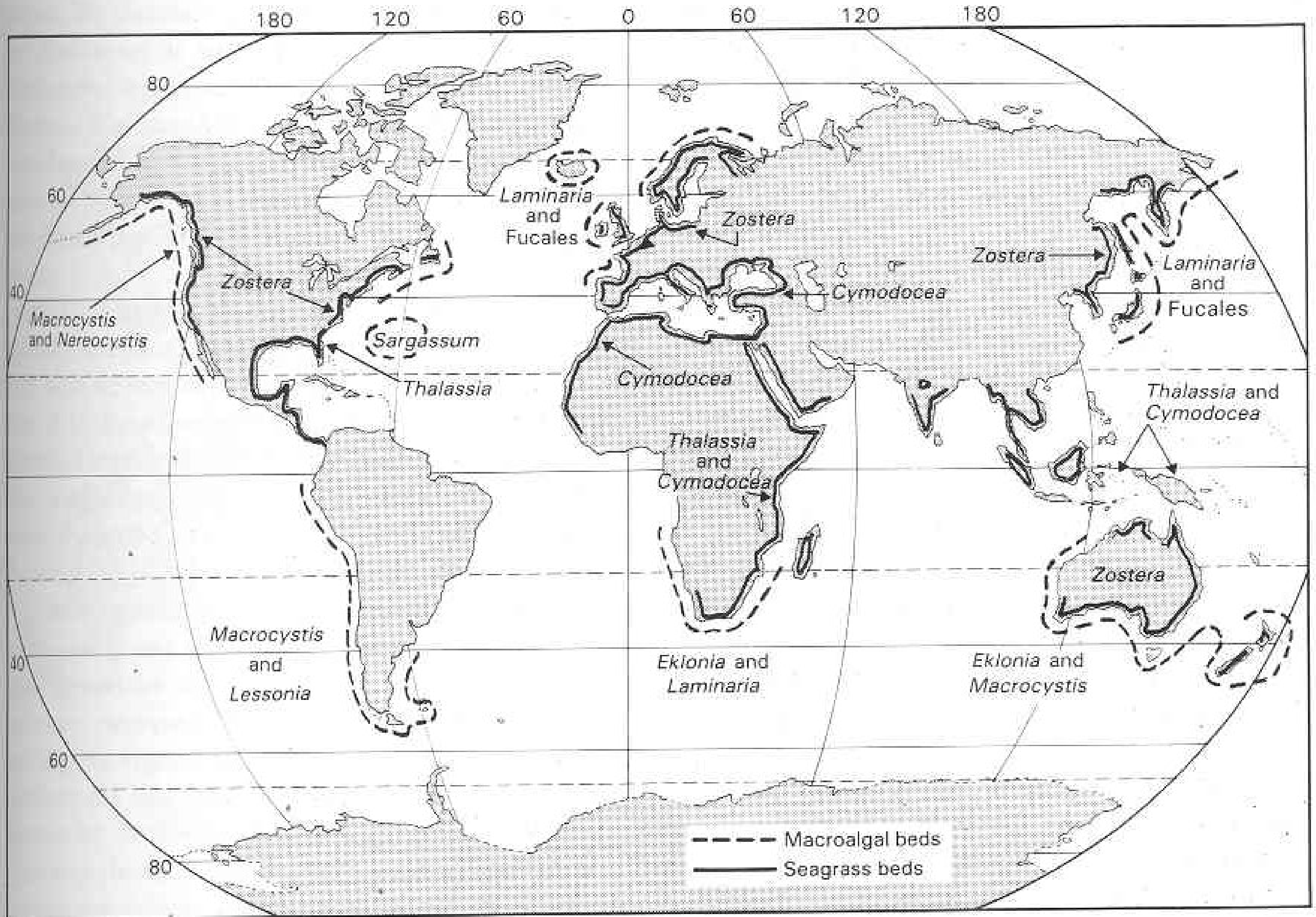


Fig. 3.1 World distribution of major seagrass and kelp genera. From Mann (1972).

Plate XXI.
Kelp Forests

XXI.1. A kelp forest bottom dominated by *Laminaria groenlandica*. (Photograph by David Duggins)

XXI.2. *Middle left,* An urchin barrens (Photograph by David Duggins)

XXI.3. *Middle right,* A kelp forest hard bottom, showing the diversity of benthic invertebrates. (Photograph by David Duggins)

XXI.4. *Bottom,* A sea otter, *Enhydra lutris,* with greenling. (Photograph by Si Simonstad)

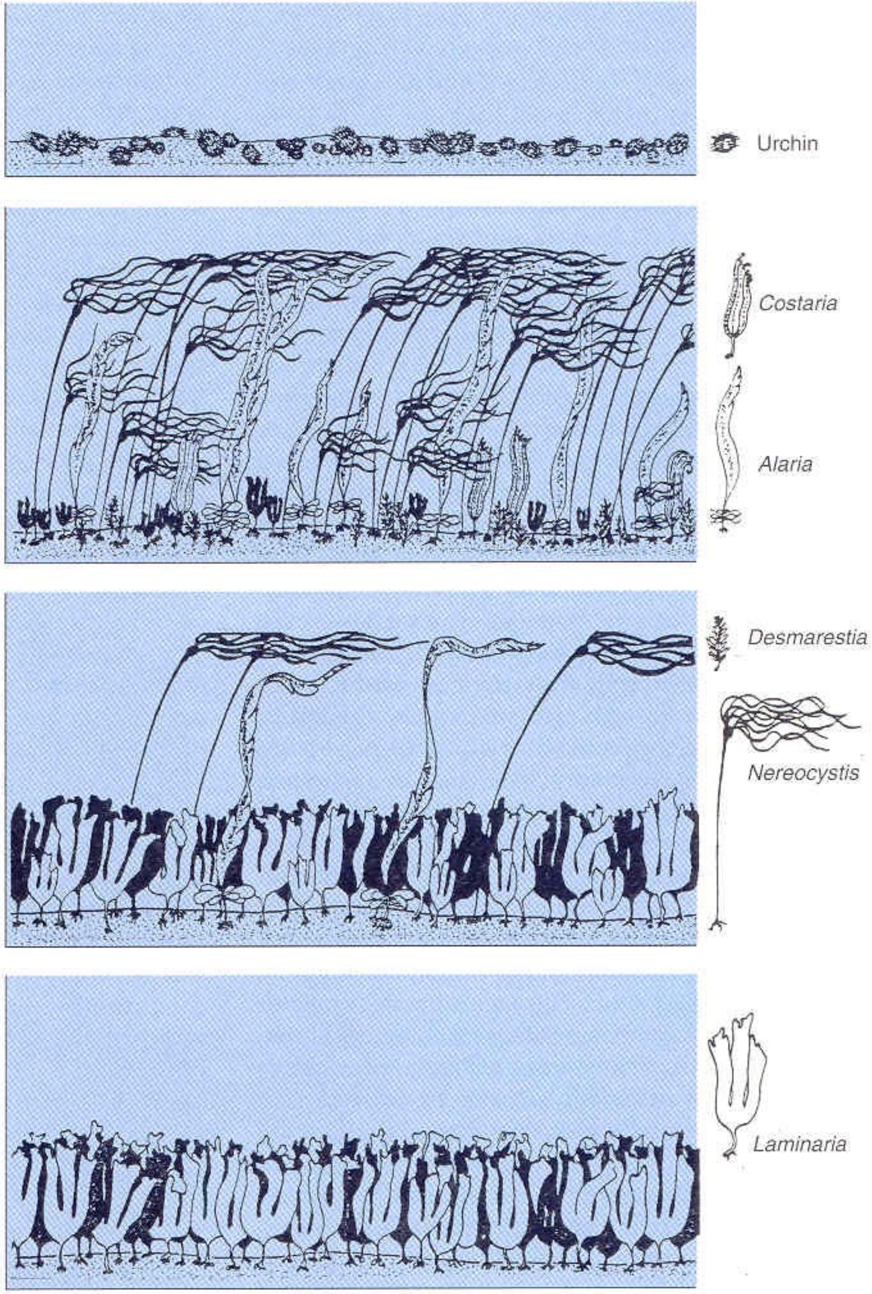


Fig. 15.9 Succession in an Alaskan kelp forest. Eventually (bottom) the kelp *Laminaria groenlandica* dominated the forest and prevented taller species from reinvading by shading out juveniles. (Courtesy of David Duggins.)

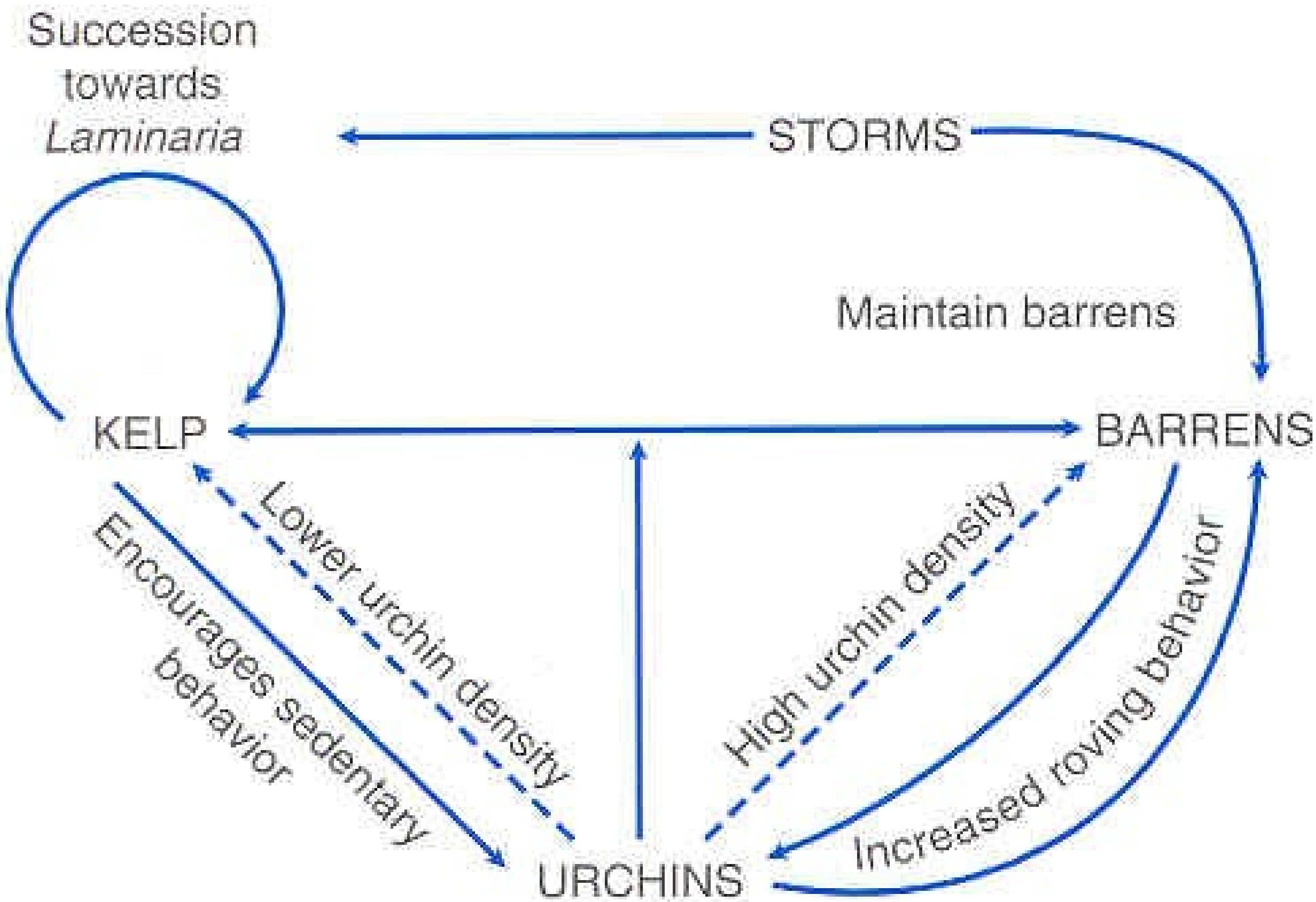


Fig. 15.8 The interactions of urchin population density, urchin behavior, and storms as they affect the character of a kelp forest.

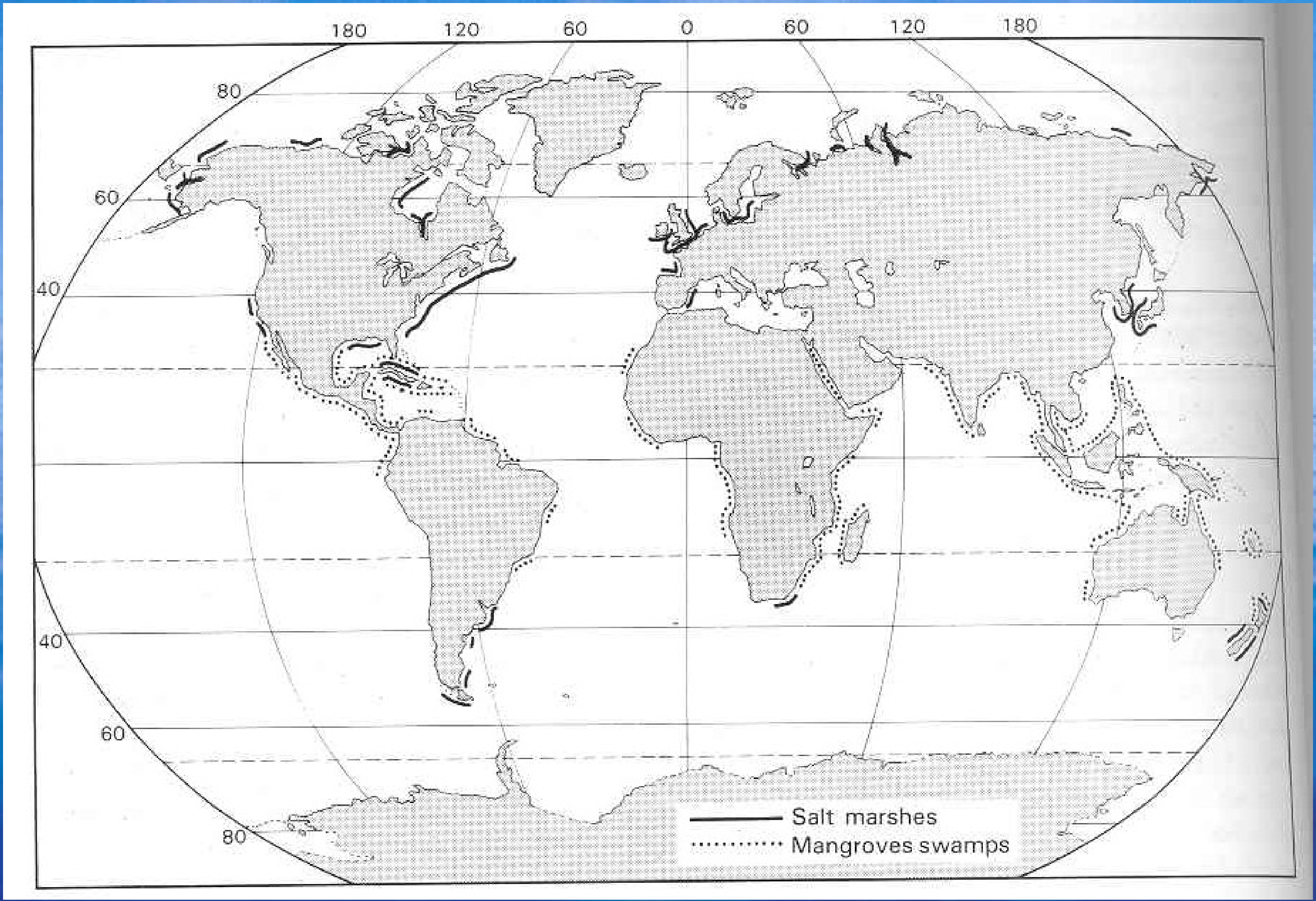

180
120
60
0
60
120
180
80
60
40
40
60
80
Salt marshes
Mangroves swamps

Plate XVIII. Mangroves

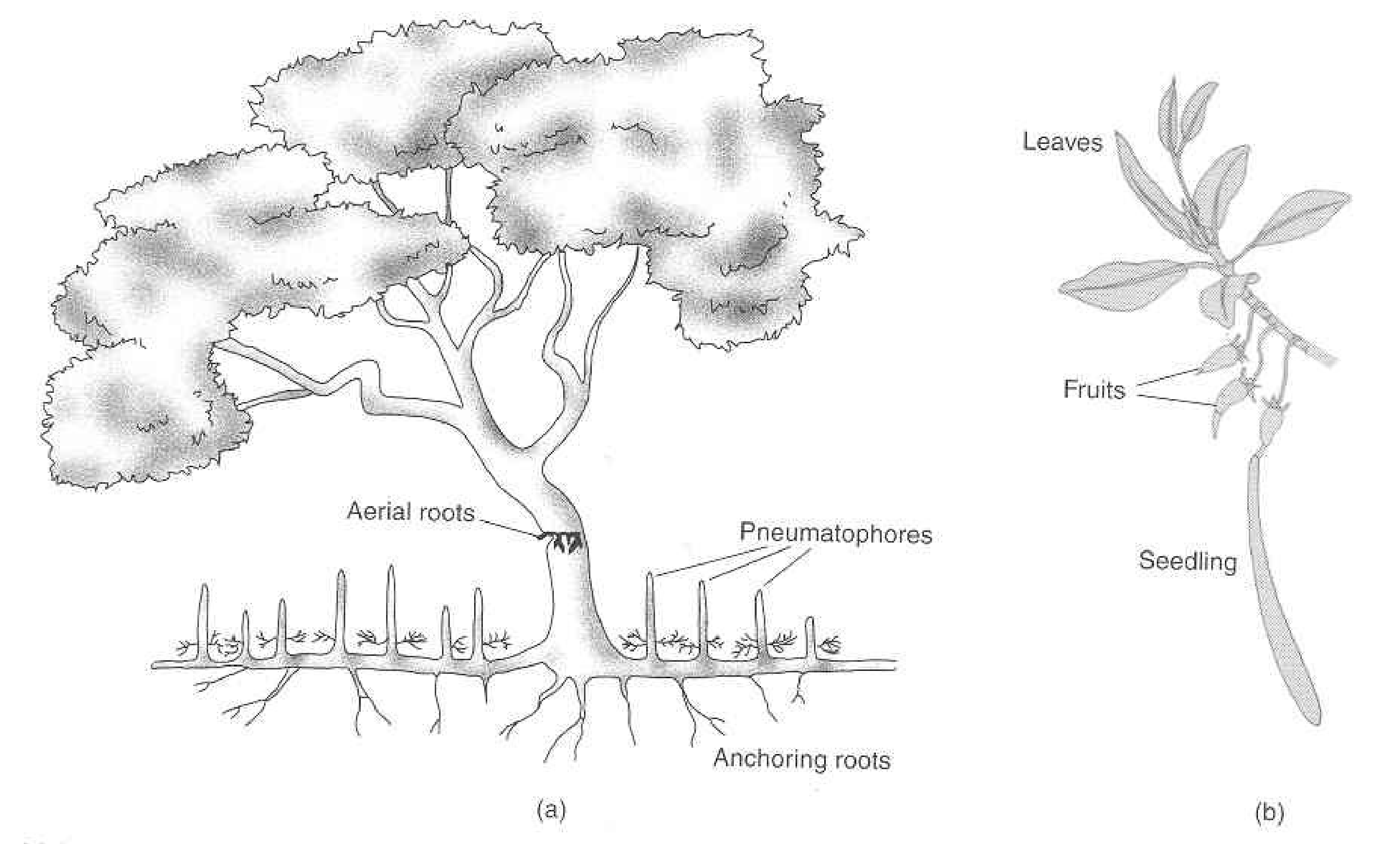
XVIII.1. *Top left,* A recently established mangrove seedling. (Photograph by Robert Twilley)

XVIII.2. *Top right,* Mangroves colonize the intertidal zone of tropical tidal creeks, as shown here along Estero Pargo in Terminos Lagoon, Mexico. (Photograph by Robert Twilley)

XVIII.3. *Middle,* Mangrove islands also occur along inland coastal area of land, as shown here in the Everglades National Park in south Florida. These mangrove islands are known as hammocks and form tear-shape patterns parallel to the flow of water and to the coast. (Photograph by Robert Twilley)

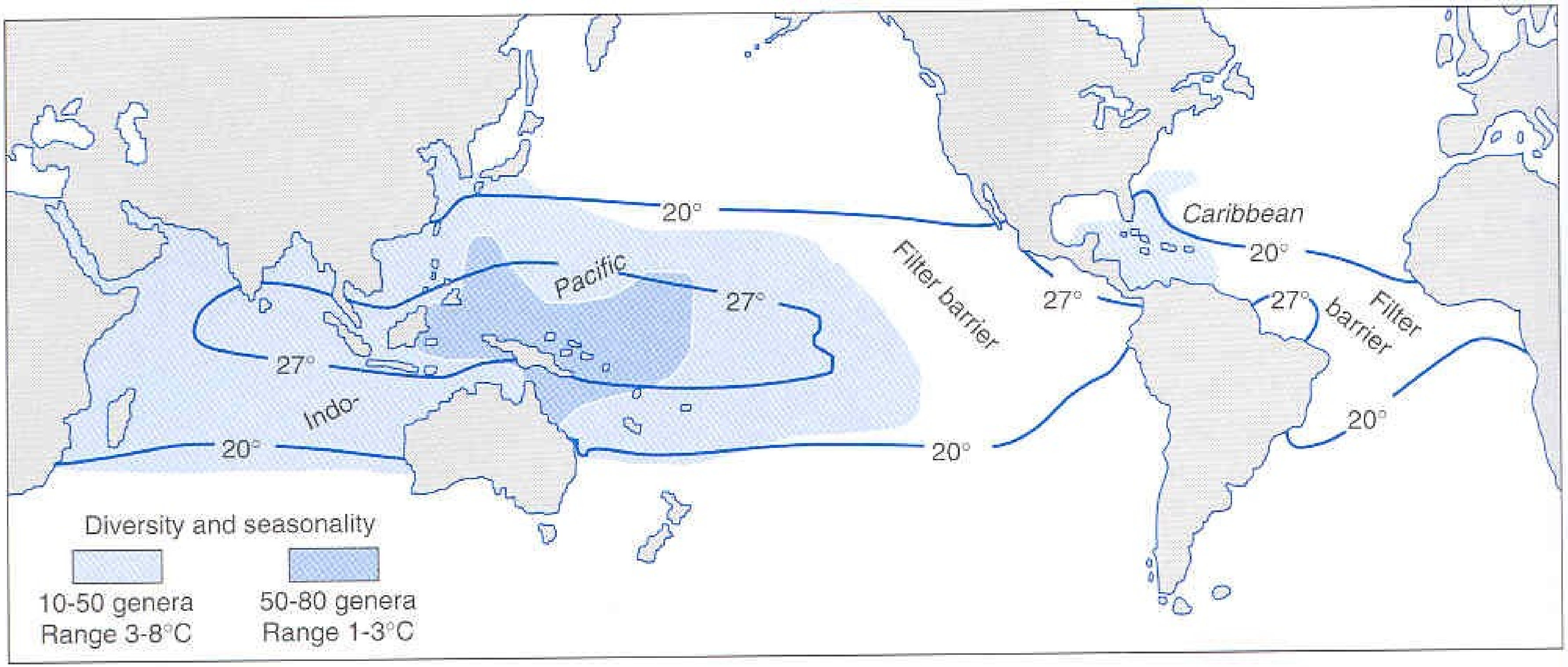
XVIII.4. *Bottom,* Many species that find refuge in mangrove habitats are commercially important to local human populations that harvest them for food and revenue. Here an Ecuadorian carries a morning's harvest of *Ucides occidentalis* from a mangrove forest along the Churute River estuary for sale in the city of Guayaquil. (Photograph by Robert Twilley)

Mangrovy

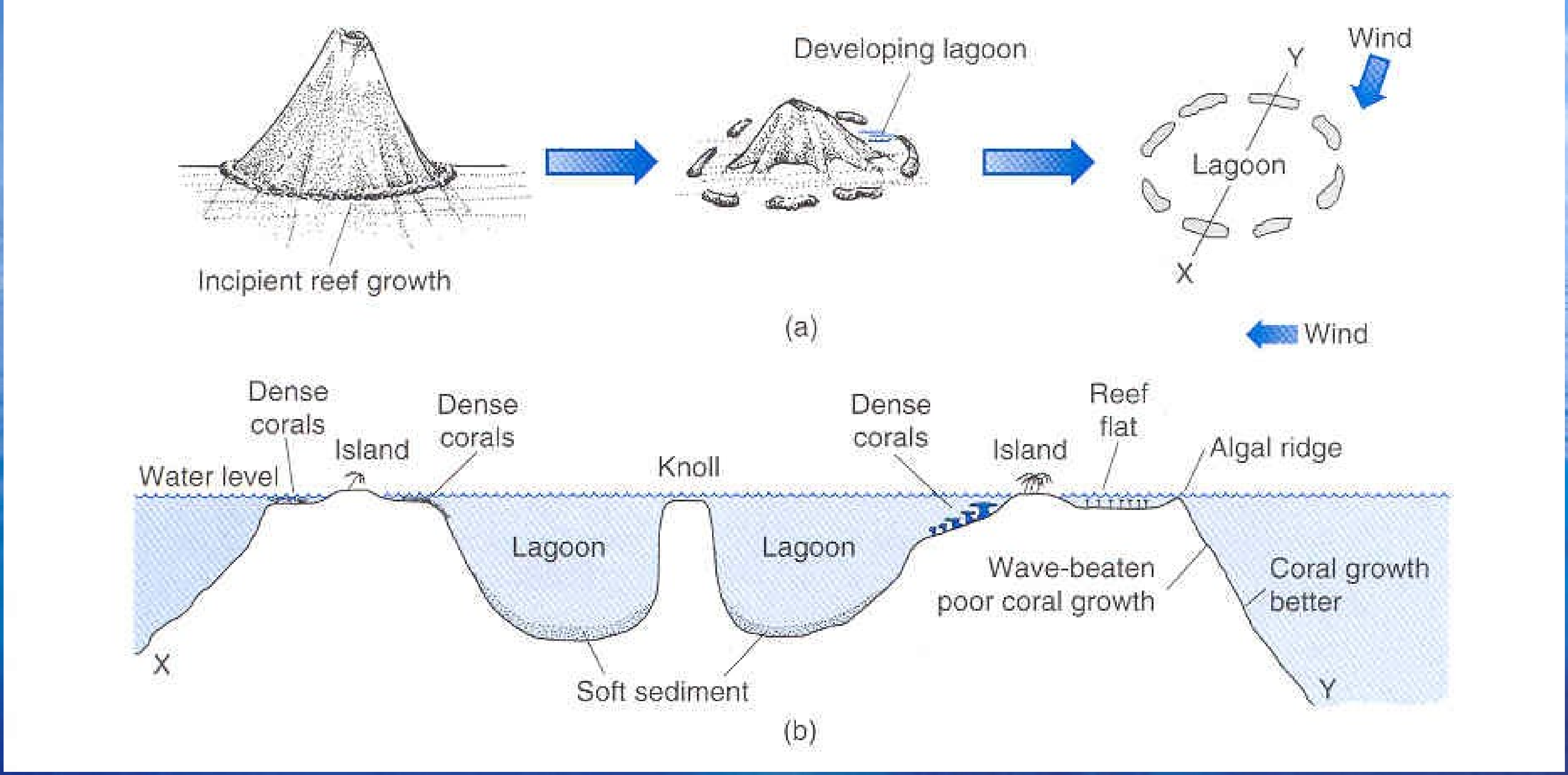


Leaves
Fruits
Seedling
Aerial roots
Pneumatophores
Anchoring roots
(a)
(b)

Korálové útesy



Korálové útesy



Korálové útesy

Table 11.1 Palaeological succession of frame-building organisms. From Fagerstrom (1987)

Period	Age (millions of years ago)	Frame-builders
Precambrian	2000–570	Stromatolite and thrombolite cyanobacteria
Early Cambrian	550–540	Calcareous cyanobacteria and Archaeocyatha
Middle Cambrian–Early Ordovician	540–500	Calcareous cyanobacteria and sponges
Middle Ordovician–Late Devonian	480–350	Calcareous algae, Stromatoporoidea, tabulate and rugose corals, Bryozoa
Late Devonian–Late Permian	360–260	Calcareous algae, sponges, Crinoidea, Brachiopoda, Bryozoa
Middle Triassic–Late Triassic	240–220	Calcareous algae, sponges
Late Triassic–Early Cretaceous	210–100	Calcareous algae, sponges, scleractinian corals (hexacorals)
Early Cretaceous–Late Cretaceous	95–65	Scleractinian corals, Hippuritacea
Paleocene–Eocene	60–40	Calcareous algae, scleractinian corals
Oligocene–Holocene	35–0	Calcareous algae, milleporine hydrozoans, scleractinian corals, Bryozoa

Morfologie a proměnlivost

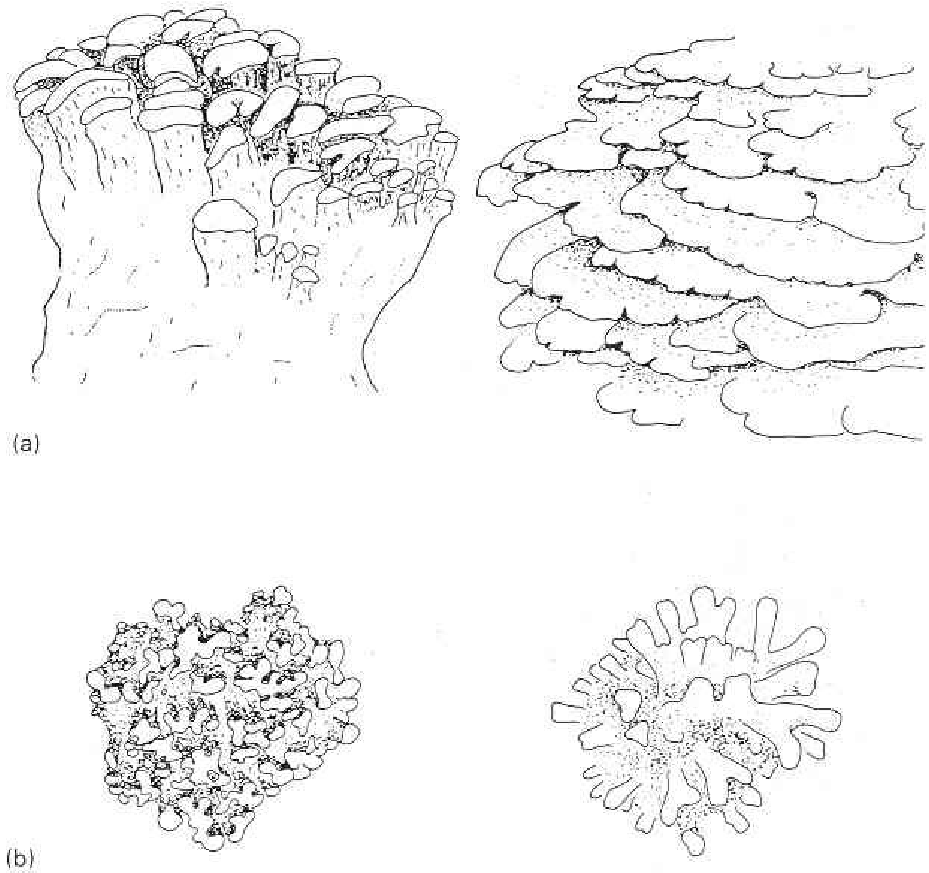


Fig. 11.6 Architectural changes in corals, associated with water depth. (a) *Montastrea annularis* with volumetric form at 5 m (left) and plate-like form at 35 m (right). (b) *Porites compressa* with stubby branches in shallows on the reef flat (left), and longer branches after transplanting to deeper water (right). From Maragos, cited in Hughes (1989).

Potravní strategie

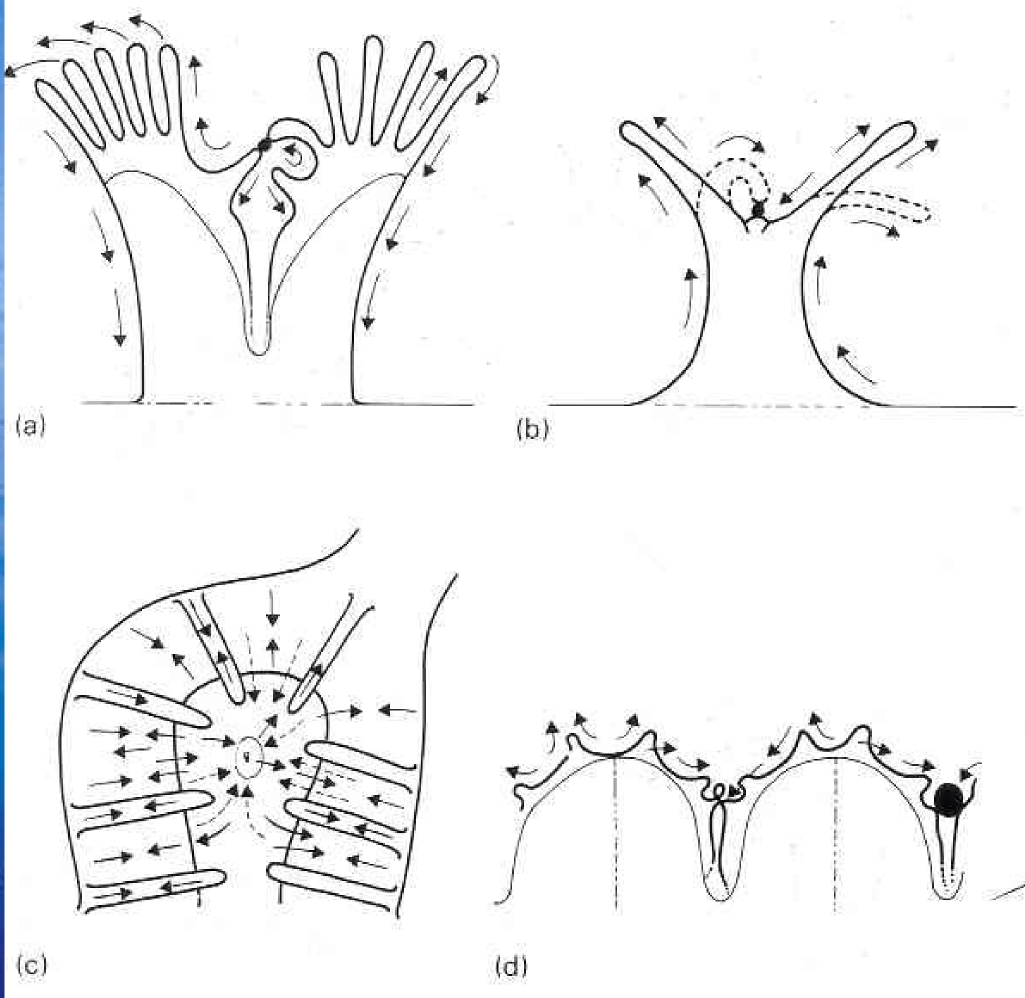


Fig. 11.5 Mucociliary cleansing and feeding mechanisms in corals. (a) Coral with large polyps; cilia beat away from the mouth. (b) Coral with small polyps; cilia beat up the column. In (a) and (b), particles are rejected from the tips of the tentacles unless the tentacles bend over to the mouth. (c) Brain coral with short tentacles; cilia can reverse beat towards or away from the mouth. (d) Massive corals with short tentacles; cilia carry all particles across the mouth; edible particles are ingested, inedible particles are rejected from the tips of the tentacles. From Yonge (1963).

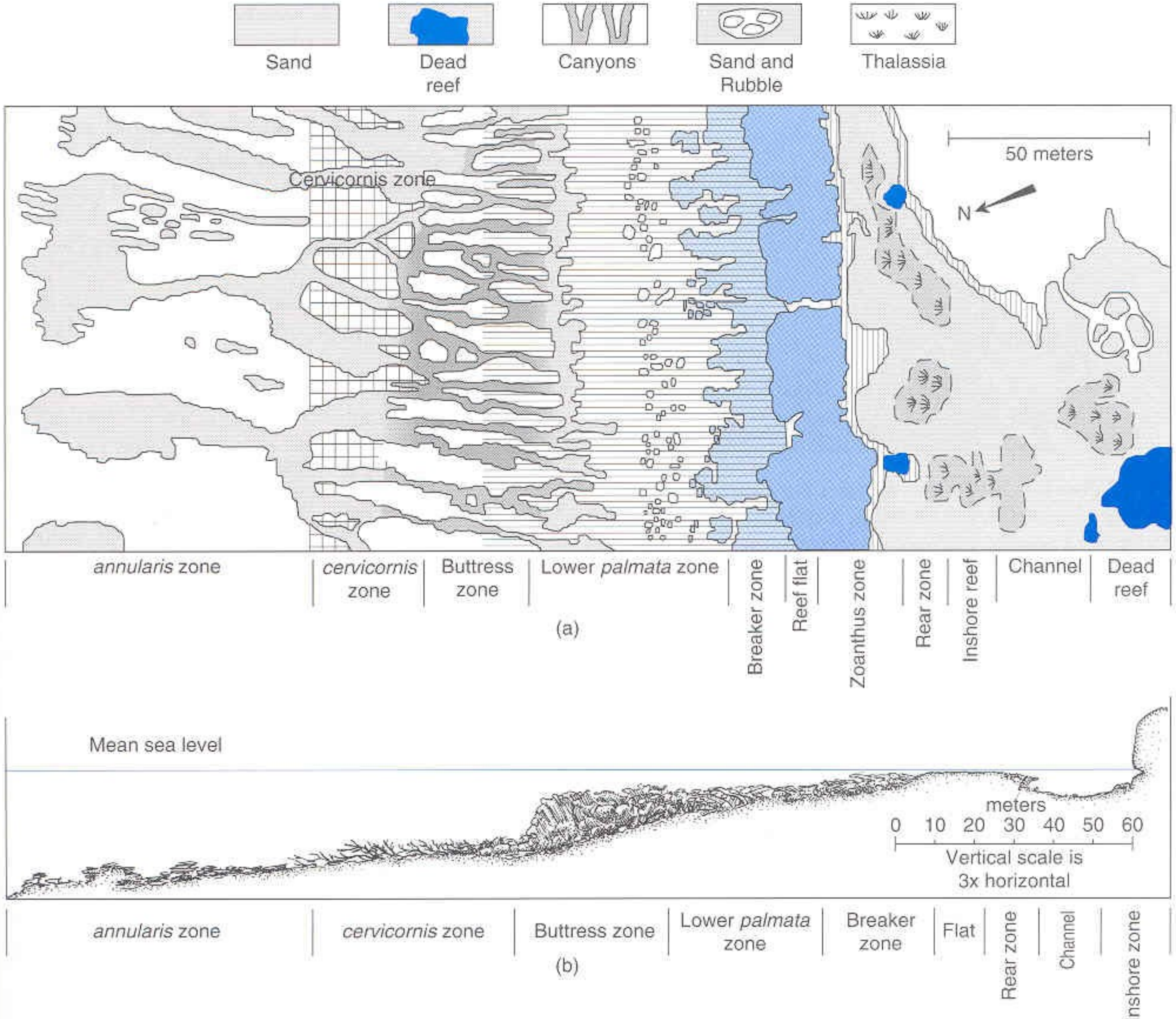


Fig. 15.19 (a) Map view of coral reef environments of the north coast of Jamaica. (After Goreau and Land, 1974.) (b) Cross-sectional view of depth zonation of the coral reef at Discovery Bay, Jamaica. (After Goreau, 1959.) Hurricanes have strongly altered these reefs in recent years.

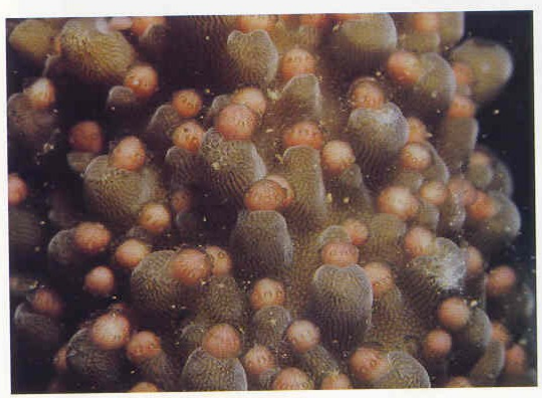
Plate XXVI. Coral Reefs

XXVI.1. *Top,* Air photograph of an atoll in the Marshall Islands, central Pacific. (Photograph by Robert Richmond)

XXVI.2. *Middle,* A patch reef in Guam. (Photograph by Robert Richmond)

XXVI.3. *Bottom left,* A Pacific *Acropora* sp. preparing to spawn. (Photograph by Robert Richmond)

XXVI.4. *Bottom right,* The unstalked crioid *Comaster* sp. on a promontory at Enewetak Atoll, Pacific. (Photograph by Robert Richmond)



Potravní sítě a produkce

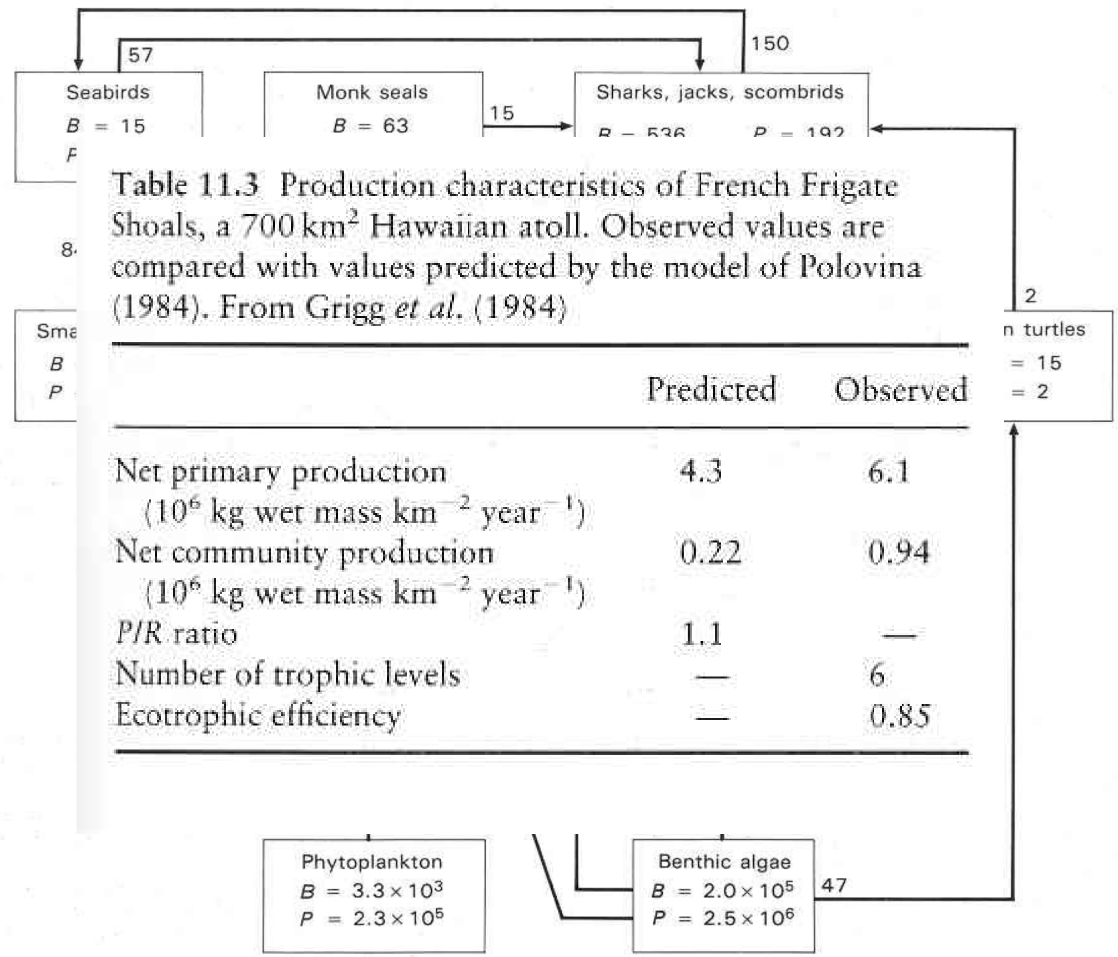


Table 11.3 Production characteristics of French Frigate Shoals, a 700 km^2 Hawaiian atoll. Observed values are compared with values predicted by the model of Polovina (1984). From Grigg *et al.* (1984)

	Predicted	Observed
Net primary production (10^6 kg wet mass km^{-2} $year^{-1}$)	4.3	6.1
Net community production (10^6 kg wet mass km^{-2} $year^{-1}$)	0.22	0.94
P/*R* ratio	1.1	—
Number of trophic levels	—	6
Ecotrophic efficiency	—	0.85

Fig. 11.15 Biomass-budget model for a 1200 km^2 coral reef. *B*, mean annual biomass (kg km^{-2}); *P*, annual production (kg m^{-2} $year^{-1}$). From Grigg *et al.* (1984).