LESSON 10

THE DEEP, THE COLD, THE DARK

Life at the End of the Line

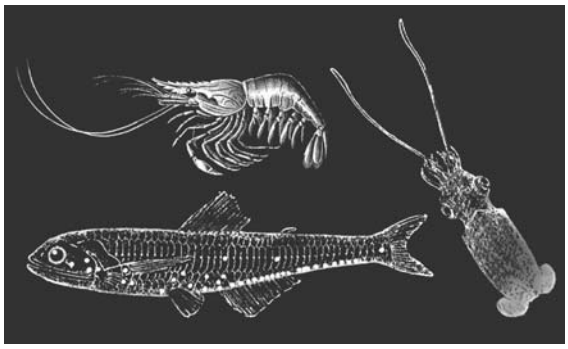

Fig. 10.01. Typical midwater creatures: red prawn, dark squid, black lanternfish; the latter two with light-producing organs.

Living in the dark is the normal state of affairs on our planet: the dark and cold waters below the sunlit surface layer of the sea constitute the largest life habitat on Earth. This habitat is largely a desert, except at the margins, including the outer shelf and upper continental slope. The animals seen in the dark and cold habitat are on the whole quite closely related to those near the surface (Fig. 10.01), but many of them have special adaptations for seeing at low light, for making light, and for stalking and attracting prey in the dark.

Different depth levels bear somewhat different kinds of animals, both in the water and on the sea floor. In the first several hundred meters below the sunlit zone, daylight still is present, albeit extremely dim. Large eyes are useful here, as well as biologically produced light for hunting, hiding, and signaling. The detection of sound over a large frequency range is useful for hunting and for avoidance of bigger hunters. The dark-adapted grazers and hunters come up into the surface layer at night, to feed in shallow water, where both phytoplankton and zooplankton is highly concentrated compared with subsurface depths. This daily vertical depth migration is the largest coherent motion of animals on the planet, and governs all marine ecosystems away from the shore to a degree commonly not fully appreciated in textbooks.

Below the uppermost subsurface layer – the midwater zone – depth zonation continues, largely because food supply keeps on decreasing with depth. Animals living in the dark and cold waters, in general, tend to be relatively small or, if large, commonly have a disproportionate amount of watery gelatin in their bodies. They move slowly to conserve energy, and many have large mouths to enable them to swallow prey their own size, to compensate for the rarity of prey.

The exploration of the dark and cold realm of the sea has benefited greatly from developments in deep-sea photography and deep diving since the middle of the 20th century. It is truly the “inner space” of life habitats on Earth, at the edge of the unknown.

Images

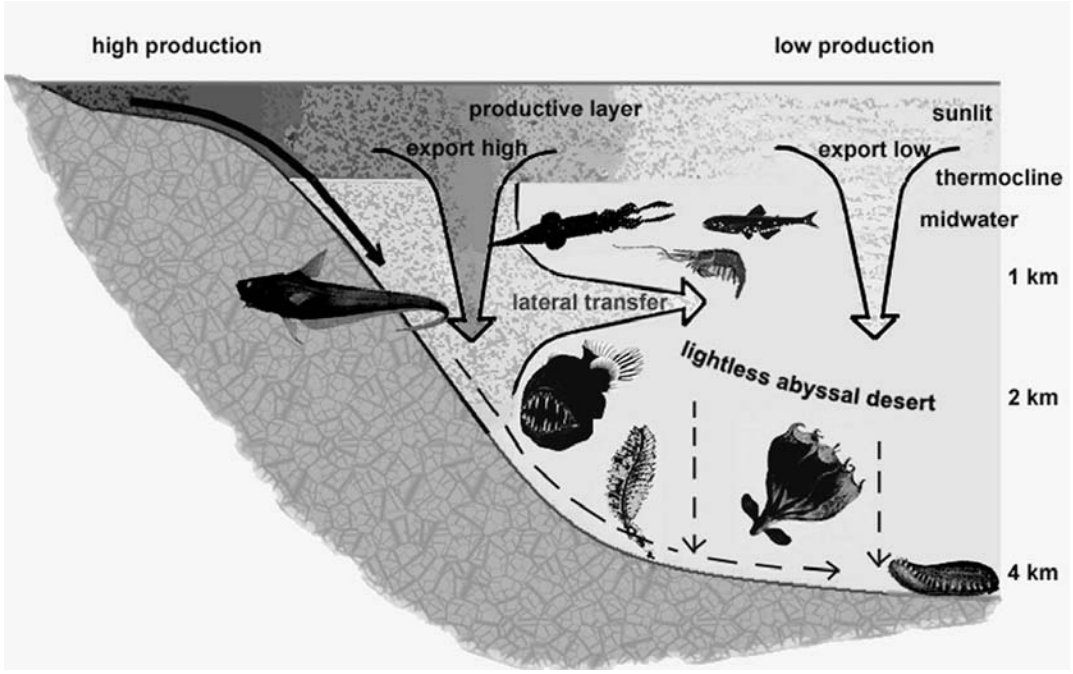

Fig. 10.02. Food for those living in the dark: the main pathways of transfer of organic matter into the deep interior of the ocean (arrows). Level of export depends on level of overlying production. The abyss itself is a desert. Animals figured (top to bottom): squid, lanternfish, shrimp, rattail fish, anglerfish, vampire squid, sea pen, and sea cucumber. Not to scale.

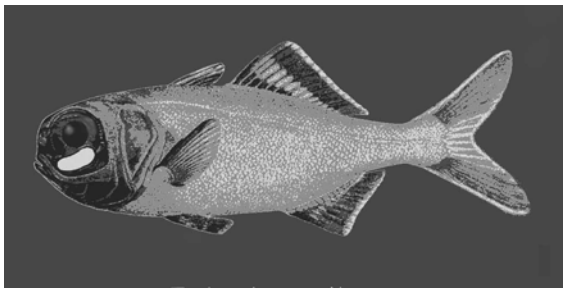

Fig. 10.03. Flashlight built in. The shape of this midwater fish suggests an ability to swim fast when necessarv.

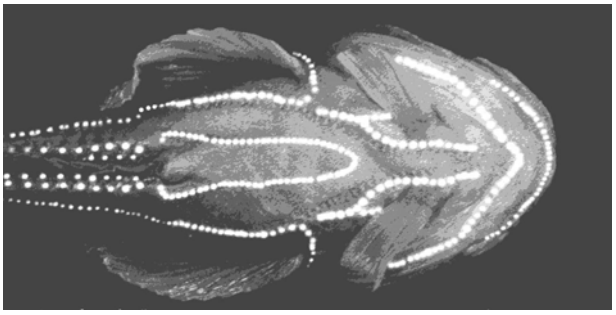

Fig. 10.04. Photophores on the underside provide for countershading, preventing the fish from being seen against the sky, from below.

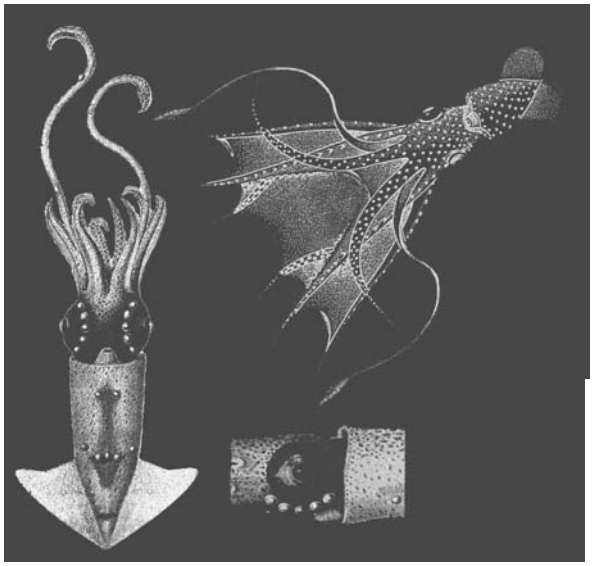

Fig. 10.05. Left-right asymmetry in eyes and photophores in squid (upper right) suggests sideways swimming. Up-down asymmetry (bottom) is normal.

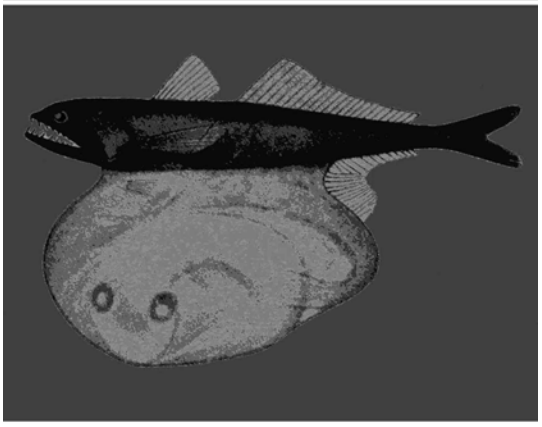

Fig. 10.06. Extensible jaws and an expandable stomach help take advantage of rare encounters with larger prey.

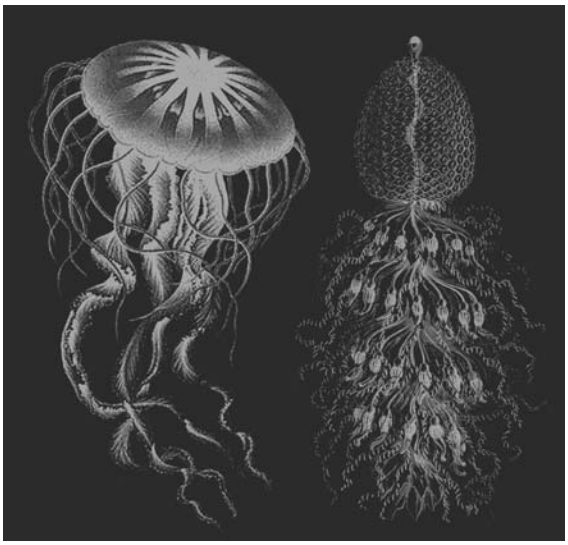

Fig. 10.07. Midwater medusa (left) and siphonophore colony, after E. Haeckel.

Fig. 10.08. A gelatinous gastropod of the deep sea, slowly winging its way through the water in search of food.

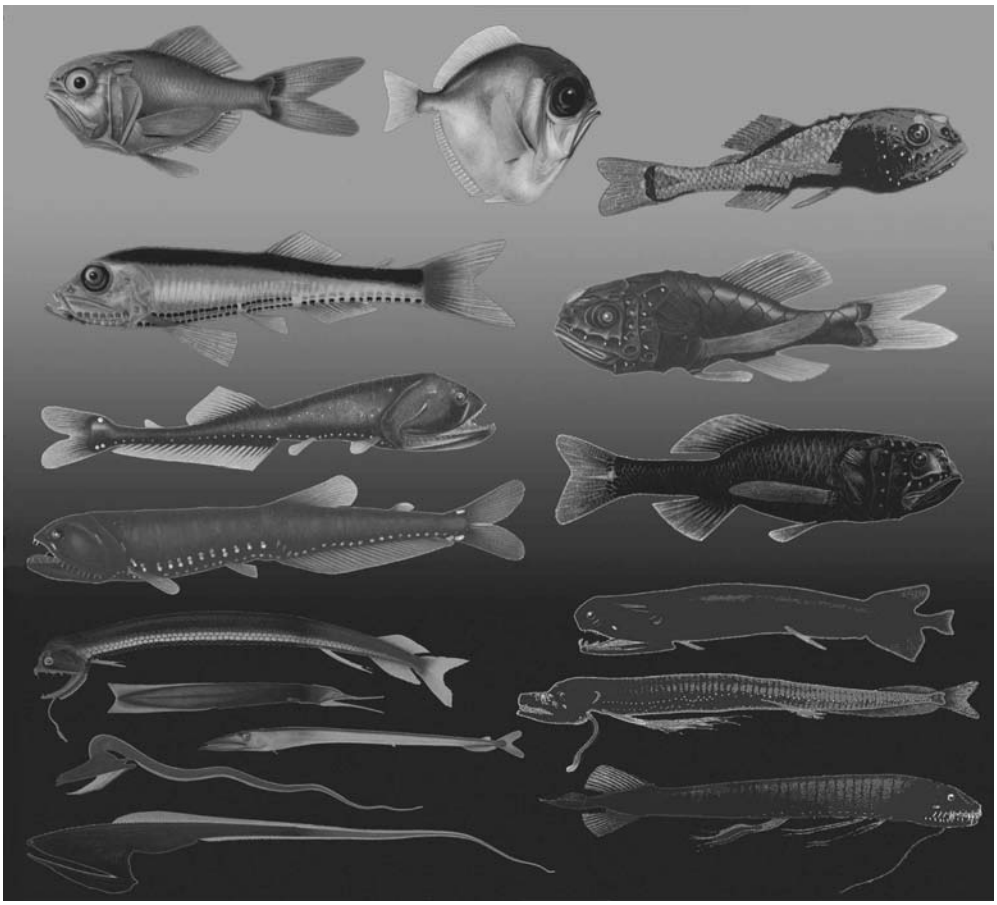

Fig. 10.09. Various small midwater fishes, including one hatchet fish (top, center). Some are clearly adapted to twilight conditions (large eyes, efficient propulsion, countershading). Others are eel-like stealth hunters with extensible jaws, suggesting rarity of prey.

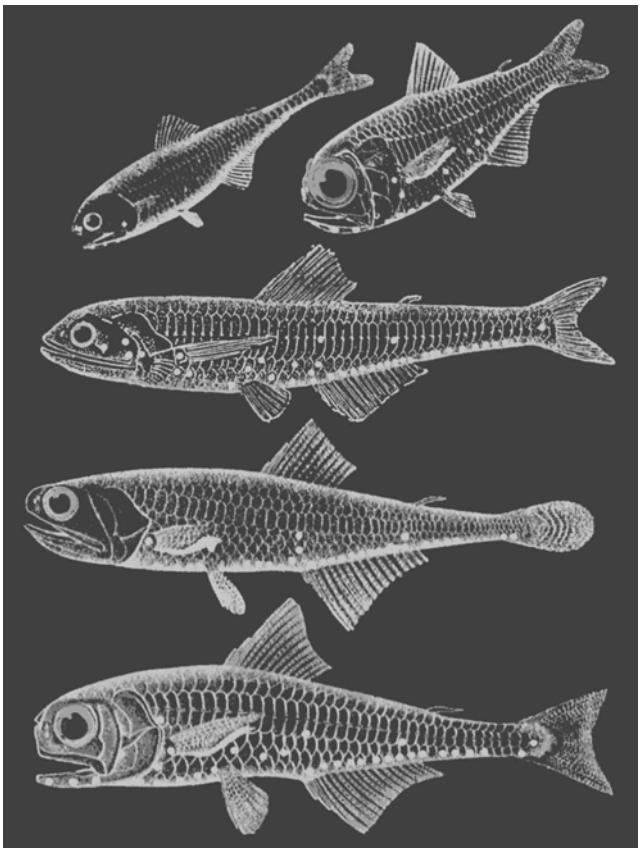

Fig. 10.10. Lanternfishes are look-alikes except for the photophore patterns. Presumably the patterns are important in signaling between members of the same population.

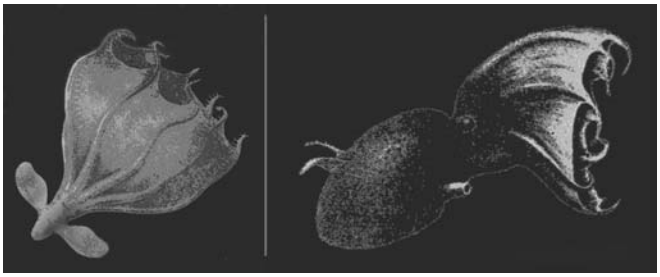

Fig. 10.11. Deep-living and slow-moving cephalopods, with enormous umbrella traps made of webbed tentacles.

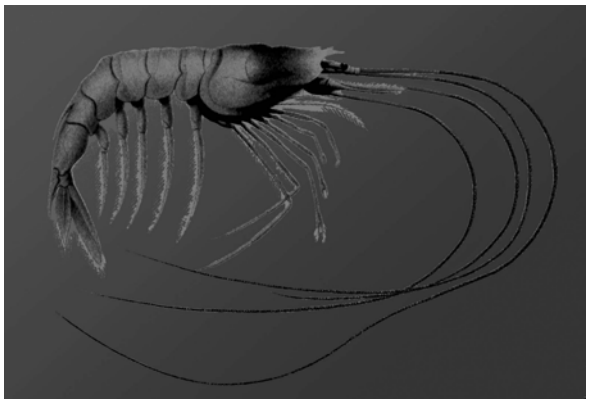

Fig. 10.12. A red midwater prawn. The long antennae, presumably, are extended forward in life, as in lobsters.

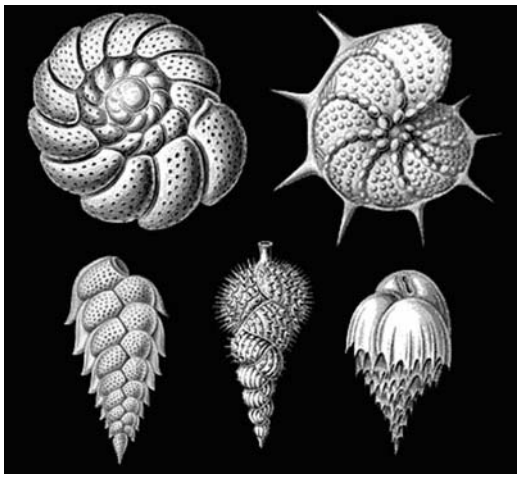

Fig. 10.13. Benthic foraminifers: pinhead-size shelled microbes on the seafloor, indicators of depth zones.

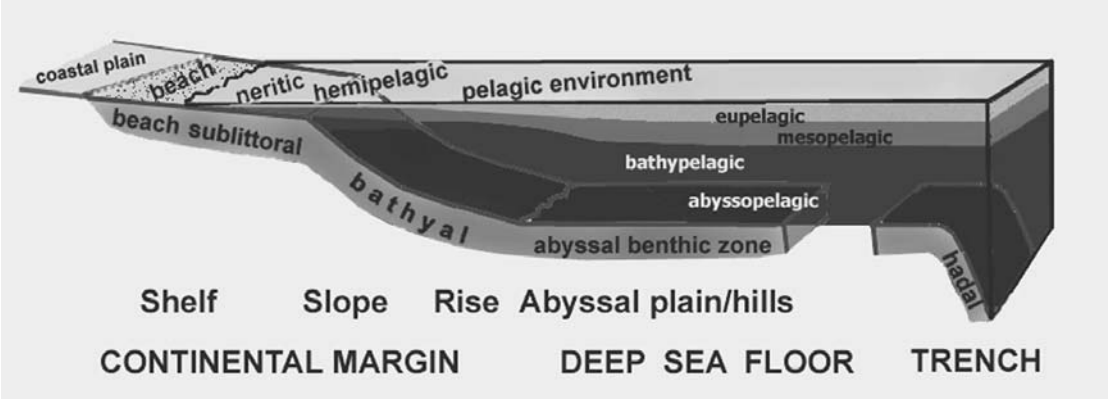

Fig. 10.14. Common names of oceanic environments, with respect to depth and distance from land.

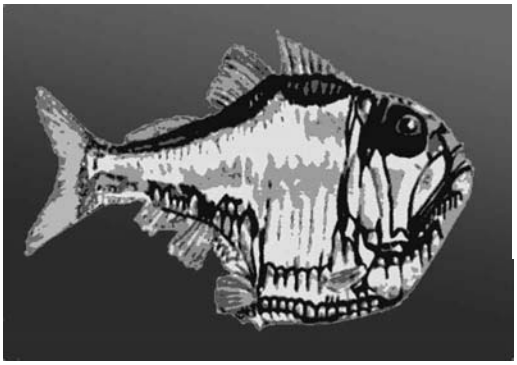

Fig. 10.15. The hatchet fish has a mirror-like side. Presumably, when flashed at it will blind the attacker.

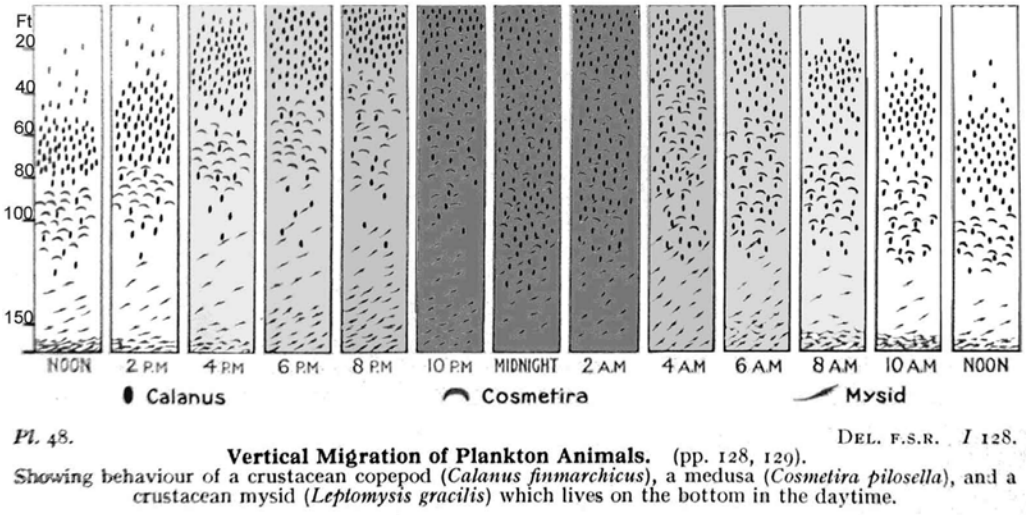

Fig. 10.16. Ups and downs of different types of zooplankton somewhere off the shores of Britain, as reported in Russell and Yonge (1936). Depth is in feet: this is the uppermost portion of daily vertical migration.

Fig. 10.17. A sea cucumber, representative of the most abundant type of large animal on much of the deep-sea floor. It eats surface mud (arrow, right), and processes the organic matter within it. The cleaned mud emerges in long fecal strings at the opposite end (arrow, left).

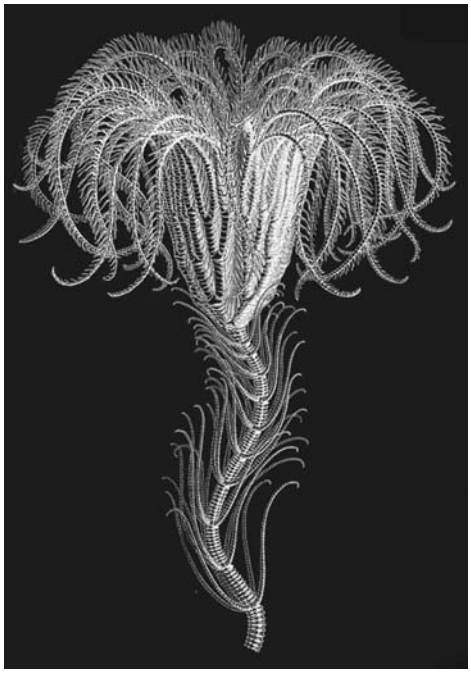

Fig. 10.18. Feathery crinoid, related to sea stars, with a long geologic pedigree. Abyssal representatives enrich the deep-sea benthic fauna.

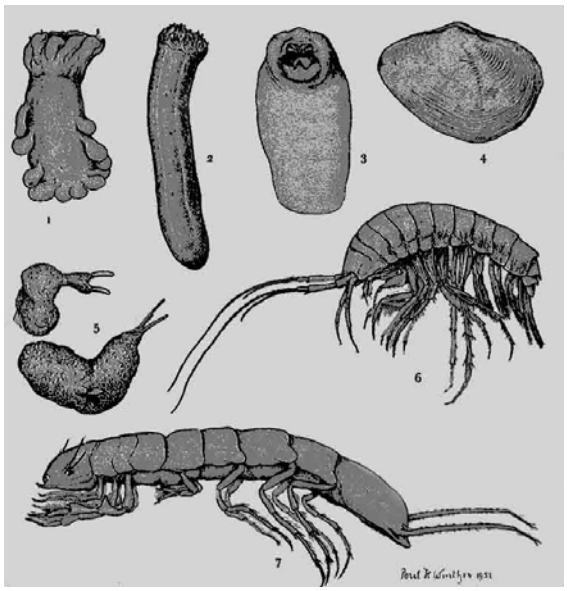

Fig. 10.19. Deep-sea organisms of mm size from the Mariana Trench, recovered by the Danish Galathea Expedition.

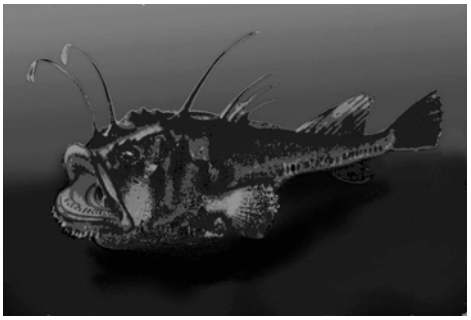

Fig. 10.20. Anglerfish sit on the bottom and save energy by waiting for prey to inspect the lure in front of the mouth. The mouth is likely closed, normally. It opens to suck in prey.

Figure sources (where based on sources in the literature, on the web or in museum exhibits: figures are considerably modified and adapted for present purposes, using Adobe Photoshop; drawings and photographs by the author are marked "orig."):
1, E. Haeckel (shrimp, see Ch. 1 for reference), and A. Hardy; 2, orig.; 3, SIO Explorations; 4, SIO Explorations; 5, Russell and Yonge 1936 (left), and Ellis 1997 (umbrella squid); 6, SIO Explorations (upper), and Russell and Yonge 1936 (see Ch. 6 for reference); 7, E. Haeckel; 8, SIO Explorations; 9, Albert I of Monaco (see Ch. 2 for reference); 10, C.P. Idyll 1964, and A. C. Hardy 1956; 11, Chun in Murray and Hjort 1912, and S. Ekman 1953; 12, Albert I of Monaco; 13, E. Haeckel; 14, orig.; 15, A. Hardy; 16, Russell and Yonge 1936; 17, Albert I of Monaco; 18, E. Haeckel; 19, Galathea Report (see Ch. 2 for reference); 20, Brehm's Tierleben (see Ch. 1 for reference). **References**: A.C. Hardy, 1956, *The Open Sea: The World of Plankton* (vol. 1), Collins, London, 335pp.; R. Ellis, 1997, *Deep Atlantic – Life, Death, and Exploration in the Abyss,* A. Knopf, New York, 395pp.; C.P. Idyll, 1964, *Abyss: The Deep Sea and the Creatures That Live in It,* T.Y. Crowell Co., New York, 396pp.; J. Murray and J. Hjort, 1912. *The Depths of the Ocean.* Macmillan, London, 821pp.; S Ekman, 1953, *Zoogeography of the Sea,* Sidgwick and Jackson, London.