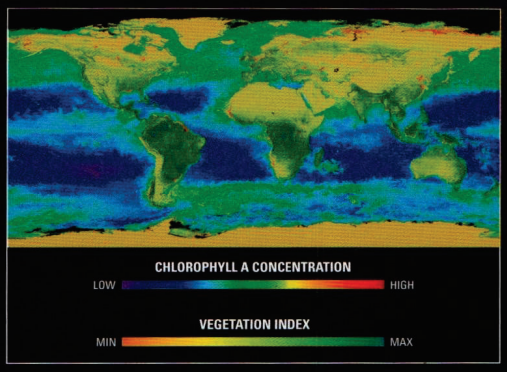
LION'S-MANE JELLYFISH
This daunting giant of the plankton can grow up to 6 ft (2 m) across, with 200-ft (60-m) tentacles.

THE PELAGIC ZONE

THE PELAGIC ZONE IS THE WATER COLUMN ABOVE the continental shelf (although the term is also used to refer to the water column of the open ocean). It is a vast environment, and temperature and salinity variations within it result in distinct water masses. These are separated by "fronts" and characterized locally by different plankton. Coastal and shelf waters are more productive than the open ocean. When calm, the water stratifies, cutting off the surface plankton from essential nutrients in the layers below. Storms cause the layers to mix, stimulating phytoplankton blooms. High latitudes have seasonal plankton cycles; in warmer waters, seasonal upwelling of nutrient-rich deeper water triggers phytoplankton growth.

MICROSCOPIC PRODUCTIVITY

Much of the primary productivity in the world's oceans and seas occurs over the continental shelves. Tiny phytoplankton floating in the surface waters harness the Sun's energy through photosynthesis to produce living cells. Some of the tiniest algae (picoplankton) are thought to supply a considerable amount of primary production. As well as sunlight, nutrients and trace metals are needed for phytoplankton growth. These are often in short supply in the open ocean, but shelf waters benefit from a continual input from rivers, mixing by waves and, on some coasts, the upwelling of nutrient-rich water.



PRIMARY PRODUCTION
This satellite map shows variations in primary production, indicated by the concentration of the pigment chlorophyll a in the oceans and the amount of vegetation on land.

DRIFTING ZOOPLANKTON
Continental shelf zooplankton contains many larvae of sea bed animals that then drift away to new areas.

THE PLANKTON CYCLE

In temperate and polar seas, optimal phytoplankton growth occurs in both spring and summer. There are long daylight hours and maximum nutrient levels after winter storms have mixed the water column and resuspended dissolved nutrients from the seabed. The well-known spring blooms can rapidly turn clear seawater into pea soup, or a variety of other colors, depending on the organism. Typically, there is a succession of phytoplankton species with short blooms. Responding to abundant food and increasing temperatures, tiny zooplankton begin grazing the phytoplankton and reproducing. Bottom-living coastal animals release clouds of larvae to feed in the nutritious broth, before taking up life on the sea bed. Spawning fish also contribute a mass of eggs and larvae. Eventually, the phytoplankton is grazed down, nutrients are exhausted, and productivity drops off, in an annual cycle that will be renewed again next spring.

HUMAN IMPACT

RED TIDE

A rapid increase in a population of marine algae is called a bloom. This bloom on the Scottish coast, known as a red tide, was caused by the dinoflagellate *Noctiluca scintillans*. Sometimes blooms poison marine life. Often, the sheer numbers of organisms clog fish gills, suffocating them. Dense blooms occur naturally, but man-made pollution from nutrient runoff into the sea may also feed these blooms, making them more frequent and extensive.

RIDING THE CURRENTS

From tiny algae to giant jellyfish, the animals and plants of the plankton either float passively or swim weakly. This is mainly to keep them up in the sunlit surface waters, where most production occurs; these drifters must go wherever the currents take them. On most continental shelves, there is a residual drift in a particular direction, although wind-driven surface currents, where most of the plankton live, can move in any direction for short periods. Some animals go on long migrations to spawn, relying on residual currents to bring their larvae back to areas suitable for their growth into adults; for example, conger eel larvae take around two years to drift back from their spawning grounds far off the continental shelf. The larvae of the majority of coastal animals, including those of barnacles, mussels, hydroids, and echinoderms, spend much shorter periods in the plankton—just long enough to disperse to new areas of coast. However, the plankton is a dangerous place, full of hungry mouths and tentacles, and though millions of eggs and larvae are released, the vast majority of planktonic feeders will die; only a lucky few find a suitable place to settle and grow.

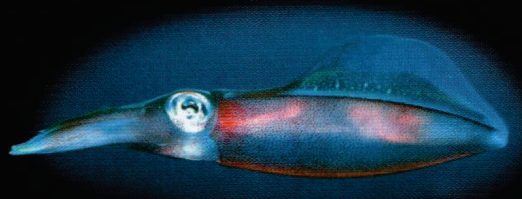
COLONIZED ROPE
This rope was colonized over the course of a year by sea squirts, feather stars, fan worms, and anemones, their planktonic larvae having been transported by ocean currents.

MIGRATORY SHOALS
Pelagic fish such as these mackerel move around the ocean in response to temperature changes. They are among the pelagic zone's larger predators.

ACTIVE SWIMMERS

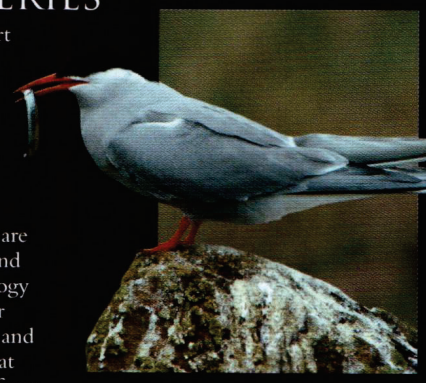
The animals of the plankton, especially small crustaceans such as copepods and krill, are eaten by fish, mainly small, shoaling species such as herring, sand eels, sardines, and anchovies. Most of these fish live permanently in midwater, using the seabed only to spawn or to avoid predators. They are strong swimmers (nekton), using speed to catch prey and evade predators. They can travel long distances against residual currents to feed and also to reach their spawning grounds. Small, shoaling fish are, in turn, food for larger predators, such as squid, tuna, cetaceans, and sharks. Whale sharks, basking sharks, and baleen whales are among the largest of the marine animals, yet they feed directly on plankton, consuming vast quantities.

NEKTONIC INVERTEBRATE
Squid are the only invertebrates that swim strongly enough to be classed as nekton. They catch a variety of prey including fish and planktonic crustaceans.



PELAGIC FISHERIES

Continental shelf waters support massive quantities of pelagic fish, ultimately sustained by abundant plankton. The most important fisheries are for herring, sardines, anchovies, pilchards, mackerel, capelin and jackfish. Squid are also fished commercially. Many fish stocks are under severe pressure as boats and nets get bigger and the technology to pinpoint shoals becomes ever more sophisticated. Pelagic fish and squid are caught in drift nets that hang about 30 ft (10 m) down from the surface. In the north Pacific, some 105,000 miles (170,000 km) of drift net is available to major fisheries; unfortunately, these nets also trap cetaceans, turtles, and diving birds. Drifting longlines are used for tuna and swordfish; these also catch juvenile fish, sharks, turtles, and seabirds. Midwater trawls capture vast quantities of shoaling fish such as herring, mackerel, and sardines. Small-scale fisheries for a wide variety of other pelagic species are important in sustaining local coastal communities worldwide.



FOOD CHAIN THREAT
Sand eels are food for seabirds (such as this Arctic tern), seals, cetaceans, and larger fish. Despite their importance at the base of many food chains, vast quantities are taken by fisheries for feeding to livestock and farmed fish, and are burned as fuel oil.