The biochemical manifestations of eutrophication

3.1 THE COMPONENTS OF NUTRIENT CYCLES IN AQUATIC SYSTEMS

Natural cycles of nutrients in aquatic systems involve the transfer of different chemical compounds and ions in different quantities through the important biological components (Fig. 1.5). Each nutrient follows different pathways and fluxes through the components which are themselves affected by external changes in nutrient loadings upon the system. The rates of flux are driven by biological processes, which are considered in their own right in Chapter 4, and affected by physicochemical processes such as flow and sedimentation, pH and temperature, and oxygen regimes.

3.1.1 Phosphorus cycles

Phosphorus enters aquatic systems from catchment runoff primarily as particulate forms, adsorbed onto inorganic silt and clay particles. Lesser amounts are in particulate organic form in detritus, and the smallest fraction is dissolved phosphate (Holtan et al., 1988; Golterman, 1973). This is a strongly seasonal process, with 90% or more running off during the winter months or after snow-melt in spring. In the tropics, this seasonality is seen as high inorganic runoff during rainy seasons (Grobler and Silberbauer, 1985b). Point sources of phosphorus often contain a higher proportion of dissolved phosphate, e.g. industrial inflows to Loch Leven, Scotland (Bailey-Watts, 1984).

On entering a lake, many of the inorganic particles and some of the organic ones will be sedimented at rates determined by the degree of mixing in the lake, its depth and retention time, and the mass of the particles (Fig. 3.1). Dissolved phosphate will remain in the lake water column where it joins the existing pool. In temperate winters it may remain in the dissolved form for considerable time, but in summer or in the tropics its residence time is very short.
Figure 3.1 Phosphorus transformations in a lake.