湖沼・内湖の物質循環
―生態系モデルによる生物学的水質浄化機能の評価―

田口　浩一*　中田　喜三郎**　田森　日出春***

Abstract

One of the effective measures to cope with eutrophication of lake waters is to remove nutrient substances that can cause to algal blooming, by taking advantage of the natural capability of water purification. Here the term 'purification' is defined, in a wide sense, as a potential role of the lake contributing to reduction of pollutants and thus restraint to eutrophication; in which various processes concerning seasonal nutrient fixation such as uptake by aquatic plants, attachment to foliage substrates and feeding by organisms of higher-trophic level are regarded as biological purification processes together with eternal losses or removals from waters. In order to evaluate the purification capacity, a numerical lake ecosystem model was developed highlighting on the role of macrophyte colonies that inhabit alongshore, and applied to Lakes Suwa, Kasumi, Biwa and five attached sublakes of Lake Biwa.

The model takes account of the biological interactions between pelagic compartments (phyto- and zooplankton, detritus, dissolved organic matter, pelagic fish and nutrients) and benthic compartments (macrophytes, attached algae, attached small animals, macro- and megalobenthos and demersal fish). Under the time-dependent conditions of meteorological and hydraulic factors, the model was run over a year to evaluate annual nutrient budget and purification capacity of each lake. The results revealed that the purification capacity is generally estimated, from the standpoints of both stock and flux, higher in the shore region than in the offshore region because of a wide variety of organisms including aquatic plants. Moreover, it almost increases in proportion to vegetation density of the shore region. Nutrient fluxes associated with purification processes turned out closely related to surface area or equivalently to retention time of lake waters, suggesting that the biological purification does not become dominant against physical turnover until the surface area reaches around 103 ha or the retention time exceeds around 10^2 days.