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Lakes Which Produce Too Much

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In a world where widespread famine is sometimes predicted within a decade, the concept of a lake being too productive may seem strange. However, lakes are not used by man solely to produce the maximum possible amount of food, and it is these other uses which dictate our definition of the best level of biological productivity.

Thus, when a lake becomes covered with scums of floating algae, its shallows choked with masses of rooted plants, and its fish population dominated by carp, suckers, perch and other fish of this kind, we say that its productivity has exceeded desirable limits. Scientists term a lake with these characteristics *eutrophic* (from the Greek word "eutrophos" meaning well nourished) and the process of enrichment *eutrophication.*

The two previous articles in this series have alluded to the causes and some of the consequences of this process. Focusing on the subject of eutrophication, we will review some of these facts and go on to discuss the influences of man and how he may minimize undesirable effects resulting from his activities.

The Symptoms

The eutrophic state cannot be defined in absolute terms. Rather, a continuum exists from very unproductive lakes, termed oligotrophic, to shallow bodies of water so productive that they are effectively passing from existence as lakes.

Most lakes begin life as a result of major geological events, such as glaciation, and at their beginning have clear waters and a paucity of biological life. With the passage of time (usually over the course of thousands or tens of thousands of years) beds of vascular plants reach upwards in the shallower waters from silt-covered bottoms. For brief periods, the water itself may become colored and murky with dense growths of small, free-floating algae. Serving as food for small crustacea and bottom-dwelling insect larvae, these plants form the basis of a food chain which ultimately determines the production of a diverse and abundant population of fish.

The process of increasing plant production continues and marked changes in the kinds of algae produced also occur. The blue-green algae, many of which float at or near the surface due to their positive buoyancy, become dominant during summer. Mats of scum composed of these plants float on the surface where they are subject to stranding in windrows along the shore. Aside from being unsightly, decomposition of these deposited algae is often accompanied by the emission of foul odors.

Aquatic plants rooted in the bottom may become more abundant during the early phases of this process. In the latter stages algae often filter out the light needed by higher plants and the extent of weed beds decreases, although they may still be unpleasantly dense in the very shallow waters.

As a lake becomes more productive fish and fish food organisms respond directly to at least three factors associated with this increase in vegetation: (1) Food, (2) visibility, and (3) dissolved oxygen. In general, more plants mean more food for the animal components of the system. Visibility decreases markedly in the upper waters due to dense suspensions of algae and the depth to which light penetrates is also lessened. During summer, oxygen levels become more variable (very high during the day and lower at night) in the upper waters; and this vital gas may be completely used up in the deeper portions of the lake by the end of the thermally stratified summer season.

Effects for the Fisherman

As a result of these interactions the total quantity of animal production in a lake initially increases along with that of the plants. Then oxygen depletion in the deeper waters exerts its effect, eventually destroying this as a habitat for fish, diurnal oxygen fluctuations in the upper waters may prove hazardous to many species, and

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