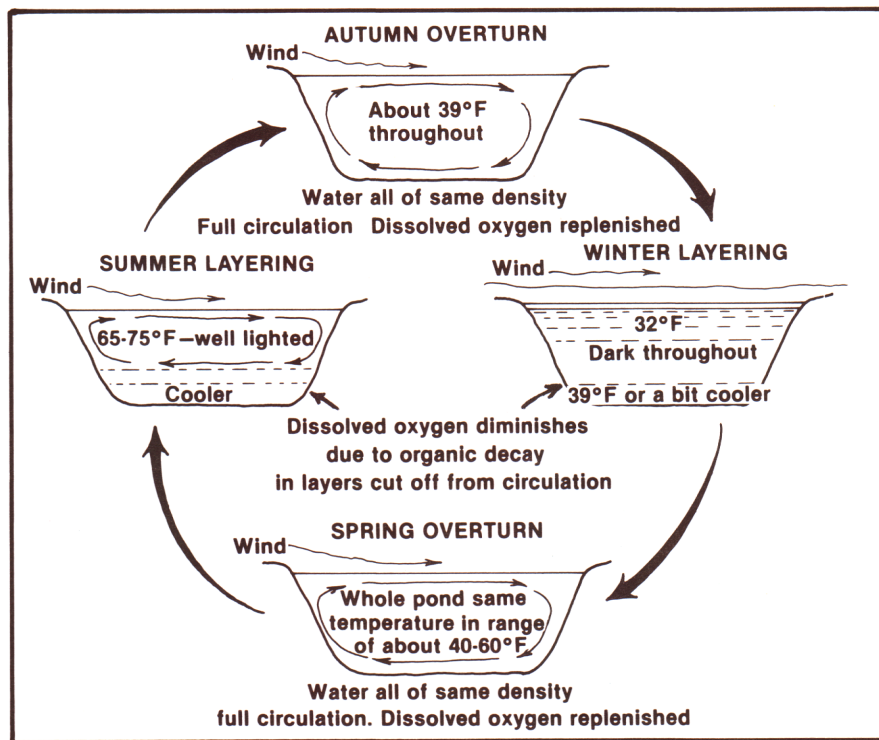


circulation and almost completely block pond breathing. In both summer and winter, the pond water sorts itself into layers representing a gradation of temperature, hence different density. The heaviest water lies on the bottom and the lightest at the top. During summer stratification or layering, only the upper part of a deep pond will be circulated by the wind. The lower part will be rather still. Summer and winter stratifications are usually broken up in fall and spring during the time that cooling and warming change all the water to an equal temperature and equal density. These events are described in the figure at right.

Investigating Pond Suitability for Fish

Pond owners often ask if the water can be tested simply for fertility and other chemical characteristics to evaluate its fish-producing capacity or to find out why fish haven't done well. Determining these things is far more involved than just sending water samples to a laboratory. As previously described, ponds are complex, and their conditions change continually. The foremost need is to be alert against land disturbances, water runoff into the pond, and human or livestock wastes that could cause overenrichment. Such observation of the pond's surroundings, combined with a program of water temperature and dissolved oxygen measurement in the pond, may provide enough information for pond management.

Judging a pond's productive capacity or diagnosing its problems is best done by a professional biologist. (Obtain list of consultants as shown in Appendix.) Properly trained aquatic biologists can evaluate conditions of the pond site and surroundings and can interpret temperature and oxygen data. At considerable added cost, the consultant should be able to make key measurements (alkalinity, pH, inorganic nitrogen, phosphorus, temperature and a few others) using special instruments and methods just after the ice goes out in spring, and with the results estimate total



production of algae and the amount that contributes to the food web for fish—as well as the amount that will be in the form of bluegreen algae. Such a detailed analysis should result in advice on adjusting the balance of alkalinity and phosphorus for best fish productivity.

The pond owner may be able to participate with a professional biologist in pond investigation—or, after study of references, may undertake measurements on his/her own. Much depends on knowledge of science, the amount of time one can spend, and the instruments and materials available. Various handy analysis kits for dissolved oxygen and other determinations are now sold (see Appendix).

Professional help is especially advisable with regard to **design** of the investigational program and **interpretation** of the results. Design involves planning the right sampling at the right times. Interpretation involves judging what the data mean in terms of pond biology and what the implications for management are.

Knowing **maximum water depth** and calculating **mean depth** are important, as are observing **abundance of aquatic plants** and keeping

Circulation and thermal (or density) layering of water in ponds. Not only temperature but amount of oxygen available to fish is strongly influenced by the progression of circulation and layering through the seasons. Very shallow ponds (not shown) may have complete circulation for much of the summer, but they are much more likely to have depletion of dissolved oxygen in winter.

records of fish caught (species, length and weight). It is essential to identify possible sources of phosphorus overenrichment, such as septic systems, livestock wastes, soil and fertilizer erosion, and roadway runoff.

Much of direct importance to fish can be learned by systematically monitoring **dissolved oxygen (DO)** and **water temperature** within the pond. Along with the chemical kit for DO measurement, a special sampling device (DO sampler) should be obtained (see sources in Appendix).

Crucial times to analyze water temperature and DO are (1) in mid or late summer after a week or more of very hot weather and (2) in winter after ice and snow have been on the pond for a month or more. For a more detailed picture, monitor the