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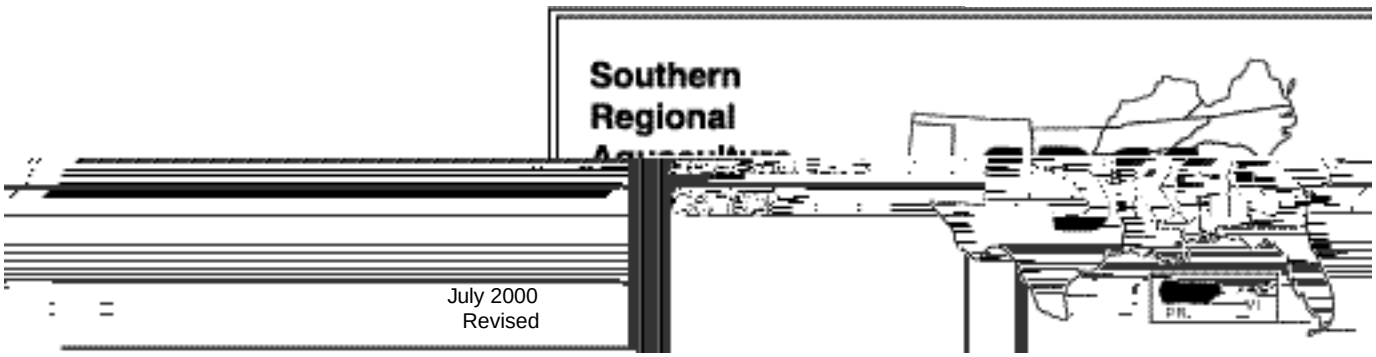

Trout Farming

Carrying Capacity and Inventory Mana gement

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The carrying capacity of a trout production unit depends on fish size and water quality factors such as oxygen content, tempera ture, water flow and volume. Most commercial trout farms in the South use rectangular concrete tanks in series, called raceways. Carrying capacity is usually expressed in terms of pounds of fish per unit of water flow (load - ing rate) or per cubic foot of rear- ing space (density). A number of different formulas have been devised to calculate carrying capacities, taking into account oxygen consumption, growth rate of fish, feeding rates, water vol- ume and temperature, and other factors. As long as the appropriate limiting factors are monitored, the choice of method for estimating carrying capacity is a matter of operator preference.

Limiting factor s

The trout culture industry in the South has developed mostly in the Southern Appalachian region, and depends primarily on divert - ed streams for water supplies. Dissolved oxygen and ammonia (un-ionized) concentrations ar e the primary limiting factors in these culture systems, with oxy- gen normally the more critical.

The surface waters where most trout farming takes place ar e poorly buffered (total alkalinity < 10 ppm), and have a pH averag- ing 6.5 to 7.0. The slightly acidic pH results in a high level (> 99 percent) of ionized ammonia, which is relatively non - toxic to fish. In water with these characteris- tics, the first limiting factor to trout produc - tion with a given water flow is oxygen availabil - ity. Water is aerated by allowing it to fall into the next tank, or by using oxygenators to add pure oxygen.

In systems where pur e oxygen is not added, the next limiting factor would be the solid wastes and nitrogenous wastes released by the fish. Depending on the system design, these metabolic wastes will become limiting after approximately 10 serial reuses of the water. Efficient waste removal can increase the number of times water can be reused.

In systems that add pur e oxygen, the next limit - ing factor will be an accumulation of carbon dioxide from the fish. The farmÕs oxygena tion and aeration systems should be able to remove carbon dioxide from the water.

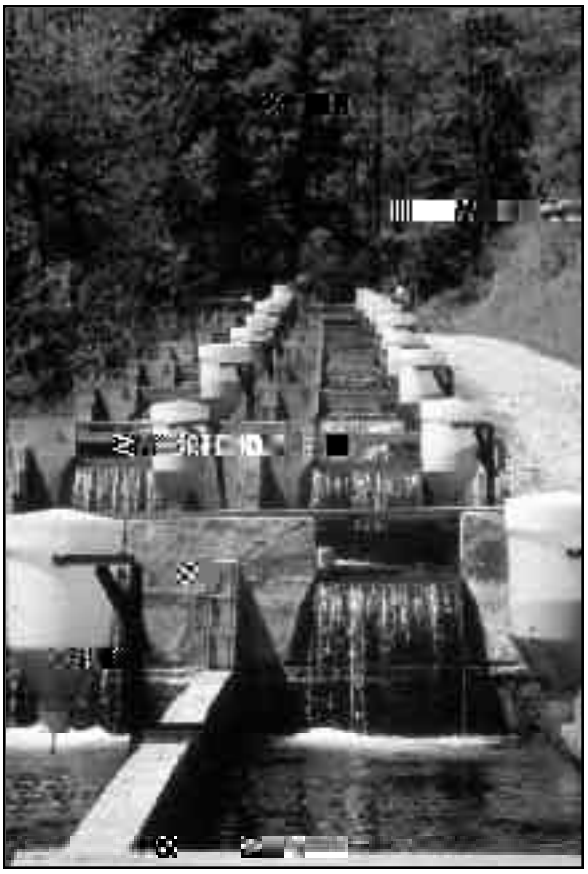

Figure 1. Serial water reuse in a Southern Appalachian trout farm.

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Where water supplies are more alkaline and have a higher pH (> 7.5), oxygen is normally the critical limiting factor for the first three to six uses of the water. After this, the buildup of un-ionized ammonia will prevent further use of the water for efficient trout production.

Tank loading rates should be decreased when dissolved oxygen levels at the outflow drop below 6 parts per million (ppm). Every trout farm should have a dissolved oxygen meter. Several models are available; buy the best you can afford and know how to use it. Smaller farms may find a chemical oxygen test kit more economical, although somewhat more difficult to use. The kits are potentially very accurate, but are relatively cumbersome and time consuming to use with multiple rearing units.

Estimating carrying capacity

There are many ways of estimating the carrying capacity of a trout farm. All are based on the metabolic requirements of the fish and the effect the wastes released by the fish have on the water. The easiest method of estimating maximum fish density for a tank is to keep maximum fish weight within a level of 0.5 to 1 times the fishesÕ length in inches, in pounds per cubic foot. For example, maximum densities for 2-inch fish would be 1 to 2 pounds per cubic foot; 4-inch fish could be kept at up to 2 to 4 pounds per cubic foot. The multiplying factor is referred to as a *density index*. Although the density index used for trout can exceed 1, production efficiency and growth rates may decline without a significant increase in management effort and water flow.

Many trout farmers simply maintain all sizes of fish on growout facilities at 4.5 pounds per cubic foot as an upper limit for fish density, although with proper management and oxygenation the density can be much higher.

When planning the quantities of fish to stock, estimate the total weight of fish the tank can support at harvest, then divide the total weight by the average size of the fish at harvest to determine the appropriate number. Allow approximately 10 percent loss for mortalities, depending upon the fish size, the length of the culture period, and the past history of fish survival on your farm.

The density index estimates only the appropriate density of fish without regard to water flow through the system. Water flow rate will determine how quickly other water quality factors become limiting in each production unit. The loading rate of a tank must also be considered when planning production. An estimate of the appropriate carrying capacity of trout relative to water flow is to keep tank loadings within a level of 0.5 to 1 times the fishesÕ length in inches, in pounds per gallon per minute (gpm) of water flow. For example, 2-inch fish at 1 to 2 pounds per gpm, 4-inch fish at 2 to 4 pounds per gpm. This factor is referred to as a *flow index*, and works on the assumption that the water flowing into a tank is at or near saturation with dissolved oxygen. If the water inflow is below saturation, then decrease the carrying capacity in proportion to the reduction in oxygen saturation. For example, a tank with 100 gpm inflow at 100 percent oxygen saturation could maintain a maximum of 1,000 pounds of 10-inch trout (at 55 to 65ºF) with normal feeding rates. The same 100 gpm inflow at 85 percent oxygen saturation should support up to approximately 850 pounds of trout.

These indices should be used as a guide for planning production and stocking on a traditional raceway-based trout farm in the South. Factors such as oxygenation or aeration capacity, extreme temperatures, or very high or very low water exchange rates will influence the carrying capacity of an individual farm. In a properly designed raceway facility with water exchange between 10 and

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