young, but move out after a few weeks of growth; corydoras look for dark corners or hide underneath surfaces if available.

3.61 Stocking density

Some comments on initial stocking numbers are made in 3.48 above. In the first stage of the two-stage culture method suggested in this book, the aim in principle is to initially stock the maximum number of fish that can reach the size at which they will be ready for transfer to the next grow-out facility, without adjusting numbers. An exception to this is mentioned in the NOTE at the end of 3.48, which explains how larvae can be stocked at much higher densities initially to increase the numbers of fry (stock levels) being held of each species. They are held at these high densities for three or four weeks, after which densities are reduced by splitting the fry when empty tanks become available. For the second stage of culture, when about two months old, the groups of fish are moved to a larger grow-out system for on-growing to sellable size.

In any culture routine, stocking density is extremely important to health and growth rates, and needs to be well understood so that if problems related to stocking density do arise these will be recognized, enabling adjustments to be made. Stocking density is particularly significant in its impact on the biological load. (See 1.2 'Water: chemistry, sources, temperature and biological load'.) The more fish weight (usually referred to as 'mass' of fish) relative to the volume of water in which they are cultured, the higher the oxygen consumption will be, the higher the food input, and the greater the amount of waste products such as faeces, urea and carbon dioxide, and thus the higher the 'biological load' will be on the water. Measuring stocking density in terms of fish weight to water volume is therefore a very useful way to gauge the load that a culture system is carrying.

Stocking density is also sometimes measured in numbers of fish stocked in a given volume of water, and less frequently, numbers of fish or fish-mass per unit of water surface area in big systems such as dams. Using numbers of fish as the measure of stocking density is less meaningful in terms of bio-load because small fish are less impacting than the same number of larger fish in the same volume of water. Nevertheless, this is a very useful measure when working with very small fish such as ornamental fish, and is most frequently used.

Another very important aspect of stocking density with ornamental fish is that fish species differ in their response to high stocking densities. This usually only becomes evident after fry are quite large, for example after about two months of age. The problem appears to be related to the proximity of one fish to another of the same or different species, or is possibly due to the release of pheromones into the water. Over-stocking in this case is evidenced by a decline in growth rate as fish grow. Good growth rates can be regained by reducing stocking densities once this is noticed.

In principle, lower stocking densities produce higher growth rates and better health in all species. There is, however, a point at which reducing the stocking density will no longer produce a useful increase in growth rate, and will in fact become uneconomical. It must also be borne in mind that there is no exact 'best' stocking density, rather a workable range between a maximum at which growth rate starts to decline too much, and a minimum at which growth rate no longer improves sufficiently to be viable.

Generally, pushing to the higher side of the acceptable range will prove optimal in most circumstances; however the manipulation of stocking density is an extremely useful tool. Growth rates can be increased or slowed by decreasing or increasing stocking densities, always bearing in mind that there is an increased possibility of problems arising at excessively high stocking densities.

This method of controlling growth/size is commonly used when holding large stocks of young goldfish which are to be sold at a small size at a later time. These are held at high stocking densities to slow their growth. Goldfish, being a relatively resilient species, are well suited to this. The cooler climates in which goldfish are normally cultured on a large scale also help the process. This is because in the cold winter months dissolved oxygen levels are higher; many diseases – though not all – are less problematic; water quality is more stable (or at least changes occur more slowly) and growth is naturally slow, as is the overall metabolism of the fish. In some regions ponds may even be covered with ice.

For the reasons explained, very high stocking densities in terms of numbers are possible while fry are very small. However, as fry grow, provided