**AQUACULTURE INFORMATION SERIES NO. 4**

# POND INVENTORY METHODS

## INTRODUCTION

Perhaps the most important fish health management tool available to the fish farmer is the population inventory. The main purpose of this procedure is to document the individual length increases, the individual and total weight gains and the feed conversion ratio obtained during the proceeding growth period. In addition, the data acquired from the inventory process provides the status of the population relative to the carrying capacities (oxygen or life support, density, and ammonia) of the pond and to the size variation within the population. These aspects are the more significant reasons for implementing population inventories on a regular basis.

The effects of exceeding one or more of the pond carrying capacities are dose dependent; i.e., the degree of effect of having ponds stocked above a carrying capacity is dependent upon the degree of the overstocking. The main clinical signs are environmental gill disease, reduced growth rate, reduced feed conversion, increased fin nipping, and fin fraying (loss of tissue between the fin rays).

The inventory process consists of three major activities: (1) sampling; (2) data collecting; (3) data analyses.

## SAMPLING METHODS

The following sampling methods are generally accepted as adequate. Before implementing one of the following methods to sample a population of fish, the fish should not have been fed for at least 18-24 hours to minimize the effects of the stress response.

A. "Grab" Sampling With Crowding:

The fish are crowded to the inflow end of the pond. It may be beneficial, if the water inflow is very turbulent, to insert a screen just downstream of the inflow to reduce the injury to the fish from the turbulence. If the water is clear, the fish are crowded to the point where the bottom of the screen is not visible. If the water is not clear, the fish are crowded to the point where they seem quite "unhappy" about the situation.

Three to five nets of fish are taken from the population at different points. The fish are either weighed in toto and counted or individually weighed and measured. In either event, the fish should be returned to the area outside the crowded population to preclude their being handled twice.

B. "Grab" Sampling Without Crowding:

A few (2-3) handsful of feed are cast into one area of the pond. When there is a "feeding boil", fish are sampled using a long-handled dipnet or a cast net. The fish are either weighed in toto and counted back into the pond or are individually weighed and measured. The process is repeated 2-3 times in different areas of the pond to ensure

representative sampling of the population.

C. The "5-by-5" Sampling Method:

The population is crowded toward the inflow end of the pond. A livebox (ca. 1 m x 1 m x 1 m) is placed just downstream of the crowding screen. Five nets of fish are removed from different areas of the crowded population and placed into the livebox. One net of fish is removed, weighed and counted into the area downstream from the crowding screen. The fish in the livebox are released downstream also. This process is repeated 5 times. The fish in at least one and preferably two of the weighed and counted samples should be individually weighed and measured.

**DATA COLLECTION**

A. Individual Lengths and Weights:

Anesthetize, weigh (+/- 0.1 g), and measure (+/- 1 mm) at least 40 fish from each of 2-3 samplings.

Of all the inventory data analyses, the individual weight and length values provide the greatest degree of sensitivity. Using the mean (average), median, and midrange values, sampling bias can be detected. If the three values are equal, then there was no bias. If the mean and/or median values are greater than the midrange value, then the sampling favored larger fish. Correspondingly, if the mean and median values are less than the midrange value, the sampling favored the smaller fish.

Sampling bias can be viewed from several aspects. At one extreme it can be dismissed, while at the other extreme it can mean collecting more data. Most people choose to ignore it and plan to do better next time. Some, on the other hand, will use it as an indication that the population should be size-graded to reduce its impact. This is by far the best interpretation and the most effective in the long run.

This method is quite time consumptive and requires more attention to detail than other methods. To be most effective, individual weights and lengths should be a routine practice. If this method is implemented once every month or so, its effectiveness diminishes. Then staff loses interest and reverts to simpler, less effective methods. The term "less effective" is not to be equated with "ineffective".

B. Lot Weight Method:

A net of fish is weighed (+/- 1-5 g) and the fish counted back into area of the pond outside the crowded population, if applicable. Otherwise, return the fish to the pond.

Weighing can be accomplished by one of the following methods:

1. Tare a hanging or platform balance with a bucket containing water. Either count the fish into the bucket before recording the weight or place fish into the bucket, record the weight and count the fish out of the bucket.

2. Tare a platform balance with an empty bucket and a wet net. Weigh a group of fish in the net placed in the bucket. Count

the fish out of the net. Record the new tare (water from the fish the bucket) with the wet net. This value is subtracted from the fish weight.

The weight of a group of fish can also be determined by the water displacement method. In this method the displacement container should be calibrated for the size of the fish being inventoried.

1. Select a 35-40 liter straight-sided container. Mark 1 mm increments on the inside of the container. Calculate the cross-sectional area and the volume of 1 mm increase in water depth.

2. Place the container on a platform balance having a sensitivity of +/- 10 g. Put a known volume (liters) of water into the container and record the mm level at the top of the water. Tare the balance to zero.

3. Put a net of fish into the container, record the weight, record the new water level, and count the fish back into the pond.

4. Calculate the biomass of fish which displaces 1 mm of water depth.

5. Weigh and count 3-5 samples per pond. Samples should come from different areas in the pond.

One disadvantage of the water displacement method is its lack of sensitivity and accuracy, especially if the unit is not calibrated. In addition, active fish in the unit can make estimating the displacement level very difficult. To reduce this effect, it is suggested that an external sight-tube be installed and calibrated.

**DATA ANALYSES**

A. From the individual weight and length values, the following parameters can be calculated:

1. Mean (average) length and weight per fish

2. Median values for length and weight in the samples. Rank the values and select the value for the n/2 fish; e.g. the median for 40 ranked values would be the value lying between the 20th and 21st sample.

3. Midrange values for length and weight. The value lying halfway between the largest and smallest value.

4. Condition factor (weight in g divided by the cube of the length in mm)

The following parameters are optional but quite informative:

1. Standard Deviation (the value +/- the mean in which 65% of the population will reside). It is a good indication of the degree of size diversity within the

population).

2. Coefficient of Variation (the Standard Deviation divided by the Mean). It is of value to indicate the size variation within the population.

Using the data from the previous inventory and the data collected during the preceding growth period, the following parameters can be calculated:

1. Average weight (g) gain per fish

   Gain = ending weight minus starting weight

2. Total biomass (kg) gain in the population

   Biomass = (headcount * mean g per fish) / 1000

   Gain = biomass at end minus biomass at start

3. Average length (mm) gain per fish

   Increase = end length minus start length

4. Average daily length (mm) increase

   Increase (mm/day) = total increase (mm) / days

5. Specific Growth Rate (daily % weight gain)

   $SGR = (((ewgt - bwgt / bwgt) + 1)^{1/n} - 1)$

   Where: ewgt = mean ending weight (g) per fish
   bwgt = mean starting weight (g) per fish
   n = number of days in the growth period

B. Using the lot weight data, the following parameters may be calculated:

1. Determine the number of fish per kilogram by totaling the number of fish and lot weights and dividing the total lot weight by the number of fish. The result is the mean weight per fish which is divided into 1000 to generate number of fish per kg.

The methods used to determine the number of fish per kg are not very time or labor consumptive. The data acquired are quite accurate and reliable - however, only if the limits of the procedures are followed. The methods provide only a limited amount of data; e.g., there can be no determinations of mean, median, and midrange length values or condition factor values. Without such data, it is very difficult to assess size variation in the population and daily length increase.

The presence or absence of sampling bias may be identified by determining the number of fish per kg in each sample lot. It is not unusual in a raceway population to have the larger fish near the inflow end and the smaller fish at the outflow end of the pond. This actually does not indicate bias. In this case, the composite no./kg would be quite representative of the population as a whole. If samples taken from a circulating or static pond indicated quite a variation in fish size, then sampling bias would be indicated.

2. Weight gain per fish during the preceding growth period can be calculated by subtracting the beginning weight (g) per fish from the ending weight (g) per fish.

3. The ending biomass (kg) and the biomass gain (kg) in the population can be calculated by multiplying the headcount by the average fish

weight (g) and subtracting the starting biomass from the ending biomass.

4. The feed conversion ratio can be calculated by dividing the amount of feed (kg) fed during the preceding growth period by the biomass gain (kg).

5. The Specific Growth Rate (daily % weight increase) can be calculated using the equation presented above.

6. Using the mean weight of individual fish calculated using the number per kg method, it is not advised to calculate the length or condition factor using a mathematical equation or a weight:length table.

**Summary**

A suggested approach to inventorying a population of fish throughout their production cycle is to implement several of the methods described.

Begin the process when the pond is stocked. Determine the number per kg and weigh the fish into the pond. At the completion of the pond stocking determine the number per kg again. Also, anesthetize a group of 40 fish for individual lengths and weights. Calculate the mean, median, midrange and standard deviation values for lengths and weights. Also, calculate the mean condition factor. This will detect size bias from the original population to the new population. It will also facilitate constructing the daily feeding regimen.

The population should be inventoried at 14-day intervals. The first 2-3 inventories could be done with grab samples with crowding. One of the samples (at least 40 fish) should be weighed and measured individually. At intervals of 2-3 months or when the pond population is reduced and or graded, the "5-by-5" inventory method should be used.

If performance data are used to their fullest advantage, the FCR's and the fish quality should improve measurably, thus reducing the production costs accordingly.

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