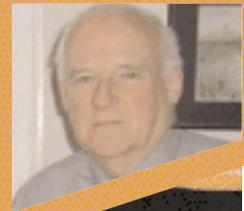
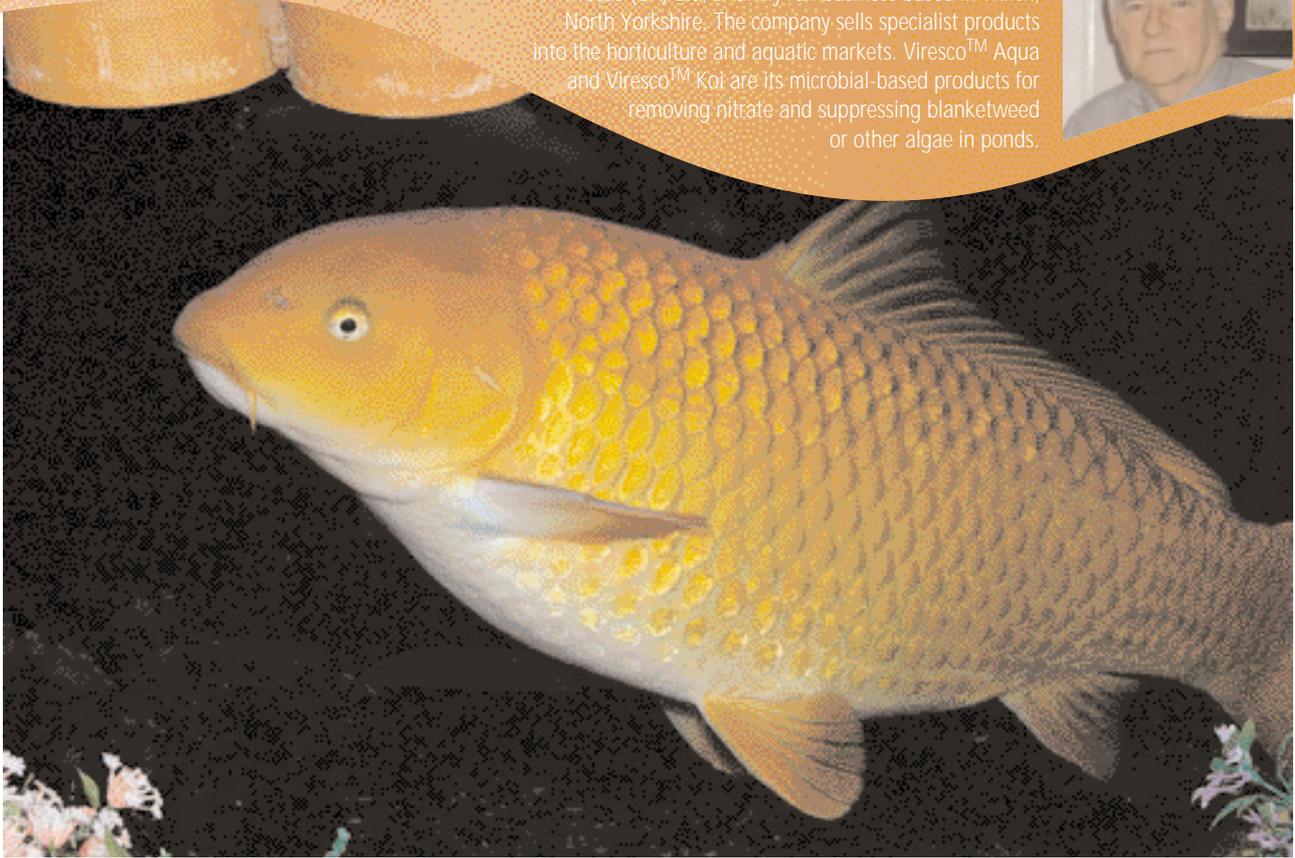


John McLauchlan is the Managing Director of Viresco (UK) Ltd, a family run business based in Thirsk, North Yorkshire. The company sells specialist products into the horticulture and aquatic markets. Viresco™ Aqua and Viresco™ Koi are its microbial-based products for removing nitrate and suppressing blanketweed or other algae in ponds.



Now, who'd have thought that a Chagoi would be the contender for the fat koi example?
Photo by Dave Bevan



weighty issues...

John McLauchlan, Managing Director of Viresco UK Ltd, talks about his new formula for assessing the weight of koi and its implications on pond treatments, stocking rates and feeding...

For a number of years, our company has been selling various microbial-based products used primarily to remove nitrate in pond and aquarium water. This results in the removal of blanketweed and algae bloom from the water. Once the nitrate level is taken down to zero, the various forms of algae die of starvation.

The first product, Viresco™ Aqua, was launched just over nine years ago. From the outset, our main microbiologist adviser suggested that a 10g pack of Viresco™ would normally be sufficient to treat a 6,000-gallon pond. Whilst we have had a great many successes with this one rate of use in general garden ponds and specialist koi ponds, we have

questioned whether this simple application rate can be appropriate for all ponds. Because the microbes in our mixes will remove all the nitrate arising from the ammonia excrement from fish, it seems sensible to assume that fish stocking levels, feeding regimes and types of food must affect the amount of ammonia being excreted by the fish and therefore the amount of nitrate coming out of the filter and into the pondwater.

We consequently suggested to koi keepers they should use more Viresco™ if their ponds contain more than 60in of fish per 1,000 gallons, if they are over-feeding and if they are feeding long runs of high protein food. Of these variables, we realise that looking at the size of fish in terms of length is rather weak

when it relates to the amounts of ammonia excreted by the fish.

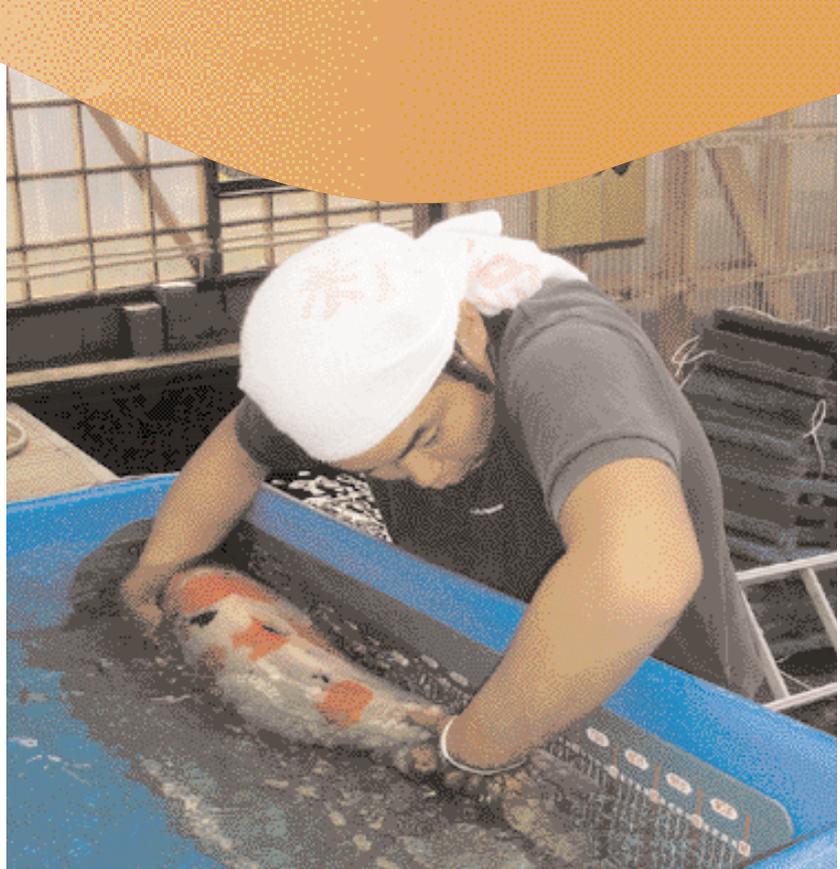
Therefore, the purpose of this article is to examine more closely the relationships between koi length, their shape, their weight, their feeding regimes and their stocking levels. This will enable koi-keepers to more accurately determine the amount of Viresco™ algae-removing products they should use in their pond, and indeed other products which depend on stocking rate information. The key to this question is the calculation of the total weight of all the koi in the pond. Knowing the weight of the fish, the koi-keeper can also determine the amount of food he should be giving. ▶

Looking at the size of fish in terms of length is rather weak when it relates to the amounts of ammonia excreted by the fish

A standard-shaped Sanke. Photo by Dave Bevan



Manju Tanaka Fish Farm measuring koi just in from the autumn harvest. Photo courtesy of Evolution Aquatics



units used

In the UK, the volumes of hobby ponds are usually measured in gallons. Fish food is sold in kilos. The lengths of fish are generally known and given in inches. We sell our pond Viresco™ products, Viresco™ Aqua and Viresco™ Koi – in grams for various pond volumes, expressed in gallons. There is thus a mixture of metric and UK units used by the pond-keeper. In this article, we shall link the length of a koi in inches to its weight in kilos! There is a particular advantage in doing this as will be seen in the section below.

weight of koi versus length

The weight of a koi of a fixed length is also related to its shape. Three distinct shapes are considered. These are 'standard', 'fat' and 'skinny'. Photographs of these typical shapes are shown.

From various sources that give the weights of koi relative to their length, we have been able to devise a simple but relatively accurate formula to calculate their weight from their length.

The weights of koi are directly proportional to the cube of their length. The approximate weight of a koi can be calculated from the simple formula, $W = L^3/K$, where W is its weight, L is its length and K is a constant that depends on the shape of the fish.

For a 'standard'-shaped koi, its

approximate weight can be calculated from the following formula:

$W = L^3/5000$ where W is the weight in kilos and L is the length in inches.

Fatter koi of the same length can be up to 50% greater in weight than the standard-shaped koi. A standard-shaped koi can be as much a double the weight of a skinny-shaped koi.

Thus the formulae for the fat and skinny koi shapes are as follows:

$W = L^3/3333$ (fat-shaped fish)

$W = L^3/10000$ (skinny-shaped fish)

It can be seen that using inches as the unit for length and kilos as the unit for weight, the three different constants for shape are relatively easy to remember – 3,333, 5,000 and 10,000. (fat, standard and skinny).

Thus, for 36in of fish, one fat one at 36in length weighs about 14.00kg and six skinny

ones, each at 6in length, weigh a total of about 0.13kg. Thus, the one fat one is over 100 times heavier than the sum of the weights the six smaller ones. Some examples are displayed in the table below.

stocking levels

Fish stocking level is a subject that should concern many more pond-keepers than it seems to at present. Many do not realise their fish can put on considerable increases of weight in a season. Some also add more fish to their pond and the filter, which during the previous year had more than sufficient capacity to turn all the excreted ammonia into nitrite and then nitrate, is now working near its limit. The calculations below can help the pond-keeper decide the ideal level of fish stocking for his pond.

Some examples are displayed in the table below:

Length in inches	Weight in kilos (fat)	Weight in kilos (standard)	Weight in kilos (skinny)
6	0.065	0.043	0.022
12	0.518	0.346	0.173
24	4.145	2.765	1.382
30	8.101	5.400	2.700
36	14.000	9.331	4.666

A standard-shaped koi can be as much a double the weight of a skinny-shaped koi

**use of Viresco™ Aqua and Viresco™
Koi in ponds**

As mentioned above, we suggest that 10g of either Viresco™ Aqua or Viresco™ Koi be used in 6,000 gallons of pondwater. These two products remove nitrate that arises from the filter from ammoniacal fish waste. The implication is that it refers to about 2½kg of koi weight per 1,000 gallons, i.e. about half the stocking level of the medium density pond of 5kg per 1,000 gallons shown below.

This means that 10g product can be used in a 6,000-gallon pond with up to 15kg of fish in it. This 15kg can consist of, for example:

- Two x fat 30in koi or
- Four x fat 24in koi or
- Nine x fat 18in koi or
- Three x standard 30in koi or
- Six x standard 24in koi or

- Thirteen x standard 18in koi or
- Six x skinny 30in koi or
- Eleven x skinny 24in koi or
- Twenty six x skinny 18in koi

For any weight greater than about 2½kg per 1,000 gallons, more Viresco™ should be used proportionate to the increased weight.

The amount of Viresco™ recommended for use relates to a maximum feeding regime of 2% of body weight, i.e. for good general growth. If overfeeding takes place, e.g. at the rate of 3% of body weight, then 50% more Viresco™ should be added. Similarly, if high protein food is used, then 50% more Viresco™ should be applied. ▶

The website of the Rocky Mountain Koi Club in the USA suggests that the fish stocking levels for a range of applications might be as follows:

1lb of fish per 1 US gallon	high density fish farm
1lb of fish per 10 US gallons	medium density fish farm, very high density koi pond
1lb of fish per 100 US gallons	low density fish farm, medium density koi pond
1lb of fish per 1,000 US gallons	high density Japanese mud pond, very low density koi pond
1lb of fish per 10,000 US gallons	low density Japanese mud pond
1lb of fish per 100,000 US gallons	well stocked fishing lake
1lb of fish per 1,000,000 US gallons	nature

The above figures approximately convert to:

1kg of fish per 2 UK gallons	high density fish farm
1kg of fish per 20 UK gallons	medium density fish farm, very high density koi pond
1kg of fish per 200 UK gallons	low density fish farm, medium density koi pond
1kg of fish per 2,000 UK gallons	high density Japanese mud pond, very low density koi pond
1kg of fish per 20,000 UK gallons	low density Japanese mud pond
1kg of fish per 200,000 UK gallons	well stocked fishing lake
1kg of fish per 2,000,000 UK gallons	nature

From the above, the stocking densities for koi ponds are as follows:

1kg of fish per 20 UK gallons	very high density koi pond
1kg of fish per 200 UK gallons	medium density koi pond
1kg of fish per 2,000 UK gallons	very low density koi pond

These figures are the same as:

50 kg of fish per 1,000 gallons	very high density koi pond
5 kg of fish per 1,000 gallons	medium density koi pond
0.5kg of fish per 1,000 gallons	very low density koi pond



This is a young male Doitsu Kohaku with a slim shape. Photo courtesy of Evolution Aquatics

feeding regimes

It is recommended the approximate food consumption for koi per day should be as follows:

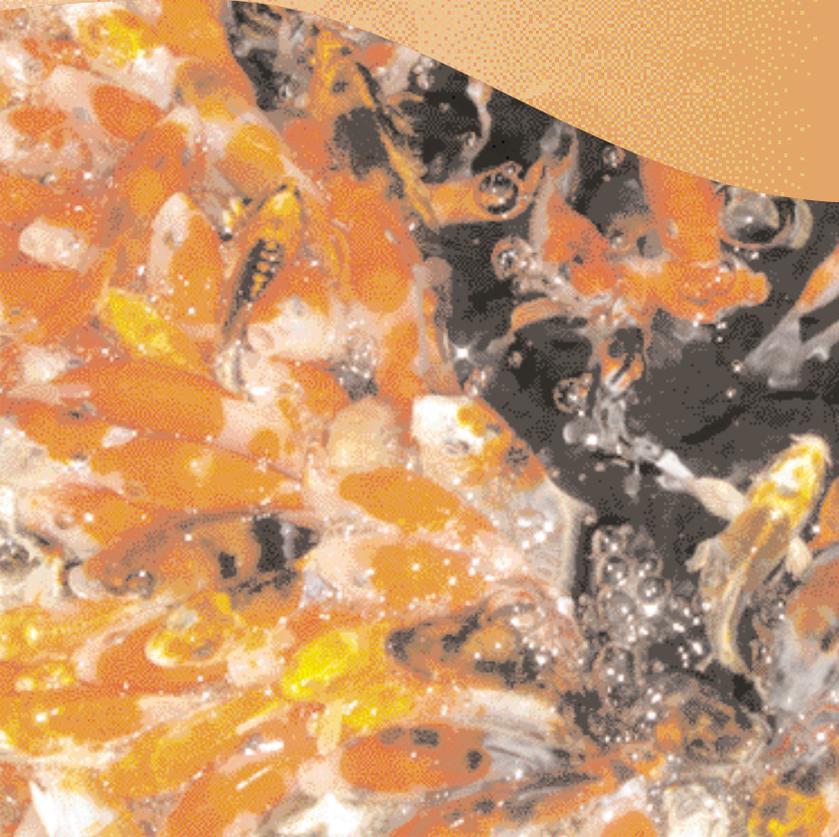
- 0.5% of body weight for minimum maintenance.
- 1% of body weight for better maintenance.
- 2% of body weight for general good growth.
- 3% of body weight for maximum growth.

Thus, the koi-keeper, knowing the lengths and the shape of each of his fish, can now calculate the total weight of all the fish in his pond. From that weight, he can then calculate accurately how much feed to use, dependent on the level of maintenance or growth he is seeking.

Bear in mind that high protein food contains approximately 50% more protein than wheatgerm. (say, 45% v 30% protein).

Fish stocking level is a subject that should concern many more pond-keepers than it apparently does at present

It stands to reason that you're going to be able to stock more koi if they're smaller – this not only depends on length, but also their weight! Photo by Christina Evatt



an example of one trial protocol

One very extreme trial situation was put to us. The relevant parameters were:

- A 2,200 gallon pond.
- Containing 15 fish each of 60cm (24in) length.
- With excessive feeding of 400g per day of very high (52%) protein food.

Assuming the 15 koi are all fat shaped, at 24in, each will weigh about 4.1kg. The total is, say, 60kg. For 2,200 gallons, our recommended stocking level would be a

maximum of 2½kg per 1,000 gallons, ie about 5.5kg, when using Viresco™ at the rate of 10g per 6,000 gallons. The total fish weight is therefore about 11 times greater than that for our recommended rate of product use. The feeding rate is 400g per day. This is about 7% of the total weight of the fish which works out to be about 3.5 times our suggested rate of 2% of fish weight per day. The protein level at 52% is very high and is about 1.7 times that of wheatgerm. Thus the amount of Viresco™ that should be

applied is 11 x 3.5 x 1.7 = about 65 times our recommended rate! If the koi were not a fat shape, then this figure of 65 times could be reduced to about 43 times if a standard shape, or 22 times if a skinny shape.

This trial situation is very extreme and the hobby koi-keeper will never be running his pond with similar parameters.

corollary

We have stated above, for a medium to low koi pond stocking density of 2½kg koi per 1,000 gallons, a minimum dose of 10g per 6,000 gallons of our microbial Viresco™ would be required. However, where fish stocking levels are much lower than 2½kg koi per 1,000 gallons, e.g. typical fishing ponds, then considerably less of our product can be used per unit volume of water.

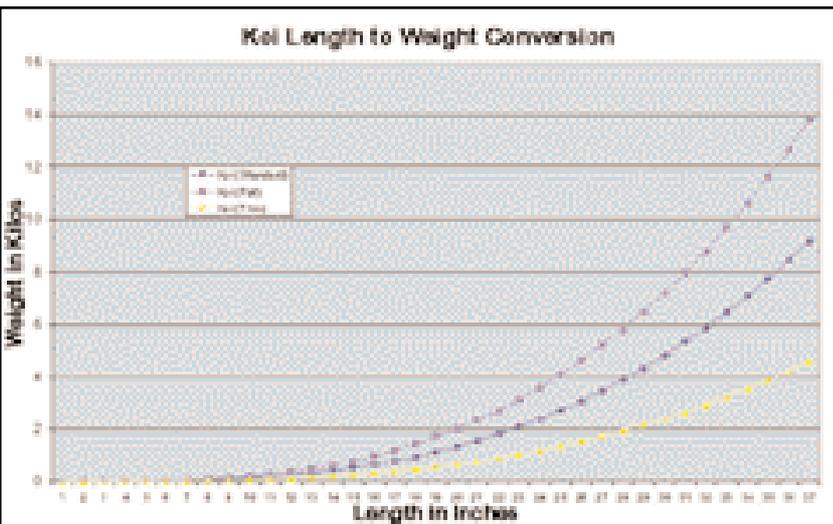
From the section above that quotes typical fish stocking levels for different applications, the stocking level for a well stocked fishing lake is given as 1kg per 200,000 gallons. This is equivalent to 0.005kg of fish per 1,000 gallons. This is one 500th of the stocking density of 2½kg per 1,000 gallons implied as a minimum weight of koi for 10g per 1,000 gallons product application. Thus on a pro-rata basis, a 10g pack of Viresco™ product should be enough to treat 3,000,000 gallons of fishing lake. Viresco (UK) Ltd is now looking at the use of their microbial nitrate removing products in large fishing ponds.

In the analysis given above, it is assumed that the entire nitrate in a koi pond arises from the conversion of ammoniacal fish excrement to nitrite and then to nitrate in the filter. However, additional nitrate can arise from the excrement of visiting birds and other pond creatures, such as newts or frogs. It can also arise from the additions of tap water, rainwater and other water in-flows such as streams or springs.

conclusion

Using the graph shown or the formulae quoted in this article, the koi-keeper can accurately determine the weights of each fish in his pond from its weight and shape. From this information, more accurate pond additions, e.g. food or our nitrate removing microbial products, can be calculated. 鯉

A graph showing the relationship between koi length and weight for the three different koi shapes is presented



Knowing the weight of the fish, the koi-keeper can also determine the amount of food he should be feeding