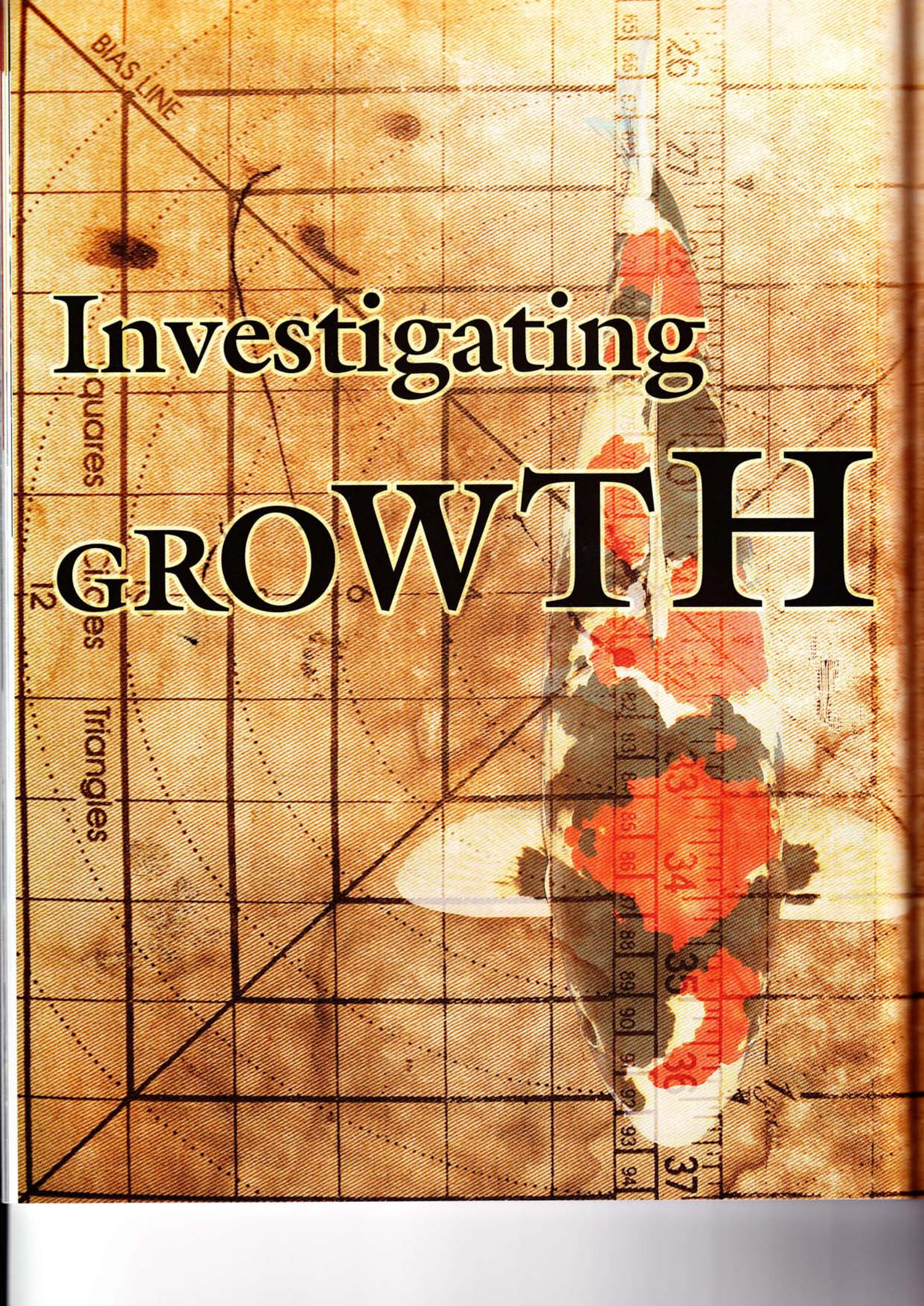


Investigating

GROWTH





What water is best for growing Koi?

BY HEFIN "MOSES" JONES

WATER QUALITY HAS LONG been a bone of contention with Koi keepers, breeders and dealers alike. Many agree that it is not only how well the water is managed, in terms of pH, ammonia, nitrite etc that has to be considered. Disagreement seems to stem from that elusive "something" that the Japanese breeders seem to use, whether it is in the North or South of the island.

Following a visit to Japan, I became bothered by the fact that despite low temperatures in the north, the breeders were just as keen as their counterparts in the south to place some of their better Koi into mud ponds. They assured me that it was not only because of financial reasons. They kept reminding me that the best rice in Japan was in the north, which suggested something in the water.

Plenty of evidence has shown that temperature plays a significant part when trying to develop a Koi to the largest size possible, whilst retaining the essential reasons for buying it, i.e. skin quality, body shape/type etc. Yet, when assessing temperature, it is necessary to consider positives and negatives. It is not only cold temperatures that stop the fish from eating. During the summer, the temperatures in the mud ponds have been known to reach above 30°C/86°F. At these temperatures, Koi are known to stop feeding. This should result in the fish not growing significantly in terms of weight and length. However, the contrary occurs.

Mud Pond Myths

Some Koi enthusiasts in the UK believe Koi are put into Japanese mud ponds because the high mineral content and low stocking levels will make the Koi potentially grow larger and at a faster rate than would otherwise be the case. Some breeders in Niigata dispute this because they know that the soil in the area is so poor that nothing much more than rice can be grown in it. Mud ponds can offer benefits such as live insects, and plankton, but some Japanese breeders do not place their fish in mud ponds and can still grow them to the British Koi Keepers' Society (BKKS) and the International Judging Standards Committee's (JSC) Size 7 and above classification of 'jumbo' (above 75cm/29½in) in length.

Some Japanese breeders, industrialists, and University professors have recently made important discoveries that link good Koi health, excellent growth and superior Hi (red) development to total dissolved solids (TDS) levels. They believe that low TDS levels will enhance Koi growth, the Hi will be thicker, so that the red will go through the scale entirely and the fukurin (skin between each scale), the shine of the skin will improve and the health of the Koi will be stimulated to reduce problems. "The lower this is (TDS) the better suited the water is to the raising of Nishikigoi. A reading below 50 parts per million is considered desirable." They believe that it is the low TDS levels of the mud pond (generally 35-108 parts per million) that enhance the fish and not the mud per se. This was the premise for my further study.

In 2008, as part of an undergraduate dissertation, I carried out a research investigation into the effects of TDS on the growth, in terms of length and weight,

Although I had originally thought that there might be some differences in growth and weight because of TDS, I was surprised at the extent.

of one-year-old female Japanese Koi carp (*Cyprinus carpio*).

The Investigation Begins

All the Koi came from Yamatoya Koi Farm, which is located in Shimane prefecture in south-western Japan. The farm is owned and run by Shiraishi-san, who breeds only Gosanke varieties and who bred the Grand Champion of the All Japan Koi Show in 2009. Through consultation with my local dealer, who is very well versed with Shiraishi san's lineage, I chose to use Kohaku from the same parents and from the same spawning.

These Koi were 14-18cm/5½in-7in when they arrived in the UK. They were placed in five different ponds in three locations within the UK. Two of these locations were in different areas in South Wales and one was in the Bristol area. The collections were housed in indoor concrete ponds with a TDS of:

30 ppm (and yes, it really is that low)
70 ppm
100 ppm
190 ppm
230 ppm

This experiment was carried out from May until October inclusively when the temperatures were warmest in the UK, so that heating costs were minimised.

All ponds were estimated to be of equal size and capacity with around the same water pressure and water flow rate. Similarly, each pond had the same amount of aeration. All environments retained the same temperature (23.5), dissolved oxygen (14.6), pH (7.2 – 7.4), ammonia (0), nitrite (0.02) and nitrate levels as well as the number of daylight hours to which the fish were exposed. All ponds were in soft water regions and were specifically chosen because soft water has been proven to retain the Beni to a higher standard, for longer. The intention had always been to grow the fish without jeopardising their quality in any way. The water parameters of each environment were measured and all results were recorded.

All fish were given the same mixed diet and the same amount of diet was offered each day. All fish were monitored for six months after one month of quarantine, with measurements of length and weight being recorded.

Before reaching any conclusions, many aspects had to be taken into consideration, such as the month of quarantine. This was not only to ensure that the fish were in top health, but also to allow for a period where the fish could de-stress and become acclimatised to their surroundings. This was in relation to research carried out by the University of Plymouth that shows fish have a memory span of at least three months.

It also related to some current theories that suggest that imported fish will not achieve their full growth potential. It is believed that when fish (especially Koi) are exposed to a situation where it is highly stressful, e.g. being transported from Japan, they are not only more likely to show signs of sickness, but are stunted in their growth. This may mean (not always) that they will never recover this growth retardation. By studying the growth of fish, which had been imported at the same time, it was anticipated that minimum effect would be noted in the results. They had all undergone the same effects.

If consideration is given as to how many times the fish is netted in Japan (for whatever reason), then this also causes stress. If Koi keepers' conditions are as close as possible to those of a mud pond, then it may be a wiser option to try to import a fish as young/small as possible. This would show that there are both pros and cons in transporting fish before they reach their optimum size.

When considering the results I gained, there is a draw to trying to spot a fish when it is very young for its quality and then growing it on at home, (providing your water quality is good).

The Findings

From carrying out the experiment over a six-month period:

- 1. Fish in the pond with the highest TDS had grown from 14-18cm/5½in-7in to 52-55cm/20½in-21½in and weighed the lightest.**
- 2. Fish in the pond with the lowest TDS had grown from 14-17cm/5½in-6¾in to 65-69cm/25½in-27in and weighed the heaviest.**

This did make me consider the knock-on effect – what was the point of putting so much food into a pond with high TDS? What kind of Koi should be purchased and placed in ponds with a high TDS? How large could Koi placed in ponds with high TDS grow?

Although I had originally thought that there might be some differences in growth and weight because of TDS, I was surprised at the extent when I considered the results as a whole because:

- **Over 90% of the variation in the mean length of the fish in each pond could be explained by differences in the TDS of each pond.**
- **Over 90% of the variation in the mean weight of the fish in each pond could be explained by differences in the TDS of each pond.**
- **Fish in water with a low TDS in one part of the UK grew twice as long and twice as heavy as fish in water with a higher TDS in a different part of the UK.**
- **The greatest percentage difference in length and weight was recorded with fish in water with low TDS levels.**

When I returned to Japan in November 2008, I was pleasantly surprised to discover that some of the fish in the pond with the low TDS had, in fact, grown larger than some of their siblings in the mud pond. It was most interesting to note that: imported fish, living in UK water with a low TDS, gained the same percentage difference/increase in length and weight as many of those in Japan between month one and month six over a six month period.

These findings could give rise to implications and further questions for Koi breeders, dealers and Koi hobbyists. They certainly raise further issues related to fish husbandry, growth, water parameters and high/low levels of TDS. The possibilities for further investigations, such as the replication of the study over a longer time scale or its application with all male Koi, should be considered.



Hefin 'Moses' Jones is studying for a Master's Degree at Aberystwyth University in Animal Science while also completing an HSC qualification. His interest in koi began at an early age which has developed to an annual pilgrimage to the BKKS national show to work with the water team and frequent visits to Japan. Reach him at writers@koinations.com

