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Nurture your water.

by Mike Snaden (www.yumekoi.com) - Supplier of BKKS 2003 GC

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There are many misconceptions about the kind of water that is necessary for raising big beautiful Koi. It is unfortunate that our Koi hobby sometimes take general aquaculture knowledge, and apply it directly to Nishikigoi. Techniques that work well for rearing fish for the food industry, should not really be applied to Nishikigoi, as the raising of Koi has different objectives as the end result.

Japanese breeders and universities are constantly striving to perfect production, growth, and health aspects of Koi. It is accepted that the Japanese are the true masters and have made important discoveries that link good koi health, excellent growth and superior Hi development to many aspects of koi keeping, including the subject of Water Hardness, and TDS levels. This wonderful hobby would benefit greatly from attempting to learn from the Japanese professional Nishikigoi industry.

It's all too common to hear people say that mains water in certain areas is too soft, and should be hardened. It's understandable that Carbonate Hardness (KH) should be elevated, but the same cannot be said for General Hardness. So the focus of this short article is to offer some explanation as to why this need not be the case in so many instances, and that indicators from Japan suggest that Soft water should be nurtured and taken advantage of, not necessarily hardened!

It is generally accepted in Japan by the Koi industry / breeders, that Koi growth is enhanced in soft, and pure water. Hi will become thicker, the shine of the skin (Tsuya) will improve, and last but not least, the health of the koi will be stimulated and greatly enhanced, hence less problems. One point worth noting is that the Japanese feel that hard water will cause pigment cells on the Koi's skin to lie flat to protect itself from hard water, hence, Koi in hard water will often look a very vivid, and hard red. But, in soft water, the pigment cells will stand up rather like velvet, giving a softer colour, but much better lustre and colour quality. Generally, people tend to believe that 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. Whilst there is an element of truth in this statement, it does not show the full picture, and can be easily misinterpreted. The fact is that many of Niigata's mud ponds have soil that is so dead from lack of minerals, that only rice (or Koi) can be grown there. However, mud ponds do offer benefits such as live insects, and plankton, which cannot easily be recreated within a closed pond system.

KH Carbonate Hardness or Alkalinity.

Carbonate hardness is essential for the buffering effect it has on the pH of water within a pond. If a recorded pH of a given volume of water is 7.5 and an amount of acid is added, it is commonly expected that the pH value should drop by the corresponding amount of acid added. If there were little or no KH value to the water, this would be the case, but

the purpose of KH is to act as a buffer, so rather than the acid directly influencing the pH value, the acid is spent on the carbonate ions in the KH value, and only when the carbonate reserves of the KH value are used up will the acid directly influence and lower the pH. Hence, if the KH value falls too low, the pond water pH will be influenced too easily by everyday occurrences such as fish respiration, fish urine, waste by-products from filtration system bacteria, plant life and even acid rain, in short just about everything that is considered normal in a pond environment that is capable of introducing an acid base. So by these examples it is easy to see why KH is so important. If a pond has a low KH, and regular pond maintenance isn't carried out, the water will lose its buffering capability, and the pH will fall. At first this isn't a problem, as Koi are best suited to a pH of 7.0. But, if left unattended, the pH will fall to dangerous levels, and quickly crash the system, resulting in acidic water, and a pond full of either very unhappy or dead Koi.

A typical example: A pond is in an area where the water has a typically low KH value. This need not be a problem if the system falls into the following criteria, I.E. the pH runs at a steady 7.0, and pond maintenance is done religiously, perhaps at twice-weekly intervals. The pond is not overstocked, and feeding is done in constant measured amounts at the same times every day. There is a good working knowledge and you understand the pond system and how it functions, plus the checking of all water parameters are done at regular intervals, leave nothing to chance. But, if none of the afore mentioned criteria are present it would be my advice to keep the pond water KH well up and therefore well buffered, or disaster will strike! A good KH level should be somewhere in the region of 2 to 6dH, with my preference being 3dH. There is no point in running a higher level than 6, as this will often result in a rise of the pH. The Japanese consider a pH of between 6.8 and 7.4 to be ideal.

GH. General Hardness.

This is a measure of the amount of dissolved solids (mineral content), E.G. calcium and magnesium, etc. GH has nothing directly to do with the KH buffering effects of water. A GH measurement is no indication of the KH value as the two are totally separate independent readings.

Japanese Nishikigoi professionals desire low GH values. GH can be measured as ppm or dH, (German Degrees of Hardness). A typical tap water reading in the Bristol area is around 14dH (250ppm, or parts per million). In Japan this would be considered extremely high! The general guide as an optimum GH in Japan is about 50ppm (2.9 dH), with many people feeling that if a reading is at or above 2 dH (34ppm), it should be lowered.

TDS. Total Dissolved Solids.

A TDS reading represents anything that is dissolved in the water being tested. This includes GH, KH, fish waste, uneaten food, chemicals, etc. It is often said that Koi will only grow to the size of the pond, but in truth, the Koi will grow according to the TDS level in the pond. A heavily stocked pond, with lack of water maintenance will result in a TDS level that will continuously escalate, hence slowing Koi growth as they get older, (consuming more food, and creating more waste).

The following are pond water statistics compiled over the past three years

Bristol.

Mains water pH 7.5

Pond pH 7.4,

TDS (pond 7800 gallons) 315ppm, KH- 5dH (89ppm), GH- 13dH (232ppm)

Pond number two, 4400-gallon, TDS 310ppm.

Rain water 30ppm (TDS).

Swansea.

Mains water pH 7.1,

Pond pH 6.9,

Mains water 51ppm (TDS),

Rainwater 25ppm (TDS),

Current pond TDS 111ppm.

Japan.

Mains water 75ppm,

Rainwater 3ppm,

Pond water (mud ponds) 35 to 108ppm (TDS)

Pond water (hobbyists ponds) 108 to 220ppm (TDS)

SWANSEA POND

The pond study case in Swansea contained only 2500 gallons of water, which was heavily stocked. This pond was rebuilt in Summer 2002 (2 months during which the Koi were in another pond, followed by then being moved back to their new pond, which had to be matured, hence growth during this period was disrupted). The new pond contains 7530 gallons. All Koi supplied by Yume Nishikigoi.

Wakabayashi male Kohaku 39cm (two years old in 2000), is now 64cm and approaching 5 years old.

Wakabayashi male Kohaku 47cm (three years old in May 2001) grew to 68.5cm (Feb 2003) (now approaching 5 years old).

Sakai (Hiroshima Showa), Tosai (one year old) in June 2000 at 26cm, now 61cm Feb 2003 (now coming up for 4 years old).

Momotaro Tosai Kohaku (one year old), 34cm in March 2002, now 52cm, and not two years old until 17th May 2003!

Momotaro Tosai Kohaku, 34cm in May 2003, now 49cm.

Momotaro Kohaku 22cm Tosai in Feb 2002. In the Summer of last year, this Koi suffered from wasting disease and lost weight to the point of becoming a skeleton. It then recovered, regained it's weight, and still managed to grow to 41.5cm! (Feb 2003).

Momotaro Kohaku, 33cm in April 2002, now 49cm.

Sakai (Hiroshima) Yamabuki Ogon, 40cm in June 2001, now 66cm.

BRISTOL POND

The Bristol pond case study is our own pond of 7800 imperial gallons. Despite being run at similar temperatures, and similar feeding rates to the Swansea case study, the Bristol pond cannot achieve the same growth rates.

The only Major difference that is apparent, between the two ponds, is water hardness, and a vastly different TDS level. The average growth in this pond has been perhaps 3 to 5cm. The normal growth rates for our pond and others in the area are similar, but generally typical growth rates for the higher TDS readings in the Bristol area would be disappointing when compared to what can be achieved in the areas where water of a lower GH and TDS is prevalent. There is no doubt that ponds in Bristol area with a lower GH have growth rates better than those with a higher GH.

JAPAN

Typical Japanese case studies are as follows; these figures are for various Japanese breeders mud ponds in the Hiroshima area. All of the readings are TDS readings, and hence represent a total of GH and KH levels combined. A 'PPM' figure should be divided by 17.9 to obtain a dH reading.

Wakabayashi 65 to 78ppm,

Takumi 76 to 85ppm,

Takigawa 105 to 108ppm,

Imai 35 to 48ppm, Inoue 35 to 48ppm,

Momotaro 75 to 85ppm.

Naturally, all of these ponds have growth rates equal to but mainly greater than the pond in Swansea! But, temperature in Japan also plays a large part, as do the many additional insects etc, that breed in the clay base to the ponds.

Other points to remember

Feeding raises TDS,

Chemicals raise TDS,

Fish waste raises TDS,

Iron, salt, and calcium raise GH, and hence also raise TDS,

High Nitrates raise TDS.

MOMOTARO KOI FARM

Momotaro is probably one of the top 3 breeders in Japan. President Maeda (Mr Momotaro) feels anxious when growing Koi in mud ponds. President Maeda feels that once Koi are placed into mud ponds; things are no longer in his control. Consequently, President Maeda is much happier growing Koi in concrete ponds, as the Koi can be carefully watched, and their growth and development can be carefully controlled. This is an area where Momotaro Koi Farm excels! President Maeda has developed a new filtration media called "Bacteria House". This media has an appearance of coral, but is a man made material, which is baked at high temperature (1300c). This media is used in his filter systems, and also in multi level shower filters. These trickle filters obviously remove Nitrates, but Mr Maeda says that this media also helps lower water hardness. President Maeda says that low water hardness and low Nitrates are of the utmost importance in the quest for maximum growth, and good development in Koi. Using such methods, President Maeda has achieved the following

Around 1997, Momotaro managed to produce a Tosai Kohaku of 51cm! Despite such fast growth, the Koi maintained wonderful quality.

He has also grown the first ONE METRE GO-SANKE! Please note that Momotaro bought this Sanke at 8years old and 80cm, from Yamamatsu (originally bred by Sakai of Isawa). This Koi was purchased as a hopeful parent, and Mr Maeda managed to grow it by 21cm in just three years. This growth is more than at any other stage in it's life.

JAPANESE OPINIONS

After asking several breeders in Japan about the topic of water hardness, it was said by all, that soft water is essential in order to grow large Koi, with good Hi quality. Teri (lustre) and Tsuya (shine) are also considered to develop well in soft water. However, Koi to compete in shows are often placed into harder water in order to 'finish' the Koi for showing.

Mr Izeke of Izeke Products is quoted as saying that, he considers a water GH value should be as low as possible, also if GH measures 2dH (34 ppm) or over, it should be lowered.

Mr Izeke achieves excellent, growths rates equal to mud pond growth rates in his concrete ponds partly by maintaining low GH and TDS values.

In the September of 1999 issue of "Nichirin", the ZNA Japanese Koi magazine there is an article entitled "Basic Koi Keeping" subtitle, Water Hardness. This article was supervised by, Dr Takeo Kuroki (Honorary Chairman of the ZNA), Mr Nobuo Takigawa (Chief of the Keeping Skills Bureau), and Professor Ken Sasaki (of Hiroshima Kokusai Gakuin University).

(quote): "Hardness. Hardness is an indication of the amount of calcium or magnesium; the lower this is the better suited the water is to the raising of Nishikigoi. A reading below 50ppm (2.92dh) is considered desirable. This degree of hardness is also said to control the appearance of the Hi and the Sumi".

WATER HARDNESS SHOCK

When Koi are harvested and put into hard water, they can sometimes roll onto their sides. The Japanese professional refer to this as Water Hardness Shock. A transition from soft to hard water is believed to cause Koi great discomfort and stress; hence they may sit on the bottom and are often to be seen rolling over on their sides. It usually takes about three days for the Koi to adjust to the water hardness and behave normally.

This can also happen when Koi are sent from Japan to England, despite sometimes the water being hardened in Japan prior to shipping, this effect can still be observed from time to time, but the Koi soon adjust.

It is also accepted in Japan that Koi are more resistant to disease and also heal at a faster rate in softer water.

Note: Water hardness shock does not occur in the case of a Koi being moved from hard into soft water. Also note that water that is regarded as being soft in the UK, is often much harder than Japan's softest water. Consequently, moving Koi from soft UK water to hard UK water doesn't seem to pose any problems.

CONCLUSION

There are two routes to take with hardness levels in your pond.

HIGH GH LEVELS / high TDS.

Good sharp white ground and sumi development, but poor growth rates. (Ideal for those that are hoping to show their Koi, or those that have less time to devote to pond maintenance). High GH levels can also cause Hi (red) to break up.

LOW GH LEVELS / low TDS.

High growth rates, deep and even Hi, but softer white skin, and slower Sumi development. Bear in mind however, that just a few weeks in hard water will improve the white skin ready for a Koi Show. It would be preferable to definitely go for the latter approach, it could be viewed as a waste of time and money to invest in buying an expensive Koi, and then restrict its growth and development. Please bear in mind that if a Koi is destined to develop Sumi, it will still develop in soft water, but will just take longer. The Japanese approach is to enjoy a Koi as a 'project'. When the 'project' is completed, they will look for a new Tategoi to work with.

After much research, I have recently purchased an ion-exchange water softener, and 'Reverse Osmosis' plant. By mixing mains water with the treated water, it is possible to make wonderful soft water that is already evident as showing improved growth. The downside is the running cost of the 0.37kW booster pump, and initial outlay on the equipment (about £2700). Using an ion-exchange water softener alone offers no real benefits, as the calcium and magnesium ions are simply exchanged for sodium ions, hence leaving the TDS reading untouched. But by using the RO plant after the softener, all minerals and chemicals are stripped out, leaving a TDS of virtually zero. This water is very unstable, and has a natural pH of about 6.6. But, by mixing mains water (25%), with RO water (75%), the mains water TDS is diluted from about 315ppm, to 80ppm. By doing regular bottom drain flushing, I can now safely maintain a TDS of 130ppm, which results in a KH of between 2 and 3, and a GH of between 4 and 5. If I were to lower my stocking levels, it would be possible to lower TDS levels further, but as a dealer, this isn't really possible. What must be remembered is that any failure to carry out the routine drain and vortex clearing will mean a sudden jump in TDS, and the KH can fall. It takes much longer to lower TDS levels, than it does to raise them! Note that an RO plant usually rejects and wastes the majority of the water that is run through it, but this unit

has been specially designed with two membranes, and recycles it's rejected water back through the unit for a second pass, hence, the majority of the water that is run through this unit is good, with a small proportion being rejected. A water softener must always be used prior to an RO plant, otherwise, the membranes will be damaged.

Compare your mains water TDS to your pond TDS. If your pond TDS is significantly higher than the mains water, then it is because you pond is probably overstocked, overfed, or perhaps just badly maintained. Weekly monitoring of the TDS levels can enable you to adjust your pond water, and hence, maximise your Koi keeping pleasure! You too can grow Koi like as though they were in Japan!... all you have to do is try! Also, bear in mind that Japanese water usually contains virtually no minerals, hence the benefit of adding clays. Ask your local water board for a report, and see for yourself what kind of mineral content is present. But, bear in mind that an abundance of minerals means a high GH, and hence, a high TDS. Don't waste the growth potential of your Koi, and don't forget that if you want to make your Koi grow big, make sure the parents are BIG!.even soft water won't make inferior Koi become big.