

Koi Tutorial Lecture

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Revision 2/1/03

I have been active in the koi hobby since 1986 and have been a certified koi Judge since 1995. I have given this **4 hour** lecture plus question and answer session once each year for many years. Several interested people have not been able to attend the single day event so I created this lecture text for those who were not able to attend but still want the information. This lecture is intended for the new koi hobbyist and will touch all aspects of koi ponds and koi care but not any one topic in depth. For in depth discussion of Koi Diseases & Medication, I highly recommend Dr. Eric Johnson's book "Koi Health and Disease". For in depth discussion on building ponds and filters, I recommend the AKCA Guides on these subjects from the AKCA Bookstore on the web or by mail thru the advertisement in each KOIUSA magazine. Each of the topics I will discuss has been covered in depth by articles in KOIUSA magazine over the years. An index of these topics is available by mail thru an advertisement in KOIUSA or on the KOIUSA website and past magazines can be ordered for \$6.00 each from KOIUSA. Much of the information I will present is also contained in the AKCA books Practical Koi Keeping 1,2 & 3 that are compilations of articles on these subjects. These books are also available from the AKCA Bookstore. The opinions presented in this lecture are my own experience or information derived from articles written by experts in each area printed in KOIUSA or books on koi like Dr. Johnson's book described above. There is no intention to represent the Associated Koi Clubs of America in this lecture. If you have reason to question any statement in this lecture, I will try to provide my source of information to your request for it. This lecture may be copied for other koi people but may not be sold. I did not prepare this lecture text for profit but for the expansion of koi knowledge to further the koi hobby. Clubs are welcome to use this document as a textbook and to take exception to the text where the instructor feels necessary.

I will proceed thru the topics in the order usually requested by vote of people attending my yearly tutorial lecture.

Ponds

Most people attend my tutorial lecture because they bought a home with an existing pond or are considering the construction of a pond in their yard. The second group is luckier because they still have time to avoid many common mistakes in pond and filter design. The first thing you need to decide before starting to design a pond is what do you really want from your pond? Do you want a landscape feature only? Do you want the sound of moving water from a waterfall to add sound to your visual treat? Do you want to be able to watch large fish swim gracefully to add relaxation to your view or do you really just want a water garden with plants and maybe some goldfish? Do you want to buy expensive koi to compete in shows for prizes as a hobby? The answers to these questions are critical before you take the next step so think about them. The consequences of the answers are mostly financial in the cost of building and running a pond. Small water garden ponds, say less than 1000 gallons, may or may not have a waterfall. If they just contain water plants and some fancy goldfish, they do not require 24hr/day pumping of water and do not require a filter. They may have a fountain squirting water to aerate the water for the goldfish or no pump at all. If this is the kind of water feature you really want, contact Van Ness Water Gardens in Upton, CA for their catalog or your nearest water garden dealer for instruction on how to build, properly stock and maintain a balanced water garden.

The purpose of this lecture is koi ponds although some of the materials and processes also could apply to water gardens. I recommend koi ponds to be at least 1000 gallons (8.5ft by 4ft with 4 ft average depth) and they cost more to build than small water gardens. Koi ponds DO require a filter to clean the contaminants the koi put into the water and a pump to feed the filter running 24 hr/day to maintain the bacteria in the filters costing more electricity than water gardens. I will discuss more on cost when we get to the discussion on pumps. Koi will root around plants in a pond to eat the roots of plants and make a mess likely to end up clogging your pump. Plastic baskets are made for floating plants to avoid this problem. Also, oxygenating plants do add oxygen to the water during the day but take oxygen out of the water at night when the oxygen levels are the lowest and also reduce the pH in the pond by addition of CO₂ at night.

How Large and how deep? - So, you want to build a pond for koi. The next decision is how large of a pond. The general rule of koi ponds is “build the largest koi pond *the first time* that fits into your landscape, budget and koi collection plans”. The larger the pond, the less sensitive it is to small mistakes in water or pond management. However, the larger the pond the more it will cost to build and in electricity to run the pump for reasonable water turn over rate thru the filters. Not to mention the fact, 90% of existing ponds become overstocked with koi for the size of the pond. When you think about it, koi in a wild or natural lake have thousands of gallons of water each. A conservative rule of thumb for koi pond stocking is one 12 inch koi for each 200 gallons of water and each 10 square feet of surface area. You can cheat on the 10 square foot rule by adding aeration of the water with a waterfall or air pump with air stones. You can cheat on the 200 gallons per 12 inch koi by having an oversized or larger filter system for the size of the pond as koi dealers must do to keep very high stocking rates. More on this in the filter discussion. Koi ponds should be a minimum of 3 feet deep sloping to greater depth at the bottom drain. 4 to 6 feet depth is better for several reasons. Koi feel less stressed from potential predators and their bodies grow better with greater pond depth. Greater depth yields more water volume. Greater depth provides a more stable water temperature. However, larger and deeper koi ponds make it more difficult to catch koi. Raccoons and Blue Herons love fish ponds 18 inches deep. We call these ponds buffets.

Where to Place the Pond? - Do you want to only be able to enjoy this water feature when you are outside on your patio or do you want to enjoy this feature during the winter months from the warm environment of your home? I suggest the second choice based on my personal experience. So place your pond where you can see it from windows or glass doors in popular living space like dens or kitchens. This will also give you more opportunity to hear fish jumping while trying to tell you there is a problem in your pond like parasites. Local building codes probably restrict how close a pond can be built to the property line (8 feet in my city). You will need a pipe to dump water from filters being cleaned to the sewer so figure that into your design. Yes, you can dump the dirty water into gardens and onto the lawn as long as you never put salt into your koi pond and I can tell you now, you will use salt someday to counter parasites. So plan for a sewer dump. Do not place the pond under deciduous trees with leaves if you can avoid it. If you do, plan to clean the leaf trap or surface skimmer daily. Ponds can be below or above ground or partially both. The ground helps to stabilize the water temperature in the pond. Note- many city codes require locked or self closing gates and doors from homes to the backyard, high fences and perhaps even a wrought iron fence around ponds to keep children from drowning. So check the local code requirements. Do not place koi ponds where rain runoff can get into the pond from hillsides, adjacent ground or from roofs. Add gutters or French drains to resolve these issues if necessary. How does this water feature fit into the

overall landscape plan for your yard? Balance of pond to gardens or lawn is usually important in any landscape.

What Shape and Design for the Pond? – Ponds can be formal shapes like long boxes and round bowls or informal Japanese style garden ponds as long as there are no dead water corners or stagnant locations. However, ponds imitating bent rivers or L shape are best for koi because the koi can't see around the corner and will spend all of their time swimming back and forth from one end of the pond to the other looking for food. This exercise is good for koi. The old style koi pond with downflow, gravel filter at one end of the pond separated by a block wall that stops 6-12 inches below the surface accomplishes this same curiosity in the koi who can't see thru the block wall so are constantly swimming into the filter area. Koi in a round or kidney shaped pond will do Ok but jets may be needed to make the koi swim more against a current for better growth and health. Any shape pond can work but there are some rules. Make the walls vertical or almost vertical. If you add a ledge 18 inches deep to place water plants into your koi pond you are providing access to raccoons and blue herons to your pond and koi. If you must add plants, use the floating plastic baskets designed for water lilies and do not build a ledge into your pond if you can avoid it. If you must have a ledge, there are electric fence devices and motion detectors with either sound or spraying water to combat these predators to some degree. But even with them, you may lose some koi to predators. Local building codes usually treat koi ponds like swimming pools if they are over 3 feet deep. So the rules for concrete swimming pools including permits, rebar, bond beam perimeter and grounding of rebar will apply. You should also ground your pump. You **MUST** use GFI or Ground Fault Interrupter plugs or circuit breakers for any electrical used for a pond for not only the safety of the koi but for yourself. Many of the materials, processes and codes applying to swimming pools will also apply to koi ponds but **DO NOT** let a swimming pool contractor design your pond and filter system. Use someone that knows pond design or learn and design it yourself and then use swimming pool contractors to build to your design. Koi pond and swimming pool systems have much in common but the differences are very important to proper functioning and maintenance of a koi pond. One difference is a koi pond requires a bowl shaped bottom sloping to a bottom drain with no corners or flat areas for proper automatic bottom cleaning. Swimming pools have flat bottoms that would require constant cleaning for a koi pond owner. Swimming pools use expensive to operate, high Hp pumps and pressure filters intended to mechanically filter the water for 4-5 hours each day. Koi ponds use inexpensive to operate, low Hp pumps feeding filters that grow beneficial bacteria to treat the water 24 hrs/day. Always design 3-4 inch bottom drains into your pond at the far end from the water source or waterfall and every 20 feet across the bottom with the bottom of the pond sloping to these drains. A surface skimmer will also be required to keep the surface free from the dust and debris on the surface of your pond. Place the skimmer furthest from the waterfall or where the wind usually blows across the pond for maximum efficiency. Either a swimming pool skimmer or a no niche skimmer may be used. The no niche skimmer requires pump suction to operate properly. A swimming pool type skimmer line is often Y branched into a line from a bottom drain so the flow from the bottom drain pulls the flow from the skimmer. Rocks, bricks or material surrounding the pond must be raised to not allow any runoff form the surrounding area. A 10inch drop from the top of the rocks surrounding the pond to the surface of the water will resolve any raccoon or cat problems and will usually keep the koi from jumping out.

Pond Materials – Prefabricated fiberglass ponds are available up to 2000 gallons and can be installed above or below ground. PVC or Butyl rubber liners are also available to create in

ground ponds and will last 20 or more years. Bottom drains are available for liner ponds. Many ponds are made with concrete blocks placed on a concrete base. However most ponds are concrete, shot-crete or gunnite. Concrete ponds with Red Label additive will harden quickly and tight so no sealer is required and they can be filed immediately. Shot-crete or gunnite ponds are porous and will require a sealer on the inside of plaster, Thoroseal (plastic cement compound), Hecht rubber or other sealer compounds for water basins. Hecht rubber requires proper surface preparation and primer for proper adhesion. All concrete, shot-crete and plaster ponds will require Muriatic acid wash to remove lime and lye from the surface layers or gallons of vinegar in the first water fill to do this task over 3-4 weeks. People have also laid their own fiberglass pond using resin and matting because they could do it in stages. Plaster must be applied in one application to provide a good seal and must not ever be exposed above the water line so the top 8-10 inches of your pond will probably require Thoroseal which is not sensitive to cracking with air exposure like plaster. All of these products work if instructions are followed. Caution – do not ever allow treated wood to come in contact with pond water, it contains arsenic. Bare redwood or cedar is OK if not treated. Know what is in your stain or surface coating on decks that could have runoff into your pond. Even some decorative bricks have been known to poison ponds when in constant contact with pond water. Do not use copper or galvanized pipe for koi pond plumbing, use PVC or ABS plastic pipe. Some brass valves are probably OK.

Pumps and Skimmers – You next have to estimate the volume of your pond in cubic feet using equations for the shape or by drawing top and side views of your pond to scale on graph paper and counting the squares. Each cubic foot equals 7.5 gallons of water so find out how many total gallons of water your pond will hold. Remember, you will need to keep the water level 10 inches from the top of the rocks, bricks or what ever material you have surrounding the edge of the pond to keep critters out and fish in the pond. Koi can jump higher than you think and many have jumped out of a pond when startled. Once you know the gallonage of your pond, then select a pump that will turn over that amount of gallons within 2 hours. Less time is better. So if you have a 4000 gallon pond, add 25% for the water in the rest of the system and filters for a total of 5000 gallons and select a pump that can pump at least 2500 gallons per hour or dividing by 60 minutes gives about 42 gallons per minute. It is much, much better to use two pumps for your pond for the following reasons. First, you can plumb your system so if one pump goes out you can switch the total filter system to the other pump. Second, when you go to treat your pond with chemicals for parasites or bacteria, you will need two pumps to run the pond and the separate filter system. A 1/6 Hp pump will deliver 42 gpm and will cost about \$350 to purchase and about \$15-20 per month to run depending on your electricity rates. High efficiency 1/4 Hp Lim brand Wave pumps are available for about the same purchase cost and run for about \$35 per month electricity and pump 80-100 gpm depending on the head. What is head? Head is the distance in vertical feet the pump must raise the water from the pump to wherever it is going, say to your filter. For above ground tank filters this is probably around 6 feet. But there are losses in the piping due to friction so you may have another 5 feet of head due to these losses. So when you look at a pump curve, you see a curved line showing less pump flow for higher heads because it takes more work for the pump to push the water higher. Look at the point on the curve with a head of about 10-12 feet to determine your true water flow. Always use 2 inch diameter PVC piping into your pump and from your pump to the filter to reduce head loss. Always use a minimum of schedule 40 PVC pipe or ABS that is the black plastic piping for drains. Minimize the use of sharp 90 degree elbows by using two 45 degrees together, ABS generous 90 degree sweeps or PVC flex pipe. PVC flex pipe must be painted to protect it from the sun's UV. Koi pond pumps are not the 1.5 – 2 Hp monster

pumps used for swimming pools. Koi pond pumps are good at pushing water but not good at sucking water so koi pond pumps should be placed in a water tight vault below the water line of the pond or pre-filter to always maintain positive water head pressure on the inlet. Pumps will suck down a pre-filter 1-3 inches before equilibrium is obtained on incoming water from the pond and outgoing water from the pump. If you must place a koi pump above the water line of the source, install a flow directional gate or check valve to keep water in the pipe going to the pump when the electricity goes off. This will keep the pump primed with water and avoid the pump sucking air when the power returns. This check valve should be below water line. This type of valve is also important if you forgot to design a bottom drain into your pond and you are bringing the water up and over the edge of the pond to the pump. You must keep water in the line going into the pump when the power goes off to have the pump work properly when the power comes back on. Pumps don't pump air very well. Swimming pool pumps resolve this with high suction, high Hp pump design. In-pond submersible pumps like Cal or Rio pumps can work for koi ponds. However, be forewarned, I have had Cal pumps leak oil and also leak small amounts of electricity into the water which will damage the koi. But I use these pumps to move water from one place to another and am always handling the pump. If placed into the pond and left alone, this may take years or may never happen with Cal pumps. Rio pumps are ceramic without oil so that issue is resolved but they will destroy themselves if run while dry without water present. High efficiency koi pumps are usually available in 1/15, 1/6, 1/4 and 1/3 Hp models. Several manufacturers are available with good pumps but I can recommend the W. Lim pumps series called Wave pumps or Dragon pumps for efficient pumps as the ones I chose for maximum efficiency and water flow.

Waterfalls – Waterfalls add a lot of charm and relaxation to a pond. Make sure the sound is blocked to the side neighbor's yard. The sound is usually blocked to the rear by the hillside the waterfall is on. Liners work well for the base of waterfalls to block water loss. Rocks can be mortared over the liner and sealed with Thoroseal. Volcanic rock will wick water so be careful if you use it. Whatever materials you use for your waterfall, make sure they do not contain any poisonous compounds because the water will erode the materials. Many small drops aerate the water better than few large drops in a waterfall.

Filters – First, we need to discuss a pre-filter. Yes, a filter before the filter. Your filter system will work much better and be maintained more easily if you pre-screen out the large particulate debris in a pre-filter usually filed with brushes or matting. The pre-filter needs a bottom drain to drain this large amount of debris to a sump and eventually to the sewer weekly. I have a sump pump with a float valve to automatically pump the sump to the sewer. This also allows me to put a standpipe in my pre-filter at pond water level to deal with torrential rains which will overflow thru the standpipe into the sump, turn on the float valve and pump the water automatically into the sewer. I never have to worry about my pond overflowing in torrential rainstorms. Properly designed filters can be cleaned in 15-20 minutes each week making pond maintenance easy. Cleaning filters depends on how much food you are feeding your koi since you are really feeding the filter with the koi as an intermediary. During the winter, I clean my filters once per month at most. During the summer I clean 2 of my 6 filters weekly. There are many, many prefab filters and filter materials available today from matting, high density foam, plastic ribbon, Bubble bead, plastic Bioball and Trickel filters in addition to the old favorite, gravel filter. All of this media will provide area for beneficial bacteria to grow that will turn ammonia waste from the koi into Nitrite and then Nitrite into harmless Nitrate in the water.

New filters usually require 2-3 months to properly seed bacteria before the pond water will be safe for koi. But you need the ammonia from koi to start this process or some people have suggested starting a filter with no koi and ammonia from a bottle. Ammonia can be treated chemically by adding Amquel water treatment but high Nitrites can only be corrected by water changes. The biological process starts with an ammonia spike in the water followed by a Nitrite spike in a day or two. A filter can be quickly seeded with bacteria if you collect buckets of dirty water from a friend's filter during cleaning and pour this dirty water into your new filter. Enough bacteria to seed your new filter within 1 week will be transferred. But, beware, you will also get any bacterial diseases or parasites that person had along with the water so make sure your friend's pond is stable without problems. Filters must run 24 hours per day to maintain the live bacteria. In case of a power failure, the bacteria will start dying off within 2-4 hours and most will be gone in 8-12 hours due to lack of oxygen from water flowing thru the filter. Many koi hobbyists have gas generators to run the pond in the event of a long power outage. Another approach is to use storage batteries to run air pumps and stones in the bottom of the filter to provide oxygen. Some of these automatic systems are very clever. Prefab filters like the BubbleBead or Bioball are much more compact than gravel filters but also much more expensive. The gravel filter is the easiest to build yourself as I did. The general rule for gravel filters is 2gpm of flow for each square foot of filter surface area. So our example of a 5000gallon system with a pump flow of 42 gpm says we need $42/2 = 21$ square feet of filter. Two filter tanks 4feet in diameter again is the answer providing 24 square feet of surface area. Or seven 2 foot diameter filter tanks could be used to obtain 21 sq ft. It is always better to have multiple filters instead of one in case you over clean one filter you still have another functioning. All filters are in parallel flow and not in series flow for maximum efficiency. The plastic barrel is 4foot diameter cost \$75 but the transport cost another \$50 so say \$130 per barrel. A 4foot diameter barrel provides 12 square foot of surface area. First, you plumb the tank to the sewer line and also to the return to the pond or to the top of the waterfall using 3 or 4inch pipe. PVC tank fittings are used to plumb thru the wall of the tank. I also put bottom drains and valves on my tanks in case I ever want to drain a tank. Next on our Upflow, gravel filter is the water delivery pipe that is a 4 foot length of 4 inch diameter ABS with a flat end cap bonded to one end. The end cap is then predrilled with 8 holes 1 inch in diameter equally spaced. Into these holes we will bond 1inch diameter PVC spokes to span from the center of our tank to within 3 inches of the outer wall. Each spoke has 3-4 holes 1/2 inch diameter drilled along the length of each spoke to spread the water and an end cap. This wagon wheel system is placed into the tank with the spokes on the bottom. On top of the spokes is placed a grid of some kind to support the gravel. Burt Ballou who designed this filter system drills hundreds of 1/2 inch diameter holes into a 4 foot diameter disc of PVC with a 4 inch hole in the center of the disc for the 4 foot ABS pipe. I found the disc too expensive and too time consuming and purchased two rectangles 2x4 feet of PVC grate 1 1/4 inch thick from Laguna Koi Ponds for \$25 each and cut the 4 foot diameter semicircle out of each 2x4 grate. This grate or disc goes on top of the spider in the tank. On top of this grate or disc goes the cleaning system consisting of a pair of 2 inch PVC risers and horizontal T with 3/4 inch spokes about 3 inches apart to cover the bottom of the tank. Each spoke has 1/16" holes drilled every 3 inches along the length alternating to the adjacent spoke so every 1.5 inches there is a hole and each spoke has a cap on the end. This air system is made up in two semi circles covering the bottom of the tank with a 2inch diameter PVC riser next to the 4inch center pipe in the tank. On top of each 2inch air riser, you install a 2" PVC open/close valve. This pair of valves allow you to select this filter instead of the next one to clean with a 2Hp Jacuzzi air pump that produces 90 cubic feet per minute of air to bubble up thru the gravel taking all dead algae or bacteria cells with it to the surface to be overflowed to the

sewer. Now is the time to add 7 inches of 1.5inch river rock on top of the grate and the air cleaning pipes. Next goes 17 inches of ½ inch crushed granite. Burt prefers the smooth ½ inch or 3/8inch gravel. Warning note – you can't just go down to the local rock quarry or material dealer and buy ½ inch granite and throw it into your filter. You will need to sieve the small stuff from the ½ inch gravel and also to wash the dirt off of the gravel before putting it into your filter. I know one person who did not do either of these who ended up with a 4foot diameter 17inch thick concrete plug for a filter when the small particles and dirt formed together to create concrete. On top of the gravel I place 7inches of #12 silica sand to mechanically polish the water. Then you simply plumb the 2inch line from your pump to the center 4inch diameter pipe and plumb the 2 inch line from your Jacuzzi blower to the two 2inch PVC air system pipes. It is a good idea to put an adjustable gate valve on the water inlet line to your filter so you have the opportunity to balance the amount of water going to several filters from the pump. Swimming pool high rate sand filters are mechanical filters and not suitable for a koi pond plus they require too much pump for efficient operation. However they can be modified with Bioballs or plastic media and efficient pumps can then be used. Also in the filter category are foam fractionators or protein skimmers as they are called in the aquarium industry. Foam fractionators bubble out DOC or dissolved organic carbons floating in your pond water making it more clear. This material is not known to be a problem with koi but clear water is always appreciated. A foam fractionator I believe will also help to reduce your Nitrate levels. Ultra Violet (UV) systems are also included in the filter category. These systems kill algae cells and also some bacteria if the flow is slow enough to give the correct water contact time. UV systems can be purchased for any size pond and usually require a bypass line from your pump. I consider both foam fractionators and UV systems luxuries for a koi pond and certainly not essential. Your filter will determine how many koi you can have in your pond. Remember, as a koi doubles in length from 12 inches to 24 inches the amount of ammonia waste that koi puts into the water goes up by a factor of 8 or so. So one 24inch koi equals eight 12inch koi or sixty-four 6inch koi in waste products.

Equivalent Koi Ammonia Loading		Pond Loading Data
koi length without tail (inches)	No. of koi equivalent to a 12" koi	nature - one 12" fish / 1 million gallons
2	90	fishing lake - one 12" fish / 100,000 gallons
4	36	breeder pond - one 12" fish / 1,000 gallons
6	8	conservative koi pond - one 12" koi / 200 gallons
8	4	conservative koi pond - one 12" koi / 10 sq ft surface
10	2	
12	1	
16	1/2	
24	1/8	
32	1/16	

This is how people find their koi dying after several uneventful years of raising koi. Their koi stocking level has outstripped their filter capacity. Koi will usually grow 6-12 inches the first

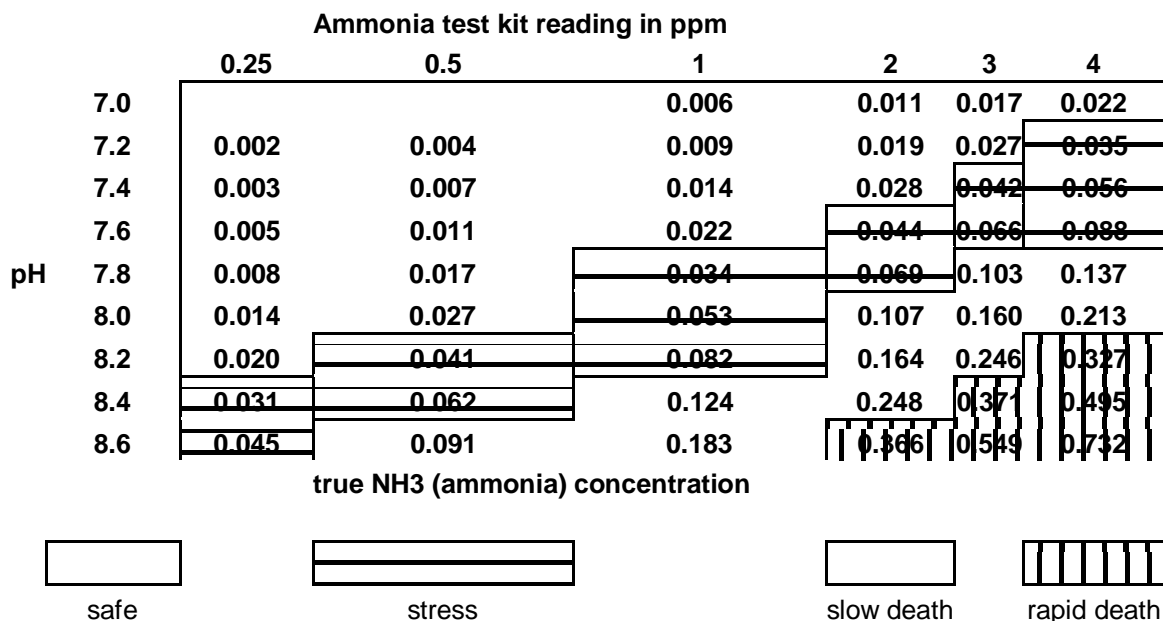
year, 4-6 inches the second year, 2 inches each year after up to about 22 inches and then ½ inch per year until they reach their max length. Food, water quality and pond size will affect koi growth but genetics will usually win. Solid color koi tend to grow to large size, multi colored koi are more hybrids and tend to grow slower and are weaker physically like poodles.

Water – The key to successful koi care is excellent water. First, source water usually contains chlorine or even chloramines that must be removed to be safe for koi. Some koi people believe they can have a small constant flow of fresh water into their pond and the filter will make it safe for the koi. Note – they also have an overflow to the sewer to maintain pond level. This may work but I do not trust it so I always use Amquel when I add water to my pond. Novaqua or Dechlor will also work for chlorine but not for chloramines. Many people have killed all of their koi because they forgot they were filling the pond and chlorinated their koi to death. So set that timer and keep it with you. There are automatic fill systems available but anything mechanical can break or fail. The most important measurement in a koi pond is temperature in my opinion. Pond water temperature will tell you: if the temperature is swinging too much day to night, how much to feed your koi, when you are in the 47-62 F Aeromonus Alley danger region discussed in the Disease section and how many days to space treatments for parasites to make sure you have broken the cycle. So go down to Radio Shack and buy the indoor/outdoor digital thermometer with a 6foot cord and sensor to put into your pond for \$15.00. This will be the best investment you will make.

What regular pond water tests are important? If you are starting a pond and your filter is weak or you see fish dashing or scratching (flashing) first test for ammonia. There are many ammonia test kits available. If you are using Amquel, make sure you wait 2 hours after using Amquel to use an ammonia test kit. Next test for Nitrites (with an I) which is the second phase of filtration. Koi are more sensitive to ammonia poisoning with higher pH and more sensitive to nitrite poisoning with lower pH. So also test your pH. The chart below will show the effect of pH on ammonia poisoning. pH is the measure of free hydrogen ions in water that affects chemical reactions. Neutral pH is 7.0. pH less than 7.0 is acidic, more than 7.0 is alkaline. Your city water system provides a pH usually about 7.4-7.8 but 8.0 is still OK with koi and it is not worth the trouble to try to adjust the pH of your pond unless there is trouble. Koi do fine at pH of 6.5 and also at pH of 8.0 but they do not like drastic changes in pH of 0.4 or so since pH is a logarithmic scale. (pH of 7.4 has 20 times H⁺ atoms of 7.2). Low pH, soft water (few minerals) like in Japan is thought to be better for red color and skin quality. Higher pH, hard water (many minerals) like most of the US is thought to be better for black color. Concrete ponds leach minerals into the water to create hardness that helps to buffer or stabilize the pH. Liner ponds do not provide that buffer and if the source water does not have sufficient minerals or hardness and if your filter is dirty creating CO₂, your pH can dive over a short time irritating the koi. They will clearly let you know when this happens by flashing over and over telling you their skin is irritated. pH can also shift with day and night. If you have a drastic pH shift towards acid, you can use Baking Soda at one teaspoon per 100gallons of water to increase the pH quickly. If you want to reduce the pH, you can slowly drip Muriatic acid into the pond in an area with good circulation but be very carefull in doing this because the pH can drop drastically when you reach a certain point. In Japan, they place bags of oyster shells in their filters to increase the water hardness and buffer pH. A simple block of hardened plaster of paris will do the same thing. If you are drawing water from a private well, have the water tested for contaminants like fertilizer or copper which may cause problems in your pond. Oxygen test kits are available but usually not necessary. Oxygen is usually highest in the afternoon and lowest around 3-4 am and can be reduced lower at night by plants in the pond. Koi need at least 6mg

Ammonia Sensitivity Chart

source - Debby Young article in KOIUSA, Volume 20, Issue 2



pH can be increased by adding aeration to strip CO2
pH can be reduced by lowering aeration to retain CO2

Nitrite is more deadly in acid pH 6.0-7.0 water
Ammonia is more deadly in alkaline pH 8.0-8.6 water

per liter of oxygen for health. This is easy with cold water with a saturation level of 14 mg per liter but warm 80 F water in summer saturation level is 8gm per liter and this is when koi can have problems. Also, when you use pond treatments like potassium permanganate or formalin, oxygen is used up by the treatment and fish can be found gasping at the surface. A quick solution to this problem is to spray hydrogen peroxide into the water to oxygenate the water or to place an air stone into the water to aerate it. Your filter also uses some oxygen but I have never been able to test the difference going in or coming out of the filter. It is recommended to add fresh water equal to 10% minimum of your pond weekly.

Algae - It is easy to forget to do adequate water change in winter when not cleaning filters and the result will be higher Nitrates and Potassium which will feed algae (floating and string varieties). You will often get string algae in your oxygenated waterfall in early Spring due to not changing enough water during the winter. Salt is the best cure for algae of any kind. 0.3% salt is recommended or 2.4 pounds per 100 gallons. Remember, salt will not evaporate and only is reduced by water changes so test your water for residual salinity before adding more salt to your pond. Eventually your filter will eliminate algae. Potassium Permanganate (PP) used in the Spring to reduce bacteria and parasite loads will also knock back your algae. Some people have also put tarps covering their pond or waterfall to starve algae of the needed sunlight with some success. There are some algaecides available but I do not have any experience with them and cannot recommend them. Salt and potassium permanganate usually work for me. Small

bales of barley hay are used to remove algae if you have a location to place them and time to let them break down and work. There is a new bio digester on the market that has worked to remove string algae from my waterfall in 1 week. This new product is Bio-Zyme-digesTer distributed by Koi Care Kennel, who also distributes Lymnozyme, a product to combat Aeromonas bacteria in pond water. The result of my use of Bio-Zyme was all of the long string algae fell off of my waterfall and collected into a ball at the bottom to be removed. This product does not seem to have effected the 1” of algae on the sides of my pond, just the long string algae.

DOC - Water clarity or turbidity can be affected by Dissolved Organic Carbons in the water. This also shows up as foam in your skimmer usually in the morning. Eliminating DOC is discussed in the filter section. A new product to the US manufactured by TerraPond is Calcium Montmorillonite clay that ties up DOC but also provides minerals for the koi. See the food section. Use minimal amounts of this clay because it has been known to clog gravel filters if overused. Potassium Permanganate also acts as a flocculent to trap DOC in your prefilter.

Landscape Around the Pond - Many plants or parts of plants like the berries are poisonous to koi and should not be used around koi ponds. A list of these plants is provided on a separate sheet. Make sure there are no deciduous trees that can drop leaves into your pond or you will have to clean the skimmer daily to remove the leaves. See list below: Landscape around the pond will be determined by the style of pond (formal or informal) and the overall landscape plan whether it is a Japanese Garden or a tropical jungle. Baby tears make a nice surround for a pond with stepping stones. Part of the landscape is the shade cloth covering for the pond. I recommend 50% shade cloth covering your total pond unless you have lots of water lilies already shading the water surface. The shade cloth provides a barrier so your pond can't radiate all of its heat to the clear sky at night or absorb a lot of heat in the sun during the day. The overhead shade cloth also keeps large birds like Blue Herons out of your pond because they usually will not go under an overhead cover. A good source for shade cloth made to size with sewn edges and grommets along each edge is Wind & Shade Screens, 6211 Yarrow Dr., Suite E, Carlsbad, CA 92009. The last phone number I had for them was (619) 471-2922. Charlies Greenhouse catalog also has finished shade cloth to size. If you use decking over your pond, never allow treated wood to come in contact with your pond because the treated wood has arsenic in it. Use redwood or cedar. Be careful the stain or cover coat is not poisonous to fish. Some bricks have been known to contain poisonous material to fish if they are in constant contact with the water.

Worse Plants to Have Around a Koi Pond

Plant	Part	Plant	Part
Amaryllis	bulbs	Jerusalem cherry	berries
Azalea	leaves	Jimsonweed	leaves, seeds
Balsam pear	seeds, fruit rind	Juniper	needles, stems, berries
Baneberry	berries, roots	Lantana	immature berries
Bird of Paradise	seeds	Larkspur	all parts
Black Locust Bark	sprouts, foliage	Laurel	all parts
Blue-green algae	some forms toxic	Lily of the Valley	all parts, their water
Boxwood	leaves, stems	Lobelia	all parts
Buckthorn	fruit, bark	Locoweed	all parts
Buttercup	sap, bulbs	Lords & Ladies	all parts
Calla lily	leaves	Marijuana	leaves
Caladium	leaves	Mayapple	all parts except fruit

Plant	Part	Plant	Part
Castor bean	beans, leaves	Mescal bean	seeds
Chalice vine	all parts	Mistletoe	berries
Cherry tree	pits, bark, leaves, twigs	Mock Orange	fruit
Christmas candle	sap	Monkshood	leaves, roots
Coral plant	seeds	Morning Glory	all parts
Daffodil	bulbs	Narcissus	bulbs
Daphne	berries	Nightshades	berries, leaves
Datura	berries	Oak	acorns, foliage
Deadly amanita	all parts	Oleander	leaves, branches, blossoms
Death camas	all parts	Philodendron	leaves, stems
Delphinium	all parts	Poison ivy	sap
Deiffenbachia	leaves	Poison Oak	sap
Eggplant	all parts but fruit	Poinsettia	leaves, flowers
Elephants ear	leaves, stem	Pikeweed	leaves, roots, berries
English Ivy	all parts	Potato	eyes, new shoots
Ilex aquafolium	berries, leaves	Privet	all parts, berries
False henbane	all parts	Rhododendron	all parts
Foxglove	leaves, seeds	Rhubarb	leaves
Golden Chain	all parts	Rosary Peas	seeds
Hemlock	all parts, its water	Skunk Cabbage	all parts
Henbane	seeds	Snowdrop	all parts, buds
Holly	berries	Snow on the Mountain	all parts
Horse Chestnut	nuts, twigs	Sweet Pea	seeds, fruit
Hyacinth	bulbs	Tobacco	leaves
Hydrangea	flower bud	Virginia Creeper	sap
Indian Turnip	all parts	Wisteria	all parts
Iris (blue flag)	bulbs	Yam Bean	roots, pods
Java (lima) bean	uncooked bean	Yew	needles, seeds

Koi Food – Koi are omnivorous so they will eat almost anything from grains to worms. Commercial koi foods are made to provide the nutrients and amino acids koi need to grow and be healthy. It is best to change koi foods every so often to give variety to the koi. The biggest problem with koi foods is age that can break down the amino acids as soon as 1 year after milling. This makes me unsure about recommending koi foods made in Japan or Taiwan because they are not dated and you don't know how many months they have been sitting in a warehouse or on a boat coming to the US. I prefer foods made in the US and also prefer to buy from a koi dealer that moves a lot of food so I know it is recently stocked. Do not keep koi foods in the refrigerator, keep them in the freezer if you must store them for a length of time. It is best to buy an amount you can use at room temperature for say 2 months. Keep foods out of the sun and hot temperatures. Long, stringy waste casings floating in a pond is a sign the food may be bad. I give my koi grapefruits or oranges cut in half for extra vitamin C although any koi food should have stabilized vitamin C in it. Koi are fed according to water temperature because they are cold blooded and will eat food in cold water because we train them to come to eat and then the food will rot in their intestines and they will

die. Do not feed koi at 50F or below. A feeding regimen by water temperature is provided on the chart below.

Some koi hobbyists believe in 20 or more feedings per day and use automated feeders to accomplish this. Feed koi as much as they will eat completely in 5 minutes. In warm summer months, higher protein foods are required and the first ingredient listed should be fish meal of some kind. In colder months, food with wheat germ and more grains with less protein are required. Cooked barley is good for koi in winter. Raw peas or other green vegetables are always good for koi. Cheerios, trout chow and catfish chow are not good for koi. Some people add sliced raw sardines to their koi diet in the summer. Summer months are when you can feed color enhancing food for better red colors which

Recommended Koi Feeding Regimen

source - Nichirin magazine

Temperature (F)	Feeding Frequency	Food Composition
below 50 F	no food	
50 F - 54 F	one or two times weekly	more grains & veggies less protein (25%) less fat
55 F - 58 F	two or three times weekly	
59 F - 62 F	one or two times daily	
63 F - 65 F	two or three times daily	less grains & veggies more protein (35%) more fat
66 F - 71 F	three or four times daily	
72 F - 77 F	five or six times daily	
78 F - 81 F	three or four times daily	
over 81 F	feed sparingly due to high heat	

Aeromonas alley

usually has spirulina or color enhancing material in it. Stop feeding color food 2 months prior to koi shows so the whites can return from the yellow color the color food creates. Many people like to make fresh food for their koi and koi recipes are out there. I have used gelatin and pulverized koi food to make my own food with oxolinic acid bacterial medicine for koi. Dr. Galen Hansen has written an article in KOIUSA describing how he uses a home made koi food to give other medicines to his koi. I prefer the smaller pellets to make my koi work harder for each meal and it allows all of the koi some food so the pigs don't scoop it all. There are excellent powder foods from Japan you can mix with water to form a paste but they are expensive and difficult to allow all of the koi to eat a share. In Japan, silk worm pupae are added to the koi diet to add more protein and these are also available in the US. Japan has known for decades some mud ponds were better for reds and some better for black. It was always thought to be the result of clay ingested by the koi as they search for food. A new product to the US manufactured by TerraPond is Calcium Montmorillonite clay. This clay can be sprinkled into your pond or can be sprinkled onto damp koi food to be ingested by the koi. The brand name product is expensive but cheap sources of this clay from the US have been found. A side benefit of this clay is it also acts as a flocculent to the DOC in your water but can clog gravel filters if too much is used and your prefilter cannot collect it. Some koi foods (Dianichi for one) already include this clay in the processed food.

Fish Care & Handling — Koi are cold blooded, hibernate below 50F and their digestive system shuts down. But we have trained them to come to eat when we

approach the pond so koi will eat out of response to this training if we let them. So watch your water temperature and feed accordingly. Their immune system also starts to shut down below 55F. The important fact is you need to observe your koi when you are feeding and any other opportunity so they can tell you if something is wrong with them. How do you know when a koi is stressed? Red veins appear in their skin and they get a pinkish tint. If this stress indicator goes away when the stressor is removed, fine. If a fish is always stressed, and not all of the fish, then there is something wrong internally or externally with that fish. If a koi is alone, that is a bad sign it has separated itself from the school. Koi on the bottom with their fins clamped is also a bad sign of illness. Koi on the bottom with their fins spread out for balance in the winter is fine, they are just resting or trying to reserve energy. If all of the koi are showing symptoms, suspect your water quality and run for your water test kits. Koi flash or skit around the pond when their skin is bothered by parasites, bad water conditions or change in pH. So watch for flashing. If a koi spends most of the time under the waterfall, it may be an indication of gill disease and that koi needs the extra oxygen. When you feed your koi you have an opportunity to see the underside of their body when they come up to eat. During *Aeromonas* alley 47-62F, it is important to take the opportunity to inspect the fish underside for ulcers. When using a net to corral koi you are not netting them because you never pick the koi up with its weight in the net. You use the net to keep the nose of the koi in the net and you guide the koi up and into a tub or plastic bag for transport. You must wet your hands before handling koi with your hands to minimize rubbing off the slime coat that is protection against parasites and bacteria. Special sock nets are available made out of nylon that is less likely to remove the slime layer. When you carry a bag with koi, make sure there is some water in the bag and that you keep the bag taught between your hands so you do not bend the koi in half and damage its spine. Larger koi require two people to carry a bag with a koi in it. *Never* carry a koi in a bag with the bottom seam down because it can break. *Always* carry a koi horizontal with the top of the bag to the left and the bottom to the right or visa versa. When transporting koi, use a strong, new plastic bag with enough water to cover the koi's gills, fill the remainder of the bag with pure oxygen, seal the end of the bag with a new rubber band and place the bag into a box or other dark container. I prefer to use Rubbermade plastic boxes in case of a leak which will not only keep the water from running all over my car but will keep the water around the koi so it can breath. If the koi is going any distance, I recommend double bagging the koi. Always travel with the koi sideways to the direction of travel so they roll side to side when you stop and start and not bang their nose and tail when you stop and start. Some koi hobbyists have covered PVC tanks with rigid supports on their pickup trucks or mini-vans to move koi to koi shows. These tanks require oxygen tanks or electric pumps to add aeration to the water during transport. Koi have also been known to get bruised by the hard supports holding the tank up. It is best not to disturb koi during the colder winter months if you can avoid it. Their stress level is best kept low during this time of minimum resistance and weakened immune system. With English style koi shows, koi are kept in their own tank so there is no concern of bringing parasites or bacteria into your pond when the koi are returned. With Japanese style koi shows, koi are mixed and there is concern of bringing parasites or bacteria back to your pond. I resolve this concern with a 10-15 minute dip using a product called Formalin 3 available from pet stores or koi dealers. An air stone is added to oxygenate the water in the treatment tank. When your koi are climbing the walls of the container, the dip is stopped. **Warning- Formalin is not compatible with salt and can kill koi if salt is present in the dip water.** I have killed a

koi by forgetting this rule. When handling koi for a medical shot, I find it easier on both the koi and me to wrap the koi in a plastic bag so it cannot move, turn the koi over to expose its belly, and give the injection thru the bag. This is much easier than anesthetizing the koi. To treat a wound or an ulcer, you will have to anesthetize the koi. Here you will find two camps. Some koi people swear by clove oil, others like me prefer to use MS-222 or Finquel as the commercial product is called. Finquel is more expensive but I find at 3gm per 5 gallons of water, the koi go down quicker and revive quicker than with clove oil. **Note – Finquel is the easiest method to put a koi down for good. 10 minutes or so is all it takes so if you use it to anesthetize koi, be quick with the treatment and get the koi back into an aerated part of the pond to recover.** Female koi will **not** usually let go of their eggs in spring if there are no plants in the pond to lay the eggs on. Sometimes, these female koi are unable to reabsorb their eggs during the following winter, the eggs rot and the koi dies of peritonitis. So it is important to try to help the koi release their eggs each year by adding water hyacinths to your pond for a short time. Dip hyacinths into a Formalin bath to kill any parasites before placing them into your pond. If you are not able to get the female to release her eggs, you might consider not feeding your koi for 1 month during the winter to aide the females in reabsorbing the protein from the eggs. Learn from someone who knows what they are doing before attempting to physically strip eggs from a female koi and anesthetize the koi while doing this. I had a koi break her tail in half when I first tried this without anesthetic. Luckily the tail grew back. When male koi are mating in the pond, you clearly see them chasing the female koi at around 68-70F. It is a good idea to lower the pond level for a few days so the male koi do not throw the female koi out of the pond, it is that violent. You will know the smell of male koi sperm when you encounter it and there will be ½ inch of foam on the surface of the pond. Do a reasonable water change to remove as much of this protein material as you can to maintain good water quality.

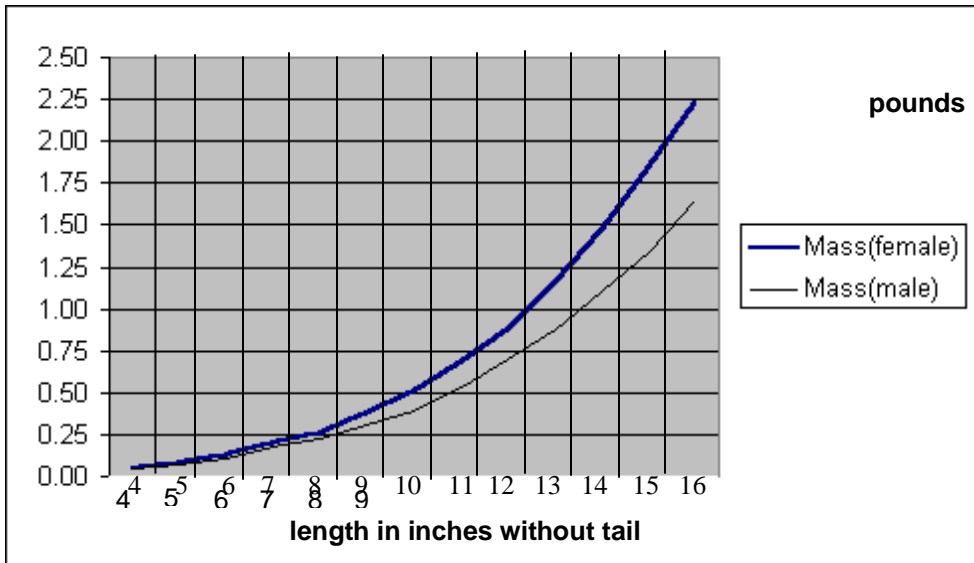
Medication & Disease – This part of the tutorial is really advanced for the beginner who should request the assistance of a AKCA Koi Health Advisor (KHA) if you have access to one in your area or the assistance of a long time koi person in your club who owns and knows how to use a microscope. AKCA is in the process of training koi technicians in clubs throughout the US and Canada to help the hobbyist with pond, filter and koi problems. KHA training has covered club representatives in the Northwest, Northeast and Texas in the 2001/2002 class. Club representatives from regions of Florida, Great Lakes and Northern California/Nevada are being trained in the 2002/2003 class and finally club representatives from the Southwest, Southeast and Midwest areas in 2003/2004 to complete the training plan. These KHA trained people donate their time to assist the hobbyist who is required to sign a waiver not to hold the KHA person or AKCA liable for any problems resulting from this assistance. First know what you are fighting, then treat. Don't get into the habit of throwing the kitchen sink of chemicals into your pond at the first sign of trouble. Let's first discuss parasites. Easiest to see are fish lice that look like small crabs or freckles on the skin and anchor worms that look like small worms sticking straight out of the side of a fish because the head is buried under the skin. 0.3% salt will usually clear up lice. Trichlorfon, Dylox or Dimilin will be required for anchor worms and several treatments will be required to break the parasite cycle because these treatments only kill during one point in the cycle of the parasite from egg to adult. **Do not feed your koi while treating with most chemicals.** The first 2 drugs will require large water change to remove the

drug after each treatment. Dimilin does not require water change but it is also *not authorized* by the government for aquatic use so it is illegal for koi. Dimilin is used to dip dogs, cattle and sheep for parasites so it is readily available. If you use Dimilin, don't tell anybody. Next are the microscopic parasites of Flukes, Trichodina and Ich and Chilodinella in order of probability. Review Dr. Johnson's book to see what these parasites look like under a microscope. So it is important to own or have access to a microscope if you own koi. And you should learn how to take a scraping from your koi to capture these parasites for your microscope inspection. Flukes are often found on koi when bought. Dealers can treat to kill the adults but do not hold the koi over to kill the eggs as they hatch. This may only be 4 days in warm water but may be a month in cold water. The best treatment for flukes is Fluke Tabs at \$0.10 each for 10 gallons. That means \$240 for 2 treatments in my 12,000gallon pond. But Fluke Tabs are the most effective. At least 2 treatments will be required to break the parasite cycle with a major water change after the treatment is finished. A new product SupaVerm is now available at much lower cost and no water change required for eradication of flukes. To be effective, SupaVerm requires .3% salt in the pond. The long term effects of SupaVerm are still not known or the problems with combining treatments with other chemicals. **SupaVerm is 100% effective in killing goldfish so take them out of the pond while treating pond until several large water changes reduces the chemical.** An alternate treatment for most any parasite is Potassium Permanganate that not only kills every bacteria it finds but also acts as a flocculent to clarify your pond water. The nice thing about PP is you know when the active ingredient is used up by the change in water color from purple/pink to tea/orange/brown. You can also immediately stop the treatment by adding Dechlor or Amquel to the pond. You will need to isolate your filters while treating your pond with PP. This is why 2 pumps are needed to run the pond and filter systems separately. The preferred use of PP as far as I am concerned to avoid burning the gills of your koi is to treat 2ppm treatments on successive days or weeks until the pink color stays at least 6 hours. This low dose is easier on the koi and is required for Doitsu koi who do not have scales and have more sensitive skin than normal koi. I use PP automatically in Spring when the water temperature reaches Aeromonas Alley which is 47-62F. This is the temperature range when the bacteria and parasites are getting active and the koi immune system is still weak from winter when it goes dormant at about 50F. This PP treatment is compatible with salt and knocks back the parasite and bacteria levels so the koi can cope until their immune system kicks in.

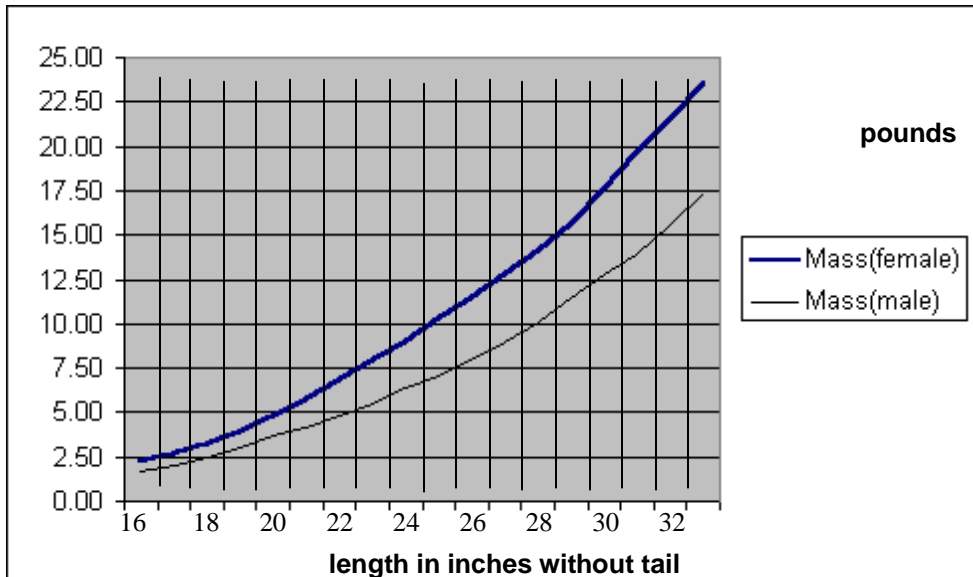
Trichodina is the second most often found parasite. It is usually killed off with 0.3% salt but some resistant varieties from Japan are now requiring 0.6% salt to die. When you are above the level of 0.3% salt in your koi pond you had better have a good salinity test kit to make sure you do not over salt your pond and reduce this level of salt after a few days with large water changes. I recommend the LaMotte Salinity test kit using the adjusted approach created by Norm Meck to double the accuracy. This approach can be used to back calculate the volume of your pond within 5% it is so accurate. Ask me for a copy of this procedure if you buy a LaMotte test kit. 37% Formalin is also effective against flukes but does not mix well in cold water, will kill back your filter, will kill koi if combined with salt and is more difficult to get out of your system. So I don't use formalin in my pond.

The next popular parasites are Ich, Chilodinella and Costia which treat easily with 0.3% salt. Winter problems include fungus and fin rot of various types. These are easily treated with a mixture of Formalin and Malachite Green sold commercially as Formalite III or DesaFin. These products are sun sensitive so treat just before dusk and turn your UV light off if you have one. Any blue stain will clear with the sun the next day as will the active ingredients. Even though the Formalin in this product is lower concentration, watch your salt level if using these products. Treatments every other day for 3 treatments is suggested and water change is usually not necessary.

Next is the area of bacterial infections in koi. This is a huge topic and I send you to Dr. Johnson's book for the proper discussion. First, I want to tell you there are medicated foods available for bacterial infections. You can also mix your own food using antibiotics. But the bottom line is you will probably have to inject a koi sometime in your life, hopefully not often. The KHA trained person or a koi friend must work with a Vet to obtain and assist you in injecting antibiotics. First you must measure your koi to know how much to inject. Sometimes Vets go by mass of the koi so here are two charts below to help you estimate the mass of males and females. The males are thinner and are the bottom curve on both graphs. The method I recommend is to place a koi in a plastic bag, carefully wrap the bag so the fins are tight against the koi, turn the koi over and have someone hold the koi while you inject antibiotics thru the bag. I find this much easier than anesthetizing the koi using Finquel per the earlier discussion in Fish Care. Inject the antibiotic once each day for 3-5 days in succession and do not miss an injection. You must keep the level of antibiotics at a certain level to kill off the bacteria and not let it get acclimated to the drug. Many drugs are now ineffective against certain bacteria due to improper medicating. I prefer to inject into the IP Inter-peritoneal cavity just behind the ventral fins and well in front of the anus. This has the potential to pierce an organ so some koi keepers prefer IM Intra-muscular injection behind the anal fin. It will take longer for the drug to get into the bloodstream but it is safer. There is a strong chance you will remove a scale with the injection but this is on the underside of the koi so who cares. Right now Azactum and Baytril are the injectible drugs of choice. However, Dr. Galen Hansen has recommended dual injections IM of Azactam and Gentamycin (or Amikacin) to kill off all forms of gram negative bacteria since he finds more than one strain active every time he grows out bacterial samples. Warning – It is a Misdemeanor to possess syringes in my county without a prescription so make sure you keep the receipt from the Vet. Some koi keepers believe a constant flow of fresh water is effective in flushing the bacteria out of your system. UV filter systems can be effective against Aeromonas if the correct watt/time density or flow rate is applied. Aeromonas hole in the side disease usually starts as a bruised spot and then the scales stick out locally and fall off leaving a hole. Any such hole or wound in koi requires treatment locally which will mean anesthesia. I recommend a topical product called Bag Balm that is a petroleum jelly type material with medication in it and can be applied to DRY surfaces so you will have to pat the water and slime off of the wound. Other products you can use are Iodine or Gentian Violet topically. But watch out, it stings so the koi will react violently. This material also tends to run down the side of the koi removing the slime as it goes which is bad. If you use MS-222 to put the koi to sleep, you need to work fast treating the wound and injecting the koi so have everything ready within reach. It is a fact koi will heal faster in 75-80F warm water so isolation or hospital tanks with heaters can be a blessing. It is also much easier and cheaper to catch



weight graph data source - Aquarium Fish magazine article by Steven Meyer



and treat koi in a hospital tank than in your pond. Do not leave one koi alone, put another koi in the hospital tank to keep the sick one company. Food with Oxolinic Acid has also been effective against Aeromonus infection. I have just scratched the surface of this topic. For discussion of quarantine tanks see the later section on Bringing new koi home. It is always better to treat koi with bacterial infections in a hospital or quarantine tank with good water quality in a controlled environment. The bacteria levels in the pond can be reduced with Potassium Permanganate, Nitrofurizone or competing, beneficial bacteria in Lymnozyme. For treatment of parasites it is best to treat the whole pond because they are probably spread throughout the pond anyway.

Buying Koi – Before we can start this discussion, I need to say something about koi classification. Koi Classification is another 1 hour lecture and I provide this lecture as a separate attachment. The Koi Classification and Judging Criteria lecture with

photos is printed in KOIUSA Volume 26, Issues 5 & 6 and Volume 27, Issues 1 & 2 still to be published as of this typing. We do need to discuss Gosanke when discussing buying koi. Gosanke are Kohaku (white with red pattern), Sanke (white with red pattern plus lacquered black spots like islands) and Showa (white with red pattern plus wrapping flat black pattern). Now I will usually get a fight when I say this about Showa because the early Showas were considered black koi with red and white pattern due to having so much black. In fact only totally black baby Showa were kept during culling by the breeder. However, the modern Showa with a balance of red, white and black is better described as a white koi with red and black pattern. It is easier for new koi people to swallow. Why are these three varieties separated from the other 11 or so varieties at a koi show and given a special group name of Gosanke? Well, Kohaku was the first class stabilized in about 1890 in Japan. Sanke was the second variety stabilized in about 1917 with Showa stabilized in about 1920. Breeders in Japan have had almost 100 years to perfect the bloodlines of these three varieties with most of the other varieties coming after World War 2. The judging criteria for these three varieties is much more stringent and demanding than for the other varieties. Also, a breeder may only get 100 (or no koi) with quality patterns out of 1 million baby koi of a Gosanke breeding. But 999,000 of 1 million solid color Ogon koi will look just like the parent koi. So the rarity and difficulty of breeding quality Gosanke koi make them much more expensive than the other varieties. This difficulty also enters into which koi usually win the major awards at koi shows and if you have noticed Gosankes usually win.

Ok, with that said, let's talk about buying koi. You need to ask yourself why you are buying koi. Are they just to look at in your pond or do you intend to show these koi? The more you learn about quality koi, the more they will cost you because you will become more selective. Next question is do you want a guaranteed result or what we call a finished koi to win immediate awards at a koi show or do you want to buy 1 or 2 year old koi and hope they will grow into the beauties you want to show? Finished koi are at their peak colors and skin quality. We have both approaches active in koi shows today. Some people are willing to spend \$10,000 to \$20,000 now for a finished koi to take Grand Champion at a koi show this year or next. I personally appreciate these people because they allow us to see koi at our shows you would have to go to Japan to see. But only watching a koi go downhill after I won the trophy is only 1/2 of the hobby in my view. I prefer to buy 1 or 2 year old koi with good bloodlines and bet on the pattern. I have now used the word bloodline. Well, some breeders are more successful breeding winners of the All Japan koi show so their koi have a better chance to grow into quality koi than other koi. Some breeders specialize on one or two varieties to breed. If you want to buy koi to grow into quality fish, you either have to work a relationship with a dealer to provide you with koi with proper *unwritten* pedigree or you need to learn a lot about bloodlines and how koi change from 1 year olds to 4 or 5 year olds. For example with Kohaku, the red pattern you see at 2 inches is the red pattern you get. The pattern does not grow as fast as the koi body so the pattern tends to come up onto the back. If you want to buy a koi to peak when young for shows, you can select a koi with a balance pattern at a young age. If you want the pattern to be balanced at 22-24 inches, pick a baby koi with a wrapping large red pattern too large for its body as a baby. You will need to learn the judging points for each variety to learn Kohaku need red on the head and should have white on the nose and just before the tail starts plus a balanced pattern when viewed from the top. There are similar judging rules or preferences for all of the

other varieties. **Tategoi** means a potential quality future koi. That koi may be 2 inches long or 24 inches long and still have potential for improvement and be called a Tategoi. The safest bet when selecting a Tategoi award is Showa because the red is what you get at a very young age but the black will still be coming 4 years later. Different bloodlines have different rates of growth or pattern development. Or you can simply buy 4 or 6 baby koi of a same variety from a reputable dealer and try to work the odds. Many koi hobbyists are not interested in show quality koi. They just want to select pretty koi they like to watch in their ponds and this is fine also. There are many, many ways to enjoy the koi hobby. You can buy 1 year old 4 inch koi for \$20 or \$200. You can buy large 20 inch koi at auction for \$30-50 or \$1000-3000. I have seen both and everything in-between. One hint with Sanke is bluish black spots under the skin is a good sign of potential black but when it comes up it will be 1/10 the size or smaller so do not be afraid of a lot of black under the skin on a young or baby Sanke. In finishing koi, the red comes first and the black will usually come later. The trick is to show the koi when both colors are up and finished as shiny as they can be before the red starts the long path downhill. So if you find a baby koi say 6 inches long with black up and finished, this koi will most likely be a good show fish as a young koi and the black will probably break up or become too much for proper color balance as the koi matures to a 22 inch and larger koi.

Now let's discuss buying koi from a local dealer or from a Japanese dealer that brings koi to the US vs going to Japan to buy koi. The cost of the koi will be similar with both options. If you go to Japan to buy koi, I strongly recommend you go with a dealer who can get you into the right places to see good koi. Also, once the koi are bought, they are yours so having a dealer along who will make sure the koi are properly taken care of until they are shipped to you is very important. The big advantages of going to Japan to buy koi is to see more quantity of better koi and to have more options in buying koi. If you wait here at home, you only have the opportunity to buy the koi the dealer brought. Some local dealers will take orders to buy a special koi for the specified amount when they make their semi-annual trip to Japan. But some dealers are hesitant to do this because you may not like the koi they select for you causing hard feelings. So it is a mixed bag. If you fly to Japan on your own to buy koi, arrange ahead for reputable dealers who have English speaking staff to deal with you. Yes, you can tromp into Niigata and visit koi breeders and may even get thru the language barrier to buy a koi, but what then? You can't exactly put it into your car and take it back to your hotel. The other advantage in going to Japan with a dealer is to get the true feeling of the koi business and the traditions behind this business. Many, many koi will never be shown to buyers outside of Japan and certainly not sold to a foreigner. This is not racism, this is usually a dealer who wants his koi to win a show in Japan because that is good for business. Winning a show in the US will not likely bring as much business to that breeder as winning a major award in a Japanese show. One way some koi hobbyists have broken this barrier is to buy a koi in Japan with the agreement you will board the koi in Japan in a dealer's mud pond and have that dealer show that koi in Japan for you. If you buy koi in Japan and have them shipped directly to you without the help of a local dealer, my experience with this process says you will have two issues to deal with. First when you know the date, airline, flight and time of arrival of the koi, you will have to make an appointment with Fish & Game to come inspect the koi which will be locked up by the airlines in their shipping area until they are cleared. Once the Fish & Game clearance papers are signed, then you will have to take them with the shipping paperwork

to another location to US Customs to pay your import duty. If you are unlucky enough to get the person I did, this may take an hour of arguing to prove you are not a dealer and do not require a dealer import license. And then another 15 minutes arguing about the value of the koi even though the shipper clearly stated the sale value. Then you pay the \$20 or so import tax for \$2000 value in koi and promise to not import more koi for the next 12 months or you will have to get an import license. Maybe this was just a bad day for the Customs agent or maybe it is just LA. Another person wrote in KOIUSA about his experience receiving koi from Japan to Chicago and had none of the problems I had. By the way, if the koi are dead, it is your loss and not likely the dealer in Japan will make amends. As I said earlier, when you buy a koi in Japan, it is yours from that point forward. Luckily, my koi were fine after 20 hours in transit plus 2 hours with paperwork. I now appreciate dealers who will take responsibility for koi until they arrive at your home alive and well. And I do not resent a healthy local dealer markup on these perishable items. How many koi does a dealer get reasonable prices for out of each 100 koi brought from Japan and how many do they have to sell at or below cost to get rid of them. I don't see rich koi dealers anywhere. Much like the breeders in Japan who have to provide expensive land, food and lakes for millions of koi over 16 years minimum to establish a bloodline to get back their investment on the few quality 3-5 year olds held over to mature to the 22-26inch specimens.

Now, should you buy a 2 year old Tategoi or wait until it is 3 years old. I have had this discussion with Roland, owner of Toyoma Koi who lives very near to my home. His good point is, "If you convince a breeder to let go of a Tategoi in the breeders mind at 2 years old, you will first pay the price of the 3 year old the breeder planned for that koi and still have a 2 year old koi. Second, do you think that koi will grow better spending the next year in your concrete pond or spending the next year in a large mud pond in Japan. The second answer is the correct answer." There is an old saying in koi "He who buys a 1 year old koi is a fool and he who sells a 1 year old koi is also a fool". What they are trying to say is with koi at 1 year old, a good breeder *may have a clue* a particular koi is a Tategoi but why take the risk if you have the room to hold the koi over to find out for sure in 1 or 2 more years and sell the koi for much more. The point is breeders only have so much room to grow koi and must use their experience to hold back only those baby koi who exhibit the characteristics of the parent koi the breeder wanted. What they are also saying is the koi hobbyist *has no clue* if a baby koi will mature into a quality koi. All we can do is buy koi from known breeders or bloodlines and hope the breeder missed this koi during his culling. What are the odds? Breeders could not stay in business if their culling skills allowed this to happen often. Bottom line – if you are into showing Gosanke koi in competition and can afford it, buy 3 year old koi from quality bloodlines and pay the price (\$2000-\$5000) at say 22inches. These koi are still Tategoi and some won't mature until 8 or 10 years old. Others will mature at 5 years old depending on bloodline characteristics.

Japanese breeders also must protect their breeding stock. There are good reasons why US breeders have not been able to create the quality of koi we see from Japan. First, US breeders cannot get the quality breeder koi. Second, they typically do not have the patience to create a bloodline that can take 13 generations of koi. Perhaps someday this will happen. Having bred koi myself 9 times at an expense of \$1500 each time mostly in food, I can tell you buying quality koi from Japan is cheaper with much higher probability of obtaining a show koi. I consider myself a lottery winner by winning a

Young Champion Award with a 21inch Kohaku I bred and a Best In Class Bekko Award with another koi. Two major awards in 9x\$1500=\$13,500.00 invested. Yes, I learned a lot about how koi change as they grow, and my wife and I did get enjoyment by watching our baby koi grow but for \$13,500 how many potential Grand Champion koi could I have purchased? At least 3 or 4.

Bringing new koi home - When you bring home a new koi, float the bag in your pond or hospital tank for 15 minutes or so to let the temperature adjust. If the koi has been in the bag for several hours, the pH will have lowered due to respiration of CO₂ and the water needs to be combined with pond water slowly so the koi doesn't get shock of a drastic change in pH. But before you do that, add some Amquel to the bag per instructions on the bottle to absorb the ammonia that accumulated during shipment **before** adjusting the pH. The good news is fish respiration tends to reduce the pH in the bag making ammonia less toxic. The bad news is when you add pond water to the bag to raise the pH, you will allow the ammonia to poison your koi if you don't absorb the ammonia first with Amquel. Try to find out if purchased koi had been kept in salt treated water and at what salt level. Going from water with 0.3% salt to zero salt may result in minor, temporary stress. Going from 0.5-0.9% salt to zero salt will cause major stress or death and you may want to raise the salt level in your pond or hospital tank to 0.3% when the new fish are added.

I strongly recommend quarantine tank isolation of new koi to observe them and to treat them for parasites for 3 weeks at 70F or higher with a koi from your pond for company to allow treatment to break the parasite reproduction cycle and to make sure the new koi does not carry KHV or SCV virus. Also a koi from your pond in the quarantine tank keeps the new koi company and shares bacteria on a small scale to find out if you will have a bacterial problem. If the new koi has bacteria your koi have no immunity against or has KHV, better to sacrifice two koi in a quarantine tank than all of the koi in your pond.

Many koi people feel it is very important to not isolate your koi pond for too long but to periodically buy new koi or take koi to Japanese style koi shows to keep their immune response active.

Koi Classification & Judging Criteria— read the separate lecture text on this subject or obtain KOIUSA Volume 26, Issues 5 & 7 and Volume 27, Issues 1 & 2 still to be published as of this typing. Start with the 14 main varietal groups of koi and what they mean and do not get confused by the many, many sub-varieties and specific names for some koi.

Koi Terminology - There are many, many Japanese terms in the koi hobby. Most of these terms you will have no need to know and the few you should know will come with time and study. I have a 236 term Japanese to English and English to Japanese dictionary I compiled for koi terminology. If you are interested in obtaining a copy via email, contact me at judgedahl@hotmail.com and I will send this Excel file to you. You may make as many copies as you wish for koi hobbyists but may not charge

more than the \$1 copy cost for sale of this document. I insist all documents I provide be free and for the benefit of the koi hobby.

History of Nishikigoi — What are Nishikigoi? **KOI** is shortened from the Japanese word Nishikigoi. Nishikigoi is formed by the symbol for the early Chinese red carp (*Cyprinus carpio*-species) and the Japanese symbol for a many colored cloth imported from India. The earliest written record of ornamental koi dates back to 500 BC in Eastern Asia. These fish were first introduced into Japan in AD 200 with the first record of color mutations in koi in the early 1800s. The mountainous region of Niigata became the koi breeding area when carp were brought into the rice paddies for protein during the winter months when access to the area was closed by snow. Also in the early 1800s, scaleless mutations were recorded in Central Europe. As the scaled Japanese carp cross bred to form beautiful colors and became too valuable to eat, the German scaleless koi found their way to Japan in 1904 to replace the scaled carp for food. These German scaleless carp are called Doitsu. These scaleless carp then cross bred with the scaled carp and they also became too valuable to eat. Eventually, most of the rice paddies in the Niigata region were turned into koi breeding ponds because they could now afford to buy their rice. Niigata is still the center of koi breeding in Japan. There are currently 14 separate judging varieties for koi based on colors and location of colors. The first modern variety was stabilized in Japan in 1890 with the majority of the varieties of koi becoming stabilized after World War II in Japan. Stabilized means the koi variety can be reproduced repeatedly and sub groups of each variety have been created along bloodlines by professional breeders much like AKC (American Kennel Club) dogs or race horses are breed. Read into this large export profits for Japan where large scale breeding occurs. Can koi be eaten? Yes, but why would you want to. They are pets in private ponds in backyards all over the US and the World. However, a recent article from the United Nations Food authority stated commercial carp are the most harvested food fish in the world, more than 10 times salmon. So, many people do eat carp. But not my pets.

Koi Anatomy — The best reference for this discussion is Dr. Johnson's video showing koi anatomy in living color. The second best reference is in the Tetra Encyclopedia of Koi. Biology is not my field and I will not attempt this subject but I will mention important facts you should know. Koi are cold blooded, hibernate below 50F and their digestive system shuts down completely at this temperature. Their immune system also starts to shut down below 55F. Koi have no stomach, just intestines so they cannot store food well. They are naturally bottom feeders ingesting clay as they search for grubs in a mud pond. They obtain minerals from this clay as well as from a varied diet. Koi are omnivorous and will eat almost anything. Koi have a protective slime layer and you should avoid rubbing this coating off if at all possible when handling koi. The front fins on either side of the shoulder on koi are called the pectoral fins. Koi maintain balance in the water by use of a swimbladder they inflate and deflate as required. Koi floating with their head or tail down may be a sign of a problem with this swimbladder that we have no cure for. Unless the koi is full of eggs and then the buoyancy of the eggs can affect the koi's ability to keep level. Once the eggs are gone, the problem may resolve itself. Koi can grow back fins if the main bone is intact and sometimes even if the main bone is gone. Lost scales will grow back but may not grow back in a nice uniform direction and may be noticeable. Koi DO have teeth. They have

some molars in the back of their mouths mainly for grinding plant material like cows and they occasionally spit out one of these teeth that look like human baby molars. Koi excrete most of their ammonia from their gills and not from their anus where they rid themselves of solid waste. Koi maintain a salinity balance on either side of their gills so adding some salt into the pond water does help the koi to maintain this balance. However, removing a koi from a pond with salt to a koi show tank without salt will upset and stress the koi for a time until the koi can adjust to the new balance point. Koi have two sets of barbels, goldfish have none. Goldfish and koi can interbreed. Koi have an external organ that looks like a raised line on each side called a lateral line. This organ senses very small sound vibrations to the koi much as we hear. This organ is so acute, my koi can sense a sliding door opening in my den and come to a certain area to feed. Continuous loud noise like jackhammers in a neighbors yard has been suspected to kill a koi.

Koi Shows - A majority of koi hobbyists do not take their koi to competitions or shows. They just enjoy their pets and their ponds. But many koi hobbyists live for the competition and the opportunity to prove they have the best koi on the block, city, state or country. It is true that moving koi from pond to unfiltered show tank for 2 days and back to the pond stresses the koi but there is no data on the long term affect of this treatment. Just placing a net into a koi pond will stress koi. It all boils down to what you want from the koi hobby and shows are a reality to many koi hobbyists. There are two types of koi shows: English style and Japanese style. English style with each owner placing their koi in one tank separate from the koi of the other owners was created so to not allow bacteria or parasites to transfer from pond to pond. Care is taken to sanitize nets, tubs or hands between uses from tank to tank. This style has been popular in the US for the last 3-5 years due to disease outbreaks in some parts of the country. Koi Judges walk back and forth judging the koi. This style of show is safest for the koi in one respect and dangerous in another respect. It will not allow bacteria or parasites from another pond into your pond from the show. However, if you isolate your koi to the point that their immune response is weak, the next time you buy a koi and place it in your pond you will have a major outbreak of diseased koi. I myself have given healthy koi from my breeding to another club member only to have all of his existing koi die leaving only the koi I gave him alive. This is a case where my koi had immunity and his koi had been isolated too long. So there are many advocates for a Japanese style show where all of the koi are mixed and sorted by size and variety into tanks where the Judges can come to judge one variety of a certain size in that tank. This exposure to some new bacteria could prove beneficial to a strong koi immune system. Now parasites are another thing and coming home from a Japanese koi show I always dip my returning koi into a commercial product Formalin 3 dip for 10-15 minutes using water free of salt. Japanese style shows are definitely easier on the Judges. But that is not the real point. Japanese style shows provide an excellent teaching forum to explain what is better or worse between two koi as the judging team is at one tank, not walking back and forth like an English style show. And at the end of the judging, the 1st, 2nd and 3rd Place koi are all in tanks side by side and marked for these awards so anybody can see which one was the winner and why. Teaching is one of the main reasons for having a koi show and that is why many koi hobbyists want to return to Japanese style shows.

Now, how do you take your koi to a show? How you catch and transport your koi was discussed in the Koi Care section. You will need to take a koi net and a blue tub to the

show. Certainly, a strong cart with large rubber tires is helpful in moving your koi in boxes to the tank in a koi show. Most clubs also have wheeled carts at shows to move your koi from your car to the show tank. Koi are usually delivered to the show site between 7-9am on Saturday morning. Out of town entrants are welcome to check their koi in Friday evening. The Show committee will measure each koi and place it in the proper variety for judging. Koi shows usually have 4-6 size groups in 2 or 3 inch increments and 14 variety groups to place koi into. Judging starts in one or two teams of judges about 10am and can take 6 hours for English style shows or 3 hours for Japanese style shows. In an English style show, you are usually required to bring a photo of each koi you take to the show for the judging panel to use during judging. Awards are noted by the judging team and you find out you won at the banquet awards ceremony. I have been to English style shows where the koi are brought in Saturday morning and returned home Saturday evening so the owners can relax at the banquet dinner knowing their koi are home safe and sound. In a Japanese style show, all of the koi are mixed and moved from entry tanks to final tanks for 1st, 2nd, 3rd Place and etc. You as the owner are required to find your koi using your photo album after the judging is completed and claim your awards by filling out your name on sheets at the winners table for all of the awards your koi won. If you forget to claim your award on the sheets, you will get no award. It is better if you attend the awards banquet in the spirit of friendship and camaraderie. It is bad manners if a major award winner is not in attendance at the awards banquet. It has become good business manners for winners of major awards to identify which dealer or breeder he/she obtained the winning koi from when accepting the award. However, if unable to attend you can retrieve your awards on Sunday from the show committee. Koi are usually required to stay for public viewing until about 3pm on Sunday. At 3pm, the show committee will say it is alright to pack up your koi and go home. However, at a Japanese style show, you will be assigned a tank to find and place your koi into and koi cannot be bagged for the trip home until all entrants have found and placed their koi into their tank. That way all of the koi go to the proper homes. Koi Show committees provide new bags, rubber bands and oxygen for you to use for the trip home. This is a confusing time with people running every way or another and net handles flying. It is good manners to aid another koi hobbyists in catching their koi so they can return the favor. It is also good manners to spend 15-20 minutes assisting in the tear down of the show and tanks before spiring you koi home. That amount of time for your koi in a bag with water and oxygen won't hurt the koi but your help will really be appreciated for the club members who worked so hard setting up and tearing down the show. That is unless you are traveling a long distance and then not helping is understood.