CALIFORNIA ORGANIZATION OF AQUATIC SHOW TROPICALS COAST

Showfish

ion of Aquatic Show Tropicals

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Announcements

- **NEXT MEETING:** **December 1—Chuck Rambo speaking about what 40 years in the fish hobby can do to person**

- **A 75gallon aquarium set-up will be auctioned off at the December meeting; this is the set-up donated to us at Pet Expo earlier this year.**

Market comparison of 75 gallon glass aquarium set-ups:

Petco in store................ **$876** incl tax: PennPlax 75 gallon tank, 29 inch stand, glass canopy, T-5 lights; no filter
Glasscages.com .... **$964** not including shipping; 75 gallon tank ($334); stand, canopy, lights, and filters ($480); light fixture with lights ($150); no filter
That Fish Place............. **$387** plus tax; **pick up in PA** only: 75 gallon tank ($168); glass canopy $38, stand ($181).
CraigsList, Used............ **$250** **pick up in NYC**: 75 gallon tank, lights, stand, lid
Fishtanksdirect.com ..... **$873**: 75 gallon tank ($352), stand, lights ,filter, cover glass; free shipping
PetSmart, tank only...... $218 incl tax (on sale), in store only: TopFin 75 gallon with hood only

The Corydoras Breeding Tank

Part 1 of a 6 part series—Breeding of Corydoras aeneus and Corydoras paleatus

By Ron Jackson

The Breeding Tank series of articles was originally printed in Showfish in 1995

Most of you know that I raise killifish. What some of you might not know is that my other love is raising catfish, primarily *Corydorus* species. I currently raise 17 different types of Corys. I plan to share some of my hints for successful breeding of Corys with you in this article. I first became interested in Corys while looking for another type of fish.

***Corydoras aenus*, the Bronze Cory**
This work has been released into the public domain by its author, Quatermass, at the English Wikipedia project.

I saw a tank full of baby *Corydoras aeneus* (Gill, 1858). They looked like a bunch of tiny tadpoles scurrying around the bottom of the tank. From that moment on, I knew I was hooked. I obtained *Corydoras aeneus* and *Corydoras paleatus*. That was over 45 years ago, and I'm still an enthusiastic breeder of Corys.

The following are my recommendations for successful breeding of these catfish:

- The number one priority is to have at least a pair of Corys. I prefer to have at least two or more males per female.
- Make sure you have mature fish. They are easier to sex and you will have more success with them.
- Feed them heavily with live foods such as white worms, daphnia, newly hatched brine shrimp, and black worms. Black worms, in my opinion, are the best live food you can feed your Corys to get them in breeding condition.
- Maintain good water quality. Although these fish are scavengers, they are very sensitive to poor water conditions.
- If you are unable to induce them to spawn, try changing 20 to 50% of their water. It still doesn't work, place several ice cubes in a plastic bag and float them in a tank to lower the temperature a little.
- Still no luck? Put a power head in the tank for some horizontal current or tilt it so it will simulate rain.

If these fail, I usually start all over again. Sometimes a change in barometric pressure, such as the onset of rain, will trigger spawning.

The two easiest Corys to induce to spawn are the *aeneus* and *paleatus*. With these two catfish, all I need to do is keep their tank clean and feed them plenty of food. When they are ready to spawn, the male will swim around the female and nudge her behind the head. He will position himself in front of her in the familiar "T" position. The male will place his vent at the female's mouth.

***Corydoras paleatus*, the Peppered Cory**
This work has been released into the public domain
by its author, NiKo at the German Wikipedia project.

There is a lot of various ideas regarding the fertilization of these eggs. After all these years of breeding them, I'm still uncertain how fertilization occurs. Possibly the female takes the sperm in her mouth and applies it to the area where she places the egg. I have seen female catfish of other species expel an egg in the pocket of her ventral fins after the "T" position. She then proceeded to place the egg on a nylon spawning mop without touching the yarn with her mouth. If Corys take in air at the surface with their mouths and expel carbon dioxide from their vents, why couldn't they take in sperm and expel them while laying eggs? (Something to think about.)

After assuming the "T" position, the female will expel three to five eggs in a pouch formed by her ventral fins. After expelling the eggs, she will rest for a few seconds and sometimes as long as a few minutes. She will then swim around looking for a place to deposit her eggs. She may place them on the glass, a box filter, or on broad leaf plastic plants like I use. She will rest for a short time, then the male will start nudging her behind the head and the whole process starts over again. This can go on for as little as two hours or can last several hours. I once had a female *paleatus* spawn continuously for 36 hours. She laid what appeared to be 400 eggs.

Cory eggs are approximately 2 mm in size. The eggs can hatch in 48 hours when the water temperature is 78 degrees. At 70 degrees, the eggs can take up to eight days to hatch. The newly hatched Corys will absorb their yolk sac within three days. During the next three to four days, I feed them micro worms and newly hatched brine shrimp nauplii. I continue feeding them this way until they are able to eat grindal worms and dried food. When they are large enough, I feed them black worms, *daphnia*, and chopped earthworms.

Sexing adult *aeneus* and *paleatus* is very easy. The adult female aeneus is very fat compared to the male. Look down at their bodies from above. The male will be thin while the female will have bulging sides. When looking at them from the side, you'll notice the female has a rounded belly. In the *paleatus*, the female has the same characteristics described above. The male, however, in addition to being thinner, also has a long dorsal fin. Some of my males have dorsal fins at least one inch long. *Cory. aeneus* females achieve a length of three inches. Males are a little shorter. My *paleatus* females are three and a quarter inches long; the males are shorter.

To set up the breeding tank, I use water from the tap that has been treated with a chloramine remover. The pH is 7.6 with a hardness of 350 ppm. In the past, I have added methylene blue to the water on occasions. This helps to correct problems with the water which I cannot detect. I believe the water needs to be treated more in relationship to the age of the fish. Older females will produce fertile eggs, but the eggs do not appear to be as strong as those laid by younger female Corys.

I hope the above information has been helpful. If any of you have questions regarding the breeding of corys, give me a call.

[Note: Ron Jackson is retired from fish keeping but maintains his lifetime membership in COAST. Contact information for him is available to COAST members in good standing.]

Essential Amino Acids

With the presentation for November's meeting being on foods and feeding, it seemed like it would be fun to include complementary information on nutrition in our first Showfish in several years.

Turns out "fun" may have been an overstatement, at least on the article preparation side of things. The studies undertaken by the many researchers on nutritional requirements seldom use the same starting, ending, or reference points for the study, which makes comparing results of one study to another somewhere between difficult and irrelevant. Important variables are often not recorded at all. Premises are based on data that newer technology could refine or refute, but the premises are built upon without being rechecked. A further difficulty—acknowledged and being addressed as tropical fish farming becomes abigger industry—is that nearly all studies have been done on temperate water fish being grown for the dinner table. The food-fish scenario makes "fastest growth for the lowest dollar" the driving consideration in food formulation.

Amino acids and unsaturated fatty acids drive tissue growth

Three things on which everyone seems to agree are 1) that all fish need the same essential amino acids (EAA) to grow to adulthood and maintain themselves, 2) that analysis of amino acids in the flesh of adult fish yields an accurate picture of which amino acids in what proportion are needed throughout a fish's life, and 3) fish meal is the ideal source of protein for aquatic animals.

"Essential amino acids (AA) are those that either cannot be synthesized or are inadequately synthesized de novo (made from scratch) by animals relative to needs. Conditionally essential AA must be provided from the diet under conditions where rates of utilization are greater than rates of synthesis. By definition, all nonessential AA can be synthesized adequately by aquatic animals. (See Table I)" (Peng Li, 2008)

Information about amino acids, how they are converted by the body, and what the body does with them has become of increasing importance because the ideal protein source (fish meal) is an increasingly expensive, variable-quality commodity in high demand with diminishing supply.

A commercial aquaculture food for trout and salmon contains as much as 50% protein; that for tilapia and catfish contains approxi-mately 32-40% protein. The most expensive ingredient in fish food is the protein (which usually has a high proportion of fish meal), and the feed comprises 30% to 50% of the cost of running a fish farm.

Getting the best protein for the species being raised, in the optimum amino acid proportions and percentage of the food, is not only a matter of immediate and recurring financial importance in itself. When protein is digested, the amino acids comprising it are released and absorbed into the body as either individual amino acids or shorter chains of amino acids, the di- and tri-peptides. The amino acids that don't get incorporated into tissue eventually end up as nitrogen in the wastewater, which the environmental agencies consider to be a pollutant: therefore, the expense of feeding fish consists not only of what goes in, but also in what comes out.

Illustration from the Biodiversity Heritage Library at www.biodiversitylibrary.org/page/3587703

***The lotus plant is the demanding diva of flowering pond plants. For descriptions on planting and caring for this aquatic star, check out this article** on page 13.*

Dr. Helen Roberts in the book Fundamentals of Ornamental Fish Health notes that "…all fish which have been tested require 10 essential amino acids… [but] the minimum percentage of the diet for any essential amino acid is different for each species… [and] can be determined only by experimentation. Of the common pet fish, the exact amino acid requirement is known for carp (koi) only."

Finding the optimum mix and amount of amino acids for fish reproduction, growth, and maintenance is crucial to finding alternate sources of protein for aquaculture feed. Continuing pricing pressure is shifting the philosophy of aquafeed formulation toward concepts of functional food and environmentally oriented food.

***Functional aquafeeds** are defined as feeds supplemented with specific ingredient(s) to achieve desirable efficiency of metabolic transformation, growth performance, health, and/or compositional traits of aquacultured animals at various developmental stages.*

***Environmentally oriented aquafeeds** are defined as feeds modified to minimize negative impacts of environmental changes (including salinity, ammonia, extreme temperatures, and stressors imposed by husbandry handling) on growth, health, and reproduction of aquacultured animals. (Peng Li, 2008)*

Table I Nutritionally essential and nonessential amino acids for fish and other aquatic animals

Essential Amino Acids	‡ Essential AA to Lysine Ratio (%), Nile Tilapia	† Essential AA to Lysine Ratio (%), Channel Catfish	Nonessential Amino Acids	Conditionally essential AA
Lysine	100.00	100	Alanine	Cysteine
Arginine	89.67	84	Asparagine	Glutamine
Histidine	35.69	29	Aspartate	Hydroxyproline
Isoleucine	62.24	51	Glutamate	Proline
Leucine	66.97	68	Glycine	Taurine
Methionine	52.51*	45	Serine	
Phenylalanine	115.04**	98	Tyrosine	
Threonine	69.03	39		
Tryptophan	11.44	10		
Valine	67.55	59		

* Methionine with Cystine: Methionine in cellular metabolism is used to synthesize cystine.

** Phenylalanine with Tyrosine: Phenylalanine in cellular metabolism is used to synthesize tyrosine.

‡ Lysine Ratios from TEIXEIRA, E.A

† Lysine Ratios from National Research Council, 1993. Nutrient Requirements of Fish. Washington, DC: National Academy of Sciences.

Knowledge on protein and amino acid (AA) requirements of fish larvae is limited and boils down to 1) larvae are not as capable of digesting and absorbing complex protein as adults and 2) larvae's amino acid requirements are greater than those of adult fish. (FURUYA and FURUYA).

What do the different amino acids do?

How amino acids are used, created, combined, or changed by fish is poorly understood, even for often-studied food fish such as channel cats. Differences in amino acid processing between cold-water and warm-water fishes, freshwater and marine fishes, or elasmobranch and teleost fishes seem to be under researched, if not downright unknown. Just what fish and mammals have in common in how amino acids are processed and benefits thereof cannot be reliably extrapolated. Sometimes, there is plentiful information on what an amino acid does, but a lack of evidence that increasing or decreasing the amount of that amino acid in the diet has a significant effect. It does seem that the changes to fish health brought about by changes to amino acids can be subtle and separated too far in time for causal relationships to be determined by a hobbyist who is not set up to do a controlled study followed by necropsy.

The table below lists what some amino acids do and the fish species that were studied in coming to the conclusions.

Table II. Roles of amino acids in physiological functions and metabolism of aquatic animals (Peng Li, 2008)

***Abbreviations:* *HMB* hydroxyl-b-methyl-butyrate; *NO* nitric oxide; *P5C* pyrroline-5-carboxylate; *T3* triiodothyronine; *T4* thyroxine**

AMINO ACID	PRODUCT	FUNCTION	SPECIES	REFERENCE
Amino acids	Various Proteins	Structure, transport, regulation, immunity, signaling, and fuels	All animals	Li et al. (2007)
Alanine, glutamate, serine	Directly	Appetite	Many fish	Shamushaki et al. (2007)
Arginine	NO	Kill invaded microorganisms	Channel Catfish	Buentello and Gatlin (1999)
Arginine	NO	Facilitate neurological function and development	Tilapia	Bordieri et al. (2005)
Arginine	NO	Regulate vascular tone, blood flow, osmolarity in gill, and cell signaling	Killifish	Hyndman et al. (2006)
Arginine, methionine	Spermine	Induce larval intestinal maturation	Sea bass	Pe´res et al. (1997)
Arginine, methionine, glycine	Creatine	High energy storage; antioxidant	Arctic charr	Bystriansky et al. (2007)
Cysteine, glutamate, glycine	Glutathione	Antioxidant and cell signaling	All animals	Wu et al. (2004)
Glutamate, glutamine	Directly	Ammonia removal	Rainbow trout	Anderson et al. (2002)
Glutamate	GABA	Promote metamorphosis	Abalone	Morse et al. (1979)
Glutamate	GABA	Regulate food intake	Japanese flounder	Kim et al. (2003)
Glutamine	Directly	Increase growth, feed efficiency and gut development	Carp	Lin and Zhou (2006)
Glutamine	Directly	Fuel for macrophage; Cell signaling	Channel catfish	Buentello and Gatlin (1999)
Glutamine, glycine, aspartate	Nucleotides	Genetic information storage and expression, biosynthesis, immunity and reproduction	Various fishes	Li and Gatlin (2006)
Glycine	Directly	Increase hepatic T4 5' monodeiodinase	Rainbow trout	Riley et al. (1996)
Glycine	Directly	Osmoregulation	Oyster	Takeuchi (2007)
Histidine	Directly and carnosine	Protection against pH change	Salmon	Mommsen et al. (1980)
Leucine	HMB	Immunity modulation; Cell signaling	Various fishes	Li and Gatlin (2007)
Lysine, Methionine	Carnitine	Lipid transporter on mitochondrial membrane	Various fishes	Harpaz (2005)

AMINO ACID	PRODUCT	FUNCTION	SPECIES	REFERENCE
Methionine	Choline	Structure in membrane; neurotransmitter; betaine synthesis	Various fishes	Mai et al. (2006b)
Proline	P5C	Redox regulation; Cell signaling	Possibly fish	Phang et al. (2008)
Proline	Hydroxyproline	Enhance growth; Collagen function	Salmon	Aksnes et al. (2008)
Phenylalanine, tyrosine	T4, T3	Influence metamorphosis	Sole	Pinto et al. (2008)
Phenylalanine, tyrosine	T4, T3	Enhance growth performance	Channel catfish	Garg (2007)
Phenylalanine, tyrosine	T4, T3	Influence pigmentation	Japanese flounder	Yoo et al. (2000)
Phenylalanine, tyrosine	Melanin	Influence pigmentation	Rainbow trout	Boonanuntanasarn et al. (2004)
Phenylalanine, tyrosine	Epinephrine, norepinephrine	Neurotransmitters that modulate stress responses	Flounder	Damasceno-Oliveira et al. (2007)
Phenylalanine, tyrosine	Dopamine	Down-regulated immunity	Shrimp	Chang et al. (2007)
Tryptophan	Serotonin	Modulate cortisol release, behavior and feeding	Rainbow trout	Lepage et al. (2003)
Tryptophan	Melatonin	Improve testicular development	Masu salmon	Amano et al. (2004)
Taurine	Directly	Osmotic pressure regulation	Carp	Zhang et al. (2006)
Taurine	Directly	Hardness adaptation	Channel catfish	Buentello and Gatlin (2002)
Taurine	Directly	Gut development	Cobia	Salze et al. (2008)
Taurine	Directly	Retinal development	Glass eel	Omura, Inagaki (2000)

Influence of origin on amino acid

The reference protein source of aquaculture feed is fish meal, because it has balanced amino acids, essential fatty acids, minerals and vitamins--and fish like the way it tastes. Formulating fish food from plants instead of fish meal is becoming increasingly important, as the amount of fish meal available is fairly constant irrespective of demand. Soy is one of the plant-based protein sources being used, with studies on efficiency being carried on for more than twenty years. Soybean meal, however, does not have a high level of digestible energy and has a lot of fiber, for which fish lack the enzymes to break down into nutrients. Furthermore, the amino acid profile of soybean meal is not a good match

http://issuu.com/international_aquafeed/docs/iaf1304_w1/1 from International Aquafeed, July-Aug 2013, p 11.

Dr. William Dew of the University of Lethridge, Canada has discovered that fish in water containing copper have specific olfactory sensory neurons impairment, such that they are unable to detect the odour released by conspecifics that are being attacked by a predator. The impaired fish is less likely to swim away from predators in a timely manner.

for that of fish meal, and it varies between producers, harvests, and regions. Even so, soybean meal is a more consistent source of digestible protein and amino acids than feather meal, blood meal, meat and bone meal, or poultry viscera meal. Nutritional supplementation, especially of threonine, is required for a soy-based food to produce growth in fish.

In the last ten or so years, however, attention has turned to the distillers dried grains (DDG), a byproduct of turning corn into bioethanol. DDG has been used in livestock feed for many years, where it is a protein-rich, economical base for food. Fish food requires different physical and functional properties than livestock feeds, however, and different technology is needed to use DDG in fish food formulation. Extrusion is generally used to achieve the necessary properties.

In the dry mill processing of corn for ethanol, the corn kernel is ground into flour which is converted to sugars by enzymatic fermentation then to ethanol by yeast. Dry milling a bushel of shelled corn produces about 18 pounds each of ethanol, distillers dried grains with solubles (DDGS), and carbon dioxide. As with soybeans, quality of DDGS varies greatly in nutrient content and physical and chemical properties depending on distiller, extraction processes, and fat content. DDGS has about three times the amount of protein as unprocessed corn yet retains a similar amino acid profile throughout the fermentation process. It also remains as digestible as plain corn, too. Between building flesh on fish, being available, and being economical, DDG and DDGS are bound to be used in more types of aquaculture feed in the maximum possible amount.

Reading the praise for using plant-based proteins to replace flesh-based protein, one wonders why these wonder ingredient isn't touted to the high heavens as it becomes the food *du jour*. We-e-ell-l-l, there's that little "not all fish are herbivores" problem. (Some "herbivorous fish" are facilitative not obligate herbivores—they are actually zooplankton eaters whose food cannot be picked out of vegetation easily, so their intestines have adapted to process many parts of the plants in order to get the live food.)

Tests in the marine herbivore Aplodactylus punctatus (from Chilean coastal waters) showed even it can't digest the insoluble fibers fully (carboxymethylcellulose, carrageenan (a moss), agar, and alginate) in spite of the fact macroalgae and other plants form 95% of its diet. Herbivorous species' intestines can range from two to six times its body length Even the progress which herbivorous fish *do* make in breaking down the insoluble fibers seems to be due partly to lysis of algal cells from stomach acid, mechanical grinding from a pharyngeal mill or gizzard like stomach, and cellulase that may be produced by endosymbiotic microorganisms in the gut. Digestion of soluble fibers, mostly by amylase, occurs almost entirely in the first third of the small intestine. (F. PATRICIO OJEDA, Cristian W. Caceres, Marine Ecology Progress Series. 118: 37-42. March 1995).

An herbivore's intestines can be anywhere from 2 to 7 times as long as their body (on average), with at least one reference that I can't locate again recording intestines 34 times the body length. The long intestines expose plant matter to enzymes, bile, and other digestive processes for long periods of time, sometimes for days. Imagine how little a carnivore, with intestines usually not even as long as its body, is capable of extract from such food!

The text, Fundamentals of Ornamental Fish Health edited by Helen Roberts, brings up an even more serious consequence of mismatching a plant-based food with fish who are omnivorous or carnivorous:

> *If readily assimilated carbohydrates such as sugar and cooked starch are fed to fish in quantity, they can cause serious problems because the fish absorb them into the body but have difficulty efficiently metabolizing them. For example, insulin occurs in fish, but since fish have evolved without carbohydrates in their diet, insulin does not play the same role in stimulating the cellular uptake and metabolism of sugar as it does in us.*
>
> *When the blood sugar of fish on an artificial diet is compared with that of fish on a natural diet it is typically twice as high. The carbohydrate that almost always comes along with an artificial ration makes fish seriously hyperglycemic. We should think of pet fish, such as koi, as type 2 diabetics and feed them the same way. When fish consume a typical ration, they use the protein and lipid components for maintenance energy and growth, but they store the carbohydrate calories as body fat because it is difficult for them to use it as energy.*

More studies are needed

Farmed-fish nutrition has been studied for over 150 years, but, in spite of the certainty of study authors about their conclusions and careful isolation of data topics, it seems studies find that too many things influence the ability of a fish to extract nutrients from food for a comprehensive study applicable to all fishes to be developed. But at least some of the influential differences have been identified now:

- Did the species come from a carnivorous or an herbivorous clade? (Clade is defined as a group of organisms, such as a species, whose members share homologous features derived from a common ancestor, per www.thefreedictionary.com.) Carnivores from an herbivorous clade often have longer intestines or intestines that can become longer to suit the content of their diet. Herbivores from a carnivorous clade often have shorter intestines and can't adapt as well to dietary plant changes.
- Intestinal mass as well as length is an important characteristic to consider when assessing how well a fish can extract amino acids and other nutrients from plant matter. Therefore, deeper bodied, thicker fish, which have more room for intestinal mass, are likely to be more capable of processing a higher percentage of plant matter in their diet (and tougher fibers). Carnivores with deep, thick bodies may need more greens in their diet than would normally be expected.
- Intestinal structure varies widely and the effects of those differences are not all that predictable. Herbivores and carnivores can both have/not have a stomach, and some fish have no pyloric "valves" while at least one species has seven.
- Some fish undergo changes from carnivorous to herbivorous as they grow. Such changes need to be included in intestinal analysis—life cycle studies need to include studies of intestinal efficiency.
- Although scientists know that the same 10 amino acids are essential to all fish, the percentages of each amino acid needed and the percentage of protein needed in the diet vary too widely from fish to fish to extrapolate between species with impunity.

The hobbyist is in a unique position to gather data about how and what a fish eats in its native habitat, how it benefits (or doesn't) from changes to its diet, and what it prefers to eat during different life stages. To gather meaningful data, fish food would have to be made of known ingredients and a control group of fish would be needed, but such a situation is one we usually set up for brief periods anyway, such as quarantine or conditioning for breeding. For those hobbyists who have a scientific bent, long term studies of the effects of amino acids or other isolated elements of nutrition offer excellent reasons for setting up more fish tanks and live food cultures.

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Oops—Curiosity killed the clam

The Ming Dynasty was in power in China, Ivan the Great ruled Russia, the Mississippian mound builders culture was coming to an end. Christopher Columbus had discovered Venezuela on his third voyage to the New World. The Spanish Inquisition was in full swing, there were people around who had firsthand memories of Vlad the Impaler (aka Dracula), and the plague had just arrived in London. Neither the Mona Lisa nor the Sistine Chapel had been painted, Lucretia Borgia wasn't poisoning anyone yet, and Friar John Cor of Scotland had invented distilling whiskey only five years earlier.

This photo is of a run-of-the-mill deep see clam, a common species often served as human food, not Ming. The clam gets 46 mm to 88 mm across; the dark surface layer on the external surface of the shell flakes off under abrasion or drying out, leaving an ivory or white surface.

Photo by Hans Hillewaert, Creative Commons license via Wikipedia

Such was the state of the world when an ocean quahog *Arctica islandica (Linnaeus, 1767)*, or deep-sea clam, was born in 1499 and settled in the waters off of Iceland.

The clam, dubbed Ming, was killed in 2006 by curious scientists, who brought it up from the sea floor and froze it for detailed examination, not realizing it was 507 years old. Apparently, the clam's shell has rings that can be counted, much like tree rings, and a panel of mollusk experts have

agreed recently on the clam's age. It was the longest-lived non-colonial animal known, except for a primitive metazoan known as a glass sponge (*Hexactinellida*), which is thought (but not known) to reach an age of 15,000 years.
http://sciencenordic.com/new-record-world%E2%80%99s-oldest-animal-507-years-old

THE BOARD OF DIRECTORS FOR 2014

November is the month the members of COAST elect a board of directors for the next year. These are the people who accepted the positions for 2014.

EXECUTIVES

President	Kristian Downs
Vice President	Nathan Kilgore
VP Alternate	Brian Downing
Treasurer	Jim Herman
Recording Secretary	Larry Guillo

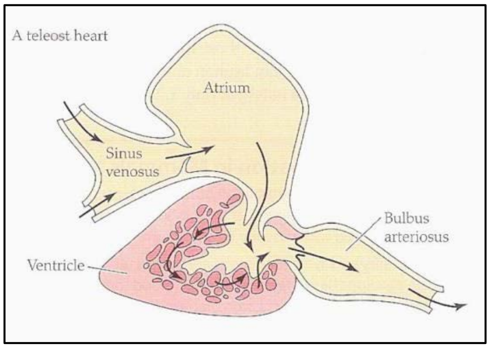
CHAIRS and DIRECTORS

Corresponding Secretary	Russ Madsen
Programs	Tammy Kramer
Programs assistant	Brian Downing
Membership	Anthony Mazeroll
Auctions	Ron Nash
Auctioneer	Duncan Mahoney
Refreshments	monthly rotation (TBD)
Showfish Editor	Charlotte Marelius
Webmaster	Shawn Rogers
Social Media	Kristian Downs

Affairs of the heart

Teleost fish synchronize their heartbeat with their opecular movements in order to match peak blood flow with the water pulses associated with the buccal pump. The bulbus arteriosus, the last chamber to pump blood, smooths the pulses out so the force of the heart pumping does not damage the gills.

From ROBERTS, Helen, Editor, Fundamentals of Ornamental Fish Health (2011-11-16) (Kindle Locations 3048-3055). Wiley. Kindle Edition.



The bulbus arteriosus smooths out the flow of blood pulsing from the ventricle, thereby protecting the tiny, fragile blood vessels of the gills from being subjected to pressure surges.
Illustration from http://www.bio.miami.edu/tom/courses/bil360/grayson17apr12/1-fish%20heart.jpg

Growing the Water Lotus

Bit of Botany trivia: The plants in the Lotus genus are terrestrial plants bearing small flowers. The Himalayan snow lotus is an alpine meadow/rock garden plant formally known as *Saussurea involucrata*, and two plants with the species name *lotus* produce fruit (*Ziziphus lotus* and *Diospyros lotus*). All water lotuses were once classified as part of the Nymphaea family.

Nelumbo nucifera by T. Voekler
(Creative Commons, from Wikipedia)

The common name lotus is applied to various genera and species of plants. The aquatic lotus, however, is not a member of the lotus genus. The Sacred Indian lotus and the American Yellow lotus are in the *Nelumbo* genus (*N. nucifera* and *N. lutea* respectively). They are the only two species in the *Nelumbonaceae* family. Egyptian lotuses are water lilies of the *Nymphaea* genus, not lotuses at all: for example, *Nymphaea caerulea*, the blue lotus; *Nymphaea lotus*, the white lotus; and the *Nymphaea nouchali*, the star lotus.

Nelumbo lutea by Altairisfar
(Creative Commons, from Wikipedia)

The water lotus is a cold-tolerant water plant that can be kept in a submerged tub in or out of a pond. If the goal of your earth-bottom pond is to have lotuses from edge to edge, the lotus can also be planted directly in the earth. Lotuses are seasonal, being dormant from about January to April, growing and blossoming during the summer and fall, and gradually becoming ready for dormancy again (during which period they look like they're dying).

Environmental requirements

- USDA Planting Zones 4 to 10 (11 for some varieties)
- Calm water deep enough to cover the planted tubers by two to three inches
- Full, direct sun for 6 hours a day (light shade if air temp is consistently over 95 ^{o}F)
- No wind
- Water temp and air temp of 70 ^{o}F for growth (below that, they start to go into dormancy, which can kill the tuber if its resources have not been rebuilt since its last dormancy period)
- Air temp of 80 ^{o}F minimum for four weeks, water temp of 75 ^{o}F to 87 ^{o}F to flower
- Storage place to spend its dormant period, such as a closet, if there is a danger of freezing temperatures

Area and volume requirements

- Surface area—even the smallest category of lotuses—dwarf or "bowl" lotuses—are big enough to have to plan for their half a dozen or more leaves, the initial ones of which will lie on the water surface.
  - Large lotus have leaves that are 1 ½ to 2 ½ feet in diameter, blooms of 6 to 12 inches in diameter, and a height of 5 to 7 feet.
  - Medium lotuses have leaves 1 to 2 feet in diameter, blooms of 4 to 7 inches in diameter, and a height of 4 to 6 feet.
  - The very small bowl lotuses will have leaves 6 to 10 inches diameter, blooms of 3 to 5 inches, and a height of 1 to 2 feet.
- Pond or container depth—maximum depth varies between one variety and another, ranging from ones that max out at 10 inches below the surface to others that are fine at 4 feet below the surface. They do need to have their tubers just a few inches from the surface when coming out of dormancy and starting their growth.
- Height above water surface—the smallest lotuses will rise up to 2 feet above the water, the medium size lotuses grow 4 to 6 feet tall, and the standard large lotus can reach 7 feet tall.
- Accessibility—unless you plant the lotus in the earth, you will have to access its container monthly and place, move, and possibly remove the container holding the lotus at least twice a year. If the tuber could be subjected to freezing temperatures, the plant must be moved to a deeper location in the pond or removed to a storage area to protect it from freezing.

Planting

- Container—the minimum size bowl or pot should be at least 12 inches in diameter and at least 6 inches deep. The large lotuses need pots that are three to three and a half feet wide. The size of the container limits the size of the plant. It should have a minimum volume of 2 gallons for small lotuses; large lotuses may need 30 to 50 gallon containers. Lotus roots are very good at spreading far and wide if allowed, so the container should have no holes in it, or, as many a nursery says, NO HOLES.

- Soil—60% clay to 40% sand is optimal. Plain old dirt is okay, amended soil is better, but avoid potting mix as it will float. A higher percentage of sand is okay, but as a compensation, there must be an increase in the amount or frequency of fertilizer application. Fill the container to within 1 to 4 inches of the top, with sand comprising the top 2 inches, and embed the lotus tuber. Next, position the container with its dry soil in the pond. Allow the pond water to fill the pot by tipping or other method, going slowly so the tuber and soil around it are not disturbed.
- Fertilizer—some nurseries instructions say put fertilizer in at the time the container is prepared, but most say wait to add fertilizer until the plant has grown a few leaves. The lotus, with its fast growth and huge leaves, is a heavy eater. Fertilizers should be tablets or pellets meant for water plants, not powders or granules. The fertilizer should not touch the tuber, as the fertilizer can burn it. Fertilization should stop in mid-July; continuing fertilization too long will delay dormancy.
- Planting the tuber—Fill the container with warm water and place the tuber horizontally on top of the sand/soil, slightly embedded so the lower surface is in good contact with the soil. DO NOT bury the tuber in the soil—it will rot. Do not harm, bruise, sneeze at, or look suspiciously at the growing tips—they're delicate. Weight down the tuber with stones, just enough to keep it from floating.
- Put the planted tuber and container in the pond (whose water by now should be warm, too), and sink it to the depth recommended by the nursery for that plant. It will be between 2 inches and 12 inches, as a balance has to be struck between the sun-warmed, well-lit water near the surface and the depth needed to help support the stalks that will carry leaves and blossoms far above the water. Leaves will appear after 2 to 3 weeks, during which time the tuber will be sending roots down into the soil.

Maintenance

Winter: January through April is the normal dormancy period for the lotus. During this period, they get no food, and the water and air temperature is cool. Depending on your climate, you may have to store them in a greenhouse or garage.

Spring: The dormant plants are removed from the pond at springtime to "wake them up" and start them growing again. Most lotuses will have to be repotted every two to three years. Lotuses don't like being repotted, so you must sneak the activity in when they are at the end of their dormant period and growth is just beginning (usually late April).

Summer: Fertilizer, sunshine, warm water—apply liberally and enjoy the day-blooming lotus for its 3 to 5 day glory, then watch the seed pod mature, changing from yellow, to green with seeds, to brown. During the summer and early fall, dying leaves and stems have to pruned (always cut stems off above the surface of the water). Note of caution: Aphids simply worship lotuses, up close and personal, so have professionally recommended countermeasures on hand.

Fall: In the late fall, remove all the dead leaves, stalks, and seed pods. Stop the fertilization. Move the plant to a deeper area of the pond to protect it from the winter cold. If your pond does not have an area below the freezing depth, the plant must be removed to a storage area. In areas that don't suffer from freezing winters, the plant can be left in the pond during the winter.

Information on growing lotuses came mostly from these four businesses:

http://texaswaterlilies.com/Lotusplantingandgrowing.html
http://www.hugheswatergardens.com/howto/lotus.pdf
http://theponddigger.com/water-lotus.php
http://www.froggyponds.com/pond-plants-planting-instructions-lotus.html

MULTILINGUAL PLANT NAME DATABASE

http://www.plantnames.unimelb.edu.au/Sorting/List_bot.html#sec.02

This database lists plant names in various languages, a helpful thing for researchers and travelers. Some plants have just one or two names in other languages listed, some have a dozen or more. Below is an example of some of entries for the Lotus genus (a terrestrial plant).

Lotus angustissimus L.
GERMAN: Zierlicher Hornklee.

Lotus conimbricensis Brotero
GERMAN: Portugiesischer Hornklee.

Lotus corniculatus L.
SYNONYM(S): **Lotus corniculatus** L. subsp. **major** (Scop.) Gams**, Lotus corniculatus** L. var. **major** (Scop.) Brand, **Lotus major** Scop.
CHINESE: 百脉根 Bai mai gen.
DANISH: Serradel.
DUTCH: Rolklaver, Gewone rolklaver, Tôchklaver.
ENGLISH: Bird's-foot trefoil, birdsfoot trefoil, Common birdsfoot-trefoil.
FINNISH: Keltamaite.
FRENCH: Lotier corniculé, Lotus corniculé, Lotus des prés, Pied de poule, Serradelle, Trèfle cornu.
GERMAN: **Gewöhnlicher Hornklee**, Hornklee, Hornschotenklee, Schotenklee (Switzerland).
HUNGARIAN: Szarvaskerep.
ITALIAN: Ginestrina, Ginestrino, Loto, Mullaghera.
JAPANESE: Miyako gusa.
NORWEGIAN: Tiriltunge.
POLISH: Komonica zwyczajna.
PORTUGUESE: Cornichão, Serradela.
SPANISH: Cuernecillo, Cuernecillo del campo, Loto de los prados, Serradella, Trébol a cuernitos, Trébol pata de pájaro.
SWEDISH: Käringgigel, Käringtand.

Lotus corniculatus L. subsp. **corniculatus**
GERMAN: Gewöhnlicher Hornklee.
Most names attributed to the species apply to this subsp. and var. corniculatus.

Lotus corniculatus L. subsp. **corniculatus** var. **alpicola** Beck von Mannagetta & Lerchenau
GERMAN: Berg-Hornklee.

Lotus corniculatus L. subsp. **corniculatus** var. **borealis** xxxx
SWEDISH: Fjällkäringtand.

Lotus corniculatus L. subsp. **corniculatus** var. **corniculatus**

GERMAN: Gewöhnlicher Hornklee.

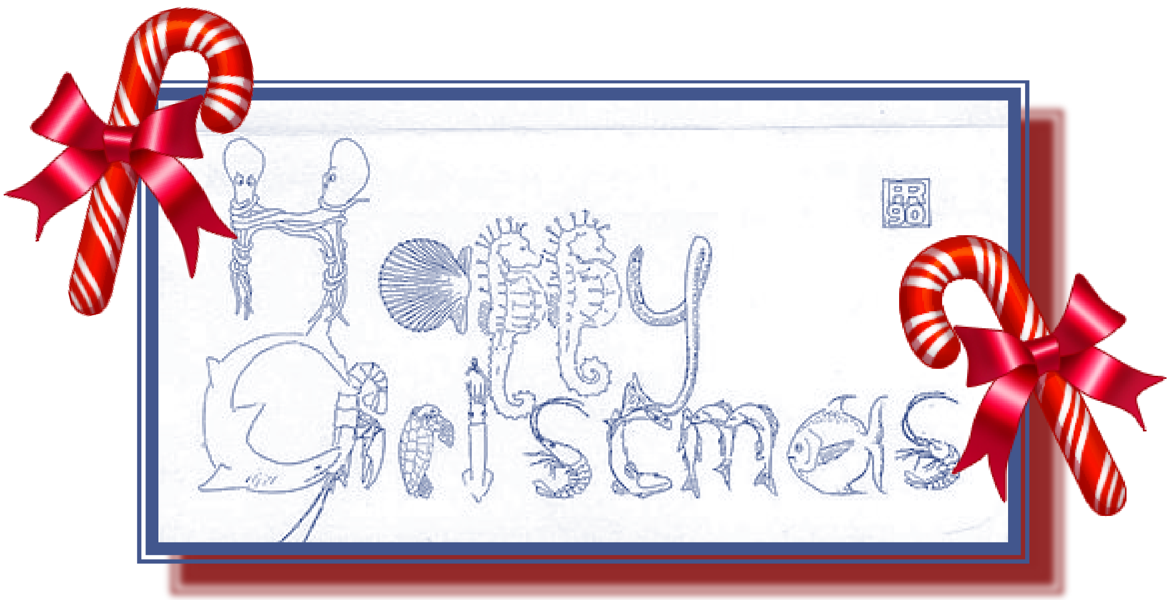
SWEDISH: Vanlig käringtand.

Most names attributed to the species apply to this var.

Lotus corniculatus L. subsp. **tenuifolius** (L.) xxxxx

SYNONYM(S): **Lotus tenuifolius** (L.) H. G. L. Reichenbach, nom. illeg. , **Lotus glaber** P. Miller

Data needed.



To COAST members, guests, and speakers, one and all!

Card design and fish alphabet by Italian artist Alberto Rava (http://albertorava.it/index.html)