THE FILTER

TBAS . . . Since 1992

Kryptopterus bicirrhis
Glass Catfish

Tampa Bay Aquarium Society
25 Years
St. Pete/Tampa
Florida

September 2017
Volume 27 Issue 2

Photo Mike Jacobs . . . 2017

September Meeting Speaker:

Elizabeth Groover - Fl. Aquaculture Lab

Cichlids "101"

September Bowl Show

1) Swordtails
2) Pleco/Sucker Type Fish

TAMPA BAY AQUARIUM SOCIETY

"THE FILTER"

Tampa/St. Pete, Florida

TBAS

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TBAS

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Hi folks . . . we are between presidents and we have an article this month that needs some explaination so I thought I would take a second and say something!

This month we have another article by Joe Gargas. You have read Joe's articles and they are just WONDERFUL . . . but this one is a bit tough. Do you remember your old Math teacher or Chemistry teacher (for me it was the English teacher)???? Remember how they lost you in the first 10 minutes and it was all over . . . but you perservered and you finally "got it" and actually learned something!!? This month's Gargas article is kinda like this! However, PERSEVER folks . . . read it 2-3 times and you will take away something and that's more important than giving up!!!

There are several things going on here . . . 1) it's a really good, good article . . . dificult to read, but GOOD 2) Joe is giving you information that almost no one else in our hobby can even give you 3) you will take away something from this experience . . . maybe not 100% but SOMETHING . . . and that's more than you knew before you started and that's what this bulletin is about and what this club is about . . . LEARNING . . . this club is also about social things, for sure, but formost it's about LEARNING! I learn from Joe Gargas and Bill Shields every time I talk with them. I learn from Bill Little more about the "air suckers" every time we talk . . . and on and on and on! That's one of the hidden beauties of this TBAS club . . . there are so many people to really learn from . . . ☺ ☺ ☺ . . . Join the learning!!

Assorted African Peacocks

Mike

Mike Jacobs, Editor TBAS

DISCUS . . . WATER . . . GARGAS!!!

Introduction

Water chemists have long used certain terms to designate the important chemical characteristics of water. The most important of these are, of course, pH, hardness, ionic strength, and alkalinity. The nitrification process by which ammonia is converted to nitrate is essential to any fish culture operation. Nobody can expect to attempt fish culture without first understanding these essential areas of water chemistry.

pH

pH is a measure of the acidity of the water. Since it is the hydrogen ion, H+, which causes acidity, pH is a measurement of the concentration of the hydrogen ion expressed in a logrithmic form. pH is equal to the negative value of the decimal logrithm of the hydrogen ion concentration (see Equation 1 below). Anyone who has taken high school chemistry should remember this.

Equation 1

$pH = -\log_{10}(H^+)$

pH is the most fundamental variable of water chemistry and since it influences the equilibrium concentrations of ammonia, nitrous acid, and carbon dioxide, as well as nitrification rates , it is the most important variable for us to measure. Mid range pH test kits can be purchased inexpensively at the aquarium shop, however, low or acid range kits are not very common. LaMotte Chemical Co. manufactures a colorimetric kit, the methyl red low range kit, which works in the acid range down to a pH value of 4.5.

I use a pH meter which measures the pH by means of the glass electrode (see Figure 1). Actually a pH meter is only a high resistance voltmeter with a scale that has been printed to read in pH units instead of millivolts (Snoeyink and Jenkins, p. 420). Inside the bulb of the glass electrode is a 0.1 molar solution

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of hydrochloric acid, 0.1 M HCl, which serves as the reference solution. Actually most of the electrodes on the market today contain a jelled solution of O.1 M HCl to avoid leakage and drying out of the reference solution. Inside the electrode is a silver/silver chloride, Ag/AgCl, coating on a platinum, Pt, wire which serves as the internal reference electrode. Virtually all pH electrodes today are combination electrodes meaning that they also contain the second electrode necessary to complete the circuit, the saturated calomel electrode (see Figure 2). In the combination electrode both the Ag/ AgCl and the saturated calomel electrode are present in the same glass electrode.

The saturated calomel electrode consists of a platinum electrode set into a paste which is a mixture of mercury metal, Hg, and mercury chloride, $HgCl_2$, and saturated potassium chloride, KCl (Snoeyink and Jenkins, p. 416). Contact with the solution whose pH is to be measured is normally through a small hole in the glass electrode which is plugged with a porous ceramic disc.

The glass electrode, most commonly a jell-filled combination electrode, should never be allowed to dry out. When not in use the electrode should be kept stored in pH 4 buffer. It is often recommended to store this electrode in pH 7 buffer but I prefer pH 4 buffer since at this low pH, bacteria cannot grow so rapidly. What happens over time is that bacteria grow over the outside of the glass bulb to form a slime layer, or else they grow over the porous disc leading to the saturated KCl solution of the calomel electrode. This slime layer will eventually become thick enough to prevent rapid diffusion of the hydrogen ion, H+, so that the response of the electrode will become sluggish. When this happens, the electrode should be soaked in household bleach for about 20 minutes to remove the slime layer. After this, it should be thoroughly rinsed off with a strong flow of tap

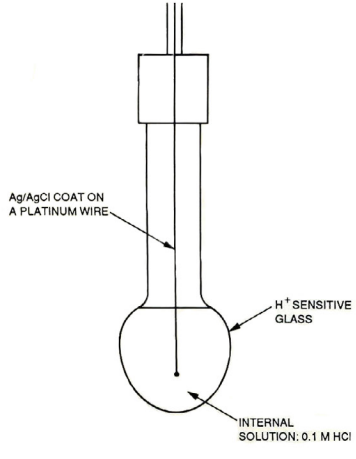

FIGURE 1
THE GLASS ELECTRODE. COURTESY OF
CORNING GLASS WORKS, CORNING, N.Y.

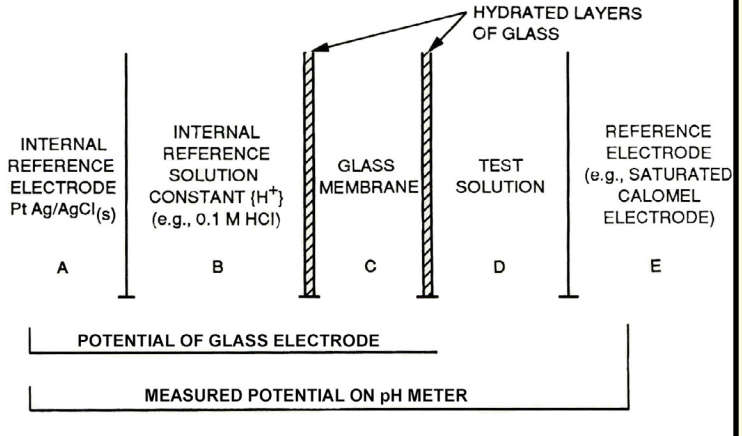

FIGURE 2
POTENTIAL IN A GLASS ELECTRODE-CALOMEL ELECTRODE SYSTEM COMMONLY USED FOR pH MEASUREMENT

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water and then allowed to soak in distilled water until the pH reading stabilizes; at this point the electrode may be recalibrated.

To calibrate the electrode, buffer solutions are used. The buffer solutions are normally chosen to be at the pH values of 4, 7, and 10. First the electrode is immersed in buffer of pH 10 and the meter adjusted to read 10, next the electrode is rinsed with distilled water and placed in pH 4 buffer and adjusted to read pH of 4. This process is repeated until the meter reads both buffers accurately without further adjustment. If this cannot be accomplished then the slope sensitivity must be adjusted by means of the screw for the sensitivity potentiometer to make it read the pH of one of the buffers. Once this is accomplished the pH of the 7.0 buffer is checked on the meter and it should read within 0.3 units of7.0. This type of full scale calibration is necessary only once in a great while, such as when first calibrating a new electrode, or recalibrating an electrode which has just been cleaned. The calibration of the meter should be checked daily by rinsing the electrode in distilled water and then placing it in a buffer whose pH value is close to that of the water which is going to be measured. The meter is then adjusted to read the pH of the buffer. A full scale calibration will not be necessary on a daily basis.

After the pH of the water has been measured the electrode should be rinsed off, preferably with distilled water and then placed back in the pH 4 buffer for storage. From time to time it will be necessary to change out the pH 4 storage buffer.

The most important thing with the glass electrode is to make sure that it is not allowed to dry out. The small pH pens on the market also contain a glass electrode which must always be kept wet. The most common reason for the trouble with these pH pens is that the aquarist does not store them with the electrode submerged in pH 4 buffer. If the glass electrode is stored, cleaned, and calibrated by the manner described above, it will give many years of accurate and trouble free service.

Hardness

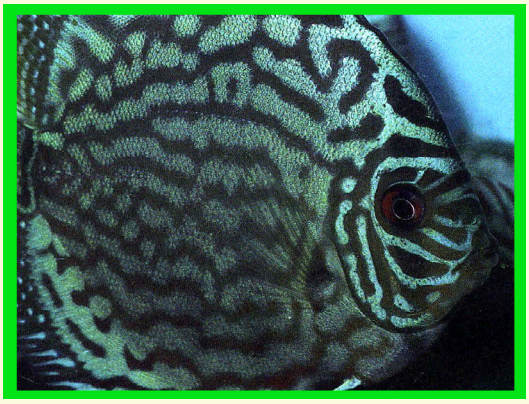
Total hardness is the sum of the concentrations of bivalent cations, expressed as ppm of calcium carbonate, $CaCO_3$. The calcium ion, Ca^{+2}, and the magnesium ion, Mg^{+2}, are the only common bivalent cations. Hardness is important since spawnings will not often occur in hard water and even when they do occur, the hatching of the eggs will rarely be successful. Furthermore, a high hardness is almost always accompanied by a high carbonate concentration which buffers the pH to a constant value so that the addition of acid does not drop the pH.

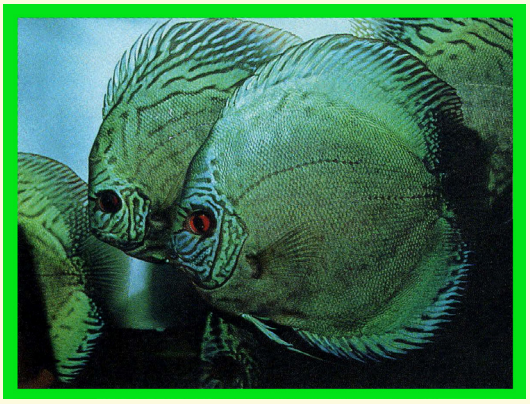
The measurement of hardness is essential to monitor the effectiveness of

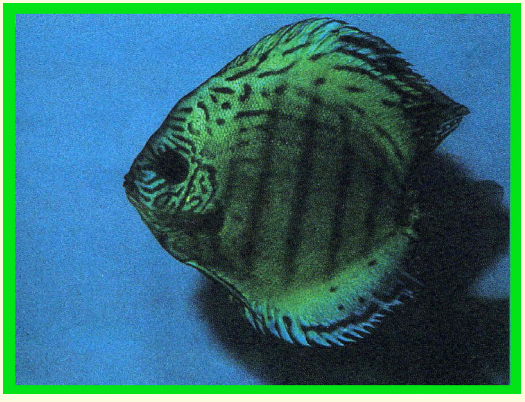
any type of deionization or other water softening processes used in preparation of the water for spawning. I use a titrametric total hardness kit manufactured by LaMotte Chemical Co., which is capable of monitoring the total hardness, Calcium, Ca^{+2} , plus Magnesium, Mg^{+2} , or the calcium alone. This kit is very accurate and an essential testing kit for the aquarist. Unfortunately, I have not seen a titrametric hardness kit in the aquarium shops, and the ones that are offered are not precise enough for my purpose.

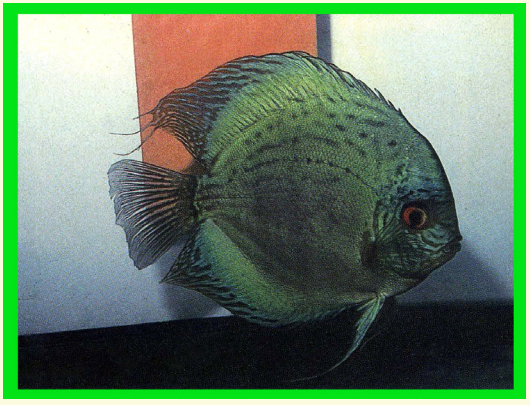
Hardness is very important when it comes to spawning discus. These fish can be raised in hard water and, in fact, it is easier to raise them in harder water since the pH is buffered and the ionic strength is high enough to prevent nitrite toxicity. My fish were all raised in Lake Michigan water whose properties are described in detail at the end of this article.

When Discus are raised properly and the water quality is in its proper perimeter, it is easy to raise beautiful fish such as these. Photos from the 1990's.









Alkalinity

Alkalinity is an expression for the sum of the anions capable of neutralizing acid. For aquaculture this means carbonate, CO_3^{2-} and bicarbonate, HCO_3^-.

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Carbonate, only exists above a pH of 9; at pH values less than 9 it is all present in the form of bicarbonate. As acid, H^+ is added, the hydrogen ion , H^+ , adds to the carbonate ion , CO_3^{2-} , to form HCO_3^- , which is bicarbonate (see Reaction 1 below). If the pH is less than 9 then acid adds to bicarbonate, HCO_3^- to form carbon dioxide CO_2 and water (see Reaction 2 below). At a pH of less than 5.5, almost all of the bicarbonate ion will be in the form of $C0_2$ (Jenkins and Snoeyink, Fig. 4-17, p. 164).

Reaction 1
$CO_3^- + H^+ = HCO_3^-$

Reaction 2
$HCO_3^- + H^+ = H_2O + CO_2$

Based on my experience, fish have respiratory difficulties in the elimination of CO_2 from their blood if the CO_2 in the water is higher than 25 ppm. For this reason the pH cannot be dropped quickly down to 5.5 unless the bicarbonates are less than about 25 ppm. This works out to a total hardness of 40 ppm $CaCO_3$. If the hardness is much higher than this, the pH must be dropped slowly with heavy aeration so that the free molecular CO_2 does not exceed 25 ppm. I use titrametric alkalinity and carbon dioxide kits manufactured by LaMotte Chemical Co.

Ionic Strength

Ionic strength is an expression of the total salt content of the water. Ionic strength equals one half of the sum of the product of each ion, multiplied by the square of its charge (Lewis and Randall, 1921) . Since it is difficult and expensive to determine the total ion analysis of a water sample, a crude approximation can be made from the total dissolved solids, TDS (see Equation 2 below) (Jenkins and Snoeyink, p 76), or from the conductivity (see Equation 3 below) (Jenkins and Snoeyink, p 76). The TDS meter actually measures conductivity but it is calibrated with sodium chloride, NaCl, solutions so that TDS is expressed in ppm of NaCl. Conductivity, on the other hand, is calibrated with potassium chloride but is expressed in micro mho/em or micro Siemens.

Note a micro mho/em = a micro Siemen (Chemical Rubber Co. 1967). To interconvert TDS and conductivity see Equations 4 and 5 below.

Equation 2 - Ionic Strength
= (2.5 x 10-5)(TDS)
= (0.000025) (TDS)

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Equation 3 - Ionic Strength
= (1.6 X 10-5) (conductivity)
= (0.000016) (conductivity)

Equation 4
TDS = (0.64) (conductivity)

Equation 5
conductivity = (1.56) (TDS)

Thus from the foregoing it can be seen that measurement of TDS or conductivity gives a crude but very useful approximation of the ionic strength.

Ammonia

Ammonia is the end product of protein metabolism in fish, and it exists in two forms: the ionic form of NH_4^+, and the molecular form, NH_3 , which is toxic to fish. The relative amounts of each are dependent upon the pH as shown in Reaction 3 below where a high pH causes a high fraction of molecular ammonia.

What this means, however, is that for every unit the pH changes, the hydrogen ion concentration changes tenfold. Knowledge of this is important, to understand the affect pH has on concentrations of toxic molecular ammonia, NH_3 , which will undergo a tenfold reduction for every unit the pH drops as the toxic molecular ammonia, NH_3, is converted into its non-toxic ionic form, NH_4^+ (see Reaction 3 below).

Reaction 3
$NH_3 + H^+ = NH_4^+$

From Reaction 3 above, it can be seen that dropping the pH will provide the fish relief from the toxic effects of molecular ammonia should the concentrations of total ammonia: ionic + molecular forms be too high. In practice, this cannot always be applied since dropping the pH will increase the free carbon dioxide by Reactions I and 2. If the nitrite ion, $N0_2^-$, concentration is high, then dropping the pH will increase the nitrous acid concentration as shown in Reaction 4 below. Furthermore, dropping the pH can result in a reduction in the nitrification rate so that total ammonia begins to slowly climb even though the molecular ammonia is reduced.

High molecular ammonia concentrations will inhibit fish growth. It has been found that when molecular ammonia concentrations reached 0.12 to 0.13 ppm, channel catfish growth stopped (Colt and Tchobanoglous, 1978). Interestingly

enough, before the absorption of the yolk sac, rainbow trout were able to withstand up to 50 times the NH_3 concentration found lethal for the adult fish (Rice and Stokes, 1975). However, the new fry are much more sensitive to ammonia than are the eggs or developing alevins of salmon (Calamari et al, 1981). With the pink salmon, Oncorhynchus gorbuscha, it has been shown that the time when they are the most vulnerable to ammonia is at the completion of absorption of the yolk sac and just before they begin to feed (Rice and Baily, 1980). What this means to the discus hatcher is that ammonia monitoring is going to be most important when the fish become free swimming.

Nitrite

The nitrite anion, N02- , is produced when the Nitrosomonas bacteria oxidize ammonia to nitrite. During this time, salt should be added to the water and the pH kept above 6.0 to prevent the formation of nitrous acid by Reaction 4 below:

Reaction 4

$NO_2^- + H^+ = HNO_2$ (Nitrous acid)

Although nitrite, $N0_2^-$, is toxic to fish, nitrous acid, HNO_2^- , is able to enter the fish through the gills faster, thus making it a greater threat. Normally, if the chloride, Cl^- , content of the water is high enough, nitrites will not be a problem as long as the pH is high enough to prevent formation of nitrous acid. The simplest solution is to put a tablespoon of common rock salt per 10 gallons of water into the tank if the nitrites are high. The literature reports wide variations in the tolerance of different species towards nitrites, however, the tilapia, a cichlid, was one of the most sensitive species tested (Tomasso, J.R., 1986).

Bacterial Nitrification

Ammonia is oxidized to nitrite and nitrite is, in turn, oxidized to the non-toxic nitrate, NO_3^- by the gram negative chemical autotropic nitrifying bacteria which require a solid substrate upon which they can attach themselves.

Ammonia is oxidized to nitrite, NO_2^- by Nitrosomonas which is rod shaped with dimensions of 1 x 1.5 microns and Nitrosococus which is a coccoid, 1.5-2.2 microns in diameter (Moriarty and Pullin, 1987).

Nitrite is, in turn, oxidized to nitrate, NO_3^- , by Nitrobacter which is pear-to-rod shaped with dimensions of 0.7 x 1.5 microns. Nitrobacter is found only in freshwater. Two other nitrite oxidizers are Nitrococcus which is a coccoid, with a diameter of 1.7 microns, and Nitrospina which is rod shaped, 0.35 x 5 microns, both of which are obligately marine, meaning that they can only live in saltwater (Moriarty and Pullin, 1987).

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Shortly after the start-up of a new bacterial filter, whether it be an under-gravel filter, a sponge, or a trickling bed filter such as I use, there will be a very sharp increase in the concentration of ammonia until the Nitrosomonas begin to convert ammonia to nitrite. The most effective solution to high ammonia concentrations is to simply add the chemical AmQueJ® manufactured by Kordon Labs and available at all aquarium shops. Within about an hour the ammonia will be converted to a non-toxic compound.The important thing to remember when using AmQuel® is that it interferes with the Nessler's Ammonia reagent, so that the Indophenol Blue Ammonia test kit must be used.

Within a few days the Nitrosomonas will have begun to convert the ammonia to nitrite and there will be a very high concentration of nitrite ion, $N0_2^-$, in the water. As the chemical energy released by the oxidation of ammonia to nitrite is much greater than the energy released by oxidation of nitrite, $N0_2^-$, to nitrate, $N0_3^-$, the Nitrosomonas establish themselves much quicker than the Nitrobacter upon the start-up of nitrification. This means that it will take about three to four weeks for the nitrite concentrations to drop down to normal after the start-up of nitrification. During this period of time, salt should be added to the water and the pH kept above 6.0 to prevent the formation of nitrous acid, $HN0_2$, as described above in the Nitrite section.

Acceptable Water Supply For the Discus Culturist

Although discus prefer soft water for spawning, I find that harder water is actually better for raising them up to adult size. To demonstrate this I performed the following experiment.

We divided a spawn into three groups for a two month period. Each group was put into a 10 gallon tank. Tank A was a mixture of Lake Michigan and de-salinated water from a reverse osmosis unit to give a final hardness of 40 ppm, a TDS of 60 ppm and a pH of 7. 0. Tank B was filled with Lake Michigan water from the tap, hardness 136 ppm and a TDS of 178 ppm, pH7.5. Tank C was brine reject from the reverse osmosis unit with a hardness of approximately 300 ppm, TDS of 480 ppm, pH of 8.0. All fish were fed the same quantity of food at the same intervals, and all water changes were conducted on a basis of equal volume and frequency. The food consisted of a beef heart mixture and live black worms. Tank B had a growth rate of 2.5 times tank A. Tank Chad the highest growth rate which was four times the growth rate in tank A which had the softest water. The foregoing experiment shows that high hardness is not detrimental, and discus will actually grow faster in hard water. The only problem with hard water is when it comes to spawning.

I have always had Lake Michigan water available from the city water utility. The following data is from the City of Chicago water purification laboratory on

the treated Lake Michigan water produced by the Chicago Water Treating Plant. It is typical for treated Lake Michigan water; however, the chlorides, 11 ppm, are higher on the treated water than on the actual lake water, 10 ppm, due to chlorination. Also, the pH of the raw lake water 8.3, is somewhat higher than before treating, which drops the pH to about 8. 0. Note that the values for bicarbonate, carbonate, and conductivity were obtained from the Hammond water treatment plant which is located on the south shore of Lake Michigan.

Lake Michigan Water Analysis
Total Dissolved Solids, TDS = 170 ppm
Specific conductance, conductivity, = 280 micromohs
Total hardness as $CaC0^3$ = 132 ppm
pH = 8.0
Alkalinity = 111 ppm

Major Cations
Calcium, Ca+2 = 34ppm
Sodium, Na+ = 6.4 ppm
Magnesium, Mg^{+2} = 11 ppm
Potassium, K+ = 1.2 ppm

Major Anions
Bicarbonate, HCO_3^- = 104 ppm
Sulfate, SO_4^{2-} = 25 ppm
Carbonate, CO_3^{2-} = 0 ppm
Chloride, Cl^- = 11 ppm

It is by no means necessary to match the characteristics of this water to successfully raise discus fish , however, to spawn them softer water is recommended. This means using rain water, peat softening, deionization or reverse osmosis for spawning. In future articles I will discuss all of these processes for the production of suitable water for spawning but, in particular, the newest and the simplest process of reverse osmosis.

Summary

Nobody can hope to succeed in fish culture and especially with discus without first understanding the important parameters of water chemistry which have been presented here. This article has been an attempt to familiarize the reader who is assumed to have no background in water chemistry with the most

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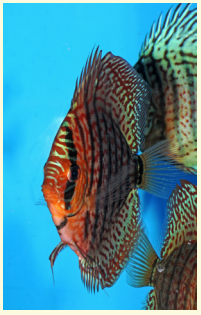
important chemical parameters in aquaculture. There is much more to be learned in the area of water treatment which will be presented in a future article.

Photos of Joe Gargas's discus from more recent times . . . 2014-2016.


Joe Gargas Discus Spawning (in the last 1-2 years)

Click on the ▶ to See Video

SEE YOU GUYS AT THE ANNUAL TBAS AUCTION . . .
SATURDAY, NOVEMBER 4, 2017
CROWNE PLAZA, TAMPA, FLORIDA . . . **see page 14**

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WHEN: Saturday, November 4, 2017

WHERE: Crowne Plaza, Tampa, Florida

TIME: Doors Open - 8:00am

TIME: Setup & Registration - 8:00am - 10:00am

AUCTION TIME: 10:00am - 5:00pm

INFORMATION: www.tbasauction.com

TBAS WEBSITE: www.tbas1.com

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OUTSIDE TUB AQUARIUMS

by Bill Little

Over the past 10 years or so I have toyed with creating a tub aquarium either outside my front entrance or on my rear deck. I have tried several containers and none of them have worked for me.

Last week my daily Amazon email, I can't believe how many I receive each day, displayed an advertisement for a book called The Tub Pond Handbook by a Ted Coleti. I finally looked at the price and it was much more than I wanted to spend on a book that I might read or refer to a few times. However, at the bottom of the advertisement, in relatively fine print was a line that said "also available in Kindle format". While I admit I read a lot of books over a year's time; I have not been a fan of Kindle, but I figured what the heck! So I ordered it on Kindle.

It looks great on my iPad. I paid less than $6.00 for the e-book copy and the quality is really great. The book is about 180 pages and you can read through it in maybe 2 and half hours. There are literally hundreds of photos included. In addition to the introduction, Dr. Coleti breaks the book into 7 chapters. He titles chapter 1, Location, Location, Location. We have heard that line applied to locating a business but never with respect to positioning an aquarium. He goes on in other chapters to discuss The Right Container, a chapter on water, one on plants, then fish and Pond Pests. His final chapter provides a Timetable and Checklist for Setup and Maintenance. He also includes an appendix at the end of the book with an extensive list of references to check for further information.

All in all it's a pretty comprehensive introduction to creating a tub pond on your back porch and you can't beat the investment!

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The Tub Pond Handbook, a Comprehensive Guild to Creating and Maintaining Patio Ponds, Container Water Gardens, Tropical Fish Breeding Tubs, by Dr. Ted Coleti, PhD, Published by Wagtail Imprints, Inc. copyright 2017 all rights reserved. Available in e-book form on Kindle.

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MONTHLY BOWL SHOW

January
1)
2) None - Plant Auction

February
1) Male Betta Splenden
(single fish)
2) Open

March
1) Tetras, Barbs, Rasbora
2) Cichlids

April
1) Platies
2) Guppies

May
No Bowl Show
Swap Meet

June
1) Corydoras
2) Anabantoids no Bettas

July
1) Arts & Crafts (hand made)
2) Fish "T" Shirt (must be worn)
3) Aquatic Photos
(personally taken)

August
1) Mollies
2) Rainbows

September
1) Swordtails
2) Pleco/Sucker type fish

October
1) Dwarf Cichilds
2) Angelfish

November
1) Goldfish & Koi
2) Invertebrates (Fresh or Salt)

December
No Bowl Show . . . Christmas Party and the 2016 Results of the Bowl Show!!!

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NAME	JAN-JUNE	JULY	TOTAL
Kent Sheets	76	16	92
Ethan Skidmore	62	18	80
Joshua McWilliams	21	0	21
Missina Rurcaw	16	0	16
Elaine Thyner	6	0	6
Danielle Lee	4	0	4
Grant Eder	1	0	1

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***Polypterus bichir lapradei* . . . Bichir Lapradei**

photo: Mike Jacobs 2017

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to See Video

THE BEST KOI ANGELFISH IN THE UNIVERSE

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Supporters of TBAS

Tampa Bay Wholesalers: Tropical Fish

alphabetical order

1) 5D Tropical Fish
2) Segrest Farms

Tampa Bay Tropical Fish Farmers:

alphabetical order

1) Amazon Exotics
2) BioAquatix
3) Carter's Fish Hatchery
4) FishEye Aquatics
5) Golden Pond
6) Imperial Tropicals
7) Lile's Tropical Fish
8) V-W Tropicals

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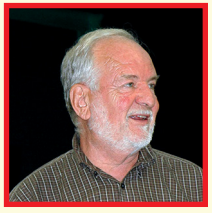

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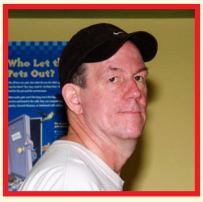
Mike Jacobs

Bill Shields



Al Starkey

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TBAS

Tampa Bay Aquarium Society
St. Pete/Tampa, Florida

Website: www.tbas1.com

FORUM: www.tbas1.com/forum

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