The Raleigh Aquarium Society
P.O. Box 31564, Raleigh, North Carolina 27612-1564
http://www.raleighaquariumsociety.org
raleighaquariumsociety@yahoo.com

April 2023 Newsletter

The Raleigh Aquarium Society (RAS) was founded in 1981 to "encourage and enhance the education, knowledge, and enjoyment of Society members at all levels of experience about the many aspects of the home aquatics hobby". We welcome participants at all levels of experience (including none - we all started that way!). Details can be found at: www.raleighaquariumsociety.org

April Calendar of Events

Thursday April 13th @ 7:30 PM: RAS Meeting. Speaker and Topic TBA. Live, In Person, and at the NC Vet School. (Click link for Google Directions)

Thursday April 20th @ 7:30 PM: Board Meeting (open to all). Contact ras-board@ras.groups.io for info.

Save The Date:

- **SUMMER SWAP – Please reach out to the RAS Board if you want to help organize this.**
- **FALL AUCTION – Please reach out to the RAS Board if you want to help organize this.**

Table of Contents

Letter from the President (Thomas Narten)

April is upon us and we have just completed a very successful return of the Carolina Aquarium Workshop. Sadly, I was unable to attend after contracting Covid, but I was able to provide some support from behind the scenes. By all accounts, people had a great time and the event went smoothly. I (and the board) received a number of positive comments during and after the event.

There is a long line of people that need to be recognized for the work that they did in making CAW a success. And I am surely going to get myself into trouble through omission. Neil Frank corralled our 4 speakers. We also assigned them "buddies" to make sure they were taken care of. Richard Mullinax put together the shrimp contest as well as organizing the volunteer pool for the Sunday auction. He also made the vendor room happen! Gerald Pottern led the collecting trip and Allan O'Briant and Saul Canzonieri (with help from Matt DeGroodt and others) made sure there was a native tank display ready to house the fish that were collected. Both the collecting trip and the native tank have been a big draw for us over the years and distinguish us from other clubs. The good news is Gerald has expressed willingness for another trip this year! So stay tuned! Board members Chris Smith, Jamye Carr, Shelly DeCorte & Caroline Morgan handled much of the preparation and execution of the weekend logistics (goodie bag additions, t-shirts, registration, lanyards, ...). And if you liked those beautiful plants from Tropica (or any of the other big item donations that were raffled), be sure to thank Shelly! She did the work of reaching out to vendors and getting them to send us donations! (If you didn't like the food, that is partly on me... But I understand it disappeared!!) Oh, and what about those cool fish bags -- ready to have handy in your car for whenever you happen by a fish store! Thank Bradley Hall (Dubey's Pet World) for that. And a special thanks goes to the vendors that had tables. We (unfortunately) didn't have the space we really needed, but it's really great to have local/regional vendors who we know and trust bringing their goods.

Our next meeting will be Thursday, April 13 at the Vet School. 2 notes: first, that is not the normal 1st Thursday of the month. It's the second. Our original calendar had us meeting on Saturday the 15th, but we didn't properly check for conflicts -- and that date conflicts with the normal 3rd Saturday that the Charlotte Area Aquarists Society (CAAS) meets. Given the overlapping participation between the two clubs, we do not want to conflict with them (or any other regional activity for that matter). We are still fine-tuning the program but are looking at a program on how to market your items for a successful auction sale.

Finally, our March regular meeting had another strong turnout. Chris Smith talked about how he upgraded his fish/plant room, and (again) brought in numerous plants that he has been growing. Jamye Carr also spoke on the activities she has been doing with kids at events and aquarium expos. And our meeting auction had 90 items!

March Auction Report (Thomas Narten)

The March meeting saw another strong auction. Folk brought in a mixture of plants, fish, shrimp and snails. Overall, 90 items were brought in. Items came from 16 sellers and went home via 29 buyers. Total revenue for all sales was $585 with an average selling price of $6.50 per item. Out of the total revenue, RAS netted $302 while sellers took home $273. One thing to note, Jamye Carr donated three 48" Marineland LED lights and they brought in a total of $100 to the club. Thank you Jamye!!!

Keep those items coming! Even if you think nobody would want your stuff, I consider it a win to have unwanted or extra items go to fellow club members rather than the compost or as fish food!

Remember also that we have a "freebie" table at monthly meetings, where you can bring unwanted items that you don't need and may not be worth auctioning, but that someone else can use.

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BAP Program

The 2023 BAP annual season runs from November 16, 2022 to November 15, 2023.
BAP standings are updated monthly and the current report can be found on the BAP page of the RAS website along with all BAP program information.

There were 3 BAP point entries completed in March:
Kris Bryant submitted Poecilia Reticulata and Xiphophorus Meyeri and **Matt DeGroodt** for Paracheirodon axelrodi.

If you are interested in learning more about the program please contact the RAS BAP Chairperson: raleighaquariumsociety+BAP@gmail.com

Upcoming Group Buys

Chris Smith is going a Group Buy from Wet Spot. Wet Spot order will arrive on Thursday 4/27. Orders need to get sent to ctyank@frontier.com by 4/22.
Payment via PayPal (same email address). You can use this online sheet for your orders: April 22nd Wetspot Group Buy

Sponsors will send an email to our ras@ras.groups.io email. You can sign up online at https://groups.io/

If you are interested in initiating a group buy, follow these steps:

Confirm board approval of your buy and your shipping budget by emailing your plan for the group buy to "ras-board@groups.io"
Announce your proposed buy to the RAS email list "ras@ras.groups.io"
Include coordinator contact information and instructions for the buy
Allow interested members a minimum of 5 days to send their order to the coordinator before the group buy order is placed with the vendor.

Chris Smith says that he's planning a Wet Spot Group Buy order for shortly after the CAW Workshop.

Remember: RAS sponsored group buys means that the RAS pays for the taxes and the shipping costs, allowing all **RAS members (Yes, You!)** to purchase fish, food, and other aquarium supplies at reduced cost. Group Buys provide access to unusual or hard-to-find fish, plants and foods that generally are not available at local fish stores (LFS). Group Buys are open to all current RAS members, and are organized by individual RAS members, **(Yes, You!)** with the approval of the RAS board. Each group buy has a "sponsor", and participants work directly with the sponsor to work out details of a specific purchase. RAS is open to proposals for additional group buys from all members. Details here.

Thank you to all our Group Buy Sponsors!

CAW Workshop Wrap-Up

Thank You to Our Speakers

Robert Lupton

Ryan Chan

Josh Wiegert

Gary Lange

Robert Lupton
Keeping Freshwater Shrimp: Top 10 Reasons Shrimp Keepers Fail.
Q&A on Breeding and Maintaining Shrimp

Ryan Chan
Unlocking the Key to Spawning Cardinal and Neon Tetras
Secrets of Breeding the Amano Shrimp

Josh Wiegert
Nano Tank Adventures: Setting Up A Small Tank.
So, You Think You Want A Giant Tank

Gary Lange
The Most Amazing Rainbowfish
It's Not a Problem it's an Adventure! The Blood Sweat & Cheers of 7 Trips Chasing Rainbowfish in New Guinea

Shrimp Bowl Contest:

Thank you, **Rob Lupton**, for coming out to our shrimp contest with your critical expertise, educational zeal, and indomitable spirit. If you are serious about a return visit, then the invitation is here. With so much more to learn, it would be great to have you back.

To the group of shrimp breeders who entered shrimp, you surpassed my expectations even as I set a goal of a large diversity of entries. 13 of you brought 21 different species and varieties for a total of 27 bowls shown. This allowed most people to see something new and exciting. Thank you for allowing me to twist a few arms to get some of you to step up. Some of the best compliments to me were that you were thankful I did push.

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Here is a photo of a few of the thirteen participants who entered shrimp in the Carolina Aquarium Workshop 2023.

(Left to Right) Ryan Chan, Debbie Negron, James Martucelli, John Adams, Diana Walstead, Trent Morton, Neil Frank, and Emily Baggett. Long time club members alongside new. A goal of creating deeper relationships well reached.

John Adams you kept the mood light and so much work vanished when you were around Friday and all day Saturday. Thank you for volunteering to help get shrimp set up in the contest and then doing so much more. Julie Martinez Hayes your 'it can be done attitude' got me through a couple times. I appreciate the positive encouragement.

So many people pitched it to make this contest a success including the BOD leadership team who supported the idea and assisted with many of the steps along the way. There were so many e-mails, texts, and calls behind getting the show together.

Therese Neal, it was great to meet you and our club is richer for your guidance. I used the rules you have set up for national competitions as a guide to create the ones we used. You truly are the shrimp princess.

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Bradley Hall, Brandon Campo, and Neil Frank offered cholla wood and plants for the bowls. Neil also caught each entry with his camera.

Diana Walstead and Mark Wampler each brought two display bowls with shrimp to show as examples for keeping shrimp. They were a hit so look for a continuation of this next year, if not an expansion to include others.

In the coming months there will be more articles about the shrimp bowl contest. There was too much information to put in one article. Hopefully they will help people plan for next year's contest.

I am so thankful to have this incredible event to look back on.

Richard Mullinax

Auction:

Those who volunteered to work the auction made a great team. No task went undone and that allowed everyone to work without being overburdened. I especially appreciate the flexibility some showed by changing tasks as needed. Here is a list of those who participated in the auction as volunteers. If I didn't mention you by name, please reach out to me so I can add you to the club records.

Jamye Carr and Carolina Morgan- registration, check out, and slides during the auction.
Russell Alcock and Todd Wenzel- assist with MyGroupAuction check ins.

Betty Gaedert, Judy Witowski Argentine, Laurie Nipp, Paul Soltero, Debbie Negron, Gerald Pottern, and a couple others who stepped up in the moment to get items checked in and placed in sections of like lots.
Chris Smith- welcome, announcements, IT, and lunch.
Matt DeGroot, Jay Levine, Brenton Koenig, Allan Abriant, Dave Herlong (Auctioneer Extraordinaire!), and Rob Crawford- assembly line the items through the auction process.
Diana Walstead (with help from **Julie Martinez Hayes, Judy Witowshi Argentine**)- post auction slips to MyGroupAuction site.
Betty Gaedert, Paul Soltero, Debbie Negron, Judy Witowski Argentine, Chip Hildreth, Jenn Kirchherr, and many others ran items out to winning bidders.

Thank you for the way you all pitch in to get the job done. Those who signed up beforehand and those who stepped up on the day. I appreciate you making the organizing much easier by your service.

Richard Mullinax

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RAS would like to thank the following Donors/Sponsors.

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https://www.oakcityaquaticsvet.com/

Diana Walstad
https://dianawalstad.com/

(Article) Diversity and Representation in the Hobby *by Jamye Carr*

In the past few years, I have worked as part of an equity team in my school district to make sure that the education that we provide to students includes representation in the curriculum. Studies have found that more than ever it is important that students see themselves represented in successful fields. Showing successful women in STEM careers, people of color represented equally in historical and cultural contexts, and inclusivity in our upper level programs have been a primary focus.

It is through this lens that I want to commend our group to being open, welcoming, and encouraging diversity. We have a long way to go, and some of the conversations that need to happen are starting to begin. People are starting to talk about our club, and in a good way. At the workshop, I overheard more than a few times people mention how many women are present at our club. Five years ago when I joined, there were fewer than 5 women who showed up regularly to club meetings, and attending conferences, workshops, and club meetings around the country, I probably knew fewer people of color in the hobby than I could count on one hand.

This is changing, and it is being noticed. Our board adapted our Code of Conduct 2 years ago and made our club's commitment to inclusivity and maintaining a welcoming environment clear. I am proud to be part of a club that has made great progress in reaching out to include more underrepresented groups. Thank you all so much for being part of this important progress! It is very important, especially when we see children entering the hobby, that they see other people like them being successful and having fun keeping aquariums!

(Article) Successful 2023 Open House held at the NCSU Vet School *by Michael Maieli*

After a three year hiatus due to COVID, the NCSU College of Veterinary Medicine (CVM) resumed its annual Open House event on the last Saturday in March. This activity invites the public to visit the entire CVM campus, with access to various classrooms, laboratories, libraries, and support buildings, enabling them to learn first hand the important academic and research work being conducted there. Over 10,000 people attended, and assorted events ranging from animal surgery to behind-the-scenes tours to locally made ice cream could all be experienced by everyone. The Raleigh Aquarium Society has been a part of this scene since 2014, joining a host of other local animal clubs and societies, but we are the only fish presence (there is an amphibian club that attends as well). Our booth was inside the main administrative building near the marine tank (which we help sponsor) and several club members volunteered to assist over 500 people learn more about our Society and the things we do every month. Various giveaways and games made this more fun for everyone and we garnered some new members. Thanks to all who came out to help. See you next year!

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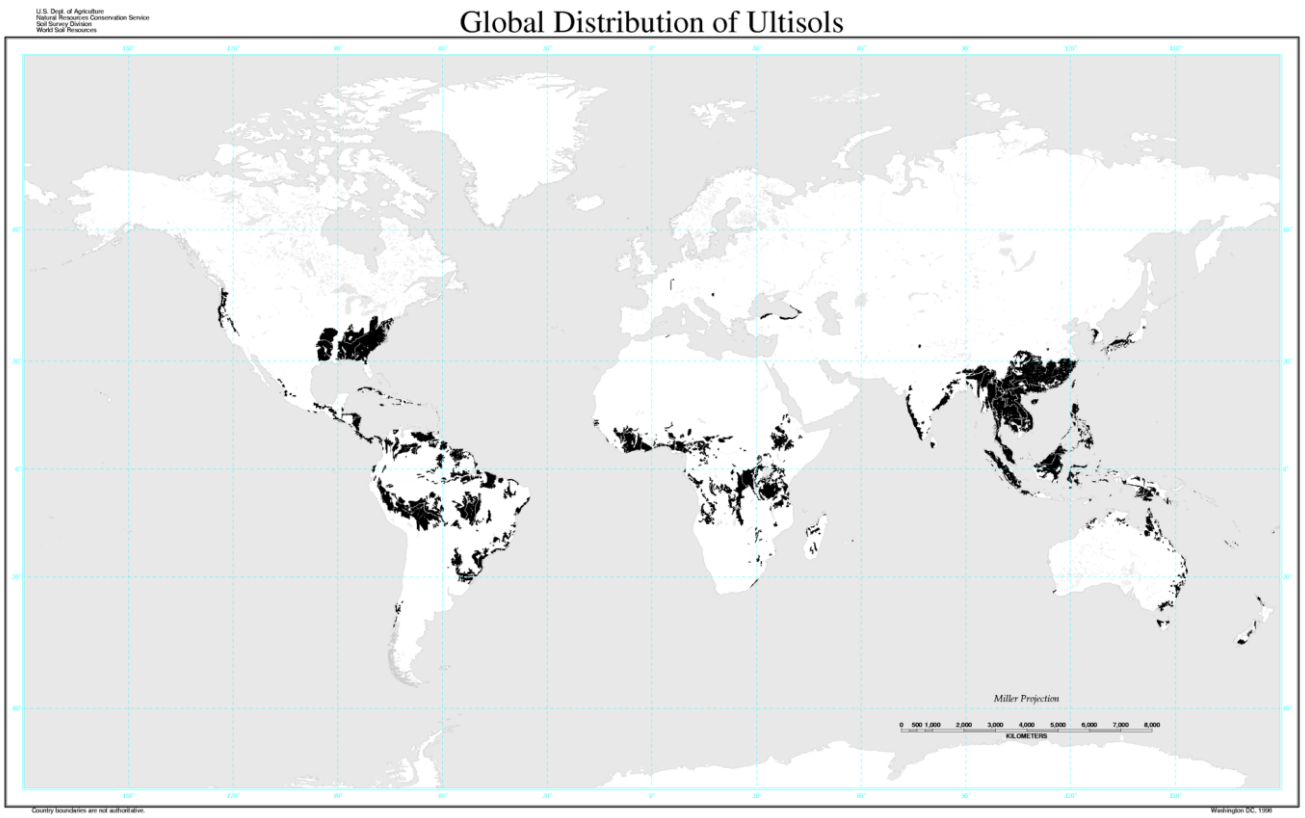
(Article) Laterite and Related Soils in the Aquarium Substrate *by Neil Frank*

Originally Published in Planted Aquaria Magazine (Winter 2000)

Introduction

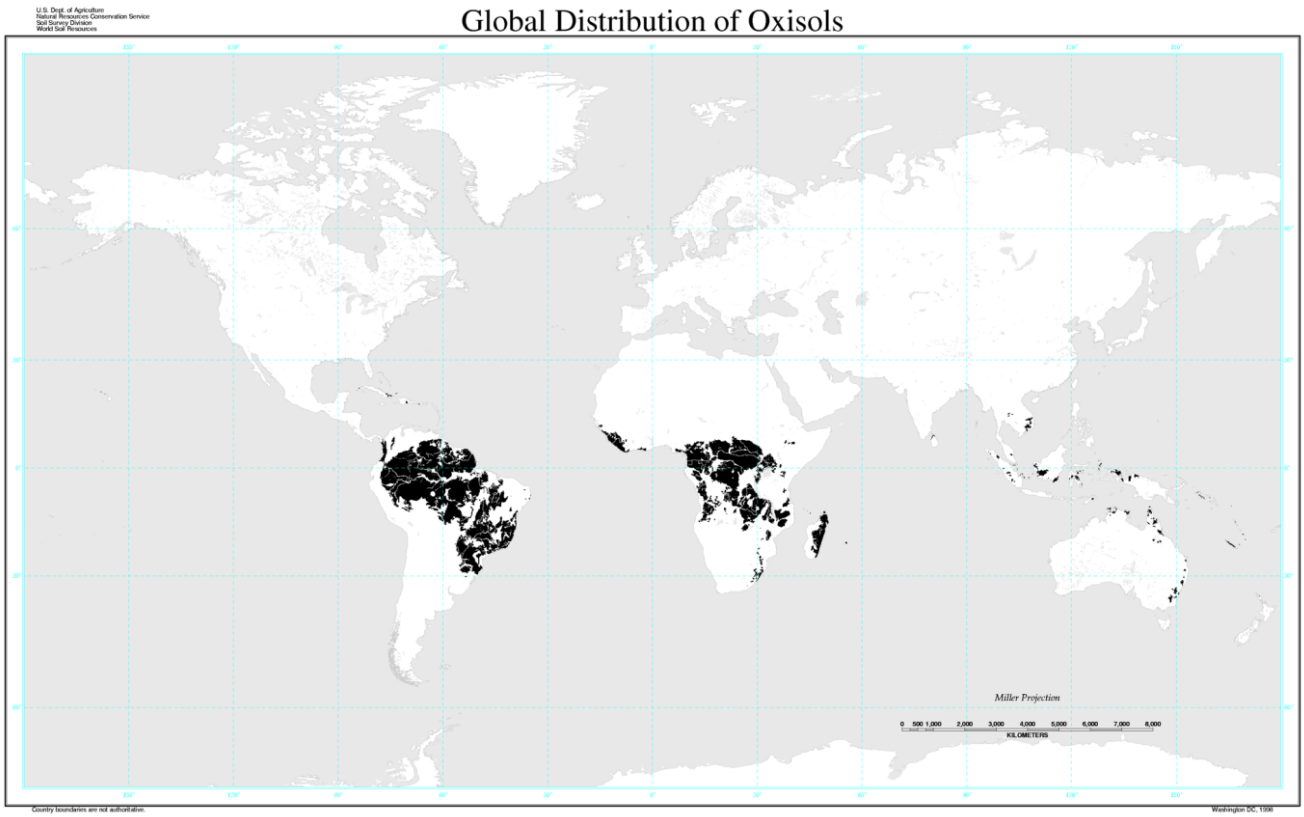
Reddish-brown clay, commonly known as laterite, is widely recommended as a substrate amendment for the planted aquarium. This material is a highly weathered, acidic soil which is essentially devoid of organic matter and low in most plant nutrients. In the classification system of soil taxonomy, there are two orders of soils which have been called laterite. These are the Oxisols and Ultisols (Brady, 1974; NRCS, 1998). Their red color comes from hydrous oxides of iron and aluminum of various types (sometimes called hydroxides). These include gibbsite (Al2O3.H2O) and goethite (Fe2O3.H2O). Some authors in the aquarium literature suggest that too much aluminum can be toxic and low concentrations of the aluminum oxides are very important for better plant growth (Horst, 1998).

Figure 1. Ultisols



Caption: World distribution of Ultisols (Source: Natural Resources Conservation Service)

Figure 2. Oxisols



Caption: World distribution of Oxisols(Source: Natural Resources Conservation Service)

The Oxisols are the intensely weathered soil type of the humid tropics and subtropics. They are classically known as lateritic soils. With repeated wetting and drying, the soil particles harden to form a brick-like material which is called laterite. This soil type is predominantly found in South America (Amazon Basin) and Central Africa (Congo Basin). As we know, however, extensive areas are also present in Southern Asia. It can also be found in Hawaii, Puerto Rico, and many other tropical islands. The Oxisols comprise 35 percent of the soils of the world's tropical rain forests (Benneh et al, 1996). The only known occurrence of an Oxisol in the contiguous 48 states is the Ione paleosol in central California (Nater, 1999).

The similar Ultisols are not as highly weathered and are found in both tropical and temperate regions of the world. They were formerly called Red-Yellow Podzolic soil, Reddish-Brown Lateritic soil and Ground Water Laterite. Ultisols comprise 28 per cent of soils of the tropical rain forest. The moist but not wet Ultisols are called Udults. These are the dominant soils of many areas of Malaysia, Thailand, Indonesia as well as the non-coastal regions of the Southeastern U.S. (from MD to FL). Similar to the classical lateritic soils, this Southern "red clay" is used to produce building bricks in the US.

Some commercially available aquarium laterite are mined in Asia. Others are said to be native to North America. The physical and chemical characteristics do vary from supplier to supplier and evidently depend on the geographic origin (See side bar discussion of the chemical composition of various high iron soils). I also note that the lateritic soils are red or reddish brown, but not all reddish soils are lateritic.

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Figure 3. (southern red clay at construction site)

Caption: *Red clay throughout the southeastern US (Ultisols) is acidic and high in iron.*

Although there is clear empirical evidence that laterite and related soils are helpful for growing plants in aquaria, these materials are certainly not the only substrate amendments needed for excellent aquatic plant growth. There are many other substrate materials, including fracted clay, organic soils, and peat, and various commercially available items. Established aquariums with mineralized detritus (i.e. mulm) as the only substrate amendment can also be used successfully. In fact, aquatic plants can even be grown in plain gravel or without gravel at all, as long as the water column has sufficient quantities of all of the necessary nutrients. Each of these substrates, however, requires a somewhat different approach in the overall management of the aquarium - both to grow the plants and to eliminate or reduce the amount of undesirable algae.

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Figure 4.

Caption: *I obtain my NC lateritic soil from the woods near my house. After scraping off a layer of leaves and organic matter, a nice loamy clay is revealed. Consistent with the directions for commercially available laterite, a small amount is mixed with the bottom layer of gravel to provide an initial source of iron and long-term sink for phosphates.*

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SIDEBAR

Material	Concentration, mg/Kg	%Fe, by weight	% Mn by weight	%Al, by weight	%Fe, expressed as goethite (Fe2O3.H2O).	%Al, expressed as gibbsite (AL2O3.H2O)				
Fe	Al	Ca	Mg	Mn						
1st Layer	118000	5110	181	140	65.9	11.8	0.007	0.5	18.8	1.1
India laterite	114000	39400	2360	1970	1390	11.4	0.139	**3.9**	18.1	8.8
Duplerit	80100	14600	728	672	1570	8.0	0.157	1.5	12.7	3.2
NC red clay	47500	16600	870	234	58.4	4.8	0.006	1.7	7.6	3.7
Finland local clay	46100	27200	4060	14500	629	4.6	0.063	**2.7**	7.3	6.0
Substrate Gold	41700	6410	718	528	30.9	4.2	0.003	0.6	6.6	1.4
CH Redart Clay	37500	13400	1470	4890	174	3.8	0.017	1.3	6.0	3.0
Raleigh loam	30100	10700	152	520	132	3.0	0.013	1.1	4.8	2.4
Yolo loam/ vermiculite	29700	30500	6210	36200	488	3.0	0.049	**3.1**	4.7	6.8
AquaTerra	27300	13300	1380	4660	159	2.7	0.016	1.3	4.3	3.0
Danish Redart Clay	24300	11000	169000	5130	334	2.4	0.033	1.1	3.9	2.4

Among the 25 substrates described in Jamie Johnson's substrate article (ref: PAM2), nine contained more than 2 percent iron. A few of their analyzed elements are listed in the accompanying table in decreasing iron concentration. Not too surprisingly, the materials with the most iron are the 3 items which are called "laterite." When we account for the oxides and bound water, the estimated percentages of iron (expressed as goethite, Fe2O3.H2O) range from 3.9 to 18.8%.

At my request, Jamie analyzed a sample of the two NC soils discussed in this article. You can see that these also rank very high in iron and estimated goethite concentrations (4.8 and 7.6 percent). I looked at 4 other elements (Mn, Al, Ca and Mg) which allow us to make some distinctions among these materials. Mn is an important trace element which the plants can use from the substrate. The Mn concentrations and ratio of Iron to Manganese varies among these materials. The highest Mn is found in Duplerit and the Indian laterite. The lowest Mn to Fe ratio are in 1st Layer laterite, Substrate gold and the NC red clay. These ratios may be suggestive of similar soil type or origin.

Some writers suggest that aluminum has a deleterious effect on aquatic plants. I also examined Aluminum concentrations for the eleven high iron substances. Al is relatively high in three materials: India laterite, Finland local clay and the Yolo loam/vermiculite. The first two clearly show the potential association of large amounts of Al in materials that are also high in iron. For the 3rd item, the Al is probably associated with the added

vermiculite to this blend. I note that these three materials are also high in Ca and Mg. These cations are low in most everything else. Studies have shown that calcareous sediments of hard water lakes had a lower capacity to adsorb inorganic phosphorus. [Wetzel, 1975]

The printed aquarium literature and Internet discussions frequently mention that the primary purpose of laterite is to provide iron as a plant nutrient. While this is especially true in newly established aquaria and for tanks that do not contain sufficient iron in the water column, the purpose of laterite is much more.

It is noted that in the absence of oxygen and with assistance of organic acids, bivalent iron is dissolved from laterite in the substrate (Horst & Kipper, 1986). Authors have also pointed out that placing iron bearing soil in the substrate will provide plants with their iron needs and it will keep it out of the water where algae can't get it (Walstad, 1993,1999). However, when the substrate becomes root bound in very densely planted aquaria or is otherwise too aerobic, then substrate iron may become unavailable.

In nature, ground water entering streams provides a continuous supply of iron after it percolates through laterite or other iron bearing soil. In the aquarium, the substrate supply is much more limited, which is why it is common practice to add iron to the water column as part of a daily, weekly or biweekly fertilization regime. Therefore, there must be more to laterite than merely supplying iron as a plant nutrient. The purpose of this article is to explore other roles of laterite and related soils and how this relates to management of the planted aquarium.

Iron and Phosphates in the Laterite Substrate

Perhaps an even more important purpose for laterite is to sequester phosphates in the substrate and limit the amount of phosphates in the water column. Phosphates exist in the aquarium as inorganic and organic compounds. When excess concentrations occur in the water column, algae may be more likely to develop. Therefore, it is desirable to avoid this situation.

In the aerobic portions of acidic iron bearing substrates, ferric ion will react with inorganic phosphate. For pH between 3 and 7, the typical form of inorganic phosphate is $H_2PO_4^-$. This reacts with hydrous iron oxide (FeOOH) to form $FeOH_2PO_4 + OH^-$ (Boyd, 1995). More ferric iron becomes available to react with phosphates as pH decrease. The resulting phosphate compounds are highly insoluble and tend to stay in the aquarium bottom. When the substrate is disturbed, the small particles can become suspended in the water column. These suspended iron particles will also react with phosphate. Therefore, an important and perhaps most important role of laterite and other iron rich soils is to bind with phosphates and effectively remove this algae food from the water column. The insoluble iron phosphate compound can then accumulate in the substrate where the rooted plants can get this important macro nutrient. The interaction between iron and phosphates is used as a basis for advanced waste treatment methods for phosphate removal from domestic waste-waters.

The relationship between Fe and P in the laterite substrate has been mentioned previously (Kelly, 1996; Frank, 1998). One of the first discussions in the English language aquarium literature was the second Dupla book: My First Aquarium (Horst, 1993). Interestingly, it was not mentioned in a more recent discussions about laterite by the same author (Horst, 1998).

The Optimum Aquarium was the first English language aquarium book to advocate the use of laterite. While it does not mention the relationship between substrate iron and phosphates, it does present the role of substrate heating cables to “bring nutrients into the laterite area of the substrate where they can be held and made available to the plant roots.” Phosphates appear to be one of the ‘nutrients’ that Horst and Kipper had in mind! Unlike soils that contain humus, laterite and related soils have a low cation exchange capacity (CEC). This means that laterite does not have an affinity to attract and hold positively charged ions like calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), ammonium (NH_4^+). However, clay particles are very small and collectively have a very large surface area. They are also electrically charged. These properties permit them to strongly absorb phosphates and other anions. This process is also favored by lower pH in the substrate (Boyd,

1995; Parks, 1967).

Laterite and other mineral soils rich in iron can also help with orthophosphates. These phosphates are contained in organic matter (like decaying plant leaves) and are released thru microbial activity. Some of this plant food will be immediately taken up by plants and algae, but the remaining part will be fixed in the laterite. In substrates with organic matter, the iron is complexed with organic acids and is not as available to bind with the new phosphate. Over time, such substrates can become super enriched with phosphates to the point they will allow excessive phosphates to leach into the water column. This situation can then become a contributor to algae. This may be the problem with "old" substrates that become hard to manage. Such substrates may not pose a problem in aquariums with heavy plant feeders or when most plants have large root systems which are capable of getting their nutrients from the aquarium bottom.

Figure 5

One of George and Karla Booth's gorgeous aquaria which all have Dupla laterite substrates

Phosphorus Gradients

When the substrate is undisturbed, there can be a tremendous concentration gradient between dissolved phosphorus in the water column and bound phosphorus in the substrate. In fact, it is deep in the aquatic substrate where the substrate can become anoxic, but then phosphorus becomes more available to the rooted plants. Just as ferric iron (Fe 3+) is reduced and then becomes more soluble, so does the iron phosphate compounds.

Boyd has studied pond water and reported water phosphorus concentrations of 0.04 ppm with a soil bound phosphorus of 1000 ppm. He found the concentration was greatest at a depth of 1-2 inches. This was an experimental pond over 20 years old without renovation at Auburn University in Alabama. Just below the surface, the phosphorus concentration in the water surrounding the sediment particles (i.e.pore or interstitial water) was one ppm while the adjacent surface water was one tenth that value (Boyd, 1995). P equilibrium occurs between the substrate particles and interstitial water, entering the water column by diffusion. It then readily mixes in the aquarium by movement from filters, power heads, convection and transpiration. With adequate numbers of aquatic plants, this P can be quickly sucked up, stored in the plant leaves and effectively removed from the water column.

Managing Phosphates

For the aquarist, there are some interesting ramifications of phosphate sequestering by iron in the substrate. Much of the phosphates introduced into the aquarium, say, from fish foods or from tap water, will soon precipitate and be excluded from the water column. This mean that the usual test of water column phosphate concentrations does not address the total amount of phosphates in the aquarium. The test does not measure the phosphates which have accumulated in the substrate and therefore do not necessarily indicate the total amount

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of phosphates that are really available to the plants.

Ideally, the phosphates which deposit in the substrate should be kept out of the water column. Plants can retrieve the phosphates thru their roots which allows them to be adequately fed while algae are starved. To keep the P contained in the substrate, however, and to reduce its chances of fueling an algae explosion, it is helpful to not disturb the substrate. An aerobic zone with coarse substrate material on top of a denser anaerobic layer would also provide a barrier to help prevent the reintroduction of P. Laterite, soil and clay can have extremely small particles. Once they are suspended in the water column, they may not readily settle out. Because phosphates are attached to substrate clay particles, new phosphates are re-introduced into the water column any time the substrate is disturbed. Suspended particles are sometimes evident because they will scatter light and cause the water to appear cloudy. Unless these particles settle quickly, perhaps with the aid of a flocculent, or are mechanically removed with filtration, the increased availability of phosphates to the water column can cause a green water bloom or other algae explosion. For this reason, the laterite or related iron rich soils are best placed at the bottom layer of the substrate. Sometimes, the release of substrate particles into the water column is unavoidable when uprooting certain plants. To eliminate suspended particles, I typically use a diatom filter any time I cause a large amount of small soil particles to become suspended in the water. To avoid this situation, use of laterite with larger or more quickly settling particles is preferred for aquarium use.

Figure 6

Coarse laterite may be better than other similar soils because its particles will settle more quickly when the aquarium substrate is disturbed.

At some point, the substrate can contain more phosphates than the amount needed to sustain vascular plant growth and may cause problems for the aquarist. To reduce the problem of recycling phosphates from the

saturated substrate to the water column, gravel washing can be utilized periodically. This typically involves the use of a siphon device to remove accumulated detritus, mineralized fish food, and decomposed organic matter from the substrate. Normally, I don't recommend routine gravel washing in planted aquaria. However, for tanks that have been set up for several years or any time algae becomes objectionable, such maintenance may be necessary to reduce phosphates and other nutrients which have deposited in the substrate.

Laterite or soil in pots

One of the ways I grow aquatic plants is to keep them in pots in bare bottom tanks. This approach offers many advantages, particularly with heavy feeders like sword plants that prefer a slightly richer substrate. With pots, the larger plants can also be removed from the aquarium together with their potted substrate, thereby avoiding the mess caused by uprooting a plant with lots of roots inside the aquarium. However, the use of pots requires some special maintenance to help manage phosphate cycling in the aquarium. I have learned that it is important to periodically siphon the accumulated mulm and detritus that collects on the unplanted bottom. This 'requirement' is reduced in tanks where I grow ferns, mosses or other plants that depend on getting their phosphorus from the water column or when roots of large plants escape from their pots.

Figure 7

Laterite or related soils can be used in pots to successfully grow plants. In this setup, mulm should be periodically siphoned between the pots to reduce the reintroduction of nutrients which have not been sequestered by a substrate.

Can an aquarium become phosphate limited?

Although large amounts of phosphates will accumulate in the laterite or related soil substrate, its diffusion into the water column may not always be adequate to support all plant growth. Therefore, the laterite aquaria can become phosphate limited for certain plants. This topic has been recently discussed on the Internet (Dixon, 2000). I conclude this article with comments on this interesting notion.

It is clear that some plants cannot obtain their phosphates or other nutrients directly from the substrate. This is certainly true for epiphytic plants and floating plants. Stem plants which generally do not have large substrate root systems may also depend on the water column for their nutrients. This is especially true when they are first planted and is probably the reason that they sometimes develop large quantities of roots above the substrate. Depending on a variety of aquarium conditions, the rate at which new phosphates are added to the aquarium together with the rate they diffuse from the substrate may not be enough to sustain optimum plant growth. In fact, phosphates must be added to aquaculture ponds to sustain phytoplankton growth despite the high phosphate concentration that accumulates in the sediment.

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In aquaria, a phosphate limited situation can occur in tanks with low fish load that are also designed for fast plant growth (i.e with high intensity lighting, adequate trace elements and CO2, coupled with supplemental nitrogen and potassium fertilization). Competition among different species of plants for water column nutrients may become another significant factor, especially in aquaria with large leaved Echinodorus or other heavy feeders. Although these plants can obtain their phosphates from the substrate, they will also suck it out of the water column.

The large reservoir of phosphates which accumulate and are sequestered in a laterite or soil based substrate is generally a good thing. However, the aquarist cannot always count on this phosphate storehouse to satisfy the phosphorous needs of all aquarium plants.

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