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6/2/14

Rocky Mountain Cichlid Association

The Cichlidafile

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Membership

Membership to the RMCA is $15 per year, due January of every year. Membership applications any other time are prorated. Meetings are the second Sunday of each month unless otherwise posted. We meet 9 months out of the year, not in July, August, or December. Membership checks can be sent to Sam Chin PO Box 172403, Denver, CO 80217 For more info call Sam at 303-915-4992 or email at samchin57@comcast.net

From your President...

To kick-off the summer right the RMCA has teamed up with the Colorado Aquarium Society for two evenings (6/6 CAS meeting and 6/8 RMCA meeting) of presentations from Juan Camilo Damelines. I had the pleasure of meeting Juan at the 2013 ACA Cnvention Banquet and I'm sure that we are all in for a couple of fun and informative presentations. Please see the newsletter for details.

As we head into the summer break I would also like to remind everyone that even though we don't have a regular monthly meeting in July or August the club will be hosting a summer picnic on July 26th. We are in the process of finalizing the time and the location so please keep an eye on your inbox and the RMCA website for more information.

For anyone interested in volunteering to help out at the Marine Aquarium Conference of North America (i.e. MACNA) there is information contained in this month's newsletter on who to contact.

Lastly, please remember to be safe this summer and don't forget about your wet pets.

Terry

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Tank Tech—Insulating Yourself Against High Power Consumption

By Steve Blakley, RMCA Member Extraordinaire

I'm not afraid to admit it. I've been called a geek, a propeller head, a techno-nerd and even a bit twiddler. My education is in engineering, and I've been blessed with a career in developing new technology. It should come as no surprise that what I enjoy the most about fish keeping is designing and building aquarium systems and habitats. If it's a pump, a filter or a lighting system, I'm all over it. If it requires being plugged into an electrical outlet, that's even better. It seems that "tank tech" is in my DNA.

The other day a fellow hobbyist and I were talking about our aquarium projects. While I was touting my new 150 gallon Frontosa tank build, his project was all about trying to gather the resources to move his growing tank count into a heated room in order to reduce his power consumption. I think his exact words were, "I've got to get my aquariums into a room. The cost of heating is killing me."

After our conversation, I couldn't stop thinking about what he said and wondering what it really costs to heat an aquarium. I started thinking about all of the heaters in my tanks and I realized I had no idea what it was costing me to run them. I could only assume that my heating costs were higher than I wanted them to be. Then I started thinking about what could be done, other than giving up some aquariums, to reduce those costs.

A typical fish room is a collection of various tanks, equipment and racks. Photo used with permission from Greg Sage of Select Aquatics at Selectaquatics.com

The most experienced hobbyists tell us that the most economical method for heating multiple aquariums is to heat the air in the room instead of heating the water in the aquariums. When put into practice, this typically requires that hobbyists' move their aquariums into a room specially outfitted for fish keeping. So there you go. Problem solved. No need to look any further, right? If you want to be a serious fish keeper you are going to need a dedicated fish room and a space heater… Wait, not so fast.

While a big fish room full of aquariums is really cool, and it does make efficient use of heating; a heated room full of aquariums isn't the perfect solution for everyone. Some fish keepers simply don't have an adequate space to dedicate to their aquariums. Other aquarists like myself, want to "live with their fish" and display them in several rooms of their home; instead of locking them away in some kind of fish dungeon.

Even when an appropriate space is available, some fish keepers simply find the heated fish room to be an oppressive work space that detracts from the enjoyment of their hobby. To be blunt, heated fish rooms are hot and humid just like the tropical environment they mimic.

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Next Meeting

Our next meeting is this Sunday, June 8th, at 5:30 p.m. at Colorado Academy, 3800 South Pierce Street, Denver, CO 80235. Juan Damelines will be speaking. We'll have our usual mini-auction, a pot luck, Bowl Show and door prizes too!

Congratulations to our May Growth Contest Winners:

Amphilophus festae

1st — Ed Duggan
2nd — Terry Havalka
3rd — Kevin Fehringer
4th — Dallas Barrett

Ed Duggan's *Amphilophus festae*

Our new Growth Contest fish, *Callichromis macrops* Ndole Red, will be due back during the November meeting.

Finally, a correction that I would like to note. The Growth Contest fish that we showed in May, was incorrectly identified previously. We have found out that we were not raising *Cryptoheros panamensis*. The correct identification is *Amphilophus festae*. I apologize about any confusion we have caused!

Trading Post

Repashy Foods!

Bob Grauer has Repashy foods gel foods available. Choose from Soilent Green for Aufwuchs eaters (algae-types), Community Plus for omnivores, Meat Pie for your carnivores, Morning Wood for your cellulose eaters, Spawn and Grow for your fry, or Shrimp Souffle for your scavengers. If you haven't tried it yet, what are you waiting for?! If you have tried it, you gotta be out by now!

Bob also has cichlids for sale from Lakes Malawi, Tanganyika, and Victoria. Email him to find out what cool fish he has available at balibob5151@gmail.com!

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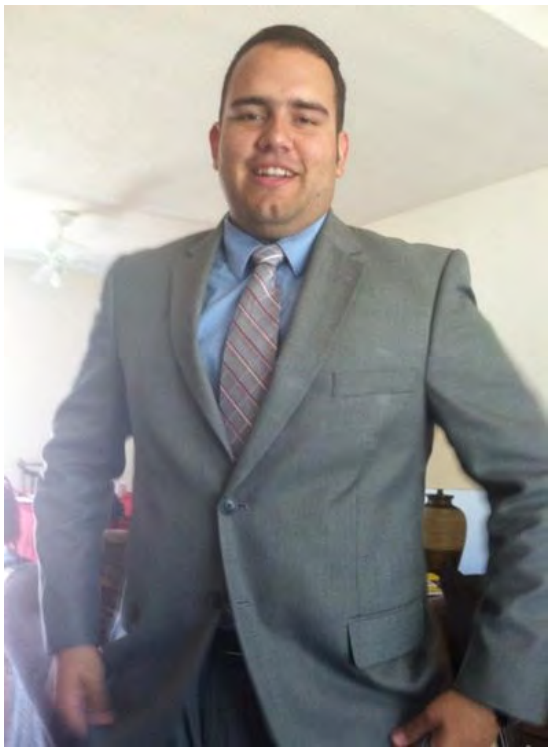
June Speaker

Juan Damelines — **The Colorado Aquarium Society and the Rocky Mountain Cichlid Association have joined forces to bring in a very sought after speaker, Juan Camilo Damelines. Juan has been a fish collector and fish keeper since early childhood. A native of Columbia, he admits to a passion for Catfish in general, Plecos as well as *Apistogramma*s and *Geophagus*. Juan recently graduated from Belmont Abbey College. He is also a HUGE fan of Xingu Black Lager beer. We won't say exactly HOW much of a fan, but suffice it to say that the brewery had to recently expand its operations. He will be giving two different talks to the clubs. So if someone were to brind along a six-pack to our meeting, his talk will probably go much more smoothly!**

His first talk will be to the Colorado Aquarium Society on Friday night, June 6th, at 7:30, Juan Camilo Damelines, will be presenting his experiences in collecting fish in the wild. Juan has collected in Uruguay and Columbia. His collecting experience will help you appreciate the fish in your tank, where they come from and what their native habitat is like. Don't miss this exciting talk on collecting in South America!



Juan will end his fun-filled weekend in Colorado by speaking to the Rocky Mountain Cichlid Association on Sunday, June 8th. He will be conducting a lecture on Breeding Plecos, catfish and other South American species. Be sure to attend the Rocky Mountain Cichlid Association meeting at 6:00 on June 8th, at the Colorado Academy, 8400 S. Pierce St., Denver, 80235.

Two meetings,
Two presentations,
Twice the excitement!

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Aquatic Experience 2014

The **World Pet Association** is bringing back "everything aquatic under one roof" with its second annual **Aquatic Experience – Chicago**, November 7-9, 2014 and would like to share some exclusive offers for the members and friends of your club: all-access weekend passes for 30% off regular price, and free booth space, if interested, at the show for your group, valued at $800. Details on both offers are copied below. We hope you'll join us for the only show in industry history to combine saltwater and freshwater fish and pond animals in one **must-SEA** experience!

Last year over 3,700 guests joined us for high-profile speakers including aquatic ecologist **Zeb Hogan**, host of National Geographic's *Monster Fish*, along with a thriving show floor of more than 85 exhibitors—all showcasing the latest in aquatic trends and products from the most sophisticated aquarium keepers, hobbyist groups, livestock and equipment experts, and the industry's best and trend-setting manufacturers.

We are happy to offer your club the following for **Aquatic Experience 2014:**

- Weekend Passes for only $89 if purchased by June 30. At 30% off regular price ($129) this is the highest discount of the year: https://www.wwpia.org/i4a/forms/index.cfm?id=402.
- Complimentary booth space for your group valued at $800, if interested, in exchange for promoting the show via social media and other channels. If you're interested in this opportunity please email Liza Massingberd at Liza@silvermangroupchicago.com to discuss how we can work together in the coming months. (Note: individual members will still need to purchase passes to the show; however, your group will receive the benefit of exposure to over 3,700 hobbyists and first-time aquarists.)

For more information on the show please visit **www.AquaticExperience.org**. Our "save the date" for **Aquatic Experience** is also copied below for sharing with your members and friends via email and Facebook. This year's high-profile speakers include: Bob Fenner, Brandon McLane, Charles Delbeek, Eric Bodrock, Heiko Bleher, Jake Adams, Jen Reynolds, Joe Olenik, Kevin Kohen, Oliver Knott, Oliver Lucanus, Patrick Dontson, Rusty Wessel, Sandy Moore, Sanjay Joshi, Steve Lundblad and Ted Judy.

The Hikari Customer Service Team

Please join us at Aquatic Experience 2014 in Chicago - November 7 to 9. The industry's only all aquatic show bringing everything for freshwater, marine, pond, goldfish and aquatic reptiles together under one roof. Visit http://aquaticexperience.org/ for details.

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Congratulations to our May Bowl Show Winners:

Malawi—1st Matt Grant - (*Pseudotropheus saulosi*), 2nd Terry Havalka - (*Pseudotropheus sp. perspicax* "Orange Cap" Ndumbi)

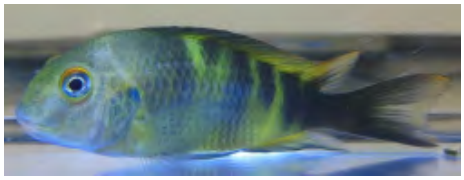
Tanganyika— 1st Dallas Barrett - (*Tropheus duboisi* "Yellow Band")

Other African / Asian— No Entries

New World— No Entries

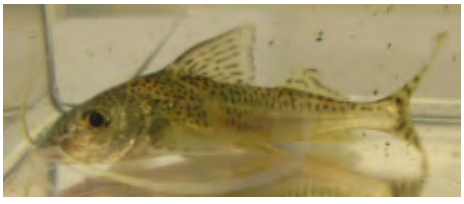
Open (Catfish, Not Sucker-Mouthed)— 1st Dallas Barrett - (*Pimelodus pictus*), 2nd Dallas Barrett - (*Synodontis nigrivetris*)

Matt Grant's *Pseudotropheus saulosi*



Dallas Barrett's *Tropheus duboisi Yellow Band*

No Entries"



No Entries

Dallas Barrett's *Pimelodus pictus*

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June Bowl Show Categories

Malawi:
GROUP 3—PEACOCKS AND OTHER MALAWI—Aulonocara, Cheilochromis, Corematodus, Ctenopharynx, Cyathochromis, Diplotaxodon, Docimodus, Genyochromis, Hemitaeniochromis, Hemitilapia, Naevochromis, Nyassachromis, Pallidochromis, Platygnathochromis, Taeniochromis.

Tanganyika:
GROUP 1—CYPRICHROMIS, GOBIES, AND OTHER TANGANYIKA—Asprotilapia, Astatotilapia (A. burtoni, A, paludinosa, A. stappersi), Baileychromis, Bathybates, Boulengerochromis, Callochromis, Cardiopharynx, Ctenochromis, Cyprichromis, Ectodus, Enantiopus, Eretmodus, Gnathochromis, Grammatotria, Greenwoodochromis, Haplotaxodon, Hemibates, Interochromis, Lestradea, Limnochromis, Limnotilapia, Lobochilotes, Microdontochromis, Oreochromis (O. karomo, O. malagarasi, O. niloticus, O. tanganicae), Paracyprichromis, Perissodus, Plecodus, Pseudosimochromis, Reganochromis, Simochromis, Spathodus, Tangachromis, Tanganicodus, Telotrematocara, Trematocara, Trematochromis, Triglachromis, Tylochromis, Xenochromis, Xenotilapia.

Other Africans/Asians:
GROUP 3—MADAGASCAR CICHLIDS, ASIAN CICHLIDS—Etroplus, Iranocichla, Oxylapia, Paratilapia, Paretroplus, Ptychochromis, Ptyochochromoides.

New World:
GROUP 1—CENTRAL AMERICAN CICHLIDS—Amatitlania, Amphilophus (not A. festae), Archocentrus, Astatheros, Cichlasoma (not C. dimerus), Cryptoheros, exCichlasoma, Herichthys, Herotilapia, Hypsophrys, Nandopsis, Neetroplus, Parachromis, Paraneetroplus, Paratheraps, Petenia, Rocio, Theraps, Thorichthys, Tomocichla, Vieja.

Open: **Botia (Loaches)**

Save The Date!

June 6– Colorado Aquarium Society Meeting, First Universalist Church of Denver

June 8—RMCA Meeting, Colorado Academy, Littleton, CO

July — No RMCA Meeting

July 26—RMCA Summer Picnic

August — No RMCA Meeting

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This constant high humidity is not only tough on fish keepers, it can be equally tough on a home's structure. Over time high humidity can degrade concrete, weaken wooden structures, promote mold and fungus growth, and corrode electrical power systems.

Considering all of this, I had to ask myself, do I really need a heated fish room? Given the small number of tanks located around my home and my dislike for humidity, I am pretty sure I do not. So having no desire to have one of these heated rooms, I had to turn a blind eye to the conventional wisdom and look for other options for aquarium heating efficiency. With a fish room out of the equation, my study of aquarium heating efficiency boiled down to these simple questions:

- ***Can individually heated tanks be made more efficient, or has the aquarium industry already done everything that can be done?***
- ***We insulate our homes; could the solution be as simple as applying some insulation to the aquarium?***
- ***Is there an insulated tank configuration efficient enough to compete with the efficiency of a heated fish room?***
- ***And really, just how many tanks does one have to have before the heating costs dictate going to the expense of building a dedicated fish room?***

All of these questions just kept nagging at me. I even dreamed about people gathering outside my home with torches and pitchforks because my aquariums ran the town out of power. To keep my sanity intact I needed answers, and if I was ever going to get a good night's sleep again, I needed these answers fast. So it was off to the Internet, the repository of everything. Surely everything I needed to know about heating and insulating aquariums would be somewhere out on the World Wide Web.

I fired up my browser and googled anything and everything that had to do with heating or insulating an aquarium. I searched for articles and read through every forum I could find. There were all kinds of answers out there, from things that seemed like they could actually work, to ideas that were just plain crazy. The one thing that was common to all of the power saving ideas from the Internet is that no one offering a solution ever backed up their idea with any proof that it would actually work. Still, I was so intrigued by the idea of making an aquarium more efficient that I kept searching.

Scouring through the suggestions I found some really strange ideas. A few people proposed using aluminum foil on your tank, but they didn't exactly say how. Even more people said put some kind of a mat under the aquarium, but they did not say what this would accomplish, other than potentially cracking the glass. One person even suggested that you should put an electric blanket over your tank. I'm not sure what this person was thinking, but I'm pretty sure that having an electric blanket anywhere near an aquarium is a bad idea.

Of all the suggested solutions, there were two that seemed to be offered the most often. The first suggestion was to use some kind of insulation on the outside of the aquarium. The second suggestion was to swap out the heater for a lower wattage unit. Both of these solutions were topics of *heated* debates on Internet forums.

Because it showed the most promise I decided to focus in on the great insulation debate. In this debate most proponents supported the concept that since heat rises, insulating the top of the aquarium would be the only way to cut heating costs. Then these same people would state the obvious, and point out that this solution makes it impossible to light the aquarium. Because of the lighting issue, the general conclusion from the "heat rises crowd" is that trying to insulate an aquarium is a complete waste of time.

Another camp on the forums, what I call the "insulate the walls crowd", propose several different sidewall solutions. These solutions propose using various insulation materials and affixing them to various places on the outside of aquarium. There were a multitude of ideas and materials suggested, but no real data was offered as to how well any of these solutions worked. In fact, neither the heat rises crowd nor the insulate the walls crowd ever provided one scrap of data supporting the merits of any of their supposed power saving solutions.

I decided that if this insulation question was going to get answered, I would have to put on my big boy pants and answer it myself. So it was off to the Internet again. This time it wasn't to read articles or scan fish keeping forums. It was to learn as much as I could about the thrilling world of thermodynamics, or in other words, how heat moves.

My one thermodynamics course in college did little to prepare me for what I found on the Internet. I learned that thermodynamics always operates in systems, not on things. I also learned that true thermodynamic analysis requires pages of complex differential equations and more often than not a computer model of the system being studied.

When I started studying the thermodynamics involved, I had hoped I would find a way to quickly and easily calculate the answers I needed. This did not turn out to be the case. However, my study of thermodynamics on the Internet wasn't a complete waste of time. I did learn, or rather re-learn, that there are three basic ways for heat to move; through convection, conduction or radiance. I also learned that the common term 'heat rises' is not always true.

The term 'heat rises' comes from the principle of convection, which is the movement of heat in a gas or liquid. Convection happens because the molecules themselves are able to move within a liquid or gas. For example; warmer water, which contains more heat, weighs slightly less than colder water. So the warmer water "floats" to the surface while the colder water sinks, effectively moving the heat. In convection heat always moves away from gravity, so in this case the term 'heat rises' is true.

Another way for heat to move is through conduction, which is the transfer of heat through a material when adjacent molecules transfer energy from one to another. Conduction always travels along the path of least resistance from warm to cold regardless of gravity. Think about the red glow radiating along a steel rod that is being heated by a torch. When conduction is happening, the term 'heat rises' is not true.

The third way for heat to move is through radiance, which is the transfer of heat as energy contained in radiation, such as infrared. Because infrared radiation is a type of light, it can easily pass through transparent materials such as water and glass. Infrared can also pass through some opaque materials, but to a much lesser extent. Like all types of light, infrared can be emitted in any direction. Therefore the 'heat rises' rule is false for radiance as well.

Looking back at the solutions that were offered, it seemed as if the different camps from the Internet each had a heat transfer type they thought was the one at work in their aquariums. The aluminum foil folks seemed to be focused on radiance. The aquarium lid insulators were looking at convection, and the proponents of the sidewall insulation were trying to stop conduction. Why each camp only chose one, I don't know. But I had to know which camp had the best solution. So I went and did the most un-scientific thing I could think of. I placed my hands on the surfaces of my aquariums to see if I could feel the heat escaping.

I was sure I wasn't going to be able to any heat escaping, but I was surprised by the warmth I could feel. A a small amount of heat could be felt coming from every glass surface that was in direct contact with the water. Interestingly when I put my hand on the aquarium's glass top, I couldn't feel any heat.

My initial conclusion was that the greatest heat loss in an aquarium must be through conduction where the water is in direct contact with the glass. I surmised that the heat loss out of the top of a tank probably isn't as large as the "heat rises crowd" claims. I started thinking that maybe the aquarium's lid holds in an air gap that acts like insulation for the top of the aquarium. I was finally getting some answers. But here again… Not so fast.

If I learned anything in science class, it's that my hand is not a very good test instrument as what a person feels isn't always accurate. I knew that without some kind of a plan to really put these insulation theories to the test, I would just have to accept everything from the Internet as true. In fact without a valid test plan, I might as well go shopping for aquarium sized electric blankets.

To truly understand this energy usage issue I needed an actual way to measure the amount heat that was leaving an aquarium. So I turned to a well-known law of physics called the conservation of energy, which doesn't exactly mean that we use our energy wisely. The way conservation of energy applies to this aquarium energy usage study is in this law from thermodynamics: *In any system that is at a constant temperature the heat lost must be equal to the heat gained*. This means that if you want to know how much heat, or energy, an aquarium is using (or losing), all you have to do is measure how much energy the heater is putting into the tank.

Armed with this information, I realized that the key to the answer was finding a way to measure the total energy output of an aquarium heater. The good thing about standards is there are so many to choose from, and energy use is no exception offering many ways measure usage. Heat and energy are very closely related and either one can be measured in units like BTUs, calories, electron Volts, and Joules. With a little manipulation heat could even be measured in horsepower. Of course none of these measurements seem to apply to an aquarium heater, but there is one measurement that does, the kilowatt-hour.

Since aquarium heaters come in various wattage ratings, the job of determining energy input seemed simple enough. One might think the wattage rating of the heater is the answer, but a heater doesn't run all of the time. To get the actual answer I would have observe the heater going on and off over time. It looked as if I was going to have to sit with a stopwatch and time the heater light going on and off for a couple of days straight. Even if I could stay awake that long, that would leave no time for eating, caring for my other aquariums, or doing my day job.

Fortunately, there are several low cost electrical meters available that track power usage over time. This meant that I wouldn't need to sit and watch the tank or use a stopwatch after all. So I purchased one of these little gadgets, selected an aquarium for my tests, and plugged the tank's heater into the usage meter. Now I had a test bed. I just needed to come up with some configurations to test.

A power usage meter essentually sums up all of energy used by an appliance over time.

The Testing Begins

The basic premise to my testing was to take a typical uninsulated aquarium and determine how much energy is used by the heater over a specific period of time, then outfit the tank with different configurations of insulation and test again for the same amount of time. Because of the conservation of energy law, the total power used by the heater during each test could be equated to that configuration's heat loss. After completing all of the tests, I could compare the data and see what the best solution was. I'm guessing that both the heat rises crowd and the insulate the walls crowd would kill for this kind of information. To begin with, here is the configuration of the test aquarium:

- **20G long with a glass top**
- **Hang on Back power filter**
- **Single air stone (lift tube style)**
- **100 Watt heater set at 79 degrees Fahrenheit**
- **The tank is on a shelf that has concrete tile board over plywood**

In the tank - 5 Neolamp. Brichardi, 1 Clown Pleco, and 2 Nerite Snails

The test aquarium was selected mainly out of convenience, but the tank's dimensions are fairly representative of a typical aquarium. This aquarium is in a basement with an average room temperature is 66 degrees Fahrenheit.

The insulation material I used for the tests was sheets of expanded foam bead insulation. This material is the same stuff that is used to make Styrofoam coffee cups, except the foam beads in the insulation sheets are not as compressed as they are in a cup. As a result, little beads of foam fall off of the material nearly every time you touch it. Because of the messiness of this material it probably isn't the best one for the job, but I had some on hand so I used it.

The Baseline Test

The baseline test was a measurement of energy used by the aquarium heater without insulation installed. The water level was marked so that each test could be performed using the same amount of water. The tank was well serviced before the testing started to emanate the need for changes during tests. The aquarium was allowed to operate as normal for 50 hours and included the lid being opened two times during the test for feeding. The fish didn't even notice their home being tested.

The 20 long test aquarium included a glass top, a HOB power filter, a bubbler and a heater. Shown here without the sand, water or fish.

This test included insuation on the back and both ends. The insulation was installed with the blue reflective side facing in.

Test-1 – Easy Side Insulation

For the first insulation test the aquarium was fitted with 1-1/2 inch thick expanded bead sheet insulation. This is a type of insulation is used in building construction, and can be found in many home improvement stores. The insulation used in this test had a light blue reflective surface on one side which was installed facing the aquarium. The insulation was placed on the back and both ends of the aquarium, leaving front open for viewing and top open for lighting. The usage meter was reset to zero and left to run for 50 hours. Again, the lid was opened only twice during the test for the feedings.

Test-2 - Adding Insulation to the Top

In the next test, a sheet of insulation was added to the top of the Test-1 configuration. This blocked most of the light from entering the aquarium just as the "heat rises crowd" had pointed out, so this configuration is not ideal. I noticed during this test that the fish were not as active, which is likely due to the lack of light. The usage meter was reset and left to run for 50 hours. This test also included two openings of the top for feeding.

Adding insulation to the top of the Test-1 configuration blocked most of the light from entering the aquarium.

With only one end open, almost no light makes its way into the aquarium.

Test-3 – End View Insulation

In the third test, the two long sides of the aquarium were insulated as well as the top and one of the ends. This left only one small uninsulated end open for viewing. This configuration is representative of aquariums in a fish room that are installed endwise and side-by-side on a shelf. During this test the fish stopped eating completely, which I attribute to the lack of light in their tank. The usage meter was reset and left to run for 50 hours. In this test the lid was opened while I fed the other tanks in the room to simulate feeding time.

Test-4 – Carefully Insulating the Bottom

In this test the insulation from Test-3 was left in place and insulation was added to the bottom of the tank. In retrospect I should have done this test first. Worming a sheet of insulation under a tank full of water is no easy task. I ended up using a more rigid insulation material because the foam beads would not stay together during the install. The issue of blocking nearly all light from getting into the aquarium in this configuration is the same as it was in Test-3. The usage meter was reset and left to run for 50 hours. As in Test-3 feeding was only simulated as the fish still would not eat in this low light.

Test-5 – A More Practical Solution

In this test one of the ends, the front, the back, and the bottom of the tank were insulated. The top was left uninsulated to once again allow light to enter the aquarium. Just one of the ends was left open for viewing. This represents a more practical configuration for tanks that are setup endwise and side-by-side on a shelf in a fish room. In a side-by-side configuration each adjacent tank would share a single sheet of insulation between the long sides of the aquarium. Once again, the test was allowed to run for 50 hours. The feeding schedule resumed as the fish once again would eat now that lighting was restored.

This configuration lets plenty of light into the aquarium and would work well for tanks that are stacked side-by-side on a shelf in a fish room.

Test -6 – Had to Test That Crazy Lower Heater Wattage Idea

After seeing some unexpected results from the first four tests, I decided that I shouldn't discount the solution that proposed using a smaller heater so I added this test to the mix. The results of Test-1 showed that with just the back and two sides insulated, a 50 Watt heater would be more than sufficient to maintain a constant temperature in a tank.

This test repeats the insulation configuration from Test-1 and uses a 50-Watt-heater in place of the 100-Watt-heater*. During this test the usage meter was used to verify that each heater was actually operating at the heaters labeled output.

**** A 100 Watt heater is the industry standard recommendation for a 20 gallon tank***

The Results

So who was right? Was it the heat rises crowd? Was it the people that wanted to put a mat under their tanks? How about the folks who said to insulate the sides of the tank? Or, should we just throw an electric blanket over the whole mess and call it good?

The results of the tests showed that just about every one of the ideas from the Internet was in some way correct. Well everyone except for that crazy guy and his electric blankets. I discovered that even though I couldn't feel it with my hand, there is a fair amount of heat lost through the top of the aquarium. This must be at least partly due to the process of convection.

An even greater amount of energy seems to be leaking through the sides of the tank where the water contacts the glass. Because the walls of the tank are made of a solid material, most of this loss must be due to conduction. Yet the science tells us that some of the loss through the sides has to be from radiance as the infrared heat from the water can pass through the glass.

Insulation Tests Using Various Materials	KWh used	Average Watts	Improvement
Baseline – Bare aquarium with no insulation	2.71	54.2	Baseline
Test-1 Expanded Foam Bead *(for comparison)*	1.91	38.2	30%
Test-A – 1/4 inch thick reflective bubble insulation	2.14	42.8	21%
Test-B – 1 inch thick polystyrene extruded foam sheet	1.83	36.6	33%
Test-C –bubble insulation backed by poly-foam sheet	1.75	35.1	35%
Test-D – Emergency "space blanket"	2.20	43.9	19%

Table-2: Results of tests using various suggested materials. The tests show that using different materials to insulate the tank provide different levels of performance.

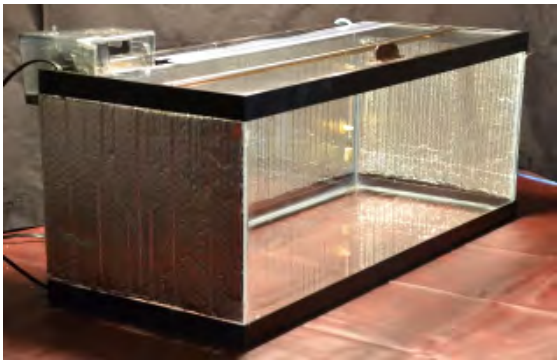
Unlike the folks on the Internet forums, I am providing the actual test data to back up my claims. Table-1 to the left, shows the results found in the testing. It can be seen that the energy needed to heat the uninsulated baseline test aquarium for 50 hours was 2.71 Kilowatt Hours (KWh), and had an average consumption of just over 54 Watts. This 50 hour usage was reduced to an incredibly low 1.05 KWh with the tank nearly encased in insulation, as can be seen in the results from Test-4. This lowest energy usage rating represents a whopping 61% decrease in energy consumption.

Adding Insulation underneath the tank did not prove to be of much value, boosting the overall savings by a mere 1% more in each test case where it was applied. This makes sense as the test aquarium is sitting on a shelf that is made mostly of wood, and wood is already an excellent insulation material.

As expected, testing the lower wattage heater in Test-6 didn't produce any savings over the same configuration with the larger heater. My initial assumption was that changing the heater couldn't possibly affect the aquarium's heat loss, and this test proved that to be true. This configuration just made the lower wattage heater stay on for longer periods of time in order to maintain the tank's temperature. Along with the baseline test, this also verifies the industry standard of using a 100 Watt heater in a 20 Gallon aquarium is correct.

Bitten by the Testing Bug

The test results using the bead foam sheet insulation were so significant that I wanted to try some of the other materials that were suggested by people on the Internet. One of the more often suggested materials was quarter inch thick reflective bubble insulation. This product is essentially a thin sheet of bubble wrap with a layer of reflective Mylar on both sides. It is also an insulation material that is readily available at home improvement stores. It is very easy to work with and can be cut with ordinary scissors, but I found it difficult to the install the material in a way that would maintain solid contact with the aquarium's glass surfaces.



This configuration is same as the one used in Test-1, except the material used is reflective bubble insulation.

The extruded polystyrene material was more durable and performed better than the other materials used.

Another tested Internet suggestion was extruded polystyrene sheet insulation, which is a material that is more rigid and durable than the other types of insulation used in the tests. The extruded styrene product has highest insulation value, or R-Value, among the materials used in the tests. Most home improvement stores have this material available in three-quarter-inch, one-inch and two-inch thicknesses. The one-inch thick material was decided on for these tests. The product selected did not have a reflective surface, but it can be found with a reflective coating in some stores. Having the reflective surface would be an advantage as it would help stop heat loss due to radiance.

During my struggle to get the reflective bubble wrap to maintain contact with the aquarium glass in Test-A, I realized that some sort of rigid material was needed to press and hold the bubble wrap to the glass. So my third materials test was to use the extruded polystyrene as backing to hold the reflective bubble wrap tight to the aquarium glass.

Finally, one last material needed to be tested because so many people on the Internet claimed that it would work. That material is the emergency space blanket. I didn't expect very good results this test, but it was suggested on the Internet so often that I had to prove its value one way or another.

All of these tests were performed with insulation installed on the back and both ends of the aquarium, leaving the top uninsulated for good lighting and the front of the aquarium open for viewing. The results from this second round of testing is shown in Table-2 below. The baseline results from the first tests are shown here for comparison. The Test-1 results are

also shown as this round of testing used the same basic configuration that was used in Test-1. Only the insulation materials were different.

Insulation Tests Using Various Materials	KWh used	Average Watts	Improvement
Baseline – Bare aquarium	2.71	54.2	Baseline
Test-1 Expanded Foam	1.91	38.2	30%
Test-A – 1/4 inch thick	2.14	42.8	21%
Test-B – 1 inch thick	1.83	36.6	33%
Test-C –bubble insula-	1.75	35.1	35%
Test-D – Emergency	2.20	43.9	19%

Table-2: Results of tests using various suggested materials.

This second round of testing shows that extruded polystyrene insulation performs slightly better than the expanded foam bead insulation. This stands to reason as the extruded polystyrene material has a slightly higher insulation value (R-Value) than the expanded foam bead material.

The two tests using the reflective materials, the reflective bubble insulation and the space blanket, did not perform as well as the bulk insulation materials. This is to be expected since their overall R-Value of the reflective materials is relatively low. The space blanket test actually performed better than expected, but that could be due to an installation decision I made while applying the space blanket to the tank. When I put the space blanket on the tank I taped the blanket to the tank's plastic rim, which left an air gap between the glass and the blanket. As an added bonus, the *N. brichardi* in the test tank really seemed to like the space blanket and spawned during this test.

Test Result Thoughts and Conclusions

Using insulation on an aquarium is one way to reduce energy consumption. While it is possible to reduce power usage by 61 percent, the insulation configuration that supports this low power utilization blocks nearly all light from entering the aquarium. Unless you are raising *Amblyopsidae* (blind cavefish) this configuration is not very practical.

I found that the most useful application of aquarium insulation would be in a fish room where aquariums are stacked on a shelf side-by-side with one end open on each tank for viewing. The testing shows that this configuration would provide roughly 47 percent of improvement over uninsulated aquariums.

In working with the higher R-Value materials I found that the more rigid extruded polystyrene material was easier to cut, shape and affix to the aquarium than the lower cost expanded foam bead material. Even though the expanded foam bead material is a lower cost product, it is really messy stuff. If this lower cost material had provided the best performance in the tests, I still probably wouldn't use it because of the mess.

The testing also shows that using an insulation material underneath the tank adds little value. After reading about people who actually cracked the glass on their aquariums, adding insulation under a tank only to squeeze out a tiny bit of efficiency doesn't seem to be worth the effort. However, some types of foam material are used to "auto-level" fish tanks. If your tank

has this type of material underneath it, I wouldn't recommend removing it just because it doesn't add a lot of insulation value.

After performing these tests and reading the data, I realized that the test aquarium used could have been made somewhat more efficient without using any insulation. I am now also realizing that there are other insulated configurations that may provide better results as well. One configuration would be to swap out the hang on back power filter for one that is fully contained inside the tank allowing the top to be more enclosed. I've also started working on some designs and prototypes that would allow lights to be embedded in a high R-Value aquarium hood.

So, Do I Need a Fish Room?

The answer to as whether or not I need a fish room is both yes and no. While I would like to have a place where I can breed and grow fish, I don't want to spend time in a room that is as hot and humid as a tropical rain forest. So the answer to my need for a fish room hinges on how many tanks I can afford to heat without one.

While I was studying the thermodynamics information on the Internet, I came across several web sites that provided computer models that would calculate how many BTUs would be required to heat a given room. At first I thought I could use these models to calculate fish tank energy usage, but I soon realized that the computer models only applied to a room filled with air, and not a glass box filled with water.

What I did get from utilizing these computer models was a consistent representation of the energy that would be needed to heat a typical 100 square foot room in a basement to a temperature that would support tropical aquariums. The energy requirement from the models was consistently around 2200 BTUs. A conversion of 2200 BTUs to electrical energy yields approximately 650 Watts.

This means that if I were to use the most practical configuration, the configuration from Test-5, each of my 20-gallon aquariums would be using an average of 28.8 Watts. This allow me to run roughly twenty-two insulated 20-gallon aquariums, and use the same power needed to heat the air in a dedicated fish room. Adding ten more aquariums would only use another 280 Watts of power.

In the end, this practical configuration isn't something that I would apply to the aquariums that are situated around my home. To be frank, an insulated aquarium is kind of ugly. However, I do have a small but growing fish room that currently has fewer than ten tanks. As this room grows I intend to make the addition of insulation part of my tank deployment ritual. I will also be adding insulation to the back glass of the aquariums around my home to conserve energy wherever I can. I am sure that the money I save on my power bill will be put to good use buying more aquariums, gadgets, and of course more fish.

Tank Tech—Insulating Yourself Against High Power Consumption (cont.)

Over the years fish keeping has provided me with countless hours of enjoyment. I enjoy almost everything about the hobby whether it's watching two cichlids spar over territory, or setting up a new aquarium. Being creative, or what my friends call exercising my cheapskate ingenuity, might be one of things I find most enjoyable in fish keeping. Performing these tests has provided me with a plan for how I want to deploy fish tanks going forward. For me, this whole journey has definitely been an exercise in cheapskate ingenuity.

So if you want to know about something in the fish keeping hobby; join a club, ask around, read some books, and search the Internet. If you don't find the answers you are looking for, don't be afraid to try something, build something, or test something; then go out and share your new found knowledge. After all, it's a hobby and all of this stuff is part of the fun.

Editor's Note: Something that I believe should be noted, but was outside the scope of what Steve was trying to accomplish with this study, is that the insulation around the outside of the aquariums has the added bonus of preventing the fish from seeing their neighboring tanks. Many of us have pondered how and with what do I paint the sides of my aquariums. This answer may have just been answered with Steve's research. Simply paint your insulating material the color you want to have on the sides, insulate your tanks, and you have accomplished two tasks at once!

Marine Aquarium Conference of America—MACNA

Denver is the site of the 2014 Marine Aquarium Conference of North America August 29-31. The location is the Denver Convention Center. It is being sponsored by the Colorado Organization for Reef and Aquatic Life in cooperation with the Marine Aquarium Societies of North America. There are a ton of great speakers, cool prizes, and hundreds of exhibits and exhibitors. For more information on the convention, please go to www.macnaconference.org/2014

As we well know, these things don't go off without a LOT of work. The Board has formally chosen not to volunteer the club on any level for this event. However, I understand that volunteers that help with setup, teardown, or other work can get free passes to the event. Time commitments can be as little as one hour. Several members of the board and club have already expressed an interest in helping out on an individual basis. If you would like to volunteer for this event, please contact the volunteer coordinator, Carissa Garnett, at carissa@macnaconference.org.

www.rmcichlid.org