Logistics for Public Display of Roanoke Logperch

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Additional Information on the Exhibit

The initial public portion of the exhibit actually begins on the second floor of the museum, one story above the base water level of the exhibit on the museum's first floor. Filtered and treated water returns behind rock-work boulders level with the upstairs viewing portion of the habitat where the visitors are amidst the tree canopy and can view the entire exhibit from above. This upper stream is heavily vegetated with both emergent plants and submerged vegetation. Both act as excellent physical filters for fine particulate matter and dissolved organics. From here the water tumbles away from view down the waterfall, an exacting replica of Dark Hollow Falls in the Shenandoah National Park system in western Virginia. This upper portion contains no fishes.

The waterfall enters the first exhibit basin–irregularly shaped due to the rockwork on two sides–which is roughly 15' x 12' x 4' deep and approximately 5,000 gallons. Over the years, the population of adult Brown Trout (*Salmo trutta*) in this exhibit had been exclusively females but currently it contains seven females and two much smaller, younger males from Montebello State Fish Hatchery (MSFH) in Nelson, Virginia, that were integrated into the population this fall. Although we have witnessed several spawning events in progress over the years and several others occurred as evidenced by newly released eggs, there have been no viable offspring. Though these animals are not successfully reproductive, the sheer size of the females makes them excellent display animals, some exceeding 13 pounds in weight. When these animals were younger and spryer, they would occasionally leap from this exhibit at night over the rocks and logs that camouflage the weir from above, and be found in the morning inside the stream exhibit, most likely with a belly full of dace.

From here water flows "downstream" and exits through a 1' x 2' weir of 1/4" PVC screening molded into the cosmetic rockwork at the waterline separating the downstream portion of the Brown Trout exhibit and the upstream portion of the stream exhibit. Water flows freely through the stream exhibit and exits a similar weir at the tail end of the stream and continues into the Rainbow Trout and Brook Trout exhibit containing a population of approximately 50 age-two fish. Both the Rainbow Trout (*Oncorhynchus mykiss*) and Brook Trout (*Salvelinus fontinalis*) regularly spawn in spring and fall and are periodically exchanged with hatchery-raised trout from the MSFH. These exchanges ensure genetic diversity and allow us to cycle out broodstock that have become too large for display. The weirs on either end of the stream not only passively control the water level in the stream portion, but (theoretically) prevent smaller fishes from exiting the stream or trout entering from either end. Unfortunately, these structures also act as skimmers constraining flow in these two regions and must be maintained daily due to leaf litter from the tree canopy and organic input such as soil and duck feathers from the other portions of the exhibit.

The stream exhibit itself is quite large and the "flow through" configuration presents a lot of physical advantages. Neither the size nor the flow-velocity requirements of fishes are limiting factors. The stream exhibit is 18.5 feet in length, an average of 5 feet in width and 20" deep with substrate. The free flow through the exhibit allows for velocities that would not be practical in a truly closed system. Flow at the head of the stream is regulated and directed by a Danner MD-12 powerhead (20 gpm) with a sponge pre-filter. The direction and angle of the powerhead are monitored daily to ensure the proper flow patterns within the

exhibit, because nearly all the fish species within the stream prefer specific flow regimes and will move accordingly with changes, affecting not only behaviors, but visibility to the public.

The volume of the stream as an individual basin estimated at 850 gallons is substantial enough to support a significant bio-load on its own, but because it is part of the larger system the working volume is actually over 15,000 gallons. Life support for the three exhibits consists of three 3-HP Hayward Super II pumps pushing through 3 Pentair Triton II TR140 sand filters, an Aqua UV 400W Stainless Viper unit, a high capacity Alfa Laval M6FG plated heat exchanger (250 gpm)–set at 50° F–, and two six-foot bio-media towers hidden behind hollow concrete "trees" within the terrestrial portion (rear) of the exhibit itself. One thousand gallons is backwashed from this entire exhibit weekly and all areas are gravel-washed as needed. The substrate and rockwork are also scrubbed and or removed to be sterilized at least every other week. A cache of substrate is kept in holding to exchange with the removed rocks so the exhibit habitats remain as stable (and clean) as possible.

The publicly visible aspect of the stream exhibit basin is the most distinctive feature. While the acrylic-enclosed viewing portions of the adjacent trout exhibits begin at the floor and rise to a depth of four feet, the bed of the stream actually begins two feet above the floor of the exhibit on cosmetic rock-work to bring the entire stream and animals closer to eye level for the visitor; 24" of acrylic exposes an entire 18.5' of viewing area and is completely open from above. A combination of flow and interior design draw the majority of fishes within inches of the acrylic, truly immersing the viewer into a stream that only snorkeling in the wild could replicate. In fact, much of the visual characteristics have been and are constantly modified to replicate actual stream snorkeling experiences in Virginia.

Renovation Procedure

Break-down of the exhibit took place three days prior to the scheduled transfer of the logperch to minimize the time fishes would be held off exhibit, but enough lead time to allow for inevitable complications. The initial step before removing the existing fishes required physical isolation of the stream system with seine net material as a (theoretically) impenetrable barrier. Escape into the populations of Brown Trout on the upstream side, or into Brook and Rainbow Trout on the downstream portion would likely result in their immediate demise. Once the barriers were in place, the powerhead regulating flow within the stream was powered off and removed. To ensure the minimum amount of stress upon the animals this process was attempted in a single effort.

The removal process began with the careful deconstruction of the largest existing physical structures and substrate, eliminating all potential hiding places to allow easier capture of the fishes. The majority of woody debris, boulders, stones, cobble, and gravel were sorted by size into several wheeled 44-gallon round Rubbermaid bins and retained for sterilization and future use. I then entered the exhibit in waders to remove the largest and least accessible boulders and stones from the rear of the exhibit, and also to capture or direct fishes out of reach from the front of the exhibit. A 4' by 6' minnow seine was used to concentrate the fishes to the front of the exhibit where the aquarium staff could carefully remove the fishes with dip nets and hand nets into holding containers. Separation by species was done as quickly as possible during the process to minimize additional handling stress. Fishes were segregated into two 150-gallon Rubbermaid trough tanks on industrial dollies that could be placed alongside the exhibit, filled with water siphoned from the exhibit, and aerated. The bins were then transported to our chilled freshwater quarantine systems until reintroduction or de-acquisition. The exhibit was then thoroughly scrubbed clean of algae by hand and flushed of any remaining detritus and waste material.

Over the next two days, sterilized substrate was repositioned within the exhibit to compliment the designed flow regimes carefully. The rear of the stream directly adjacent to the highest flow patterns was lined with large boulders, some in excess of 100 pounds. A permanent ridge of limestone slabs set within the molded concrete runs three feet from the upstream portion of the stream lengthwise parallel to the exhibit acrylic in the front and the boulder along the back (Zone 1 on the Stream Diagram). The powerhead is situated behind the ridge and directed to flow over diagonally, creating a long riffle nearly the entire length of the ridge and a high-velocity chute behind. This configuration disguises the origin of the flow from visitors (the powerhead) and provides a very sheltered

high-velocity habitat for fast-water species. On the downstream side of the ridge, the lengthy diagonal riffle oxygenates the entire stream as it spills turbulently over the ledges and provides an excellent open water high-velocity flow regime. To the left of this riffle, between the ridge and the front of the exhibit is a section of quiescent water in which pool-related fishes such as Snubnose (*Etheostoma simoterum*) and Fantail (*E. flabellare*) Darters congregate (Zone 6). Moving downstream along the acrylic (front), the flow slowly and naturally dissipates further downstream from the powerhead. Another low permanent "L" shaped ridge of limestone shelves was created at the far end creating an eddy in front and slack water behind. The swirling eddy (Zone 4) is the most populated area, not only by species, but by individual fishes.

The majority (~ 65 % by area) of the substrate generally classifies as a combination of very fine gravel (4 – 8 mm) to very coarse gravel (32 – 64 mm) on the Wentworth Scale interspersed with cobble (64 – 256 mm) and boulders (> 256 mm) of varying size to match the appropriate flow regime; the strength of the flow also helps to naturally sort the material. The marriage of flow/substrate micro-habitats allows specific fish species to gravitate towards their natural habitat preferences and hopefully reduces interspecies aggression.

Continuity of care and availability of habitat similar to that in which they were last housed is usually a major factor during behavioral acclimation of the fishes prior to their pending public display. The fishes at this point had minimal visual contact with humans and were certainly not accustomed to the exhibit that is open from above and allows exposure to the general public; a process which some species and individuals do not necessarily ever become accustomed to. However, further quarantine seemed a more stressful process for the animals and would do little to accustom them to visual exposure. Their previous holding tank was a covered 100-gallon round fiberglass tank so an adjustment period was expected, but captive-raised animals generally acclimate more quickly and are generally less wary and hide less readily than their wild counterparts (El Balaa and Blouin-Demers, 2011).

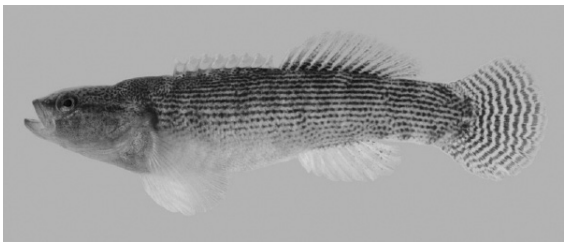
Current Mountain Stream Species and Stream Exhibit Zones (see figure on P. 12)

Mountain Redbelly Dace *Chrosomus oreas*	4
Longnose Dace *Rhinichthys cataractae*	4
Rosyside Dace *Clinostomus funduloides*	3,4
Central Stoneroller *Campostoma anomalum*	4
Warpaint Shiner *Luxilus coccogenis*	4
Common Shiner *Luxilus cornutus*	5
Torrent Sucker *Thoburnia rhothoeca*	3
Northern Hog Sucker *Hypentelium nigricans*	5,6
Greenside Darter *Etheostoma blennioides*	1,2,3
Banded Darter *Etheostoma zonale*	2,3,4
Snubnose Darter *Etheostoma simoterum*	4,5,6
Longfin Darter *Etheostoma longimanum*	3,4,5
Fantail Darter *Etheostoma flabellare*	3,4,5,6
Tessellated Darter *Etheostoma olmstedi*	4,5,6
Redline Darter *Etheostoma rufilineatum*	1,3,5**
Bluebreast Darter *Etheostoma camurum*	2,3
Gilt Darter *Percina evides*	2,3,4
Roanoke Logperch *Percina rex*	1,2,3,4,5,6
Rainbow Trout *Oncorhynchus mykiss*	1,2*
Brook Trout *Salvelinus fontinalis*	1,2*

*seasonally as captive reared juveniles (< 80 mm)
**female *E. rufilineatum* tend to congregate in slower water than males

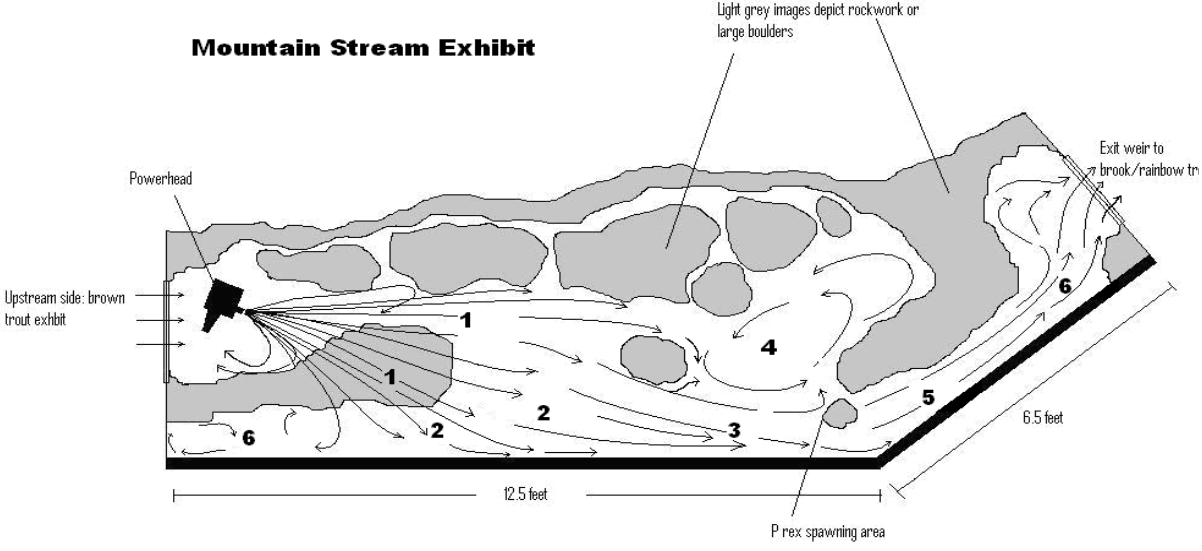
Literature Cited

El Balaa, R., and Blouin-Demers, G. 2011. Anti-predatory behavior of wild-caught vs. captive bred freshwater angelfish *Pterophyllum scalare*. Journal of Applied Ichthyology. 27: 1052-1056.



Fantail Darter (*Etheostoma flabellare*)
Uland Thomas

Warpaint Shiner (*Luxilus coccogenis*)
Fritz Rohde


Mountain Stream Exhibit
Light grey images depict rockwork or large boulders
Powerhead
Upstream side: brown trout exhibit
Exit weir to brook/rainbow tr
1
1
2
2
3
4
5
6
6
6.5 feet
12.5 feet
P rex spawning area

Mountain Cove Habitarium Waterfall

Tennessee Snubnose Dater (*Etheostoma simoterum*)

Longfin Darter (*E. longimanum*)

Redline Darter (*E. rufilineatum*) basking in the sunlight