

King of the Perches: Observations of Captive Roanoke Logperch

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Author's Note

Ten Roanoke Logperch (*Percina rex*) were acquired in October 2011 by the Virginia Living Museum (VLM) in an effort to expand our educational efforts and live collection, especially with regards to threatened native species and critical habitats. The Roanoke Logperch serves as an excellent example of the tenuous nature of our native wildlife and serves as a cautionary tale of the ever-increasing human impacts upon wild fish populations in Virginia and elsewhere; it is yet another exceptional species reduced to a fragment of their former populations by the ever increasing development in Virginia.

The life history, ecology, and habitat requirements of the Roanoke Logperch have been described in several excellent research papers, many of which are referenced within this article and were used at our facility to provide ideal husbandry conditions. These studies were referred to extensively during the research process prior to acquisition of our logperch, including the protocols used by Conservation Fisheries Inc. (CFI) of Knoxville, Tennessee, from which these specific animals originated.

As husbandry professionals, my staff and I strive to replicate the best practices and utilize the most comprehensive research to not only effectively house our animals, but to also most closely represent their natural environment to ensure optimal health and give a natural representation to the public to augment our educational mission. The research and efforts of the individuals concerning the Roanoke Logperch is greatly appreciated and has proved invaluable to our successful efforts. I would also like to mention the efforts and cooperation of several governmental bodies that allowed us this opportunity, especially Virginia

Department of Game and Inland Fisheries (VDGIF) and U. S. Fish and Wildlife Service (USFWS). These animals remain on loan from the VDGIF, who in turn is a sub-permittee of an endangered species recovery permit issued by the USFWS. These animals represent a portion of over 200 captive-bred offspring from 14 adults – 13 of which were used as brood stock – that were originally collected from the upper Roanoke River by CFI as part of a successful effort to develop protocols for the captive propagation of Roanoke Logperch. The following provides an overview of the literature, but focuses primarily on our acquisition and processes involved in the display of these unique and beautiful animals. Many NANFA readers are freshwater enthusiasts, even darter fanatics as am I, and will hopefully appreciate any insights or experiences that we can share regarding our efforts.

Introduction

The Roanoke Logperch (*Percina rex*) is one of 48 Virginia darter species (Virginia Department of Game and Inland Fisheries, 2010) from either the genera *Etheostoma* or *Percina*, the latter of which contains the subgenus *Percina*, or logperches. The logperches are the largest darters found in Virginia and are generally characterized by their cigar-shaped body, unusual large size for a darter (up to 160 mm), and a conical snout used to flip rocks while foraging. *Percina rex*, or literally “little perch king,” was once believed to be endemic only to Virginia within the Chowan River basin and upper and middle portions of the Roanoke River basin (Jenkins and Burkhead, 1994), however the accidental capture of a single *P. rex* in 2007 and the subsequent discovery of several age classes of *P.*

rex expanded their known range into North Carolina as well (Wood, 2008). Biologists now suspect that the North Carolina portions of the Mayo River and the Smith River, both within the Roanoke River basin, also have self-sustaining populations.

Despite the recent good news, the Roanoke Logperch has been classified as Federally Endangered since 1989 and populations are continually threatened by human activity (USFWS, 1992). All the major river drainages in which *P. rex* occurs are extensively dammed for reservoirs, fragmenting populations, and altering historical flow patterns while increasing sedimentation and concentrating human population centers. Unfortunately, the strongest populations at the moment are believed to be within the upper Roanoke River just below the densely populated city of Roanoke (Jenkins and Burkhead, 1994) and susceptible to “considerable stress” of water quality degradation and further downstream sedimentation, both significant factors in their overall decline (USFWS, 1992). The USFWS Roanoke Logperch Recovery Plan outlines several mandates towards the ultimate goal of delisting the species including but not limited to: protection of presently used habitat, soliciting help from outside agencies (including the development of educational display materials), and the viability of introductions of artificially (hatchery) reared *P. rex*. Through the cooperation of the USFWS and VDGIF, the VLM located in Newport News, Virginia, has been fortunate to acquire 10 *P. rex* propagated by CFI, progeny of wild-collected adults from the Roanoke River in 2008 and to contribute, albeit in a limited capacity, towards several of the recovery plan’s goals through their public display. Public aquaria are excellent platforms to educate and emotionally connect the public to animals they ordinarily do not see represented within the context of their idealized natural habitat.

The Exhibit

To successfully display the Roanoke Logperch within their “natural” environment we needed to replicate their representative habitat and physical conditions to provide ample opportunity for natural behaviors while still being visible to the public. Aesthetics and educational context are factors in publicly displaying any animal, but ultimately are secondary concerns to producing an exhibit that closely resembles the optimal physical parameters required for

specific species. Proper flow regime and microhabitat configuration within the system ensures food access to all inhabitants while minimizing captive stress due to exposure, space limitation, or interspecies aggression and therefore greatly reduces physiological stress on the animals.

Because these animals were acquired by the VLM as adults, we focused primarily upon replication of the natural habitat utilized by the most robust populations of wild adult logperch, presumably indicative of the most ideal habitat. Rosenberger and Angermeier (2002) described that Roanoke Logperch exhibited ontogenetic habitat selectivity that varied slightly by specific river system, but adult logperch consistently utilized higher velocity habitats than sub-adults and were significantly associated with silt-free, loosely embedded gravel that allows for their unique stone-flipping feeding strategy. Additionally, previous research specific to the Roanoke River also indicated that adult *P. rex* preferred higher velocity, deep riffle and run habitats naturally conducive to both feeding and spawning requirements (Burkhead, 1983). By combining the available *in situ* habitat use data, and the successful captive spawning methods used by Ruble, Rakes, and Petty (2010) of CFI, we determined the ideal habitat for our exhibit should consist of clean (silt free), loose gravel and cobble-based substrate intermingled with larger boulders and ledges and a moderate to moderately-high velocity flow regime.

The Mountain Stream exhibit that currently houses the Roanoke Logperch is technically a portion of a much larger exhibit (20,000 gal total) named the Appalachian Cove Habitat, officially described by the VLM as a “glass-covered walk-through habitat” featuring a “two-story waterfall, a swift-running mountain stream plus free-flying birds and communities of native plants and animals.” An exhibit of this scale presents many logistical challenges and has undergone many changes and thematic iterations since construction in 2004, but basically is composed of four consecutive exhibits. The life-support systems for three of the four portions are integrated, but remain distinct entities both thematically and logistically, formally named in order upstream to downstream: Brown Trout, Mountain Stream and Brook and Rainbow Trout. The fourth portion, Mountain Lake, operates as a singular unit and has no connection to the stream exhibit. A detailed description of the exhibit is in the article immediately

following this one.

For the first six years the stream was home to nearly two dozen species of fishes, but many were indistinguishable to most guests, presented no unified theme, and frankly, were uninspiring. The suite of species included: several shiner species (*Notropis* spp.) difficult to discern for even professionals, fishes that were not viable long-term inhabitants such as Bluehead Chubs (*Nocomis leptocephalus*) and Creek Chubs (*Semotilus atromaculatus*), the ubiquitous (in Virginia anyway) Fallfish (*Semotilus corporalis*), the ever-voracious Mottled Sculpins (*Cottus bairdii*) and Banded Sculpins (*Cottus carolinae*). Smaller species, such as darters, many dace species, and juveniles of any kind simply could not thrive amongst some of these highly piscivorous and often much larger species, as noted by Katula (1996). Also, most of these species represented an assemblage of fishes strongly associated with a low-gradient, low-flow, and temperate-to-warm waters (Moyle and Cech, 1996), not the cold, swift highland stream that the VLM was attempting to represent.

As a freshwater species enthusiast, I had long wanted to not only re-model the interior of the exhibit to be more naturalistic and to more accurately portray a swift Virginia stream, but also to create a more interesting and dynamic exhibit from a visitor's standpoint. Virginia boasts a spectacular array of darter and dace species that are not only exceedingly beautiful, but display a wide variety of interesting behaviors. These are fascinating fishes the average visitor ordinarily does not see and would give the VLM an exceptional opportunity to educate the public. Serendipitously, a former colleague of mine, freshwater aquarist Nick Little, currently at the National Aquarium in Washington, D.C., which exhibits a plethora of rare freshwater species themselves, alerted me to the possible availability of Roanoke Logperch at CFI. With the cooperation and generosity of CFI and the VDGIF who had taken possession of the animals, we were able to formulate a plan to completely renovate the exhibit specifically to showcase the "darter king." Once all the legal and permitting issues had been resolved (summarized as the very definition of "a long story short"), a complete renovation of the entire exhibit was needed.

The obvious next step was to determine a suite of species that would complement the Roanoke Logperch and ensure their long-term safety from predation and

allow them context to facilitate their natural behaviors. There were some species that we wanted to retain, and would fare much better with the removal of the rest of the previous suite of fishes. The most notable examples were Mountain Redbelly Dace (*Chrosomus oreas*), Rosyside Dace (*Clinostomus funduloides*), Redline Darter (*Etheostoma rufilineatum*), and Greenside Darter (*E. blennioides*). Several of the largest and most wary of these two darters were able to hold their own in the previous exhibit with the big boys, but there were also far too many times I watched in horror as a 6-inch sculpin swam around with just the telltale red, cream and black-banded tail of an adult male Redline sticking out of its mouth. The removal of all the sculpins was of paramount importance, due to a highly predatory nature that bordered on suicidal. Many large individual sculpins had been occasionally observed on exhibit devouring darters and other species over 50% their body length, including one individual that died during the process of consuming a Warpaint Shiner (*Luxilus coccogenis*) nearly its own size, presumably suffocating during the effort. The largest sculpin removed was over 7 inches long and would easily be able to eat or definitely attempt to eat one of the smaller logperches given the chance. Although we were to receive large adult logperch, ranging in size from 4 to 6 inches, the risk of predation either by the existing sculpins or (possible) subsequent generations dictated the removal of all age/size classes; this proved easier said than done. In fact, sculpins have proven to be very resilient and apparently highly fecund; individuals of all age classes are still found intermittently in both trout exhibits and occasionally even in the stream. Their removal remains an ongoing process.

The Roanoke Logperch were transported over a period of six hours in two large aerated coolers without any major issues, such as mortality or equipment failure. Upon arrival, the coolers were placed within the exhibit and ~ 50% of the water was manually exchanged. The temperature of the flow-through system—the hatchery drawn from the South Fork of the Holston River (in October)—was within a few degrees of the stream after transport. After the acclimation period, the fish were released into the exhibit after hours, in low light conditions, and promptly disappeared into cover. Not an auspicious start, but certainly not unusual. During the next day on public exhibit, they ventured out only briefly, but their priorities were immediately apparent.

What soon became apparent about the “kings” was that they ate like kings. Not only were they already rather stocky, enough for me to concentrate on slimming them down, but they came out enthusiastically for their first feeding. In the short time that the Roanoke Logperch have been on exhibit, they have proven to be an excellent display animal from almost every professional criteria, such as acclimating well, eating a variety of food, tolerant of other species, disease resistant, etc. They have endeared themselves not only to staff, but have also become the centerpiece of this dynamic exhibit and a popular part of our “Threatened and Endangered Species” tour, where they are always front and center of the exhibit, literally and figuratively.

Observations on Captive Behaviors and Inter/Intraspecies Interactions

The logperch are currently housed with a suite of Virginia stream species including several other darter, dace, and shiner species, several of which are not naturally found within the same watersheds inhabited by Roanoke Logperch in the wild. The dynamic interactions between disparate species at high population densities (in relation to the wild) illuminate some interesting behaviors in *P. rex*, especially during feedings.

The entire exhibit is broadcast-fed Opossum Shrimp (*Mysis relicta*) from Piscene Energetics once daily, or twice daily with live blackworms (*Lumbriculus variegatus*). Additional nutrition is occasionally provided by diced and rinsed cooked crayfish tail meat, diced Mazuri 5M70 gel diet, smelt roe, or pulverized AquaMax 400 commercial feed. Slackwater areas are fed specifically to ensure coverage for the more passive species. The vast majority of the food is consumed within a minute and any food settling into interstitial spaces is foraged quickly. Amounts are carefully adjusted and monitored to ensure no remaining excess waste.

Most of the dace and shiner species, such as the Mountain Redbelly Dace and Warpaint Shiners, inhabit the upper water column and have minimal interaction with the logperch. Despite the fact that the Hog Suckers, Torrent Suckers, and Blacknose Dace are more demersal feeders and tend to inhabit the same stream zones within the exhibit as *P. rex*, there has been no observed competitive aggression. The logperch is the only darter species that actively feeds up in the

water column amongst the dace, but settle to forage the substrate directly after, commonly displaying their characteristic stone-flipping behavior. Interspecific conflict is also rare between *P. rex* and the other darter species, several of which are noticeably more territorial and aggressive amongst each other than the logperch, especially the Bluebreast (*Etheostoma camurum*) and Redline darters. The dominant males of these two species commonly jockey for prime real-estate and joust during feeding, but the logperch simply follows the food and displace other fishes.

Their sheer size alone and general disregard for the seemingly hard-fought territories of the smaller darters allows them to dominate the prime feeding stations and preferred habitat. They are also confident and fearless, often becoming directly physically involved with staff during routine cleaning and feeding activities, even swimming into and amongst their hands. Most, if not all, of the other darter species retreat into cover or stay closely associated with “home base” for security into which they can dart when challenged, exposing themselves only during feedings. Additionally, they are unfazed by external stimuli ranging from Green-winged Teals nibbling at algae within the exhibit, overhead shadows, or visitors separated by a mere three inches of clear acrylic, as they feed and mate in full view of the public.

The logperch do not seem to adhere to a regular “territory” within the stream; instead they actively utilize the entire exhibit, across all flow regimes and all portions of the water column. They are commonly observed at rest in close physical contact with individuals of nearly every species of the stream fishes and have little respect for “personal space”, often settling directly upon other fishes indiscriminately. Wild Roanoke Logperch display a propensity for site fidelity (Roberts et al., 2008) within a relatively large territory (> 15 m but < 150 m) for darters and perhaps the entire stream exhibit is their adopted territory, well within the parameters of their observed movement in the wild. Mostly they tend towards the areas of strongest flow when actively feeding and otherwise search the substrate in its entirety, displaying their stone-flipping behavior, though less frequently than observed in wild fishes (Jenkins and Burkhead, 1994). Despite a substrate composition designed to encourage the logperch to exhibit such behavior, they flip stones only after they have fed from the water column and

then scour the gravel surface for exposed food.

Mating Behavior Observations

Since their arrival, the Roanoke Logperch have demonstrated brief spawning behaviors during two distinct time periods: their first spring on public display and most recently during the first week of January 2013. The spring events, partially observed twice over a two-day period in late April 2012, roughly coincided with their natural spawning cycle in local waters (Jenkins and Burkhead, 1994) and aligned with the same spawning period exhibited during captive propagation at CFI (Ruble et al., 2009). Natural light illuminates the exhibit and experiences seasonal photoperiod cycles resulting in increased sunlight intensity and duration. Subsequent increases in air temperature within the exhibit (a true “greenhouse effect”) resulted in water temperature fluctuations both daily and cumulatively, and likely triggered the spring spawning event. However, the most recent January event was most likely triggered inadvertently by “unnatural” temperature changes within the surrounding exhibit environment as well. In December of each year, temperatures are allowed to drop within the exhibit to naturally winterize the trees (induce dormancy) by opening passive air vents for controlled exchange with external air. This practice resulted in rapid heat loss in the exhibit overnight with air temperatures often falling into the low 10s C°, cumulatively reducing the water temperature in the exhibit from a December average of 16.4 C° to a daytime low of 14.2 C° in less than a week. Temperatures remained several degrees below the yearly average for nearly four weeks before being allowed to passively increase, slowly increasing water temperature in the process, and possibly triggering spawning after the mini-winterization period. Sunlight on the last observed spawning day was 9 hours and 55 minutes, exhibit temperature was 14.2 C°, pH 8.08, dissolved oxygen 9.5 mg/L, and all water chemistry parameters such as ammonia/ammonium, nitrate, nitrite, and phosphates measured at 0 ppm. As per our permit regulations, no purposeful effort was made to induce spawning; instead each spawning period was likely a byproduct of external environmental changes that triggered their natural instincts.

I had witnessed the first spring spawning event already in progress, but fortunately was able to observe the latest event in its entirety. In the week prior, the males

of most species began to display breeding coloration within the exhibit, including the logperch, signaling a potential spawn. The male logperch prominently displayed highly accented black eye-banding and vivid red dorsal coloration. Overall body coloration had also become more distinctly golden, overlain with significantly darkened olive body banding. Many of the other darters had also changed positioning during this period within the exhibit itself, a characteristic sign that at least one species was actively seeking ideal spawning habitat and changing the territorial dynamic within portions of the exhibit. Under normal conditions, micro-habitats and flow regimes attract the largest males of each species to specific stream zones as permanent residence in prime real-estate or where the food is easiest to come by in that particular area. Voluntary repositioning by dominant individuals or darters overtly pairing off within the exhibit is usually indicative of breeding. A little more than an hour after sunrise, during routine exhibit check-in, most of the Roanoke Logperch had begun to gather in the same spawning location as the spring event, in fact under the same cobble stone. Four males in prime breeding colors began to chase each other in circles with extended dorsal fins and slightly arched body postures while a lone female remained stationary positioned alongside the stone. The single female was guarded aggressively from three other suitors by the presumptive favorite as she settled into a low body-long seam beneath a large rock over loose gravel. The dominant male in this exchange was not even close to the longest, but was easily the stockiest, and appeared most vibrant, possibly indicative of his agitated state or perhaps the reason he was chosen by the female. No physical manipulation of the substrate was observed by either the males or the female before or after mating.

The dominant male also showed uncharacteristically aggressive behavior toward other species, tail chasing and nipping at fins, but returned quickly to the female’s side. Shamelessly, I watched the entire event and carefully noted the behavior: the male lay beside the female parallel to her body and quivered his entire body rapidly similar to behaviors observed by Jenkins and Burkhead (1994). Her body remained wedged to one side in a depression; her ventral side tilted slightly toward the male. He quivered repeatedly for a few seconds at a time with the other males nearby, but periodically chased off the other males

before repeating the mating ritual. When the male and female were not actively engaged, the other males, who constantly hovered nearby, closed in around the female and surrounded her, jockeying for position, up to three or four at a time, physically covering her body; no mating was observed with these males. The whole incident ended several minutes after it began when the female simply swam off and no one followed. There have been no additional events observed since and the fishes have settled into their normal behaviors and coloration.

Summary

Darters are beautiful and fascinating fishes, and each species has its signature characteristic or behavior, but I would have to agree with David Starr Jordan (Jenkins and Burkhead, 1994) that the Roanoke Logperch is a superb darter and earns the name *Percina rex*. My staff and I greatly appreciate the opportunity we have had to raise these fishes, as do guests to the VLM; they are an excellent display species and exhibit fascinating behaviors while being large and attractive enough to capture the attention of visitors. Obviously, their successful captive propagation is possible (Ruble et al., 2009) proving possible hope for re-introduction. This species adapts well to multi-species enclosures and adapts readily to captivity given proper conditions. They are remarkably low maintenance and gregarious with other fishes, making all the more tragic that they are an endangered species, not more so because of their aesthetic value compared to a more “common” or drab darter, but because they are neither so specialized nor so fragile that they could only survive under pristine conditions. I have raised many fishes and I believe the Roanoke Logperch could easily thrive in either captivity or the wild given the proper conditions. In fact, I witness them thrive within in a man-made stream myself. It is a dubious practice to extrapolate much about wild fishes from their captive-reared counter parts, but it is obvious to me that *Percina rex* could hold its own in the wild, possibly even adapt to less than ideal conditions, given the habitat necessary for them to reproduce and thrive. Some species are doomed to extinction at the hands of humans, either because we fear them, loathe them, collect them for our enjoyment, enjoy hunting them, or simply want to eat them. But the Roanoke Logperch is simply losing its world to us. We cannot stop progress due to any one animal, but the plight of

this fish seems fixable. Over my lifetime in Virginia, there is not a creek, stream, river, or lake, no matter how far afield or how remote, that is not being degraded by human activity. This is not a *P. rex* problem, this is our problem. These stream species that exist in the clear waters of Virginia streams are truly gifts to those who love fish as I do. The Roanoke Logperch, as is the case with many threatened and endangered species, is savable but it takes conscious effort to balance our desires with the value we put on what exists in nature around us; it takes measuring our impacts on the natural world against what type of world we wish to live in. I want a world where there are darters and dace – and sculpins – in our streams. I walk by the tank every day and remind myself of that fact.

Acknowledgments

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