American Currents

Publication of the North American Native Fishes Association

Volume 36 Number 1 Summer (Aug.) 2010

In this issue:

The North American Native Fishes Association

est. 1972 - John Bondhus, founder

Mission: The North American Native Fishes Association (NANFA) is dedicated to the appreciation, study and conservation of the continent's native fishes. NANFA is a not-for-profit, tax-exempt corporation chartered in the State of Maryland. The purposes of the organization are: • to increase and disseminate knowledge about native North American fishes; • to promote practical programs for their conservation and the protection/restoration of their natural habitats; • to advance the educational, scientific and conservation benefits of captive maintenance and husbandry; • to encourage the legal, environmentally responsible collection of native fishes for private aquaria as a valid use of a natural resource; and • to provide a forum for fellowship and camaraderie among its members.

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American Currents

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Volume 36 Number 1 Summer (Aug.) 2010

Brian J. Torreano, editor

Susan Binkley and Rob Denkhaus, associate editors. Christopher Scharpf, editor emeritus.

FRONT COVER: An adult male White River Springfish (*Crenichthys baileyi*). Photo by Tony Terceira. Please see the springfish article, "2010 Convention Teaser: Part 2, North Beyond Las Vegas", by Peter Unmack beginning on page six.

IS YOUR ADDRESS CHANGING? Please let us know. Since *American Currents* is mailed bulk rate, copies mailed to your old address will *not* be forwarded to your new address. Thank you.

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A Letter From the Editor

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By the time you read this, summer will be all but gone and fall will be soon upon us. Here in Wisconsin, we had one of the hottest summers on record. By the sounds of it, most of the country shared in our fate as well. At least now, most of us can collect fish without frying in our waders!

As you have probably noticed, this issue of *American Currents* is the issue of MORE! We're bringing you 12 more pages of content, which includes two more pages of full color! And oh, what content we've got! Firstly, we bring you the second half of Brian Skidmore's article, "2009 Convention Recap" (p. 2). We're also bringing you part two of Peter Unmack's series of convention teasers, "2010 Convention Teaser: Part 2, North Beyond Las Vegas" (p. 6). You will find a 2010 convention flyer on page nine. For the first installment of new content in this issue, Phil Cochran brings us, "Fictional Accounts of Predation on Lampreys" (p. 10). Our feature article this month, "AquaCam Snorkel Camp 2009: Part 1," (p. 12) is brought to us by a regular contributor to this publication, Casper Cox. Thanks, Casper, for all of the great content! Please don't forget to see Casper's photo story-boards related to his article on pages 21 and 22. Also new this month, we bring you the "Introduction to the Third Edition of the *Florida Collecting Guide*" by Charlie Nunziata (p. 16). The *Collecting Guide* was put together by a bunch of NANFA members and is really a great body of work! Even if you don't make it down to Florida to do any collecting, this publication is a must-have for your library. It's really great, and available at a reduced cost this issue!

On page 20 starts our four-page spread of color plates. We have photos of springfish, some pictures of the cover and content from the *Florida Collecting Guide*, two pages of AquaCam Snorkel Camp pictures, and a subsequent page of killifish photos. Thanks to our printer for giving us more color for no additional cost!

As if that weren't even enough, Charlie Nunziata brings us the first article in his series about North American killifish, "North American Killifish: Part 1, *Lucania goodei* Jordan 1880, A Summary Review" (p. 25). Also, former *AC* editor Chris Scharpf brings us an addenda and errata section to his "Annotated Checklist of North American Freshwater Fishes, Including Subspecies and Undescribed Forms" (p. 40).

As usual, we have our "Riffles" section (p. 34) with info about new and recent publications. Following that, our "NANFA News" section (p. 38) tells about some NANFA grant awardees and congratulates NANFA member Brian Zimmerman on the completion of his Master's thesis. It sounds like it was a really neat body of work!

Whew! Just writing about all of this content has made my fingers tired! I hope you really enjoy this issue of MORE!

Brian J. Torreano - *AC* Editor

2009 Convention Recap: Part 2

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Ed. note — Last issue, Brian described for us his experiences with the setup and registration for the convention. He then walked us through the first several speakers. We pick back up with Brian on Friday evening at the convention.

Following a break to get a bite to eat for dinner, we reconvened in the conference room Friday evening for a special "Live Foods Workshop" hosted by Mike Jacobs and Bill Shields of the Suncoast Killifish Society. Mike and Bill gave an excellent "how to" overview on culturing a variety of live food organisms including microworms, grindal worms and white worms, along with a demonstration on the proper way to decapsulate brine shrimp cysts. Culture samples were passed around for inspection and starter cultures were also available for purchase at the sales table in the registration area.

Friday evening wrapped up with more socializing in the Hospitality Room. Some folks also took the opportunity to plan out their Saturday field trip forays.

Saturday morning found the hotel bustling with activity as convention goers hustled to finish their breakfast, get their collecting gear gathered and make sure they located their designated tour guide for the various field trip destinations. After handing out maps and directions to each of the groups, our intrepid collectors were off to enjoy a beautiful Florida day collecting native fishes.

Doug Dame led a small group to the South Skyway Bridge on the southwest edge of Tampa Bay where salt water fishes such as Green Sailfin Mollies, Diamond Killifish, Sheepshead Minnows, Gold-Spotted Killifish, Rainwater Killifish and Gulf Pipefish were hauled in with each pass of the seine.

Doug Stuber and Brady Porter (Fig. 1) guided a group down to southern Hillsborough County to the Alafia River drainage. This group was successful in finding the very beautiful and soon-to-be-described Alafia Sailfin Shiner at the picturesque Hurrah Creek. Other species collected here included Coastal Shiner, Dusky Shiner, Lake Chubsucker, Swamp Darter, Speckled Madtom, Spotted Sunfish, Bluegill, Hogchoker, Mosquitofish, Brook Silverside and Seminole Killifish. The group even set up a "field photo lab" to shoot on the spot photos of the catch (Fig. 2).

Fig. 1.
Doug, Bobbi, Brady, Peter & Bob.

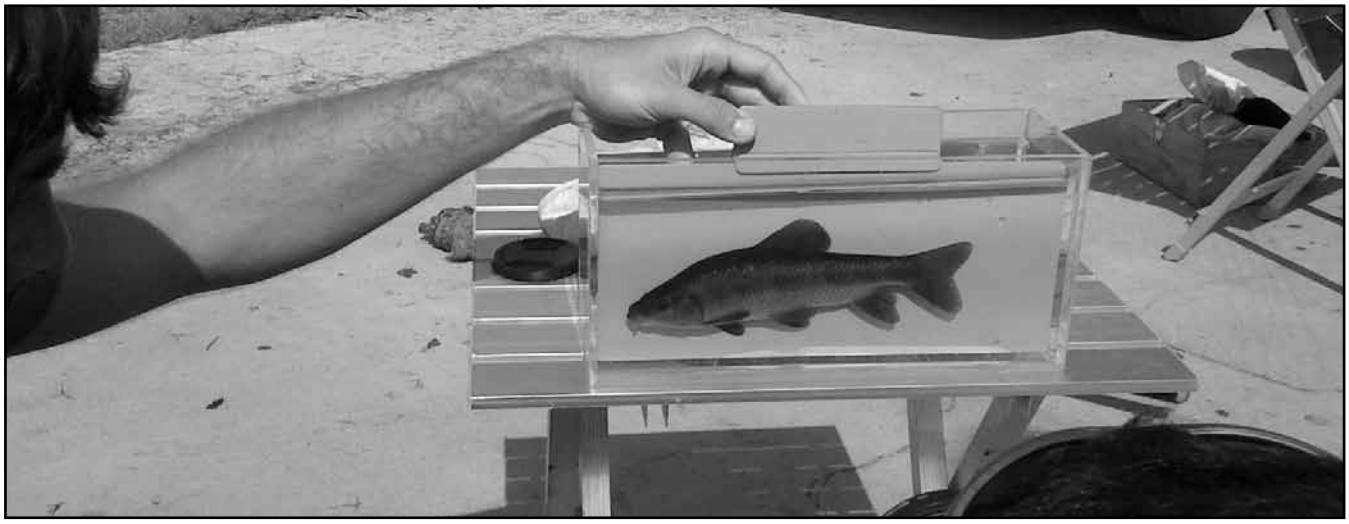

Fig. 2.
Photo Tank Session. Being photographed is a Lake Chubsucker (*Erimyzon sucetta*).

Our third group headed out to the Hillsborough River drainage with intrepid leader Bill Shields. Locations along the route included: Rotary Park and Morris Bridge Park, both on the Hillsborough, as well as Baker Creek at its confluence with Lake Thonotosassa. The group was able to collect a variety of natives including Florida Bluefin Killifish, Golden Topminnow, Mosquitofish, Swamp Darter, Everglades Pygmy Sunfish and Flagfish, as well as some non-natives such as Tilapia, Black Acara and Weather Loaches. Bill's unrecognizable and heavily soiled brand new convention T-shirt was a testimony to the fact that he didn't just supervise from the banks!

Jaap Jan deGreef played host to a group who headed down to his homestead property near the small town of Parrish in northern Manatee County. In addition to providing folks an opportunity to try their hand at collecting in Gambel Creek, where they netted Hogchokers, Ironcolor Shiners and silversides, Jaap also treated everyone to a barbecue picnic and a tour of his fish "house", tropical fruit garden, and huge show aquarium in his living room. Jaap's superb hospitality, along with some unexpected surprises, was definitely a crowd pleaser.

On Saturday afternoon the different field trip groups began to filter back into the hotel, with people lugging in buckets and bags full of fishes to be placed in the prepared holding tanks in the registration area foyer. By Saturday evening the tanks were full of a variety of fishes and other creatures, providing a focus for observation and discussion. After a good "hosing off" — or a warm shower for those so inclined — and a change of clothes, folks began to assemble in the registration/lobby area in anticipation of the traditional Saturday banquet and auction. As a primer to the evening's events, Tony Terceira moderated a fish photography workshop. Tony, who is the official photographer and photo editor for the American Killifish Association, shared his experience, techniques and beautiful photographs. After a very informative PowerPoint outline and summary, Tony and the rest of the group migrated out into the foyer area for some hands-on photography using a prepared photo tank setup.

By 6:30 pm we were beginning to gather in the banquet room for dinner. With the banquet staff running about ½ hour behind schedule, Phil Nixon stepped in to keep us all entertained by kicking off some pre-dinner auctioneering. Was it just me, or did the table with the open wine bottles seem to be bidding higher and more frequently than the others? After Phil infused the group with his lively auction style and we distributed some of the auction items on display, dinner was served. Following our tasty dinner, which was accompanied by an unexpected — and a bit distracting — serenade of gospel music from the adjoining banquet room, Dr. Devon Graham delivered a very entertaining and informative presentation on the Florida Everglades ecosystem. Devon's mastery of his subject was well balanced with his humorous slides, and he proved to be a great sport as he "competed" with the lady from the next room belting out gospel tunes.

After a round of applause for Devon, and some announcements from the NANFA Board of Directors (BOD), Phil Nixon cranked the auction back up. We had many fantastic donated auction items ranging from books, to nets, to beautiful artwork. Tony Terceira's signed and matted 8"x10" photo-

Fig. 3.
Jim Cormier (left) & Charlie Nunziata.

graphs proved to be especially popular. Thanks to all the individuals, organizations and manufacturers who donated and helped to make the auction successful. With the bidder number system used this year for the auction registration, Mike Jacobs and Jim Cormier (Fig. 3) were able to quickly get folks checked out and paid following the auction.

For those who weren't yet ready to call it an evening, we headed back up to the Hospitality Room for more socializing and some planning for the Sunday field trips and journeys back home. My beautiful wife Diana, with some assistance from Bobbi Diller and Lanita Watson, was a very gracious and attentive hostess, making sure everyone had a cold drink and plenty of food. The mingling and conversations that take place in this type of setting are justification that providing such an opportunity for casual socializing is an important component of any successful NANFA Convention.

Sunday morning found everyone packing their bags for home or readying their collecting gear for the last round of field trips. The Sunday field trip destinations included the Santa Fe River drainage northwest of the Gainesville area, a series of locations in and around Ocala National Forest, and for those heading even further north on their way home, a stop at Wacissa Springs just southeast of Tallahassee. For the lucky few who were able to take even more time, Casper Cox hosted a group of die-hard adventurers at the Florida Marine Lab near the lovely town of Carabelle in the Florida panhandle. All of these trips proved to be fruitful not only terms of native fishes collected, but because of the great company and the intangible pleasure of being outdoors — experiencing nature's many wonders.

A convention recap article would not be complete without thanking those individuals who helped to bring it all together. The NANFA Board of Directors was very helpful in providing guidance and answering questions during the planning stages. Sajjad Lateef stepped in late in the planning process to help get critical information posted on the website. Tom Watson was especially helpful coordinating registration information and providing as-needed documentation for solicitation of donations. I would like to extend a special "thank you" to Casper Cox who provided guidance and suggestions, lined up our T-shirt artist and once again created a perfect design for our convention T-shirt. Members of the local Tampa Bay Aquarium Society — Patti Moncrief, Jim Cormier, Jim Norris, Mike Lobello and Hank Darin pitched in to help with the registration and sales tables. Special thanks to our field trip guides — Doug Stuber, Doug Dame, Ken Normandin, Brady Porter, Bill Shields and Jaap Jan deGreef. We greatly appreciated the time and talent generously given by all of our guest speakers who kept us informed and entertained — the presentations are the backbone of any convention.

The Convention Committee: Mike Jacobs, who prepared the Convention Program, handled the registration packages and database, coordinated the field trip links for the website, coordi-

Sidenote

An interesting and encouraging thing happened at this convention, and while I'm sure that this isn't the first time we have seen this phenomenon, I do want to make particular mention of it here. As we absorbed the information delivered in each of the various presentations, from professional ichthyologists and academia to avocational ichthyologists and hobbyists, the wheels started to turn on both sides. Dr. Brady Porter, having had the opportunity to listen to presentations from accomplished hobbyists like Philip Kukulski (Fig. 4) and Bob Muller, recognized how these individuals, and others like them, had already contributed greatly to our store of knowledge about native fishes. But Brady also saw additional opportunities. He and his colleagues have suspected that the life cycle of our native sailfin shiner species involves an obligate stage where the newly hatched juveniles "hang" onto shrub branches dangling into the water until such time as they are ready to become pelagic/free swimming. What Brady wanted to know is, how long does this occur for, is it indeed obligate in their life cycle and do all of the species in this complex share the same behavior? Not long after the 2009 Convention, Brady passed on a message, which I posted on the NANFA Forum, requesting involvement (research) from those members who are keeping and attempting to reproduce sailfin shiners in aquariums. This is a great example (and a unique opportunity) to reinforce the importance of scientists working with enthusiasts to expand our knowledge or prove a theory. For Brady and for Jason Allen, who over the past several years have taken to the field in search of voucher specimens for their ongoing study of the sailfin shiner species complex, this collaboration began with enlisting the skills and local knowledge of NANFA members in the southeastern United States. These members were more than willing to jump into the creek and seine up some of their local shiners for classification and study. Let's hope that this kind of cooperation becomes the standard in the study of our native fishes – both groups have so much to gain.

nated the audio-visual needs for all of our speakers, and generally handled all things technical and electronic. Bill Shields, who constructed the rack system for the 10-gallon holding tanks, set up our native fishes display aquariums, led field trips and generally pitched in wherever necessary. Charlie Nunziata, our NANFA Regional Representative, who once again proved to be a tremendous help and was a large reason for the success of this convention. Charlie coordinated all auction donations, helped to line up presentation speakers, coordinated registrations and payments with Tom Watson, served as liaison with the BOD and generally helped me to retain my sanity.

On behalf of the 2009 NANFA Convention Committee and the Central Florida Regional Chapter of NANFA, it has been an honor and a pleasure to host the 2009 NANFA Convention. Meeting new friends and putting a face to a name is always the greatest pleasure and benefit from attending one of these conventions. "Thank you" to all who took the time to visit us in Tampa!

© Brian Skidmore

Fig. 4.
Philip Kukulski.

NANFA Convention 2010: Part 2: North Beyond Las Vegas

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In the previous issue, I highlighted the fishes and habitats in Ash Meadows that we will visit during the first half of the 2010 NANFA convention. After the "regular" portion of the convention is over, we will have an extended field trip of over one to three days visiting a number places east and north of Las Vegas. For the most part, we will be no more than four hours away from Vegas, so folks can tag along for as long as they like before heading home. This area has historically been associated with the Colorado River Basin, but due to its arid nature most of it is now highly isolated and nearly all of the fishes there are endemic to the region. Many of the aquatic habitats have been altered due to human use of the region's water supply. Not surprisingly, most of the area's fishes are either threatened or endangered.

One of the first places we will visit is Rogers Spring in the Lake Mead National Recreation Area. This is one of the strangest fish habitats around, not because of the environment, but because of what you might see there. In its original state, the spring likely didn't have any fishes whatsoever. At some point in time the spring was backed up with a small berm which created a large pool of warm water (86°F). Since at least the 1960s this spring has been a dumping ground for aquarium fish. I visited this site every four to six weeks in the late 1990s and on every trip we found new species that had not previously been recorded! Typically, the spring contains large numbers of Shortfin Molly (*Poecilia mexicana*), Convict Cichlid (*Amatitlania nigrofasciata*) and Rio Grande Cichlid (*Herichthys cyanoguttatus*), all of which can easily be observed from the shore or while snorkeling. It is anyone's guess what other species might be present.

Springfishes are the main group of fishes whose habitats we'll be visiting. Springfishes inhabit many spring-fed environments along the Pluvial White River Valley, a currently dry river that, during wetter time periods, likely formed a continuous stream from north of Preston until it reached the Moapa River (which drains into the Colorado River via the Virgin River). It's amazing to drive along the river valley and picture the river with water in it and how different the valley must have appeared. Some portions are wide open, while in a couple of areas the river passes through narrow canyons where I usually picture myself seining against the canyon walls thousands of years ago when the river flowed with both water and life!

Two species of springfish are currently recognized: White River Springfish (*Crenichthys baileyi*)(Fig. 1 and color plate 1, p. 20) and Railroad Valley Springfish (*C. nevadae*). The first species occurs along the entire length of the Pluvial White River, while Railroad Valley Springfish is limited to several springs in Railroad Valley, which occurs immediately west of the White River Valley. White River Springfish exist as a number of extremely isolated populations that have been recognized as five subspecies. Several of the springs inhabited by springfishes are quite warm, between 30-37°C (86-99°F). A few other native species also occur in these areas, but they are mostly limited to areas with cooler water.

I will now provide specific details on the habitats from south to north as we move upstream on the Pluvial White River.

The lowermost portion of this valley contains the Moapa River, which starts as a large number of springheads just northwest of the town of Moapa. As is common in the western deserts, many aquatics habitats are spring fed and, as a result, often have large numbers of endemic species of both

Fig. 1.
Adult male *Crenichthys baileyi*.

fishes and invertebrates such as snails, amphipods and others. The Moapa River is no exception as it contains an endemic genus of minnow, the Moapa Dace (*Moapa coriacea*), an endemic subspecies of Moapa White River Springfish (*C. b. moapae*), an endemic subspecies of Moapa Speckled Dace (*Rhinichthys osculus moapae*), and important populations of Virgin River Roundtail Chub (*Gila seminuda*). These fishes all occur with some degree of separation as the first two species are only found near upper spring sources, while the other species are more common downstream in cooler temperatures. In addition, a number of exotic fishes are present including: Red Shiner (*Cyprinella lutrensis*) in the lower sections, *Poecilia mexicana*, Western Mosquitofish (*Gambusia affinis*) and Blue Tilapia (*Oreochromis aureus*). We will visit the Moapa National Wildlife Refuge, which has a number of smaller springheads and lots of opportunities to observe the native fishes including a side-on viewing window.

The next series of springfish habitats occur approximately 60 miles upstream of the Moapa River. Here, three large springs — Ash, Crystal and Hiko — feed a series of aquatic habitats that contain two springfish subspecies, Ash White River Springfish (*C. b. baileyi*) and Hiko White River Springfish (*C. b. grandis*), while the lower reaches contain an endemic Pahranagat Speckled Dace subspecies (*R. o. velifer*), Pahranagat Roundtail Chub (*Gila jordani*). The area also was home to the extinct Pahranagat Spinedace (*Lepidomeda altivelis*) and the extirpated White River Desert Sucker (*Catostomus clarkii intermedius*). Several exotic species now occur in the springheads including Shortfin Molly, Western Mosquitofish and Convict Cichlid. These larger springs are delightful to snorkel in as they contain extensive mats of plants and green algae that provide a strong contrast to the orange coloration of the springfish. Ash Spring at the source is around 97°F while Crystal Spring is a cooler 79°F. We should be able to snorkel in both.

Another 60 miles north are a series of warm springs that contain the Morman White River Springfish (*C. b. thermophilus*). Here we'll be able to visit and snorkel a spring called Hot Creek which has an abundant population of springfish that live at 88°F in crystal clear water. No other native fishes are known from these springs due to the warm water, although Speckled Dace likely once lived in the lower outflows.

The last series of springs occur at Lund and Preston, 35 miles north of Hot Creek. Most of these springs are smaller and usually consist of streams rather than spring pools as they have not been dammed up. The water here is much cooler too, usually between 66-72°F. As a result, these springs historically had a number of co-occurring native fishes including Preston White River Springfish (*C. b. albivallis*), Preston Speckled Dace (undescribed subspecies), and the extirpated

White River Desert Sucker and White River Spinedace (*Lepidomeda albivallis*). Oddly enough, the only introduced species is the Guppy (*Poecilia reticulata*), which is particularly abundant.

Nearly all of the springs in the region have been modified, typically for irrigation by damming up the springhead and via diversions in the lower spring channels. Other modifications have been made for bathing and the extensive introduction of non-native species (including parasites like anchor worm) has done little to help the native fishes survive. Several species exist as tiny populations. For example, it is estimated that less than 50 adult Pahranagat Roundtail Chub have existed in recent times, and at one time the entire known population of White River Spinedace was also less than 50 individuals. Several springfish, sucker and spinedace populations have been eliminated, although some have been reintroduced. Introduced species have been a major problem, especially Largemouth Bass (*Micropterus salmoides*), which can quickly eliminate most native fishes from small habitats. In addition, cichlids and various livebearers depress native fish abundance. All of these factors continue make these environments quite threatened and many of the species are listed at state or federal level. Current proposals to pipe water to Las Vegas from the aquifers that feed most of these springs further endanger their long term persistence. It is only through the vigilance of many individuals from several state and federal agencies since the 1960s that these species continue to exist.

I hope that you will be able to visit and enjoy these species up close during the NANFA 2010 convention!

For more information about the convention, please see the ad on the following page, and/or contact Peter Unmack peter.nanfa@unmack.net

Meet the pupfishes of Ash Meadows in this fascinating DVD by Tom Webster

Crystal-clear pools shine like emeralds on a desolate desert valley floor. While pupfishes "play" in these oases, conservationists battle to save their habitat from water-thirsty developers, and biologists and aquarists team up to remove thousands of exotic fishes, crayfishes and frogs.

This 30-minute DVD introduces you to the three kinds of pupfishes that live in the desert springs of Ash Meadows, Nevada, and the efforts of native fish enthusiasts to save them. Also included is little-seen footage of divers entering Devils Hole to count the Devils Hole Pupfish (which holds the distinction of living in the most restricted habitat of any vertebrate in the world).

The 23,000 acres of the Ash Meadows National Wildlife Refuge will be the site of the 2010 NANFA Convention, October 14-19. If you can't make it, this DVD will show you some of what you missed. If you do make it, this DVD will be a cherished souvenir.

To order: Pricing is $10 per disk, shipping included. Make check or money order payable to NANFA and send to: NANFA, P.O. Box 1596, Milton, WA 98354. Thanks!

Desert Fishes Rule!

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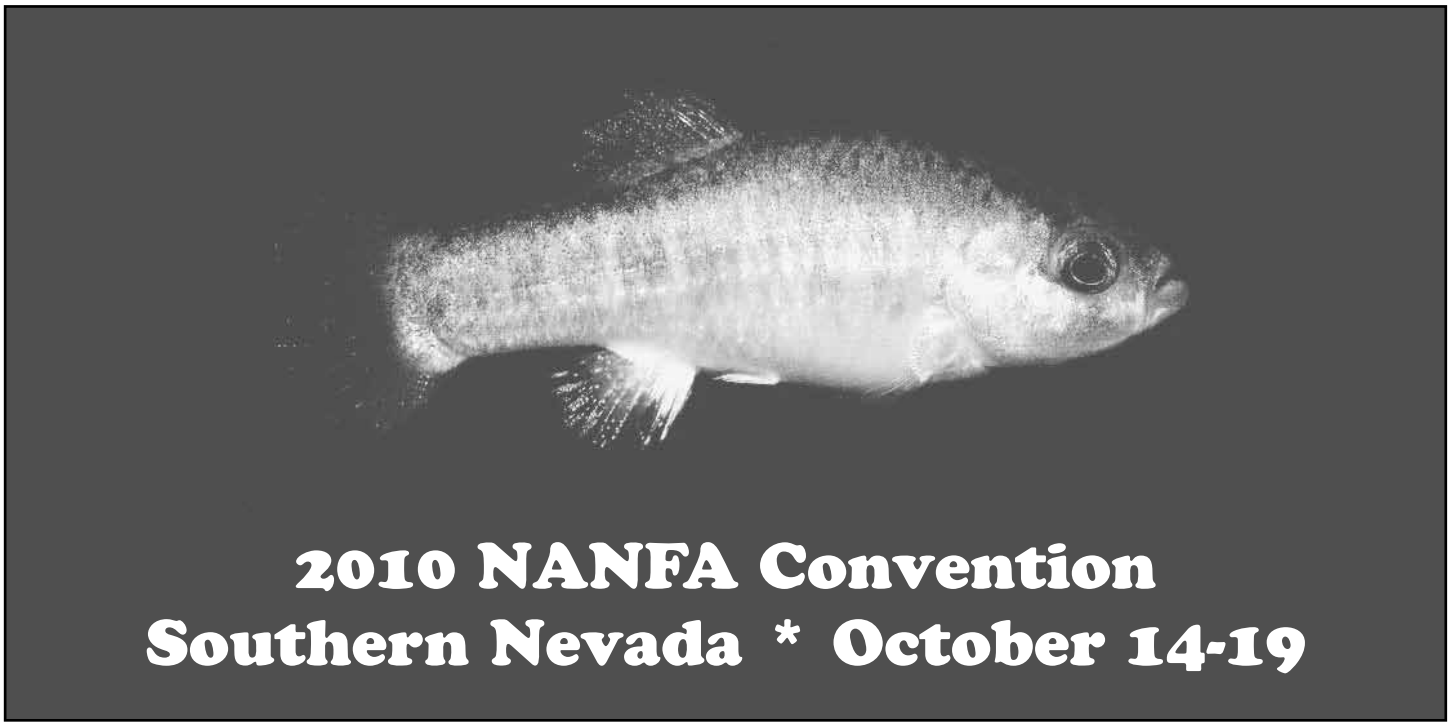

2010 NANFA Convention
Southern Nevada * October 14-19

SEE
rare desert fishes (pupfishes, dace, springfishes) and their amazing jewel-like desert spring habitats

VISIT
the home of the Devils Hole Pupfish, the most range-restricted vertebrate species on Earth!

EXPLORE
Ash Meadows, home to more endemic species for its given area than anywhere else in the USA

HELP
the imperiled fishes of Ash Meadows by removing exotics for their habitat

ATTEND
fascinating talks on desert fishes at the Death Valley National Park visitors center

LEARN
how hobbyists and management agencies can work together to further our knowledge of the captive needs of desert fishes

SNORKEL
various warm springs (86°F+) during a 2-day convention extension to several unique locations north of Las Vegas

2010 NANFA Convention
Southern Nevada * October 14-19

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www.nanfa.org/convention/2010.shtml

Photo: *Cyprinodon nevadensis armagosae*. **© Tony Terceira.**

NOTE: WHILE YOU WILL BE ABLE TO SEE DESERT FISHES UP CLOSE AND PHOTOGRAPH THEM, FEDERAL LAW PROHIBITS THEIR REMOVAL.

Fictional Accounts of Predation on Lampreys

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Biologists who study organisms that are obscure, reviled, or both are usually eager to find mentions of their subjects in the popular literature. As a lamprey biologist, I have surveyed over the years books and articles written for the general public, including fictional accounts, for occurrences of my favorite fishes. The purpose of this note is to summarize fictional cases of predation on lampreys. It is meant to complement a recent review of predation on lampreys that was based on previously published accounts in the scientific literature, my own observations, and observations provided to me by other biologists (Cochran 2009).

I have often been asked about what sorts of predators feed on lampreys. Most often the folks posing the questions were wondering about the potential for predators to control the sea lamprey in the upper Great Lakes, where this exotic invader has caused great destruction of fish stocks. However, there is also increasing concern about the status of native lamprey populations, especially on the west coast, where some populations are threatened or endangered (Close et al. 2002). And some people seem to find value in a species if it benefits other animals that they value more highly. Anglers, for example, may come to appreciate brook lampreys when they learn that they are eaten by trout. In addition, it has been suggested that lampreys in tributaries to the Pacific coast of North America draw the attention of predators away from more highly valued salmonids (Landeen and Pinkham 1999, Close et al. 2002).

Results and Discussion

Several fictional accounts of predation on lampreys have been incorporated into books that describe the life of a fish or aquatic mammal. Williamson (1928) provided a scene in which a male otter pulls a lamprey off a brown trout to use as an offering to a female. He also included several incidents of predation on lampreys in his novel about an Atlantic salmon (Williamson 1936): a hagfish attacks a sea lamprey that has attached to the salmon in an estuary, a sea-run brown trout feeds on river lampreys, and a dragonfly nymph feeds on small ammocoetes. In a novel about a goldfish in a watershed in the eastern U.S. (Mannix 1969), a raccoon feeds on a dying goldfish and the sea lampreys attached to it, and goldfish eliminate lampreys from a stream system by feeding on their eggs. In another novel (Scheffer 1970), a fur seal feeds on a lamprey (probably a Pacific lamprey) off the mouth of the Columbia River. Finally, in a break from works by nature writers, gulls and goosanders (common mergansers) feed on spent post-spawning lampreys near the mouth of a Scandinavian river at the opening of Norfolk's (1996) epic historical tale.

Some of these fictional accounts of predation on lampreys are consistent with actual cases of predation. Brown trout, gulls, goosanders, raccoons, otters, and fur seals have all been reported as predators of lampreys in the scientific literature (Cochran 2009).

In some fictional "biographies" of fish protagonists, lampreys seem to be cast in the role of the "evil" antagonist (Williamson 1936, Mannix 1969). These and others stories may include the removal by a predator of a lamprey attached to a fish. No doubt this was in at least some cases a convenient plot device that allowed the author to snatch the protagonist from a jawless death (I almost wrote "from the jaws of death" but that did not seem appropriate when applied to lampreys). However, in a laboratory setting, I have observed a rainbow trout strike at a sea lamprey attached to another trout, and it has been suggested that some lampreys in the guts of large marine predators may have been ingested along with their hosts (Hubbs 1967 and references therein).

Humans may act as predators of lampreys. Indeed, throughout history, lampreys have been consumed by people of many cultures. I have found two fictional examples. A

novel by Lesley (1989) includes use of lampreys ("eels") in a traditional Native American feast in the Pacific Northwest, and a mystery by Wishart (2005), set in the days of ancient Rome, includes a subplot involving a missing basket of lampreys. Additionally, an oblique reference to consumption of lampreys by humans is provided by a novel entitled "Surfeit of Lampreys" (Marsh 1941). I tracked this one down because historical references almost inevitably (and perhaps apocryphally) ascribe the death of King Henry I to a "surfeit of lampreys." However, despite the illustration that appears on the cover of at least one edition (Fig. 1), this book is populated by a human family named Lamprey and only hints at the consumption of fish by the same name ("'Mrs. Burnaby brought them up,' said Tinkerton, as if Nanny had suffered from a surfeit of Lampreys and had taken an emetic for it.").

Finally, it is not a work of fiction, but Wallace's (2007) review of the prehistoric and historic megafauna of the Pacific coast of North America features repeated speculation that the early pinniped Enaliarctos included lampreys in its diet.

Acknowledgments

I thank the librarians at Saint Mary's University and Saint Norbert College who have cheerfully helped me obtain copies of obscure articles and books.

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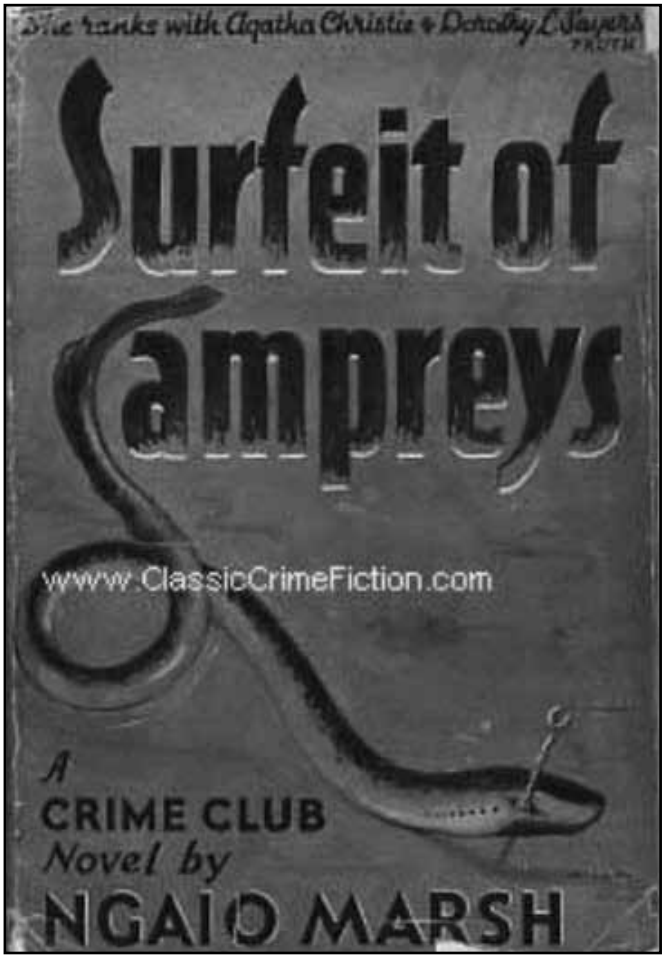

Fig. 1.
An early edition of Marsh (1941).

AquaCam Snorkel Camp 2009: Part 1

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I arrived earlier than expected, leaving Chattanooga promptly after dropping my girls off at school. I burned the back roads westward and found myself rained-upon as I approached Hohenwald. The creek flowing alongside the road was running high and cloudy. When I arrived at the campsite I took a quick walk down to the gravel bar, and the stream here was flowing clear and sweet. Within the next 30 minutes it was swollen, rising and opaque. The highway upstream was being widened to accommodate four lanes and all the trees between the creek and current road had been cut back. Though hay bales and silt fences had been installed, lots of sediment and debris was being rushed downstream.

I picked a good site and set up my tent. Since the creek was now uninviting, I did not have many options. I took a short walk hoping to find some edible fungi, and when I returned, big yellowish deer flies started working on me. I studied the map and decided to drive to the headwaters of a neighboring creek system. I left a note for the others (Fig. 1) and decided to take advantage of the now sunny afternoon.

The bridge crossing offered a motivational view. A big snapping turtle cruised his way under the structure and the remnants of a four-foot diameter chub nest marked the substrate just downstream. Access down was sharp-bouldered and unnerving but I was soon snorkeling through several clear flowing pools and easing steadily upstream. The rain had reduced the visibility to only a few feet but the water felt good and there were plenty of shiners and darters in my facemask to keep me company. I walked over a stretch of slippery bedrock and found a tiny tributary flowing into the stream. An angled log embedded in the gravel created a pool just big enough for me to lie and turn around in. It was crystal clear and I worked carefully not to stir up the leaves and the bit of sediment within. I was hoping to see cold water dace but I was

Fig. 1.
Pointing the way to clear water.

Fig. 2.
Fisheye view of the snorkel camp.

most surprised to see a fish I had never seen in the area before. It was well camouflaged and had a dual lateral line down its side and trimmed in gold. I thought it could be a chubsucker but was surprised that it would be found in a Tennessee stream. I've seen them often enough in Florida but this one was uniquely patterned and occupying a tiny, cold spring fed pool here in my home state. After a few minutes of observing, I climbed out and headed further upstream. I soon came across a Mason jar and found a piece of cloth nearby. Remembering my skill at talking an Arrow Darter into a plastic bag a couple years back, I decided to try the same using these found items. Back to the pool and after 30 frustrating minutes of careful jar positioning and twig nudging and garbled fish chatter, no success. I much wanted to return to the camp with my prized mystery fish swimming proudly cramped in a double quart Mason Jar, but it was not to be. I'm a bit worried that I don't have the "gift" anymore.

In the late afternoon I arrived back at the site to meet Lance swatting the pesky yellow flies. Ed soon pulled in his VW camper and popped the top as Dave arrived and considered a tent site underneath a tree strewn with dead limbs. Firewood was needed, and a stick and a length of double-A parachute cord were soon hurled skyward. Limbs began to crash onto the campsite. Some throws were more accurate than others, but the most promising limb failed to yield even to stout pulling sessions. After consultations, cord palm burns and plenty of "heave-hos" Dave positioned his truck and I tied a quick double knot to the hitch and Dave eased forward. We all nervously huddled behind makeshift barriers as the cord pulled tight, the stout limb leaned slightly and, "snap!", the cord snapped clean shaking lose another round of falling branches. But the big limb still stood tall with a big widowmaker swinging to and fro beneath it. Dave's tent site was abandoned for a safer spot and all the fallen dead wood gathered. Todd and Scott arrived as we were recovering from the excitement and we discussed a chainsaw or triple-A cord as the only viable option. While Todd and Scott set up their tents (Fig. 2), I remembered Bill had told me about a recently cut tree down the road at a church. So, Lance, Dave and I drove over and loaded the van with a jumble of fresh cut logs of Bradford Pear. Lance went to work getting a fire started as we considered our dinner options. Goods were laid out on the picnic table and a menu planned, with Ed becoming the head chef. The fire burned bright then smoldered and smoked with the unseasoned, still green wood and no amount of fan waving, new twigs or rearranging could get a decent spread of hot coals. Darkness was well upon us when Todd offered and set up his Coleman stove and finished the cookery. We were soon content with sausages, cajun boudin and white rice along with a pot of stewed onions, tomatoes and beans.

The next morning, Jeremy arrived with his photo gear. He has been at work documenting life in freshwater streams and was a welcome addition to our group. We shared in a breakfast and gathered our gear into two vehicles to make the trek westward. A short stop at the bathhouse caught Bryce arriving just in the nick of time. A bit more room was made and all eight of us headed southeast to Metalford and a quick look at the Buffalo. A recent "good 'ol boy" damming project made for easier canoe passage and the water was clearer than I had seen in previous visits. Lance had stood at this spot a couple years before with his father and it is a common site for locals to gather and play in the water. I have never snorkeled here as the water has been tinged with green on every visit. A better place beckoned and a 45-minute drive put us at Indian Creek above Hwy. 64. Reasonably clear, we were all soon wetsuited and in the water with cameras and gear (Fig. 3).

The stretch offered several good sites from calm pools to swift runs to crystal clear filtered side pools. The substrate in this part of the state is often a pitty gravel. The erosion of this gravel fills deep pools and reduces habitat for bigger fish but darters (Fig. 4) and shiners love it. This gravel also offers exceptional filtration and in some places that was quite obvious. Small pools off to the side would have water flowing into them from upstream but the water was flowing largely under and through the filtering gravel. Very clear. Darters, sunfish and shiners were all using these quiet pools to feed in. Excellent photography conditions presented themselves and we took full advantage of it.

Fig. 3.
Bryce going for the closeup while the school passes.

After a couple hours we gathered for lunch and shared accounts and pointed out locations to visit. Back in the water we went for another hour and then re-gathered for a short drive to another site. California Jack had recently bought a piece of property with a spring-fed stream flowing through it. On a small bluff above this wide branch sits a small hand-hewn poplar log cabin that he stays in while visiting. When I first eased into this stream a couple years ago, I was much impressed by the diversity of fishes encountered in such a tiny stream. Over 20 species on last count and the clarity is incredible. The water is chilling, however, especially on an overcast day. We all had a bit of fun while chattering, snapping photos and crayfish wrangling. Then we called it a day for snorkeling.

Fig. 4.
Coppercheck Darter on the prowl.

A short options consultation led us back and up to Clifton where we looked out across the mighty Tennessee River from a high bluff line. Across the river a sandy shore beckoned for our seines but it would require a 20 mile round trip. The day had been full, so we entered the Pirate's Lair, a cajun eatery located downtown in this quaint, little, almost was, state capital. A good meal was had by all and crayfish and oysters shared. Especially good was their cheesy bread offerings passed back and forth throughout the meal.

When finished, we walked outside to view the river from the overlook just at the end of the main street. The sun was low and the horizon pretty and wavering light reflecting in the river beyond. Below us stretched a long boat ramp that was gated above but where it reached the water a gravel bar stretched a hundred yards or so upstream. Seines were pulled off the vehicles and

we went down and debated who would take the chilling deep end. Volunteers stepped forward and we were soon pulling up Logperch, Spotfin Shiners and sunfish to please ourselves. I was quite surprised, but was assured that it is not uncommon to find Logperch in such a spot. The experience offered a nice end to the day's fishing activities while Ed cracked abandoned Drum heads to pass around the pearls found within. Dave had taken to shaking during the meal and was soon feeling the pangs of flu as he cranked up the truck's heat to stop his cold fever-shivers.

Fig. 5.
Duck Darter Party.

Back at the darkening camp we pointed out the last remaining tent site to Bryce and offered to help him set up his tent. But with a flashlight shined high, Bryce declined to sleep below the widowmaker and chose a low site downhill. Dave took to his hammock while Lance brought the smoldering fire back to life. But tonight the fire was not gathered around as it had been the night before. Tonight we were all huddled together behind the soft glow of Todd's wide screen laptop swapping cards and flash drives and admiring each other's photos (Fig. 5). Camp Chair Theatre, destined to be the standard activity at future NANFA camp gatherings. I had studied on buying a projector but the $100.00 Home Shopping Network device suffered terrible ratings. Perhaps one will soon be available that is popcorn-worthy and allow for a larger audience. All night we kept debating who would win the $100.00 cash pot prize for the best photo but with every picture gaining new raves we eventually called it a draw. These new cameras really add to the snorkeling experience and offer the ability to share the wonderful things seen with others.

Midnight had us all asleep and the morning sunshine brought more promise of clear waters. We cooked a dozen eggs with onions and cheese and Ed brought a new delight to the table from the streamside woods beyond the widowmaker — Paw Paws, North America's largest native fruit. No, apples and watermelons ain't from 'round here but the Lewis and Clark expedition were said to have lived on these native fruits for two weeks. A unique taste, kind of like banana custard, they were once prized for their tropical flavor. But with the rise of imports in the early 1900s they fell out of favor. A good camp breakfast complimented with flathead biscuits and watermelon too.

Dave was ready for a home recovery from the Indian or Buffalo Flu and Ed, eager to spend time with his son, left us six. We revised our plan to spend the first part of the day snorkeling the campside stream. I tried to call President Bruce as we were to meet him at another site that morning, to let him know of our change of plan. Unfortunately no contact was made and Bruce spent his day pushing a rolled up 12' seine in solitary fashion. Sorry, Bruce, but he told me he had a good time in clear fish-laden water though was muscle-worn from his efforts. The water here at the campsite had returned to crystal clarity and we were soon immersed and clicking fishy photos and sharing garbled snorkel speak. Many of us were content to stay in one run for an hour or more as the diversity that presented itself was quite spectacular. Multicolored darters, subtly patterned shiners, stark-banded sculpins along with shimmering herds of stonerollers all enjoyed the sunshine streaming in. Longear Sunfish, pretty in the light, promoted themselves while red-eyed Rock Bass hung back deep in the shadows. Disturbed madtoms raced to dark crevasses as stones were gently turned. Tennessee Shiners in shimmering blue and vermilion-finned Redtailed Chubs gathered downstream of our stirring hoping to catch any tiny morsels exposed. The light continued to stream in and the fish flashed brilliant in the sun and clear water, and yet the day was still young.

...continued in the next issue of *AC*

Please see Casper's photo storyboards related to this article on pages 21 and 22!

Introduction to the Third Edition of the *Florida Collecting Guide*

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The state of Florida, in addition to being blessed with an incredible and diverse array of fauna and flora, is fortunate to be the home of a group of active fish hobbyists and collectors who, over the years, amassed a vast store of practical knowledge of its aquatic resources. A rudimentary list of collecting sites was originally assembled by Belgium hobbyist and part-time Florida resident Henri DeBruyn in the early 1990s. In the late 1990s, several hobbyists in the Tampa Bay area of Florida area began collecting on a regular basis, visiting Henri's sites and discovering new ones.

As time went on, the collecting site list grew and, with the addition of GPS data, became more accurate and useful. In 2000, the group organized under the NANFA Outreach Program as the Central Florida Region and met regularly as part of the Suncoast Killifish Society. As part of discussions about promoting NANFA and awareness of Florida native fishes, the idea arose to document our store of collecting data and experience into a form that would be useful to anyone wishing to collect native fishes in Florida. We initially produced a loose leaf binder that included a list of collecting sites, 60+ photographs from our members, a paper on local regulations and a few other items of interest.

Originally intended only for limited local use, we became intrigued by the potential of the publication to generate funds for NANFA, and after some redesign we believed we had a product that could be sold. The first edition of the *Florida Collecting Guide* was born. We also decided that from the first book sold, all profits would be donated to the NANFA general fund.

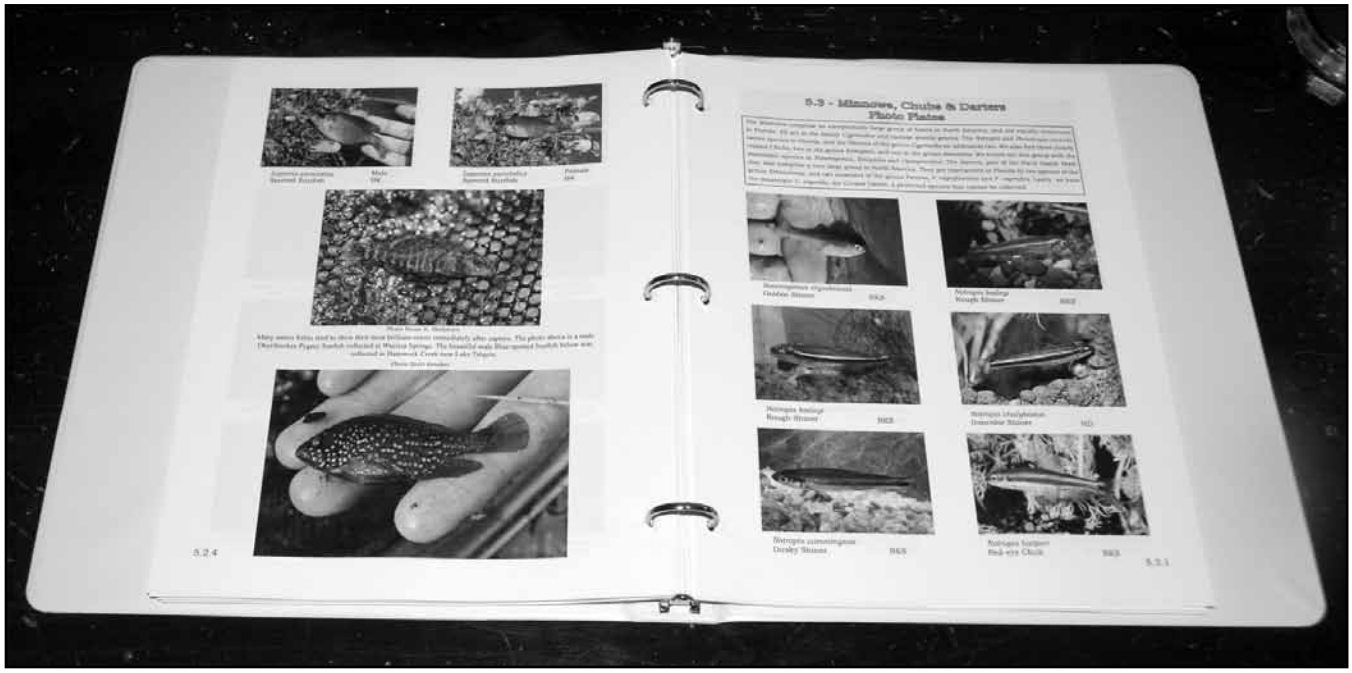


Fig. 1.
A look inside one of the photo spreads in the *Florida Collecting Guide*.

Site No.	Map #	Location	N Lat. (+)	W Lon. (-)	Water Conditions			Species Collected
					pH	pp m/ mS	T(F)	
1	26	Mystic River Boat Ramp. Route 29, south of McDavid.	31.8555	87.3117				*E. sp. (zonatum or okefenokee, Es. americanus, F. blairae, F. olivaceus, Shiner sp.*
2	26	Canney Creek/Lake Miccosukee. SR10/US90 2 miles east of the Leon County line.	31.5345	83.9340				*F. chrysotus, G. holbrooki, H. formosa, Lept. ommata, Misc. Sunfish, Unidentified Darters*
3	26	Pine Barren Creek at County Rd. 4, west of Century.	30.9668	87.3314	5.4	40	65	*Ch. gulosus, Es. americanus, Eth. colorosum, Eth. edwini, F. olivaceus, G. holbrooki, Ic. Gagei, Lep. marginatus, Lep. Punctatus, N. harperi, N. hypselopterus, Not. funebris, P. nigrofasciatum*
4	26	Stone Lake, CR4, approx. 2 miles wsest of Century	30.9667	87.2919				*Flooded, no collections. Appears to be a productive site.*
5	26	Beaverdam Creek – SR 4, west of Highway 29 (next major creek crossing to the west of Canoe Creek). Medium size creek, muddy bottom, slow flow. Steep side banks somewhat treacherous, fish the shore side.	30.9653	87.4472				*E. zonatum, F. olivaceous, G. holbrooki, Lep. punctatus.*

Site # is the refernce on the fold out maps. (See below)

Refers to the site's location on DeLorme's Gazetteer for Florida

Details and in many cases directions to the collecting site

Latitude and longitude, each one verified for accuracy. Presented in latitude order from North to South

A few sites, not many, have water data.

An alphabetical listing by genera, then species of every fish species caught at the site.

Fig. 2.
A sample from the more than 20 pages and 190+ entries of collecting site data.

The first edition was launched at the Year 2000 American Killifish Association Convention in Tampa. Several dozen books sold, and additional sales followed over the next few years through *American Currents* and the NANFA website.

Encouraged by the success of the first edition, the second issue was issued a few years later. This edition not only addressed some shortcomings of the first, but also added a significant amount of new information. It was divided into logical subsections, each devoted to specific subjects with the intent to only issue updates in the future. Forty additional fish photos were included and several new sections were introduced.

There was a section on aquarium-friendly collectible plants supported by 29 color photos, and a collectible native invertebrate section with an additional nine photos. The site location data was expanded to 81 sites, and updated to include more species details. A new section tabulated maintenance and spawning data for many species, and another provided general tips about the collecting process. Lastly, a new section on general species and habitat preferences was added.

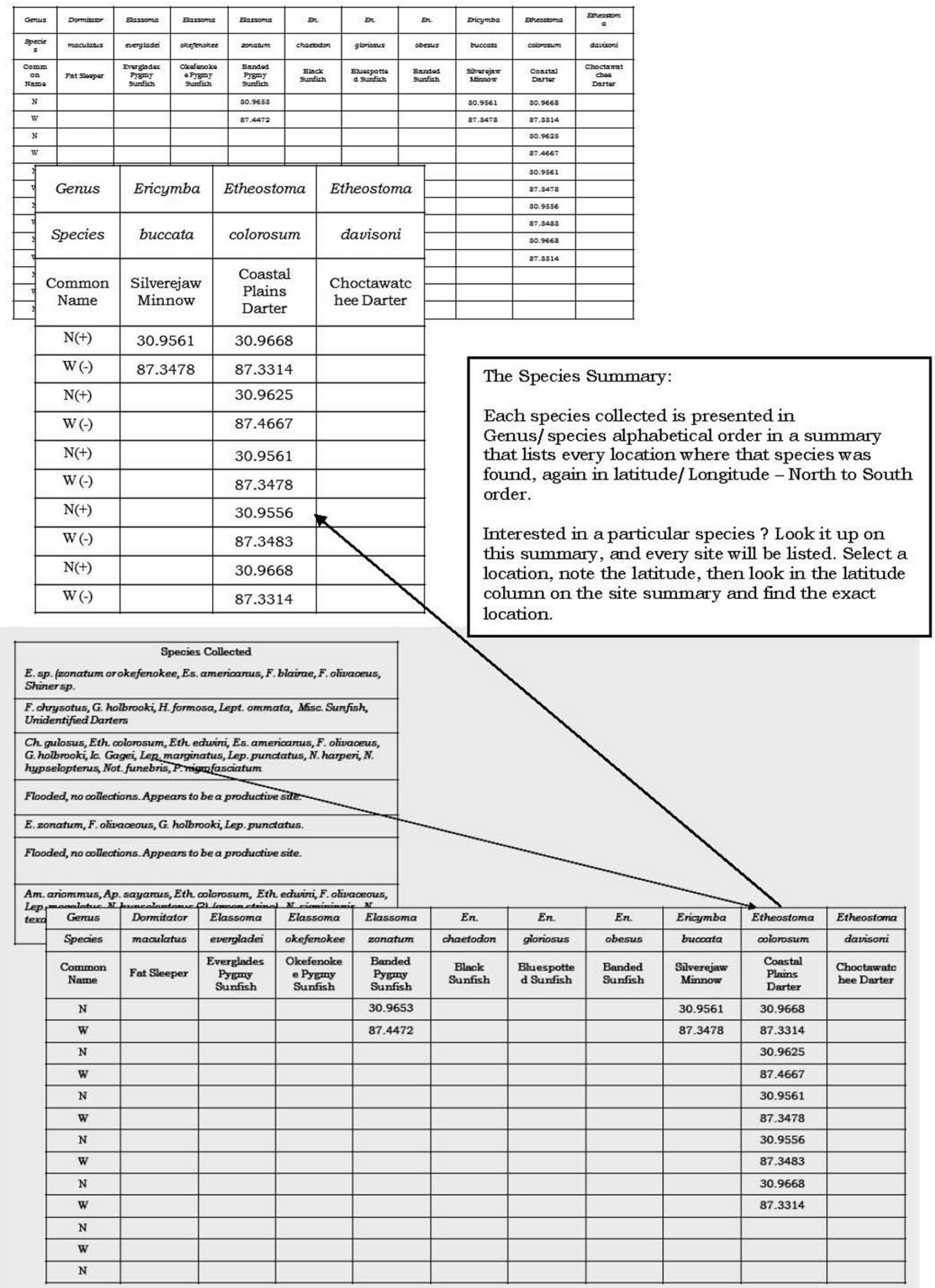
Once again, sales were very good for such a limited subject publication. However, within a short time additional ideas surfaced, and we realized that certain shortfalls and omissions would need to be addressed if the publication were to be made fundamentally complete. We realized that the goal of requiring only periodic updates to remain current could not be reached with this edition without a major rewrite and expansion.

Five years later we have the results of that labor — the third edition (Fig. 1). This edition represents not only a significant expansion of the resources introduced in the second edition, but introduces additional resources that essentially completes the presentation and reaches the goal of an easily update-able reference that will remain both relevant and current.

The following major changes were made in the third edition:

- More native fish photographs: This issue upgrades several photos and adds a substantial number of new ones from additional photographers, bringing the total to over 170. In addition, the layout of the photo pages was standardized.

- The section on aquarium-friendly native plants, introduced in the second edition, has been greatly expanded,



Genus	Dormitator	Elassoma	Elassoma	Elassoma	En.	En.	En.	Ericymba	Etheostoma	Etheostom a
Specie s	maculatus	evergladei	okefenokee	zonatum	chaetodon	gloriosus	obesus	buccata	colorosum	davisoni
Comm on Name	Fat Sleeper	Everglades Pygmy Sunfish	Okefenoke e Pygmy Sunfish	Banded Pygmy Sunfish	Black Sunfish	Bluespotte d Sunfish	Banded Sunfish	Silverejaw Minnow	Coastal Darter	Choctawat chee Darter
N				30.9653				30.9561	30.9668	
W				87.4472				87.3478	87.3314	
N									30.9625	
W									87.4667	
									30.9561	
									87.3478	
									30.9556	
									87.3483	
									30.9668	
									87.3314	

Genus	Ericymba	Etheostoma	Etheostoma
Species	buccata	colorosum	davisoni
Common Name	Silverejaw Minnow	Coastal Plains Darter	Choctawatc hee Darter
N(+)	30.9561	30.9668	
W (-)	87.3478	87.3314	
N(+)		30.9625	
W (-)		87.4667	
N(+)		30.9561	
W (-)		87.3478	
N(+)		30.9556	
W (-)		87.3483	
N(+)		30.9668	
W (-)		87.3314	

The Species Summary:

Each species collected is presented in Genus/ species alphabetical order in a summary that lists every location where that species was found, again in latitude/ Longitude – North to South order.

Interested in a particular species ? Look it up on this summary, and every site will be listed. Select a location, note the latitude, then look in the latitude column on the site summary and find the exact location.

Species Collected
E. sp. (zonatum or okefenokee, Es. americanus, F. blairae, F. olivaceus, Shiner sp.
F. chrysotus, G. holbrooki, H. formosa, Lept. ommata, Misc. Sunfish, Unidentified Darters
Ch. gulosus, Eth. colorosum, Eth. edwini, Es. americanus, F. olivaceus, G. holbrooki, Ic. Gagei, Lep. marginatus, Lep. punctatus, N. harperi, N. hypselopterus, Not. funebris, P. nigrofasciatum
Flooded, no collections. Appears to be a productive site.
E. zonatum, F. olivaceous, G. holbrooki, Lep. punctatus.
Flooded, no collections. Appears to be a productive site.
Am. ariommus, Ap. sayanus, Eth. colorosum, Eth. edwini, F. olivaceous, Lep. ... texa...

Genus	Dormitator	Elassoma	Elassoma	Elassoma	En.	En.	En.	Ericymba	Etheostoma	Etheostoma
Species	maculatus	evergladei	okefenokee	zonatum	chaetodon	gloriosus	obesus	buccata	colorosum	davisoni
Common Name	Fat Sleeper	Everglades Pygmy Sunfish	Okefenoke e Pygmy Sunfish	Banded Pygmy Sunfish	Black Sunfish	Bluespotte d Sunfish	Banded Sunfish	Silverejaw Minnow	Coastal Plains Darter	Choctawatc hee Darter
N				30.9653				30.9561	30.9668	
W				87.4472				87.3478	87.3314	
N									30.9625	
W									87.4667	
N									30.9561	
W									87.3478	
N									30.9556	
W									87.3483	
N									30.9668	
W									87.3314	
N										
W										
N										

Fig. 3.
A sample from the more than 1,000 entries of specific species location data.

Index (Sample)

Acantharchus, habitat-collecting review, 4.1.1
Acantharchus, pomotis, mud sunfish, 4.3.1, 4.4.1
Acipenser, brevirostrum, shortnose Sturgeon, 2.1/2.1.1, 4.2
Acipenser, oxyrhynchus, Atlantic sturgeon, 2.1/2.1.1, 4.2
Adinia, habitat review, 4.1.1
Adinia xenica, diamond killifish 2.6, 4.3.1, 4.4.1, 4.4.1
Aequidens pulcher, blue Acara, Exotic, 4.5.2
aestivalis, Alosa, 4.2
african jewelfish, Exotic, 4.5.1
Alafia River drainage, 4.7.1
Alligator weed, 6.1.3/6.1.4
albus, Monopterus, Exotic, 4.5.1
Alosa aestivalis, blueback Herring, 4.2
Alosa mediocris, hickory shad, 4.2
Alosa sapidissima, American shad, 4.2

Fig. 4.
A sample from the fully cross-referenced index.

with additional text and color photos, bringing the total number of plant photos to 71.

- Many other color photographs have been added to augment text and to illustrate methods and practices. However, the section on aquarium-suitable native invertebrates that was introduced in the second edition has been dropped from this edition in favor of providing a more comprehensive focus on the sections dealing with fish and plants.

- Collecting Site Location Data: The number of collecting sites has more than doubled and all have latitude and longitude data that has been individually verified for accuracy. In addition, each location carries a *Florida Gazetteer* map reference and some include water quality information as well. The species collected at each site are listed in genus-species order, using an abbreviation table.

- Other sections from the second edition that have been retained and, in most cases, expanded include collecting tips and methods, habitat review by genus, and species maintenance and spawning information.

- In a major new section, we've added a species cross-reference that lists every species collected and tabulates the latitude and longitude data for every collection site at which the species was found. This data set has more than 1,000 entries, and there will be many more to come in future updates.

Other new information added to the third edition includes a short review of Florida's water resources, advice on locating potential collecting sites and, most importantly, identification of micro-habitats and what fishes are likely to be among them. It is this section that provides new collectors with critical information that will greatly increase their chances of successfully collecting our native fishes. For those interested in exotics, a new section reviews exotic fish populations in Florida, their status and the applicable regulations. We also review the general areas in which they are found, but no specific locations are given except for those we have actually collected. See "Updates" below for additional information on exotics.

To provide the fundamental structure missing in past editions, the table of contents has been rewritten, a fully cross-referenced index with more than 2,000 entries has been added, as well as cited references, recommended readings and a list of useful web pages. The graphic design has been redone to appeal to a broader audience including the institutional community and more technically oriented entities. We trust that we have successfully achieved that without materially altering the local and personal feel of the publication.

Updates

There are no plans to print full books beyond this edition. Rather, we believe that with this edition we will be able to provide periodic updates as new collections are made, new photos obtained and new information is developed. And although updates are always problematical, the reorganization that the third edition has undergone should minimize the pages that will need to be replaced by any future updates. A major initiative of the next update will be to address the shortfall in collecting sites from southern and southeastern Florida, where exotics abound.

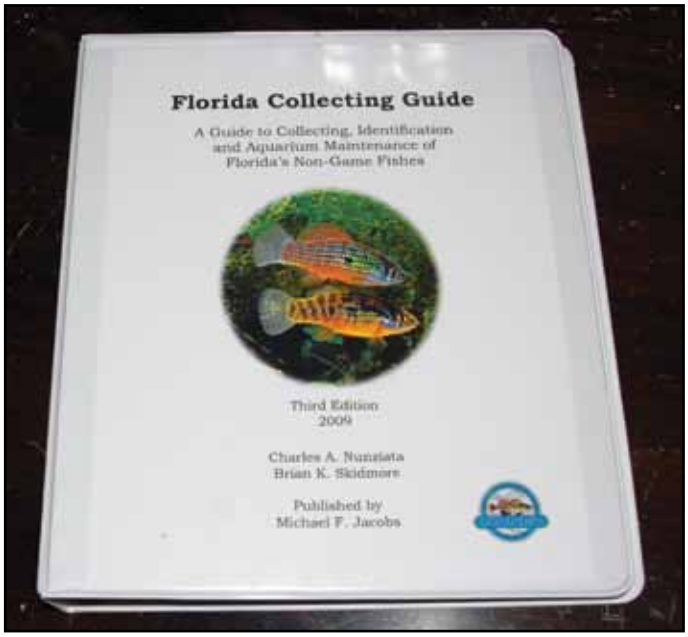
Some sample figures will give the reader a better feel for the third edition.

- Figure 2 is a sample from the more than 20 pages and

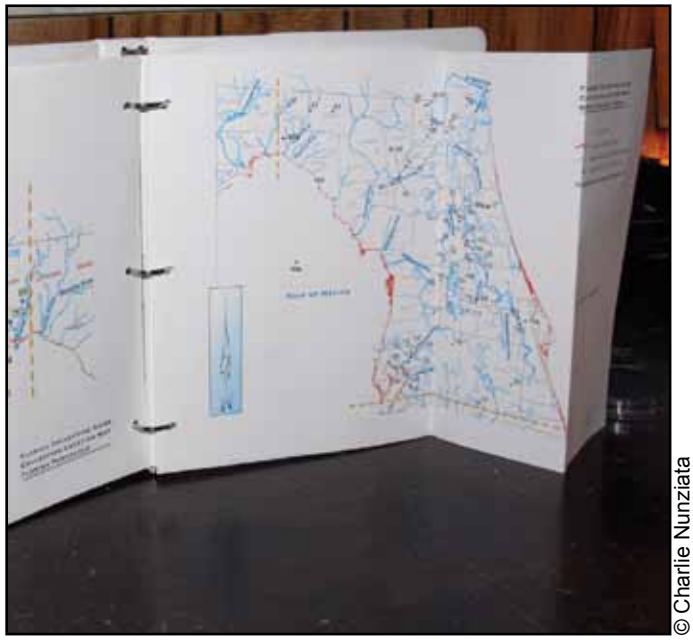
...cont. on p. 24.

Color Plates

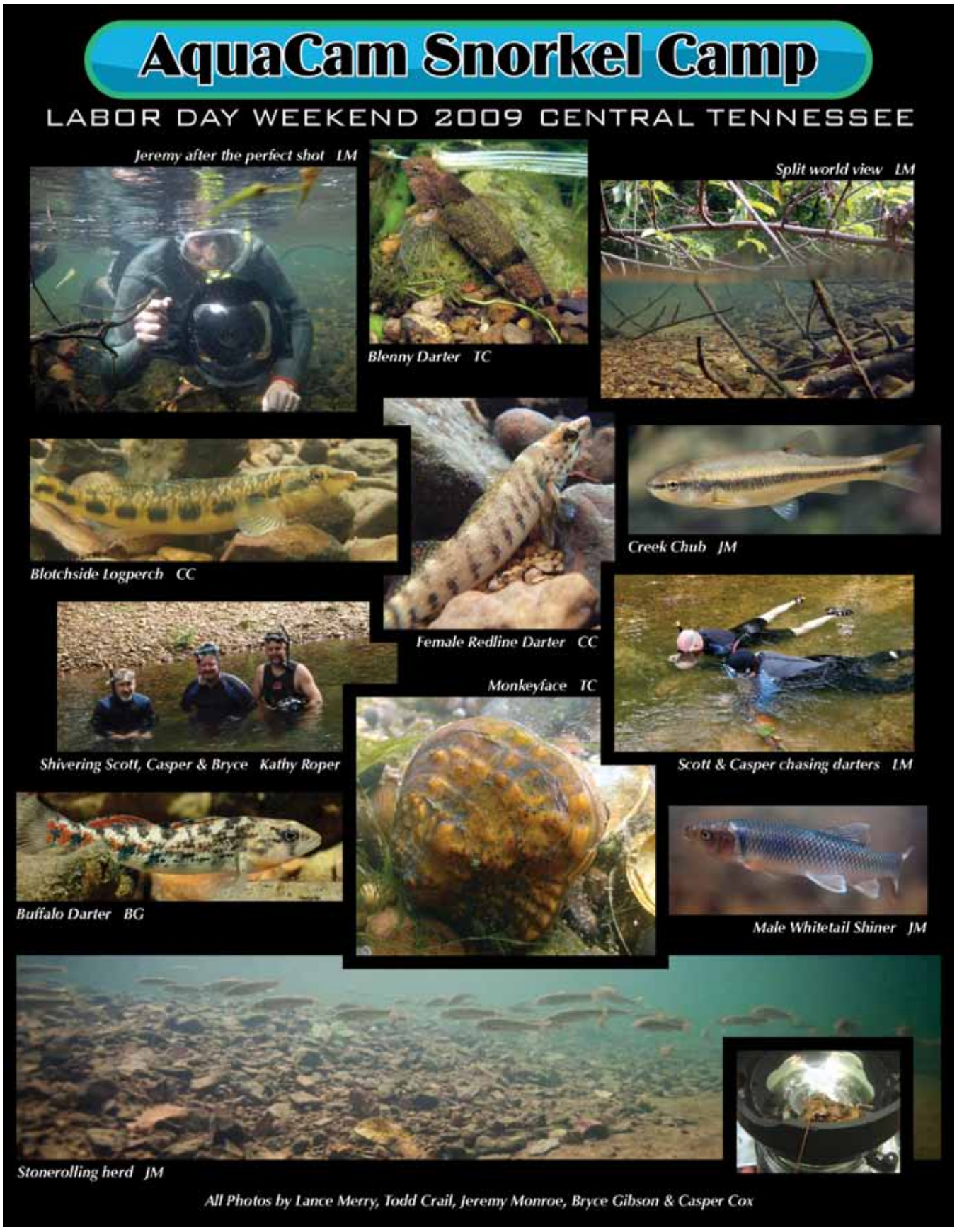
I. Adult male White River Springfish (*Crenichthys baileyi*).

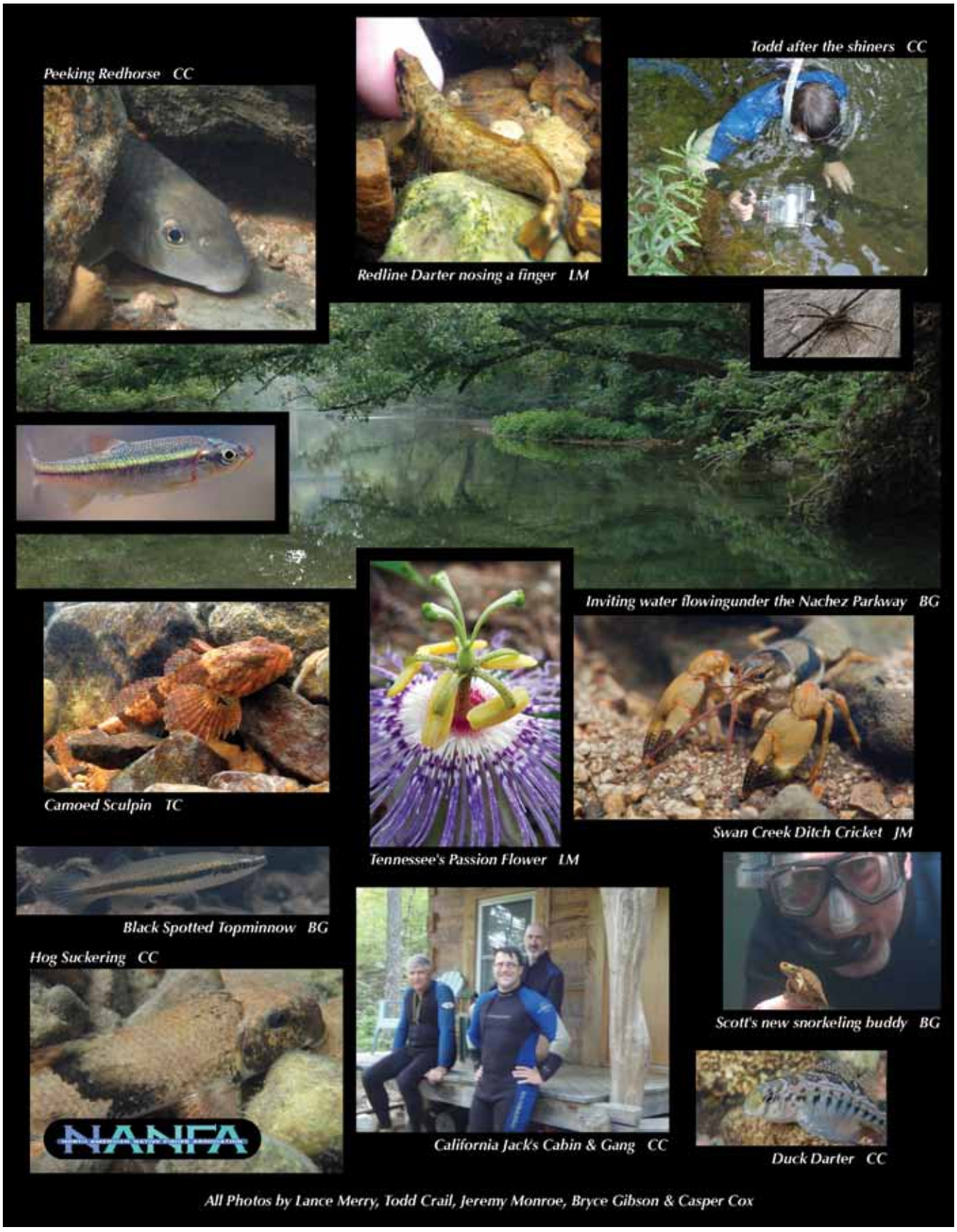


2. Cover of the third edition of the *Florida Collecting Guide*.



3. Fold-out maps in the third edition of the *Florida Collecting Guide*.


AquaCam Snorkel Camp
LABOR DAY WEEKEND 2009 CENTRAL TENNESSEE
Jeremy after the perfect shot LM
Blenny Darter TC
Split world view LM
Blotchside Logperch CC
Female Redline Darter CC
Creek Chub JM
Shivering Scott, Casper & Bryce Kathy Roper
Monkeyface TC
Scott & Casper chasing darters LM
Buffalo Darter BG
Male Whitetail Shiner JM
Stonerolling herd JM
All Photos by Lance Merry, Todd Crail, Jeremy Monroe, Bryce Gibson & Casper Cox


Peeking Redhorse CC
Redline Darter nosing a finger LM
Todd after the shiners CC
Inviting water flowingunder the Nachez Parkway BG
Camoed Sculpin TC
Tennessee's Passion Flower LM
Swan Creek Ditch Cricket JM
Black Spotted Topminnow BG
Hog Suckering CC
California Jack's Cabin & Gang CC
Scott's new snorkeling buddy BG
Duck Darter CC
All Photos by Lance Merry, Todd Crail, Jeremy Monroe, Bryce Gibson & Casper Cox

4. *Lucania goodei* blue form. Morris Bridge Wilderness Park, Tampa, Florida.

5. *Lucania goodei* from the transition zone between Tampa and Sarasota Florida, captured in Myakka State Park. The anal and dorsal are primarily blue but show the intrusion of some red coloration. This illustrates the transition from the full blue anal fin specimens from Tampa and north, to full red anal fin specimens found south of Sarasota.

6. Green anal form. Anal is green with a black border, darker blue-black along rays at base. Dorsal green with dark blue along rays at base.

7. Red anal form. Anal is red with a narrow blue submargin and black border, lighter blue at base. Dorsal is intense blue, with a red distal region.

8. Yellow anal form. Anal pale orange distally, greenish at base. Dorsal is blue, with a orange distal region.

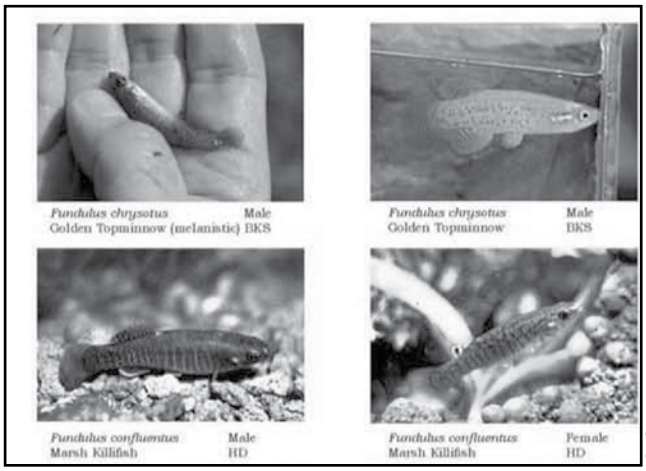


Fig. 5.
A sample from a fish photo page.

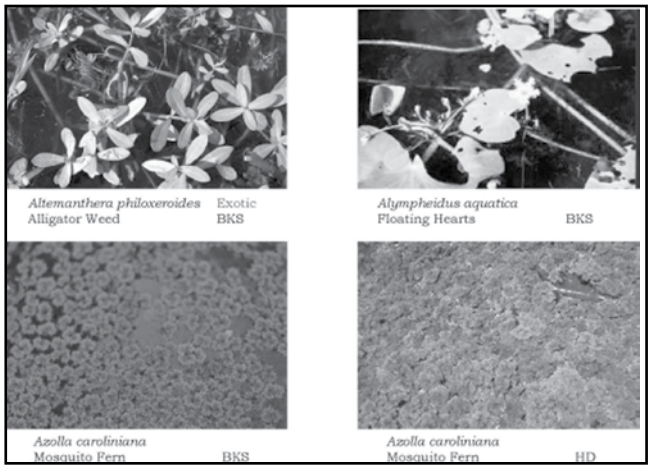


Fig. 6.
A sample from a plant photo page.

Florida Collecting Guide...cont. from p. 19.

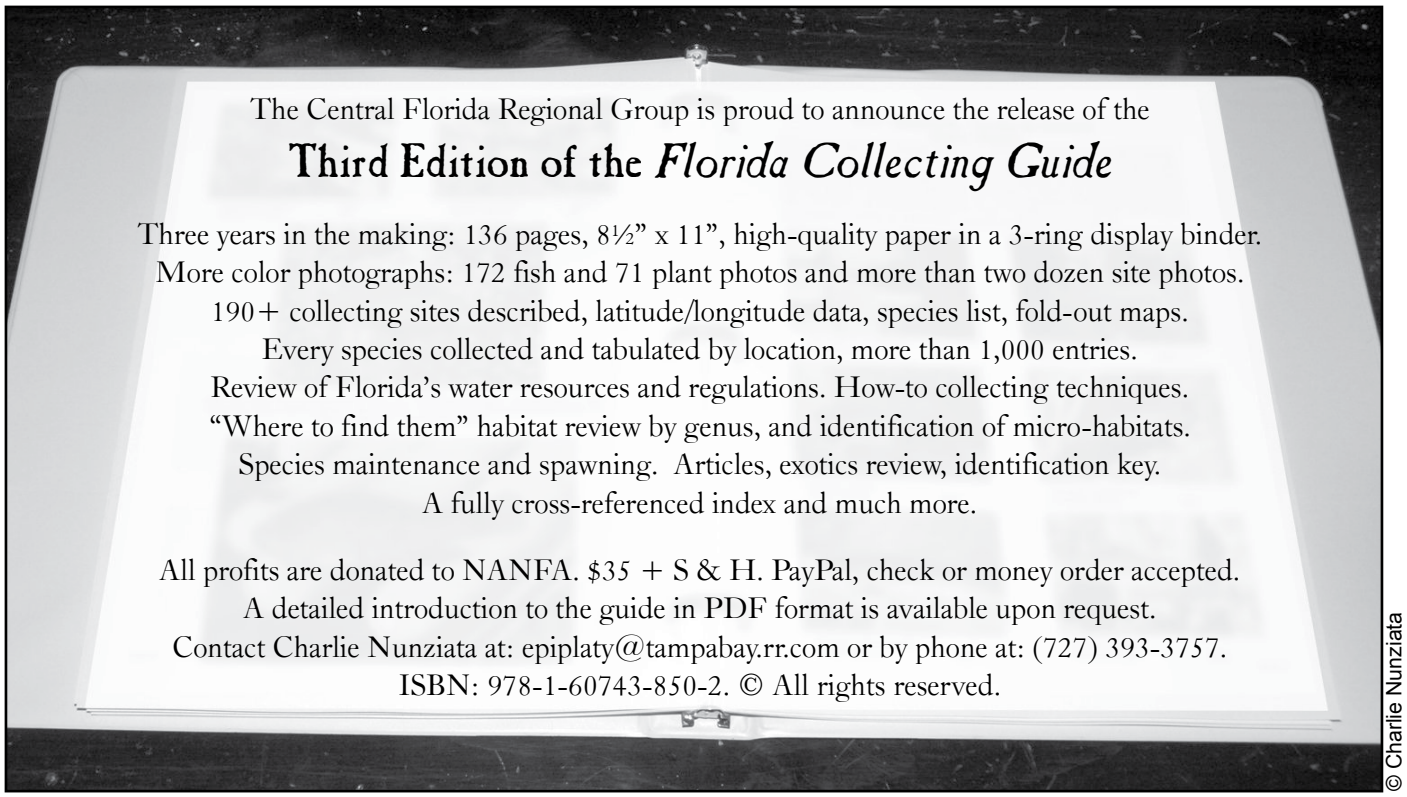
190+ entries of collecting site data.

- Figure 3 is a sample from the more than 1,000 entries of specific species location data.
- Figure 4 is a sample from the fully cross-referenced Index.

Partial samples from a fish photo (Fig. 5) and plant photo page (Fig. 6) are also shown, as well as a photo of the finished book (Color plate 2, p. 20) and fold-out maps (Color plate 3, p. 20).

We hope the reader finds this publication an interesting and appropriate addition to his or her library. More importantly, we hope we have encouraged you to experience the natural treasures that is Florida and share with us the beauty and wonder of this special place.

Price: $35 + shipping and handling. Postage costs are dependent on Zip code. Call or contact before ordering to get your postage and packing costs. For more details, please see the ad below. Thanks!



North American Killifish - Part 1
Lucania goodei Jordan 1880
A Summary Review

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This article is the first in a planned series featuring killifishes of North America. Fresh, brackish and the few full-marine species that occur from the U.S. south to Mexico and the Caribbean islands will be included. Although the definition of North America encompasses Central America and the transition zone to South America at the Panama-Columbia border, the many killifishes from these regions will not be included in this series.

Some reviews, especially of little-known or studied killies, will be cursory. Others reviews, especially those that relate to more common and better studied species, will be more extensive. And because it has not yet been determined how groups of closely related species may be combined in a given review, it is uncertain how many installments will ultimately comprise this series. *Lucania goodei* (Fig. 1) is our first subject for no other reason than it is one of my favorite native fishes.

Nomenclature

L. goodei has variously been known by the common names "Blue Dace" and the "Bluefin Dace," but it is a true killifish and not a dace at all. The accurate common name is the "Rainwater Killifish." It is one of only three species in the genus *Lucania*, a genus erected in 1859 by Girard. The other two include: *Lucania interioris*, which is an IUCN Red Listed species designated as critically endangered (Contreras-Balderas and Almada-Villela, 1996), and *Lucania parva*, a primarily saltwater species that has a few relict freshwater populations. These species will be the subject of a future article.

The subgenus under which *L. goodei* is placed, *Chriopeops* (Fowler, 1916) was for a time incorrectly used as the genus for this species. That is no longer the case, and the current nomenclature appears well settled. *Chriopeops* is still considered a valid subgenus. *L. goodei* is the type for the genus and its type locality is the Arlington River, a tributary of the St. Johns River which flows through a vast region of northeastern Florida.

Distribution

L. goodei is found over a vast range, stretching from throughout the Florida peninsula and to the panhandle where it occupies the east coast and the regions west to the Choctawhatchee River drainage (Page and Burr, 1991). It continues north from the Florida panhandle into the extreme southeastern corner of Alabama, and the Chipola River drainage. It is also found in discontinuous ranges along Atlantic Coast as far north as central South Carolina where it is thought to have been introduced. There are also reports of introductions in Texas and California as well (Buchell, 1998). *Lucania goodei* is common throughout its natural range and appears to be very well equipped to not only survive, but to thrive in a number of different habitats.

Literature

A beautiful and adaptable native American killifish, *L. goodei* has been the subject of many articles over the last few decades. However, a review of this body of literature reveals some startling variations in the description and experiences of the various authors. We read largely differing accounts of fin color, and to a lesser extent, variations in accounts of breeding habits, natural conditions and rearing requirements. It turns out that virtually all the reported observations are true. They are, however, incomplete because they are essentially personal observations limited to localized populations. As such, these

reports represent small samplings of specific population variances and the range environments. This article attempts to present a larger view of the species by consolidating these fragmentary reports and adding the results of personal experiences with the numerous Florida populations.

Description

Male: The dorsal fin is blue in most populations, but can exhibit combinations with other colors as well. This fin has from nine to 12 rays and is positioned in front of the anal fin insertion (Page and Burr, 1991). It is in the anal fin coloration where we see significant variations among and within populations. With some notable exceptions, these variations roughly correlate to geographic regions. The color of the anal fin varies from almost clear to a rich red, yellow, blue or green, and often in combinations of these colors.

In general terms, the *L. goodei* from the southwest coastal regions of Florida, defined for our purposes from Sarasota to Port Charlotte to Fort Myers, exhibit anal fins that are red-orange to red, with little blue coloration. These populations also show red in the posterior region of the dorsal fin (De Bruyn, 1999),(Specht, 1977). In central Florida, a region we define from Gainesville through Tampa Bay and south to Sarasota, we see *L. goodei* dorsal and anal fins in bright iridescent blue, edged in black, and with a black band at the base (Fig. 2 and color plate 5, p. 23). The central region is considered a transition zone, however, because we also see isolated populations exhibiting orange or smaller amounts of red color in the anal, replacing the blue. In areas from Gainesville to the Florida panhandle and north to Georgia, we find populations with green, yellow and greenish-yellow anal fins (Skidmore, 2000), tending to lemon yellow in the upper Florida panhandle (De Bruyn, 1999),(Specht, 1977). The coastal part of the range from Georgia to South Carolina produces specimens with clear to pale yellow or pale green anal fins with no red, orange or blue.

However, there are significant variations even within these regions. For example, at a site in Hillsborough County east of the city of Tampa, we find individual *L. goodei* males with blue anal and dorsal fins, together in the same site with males that exhibit a great deal of orange to red in both fins (Skidmore, 2000). Obviously, the genes for both color forms exist within that same population, and at this site at least, both colorations are expressed. Likewise, in Citrus County, located in the northern part of the central region, we find isolated populations exhibiting a greenish-yellow anal fin. At Hunter's Spring on the Crystal River just south of the

Fig. 1.
Lucania goodei blue form from Morris Bridge Wilderness Park, Tampa, Florida. See this photo as a color plate on p. 23.

Florida panhandle, *L. goodei* is reported with clear fins (Arbour, 1990). Yet north of there, in the vicinity of Tallahassee, pink anal fins are reported and this region is very far from the orange and red forms found at Port Charlotte (Ballard, 1987). The series of photos illustrate some of the color variations encountered (see color plates, p. 23).

The caudal fin is generally red-orange in all populations, but is not as intensely colored as the other unpaired fins (Webster, 1977). There is a small region of pale blue at the base, followed by a region of red or red-orange varying in intensity and the amount of red coloration. The caudal terminates with a translucent region at the margins. In those populations that exhibit a pink anal fin, there is also a pink to red region at the caudal base, virtually replacing the blue (Ballard, 1987).

The maximum male size is listed by most sources as two inches, but slightly larger males have been collected in Florida by this author and others. The body of the male *L. goodei* is fairly slender and compressed, with a small upturned mouth. There is a characteristic and rather wide zigzag patterned stripe that is a black to cocoa color, and varies in intensity dependent on both the condition of the specimen and where it is found. This stripe extends from the tip of the snout through the center of the eye, then widening on the flanks, and narrowing again as it approaches the peduncle. It terminates there to a black spot on the base of the caudal fin. There is a dark-edge to the scales that, when prominent, gives a net pattern to the flanks. The overall body color of the fish is light brown, lighter above the line, grading to an olive or dusky gray back. The area above the line sometimes exhibits a hazel sheen (De Bruyn, 1999). The body color below the zigzag pattern is darker brown grading to a cream underside. The number of lateral scales varies from 29 to 32 (Page and Burr, 1991).

Female: The females are slightly smaller than the males, getting to 1 ¾". The body of the female is light brown with a hint of the aforementioned zigzag pattern. The brown sometimes gives way below to a brilliant silver underside. Otherwise, she lacks the complex body patterns and colors of the male. All fins are clear or yellowish (Buchell, 1998)(Webster, 1977).

Habitat

It is no surprise that such a highly variable fish would be found in a number of different natural settings. *Lucania goodei* is found in virtually every habitat available throughout its range, except perhaps in swiftly moving streams. It has been reported in cool and deep springs, with extremely clear water, and much aquatic competition (Arbour, 1990). Interestingly, clear springs are also the locale of the "clear fin" variety. This is reminiscent of the African killifish genus *Nothobranchius*, whose caudal fin color and intensity are often dependent on the clarity of their habitat. In these springs, the *L. goodei* are often found at a depth of 10 feet or more, perhaps giving rise to the reports that they are found in deep water.

Other habitats include: natural springs, rivers, lakes, small pools, and man-made retention ponds. While some people have observed that *L. goodei* remains well below the surface (Buchell, 1998; Page & Burr, 1991), others, including this author, often find them at the surface and in shallow water where they appear to prefer the protection of plants. Even in a river habitat where there is some current, *L. goodei* can be found under plants floating at the surface (De Bruyn, 1999). At Alexander Springs in central Florida, the water is often less than two feet deep, with large patches of rooted plants that are bent over by the modest flow from the spring. Each swipe of my net through these plants, and in the direction of the flow yielded a number of *L. goodei*. They were lying just below the plants, and no more than one or two feet deep.

The temperature variations among these habitats are quite large due to seasonal factors, the water source, and its depth. Many collections of *L. goodei* have been made by members of the Central Florida Region during warm summer months where standing water easily gets into the high 80s°F. Long time hobbyist Dr. Harry Specht reports that he collected them in shallow ditches in direct sunlight when the water was so hot it was uncomfortable for him to stand still and fish (Specht, 2000)! Low temperatures are equally well tolerated. This author has gotten viable eggs from *L. goodei* in water at 62°F, and has collected this species in January where the water temperatures were well below 60°F. Some members report no losses when *L. goodei* is maintained in tanks and tubs outdoors where temperatures as low as the upper 40s°F occur in the winter (Specht, 2000). There are no reports however of breeding occurring at these extremes.

Natural water characteristics are quite varied, especially between the coastal and inland regions, both of which are greatly influenced by periodic heavy rains that are characteristic of southeastern U.S. summers. The water found in inland Florida for example, tends to be slightly acid and soft, with low conductivity. The water at Florida's coastal regions is quite hard, has high conductivity, and pH values are often in excess of 7.5. The composition of natural springs and their

extensive outflows tend to be much more stable because of the constant replenishment from the deep aquifer. Therefore, these habitats are not as much affected by rainfall or external temperature. They tend to be somewhat acid, yet moderately hard, and temperatures hover around 72°F throughout the year.

Since *Lucania goodei* thrives in all these environments, it is obviously quite tolerant of water chemistry and temperature extremes, confirming its ability to adapt not only to highly variable natural environments, but the unnatural environment of the aquarium as well. It should be noted that some older literature implies that salt or brackish water is tolerated or even recommended. I believe that these references confused the requirements of the closely related marine form, *Lucania parva*, and inadvertently applied them to *L. goodei*. This species may be able to withstand such water conditions for periods of time, but their natural habitat is fresh, not brackish water.

Collecting

Henri DeBruyn's excellent article (De Bruyn, 1999) provides a practical and general tutorial on collecting Florida natives. Because of its common distribution and its propensity to take shelter under overhanging or floating plants, *Lucania goodei* is one of the more easily collected killies. A dip net, quickly thrust under the plants or around submerged objects and quickly lifted or dragged to the bank will produce a few *L. goodei* with each try. Partially submerged logs and stemmed plants in a few feet of water are ideal habitat, and *L. goodei* can sometimes be found in large numbers in such micro-habitats (Fig. 3). Some will also be taken in seines especially if worked through plant beds. It is often found with *Poecilia latipinna*, *Heterandria formosa*, *Gambusia affinis holbrooki*, and *Fundulus chrysotus*.

Generally, the sexes are quite even and pairs will inevitably be caught. Although *L. goodei* sometimes appears to shoal, it is not truly a schooling fish, and once a group is scattered fewer individuals are picked up with each pass. The group will not reassemble until the interlopers have left, and the water is once again calm.

Aquarium Environment

L. goodei is not a gregarious species or one that displays readily. It is skittish, will lose color and crowd around any

Fig. 2.
L. goodei from the transition zone between Tampa and Sarasota Florida, captured in Myakka State Park. The anal and dorsal are primarily blue but show the intrusion of some red coloration. Please see the color copy of this photo on p. 23.

Fig. 3.
Rum Island Park, Swanee River drainage system. Many *L. goodei* were taken around the partially sunken log, along with several madtom catfish.

object in bare aquariums or those with little cover. To observe any kind of natural behavior, and to appreciate the wonderful colors, one must provide a heavily planted tank with plenty of overhanging or floating vegetation, or artificial spawning mops that provide the same kind of cover. For those who are unfamiliar with the construction of a spawning mop, a sketch and step by step instructions are given at the end of this article. Any activity around the tank will send this species hiding. A quiet environment will be rewarded with observations of colorful males actively courting females, driving them into the spawning mops or strands of vegetation to deposit their eggs. In the presence of a group of compatible species such as the *Pteronotropis* types, some individual *L. goodei* will swim and feed with the group, and abandon their normal shyness.

Males are not aggressive and although occasionally driven, females are not harassed or damaged by the spawning process. Large groups can be maintained in a 20-gallon aquarium, and one pair or trio do well in a 2.5-gallon tank. Overcrowding however will result in loss of color. The fact that this killie is highly tolerant of water variations does not imply that poor aquarium management is tolerated without a corresponding decline in vitality. This is a tough little fish and not prone to disease, so if they appear uncomfortable or lose color, water quality should be immediately examined.

There is a difference of opinion regarding the impact of large water changes. To be sure, *L. goodei* is subject to rapid and extreme changes in water conditions in their natural habitats where large rainfalls inundate and cleanse watercourses in a matter of minutes to hours. Nonetheless, some authors have indicated that large water changes will require a recovery period before *L. goodei* will resume normal activity (Buchell, 1998), while others hold that frequent water changes induce spawning (Terceira, 1972). I normally change 30% of the water each week without noticeable changes in behavior. However, the new water is quite close chemically to the old, minimizing any shock potential. As in all things, moderation is recommended, and if the new water matches the water it is replacing, large water changes should not be a problem. At a minimum, moderate weekly water changes are highly recommended to keep pollutants at their lowest practical level.

As in nature, temperature extremes in aquaria are well tolerated. My fishroom is an air-conditioned and insulated, but unheated garage. The *L. goodei* tank is on a lower shelf and remains in the high 70°F range throughout the hot summer, and in the mid to low 60°F range in the coldest part of the winter. I have not observed any change in behavior or seasonality under these conditions except that spawning ceases when the temperature is less than 60°F. The age of the

fish and nutrition seem to be more important than temperature regarding the health and propagation of this species.

Feeding

L. goodei have large appetites as do most North American killifish, and they can consume surprising amounts of food given their size. They tend to dash from their hiding places to feed, then quickly retreat. They will feed at leisure only when there is no nearby activity, or when they are associated with a group of compatible species. Some earlier articles indicated that only live foods are taken, but this is simply not so. All manner of food is taken and generally taken eagerly. Of course, all live foods are relished as are most freeze dried and frozen foods. Dry food is also reported to be taken without problems (Specht, 1977).

The technique of keeping native fishes in outdoor ponds and aquariums is not uncommon in the southern states, and in the case of *L. goodei*, is quite successful within the temperature range from the upper 40s°F to the low 80s°F. Experienced hobbyists have had success in outdoor aquariums that have an abundance of green water, and are planted with *Elodea*, Hornwort, and Java Moss clumped on the bottom (Specht, 2000). Occasional feedings are necessary because it is unlikely that enough insect food sources in the typical urban area will find their way into a backyard pond or aquarium.

Pre-Breeding Conditioning

Quite simply, pre-conditioning is a two-week process that includes increasing the quantity and nutritional value of the foods offered, more frequent water changes and separating the males and females. Please note that pre-conditioning is not necessary to propagate this species. However, as with most killifish, *L. goodei* will respond to a pre-breeding conditioning regime with more eggs than if such a process is not employed.

Breeding and Fry

Although fry are sexable at three months, *Lucania goodei* will not produce viable eggs until it is eight to 10 months of age. It is a obligate plant spawner that will deposit eggs in nylon spawning mops, standing plants, or peat fiber and Java Moss in clumps on the substrate. Most breeders use floating nylon mops that are longer than the tank is high so that some portion of it spills over the bottom (De Bruyn, 1999). *L. goodei* employs a breeding routine that is common for top-spawning killifish. The male approaches from below, behind or aside the female, and when she pauses at the spawning media, they assume the expected "S" shape followed by rapid gyrations and the simultaneous release and fertilization of the egg.

Although some authors report that many eggs are laid by well-conditioned females, others indicate that eggs are sparingly laid each day. This author has not seen an extraordinary number of eggs at one time, generally picking less than 15 after a few days. However, this may be due to the recorded propensity for *L. goodei* adults to eat eggs, a practice sure to hold down apparent egg production.

Many hobbyists, this author included, consider the mid 70s°F the best spawning temperature, and do not prepare water with any special qualities. Clean non-polluted water at nominal pH conditions and temperatures in the 70s°F will keep this species in top form, and will bring good breeding results.

Artificial Egg Incubation

The egg size is fairly small at about 1 mm (0.04"), and they are not particularly delicate to handle. In fact, all killifish eggs are firm and are easily handled without damage, and a healthy fertilized egg is quite difficult to crush between the fingers. The eggs are picked from the spawning mops and placed in a shallow container with a small amount of aged tap water. The eggs are exceptionally clear and the development of the embryos is very easy to observe with even a modest microscope.

The eggs are examined every few days, dead eggs removed, and the incubation water is periodically changed to eliminate contamination. As the accompanying graph illustrates (Fig. 4), the rate of egg development is highly correlated to and almost linear with storage temperature. These data were generated from several incubation lots stored at various times of the year, and hence at different temperatures in my uncontrolled garage. As expected, visual examination did not produce evidence of resting or diapause stages, or periods within the maturation cycle where the rate of development varied. In essence, development proceeded continuously and more or less consistently as it does with most non-annual killifish.

At least one author observed that eggs incubated at higher temperatures result in fry weaker than those incubated at lower temperatures (Buchell, 1998). My observations did not support this contention, and since the robustness of

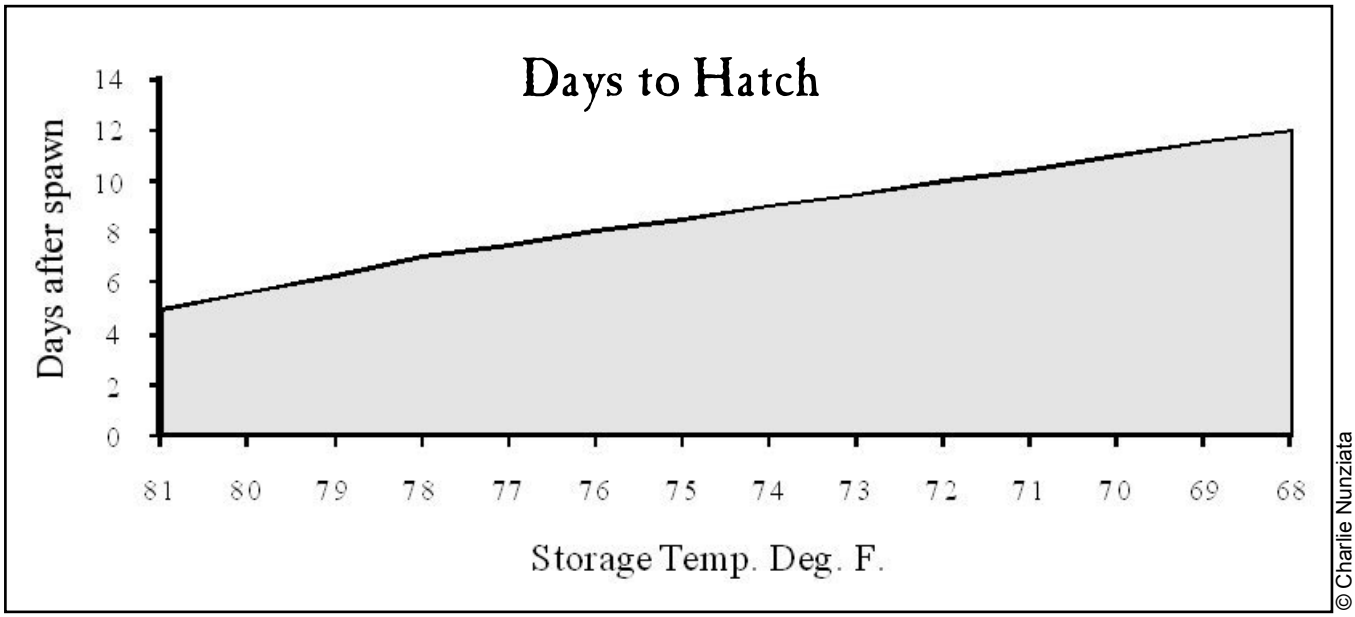

Fig. 4.
Correlation of egg development and egg storage temperature.

the fry can be affected by many factors, additional evidence would be required to support this idea. Nonetheless, there is an obvious rationale for weaker fry when incubation is at elevated temperatures. To simplify a very complex process, at some point in the embryo's development, nutrients are stored in a structure often referred to as the yolk sack. This nutritional source is thereafter consumed as the embryo develops and, in killifish, is essentially exhausted at the point of hatching. Killifish fry do not normally hatch with a significant yolk structure.

Incubation at elevated temperatures increases the animal's metabolism, accelerating the consumption of the yolk resource. The graph illustrates this effect through the greatly reduced incubation time as the storage temperature increases. Obviously, the embryo consumes the nutrition in the yolk more quickly at elevated temperatures to support this accelerated development. If the hatching is delayed by even a few days beyond the optimum hatching point, the yolk may be completely consumed, and energy is thereafter drawn from body elements, weakening the fry.

Natural Egg Incubation

If eggs are allowed to hatch in the tank, the parents will consume most of the fry (Specht, 1977). However, many fry will survive in aquariums and outside ponds that are heavily planted and provide good cover (Specht, 1977). The term "natural aquarium" is applied to the husbandry of killifish in this manner. From a practical standpoint, it is an aquarium with enough natural or artificial plants to act as spawning media and to provide sufficient cover to allow fry to hatch and safely feed in the presence of their larger tankmates.

Killie-keepers that employ this method will simply harvest the surviving fry periodically. For some species whose eggs are very small, this is the only practical breeding method, but many hobbyists prefer to use this method for other species as well simply because it eliminates the labor associated with the artificial method noted above. And although the number of fry that result from this method is substantially less than the artificial method, it is often productive enough to fulfill the goals of the breeder.

Fry Care

If there is a difficulty propagating *L. goodei*, most authors agree that the problem is the loss of fry in the first few days after hatching. Such losses mostly result from contaminated water and to be sure, deterioration of water quality will almost certainly kill the fry. Once past the critical first few weeks, however, the fry are easy to raise with few if any losses.

Although not supported with hard evidence, most hobbyists believe that many fry are not able to take newly hatched brine shrimp immediately after hatching, but rather require microscopic foods such as infusoria, rotifers and the like. For those that do not culture microscopic foods, thread-like plants that harbor incredibly large colonies of microscopic life —

hair and string algae particularly — can be used to provide these food sources. Clumps of these plants added to the fry container will provide an ample food supply until the fry grow enough to take larger foods.

Microworms and newly hatched brine shrimp can be added after a few days while infusoria or a like food is continued for the slower growing fry (De Bruyn, 1999). Cyclopeeze® and other small non-living foods can be added to the diet three or four weeks after hatching. A feeding regime like this will result in maximum fry growth. Overfeeding is difficult to control, so it is recommended that some snails be added to the fry tank immediately after the first feeding to mop-up the uneaten food.

Water changes must be made, but there have been some concerns regarding the volume of water that can be safely changed. Some authors warn that large or frequent water changes can shock the fry and result in losses (Buchell, 1998). This author finds that losses from water changes can be eliminated if the new water and the fry tank water are chemically similar. Every attempt should be made to match the hardness of the replacement water to that of the fry tank water. In the first few weeks, fry water changes should be made slowly, over the course of a few hours. Thereafter, a weekly 30% water change in fry tanks can be done at once along with the adult tanks. A very small amount of rock salt, the equivalent of ¼ teaspoon per gallon, should be added to the fry tank after the water change is complete. This will substantially reduce the bacterial load.

Conclusion

I've been keeping and raising killifish since the mid-1960s and it was not until I moved to Florida in 1993 that I became familiar with and developed an appreciation for this wonderful little fish. Try a pair or two of *Lucania goodei*, and if you do, you will come to treasure them as I have. Once they are in your fishroom, they are there to stay for a very long time!

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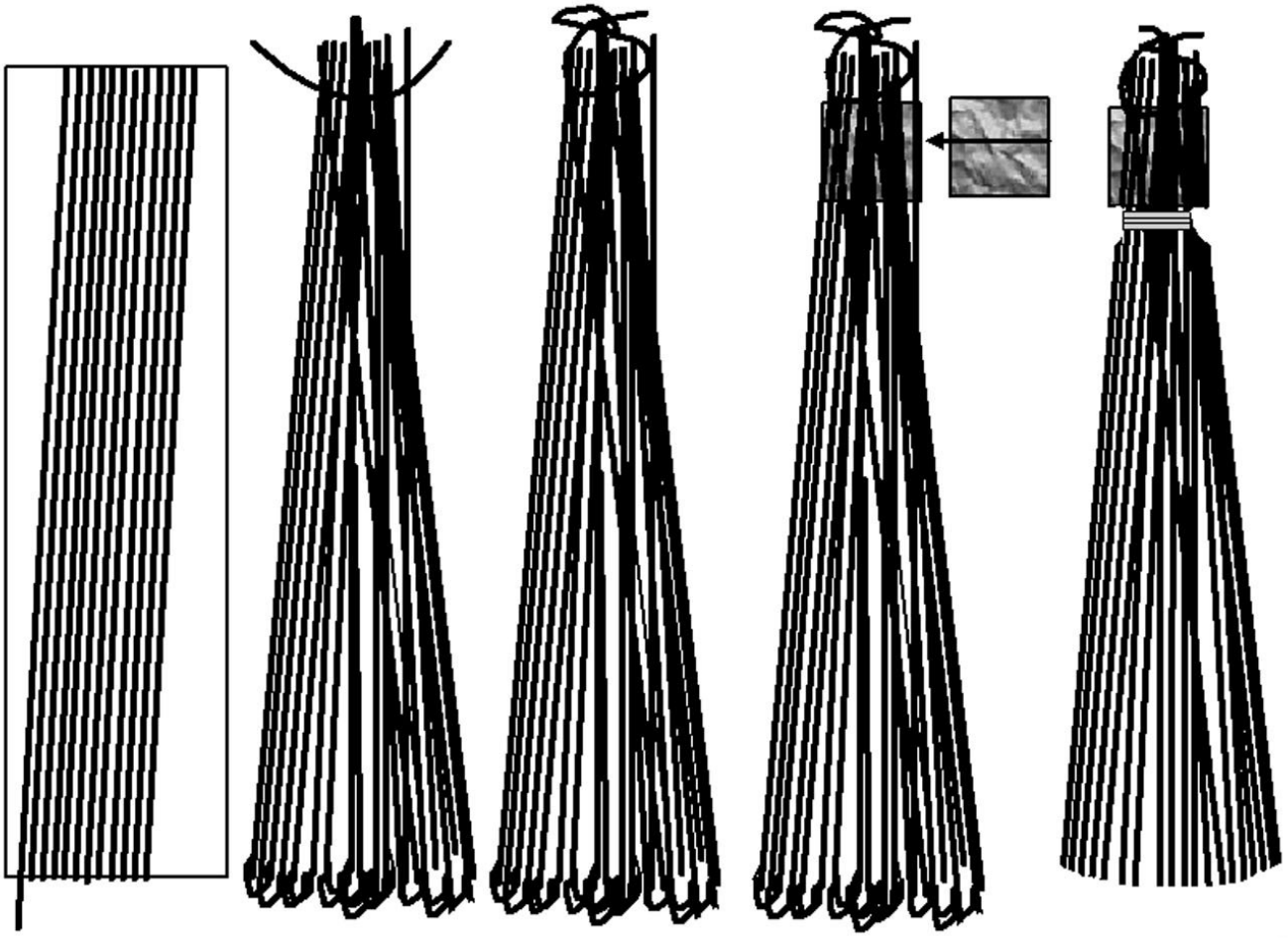
Please see the spawning mop info on the following page and the color plates related to this article on p. 23!

Addendum: Making a Killifish Spawning Mop



Step 1: Wind yarn* threads around a flat stiff object such as a hardcover book. 100 to 150 turns is ideal. Make sure the length is appropriate for the tank depth.

Step 2: Gather and slide the yarn bundle off book.

Step 3. Hold the loops on one end together.

Step 4. Hold and thread length of yarn through and under the loops of the pinched end.

Step 5: Tie knot to secure upper end of bundle.

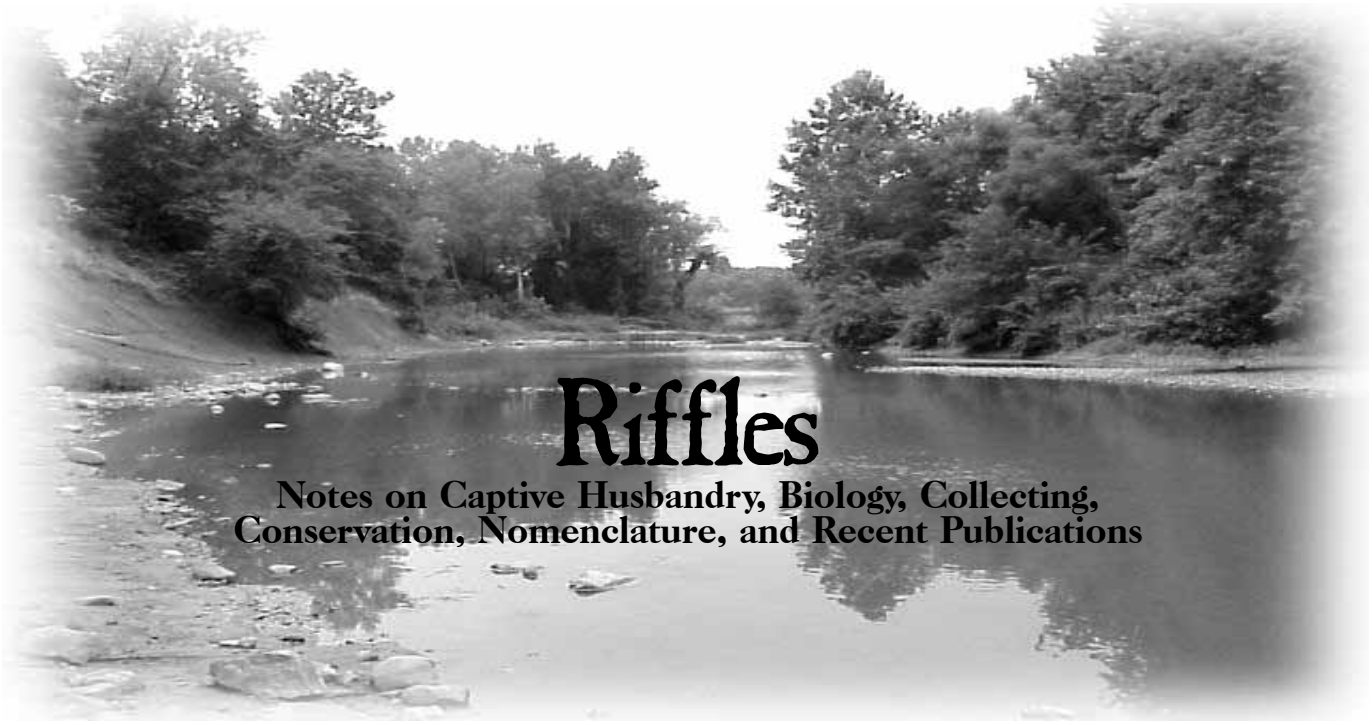
Step 6: Insert float. Any material that will not leach into the water is acceptable. Foam cubes or balls are ideal.

Step 7: Tie a length of thread or rubber band below float, securing it against knot.

Step 8. Cut open other end of bundle with scissors, and trim irregular ends.

*Any colorfast, non-shrinking nylon yarn can be used. A dark color will show the eggs more clearly, and the color of the breeding fish will not fade. I personally use a dark green usually noted as "green sage".

The most commonly used yarn is a medium weight, designated as #4. The symbol shown will be on the packaging. Yarn with a smaller diameter will take a lot more turns to produce a mop, and it will be dense. Too large in diameter will make the mop bulky, and smaller eggs tend to get buried within the individual strands rather than sit on top of it. But many killifish breeders will use all these sizes with success.



Riffles

Notes on Captive Husbandry, Biology, Collecting, Conservation, Nomenclature, and Recent Publications

A Comparison of Native and Exotic Hosts for the Silver Lamprey

This paper, by NANFA member Philip Cochoran, appeared in the *American Fisheries Society Symposium* 72:165–172, 2009. The abstract follows:

"Silver lamprey *Ichthyomyzon unicuspis* has been most strongly associated with native host species that are relatively large and have naked skin or relatively small scales, including paddlefish *Polyodon spathula*, lake sturgeon *Acipenser fulvescens*, lake trout *Salvelinus namaycush*, ictalurid catfishes, and esocids. In many regions, however, and especially in the southern part of the silver lamprey's geographic range, these host species have declined in abundance through a combination of human impacts, and the most abundant large fish species is now the common carp *Cyprinus carpio*, an exotic species with large scales. Silver lampreys removed from paddlefish in the Wisconsin River and allowed to feed on carp in the laboratory displayed very little growth relative to lampreys in the river. Although paddlefish lack scales, skin densities of carp and paddlefish, measured as dry mass per unit area, were similar. However, dried samples of paddlefish skin displayed a substantial lipid residue, and skin density of paddlefish expressed as ash weight was less than that of carp. It is likely that increased handling time contributes to reduced growth by silver lampreys on carp. The importance of paddlefish skin lipids to silver lamprey feeding ecology should be investigated."

Indirect genetic estimates of breeding population size in the polyploid Green Sturgeon (*Acipenser medirostris*)

This paper, by J.A. Israel and B. May, appeared in *Molecular Ecology* 19:5, pp. 1058–1070, March 2010. The abstract follows:

"The utility of genetic measures for kinship reconstruction in polysomic species is not well evaluated. We developed a framework to test hypotheses about estimating breeding population size indirectly from collections of outmigrating Green Sturgeon juveniles. We evaluated a polysomic dataset, in allelic frequency and phenotypic formats, from Green Sturgeon to describe the relationship among known progeny from experimental families. The distributions of relatedness values for kin classes were used for reconstructing Green Sturgeon pedigrees from juveniles of unknown relationship. We compared three rarefaction functions that described the relationship between the number of kin groups and number of samples in a pedigree to estimate the annual abundance of spawners contributing to the threatened Green Sturgeon Southern Distinct Population Segment in the upper Sacramento River. Results suggested the estimated abundance of breeding Green Sturgeon remained roughly con-

stant in the upper Sacramento River over a 5-year period, ranging from 10 to 28 individuals depending on the year and rarefaction method. These results demonstrate an empirical understanding for the distribution of relatedness values among individuals is a benefit for assessing pedigree reconstruction methods and identifying misclassification rates. Monitoring of rare species using these indirect methods is feasible and can provide insight into breeding and ontogenetic behavior. While this framework was developed for specific application to studying fish populations in a riverscape, the framework could be advanced to improve genetic estimation of breeding population size and to identify important breeding habitats of rare species when combined with finer-scaled sampling of offspring."

Elassoma gilberti, A New Species of Pygmy Sunfish (Elassomatidae) from Florida and Georgia

This paper, by Franklin F. Snelson, Jr., Trevor J. Krabbenhoft, and Joseph M. Quattro appeared in the *Bulletin of the Florida Museum of Natural History* Vol. 48(4): 120-144. The abstract follows:

"A new species of pygmy sunfish, *Elassoma gilberti* (Elassomatidae), is described from northwestern Florida and extreme southwestern Georgia. It previously has been confused with its sister species, *Elassoma okefenokee* Böhlke 1956. The two are very similar morphologically, but differ in the number of preopercular canal pores (four in *E. gilberti*, three in *E. okefenokee*), in average number of anal fin rays (usually seven in *E. gilberti*, usually eight in *E. okefenokee*), and in more subtle differences in coloration, body depth, and dorsal and anal fin size. The distinction of the two species is supported by eight fixed differences at the mitochondrial 16S rRNA locus and 12 fixed differences at the nuclear S7 locus. Phylogenetic analyses using these molecular characters supported monophyletic clades that contained haplotypes and alleles found uniquely in the two taxa. *Elassoma gilberti* is found in stream systems draining into the Gulf of Mexico from Choctawhatchee Bay in the Florida panhandle south to the Withlacoochee and Homosassa drainages in west-central Florida. Both species occur in the Suwannee River drainage, *E. gilberti* in the lower and middle sections and *E. okefenokee* in the middle and upper sections. They remain genetically distinct where sampled in this drainage but have not been found syntopically. The history and nomenclatural status of the name *Elassoma evergladei orlandicum* Lönnberg 1894 is discussed and a lectotype is designated based on the earlier findings of R. M. Bailey and J. E. Böhlke. Lectotype designation relegates the name to the synonymy of *Elassoma evergladei* Jordan 1884."

Habitat Suitability of the Carolina Madtom, an Imperiled, Endemic Stream Fish

This paper, by Stephen R. Midway, Thomas J. Kwak and D. Derek Aday appeared in the *Transactions of the American Fisheries Society* 2010; 139: 325-338. The abstract follows:

"The Carolina Madtom *Noturus furiosus* is an imperiled stream ictalurid that is endemic to the Tar and Neuse River basins in North Carolina. The Carolina Madtom is listed as a threatened species by the state of North Carolina, and whereas recent distribution surveys have found that the Tar River basin population occupies a range similar to its historical range, the Neuse River basin population has shown recent significant decline. Quantification of habitat requirements and availability is critical for effective management and subsequent survival of the species. We investigated six reaches (three in each basin) to (1) quantify Carolina madtom microhabitat use, availability, and suitability; (2) compare suitable microhabitat availability between the two basins; and (3) examine use of an instream artificial cover unit. Carolina Madtoms were located and their habitat was quantified at four of the six survey reaches. They most frequently occupied shallow to moderate depths of swift moving water over a sand substrate and used cobble for cover. Univariate and principal components analyses both showed that Carolina Madtom use of instream habitat was selective (i.e., nonrandom). Interbasin comparisons suggested that suitable microhabitats were more prevalent in the impacted Neuse River basin than in the Tar River basin. We suggest that other physical or biotic effects may be responsible for the decline in the Neuse River basin population. We designed instream artificial cover units that were occupied by Carolina Madtoms (25% of the time) and occasionally by other organisms. Carolina Madtom abundance among all areas treated with the artificial cover unit was statistically higher than that in the control areas, demonstrating use of artificial cover when available. Microhabitat characteristics of occupied artificial cover units closely resembled those of natural instream microhabitat used by Carolina Madtoms; these units present an option for conservation and restoration if increased management is deemed necessary. Results from our study provide habitat suitability criteria and artificial cover information that can inform management and conservation of the Carolina Madtom."

Patterns of Natural Hybridization in Darters (Percidae:

Etheostomatinae)

This paper, by Benjamin P. Keck and Thomas J. Near appeared in *Copeia* 2009(4): pp. 758–773. The abstract follows:

"Hybridization is an evolutionarily important process with varied outcomes that depend on interacting factors of time since common ancestry, behavioral differences, and environmental conditions. Hybridization is relatively common in teleost fishes, and patterns from naturally occurring hybrids and experimental interspecific crosses provide insight into the evolution of reproductive barriers that lead to speciation. It has been several decades since records of hybrid darter specimens (Percidae: Etheostomatinae) have been collected and analyzed. We assembled a dataset of 252 reported natural hybrids from museum collections and literature reports that comprise 67 unique hybrid combinations involving 63 darter species. Frequencies of unique hybrid combinations decrease with phylogenetic distance and are lower between species with different egg deposition behaviors. Large range size and egg burying reproductive behavior were characteristics of the species most frequently identified as a parental species of hybrid specimens. Evidence of genetic introgression was not consistently predicted by the frequency of records for a particular hybrid combination. This dataset likely underestimates the amount of hybridization that has occurred among darter species, because of the relatively narrow evolutionary time frame during which specimens have been collected and identified."

Toxic Hydrogen Sulfide and Dark Caves: Life-History Adaptations in a Livebearing Fish (*Poecilia mexicana*, Poeciliidae)

This paper, by Rüdiger Riesch, Martin Plath and Ingo Schlupp appeared in *Ecology* 91:1494-1505. The abstract follows:

"Life-history traits are very sensitive to extreme environmental conditions, because resources that need to be invested in somatic maintenance cannot be invested in reproduction. Here we examined female life-history traits in the Mexican livebearing fish *Poecilia mexicana* from a variety of benign surface habitats, a creek with naturally occurring toxic hydrogen sulfide (H_2S), a sulfidic cave, and a non-sulfidic cave. Previous studies revealed pronounced genetic and morphological divergence over very small geographic scales in this system despite the absence of physical barriers, suggesting that local adaptation to different combinations of two selection factors, toxicity (H_2S) and darkness, is accompanied by very low rates of gene flow. Hence, we investigated life-history divergence between these populations in response to the selective pressures of darkness and/or toxicity. Our main results show that toxicity and darkness both select for (or impose constraints on) the same female trait dynamics: reduced fecundity and increased offspring size. Since reduced fecundity in the sulfur cave population was previously shown to be heritable, we discuss how divergent life-history evolution may promote further ecological divergence: for example,

reduced fecundity and increased offspring autonomy are clearly beneficial in extreme environments, but fish with these traits are outcompeted in benign habitats."

Fish Assemblages in Talladega National Forest's Choccolocco, Shoal, and Scarbrough Creeks

This paper, by Mark Meade, Jeffrey O'Kelley, Greg Scull, and Josh Turner appeared in the *Southeastern Naturalist* 2009. 8(4):677–686. The abstract follows:

"Fish assemblages within Choccolocco, Shoal, and Scarbrough creeks (Shoal Creek District, Talladega National Forest, AL) were surveyed each July from 2003–2007. Mean species diversity (Shannon Index) was 2.3 or higher for all sites except Scarbrough Creek (headwater site). Calculated IBI's for all sites scored were "good" with the exception of Scarbrough Creek which scored "poor." At all sites except Scarbrough creek, fish communities were dominated by *Cyprinella trichroistia* (Tricolor Shiner), *Semotilus atromaculatus* (Creek Chub), *Hypentelium etowanum* (Alabama Hogsucker), *Campostoma oligolepis* (Largescale Stoneroller), and *Notropis xaenocephalus* (Coosa Shiner). At one site near a large lake (Shoal Creek), sunfish were also predominant. Limited numbers of the state-listed *Etheostoma brevirostrum* (Holiday Darter) were also observed in Shoal Creek. The Creek Chub was the only fish species observed in Scarbrough Creek at its headwaters. Although species diversity may be reduced relative to historical data, those fish populations observed in the streams currently appear stable."

***Cottus immaculatus*, a new species of sculpin (Cottidae) from the Ozark Highlands of Arkansas and Missouri, USA**

This paper, by Andrew P. Kinsiger and Robert M. Wood appeared in *Zootaxa* 2340: 50–64 (2010). The abstract follows:

"*Cottus immaculatus* (Fig. 1), new species, is described from the Current, Eleven Point, Spring and White river systems of the White River drainage, in the Ozark Highlands of Arkansas and Missouri, USA. *Cottus immaculatus* is a member of the Uranidea clade and distinguishable from all members of the genus *Cottus* using genetic and morphological characters. *Cottus immaculatus* possesses a previously unreported but possibly widespread character in the genus *Cottus*, enlargement of the tips of the dorsal-fin spines of males. The description of *Cottus immaculatus* brings the total number of species recognized within the genus *Cottus* to 68."

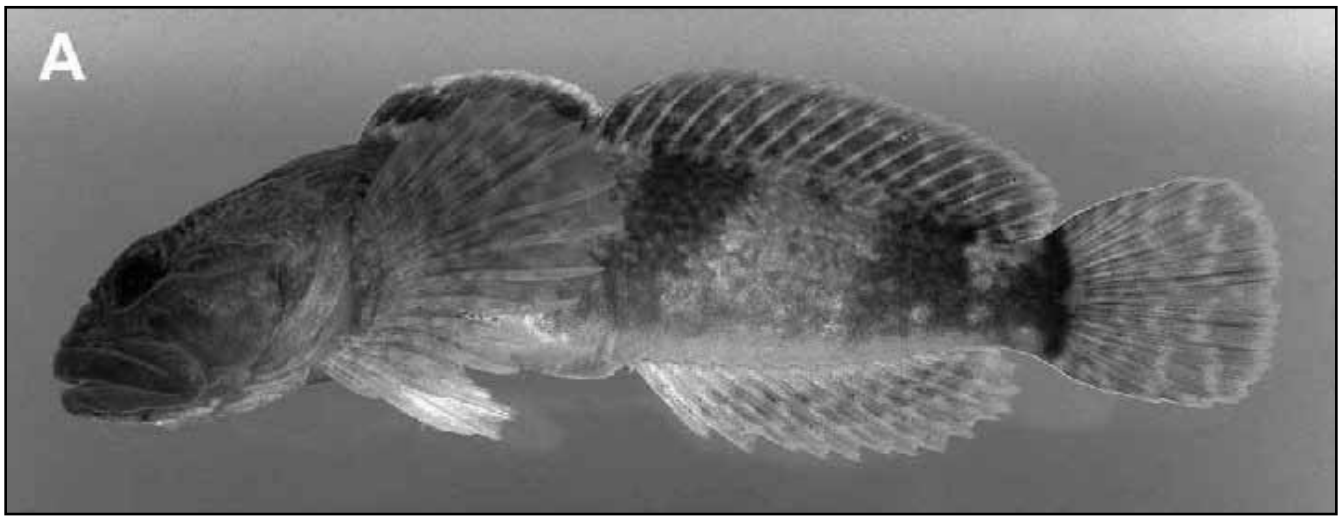


Fig. 1.
Cottus immaculatus.

NANFA News

Members, Events, Accomplishments and Administrivia

2010 Research Grant Awardee

This year, NANFA supported the following proposal with a grant of $1,000. It's a proposal that studies the decline in a widespread group of *Notropis* shiners. Here's the condensed description compiled from her proposal, along with the name and affiliation of the awardee:

Suzanne M. Gray, Department of Biology, McGill University, Montreal, Canada. "Turbidity tolerance in Blackline Shiners: Implications for conservation and recovery."

The primary research goal is to compare turbidity tolerance across members of the Blackline Shiners complex with reportedly varying turbidity tolerance to determine if turbidity can be directly implicated in the decline of vulnerable species, and to inform action plans for the recovery of these species. In Canada, turbidity is the putative cause for the decline of several species in this complex, including the Endangered Pugnose Shiner (*Notropis anogenus*) and Threatened Bridle Shiner (*N. bifrenatus*). Turbidity can have direct physiological effects such as reduced feeding and respiratory impairment, and can also alter visually-mediated behavior such as foraging and social interactions.

The research will compare the responses of four Blackline Shiner species typically found in clear waters (*N. anogenus*, *N. bifrenatus*, *N. heterodon* and *N. heterolepis*) and one related minnow found in a range of habitats (*N. volucellus*) to varying turbidity conditions in aquaria. The behavioral responses of individuals of all five species to increasing turbidity over a three-week period will be compared. A second experimental treatment of the same five species will examine the physiological and behavioral responses to individuals held under high turbidity levels for two months. The results of this research should have direct and immediate implications for the recovery and management of the Endangered Pugnose Shiner, Threatened Bridle Shiner and other sympatric species in this group.

2010 Corcoran Education Grant Awardee

This year, NANFA awarded its annual Corcoran Education grant to Dr. G. Reid Bishop for his proposed study, "A Checklist of Fishes of the Lower Mississippi." The purpose of this project is to develop an illustrated field checklist of fishes of the lower Mississippi River. The areas to be covered include those found in both the main channel and in the highly diverse backwater habitats found along the river. The checklist would be produced by a team of Audubon Mississippi River Master Naturalist students working in collaboration with Audubon's Mississippi River Field Institute and local professional members of NANFA. The checklist would serve as a convenient field guide for future naturalist course participants. The resources to be used for the compilation of the illustrated checklist would include those from the published literature, the native fish collection at the Mississippi Museum of Natural Sciences in Jackson, MS and from actual surveys conducted as a field component of the naturalist course.

The checklist would be distributed in print form as a

waterproof laminated brochure and would also be more widely available as a printable PDF file via Audubon's Mississippi River Initiative website (http://mri.audubon.org). The requested funds will be used to cover basic fish survey equipment for the Audubon naturalist program, naturalist and instructor travel expenses, desktop publishing, and printing costs. The subject material for the brochure will be based, in part, on actual surveys conducted by naturalist students in the company of local native fish experts and will be a unique educational process in itself. The overall project will engage dozens of adult naturalist students, including middle and high school Audubon Teacher Naturalists from predominantly African-American communities of the upper and lower Mississippi Delta. Several sampling field trips to two primary sites will be conducted beginning in the summer of 2010.

NANFA member Brian Zimmerman submits Master's Thesis

Brian's thesis, titled "Microhabitat Use by the Redside Dace (*Clinostomus elongatus*) in Ohio", was submitted to the Graduate College of Bowling Green State University in December 2009. His thesis work was funded in part from a grant by NANFA. The abstract from his thesis follows:

"Few studies have attempted to characterize microhabitat use by cyprinids, particularly over a broad temporal scale. In this study, I quantified the physical in-stream characteristics of habitat use by the Redside Dace, *Clinostomus elongatus* using a one-square meter spatial scale. These characteristics were delineated in four Ohio streams that contained substantial populations of Redside Dace. Individual Redside Dace locations within the study site were recorded, along with stream velocity, depth, proximity to woody debris, and distance to the edge of the wetted stream channel, seasonally throughout the study. Redside Dace positions within the stream were found to be non-random in relation to most variables and seasons. Generally, Redside Dace oriented toward positions with slower current velocities (0.00-0.08 m/s observed versus 0.00-0.19m/s based on randomization sampling), greater depths (0.33-0.84m observed versus 0.07-0.35m random), closer to woody debris (0.00-1.61m observed versus 0.53-5.64m random), and further from the edge of the wetted stream channel (0.60-1.93m observed versus 0.17-0.71m random). From this study it is clear that Redside Dace are drawn to particular habitat features. Additionally, there were some differences observed for the different seasons which may be important for the persistence of populations over time. During winter they stayed closest to woody debris (average of cells with Redside Dace present for all sites during winter 0.32m; spring 0.86m; summer 0.55m; fall 0.78m). In spring they used areas that were shallower (spring 0.53m; summer 0.60m; fall 0.58m; winter 0.69m) and with higher velocities (spring 0.05m/s; summer 0.01m/s; fall 0.03m/s; winter 0.03m/s) because of spawning activities in riffles and runs. These differences in microhabitat use would have been missed if this study had not covered a time span of a full year."

Welcome, new members

Jeff Baker, JASPER, AL
George Barkell, SHOREHAM, VT
Bruce Bessert, WAUWATOSA, WI
Josh Blaylock, RICHMOND, KY
Charles Brown Jr., COVENTRY, CT
Nathan Bussard, WOODSBORO, MD
John Chapek, MAPLE HEIGHTS, OH
Robert Colombo, CHARLESTON, IL
Richard Hill, BIG COVE, AL
Mike Hook, WOODLAND HILLS, UT
Howard Kern, WESTLAKE VILLAGE, CA
Raymond King, TUNNEL HILL, GA
Justin Lawson, CHARLTON, MA
Doug Ludemann, APPLE VALLEY, MN
Dave Marshall, BARNEVELD, WI
Michael McMicken, PLAINFIELD, IL
Jeremy Monroe, CORVALLIS, OR
Conal O'Keefe, NEW LONDON, CT
Jerrod Parker, DUBUQUE, IA
Ronald Preston, BARNESVILLE, OH
Joseph Quattro, COLUMBIA, SC
Kenneth Rippey, RICHMOND, VA
Lester Rose, WICHITA, KS
Alex Schubert, GRANITE CANYON, WY
Willian Snyder, MORRISVILLE, NY
Lisa Stillings, RENO, NV
John Waldman, SEA CLIFF, NY
Ann Wheeler, ANNAPOLIS, MD
Erica Wieser, AVON LAKE, OH
Brian Wight, EAGLE RIVER, AK
James Wild, HERRIN, IL
Bob Wright, TORONTO, ONT

Annotated Checklist of North American Freshwater Fishes, Including Subspecies and Undescribed Forms
Addenda & Errata #5

Christopher Scharpf
1107 Argonne Drive, Baltimore, MD 21218, ichthos@comcast.net

Part I

pg. 4 ***Ichthyomyzon fossor*** update QC STATUS from SC to E

pg. 5 ***Lampetra*** Reflecting what appears to be preferred usage among contemporary lamprey taxonomists, the four subgenera of *Lampetra*—*Entosphenus*, *Lampetra*, *Lethenteron* and *Tetrapleurodon*—are now recognized as full genera. The spellings (reflecting a change in gender) and/or authorships of the following names are affected:

Entosphenus hubbsi Vladykov & Kott 1976 [remove parentheses; also note placement in *Entosphenus* and not, as incorrectly noted, in *Lampetra*]

Entosphenus lethophagus (Hubbs 1971) [change gender and add parentheses]

Entosphenus macrostomus (Beamish 1982) [change gender and add parentheses]

Entosphenus minimus (Bond & Kan 1971) [change gender and add parentheses]

Entosphenus similis Vladykov & Kott 1978 [remove parentheses]

Entosphenus tridentatus [change gender]

Lethenteron camtschaticum [change gender]

Tetrapleurodon geminis Alvarez 1964 [remove parentheses]

Tetrapleurodon spadiceus (Bean 1887) [change gender and add parentheses]

pg. 6 ***Acipenser fulvescens*** STATUS: add NC (KS)

pg. 7 ***Scaphirhynchus platorynchus*** STATUS: add PT (US, due to similarity in appearance to *S. albus*) [proposed listing announced 22 Sept. 2009]; add SC (WY)

pg. 8 ***Hiodon alosoides*** STATUS: add SC (WY), NC (KS)

pg. 10 ***Algansea*** add the following new species:

Algansea amecae Pérez-Rodríguez, Pérez-Ponce de León, Domínguez-Domínguez & Doadrio 2009 [no common name]
ETYMOLOGY: referring to Río Ameca basin, type locality
DISTRIBUTION: eastern headwaters of Río Ameca basin (Jalisco), now found in only one small stream with little flow in La Coronilla (Pérez-Rodríguez et al., 2009)
STATUS: critically imperiled

pg. 12 ***Couesius plumbeus* ssp.** DISTRIBUTION: add WY; STATUS: add SC (WY)

pg. 13 ***Cyprinella callistia*** add NOTE: A highly divergent species, both morphologically and genetically, that probably warrants its own genus (Schönhuth and Mayden, 2010).

Cyprinella lutrensis lutrensis amend NOTE: Schönhuth and Mayden (2010) suggest *C. l. suavis* represents a valid species.

pg. 14 ***Cyprinella nivea*** add NOTE: Schönhuth and Mayden (2010) suggest Savannah R. pop. represents a separate species.

pg. 15 ***Cyprinella* cf. *zanema*** replace NOTE: Schönhuth and Mayden (2010) suggest NC and SC pops. represent separate species.

pg. 16 ***Erimystax x-punctatus trautmani*** STATUS: add T (IL)

pg. 18 ***Gila nigra*** STATUS: C (US), E (NM)

pg. 20 ***Hybognathus argyritis*** STATUS: add SC (WY)

pg. 22 ***Luxilus albeolus*** amend ETYMOLOGY: whitish, the sides and fins a "pure silvery white"

Luxilus cardinalis*, *L. c. chrysocephalus and ***L. cornutus frontalis*** STATUS: add NC (KS)

pg. 24 ***Macrhybopsis meeki*** STATUS: add SC (MT)

pg. 25 ***Nocomis biguttatus*** STATUS: add SC (WY)

pg. 27 ***Notropis bifrenatus*** STATUS: add T (SC)

pg. 28 ***Notropis boops*** STATUS: add NC (KS)

Notropis buchanani clarify DISTRIBUTION in Mississippi basin: Mississippi R. basin from ON and PA south to AL and LA

pg. 31 ***Notropis percobromus*** change NOTE to NOTES: (1) Some pops. from Ozark and Ouachita highlands may warrant species status (Berendzen et al., 2008, 2009). (2) Wabash pop. may be assignable to *N. rubellus* (Berendzen et al., 2009).

pg. 32 ***Notropis rubellus*** STATUS: add SC (QC); change period at end NOTE to a comma and add: and perhaps another undescribed form (Berendzen et al., 2008, 2009).

pg. 33 ***Notropis suttkusi*** add NOTE: Pops. from Ouachita and Caddo R. in the eastern Ouachita Highlands may represent an undescribed form (Berendzen et al., 2008, 2009).

pg. 34 change ***Phoxinus*** to ***Chrosomus*** **Rafinesque 1820**
Previously considered a subgenus of *Phoxinus* Rafinesque 1820, *Chrosomus* was elevated to full genus by Strange and Mayden (2009), restricting *Phoxinus* to Eurasian taxa. Two subgenera continue to be recognized: *Chrosomus* (*chroma*, color; *soma*, body, referring to overall vibrant coloration) and the monotypic *Pfrille* Jordan 1924 (a German name for *Phoxinus phoxinus*). With the revised classification, parentheses need to be added or removed from the authorship of several names: *C. cumberlandensis* (Starnes & Starnes 1978), *C. neogaeus* (Cope 1867), *C. saylori* (Skelton 2001) and *C. tennesseensis* (Starnes & Jenkins 1988) [parentheses added]; *C. eos* Cope 1862 and *C. oreas* Cope 1868 [parentheses removed].

Phoxinus (now ***Chrosomus***) ***erythrogaster*** STATUS: add NC (KS)

pg. 36 ***Platygobio gracilis gracilis*** STATUS: add SC (WY)

Pteronotropis The inclusion of two undescribed *Pteronotropis* is based on the unpublished studies of B. A. Porter and R. D. Suttkus (B. A. Porter, pers. comm.).

Pteronotropis hubbsi STATUS: update E (IL) to extirpated (IL)

Add two undescribed species:

Pteronotropis **cf. *hypselopterus***
DISTRIBUTION: St. Marys, St. Johns and Withlacoochee R. (GA, FL)
STATUS: apparently secure

Pteronotropis **cf. *metallicus*** (Alafia Shiner)
DISTRIBUTION: Alafia R. system (Hillsbourough Co., FL)
STATUS: imperiled

pg. 38 ***Rhinichthys obtusus*** amend STATUS: NC (KS, as *R. atratulus*)

pg. 40 ***Scardinius*** Additional research suggests a new etymology for the name; rather than being named for the Scardus mountains, which do not occur within the native range of rudds, it appears the name is derived from either *scardafa* or *scarda*, which were Roman (now Italian) vernacular names for rudds

Part II

pg. 2 ***Campostoma anomalum pullum*** red-finned form is now recognized as a full species (see Part IV, pg. 3, below)

pg. 4 ***Carpiodes velifer*** update DISTRIBUTION: change Choctawhatchee R. (FL, AL) to Apalachicola R. (FL) [new record reported by Young et al., 2010]

pg. 9 ***Erimyzon*** revised ETYMOLOGY: *eri-*, very; *myzo*, to suck, a "free translation" of the vernacular name chubsucker

pg. 11 ***Moxostoma carinatum*** update QC STATUS from SC to T

pg. 12 ***Moxostoma pisolabrum*** append DISTRIBUTION: recently reported from Strawberry R. (AR) (McAllister et al., 2009)

pg. 21 ***Esox niger*** STATUS: add SC (QC)

pg. 22 ***Hypomesus transpacificus*** STATUS: on 4 April 2010 U.S. Fish and Wildlife Service announced that status deserves to be reclassified from T to E but is "precluded by other higher priority listing actions"

pg. 23 ***Thaleichthys pacificus*** STATUS: add T (US, southern DPS only) [listing announced 18 March 2010; southern DPS ranges from Nass R. (BC) south to and including Mad R. (CA)]

pg. 26 ***Oncorhynchus clarkii alvordensis*** under DISTRIBUTION: "Thouand" should be spelled "Thousand"

Oncorhynchus clarkii bouvieri and ***O. c. pleuriticus*** STATUS: add SC (WY)

O. clarkii lewisi STATUS: add SC (WY) and T (AB)

pg. 27 ***Oncorhynchus clarkii utah*** STATUS: add SC (WY)

pg. 31 ***Oncorhynchus mykiss gairdneri*** STATUS: add T (AB, native Athabasca R. pop. only)

pg. 34 ***Thymallus arcticus*** STATUS: add SC (WY)

Part III

pg. 2 ***Campostoma anomalum pullum*** revised NOTE 1: red-finned "Ouachita" form (erroneously thought to be referable to *Dionda grisea*) is now recognized as a distinct species per Cashner et al. (2010):

Campostoma spadiceum (Girard 1856); Highlands Stoneroller
ETYMOLOGY: nut-brown, referring to brown-red coloration on upper part of body
DISTRIBUTION: Red, Ouachita and lower Arkansas R. basins from eastern OK to central AR
STATUS: apparently secure

pg. 13 ***Fundulus kansae*** STATUS: add SC (WY)

pg. 18 ***Gambusia senilis*** under note 2: *guayacón de San Diego* has been described:

Gambusia zarskei Meyer, Schories & Schartl 2010
ETYMOLOGY: in honor of Axel Zarske, for his "valuable contributions to discussions on the conservation biology and problems of endangered fishes" such as this one
DISTRIBUTION: upper Rio Conchos system east of San Diego de Alcalá (Chihuahua)
STATUS: data not available but likely at least vulnerable
SUBGENUS: ***Arthrophallus***

pg. 23 ***Xiphophorus couchianus*** in addition to spelling correction

and status update noted in Part V (p. 18), change NOTE to following: Phenotypically distinct Apodaca pop. is treated as a subspecies by Chavarria Gallegos et al. (2008) and given a name, *X. c. apodaca*, clearly a *nomen nudum*, by Valdés-Gonzalez et al. (2008); others believe this form to be a hybrid with *X. meyeri* and/or introduced hobby strains (Coletti, 2009).

Add the following species:

Xiphophorus* cf. *couchianus (Tunnel Platyfish)
DISTRIBUTION: Arroya Santa Ana, a headwater tributary of Arroyo Ebanol of Río San Juan (near Monterrey, Nuevo León)
STATUS: critically imperiled; its habitat will most likely be destroyed by the building of an aqueduct (hence its proposed common name) (Coletti, 2009)
NOTES: (1) Distinguishing characters given by Valdés-Gonzalez et al., 2008. (2) A ms. name ("*regio*") has been proposed and is circulating in hobbyist literature (Colletti, 2009).

pg. 25 ***Allotoca goslinei*** update STATUS: likely extinct in nature due to competitive displacement with invasive *Xiphophorus helleri* (Helmus et al., 2009); captive pops. in university and hobbyist aquaria

pg. 28 ***Goodea*** intro paragraph, 5th line, correct "1984" to "1894"

pg. 33 ***Cyprinodon pachycephalus*** delete NOTE: this pop. has been described as a new species:

Cyprinodon julimes De la Maza-Benignos & Vela-Valladores 2009; Julimes Pupfish (*cachorrito de Julimes*)
ETYMOLOGY: from the town of Julimes
DISTRIBUTION: El Pandeño de los Pandos, a thermal spring in Río Conchos basin, Julimes, Chihuahua
STATUS: critically imperiled (E, Méx., as *C. pachycephalus*)

Part IV

pg. 4 ***Pteronotropis metallicus*** delete NOTE; Alafia R. pop. now listed as an undescribed species (see Part 1, p. 36, above)

pg. 6 ***Lota lota maculosa*** STATUS: add SC (WY); possibly extirpated in KS and NE (Stapanian et al., 2010)

pg. 10 ***Cottus* cf. *hypselurus*** has been described:

Cottus immaculatus Kinziger & Wood 2010; Knobfin Sculpin
ETYMOLOGY: immaculate, referring to absence of melanophores on ventral surface of peritoneum (vernacular refers to fleshy knobs at tips of dorsal fin spines of spawning males)
DISTRIBUTION: Current, Eleven Point, Spring and White R. drainages (MO, AR)
STATUS: apparently secure
CLADE: Uranidea

pg. 17 ***Micropterus punctulatus*** STATUS: add SC (OK, "*wichitae*" hybrid [see note 1, below] only)

pg. 18 **FAMILY PERCIDAE** add to end of intro paragraph: For a complete list of reported natural darter hybrids, see Keck and Near (2009).

pg. 19 ***Ammocrypta clara*** add to DISTRIBUTION: lower Elk R. (WV) [new records reported by Cincotta and Walsh, 2010]

pg. 20 ***Lepomis miniatus*** STATUS: update T (IL) to E (IL)

pg. 25 ***Etheostoma exile*** STATUS: add T (IL)

pg. 28 ***Etheostoma nigrum*** STATUS: add NC (KS)

pg. 29 ***Etheostoma ookaloosae*** update STATUS: E, PT (US) [proposed downlisting from E to T announced 2 Feb. 2010]

pg. 30 ***Etheostoma perlongum*** add NOTE: Citing DNA evidence, McCartney and Barreto (2010) say this species is an isolated pop. of *E. olmstedi* and that its taxonomic status should be reevaluated.

pg. 35 ***Etheostoma whipplei*** STATUS: add NC (KS)

pg. 40 ***Percina shumardi*** STATUS: add SC (OK)

Sander delete 4th sentence of intro paragraph and add the following exotic species:

EXOTIC
Sander lucioperca (Linneaus 1758); Zander
ETYMOLOGY: *lucius*, pike; *perke*, perch, being a pike-shaped perch
DISTRIBUTION: native: Continental Europe to western Siberia; US: small reproducing pop. in Spiritwood Lake (ND), where they were stocked for sportfishing in 1989

Part V

pg. 3 ***Elassoma* cf. *okefenokee*** has been described and a different common name has been proposed:

Elassoma gilberti Snelson, Krabbenhoft & Quattro 2009; Gulf Coast Pygmy Sunfish
ETYMOLOGY: in honor of Carter R. Gilbert, Curator of Fishes, Florida Museum of Natural History from 1961-1998 and now Curator Emeritus, for his many contributions to the study of North American fishes, and for serving as a guide and mentor for many years
DISTRIBUTION: Gulf drainages from FL panhandle and extreme southwestern GA south through western portion of north-central FL peninsula
STATUS: secure or apparently secure

pg. 11 ***Gobiesox fluviatilis*** DISTRIBUTION: add Zacatecas to list of districts in Río Grande de Santiago basin [oversight]

pg. 14 ***Rhinogobius brunneus*** add parentheses around authority names and date [correction]

pg. 16 ***Luxilus albeolus*** amended ETYMOLOGY is incorrect (see Part 1, p. 22, above)

pg. 17 ***Spirinchus thaleichthys*** correction: species proposed for federal protection (and confirmed, see Part II, p. 23, above) is actually *Thaleichthys pacificus*

pg. 18 ***Xiphophorus couchianus*** delete NOTE 2; this isolated pop. is now listed as an undescribed species (see Part III, pg. 23, above)

pg. 21 **Supplementary Material** 1st paragraph, 5th line: correct "232 native genera, 11 exotic genera" to "211 native genera, 32 exotic genera," then add 3 more native genera (=214) with the split of *Lampetra* noted above; change other numbers as noted for Table 3 (next entry); 3rd paragraph, revise as follows:

One thing is certain: The number of described and valid North American native freshwater fish species will continue to grow. Indeed, that number has grown significantly (up 14.5%) since the most recent authoritative checklist of North American freshwater fishes — that of Mayden et al. — was published in 1992. In that checklist 979 named native species were listed as valid, compared to the 1121 named native species listed in this series (162 additions and 20 deletions for a net gain of 142 species). Newly described species (60%), elevated subspecies (17%) and resurrected synonyms (17%) account for most of the additions (Table 4, pages 8-9). Synonymy accounts for half of the deletions (Table 5, page 10).

pg. 22 **Table 3, Petromyzontidae** update native genera from 3 to 6; **Cyprinidae** update 304 described native species to 306 and 15 undescribed native species to 17; **Poeciliidae** update 75 described native species to 76 and 0 (-) undescribed native species to 1; **Cyprinodontidae** update 34 described native species to 35; **Cottidae** update 33 described native species to 34 and 11 undescribed native species to 10; **TOTAL** update 211 native genera to 214, 1115 described native species to 1121, and 59 undescribed native species to 60

pg. 23 **Percidae** update 1 exotic species /subspecies to 2; **TOTAL** update 54 exotic species/subspecies to 55

Table 3 Summary update 1115 described native species to 1121; update 1174 total species to 1181; update 59 undescribed species to 60; update 1404 total natives to 1410; update total exotics to 55; update bottom line total from 1458 to 1466

pg. 24 **Table 4** with additions of *Algansea amecae*, *Gambusia zarskei*, *Cyprinodon julimes*, *Cottus immaculatus* and *Elassoma gilberti*, newly described species now total 97 (n=97); with addition of *Campostoma spadiceum*, resurrected synonyms now total 28 (n=28)

Table 6 North America: update 16% Critically Imperiled to 16.5%, and 4% Extinct or Extirpated to 3.5%; México: update 27% Apparently Secure to 26.5%, 16.5% Imperiled to 16%, and 25% Critically Imperiled to 26%

pg. 26 **Fig. 14** with addition of *Campostoma spadiceum*, Mississippi = 419 species (42% endemic); with additions of *Pteronotropis* cf. *hypselopterus* and *P*. cf. *metallicus*, Southeastern = 302 species (39% endemic); with additions of *Xiphophorus* cf. *couchianus*, *Gambusia zarskei* and *Cyprinodon julimes*, Rio Grande = 161 species (54% endemic); with addition of *Algansea amecae*, Central México = 225 species (still 63% endemic)

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