Egg Mimicry Observed in Slimy Sculpin *(Cottus cognatus)*

Ray Katula, Onalaska, WI
missfish_aqua@hotmail.com

The Sculpins of the family Cottidae represent a large number of species found in the Northern Hemisphere with about 250 species; the majority of these are found in marine waters. Their freshwater range encompasses North America and northern Eurasia with 33 species found in North America. Several forms have been found in caves and more species, subterranean or not, will likely be described in the future. The majority of the species found in fresh water are in the genus *Cottus* with a few species, primarily on the West Coast, that can also occur in brackish water. Identifying the species of this seemingly generic family can be extremely difficult. The *Peterson Field Guide to Freshwater Fishes* (Page and Burr 2011) likewise reports this is a difficult family to diagnose due to varying factors such as prickles on the skin that differ from habitat to habitat. Furthermore, diagnostic characteristics sometimes merge and other traits such as palatine teeth require microscopic examination.

The sculpins are a fascinating group of benthic fishes and primarily found in cool-water streams and deep lakes. They can make fascinating aquarium inhabitants, but several criteria need to be addressed for their proper care. All species require cool water to some degree, good aeration, and filtration is a must. If fellow tank inhabitants are being considered, they must be of proper size and temperament to avoid the predatory nature of these interesting fish. Spawning sculpins in aquaria is not all that difficult providing they can be overwintered properly and well conditioned.

This article primarily focuses on the Slimy Sculpin (*Cottus cognatus*) [see pages 14-15] and includes observations I have made on the species utilizing egg mimicry during spawning. I will also discuss circumstantial evidence that other species might be utilizing egg mimicry as well. The Slimy Sculpin has a wide distribution that includes isolated populations occurring farther south of where their habitat requirements of very cold water occur. Many sources of literature theorize that slimies exist in remnant populations since the glaciers of the last ice age retreated and they persist only in cooler spring-fed streams whereas in colder global periods the species was likely more widespread. Currently the Slimy Sculpin's range includes eastern Siberia, throughout Alaska, and most of Canada (Figure 1). In the lower 48 states, where extirpations are suspected, the species occurs as far south as Idaho, Montana, Iowa, Illinois, and Virginia. NatureServe Explorer (2011) ranks the species' status as Vulnerable in Washington, Iowa, New Jersey, Connecticut, and Labrador; Imperiled in Indiana and Virginia; and Critically Imperiled in Illinois, West Virginia, and Prince Edward Island. Majeski and Cochran (2009) reported on the extirpation and subsequent recolonization from relict populations or reintroduction into Garvin and Gilmore creeks (Winona Co, MN). They postulate the extirpations occurred in the late 1800s to early 1900s following widespread deforestation which reduced groundwater input and increased stream water temperatures. Despite surveys in both streams, Slimy Sculpin were not reported in Garvin Brook until the mid-1970s and Gilmore Creek in 1989.

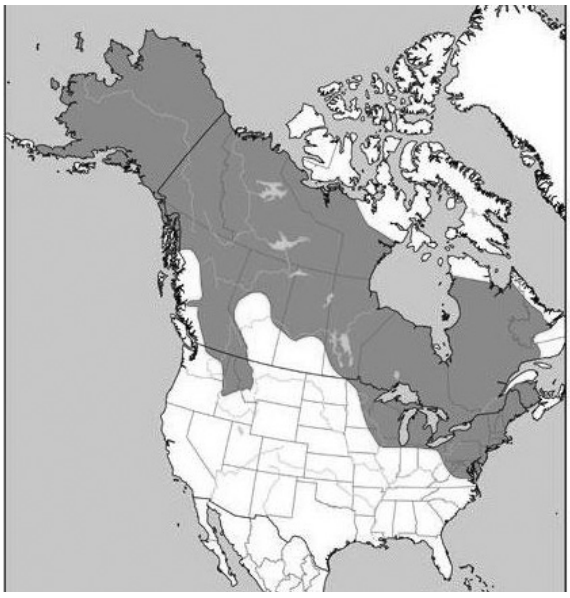


Figure 1. Range of Slimy Sculpin

Slimy Sculpins occur in the Great Lakes and smaller cold, deep lakes ranging from shallows to depths greater than 30 m (Figures 2, 3). Some investigators thought populations in lakes differed from those found in streams, but Lyons (1990) reported there was no variation to distinguish distinct forms or species. One subterranean form of a possible Slimy Sculpin was discovered in a Pennsylvania cave with reduced eyes and transitional troglomorphic characteristics. Hybrids of Slimy and Mottled Sculpin (*Cottus bairdii*) have been reported.

The Slimy Sculpin's habitat includes cool, spring-fed streams or deep, cold lakes. Substrates can vary where more northern populations have been reported over mud (Morrow 1980) and most populations further south found over cobble, gravel, and occasionally sand as long as there are cover types of logs, detritus, or overhanging banks etc. In Garvin Brook (Winona County, MN), I have collected slimies in some vegetation (mostly watercress) over substrates of cobble to gravel. While juveniles can often be encountered in more open areas, adults prefer substantial cover. Seining in streams can be problematic, but dipnetting and electrofishing are much more effective when, and if. legal.

Furthermore, I have found dipnetting at night to be more productive than during the day. This is due to the sculpin's foraging habits when they venture out into open areas away from cover. Scanning the streambed with a flashlight will reveal sculpins if they are present. The light temporarily blinds them and easy pickings to scoop with a dip net. Since they are more often than not found in trout streams be aware of local collecting laws. In Minnesota and Wisconsin, special permits are required to collect in designated trout streams. In some cases, minnow traps are legal only during established fishing seasons and should not be overlooked as an alternate method.

The Slimy Sculpin requires water temperatures lower than Mottled Sculpin (Johnson 1972). The average temperature in Wisconsin in summer was 13.8° C (Becker 1983). In the wild, slimies mostly feed on insect larvae, especially midges and also take worms, small crustaceans, clams, and snails. Small fish and fish eggs are rarely taken (Jenkins and Burkhead 1994). I have noted on many occasions, usually after summer storms, numerous slugs washed into the waters of Garvin Brook and wondered if the sculpin took the opportunity to feed on this abundant, albeit temporary, food source. The icy cold water likely shutdown the slug's metabolism and prevented their chance of escaping from the water. Most southern Slimy Sculpin populations mature at two years of age, but populations in Alaska take four years. The oldest fish reported was age 7 (Craig and Wells 1976). The largest specimen reported was 127 mm/5.0 in TL in Saskatchewan (Morrow 1980). I could not determine where the common name was derived from and cannot rank the slime coats of other species.

In the spring of 1999, Konrad Schmidt and I used a backpack electroshocker in a St. Croix River tributary called Valley Branch near Afton, MN (Figure 3). We captured several Slimy Sculpins from the site and retained six larger specimens of what I determined to be two males and four females. We also caught and released several American Brook Lamprey (*Lampetra appendix*), Rainbow Trout (*Oncorhynchus mykiss*), Brown Trout (*Salmo trutta*), Brook Stickleback (*Culaea inconstans*), and last but not least, Central Mudminnow (*Umbra limi*). Konrad told me that Brook Trout (*Salvelinus fontinalis*) were found there, albeit likely further upstream. We transported the fish to Konrad's house where he kept a few additional specimens to photograph and shortly afterwards I drove two and a half hours home without losing a single fish. The sculpins were placed in a 29-gallon aquarium with undergravel filters in my basement where temperatures in early spring were in the mid 40s F. Numerous rocks provided cavities for hiding and potential spawning sites. The sculpin were fed a diet of glassworms and whiteworms. Females were easily distinguishable due to their ripened conditions and smaller size in comparison to the males. Prior to spawning, the males developed a dark, black body with a bright, orange band in the first dorsal fin. Using a programmable timer, aquarium lights mimicked sunlight providing a gradually increasing photoperiod (day length). On the evening of April 13th, I peered inside the sculpin aquarium using a flashlight to monitor activities. At first glance inside the dark cavities I thought, "Fantastic, they laid some eggs." I pondered my next move. Do I remove the adults or remove the eggs? However, after checking again with the

Figure 2. Lake Superior Slimy Sculpin shoreline habitat

Figure 3. Valley Branch Slimy Sculpin habitat

flashlight I realized I was wrong. The second dorsal fin of the male sculpin was lit up like a Christmas tree and "mimicked" a clutch of sculpin eggs. Excited, I checked a few more times throughout the evening. The next morning I noticed real eggs deposited in the cave. The male was giving the eggs his undivided attention by fanning them constantly. I also observed the "fake" eggs in the dorsal fin had vanished. Apparently once the "deed is done" there is no need to show off any longer.

After this unexpected observation, I searched the literature for egg mimicry in sculpins and found one account by Dr. Carol Johnston (2000) of Auburn University in her life history study on the Pygmy Sculpin (*Cottus paulus*). She believed she had observed egg mimicry while snorkeling in an Alabama spring which is the species' entire range. It later dawned on me that I may have witnessed this while spawning the Reticulate Sculpin (*Cottus perplexus*) in early 1990s (Katula 1990-1991). Just prior to spawning, the second dorsal of this species had an elaborate decoration of wavy lines, which in hindsight did somewhat resemble a clutch of eggs. Immediately after egg laying the dorsal fin display faded as what occurred in the Slimy Sculpins.

During a collecting trip to Missouri in early April of 2010, we (Bob Hrabik, Konrad Schmidt, Nick Proulx, Lance Merry, and Todd Crail) collected that region's version of a Mottled Sculpin from the Castor River drainage. The second dorsal fin of what I believed to be a male had small red spots which can be an indication of egg mimicry. I have observed red spots in the dorsal fin of male Longfin Darters (*Etheostoma longimanum*) while spawning the species in aquaria. The Longfin Darter's second dorsal fin lights up during spawning and displays a uniform pattern of red spots. In a cave, these red spots perfectly duplicate a cluster of eggs. Other egg-mimic darter species are well documented, particularly among the *Catanotus* subgenus. Subsequent spawning of the Mottled Sculpin collected in Missouri occurred in the spring of 2011, but I did not detect any obvious egg mimicry. However, the mild shifting of color/shade tones in the second dorsal fin did faintly hint of egg mimicry. This behavior has been documented in the Sharpnose Sculpin (*Artedius harringtoni*) of the North Pacific Ocean, but occurs in the anal fin (Allen et al 2006). Also, if one looks at the sculpin dorsal diagrams shown in the Fishes of Virginia (Jenkins and Burkhead 1994) it is easy to imagine the second dorsal displays that is likely subdued outside of spawning period as drawn representing a clutch of sculpin eggs. But getting back to the spawning Slimy Sculpins, I noticed there were two clutches of eggs deposited in the one nest. Egg numbers were difficult to assess, but I estimated 75 to 100 eggs per clutch. In the wild, up to ten clutches have been found in a nest (Morrow 1980; Heufelder 1982). In early spring of 2004, I attempted to duplicate the Slimy Sculpin spawning and this time used a video camera to hopefully capture the events on film. We (Konrad Schmidt and I) captured fish from the same locale. Unfortunately, I missed the spawning act because I did not have the camera running 24/7. They did spawn within a day or two of aquarium introduction. The filming did give some insight to brooding behavior without an audience to intimidate them. The male vigorously aerated the clutches waving every fin he could utilize as well as the posterior portion of his body. It must have been extremely excruciating on his body. Another male in the aquarium was constantly chased away from the egg cave and eventually removed to allow the dominant and nesting male to concentrate on egg care. The eggs hatched in about 25 days, but

the fry quickly succumbed to unknown causes. More than likely it was due to rising temperatures of the fish room; the adults also expired shortly afterwards. I did not have a chiller at my disposal and with the natural warming temperatures of late spring the cold loving slimies could not survive. However, many other sculpin species I have kept survived summers without a loss.

Conclusion

There appears to be different forms of egg mimicry utilized within the sculpins (Cottidae). Future research will hopefully affirm my observations and determine how extensive this behavior may occur in other species. Obviously this behavior would not be obligatory for all species. For the subterranean species this behavior would be useless as well as for the Deepwater Sculpin (*Myoxocephalus thompsonii*) since at depths where they occur, little if any light would penetrate. Also, the mimicry display appears to be very temporary. Immediately after eggs are laid the "eggs" in the dorsal fin vanish in the two species I have observed.

Special thanks go out to all the individuals who helped obtain specimens for this study including Konrad Schmidt, Robert Hrabik, Nick Proulx, Ramus Wolfe, Todd Crail, Lance Merry, and others I might have forgot to mention.

References

Allen, L.G. Horn, H. M., and Pondella, D.J. 2006. Ecology of Marine Fishes: California and Adjacent Waters. Nature. 660 pp.

Becker, G.C. 1983. Fishes of Wisconsin. University Wisconsin Press. Madison, WI. 1052 pp.

Craig, P. C., and J. Wells. 1976. Life history notes for a population of slimy sculpin (*Cottus cognatus*) in an Alaskan Arctic stream. Journal of the Fisheries Research Board of Canada 33:1639–1642.

Heufelder, G. R. 1982. Family Cottidae, sculpins. Pages 656–676 *in* N. A. Auer, editor. Identification of larval fishes of the Great Lakes basin with emphasis on the Lake Michigan drainage. Great Lakes Fishery Commission Special Publication 82-3, Ann Arbor, MI.

Jenkins, R. E., and N.M. Burkhead. 1994. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, Maryland. 1079 pp.

Johnson, M. 1972. Distribution of Sculpins (Piscess: Cottidae) in Iowa. Proceedings of the Iowa Academy of Science 78(3-4): 79-80.

Johnston, C. E. 2000. Allopaternal care in the Pygmy Sculpin (*Cottus pygmaeus*)**.** Copeia Vol. 2000, No. 1 (Jan) pp. 262-264.

Katula, R. S. Dec. 1990-Feb. 1991. Spawning of the Reticulate Sculpin, American Currents. pp. 13-15.

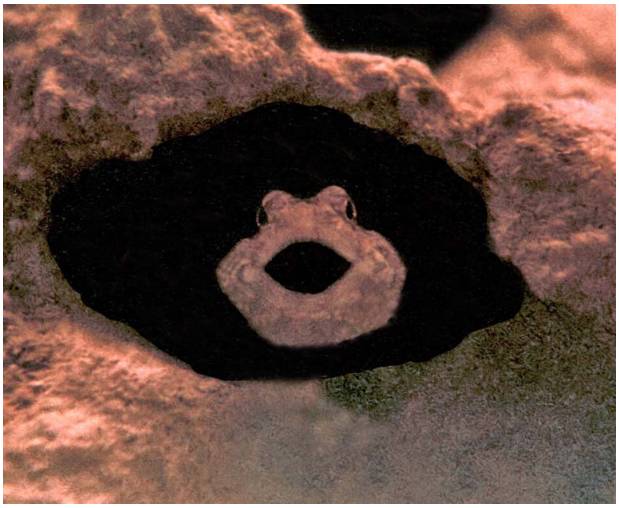
Lyons, J. 1990. Distribution and morphological variation of the Slimy Sculpin (*Cottus cognatus*) in the north-central United States. Canadian Journal of Zoology 68:1037-1045.

Majeski, M.J., and Cochran, P.A., June, 2009. Journal of Freshwater Ecology, Spawning Season and Habitat Use of Slimy Sculpin (*Cottus cognatus*) in Southeastern Minnesota, Volume 24, Number 2.

Morrow, J.E. 1980. The Freshwater Fishes of Alaska. Anchorage, Alaska: Alaska Northwest Publishing Company. 300 pp.

NatureServe. 2011. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: April 9, 2012).

Page, L.M., and B.M. Burr 2011. Peterson Field Guide to Freshwater Fishes. Houghton Mifflin Harcourt, Boston, New York, 663 pp.



Barking Mottled Sculpin *(Cottus bairdii)*
Konrad Schmidt

Slimy Scuplin: Valley Branch - Washington Co, MN (left). Saganaga Lake - Cook Co, MN (right)

Slimy Sculpin: Lake Superior - Ashland Co, WI: male (left)/female (right)

Photos - Konrad Schmidt