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New discovery leads to a whole new meaning of “trash fish”

Fishes are the most abundant vertebrates and new species are being described every month. One new species has been living right under our noses and has actually evolved to live with our trash. Students at Oregon State University were conducting a trash cleanup on the Mary's River in Corvallis, when they noticed small fish inside of bottles and cans that were pulled from the river. At first, they feared the fish were becoming trapped in trash. Human garbage polluting rivers and oceans is a serious issue. The giant Pacific garbage patch is a well known problem and sea life washing up on beaches dead and full of plastic is commonplace. Microplastics can bioaccumulate in fish and we can ingest them when we eat seafood. The microplastic issue is not limited to oceans. It have been found in rivers, including in both the water and the sediment (Lin et al 2018). After the students found several dozen of these small fish, they decided to alert the local fish experts, Dr. Sid and his class of ichthyology students.

The class visually identified pictures of the fish as sculpin similar to those in the family Cottidae, then contacted the Oregon Department of Fish and Wildlife to assist with collecting specimens. A swimming hole near where the trash cleanup had occurred was located and therein, the students found their quarry. Almost every piece of glass or plastic with an opening had a small sculpin in it. Several of the fish were sacrificed for

science by killing them with MS-222, an anaesthetic, and many were taken alive for observations.

Back in the laboratory in Nash Hall, at Oregon State University, the work continued. Short sequences of mitochondrial RNA from the newly discovered fish were compared to those of the torrent sculpin (*Cottus rotheus*), a morphologically similar sculpin that lives in the same area. The fishes were found to be closely related but were genetically dissimilar enough that a new species name is being considered.

Sculpin are small, bottom-dwelling fishes that dart about eating whatever can fit in their mouth. They hide in rocky areas for shelter from predators and for ambushing prey. Their wide pectoral fins enable them to cling close to the bottom and their posterior-placed dorsal and anal fins allow extra thrust when pouncing upon smaller fish or insects. They are generally mottled brown and black, however, the new species has bright green sides along with brown and black coloration. The morphology of the new fish is also different from other sculpins. The head, while still large compared to the body, has become slightly smaller. This may help it more easily enter and exit the mouths of the bottles and cans which it inhabits. The pectoral fins are also not quite as large since it doesn't spend as much time on the bottom of its environment (see figure 1). As the sculpin grows, it must seek out a larger bottle, much like a hermit crab outgrows its shell. The ultimate size of the fish seems to be limited by how large we manufacture container openings. It is worth noting that the world record was found inhabiting a pickle jar.

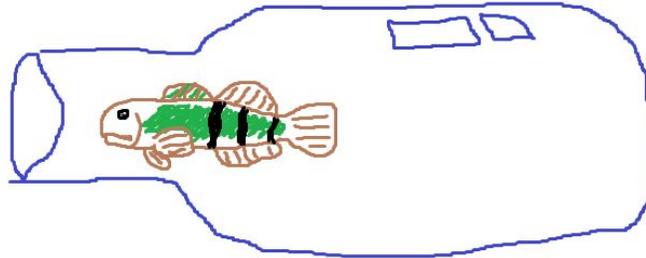


Fig. 1: Artist's rendition of the genie sculpin in all of its glory

After winning a generous National Science Foundation research grant for their groundbreaking discovery, the ichthyology class performed behavioral studies on the new green, trash-dwelling sculpin and *Cottus rotheus*. The fish were kept together in tanks with a variety of habitat available for their use, including empty beer bottles, which the students seemed to have a surplus of at home. The little green sculpin, which were dubbed “genie sculpin” by the young researchers, quickly occupied the empty bottles. Only a single fish occupied each bottle and several violent battles were fought over ownership. It was then that the variation in green coloration present in the genie sculpin specimens was found to be a case of sexual dimorphism. The brighter green male fish occupied empty containers while the less brightly colored female fish did not have a

preference between living in a bottle or staking out a territory in the rocks among the torrent sculpin. Sculpin will fiercely defend territories. Petty and Grossman described territoriality in adult mottled sculpin for food resources in a North Carolina stream (2011).

The bright green color of the genie sculpin is thought to be used by males for displaying when battling for a choice beverage container and to further attract female sculpin. The male genie sculpin kept their bottles bright and clean. They diligently removed algae and detritus by brushing it off with their large pectoral fins. Amazingly, the fish bred in captivity and showed male parental care. The males with the brightest coloration and shiniest bottles were visited most frequently by females, who laid their eggs in the male's bottle. The males then fertilized and guarded the eggs until they hatched. The fry fed on the food scraps of the males until they were large enough to disperse on their own. Kierl and Johnston found that mate choice in pygmy sculpin, another stream-dwelling fish from the family Cottidae, was influenced by the intensity of male coloration. The male pygmy sculpin with the brightest colors had the best body condition. Body condition of male sculpin determines how well they can care for their eggs (2015). The males of the round goby, another benthic-dwelling fish with large pectoral fins, fan their eggs to prevent fungus from growing on them (Wantola et al. 2013). The ability of male genie sculpin to fan algae from their bottles may demonstrate their egg-fanning potential to females. The torrent sculpin did not interbreed with the genie sculpin, though they inhabited the same tanks; however, this did not surprise the researchers. 2 sculpin species in South Korea that look very similar and live in the same

rivers don't interbreed because of their different life histories (Baek et al 2018). Researchers found that 2 populations of threespine stickleback on Vancouver Island were genetically distinct from each other because of their different habitat choices in addition to the physical distance between the populations (Weber et al. 2016). The genie sculpin may have evolved its life history strategy to take advantage of the ecological niche presented by ever-increasing human litter. Female mate choice may have driven the evolution of green coloration in the genie sculpin and a review by Tinghitella et al suggests that competition between male fish plays a large role in divergence between species (2018).

What does a fish that lives in a discarded container eat? Whatever it "can"! The little fish isn't picky and will eat almost anything that fits in its mouth. Observations in the wild have confirmed that the genie sculpin sits in the mouth of its container and waits for food to swim or drift by. It then uses its large tail and posterior-placed fins to dart out and grab its prey. Small fish and insects that venture past a genie sculpin's bottle usually meet an unfortunate end.

The discovery of a new species does not come without controversy. Because of the lack of interbreeding with other species and the genetic distinctness of the genie sculpin, it has been proposed as a new species. This will surely be debated hotly by ichthyologists and taxonomists the world over. Meanwhile, students from the University of Oregon were recently suspected of visiting Nash Hall with the intent of stealing a specimen of the genie sculpin. The specimens have since been kept in a vault in the depths of the ichthyological collection with a guard of volunteers until the fish can be

formally described. The student with the highest grade in the OSU ichthyology class this term will have the honor of officially naming the new fish. Test scores increased significantly after this announcement. Currently, the ichthyology students are engaged in an ongoing discussion about the ethics of reaching out to beverage companies for sponsorship opportunities. Textbook companies are eagerly awaiting a formal description so they can add the genie sculpin to new editions of ichthyological textbooks, which will be sold at premium prices to future students.

Fish management agencies are working on conservation plans for the new species of sculpin. The first step is to identify where the species exists. A problem arose with survey methods. Conventional fish sampling methods such as seining and electro-fishing were found to be ineffective for sampling this species. The most reliable way of finding them involves hand-collection of litter. So far, the Oregon Department of Fish and Wildlife, aided by the infamous ichthyology class has found 3 more populations in nearby rivers. A tagging study confirmed that the fish will swim many miles to locate suitable habitat, which is often in an urban stretch of stream or a popular swimming hole. The US Fish and Wildlife Service is considering a petition to list the genie sculpin under the Endangered Species Act because of the low number of known populations and the ongoing threat of trash cleanup events, which remove essential habitat.

After learning about this amazing discovery by aspiring scientists, we decided to join the OSU ichthyology class for a day of field sampling. A new population was discovered in the Calapoia River in Albany and the class set out to conduct a population count. The students donned waders and polarized sunglasses and placed

bets on who would find the first fish, the most fish, and so on. The path to the site was muddy and lined with thorny blackberry bushes. There was a steep drop down to the water, which didn't look any less muddy. After 5 minutes of searching, Fisheries and Wildlife student Drew Chione let out a victorious yell and held up a clear glass bottle. Inside could be seen a small wriggling fish. "It helps to look for shiny objects since their homes are usually made of glass or aluminum and the sculpin keep them clean" Drew said. After a couple empty cans, he found an occupied plastic gatorade bottle. "It's important to put them back the way you found them" he said as he made a tally in a notebook and carefully placed the litter back into the shallow water near the bank. The class recorded the type and color of the occupied containers they found. So far, the fish prefer clear or blue bottles, when available, with shiny aluminum cans being a close second. We asked Drew what his goals are for his education and career and if he wants to continue studying fish. He informed us that he wants to restore rivers. He told us that "rivers have been polluted and degraded and if we do more to protect and restore them, maybe fish won't have to live in our trash."

Plastic pollution in rivers is not studied as much as in oceans and while the genie sculpin may benefit, other fish may not (Blettler 2018). So, think twice the next time you think of hurling that candy bar wrapper or soda can into a river or down a storm drain!

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