Flashlight Fish in Captivity

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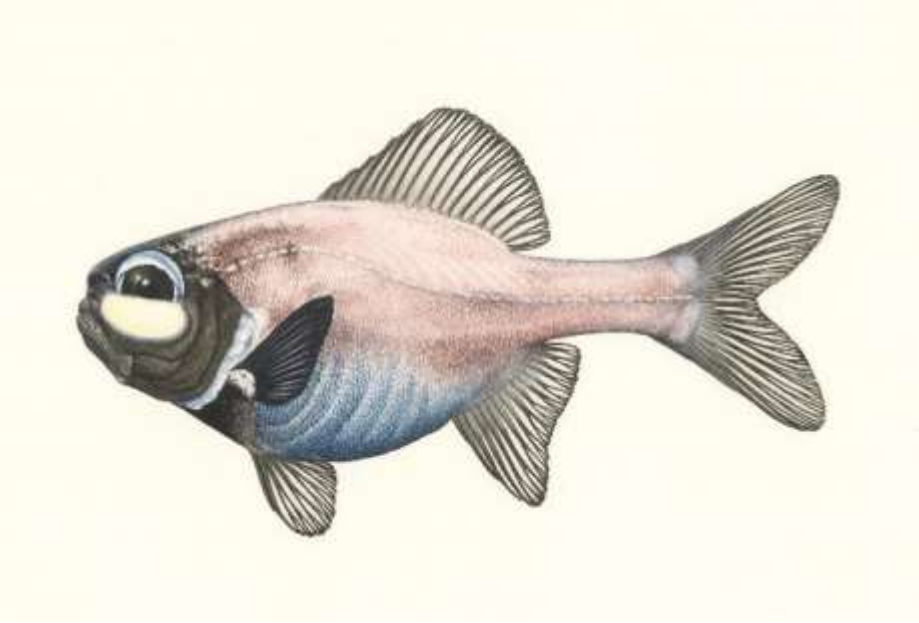
C. 2020

Introduction

Flashlight fish, with their eerie green glowing photophores (light emitting organs), are arguably one of the most unique fish available to marine aquarists. One of only two families of fish kept in aquariums that are bioluminescent (the other being the pinecone fish), flashlight fish hold a strong fascination for many people, myself included. I worked with them over 30 years ago at the John G. Shedd Aquarium, and we have exhibited these at the Toledo Zoo Aquarium since 1990. Rarely a day goes by that I don't enter the curtained area in front of their darkened exhibit just to enjoy them for a few minutes.

While not impossible to keep in the home, public aquariums are generally better suited to meet the care requirements of this group of fish. Home aquarists wanting to keep flashlight fish need to be willing to make some concessions in order to meet their husbandry needs. A flashlight fish purchased on a whim, and casually added to an un-modified aquarium will almost always perish in short order.



Photoblepharon palpebratum – drawing by Marcos Oliveira

Natural History

Sometimes called Lanterneyes, the flashlight fishes, belong to the order Beryciformes, which also includes the pinecone fishes, squirrelfishes and roughies. There are nine species of flashlight fish, all in the family Anomalopidae (Fishbase 2011). Flashlight fish possess a light organ called a photophore, beneath each eye. Inside this organ is a colony of luminescent bacteria that constantly glows with an pale green light. The flashlight fish can obscure their light organs either with a shutter mechanism or by rotating the light organ, effectively turning the lights on and off.


Flashlight fish at the Toledo Zoo and Aquarium – Martin Dorhn, Ammonite Productions

Bioluminescent fishes have four primary ways for which they use their lights: To communicate with one another, to better see their prey, to confuse predators and to lure their prey to within reach. Unlike most species that use bioluminescence for a single reason, it's been reported that flashlight fish use their lights for all four (McCosker 1977). In my opinion, they only use their lights for two reasons; to see their food and to help maintain a cohesive shoal as they swim above a dark reef. Their lights are not bright enough, nor do they remain on long enough, to attract their invertebrate prey. Their lights actually serve to draw unwelcome attention from predators. That's why these fish have developed a "blink and run" strategy. They unshutter their photophores, take a quick look around for any food, then obscure their light organ and dart off rapidly in a new direction. Thus, any predator attracted to their light ends up where the flashlight fish was, not where it is now.

The bacteria which live in the flashlight fish's photophores belong to the family *Vibrionaceae* which contains members that are pathogenic as well as symbiotic. The *Vibrios* are a notorious group of gram negative bacteria; from causing the disease cholera, to producing Tetrodotoxin (TTX) that makes some fish poisonous, to being implicated in coral bleaching events. The actual species harbored by flashlight fish has not yet been maintained in culture, but research by Dr. Tory Hendry using material gathered from the flashlight fish exhibit at the Toledo Zoo has given the name Ca. *Photodesmus katoptron* strain:Akat8 to the bacteria. The "Ca." is short for "Candidatus", showing that this is just a candidate species until it can be cultured for further study. She discovered that this species has a very reduced genome, meaning that it is wholly dependent on the host fish to supply its energy needs (Hendry 2014).

Anomalops katoptron – close-up of photophore. Image by Jay Hemdal

Four species of flashlight fish have been reportedly kept in aquariums:

Atlantic flashlightfish, *Kryptophanaron alfredi* – Tropical Western Atlantic. Collected by public aquariums only a few times, this species is not available in the pet trade.

Single fin flashlight fish, Eyelight fish, *Photoblepharon palpebratum* – Tropical Western Pacific Ocean. Rarely seen in the pet trade, this species has a photophore that is "on" and then is blinked "off". This results in their lights are uncovered most of the time, making them a better display animal. One specimen lived at the Toledo Zoo Aquarium for over 18 years before being sent to another facility. This species seems to do best at a water temperature of around 73 degrees F. When this species is kept at greater than 78 degrees for long periods, their feeding response is greatly diminished, and the fish begin to show signs of stress.

Red Sea flashlight fish, *Photoblepharon steinitzi* - Western Indian Ocean, Red Sea. The first collections of flashlight fish for public aquariums were probably of this species (McCosker 1977). This species is sometimes shown on collector's price lists from this region, so this species has most likely entered the pet trade.

Splitfin flashlightfish, *Anomalops katoptron* - Western tropical Pacific Ocean. This species is by far the most commonly seen flashlight fish in the pet trade and at public aquariums, but it is also the most delicate. Additionally, the photophores of this species are normally covered, so they are normally "off" and then blinked "on" for only a brief instant. The genus name is occasionally misspelled as "*Anomolops*" (including in an early paper by myself!).

Anomalops katoptron – photo by Jay Hemdal

When to Buy a Flashlight Fish?

Flashlight fish are normally not collected around the time of the full moon, because it takes a dark night to bring them closer to the surface where divers can catch them. Data from 16 scientific collections made of flashlight fish since the 1970's showed that on average, the fish were collected within 5 days of the new moon.

Since you want to get a flashlight fish that was very recently collected, (so it will have the best chance of retaining bright lights) you should try to buy one within one week of the previous new moon phase.

It has been reported that flashlight fish are more commonly collected during October in the Philippines when the surface waters are cooler (McCosker 1987). However, purchase information for ten shipments of flashlight fish at the Toledo Zoo, spanning twenty years, showed that 40% were acquired in December, while 60% were acquired during late spring and early summer.

Captive Care

Flashlight fish are almost always a special order item. This is a good thing, as it makes it less likely that an aquarist will purchase one on impulse. Since you will need to plan for their arrival, you'll have time to do things right. When your tank is ready, contact your dealer and have them order the fish from an importer. In turn, the importer may need to ask the exporter to acquire the fish. Since home aquarists typically order one or a few flashlight fish, this process may not always work. Public aquariums, who often order dozens of fish at one time can sometimes work back through the supply chain and prompt the collectors to go after these fish

for them. An alternative is to monitor the stock of online fish vendors and order one and have it shipped to you.

It should go without saying that flashlight fish should be transported and acclimated to their new home while being kept in as near total darkness as possible. The aquarium housing these fish must either be kept dark 24/7, or possess deep cave areas where the flashlight fish can congregate during the day. Quarantine tanks can be draped with black plastic sheeting to keep the fish dark.

Water temperature is an important parameter for flashlight fish in captivity. Although these fish are normally found in tropical regions, in captivity, they thrive at lower temperatures. Probably due to their high dissolved oxygen requirements (and cooler water can have more oxygen dissolved into it) flashlight fish seem to maintain their lights best at around 72 to 74 degrees Fahrenheit. If kept above 80 degrees, captive flashlight fish may begin to lose their lights as they struggle to receive enough dissolved oxygen to supply their symbiotic bacteria.

Initiating a good feeding response in newly acquired flashlight fish is often a problem. These fish have not fed during their transport to you, and each day that goes by without food increases the chances they will lose their lights due to lack of food energy for the luminescent bacteria. A study showed that the photophores of *Anomalops* dimmed with starvation of the fish, and the lights were completely lost after three weeks of no food (Meyer-Rochow, 1976a). Since it is probable that the flashlight fish has not been fed for 10 to 14 days as it traversed the supply chain from the collector, and because it takes a few days to get them accustomed to captivity once they arrive, there is very little margin of error in terms of getting them feeding enough to sustain the bacteria. Live mysid shrimp, *Americamysis bahia* is the best starter food, but are expensive and difficult for some aquarists to acquire. Live baby guppies or mollies also work fairly well as a starter food. Live adult brine shrimp, *Artemia sp*. is a poor third choice. In some cases, even without live food to start them off, flashlight fish will learn to feed on frozen mysis and small krill soon enough that their photophores are not damaged, but this is generally not the rule.

Sometimes, the aquarist's actions trying to confirm that they feeding (such as peeking at them with a small penlight or using a red room light) will cause problems. Better to just keep the fish totally dark and hope for the best, than to potentially put them off their feed by lighting the tank enough to be able to observe them eating.

Once the fish have begun feeding well on live foods, the introduction of frozen mysis and small krill can begin. Flashlight fish should be fed at least twice a day, (actually, "twice a night" is more accurate!). Since you cannot see them eat, it is difficult to judge how much food to add to their aquarium. It's better to err by adding too much food and removing it later with a fine mesh fishnet. Supplementation of their food with products that contain Highly Unsaturated Fatty Acids (HUFAs) is done by many public aquariums.

Once a flashlight fish's photophores have dimmed and gone out, (through lack of food or exposure to medications) the light rarely returns on its own. Luminescent bacteria, *Vibrio* (*Photobacteria*) *fischeri* is available from biological supply houses as a pure culture. I explored the idea of adding these bacteria to aquariums in an attempt to "re-light" the photophores of flashlight fish. Only limited success was seen in flashlight fish, although the technique did seem to help redevelop the photophores of pinecone fish (Hemdal 1992).


Pineconefish – Jay Hemdal

Little is known about the compatibility of flashlight fish with other species as they are most often kept in single-species aquariums. Presumably, they would be very similar in nature to a squirrelfish of the same size; so they will eat small shrimp, but will leave other fish alone if they are too large to swallow. *Photoblepharon sp.* have been seen to become seasonally aggressive towards other flashlight fish. This is thought to be related to spawning activity. All flashlight fish seem to do best if housed in a group. In fact, blinking a small light at a tank full of these fish will cause them all to respond by blinking more rapidly – as if they are communicating in some fashion. That said, it is difficult to determine how fish kept in a darkened aquarium are actually getting along. When large groups of flashlight fish are housed together, it is not unusual to discover a dead one from time to time – with all the markings of having been attacked by a tank mate. It may well be that flashlight fish are similar to red-bellied piranha – in forming loose aggregations, but still with a lethal amount of in-fighting from time to time.

Despite their specialized care requirements, I was once able to maintain a single flashlight fish in an unlighted ten-gallon aquarium with a half Tridacna shell as a daytime hiding place. I had "rescued it" from a local pet store that was unequipped to house the fish. This flashlight fish would spend the day under the shell, and would come out to feed at night when all the room lights were off. It lived for over a year in that tank, but died due to an equipment malfunction.

Diseases

While flashlight fish are fairly resistant to protozoan and bacterial infections, they are extremely susceptible to a variety of multicellular parasites; gill and skin flukes, internal parasites and sometimes copepods. All flashlight fish should be quarantined for at least six weeks, and given three preventative treatments with Praziquantel spaced 14 to 21 days apart (far enough apart to kill any trematodes arising from un-hatched eggs). Praziquantel has been used on flashlight fish at doses ranging from 2 to 4 ppm as a constant bath.

Never use ethanol as a solvent for the Praziquantel; bacteria may grow in the water, using the alcohol as a food source, and in turn stripping oxygen from the water. Flashlight fish have very high oxygen requirements and multiple reports of them being "sensitive to Praziquantel" have been attributed to oxygen deprivation when alcohol was used as a solvent (Hemdal 2006).

Formalin can also be used as a treatment as it does not seem to affect the luminescent bacteria to any great degree. However, this medication is toxic to people, difficult to handle and often does not break the life cycle of the parasites.

Obviously, you should never expose flashlight fish to antibiotics if the goal is for the fish to retain its bioluminescent bacteria. Likewise, copper treatments will also harm the glowing bacteria. Most importers house their flashlight fish in their invertebrate systems so that they are not exposed to copper.

Over the years, three odd animals have been found living in or on flashlight fish. Upon necropsy, *Anomalops* are often found to have a pair of trematode-like worms living in their gall bladder. It is unknown if these cause the fish any real harm. Tiny sea anemones were once found living on the skin of a group of flashlight fish. These anemones did not seem to cause the fish any discomfort, and when removed, the anemones lived for many months in a container of seawater, so were not truly parasitic. The body cavity of one freshly deceased flashlight fish was found to contain dozens of Cirolanid copepods. There are a number of copepod species around the world that are voracious micro predators on injured or aging fishes. They often enter through the anus (or other orifices) and consume a fish from the inside out.

The Mystery of the Giant Flashlight Fish

Most flashlight fish species are reported to reach a maximum size of around 4 ½" (12 cm). However, Fishbase give the maximum size for *Anomalops katoptron* of 13 ¾" (35 cm). Despite this size record, even after a decade of growth, *Anomalops katoptron* reach no larger than 4" in captivity (pers. obs.). One very large flashlight fish was shipped from the Cook Islands to an importer, and then to the Toledo Zoo, but it was dead on arrival and its body was not retained. By my recollection, this fish was around 8" (20 cm) long. It is possible that this fish was actually a different, recently described species, *Protoblepharon rosenblatti* (Baldwin et-al, 1997). *P. rosenblatti* was described on the basis of one specimen collected in the Cook Islands that was 9" (23 cm) long and was collected at a depth of 900' (274 m) using hook and line. Could juveniles of this species occasionally stray into shallower water and be collected along with *Anomalops*?

One researcher, (McCosker 1987) speculates on the issue of the "giant *Anomalops*". He states that such a size differential between shallow and deep-water forms is "without parallel." But seems to conclude that the large and small forms are the same species. His paper precedes Baldwin's by ten years, and he did not have access to the captive growth information mentioned above, so it is still possible that the deep and shallow water forms comprise separate species. The California Academy of Science's web site (where McKosker worked) shows an image of one of these giant flashlight fish; it looks to be as tall as man's hand is wide, and about 14" long.

Reproduction

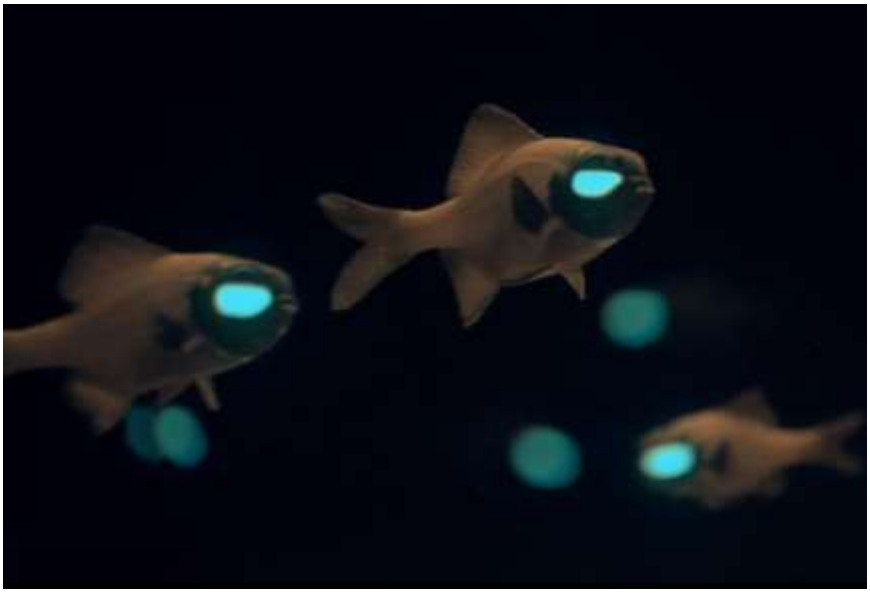
Little is known about the reproduction of flashlight fish other than they are egg layers, and that post-flexion juveniles have been found. One public aquarium reported that they thought *Anomalops* was a mouth brooder. They had examined one of their fish that had recently died,

and found a mass of eggs in its mouth. However, genetic testing showed that the mass of eggs was actually from a smelt and had gotten tangled in the flashlight fish's gill rakers while it was feeding. Spawning *Photoblepharon palpebratus* (Boddaert) was observed in captivity in 1976. Females were found to be slightly larger than the males, with rounded caudal fins. Spawning was observed around the new moon in April and May. Up to 1000, 1.2 mm eggs were produced. After a 5 – 10-hour planktonic existence, the eggs were reported to continue their development while adhering to the substrate in the aquarium (Meyer-Rochow, 1976b). No information is available regarding post-hatch flashlight fish larvae.

Conclusion

In light (pardon the pun) of my experiences in maintaining flashlight fish's photophores at full luminosity, I feel it is important to provide these fish with a completely dark environment, copious nutritious foods, (but avoid grossly overfeeding) maintain a stable, relatively low temperature of 72-74 degrees F., and quarantine all new flashlight fish with a prophylactic treatment of Praziquantel.

If you do decide to acquire flashlight fish, you'll be in for a real challenge, but also an unparalleled aquarium-keeping experience. During the day, your aquarium will look no different than any other, but imagine sitting in a darkened room in front of your aquarium, watching the eerie green glow of your flashlight fish as they blink their lights on and off and dart around your aquarium looking for food. If you are willing to meet their stringent care requirements, flashlight fish may well be **"the best fish you'll never really see".**



Photoblepharon palpebratus – Martin Dorhn, Ammonite Productions

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