

Walleye Culture – Habituation to Feed in the Dark

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Walleye (*Sander vitreus*) are notoriously difficult to culture intensively because juvenile fish are difficult to train to formulated feeds. Reports of poor feed acceptance, poor survival and cannibalism are common in walleye literature dating back to the '60s. To avoid the difficulties of feed training these voracious predators, walleye are commonly stocked as fry or pond fingerlings to avoid losses. However, data generated by Iowa Department of Natural Resource (IDNR) researchers has shown time and again that continued stocking with advanced (8+ inch) is needed to maintain year class strength in most Iowa impoundments. Over the years, it's been shown that stocking larger fish has created better fishing in the state of Iowa, and as a result, demand for large fingerling walleye remains high. Although the IDNR's Rathbun Fish Hatchery (RFH) had cultured many cool- and warmwater fish species, because of the difficulties of fingerling culture, researchers relied on fry and small fingerling recruitment to maintain the walleye population in Rathbun Lake. However, in 1985, collapse of the Rathbun Lake walleye broodstock population forced the RFH to establish an intensive walleye culture program. Since then, Rathbun fish culturists have sustained efforts to improve walleye culture techniques used at the hatchery. In this note, one key aspect of the RFH walleye culture method –eliminating overhead light during feed training – will be described

Walleye are typically cultured using a tandem pond/tank culture technique. Fry are stocked in fertilized ponds to forage on zooplankton until they reach a size of 1.5-2 inches. This is done to avoid the labor- and cost-intensive process of culturing fry with formulated feeds or bring shrimp. The fingerling walleye are then harvested and moved to culture tanks where they are habituated to formulated feeds. Once feed trained, the fish can be kept in culture tanks for continued grow-out to meet the production needs of the individual hatchery or culturist.

Typically, the biggest bottleneck in this process is the habituation of pond-reared fingerlings to formulated feeds. To ensure maximum habituation success, you must first begin with fingerlings that are in good condition and of a certain size. In our experience, fingerlings weighing

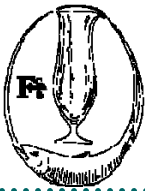


between 0.5 to 0.65 g survive very well compared to smaller fish; though larger fingerlings might fare even better, larger size classes are not routinely harvested from our ponds. Second, you must have a habituation diet that is both nutritionally complete and highly palatable to ensure feed acceptance and good survival. Of the various diets we have evaluated for feed training walleye, Otohime C2 diet (Reed Mariculture, Campbell, CA) yields the greatest survival rates in our hatchery. After 10 days on Otohime C2 diet, we gradually transition the fingerlings to Walleye Grower 9206 diet (Nelson and Sons, Murray, UT).

The third, and perhaps most crucial element of our success was the adaptation of RFH's fingerling culture room into a darkroom with submerged lighting (DSL). In the past, RFH's tank room was well-lit by south-facing overhead windows and fluorescent lights over each tank. After blocking the windows and overhead lighting with a



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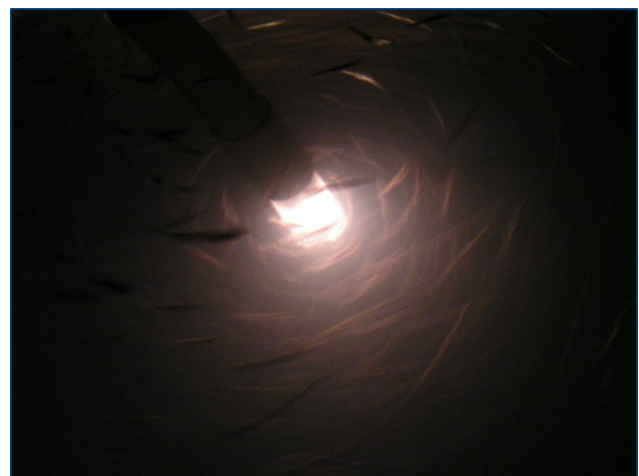
plastic ceiling, we installed submerged lighting fixtures (see construction guide for details) in each of the culture tanks. We recently conducted a production scale study to evaluate habituation survival of walleye cultured in a DSL environment compared with the survival of walleye cultured under full illumination of the tank room. Results from the study showed that survival increased by 63% for walleye habituated under DSL conditions compared to those habituated under standard conditions with overhead lighting. Additionally, we saw improved growth rates in the DSL. Results from this study prompted the immediate conversion of 24 of our raceways to the DSL configuration.

What is the significance of this research? Although other researchers (Nagel 1976, Kuipers and Summerfelt 1994, Malison and Held 1996) have described use of similar lighting conditions to enhance walleye culture, our evaluations are the first to provide tangible data supporting the use of DSL conditions during walleye feed training. For RFH, conducting this research was an important step in changing the operation and functionality of our indoor facilities. The data was the deciding factor in our current plans to construct a retractable cover and sidewalls for use during walleye habituation – not a small or inexpensive project to undertake.

But don't rely on just one success story – others have used our techniques with similar results. Success story number one is that culturists at Spirit Lake Fish Hatchery (IDNR, Spirit Lake, Iowa) have used the DSL environment the past two years to increase growth rate of walleye fingerlings during habituation and grow out. Success story number two is that Dr. David Bergerhouse (Quad Cities Spray Canal Project, Cordova, IL) produced several thousand walleye for mussel glochidia attachment experiments using the DSL environment and reported excellent survival results. In his words, "We used the system similar to Rathbun's and it worked."

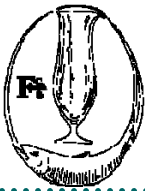
So why does it work? Walleye have a highly reflective tapetum lucidum-- although this adaptation increases visual acuity in low ambient light environments (Lawrence and Strange 2002), exposure to bright light can cause interference and blur vision. Think "deer in headlights"—the eyeshine you see in the deer's eyes (and freezing in front of your oncoming bumper) is the result of tapetum lucidum interference. This problem is made worse by the

fact that walleye have no means to occlude light or escape light in a tank environment. Fish Anatomy 101: fish don't have eye lids, nor do they have a pupil that dilates to reduce light coming into the eye. Humans can't fully comprehend how dark and light are perceived by a walleye, nor how stressful intense light can be to walleye. Additionally, walleye are easily startled in response to overhead movements and shadows (Malison and Held 1996). After the stress of pond harvest, the DSL is more suitable for recovery and increases the likelihood that the fish will see and recognize the prepared feeds as food.



There are marked differences in walleye behavior when cultured using overhead lights vs. those that were cultured using DSL environments. The most notable behavioral differences of walleye cultured under a DSL environment is that they no longer race from end to end of the tank when you walk by or fill the feeder. Rather, they will continually swim around the submerged light waiting for feed to fall into water, where it is readily consumed. It's interesting to note that even in a raceway, the fish will swim in circles around the light and the direction appears to be random among raceways.

For facilities dedicated to walleye culture, we recommend converting full illumination culture rooms to DSL conditions, and that traditional overhead lights only be turned on as needed for cleaning or other maintenance. For example, at RFH, one incandescent light located at the rear of the raceway is turned on during tank cleaning. We discovered that when rear lights are turned on, fish tend to avoid the work area, making it easier to remove uneaten



feed and fecal material. Other tasks, such as calibrating and filling autofeeders, administering disease treatments, etc., are performed using lighting from personal headlamps. In all cases, work in the dark room should be scheduled to minimize the frequency and duration of disturbances to the walleye.

Various designs of submerged lights have been reported and many of the designs appear adequate. Our light system entails using a piece of two-inch PVC pipe with a 150 mm clear PVC section at the bottom and a 4.3 watt bulb (13 volts AC) positioned in the center of the clear section. The fixture is attached to the tank wall with the bulb placed at mid depth in the raceway. At the RFH, the raceways are 4,588-L (3 ft x 3 ft x 18 ft) and positioning the fixture as described provides 21 to 25 lux of light at the tank wall, 46 cm from the light. The system is powered by a low voltage transformer used forandscape lighting. Each light fixture can be constructed for about \$19, and the low voltage transformer that can power at least 24 light fixtures costs \$119 (Table 1). The entire culture area can be converted to DSL conditions, or individual raceways may be covered and lit with submerged lights. However, we have found that removing and replacing individual tank covers “spooks” the fish, and daily fish inspections may be easier if the entire room is converted to a dark room.

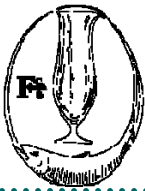
In summary, walleye habituation survival can be improved by (1) using quality walleye fingerlings for habituation, (2) feeding walleye a highly palatable habituation diet, and (3) culturing walleye under DSL conditions. We believe our production-scale research demonstrates that walleye feed training success can be substantially improved by using these techniques. From a broader perspective, our findings underscore the importance of taking the adaptations of different species into consideration when designing a culture facility. With an inexpensive light system and a roll of black plastic sheeting, hopefully you can increase your success in culturing walleye.

For more information about constructing a DSL environment, please contact Alan Johnson at alan.johnson@dnr.iowa.gov



Tips and tricks:

Specific measurements were left out so that you could customize the light fixture to your tank or raceway. We position the light at mid-depth in the water column. The length of the PVC and the dowel rod depend on water depth, tank freeboard, and mounting device. Remember, DO NOT glue the top PVC endcap that holds the dowel rod and light bulb, it should slip freely so the light bulb can be replaced when it expires. The Delphi connector is really nice, but you could also start out with simple male and female spade connectors.



Item	Supplier	Supplier Part #	Unit Price	# Needed Per Tank	Price Per Tank
Delphi Weather Pack Connector					
plug	McMaster-Carr	9171T19	1.97	1	1.97
receptacle	McMaster-Carr	9171T24	1.41	1	1.41
pins	McMaster-Carr	9171T12	0.33	2	0.66
sockets	McMaster-Carr	9171T14	0.36	2	0.71
wire seals	McMaster-Carr	9171T15	0.27	4	1.08
Lampholder SPC21723	Newark	16M1214	2.57	1	2.57
Lamp (GE 1893/BP2)	Grainger	3BA72	1.23	1	1.23
PVC Pipe schedule 40 white	McMaster-Carr	48925K16	1.48/ft	1.67	2.46
PVC Cap	McMaster-Carr	4880K56	1.00	1	1.00
PVC Pipe Clear	McMaster-Carr	49035K88	6.72/ft	0.5	3.36
PVC Coupling	McMaster-Carr	4880K76	1.16	1	1.16
Cotter pin	McMaster-Carr	98401A421	0.03	1	0.03
Wood Dowel	McMaster-Carr	9683K15	0.81	1	0.81
Outdoor lighting cable	McMaster-Carr	5744K21	0.34/ft	2.5	0.85
Zip tie	McMaster-Carr	7130K12	0.02	1	0.02
				Fixture Total	\$19.34
Transformer 600 watt (Intermatic Inc, ML600TW)	Home Depot	100004842	119.00	1	119.00
Extraction Tool	McMaster-Carr	9171T7	6.00		6.00
Crimper	McMaster-Carr	9171T9	34.18		34.18

Table 1. Parts list for light fixture assembly, connections, and transformer for submerged light system used at Rathbun Fish Hatchery for habituation of pond-reared walleye fingerlings.

References

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