channel catfish OF to see if sperm performance was enhanced and 2) assess if sperm behaved differently when exposed to OF from individual females.

To explain briefly, sperm from four males were activated under the microscope without OF (control) and with OF from six unique females, creating 24 experimental crosses (Fig 1A). Sperm motility (% of sperm moving in a frame) and velocity (swimming speed in µm/s) were analyzed during each trial using computer assisted sperm analysis (CASA) software. Videos were taken every 10 seconds until sperm motility ceased. The results showed that OF had an immediate positive impact on sperm velocity when compared to the control. Not only that but by 30 s post-activation when motility had ceased for all the controls, sperm were still readily moving for all the OF treatments (Fig. 1B). In all cases, OF always increased longevity, causing the sperm to swim for up to several minutes. An interesting thing to note was that longevity was greatly affected by the specific OF sperm was activated in (Fig. 1C). In other words, interactions between males and females greatly skewed sperm performance in each trial. Not all pairs performed equally, with differences in longevity of up to 100 seconds between the best and worst pairs.

So in conclusion, our overall results show that female channel catfish OF differentially enhances behavior of blue catfish sperm. From this study, we discovered how important female OF is during fertilization, although there are still questions to be answered on how and why these interactions occur. We can also ask if such differences in sperm performance affect fertilization and hatch success for fry production. Do the best-performing pairs also have higher fertility? Only future research could tell us for sure. On a broader scale perspective, this knowledge can hopefully be applied to improve hybrid catfish aquaculture and also expand on our current knowledge of the remarkable reproductive strategies found in freshwater fishes both in hatcheries and the wild.

Improving Catfish Pond Water Quality by Reducing Planktivorous Fish Abundance

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In highly productive aquaculture ponds, conditions for phytoplankton blooms are intensified. The presence of increased nutrient availability, shallow waters with regular mixing through aeration, warm temperatures, and high intensity sunlight common in these settings often leads to dense blooms of phytoplankton throughout most of year. However, cyanobacteria (also commonly called, blue-green algae) often dominate the phytoplankton community during the growing season (May-October) and can negatively affect aquaculture production through the release of off-flavor compounds, such as geosmin and 2-methylisoborneol (MIB), and toxins, such as the liver toxin microcystin and/or neurotoxin saxitoxin. In extreme cases, phytoplankton blooms can promote hypoxic conditions when they degrade and lead to fish kills that can devastate producers' livelihood. Catfish aquaculture ponds may include catfish of mixed sizes due to incomplete harvesting as well as intentionally or unintentionally introduced planktivorous fish, such as threadfin shad, gizzard shad, bluegill, green sunfish, and/or fathead minnows. Reports suggest that some planktivorous fish eat and possibly control phytoplankton, although there is a long history of research that shows that these fish eat zooplankton (small animals that consume phytoplank-

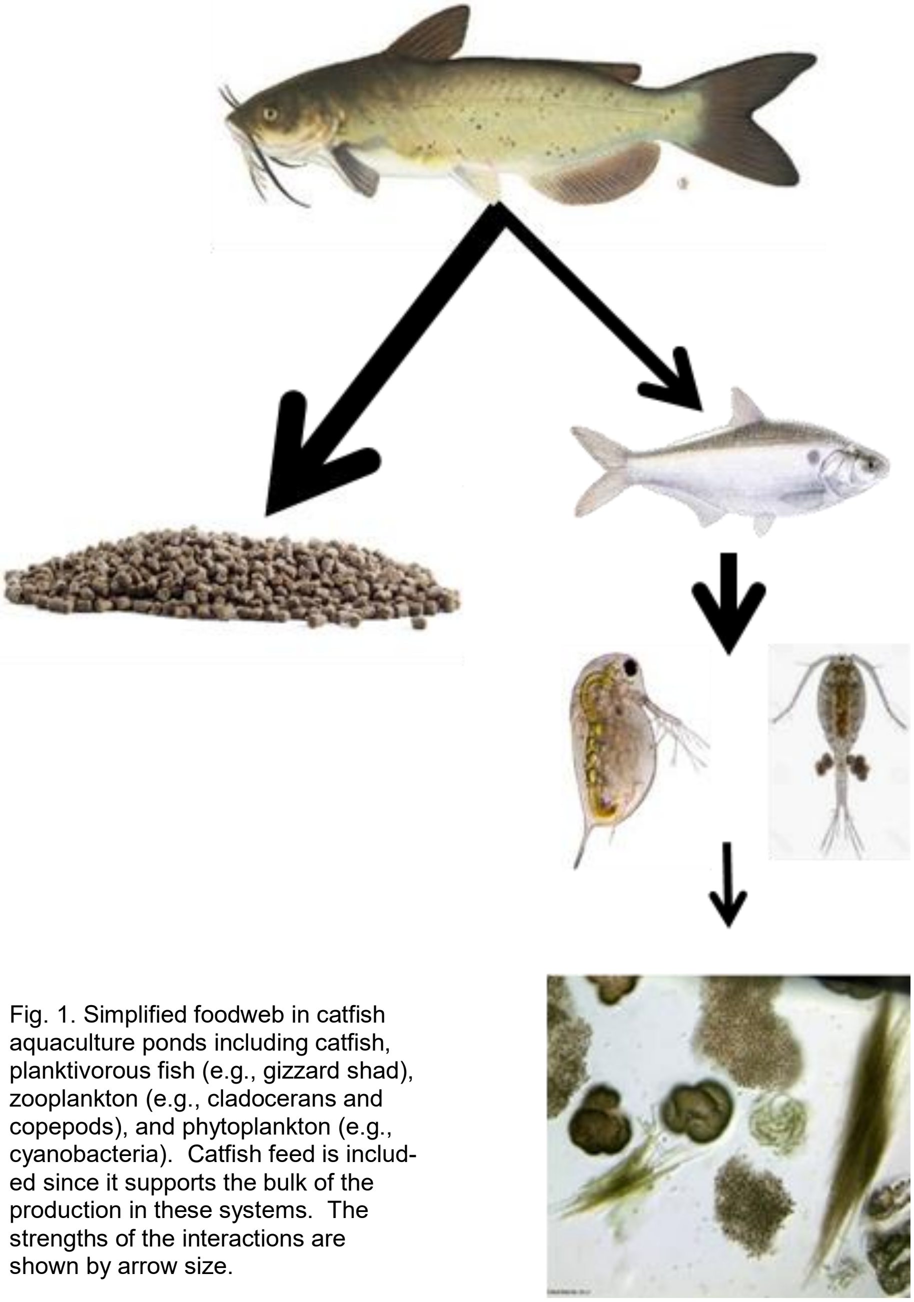

Fig. 1. Simplified foodweb in catfish aquaculture ponds including catfish, planktivorous fish (e.g., gizzard shad), zooplankton (e.g., cladocerans and copepods), and phytoplankton (e.g., cyanobacteria). Catfish feed is included since it supports the bulk of the production in these systems. The strengths of the interactions are shown by arrow size.

ton; Fig. 1 and 2), especially large-bodied taxa (e.g., *Daphnia*) that have been shown to heavily consume phytoplankton, including cyanobacteria. When planktivorous fish are present in a pond, their primary diet consists of zooplankton although they may eat residual feed not consumed by catfish. The catfish feed contains nutrients, such as nitrogen and phosphorus, that become available for phytoplankton after passing through fish or as the feed degrades. However, when the planktivorous fish are absent, zooplankton thrive and may control phytoplankton (also called a trophic cascade). When one level of the ecosystem has been altered, it will directly and indirectly affect the rest of the system.

Over the past two years, our sampling efforts of more than 20 catfish production ponds in which several have reduced or eliminated planktivorous fish prior to stocking show strong and clear effects of these foodweb manipulations, namely that ponds with less planktivorous fish lead to higher densities of large-bodied zooplankton and clear water, whereas ponds with abundant planktivorous fish have less zooplankton and much higher concentrations of phytoplankton (Fig. 2). There are numerous factors that influence the development and persistence of phytoplankton blooms, such as excess nutrients and elevated temperatures (both common features of catfish production ponds); however, we contend that the presence of small planktivorous fish are an important and feasible component that can be managed (i.e., remove planktivorous fish) to reduce phytoplankton blooms by allowing the natural control of phytoplankton in highly productive systems thus significantly improving the water quality in the ponds by affecting the formation, frequency, and intensity of cyanobacterial blooms.

Although we argue that foodweb manipulations that reduce or eliminate planktivorous fish should be considered as a pond management tool in aquaculture, we acknowledge the important role that phytoplankton can play in maintaining a healthy pond environment, namely by producing dissolved oxygen through photosynthesis or taking dissolved nutrients that can poison fish, such as ammonia and nitrite. Green productive pond water is not necessarily indicative of a bad system; however there is a chance, especially in the summer months, a bloom of cyanobacteria could be present. Thus, we encourage producers to work closely with extension personnel and researchers to monitor water quality to avoid situations that could harm fish especially considering that relatively clear aquaculture ponds are unusual at most farms. Our lab doors are always open to support aquaculture farmers.

Fig. 2. Zooplankton (second level) and phytoplankton (third level) samples from aquaculture ponds with abundant small, planktivorous fishes (such as gizzard shad; left side) or few to no planktivorous fishes (right side). Zooplankton photos were taken at the same sample volume and magnification (see scale bar for reference) from green or clear ponds. Zooplankton in green ponds were less abundant and dominated by copepods compared to clear ponds that included abundant, ambient large-bodied zooplankton, such as *Daphnia*.