

Buckeye Aquafarming

The Ohio State University South Centers

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Upcoming Events

Aquaponics 101-Teachers Workshop
 Auburn, AL
 July 9-13, 2018
alearn.info

Intensifying Pond Production of Fish
 Marysville, OH
 July 14, 2018
ohioaquaculture.org/events

Ohio State Fair
 Columbus, OH
 July 25-August 5, 2018
ohiostatefair.com

Ohio Fish and Shrimp Festival
 Urbana, OH
 September 15-17, 2018
fwfarms.com/festival

Farm Science Review
 London, OH
 September 18-20, 2018
fsr.osu.edu

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Mini-aquaponics: engineering a more sustainable world through education and implementation



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Global Overview

It is a well-known fact that the global human population is expanding. By 2050, the Earth will be supporting close to 10 billion people according to the United Nations. The Midwestern United States plays a major role in providing food, fiber, and fuel for people worldwide. Beef, pork, poultry, corn, soybeans, and wheat are supplied domestically and exported internationally. However, globally there are roughly one billion people who rely on fish as their primary protein source (World Health). Although most of these individuals reside in developing countries, the Midwest is well poised, with its established commodity distribution infrastructure, to dramatically increase aquaculture production and supply to reduce the overall cost of seafood products globally.

To complicate issues, increasing urbanization in conjunction with a burgeoning global population means that less people are farming, but demand is increasing. *(continued on page 2)*

Mini-aquaponics: engineering a more sustainable world... (continued)

The average American is three generations removed from the farming lifestyle (American Farm Bureau). Farm families now make up less than 2% of the U.S. population, but more farmers are needed to produce the required amount of food (American Farm Bureau). In a time where people lack the general understanding of where their food comes from, much less how to produce it themselves, the world needs innovation in aquaculture. By implementing agricultural engineering solutions, we not only educate the public about agriculture industry, but we progress toward a more secure and sustainable future for food production.

Importance of STEM

STEM (Science, Technology, Engineering, and Mathematics) education is being promoted across the United States, and for good reason. Many jobs in the future economy are based in these skills, yet less and less students are interested in pursuing careers in them. The number of engineering degrees awarded since 1985 has decreased by 20% (Mullich, J.) and there are roughly 3 million unfilled STEM jobs nationwide. The U.S. is only generating about 300,000 university STEM graduates annually (Vindis, M.), and an increasing number of them are international students who come to the U.S. to obtain their degree (Beard, K). To stay competitive in the global marketplace, the U.S. needs to have more skilled and educated people in STEM fields.

To boost STEM student engagement, there are several methods educators can add to their teaching repertoire. Discussion and inquiry, hands-on learning, and integrating technology in the classroom all help introduce problem solving and enhance critical thinking. By developing these skills, students are more likely to choose a STEM discipline as a career. Aquaponics is a technology that can be easily integrated into a classroom and meet these

Increased engagement in STEM will help ready the next generations for the challenges facing a growing world population and allow the U.S. to remain competitive in the global economy.

objectives. Increased engagement in STEM will help ready the next generations for the challenges facing a growing world population, and allow the U.S. to remain competitive in the global economy.

Aquaponics is an excellent tool to teach STEM concepts, with a large number of STEM-based skills

that can be demonstrated compared to many other topics in science. These include chemistry, design evaluation, stoichiometry, statistics, technology transfer, and many more.



Aquaponics captures the imagination and empowers people to expand and hone their skills because it is scalable from the bench-top hobby aquarium to the commercial production scale.

Mini-Aquaponics

Mini-Aquaponics was a project made possible by Iowa State University Extension and College of Agriculture and Life Sciences through the Science with Practice program, an independent research program specifically geared toward enhancing STEM education at the undergraduate level. The goal of the project was to promote public education and empowerment by engineering a cost-effective, small-scale aquaponic system, and deliver it to the public through workshops, videos, and publications.

To start, a prototype was developed by ISU Extension for a hands-on aquaponic system construction workshop. Workshop participants were surveyed via Qualtrics to assess the quality of design, scale, budget, and desired production volume so that a refined system could be developed. Two new prototypes were developed based on the survey results. The first system is an economy model, built to fit a budget range of \$30-\$100 and fit on a benchtop. This low-investment, low-risk system fits the needs of many first-time aquaponics learners. The economy system was designed for workshop applications for beginners, including a companion extension publication (FA 0014). (continued on page 3)

Mini-aquaponics: engineering a more sustainable world... (continued)

The second design is the deluxe hobby model, catered to fit a budget of \$500+ and produce supplemental greens and vegetables for a small family. The deluxe system was designed for use in a household or classroom and has a video guide series for construction currently underway. The deluxe model was used for a cost analysis and production potential study (Tables 1 and 2).

Survey results from workshops to construct the economy system revealed that the mini-ponics project is reaching a wide range of individuals. The workshops extended to individuals ranging from under 18 to over 65 years of age, with both males and females and multiple ethnic groups represented (Figures 1 and 2).

Summary

Mini-aquaponics plants a seed of interest in the minds of youth and adults alike, helping establish a connection between the general public and the aquaculture industry. By raising consumer awareness and engagement, mini-ponics can help cultivate a positive market response to the aquaculture industry. Additionally, mini-ponics makes STEM concepts accessible, tangible, and interesting for students and teachers alike. By implementing aquaculture innovations and education, we can contribute to a more sustainable future in food production, one small step at a time.

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Table 1: Cost Analysis

Cost Analysis	
Component	Cost
System (one-time)	\$391.27
Electric (Annual)	\$49.43
Feed (Annual)	\$136.40
Fish (one-time)	\$16.50
Seed (Annual, Basil)	\$7.95
Water Chemistry Kit (Annual)	\$24.99
Total	\$626.54

Table 2: Production Potential

Production Potential				
Crop Variety	Retail Price (\$/oz.)	Days in System	System Capacity (Plants/Cycle)	Net Value
Bibb Lettuce	\$0.44	30	15	\$628.20
Sweet Basil	\$3.99	45	33	\$1,052.48

Figure 1: Age Demographics

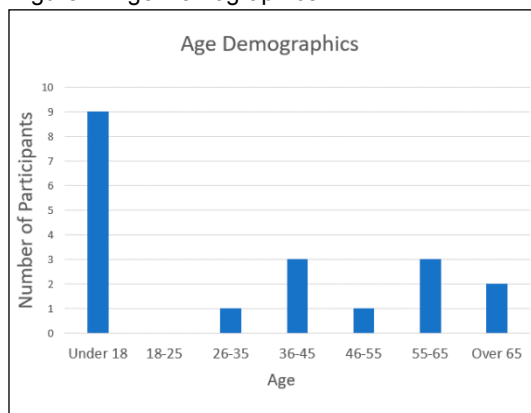
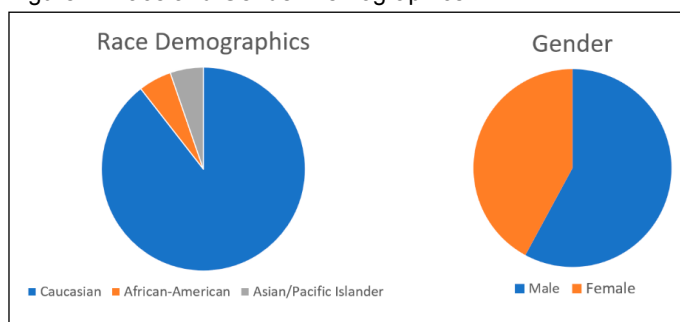


Figure 2: Race and Gender Demographics



Update for Aquaculture Boot Camp-2

By Jordan Maxwell¹ and Emma Wiermaa²

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²Aquaculture Outreach Specialist,
University of Wisconsin-Stevens Point

The Ohio State University South Centers, in partnership with Ohio Aquaculture Association and University of Wisconsin-SP, has successfully started the second year of Aquaculture Boot Camp-2 (ABC-2). The program offers a multi-faceted approach, including classroom and hands-on training, paired with industry mentoring to enhance the sustainability of new and beginning aquaculture/aquaponics and next generation farmers in the Midwest. The ABC-2 2018 Intensive class consists of 35 highly motivated fish farmers and aquaponics producers from across Ohio and West Virginia. The individuals selected consist of educators, business owners, researchers, students, and more, offering a broad spectrum of experience and knowledge.

The kick-off session held in February offered students and their business collaborates an in-depth look into aquaculture/aquaponics production planning, business plan structures, and market identification. The students toured the OSU South Centers' newly updated aquaponics system and research facility, where they will be actively involved in throughout the year.

ABC-2 students also traveled to Fresh Harvest Farm, owned by Doug and Jeni Blackburn, in March for a tour of their aquaponics facility and a full day of learning. Matthew Smith, Aquaculture Extension Specialist, covered key principals of aquaculture and aquaponics in the morning while guest speaker Brad Bergfeld, Horticulture Specialist at the OSU South Centers, talked about plant selection and considerations in aquaponics. The afternoon breakout sessions focused on harvesting, packaging, legal considerations in aquaponics, system components and construction, and successful fish husbandry practices.

The third session held in April at the OSU South Centers combined business and biology. Hannah Scott, the CFAES Center for Cooperatives Program Manager, gave an overview of cooperatives and their structure while Brad



Bapst, the Small Business Development Center Director, dove into cash flow. The afternoon breakout sessions offered the students a hands-on opportunity to learn about yellow perch spawning, egg ribbons, artificial fertilization, and fry estimation with the South Centers research assistants. Matthew Smith introduced Recirculating Aquaculture System (RAS) and Biofiltration to the students and walked through the South Center's aquaponics system design.

UW-Stevens Point has collaborated with Ohio State University, Wisconsin Aquaculture Association, and Nelson and Pade, Inc. to offer Wisconsin's first Aquaculture Boot Camp. 35 applicants have been selected that include educators, horticulturists, hobbyists, current aquaculture producers, researchers, and business prospectors. The applicants represent not only Wisconsin, but also Minnesota and Illinois. The session locations include UWSP Campus, UWSP Northern Aquaculture Demonstration Facility (Bayfield, WI), UWSP Aquaponics Innovation Center, and Nelson & Pade, Inc. (Montello, WI) and Lac du Flambeau Tribal Hatchery. The two first sessions had an attendance of over 30 students.

The second session of their ABC was in collaboration with the Wisconsin Aquaculture Association Conference and focused on product marketing and labeling. Speakers were brought in from commercial businesses of both Wisconsin and Minnesota such as Superior Fresh, Urban Organics, and Plymouth Springs Fish Company. Other speakers represented Wisconsin Department of Natural Resources, Virginia Tech, Wisconsin Sea Grant, Kasco Marine, Clayton Veterinary Care, and The University of Minnesota. *(continued on page 5)*

Update for Aquaculture Boot Camp-2

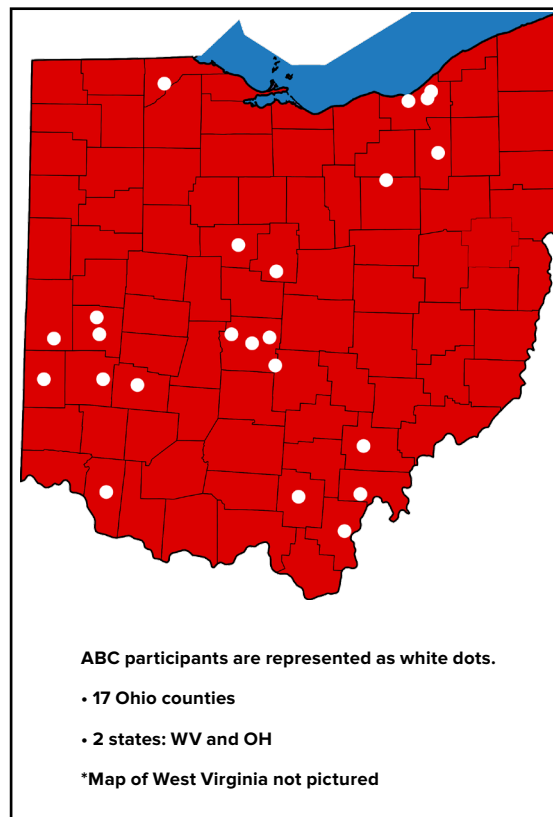
Future sessions will bring in speakers representing companies including Global Aquaculture Alliance, YSI, Skretting, Kasco, and private industries. Various topics include reproduction and fry production, pond culture, water quality, plant & fish health, aquaponics, species selection and feeds, harvesting and processing, and recirculating aquaculture systems.

The OSU South Centers and UW-Stevens Point anticipate future sessions throughout the year and look forward to working together to bring ABC students the most up-to-date industry information and practices. For more information about ABC-2, please contact Ms. Jordan Maxwell, ABC-2 Program Coordinator, at maxwell.411@osu.edu



2018 Intensive program participants

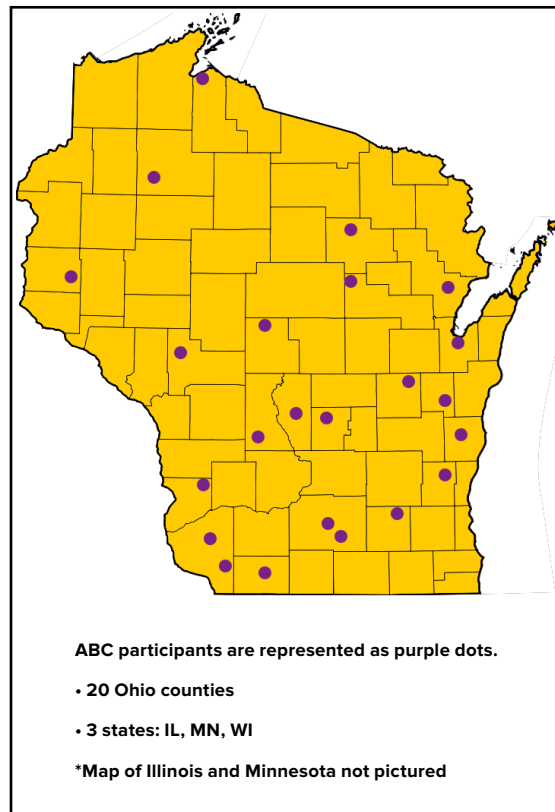
Peter Aldag Columbus
Joe Beringer Batavia
Brett Boothe Gallipolis
Kevin Calhoun Cleveland
Suzanne Csejtey Columbus
Theodore R. Darden III Shaker Heights
Tony Dean Cleveland Heights
Steve Frigon Batavia
Penelope Frigon Batavia
Marion Goetze-Lambes Piqua
Andrew Goodwin Athens
Raymond Hicks Gahanna
Amanda Hill Marion
Chris Holt Marengo
Samule Jones Jackson
Judy Jordan Eaton
Kevin Klawon Troy



Jeffrey Kurtz Maumee
Matthew Maline Columbus
Peter Mokmane Parkersburg, WV
Ryann O'Bryant Cleveland Heights
Chris Peugeot Columbus
Janeen Sands Columbus
Amadou Sarr Canal Winchester
Maxwell Slater Columbus
Mark Swann Parkersburg, WV
Julian Swann Parkersburg, WV
Geri Unger Cleveland
Alexander Valigosky Cuyahoga Falls
Gardner Watkins Hilliard
Kimberly Wildman Xenia
Eva Wiley Arcanum
Adam Woirol Langsville
Ron Zickefoose Creston

2018 Intensive program participants

Jeff Bakken Cross Plains
Tracy Bartels Chilton
Linda Bertz Marshfield
Phil Bertz Marshfield
Jeff Bohlen Northfield
Jen Boush Watertown
Lucas Bradburn Westfield
Scott Cooper Plymouth
Matt and Holly Engel Adams
Bob Feiden Platteville
Gordy Gotsch Dundee, IL
Pam Green Neenah
Andrew Horner Soldiers Grove
Joseph Koch Wilson
Sue Menzel Couderay
Jim Moran Neenah
Ethan Noordyk Green Bay



Matt Pedersen Duluth, MN
Susan Priebe McFarland
Amanda Prine Darlington
Dave Reto Ashland
Eric Rusch Elcho
Jennai Rusch Elcho
Kaleb Santy Onconto Falls
Michael Schab Niles, IL
Kelvin Schmidt Stitzer
Jesse Schroeder Watertown
Rachel Schroeder Watertown
Sam Spotts Elroy
Bob Weed Aniwa
Ryan Weed Green Bay
Tony Wierl West Bend
Gina Younk Elcho
Phil Younk Elcho

The University of Wisconsin-Stevens Point hosts a workshop on pond culture

By Emma Wiermaa, Aquaculture Outreach Specialist, University of Wisconsin-Stevens Point

Pond Culture Workshop

While nationally the aquaculture industry continues to expand, growth of the Great Lakes region's aquaculture industry has slowed. Many new and existing fish farmers cite a need for technical training and dissemination of current production knowledge. University of Wisconsin-Stevens Point has been funded by the UW Sea Grant Institute to increase workforce training and education for environmentally and economically sustainable Great Lakes aquaculture. Specific objectives of the project are to develop a series of three-to five-day teaching modules based on topics the Great Lakes aquaculture industry has identified as deficient in current education offerings, and deliver these teaching modules using online lectures and in-person workshops for direct technology transfer. One of the topics identified was pond culture. (continued on page 7)

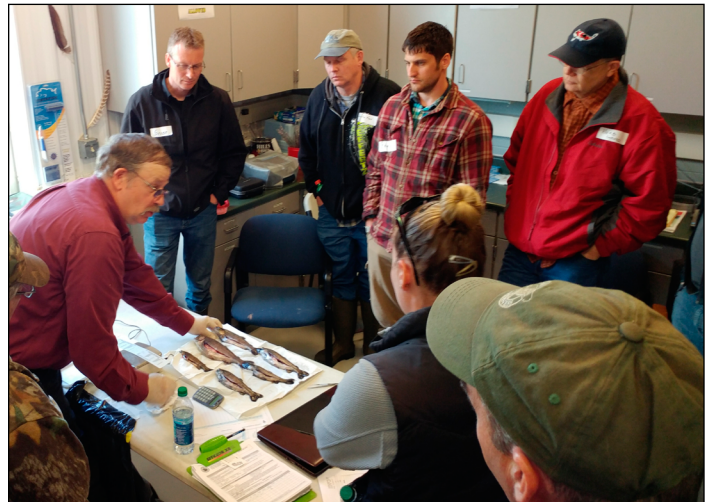


Attendees at one of two hands-on pond culture workshop trainings. Specific activities and topics included small fingerling to extended fingerling walleye production, seining and harvesting techniques, pond fertilization and vegetation management, plankton sampling, clay-lined vs lined pond management, and forage minnow feeding. Both events included a pond aeration demonstration by Kasco Marine, and fish health demonstration by Clayton Veterinary Care.

The University of Wisconsin-Stevens Point hosts a workshop... (continued)

Last summer, UW-Stevens Point Northern Aquaculture Demonstration Facility (UWSP NADF) offered a pond culture workshop. The workshop consisted of four online video PowerPoint modules and two hands-on workshops. The online modules included pond construction, pond fertilization, water quality, and fish management. The videos were created by UWSP NADF and Lac du Flambeau Tribal Hatchery, based on various resources and past rearing experience and success. The hands-on training occurred in May at UWSP NADF and September at Lac du Flambeau. Specific activities and topics included small fingerling to extended fingerling walleye production, seining and harvesting techniques, pond fertilization and vegetation management, plankton sampling, clay-lined vs lined pond management, and forage minnow feeding. Both events included a pond aeration demonstration by Kasco Marine and fish health demonstration by Clayton Veterinary Care. Walleye was the main species of interest for this workshop.

For more information or to view the full report visit: aquaculture.uwsp.edu>Projects>Workforce Training and Education



A fish health demonstration was led by Clayton Veterinary Care for the pond culture workshop.

Walleye Pond Culture Report

Since 2005, the University of Wisconsin-Stevens Point Northern Aquaculture Demonstration Facility (UWSP NADF) has been raising walleye in clay-lined, drainable ponds for research, demonstration, and collaborative stocking efforts. Fish can be harvested from small fingerling to extended growth sizes. To share techniques, management practices, and other information, the facility produces pond culture reports each year.

Due to a collaboration with Red Cliff Tribal Hatchery, last summer UWSP NADF provided small fingerling walleyes (~45mm) for stocking in inland Wisconsin lakes. These walleye were raised in two outdoor rearing ponds at the UWSP NADF and were stocked by Red Cliff Tribal Hatchery staff. The UWSP NADF compiled a pond culture report from this harvest, which describes the methods and techniques used by UWSP NADF to incubate and pond raise walleyes to small fingerling size. The facility used two outdoor earthen ponds, each 0.4 acres (0.16 ha) in size, utilizing both organic and inorganic fertilizers, various aeration systems, and an external collection kettle for harvesting. In June of 2017, two ponds were harvested totaling around 50,000 small fingerling walleye, which averaged about 81% success in Pond 1 and 50% success in Pond 2 from fry to small fingerling.

The full report and others can be found at: aquaculture.uwsp.edu>Publications>Project Reports>Walleye and Hybrid.



The importance of microbes in aquaculture and aquaponics

By Matt Rogge, Assistant Professor, University of Wisconsin-Stevens Point

The term “microbe” includes any type of organism that is microscopic and includes bacteria, viruses, fungi, and unicellular organisms such as protists and amoeba. Microbes are an important part of an ecosystem due to their ability to perform a variety of metabolic functions, including breakdown of organic material and recycling of important nutrients. These processes are usually beneficial, but can also be detrimental if undesirable waste products are produced. Much of the makeup of microbial communities in aquaculture and aquaponic systems will be dominated by bacteria, so bacteria will be the focus of this article.

What are bacteria and why are they important?

Bacteria are very small, unicellular organisms that are found in almost any environment, and different types of bacteria have evolved mechanisms to harness energy and nutrients from their surroundings under various and sometimes extreme environmental conditions. For the purpose of this article, bacteria will primarily be placed into functional groups as opposed to talking about specific species of bacteria. Some common functional groups of bacteria found in aquaculture and aquaponic settings include heterotrophic bacteria, nitrifying bacteria, denitrifying bacteria, and pathogens. Heterotrophic bacteria break down organic matter and can mineralize it, meaning they release important compounds from the organic matter that are needed by other organisms. Nitrifying bacteria take nitrogen released by mineralization (Figure 1), usually in the form of ammonia/ammonium ($\text{NH}_3/\text{NH}_4^+$), and convert it into nitrite (NO_2^-). Subsequently, the NO_2^- is used by a different group of microbes, and nitrate (NO_3^-) is formed. This process is extremely important, because both NH_3 and NO_2^- forms of nitrogen are highly toxic to fish, whereas NO_3^- is much less toxic. Denitrifying bacteria can take NO_3^- and convert it back into NO_2^- , NH_4^+ , or nitrogen gas (N_2). Pathogens are organisms that can cause infectious disease in another organism, such as fish, plants, or humans. Generally, the presence or possible presence of these organisms has negative effects on production or public perception of the product. In addition to groups of microbes described thus far, there are many other types that will be present in production systems, but do not fit into the above categories.

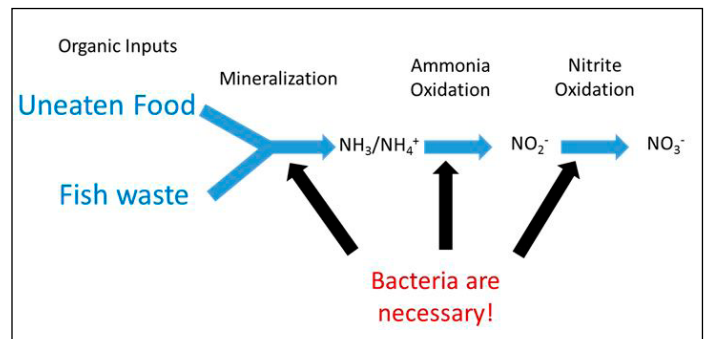


Figure 1. The nitrification cycle. Organic material accumulates from uneaten feed and fish waste. Microbial communities mineralize the organic materials, releasing ammonium. The ammonium can be converted to nitrite and nitrate by the activity of other microbial communities. Through the process of denitrification, the reactions can be reversed, leading to decreased nitrate levels.

These other groups likely have important functional roles in maintaining optimal production of the system, but few studies have been performed to identify those functional roles or their importance. Although there is a breadth of microbial diversity in aquaculture and aquaponic systems, the role that a vast majority play is currently unknown. It is possible that extensive studies of microbial communities in aquaculture and aquaponic systems can lead to strategies to manipulate the communities for increased productivity of the system and a higher quality product.

Where are the bacteria?

In short, bacteria are everywhere in a system, including in the water column and on any surfaces within the water (Figure 2). The amount and types of bacteria present, however, will depend on system type and production parameters. Surfaces tend to have more microbial biomass than the water column, because many bacteria are capable of forming extensive biofilms, which are large aggregates of bacteria. Some biofilm bacteria can break off from the biofilm and attach to other surfaces, forming a new biofilm. In the water column, there are planktonic bacteria, meaning those bacteria are always found in the water column and not commonly found in high concentrations on surfaces. (continued on page 9)

The importance of microbes in aquaculture and aquaponics (continued)



Figure 2. Biological sludge accumulation of surfaces within an aquaponic production system. The material is composed of organic debris and microbial biofilms. The biomass can be removed and analyzed to determine the microbes present on surfaces.

The types of bacteria present in any given portion of a system will be affected by various environmental parameters characteristic of that location, including temperature, dissolved oxygen (DO), nutrient content, pH, salinity, and perhaps composition of the surface material (e.g., plastic or metal). When trying to promote the growth of desirable microbes, it is important to know the optimal conditions for those microbes to thrive.

How do I support the growth of the “good” bacteria?

First off, many of the nitrifying bacteria, which are important for aquaculture (especially intensive systems) and aquaponics, need a lot of surface area for biofilm formation. The surface area can be provided by biofilter media, such as sand, gravel, or plastic beads, or even by the walls of the fish tanks or pipes. The more surface area there is, the more nitrifiers you will be able to support. Second, nitrifiers require oxygen to convert toxic nitrogen compounds (NH₃ and NO₂⁻) into less toxic molecules (NO₃⁻). Heterotrophic bacteria that break down organic matter also perform more efficiently in an oxygen-rich environment. These types of bacteria can have a tremendous effect on the biological oxygen demand (BOD), and if the system is too nutrient rich, the microbial activity can drop DO to harmful levels for fish. If DO levels decline, the composition of your microbial communities can also change. The loss of

The more surface area there is, the more nitrifiers you will be able to support.

oxygen can select for the growth microbes that utilize nutrients in an anaerobic manner. Although nutrient conversion can still occur, the growth of anaerobes can lead to production of undesirable waste products, such as hydrogen sulfide gas (H₂S). Organisms that denitrify NO₃⁻ tend to do so in oxygen-deprived environments, so if excess nitrate is present in a system, an anaerobic or low oxygen portion of a system may be beneficial for reducing NO₃⁻ levels.

What about the bad bacteria?

Typically, the bad bacteria in a system include those described above that are related to producing undesirable waste products in anaerobic conditions. Their metabolism is different than aerobic bacteria, and they can negatively affect the balance of the system, which can lead to water quality problems that affect fish, plants, and other bacteria. Beyond the anaerobic bacteria, there is also the problem of pathogens. In an aquaculture system, the main concern is fish pathogens, but in aquaponic production, there are additional concerns of plant and human pathogens that can contaminate food meant to be eaten raw. Regardless of the type of pathogen, strict biosecurity measures can be enforced that reduce the risk of contamination of the system by pathogenic bacteria. Incoming fish will be the main source of fish pathogens, so a rigorous quarantine strategy should be used before adding new fish to a system. When purchasing fish, acquire them from a reputable supplier and have health inspections performed by a certified fish disease specialist to minimize the risk of system contamination. Also, avoid sharing water between systems or using equipment (e.g., nets) in multiple systems. If an infection does occur, you want to be able to isolate it from the other systems.

When it comes to fish health, prevention is the best strategy. Outbreaks of fish disease are usually correlated with poor water quality conditions, particularly issues with DO, NH₃, NO₂⁻, and pH. The poor water quality stresses the fish, which results in immune suppression, causing the fish to be more susceptible to infectious disease. Some problematic fish pathogens are commonly present in aquatic environments, but only are able to cause infection when fish are stressed. Diseases such as columnaris, fungal infections, and aeromonad infections can cause severe fish losses, but are generally avoidable with good management of the system. *(continued on page 10)*

The importance of microbes in aquaculture and aquaponics (continued)

For aquaponic systems, introducing plants from outside the facility is a potential source of infection, because the soil used to grow those plants can harbor various types of plant pathogens. Rather than using plants, plant seeds should be acquired from a reputable source and germinated in a non-soil medium (rockwool, coco coir, etc) on site to prevent outside soil contamination. Plants should be monitored and promptly removed if they show signs of infectious disease.

When it comes to human pathogens in an aquaponic system, the primary sources are going to be warm-blooded animals, such as birds, mammals, and humans. Again, strict biosecurity should be implemented to control animal access to the systems, and employees should be properly trained on handwashing, the use of disinfectants, and the use of proper protective equipment (PPE) commonly used in food handling, such as disposal gloves, aprons, hairnets, etc. If facility tours are a revenue source, be sure patrons disinfect their hands and shoes before entering the facility, and also try to maintain distance between patrons and the production systems to avoid accidental contamination.

While these strategies greatly minimize the risk of contamination, they do not completely prevent contamination. As such, it is important for aquaculture producers to have access to fish health professionals to diagnose and treat infectious disease. Aquaponic producers should have similar access, but also work with plant health professionals to identify and treat plant diseases. Furthermore, aquaponic producers should have water and raw produce samples periodically tested for pathogens by a certified water and food testing lab.

What is the next step?

Much is known about the importance of the nitrification process and the microbial involvement in that process as related to aquaculture and aquaponics. Additionally, there is extensive knowledge of the pathogenic microbes that can lead to production problems. Beyond that, however, little is known about the other types of microbes that are found in aquaculture and aquaponic systems. Recent advances in the genetic analysis of microbes for the study of the human microbiome and environmental populations of microbes in soil, water, and wastewater treatment are opening up the “black box” of microbial communities, allowing for more in depth

studies of which microbes are present in a sample and what role they may play in their ecosystem.

These analyses can be applied to microbial communities in aquaculture and aquaponics to better understand the role of these organisms in successful production, as well as identify the microbes that can lead to inefficiencies in production. Once functional roles for the microbes can be determined, strategies can be developed to introduce and support the beneficial microbes while restricting the growth of detrimental microbes. The ability to manipulate microbial populations hopefully will lead to more efficient production and better yield.

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Upcoming summer 2018 workshop: Intensifying Pond Production of Fish

By Bill Lynch, Ohio Aquaculture Association President and Owner of Millcreek Perch Farm, LLC

The Ohio Aquaculture Association (OAA), the North Central Regional Aquaculture Center (NCRAC), and The Ohio State University's Aquaculture Boot Camp (ABC) program are pleased to announce their joint summer 2018 workshop "Intensifying Pond Production of Fish." The goal of this workshop is to provide information and strategies that might allow pond culturists to intensify their operation and grow more pounds of fish per acre of water. New ponds are increasingly more expensive to build, so it makes sense to maximize production in existing ponds.

Topics to be covered during the workshop are 1) OSU's ongoing NCRAC research project on intensifying pond production via intensive aeration and/or split pond production, 2) hands-on water quality testing (courtesy of YSI Inc.) and interpretation of results, and 3) in-pond demonstration of various aeration techniques pond culturist can use, including the pros and cons of each.

The workshop will be held July 14th, 2018 at Millcreek Perch Farm, LLC and the Millcreek Township Hall. Lunch will be provided. Cost is \$50 for OAA members and \$75 for non-members. The workshop will begin at 9 a.m. at the Township Hall, 10420 Watkins Rd., Marysville, OH 43040 and wrap-up at 4 p.m.

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