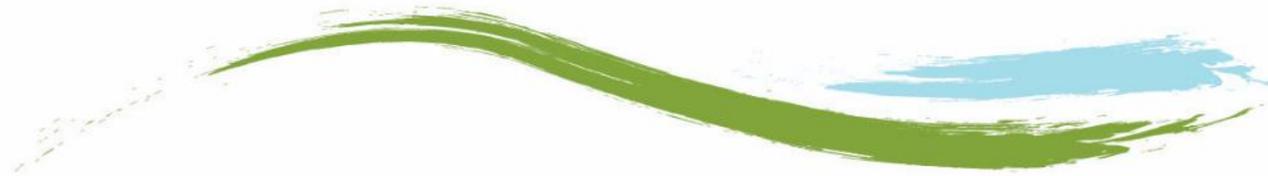


# Trends in Aquaponics



Chris Hartleb

University of Wisconsin-Stevens Point  
Northern Aquaculture Demonstration Facility  
Aquaponics Innovation Center

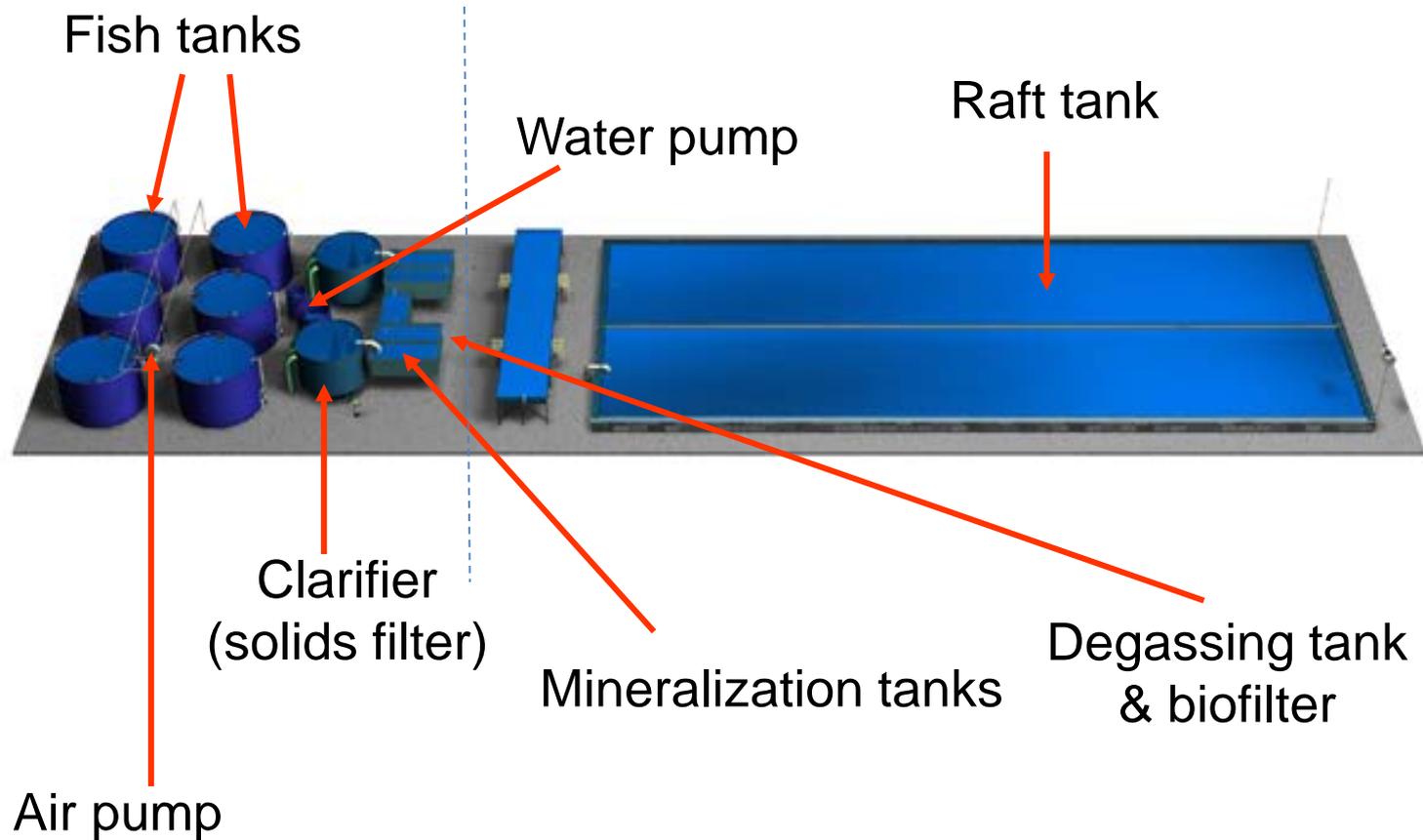


# Aquaponics

- Integrated & soilless
- Free of biocides
- Conservative use of water, space & labor
- Produces both vegetable & protein crop
- Continuous year-round production
- Meets socio-economic challenges
  - Urban, peri-urban, rural
  - Locavore movement



# Aquaponic Systems UVI Design



# Plant Production Systems

- Raft (Revised agriculture float technology)
  - Deep water culture
    - Large volume water
    - Root aeration
    - Nutrient uptake: High
- Media based
  - Biofiltration in media
  - Clogging & cleaning present
  - Nutrient uptake: High
- Nutrient film technique
  - Low volume water
  - Less system stability
  - Nutrient uptake: Low

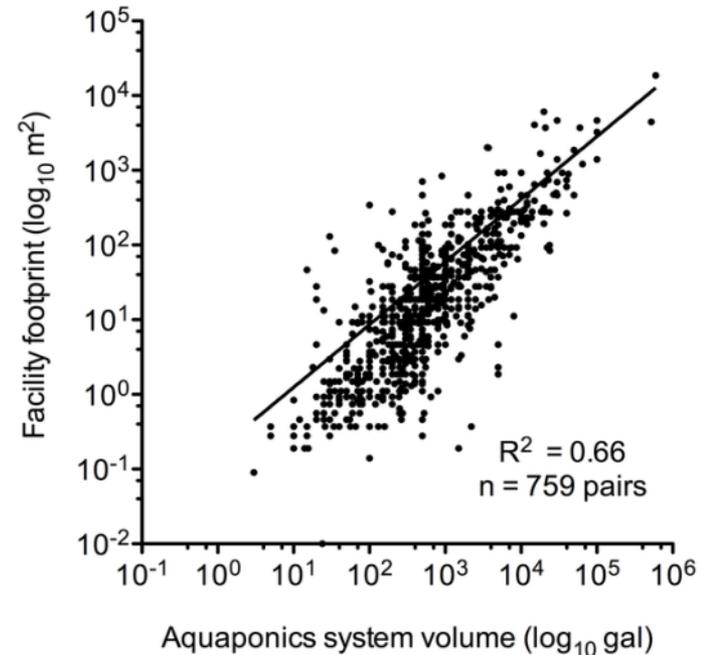
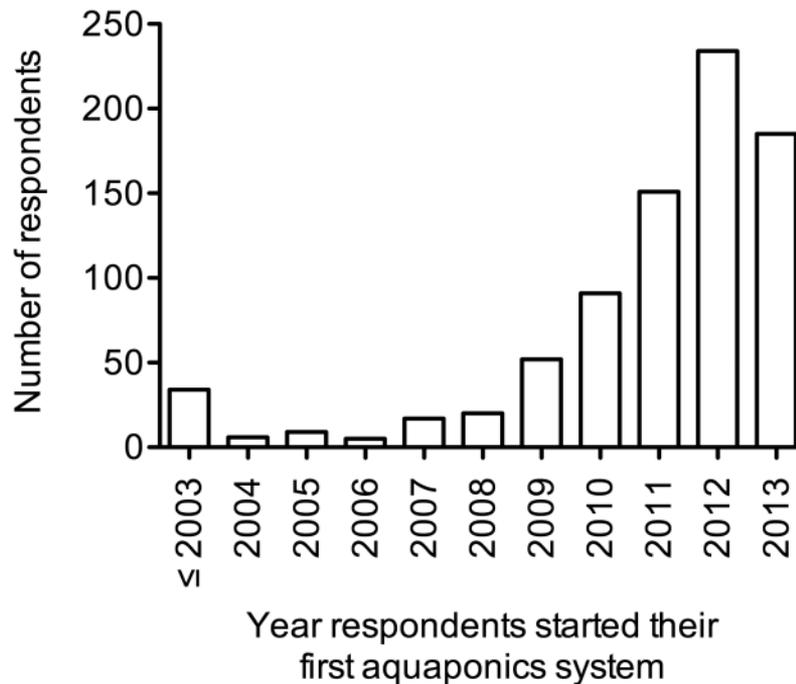


# Modified Designs

- Vertical farming
  - Living walls
  - Vertical
- Robotics
- Complete artificial light



# Who's Growing using Aquaponics?



Love, Fry, Li, Hill, Genello, Simmons & Thompson. 2015.  
Commercial aquaponics production and profitability:  
Findings from an international survey. *Aquaculture* 435:67-74.





# How Many is That?

- Limited survey response
- Most likely underestimated number and location



# Types of Aquaponics

- Scalable:
  - Hobby and Home food production
  - Farmers market food production
  - Social & Community systems
  - Commercial food production
  - Education
  - Research



# Aquaculture North America

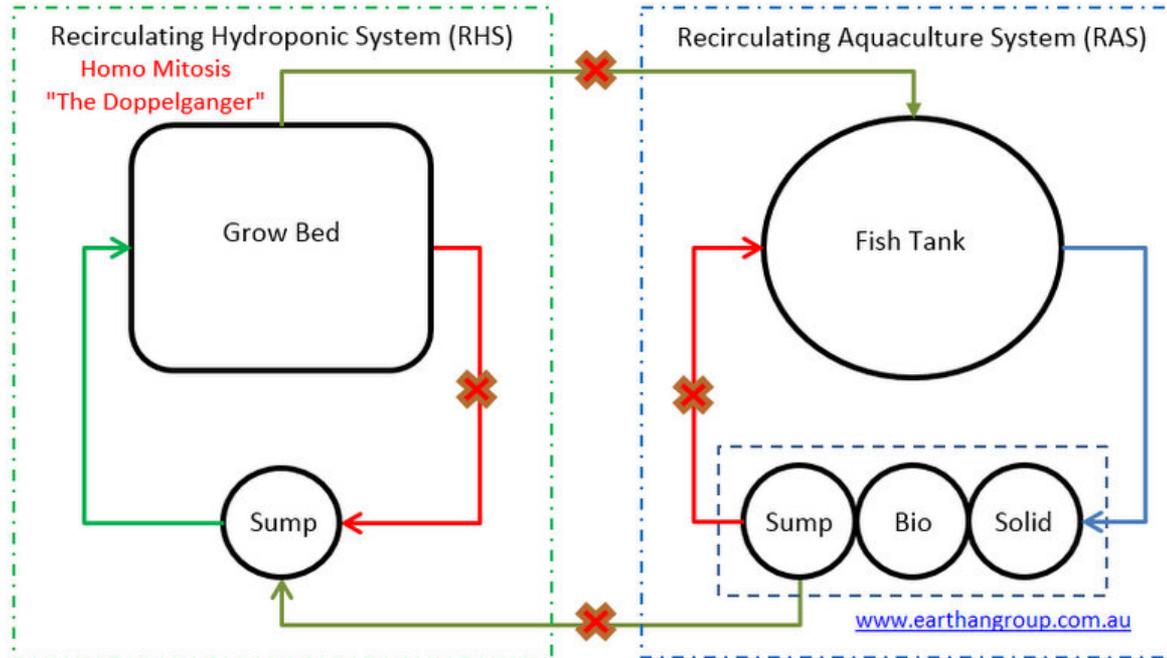
January/February 2018

- Trends driving the seafood sector
  - Climate change impact
    - Controlled environment agriculture
  - Shortage of food
    - High density farming
  - Product globalization and internet sales
  - Health conscious consumers
    - Locavore



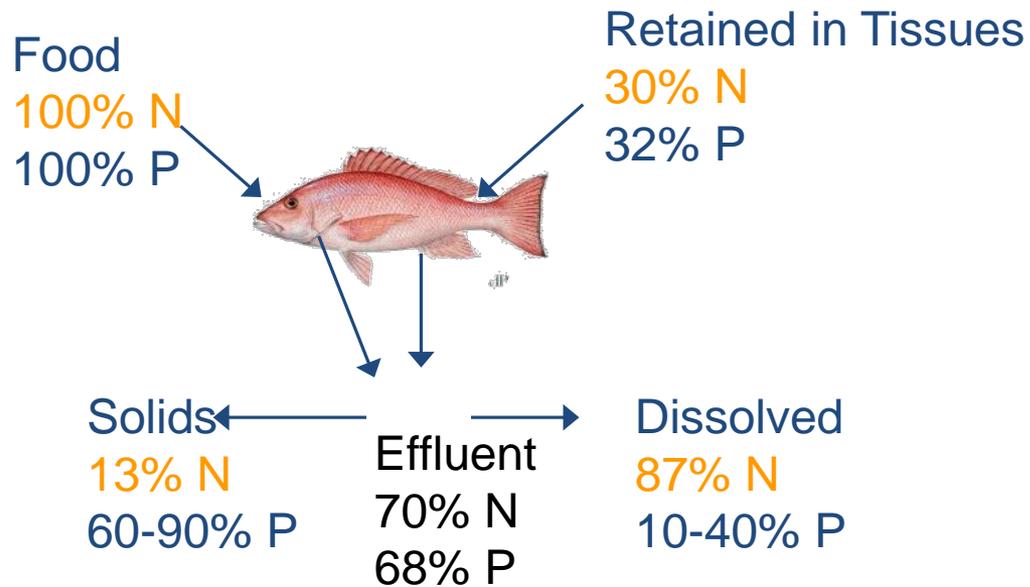
# Coupled and Decoupled

- Tropical (warm water) fish in greenhouse
- Raise cool and cold water fish
- Greater management



# Aquaponic Mechanics

- *Feeding rate ratio: 60-100 g/day/m<sup>2</sup>*  
(Tilapia & leafy greens grown on rafts)
- Nitrification
- Mineralization
- Why does it work? Similarities



## 87% Overlap

Fish	Plants
<i>Organic (protein)</i>	<i>Nitrogen</i>
<i>Potassium</i>	<i>Potassium</i>
<i>Calcium</i>	<i>Calcium</i>
<i>Magnesium</i>	<i>Magnesium</i>
<i>Phosphorus</i>	<i>Phosphorus</i>
<i>Sulfur</i>	<i>Sulfur</i>
<i>Chlorine</i>	Chlorine
<i>Sodium</i>	
<i>Iron</i>	Iron
	Boron
Manganese	Manganese
Zinc	Zinc
Copper	Copper
Molybdenum	Molybdenum
Nickel	Nickel
Iodine, Cobalt, Fluorine, Vanadium, Chromium, Selenium, Tin, Silicon	



# Superior Fresh, Northfield, WI

- 1<sup>st</sup> aquaponic Atlantic salmon & leafy green in world
  - ~1,000 MT/yr leafy green production

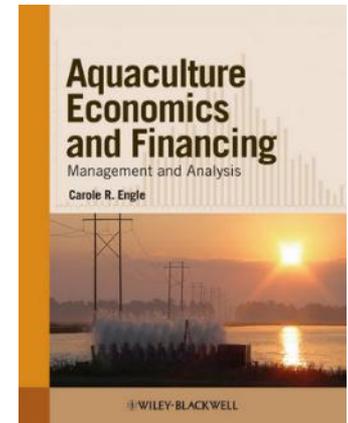


# Urban Organics, St Paul, MN



# Economics

- Still difficult to get loans/funding for startup and expansion
  - Banks want proven success
- No consistent data available for aquaponics
  - Too new
  - Diverse
  - Unique
  - “Next wave of ecopreneurs hopes to find key to making aquaponics profitable”
    - $12 - 6 - 3 = 3$
- Foreign imports
  - 90% U.S. seafood imported
  - Trade deficit \$11.2 billion
  - 2-3% inspected



Chicago Tribune

## Uptick in sight for depressed US tilapia market

By Jeanine Stewart Mar 27, 2017 10:51 GMT



undercurrentnews  
seafood business news from beneath the surface





*Grassroots certification that builds farms and communities*

# Challenges

- Zoning & permitting
  - Loans
    - Proven, large-scale, commercial operations; Not subsidized
  - Competition (market)
    - Organic
  - Diversification of crops (fish & plants)
- Nursery provider
    - Out-of-season
    - Indoor production of fry
      - Biosecurity risk
  - Diseases (fish & plant)
  - Science-based education



University of Wisconsin-Stevens Point  
College of Letters & Science

# Tilapia Considerations

- Variety of products from live to IQF
  - Price \$0.45 to \$6 per lb (IQF import to live retail)
- Foreign imports dominate market
- Separate nursery & grow-out in U.S.
- Disease tolerant but not immune
- Problems with uniformity of size
- Processing



RESEARCH ARTICLE



## Characterization of a Novel Orthomyxo-like Virus Causing Mass Die-Offs of Tilapia

Eran Bacharach,<sup>a</sup> Nischay Mishra,<sup>b</sup> Thomas Briese,<sup>b</sup> Michael C. Zody,<sup>c</sup> Japhette Esther Kembou Tsofack,<sup>a</sup> Rachel Zamostiano,<sup>a</sup> Asaf Berkowitz,<sup>d</sup> James Ng,<sup>b</sup> Adam Nitido,<sup>b</sup> André Corvelo,<sup>c</sup> Nora C. Toussaint,<sup>c</sup> Sandra Cathrine Abel Nielsen,<sup>b\*</sup> Mady Hornig,<sup>b</sup> Jorge Del Pozo,<sup>e</sup> Toby Bloom,<sup>c</sup> Hugh Ferguson,<sup>f</sup> Avi Eldar,<sup>d</sup> W. Ian Lipkin<sup>b</sup>

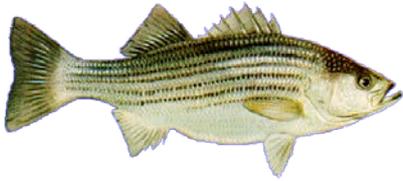
Department of Cell Research and Immunology, The George S. Wise Faculty of Life Sciences, Tel Aviv University, Tel Aviv, Israel<sup>a</sup>; Center for Infection and Immunity, Mailman School of Public Health, Columbia University, New York, New York, USA<sup>b</sup>; New York Genome Center, New York, New York, USA<sup>c</sup>; Department of Poultry and Fish Diseases, The Kimron Veterinary Institute, Bet Dagan, Israel<sup>d</sup>; Easter Bush Pathology, The Royal (Dick) School of Veterinary Studies and The Roslin Institute, University of Edinburgh, Midlothian, Scotland<sup>e</sup>; Marine Medicine Program, Pathobiology, School of Veterinary Medicine, St. George's University, Grenada, West Indies<sup>f</sup>

\* Present address: Sandra Cathrine Abel Nielsen, Department of Pathology, School of Medicine, Stanford University, Stanford, California, USA.

E.B. and N.M. contributed equally to this article.

**ABSTRACT** Tilapia are an important global food source due to their omnivorous diet, tolerance for high-density aquaculture, and relative disease resistance. Since 2009, tilapia aquaculture has been threatened by mass die-offs in farmed fish in Israel and Ecuador. Here we report evidence implicating a novel orthomyxo-like virus in these outbreaks. The tilapia lake virus (TiLV) has a 10-segment, negative-sense RNA genome. The largest segment, segment 1, contains an open reading frame with weak sequence homology to the influenza C virus PB1 subunit. The other nine segments showed no homology to other viruses but have conserved, complementary sequences at their 5' and 3' termini, consistent with the genome organization found in other orthomyxo-viruses. *In situ* hybridization indicates TiLV replication and transcription at sites of pathology in the liver and central nervous system of tilapia with disease.





# More Challenges



- Proven economic viability
- Multidisciplinary knowledge: Enthusiasm > knowledge
  - STEAM (science, technology, engineering, agriculture & math)
    - Fish & plant biology; microbiology; environmental, mechanical & civil engineering; computer science; economics, finance & marketing
- Fish-plant couples
  - Similar environmental & nutrient conditions
- Should diminish pollution & need for resources
  - 10-20% water use compared to field agriculture

