

# The basics of Aquaponics

Biological function and selection of species

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# The system as an Ecosystem

- ▶ Based on the cooperation of different organisms
- ▶ Small - Bacteria
- ▶ Large - fish and plants

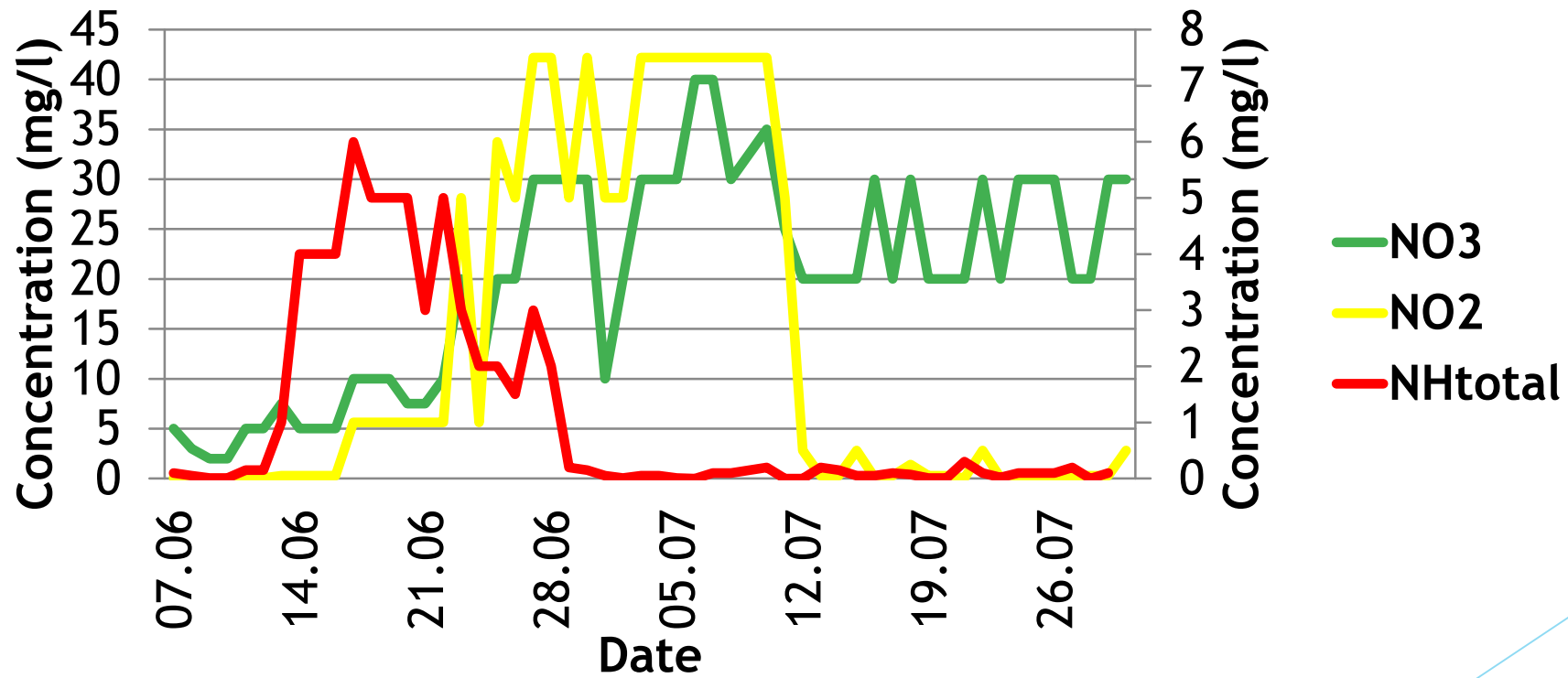
# How does this Cooperation work?

- ▶ Fish produce waste
- ▶ Fish waste fouls the water
- ▶ Plants use the waste
- ▶ Plants clean the water
- ▶ Simple, right?

# But this isn't that simple

- ▶ Bacteria!
- ▶ The bacteria are the heart of the system
- ▶ Nitrification
- ▶ Ammonia/ammonium ( $\text{NH}_3$ ,  $\text{NH}_4^+$ )
- ▶ Nitrite ( $\text{NO}_2$ )
- ▶ Nitrate ( $\text{NO}_3$ )

# The Nitrogen cycle



# Now let's talk about something fun

- ▶ To the horticulturist the fish are the main source of fertilizer
- ▶ To the aquaculturist the plants are a tool for minimizing water changes
- ▶ And to the backyard farmer the system means cheaper food
- ▶ But what can this system produce?

# Tilapia (*Oreochromis spp.*)

- ▶ Tilapia is one of the most commonly farmed fish in the world
- ▶ Tolerant of a wide range of water parameters
- ▶ Omnivore!
- ▶ Breeds fast



# Other kinds of fish

- ▶ Goldfish
- ▶ Catfish
- ▶ Silver perch
- ▶ Rainbow trout



# Plant species

- ▶ Leafy greens have proved a success
- ▶ Basil (*Ocimum basilicum*)
- ▶ Mint (*Mentha spp.*)
- ▶ Lettuce (*Latuca Sativa*)
- ▶ And recently Pak-choi (*Brassica campestris* var. *Chinensis*)

# Basil and mint from last summer

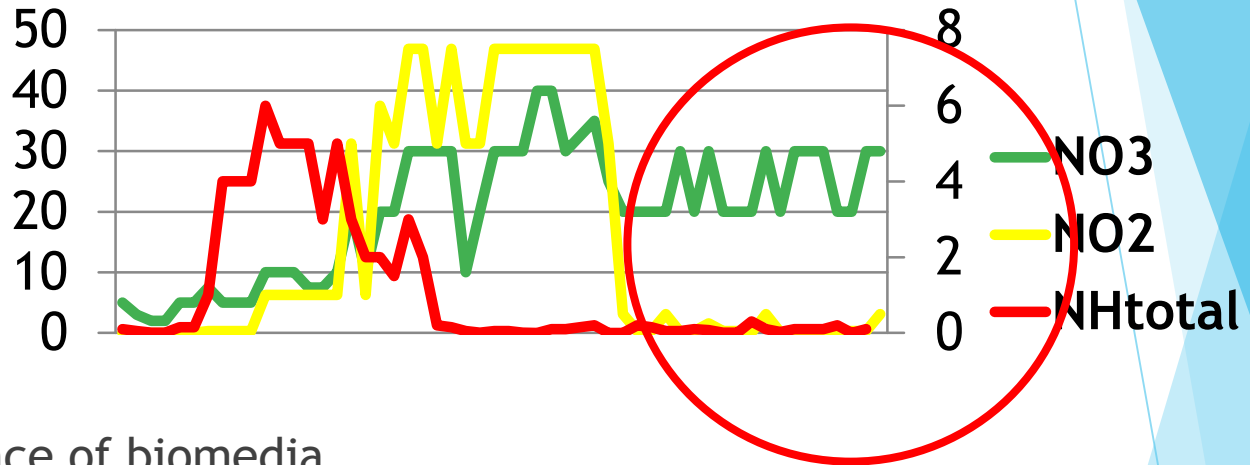


# Pak Choi from my recent system



# Most important

- ▶ Keeping a balance
- ▶ Right amount of fish vs. Plants
- ▶ Right amount of feeding vs. Surface of biomedica
- ▶ Remember that an aquaponic system is Eutrophic!





# What happens in a Eutrophic System?

- ▶ Excess of nutrients creates good conditions for algae
- ▶ Sunlight triggers algae growth
- ▶ Then this happens →
- ▶ Algae can be harmful
- ▶ Block sunlight



# Multitrophic systems

- ▶ Some systems offer extra space
- ▶ Smaller creatures can benefit from that
- ▶ Mineralization of nutrients
- ▶ Maintenance animals
- ▶ Valuable animals?

# Unexpected allies



# Mineralization of Nutrients

- ▶ Release of nutrients from waste
- ▶ Sediment is collected
- ▶ Phosphate f.ex. Tends to stick to surfaces
- ▶ Animals that feed on sediment help mineralizing



# Crayfish

- ▶ Red-clawed crayfish / Yabbie (*Cherax quadricarinatus*)
- ▶ Peaceful (relatively)
- ▶ Grows fast
- ▶ Feeds mainly on sediment!
- ▶ Valued as food



# Other kinds of crayfish

- ▶ Marbled crayfish (*Procambarus fallax*)
- ▶ Breeds extremely fast
- ▶ Larger fish will eat the young
- ▶ Inexpensive and available
- ▶ Will spread throughout the system



# Shrimp

- ▶ Red cherry shrimp (*Neocaridina heteropoda*)
- ▶ Very effective in eating biofilms
- ▶ Small and breed fast
- ▶ Will spread but are not harmful
- ▶ Fish will eat young and adults





# But not all life in the system must be aquatic

- ▶ Vermiculture - feeding worms with waste
  - Helps with mineralization
  - Composting
  - Other uses



<http://home.howstuffworks.com/vermicomposting.htm>

- ▶ Insects
  - Black soldier fly
  - Crickets



<http://www.thebiopod.com/pages/resources.html>



<http://www.examiner.com/slideshow/crickets>

# Summary

- ▶ The system is an ecosystem
- ▶ Good balance is essential
- ▶ Species selection is limited only by your imagination

Questions/spurningar?