



Research group AGR-268

Urban greening & biosystems engineering



***Design and preliminary assessment of a
vertical aquaponics system for
ornamental purposes***

**International Conference on Living Walls and Ecosystems Services
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INTRODUCTION

What is Aquaponics?

The method of growing crops and fish together in a re-circulating system.

An integration of two systems:
Hydroponics and **Aquaculture**



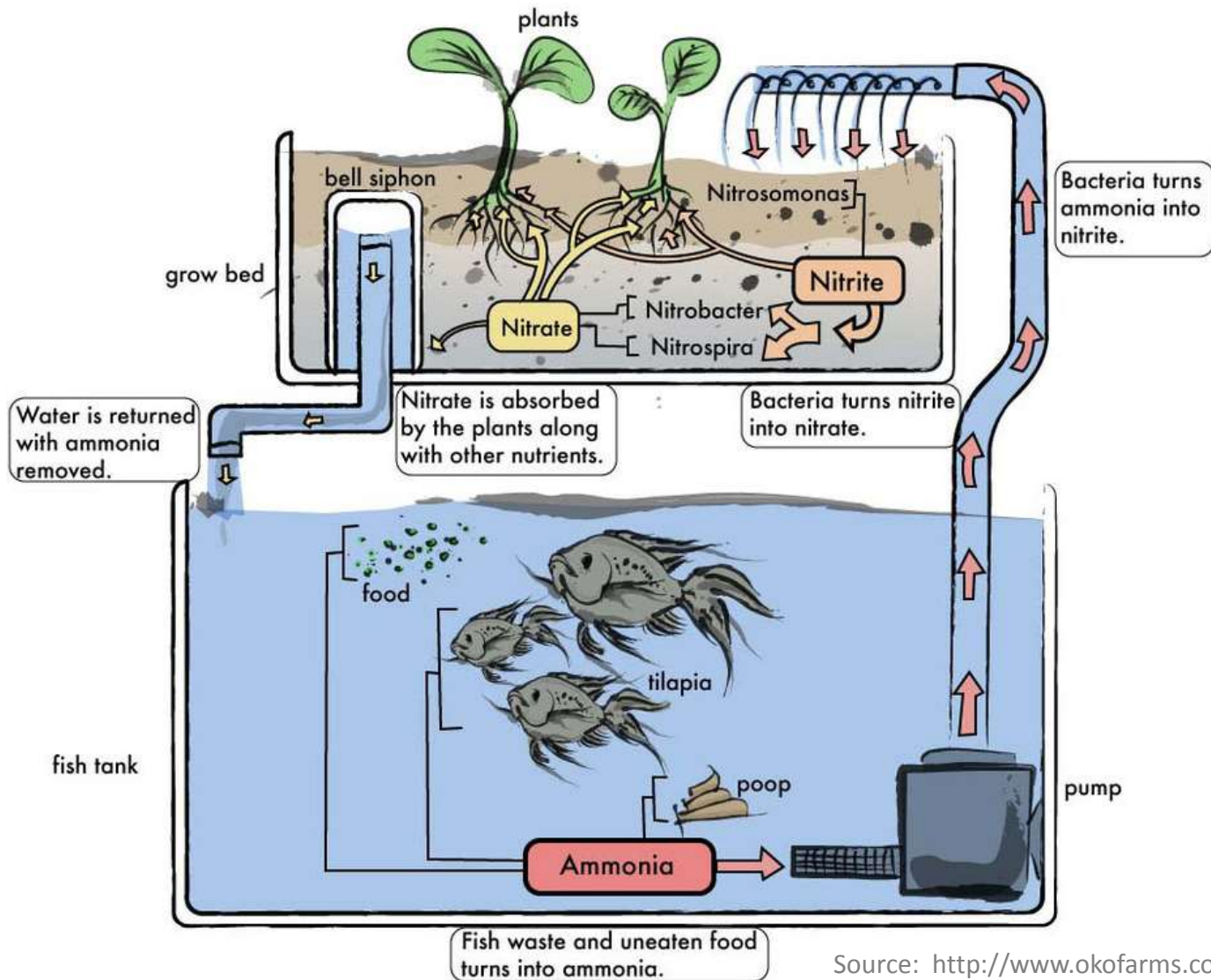
The process of growing food in an inert medium by controlling and adding nutrients but **without soil**



The cultivation of aquatic animals or plants for food.



aquaponic nitrogen cycle



History



Chinampas in Lake Tenochtitlan, Mexico
Built by Incas and Aztecs
Between 14th -16th century A.D

History



Paddy Fields In China and Thailand (Since the sixth century)

History

The development of modern aquaponics:

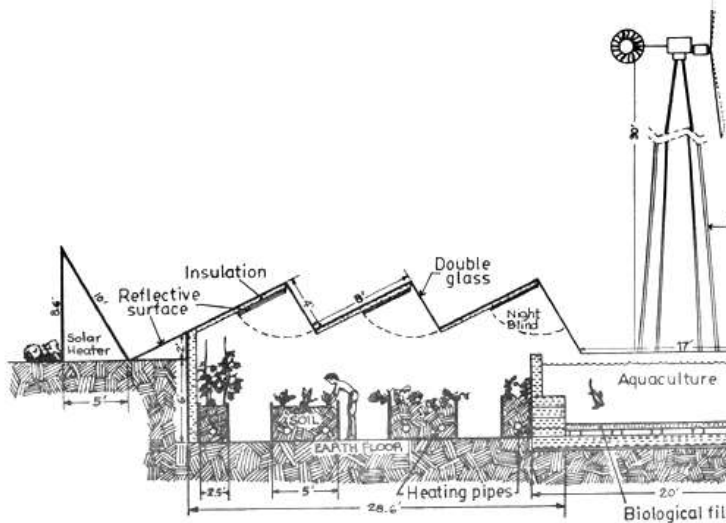
In a modern context, **Aquaponics** emerged from the **aquaculture industry** as fish farmers were exploring methods of **raising fish** while trying to decrease their dependence on the land, water and other resources.



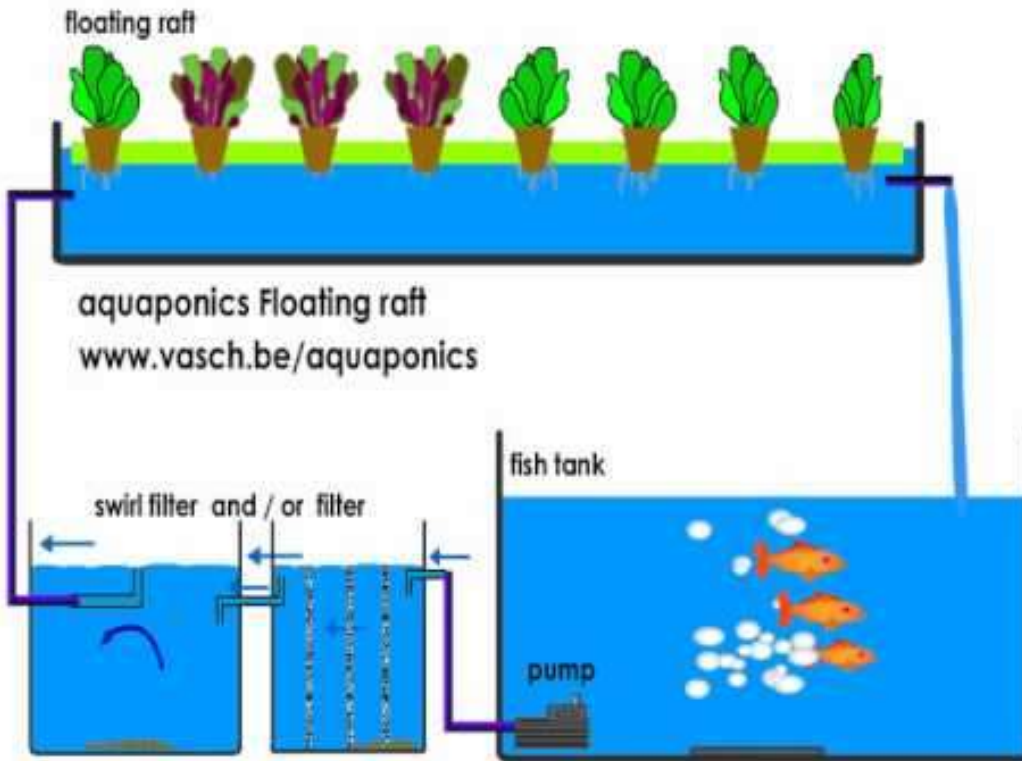
History

The term **aquaponics** is often attributed to the various works of the **New Alchemy Institute** and the works of **Dr. Mark McMurtry** at the North Carolina State University.

In 1969, John and Nancy Todd and William McLarney founded the **New Alchemy Institute**. The culmination of their efforts was the construction of a prototype **Bioshelter**, the “Ark”.

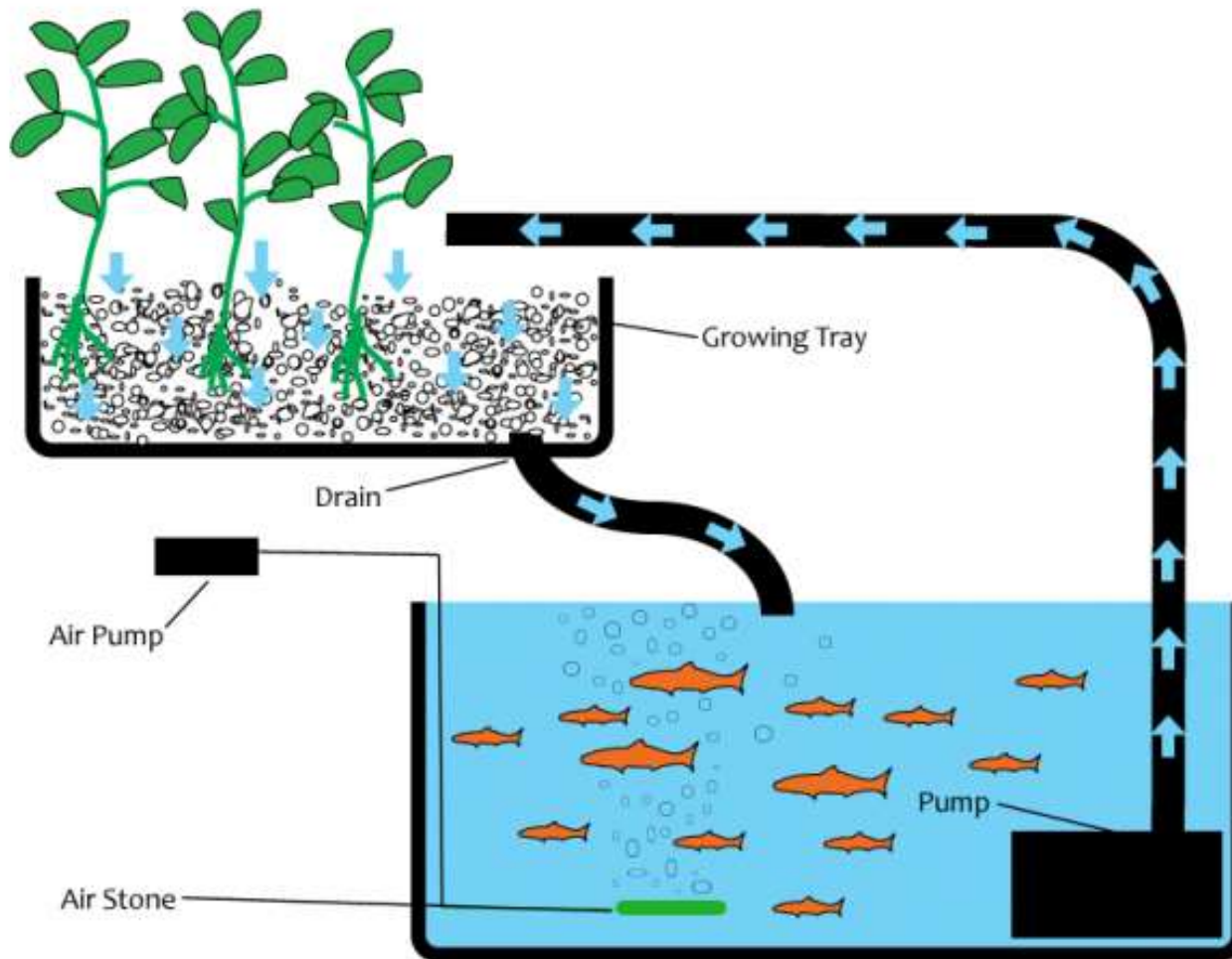


AQUAPONICS SYSTEMS



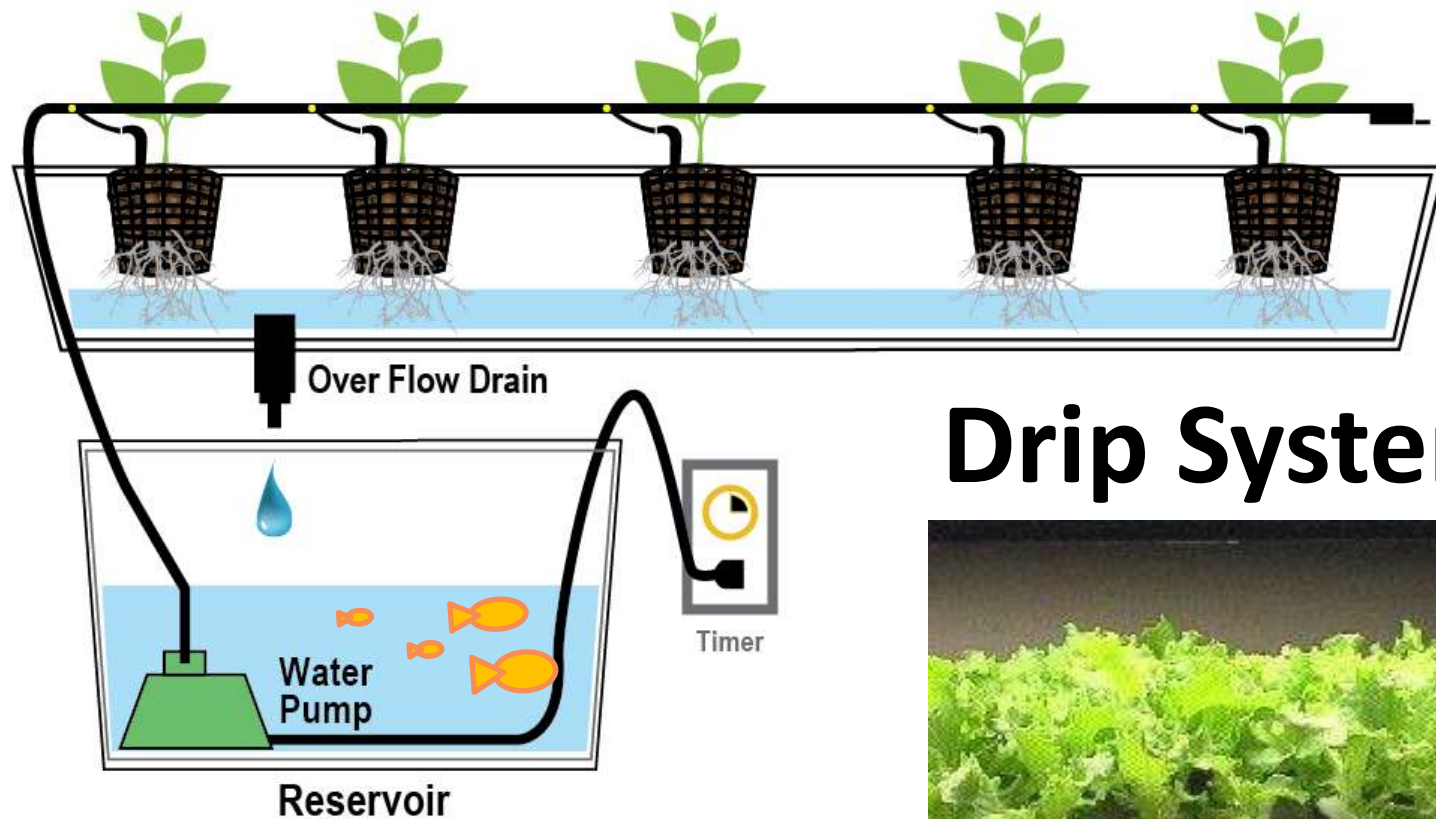
Floating Raft System

AQUAPONICS SYSTEMS

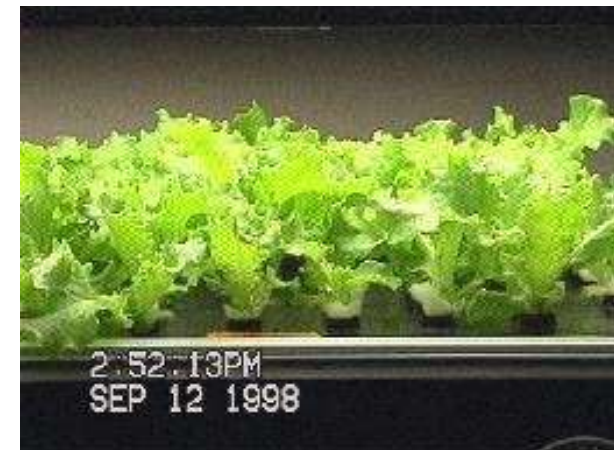


Flood and Drain System (EBB and Flow)

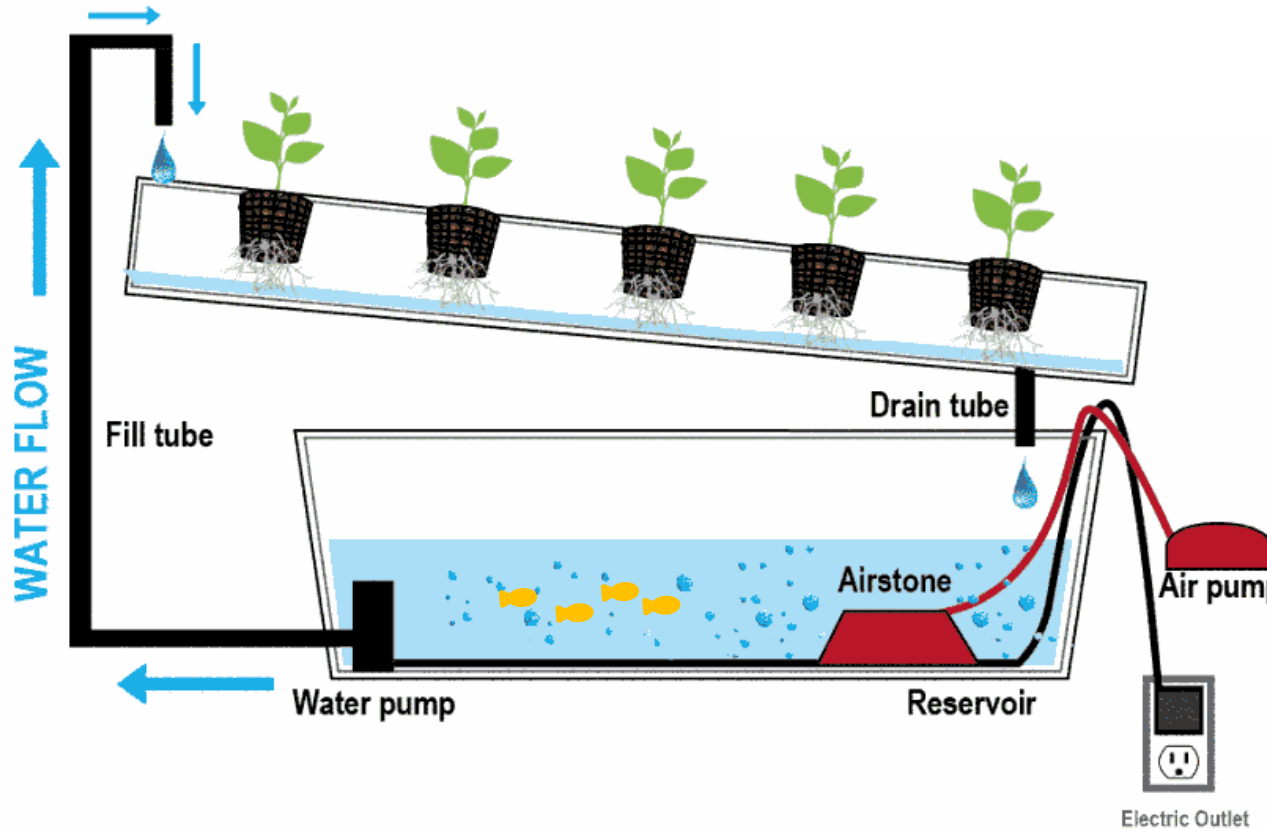
AQUAPONICS SYSTEMS



Drip System



AQUAPONICS SYSTEMS



Nutrient Film Technique (NFT) System

Why Aquaponics ?

Advantages

- Reduced labour
- Nutrient management/effluent mitigation
- Plan grow 2x as fast
- Year round production possible
- 75% smaller footprint: Less space required per plant
- Prolonger individual plant life
- 90% Less water consumption
- Soil pathogens eliminated
- Plants can be grown at desired height
- No weeding

Why Aquaponics ?

Disadvantages

- Higher Initial Cost over Raised Beds and Hydroponics
 - To fill up water tanks
 - To build the system (Greenhouse, pumps etc.)
- Climate control & Lighting
- Government regulation of “fish raising”
- Competitive market prices

Why Vertical Aquaponics ?

Better use of space

Greater design possibilities

Vertical Aquaponics ?



Green Sky Growers, located on a building's rooftop, Orlando Florida

Vertical Aquaponics ?



Vertical Aquaponics with Zipgrow towers (Aquaponic Lynx, Florida, USA)

Vertical Aquaponics ?



Aquaponics with an Integrated
Vertical Tube System
from [brainright.com](http://www.brainright.com)



Vertical Aquaponic system by Inka Biospheric Systems

Ornamental Vertical Aquaponics ?



EcoWalls in the Classroom
(Lafayette College)

OUR OBJECTIVES

GENERAL :

- Assessment of a vertical aquaponics system for **ornamental purposes**

SPECIFICS:

- Evaluate water quality and the development of fish population in an aquarium using a Living wall as filter system, comparing it with an aquarium with a commercial filter system
- Growth and ornamental value assessment in an aquaponic living wall system.

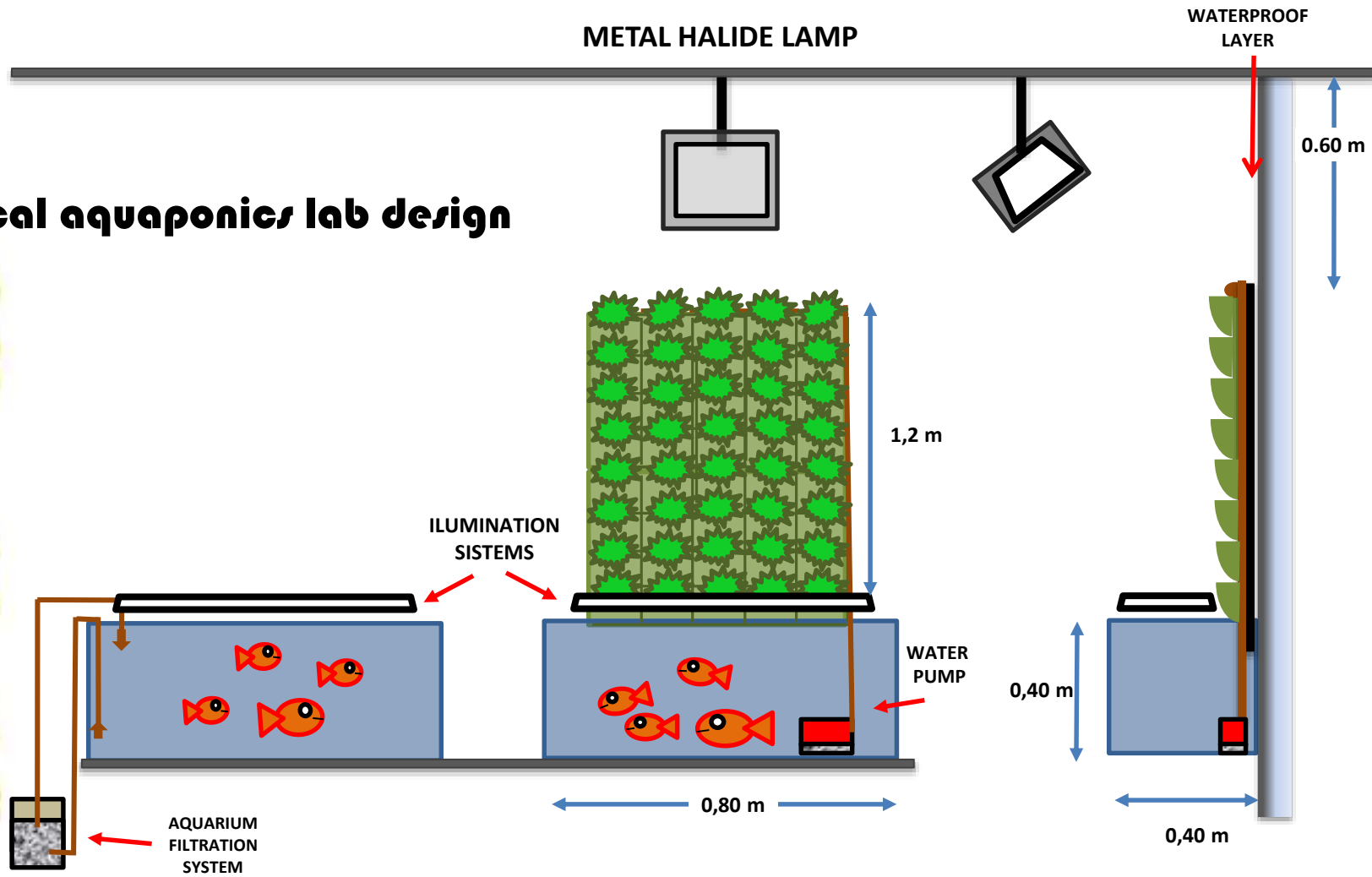
MATERIAL AND METHODS

Features Overview

- Living Wall System:*** ® *Fytotextile* from Terapia Urbana
- Location:*** Indoor laboratory in University of Seville (Spain)
- Planting system:*** bare-root plants
- Culture medium:*** perlite
- Fertilization:*** no
- Irrigation:*** cycles of 45' irrigation – 15' pause
- Trial period:*** July 2014-June 2015
- Lighting cycle:*** 12 h/ day artificial
- Lighting system:*** metal halide lamp (200 W)

MATERIAL AND METHODS

vertical aquaponics lab design



MATERIAL AND METHODS



February 2014

MATERIAL AND METHODS



July 2014



June 2015

MATERIAL AND METHODS

FISH SPECIES USED



Xiphophorus helleri (swordtail)



Paracheirodon axelrodi (cardinal tetra)



Crossocheilus langei
(Siamese Algae Eater)



Ancistrus sp.



Danio rerio (zebrafish)



Poecilia wingei (Endlers Livebearer)

MATERIAL AND METHODS

PLANT SPECIES USED



Soleirolia soleirolii



Spathiphyllum wallisii

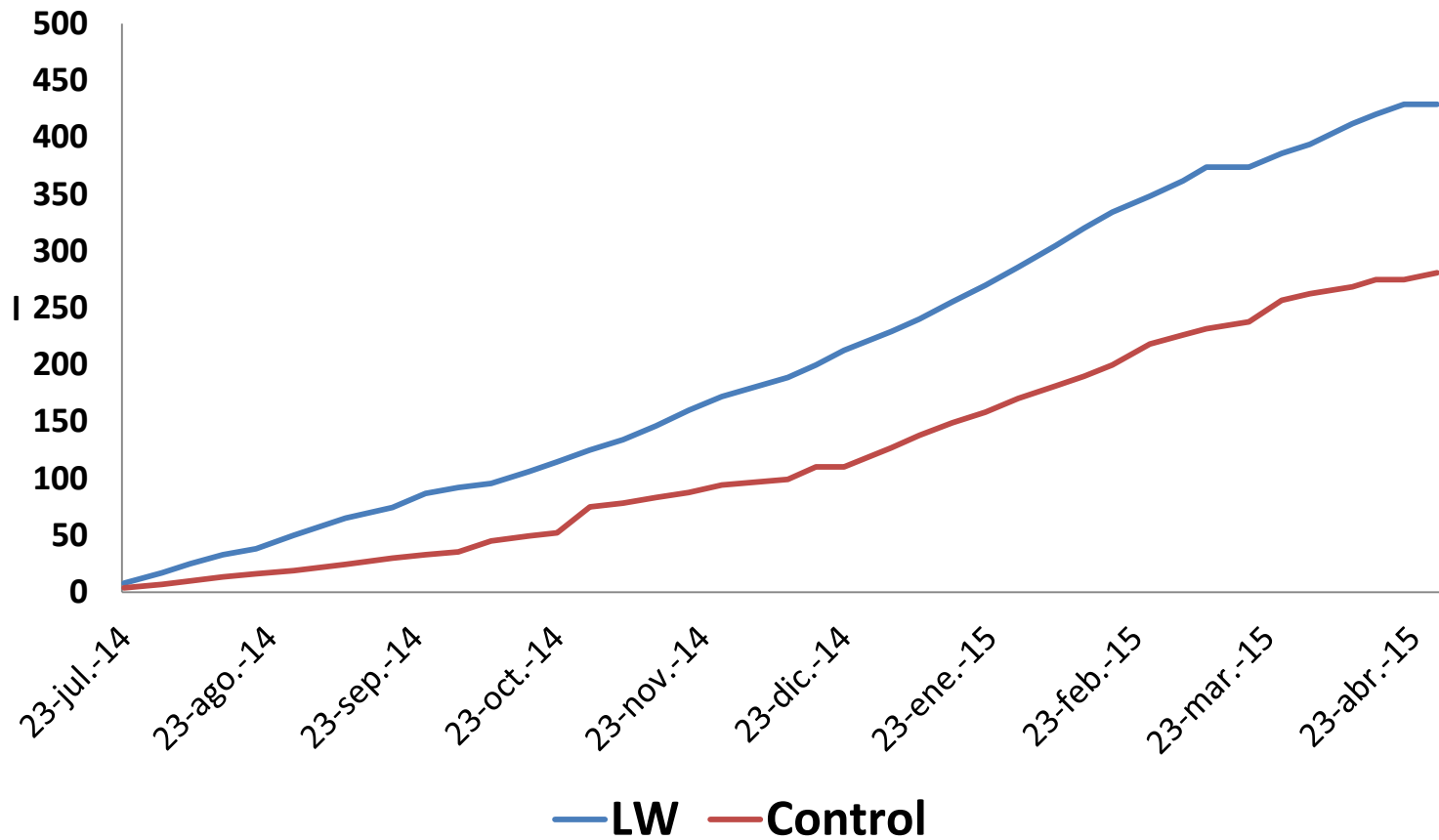


Maranta leuconeura



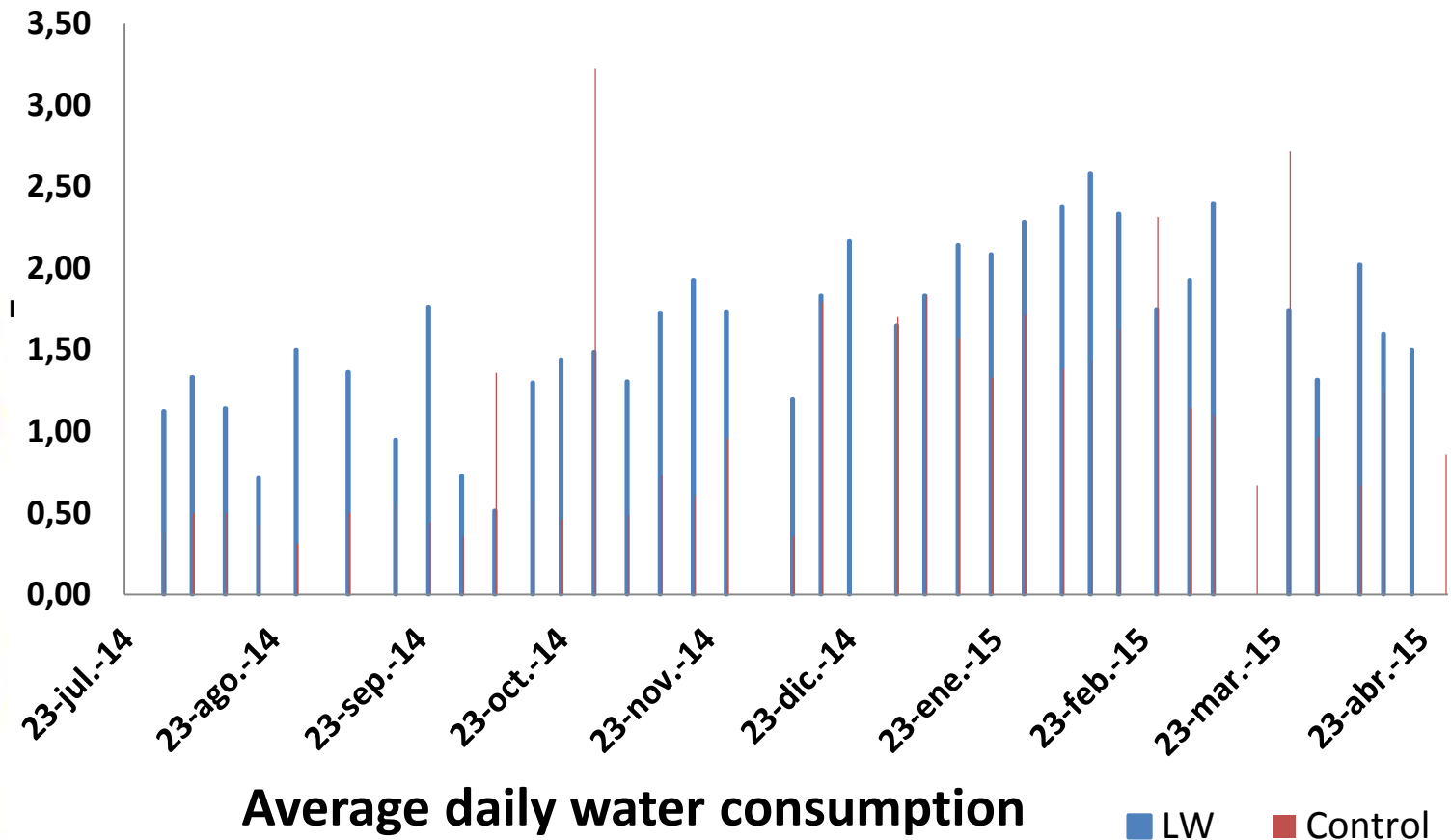
Nephrolepis exaltata

RESULTS



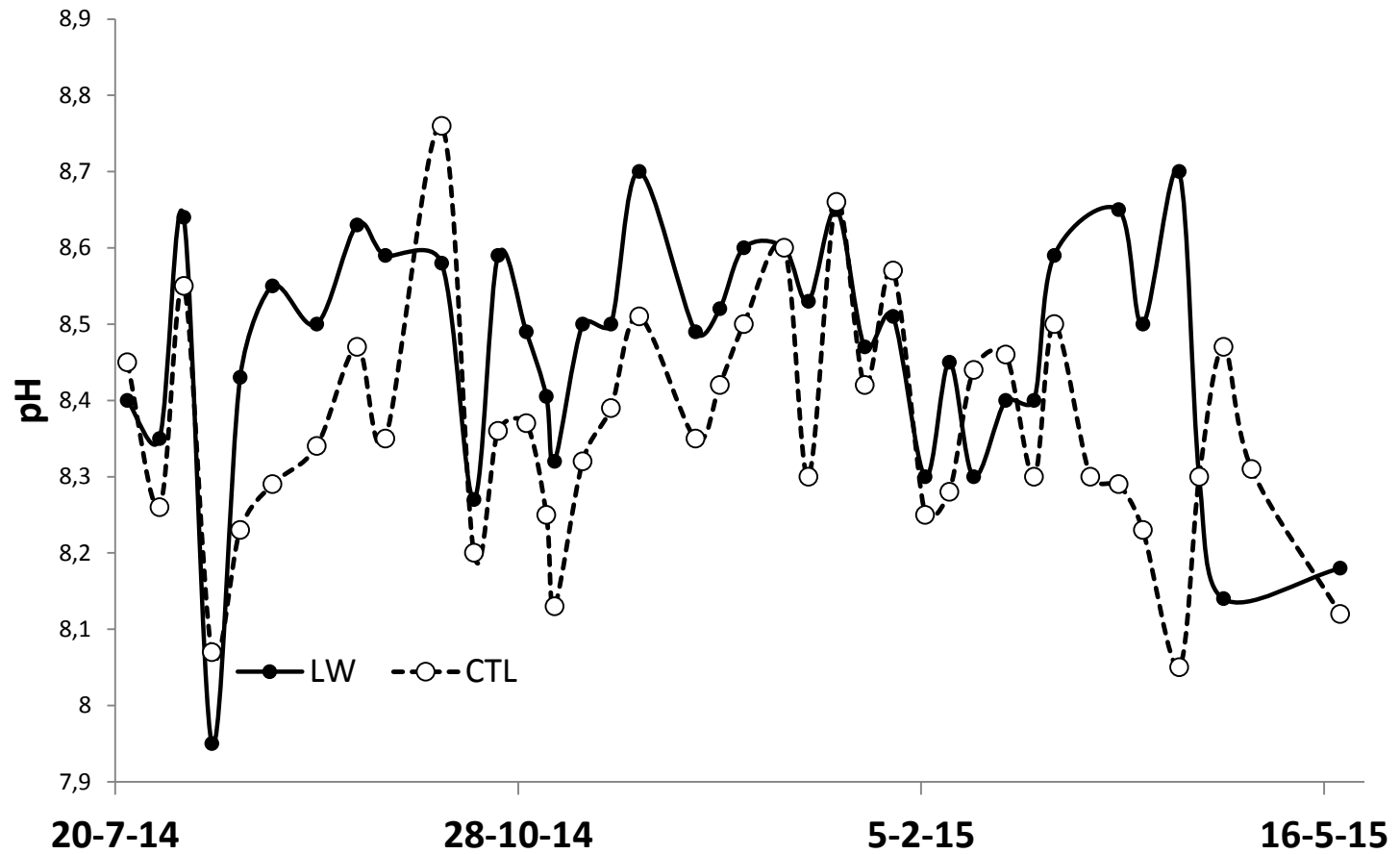
Cummulative water consumption

RESULTS



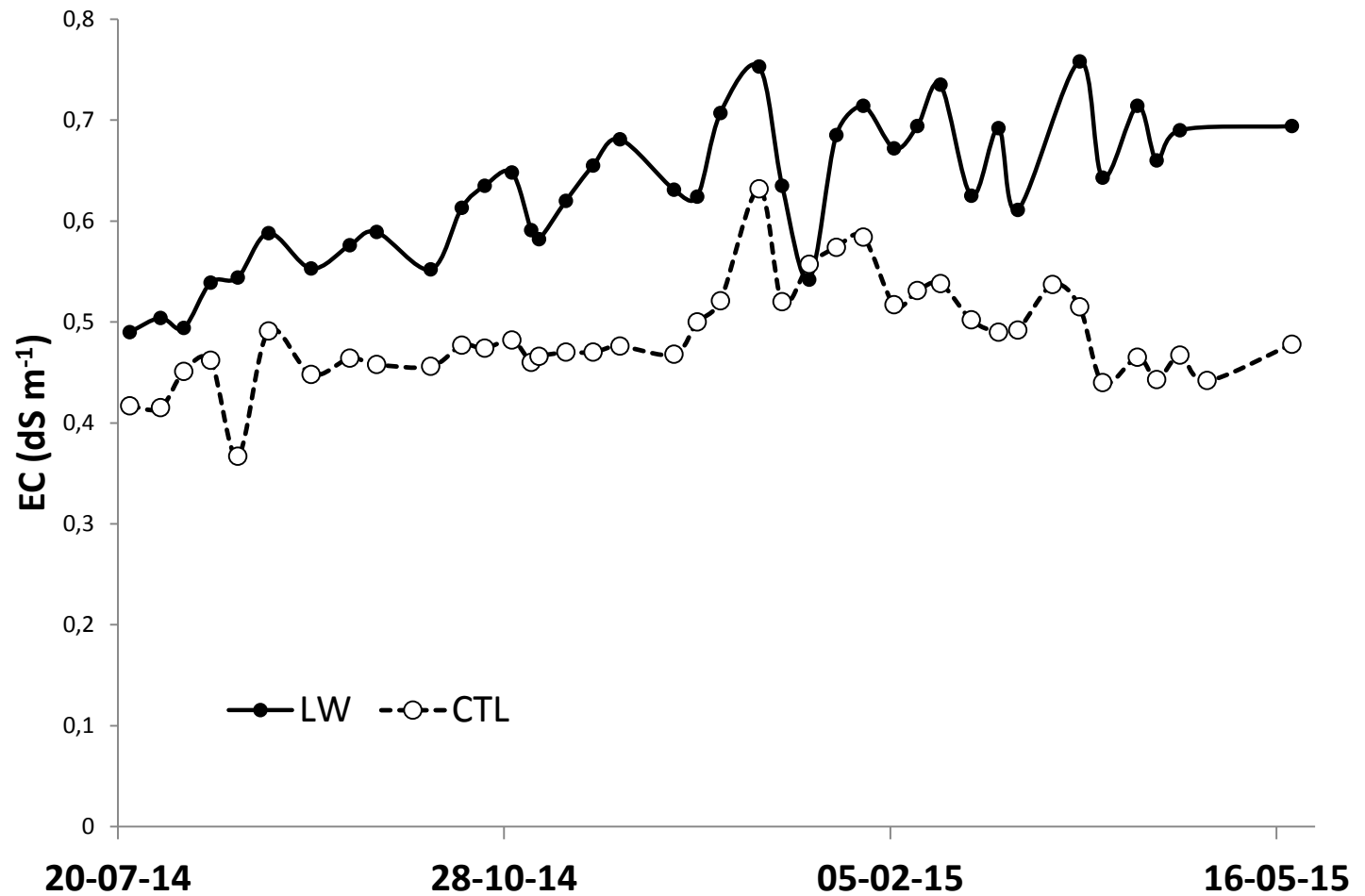
Average water temperature: LW: 24.8 °C and CTRL: 24.9 °C

RESULTS



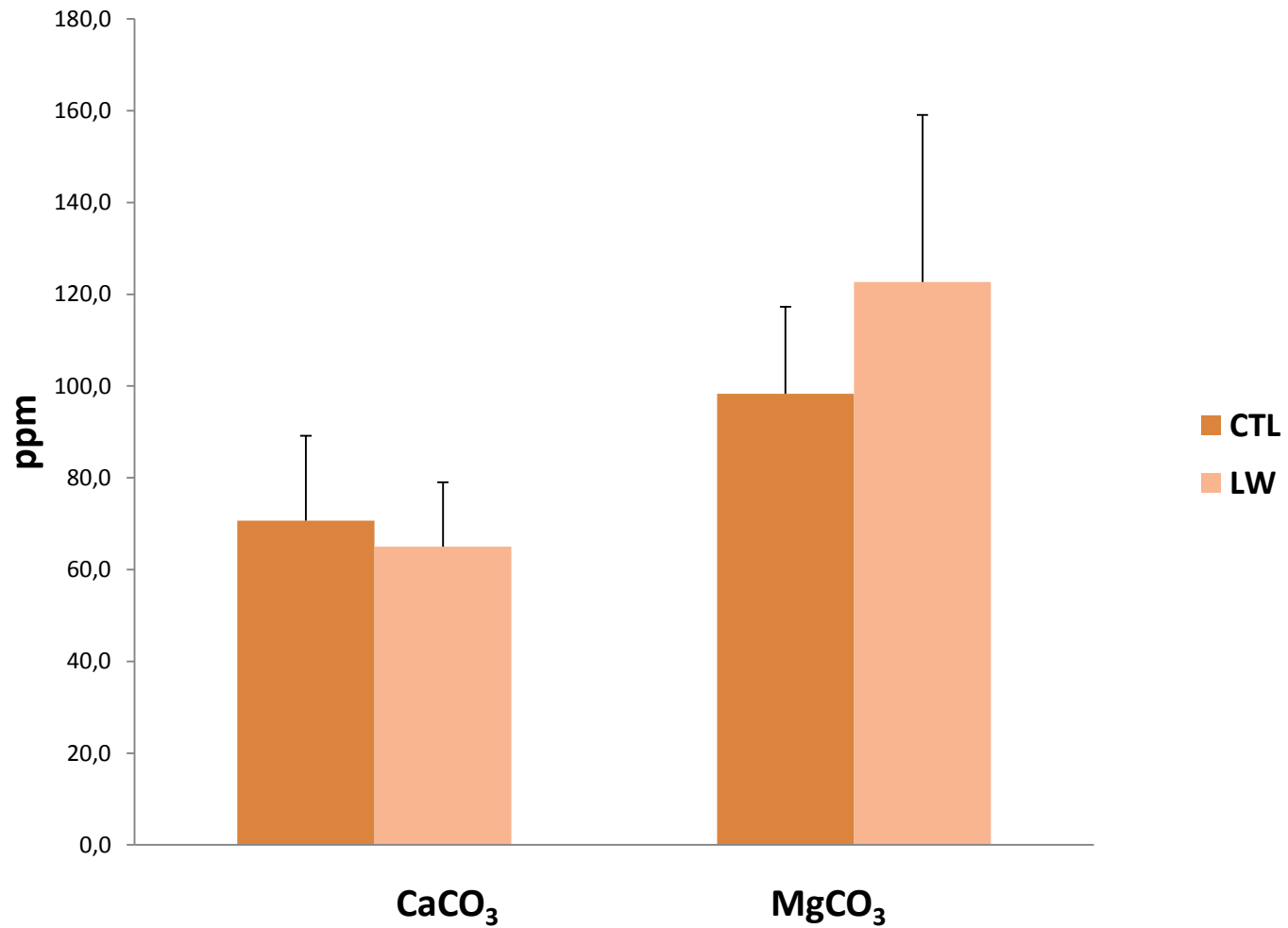
Level of pH

RESULTS

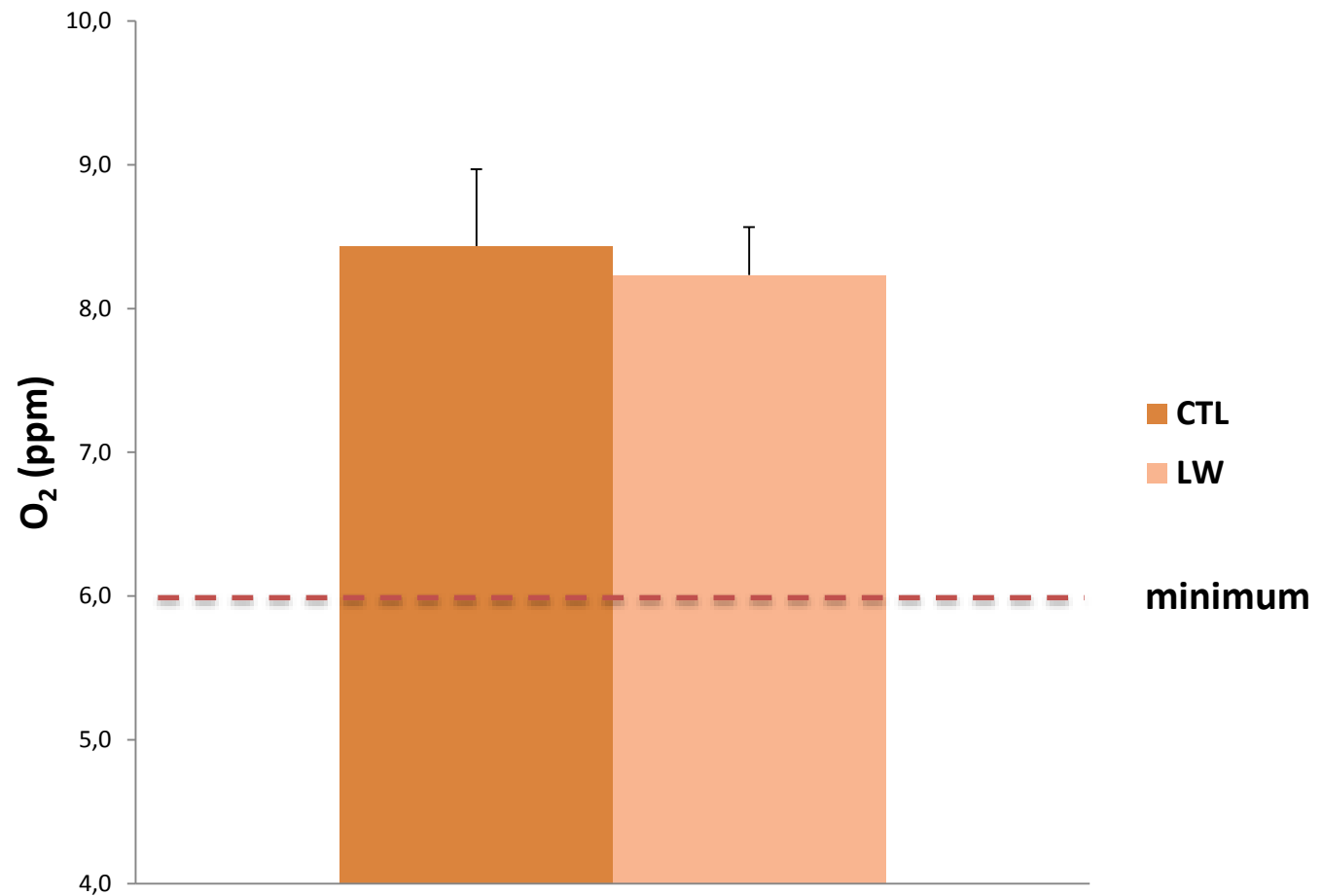


Level of Electrical Conductivity

RESULTS

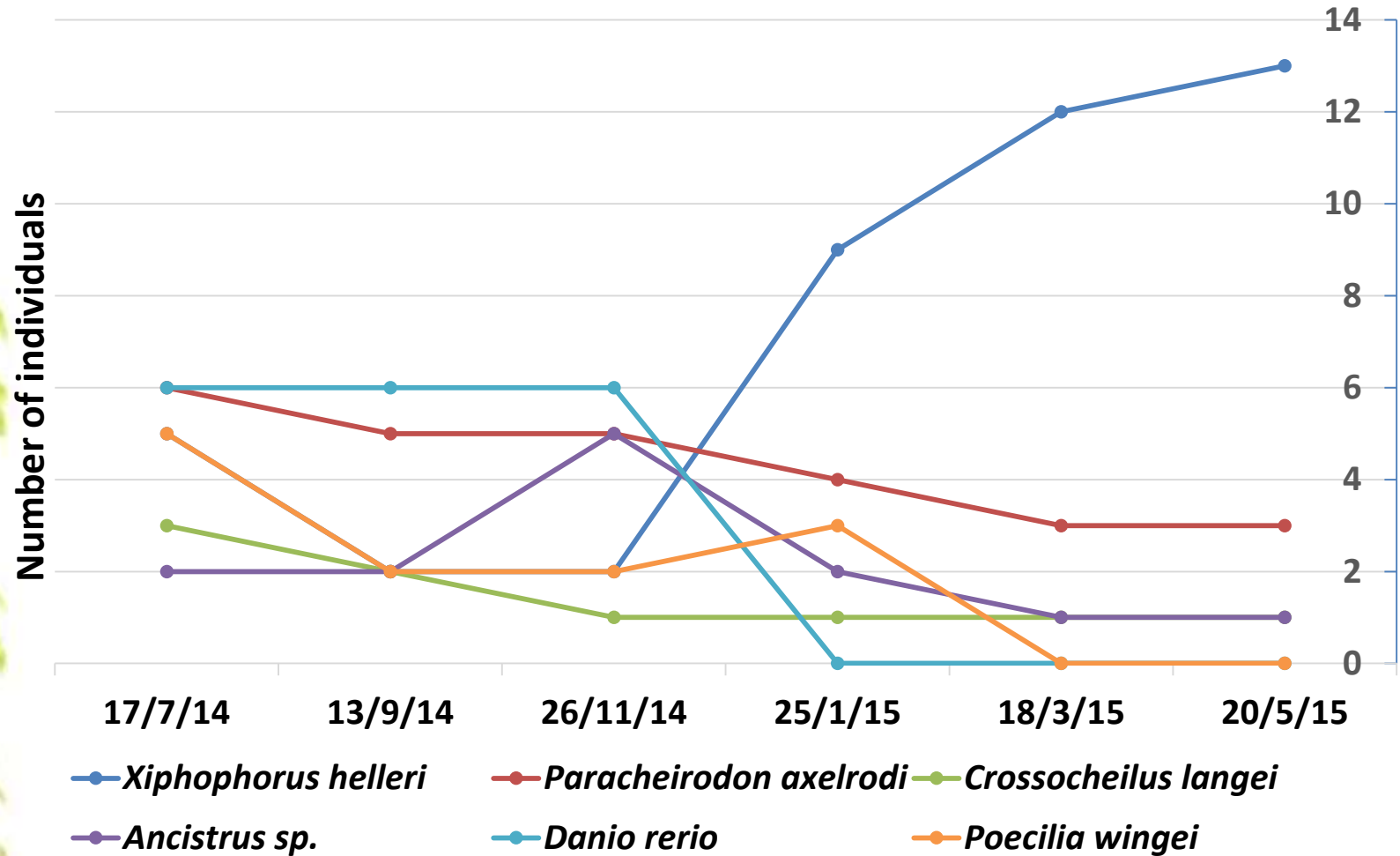


Measurement levels of calcium carbonate and magnesium carbonate



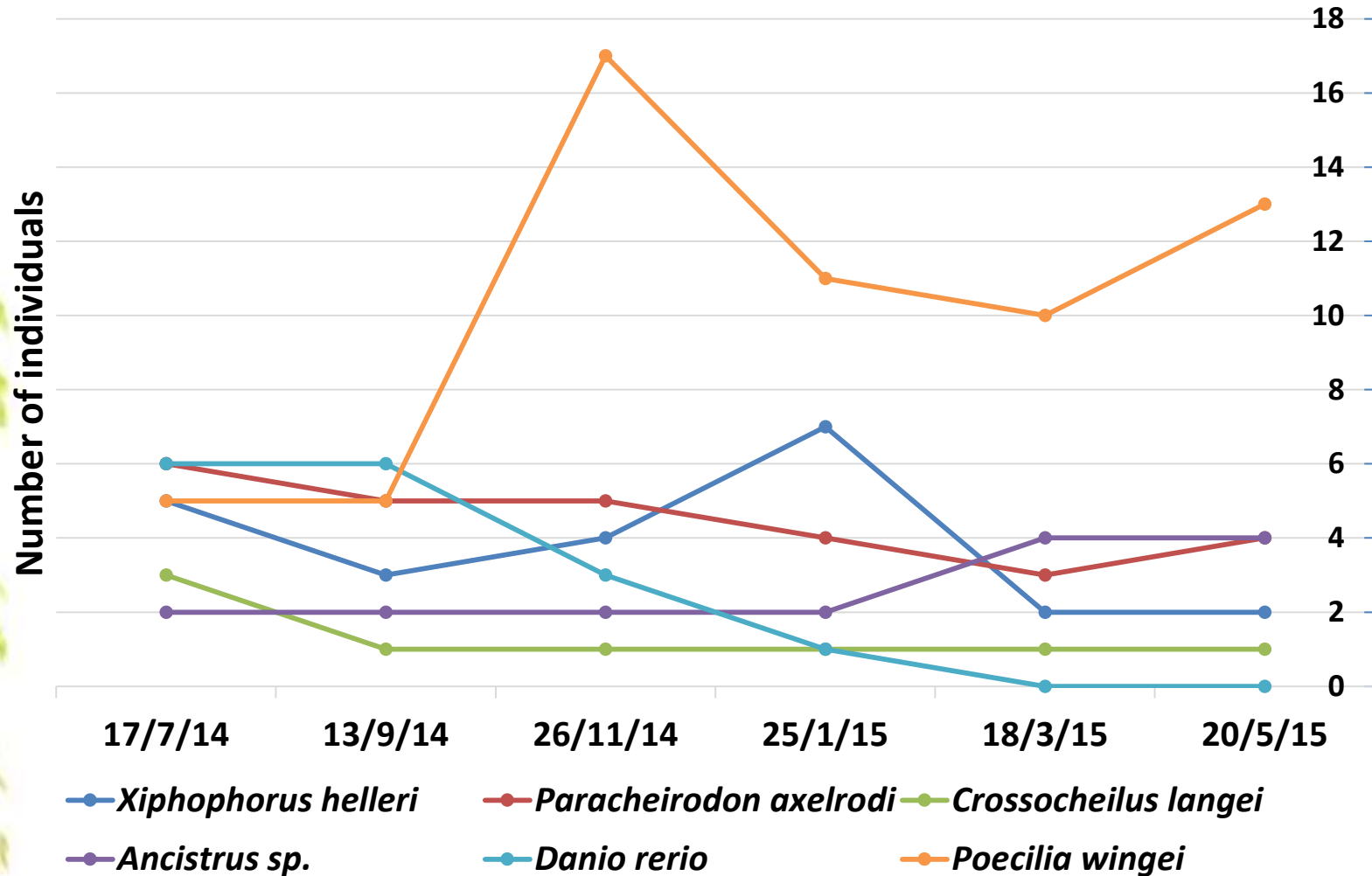
Measurement levels of level of dissolved oxygen

RESULTS



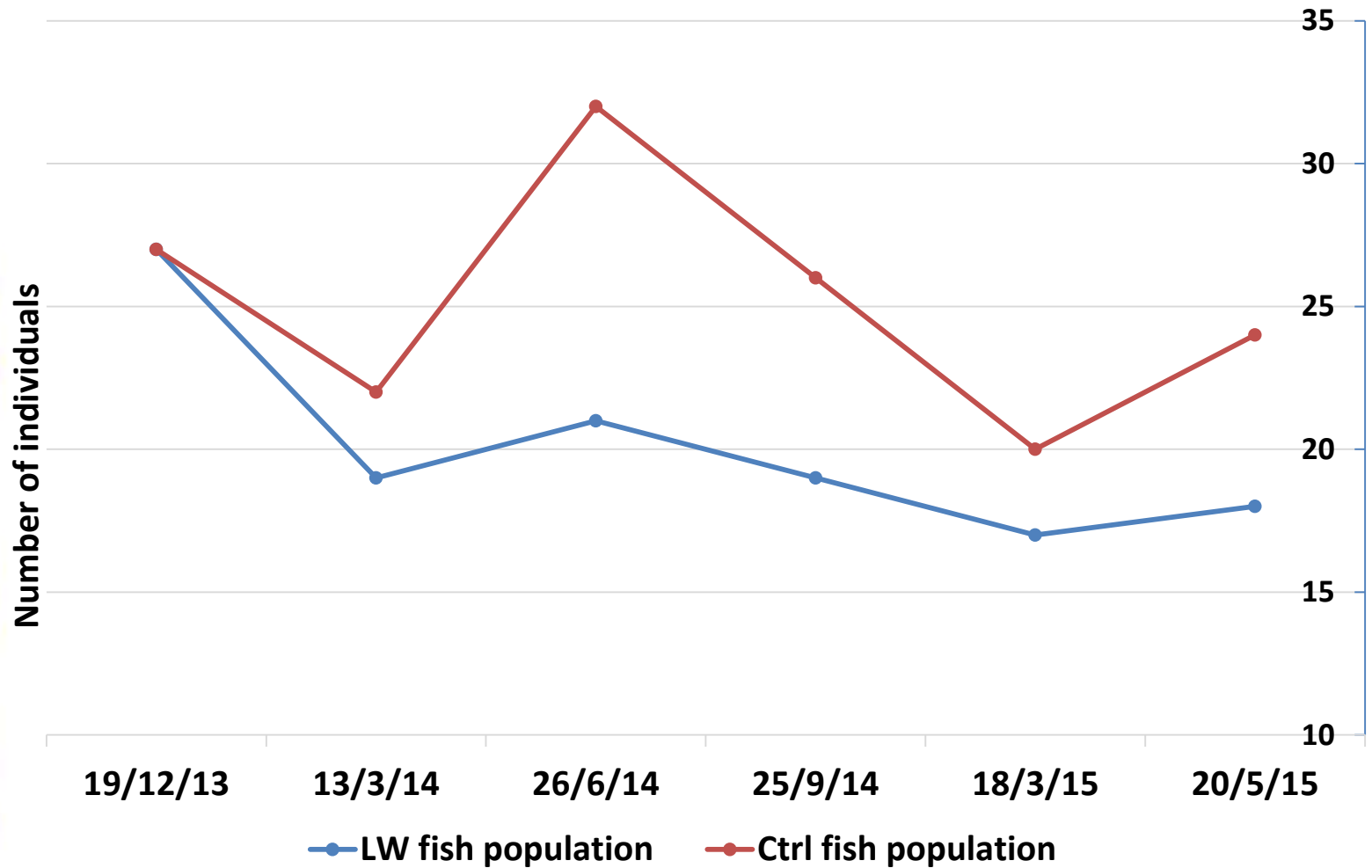
Fish Population Evolution in Living Wall Aquaponic System

RESULTS



Fish Population Evolution in Control System

RESULTS



Fish Population Comparative in Control and Aquaponic Living Wall Systems

RESULTS

PLANTS SPECIES PERFORMANCE

| PLANT SPECIES | GENERAL PERFORMANCE | ORNAMENTAL VALUE | ROOTS GROWTH | ABOVEGROUND PLANT GROWTH |
|-------------------------------|---------------------|------------------|--------------|--------------------------|
| <i>Soleirolia soleirolii</i> | M | M | L | M |
| <i>Spathiphyllum wallisii</i> | M | M | M | M |
| <i>Maranta leuconeura</i> | H | H-M* | H | H |
| <i>Nephrolepis exaltata</i> | H | H | M | H |

* Currently show symptoms of chlorosis

CONCLUSIONS

1. **Vegetation** had good development in all cases
2. The main parameters of **water quality**, with the exception of pH, were maintained within acceptable ranges in both systems
3. The evolution of the **fish population** was slightly better in the aquarium control. different species were dominant in each of the systems.
4. In the aquarium with living wall only one specie (*Xiphophorus helleri*) presented an **effective reproduction**, while in the aquarium control there was more diversity in reproduction (3 species)

Our Future research...

Bigger LWs

More complex designs (integration with ponds)

Combining with edible fishes and horticultural plants production



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terapia urbana



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Thank you for your attention



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