Geothermal Potential in Whiteleg Shrimp Recirculating Aquaculture Technology

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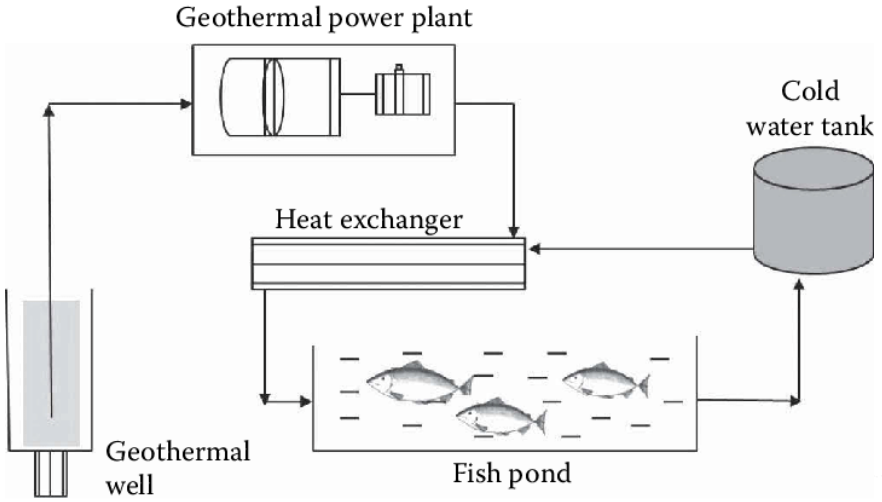
Geothermal aquaculture – innovative solution

- Purpose – to heat the water to optimal temperatures **(13-30 °C)** for cultivated organisms
  - Regulating temperature could increase growth of aquacultured organisms by 50-100 %.
  - Heat exchanger technology or direct use
- Leading countries: China, USA, Iceland, France, Hungary, Italy, Israel, New Zealand and others
- Species: tilapia, salmon, trouts, bass, catfish, sturgeon, shrimps, lobsters, microalgae etc.
- Very much related to aquaponics technology – to heat greenhouses.
- Environmental and marketing aspects – clean, green energy (CO_2 zero emission), low environmental impact, sustainable production



Geothermal aquaculture in Lithuania?

- Western Lithuanian Geothermal Anomaly
  - In the deep of 1300 m the water is 38 ^{o}C warm
  - Significant geothermal resources from Devonian-Cambrian aquifers
- The first and only geothermal power plant Geoterma was seeking for diversification of its geothermal heat application to create higher added value – blue biotechnology and/or aquaculture
- Several feasibility studies indicated that the most suitable species for geothermal aquaculture applicaton – shrimp (whiteleg shrimp *Litopenaeus vannamei*)
  - Optimal temperature 28-32 ^{o}C
  - Eurihaline species, however natural habitat salinity is >30 ppt
- What is the efficiency of shrimp warm saltwater RAS technology in local conditions?

KLAIPĖDA SCIENCE AND TECHNOLOGY PARK

Supply Chain for geothermal aquaculture
Feasibility study

Sea-Kult

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First shrimp RAS in Lithuania

- Pilot infrastructure created within **InnoAquaTech** project – Development and transfer of innovative and sustainable aquaculture technologies in the South Baltic area.
- RAS for *L. vannamei* shrimp cultivation integrated with renewable energy sources at KU Business Incubator
- The goal is to acquire shrimp cultivation knowledge and to optimize growth technology for local conditions.

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Interreg South Baltic

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InnoAquaTech

- Drum filter
- Biological filter
- Sump
- Protein skimmer
- Denitrification filter
- Oxygenation cone
- Heater
- UV
- Monitoring and control system
- Salt water preparation system

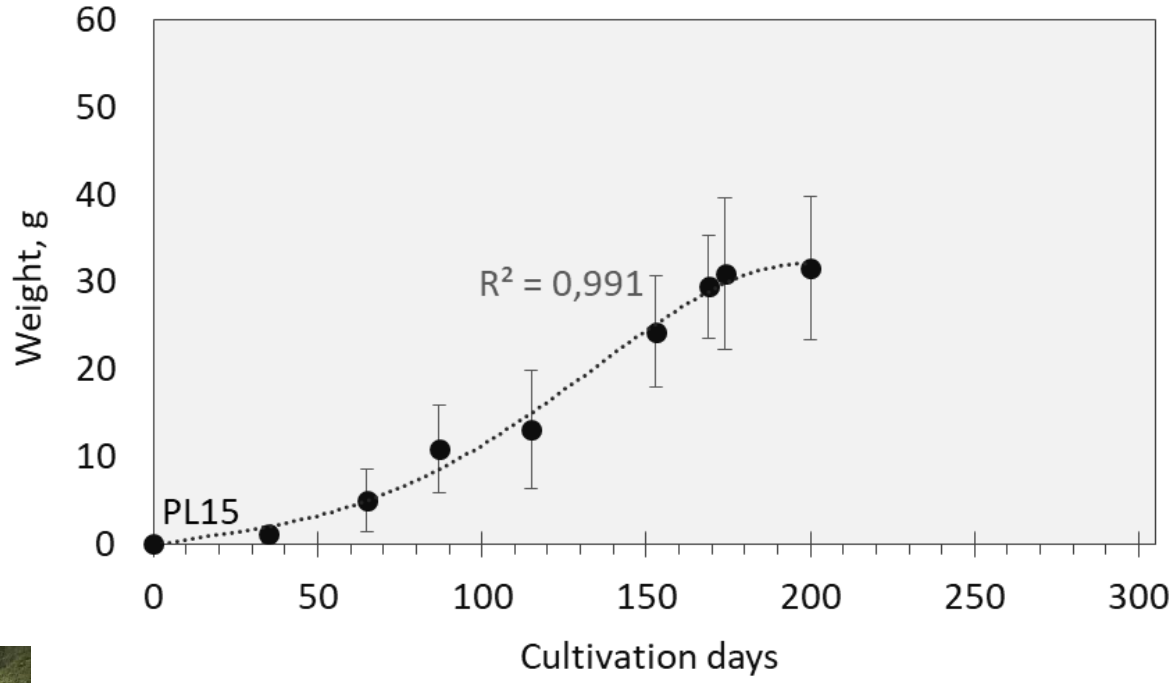
First shrimp RAS in Lithuania

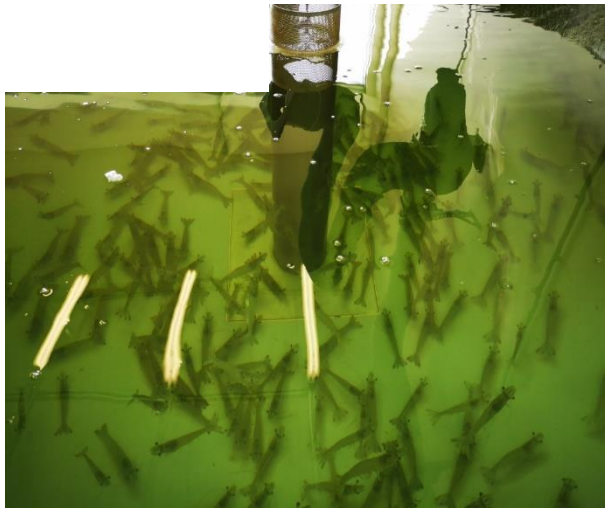
General parameters of the system:

- Artificial saltwater RAS
- Uses solar energy
- Unique to LT – denitrification filter
- System setup in two rooms
- Water volume – ~40 m^3
- Daily water loss – ~2 % (so far)
- 8 rearing tanks, surface area – ~29 m^2
- Max yield/cycle ~145 kg (5kg/m^2)
- Electricity consumption – 5 kW/month
- 2 employees

First results of growing *L. vannamei*

- Temperature – 28.5 (28-30)°C
- Salinity – 15-16 ppt
- Good nitrification, but problems with denitrification
- Growth to the market size took 5 months and average size was 24.3±6.4 g (up to 40 g)
- Stocking density 2,5-3 kg/m^2
- Total harvest 80 kg
- FCR – 1,9-2,0

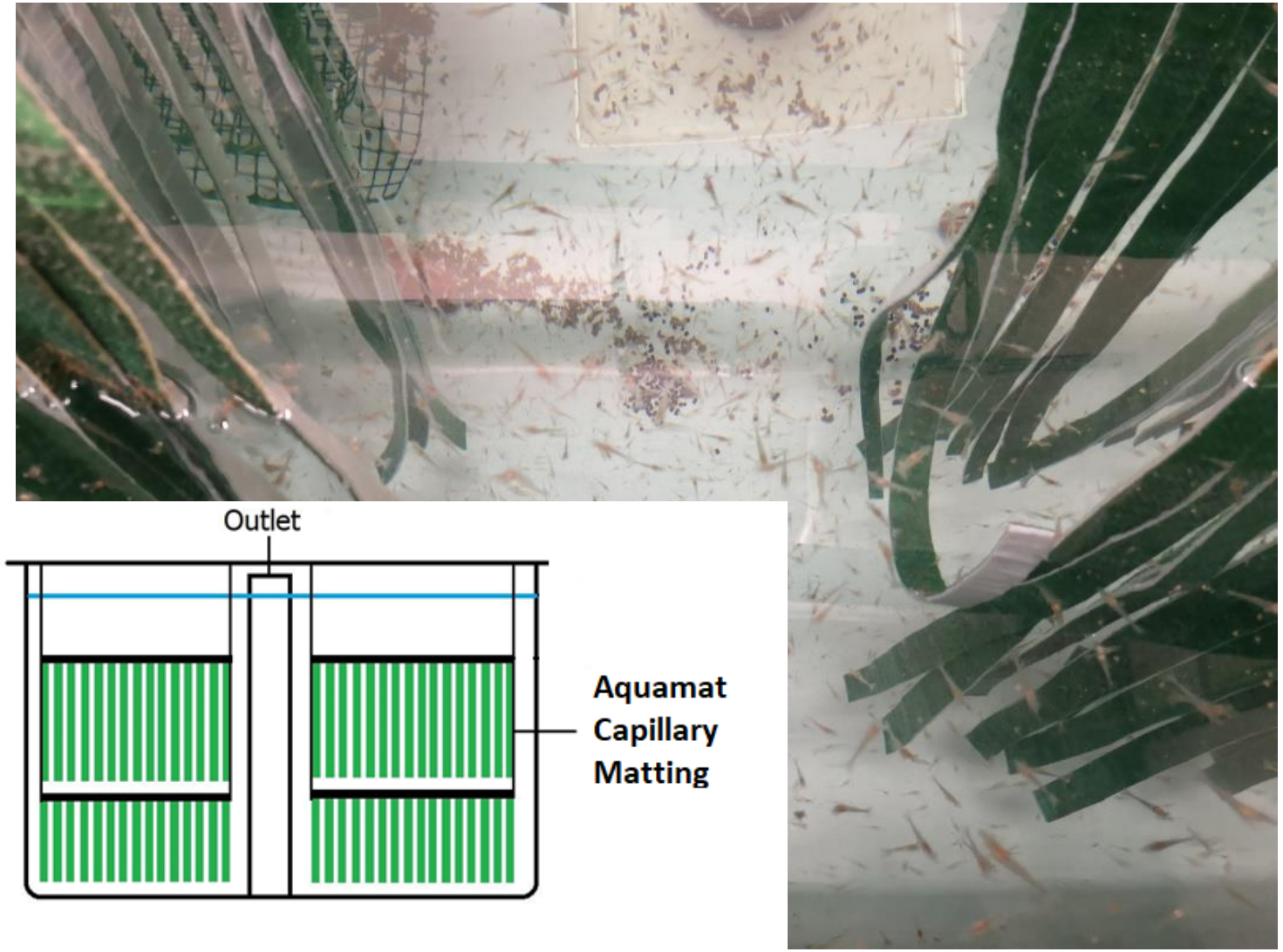




Feeding rate ~2%, manually x4/day
Growth rate 0.18 g/day
Mortality ~65 %
Handling mortality: 20-25 %
Cannibalism observed
Jumping issue

First harvest

Issues to be solved



- To run fully loaded system
- Denitrification filter
- To optimize water quality
- Feeding management
- Reduce mortality
- Unequal growth rate during first few months
- Shrimp tank design – extra surface area

Geothermal potential?

- **Heating was not as crucial as it was thought initially**
- **High operational costs for reconstituted sea salt (RSS)**
  - **Solutions**:
  - Low cost salt mixture LCSM: (Na, Mg, Ca, K chlorides, Mg sulphate)
  - Geothermal brine (110 g/L) from 1300 m deep Cambrian aquifer, which is highly rich in sodium, calcium, magnesium and other, including trace, elements.
  - Concept of direct use of geothermal water from the large and shallow Upper-Middle Devonian aquifer containing 15-35 g/L salts and 20-30^{o}C temperature.
    - Technical aspects
    - Legal aspects

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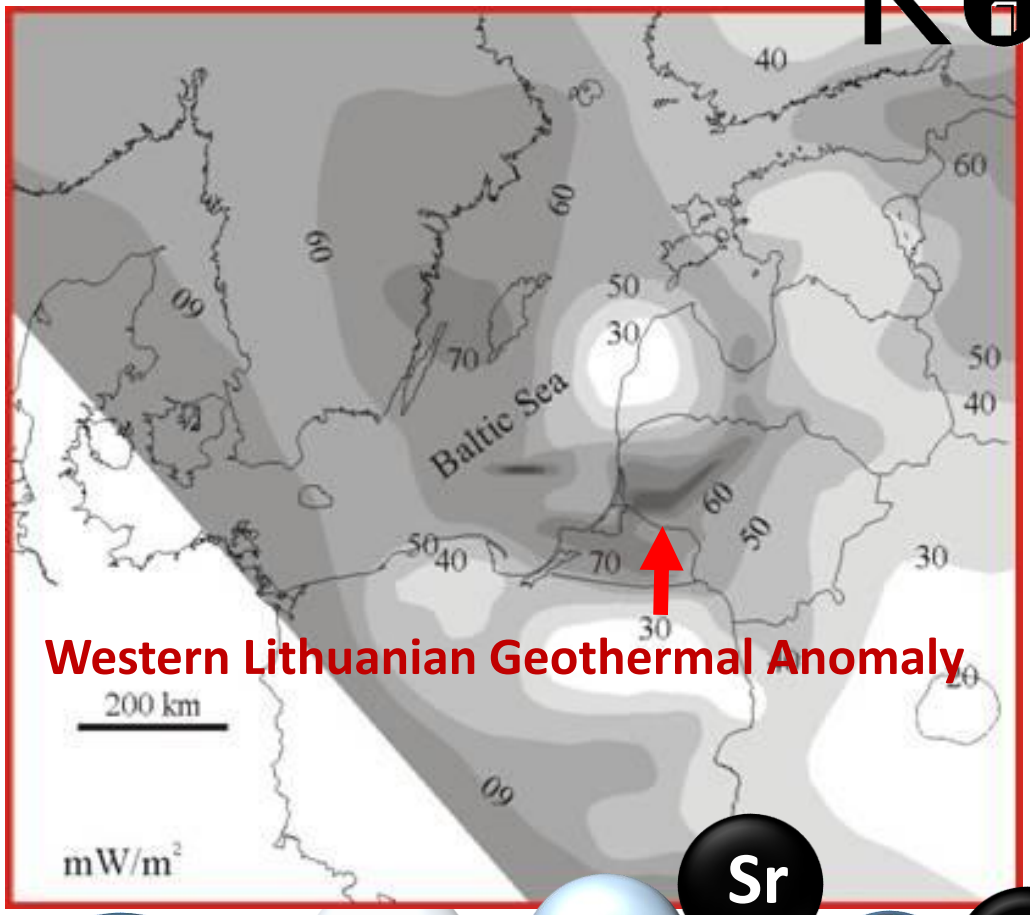
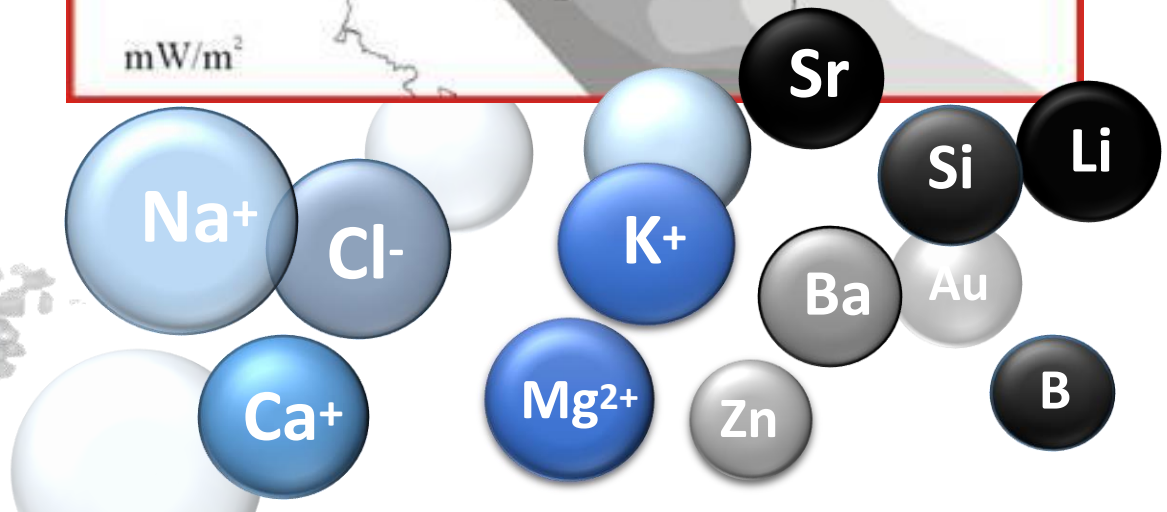
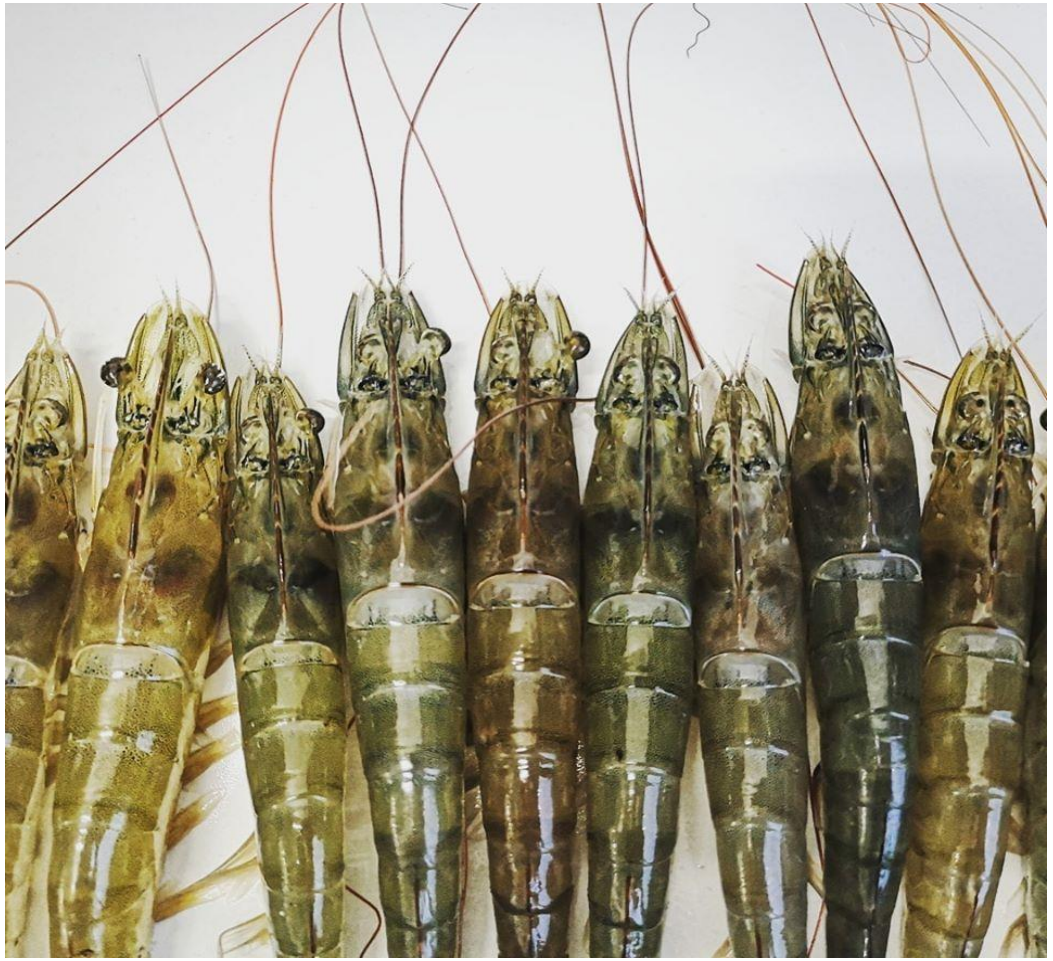




Geothermal potential

Marine recirculating aquaculture technology development

- Shrimp tower concept
- Assessing the effects of water salination for freshwater species
- Geothermal water application economic and biological effects and technical possibilities



Final goal: aquire competences necesary for the development of marine recirculating aquaculture like salmonid grow-out RAS or large-scale shrimp aquaculture by using unique coastal geothermal resources

Thank You!

Klaipeda University
Marine Research Institute

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Interreg Baltic Sea Region

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Blue Platform