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History of RAS, advantages and disadvantages of using of RAS technology

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www.frov.jcu.cz

History of RAS in Europe – the 1970s

- The beginning of use RAS for intensive aquaculture
- Optimization of survival, growing fish and feed conversation ratio through the optimal conditional (temperature of water, the concentration of dissolved O_2, pH, NH_4, NO_2)
- The technology of mechanical and biological filtration was taken from wastewater treatment plants
- The whole technology had to be significantly modified in aquaculture, because of the low differences between safe and toxic concentration of NH_4 and NO_2 compared with wastewater treatment plants
- It was necessary to keep a lower concentration of ammonia and nitrites in an aquatic environment – that meant to provide the optimal conditions for the nitrification process
- The improper function and adjustment of biological filters in connection with the deficient experience of staff – it was a reason for a lot of mistakes
- We could observe a huge mortalities of farmed fish

History of RAS in Europe – the 1980s

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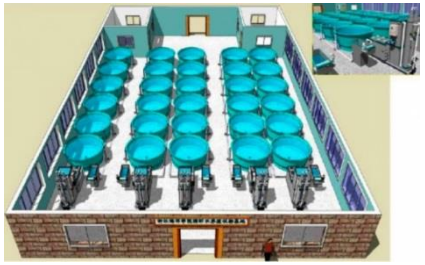
- The great development of intensive aquaculture for Eels (*Anguilla anguilla*) in Denmark and the Netherlands
- The total of annual production was approx 6 000 t of fish for sale
- There were still the technological and operating faults
- Intensive farms did not have the required biological and physiological conditions for fish considering on breeding biomass of fish
- The most common and the biggest technological lack was a deficient capacity and stability of biological filters
- There were issues with continuous and effective removing of toxic ammonia and nitrites from these systems
- In this period was found out, that RAS has to provide the optimal conditions not only for farmed fish but also for the bacteria, which are living in the biological filters



History of RAS in Europe – the 1990s

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- The technical issues were gradually solved, there were being introduced the new technologies for oxygenation, sterilization of water, measuring the quality of water, adjustment of water flow, control systems and alarms

- At the beginning of the 2000s and the 2010s, it was a huge development of intensive farms in Europe

-This way of culture was used especially for ornamental fish species, European eels, sturgeons, Common carps and Salmonidae fish

- Since 2004 in Europe RAS has been testing and optimizing for the new kind of fish like European perch, Pikeperch, tench and Salmon breeding on the land

- The denitrification tanks were being introduced at farms for the minimizing exchange of freshwater

- It was a start with experiments for a combination of intensive aquaculture and hydroponic systems – the origin of aquaponic systems

The present of RAS in Europe

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The basic characteristic of these systems

- RAS is very effective for industrial fish production
- Use of these breedings have to meet the strict and high levels for zootechnical aspects
- It is the elimination of health and nutritional problems
- The breedings provide the continuous, quality, predictable and environmentally friendly production

It is necessary to keep an eye on the profitability of production

The present of RAS in Europe

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The basic characteristics of these systems

- RAS is connected with: investment, the modern breeding equipment, the higher electricity consumption, the technical and technological maintenance, especially very qualified, reliable, responsible and dedicated staff
- On the other side these systems allow to produce in very high biomass of fish in a limited space, concurrently with the minimum requirements on the consumption of freshwater
- Another benefits are opportunities using the dry pellets and achieving of high labour productivity

It is necessary to keep an eye on the profitability of production

The profitability of RAS farms

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- The stable function of all technological components
- Fish in the high breeding biomass, the maximum of utilization od breeding capacity (up the 100 %)
- Fish have to be healthy, good physical condition, the minimum of mortalities, very high SGR and FCR

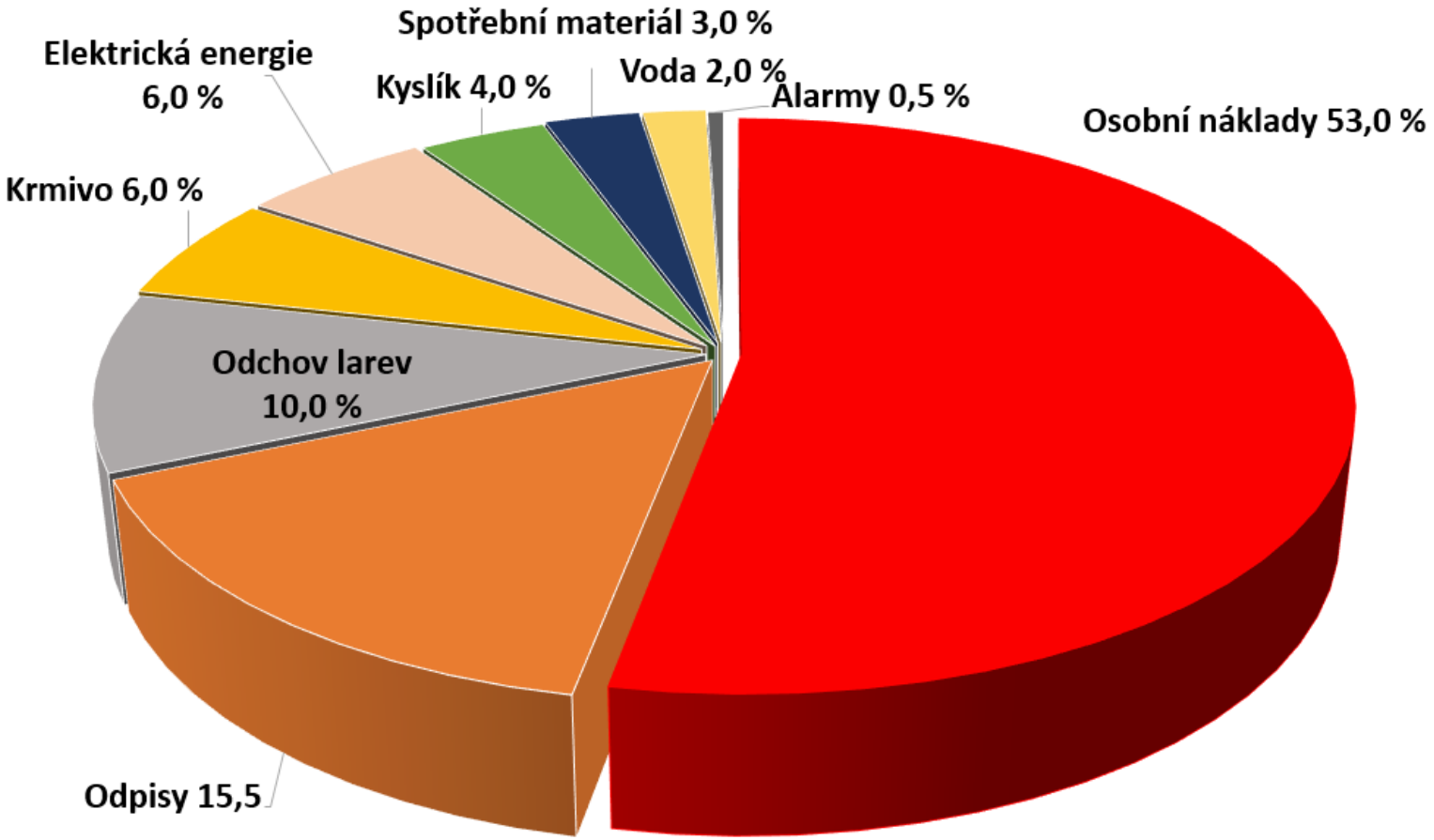
- It is necessary to keep a continuous (annual) production for juvenile fish, reduce the consumption of electrical energy
- 20-25 years ago the electrical consumption was 10 kW for 1 kg of produced fish
- In the present is the electrical consumption about 1-2 kW/kg
- The new technologies are still evolved: lower electrical requirements for the pumping water, the biological filters, the sterilization and the oxygenation

The production costs of RAS

Costs are different depending on:

- breeding systems
- kind of fish,
- fish age

The economy of RAS – the production costs for the annual production for 10 000 pcs juveniles of Pikeperch (15 g)



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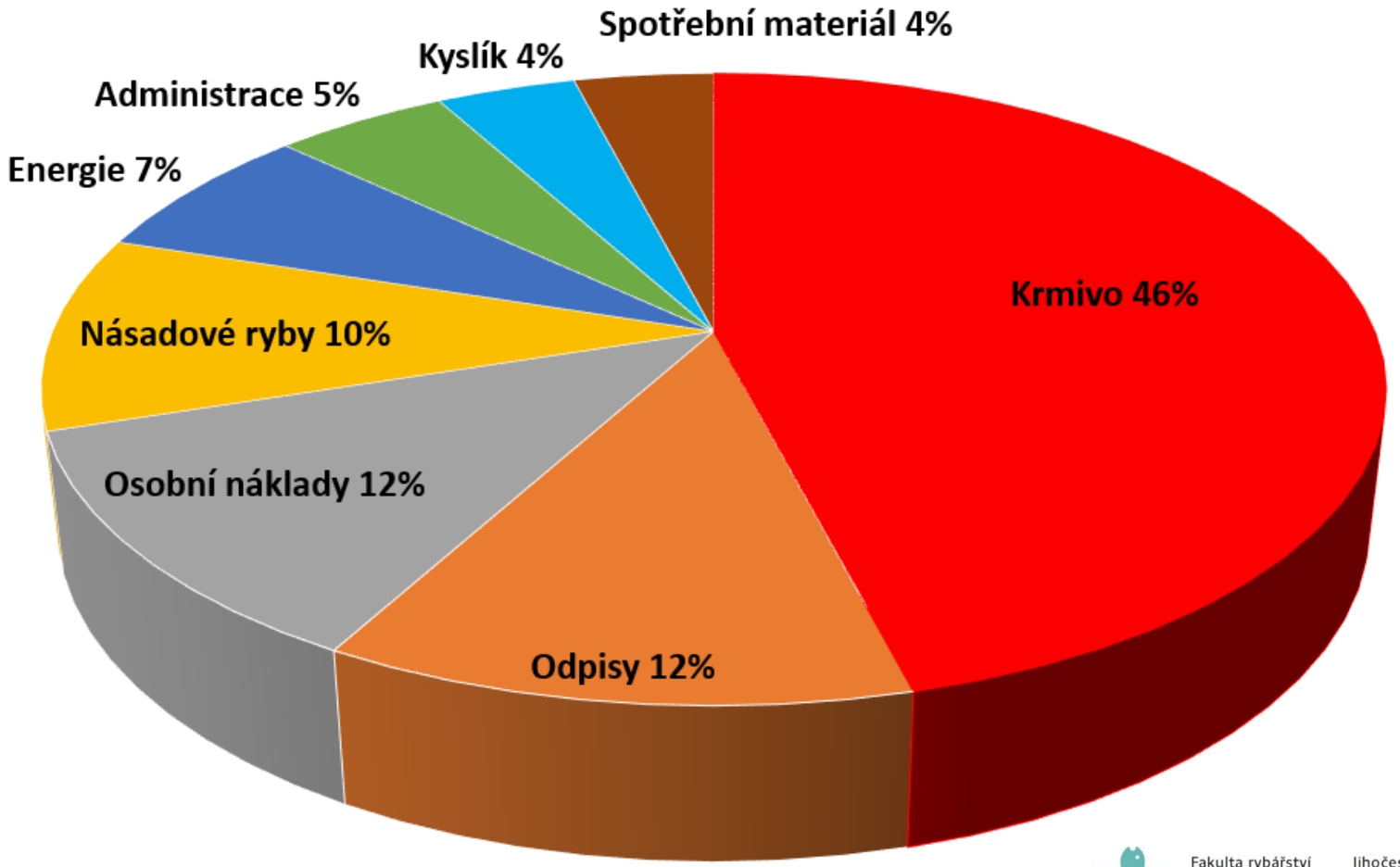
The economy of RAS –the production costs for the annual production for 50 t of Rainbow trouts for sale (400 - 500 g)



The advantages of using RAS

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- The optimal conditions for effective breeding and without the seasonal changes

- The continuous control of water quality and breeding fish

- There is a possibility to observe the behaviour of fish

- We can improve or positively influence the physiological, medical and condition of fish

- The produced fish is possible to grade and manipulate very sophistically

- A breeder has an actually (continuous) information about the biomass of fish (quantity and size)

- The strict evidence of breeding fish helps for sales planning

- The sale is continuous during a whole year with the same quality of product

The advantages of using RAS

- It is possible to manage the light and temperature conditions – it means the stimulation of broodstock (different kind of fish) out-of season spawnings

- A breeder is able to reproduce the fish continuous during the whole year

- RAS has the high production of fish considering on unit of area or volume of water, together with high biomass of fish

- Fish are fed with dry pellets, the high labour productivity

- Fish are protected from piscivorous predators, poachers, improper environmental conditions like oxygen deficits, extreme pH values of water, periods of drought or floods

The advantages of using RAS

- Significantly the lower consumption of electricity for the water heating as compared with fish culture in flow-through systems for breeding thermophilic species in a mild climate

- There is a higher tolerance during the sudden interrupt of heat supply

- RAS are not demanding on the built-up area in view of the high biomass of breeding fish

- In the future RAS will be building not far or inside of urban agglomeration – close to the potential customers

- There is still an opportunity for the effective combination of breeding fish and plants = aquaponics systems

- The purpose is to improve a profitable, quality and fresh production of fish without the transport of these products on the very long distances

The suitable species for breeding

- There is a higher requirement for technical and economical aspects, electrical energy and for breeding fish in RAS systems

- The production of valuable fish for sale and more demanding fish species

- The fish species which need a very high water quality, a special conditions or a breeding procedures (for instance: periodic sorting, a special lighting conditions in the beginning of breeding, higher or lower constant temperature of water, higher concentration of dissolved oxygen in the water – around 100 %)

- These kinds of fish have a higher market price and demand is higher than supply

- The using of RAS is for different kind of broodstock with the purpose to achieve a very quality sperms or eggs fo spawnings

The suitable species for breeding

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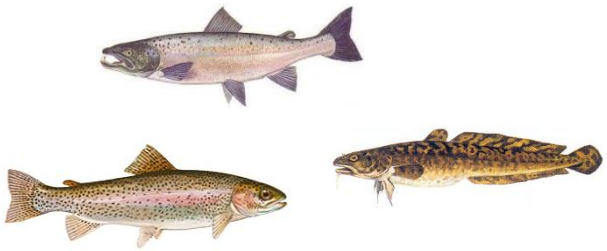


Atlantic salmon – *Salmo salar*

Rainbow trout – *Oncorhynchus mykiss*,

Brook trout – *Salvelinus fontinalis*

Burbot – *Lota lota*

Pikeperch (Zander) – *Sander lucioperca*,

European perch – *Perca fluviatilis*,

Wels catfish – *Silurus glanis*,

African catfish – *Clarias gariepinus*,

Largemouth bass – *Micropterus salmoides*,

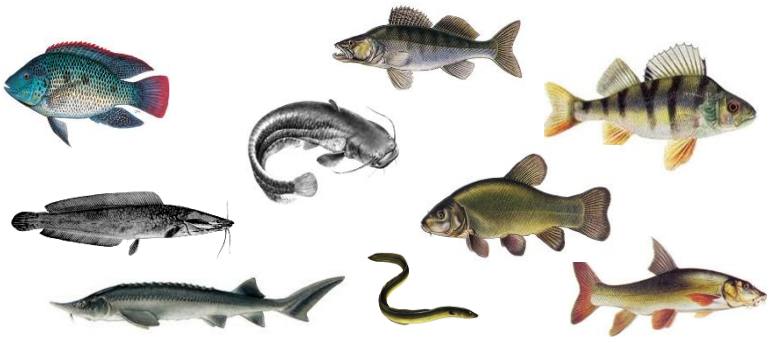
Different kind of tilapia = genus of *Oreochromis*

Different kind of genus Acipenser

European eel – *Anguilla anguilla*

Common barbel – *Barbus barbus*

Tench – *Tinca tinca*



The disadvantages of using RAS

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- The system has to be designed and built without any technical lack
- It is needed to calculate with the relatively high investment costs
- Somewhere is observed very high operating costs
- Higher and continual consumption of electric power
- Continual delivery of oxygen and feed
- A very high requirement for qualified and responsible staff
- The regular control and the technical maintenance of the system
- In these systems can not be an unexpected mortalites

The examples of RAS/fish cultures in the Czech Republic

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Tilapia s.r.o. – HAPPY FISH

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- Nuzbely at Tábor,
- It was built in 2015, the annual production is around 60 – 100 tons of African catfish
- The modern, clean and top-quality breeding without the technical issues
- African catfish is relativaly simple for breeding, the farm has an own processing plant
- 100 % of produced fish is sold in the form of fish products
- High added value
- The combination with a biogas plant
- Approx 10 – 15 different kind of fish products are offered continually to the markets and chain stores

FISH Farm Bohemia s.r.o. ROKYTNO

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Fish Farm Bohemia s.r.o. was built in 2011. It is located in the area of a collective farm in Rokytno, near cities Hradec Králové and Pardubice.

Jezerní pstruh s.r.o. Kořenov

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- The production of Salmonidae fish, Rainbow trout to the size of salmon trout, Brook trout
- The Company was founded in 2016
- The annual production is 1 000 tons of fish
- Managers are Martin Junek a Rudolf Beneš

BioFish s.r.o. Pravíkov

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- Danish RAS system for the production of salmonid fish – rainbow trout (approx 60 t per year), in these days breeding of Brook trout sporadically
- At present, there are 2 RAS with 10 tanks and another 2 systems with 4 tanks overall
- The company was founded in 2010
- Manager Ing. Petr Tůma,
- A breeding different kind of geographic population of rainbow trout (from Denmark, Northern Ireland, the Republic of South Africa, Slovenia and Italy).








Kinského rybářství Žďár nad Sázavou

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RAS „dánského typu“ Kinského rybářství Žďár nad Sázavou – chov síhů, ve výstavbě

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- A family farm since 2010, in insolvency – transfer to the new owner (Bishopric in České Budějovice)
- The production of Rainbow trout, Brook trout and sturgeon
- Sale of live and processed fish
- The annual production is approx 40-60 tons of fish

Anapartners Prague - Horní Počernice

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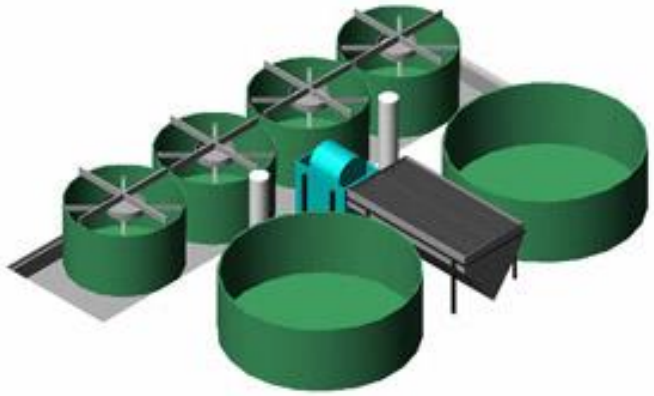
-The breeding of European perch and Pikeperch



SALMOFARM Nedvědice

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- It was founded in 2016
- The total production is planned about 80 tons of Salmonidae fish per year - Rainbow trouts
- At the moment there are production problems

Aquaponia s.r.o. Lážovice

FARMA PRO VŠECHNY
Rybná 716/24
110 00 Praha 1

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- The farm has 1700 m^2
- They should produce 500 pcs of salad and 80 tons of fish per year
- Breeding fish: African catfish, Wels catfish, ornamental fish

NDC fish Volary

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- It was founded in 2017
- The total production should be 10 tons of fish per year
- At the present: breeding juvenile carp
- Breeding of European eel
- It has been tested another kind of fish like Pikeperch, Largemouth bass
- Breeding of rainbow trouts in the ponds, sale of live fish
- A combination with pond farming
- 1,5 employee

NDC ryba

www.ndcon.cz

ZOD 11 of May a.s. Milín

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- Intensive aquaculture of African catfish, the production approx. 10 – 20 tons per year, near to village Smolotely
- The use of waste heat from the biogas plant, which is located near this farm
- The total volume of water for breeding is 26 m3
- They buy a small fish about 5-10 grams
- Sale of live and killed fish
- The price is 100 CZK for a kilo
- The one employee
- The supplier is Agrico Třeboň

Velká Bystřice at Olomouc – breeding of European eel for reintroduction into open waters

- A manager Jaroslav Švarc,
- It was founded in 1992
-They started with market Wels catfish

Agrico Třeboň

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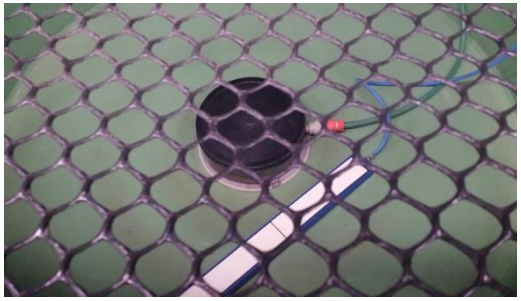
- The testing model from Agrico Třeboň,
- It was using like an exhibition system for a people who are interested in intensive aquaculture
- They were testing a breeding of Pikeperch, African catfish and Wels catfish
- At the present this, system is not working



ALCEDOR Zliv

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- I was founded in the June 1999
- The owners are Luděk a Eva Štěchovi,
- Breeding of ornamental fish, especially koi carps
- Sale of fishing equipment and feed
- Commercial construction of garden ponds

Various applications of RAS for ornamental and aquarium fish in the Czech Republic

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The first experimental RAS at Research institute of fish in Vodňany

- Model workplace for intensive aquaculture
- Is was built thanks to prof. Kouřil in the 1980s
- The reconstruction was in 1999-2000
- One to three systems, together 18 tanks with a volume of water about 1 000 litres + another small systems






Experimental fish breeding hall FROV JU

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- It is located in the area of Experimental fish culture and facility in Vodňany

- Investment 5 725 000 CZK with VAT

- Two modern RAS (independent) – a volume of water is 30 m^3

- For breeding is 15 m^3 in the 10 tanks

- Professional staff – 1,5 working time

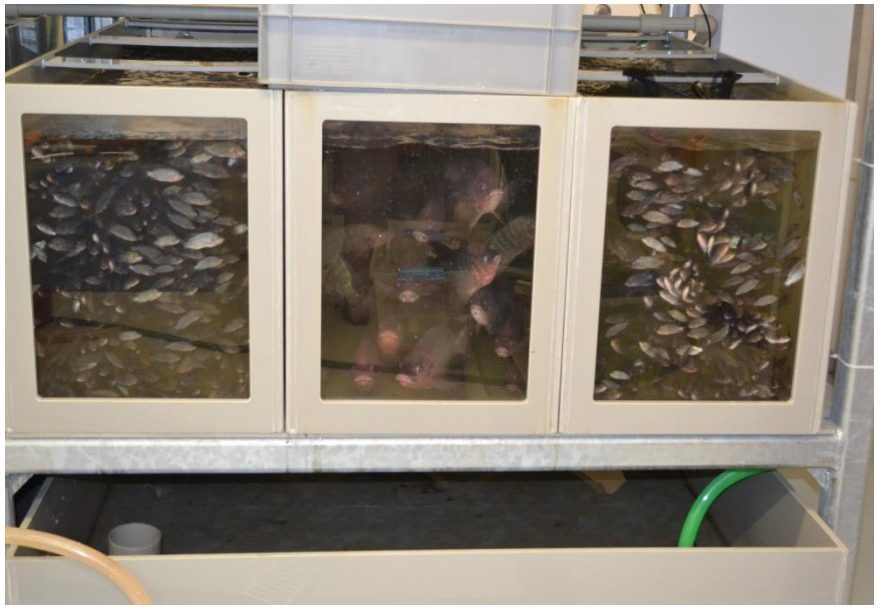
The annual costs

Položka	Náklad (Kč)	Podíl (%)
voda + elektrika	320 000	22,6
kyslík	70 000	4,9
krmivo	100 000	7,1
násada	100 000	7,1
obsluha	600 000	42,4
odpisy	175 000	12,4
spotřební materiál	50 000	3,5
CELKEM	**1 415 000**	**100**

The present

The breeding of Pikeperch – a combination of RAS and pond farming aquaculture, 50 – 70 thousand pcs during 4 months, profit = 1 – 1,4 million CZK
Realization of the experiment during 8 months.

Insitute of aquaculture FROV JU in České Budějovice



Other systems under construction and another intensive fish culture in the Czech Republic

- Trout farm Koroužné
- Farm Kaly s.r.o.
- Fishery Holohlavy s.r.o., Karel Dunas
- Blatenská ryba spol. s r.o. – RAS Blatná
- Collective farm Hrotovice