Combined rearing of Siberian sturgeon *(Acipenser baerii)* and European perch *(Perca fluviatilis)* in geothermal water

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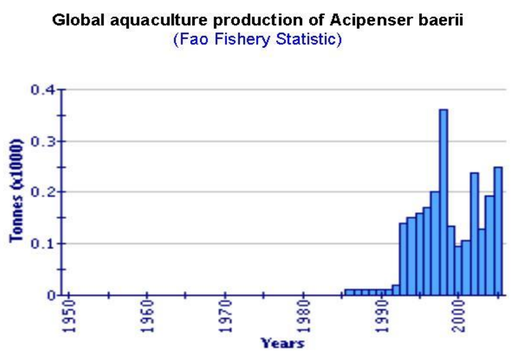
Summary: The possibility of using perch as a stock component during the rearing of sturgeon in geothermal water was investigated. In the experiment, 40 sturgeon with a body weight of 807.3 ± 135.0 g and 450 perch with a body weight of 10.4 ± 4.0 g were reared in monoculture. Also 40 sturgeon with a body weight of 783.5 ± 133.3 g and 450 perch with a body weight of 10.0 ± 3.8 g were reared in biculture, the perch comprising 14% of the sturgeon biomass. The experiment was conducted at a water temperature of 16.2 ± 1.5 °C, the water flow rate in the three (1.6 m^3 round tanks) being 0,55 ± 0.05 l/s. The feed rate was 2% per kg fish per day for perch and 1% per kg fish per day for sturgeon. Specific growth factor, body index and feed conversion ratio were evaluated for fish in all groups. In the experiment, the perch reared in biculture with sturgeon acquired the same body growth rate compared with the monoculture variant. Perch survival was 91.8% in the biculture and 98.4% in monoculture. Pathogen bacteria, viruses or parasites were not found in living perch in both monoculture and biculture. Some of the fish in perch monoculture had large white to reddish foci on the fin skin, often overgrown with *Saprolegnia* sp. Some of these fish showed extensive erosions on the fins, primarily on the pectoral and caudal fins. Fins of dead fish in perch monoculture had haemorrhages caused by cannibalism. Although cannibalism caused losses in biculture, the authors believe that the feasability of rearing these two species together comes from their different feeding behavior and different growth. During the time of about 8 years required for the rearing of sturgeon for caviar production, several generations of perch may grow together with sturgeon to a marketable size. Another benefit of sturgeon-perch biculture is thut left over not consumed feeds and excrements to be removed less frequently, which will also reduce disturbance of the fish during rearing.

Key words: sturgeon, perch, biculture, geothermal water .

Introduction: The aquaculture aims at the sustainable production of sturgeon and other species in a semi-intensive organic recirculation system.

By semi-intensive organic production we understand the implementation of IFOAM (International Federation of Organic Agriculture Movements) rules and Swiss standards for organic agriculture: (which means among others), low stocking densities, application of bio-feed avoiding fish meal and fish oil as much as possible and no preventive antibiotic treatment. An important aspect of organic aquaculture is the possible advantage of rearing a main species, which will share the environment with other related species, e.g. a target fish with other complementary fish. Such biculture and polyculture is recommended by Naturaland directives for organic production (Bergleiter, 2003).



Depending on the degree of niche overlap, the complementary fish may compete with the target species for food, habitat, etc. On the other hand, they may facilitate its growth and health through supporting activities, e.g. an omnivore fish with carnivore tendency such as the sturgeon and a complete carnivore like perch. Biculture describes the deliberately mixed culture of complementary species, i.e. species occupying complementary niches, especially in regard to their food and feeding habits. Biculture increases production per unit area or volume of the tank by maximizing the utilization of all nutritional niches within the aquaculture (Southgate, 2003).

Aim of the present study:
Evaluation of an aquaculture system to maintain combined rearing of Siberian sturgeon *(Acipenser baerii)* and European perch *(Perca fluviatilis)* in geothermal water.

THF sturgeon pilot fish farm

Filtration system at the THF sturgeon pilot fish farm

Outlook in biculture fishtank

The experiments were conducted at the THF (www.tropenhaus-frutigen.ch) sturgeon pilot fish farm in the autumn/winter season of 2006-2007. The THF sturgeon pilot fish farm located at Frutigen (Bernese Oberland, Switzerland) just close to the north portal of Lötschberg-Basetunnel (Hufschmied, 2004), a railway tunnel, crossing the Swiss Alps at a depth of up to 1500 m below ground surface. Warm geothermal water (20 °C) flows out of the tunnel with rate of approximately 100 l/s and is disposed off into the river Kander, a tributary to the Lake Thun. The river Kander is an important spawning ground for the endangered brown trout *Salmo trutta* living in lake Thun. In order to avoid increase of the water temperature in the river, especially during the winter season with low water flow in river, the geothermal water from the tunnel must be cooled. The private project idea, the THF project, was developed in 2002 to cool the water by using it for a warm water aquaculture combined with a greenhouse.

Results

Finn dammage by perch in monoculture

Sturgeon cannibalism

Mortality in perch was sighted only in monoculture (nearly all perch corps disappeared in biculture), but survival in monoculture was as much as 7.4% higher than in biculture. Perch losses in biculture were caused through sturgeon cannibalism. However, to prevent cannibalism among many species of predatory fish (mainly larval and juvenile stages), the rearing technique applied involves feeding in excess so as to teach the fish to accept artificial feed during this early period. The complete elimination of cannibalism in aquaculture, and especially in larviculture, is probably impossible (Baras, 2002). The loss of some fish was however compensated by a more intensive growth of perch and sturgeon biomass. Biomass at the end of the experiment in monoculture rearing of perch and sturgeon reached 28 kg/m^3 and 31 kg/m^3, respectively. Thus, stocking density was markedly lower in monoculture than in biculture with 65 kg/m^3 (22 kg/m^3 perch, 43 kg/m^3 sturgeon).

Conclusion:
The introduction of perch as a stock component during the rearing of sturgeon in tanks provides a better-feed utilization, lower feed conversion ratios and reduction in the labor required to clean the tanks. Hence, the placement of two species in biculture had a positive economical impact. Additionally, co-culture of healthy perch and sturgeon opens new perspective s for organic aquaculture without the use of antibiotics.

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