INTEGRATION OF HYBRID STRIPED BASS *MORONE SAXATILIS* x *M. CHRYSOPS*, NOBLE CRAYFISH *ASTACUS ASTACUS*, WATERCRESS *NASTURTIUM OFFICINALE* AND MICROALGAE *NANNOCHLOROPSIS LIMNETICA* IN AN EXPERIMENTAL AQUAPONIC SYSTEM

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Introduction

Aquaponics combines hydroponics and aquaculture in recirculating aquaculture systems (RAS) to increase resource efficiency; however, suitable species combinations remain limited. In the current study, four high-value species (hybrid striped bass *Morone saxatilis* x *M. chrysops*, noble crayfish *Astacus astacus*, watercress *Nasturtium officinale* and microalgae *Nannochloropsis limnetica*) were held in a multitrophic small-scale RAS system combining several trophic levels and thus optimizing resource use. The tested aquaponics system is intended for small scale applications, such as backyard aquaponics or self-supply for gastronomy/gastro-experience where low maintenance and labour costs are essential. Repeated operational testing optimized the system for each species' requirements in terms of animal welfare and production.

Material and Methods

The experimental system was operated at the Centre for Aquaculture Research (ZAF, Alfred Wegener Institute Bremerhaven, Germany) with an approx. 3,000l freshwater volume (Fig. 1).

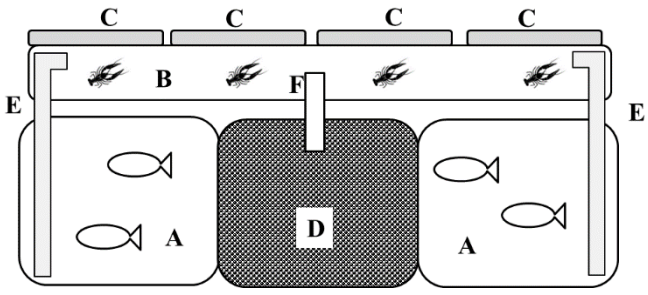

Fig. 1 Aquaponics system, designed for the incorporation of four trophic levels: fish, crayfish, vegetables and microalgae.
A: Fish tanks
B: Crayfish basins
C: Plant floats
D: Biofilter
E: Air lifts
F: Siphon

Growth performance of striped bass was determined in feeding trials with three commercial diets (two trout diets containing 44 and 46% protein and one pike perch diet containing 52% protein). Crayfish growth and survival were tested when fed fish feces and watercress roots or commercially available diets for fish (i.e., pike perch). Watercress was tested for its persistence and response towards predation and growth rates were monitored. Labour input (h) water parameters and dissolved nutrients were recorded.

Results and Discussion

Fish, crayfish and plants all obtained good growth rates with minimal labour input (< 6 h /week). Best fish growth performance was obtained with pike perch diet containing 52% protein (Table 1) despite recommendations for trout diet use in the literature (Ende et al., 2017, *submitted*). The crayfish also showed highest growth rates when directly fed the pike perch diet but also obtained commercial growth rates when fed watercress roots and fish feces as intended in the system design (Table 1). Watercress grew at commercially viable rates despite crayfish consuming roots. Dissolved nutrients within the system were below the reported optima for leafy vegetables (Schuhn, 2016). Microalgae micronutrient demand could not be met by the RAS process water. A bypass system allowed decoupled addition of fertilizers for microalgae production.

While monoculture of the species studied may result in better yields, each species showed strong growth performance and minimal mortality. In terms of optimized co-culture of the species, the tested combination of species is suitable for small-scale aquaponics. If the emphasis shifts towards higher production yield, a decoupled system, in which every component serving each species can be managed separately, may be more feasible (Goddek et al. 2016).

	Diet	Pike perch	SD	Trout I	SD	Trout II	SD
striped bass	Final body weight (g)	134.2	3.67	124.7	2.32	127.2	1.91
	Final total length (cm)	20.7	0.08	19.8	0.15	20	0.52
	Specific growth rate (%)	1.15 *	0.04	1.04 *	0.03	1.07 *	0.03
		Pike perch	SD	feces	SD	watercress+feces	SD
crayfish	Final body weight (g)	13.84 *	1.2	11.14 *	0.47	12.91 *	1.98
	Final total length (cm)	7.23 *	0.07	6.89 *	0.11	7.31 *	0.34
	Specific growth rate (%)	0.49	0.07	0.09	0.13	0.30	0.24

Table 1. Growth performance of striped bass and crayfish in a small-scale aquaponics system over an experimental period of 69 days.
The striped bass had a mean initial weight ± SD of 60.7g ± 12.1 and mean initial length SD of 17.2 cm ± 1.1). For crayfish, mean initial weight ± SD was 10.7g ± 3.5 and mean initial body length was of 3.1 cm ± 0.4.
* indicates $p < 0.05$ as calculated by one-way ANOVA and t-test

References

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