Deliverable 13.1
Analysis of access provided by UNI-MATE aquaculture experimental facilities: types and users

Version 1

WP 13
Deliverable 13.1
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Executive Summary

Objectives

MATE Research Center for Fisheries and Aquaculture conducts R&D&I activity targeting the development of aquaculture with the main tasks of species and technologies diversification, integration of alternative protein sources for fish nutrition, and gene-banking for purposes of breeding and conservation. The two installations provided are set in two different environments, a recirculation aquaculture system and ponds and both vary in size and technological advancement to be suitable for various trials in terms of species, age class and breeding purposes. Accordingly, our access is offered mainly for such tasks that require straightforward application in an environment that resembles the commercial and is suitable for both research entities and companies with innovation activities.

Main Results:
In total, the five accesses have been provided, out of which a single one was performed in the pond (OEPS) environment. Out of five user organizations, one was from the industry, while the other users were academic scientists. Likewise, two of the user organizations were those previously accessed in AquaExcel projects, while we had three new users. In each TNA project, one of the personnel went through the training program, gaining new methodological approach.

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1. Overview of TNA users projects realized in UNI-MATE

1.1.1. Installations

RECIRK installation (1) is composed of 5 independent recirculation systems: larviculture system for percids and cyprinids composed of twelve 250L cylindro-conical tanks and equipped with twelve 2L egg incubation Zug jars; larviculture system for sturgeons and catfishes composed of eight 250 L raceway type tanks equipped with six 8L egg incubation Zug jars; juvenile rearing system composed of three identical and separated systems each composed of six 1000 L tanks each supplied with swirl separator, each system suitable for independent temperature in range 15-25 ^{o}C; quarantine system composed of three 5 m3 raceway tanks suitable for seasonal and out-of-season reproduction trials; disease challenge system is used for challenge tests with bacteria (Aeromonas hydrophila) flexible in terms of tank size and number.
Our recirculation systems are suitable for the trials on the breeders, eggs, larvae and juveniles in almost all freshwater European species. Disease challenge system is used for challenge tests with bacteria (Aeromonas hydrophila) either for the independent studies or for the challenge tests on the fish previously subjected to experiments in other systems. Our researchers and technicians of the group for aquaculture technologies are skilled in the needed technological solutions for propagation and rearing in almost all freshwater aquaculture species offering wide range of trials on larvae and juveniles. Researchers and technicians of the department for fish biology are well experienced in trials on fish genetics, fish welfare and fish nutrition.
Unfortunatelly, during the project duration, we lost our acreditation for the disease challenge system, and therefore we needed to cancel one application.In general, this system was used for four different TNA project that were used for common carp reproduction, largemouth bass larviculture, Russian sturgeon juvenile feeding and African catfish growout nutrition. Therefore, we might say that the main advantage of our facility – diversity or systems and species has been fully utilized by users.

OEPS installation (2) consists of earthen ponds with the following distribution: 9 x 3500 m^2; 15 x 1700 m^2; 8 x 500 m^2; and in largest ponds we offer installation of cages of the following sizes: 17 x 4 m^2 (15mm); 42 x 4 m^2 (30mm); 23 x 9 m^2 (30mm); 6 x 18 m^2 (30mm); with maximum 18 m^2 cage per pond. This installation is suitable for outdoor trials in various rearing systems, from extensive to super intensive, enabling wide range of possible trials on: the applicability of different feed additives; nutrient dynamics in pond ecosystems; integrated fish production systems i.e. combination of ponds and cages; Nutrient remediation experiments in wetlands and ponds.
We hosted one TNA in this installation that utilized 8 ponds of 1700 m^2, and was used for still innovative approach of intensive common carp pond rearing. Therefore, the project required for ponds advanced technological tools that were successfully applied considering the challenging approach (simulation of the lack of rainfall) and high yield and exceptional growth rates achieved.

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Typically 20 lines per installation, potentially with an image

1.1.2. User projects

Min. quantity of access units to be provided according ther DoA: RECIRK= 51 OEPS= 49
Total number of access units (sum of access units in the table): 106 (RECIRK: 83 OEPS: 23)

Installation number	Installation code	Project title	Project acronym	Description about the experiment	User Coordinator, Affiliation, Country,	Already used installation (Yes/No)	Nature of the access unit*	Number of used access units during the project, Date of Access	(Potential) paper	How many people was trained by this procedure ?
1	MATE HAKI-RECIRK	Probiotic supported indoor larviculture as a step forward in cost-effective production of largemouth bass (Micropterus salmoides) fingerlings	PROBASSIC	The trials (both in vitro and in vivo) were dedicated toward nutrition of the largemouth bass larvae during and post weaning	Dr. Jovanka Lukić, Institute of Molecular Genetics and Genetic Engineering (IMGGE), Universi	Yes	system. week	17, 23.11. 2022	Two papers were already published with DOIs: 10.17221/129/2024-CJAS 10.3390/ani13203179	1

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					ty of Belgrade,Serbia					
2	MATE HAKI-RECIRK	Preparation and Application of Electrosprayed Alginate Nanoparticles for Controlled Release of GnRHa and Carp Pituary Exract in Common Carp	ALGEPHORM	Investigated the reproductive effects of electrosprayed alginate microparticles injected with different hormon doses in common carp at artificial reproduction.	Mustafa Erkan Özgür, Malatya Turgut Ozal University, Department of Aquaculture, Faculty of Fishery, Turkey	Yes	system. week	9, 06.05. 2024.	There is one paper in preparation	1
3	MATE HAKI-OEPS	Adaptive Pond Management Strategies for Climate Change: Investigating the Impact of Water Stress, Stocking Density, and	AQUACARE	Experiment on the level of two modalities of intensification of juvenile common carp production, in the scenario	Pintér Zsolt, Aller aqua Balkan, Serbia	Yes	ha.week	23, 21.06. 2023.	There are two published abstracts (conferences) and, one paper in preparation	1

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		Feeding Regime on Common Carp Production and Health		of water shortage.						
4	MATE HAKI-RECIRK	Evaluation of barley protein concentrates as cost-effective sustainable feed ingredient in hybrid African catfish (Clarias graiepinus × Heterobranchus longifilis) feed	PROCAT	Both digestibility and nutritional trial were performed with African catfish juveniles to determine the optimal inclusion level of barley protein concentrate in the feed	Shivendra Kumar, Department of Aquaculture, College of Fisheries, Dr. Rajendra Prasad Central Agricultural University, India	Yes	System. week	34, 18.02. 2025.	one paper in preparation and second paper planned	1
5	MATE HAKI-RECIRK	Effect of dietary GABA supplementations on the zootechnical and physiological	GABAFEED	Feeding trial with Russian sturgeon fingerlings was carried out to	Piotr Gomułka, Department of Ichthyol	Yes	System. week	23, 17.06. 2024.	One paper in preparation.	1

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		parameters of Russian sturgeon (Acipenser gueldenstaedtii) fingerlings		evaluate the optimal dietary inclusion level of GABA.	ogy and Aquaculture, University of Warmia and Mazury, Poland					

* *Access units describe how accesses are calculated, typically 1 day x 1 pot, 1 season x 1 microplot, etc …*

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2. TNA projects

2.1.1. TNA project description

PROBASSIC

The project was dedicated to the nutrition of largemouth bass during larviculture. Three trials were executed during the project. First trial, on in vivo and in vitro base prelimary tested the feeds of interest, while the other two were conducted in a pilot-scale system on real larviculture. Both trials evaluated four feeds, three commercial and one experimental. While the first trial was dedicated to weaning, the second evaluated the post-weaning period. The research compared available commercial diets with recommendations for the further development of specially formulated weaning feed, while in the case of the post-weaning period, one of the tested diets was recommended as optimal. Both trials were already published as articles in Q1 and Q2 scientific journals.
Through ongoing communication with MATE's staff, PROBASSIC's lead researcher was acquainted with the major bottlenecks and challenges in the largemouth bass (LMB) life cycle and the key rearing milestones relevant to PROBASSIC's experimental workflow. Moreover, the lead researcher gained practical experience by being introduced in person to MATE's LMB rearing facilities and RAS protocols.

ALGEPHORM

The work was organized into five work packages (WP1–WP5), with foundational development (WP1–WP4) carried out by Turkish experts and in vivo validation (WP5) conducted jointly with Hungarian collaborators. In WP5, male and female carp were assigned to five groups—Control (saline), standard GnRHa, standard carp pituitary extract (CPE), alginate-encapsulated GnRHa, and alginate-encapsulated CPE. Post-injection sampling included sperm, eggs, and blood. We measured sperm motility and kinematics, antioxidant markers (NO, MDA) in gametes, and blood biochemistry (AST, PKA, ATP, lipase).
Early data indicate that alginate-encapsulated hormone treatments outperformed both control and conventional formulations in male sperm quality metrics, despite using half the hormone dose—suggesting significant cost and toxicity reductions. Female ovarian maturation, however, did not improve under the current protocols, highlighting a key area for further study. This work pioneers the application of alginate-based encapsulation in fish reproduction, offering a scalable, low-toxicity platform that advances beyond existing hormone induction methods.
The main results of the trial are planned to be published in a Q1 scientific journal in the near future. The ALGEPHORM project’s lead researcher gained experience in process of artificial reproduction of common carp moreover, the pond and RAS infrastructures of MATE was introduced to him.

PROCAT

The digestibility trial was conducted to determine the *in vivo* apparent digestibility coefficients (ADC) of barley protein concentrate as a promising feed ingredient. Appreciable ADC values were found for protein, dry matter, and fibre, supporting its potential for dietary application. The long-term nutritional trial was set o determine the optimum BPC inclusion level for African catfish juveniles. Following the evaluation of parameters related to growth performance,

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nutrient utilization, metabolic processes we have concluded to set a maximum 10% BPC inclusion level without compromising the nutrient uptake and growth of African catfish juveniles. The results of the trials will be published in Q1 journals. In the project implementation a young PhD student from the applicant's team was involved who personally participating in data collection and laboratory work. During his stay he was introduced in the MATE RAS facilities and trained for daily fish maintenance work for several fish species.

AQUACARE

The project involved a multifactorial experiment with three key factors: water shortage, stocking density, and feeding strategy (traditional vs. complete feed). The trial was conducted over one production season during the first year of rearing common carp (Cyprinus carpio).
A comprehensive statistical analysis revealed a large number of significant interactions and correlations, which contributed to the conceptual structuring of the data. The complexity of the findings highlights the multifaceted nature of intensive carp farming under variable environmental and technological conditions. The results have been presented at two scientific conferences, and a manuscript is currently being prepared for submission to a Q1 journal.
Throughout the project, the applicant successfully transformed extensive but previously informal experience in intensive common carp farming into a structured scientific experiment, supported by researchers at the MATE Institute. The applicant was actively involved in the experimental procedures, including anaesthesia, growth measurements, and blood sampling, and became familiar with key aspects of scientific methodology in aquaculture.

GABAFEED

The aim of the study was to evaluate the effect of different dietary GABA supplementations (0 mg/kg, 50 mg/kg 100 mg/kg, 150 mg/kg) on the zootechnological (e.g weight gain, SGR, feed conversation ratio, condition factor, survival) and physiological parameters (digestive enzymes (amylase, lipase, trypsin), antioxidant (MDA, SOD, CAT, Total antioxidant capacity, GSH), and immune status (lysozyme, total protein and immunoglobulin level) of Russian sturgeon (Acipenser gueldenstaedtii) fingerlings. Preliminary results indicate that the different supplementations of GABA did not affect the different production traits of Russian sturgeon fingerlings compared to the control group. On the other hand preliminary data on physiological parameters showed a slight difference in terms of different GABA supplementations. The main results of the trial are planned to be published in a Q1 scientific journal. In the project implementation a young BSc student was involved who personally participated in laboratory work. He was also introduced in the MATE RAS facilities and trained for daily fish maintenance work for several fish species.

2.1.2. One exemplary project

Probiotic supported indoor larviculture as a step forward in cost-effective production of largemouth bass (*Micropterus salmoides*) fingerlings - PROBASSIC
The project addressed nutritional challenges associated with rearing largemouth bass, LMB (*Micropterus salmoides*), in a closed system from its larval stage. Commercially available feeds (Otohime, Aller, Biomar, and Aqua Start) and one experimental locally made feed were tested *in vivo* in MATE's RAS rearing facilities. Feeds were chosen to feature diverse levels of Monounsaturated Fatty Acids (MUFA), Polyunsaturated fatty acids (PUFA), ω3 to ω6 ratio, fat percentage, free amino acid, and soluble proteins. In addition, a commercially available diet

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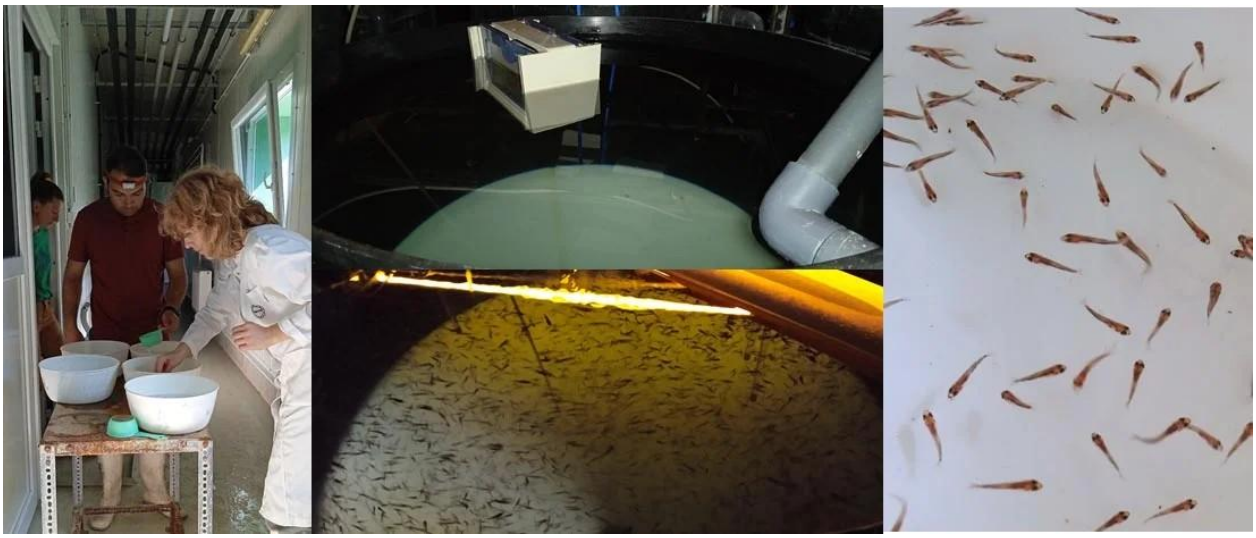
comprising Lactic Acid Bacteria (LAB) probiotic strain was included in the trial. Both the weaning and post-weaning stages were assessed. Biometric indices, digestive enzyme levels, hormones, skeletal and muscle gene expression, and the pathogenic bacteria levels were evaluated. The results revealed that balancing the amount of intact proteins and the ω3 to ω6 ratio during the weaning phase is the key to optimal skeletal development and suppression of the growth of opportunistic pathogens. Similarly, during post-weaning, the ω3 to ω6 ratio and MUFA percent strongly influenced skeleton development, while fish growth was mainly affected by fish digestive capacity, beneficially modulated by probiotic addition. Total fat percent in both cases did not affect skeleton development, but was rather linked to fish weight gain and survival. This showcases the feasibility of rearing LMB larvae and post-larvae on sustainable diets with less marine ingredients, as long as the ratios of ω3 to ω6 are optimized. Moreover, this is the first study to demonstrate the technical feasibility of LMB indoor rearing from its larval stage.
The project was carried out in MATE RAS rearing facilities and laboratories, with the kind support of MATE researchers and assistants throughout the project. Photos below capture part of the atmosphere during PROBASSIC implementation in May and June 2023.



The left photo shows lead PROBASSIC researcher, Jovanka Lukic, IMGGE (right), working in MATE AKI HAKI research facilities with Uros Ljubobratovic, MATE AKI HAKI (middle), and Tijana Ristovic, MATE AKI HAKI (left). The middle photo shows the MATE AKI HAKI indoor larval rearing facility with LMB larvae, and the right one depicts the LMB larvae reared in MATE RAS. Credit: Jelena Stanivuk, MATE AKI HAKI, and Jovanka Lukic

3. Reflection on results of the TNA programme

Our main impression of the TNA programme performed within AE3.0 is that our infrastructure got quite an attention from all over the world, which is visible in the utilization of all UoAs. All accepted trials were successfully performed despite rather challenging conditions that required quite some postponement of project initiations. Nevertheless, we ended up in either strengthening our earlier established collaborations or establishing new ones and in both cases,

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the communication between visiting and host researchers before, during and after the TNAs remained at the highest level. For our installation, it was pioneering in several aspects:

- The first time we worked on largemouth bass larvae;
- The first time we used algae preparate as the vector for the application of hormonal agents;
- The first time we faced serious measures to secure the ethical approval papers from higher authorities than university and this task was tackled successfully;
- The first time we collaborated with guest from Asia in the frame of TNA programme, and this challenging task was likewise solved successfully.

For the future programmes, we must recommend higher flexibility in terms of planning of "average" access. Namely, the differences in the cost of planned average trial at the time of project application and the realistic ones that followed some years later differed significantly in terms that could be characterized as folds. Nevertheless, the project leadership was very helpful and understanding of the situation that led to fewer projects, yet, feasible in terms of financing.

4. References

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