LAND-BASED PILOT IMTA: USING SEABASS HATCHERY EFFLUENT TO GROW SEAWEEDS IN A MEDITERRANEAN AQUAFARM

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Introduction

Effluent from marine hatcheries, such as those rearing Mediterranean seabass (*Dicentrarchus labrax*), still after treatment. contains considerable levels of inorganic nutrients which could contribute to coastal eutrophication. Integrated multitrophic aquaculture (IMTA) offers a sustainable solution by incorporating extractive species to recover nutrients. The green macroalga *Ulva* spp., with its high nutrient uptake efficiency and rapid growth under variable Mediterranean conditions, is an ideal candidate for such systems (Shpigel et al, 1993).

This work evaluates the cultivation of *Ulva* using seabass hatchery effluent to remove inorganic nutrients while producing biomass for biomaterial applications. We quantify nutrient removal performance, assess biomass yields, and discuss the potential of integrating *Ulva* production into IMTA frameworks to enhance environmental sustainability and circular bioeconomy outcomes in Mediterranean aquaculture.

Materials & Methods

A land-based pilot IMTA unit was set up at the Kefalonia Fisheries SA finfish hatchery on Cephalonia Island, Greece, to cultivate green seaweed (*Ulva* sp.) using hatchery effluent from sea bass (*Dicentrarchus labrax*) broodstock and juvenile tanks. *Ulva* sp. seedlings sourced locally were loaded at 1 kg/m^3 into translucent HDPE tanks (1 m^2 each) supplied with sedimentation tank water (the final stage of the hatchery's biological water treatment process), rich in inorganic nutrients, at a 20-minute residence time. Each two-week cultivation cycle included monitoring light, pH, DO, and nutrient levels. All biomass was harvested by net, sun-dried in a greenhouse, weighed, and stored at the end of each cycle.
Light (lux), pH, DO (mg/L) and salinity data were averages of daily measurements (2-points, morning-noon). Analyses for nutrients were carried out twice per week. Yield represents the final biomass harvested after two weeks minus the initial loading. Daily growth was calculated from the formula % per day =100*LN(X_t/X_{t0})/t-t_0.

Results & Discussion

Table 1 shows that cultivating *Ulva* with treated hatchery effluent could be promising if optimised. Biomass output depended on changing ambient factors and nutrient input from the effluent. Nutrient output data were inconsistent, so further experimentation is needed. Generally, dissolved inorganic nitrogen recovery was highest when daily seaweed growth was high (94.43 ± 3 mg/L), medium at moderate growth (65.84 ± 7.08 mg/L), and low at low growth (7.58 ± 1.61 mg/L), though this pattern requires more validation through a different experimental approach (Shpigel personal communication).

Table 1. Results of bi-weekly cultivation cycles of *Ulva* sp., on hatchery effluent. Data from one representative tank from 26/2 until 4/8/2025. First row data are averages and second row data are standard deviations

no	Days	lux	T	S	pH	DO	DIN	PO4	yield kg/m3	%/day
1	14	16,569	16.08	31.45	7.87	7.50	0.98	0.80	1.25	5.79
		5,462	0.95	1.07	0.20	0.36	0.12	0.85		
2	14	20,628	16.83	31.93	7.96	7.37	0.63	1.40	0.73	6.40
		9,049	0.79	1.64	0.15	0.48	0.21	0.92		
3	11	24,686	17.59	32.41	8.05	7.24	0.76	1.35	0.57	1.19
		12,637	0.63	2.22	0.10	0.59	0.30	2.99		
4	14	26,185	19.46	26.00	8.07	6.77	1.76	2.51	2.87	5.92
		11,471	0.89	-	0.14	0.21	0.98	3.63		
5	11	32,239	20.26	26.00	8.16	7.07	1.10	0.01	13.95	21.93
		14,521	1.48	-	0.22	0.88	0.12	-		
6	19	32,218	21.14	26.00	8.17	7.01	1.18	0.01	14.75	13.30
		17,610	0.95	-	0.25	0.71	0.05	-		
7	13	20,619	23.35	30.78	8.21	6.90	1.20	0.83	12.34	18.35
		13,750	1.63	2.53	0.21	0.67	0.47	0.82		
8	13	19,750	24.08	28.37	8.28	6.70	0.85	1.65	12.12	17.47
		13,284	1.34	0.49	0.21	0.50	0.27	1.35		
9	15	19,258	25.03	28.23	8.13	6.86	2.01	0.10	0.73	3.12
		13,128	2.18	2.10	0.23	0.83	0.42	-		
10	14	23,542	24.13	26.79	8.16	6.67	1.39	1.73	3.04	8.85
		22,893	2.00	0.77	0.17	0.46	0.69	1.96		

Yields and daily growth rates matched the highest values reported in literature (18-20% for land-based *U. lactuca* on fish effluent; Neori et al., 1991; Drawbridge et al., 2024). Optimisation could further improve nutrient recovery and biomass output. Since using animal waste–derived biomass for food or feed is challenging to license, ongoing trials are exploring biomaterial applications such as biofertiliser, biostimulants, and biocomposites, which may be financially viable for the modest output of a typical Mediterranean marine finfish hatchery.

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