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# IS EUROPEAN SEABASS *Dicentrarchus labrax* (Linnaeus, 1758) A BETTER OPTION FOR ROMANIAN MARINE AQUACULTURE?

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***Abstract***

*Romanian marine aquaculture is a recent development, as a consequence of both harsh environmental conditions and a cumbersome legislative framework. The much-awaited settlement of the water concession opened the way for this activity. After the successful testing of rainbow trout Oncorhynchus mykiss (Walbaum, 1792) and gilthead seabream Sparus aurata (Linnaeus, 1758), this research aimed at investigating the potential of European seabass Dicentrarchus labrax (Linnaeus, 1758) for culture under Black Sea conditions. The laboratory experiment demonstrated the possibility of transferring 4-months old juveniles from a salinity of 35‰ directly into brackish water (salinity 15‰), with no mortalities and rapid post-stress recovery (24 hours after transfer glycaemia levels returned to normal, with a mean value of 78 mg·dL$^{-1}$). A control batch was kept at the original 35‰ salinity. Biomass increase was normal, from 7-8 grams initially to 300 g after nine months (during autumn-winter), with no significant differences between salinities. The species proved its suitability for culture at the Romanian coast especially due to its wide temperature range tolerance, being able to feed and grow during colder Black Sea winters.*

***Key words***: *adaptability, marine aquaculture, salinity, seabass, temperature.*

## INTRODUCTION

Marine aquaculture has a relatively recent history in the Black Sea and especially on the Romanian coast. Despite all the difficulties, there is a desire for regional development in the future, both from a scientific and technological point of view (Massa et al., 2021). The major bottlenecks to the development of mariculture in Romania are due to the traditionally unstable natural conditions, high financial risks, vulnerability to storms and currents and the lack of sheltered areas, but especially the lack of attractiveness for businesses in the field due to a burdensome legislative framework (Nenciu et al., 2023). In the past, in Romania there have been attempts by investors interested in both the cultivation of non-indigenous triploid oysters and mussels in small-sized long-line installations (Zaharia et al., 2017; Niță & Nenciu, 2020), and turbot in land-based recirculating systems (RAS) (Massa et al., 2021), but inadequate legislation and the lack of funds necessary for investments have led to the stagnation of mariculture activities. The major issue that hindered the development of marine aquaculture in Romania was the unclear and restrictive legislative framework. Thus, until 2020, the lack of microbiological classification of the Black Sea waters, as required by European Commission Regulation No. 627/2019 (previously Regulation No. 854/2004), prevented any potential economic operator from marketing bivalve production in the European Union, for public health reasons. Moreover, another fundamental impediment that made it impossible to practice offshore marine aquaculture was the impossibility of concessioning the water surface for the installation of farms at sea and the anchoring system on the seabed (Nenciu et al., 2020). The microbiological survey of the areas proposed for classification was completed in 2020, with all three live bivalve mollusk production and relaying areas in the Romanian sector of the Black Sea being included in class A, which brought immense opportunities for bivalve aquaculture on coast (Nenciu et al., 2020).

Also, the concession of the Black Sea water surface for aquaculture activities has become possible: Government Decision no. 1.283/2022 finally allowed Black Sea water lease for 20 years, opening the way for economic developments in the field, the first perimeters being already leased in at the end of 2024.

The resolution of legislation has also unlocked the activity of fish mariculture in floating cages on the Romanian coast, with several operators expressing their interest in setting-up offshore farms. In the effort to constantly support the development of marine aquaculture on the Romanian coast, we have tested finfish species suitable for this type of activity, carrying out, for example, a study testing the growth rate and optimal size for introducing rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) into marine water (Nenciu et al., 2022) and an experiment on the adaptability of gilthead seabream *Sparus aurata* (Linnaeus, 1758) for use in marine aquaculture in Romania (Nenciu & Niță, 2024). These experimental trials suggested that both *O. mykiss* and *S. aurata* are suitable for culture in the north-western Black Sea in a rotational system, in compliance with their temperature requirements: rainbow trout during the cold season and gilthead seabream during warmer months. This approach would encourage the development of Romanian marine aquaculture by maximizing economic profit and using production facilities throughout the year.

In this light, a new research question emerged: is there a finfish species appropriate for year-round culture under Romanian Black Sea conditions? Aiming at answering this query, European seabass *Dicentrarchus labrax* (Linnaeus, 1758*)* was considered as a potential candidate, as it is documented to tolerate wider ranges of environmental parameters (temperature in particular) (Claireaux & Lagardère, 1999; Person-Le Ruyet et al., 2004; Person-Le Ruyet & Le Bayon, 2009).

The European seabass is a eurythermal and euryhaline species, documented to tolerate temperatures between 2-32°C (Vandeputte et al., 2019) and salinities ranging from 3‰ to 40‰ (FAO, 2025). Thus, it can inhabit both coastal and marine waters, but also enters estuaries and brackish lagoons, being common in the Mediterranean Sea and the Atlantic Ocean and appearing sporadically in the Black Sea (FAO, 2025). It has only one spawning season per year, which takes place in winter in the Mediterranean. European seabass lays small pelagic eggs in water with salinities below 35‰, near the mouths of rivers and estuaries or in coastal areas where salinity is relatively high (≥30‰). Not being a particularly sensitive species to low temperatures, some specimens may also overwinter in coastal lagoons instead of returning to the sea (FAO, 2025). Yet, during winter, most individuals migrate from the coastline to deeper waters, where the temperature is more stable, as they prefer values around 8-10°C (Pickett & Pawson, 1994).

European seabass supports a massive aquaculture production worldwide and it was the first marine non-salmonid species to be commercially cultured in Europe (FAO, 2025). In Europe, the seabass industry has grown steadily in the last two decades. According to the most recent statistics available, *D. labrax* is the second most cultured species in the Mediterranean basin (272,096 tons, 33% of the total production), following closely *S. aurata*, which accounts for 34.1% (FAO, 2023). The largest exporter by volume worldwide is Türkiye, with 42,590 tonnes, followed closely by Greece, with 40,677 tons (Carvalho & Guillen, 2021). Regarding consumption, Türkiye is the first consumer of European seabass at global level, with 74,500 tons. In 2018, the total consumption of the European Union was estimated at 97,000 tons, Italy being the EU country with the highest apparent consumption of European seabass (FAO, 2021).

Given the extended culture of this species, the aim of the research was to investigate on the potential of *D. labrax* for aquaculture under Black Sea particular conditions, with the purpose of testing whether year-round culture is possible.

## MATERIALS AND METHODS

### Fingerling Supply, Adaptation and Transfer to Laboratory Conditions

The European seabass fingerlings (N = 309 individuals, aged approximately three months) were purchased in June 2024 from an aquaculture farm and hatchery from Italy (Adriatic Sea). The fish were transferred to NIMRD's aquaculture laboratory in a live fish fiberglass reinforced transport container provided with oxygen supply (Figure 1). Temperature in the transport water was 22°C and salinity 35‰, similar to the conditions in the hatchery of origin.

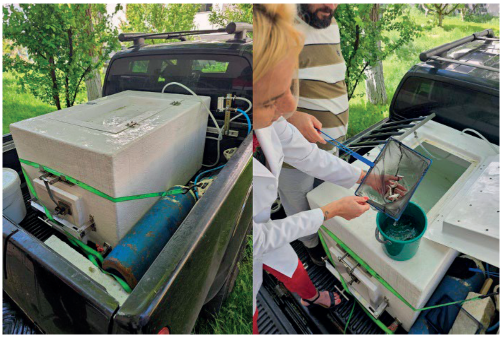

Figure 1. Delivery and extraction of European seabass fingerlings from the live fish fiberglass reinforced transport container (*Original photos*)

Before the fish arrived in the laboratory, the stocking tank's salinity was adjusted to 35‰ using Instant Ocean sea salt. A thorough temperature check was performed before the fish were progressively released into the stocking tank, kept in a recirculating regime. In order to boost the water's oxygen concentration, aeration pumps were used. There were no mortalities during transfer or during transportation. To mitigate transport stress and ensure a healthy batch, the fingerlings were maintained in a 900-L circular stocking tank for 14 days, as recommended for acclimation (Niță et al., 2022). During the adaptation period, the fish were fed ad libitum with Skretting Protec MP L pellets, all food being consumed and faeces removed by syphoning.

The average water temperature in the stocking tank during the two-week quarantine period was 22°C. Three fish were randomly removed for blood glucose testing prior to the transfer to Black Sea water. After the two-week quarantine period, the seabass fingerlings were divided in 6 batches (3 replicates per salinity treatment) and transferred to the 500-L experimental tanks (Figure 2). The 35‰ replicates (control batches) contained 50 fish each, while the 15‰ replicates initially contained 52 fish each. 1 hour and 24 hours, respectively, after transfer to Black Sea water, 1 fish was extracted from each 15‰ replicate tank for blood glucose analysis, thus for the entire experimental period except for the first 24 hours all replicates contained an equal number of fish (N = 50). Prior to transfer, each fish was weighed and measured individually.

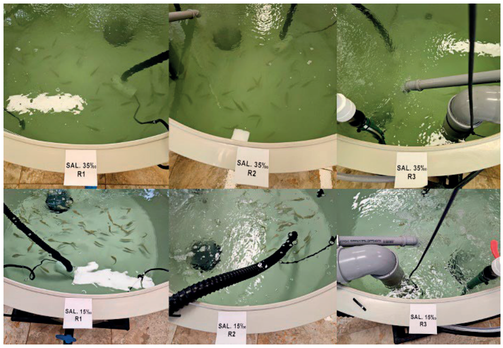


Figure 2. Transfer of European seabass juveniles from the stocking to the experimental tanks (control - salinity 35‰ and experimental - salinity 15‰ (*Original photos*)

NIMRD's pump-ashore system (PAS) supplied the first delivery of Black Sea water. Before entering the tanks, the water that enters the PAS is pumped straight from the Black Sea and held in a covered settlement tank for sedimentation and suspended particles reduction (Niță & Nenciu, 2021). Subsequently, to guarantee appropriate water quality, the experimental tanks were equipped with an effective aquaculture recirculation system (RAS) that included oxygen pumps, UV sterilization, mechanical and biological filtration, and protein skimmers. Throughout the experiment, water temperature was not altered and at the time of transfer it was 22°C. From late June 2024 to early March 2025, a total of nine months were covered by the experiment.

A Mettler Toledo Seven Excellence Multiparameter was used to measure temperature (°C), salinity (‰), pH, and dissolved oxygen (DO) (%) in the experimental and control tanks, as well as the original stocking tank on a regular basis. Real-time transmission Seneye version 2 sensors of the aforementioned parameters, plus a sensor for free ammonia ($NH_3$), were installed in the experimental RAS tanks, along with a trigger for the backup aeration pump in the event that values fell below the predetermined 80% dissolved oxygen threshold.

**Feeding**

Seabass fingerlings were initially fed with Skretting Protec MP L pellets (2 mm) (crude protein 54%, crude fat 15%, ash 9%, raw fibers 1%) for the first four months and Skretting Optibass 2P pellets (4.5 mm) (crude protein 43%, crude fat 20%, ash 9%, raw fibers 1%) until the completion of the experiment. Two identical doses of feed were given throughout the day (morning and afternoon), with the computed daily feed ratio being 2% of the biomass (Zaharia et al., 2017). In order to modify the feeding ratio, monthly biomass measurements were carried out.

**Growth Parameters Calculation**

Every month, all 50 fish from each experimental tank had their weight and length measured. The specimens' total length (TL) was measured to the closest 0.5 millimetre using an ichthyometer. A Kern PBJ-N top loading precision balance, readability d ≥ 0.01 g, was used to determine the fish's total weight (TW) (Figure 3).

Figure 3. Weight and length measurements on European seabass individuals (*Original photos*)

The Feed Conversion Ratios (FCR), Specific Growth Rates (SGR%/day), and Fulton's Condition Factor (K) were calculated using the biometric and gravimetric data gathered throughout the course of the nine-month investigation. Additionally, the whole lot's Length/Weight relationship was determined, per salinity treatment (Froese, 2006).

The following formulas were used to determine the Specific Growth Rate (SGR%/day) and the Feed Conversion Ratio (FCR) (Hopkins, 1992):

$$FCR = \Sigma_{fk}/W_t\text{-}W_0 \quad (1)$$

$$SGR = 100[(\ln W_t\text{-}\ln W_0)/t] \quad (2)$$

Where: t = feeding days; $W_0$ = initial live weight of fish (g); $W_t$ = final live weight of fish (g); L = total length (cm), and fk = weight of feed consumed by fish at each feeding (feed intake) (g).

Fulton's Condition Factor (K) was calculated using the equation below (Nash et al., 2006):

$$K = (W/L^3) * 100 \quad (3)$$

Where: W = total weight (g), L = total length (cm).

**Blood Glucose Determination**

Blood sugar was investigated as stress indicator proxy and, in order to get a baseline glucose value, three fish were initially removed from the stocking tank prior to transfer and readings were performed per individual fish. One hour and 24 hours after transfer into Black Sea water, respectively, one fish was randomly extracted from each experimental replicate (total number of extracted fish = 9, remaining fish in each experimental tank = 50) and euthanized by immersion in a 500 $mg \cdot dL^{-1}$ buffered one third tricaine methanesulfonate (MS-22) and two thirds sodium bicarbonate solution (AVMA, 2020). The caudal fin was removed once respiration stopped (Witeska et al., 2022), and blood was taken using an OK Meter Match II automatic glucose reader to measure blood glucose levels (Figure 4). The extracted blood was analysed right away, thus no anticoagulant treatment was applied to it.

Figure 4. Blood glucose readings on European seabass juveniles: baseline (left), one hour after transfer (middle) and 24 hours after transfer (right) (*Original photos*)

**Biochemical Analysis**

Upon completion of the experiment, a comparative analysis of the proximate composition of European seabass meat was performed. European seabass individuals raised in Black Sea water (15‰) and in the control tanks (35‰) for nine months were used to compare the proximate composition of *D. labrax* meat after the experimental period was over. Biochemical determinations were made in duplicate for each treatment. An accredited laboratory (Biosanivet Ltd.) conducted the analysis, which included the following parameters: crude protein (%, as per SR ISO 937:2023), crude fat (%, as per SR ISO 1444:2008), moisture (%, as per SR ISO 1442:2023), total ash (%, as per SR ISO 936:2009), salt content (%, as per SR ISO 1841-1:2000) and energy values (kcal/100 g and KJ/100 g, as per PA-L-34).

**Statistics**

Data from each group's replicates were combined for a one-way ANOVA analysis for statistical interpretation, and Tukey's Honestly Significant Difference (HSD) test was used to determine differences that were significant at the 5% level ($p < 0.05$) (Lane, 2010).

## RESULTS AND DISCUSSIONS

The European seabass fingerlings were carefully monitored immediately after reaching NIMRD's aquaculture laboratory. All fish exhibited normal behaviour and showed no signs of stress after being moved from the transport container into the stocking tank (35‰ salinity). Over the course of the experiment, no deaths were recorded. 24 hours after the transfer, feeding began, and the pellets were fully consumed. Throughout the nine-month trial period, a 2% body mass feeding ratio was used, adjusted after each monthly weighing of the fish.

Following transfer into the experimental tanks, temperature, dissolved oxygen, pH and free ammonia ($NH_3$) were continuously measured; no discernible differences were seen between the replicates and salinity treatments ($p > 0.05$). Dissolved oxygen values ranged between a maximum of 124% in August (salinity 35‰) and a minimum of 97% in December (salinity 15‰), as higher salinity results in a higher saturation (Chatelier et al., 2015). pH was extremely constant throughout the entire experimental period, ranging between 7 and 8 in both salinity treatments. Free ammonia recorded rather low values, from 0.001-0.005 mg/L for most of the period to occasional peak values of 0.025-0.026 mg/L (in July, August and January), which can be considered alert values (between 0.020 and 0.050 mg/L) (Seneye, 2025). $NH_3$ levels immediately dropped to safe values after changing 50% of the water in the experimental tanks, as free ammonia may be harmful and cause physiological and behavioural disturbances in fish (Franklin & Loveson, 2019).

Another parameter that was screened upon transfer to Black Sea water was blood glucose. Table 1 below displays blood sugar mean values that were calculated as a proxy for stress in juvenile European seabass due to the abrupt change in salinity. Glycaemic levels ranging between 81-93 mg/dL prior to the abrupt change in salinity, 145-155 mg/dL one hour after transfer, and 63-93 mg/dL 24 hours later were documented (Table 1).

Table 1. Comparative blood glucose values of *D. labrax* juveniles before, one hour and 24 hours after transfer to Black Sea water, respectively

| Glucose level ($mg \cdot dL^{-1}$) | Stocking (before transfer) | | | 1 h after transfer | | | 24 h after transfer | | |
|---|---|---|---|---|---|---|---|---|---|
| | R1 | R2 | R3 | R1 | R2 | R3 | R1 | R2 | R3 |
| | 81.00 | 91.00 | 93.00 | 155.00 | 150.00 | 145.00 | 63.00 | 78.00 | 93.00 |
| **Mean** | | **88.33** | | | **150.00** | | | **78.00** | |
| **±SD** | | 5.25 | | | 4.08 | | | 12.25 | |

The growth and biomass gain of juvenile European seabass raised in two salinity regimes (35‰ and 15‰, respectively) are summed up in Table 2. The juveniles' mean length progression was a typical linear rise, going from an initial length of about 7 cm to a final length of 27 cm (Figure 5). There were no statistically significant variations among the 3 replicates of each salinity treatment. From a starting weight of around 8 g to a final weight of about 300 g, all fish gradually gained weight over the experimental rearing process of nine months (Figure 6). The three replicates of each salinity regime did not differ statistically significantly from one another, similarly to length evolution ($p > 0.05$).

Table 2. Mean values of *D. labrax* growth parameters recorded during the experiment (averages and standard deviations) per salinity treatment

| Parameter | Sal. 35‰ | Sal. 15‰ | ANOVA |
|---|---|---|---|
| Initial length (cm) | 7.01±0.29 | 6.98±0.33 | The values among salinity treatments and replicates were not significantly different (p≥0.05) |
| Final length (cm) | 27.12±0.94 | 27.80±1.17 | |
| Initial weight (g) | 8.10±0.59 | 8.04±0.48 | |
| Final weight (g) | 287.10±16.94 | 309.94±29.09 | |
| K | 1.44±0.36 | 1.48±0.35 | |
| FCR | 1.87±1.22 | 1.89±1.33 | |
| SGR (%/day) | 1.96±1.02 | 2.00±1.17 | |

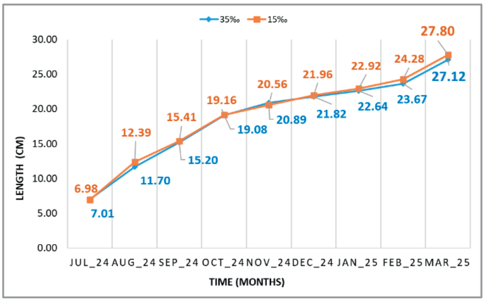


Figure 5. Evolution of European seabass total length (mean monthly values)

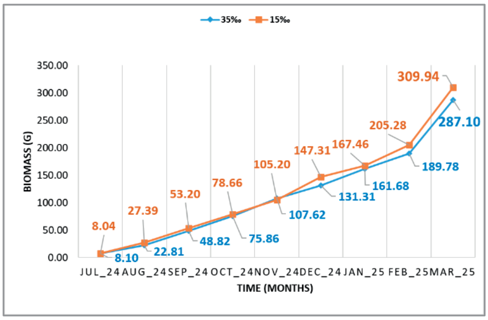


Figure 6. Evolution of European seabass weight (mean monthly values)

The calculation of Fulton's Condition Factor (K) for the European seabass juveniles reared in the two salinity regimes recorded mean values of 1.44 at 35‰ and 1.48 at 15‰, respectively (Figure 7), thus no significant differences were observed. The values calculated are consistent with literature data reported for cultured *D. labrax* and indicate a good condition of the fish (Petereit et al., 2022; Tarricone et al., 2022).

As benchmarks of fish growth, Length-Weight Relationships showed a negative allometry ($b<3$), the fish increasing in length faster than in weight in both salinity regimes (Figure 8 and Figure 9).

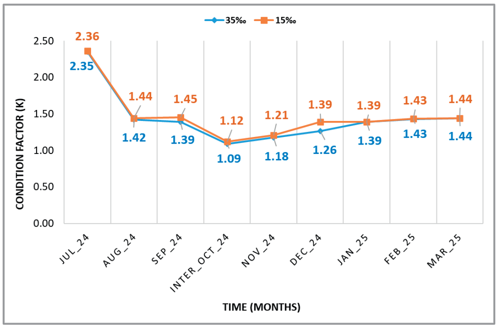


Figure 7. Monthly evolution of the Condition Factor (K) of European seabass

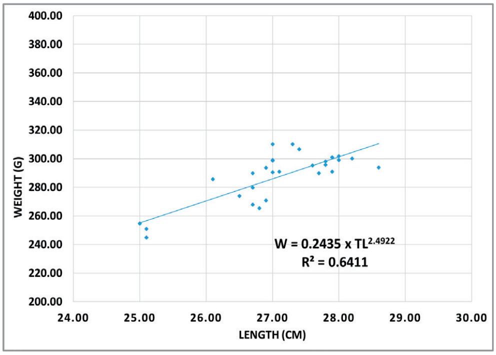


Figure 8. Length-Weight Relationship of European seabass reared at 35‰ salinity after nine months

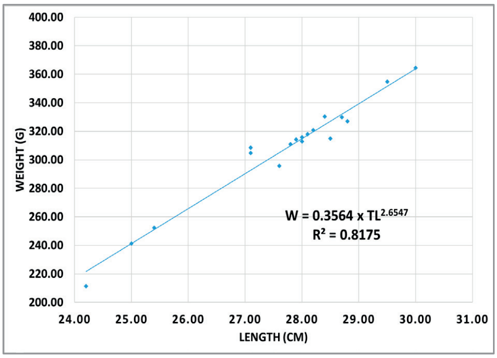


Figure 9. Length-Weight Relationship of European seabass reared at 15‰ salinity after nine months

The results, with the parameter *b* (slope) lower than the ideal isometric value of 3 (2.49 for the 35‰ salinity and 2.65 for 15‰, respectively), imply a faster growth in length compared to the gain in weight, or, alternatively, the body assuming a more elongated shape with growth, findings which are in line with values reported in bibliographic sources (Hegazy & Sabry, 2001; Mandić, 2017; Reis, 2020; Orduna et al., 2023).

Regarding feed efficiency and fish growth, the Food Conversion Ratio (FCR) recorded mean values of 1.87 (35‰ salinity) and 1.89 (15‰ salinity), respectively, with no significant difference among salinity regimes and replicates (Figure 10).

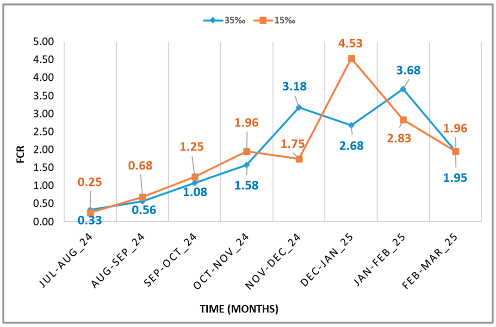


Figure 10. Monthly evolution of the Food Conversion Ratio (FCR) in European seabass

The mean Specific Growth Rates SGR (%/day) were similar for the two salinities, namely 1.96 for 35‰ salinity and 2.00 for 15‰ salinity, showing no significant differences among experimental replicates (Figure 11).

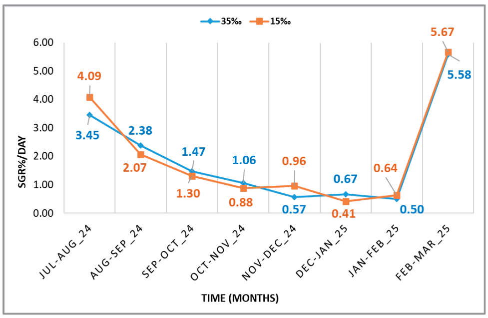


Figure 11. Monthly evolution of the Specific Growth Rates (SGR%/day) in European seabass

The biochemical analysis of European seabass meat revealed a highly similar proximate composition of fish reared at the two salinities (Figure 12). The total lipid content (around 8% FW), crude proteins (19% FW), carbohydrates (0%), ash (1%) and moisture (70%) in both treatments were comparable to values recorded in Mediterranean aquaculture farms (Kocatepe & Turan, 2012; Tarricone et al., 2022).

The analogous protein-lipid balance between the two batches resulted in very close energy values: 156 Kcal/652 KJ/100 g FW (35‰ salinity) and 152 Kcal/637 KJ/100 g FW (15‰ salinity), respectively. The only statistically significant difference was recorded in salt contents: the sample from fish reared at Mediterranean salinity (35‰) recorded an almost double amount of salt (0.058% FW) compared to the sample from fish cultured in Black Sea water (0.029% FW), which is a consequence of osmotic exchanges between fish organism and the culture environment (Claireaux & Lagardère, 1999).

Overall *D. labrax* meat quality parameters are summarized in Table 3 (where FW = fresh weight).

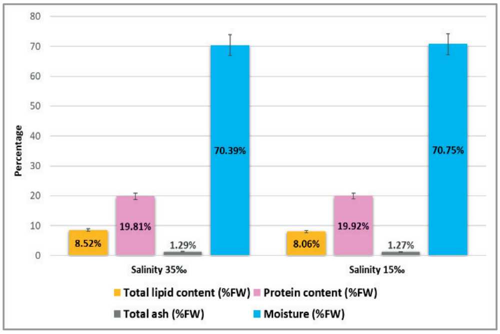


Figure 12. Proximate composition of European seabass meat (comparison between individuals reared at 35‰ and 15‰ salinities, respectively)

The present research primarily aimed to investigate whether European seabass is a feasible species for developing Romanian marine aquaculture in floating cages, as an alternative to temperature-dependant fish, such as rainbow trout or gilthead seabream. Previous studies have shown that *O. mykiss* grows steadily in Black Sea water under cold season conditions (Nenciu et al., 2022), while *S. aurata* succesfully tolerates high temperatures during summer (Nenciu & Niță, 2024), which occur as a follow-up of the continuous warming of seawater at the Romanian coast, with a 2023 average temperature of 14.89°C (2.44°C higher compared to the 1953-2022 annual means) (Vlăsceanu-Mateescu & Lazăr, 2024).

Table 3. Meat composition of European seabass comparatively reared at 35‰ and 15‰ salinities

| Salinity | Total lipid content (%FW) | Protein content (%FW) | Carbohydrate content (%FW) | Total ash (%FW) | Moisture (%FW) | Salt (%FW) | Energy | |
|---|---|---|---|---|---|---|---|---|
| | Mean+SEM* | Mean+ SEM | Mean+ SEM | Mean+ SEM | Mean+ SEM | Mean+ SEM | Kcal/ 100 g | KJ/ 100 g |
| 35‰ | 8.52±0.07 | 19.81±0.12 | 0.00±0.00 | 1.29±0.01 | 70.39±0.06 | 0.058±0.00 | 156 | 652 |
| 15‰ | 8.06±0.11 | 19.92±0.00 | 0.00±0.00 | 1.27±0.01 | 70.75±0.06 | 0.029±0.00 | 152 | 637 |
| ANOVA | NS** | NS | NS | NS | NS | p =0.02 | NS | NS |

*SEM = standard error of mean; NS = non-significant (statistically), p ≥0.05

Both rainbow trout and gilthead seabream adapted smoothly to Black Sea brackish water (with an average salinity around 15‰), with no significant stress signs and no mortalities during the experimental trials (Nenciu et al., 2022; Nenciu & Niță, 2024). European seabass, however, has been documented to have a tremendous temperature tolerance range (from 2 to 32°C) (Vandeputte et al., 2019) and a strong euryhaline character (FAO, 2025), making it a promising candidate to year-round culture under Black Sea environmental conditions.

The first notable outcome of the experiment was the finding that a sudden transfer to Black Sea water of *D. labrax* juveniles is achievable, as there is no time for gradual adaptation when aquaculture farms (marine cages) are stocked with fingerlings from hatcheries with higher salinities; hence, rapid osmoregulation is crucial (Roncarati et al., 2006; Goda et al., 2019). Blood glucose was used as a stress level indication to show the swift adaptability. Catecholamine release and hypothalamic-pituitary-internal axis activation are key components of fish's fundamental response to stress. In addition to excessive muscular activity, anaerobic glycolysis, and an increase in plasma lactate, hypothalamic-pituitary-internal activation also results in energy source mobilization, glycogen depletion, and an increase in plasma glucose levels (Arends et al., 1999). Consequently, stress levels are often assessed by measuring the amount of glucose in plasma (Fazio et al., 2015). Similarly to gilthead seabream tested in previous experiments (Nenciu & Niță, 2024), glucose levels regulated quickly after transfer to brackish water. The values measured before transfer (between 81 and 93 mg/l) are normal for the species, as blood glucose values for European seabass usually range between 75 and 95 mg/L (Lupi et al., 2005; Roncarati et al., 2006; Goda et al., 2019). One hour following the abrupt change in salinity, a sharp rise in blood glucose levels (145-155 mg/dL) was noted, as well as a change in the fish's colour and swimming behaviour: they darkened, swam individually, and refused to eat. However, the recovery of the normal colour and the resumption of vigorous feeding and schooling behaviour were noted within 12 hours following the transfer. Blood glucose levels measured 24 hours after transfer (63-93 mg/dL) showed a decrease in stress, which was supported by the fact that no deaths were noted over the whole trial.

Moreover, the growth parameters recorded during the nine-months experimental period underpin the species' potential for commercial exploitation in the Black Sea area, as fish reached the first commercial size of 300 g, displaying a normal growth rhythm compared to seabass reared in the Mediterranean. (Goda et al., 2019; Reis, 2020; Tarricone et al., 2022; Orduna et al., 2023). The mean condition factor of individuals reared in Black Sea brackish water (K = 1.48) indicated a good condition of the fish (Petereit et al., 2022; Tarricone et al., 2022), which showed a negative allometry ($b < 3$), the fish increasing in length faster than in weight and assuming the elongated shaped characteristic for the species (Hegazy & Sabry, 2001; Mandić, 2017; Reis, 2020; Orduna et al., 2023). Concerning feed conversion efficiency, the European seabass reared in Black Sea water recorded a mean FCR of 1.89, suggesting a good intake of the pellets, in line with the control batches reared at 35‰ salinity (FCR = 1.87) and values documented for the Mediterranean (Rodde et al., 2020). The Specific Growth Rate (SGR = 2.00%/day) for individuals reared in Black Sea water (15‰ salinity) also confirms a steady increase in body mass, slightly higher compared to the one recorded at the 35‰ salinity in control batches and the ones reported in the Mediterranean (Eroldoğan et al., 2004). Research also suggests that European seabass recorded better growth performances at lower salinities (10‰, 20‰, 25‰ and 30‰) (Goda et al., 2019).

Upon completion of the experiment, the biochemical analysis revealed a good quality of the meat of individuals reared at the 15‰ salinity, with a balanced protein (19.92% FW) and lipid (8.06% FW) content, in line with documented values of Mediterranean reared European seabass (Lupi et al., 2005; Kocatepe & Turan, 2012; Goda et al., 2019; Tarricone et al., 2022) and the control batches we maintained at 35‰ salinity (protein content 8.52%FW and lipid content 19.81%FW, respectively).

## CONCLUSIONS

The study, which aimed to investigate whether European seabass is feasible for aquaculture under the Romanian Black Sea conditions, proved that *D. labrax* is a species with high culture potential, as an alternative to the previously tested *O. mykiss* and *S. aurata*.

The laboratory experiment showed that 4-month-old juveniles can be safely transferred straight from a salinity of 35‰ to brackish water (15‰) with no mortality and a quick recovery from stress (glycemia levels returned to normal 24 hours after transfer).

There were no appreciable variations in biomass between salinities, and the biomass increase from 7-8 g at the beginning of the test to 300 g after nine months was normal.

The species demonstrated its appropriateness for aquaculture production in Romania, particularly because of its broad resistance to temperature, which allows it to feed and grow during colder Black Sea winters, making it suitable for year-round culture.

Consequently, European seabass is a viable option to the rotational farming system of rainbow trout in winter and gilthead seabream in summer, aiming to use the farming facilities (cages) all year and maximizing production and revenues of farmers.

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## REFERENCES

Arends, R. J., Mancera, J. M., Munoz, J. L., Bonga, S. E. W., & Flik, G. (1999). The Stress Response of the Gilthead Seabream (*Sparus aurata* L.) to Air Exposure and Confinement. *Journal of Endocrinology*, *163*, 149-57. https://doi.org/10.1677/joe.0.1630149.

AVMA (2020). *Guidelines for the Euthanasia of Animals*. Schaumburg, USA: American Veterinary Medical Association Publishing House.

Carvalho, N., & Guillen, J. (2021). *Aquaculture in the Mediterranean. IEMed. Mediterranean Yearbook 2021*. Retrieved January 31, 2025, from https://www.iemed.org/publication/aquaculture-in-the-mediterranean/.

Chatelier, A., McKenzie, D. J., & Claireaux, G. (2005). Effects of Changes in Water Salinity upon Exercise and Cardiac Performance in the European Seabass (*Dicentrarchus labrax*). *Marine Biology, 147*, 855-862. https://doi.org/10.1007/s00227-005-1624-7.

Claireaux, G., & Lagardère, J.-P. (1999). Influence of Temperature, Oxygen and Salinity on the Metabolism of the European Seabass. *Journal of Sea Research, 42*(2), 157-168. https://doi.org/10.1016/S1385-1101(99)00019-2.

Eroldoğan, O. T., Kumlu. M., & Aktaș. T. (2004). Optimum Feeding Rates for European Seabass *Dicentrarchus labrax* L. Reared in Seawater and Freshwater. *Aquaculture, 231*, 501-515. https://doi.org/10.1016/j.aquaculture.2003.10.020.

FAO (2021). *Fishery and Aquaculture Statistics 1976-2019*. Retrieved February 4, 2025, from www.fao.org/fishery/statistics/software/fishstatj/en.

FAO (2023). *The State of Mediterranean and Black Sea Fisheries 2023 - Special Edition*. Rome, IT: General Fisheries Commission for the Mediterranean (GFCM). https://doi.org/10.4060/cc8888en.

FAO (2025*). Dicentrarchus labrax. Cultured Aquatic Species Information Programme*. *Fisheries and Aquaculture*. Retrieved January 30, 2025, from https://www.fao.org/fishery/en/culturedspecies/dicentrarchus_labrax?lang=en.

Fazio, F., Ferrantelli, V., Fortino, G., Arfuso, F., Giangrosso, G. & Faggio, C. (2015). The Influence of Acute Handling Stress on Some Blood Parameters in Cultured Seabream (*Sparus aurata* Linnaeus, 1758). *Italian Journal of Food Safety*, *4*(1), 4174. https://doi.org/10.4081/ijfs.2015.417.

Franklin, D. A., & Loveson, L. E. (2019). Ammonia Toxicity and Adaptive Response in Marine Fishes - A Review. *Indian Journal of Geo Marine Sciences*, *48*(03), 273-279.

Froese, R. (2006). Cube Law, Condition Factor and Weight-Length Relationships: History, Meta-analysis and Recommendations. *Journal of Applied Ichthyology*, *22*, 241-253. https://doi.org/10.1111/j.1439-0426.2006.00805.x.

Goda, A. M. A. S., Srour, T. M., Mansour, A. T., Baromh, M. Z., Sallam, G. R., & Baromh, A. Z. (2019). Assessment of Stressful Ambient Water Salinity on Growth, Feed Utilization and Hematological Indices of European Seabass, *Dicentrarchus labrax*, Juveniles. *AACL Bioflux 12*(2), 553-563.

Hegazy, M. R., & Sabry, E. A. (2001). Stock Assessment for the Seabass (*Dicentrarchus labrax* L., 1758) - Pisces: Moronidae in Bardawil Lagoon, *Journal of the Egyptian-German Society of Zoology*, *34*(B): 41-55.

Hopkins, K. D. (1992). Reporting Fish Growth: A Review of the Basics. *Journal of the World Aquaculture Society*, *23*(3), 173-179.

Kocatepe, E., & Turan, H. (2012). Chemical Composition of Cultured Seabass (*Dicentrarchus labrax*, Linnaeus 1758) Muscle. *Journal of Food and Nutrition Research, 51*(1), 33-39.

Lane, D. M. (2010). *Tukey's Honestly Significant Difference (HSD)*. Retrieved February 8, 2025, from https://methods.sagepub.com/ency/edvol/encyc-of-research-design/chpt/tukeys-honestly-significant-difference-hsd.

Lupi, P., Vigiani, V., Mecatti, M., & Bozzi, R. (2005). First Haematic Results for the Seabass (*Dicentrarchus labrax*) Metabolic Profile Assessment. *Italian Journal of Animal Science*, *4*(2), 167-176. https://doi.org/10.4081/ijas.2005.167.

Mandić, M. (2017). *Condition of Cultured Seabass and Seabream and Occurrence of Their Spawning in the Cages in Boka Kotorska Bay*. Retrieved March 02, 2025, from https://www.researchgate.net/publication/320830820_Condition_of_cultured_sea_bass_and_sea_bream_and_occurrence_of_their_spawning_in_the_cages_in_Boka_Kotorska_Bay#fullTextFileContent.

Massa, F., Aydın, I., Fezzardi, D., Akbulut, B., Atanasoff, A., Beken, A. T., Bekh, V., Buhlak, Y., Burlachenko, I., Can, E., Carboni, S., Caruso, F., Dağtekin, M., Demianenko, K., Deniz, H., Fidan, D., Fourdain, L., Frederiksen, M., Guchmanidze, A., Hamza, H., Harvey, J., Nenciu, M., Nikolov, G., Niță, V., Özdemir, M. D., Petrova-Pavlova, E., Platon, C., Popescu, G., Rad, F., Seyhaneyildiz Can, Ș., Theodorou, J. A., Thomas, B., Tonachella, N., Tribilustova, E., Yakhontova, I., Yesilsu, A. F., & Yücel-Gier, G. (2021). Black Sea Aquaculture: Legacy, Challenges and Future Opportunities. *Aquaculture Studies*, *21*, 181-220. http://doi.org/10.4194/2618-6381-v21_4_05.

Nash, R. D. M., Valencia, A. H., & Geffen, A. J. (2006). The Origin of Fulton's Condition Factor - Setting the Record Straight. *Fisheries, 31*(5), 236-238.

Nenciu, M., & Niță, V. (2024). Tailoring Western Black Sea Aquaculture to Impending Climate Change: Laboratory Testing of Gilthead Seabream *Sparus aurata* (Linnaeus, 1758) as a Potential Candidate. *Scientific Papers, Series D, Animal Science*, *LXVII*(1), 745-754.

Nenciu, M., Niță, V., & Hamza, H. (2020). Recent Outcomes of the Shellfish Aquaculture Demonstrative Center (S-ADC). *Cercetări Marine - Recherches Marines, 50*(1), 192-197, https://doi.org/10.55268/CM.2020.50.192;

Nenciu, M., Niță, V., Lazăr, L., Spînu, A., & Vlăsceanu-Mateescu, E. (2023). Fostering the Development of Western Black Sea Aquaculture: A Scientific Case Study for Finfish Cage Farming Allocated Zone Designation. *Fishes, 8*(2), 104. https://doi.org/10.3390/fishes8020104.

Nenciu, M., Niță, V., Nicolae, C. G., & Akbulut, B. (2022). Boosting Biomass Gain and Meat Quality of Rainbow Trout *Oncorhynchus mykiss* (Walbaum, 1792) - An Approach for Fostering Romanian Aquaculture. *AgroLife Scientific Journal*, *11*(1), 145-156. https://doi.org/10.17930/AGL2022117.

Niță, V., & Nenciu, M. (2020). *Practical Guideline for Shellfish Culture*. Bucharest, RO: CD Press Publishing (In Romanian).

Niță, V., Nenciu, M., & Coatu, V. (2022). Suitability and Sensitivity of Golden Grey Mullet *Chelon auratus* (Risso, 1810) as a Reference Fish Species for Ecotoxicity Tests in the Black Sea. *Toxics, 10*(5), 222. https://doi.org/10.3390/toxics10050222.

Orduna, C., De Meo, I., Rodríguez-Ruiz, A., Cid-Quintero, J. R., & Encina, L. (2023). Seasonal Length-Weight Relationships of European Seabass (*Dicentrarchus labrax*) in Two Aquaculture Production Systems. *Fishes*, *8*(5), 227. https://doi.org/10.3390/fishes8050227.

Person-Le Ruyet, J., & Le Bayon, N. (2009). Effects of Temperature, Stocking Density and Farming Conditions on Fin Damage in European Seabass (*Dicentrarchus labrax*). *Aquatic Living Resources, 22*(3), 349–362. https://doi.org/10.1051/alr/2009047.

Person-Le Ruyet, J., Mahé, K., Le Bayon, N., & Le Delliou, H. (2004). Effects of Temperature on Growth and Metabolism in a Mediterranean Population of European Seabass, *Dicentrarchus labrax*. *Aquaculture, 237*(1-4), 269-280. https://doi.org/10.1016/j.aquaculture.2004.04.021.

Petereit, J., Hoerterer, C., Bischoff-Lang, A. A., Conceição, L. E. C., Pereira, G., Johansen, J., Pastres, R., & Buck, B. H. (2022). Adult European Seabass (*Dicentrarchus labrax*) Perform Well on Alternative Circular-Economy-Driven Feed Formulations. *Sustainability, 14*(12), 7279. https://doi.org/10.3390/su14127279.

Pickett, G. D., & Pawson, M. G. (1994). *Seabass - Biology, Exploitation and Conservation*. London, UK: Chapman & Hall Publishing House.

Reis, I. (2020). Length-Weight Relationships of 12 Fish Species from the Köyceğiz Lagoon, Turkey. *Marine Science and Technology Bulletin, 9*(2): 136-144. https://doi.org/10.33714/masteb.722480.

Rodde, C., Vandeputte, M., Allal, F., Besson, M., Clota, F., Vergnet, A., Benzie, J. A. H., & De Verdal, H. (2020). Temperature and Feeding Rate Effects on Individual Feed Efficiency in European Sea Bass (*Dicentrarchus labrax*). *Frontiers in Marine Science,* *7*, 578976. https://doi.org/10.3389/fmars.2020.578976.

Roncarati, A., Melotti, P., Dees, A., Mordenti, O., & Angellotti, L. (2006). Welfare Status of Cultured Seabass (*Dicentrarchus labrax* L.) and Seabream (*Sparus aurata* L.) Assessed by Blood Parameters and Tissue Characteristics. *Journal of Applied Ichthyology,* *22*(3), 225-234. https://doi.org/10.1111/j.1439-0426.2006.00741.x.

Seneye, I (2025). *What Ammonia Level Is Safe?* Retrieved February 26, 2025, from https://answers.seneye.com/en/water_chemistry/what_is_ammonia_NH3_NH4/what_ammonia_level_is_safe.

Tarricone, S., Caputi Jambrenghi, A., Cagnetta, P., & Ragni, M. (2022). Wild and Farmed Seabass (*Dicentrarchus labrax*): Comparison of Biometry Traits, Chemical and Fatty Acid Composition of Fillets. *Fishes*, *7*(1), 45. https://doi.org/10.3390/fishes7010045.

Vandeputte, M., Gagnaire, P. A., & Allal, F. (2019). The European Seabass: a Key Marine Fish Model in the Wild and in Aquaculture. *Animal Genetics, 50,* 195-206. https://doi.org/10.1111/age.12779.

Vlăsceanu-Mateescu, E., & Lazăr, L. (2024). Seawater Temperature. In F. Timofte, & L. Boicenco (Eds.), Report on Marine and Coastal Environment State in 2023 (pp. 28-31). Constanța, RO: Internal Report of the National Institute for Marine Research and Development “Grigore Antipa“ (In Romanian).

Witeska, M., Kondera, E., Ługowska, K., & Bojarski, B. (2022). Hematological Methods in Fish - Not Only for Beginners. *Aquaculture*, *547*, 737498. https://doi.org/10.1016/j.aquaculture.2021.737498.

Zaharia, T., Niță, V., & Nenciu, M. (2017). *Background of Romanian Marine Aquaculture*. Bucharest, RO: CD Press Publishing (In Romanian).