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PRODUCTION EFFORTS FOR NEW CANDIDATE FINFISH SPECIES IN TURKISH MARINE AQUACULTURE

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Abstract

The present study covers a summary of efforts for Turkish marine finfish aquaculture over the past twenty years with a special insight to candidate species which could be an alternative to those traditionally produced at present. With its rapid growth trend, the Turkish aquaculture industry has become a key player among the World's leading producers in marine fishes, especially seabream, seabass and trout farming. However, the oversupply of such species causes price fluctuations from time to time, that result in reduction of cash flow and farm profitability. Bottlenecks driven by the market imbalances cause severe problems for small and medium sized companies that come to crossroads for new business strategies. In the present study, the circumstances coupled with new marketing strategies to overcome profitability challenges have been evaluated with background information of the efforts to introduce new candidate species into the Turkish aquaculture industry.

Keywords: Alternative finfish species, candidate species, Turkish aquaculture, marketing strategies, profitability challenge

Introduction

Turkish aquaculture demonstrated a rapid growth over the last two decades and ranks today among the top producers in Europe and the world. The expansion of Turkish finfish aquaculture reached 467.048 ton of production in year 2021, which is around 493.6 % higher than the harvested volume of 78.683 tons in 2000, according to the statistical data provided by Food and Agriculture Organization of the United Nations (FAO, 2023). Considering the rapid growth that shows around 23% increase of annual harvest from 2000 to 2021, it can be estimated that the Turkish finfish production may reach over 600.000 tons of harvest by the end of 2023. In terms of economic revenues, the sales value increased from 218.913.900 USD in 2000 to 2.080.237.000 USD in 2021, which is around 10-fold increase over the last two decades.

The European seabass (*Dicentrarchus labrax*), gilthead seabream (*Sparus aurata*) and rainbow trout (*Oncorhynchus mykiss*) are the main three key species dominating the Turkish production in marine finfish aquaculture, with a harvest yield of 155.151 tons, 133.476 tons and 165.683 tons for the three species in 2021, respectively. By subtracting the total of the main key species (454.310 tons) from the grand total of finfish harvest in 2021 (467.048 tons), the remaining represents new candidate species, which are labelled as “Alternative species” in the Turkish finfish aquaculture sector.

As a noun the term “alternative” points on something that is different from something else, especially from what is usual and offering a choice (Cambridge Dictionary, 2023). However, what is meant by “alternative species” in the Turkish finfish farming is for a fish that shows suitable potentials for aquaculture conditions and to the water characteristics available in the area, which actually can be described as “candidate species for aquaculture for a specific region”.

In the present study, trends of marine finfish production in the Türkiye were evaluated with insight to the efforts and challenges towards species diversification as a production strategy to ensure continuous growth of business and expand the market oppression by addressing perspectives for the future of the Turkish finfish aquaculture enterprises.

Competitive profitability challenges of fish farms

There is strong competition in the seabream and seabass farming in the Mediterranean and trout aquaculture in Europe as well as worldwide, and the profitability of farm activities are affected by many factors. The remarkable growth of aquaculture activities in the world turned to an industry with entries of companies every year. The increase of production amounts resulted by time in declines of market prices and as a result, profits of the companies decreased (Fernández Sánchez et al., 2022). These profitability struggles caused bottlenecks of cash flow as a result of the oversupply and price declines, many small to medium size companies reduced their farm business as a consequence, while some others combined their business to reduce operation costs (Fernández Polanco & Llorente, 2019).

In order to overcome the bottlenecks faced over time, most companies continued to grow resulting in an increased of the market supply. The consequence of this is an ever increasing volume of production to the domestic and the international markets, which is a risky challenge of competition which necessitates either a price reduction or a quality increase. Product abundance can cause fluctuations or even declines in prices, a familiar value-flow in marketing. Therefore, to combat this challenge which started in the early 2000s, companies began to adopt new business strategies in order to survive in these competitive trade conditions. Besides selling

higher volumes, increasing the quality to enable a higher sales price to be demanded, or even harvesting larger sized fish were noted as alternative solutions for surviving the struggle of profitability in seabass farming in the Mediterranean (Fernández Sánchez et al., 2022). Hence, the introduction new species as a product diversification could be attractive to consumers, providing a solution for the combat of profitability problems in aquaculture.

The search for new candidate species in the Turkish aquaculture business started in the early 1980s with the production of common two-banded seabream (*Diplodus vulgaris*), that was followed by mullets (*Mugil cephalus*) in the 1990s. While the production of common two-banded seabream started with 1 ton per year in the trial phase in 1986, it reached up to 100 tons of production in 1991. However, it was observed that production did not continue in both common two-banded seabream and mullet, probably due to low consumer preferences and market prices.

The trials on the production of alternative or new candidate species stopped abruptly in 1993 and no new record of production was noted until 2011. There could be various reasons for this outage. An incident that took place in this process is noteworthy. Namely, in the early 1990s, Atlantic salmon farming activities started in the Black Sea received a great deal of attention across the country resulting in the production activities on Kefken Island, off the Turkish coast of western Black Sea, were carefully followed by other farmers.

In addition the use of unpainted nets in large-scale cage systems due to the lack of technological infrastructure in those years, caused devastating escapes of the 7-8 kg sized salmon as a result of the tears in the nets, which had become heavier due to biofouling growth, and could not withstand the tension force when the semi-submersible cage system was brought to the water surface. The results were catastrophic, when the net was torn. Actually, it was a failure of technical applications and farm management, however no one was interested in the reasons behind these events.

In the foreground was an unsuccessful new approach for alternative or candidate species for the Turkish aquaculture. This incident caused a slow-down of new enterprises for offshore technologies or even new candidate trials, which was a loss of nearly 10 years for the industry revival and transition to offshore systems in Türkiye. By the early 2004, offshore cage technologies with large cage diameters were introduced in the fattening of Atlantic Bluefin tuna in the Mediterranean, with 440 tons of harvest, that double to 870 tons in 2007, and tripled to 1.136 tons in 2014, and reached around 5.000 tons in year 2021, according to FAO estimates (FAO, 2023). It is also interesting to note that the production of some new candidate species was revived in 2012, with 409 tons of porgies and 955 tons of sciaena sp. The production of meagre (*Argyrosomus regius*), also known as croaker deserves attraction, because the harvest yield was 3.281 tons when it was introduced into the market in 2014, and doubled to around 6.000 tons of the last 6 years.

New entries of harvest records exist for common dentex (*Dentex dentex*, 113 tons), red porgy (*Pagrus pagrus*, 106 tons), pink dentex (*Dentex gibbosus*, 75 tons), shi drum (*Umbrina cirrosa*, 39 tons), and sharpsnout seabream (*Diplodus puntazzo*, 8 tons) in 2014, and red-banded seabream (*Pagrus auriga*, 66 tons) and bluespotted seabream (*Pagrus coeruleostictus*, 122 tons) in 2017, which however did not last any longer after 2017, and harvest records declined gradually over the following years to only 2, 3, and 4 tons of production in 2021 for shi drum, red porgy, and pink dentex, respectively (FAO, 2023).

The production volumes for the candidate species that was achieved during the initial trials between 1993 and 1996 are given in Figure 1.

Among the candidate finfish harvest yields, species with over 300 tons of annual production in Turkish marine farms have been presented in Figure 2, while those with less than 300 tons of annual production are illustrated in Figure 3.

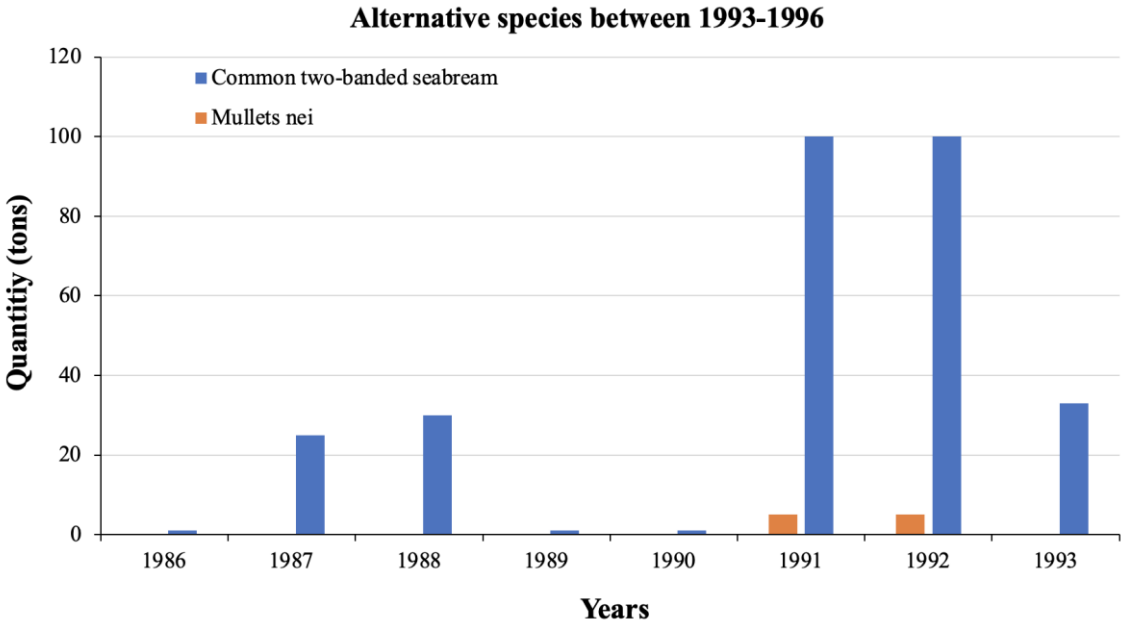

Figure 1. Production volumes of alternative species trials between 1993 and 1996 in Turkish aquaculture (Figure produced by relevant FAO statistics of online query panels; FAO, 2023).

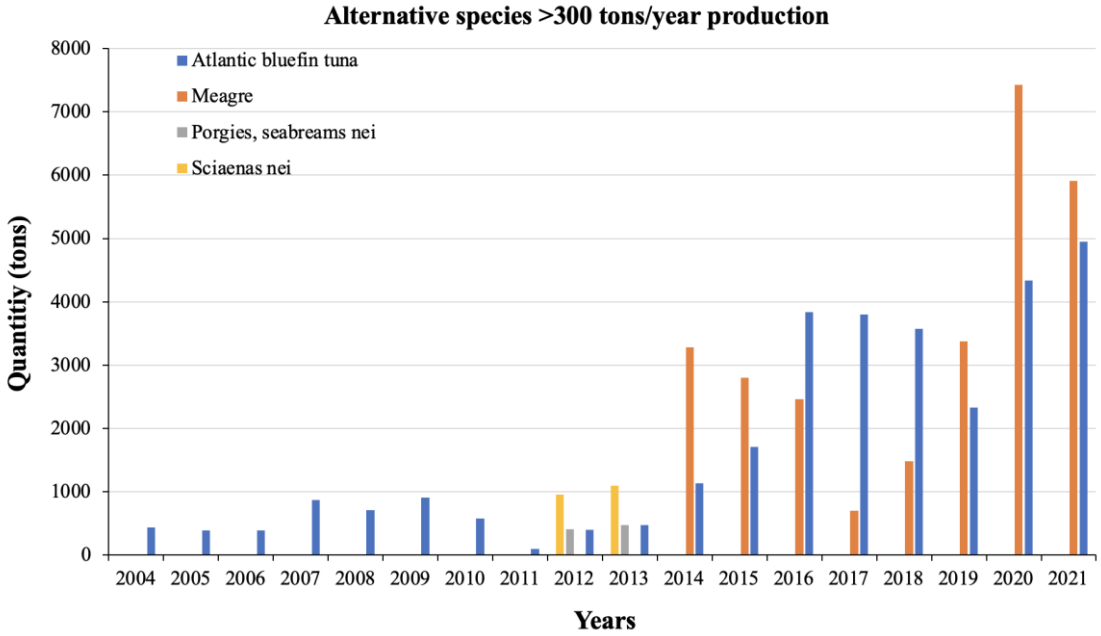

Figure 2. Fish species with over 300 tons of annual harvest from Turkish marine farms between 2004-2021 (Figure produced by relevant FAO statistics of online query panels; FAO, 2023)

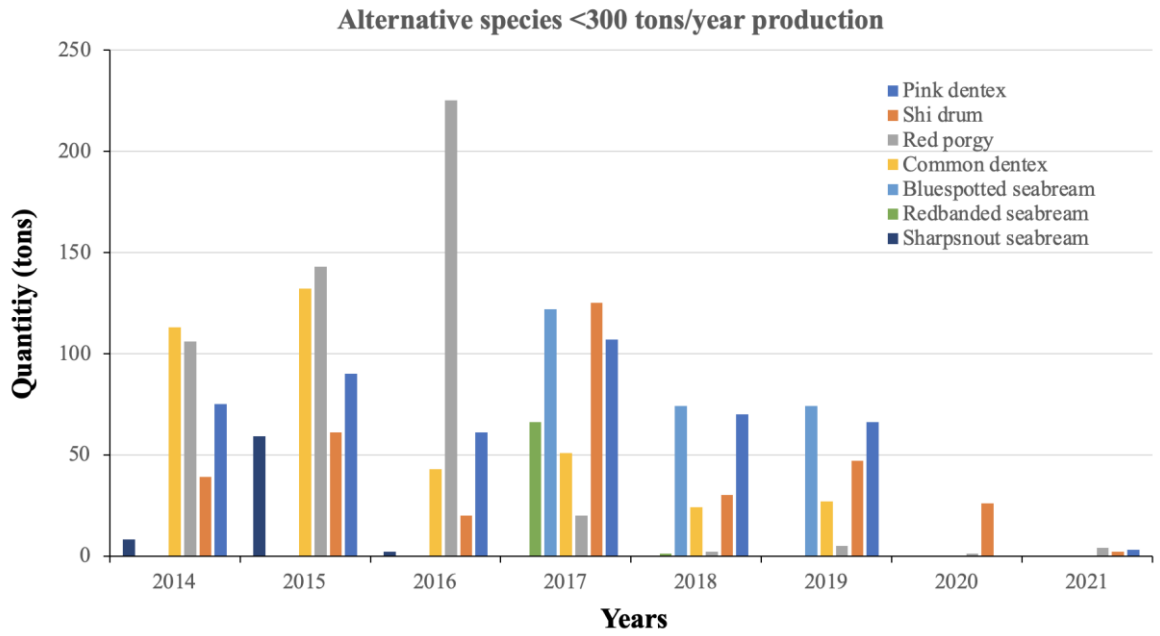

Figure 3. Alternative species with less than 300 tons of annual production from Turkish marine farms (Figure produced by relevant FAO statistics of online query panels; FAO, 2023).

Challenges of introducing "New Species" in aquaculture

The main key species of seabream, seabass and rainbow trout, dominating the Turkish aquaculture industry, are fish species with remarkably high protein requirement. There are strenuous efforts for reducing dietary incorporation levels of fish meal in aqua-diets, which however are curbed by the imbalance of amino acid profiles in the feed, when fish meal is substituted with excess alternative protein sources such as plants or other animal by-products (Türker et al., 2005; Yigit et al., 2006; Ergün et al., 2008a, b; Yildirim et al., 2009; Yigit et al., 2010, 2012; Bulut et al., 2014). Similar to fish meal, the replacement efforts for fish oil are also an important issue for the challenge of less fish-based oil use in aqua-diets (Harmantepe et al., 2014; Kesbic et al., 2016).

Some recent efforts for introducing other sparid fishes (species belonging to the family Sparidae) with less protein requirements, such as Salema (*Sarpa salpa*, Sahinyilmaz & Yigit, 2017, 2018), and Axillary seabream (*Pagellus acarne*, Yigit et al., 2016; Öztekin et al., 2018, 2020) are noteworthy. However, these efforts remained at research level and have not been commercially implemented, possibly due to the market demand that is mainly driven by consumer preferences (Yigit et al., 2023).

Besides the above-mentioned fish species introduced to the Turkish aquaculture, the Black Sea turbot (*Scophthalmus maeoticus*) is another candidate that has been under investigation in Türkiye for over 15 years, and today several fish farms have a number of fish stocked in hand. However, it is likely that turbot is not yet in commercial implemented due to its high production costs, that eventually would require high sales values. The continuous search for new species is important in order to cope with both the price fluctuations and the price drops in the market caused by the high production volumes of limited numbers of species. Harvesting larger fish could be an alternative to the present products available in the market, as it was the case for the rainbow trout, that has been introduced with size of over 2.5 kg and named as Turkish salmon recently (Yigit et al., 2023), which can also be effective for the seabream and seabass as well,

AQUATIC ANIMAL REPORTS

as was reported earlier for the seabass culture in the Mediterranean, with better profits by larger fish delivery to the market (Fernández Sánchez et al., 2022).

Conclusion

The present study focused on the trend of the efforts for the introduction of "new candidate species", leading to the identification of the species which could potentially be an alternative to the present species in aquaculture, for the diversification and expansion of product range for marketing. This however depends on a variety of factors and conditions such as growth potential, feed utilization and efficiency, adaptation abilities to capture conditions, stress and welfare of fish under farm conditions as stocking rates, handling and transport stress are important for fish welfare in farm conditions. Besides all these factors, the reproduction protocols are most important issues for a candidate fish to be introduced into aquaculture, which can be assessed as farmers' acceptability. Beyond all, the market value that is closely linked to consumer preferences plays a major role in development and success of new candidate species in aquaculture enterprises. Eventhough some species are already introduced in the Mediterranean aquaculture, including Turkish farms, the production volumes are still handled with care. It is likely that new candidate species, alternative to the dominant once, may need several years of efforts.

Investigations with new scopes on consumer preferences towards the traditionally farmed fish species need more attention and encouraged in future studies, that in turns might help to understand and answer the question "How new candidate finfish species could attract consumers to achieve attention in the market?".

Ethical approval

Not applicable

Informed consent

Not available

Data availability statement

The authors declare that data can be provided by corresponding author upon reasonable request.

Conflicts of interest

There is no conflict of interests for publishing this study.
The corresponding author is responsible on behalf of all authors' declaration.

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Contribution of authors

Ümüt Yigit: Conceptualization, Investigation, Methodology, Data source and analysis, Writing original draft
Nic Taylor: Conceptualization, Resources, Supervision, Validation, Review, Editing
Sebahattin Ergün: Conceptualization, Methodology, Writing original draft, Validation
Murat Yigit: Conceptualization, Data source and analysis, Validation, Review, Editing
All authors have read and agreed to the published version of the manuscript.

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