

The Role of Greek State Hatcheries in Freshwater Aquaculture: A Mini Review Concerning Production Trend, Problems and Future Perspectives of Pella Hydrobiological State Hatchery

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Abstract

Although aquaculture in Greece is mostly dedicated in marine fish farming, freshwater aquaculture, mainly rainbow trout farming, has traditionally enacted a crucial role for regional economy, contributing in counterurbanisation and rural population recovery. Contrariwise to mariculture, where hatcheries are owned by big companies, freshwater rainbow trout culture has been largely based on juveniles provided by state hatcheries for decades. This short review paper presents the main features of Greek state hatcheries with an emphasis on production trend, role and problems and future perspectives of one of the three major freshwater state hatchery, namely the Hydrobiological Station of Pella, located in the Region of Central Macedonia, Greece. The role of state hatcheries in supporting rainbow trout farming has been proved crucial during the last decades, providing juveniles in new aquaculture units, as well as supporting the recovery of fish farm units from various damages that led to stock losses. The main problems of state hatcheries are the reductions in employees and financial recourses, a fact mostly observed after the economic crisis of the 2010s. Apart from the support to freshwater aquaculture and introduction that may lead to negative effects, future perspectives may include research activities in collaboration with Universities and research institutes.

Keywords

freshwater aquaculture, *Oncorhynchus mykiss*, rainbow trout, state hatchery

1. Introduction

The most important branch of world aquaculture is fish farming, which during the last 30 years presents a more than 10% annual growth rate [1]. It is therefore clear that in response to the increasingly high demand for fish, in combination with the declining fish supplies from fisheries, fish farming is the only manner to cover the global fish needs of the 21st century [2].

In line with the Greek coastal topography, marine aquaculture is by far more developed than freshwater aquaculture in Greece [3]. Indicatively, in the annual report on aquaculture in Greece for 2020, the Federation of Greek Mariculture notes concerning the current situation that “it is worth noting that fish farmed in sea water represent 98% of the total farmed fish, whereas only 2% comes from freshwater fish farming, with the main species being rainbow trout, to a lesser extent carp and the European eel, followed in a very small proportion by aquatic plants such as the cyanobacterium *Spirulina* sp. and the macroalgae *Ulva* sp., which can be used as food supplements, raw material in the cosmetics industry, biofuels, etc”. However, the peculiarity of inland aquaculture is that it constitutes a traditional form of primary production and a source of main or supplementary employment and income for the inhabitants of mountainous and remote mainland areas, while in the Greek lagoons, the traditional extensive aquaculture is practiced, with special economic and social importance at local level [4].

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Despite the fact that the sector of Greek aquaculture is mostly known for marine fish farming with the largest proportion being export oriented, it should be mentioned that freshwater aquaculture development is dated back in the 50s, whereas fish mariculture in Greece is more recent, starting in the 80s [3]. Aquaculture can be generally divided into two main phases, with the first being carried out on land facilities such as fish breeding stations or hatcheries, and the second corresponding to the transfer of hatched fish juveniles or fingerlings to fish farms where fish grow, up to the market desired size [4]. Keeping this in mind, the fish hatcheries are responsible for a major activity, i.e. hatching and rearing the early life stages of the farmed fish. While private marine fish farms in Greece have developed their own hatcheries or are based on the supplement of fish from other private fish farms, a large proportion of freshwater fish farms in Greece depend on state fish hatcheries for providing fish juveniles and fingerlings for decades.

This work represents an attempt to investigate the role, history, production trend, limitations and perspective of the state fish breeding stations, for covering freshwater aquaculture demands in hatched fish as well as busting recreational fishing by restocking activities in artificial reservoirs.

2. Short History and Scope of the Greek State Hatcheries

The recent history of aquaculture in Greece begins with the establishment and operation of the first state fish breeding station across the springs of the river Louros in the Region of Epirus close to Ioannina city in 1951, whereas 14 years later, in 1967, the second state hatchery was established in the Region of Central Macedonia, close to the city of Edessa. During the 1970s, rainbow trout farming was still the main form of aquaculture in the country, as marine fish farming appeared only in the early 1980s [5].

According to the Greek Ministry of Rural Development and Food, in the context of the public policy for the strengthening of natural resources and the support of aquaculture of freshwater species, the state hatcheries provide juveniles for free in the following cases:

- New freshwater fish farmers for the first operational year of the unit
- Freshwater fish farmers, whose production has been destroyed by a natural disaster
- Public bodies, Management Bodies and Fisheries Cooperatives for fish restocking purposes in inland water basins.

The last two decades stocking activities are limited in artificial ecosystems, acknowledging their negative effects on freshwater ecosystems and especially on wild trout populations. Juveniles of two species, namely the rainbow trout (*Oncorhynchus mykiss*, Walbaum 1792) and the carp (*Cyprinus carpio*, Linnaeus 1758), are produced in the state hatcheries, with the first one being the most important.

3. Pella State Hatchery

Although more public hatcheries for rainbow trout were initially designed by the Greek Ministry of Rural Development and Food, less were finally developed, and only two are still working, namely Pella and Ioannina state hatcheries, whereas the third one still working, the Arta state hatchery, produces only carp and experimentally eel. More specifically, Pella state hatchery (Hydrobiological station of Pella) was established in 1967, in a poplar forest outside Edessa, on a land plot granted to the Ministry of Rural Development and Food by the local municipality authorities.

During the next two decades, when several harmful meteorological events and catastrophic factors were observed that severely affected the rainbow trout farming units in the region, the supporting role of Pella hatchery was of great importance in a sector-sustaining point of view [6]. Later, nevertheless, after the 2000s, a downward trend of the majority of public institutions of the Ministry of Rural Development and Food followed, in terms of employees and resources. Efforts, such as the gradual reopening or creation of new units, including an attempt towards eel cultivation, were proved unsuccessful mainly because of the lack of resources and technical support.

Nowadays the Pella hatchery's facilities provide updates and training programs, while generally contribute to the support of freshwater aquaculture farms, most of which are small family-type units without the possibility of employing scientific staff. Also, efforts are being made to apply new methods for the cultivation of aquatic organisms as well as the reproduction of wild trout. In addition, since 2016, monitoring of fish populations and especially wild ones is performed in various rivers, in

collaboration with the Fisheries Departments of Imathia, Pella and Grevena Regional Units as well as the Management Unit of Northern Pindos National Park, aiming to guide public authorities concerning measures that need to be taken in order to protect riverine and riparian habitats. Workshops organised by the Pella state hatchery, raising public awareness, aim at the same direction.

3.1. Production Trend in Pella State Hatchery

After a production decline, which was in general accordance with the economic crisis of the previous decade, the level of productive operation of the station seems to be stabilizing in recent years (Figure 1). The largest production proportion of rainbow trout fry are supplied exclusively to organizations and associations whose main goal is the restocking of artificial reservoirs scoping in busting recreational fishing activities (Figure 2). Interestingly after the period of 2018-2019 and until 2022, during the COVID pandemic period, there is no supply of juveniles towards private fish farmers.

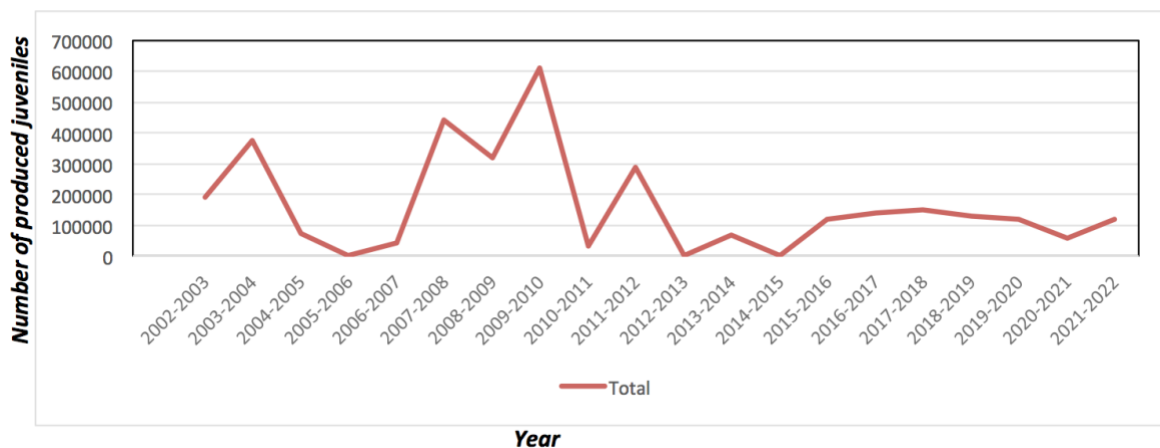


Figure 1: Rainbow annual production in Pella state hatchery

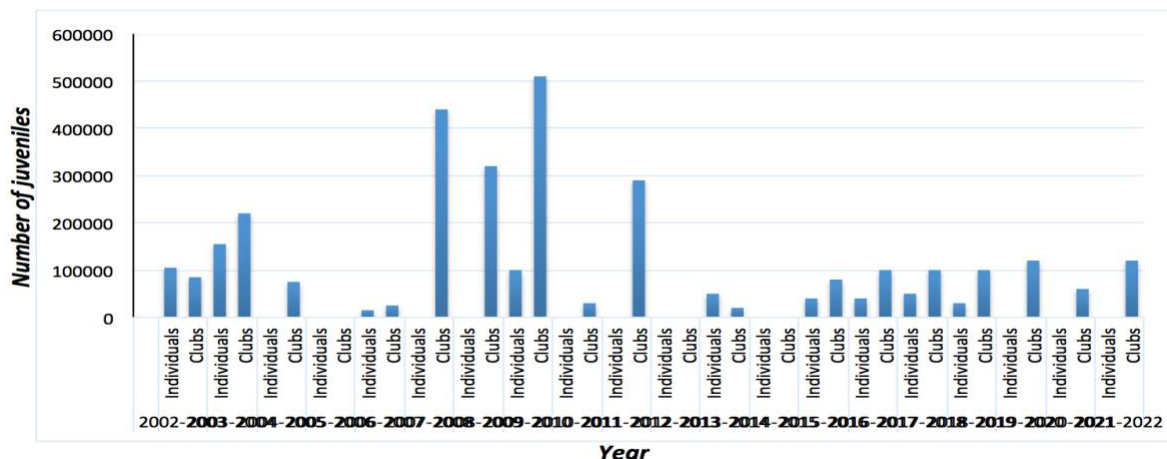


Figure 2: Supplying direction of produced juveniles. With the term individuals, the private companies are concerned, whereas the term clubs include Public Bodies, Management Bodies and Fisheries Cooperatives

Both production and supplying direction trends (Figures 1 and 2) indicate an on-going decreasing interest in rainbow trout production sector by all stakeholders' categories. More specifically, older producers retire from the production process, and are usually neither replaced by younger new ones nor by their children who generally prefer to move in large cities [7]. Also, the younger ones consider

the financial risk of such an investment to be excessive, despite the ambitious help and support offered by the competent state bodies, including the fish breeding stations.

It should be noted however that the production capacity of the above-mentioned station seems to be up to four times of the current. This productive potential requires an increase in both financial and human resources. The level of employees' expertise in the state hatcheries can be characterised at a satisfactory level, who, thanks to their own efforts, maintained the facilities despite the problems during the ten – year economic crisis. The reductions in employees as well as in resources related to economic situation are considered among the main problems causing this situation.

Notably, the today need for financial support of the specific state infrastructures is obvious since the motivation of the business activity in the aquaculture seems to be gaining interest in a regional development point of view, with the fish breeding stations exhibiting an important perspective role to enact.

3.2. Research Activity – Ecological Role

In addition to the production of juveniles for aquaculture support purposes, brood production is also performed for stocking purposes in freshwater ecosystems. However, these introductions, especially in the past, have not always led to the desired results. Genetic and population studies have revealed introgression and antagonism with local populations, occasionally leading to negative impacts even local extinctions of the brown trout *Salmo trutta* [8]. Hybridization due to imports of other trout species has also been reported, while conspecific juveniles have also been imported between different regions [9], whereas the contribution to fisheries was eventually not significant [10]. An important factor worsening the above situation has been performed by a bunch of informal enrichment actions carried out by local services and non-professional fishermen, which are not officially recorded [11]. Keeping these incidences in mind, during the last two decades juveniles of rainbow trout produced by the Pella state hatchery are provided for stocking activities limited only in artificial freshwater ecosystems.

Regarding the research activities, it has to do mainly with the means provided by the state. In the last twelve years, the effort has focused mainly on maintaining functionality and no resources have been spent towards this direction, although there is a corresponding interest from the scientific staff.

4. Conclusions

In conclusion, the role of Greek public hatcheries in supporting freshwater fish farming, in particular rainbow trout, has been of great importance during the last four decades. Production trends have been greatly influenced by the economic crisis, employees, and resources reductions with a potential harmful effect on rainbow trout aquaculture. On the other hand, new roles of state hatcheries as monitoring of fish populations contribute to riverine habitat research, management and protection. Genetic improvement and evaluation of climate change effects on the production and stress of reared fish could also be a potential field of research for state hatcheries.

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