STATS OF FISHERIES AND DISEASE CONTROL IN THE REPUBLIC OF NORTH MACEDONIA IN THE ERLY 21th CENTERY

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ARTICLE INFO

Review Article

Received: *30 May 2022*

Accepted: *30 July 2022*

doi:10.5937/ekoPolj2203887T

UDC 639.2:639.3.09(497.11)

Keywords:

Aquaculture, stats, disease control, Republic of North Macedonia

***JEL**: Q22*

ABSTRACT

This review aims to show the current state of fisheries in the Republic of Northern Macedonia as well as the strategy for the prevention and control of World Organization for Animal Health (OIE) notifiable diseases in aquaculture in order to comply with European legislation. At the moment, Macedonia produces about 1,700 tons, which dominates the production of trout with 63% and carp with about 29% of the total production. This sector has had a constant. Positive growth in recent years, attracting new investors, especially in cold-water aquaculture. Although the consummation of 5 kg per capita of fish is modest, domestic production does not satisfy their needs, so the market is supplemented with fish imports. One of the conditions for this sector to continue to grow at such a pace is to limit losses in aquaculture production. The most serious limitation that serious producers deal with is the appearance of infectious diseases.

Introduction

Aquaculture in the Republic of North Macedonia dates back to the early thirties of the last century. The endemic species of trout Salmo letnica Karaman was originally bred for stocking Lake Ohrid and population maintenance. After World War II, rainbow trout farms (Oncorhynchus mykiss) were built in many places with a total capacity of about 300 tons. Carp farms were also established in the 1950s and raised in ponds. In the late 1970s and early 1980s, cage breeding of rainbow trout and carp began in some of the irrigation lakes. In the late 1980s, polyculture began to be introduced by introducing Asian fish species such as grass carp (Ctenopharyngodon idellus), silver carp (Hypophthalmichthys molitrix), and bigheaded carp (Hypophthalobic). Experiments were also conducted to breed warm-water fish in rice fields, but without success. By the end of the 1980s,

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the entire aquaculture sector was state-owned. The aquaculture sector is now privately owned. Unfortunately, large farms producing hot-water fish are drastically reduced. The production of rainbow trout and its albino forms is dominant. In the physical plan of the Republic of North Macedonia for the period 2002-2020 is expected to increase fish production from 989 tons to 2,300 tons (. Introduction is the first section of an IMRAD paper. It purposes is to state clearly the problem investigated and to provide the reader with relevant background information. State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

Materials and methods

Articles, newsletters, annual reports, forecasts and other official materials from various authors were used for this research, including institutions such as the Ministry of Agriculture, Forestry and Water Management (MAFWM), the Food and Veterinary Agency (FVA) and the State Statistics Office of the Republic of North Macedonia. Additional information on fish production has been collected by various authors, while some have been collected during fish market visits in 2020 as a joint activity of the Faculty of Veterinary Medicine -Skopje (FVMS) and the Food and Veterinary Agency as part of the national program for monitoring viral diseases in aquaculture.

Results and discussion

In the Republic of Northern Macedonia, fishing is performed on all fishing waters within and under conditions determined by law. Fishing waters in Macedonia cover about 56,000 hectares, of which 83% are fishing areas including natural lakes (Ohrid, Prespa and Dojran), 11% are fishing zones and recreational zones on artificial lakes, 4% are fishing areas - rivers. Within these 56,000 ha, 1% are aquaculture facilities where fish are raised. Social and political changes in Macedonia have led to negative consequences in this sector, which has resulted in minimizing the role of the sector in the overall economy (Annual Report on Agriculture and Rural Development (2001-2019)). However, the importance of the sector and its potential for the development of rural tourism and aquaculture production, as well as the social and environmental roles in a balanced and diverse agricultural and rural development policy, should not be underestimated. From the aspect of the national economy, fisheries has an imperceptible share in GDP of only about 0.1% (Annual Report on Agriculture and Rural Development (2001-2019)). Outdoor fishing can be commercial, recreational, and selective, land reclamation and fishing for scientific research purposes. Commercial fishing is carried out on fishing areas and fishing zones, recreational fishing is organized on fishing grounds and recreational zones, and selective, land reclamation and fishing for scientific research purposes are performed on all fishing waters with previously obtained approvals and permits. Aquaculture (fish farming) is done in fishing facilities (full-systemic fish farm and semi-systemic fish farms) which are registered in the ministry. Commercial fishing in fishing areas has been steadily declining in the past. This is due to the reduction of the stock of some important fish species which led to the adoption of bans on their commercial fishing. Unlike commercial fishing in open

fishing waters, fish production in aquaculture has been growing steadily in recent years. In aquaculture, most of the production is related to rainbow trout and carp. Concrete fish farms are predominate in the production facilities for cold water aquaculture and there are also several farms with cage breeding of trout, while for warm water aquaculture the cage breeding of artificial lakes predominantly on Lake Tikvesh. The hot water polyculture with more serious capacities is available in two locations in the country, and the other fish farms are on artificial lakes - small dams - ponds with small production capacity.

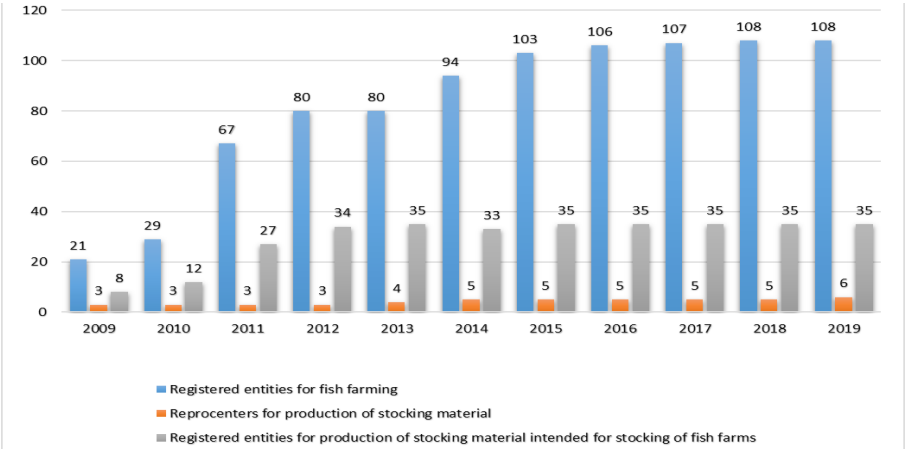
Currently, according to the State Statistics Office of the Republic of North Macedonia, there are 108 aquaculture farms, of which 52 are cold-water fish farms and 46 are hot-water fish farms (20 of which are cage farms) and 9 combined farms. Out of 108 farms, only 35 produce offspring for their own needs, also they sell to other fish farms. In Macedonia we also import fertilized eggs and offspring to meet the needs. And for stocking the waters with indigenous species, 6 repro-centers have been registered: 2 for hot water species, 1 for cold water and 3 combined.

Table 1. Fish farms divided by production capacity

Type of fish	Registered capacity				Total number
	< 20 t	20-50 t	50-100 t	> 100 t	
Trout	33	10	7	3	53
Carp in cages	15	7	3	1	26
Carp in fishponds	17	1	2	-	20
Combined	6	3	-	-	9
Total	71	21	12	4	108

Source: Annual Report on Agriculture and Rural Development (2001-2019). Ministry of agriculture, forestry and water management

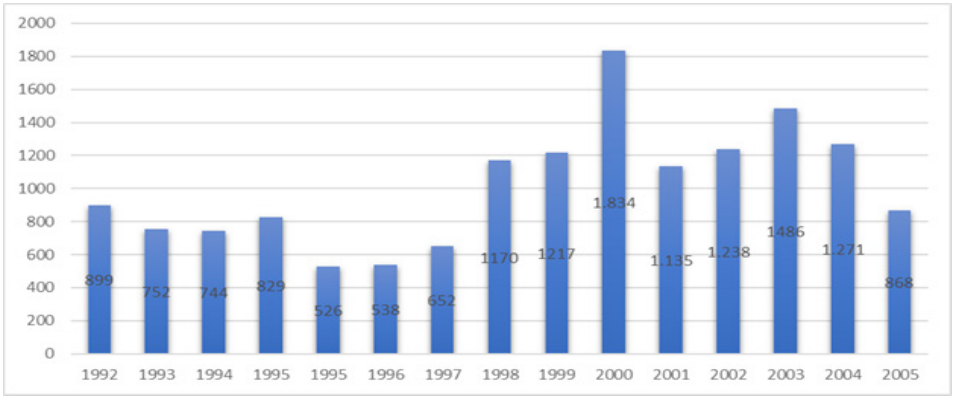
Figure 1. Number of registered entities for fish production



Source: Annual Report on Agriculture and Rural Development (2001-2019). Ministry of agriculture, forestry and water management

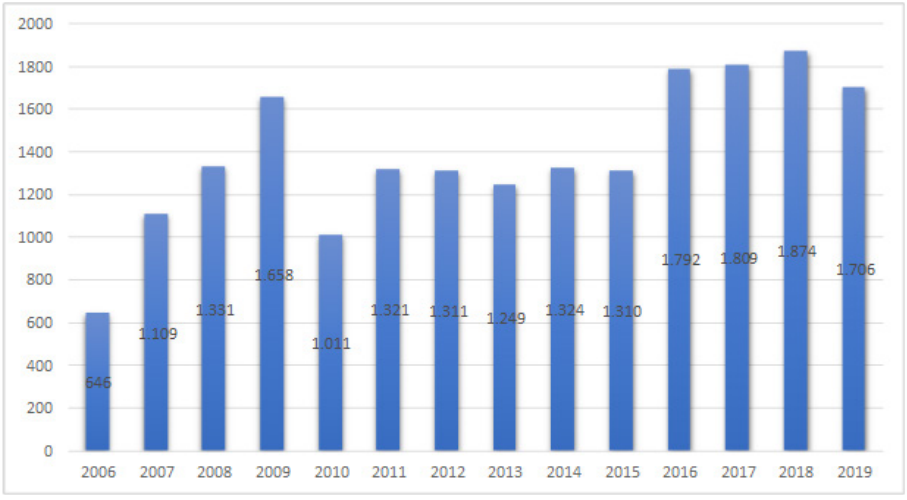
Although the number of breeders has a positive growth in the last 10 years, the production in aquaculture does not have a constant increase and there are many variations. From the 1990s until 2020, it has almost doubled, which is a good sign, although the projected 2300 (Annual Report on Agriculture and Rural Development (2001-2019)) tons have not been exceeded

Figure 2. Total production capacity 1992-2005 in tons



Source: Annual Report on Agriculture and Rural Development (2001-2019). Ministry of agriculture, forestry and water management

Figure 3. Total production capacity 2006-2019 in tons



Source: Annual Report on Agriculture and Rural Development (2001-2019). Ministry of agriculture, forestry and water management

Most of the fish production in Macedonia belongs to the cold water aquaculture with the most dominant species of rainbow trout (Oncorhynchus mykiss) and significantly

smaller amount of river trout (Salmo farioides), Macedonian trout (Salmo Macedonicus) Ohrid salmon (Salmo letnica Karaman), Brook trout (Salvelinus fontinalis). In the warm-water aquaculture, the production of carp (Cyprinus carpio) is dominant and besides carp, grass carp (Ctenopharingodon idella), silver carp (Hypophthalmichthys molitrix), bigheaded carp (hypophthalmichthys nobilis) are also grown. In addition to trout and carp, commercial eel (Anguilla anguilla), red fin (Rutilus rutilus), whitefish (Salmo ohridanus), perch (Perca fluviatilis) and others are caught as important economic species.

Table 2. Fish production in North Macedonia in tons

Species	Year									
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Trout	646	837	829	782	834	963	1128	1128	1156	1132
Carp	342	455	417	348	355	405	514	589	614	524
Catfish	10	14	6	9	5	0.5	3	5	6	2
Eel	/	/	3	4	4	0.8	0.9	0.9	0.4	0.4
Other species	13	26	56	107	124	106	131	85	98	47

Source: Annual Report on Agriculture and Rural Development (2001-2019). Ministry of agriculture, forestry and water management

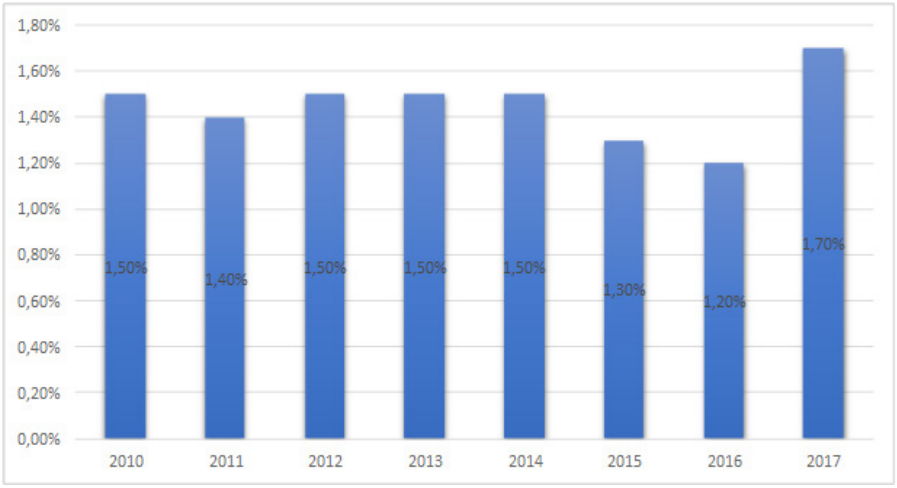
Consumption and import of fish

According to the official statistics of the State Statistics Office of the Republic of North Macedonia, the average household in Macedonia consumes about 21 kg fish and fish products per year or about 5 kg per capita (Annual Report on Agriculture and Rural Development (2001-2019)). Consumption of fish in 2005 was 3.5 kg per capita Hristovski et al.,2005), where there is an increase but still not enough compared to the world average of 15-20 kg per capita (Annual Report on Agriculture and Rural Development (2001-2019)).

The trade of fish products reflects Macedonia's dependence on marine fish and fish products given that the country has no access to the sea. The share of the import from the European Union of these products in the total import of agro-food products in the period from 2010-2017 ranges from 1.2% to 1.7%, i.e. on average 1.45% (Annual Report on Agriculture and Rural Development (2001-2019)).

The majority of imported fish and fish products are frozen fish with about 50% of the total value of imports; then canned fish (whole or in portions) by about 38%; and fresh fish by about 6%. The remaining 6% consists of fish fillets, mussels, mollusks, smoked fish and caviar. Most of the value of imported fish products were imported from Argentina (23.2%), Croatia and Spain (each with 10%), Greece (5.5%), followed by Bulgaria, Serbia and Montenegro (Annual Report on Agriculture and Rural Development (2001-2019)).

Figure 4. Share of fish import and fish processing from the total import of agri-food and fish production



Source: Annual Report on Agriculture and Rural Development (2001-2019). Ministry of agriculture, forestry and water management

The reasons why Macedonia has low consumption of fish is lack of habit and tradition to consume fish, seasonal fishing nature, lack of well-organized infrastructure in the market for fish and fish products, high prices of fish products compared to living standards; high prices of imported fish products in relation to the average income of the population. The increase in fish consumption is due to the development of rural tourism and the construction of so-called ethno-complexes and fish restaurants that promote fresh natural food.

Financial support program in fisheries

Ministry of Agriculture, Forestry and Water Management has implemented a "Program for financial support of fisheries and aquaculture" in order to protect the aquatic flora and fauna, investments in aquaculture, technical assistance for the development of new markets and promotional campaigns. For the realization of the envisaged measures in the program, the funds are allocated from the budget of the Republic of Northern Macedonia (Approximately 1.500.000 euros for 2021). The funds in the program are mostly intended for investments in fisheries and aquaculture and provision of stocking material for production fishing facilities (54%), for protection of aquatic flora and fauna about 14% and about 4% for technical assistance and development of new markets and promotional campaigns. The remaining funds are for unrealized liabilities in relation to concluded contracts and submitted requests.

Health status and disease control

The development of the aquaculture sector and the growth of intensive aquaculture production in Macedonia is followed by the development of accompanying scientific expertise with active involvement of the veterinary profession. The European Operational Model has been applied and a system for monitoring and control of fish diseases has been established at the state level in order to prevent, control and eradicate infectious fish diseases according to the standards of the World Organization for Animal Health. At the same time, appropriate legislation has been established that will regulate the problems in aquaculture in Macedonia and is in line with Europe Union directives. For the first time surveillance of diseases in aquaculture was conducted in 2015 by sending samples to the Veterinary Institute in Belgrade (Serbia) while in 2019 a national reference laboratory for viral diseases in fish was established at the Faculty of Veterinary Medicine in Skopje and actively participates in proficiency testing conducted by the European Reference Fish Laboratory in Copenhagen, Denmark.

According to the annual order for animal health protection, infectious diseases in aquaculture are prescribed for which active supervision is carried out, in salmonide: viral hemorrhagic septicemia (VHSV), infectious hematopoietic necrosis (IHNV), infectious necrotic pancreatitis (IPNV) and bacterial kidney disease (BKD). In cyprinid species of fish: Koi herpes virus (KHV) and spring carp viremia (SVCV). In order to determine the epidemiological situation in aquaculture animals, active surveillance of fish in fishing waters will be carried out, as well as passive surveillance of aquatic animals. Due to the determination of the health status in the facilities for production of aquaculture as well as for the improvement of the level of health care of aquatic animals, the breeders of animals from aquaculture should regularly report the increased (if we have a cumulative mortality of 0.5% per week.) (Cvetkovic et al., 2020);(Law on Health Protection of Animals from Infectious Diseases).

Although there are no national programs for monitoring bacterial or parasitic diseases, data obtained from fish farms through National Referent Laboratory (NRL) cooperation with fish farms indicate sporadic cases of furunculosis and yersiniosis in salmonids and erythrodermatitis in carp. Parasites such as Ichthyophthirius multifiliis and Gyrodactylus spp. have been observed in salmonid and cyprinid in intensive production systems, but through the implementation of preventive measures in fish farms and internal control of health status, the presence of bacterial and parasitic pathogens is minimum (Boshnakovski et al., 1991); (Markic, et al.,1999); Hristovski M. et al., 2001); Hristovski N. et al., 2001); (Hristovski & Cvetkovic, 2005) ;(Cvetkovic et al., 2007); (Cvetkovic et al., 2009); (Cvetkovikj et al., 2020).

Conclusions

The geographical location as well as the natural resources that Macedonia possesses, above all the quality mountain waters, meet the criteria for intensive aquaculture cultivation, especially cold-water aquaculture. Fisheries in Macedonia has the potential

for development, although it did not reach the projected physical plan with production of 2300 tons (Annual Report on Agriculture and Rural Development (2001-2019)) in 2020, which may be a result of the early implementation of outflow treatment that increases operating costs and the issue of biodiversity protection. But the continuation of the program for financial support in fisheries is likely to continue with positive growth in aquaculture. There is also potential in increasing the production of indigenous fish species promoted by scientific institutions in the country, but producers are not so interested due to the slow growth rate. Inclusion of aquatic animals in the annual order for animal health protection is another measure that will contribute to a better insight into the health status of existing facilities as well as a potential increase in capacity and the possibility for producers to export fish or juveniles to the Europe Union.

Conflict of interests

The authors declare no conflict of interest

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