POLISH JOURNAL OF NATURAL SCIENCES
Abbrev.: Pol. J. Natur. Sc., Vol 26(4): 333–344, Y. 2011

REARING OF BLACK MOLLY *POECILIA HYBRIDS* (VALENCIENNES, 1846) IN WATER OF DIFFERENT SALINITY

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Key words: *Poecilia* spp., aquarium fish, rearing, salinity, aquaristics.

Abstract

This study analysed the rearing of Black Molly *Poecilia* hybrids. It is a crossbreed of sailfin molly *Poecilia latipinna* and short-finned molly *Poecilia sphenops*. Black mollies are very popular aquarium fish which are frequently put into marine aquaria to speed up the maturation of such aquaria. Without being acclimatised to high salinity, the fish are put into water with a salinity of SG 1.025 or 33 ‰. The results indicate that fish which are shorter than 20 mm die in water whose salinity is higher than SG 1.020. However, fish longer than 25 mm can adapt to higher salinity. The results indicate that fish which have been reared in water of higher salinity grow faster.

PODCHÓW MOLINEZJI CZARNEJ "BLACK MOLLY" *POECILIA HYBRIDS* (VALENCIENNES, 1846) W WODZIE O RÓŻNYM ZASOLENIU

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Słowa kluczowe: molinezje, ryby akwariowe, podchów, zasolenie, akwarystyka.

Abstrakt

Przeprowadzono badania nad podchowem molinezji czarnej "Black Molly" *Poecilia* hybrids. Jest ona krzyżówką molinezji szerokopłetwej *Poecilia latipinna* oraz molinezji ostroustej *Poecilia sphenops*. Molinezja "Black molly" jest bardzo popularną rybą akwariową, którą często umieszcza

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się w akwariach morskich, aby przyspieszyć proces dojrzewania tych zbiorników. Molinezje czarne bez wcześniejszej aklimatyzacji do dużego zasolenia, od razu umieszczane są w akwariach o zasoleniu SG 1,025, czyli 33‰. Uzyskane wyniki wskazują, iż ryby o długości poniżej 20 mm sną w wodzie o zasoleniu wyższym niż SG 1,020. Osobniki o długości powyżej 25 mm są natomiast w stanie przystosować się do wyższego zasolenia. Uzyskane wyniki wskazują, że ryby podchowywane w wodzie o wyższym zasoleniu szybciej przyrastają.

Introduction

The results of recent studies in aquaculture have highlighted the need for a detailed elaboration of the technology associated with reproduction biotechniques (GLOGOWSKI et al. 1999, KUCHARCZYK et al. 2005, 2008a, KREJSZEFF et al. 2008, 2009, SZCZERBOWSKI et al. 2009, ŻARSKI et al. 2009, 2010, CEJKO et al. 2010, TARGOŃSKA et al. 2010), as well as the biotechnique of rearing larvae and juvenile stages (KUCHARCZYK et al. 1997, 1998, KUJAWA et al. 1997, 2010, KUPREN et al. 2008, ŻARSKI et al. 2009). The differences have not only been observed between species, but also between populations or shoals of fish of the same species (KUCHARCZYK et al. 2008a, KREJSZEFF et al. 2009, 2010a). Even small differences in the composition of water used to activate gametes, including its salinity, can affect the results of eggs fertilization (KUCHARCZYK et al. 2010b). All these details are later important in calculation of the production efficiency (HAKUĆ-BŁAŻOWSKA et al. 2009, 2010) and may determine its economic success.

Aquaristics is a very popular branch of aquaculture. Tropical ornamental fish are bred in many places around the world, and trading in them brings huge profits (TLUSTY 2002). However, despite its popularity and considerable economic benefits, brought about by breeding and trading aquarium fish, publications about their biology and breeding have been scarce (KUCHARCZYK et al. 2008b, 2010a, KUPREN et al. 2008, TARGOŃSKA and KUCHARCZYK 2011). Fish of *Poecilia* spp. inhabit the fresh and slightly saline and even sea waters of Central America (COSTA and SCHLUPP 2010). *Poecilia sphenops* can be found even in the Atlantic, a long way off the coast. They reach a length of 10 cm and prefer medium hard to hard, alkaline water with the temperature ranging from 24 to 28°C. The fish are in a better shape when kept in water with a specific gravity of 1.002–1.005 than in fresh water. Black mollies have been used for a long time in newly established marine aquaria to start the nitrogen cycle.

Poecilia spp. seem to be particularly sensitive to nitrates and nitrites. The addition of salt to water reduces the toxicity of the compounds. Salt added to water is also an effective anti-parasitic and antifungal agent. Water with the salinity of 5 to 8‰ 7 is hard to live in for freshwater parasites, and changes

caused by fungi disappear quickly as compared to fish kept in fresh water. Fish of *Poecilia* spp. which are kept in fresh water are susceptible to many diseases, such as white-spot disease caused by *Ichthyophthirius multifiliis*, a fin necrosis caused by *Pseudomonas fluorescens*. The fish often suffer from molly disease and become unable to swim properly and they swing sideways. This is caused by deficit of electrolytes which are necessary for proper metabolism. The disease does not occur in mollies kept in slightly salty or salty water.

Carrying out pioneer research frequently requires constructing special systems which allow researchers to perform repeat studies and to achieve reliable results. Such systems have been developed to keep spawners (KUJAWA et al. 1999), to incubate eggs (KUCHARCZYK et al. 1996) or to rear larvae at different densities (Kujawa et al. 2000, Krejszeff et al. 2010b). However, no systems have been developed for simultaneously rearing larvae in water of different salinity.

The aim of the study was to determine the survival and growth rate of fish in fresh, slightly salty and sea water. However, to perform the task, special experimental runs have been developed and constructed.

Materials and Methods

The fish used in the experiment were obtained from an aquarium fish breeding farm. Upon arrival, they were 16–17 mm long and weighed 0.057–0.081 g. All the fish (600) were put into a tank (192 dm^3) with fresh water where they were kept for 7 days. The water temperature was 25°C, pH 7. No nitrites or ammonia were detected in the water while the fish were kept in it (Table 1). During the experiment, the fish were fed Artemis nauplii twice a day, 10 g of cysts per feeding. The fish were not fed on the day before being transferred to separate tanks. After a period of acclimatisation, the fish were put into 12 aquaria, 50 fish in each, the aquaria being parts of 6 independent rearing circulations with water of different salinity (Figure 1). Meersalz (produced by Aquamedic) synthetic sea salt was used, which contains the essential nutrients and has buffering properties. Salinity was measured with a refractometer of the same manufacturer. The salinity of the systems were:

- system 1 – salinity SG 1.000; 0.0‰;
- system 2 – salinity SG 1.005; 6.7‰;
- system 3 – salinity SG 1010; 13.3‰;
- system 4 – salinity SG 1.015; 20.0‰;
- system 5 – salinity SG 1.020; 26.7‰;
- system 6 – salinity SG 1.025; 33.3‰.

Table 1

The water parameters during the experiment

Parameter	Aquaria	
	experiment start	experiment end
Temperature [°C]	25°C	25°C
pH	6.9–7.2	6.9–7.2
NH_3, NO_2 [mg dm^{-3}]	0	< 1.0
NO_3 [mg dm^{-3}]	0	< 10

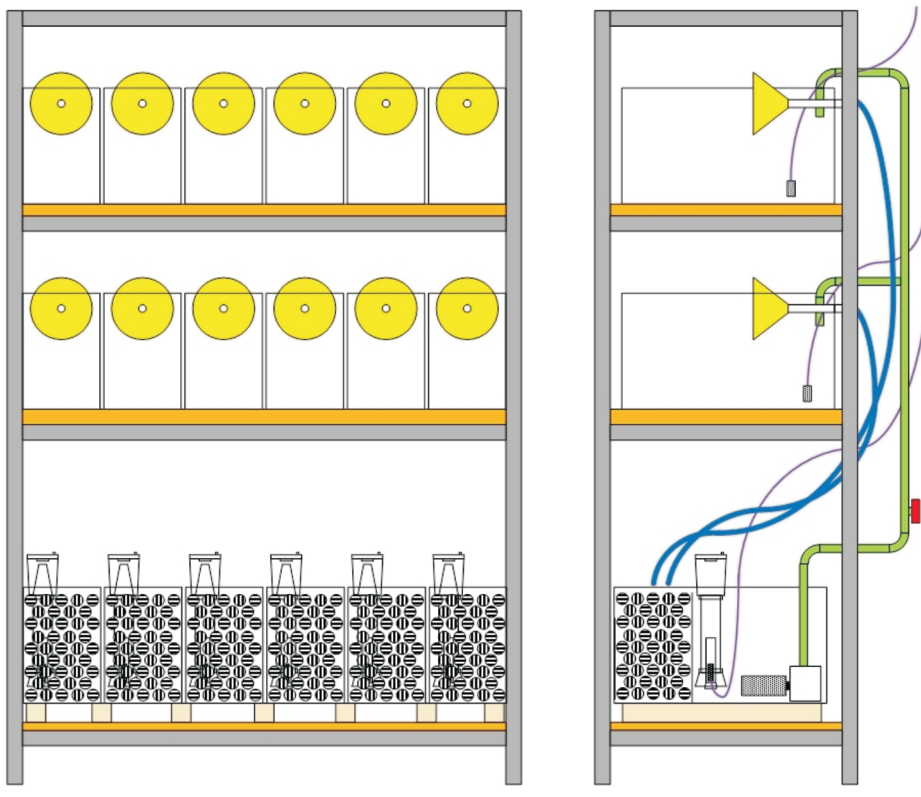

Fig. 1. A diagram of the system of 6 aquaria with water of different salinity, used to conduct this study. The front view – on the left and the side view – on the right

Each system consisted of three interconnected aquaria with the working capacity of 25 dm^3 each. The fish were kept in two upper tanks, whereas in the lower tanks there were biological deposits as bio-bale with the total volume of 8 dm^3, a cube protein skimmer (Aquamedic miniflotor) and an Atman AT-306 pump. The pump pumped the water to the medium

and upper tanks, from where it was moved by gravitation to the lower tank through an outlet system with a meshed funnel at the end. The lower aquaria were placed in a 297 dm^3 water bath with two 500 W heaters. The water temperature in the aquaria during the experiment was maintained at 25°C ± 0.2°C. The aquaria were lit with fluorescent light for 12 hours. Mollies were fed twice a day with JBL Novo Bea feed which consisted of raw protein (45.2%), raw fat (5%), raw fibre (1.5%) and raw ash (9.7%). The feed is intended for guppies and other small fish species of the family *Poeciliidae*, which also includes mollies. The feed has the form of small flakes, which initially float and then slowly sink. The feed was supplied through a bi-chamber automatic feeder, manufactured by Eheim. A single feed dose was 0.58 g per tank. The rearing was conducted for 70 days. The feed dose was increased every 10 days and was adapted to the weight of the fish.

The parameters measured during the experiment included water temperature, the number of dead fish, nitrates and ammonia content. The fish were measured every 4 days. A sample each time consisted of 10 fish from each tank. After being caught, the fish were put into a 5 dm^3 tank, where they were anaesthetised with propiscin at 1 mL/dm^3. After anaesthetising them, their total length *l.t.* was measured with an electronic calliper. Subsequently, the fish were transferred to a water tank placed on precise scales, where they were weighed.

The regression analysis fish length, weight in relationship to the days was conducted.

Results

The results of the experiment have shown that using salt water in rearing juvenile stages of molly positively affected the growth rate and the final length (Figure 2, Table 2). The fish kept in fresh water grew much more slowly and achieved the smallest final length.

Using salt water in rearing juvenile stages of molly positively affected the growth rate and the final weight (Figure 3, Table 3). On the initial days of the experiment, the fish kept in water at the salinity level of SG 1.015 and 1.020 grew slower than those kept in fresh and slightly salty water. This was caused by acclimatisation of the fish to the salty environment and by achieving the osmotic equilibrium in fish. After 12 days, the fish kept in water of higher salinity started to grow faster, ultimately weighing more by 16 to 38% than those kept in fresh water.

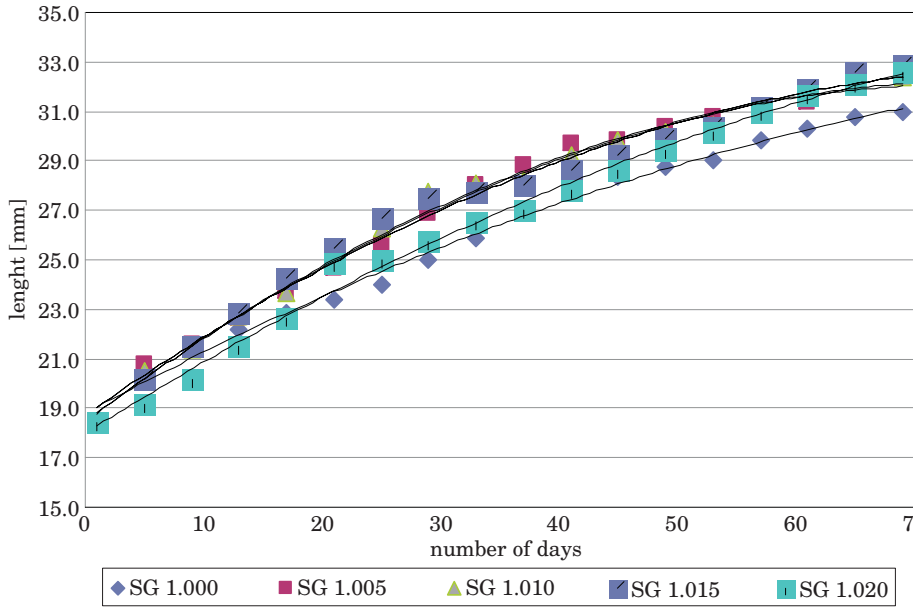

Fig. 2. The relationship between days of rearing and the total length *l.t.* of mollies kept in water of different salinity

Table 2

Equations of regression and coefficients of determination for the relationship between the days of rearing and the total length *l.t.* of mollies at different density levels

Salinity SG	Equation	Value of R^2
1.000	$y = -0.001x^2 + 0.257x + 18.80$	$R^2 = 0.992$
1.005	$y = -0.002x^2 + 0.357x + 18.47$	$R^2 = 0.995$
1.010	$y = -0.002x^2 + 0.364x + 18.42$	$R^2 = 0.994$
1.015	$y = -0.002x^2 + 0.335x + 18.72$	$R^2 = 0.987$
1.020	$y = -0.001x^2 + 0.302x + 17.98$	$R^2 = 0.994$

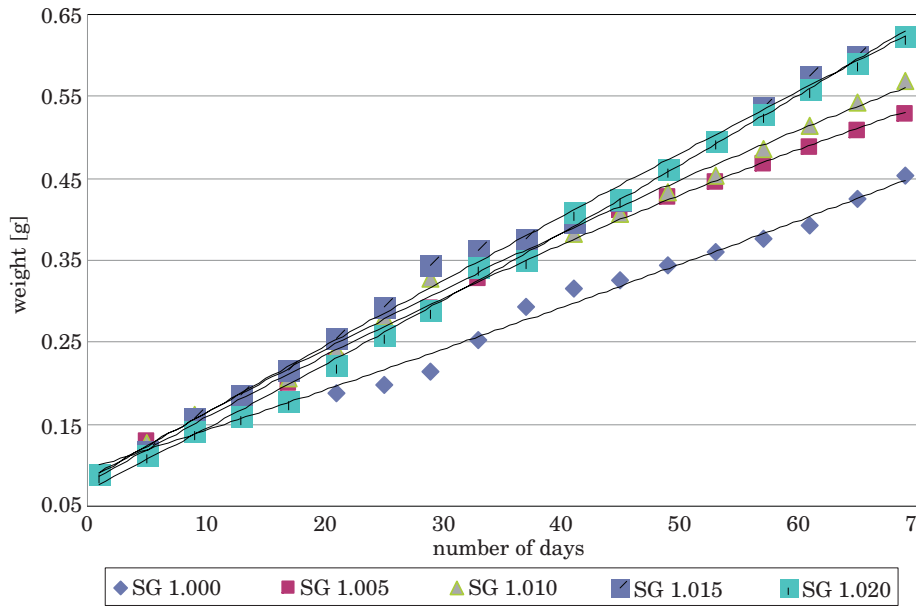

Fig. 3. The relationship between the days of rearing and the weight of mollies reared in water of different salinity

Table 3

Equations of regression and coefficients of determination for the relationship between the days of rearing and weight of mollies at different density levels

Salinity SG	Equation	Value of R^2
1.000	$y = 6E\text{-}06x^2 + 0.004x + 0.095$	$R^2 = 0.988$
1.005	$y = -2E\text{-}05x^2 + 0.008x + 0.078$	$R^2 = 0.996$
1.010	$y = -2E\text{-}05x^2 + 0.008x + 0.082$	$R^2 = 0.995$
1.015	$y = -7E\text{-}06x^2 + 0.008x + 0.081$	$R^2 = 0.995$
1.020	$y = 1E\text{-}05x^2 + 0.007x + 0.069$	$R^2 = 0.997$

The results show that transferring the fish kept in fresh water to water with salinity exceeding 26.7‰ causes mass fish deaths (Figure 4, Table 4). Fish should be gradually acclimatised to higher salinity.

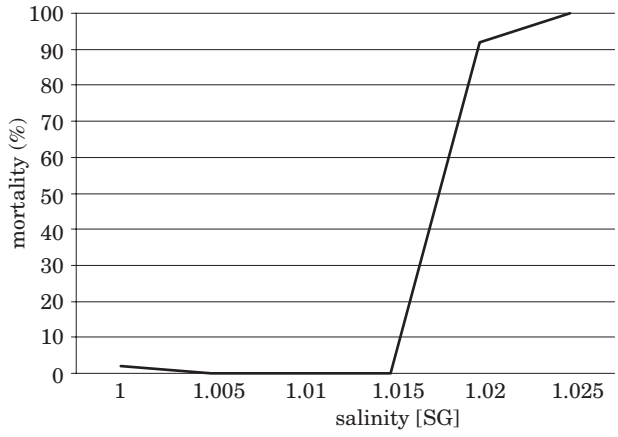

Fig. 4. Aggregated mortality of mollies in water at different salinity

Table 4

Mortality of mollies in water with different salinity

Salinity SG	Mortality [%]			
	after 24 hours	after 48 hours	after 96 hours	total at the end of the rearing period
1.000	0	1	1	2
1.005	0	0	0	0
1.010	0	0	0	0
1.015	0	0	0	0
1.020	82	6	4	96
1.025	100	0	0	100

The results show that the calculated partial growths (measured every 4 days) are uniform; however, they are 35 to 40% higher in salty water than in fresh water (Figure 5).

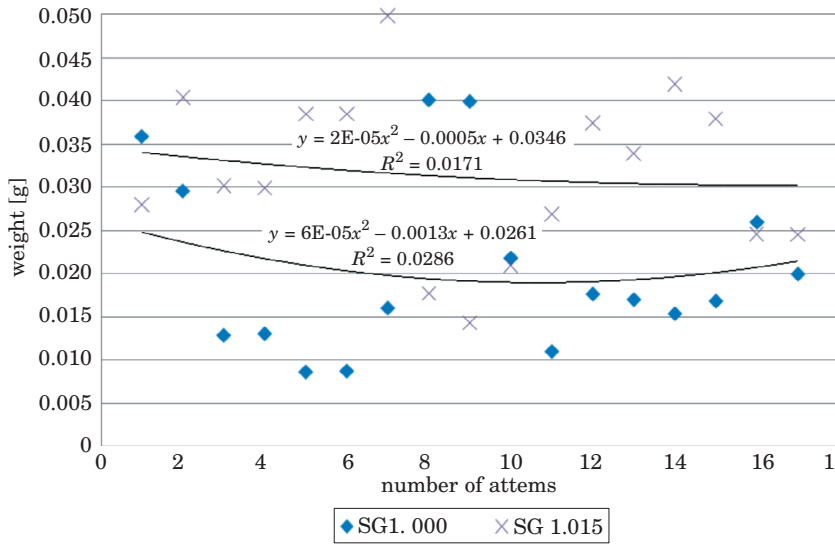

Fig. 5. Differences in increments of the fish weight in fresh water and in water of 20.0‰ (SG 1,015) salinity

Discussion

There has been a rapid development of aquaculture in recent years, both in breeding of fish for consumption, such as the carp, but also among species which are less important, whose production is aimed at fry-stocking (KUJAWA et al. 2010). Tropical and ornamental species have also become increasingly popular (TLUSTY 2002). Moreover, recently there has been an increase in research into the conditions of rearing ornamental fish and the breeding of new species has been taken up. The most readily studied aspects include using different feeds, both live and artificial (LIM et al. 2003, SALES and JANSSENS 2003, TARGOŃSKA 2007). Ensuring proper environmental conditions for fish is one of the major problems in rearing fish larvae in controlled conditions (OPUSZYŃSKI 1983). Salinity in molly breeding is certainly one of these conditions.

Salinity affects many aspects associated both with reproduction and with rearing in many fish species. This is of particular importance in such fish as white sea bream (*Diplodus sargus* L.), gilthead sea bream *Sparus aurata* L. or flatfish, which live in salty or slightly salty waters (GAVLIK and SPECKED 2004, WANG et al. 2007, APPELBAUM and JESUAROCKIRAJ 2009, DIMITROGLOU et al. 2010). A properly selected level of salinity positively affects growth, but it also reduces disproportions among the reared fish, brings about synchronous

metamorphosis in Pleuronectidae and significantly affects survival rate (SMITH et al. 1999, GAVLIK and SPECKED 2004, WANG et al. 2007, KEARNEY et al. 2008, APPELBAUM and JESUAROCKIRAJ 2009, DIMITROGLOU et al. 2010, IMSLAND et al. 2010). Similar relationships have been observed in molly rearing in this study. The growth rate of mollies kept in fresh water was the lowest, but it was the highest when the fish were kept in water whose salinity was between 20 and 26.7‰. However, the aggregated mortality at the latter value exceeded 95%, whereas no deaths were recorded when the salinity level was 20‰. All the fish died at the beginning of the experiment in water with the highest salinity level tested in the experiment (33.3‰). The issue of water salinity is also used in breeding of other aquarium fish, such as the sea horse (MURUGAN et al. 2009). There may be several reasons for the positive – as seen from the aquarist;s perspective – effect of salt dissolved in water on the results of rearing fish, including the molly. One of these effects may be the intensive activity of gills and kidneys, as was observed by LIN et al. (2004) in the spotted green pufferfish *Tetraodon nigrovirdis*. When kept in water with the proper salinity level, fish used less energy for ion exchange and could grow faster. FURTHERMORE and RILEY et al. (2002) reported that keeping Mozambique tilapia, *Oreochromis mossambicus*, in salt water significantly activates the growth hormone. Higher levels of secretion and higher activity of the growth hormone result in the higher growth rate of the fish.

The results of this experiment have indicated the need to rear mollies in water whose salinity is between 6.7 and 20.0‰. In these conditions, the highest growth rate is achieved with no deaths. Another possible solution to be applied in aquarium fish breeding, which requires salty water, is one proposed by APPELBAUM and JESUAROCKIRAJ (2009), in which salt was given to fish in their feed instead of in water. With properly selected doses of salt, an increase in growth and survival rate was achieved in juvenile stages of gilthead sea bream reared in slightly salty water.

Translated by JOANNA JENSEN

Accepted for print 4.10.2011

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