



- [GOAL Events](#)
- [Advocate Magazine](#)
- [Aquademia Podcast](#)
- [Blog](#)
- [Contact](#)

-
-
-
-
-

- [Log In](#)



- [About](#)
 - [Who We Are](#)
 - [Our History](#)
 - [Our Team](#)
 - [Sustainable Development Goals](#)
 - [Careers](#)
- [Membership](#)
 - [Overview](#)
 - [Our Members](#)
 - [Corporate Membership](#)
- [Resources](#)
- [Certification](#)
 - [Best Aquaculture Practices](#)
 - [Best Seafood Practices](#)

Search...



[Log In](#)

- [About](#)
 - [Who We Are](#)
 - [Our History](#)
 - [Our Team](#)
 - [Sustainable Development Goals](#)
 - [Careers](#)
- [Membership](#)
 - [Overview](#)
 - [Our Members](#)
 - [Corporate Membership](#)
- [Resources](#)
- [Certification](#)
 - [Best Aquaculture Practices](#)
 - [Best Seafood Practices](#)
- [GOAL Events](#)
- [Advocate Magazine](#)
- [Aquademia Podcast](#)
- [Blog](#)
- [Contact](#)



Health & Welfare
Health & Welfare

Influencing sex ratios in Nile tilapia



1 February 2003 Misikire Tessema Lemma, Ph.D. Andreas Müller-Belecke, Ph.D. Gabriele Hörstgen-Schwarz, Ph.D.



Interactions between genotype, temperature



Setup for artificial incubation of Nile tilapia eggs.

The importance of monosex (male) culture for profitable Nile tilapia aquaculture has long been recognized. Masculinizing with hormones is in many cases done to increase the percentage of males. A growing number of consumers is interested in environmentally-friendly production and do not accept products that were produced with the use of hormones or similarly active substances. Environmental factors can influence the sex determination of reptiles and fishes, and this knowledge could be useful to develop all-male Nile tilapia stocks without the use of hormones in the near future.



Setup for temperature treatment of first-feeding Nile tilapia fry.

Temperature and sex ratios

Initial indications on the influence of temperature on sex ratios in lizards go back to the mid-1960s. Numerous studies conducted since then have shown temperature-dependent sex determination in other reptiles like turtles and alligators, and later also in some fish species.

Different species models have been reported, where sex ratios are skewed to one sex at high or low temperatures, or where one sex results from intermediate and the other sex from lower and higher temperatures during egg incubation or fry rearing (Lemma, 2001).

Study setup

We recently conducted a study to test the effect of different fry rearing temperatures on the sex ratios of Nile tilapia (*Oreochromis niloticus*) from two different sources: Lake Manzala in Egypt and Lake Rudolph in Kenya. Male and female breeders from both sources were individually tagged and maintained in glass aquaria. Fish were manually stripped when the females showed signs of readiness for spawning (swollen and reddened urogenital papilla and territorial behavior). After artificial fertilization, eggs and hatching larvae were incubated at 28 degrees-C up to day 9 after fertilization.

Temperature treatments

At day 9 the individual offspring groups were separated into treatment and control groups. Controls were maintained at a constant 28 degrees-C. Temperature treatments were applied at 18 degrees-C for 20 days or at 36 degrees-C and 38 degrees-C for 10 days starting on day 10, and then survival rates in the treatment and corresponding control groups were recorded. Then all groups were separately reared at 28 degrees-C until individual fishes could be sexed by external examination. Differences in sex ratios between treatment and control groups were analyzed for significance by χ^2 -tests ($p < 0.05$).

Results

Table 1 shows data on the sex ratios observed within full sib groups of randomly selected male and female breeders from the two original sources, after different temperature treatments and in the corresponding control groups. Treatments with 18 degrees-C for 20 days typically did not result in sex ratios significantly different to controls. In contrast, in most cases the 36 degrees-C treatment for 10 days led to a significantly higher percentage of males when compared with the corresponding controls.

Table 1. Influence of temperature treatments on offspring sex ratios in Nile tilapia from different origins.

Origin: Lake Manzala											
Control (28° C)			18° C for 20 days			36° C for 10 days			38° C for 10 days		
N ₁ ⁽¹⁾	N ₂ ⁽²⁾	% M. ⁽³⁾	N ₁	N ₂	% M.	N ₁	N ₂	% M.	N ₁	N ₂	% M.
21	2,264	50.1	11	1,555	54.2	20	2,050	79.3	11	1,168	68.8

Origin: Lake Rudolph											
Control (28° C)			18° C for 20 days			36° C for 10 days			38° C for 10 days		
N ₁	N ₂	% M.	N ₁	N ₂	% M.	N ₁	N ₂	% M.	N ₁	N ₂	% M.
13	865	53.0	6	484	53.3	13	894	61.0	5	371	52.0

¹ Number of tested offspring groups resulting from different matings.
² Number of sexed individuals.
³ Percentage of males.

Increasing the treatment temperature to 38 degrees-C did not increase male percentages, when compared to the 36 degrees-C treatment. Because survival rates in controls and treatment groups were similar (controls at 28 degrees-C, 95 percent survival; at 18 degrees-C treatments: 91 percent survival; at 36 degrees-C treatments: 95 percent survival; at 38 degrees-C: 87 percent survival), differences in survival rates between sexes are probably not responsible for the observed differences between treatment and control groups.

Considerable differences in the sensibility of the sex determining mechanism to temperature treatments were observed between animals of different origin (Table 1). In the 36 degrees-C treatment, 17 of the 20 tested offspring groups with a Lake Manzala origin showed significantly more males than the corresponding control groups. The mean percentage of males after 36 degrees-C treatment was 79.3 percent (range 44 to 100 percent). For animals of Lake Rudolph origin, only three of the 13 tested groups showed a significantly increased percentage of males. The mean value of 61.0 percent (range 44 to 79 percent) was also lower.

Repeatability and individual influence

To examine the repeatability of the response of sex ratios to temperature treatment, spawns were repeated (Table 2). The percentages of males in the 36 degrees-C treated replicated spawns differed only by 1.7 to 3.7 percent.

Observations within groups of paternal half sibs showed the individual influence of breeders on the response of the sex ratio to the temperature treatment. Table 3 shows data from three different males each mated with three randomly selected females. Compared to their control groups, all groups treated at 36 degrees-C showed significantly higher percentages of male offspring, and the level of response to the treatment depended on the individual females. Differences in sex ratios of up to approximately 20 percent were observed within half sibs of single males.

Conclusion

Results of this study showed that simple temperature treatments can repeatedly increase the percentage of males in the offspring of Nile tilapia of different origins. The resulting sex ratios in offspring of populations of different origin and individual fish from the same origin after temperature treatments evidence the interactions between genotype and the sensitivity of the sex determination in Nile tilapia to temperature treatment.

The genetic component of the observed response of sex ratios to temperature treatments is promising for genetic improvement. Further experiments will evaluate selection programs to generate Nile tilapia strains that can efficiently and cost-effectively produce all-male stocks by temperature treatments.)

(Editor's Note: This article was originally published in the February 2003 print edition of the Global Aquaculture Advocate.)

Now that you've finished reading the article ...

... we hope you'll consider supporting our mission to document the evolution of the global aquaculture industry and share our vast network of contributors' expansive knowledge every week.

By becoming a Global Seafood Alliance member, you're ensuring that all of the pre-competitive work we do through member benefits, resources and events can continue. Individual membership costs just \$50 a year.

Not a GSA member? Join us.

[Support GSA and Become a Member](#)

Authors

-  Misikire Tessema Lemma, Ph.D.

Misikire Tessema Lemma, Ph.D.


Institute of Animal Husbandry and Genetics
University of Göttingen
Albrecht-Thaer-Weg 3
D-37075 Göttingen, Germany

-  Andreas Müller-Belecke, Ph.D.

Andreas Müller-Belecke, Ph.D.

Institute of Animal Husbandry and Genetics
University of Göttingen
Albrecht-Thaer-Weg 3
D-37075 Göttingen, Germany





[101,100,46,103,100,119,103,64,53,101,108,108,101,117,109,97]

-  Gabriele Hörstgen-Schwark, Ph.D.

Gabriele Hörstgen-Schwark, Ph.D.

Institute of Animal Husbandry and Genetics
University of Göttingen
Albrecht-Thaer-Weg 3
D-37075 Göttingen, Germany

Share

-  [Share via Email](#)
-  [Share on Twitter](#)
-  [Share on Facebook](#)
-  [Share on LinkedIn](#)

Tagged With

[Nile tilapia](#) [Andreas Müller-Belecke](#) [Gabriele Hörstgen-Schwark](#) [Misikire Tessema Lemma](#)

Related Posts

[Responsibility](#)

[‘Model’ tilapia venture shows mettle in Mozambique](#)

On the shores of Lake Cahora Bassa, Chicoa Fish Farm hopes to create a ripple effect to improve fish supply and quality of life for an impoverished region.

[Health & Welfare](#)

[GESIT tilapia: Indonesia's genetic supermales](#)

Tilapia quickly reach sexual maturity in culture, and unless controlled, the fish reproduce and offspring compete for food. All-male culture of tilapia is preferred because of their fast growth and larger average size.

Health & Welfare

[Tilapia show immunization response against Ich](#)

In research on alternatives to formalin treatment to control Ich infestation, the authors performed a study that compared the immune responses of Nile tilapia and red tilapia against the parasite.

Health & Welfare

[Sizing up TiLV and its potential impact on tilapia production](#)

An international research effort has commenced to find a solution for Tilapia Lake Virus (TiLV), a contagion causing high rates of mortality in farmed and wild tilapia stocks in Israel, Colombia, Ecuador, Egypt and Thailand.

About The Advocate

The Responsible Seafood Advocate supports the Global Seafood Alliance's (GSA) mission to advance responsible seafood practices through education, advocacy and third-party assurances.

[Learn More](#)

Search Responsible Seafood Advocate



Advertising Opportunities

[2022 Media & Events Kit](#)

Categories

[Aquafeeds](#) > [Health & Welfare](#) > [From Our Sponsors](#) > [Innovation & Investment](#) > [Intelligence](#) > [Responsibility](#) > [Fisheries](#) > [Artículos en Español](#) >

Don't Miss an Article

Featured

- [Health & Welfare](#) [An update on vibriosis, the major bacterial disease shrimp farmers face](#)
- [Intelligence](#) [A seat at the table: Fed By Blue team says aquaculture needs a stronger voice](#)
- [Responsibility](#) [Quantifying habitat provisioning at macroalgae cultivation locations](#)

Popular Tags

All Tags ▾

Recent

- [Fisheries](#) [Second Test: Another filler for the fisheries category](#)
- [Fisheries](#) [Test: This is filler for the fisheries Category](#)
- [Aquafeeds](#) [Test Article](#)
- [Responsibility](#) [Study: Climate change will shuffle marine ecosystems in unexpected ways as ocean temperature warms](#)
- [Health & Welfare](#) [Indian shrimp researchers earn a patent for WSSV diagnostic tool](#)



- [About](#)
- [Membership](#)
- [Resources](#)
- [Best Aquaculture Practices \(BAP\)](#)
- [Best Seafood Practices \(BSP\)](#)
- [GOAL Events](#)
- [Advocate Magazine](#)
- [Aquademia Podcast](#)
- [Blog](#)
- [Contact](#)

Stay up to date with GSA

-
-
-
-
-

[Privacy](#)
[Terms of Use](#)
[Glossary](#)