MORPHOLOGICAL AND BEHAVIORAL RESPONSES OF FEMALE RED TILAPIA (*Oreochromis* sp.) EXPOSED TO DIFFERENT SALINITY CONCENTRATIONS

By

PRINCESS JOY PASCUA SANTACERA

An Undergraduate Thesis Manuscript presented to the faculty of the College of Fisheries in partial fulfillment of the requirement for the degree of

BACHELOR OF SCIENCE IN FISHERIES

COLLEGE OF FISHERIES
CENTRAL LUZON STATE UNIVERSITY
Science City of Muñoz, Nueva Ecija

2018

CF Thesis Form No. 8

COLLEGE OF FISHERIES
CENTRAL LUZON STATE UNIVERSITY
Science City of Muñoz, Nueva Ecija

MORPHOLOGICAL AND BEHAVIORAL RESPONSES OF FEMALE RED TILAPIA (*Oreochromis* sp.) EXPOSED TO DIFFERENT SALINITY CONCENTRATIONS

by

PRINCESS JOY P. SANTACERA

Undergraduate Thesis presented to the Faculty of the College of Fisheries in partial fulfillment of the requirements for the degree of

BACHELOR OF SCIENCE IN FISHERIES

APPROVED:

EMMANUEL M. VERA CRUZ — Feb. 28, 2018
Adviser — Date

JOSE S. ABUCAY — March 1, 2018
Critic — Date

NOTED:

KARL MARX A. QUIAZON — March 7, 2018
Department Chair — Date

RECORDED:

REMEDIOS B. BOLIVAR
College Research Coordinator
March 7, 2018
Date

ACCEPTED:

RAVELINA R. VELASCO
Acting Dean
March 7, 2018
Date

BIOGRAPHICAL DATA

Personal Data

Name	Princess Joy P. Santacera
Birthday	September 9, 1993
Birth Place	Bongabon, Nueva Ecija
Address	Bongabon, Nueva Ecija
Parents	Arsenio B. Santacera and Elva P. Santacera

Educational Attainment

Elementary	LPI Agape Christian Academy Inc. Lusok, Bongabon, Nueva Ecija
Secondary	LPI Agape Christian Academy Inc. Lusok, Bongabon, Nueva Ecija
Tertiary	Central Luzon State University Science City of Muñoz, Nueva Ecija

ACKNOWLEDGEMENTS

The author would like to extend her deepest gratitude to the following persons behind the success and accomplishment of this paper:

First, to God Almighty for giving the author enough knowledge, wisdom, strength, guidance, blessing and love that she needed to accomplish this paper.

To her parents, Mr. Arsenio B. Santacera and Mrs. Elva P. Santacera "Ma, Pa, maraming salamat po sa lahat. I love you both". To her beloved brothers; Jo Ariel, Michael John and Jayvee for the moral support, love and guidance they give to the author.

To Dr. Emmanuel M. Vera Cruz, her adviser; Dr. Jose S. Abucay, her critic and Dr. Remedios B. Bolivar, the College Research Coordinator for the support, guidance, technical knowledge and criticisms they shared for the improvement and fulfillment of this paper. Also, the author would like to thank her other professors, mostly; to Dr. Lorenz Fajardo who acts as an OIC, College Research Coordinator, Prof. Rodora M. Bartolome for talking what fisheries course is all about, Prof. Janet O. Saturno and Mam Rea Mae C. Templonuevo who lectured about fish processing, Prof. Samantha Claire Juanico, Dr. Karl Marx M. Quiazon, Dr. Apolinario V. Yambot and Dr. Alvin T. Reyes who gave knowledge in some fisheries subjects and also guidance to the author.

The author would also like to thank Mam Juliet Holasca, Sir Zaldy Bartolome, Sir Eddie Boy Jimenez and to all the faculty and staff of FAC-CF for their help in various ways in the conduct of this thesis.

The author would like to give her deepest thanks to the President of CLSU, Dr. Tereso A. Abella, through him the author pursued and finished the course and for giving encouragement and inspirations during the time the author wants to give up.

To Mr. Patrocinio Panahon and Mrs. Cecille Panahon and to all the residents in the Panahon's Residence especially Victor, James, Marjorie, Jomari, Blossome, Paolo, Lea, Laiza, Roseanne, Jeric, Gross, Lambert, Michael Calapardo, Michael Apan, Clifford, Kenneth, Hannah, Nicole, Divine, Sarah, Ate Maricel and Dean for the friendship and support they have given to the author to finish this paper while staying at CLSU. "Salamat sa inyo, Guys!"

The author would like to extend her gratitude to the author fellow classmates for the support, most especially to Mark Joseph, Lea, Jenica, Joymee, Cherina, Aileen, Queenie, Lara and Tessa to finish this paper. "Finally, eto na!"

To her friends, cousins and to her brothers and sisters of Omega Rho Omicron "Epsilon Chapter" and the Ichthyological Society for the support and encouragement to finish this paper.

PRINCESS JOY PASCUA SANTACERA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDIX TABLES

LIST OF APPENDIX FIGURES

MORPHOLOGICAL AND BEHAVIORAL RESPONSE OF FEMALE RED TILAPIA (*Oreochromis* sp.) EXPOSED TO DIFFERENT SALINITY CONCENTRATION[1/]

ABSTRACT

The study evaluated the morphological and behavioral response of female red tilapia (*Oreochromis* sp.) exposed to different salinity concentrations. The objective of the study was to determine if ECP and VR can be an effective stress indicators in juvenile stage of female red tilapia exposed to different salinity concentrations. Also the salinity tolerance of female red tilapia was assessed. Juvenile female red tilapia of size 12 were used in the study. The salinity concentration was gradually raised every hour (within 8 hours) until they reached their respective levels and monitored 24 hours. The salinity concentrations used were 0 (Control), 5 ppt, 10 ppt, 15 ppt, 20 ppt and 25 ppt.

Mean ECP at 5 ppt (2.28±0.61) and 10 ppt (2.01±0.24) were comparable but both were significantly higher compared to those in the other treatments. The mean ECP at 0 ppt (1.95±0.30) and 20 ppt (1.95±0.12) were also comparable but both were significantly higher than those at 25 ppt (1.90±0.06) and 15 ppt (1.55±0.16). The latter two means were not significantly different from each other. There exist an insignificant weak negative relationship between mean ECP and salinity concentration (r= -0.388; n=6; P<0.05). Mean VR at 10 ppt (1.47±0.05) and 0 ppt (1.46±0.05) were comparable but both were significantly higher compared to those in the other treatments. The mean VR at 5 ppt (1.42±0.57) and 15 ppt (1.42±0.05) were also comparable but both were significantly higher than those at 25 ppt (1.37±0.03) and 20 ppt (1.37±0.06). The latter two means were not significantly different from each other. There exist is significant weak negative relationship between the mean VR and salinity concentration (r= -0.815; n=6; P<0.05).The mortality recorded were from 20 and 25 ppt salinity level concentrations. In the first eight hours, 25 ppt treatment had recorded one fish died on the seventh hour in replicate 3 and another one died on the eighth hour in replicate 4. While on the twenty-fourth (24th) hours, two fish died on replicates 3 and 4 on the 20 ppt treatment and another two fish died on replicates 1 and 2 of the 25 ppt treatment. Another one has been recorded on the thirty-sixth (36th) hour - in replicate 5 of 25 ppt treatment. And the last recorded was on the forty-eighth (48th) hour- in replicate 1 of the 20 ppt treatment. Results of the study indicate that ECP and VR are not reliable tools for the assessment of stress in red tilapia exposed to different salinity levels because of varying results. However, gradual increase of salinity concentration up to 15 ppt can be tolerated by the fish.

1/ Undergraduate thesis presented to the faculty members of the College of Fisheries, Central Luzon State University as partial fulfillment of the requirements for the degree of Bachelor of Science in Fisheries. Prepared at the Department of Aquaculture under the supervision Dr. Emmanuel M. Vera Cruz

LITERATURED CITED

Baroiller, J.F. and A. Toguyeni. 1997. The tilapiini tribe: environmental and social aspects of reproduction and growth. Fisheries and Aquaculture, 3: 1-10.

Barreto, R.E. and G.L. Volpato. 2004. Caution for using ventilator frequency as an indicator of stress in fish. Behav. Process., 66: 43–51.

Barreto, R.E., G.L. Volpato, C.D. Faturi, P.C. Giaquinto, E.G. de Freitas and M.F. de Castilho. 2009. Aggressive behaviour traits predict physiological stress responses in Nile tilapia (*Oreochromis niloticus*). Mar. Freshwater Behav. Physiol., 42: 109–118.

Barreto, R.E. and G.L. Volpato. 2011. Ventilation rates indicate stress-coping styles in Nile tilapia. Journal of Bioscience, 35: 1-5.

Barton, B.A. 2002. Stress in fishes: a diversity of responses with particular reference to changes in circulating corticosteroids. Integrated and Comparative Biology, 42: 517-525.

Behrends L.L., R.G. Nelson, R.O. Smitherman and N.M. Stone. 1982. Breeding and culture of the red-gold color phase of tilapia. Journal of the World Mariculture Society, 13: 210-220.

Benigno, M. 2016. Morphological and physiological responses of FaSt and GET-ExCEL strains of Nile tilapia *(Oreochromis niloticus L.)* exposed to different salinity concentrations. Undergraduate Thesis. College of Fisheries, Central Luzon State University. Science City of Muñoz, Nueva Ecija. 48 p.

Chervinski, J.,1982. Environmental physiology of tilapias. p. 119-128. *In*: Pullin, R.SV., R.H LoweMcConnell (Editors). The Biology and Culture of Tilapias. ICLARM Conference Proceedings No. 7. International Centre for Living Aquatic Resources Management. Manila, Phillipines. 432p.

El-Sayed, A.M. 2006. Tilapia culture in salt water: environmental requirements, nutritional implications and economic potentials. p. 95-106. *In*: L. Elizabeth Cruz Suarez, D. Ricque Marie, M.T. Salazar, M.G. Nieto Lopez, D.A. Villareal Covazos, A.C. Puello Cruz y Armando Garcia Ortega (eds). Advances on Aquaculture Nutrition. Proceedings of the VIII Simposium Internacional de Nutricion Aquicola, Universidad Autonoma de Nuevo Leon Monterrey, Nuevo Leon, Mexico. 483p.

El-zaeem, S.Y. 2010 Production of salinity tolerant Nile tilapia, *Oreochromis niloticus* through traditional and modern breeding methods: II. application of genetically

modified breeding by introducing foreign DNA into fish gonads. African Journal of Biotechnology, 4: 684-695.

Fineman-Kalio, A.S. 1988. Preliminary observation on the effect of salinity on the reproduction and growth of freshwater Nile tilapia, *Oreochromis niloticus* (L.), cultured in brackishwater ponds. Aquaculture and Fisheries Management, 19: 313-320.

Fitzgerald, W.J. 1979. The red orange tilapia: a hybrid that could become a world favourite. Fish Farming International, 6(1): 26-27.

Foo, J.T.W. and T.J. Lam. 1993. Serum cortisol response to handling stress and the effect of cortisol implantation on testosterone level in tilapia, *Oreochromis mossambicus*. Aquaculture, 115: 145-158.

Freitas, R.H.A., C.A. Negraob, A.C. Feliciob and G.L. Volpato. 2014. Eye darkening as a reliable, easy and inexpensive indicator of stress in fish. Journal of Zoology, 117(3): 179-184.

Galman, O.R. and R.R. Avtalion. 1983. A preliminary investigation of the characteritics of red tilapias from the Philippines and Taiwan. p. 291-301. *In*: L. Fishelson and Z. Yaron (compilers). Proceedings of the International Symposium on Tilapia in Aquaculture, Nazareth, Israel, 8 - 13 May 1983. Tel Aviv University, Tel Aviv, Israel. 624 p.

Güner, Y., O. Özden, H. Çagirgan, M. Altunok and V. Kizak. 2005. Effects of salinity on the osmoregulatory functions of the gills in Nile tilapia (*Oreochromis niloticus*). Turk. J. Vet. Anim. Sci., 29: 1259-1266.

Hamzah, A., N.H. Nguyen, R.W. Ponzoni, B.N. Kamaruzzaman and B. Subha. 2008. Performance and survival of three red tilapia strains (*Oreochromis* spp.) in pond environment in Keddah State, Malaysia. p, 199-211. *In*: Elgobashy, H., K. Fitzsimmons and A.S. Diab (editors). From the Pharaohs to the Future. 8th International Symposium on Tilapia in Aquaculture. Cairo, Egypt. 1447 p.

Hassan, M., M.I. Zakariah, W. Wahab, S.D. Muhammad, N. Idris and S. Jasmani. 2013. Histopathological and behavioral changes in *Oreochromis* sp. after exposure to different salinities. Journal in Fisheries Livestock Production, 1: 2- 4.

Kamal, A.Md.M. and G.C. Mair. 2005. Salinity tolerance in superior genotypes of tilapia, *Oreochromis niloticus*, *Oreochromis mossambicus* and their hybrids. Aquaculture, 247: 189-201.

Karsi, A. and H.Y. Yildiz. 2004. Secondary stress response of Nile tilapia after direct transfer to salinity. Tarim Bilimler Dergisi, 11(2): 139-141.

Kirk, R.G. 1972. A review of the recent development in tilapia culture with special reference to fish farming in the heated effluents of power stations. Aquaculture, 1: 45-60.

Lawagan, D. 2016. Behavioral and physical responses of two ages of Nile tilapia (*Oreochromis niloticus* L.) exposed to different salinity levels. Undergraduate Thesis. College of Fisheries, Central Luzon State University. Science City of Muñoz, Nueva Ecija. 45 p.

Likongwe, J.S., T.D. Stecko, J.R. Stauffer, Jr. and R.F. Carline. 1996. Combined effects of water temperature and salinity on growth and feed utilization of juvenile Nile tilapia *(Oreochromis niloticus)*. Aquaculture, 146: 37-46.

Miller, C.A., A.J. Fivizzani and A.H. Meier. 1983. Water temperature influences salinity selection in the Gulf Killitish, Fundulus Grandisa. Can. J. Zool., 61: 1265- 1269.

Miyai, C.A, F.H.C., Sanches, T.M., Costa, K.D., Colpo, G.L. Volpato,and R.E. Barreto. 2011. The correlation between subordinate fish eye colour and received attacks: a negative social feedback mechanism for the reduction of aggression during the formation of dominance hierarchies. Zoology, 114: 335-339.

Øverli, O., W.J. Korzan, E. Hoglund, S. Winberg, H. Bollig, M. Watt, G.L. Forster, B.A. Barton, E. Øverli, K.J. Renner and C.H. Summers. 2004. Stress coping style predicts aggression and social dominance in rainbow trout. Hormones and Behavior, 45: 235-241.

Perschbacher, P.W. and R.B. McGeachin. 1988. Salinity tolerance of red hybrid tilapi fry, juvenile and adults. p. 415-420. *In*: Pullin, R.S.V., Bhukaswan, T., Tonguthai, K. and Maclean, J.L. (eds). Proceedings of the Second International Symposium on Tilapia in Aquaculture. ICLARM Conference Proceedings No. 15. Department of Fisheries, Thailand and ICLARM, Manila, Philippines. 623p.

Philippart, J-CL. and J-CL. Ruwet. 1982. Ecology and distribution of tilapias. p. 15-59. *In*: Pullin, R.S.V. and R.H. Lowe-McConnell (Editors). The Biology and Culture of Tilapias. ICLARM Conference Proceedings No. 7. ICLARM, Manila, Philippines. 113 p.

Romana-Eguia, M.R. and R.V. Eguia. 1999. Growth of five Asian red tilapia strains in saline environments. Aquaculture, 173: 161-170.

Stauffer, J.R., Jr. 1986. Effects of salinity on preferred and lethal temperatures of the Mozambique tilapia, *Oreochromis mossambicus* (Peters). Water Resour. Bull., 22(2): 205-208.

Stauffer, J.R., Jr., D.K. Van and C.H. Hocutt. 1984. Effects of salinity on preferred and lethal temperatures of the blackchin tilapia, *Sarotherodon melanotheron*. Water Resour. Bull., 20(5): 771-775.

Suresh, A.V. and C.K. Lin. 1992. Tilapia culture in saline waters: a review. Aquaculture, 106: 201-226.

Suter, H.C. and F.A. Huntingford. 2002. Eye color in juvenile Atlantic salmon: effects of social status, aggression and foraging success. Journal of Fish Biology, 61: 606-614.

Vera Cruz E.M. and C.L., Brown . 2007. The influence of social status on the rate of growth, eye color pattern and Insulin-like Growth Factor-I gene expression in Nile tilapia, *Orechromis niloticus*. Horm.Behav., 51: 611-619.

Vera Cruz, E.M. and M.P. Tauli. 2015. Eye color pattern during isolation indicates stress-coping style in Nile tilapia *Oreochromis niloticus* L. International Journal of Scientific Research in Knowledge, 3(7): 181-186.

Volpato, G.L., A.C. Luchiari, C.R.A. Duarte, R.A. Barreto and G.C. Ramanzini. 2003. Eye color as an indicator of social rank in the fish Nile tilapia. Brazilian Journal of Medical and Biological Research, 36: 1659-1663.

Watanabe W.O. and C.M. Kuo. 1985. Observation on reproductive performance of Nile tilapia (*Oreochromis niloticus*) in laboratory aquaria at various salinities. Aquaculture, 49: 315-323.

Watanabe, W.O., C.M. Kuo and M.C. Huang. 1985. The ontogeny of salinity tolerance of the tilapias *Oreochromis niloticus, O. aureus* and an *O. mossambicus* x *O. niloticus* hybrid, spawned and reared in freshwater. Aquaculture, 47: 353-367.

Watanabe W.O., K.E. French, B.L. Olla, D.H. Ernst and R.I. Wicklund. 1989. Salinity during early development influences survival and growth of Florida red tilapia in brackish and seawater. Journal of the World Aquaculture, 20: 134-142.

Watanabe, W.O., J.H. Clark, J.B. Dunham, R.I. Wicklund and B.L. Olla. 1990. Culture of Florida red tilapia in marine cages: effect of stocking density and dietary protein on growth. Aquaculture, 90: 123-134.

Watanabe, W.O., D.H. Ernst., M.P Chasar, R.I. Wicklund and B.L. Olla. 1993. The effects of temperature and salinity on growth and feed utilization of juvenile, sex reversed male Florida red tilapia cultured in a recirculating system. Aquaculture, 112: 309-320.

http://en.wikipedia.org

http://www.thefreedictionary.com