IMPROVING GROWTH PERFORMANCE OF FINGERLINGS OF *Clarias anguillaris* THROUGH INTRASPECIFIC HYBRIDIZATION

M. YISA[1], S.O. OLUFEAGBA[3], M. IWALEWA[2], S.S. GABRIEL, O.M.OLOWOSEGUN, M.I. GONI[1], D.C.NWANGWU[1]

[1]National Institute for Freshwater Fisheries Research (NIFFR), P.M.B. 6006, New Bussa, Niger State, Nigeria.

[2]Nigerian Institute for Oceanography and Marine Research, 3 Wilmot Point Road, Off Ahmadu Bello way, Victoria Island, Lagos, Nigeria

[3]Federal University of Agriculture, Makurdi, Benue State, Nigeria

Correponding author Email : mosrence@yahoo.com

ABSTRACT

The development of aquaculture in Africa has been very slow due to lack of feeds and high quality seed (fingerlings). Hybridization is employed to combine desirable characteristics from one species to another to improve the genetic quality of parental stock with respect to fast growth, high percentage survival, resistance against unfavourable environment and diseases. This study was conducted to evaluate the growth performance of three strains of local *Clarias anguillaris* obtained from Onitsha (Rain forest), Makurdi (Guinea Savanna) and Maiduguri (Sahel Sananna) in Nigeria through intraspecific hybridization. The three strains were hybridized and the percentage survival, weight and length parameters were determined. The percentage survival was significantly higher in parental and intraspecific mating combinations. The mean values of initial and final weight at indoor rearing showed no significant differences ($P>0.05$) between the parental and intraspecific mating combinations. However, the mean values of final weight at the outdoor rearing showed significant differences ($P<0.05$) between the parental and intraspecific mating combinations. The initial length revealed significant differences ($P<0.05$), while the final length are not. The Maiduguri parental strain recorded highest length gain of 8.97cm and Onitsha strain hybridized with Maiduguri strain recorded 7.93cm. However, Onitsha strain hybridized with Maiduguri strain showed superiority in growth performance in both indoor (16.05 g) and outdoor (1127.43 g) experiment. This could be further propagated to mass produce fingerlings for farmers.

Keywords: Hybridization, *Clarias anguillaris,* growth performance, fingerlings

RESUME

AMELIORATION DE LA PERFORMANCE DE CROISSANCE D'ALEVINS DE Clarias anguillaris PAR HYBRIDATION INTRASPECIFIQUE

Le développement de l'aquaculture en Afrique a été très lent à cause du manque d'aliments et de semences de bonne qualité (alevins). L'hybridation a été utilisée pour combiner les caractéristiques souhaitables d'une espèce à l'autre afin d'améliorer la qualité génétique du stock parental par rapport à la croissance rapide, à un pourcentage élevé de survie, à la résistance contre un environnement défavorable et les maladies. Cette étude a été menée pour évaluer la performance de croissance de trois souches locales de Clarias anguillaris *obtenues à partir d'Onitsha (forêt tropicale), Makurdi (Savane Guinéenne) et Maiduguri (Sahel) au Nigeria par hybridation intraspécifique. Après l'hybridation des trois souches, le pourcentage de survie, le poids et la longueur ont été déterminés. Le pourcentage de survie était significativement plus élevé dans les combinaisons parentales et intraspécifiques. Les valeurs moyennes de poids initial et final en élevage couvert ne révèlent aucune différence significative ($P> 0,05$) entre les combinaisons parentales et intra spécifiques. Cependant, les valeurs moyennes de poids final à l'élevage en plein air ont montré des différences significatives ($P <0,05$) entre les combinaisons parentales et intra spécifiques. La longueur initiale a révélé des différences significatives ($P <0,05$), tandis que la longueur finale ne l'est pas. La souche*

parentale de Maiduguri a enregistré le gain en longueur le plus élevé (8,97cm) et la souche Onitsha hybridée avec la souche Maiduguri a enregistré un gain en longueur de7,93cm. Cependant, la souche Onitsha hybridée avec la souche Maiduguri a montré la meilleure performance de croissance à la fois en élevage couverte (16,05 g) qu'ouverte (1127,43 g). Ces travaux devraient être poursuivis en vue de la production en masse des alevins pour les pisciculteurs.

Mots-clés : *Hybridation,* Clarias anguillaris*, performance de croissance, alevins*

INTRODUCTION

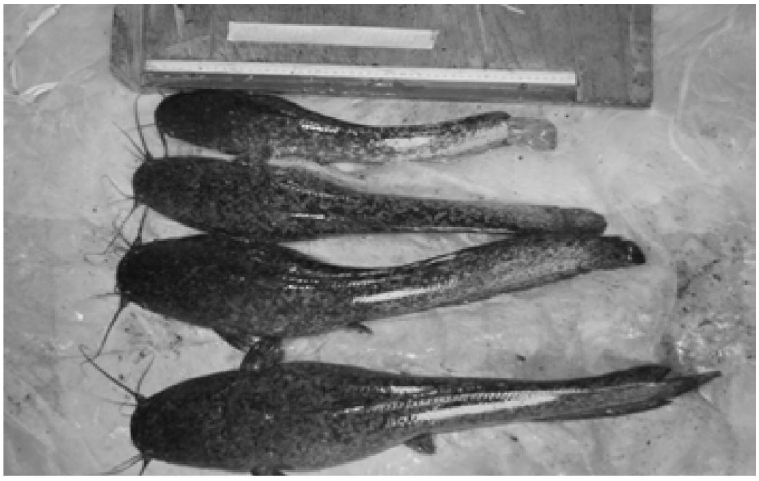
Hybridization is a method employed to combine desirable characteristics from two different species or populations with a view to improving the genetic quality of the offsprings or hybrid as compared with those of parental stock. Hybridization has been utilized in breeding programmes aimed at identifying mating combinations between different populations of fish which produce superior offsprings for grow-out that will exhibit hybrid vigour (Tave, 1993). Fish hybridisation is one of the major breeding strategies that have been used to improve production characteristics in aquatic organisms (Wholfarth, 1993; Bakos and Gorda, 1995; Wangila and Dick, 1996). Improving growth rate will decrease the time it takes to grow a fish to marketable size which is advantageous for fish farmers. This will increase production efficiency, fish production and farmer's income. Pan and Zheng (1986) mentioned that intraspecific hybridization of fish has been considered to combine valuable traits from two or more species to obtain hybrids that exceed both parents' species. Fast growing species obtained from these crosses are often cherished by many farmers. Intraspecific hybrids are obtained when parents from different ecological zones are crossed.

The species of the two genus of Clariidae namely *Clarias* and *Heterobranchus* are very popular with aquaculturists and consumers in Africa and hence have very good commercial value. They are cultured primarily in freshwater ponds in tropical countries where they are widely found (Venden Bossiche and Bernacsek, 1990). Aquaculture production of African catfishes *Clarias gariepinus* and *Heterobranchus longifilis* has been practiced for a long time in Africa. Increased productivity of fry and fingerlings with attributes of faster growth rates and better environmental tolerance is *sine qua non* to ensuring fish food security in Africa.

The scarcity of genetically improved fish seed is one of the major constraints to the rapid development of aquaculture industry and stock management in Nigeria. A good supply of high quality fingerling is essential for successful aquaculture production. Many hatcheries in Nigeria use male and female broodstock developed from the same parents that have been used several times over for many years. Thus, broodstock in most hatcheries do not benefit from intraspecific exchange of genes thereby leading to reduction in overall productivity of fingerlings (Aluko and Shaba 1999). The deteriorating performance of domesticated *Clarias* sp. with the attendant decline in growth, sperm quality, and disease resistance as well as body deformities has been of great concern to fish farmers**.** The hybridization of specimens from different water bodies is expected to combine traits from both parents to address these problems, thus facilitating greater production of fast-growing, high resistant fish fingerlings and increasing farmers output. This study was therefore designed to identify the F_1 of local collections of *Clarias anguillaris* with the best growth rate and survival.

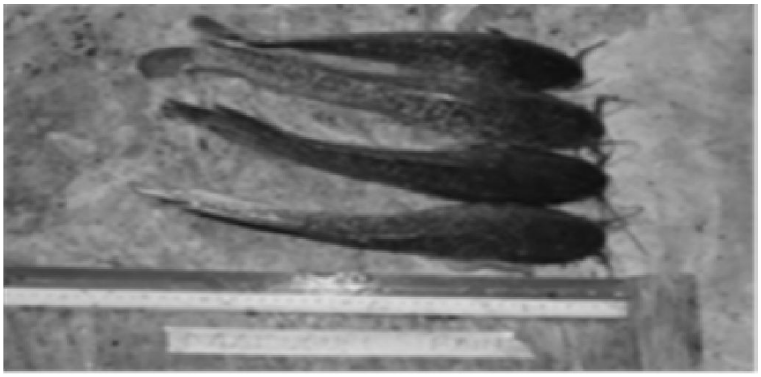
MATERIALS AND METHODS

The study was carried out at the National Institute for Freshwater Fisheries Research (NIFFR), New Bussa, Niger State, Nigeria. Bloodstocks of *Clarias anguillaris* were sourced locally from Makurdi, Maiduguri and Onitsha (Plate 1).



a. Makurdi strain

b. Onitsha strain



c. Maiduguri strain

Plate 1 : Broodstock of *Clarias anguillaris.*

Shift to the right

The mature females were selected based on their swollen, reddish vent, well distended soft abdomen and extraction of few eggs on gentle running of finger on the abdomen. Ripe males were also selected based on their reddish urino-genital papilla. The male and females of each combination were weighed and females were injected with synthetic ovaprim hormone. The ovaprimwas administered intra-muscularly at the rate of 0.5ml per kilogram of fish.

The milt was collected by sacrificing the male. The females were striped of eggs following a gentle pressing of finger on the abdomen after 12 hours latency period. The eggs were collected into a dry labelled Petri-dish and kept with labels. The testes were cut opened using razor blade and the milt was released. The milt was used to fertilize the eggs.

Different intra-specific Clarias anguillaris mating combinations were generated as shown below:-

Parental crosses

♀*C. anguillaris* MD X ♂*C. anguillaris* MD

♀*C. anguillaris* MK X ♂ *C.anguillaris* MK

♀*C. anguillaris* OO X ♂ *C. anguillaris* OO

Intraspecific crosses

♀ *C. anguillaris* MD X ♂ *C. anguillaris* MK

♀ *C. anguillaris* MD X ♂ *C. anguillaris* OO

♀ *C. anguillaris* MK X ♂ *C. anguillaris* MD

♀ *C. anguillaris* MK X ♂ *C. anguillaris* OO

♀ *C. anguillaris* OO X ♂ *C. anguillaris* MD

♀ *C. anguillaris*OO X ♂ *C. anguillaris* MK

Key

MD = Maiduguri strain of *Clarias anguillaris*

MK = Makurdi strain of *Clarias anguillaris*

OO = Onitsha strain of *Clarias anguillaris*

Incubation of fertilized eggs was done in well aerated aquarium tanks and clean kakabans (egg collector) were placed in each aquarium for eggs to attach. The fertilized eggs were spread on the kakaban in the aquaria for hatching.

At the fourth day of hatching, the experiment was set indoor and each treatment for both the parental and the intraspecific crosses were triplicated with 200 hatchlings placed in a well aerated aquarium tank measuring 60 x 30 x 30cm^3.The initial pooled weight and lengths were taken. The Zooplankton was harvested from the natural fish food production tanks of NIFFR, New Bussa. Zooplanktons and 0.2mm Coppens feed were fed to the hatchlings for a period of 21 days indoor. The percentage survival of fry in each aquarium per treatment, pooled weight and pooled length were taken weekly. The percentage survival was calculated as follows:

% Survival = (Total number of fry survived / Total number of fry stocked) X 100

The nine crosses were duplicated and stock in 2x2x1m^3 outdoor concrete tanks at 220 fry per tank. The fry were fed with Coppens feed of 0.2mm – 0.3mm, 0.3mm – 0.5mm and 2mm. Feed was supplied at 5% body weight, divided and given twice daily (morning and evening). Biweekly sampling for pool weight, length and survival was carried out for fifty eight days.

The data obtained from the study were subjected to one-way analysis of variance (ANOVA) in SPSS version 15.0 for windows and where significant differences were observed means were separated using Duncan multiple range test at 5% level of significance.

RESULTS

Figure 1 showed a comparison of the weight parameters, initial weight, final weight and weight gain of all the mating combinations for a period of 21 days indoor. The mean values showed no significant differences (P>0.05) between the mating combinations both at the initial and final weight. The intraspecific mating combination, Onitsha strain hybridized with Maiduguri strain and the reciprocal recorded highest weight gain of 16.05 and 15.69 respectively. Figure 2 showed that the initial length revealed significant differences (P<0.05), while the final length are not, but Maiduguri strain hybridized with Onitsha strain and the reciprocal recorded highest length gain of 1.7 and 1.63 respectively. Figure 3 revealed the lowest indoor percentage survival

of the MDxMK and OOxMK mating combinations.

Figure 4 showed a comparison of the weight parameters, initial weight, final weight and weight gain of all the mating combinations for a period of 58 days outdoor. The mean values showed significant differences (P<0.05) between the mating combinations both at the final weight. The intraspecific mating combination, Onitsha strain hybridized with Maiduguri strain still recorded highest weight gain of 1127.43g outdoor. Figure 5 also showed that the initial length revealed significant differences (P<0.05), while the final length are not, but Maiduguri parental strain recorded highest length gain of 8.97cm and Onitsha strain hybridized with Maiduguri strain recorded 7.93cm. Figure 6 revealed the outdoor percentage survival of the generic mating combinations.

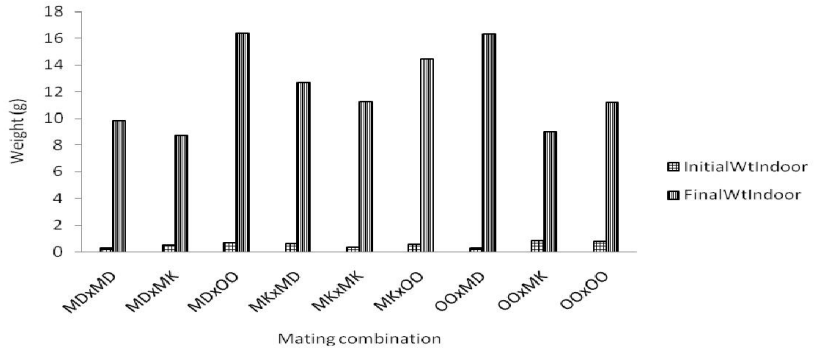


Figure 1: Growth performance of the fry of the various mating combinations reared indoor for 21 days

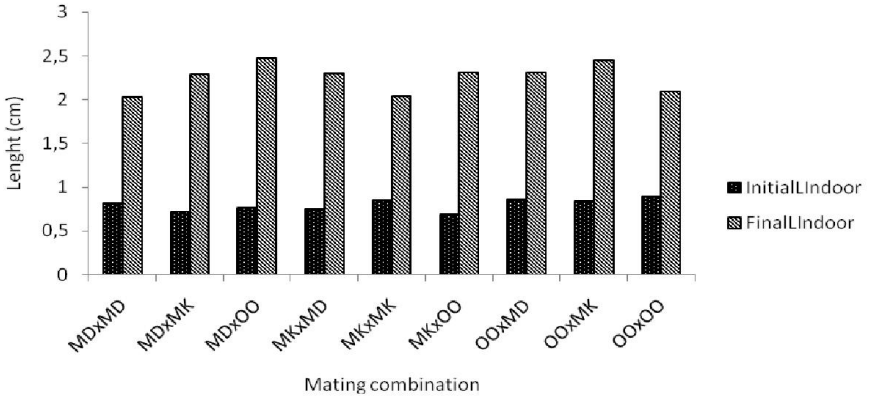


Figure 2 : Length parameters of the nine mating combinations of *Clarias anguillaris* reared in indoor aquaria tanks for 21 days

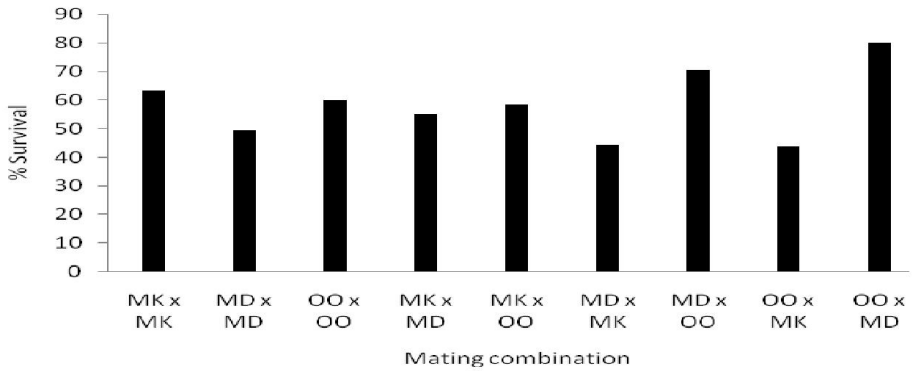


Figure 3 : Percentage survival of the mating combinations indoor

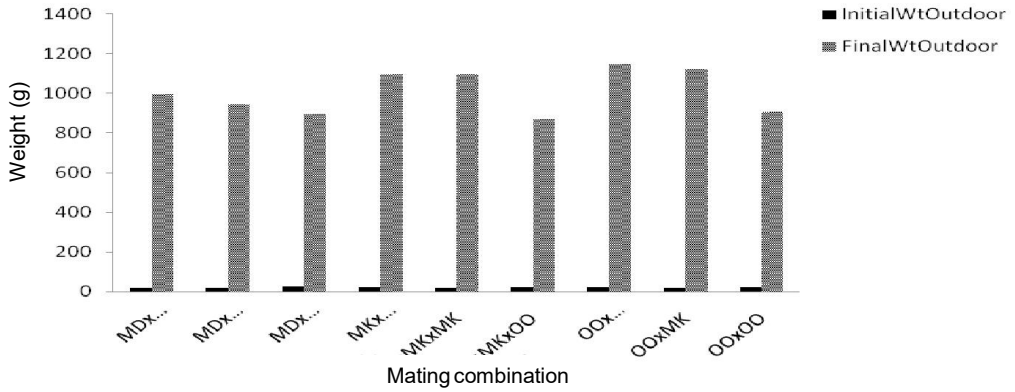


Figure 4 : Growth performance of the fingerlings of the various mating combinations reared for 58 days in outdoor concrete tanks

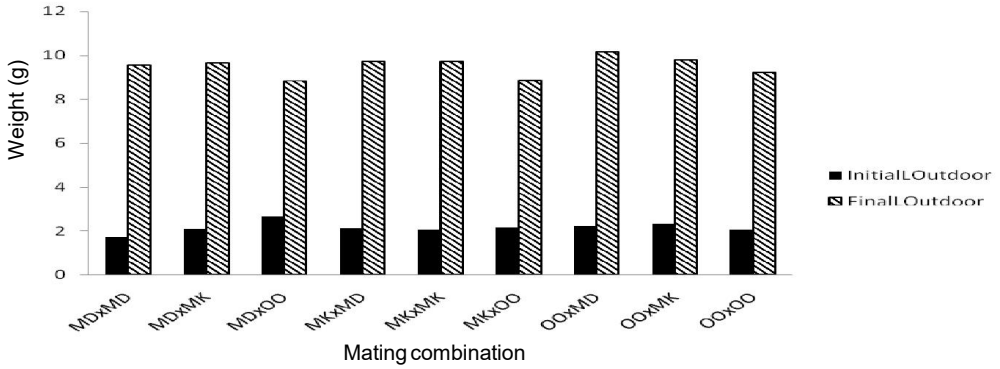


Figure 5 : Length parameters of the nine mating combinations of *Clarias anguillaris* reared in outdoor aquaria tanks for 58 days

DISCUSSION

Growth and survival are among the most important traits determining yield potential. Purdon (1986) reported that species evolve to maximize their chances of survival against a background of turmoil. He stressed further that domestication of any species of animal or plant is likely to find the turmoil replaced by order and constancy. In this study, the high survival value in all the mating combination especially at the outdoor rearing might be due to adequate feeding and good management. Brenda and Riley (1981) observed that the survival of larvae beyond the yolk sac stage is dependent on the provision of a suitable food sources as they have no built in reserve of food. The high percentage survival recorded in all the mating combination might also be due to the fact that average value for water quality parameters recorded was within the range recommended for good performance of freshwater fishes. Culver and Geddes (1993) have related low survival rates of fish larvae to low levels of zooplankton forage-available to the fish larvae.

The growth rate is easy to record as body weight or body length. This trait has great economic importance and is probably the most important for all breeding programs and all species (Refstie, 1986). The results of this study revealed that *Clarias anguillaris* strain could be readily artificially hybridized to produce offspring as shown from the nine generic mating combinations generated. The Onitsha strain hybridized with Maiduguri strain showed superiority in growth performance in both indoor and outdoor experiment. However, the significant difference in weight in outdoor rearing showed hybridization effect. Chevassus and Coche (1986) stressed that productivity in carp, catfish and tilapia has been improved upon by intraspecific hybridization. Hybridization of fish is to develop improved qualities as compared with those of pure stocks, especially from the culture angle. (Aluko, 1999) reported that catfish hybrids have advantageous qualities like fast growth, better

food conversion, higher survival and resistance against unfavourable environmental condition and disease. The Onitsha strain hybridized with Maiduguri strain performed better than the other crosses in this study. Consequently, breeding exercises should focus on this mating combination with the view to achieving better growth rate. Improving growth rate will decrease the time it takes to grow a fish to marketable size. This will increase production efficiency; increase fish production and farmer's income.

CONCLUSION

The fish from different ecological zones used for the study were successfully hybridized artificially. The Onitsha strain hybridized with Maiduguri strain showed superiority in growth performance in both indoor and outdoor experiment. We therefore, recommend the mating combination for propagation to produce fingerlings for farmers.

ACKNOWLEDGEMENT

We wish to express profound gratitude to World Bank and West Africa Agricultural Productivity Programme (WAAPP) for the privilege given us to carry out this novel project.

REFERENCES

Aluko, P.O. 1999. Genetic approaches in catfish hybridization : Efforts of NIFFR, Nigeria. *NIFFR Newsletter* 16 (2) : 3 - 8.

Aluko, P.O. and M. Shaba. 1999. Intra and Interspecific Hybridization Studies between exotic *Clarias gariepinus* and two indigenous Clariid species. *Nigerian Journal of Genetics* 14 (1999) : 56 - 63.

Bakos, J. and S. Gorda,. 1995. Genetic improvement of common carp strains using intraspecific hybridization. *Aquaculture 129* : 183 - 186.

Brenda, M.T. and J.D. Riley.1981. Egg and larval development studies in the North Sea Cod Gadus Morhua L. Rapp. P-V. Reun. *Journal of Conseil International pour l'Exploration de la Mer* 178 : 553 - 559.

Costa Araajo, F.G. 2003. Lenght-weight Relation and condition factor of *Micropogramia furnieri* (Perciformes sciaenidae) in the Sepetitb bay, Rhoda Jaweiro State Brazil Vol. 20 No.4 pp. 209 - 213.

Chevassus, B. and A.G. Coche.1986. Report of the Symposium on Selection, hybridization and genetic engineering in aquaculture of six fin and shell fish for consumption and stocking, Bordeaux, France, 27-30, 1986. European Inland and Fisheries Advisory technical Paper : (50). 52 p.

Culver, D.A. and M.C. Geddes. 1993. Limnology of rearing ponds for Australian fish larvae: relationships among water quality, phytoplankton, zooplankton, and the growth of larvae fish. *Australian Journal of Marine and Freshwater Research*. 44 (4.5) : 37 - 5511.

Hamoivici, M. and G. Velasco. 2002. Length-weight relationship of Marine Fishes from Southern Brazil. Naga. International Centre for Living Aquatic Resources Management. 23 (1) : 14 - 16

Pan, J.H. and W. B. Zeng. 1986. Study on the artificial crossing of *Clarias lazera* and the culture effect of the hybrid. Acta. Hydrbiol. Sin. 10 (1) : 96 - 98.

Purdon, C.E. 1986. Methodology on selection and intraspecific hybridization in Shellfish-critical review. From proceeding of World Symposium on selection, hybridization and genetic engineering in aquaculture, Bordeaux 1 : 285 - 291.

Rosenstein S. and G. Hulata 1993. Sex reversal in the genus *Oreochromis* immersion of eggs and embryos in oestrogen solutions is ineffective. Aquacult. Fish. Manage. 23 : 669 - 678.

Refstie, T. 1986. Selective breeding and intraspecific hybridisation of cold water finfish. In : Proc. Of World Symp. On selection, hybridisation and genetic engineering in aquaculture, Bordeaux 27 - 30 May, 1986. Vol.1 Berlin, 1987.

Tave, D. 1993. Genetics for fish hatchery Managers. Second edition. An Avi Book.

Van den Bosche, J. P. and G. M. Bernacsek.1990. Source book for the Inland Fishery Resources of Africa: 2: CIFA Technical paper No. 18/2 FAO, Rome, pp 159 - 192.

Wangila, B.C.C. and T.A. Dick.1996. Genetic effects and growth performance inpure and hybrids strains of rainbow trout, *Oncorhynchus, mykiss* (Walbaum) (Order: Salmoniformos family: Salmonidae). *Aquaculture research* 27 : 35 - 41.