



Full Length Research Paper

Colour pattern of flanks, throat and chest as complementary criterion for identification of *Tilapia zillii*-*T. guineensis*-hybrids complex in Ayame man made lake, at Sub-Eastern of Cote d'ivoire

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Pure strain *Tilapia zillii* and *T. guineensis* have been reproduced in order to obtain pure lines of these two species. The intraspecific crosses were then carried out, to engender first generation reciprocal hybrids F1A (*T. zillii* (Male) x *T. guineensis* (female)) and F1B (*T. zillii* (female) x *T. guineensis* (male)). The latters, have been reproduced each other to get F2A (F1A x F1A) and F2B (F1B x F1B) second generation hybrids. The flanks, throat and chest have been observed during the fish growth from the juvenile to adult stage. Reddish or pale reddish colorations were seen on flanks, and blackish or grayish flecks on the throat and the chest. Whatever the species and hybrids, small size samples (2 to 8 cm LS) considered as mixed show little or no shade on the parts of the body studied. Among *T. Zillii*, the males have pale red flanks while the throat and the chest are grayish. The females of this group show respectively reddish and blackish flecks. Whatever the sex, the *T. guineensis* flanks is reddish and the throat and the chest are blackish. Blade colors are observed in males of first generation hybrids and dark in the females group. Concerning the second generation hybrids, within a same sex group, hues are heterogeneous. Dark or light shades can be observed.

Key words: Colour, identification, hybrids, tilapia

INTRODUCTION

Tilapia zillii and *T. guineensis* present a genetic nearness resulting from a common ancestral origin (Pouyau, 1995). For this reason, the identification of these two species is not easy. Massive hybridization of these fish is due to the hydroelectric dam on the Bia river. It contributes to make more difficult, the identification of parental stocks above named and that of their descendants.

According to Schwanck and Rana (1996), identification can be made with morphometrics data. Teugels and Thys Van Den Audenaerde (2003) noticed that *T. zillii*, *T. guineensis* and their hybrids can be distinguished by color pattern. However, according to Bamba (2001), when taxinomics criteria are coupled with genetic analysis, results seem to be contradictory. Moreover, these criterias aren't always useful directly on the field. The

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problem of living stocks characterization, on the sampling site seems to be solved by Nobah *et al.* (2006). These authors purpose an identification key of the parental species and their hybrids alive, based on the colour pattern of the caudal fin. This key can be used on the field but is valid only for specimen with standard length superior than 14 cmLS.

During the growth of the parental stocks and hybrids of *Tilapia zillii* and *T. guineensis*, observations on the field shows blackish, greyish, reddish and pale reddish stains on these fish throat and chest. Can these colors, added to the identification key purposed by Nobah *et al.* (2006) contribute to make easy and fast identification of *Tilapia zillii* and *T. guineensis* alive, as well as that of their hybrids?

The aim of this study is to determine how those hues can contribute to easy identification. Moreover, the evolution of visible chromatic characters on the living specimen's throat, chest and sidewall will be watched according to sex during all development stages of parental species and hybrids.

MATERIALS AND METHODS

This study was carried out in the Aboisso Fish-Farming Center located in the South East of Côte d'Ivoire, from 20 km of the Ayamé man made lake (5 ° 36 ' N and 3 ° 10 ' W). It was built since 1959 on the Bia river, a coastal small pool of 300 km in length and 9650 km² of area.

The stock of *Tilapia zillii* and *T. guineensis* used as parents come from the lake cited. They were chosen according to Dadzie & Wangila (1979) and Legendre & Ecoutin (1989) criterias. There are standard length (SL) and observation of genital papilla to separate males to females. Fish were captured with keepnets or with seines of shore. After the catching, 30 males and 30 females of each species were introduced separately in oxygenated water and immediately routed at the Aboisso Fish-Farming Center. Fish were acclimated during 15 days in 2 cemented tanks. Parental stocks intended for reproduction were then stocked separately in 2 ponds. To make sure that they are pure strain, genetic tests were performed on *Tilapia zillii*, *T. guineensis* and first generation hybrids stocks (Nobah *et al.* 2006; Nobah *et al.* 2015). Six pairs of broodstocks mean weight ranging from 79 g to 98 g and 128 g to 133 g respectively for females and males were introduced into concrete tanks (6.24 m³) for intraspecific, interspecific and introgressive crosses (Legner, 1978; Guerrero & Garcia 1983; Siraj *et al.* 1983; Legendre 1986). Sex control occurred regularly. The reciprocal interspecific crosses, between *T. zillii* (Male) and *T. guineensis* (female) and between *T. zillii* (female) and *T. guineensis* (male) were performed to obtain first generation hybrids named respectively F1A

and F1B. Concerning introgressive crossings, the F1A were crossed each other to get second generation hybrids called F2A. It is the same for the F1B which have F2B as descendants. Each group of fish stocked for the reproduction was followed for a year Pullin & Lowe McConnell (1982). The chromatic characterizations concern the tasks noticed on the side, the throat and the chest of fish during their growth. Every 28 days, the monitoring of shades evolution occurred on 90 specimens of parental and first or second generation hybrid, representing 540 monthly descriptions. The rearing lasted one year. The sex separation was possible after 8 cm LS so that mixed population concerns the fish between 2 cm and 7.9 cm SL while the males and the females are between 8 cm and 19.9 cm SL. Factorial Correspondence Analysis (FCA) was performed to study the sharing out of shades, their presence or absence according to the sex.

RESULTS

The **Figure 1** presents the FCA diagram of *T. zillii* and *T. guineensis*. In *Tilapia zillii* samples, axes one and two represent 93.04 % of total variability. According to variables projection, most of the males with presence of pale red flanks characters or not are positively correlated to axis 2. Male populations seem to be mottled pale red on the sides. Females with reddish flanks and blackish or greyish throat and chest are in majority positively correlated to the axis 1. The mixed population present no stains for some and greyish flecks on the throat and the chest for others. Concerning *Tilapia guineensis* diagram, the first two axes hold 78.57 % of complete variability. Males with blackish throat and chest character are positively correlated to the two axes. Females with reddish flanks or greyish throat and chest characters are on the positive side of axis 1. The mixed population of fish as well as the absence of hues character are negatively correlated to axis 1.

Figure 2 shows the FCA diagram of F1A and F1B hybrids population. The projection of mixed population, male and female of F1A hybrids shows that the first two axes explained 90.14 % of the total variance. Within F1A hybrids, males with pale reddish flanks, greyish throat and chest characters are positively correlated to the axes 1 and 2. Females are on the negative side of axis 2. Mixed sample and absence of flecks are negatively correlated to axes 1.

The projection in the plan of male and female populations of hybrids F1B shows that the two first axes hold 81.16 % of total variability. The majority of the male, pale reddish flanks and greyish throat or chest characters are in negative plan of axis 2. The positive part of the axis 1 gets high contribution in female with blackish chest and throat as well as reddish flanks character. Mixed

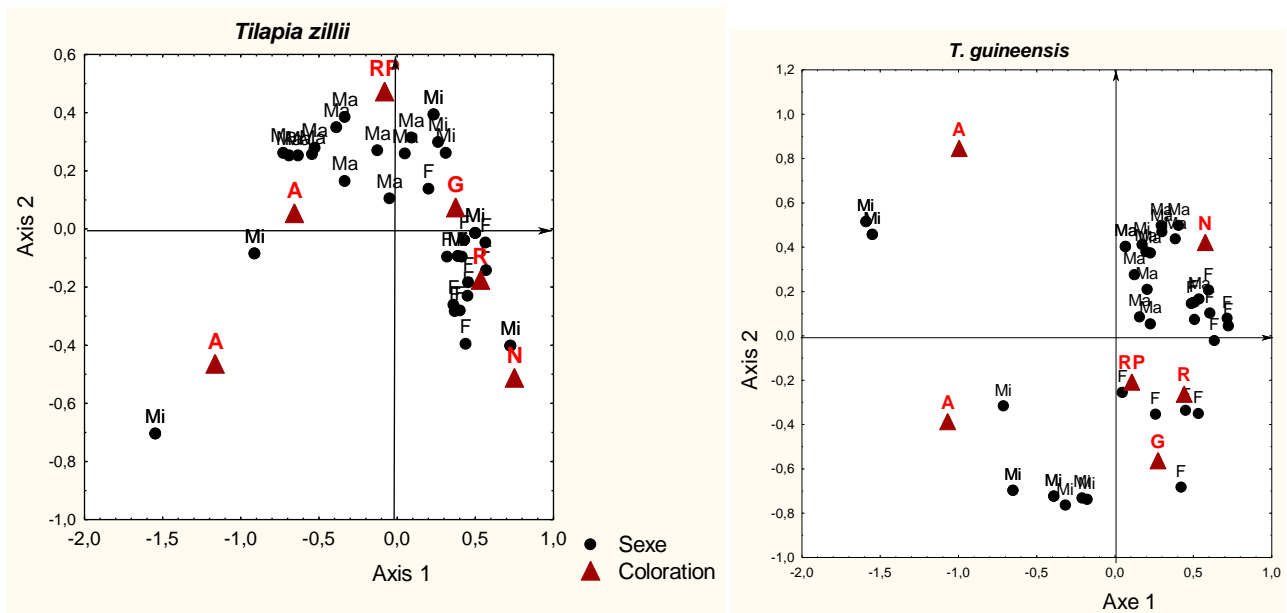


Figure 1: Factorial Correspondence Analysis (AFC) diagram of *T. zillii* and *T. guineensis* males (Ma), females (F), mixed (Mi) versus color pattern of flanks, throat and chest. Reddish (R), greyish (G), pale red (PR), absent (A).

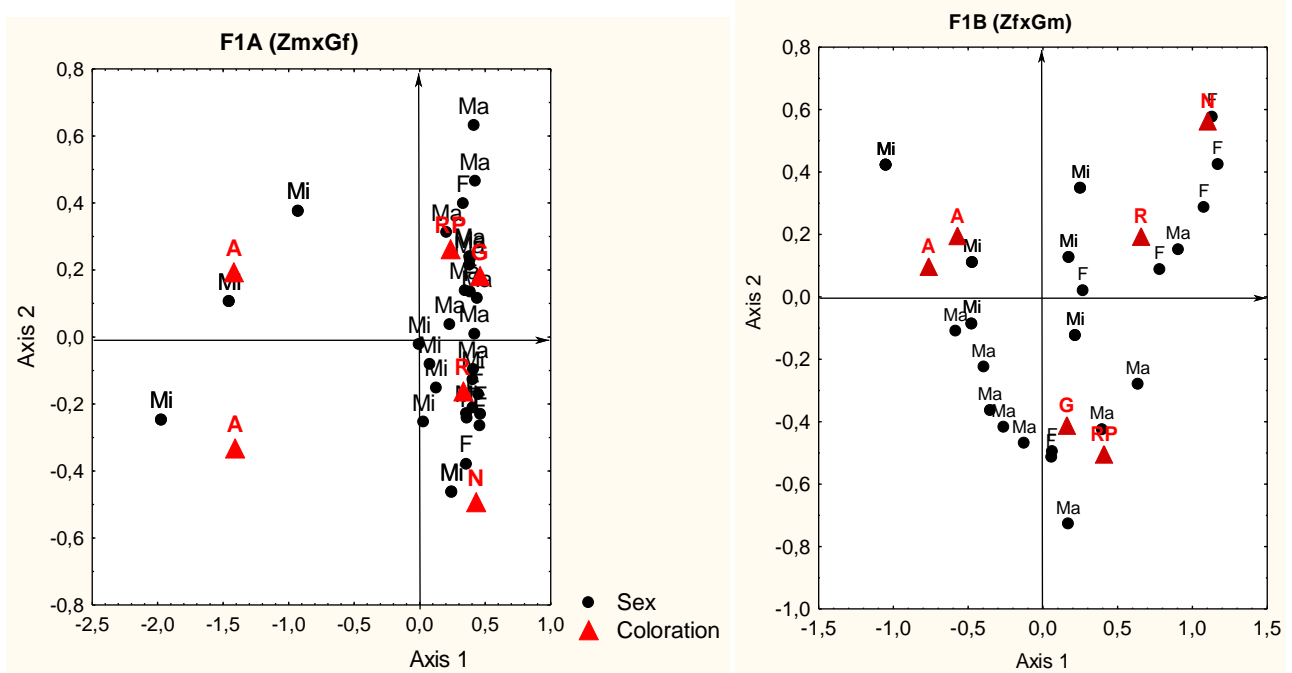


Figure 2: FCA diagram of F1A and F1B males (Ma), females (F), mixed (Mi) hybrids versus color pattern of flanks, throat and chest. Reddish (R), greyish (G), pale red (PR), absence (A).

population and absence of hues are in majority positively correlated to axes two.

The **Figure 3** presents FCA diagram of the projection in the plan of the mixed, male and female hybrids F2A and F2B.

In F2B hybrids population, the first two axes cumulate 82.71% of the total variability. In this group, all the male, with greyish chest and throat, reddish or pale red flanks characters are positively correlated to the axis 1. The female hybrids, blackish chest and throat with reddish

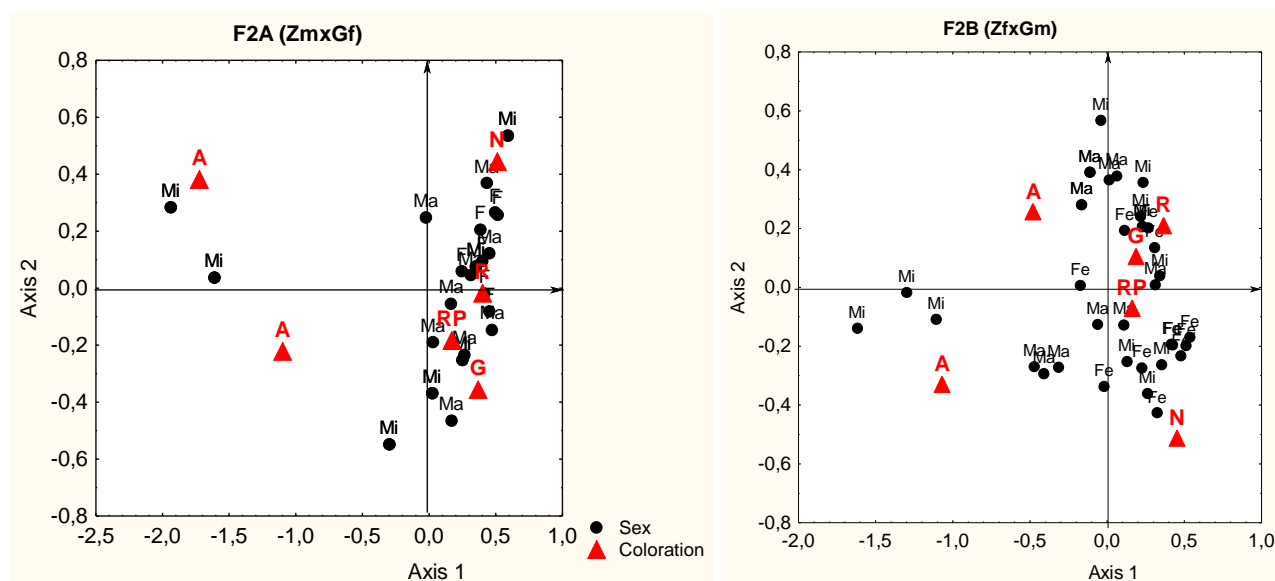


Figure 3: FCA diagram of F2A and F2B males (Ma), females (F), mixed (Mi) hybrids versus color pattern of flanks, throat and chest. Reddish (R), greyish (G), pale red (RP), absence of hues (A).

flanks characters are in majority on the positive plan of the axes 1. The mixed population is in majority negatively correlated to the axis 1 with absence of flecks on sidewall, throat and chest characters.

Concerning F2B hybrids, the first two axes cumulate 82.71% of the total variance. The male fish are strongly positively and negatively correlated to the axis 1. Females are in majority on the positive plan of the axis 1, with reddish flecks on flanks and blackish throat. With regard to the mixed populations, the axis 2 contributed strongly in their distribution. These fish show no hue on the different parts of body.

DISCUSSION

The description of parental species and hybrids flanks, throat and chest allows distinguish tree groups. The first represents the majority of male. They are characterized by a pale reddish sidewall and greyish throat and chest. The second group concern females. They have reddish flanks, blackish throat and chest. Within the first two groups, colors observed are not fixed, they change according to fish. The third group represent fish which sex determination was not possible because of their small size (from 2 to 8 cmLS). In this population, no flecks was observed on flanks, throat and chest. According to Voss (1980), the coloration of the flanks, throat and chest depends on development stages. It is linked to the ethological factors. For this author, each color corresponds to a motivation. The different color patterns observed in the present study can be correlated to reproduction process. Among the cichlids, this

phenomenon is accompanied by the establishment of a coloring that can play a role in the recognition of congeners (Seehausen *et al.*, 1999). Colorations augured in the intraspecific sexual selections, for the choice of female or male, in order to competition or reproduction. Thus, for male *Sarotherodon melanotheron*, sexual maturity is reflected by a coloring golden metal of the operculum while it is transparent in the mature female (Trewavas, 1982). Observations of this studie can be link to Voss (1980) results. The fact that colors change with sex an development stage shows clearly a relationship between fish colorful patterns and reproduction process. According to this author, at territorial stage, male *T. guineensis* and *T. zillii* throat and chest become increasingly dark and a few red stains begin to appear on flanks of this latter species. At the first stage of the sexual parade, male and female of *T. guineensis* as well as male *T. Zillii* are mottled red. At the second stage of this process, the two sexes of these species have blackish hues on the throat and the chest. Among *T. zillii*, red flecks appear on the base of the sidewalls. At spawning time, the respectively red and black hues on the flanks and the throat as well as the chest of *T. guineensis* are well visible. At the care of eggs step, the black coloring is very thick on this population and *T. Zillii* are mottled red. At fingerlings guard stage, males and females of the two species have black flecks very thick in the throat and the chest with red tasks. If an additional motivation occurs unexpectedly, the appearance may change more or less rapidly, partly or totally (Voss, 1980). That is why, in juveniles of the two species, precisely in a stage of abandonment or submission, the throat and chest are devoid of tasks. The

present studie don't agree with Teugels & Thys Van Den Audenaerde (2003) and Nobah *et al.*, (2006) who noticed that the differentiation of *T. zillii*, *T. guineensis* and hybrids is based on color pattern.

CONCLUSION

The colorations observed on the flanks, throat and chest seem to vary according to the maturity stage and sex. They may not be taken into account as an additional criterion for those fish identification.

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