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Reproduction parameters in *Phrynobatrachus latifrons* Ahl 1924, a frog in degraded areas of Banco National Park (Ivory Coast)

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Abstract

The study of the reproductive ecology of *Phrynobatrachus latifrons* at the fish farm of the Banco National Park showed that the smallest mature individual measures 12.5mm in males and 17mm in females. All individuals greater than 18.9mm in males and 24.26mm in females are mature. The size of first sexual maturity (L50) calculated is 15.37mm for males against 20.20mm for females. The sex ratio, with the exception of the small rainy season is in favor of the females. Absolute fertilitymuzzle-anus length and absolute fecundity/body weight ratios showed a low correlation. The breeding activities of *P. latifrons* occur in the dry season as well as in the rainy season.

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Introduction

Amphibian ecology has been little studied in Africa (Channing, 2001). Nevertheless, nowadays, they are ranked the vertebrate ones the most threatened of extinction in the tropical forests (Rodrigues *et al.*, 2004; Ernest *et al.*, 2007). In Ivory Coast particularly, animal species such as elephants, bush pigs, buffaloes and panthers have disappeared (BELIGNE, 1994) due to deforestation, rapid population pressure and movements of human populations within most parks and nature reserves (Bakarr *et al.*, 2001; Branch and Rödel, 2003).

Among the 11 parks and reserves in the country, the Banco National Park presents a remarkable characteristic because of its geographical position in full heart of Abidjan, the country's economic capital. This ecosystem is disrupted by logging, plantation creation and pollution (Lauginie, 2007).

These disturbances threaten the life of plant and animal communities, including amphibians, recognized among vertebrates, as being the most vulnerable to habitat destruction (Lips 1998, 1999; Raxworthy and Nussbaum, 2000; Sala *et al.*, 2000; Lips *et al.*, 2003).

Phrynobatrachus latifrons is a very abundant frog species on the fish farm in this park (Assemien *et al.* 2006). The data associated with this species we have is related to the determinism of his croaking rhythm (Blayda *et al.*, 2008) and his diet (Blayda *et al.*, 2015). Also, knowledge of the parameters of its reproduction would allow us to better understand the biology of this species, which is a bio-indicator of the state of health of the environment.

Material and methods

Study site

The present study takes place at the fish farm of the Banco National Park (BNP). The location (Fig. 1), the view (Fig. 2), the description and the characteristics of the park and the fish farm were presented by Tohe *et al.* (2008; 2014).

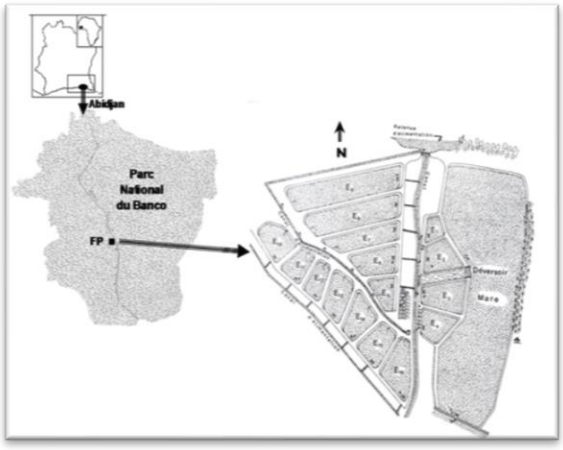

Fig. 1. Location of the sampling site in the Banco National Park (Tohe *et al.*, 2008). FP = fish farm; E 1 to E 16 = ponds or fish ponds.

Fig. 2. View of the fish farm in the Banco National Park.

Methodology

Specimens of *Phrynobatrachus latifrons* are captured either by hand or using a capture box. The sampling campaigns were one campaign per season. After identifying with the Rödel keys (2000) and measuring the muzzle-anus length to the nearest millimeter with a plastic caliper, the frogs are anesthetized with chlorobutanol and dissected. Each gonad removed is weighed and then stored in a pill container containing 70% alcohol solution for laboratory studies. In the laboratory, each gonad is freed of its membrane and the released oocytes are counted using a mechanical counter.

Results

Sizes of first sexual maturity

The sizes of first sexual maturity (L50) calculated is 20.20mm for females (Fig. 3a) versus 15.37mm for males (Fig. 3b).

The smallest mature individuals measure 17mm and 12.5mm respectively. All individuals greater than 24.26mm in females and 18.9mm in males are mature.

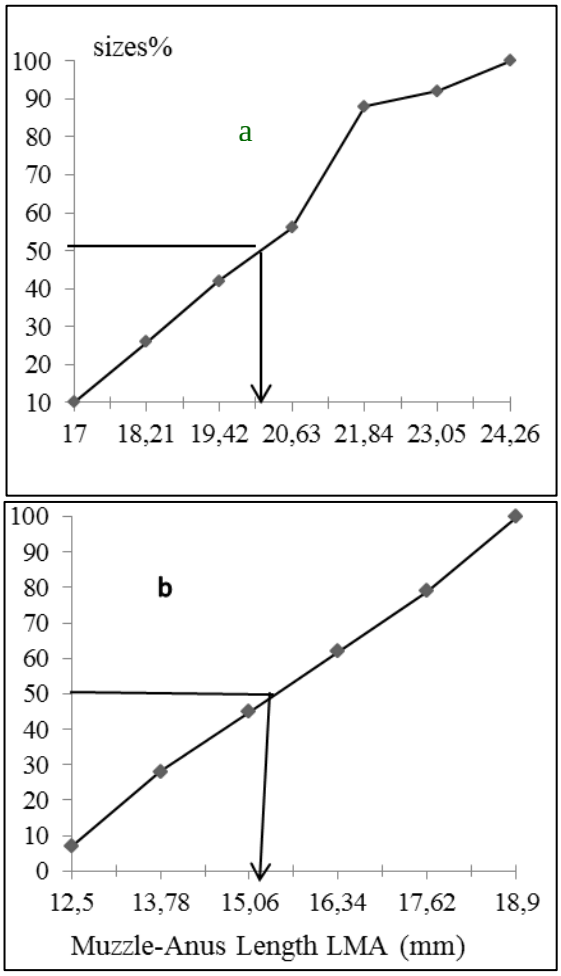

Fig. 3. Sizes of first sexual maturity in females (a) and males (b) of *Phrynobatrachus latifrons* of the Banco National Park fish farm.

Sex ratio

With the exception of the small rainy season (SRS) where there are as many males as females sampled (1/1), the sex ratio is in favor of females in other seasons. The corresponding values are 2/1 during the short dry season (SDS) and 2.22 / 1 for the long dry season (LDS) and during the long rainy season (LRS) the corresponding value is 2.125 / 1 (Fig. 4).

Gonado-somatic report (GSR)

Seasonal gonado-somatic report (GSR) variation in female of *Phrynobatrachus latifrons* is shown in Fig. 5. The greatest variability in GSR (2.8 to 40%) is observed during the short rainy season (SRS). Its lowest variability (1.42 to 8%) is noted in the long dry season (LDS).

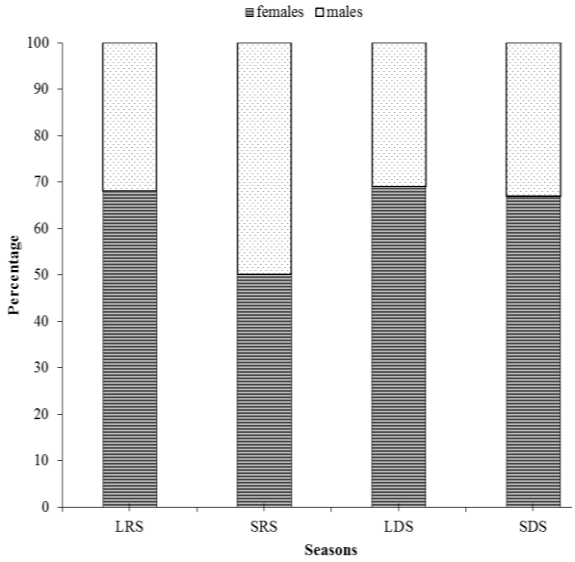

Fig. 4. Sex ratio of *Phrynobatrachus latifrons* populations at the Banco National Park fish farm. LDS = long dry season; SDS = small dry season; LRS = long rainy season; SRS = small rainy season.

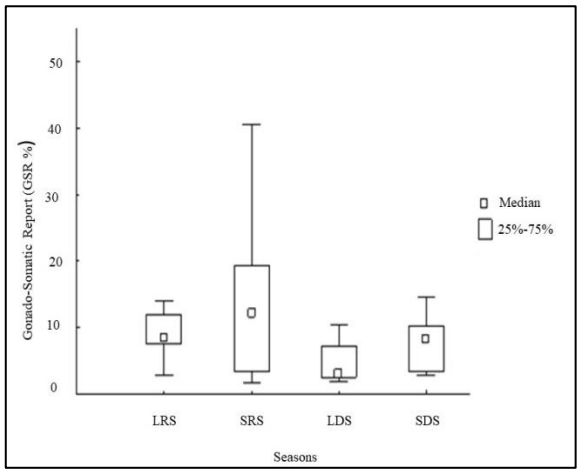

Fig. 5: Seasonal variation of the Gonado-Somatic Report (GSR) of female specimens of *Phrynobatrachus latifrons* from the Banco National Park fish farm.

Absolute fertility

In the great rainy season, the number of oocytes counted is 75 to 403 higher than that counted in the short rainy season (40 to 407). On the other hand during the great and the short dry season, values between 52 and 328 are observed for the long season and 69 to 350 oocytes for the short season (Fig. 6).

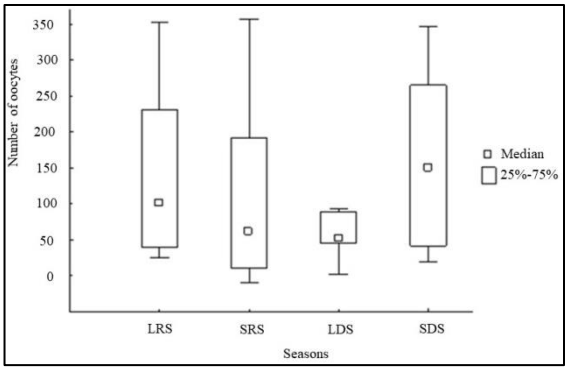

Fig. 6. Seasonal variation in absolute fecundity in females of *Phrynobatrachus latifrons* on the Banco National Park fish farm.

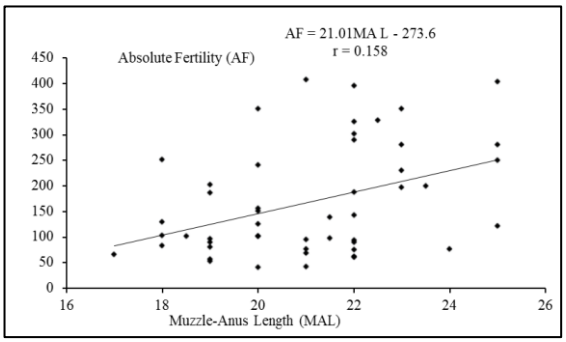

Fig. 7. Variation in absolute fecundity (AF) versus muzzle-anus length (MAL) in females of *Phrynobatrachus latifrons* of the Banco National Park fish farm.

Absolute fertility and body weight relationship

The relationship between body weight (BW) and absolute fertility (AF) (Fig. 8) gives a straight line of equation AF = 144.8 BW + 35.06. Absolute fecundity in females of *Phrynobatrachus latifrons* is very weakly correlated with body weight (r = 0.171).

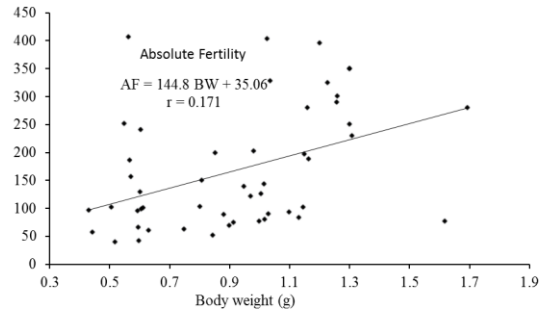

Fig. 8. Variation in absolute fecundity (AF) versus body weight (BW) in *Phrynobatrachus latifrons* of the Banco fish farm.

Absolute fecundity and muzzle-anus length relationship

Fig. 7 shows the relationship between absolute fecundity / muzzle-anus length in female specimens of *Phrynobatrachus latifrons* studied. It is noted that absolute fecundity (AF) in this species is very weakly correlated with muzzle-anus length (r = 0.158).

Discussion

In terms of sizes of first sexual maturity and the smallest mature individual, our study shows that they are higher in females than in males. Males would be more precocious than females. Regarding the size of the smallest individual captured, our data are partly consistent with those of Rödel (2000). This author has reported that in the Comoé National Park, *P. latifrons* specimens are 14mm in size for the male and 16mm in the female.

This difference in size of maturity between males and females has already been observed in *Ptychadena mascareniensis* and *P. pumilio* (Tohe *et al*., 2015; Yao *et al*., 2017) and in *Hoplobatrachus occipitalis* (Tohe *et al*., 2016). This difference in size of maturity could be explained by sexual dimorphism. Indeed, in amphibians, it is recognized that males are smaller in size than females.

With respect to the change in absolute fertility, no difference is observed between the values obtained in dry seasons and those of rainy seasons. This parameter is therefore not linked to the season, since the fish farm is permanently fed by water.

The relationship between absolute fecundity/muzzle-anus length and absolute fecundity/body weight showed a very low correlation in *Phrynobatrachus latifrons* ($r \leq 0.5$). Thus, the increase in size or body weight of the individual would not be related to the increase in the number of oocytes. This has already been reported by Tohe *et al.* (2016) in *Hoplobatrachus occipitalis*.

In addition, our results show in *Phrynobatrachus latifrons* that sex ratio in favor of females. In fact, there is a territorialism in the frogs and the song of

the male during the breeding season, while attracting the female, beats its territory against the approach of other males. This strategy which limits the competitions for the conquest of the female by the male could explain the high number of females captured. With regard to the gonado-somatic relationship, our results reveal that *Phrynobatrachus latifrons* breeds in the dry season and the rainy season. The last season being the most favorable for breeding. Our results are partly in agreement with those of Rödel (2000).

Indeed, this author reports that in the Comoé National Park this species does not breed until the rainy season. It suspends all breeding activity during the critical period of the year that is the dry season. At the level of the banco national park fish farm, irrigation of the ponds is ensured all year long, this is in favor of a high relative humidity and a softer temperature making the breeding favorable even in the dry season.

Conclusion

Amphibians are very sensitive to variations in environmental conditions; therefore, some species are even subservient to micro-habitats and microclimates. Phrynobatrachus Latifrons in the fish farm of the Banco National Park, due to the almost permanent presence of water, recurs throughout the year. However, the abundance of this species, characteristic of highly anthropized environments in the very center of this park, poses the crucial problem of the conservation of parks and reserves in the world and particularly in Africa.

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