International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Ethological Study and Breeding Trials of Aulacodes (*Thryonomys swinderianus*, Temminck, 1827) Captured in the Forest Area of Sika-Komenankro (Ivory Coast)

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Abstrat: ***Aulacod meat is highly appreciated by the Ivorian population for its tenderness and flavor. Its breeding would be an alternative for the conservation of this species and a probability to satisfy the demand in animal protein of the populations. The aim of this study was to condition wild aulacodes into docile strains for sustainable breeding. Ethological parameters such as flight, hiding, aggressiveness and tolerance were evaluated on aulacodes captured in cultivated and forested areas and in fallow land in the village of Sika-komenankro. A matching test and intra-specific confrontation were carried out before the breeding groups were formed. Zootechnical parameters were monitored for 24 months. The results showed that the captured aulacods were indocile, with a 100% rate of flight, hiding and intolerance, and a 0% rate of aggression. After 30 days, the bonding test revealed that the aulacodines acquired docile behavior with a 0% rate of escape, hiding, tolerance and aggression. The aulacodines performed well reproductively, with an average litter size of 4, an overall fertility rate of 100% and an overall fecundity rate of 400%. Mortality rate of 2.08% and escape rate of 8.5% were recorded. The matchmaking method seems to be the best way of achieving sustainable breeding. It produces docile, reproductive aulacods.***

Keywords: Capture, *Thryonomys swinderianus*, ethologie, aulacodiculture, Sika-komenankro

1. Introduction

Côte d'Ivoire contains ecosystem diversity, resulting in faunal diversity (**Akpatou and *al*., 2018; Cuny and *al*., 2023**). This specific diversity is exposed to strong anthropogenic pressure such as poaching, logging, bush fires, agriculture, urbanization and water pollution. Faunal diversity is highly vulnerable to this anthropogenic pressure (**Béné and *al*., 2018**). The most valued animal species are overexploited and their habitat destroyed. These species are endangered and disappear over time (**Koffi and *al*., 2008; Kadjo and *al*., 2014; Bitty and *al*., 2015**). Extinction of certain species is likely at local level (**Gonédele Bi and *al*., 2014**).

To solve this problem, since 1965, Côte d'Ivoire has adopted a law (law N°65-225 of August 4, 1965), modified in 1994 (law N°94-442 of August 16, 1994), which protects wildlife, and prohibits hunting, authorizing in its article 9, the hunting of certain large mammals, reptiles and birds and recommending above all the breeding of animals (**Ministry of Water and Forests, 2013**). As a result, a great deal of scientific research is being carried out into the technical and economic aspects of breeding and the domestication of certain species. These include the aulacode. It is undoubtedly one of the largest, most hunted, consumed and traded rodents in West Africa (**Lawani, 1989**). Its consumption is around 80 million head per year in West Africa (**Mensah, 1993; Fantodji and Mensah, 2000**) and 8 million head in Côte d'Ivoire (**Fantodji and Soro, 2004**). Its meat accounts for the largest proportion (43.28%) of species sold on the Yamoussoukro bushmeat market in the mammal class (**Sikpo and *al*., 2023**). Moreover, as **Monod (1970)** asserts, aulacods are sometimes assigned therapeutic virtues. **N'goran (1985)**, for example, states that aulacod liver is used to treat jaundice in the Toumodi region of Côte D'Ivoire.

Captive and semi-captive aulacod breeding (aulacodiculture), adopted and implemented in numerous research programs by **Mensah (2000)**, can curb the abusive exploitation of these species. It really got off the ground in Côte d'Ivoire in 1998, with the help of a program to support the development and promotion of non-conventional animal breeding (**Goué and *al*., 2005**). This program was piloted by **Fantodji and *al*, 2004** at the Université Nangui ABROGOUA, formerly the Université d'Abobo-Adjamé.

Aulacodes are becoming more and more widely adopted in livestock farming and are sometimes a source of income and then of animal protein (**Ettian and *al*., 2019**). They are also important in several fields such as pathology, ecology anatomy, ecoethology, feeding and reproduction (**Fantodji and Soro, 2004; Emanfo and *al*., 2013, Soro, 2007**). A typological study of aulacod farms in Côte d'Ivoire carried out in 2007 revealed that of 105 farms surveyed, 66 were functional (**Goué and Yapi, 2015**). This shows that the production of farmed aulacod meat for food cannot meet the population's high demand. To make up for this shortfall, the capture of aulacods by non-vulnerable aulacodders, in order to optimize their rearing, is one solution (**Kprié and *al*., 2024**). To breed wild aulacods successfully, it is important to control their behavior. This justifies the interest in

carrying out an ethological study and breeding trials on aulacodes captured in the Sika-komenankro forest zone.
The general aim of this study is to tame aulacodes from wild strains (paniquard) to obtain docile strains for sustainable breeding. Specifically, it aims to study the behavior of captured aulacodes, to control rearing conditions and to evaluate the zootechnical parameters of these aulacodes.

2. Materials and methods

2.1. Materials

2.1.1. Biological materials

Biological material is made up of plants and animals.

The vegetation consists of green fodder, fruit, vegetables and tubers used as food.

The animals are a species of aulacodes (*Thryonomys swinderianus*) captured in the secondary forest patches of the Sika-komenankro village.

2.1.2. Technical equipment

Technical equipment includes aulacoderie, aulacodrieres and feeding aids such as feeders and troughs.

2.1.2.1. Aulacoderie

Captured aulacods are held in captivity in the 17.5 m^2, 2.5-metre-high aulacodery. It is built of rammed earth and the roof is covered with black plastic sheeting protected by palm leaves.

2.1.2.2. Aulacoderie equipment

Figure 1: Feeding and weight-gain aids

2.2 Methods

2.2.1. Prophylactic measures

Brooms, shovels, pieces of mattress, odorless detergent and containers were used for building maintenance to prevent fungal diseases. A shed-mounted drying rack was built to reduce the parasitic load on green fodder. A weighing scale was needed to measure the weight of the aulacodes and monitor their health.

Curative protection measures were used. These are summarized in **Table 1**. They include lemon-sugar water for intestinal cleansing and anti-stress, dried guava leaves and papaya seed powder for quarterly deworming.

Table I: List of medicinal plants (**Soro, 2007; Sacramanto and *al*. 2022; Sacramanto and *al*., 2023**)

Designation	Directions for use	Treatment cases
Dried guava leaves	Powder mixed with food supplement	Coccidiosis (Diarrhea)
Papaya seed	Powder mixed with food supplement	Dewormer
Sweet lemon water	In drinking water	Intestinal cleansing and anti-stress

2.2.2. Study of the docility of newly captured aulacods

The ethological parameters such as flight, hiding, aggressiveness and tolerance to humans are evaluated by observation to assess the docile or indocile nature of the animals. To this end, 5 aulacodes (1 male and 4 females) were visited consecutively over three days and three times (morning, noon and evening), while attempting to approach or handle them. During these visits, information is collected on note cards and concerns only the parameters to be studied. Parameters are marked with a positive sign (+) when the behavior is performed, and with a negative sign (-) when the behavior is not performed. At the end of the tests, the positive signs are totaled. This is known as :

- Flight (Fli); when the animal runs away at full speed, making great, disordered leaps in the presence of the keeper,
- Aggression to Humans (AgrH); when the animal tries to attack or bite when the keeper tries to catch or touch it,
- Hiding (Hid); when the animal runs and hides under the sheet metal, in the pipe in the presence of the keeper,
- Tolerance (Tol.) ; when the animal accepts easily or none of the other parameters are checked in the presence of the keeper.

The parameters studied are calculated as follows:

$$Leakage\ rate\ (\%) = \frac{Number\ of\ leaks\ (possible\ tests)}{Total\ number\ of\ tests}\ X\ 100 \qquad (1)$$

$$Cache\ rate\ (\%) = \frac{Number\ of\ caches\ (positive\ tests)}{Total\ number\ of\ tests}\ X100 \qquad (2)$$

$$Aggression\ rate\ (\%) = \frac{Number\ of\ aggressiveness\ (positive\ tests)}{Total\ number\ of\ tests}\ X100 \quad (3)$$

$$Tolerance\ rate\ (\%) = \frac{Number\ of\ tolerances\ (positive\ tests)}{Total\ number\ of\ tests}\ X\ 100 \quad (4)$$

2.2.3. Rapprochement test to aulacodes

The rapprochement test consists in establishing a familiar bond with the animals. The aim is to reduce unruly behavior, making it easier to talk to, handle and observe the animals. To achieve this, 5 aulacodes are fed directly into the keeper's palm for 30 days, using food supplements such as corn and sugar cane, followed by an attempt at petting.

Before the test, the food supplements are distributed to the animal over 3 days, so that it becomes familiar with them. To perform the test, the keeper presents the food supplements to the animal in the palm of his hand over a period of time (maximum 05 minutes). If the food is retrieved within five minutes, the test is positive: it is noted (+). Beyond five minutes, the test is negative: is marked (-). When the test is negative, the keeper places the food in the feeder so that it can be eaten in his absence. At the end of each test, the number of positive tests (+) per day is counted according to animal groups. The information collected concerns: ethological parameters expressing the docile or indocile behavior of the animals and the date of first retrieval of the test food from the keeper's palm.

2.2.4. Intra-specific confrontation of captured animals

Captured animals are confronted two by two to detect intra-specific tolerance in order to better form breeding groups and, above all, avoid individuals fighting and killing each other. The various confrontation possibilities can be summarized as follows:

- reaction between female and female;
- reaction between male and male;
- reaction between male and female.

In the event of a fight, one of the animals is immediately removed to avoid injury or death. We have the animals interact three times a day (morning, noon and evening) over a 72-hour period, giving a total of 9 interactions, with the reaction of fighting or cooperation noted.

2.2.5. Feed distribution

The aulacodes are all brought together and fed the same food. Food and water are provided in sufficient quantities. Feed and water are distributed in the morning and evening, while fruit, tubers and supplements are given during the day.

Types of food distributed

The aulacodes are fed mainly on natural green fodder, plants, fruit and vegetables, and tubers identified during the ecological survey. The green fodder supplied to the aulacodes consists mainly of *Pannicum maxicum*, *Pennisetum purpureum*, *Guatemala grass*. *Elaes guineensis* and *Manihot esculenta* are aulacod food plants. *Zea mays* is the only fruit used for feeding aulacodes. Cooking salt in the form of salt water is served once a week. A board and bones are deposited to facilitate tooth filing.

Aspects of food distribution

The feed is distributed under several aspects in order to identify which aspects the animals prefer to consume. Aspects include shape, texture, hardness and condition. By means of observation, the palatability of the animals is regularly recorded according to the different aspects.

The different aspects are defined as follows:

- shape refers to completeness and cutting into small pieces of 5 to 15 centimeters,
- hardness refers to hard or soft aspect,
- texture refers to pasty, liquid or powder aspect,
- condition refers to fresh or dry aspect.

Stems and leaves are cut from wooden trunks using a sharp walker. Grinding and cooking make certain foods soft and powdery. The liquid aspect is obtained by extraction or kneading. The food served is checked and some is dried to avoid using moldy (cassava pods) and parasitized food.

2.2.6. Formation of breeding nuclei

Breeding is the biological ability of a female to give birth to offspring (number of animals born to a female). It is a global characteristic that depends on fertility (reproductive ability) and prolificacy (number of live offspring born per farrowing). To assess the parameters and reproductive performance of broodstock, the following method of mating animals is adopted.

Aulacode mating habits

Permanent polygamous mating is practiced over a 24-month period. Pregnant females are not separated from the group. One (1) breeding group is formed. It consists of one male and four (4) females. Parturition takes place within the breeding group, and the young are separated from their parents at the adult stage. Breeding aulacods and young aulacods are fed in the same area, and all receive the same food in sufficient quantities.

2.2.7 Data collection

Data is collected by monitoring mated animals through to the adult stage of newborns. Data sheets are drawn up to record daily events such as: the number of breeders, the number of farrowings, the litter, the number of neonatal mortalities, the number of pre-weaning mortalities, the number of post-weaning mortalities, the number of adult mortalities, the number of escaped neonatal pups, the number of escaped pre-weaning pups, the number of escaped adults. All these data need to be determined:

- breeding performance (**Table 2**) (litter size, fertility rate, fecundity rate, prolificacy, sex ratio),
- breeding parameters (**Table 3**) (neonatal mortality rate, pre-weaning mortality rate, post-weaning mortality rate, adult mortality rate),
- escape parameters (**Table 4**) (neonatal escape rate, pre-weaning escape rate, adult escape rate).

Table II: Formulas for calculating aulacod reproductive performance (**Adjahoutonon and *al*., 2007**)

Reproduction performance	Formulas
Size of litter	$Number\ of\ newborns$
Fertility rates (%)	$\frac{Number\ of\ females\ giving\ birth}{Number\ of\ females\ in\ breeding}$ x 100
Fecundity rates (%)	$\frac{Number\ of\ live\ newborns}{Number\ of\ females\ covered}\ x\ 100$
Prolificity	$\frac{Total\ newborns}{Number\ of\ females\ giving\ birth}$
Sex-ratio	$\frac{Number\ of\ males}{Number\ of\ females}$

Table III: Formulas for calculating aulacod reproduction parameters (**Ngoula and *al*., 2009**)

Reproduction parameters	Formulas
Neonatal mortality rate (%)	$\frac{Number\ of\ babies\ born\ dead}{Total\ number\ of\ newborns}$ x 100
Pre-weaning mortality rate (%)	$\frac{Number\ of\ newborns\ who\ died\ before\ weaning}{Total\ number\ of\ pre-weaning\ newborns}$ x 100
Post-weaning mortality rate (%)	$\frac{Number\ of\ animals\ dead\ after\ weaning}{Total\ number\ of\ animals\ after\ weaning}$ x 100
Adult mortality rate (%)	$\frac{umber\ of\ dead\ animals\ at\ adult\ stage}{Total\ number\ of\ adult\ animals}$ x 100

Table IV: Formulas for calculating evasion parameters

Evasion parameters	Formulas
Neonatal evasion rate (%)	$\frac{Number\ of\ newborns\ escaped\ at\ birth}{Total\ number\ of\ live\ newborns}$ x 100
Pre-weaning evasion rate (%)	$\frac{Number\ of\ young\ escaped\ at\ pre-weaning\ stage}{Total\ number\ of\ live\ young\ at\ pre-weaning\ stage}$ x 100
Adult evasion rate (%)	$\frac{Number\ of\ adults\ escaped}{Total\ number\ of\ adults}$ x 100

2.2.8 Study of livestock evolution over 24 months

The evolution of the herd here corresponds to the increase in the number of animals bred over this period. It is determined by the overall litter size, overall mortality rates and overall escape rates.

2.2.9 Study of the growth of small

Weight is the only parameter used to determine the well-being or the presence of problems that could threaten the health or life of the aulacodes, and also to monitor their evolution. For this purpose, weekly weighings are carried out from 2 days to 20 weeks (5 months) of age, depending on litter size. By taking the weight, certain morphological and behavioral characteristics are recorded.

Average weight (AW)

The average weight is the average weight of the animals weighed per week. It is obtained using an electronic scale (precision weighing) and a bag of known weight. The weight of the bag is always subtracted after each weighing. This weighing is carried out early in the morning when the animals are fasting. The average weight is determined as follows :

$$AW = \frac{Sum\ of\ animal\ weights}{Number\ of\ animals} \qquad (5)$$

2.2.10 Statistical analysis

The values for ethological data, breeding parameter data and animal breeding performance data are expressed as averages. The non-parametric Chi2 test in STATISTICA software was used to analyze these results. It also enabled us to understand the differences observed in the results. $P > 0.05$ the observed difference is non-significant and $P < 0.05$ the observed difference is significant.

3. Results

3.1 Ethological study

3.1.1 Docile behavior

Ethological parameters of newly-captured aulacodes evaluated over three (3) days (**figure 2**) indicate that the escape rate and hiding rate are at 100%, while the aggression rate and tolerance rate are at 0%.

Putting together flight, hiding and aggressiveness to translate the indocile effect, and tolerance to translate the docile effect of aulacodes (**figure 3**) shows that the indocility rate is 67%, while that of docility is 0%. Comparison of the docility and indocility rates using the non-parametric Chi2 test indicates that there is a significant difference between the indocile and docile traits ($P<0.05$). Newly captured aulacods are indocile.

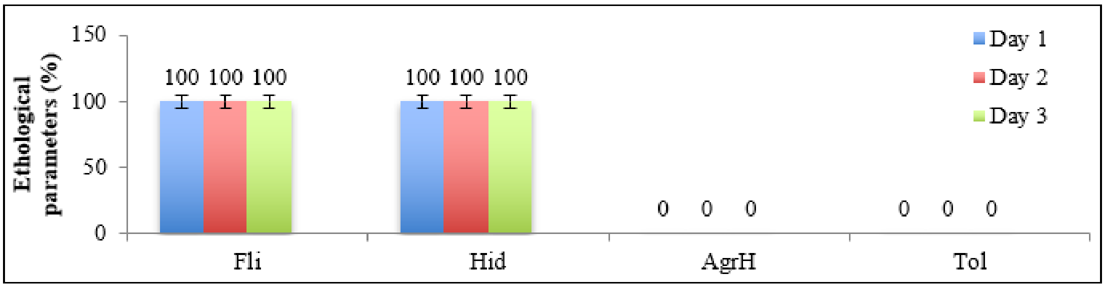

Figure 2: Average rates of ethological parameters in newly-captured aulacods over three days Fli: flight, Hid: hiding place, AgrH: aggressiveness to humans, Tol: tolerance.

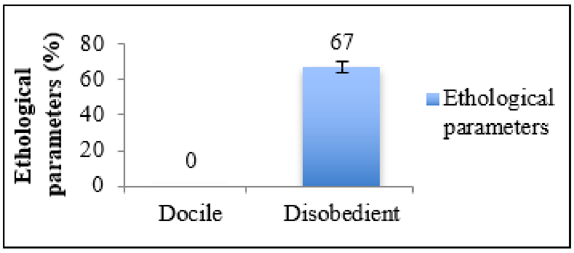

Figure 3: Average rates of parameters reflecting aulacod indocility and docility

3.1.2. Test de rapprochement

The curves showing the average levels of the ethological parameters assessed during the aulacod matching test are divided into three phases (**figure 4**).

Phase 1: corresponds to total refusal of the test food. It occurs between days 1 and 10. In this phase, the average rate of flight remains constant at 100%, then that of hiding decreases from 100% to 20%. The average rate of tolerance and aggressiveness remain constant at 0%. No recovery of the test food from the keeper's palm during this first phase. This shows that aulacodes are still indocilent.

Phase 2: This is the partial refusal or intermediate phase. It occurs between days 10 and 20. In this phase, the average leakage rate decreases and is cancelled out by day 20, as is the hiding rate, which is cancelled out by day 15. The tolerance rate increases from 0% to 100%. Aggression remains at zero. At this level, the animal gradually takes an interest in the keeper, remaining static in places. When the keeper enters the building, the aulacod stops all activity, stares at the keeper while remaining on guard, uttering little cries of "crou, crou" and making advances interspersed with stops towards him. The first recovery of the test food takes place in phase 2. The aulacod becomes less docile in phase 2.

Phase 3: This is the acceptance or collaboration phase. It takes place between days 20 and 30. In this phase, the rates of escape, hiding and aggression do not vary (0%), while the rate of tolerance remains constant at 100%. The animal comes to the keeper, accepts caresses, eats, drinks, plays and rests quietly in the keeper's presence. Aulacodes become docile in phase 3 (**figure 5**).

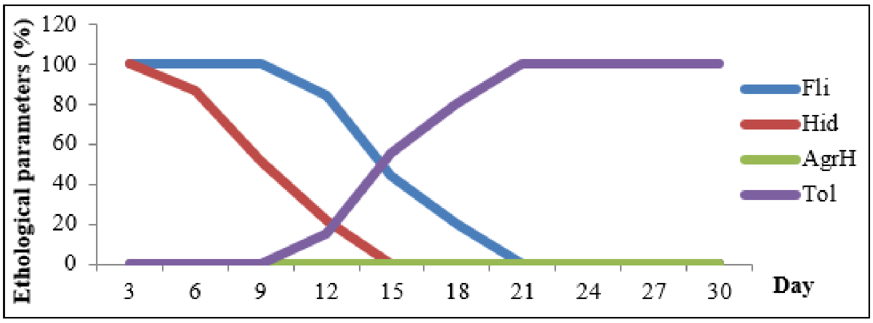

Figure 4: Rates of aulacod ethological parameters during the approach test
Fli: flight, Hid: hiding place, AgrH: aggressiveness to humans, Tol: tolerance.

P1 P2 P3 P4

Figure 5: Image showing the attitudes of the aulacodes to accepting the presence of the keeper and his new living environment.
P1 Retrieving test food; P2 Playing with the keeper; P3 Aulacode at rest; P4 Aulacode in sleep state.

3.1.3. Intra-specific behavior

As no two males were captured, the result of the aulacods' confrontation was only that of the females. Thus, the confrontation of captured female aulacods shows 0% aggression between them. Confrontation between males and females also showed 0% aggression. In other words, male and female aulacods cohabit without aggression or fighting after capture in the wild. A case of tolerance between two aulacodines is illustrated in **figure 6**.

Figure 6: Collaboration between two aulacodines

3.1.4. Appearance of food consumed

The different types of forage consumed by aulacods show that aulacods eat with ease, preferring certain types of food to others (**Table 5**).

In terms of hardness: they greedily eat roughage when it is hard, and do not eat it when it is soft.

In terms of shape : they eat forage very well whole and cut up.

In terms of texture: they don't want feed in paste, powder or liquid form.

In terms of condition: they excessively consume forage foods in their fresh and dry state.

The different aspects of fruit and tuberous foods consumed by aulacods also show a preference for consumption of these foods according to their aspects (**Table 6**).

In terms of hardness: Aulacodes eat fruit and tuberous foods very well when hard, but not when soft.

In terms of shape: They eat them well when whole and cut up.

In terms of texture: Aulacodes do not consume fruit and tuberous foods in pasty, liquid or powder form.

In terms of condition: They consume fruit and tuberous foods in both fresh and dry states.

Table V: Different aspects of forage consumed by aulacods

Types of food	Food aspects								
	Hardness		Shape		Texture			Condition	
	Hard	Pout	Integer	Debited	Batter	Liquid	Powder	Fresh	Dry
Guinea grass	**	-	**	**	-	-	-	**	*
Sugar cane	**	-	**	**	-	-	-	**	*
Elephant grass	**	-	**	**	-	-	-	**	*
Fake sugar cane	**	-	**	**	-	-	-	**	*
Oil palm	**	-	**	**	-	-	-	**	*
Cassava	**	-	**	**	-	-	-	**	*
Maize	**	-	**	**	-	-	-	**	*

Table VI: Different aspects of fruit and tuberous foods consumed by aulacodes

Types of food	Food aspects								
	Hardness		Shape		Texture			Condition	
	Hard	Pout	Integer	debited	Batter	Liquid	Powder	Fresh	Dry
Cassava	**	-	**	**	-	-	-	**	*
Maize	**	-	**	**	-	-	-	**	*

**: food consumed a lot, *: food consumed less, -: food not consumed.

3.2 Aulacode breeding trial

3.2.1. Reproduction performance

The reproduction of aulacods according to parturition over 24 months (**Table 7**) shows that the aulacods had three parturitions. This gives a total of 48 aulacods. The distribution of aulacods according to parturition gives 13 aulacods at first parturition, 18 aulacods at second parturition and 17 aulacods at third parturition, i.e. an average litter size of 4.

Size of litter (or prolificacy)

Analysis of average aulacod litter size using the non-parametric Chi2 test shows a non-significant increase from 3.25 to 4.5 at the second farrowing, and a non-significant decrease to 4.2 at the third farrowing (P>0.05). Breeding females are likely to achieve the same litter size at each farrowing.

Sex ratio at birth

The aulacods numbered 48, including 26 males (54.17%) and 22 females (45.83%). The mean sex ratio determined was 1.18 in favor of males. It increased non-significantly over the three parturitions (P > 0.05).

Fertility rate

All females bred gave birth. The value of the aulacodina fertility rate remained constant at 100% over all breeding periods, giving an average fertility rate of 100%.

Fertility rate

The fertility rate generally improved from the first farrowing to the second. It rises from 325% to 450%, then drops slightly to 420% by the third farrowing. A comparison of the fertility rate of the breeding females using the non-parametric Chi2 test over three farrowings shows no significant difference (P >0.05). This means that the breeding parents remained fertile over all these breeding periods. The overall value of the broodstock fecundity rate determined is 400%.

Table VII: Breeding performance of Thryonomys swinderianus as a function of parturition over 24 months.

Farrowing number		N°1	N°2	N°3	Average
Numbers of spawners		1	1	1	
Number of breeding females		4	4	4	
Average litter		3,2	4,5	4,2	4
Number of live aulacods	Males	6	10	10	26
	Females	7	8	7	22
Number of dead aulacods	Males	0	0	0	0
	Females	0	0	0	0
Sex ratio at birth (M/F)		0,85	1,25	1,42	1,18
Fecundity rate (%)		325	450	420	400
Fertility rate (%)		100	100	100	100
Prolificity		3,2	4,5	4,2	4
Neonatal growth rate (%)		160	260	240	220

3.2.2. Reproduction parameters (or aulacod condition)

The condition of the aulacods during the breeding period indicates an overall mortality rate of 2.08% (**Table 8**).

Neonatal, post-weaning and adult mortality rates

Neonatal, post-weaning and adult mortality rates remained zero throughout the breeding period, with an average rate of 0%.

Pre-weaning mortality rate

The pre-weaning mortality rate was zero in the first and third farrowings. Mortality occurred at the second farrowing, at a rate of 5.88%. Comparison of pre-weaning mortality rates using the non-parametric Chi2 test shows no significant difference between first and second farrowing, first and third farrowing, second and third farrowing (P > 0.05). This means that mortality is not as high.

Table VIII: Reproduction parameters calculated as a function of the number of births

Farrowing number	N°1	N°2	N°3	Total
Number of animals born	13	18	17	48
Number of neonatal deaths	0	0	0	0
Number of pre-weaning deaths	0	1	0	1
umber of adult deaths	0	0	0	0
Neonatal mortality rate (%)	0	0	0	0
Pre-weaning mortality rate (%)	0	5,88	0	2,08
Adult mortality rate (%)	0	0	0	0
Total	0	5,88	0	2,08

Evasion rate

Based on the calculated animal escape parameters (**Table 9**), the overall escape rate is 8.5%, with no escape rate for the first and third farrowings. Escapes occur at the second farrowing, with an average rate of 24%. Taking age into account, the escape rate is zero at the neonatal, pre-weaning and post-weaning stages. Escapes occur at the adult stage, with an average rate of 8.5%. The overall escape rate for aulacods was 8.5%, and this occurred in the adult stage at the second farrowing.

Table IX: Escape parameters calculated as a function of farrowing.

Farrowing number	N°1	N°2	N°3	Total
Number of live animals	13	17	17	47
Number of neonatal escaped	0	0	0	0
Number of pre-weaning escaped	0	0	0	0
Number of adult animals escaped	0	4	0	4
Rate of escaped neonatal animals (%)	0	0	0	0
Rate of preweaned animals escaped (%)	0	0	0	0
Rate of adult animals escaped (%)	0	24	0	8,5
Total	0	24	0	8,5

Livestock status after 24 months

A summary of data on breeding performance, reproduction and escape parameters shows that 89% of aulacods reach maturity (**figure 7**). They comprise 48% males and 41% females, with a sex ratio of 1.17 in favor of males. This value is close to that of neonatal aulacods.

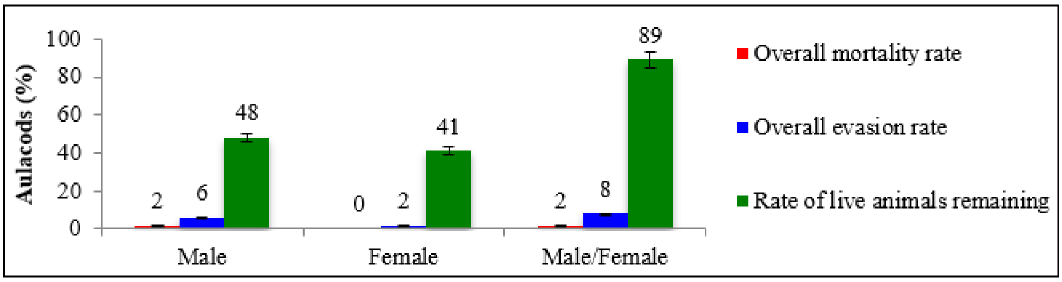

Figure 7: Rate of change in Thryonomys swinderianus numbers over 24 months

Causes of mortality and evasion

The cause of aulacod mortality is an accident linked to the invasion of the aulacoderia by magnans (Dorylus nigricans). The escape of aulacods is due to the ageing of the building.

Symptoms and diseases

The most common illnesses encountered during aulacod rearing are hair loss, wounds, diarrhea and gastrointestinal infections.

Treatment of certain illnesses

The decoction of lemon and guava leaves and fruit is given as drinking water for the treatment of diarrhea and gastrointestinal infections.

3.2.3. Weight growth of aulacods

The average weight growth values obtained on three (3) different litters between two (2) days and twenty (20) weeks of age (**figure 8**) show that :

- at two (2) days of age, the average weight of aulacods was 198.4g for a litter of 3 young, 150.4g for a litter of 4 young and 137.7g for a litter of 5 young ;
- from 1 to 5 weeks, the average weight of aulacods is 923.1g for a litter of 3 pups, 568.5g for a litter of 4 pups and 474.5g for a litter of 5 pups;
- from 5 to 10 weeks, the average weight of aulacods increases to 1631.7g for a litter of 3 pups, 1087.8g for a litter of 4 pups and 1007.2g for a litter of 5 pups;
- from 10 to 15 weeks, the average weight of aulacods increases to 1631.7g for a litter of 3 pups, 1087.8g for a litter of 4 pups and 1007.2g for a litter of 5 pups ;
- from 10 to 15 weeks, the average weight of aulacods reaches 2329.4g for a litter of 3 young, 1442.4g for a litter of 4 young and 1440.7g for a litter of 5 young ;
- from 15 to 20 weeks, the average weight of aulacods reaches 2572.8 for a litter of 3 young, 1689.3g for a litter of 4 young and 1649.1g for a litter of 5 young.

The weight growth curves per litter of aulacods as a function of age show little similarity between the 4- and 5-pup litters, but the weight growth of the 3-pup litter is clearly higher than the other two.

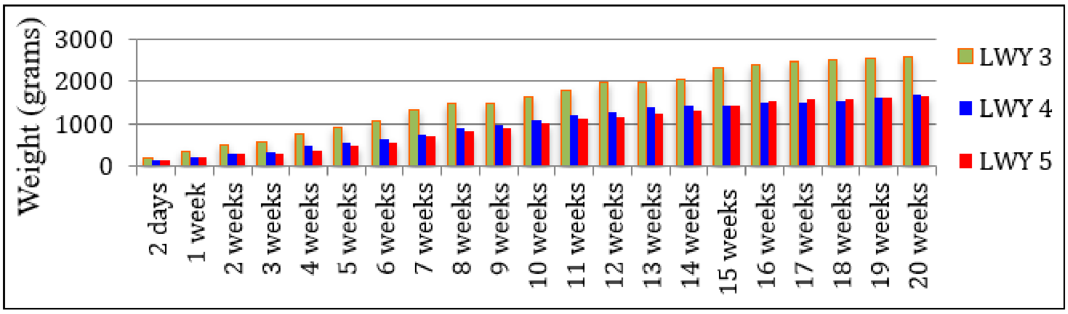

Figure 8: Weight growth of aulacods as a function of the number of young per litter
LWY3: litter with 3 young, LWY4: litter with 4 young, LWY5: litter with 5 young.

Weight growth curves for aulacods as a function of sex (**Figure 9**) show :

- For the 3-calf litter, weight growth is similar in males and females between two (2) days and 17 weeks. From the 17th week onwards, growth is less marked in males than in females. At twenty (20) weeks, the male becomes much heavier than the female, with respective average body weights of 2630.1g and 2515.5g.
- For 4- and 5-calf litters, weight growth in males and females is similar between two (2) days and 18 weeks. From the 18th week, male growth is greater than female. At twenty (20) weeks, the live body weight of the male of the 4-calf litter is 1747.2 g and that of the female 1631.4 g, then that of the 5-calf litter is 1690.4 g for the male and 1607.8 g for the female.

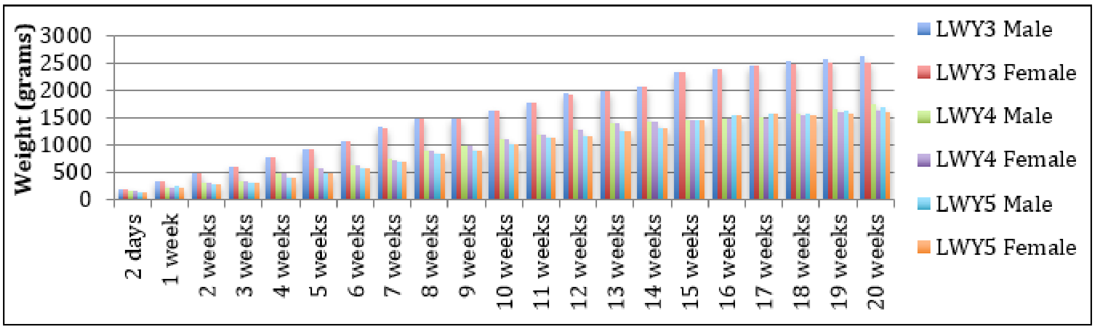

Figure 9: Weight growth of aulacods as a function of sex
LWY3: litter with 3 young, LWY4: litter with 4 young, LWY5: litter with 5 young.

3.2.4. Morphological characteristics, social and feeding behavior

Morphological characteristics

Observation of aulacods from two days to 20 weeks of age has shown that there are no remarkable distinguishing features between aulacods and adult aulacods. At two days of age, their skin is completely covered with adult-like hairs. The external auditory canal, auricle and eyes are not closed. Incisors, vibrissae and nails are visible (**figure 10 P5**).

Social behavior

At two days old, they can perform coordinated movements such as walking, running and jumping. They become agitated, flee human presence and refuse to be petted. They struggle strongly when grabbed by the hand, and cry out to express their displeasure. During cold spells, aulacods separate from their mothers, huddling together for warmth. This is the beginning of their social life (**figure 10 P6**).

Feeding behavior

At two days of age, aulacods suckle greedily and are unable to eat forage or fruit foods. From one week of age, they start to nibble on the small slices of forage left by their mother (**figure 10 P7**) and continue to cluster together during cold spells. At three weeks of age, they suckle occasionally while eating all kinds of forage and fruit, then drink regularly. From the fourth week, aulacods stop suckling their mothers. Both aulacods and parents feed in groups, with no competition for food (**figure 10 P8**). Aulacodes leave

Paper ID: SR24908214219 DOI: https://dx.doi.org/10.21275/SR24908214219

excrement and urine on the spot where they forage. With their powerful incisors, they gnaw on wooden objects (white, doors, lids) and rubber. These are just some of the damage aulacodes can cause in buildings.

P5 P6 P7 P8

Figure 11: Morphological characteristics and behavior of aulacods
P5 two-day-old aulacods; P6 grouping of aulacods to avoid the cold; P7 photograph showing 1st day of forage nibbling by five-day-old aulacods; P8 photograph showing 4-week-old aulacods feeding with parents.

4. Discussion

4.1 Ethological study

Ethological studies have shown that aulacods are indocile during the first three days of captive life. They react immediately to human contact by fleeing and hiding. They adopt this attitude because they are not used to the keeper and the new habitat. Aulacodes' high rate of flight and hiding is justified by the fact that they are panicky by nature. This result was noted by **Heymans and Mensah (1984**), according to whom recently captured aulacods often rebel against the demands of captive life and injure themselves as a result of disorderly, abrupt and frequent good behavior.

The rapprochement test has enabled the transition from indecisive to docile aulacods. Docile aulacods identify themselves through their familiarity with humans. It is not stressed by the presence of man. It plays, rests and eats in the janitor's presence without fear. This is borne out by the work of **Heymans and Mensah (1984)**, when they state that the aulacod becomes as gentle as a domestic rabbit, and that some males wander outside their cage and seek caresses.

In terms of feeding behavior, aulacods are avid eaters of forage and fruit foods. They eat them hard, whole, chopped, fresh and dry, but do not prefer them soft, pasty, powdery or liquid. Aulacodes have a herbivorous diet, and consume food in stages. These stages have been described by **Mensah and Ekue (2003**), according to whom aulacods eat by first seizing and cutting the food, then holding the slices with the front legs before cutting them with the incisors.

4.2 Breeding aulacodes

The overall average litter size is 4, within the range found by **Zougou-Tovignon (2005)** of 2.7 to 5.1. It is equal to that found by **Yewadan and Schrage (1995)** and smaller than that found by **Ntsame and Edderai (2000),** which is 5.5.

The mean sex ratio at birth obtained in our results is 1.18. This is higher than the 1:1 ratio found by **Yewadan and Schrage (1995),** 1:1.2 by **Jori (1998)** and 1:1 by **Ntsame and Edderai (2000)**.

The fertility rate of breeding aulacodines (100%) is higher than that recorded by **Ntsame and Edderai (2000)**; **Goué and *al*., (2005); Bohoussou and Blé (2020**). They scored 94%; 83.33% and 87.50% respectively. The overall fertility rate is 396% higher than the 315% found by **Bohoussou and Blé (2020)**. This could be explained by the fertility of the breeding stock. Neonatal mortality (0.00%) was similar to that observed by **Ngoula and *al*. (2009)** for aulacods weighing less than 1500 g (0.00%).

Pre-weaning mortality was 5.88% lower than that recorded by **Ngoula and *al*, (2009)** for aulacodes weighing less than 1500 g (12.50%) and higher for those weighing between 1500 g and 2000 g (3.75%), then for those weighing over 2000 g (0.00%).
Adult mortality (0%) is lower than the range found by **Fantdji and Soro (2004)**, which varies between 5% and 25%.

Overall aulacod mortality in this study was 2.08% lower than the 30.15% reported by **Bohoussou and Blé (2020)**. **Mensah and Ekué (2003)** also note that the cause of death for aulacods is accidents. Others, notably **Jori and *al* (2001)**, indicate that the cause of aulacod mortality is psychosomatic disorders (30%), septicemia (12%), respiratory disorders (10%), digestive disorders (5%) and almost 30% of mortalities are from unknown sources.

The aulacod escape rate was 8.5%, and this occurred in the adult stage at the second farrowing. The causes of aulacod escape are related to the invasion of magnans (Dorylus gribodoi) and the ageing of the building. **Mensah (2000)** recommends buildings made from strong, durable materials.

At two days old, aulacods morphologically resemble adults. They are capable of coordinated movements. The growth of these aulacods has made it possible to record their weight according to the number of offspring per litter. This survey begins with birth weights. The average birth weight of the 5-pup litter is 137.7g, that of the 4-pup litter is 150.4g and the 3-pup litter is 198.4 g. These average weights are higher than those found by **Yewadan and Schrage (1992)** at 133g, **Jori (1998)** at 138g and **Ntsame and Edderai (2000)** at 133g. These values fall within the range found by **Zougou-Tovignon (2005)**, which is 104 to 154g. These differences in weight could be explained by the number of offspring at birth, and the weight and diet of the parents during the gestation period.

The growth curves obtained show a regular evolution of the aulacods. At 6 weeks of age (weaning weight), the average weight of the 3-calf litter was 1060.6g, that of the 4-calf litter was 637.3g and that of the 5-calf litter was 552.7g. The average weights of the 3-calf and 4-calf litters are higher than the range found by **Zougou-Tovignon (2005)**, which lies between 374g and 610g. However, that of the 5-calf litter falls within this range. At 20 weeks of age (5 months), the average weight of the 3-calf litter rises to 2572.8g, the 4-calf litter to 1689.3g and the 5-calf litter to 1649.1g. The average weight of the 3-pup litter is higher than that of the 4- and 5-pup litters. The value of the 3-pup litter is very close to that obtained by Asibey (1974) in 6 months (2500g). The growth curve shows that aulacods from small litters grow faster than those from small litters. What's more, from 20 weeks of age, the male grows faster than the female **Fantodji and Soro (2004)**.

5. Conclusion

Ethological studies have shown that newly-captured aulacods are indomitable. Following an approach test, the animals became calm, accepted human presence and quickly acclimatized to their new habitat. Mastering the aulacods' behavior thus facilitated the management of their breeding. This has resulted in good reproductive performance and a relatively low mortality rate. The bonding test is proving to be an effective method of familiarization with captive animals, helping to avoid the degranulations that could result from the agitation of newly-captured animals.

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