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Bibliographical Synthesis on the Species of Frog *Aubria Subsigillata* (Dumeril, 1856)

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Abstract

Aubria subsigillata is an aquatic frog widely consumed in the Ouémé valley and unsustainably exploited by people. Thus, with the aim of contributing to the domestication of this species with a view to preserve the biodiversity of anurans, this article provides a critical synthesis of the research work undertaken on the species A. subsigillata in order to identify the points to be addressed for the control of captive breeding of this species in Benin. The literature search was performed using the google chrome, google scholar, semantic scholar and scinapse search engines. The keywords were introduced in search engines in French as well as in English. The results revealed a plenty of quantitative and qualitative informations on the systematics, taxonomy, description, living habitat, food diet and parasitic diseases of A. subsigillata. However, the informations collected on A. subsigillata are insufficient and research on its reproduction, its food needs, its ecological preference must be encouraged for the success of its domestication.

Keywords. *Aubria subsigillata, conservation, documentary research, frog breeding, ecology.*

Introduction

Since the 1800s, batrachians have been used by man to meet various needs inherent to them. Thus, they are used in traditional medicine to heal many ailments including coughs, appendicitis, wounds, measles, scorpion stings, boils, facial pain ... [1], [2], [3], [4], [5]. Culturally, many ethnic groups in West Africa and in Gabon use batrachians in particular ceremonies as traditional beliefs, totems, and fetishes [6], [4], [7]. Batrachians are also traded as domestic animals [8], [3], [7] and their skins are used for leather production [4].

Apart from these therapeutic and mystical uses, batrachians and in particular frogs are abundantly used in human gastronomy [9], [4], [7], [5]. Perceived in both Asia and Africa as an animal with a taste similar to chicken meat [10], billions of frogs are hunted and captured annually for human consumption [11]. To this effect, [12] recorded startling data on the quantities of frogs collected in the wild and [5] noted that a total of two million seven hundred and thirty-eight thousand six hundred and ten (2,738,610) frogs are collected on average per capture season in southwest Nigeria. An investigation by [11] on the consumption of frog meat in Ibadan (Nigeria) revealed that out of a requirement of two hundred and ninety-four thousand seven hundred and fifty-two (284,752) frogs, only one hundred and twenty-six thousand six hundred and seventy-two (126,672) frogs are provided by the wild supply. This could therefore lead to a decline in frog populations. Indeed, it has been estimated that between 1920 and 1992, frog populations in Iowa (USA) declined from less than twenty million to fifty thousand and that the causes could be attributed to overexploitation and disturbance of frog habitats. This is the case in Benin of the frog species *Aubria subsigillata*. Indeed, in the departments of Ouémé and Plateau, *A. subsigillata* is one of the frog species appreciated by the population. The populations of the Ouémé Valley exploit it for self-consumption and for marketing in the markets of the departments of Ouémé, Plateau and Nigeria. To this end, individuals of *A. subsigillata* are caught, killed, smoked and sold as food by fishermen, hunters and farmers. However, this species of frog is exploited unsustainably. The quantities caught, the number of catchers, catch techniques and catch periods are not regulated [13]. This leads to a daily decrease in the number of individuals caught. In addition, pregnant females are more prized for consumption and are therefore hunted and caught for their body density. This mode of exploitation constitutes an imminent threat to the biodiversity of Anurans in general and of individuals of the species *A. subsigillata* in particular. Thus, with regard to the mode of collection of individuals of *A. subsigillata* in the wild, the present article proposes to make a critical

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assessment of the existing research work on the frog species *A. subsigillata* in order to identify the points to be addressed to develop its breeding with a view to preserving the biodiversity of frogs in Benin.

2. Materials and methods

In a first step, a search was undertaken on the internet and with a laptop computer for one week. All scientific publications that dealt with the species *Aubria subsigillata* or in which the species is cited at least once were downloaded. Different search engines were used for this purpose. First, google chrome then google scholar; then semantic scholar and finally scinapse. Many keywords referring to the subject *Aubria subsigillata* were introduced in these search engines. First of all these keywords were written in French in each search engine, which allowed to generate at first glance nearly 10 documents on the topic. These keywords were the following: Aubria, *Aubria subsigillatata,* amphibiens, anoure, biodiversité, description, taxonomie, morphologie, élevage, parasite, distribution, habitats de vie, systematique. Then, the keywords were rewritten in English. More than 30 documents were identified. They were Aubria, *Aubria subsigillata,* amphibians, anurans, biodiversity, description, taxonomy, morphology, breeding, living habitats, parasite. The bibliographical references of the documents collected from the first documentary search were reintroduced in the search engines. This allowed to generate nearly 20 new documents. Some screenshots of the documents that could only be consulted online were made. A more thorough reading of all the downloaded documents was made in order to sort and remove from the batch the documents that are not correctly referenced, the documents downloaded more than once, as well as the documents that do not report relevant informations on the subject. Then, the remaining documents according to the aspects they develop were sorted. Thus, after sorting, 32 different documents were retained including 25 scientific articles, 4 reports, 2 Master's theses and 1 PhD thesis. After classifying the documents collected per aspect they deal with, 4 different types of documents were listed. These were documents dealing with systematics, taxonomy and description, those dealing with diet, documents on habitats of life and those dealing with parasitic diseases in *A. subsigillata.* After classifying the documents collected per aspect, it was counted 8 documents dealing with the systematics, description and taxonomy of *A. subsigillata*, 2 documents dealing with diet, 12 documents on the living habitats of *A. subsigillata* and 10 documents dealing with parasitic diseases in *A. subsigillata.* The figure 1 below provides information on the percentage of documents collected according to the aspects covered on *A. subsigillta*.

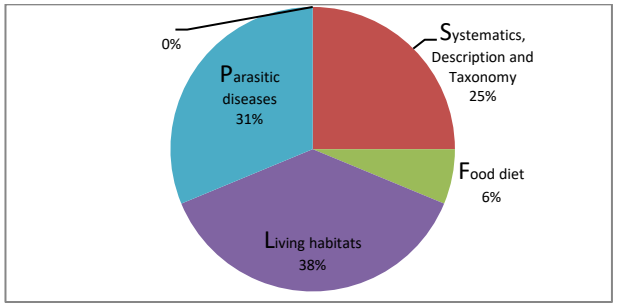
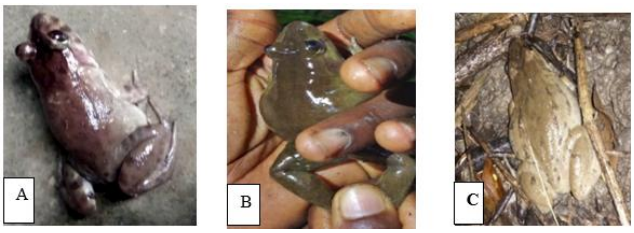


Figure 1: Proportions of documents collected per aspect addressed

3. Results

3.1 Systematics, taxonomy and description of Aubria subsigillata

The figure 2 below shows three individuals of *Aubria subsigillata* photographed in the Ouémé Valley in Benin.



A: a blackish *Aubria subsigillata* individual photographed at the edge of the Bamèzoun forest in the Commune of Aguégués.
B: a black-greenish individual of *Aubria subsigillata* captured and photographed in a wet meadow of Gnanhouizoumè in the Commune of Bonou.
C: a beige *Aubria subsigillata* individual photographed in the forest of Gnanhouizoumè in the Commune of Bonou.

Figure 2: Individuals of *Aubria subsigillata* photographed in the Ouémé Valley in Benin [13]

Aubria subsigillata is an aquatic frog commonly known by the English name "Brown ball frog" or "West African brown frog". It is a species belonging to the family Pyxicephalidae [14], [15]. Its protonyme *Rana subsigillata* has undergone many changes through the ages and many synonyms have emerged. Thus we distinguish the following binomial names: Rana *subsigillata* [16]; *Phrynopsis ventrimaculata* [17]; *Leptodactylodon ventrimaculata* [17]; *Rana (Aubria) subsigillata* [16]; *Aubria occidentalis* [18]. The ergonym *Aubria subsigillata* is the valid name, officially recognized and adopted of all herpetologists. The speciation "subsigillata" is etymologically derived from the Latin "sub" meaning under and "sigillatus" meaning to adorn with small marks; in reference to the spots present on the abdominal part of this species [15]. Its scientific classification according to [16] is the following:

Domain	Eukaryote
Reign :	Animal
Under – reign :	Eumetazoaire
Bilateria :	Deuterostomians
Branch :	Vertebrates
Super - class :	Lissamphibians
Class :	Amphibians
Super - order :	Salientians
Order :	Anurans
Sub - order	Neobatrachians
Family	Pyxicephalidae
Sub - family	Pyxicephalinae
Genus	Aubria
Species	*Aubria subsigillata*

Aubria subsigillata is a large, stocky aquatic frog with a head attached to the body by a broad and short neck [15]. The head is slightly longer than it is wide. The mouth is widely split with a pair of nostrils on top. The eyes are protruding and bulging. They are protected by 3 eyelids: A mobile lower eyelid that covers the eye and is more developed than the upper eyelid. The third eyelid (nictitating), transparent, is placed in front of the eye when *A. subsigillata* is under water. This frog has a relatively small but visible eardrum that is located behind the eyes [15]**.** The muzzle is rounded. The canthus rostralis is blunt and curved. The nostrils are closer to the end of the muzzle than to the eye (5/6). Vomerian teeth are strong, oblique in a V-shape and touch the front edge of the choane. On each tooth there are denticules (2-5). The oval-shaped tongue is bifid at the end. The forearm is slightly longer and larger than the upper arm. The hand (from the wrist to the tip of the third finger) is longer than the forearm. The first finger is much longer than the second. The third finger is the longest. The fingertips are blunt, not enlarged and sub-articular. The external palmar tuber is oval in shape. The hind limbs are short. The tibio-tarsal joint extends to a point between the eardrum and the eye. The toe IV is the longest of the foot. Toe III is slightly longer than toe V and toe I is about half as long as toe II. The tips of the toes are narrow and rounded. The foot and sub-articular tubercles are oval in length. The medial metatarsal tuber is protruding and laterally compressed with a small free distal lobe. The plantar tubers are minute. The surface of the tarsus bears fine warts. The tarsal fold is continuous between the medial metatarsal, tubercle joint and tibio-tarsal joint. The skin is smooth on the head and wrinkled anteriorly on the back becoming granular or warty posteriorly. The skin of the belly is striated transversely. The glandular areas are generally apparent at the base of the upper arm on the ventral surface [18]. The body secretes mucous glands, the muscoproteins that lubricate and moisten the skin [19]. These granular glands play many functions such as protection against predators and pathogens [20]. The cells of the superficial layer of the skin of *A. subsigillata* (epithelial cells) are juxtaposed and irregularly shaped with a clearly visible nucleus. The skin layer moults periodically. Males have a snout-vent length (SVL) between 0.065m and 0.088 m and females show a SVL between 0.076m and 0.095m [15]. The individuals of *A. subsigillata* encountered and described present two distinct morphological forms [18]. Some individuals have femoral glands and long legs and are found in Central Africa. These individuals are named *A. masako* [18], [21]. Other individuals have small legs; femoral glands located in the middle of the femur and are found in the forests of West Africa [18]. These individuals are named *A. subsigillata*. [46] differentiated on the basis of vocalisation and living habitat another species similar to A. *subsigillata* and which was named *A. occidentalis.* [22] noted that *A. subsigillata* has a vocalization similar to deep drum beats.

Male and female individuals of *A. subsigillata* are very similar [15]. Size dimorphism and the existence or not of femoral glands differentiate males from females. Indeed, females of *A. subsigillata* have large and developed femoral glands while males do not have them or, if they do exist, they are less developed and very small in size. Individuals of *A. subsigillata* are oviparous. Their eggs are small in size and black in color. The tadpoles are plump and black in colour. They live in an agglutinated way and have a size between 0.035m and 0.04m [23].

From the coloration point of view, *A. subsigillata* has a uniform dorsal and flank; the coloration is beige, brown or olive. It is brown with black spots of variable shape. It has irregular dark spots on the forearm and two oblique black sub-orbital spots. The thigh has black bars on the top. The femoral pattern is covered with small round white spots. The tibia is mottled with black bars. The external face of the tarsus is regularly speckled with black. The abdomen is decorated with yellow or white spots of varying sizes and shapes. The throat, abdomen and the periphery of the thighs and tibia have a grayish-beige background more or less purplish blue. Small round luminous spots are found under the hind legs (Figure 2) [18].

3.2 Geographical distribution

Aubria subsigillata is a species of frog endemic to Africa. It has a discontinuous distribution that extends from Southern Guinea through Liberia and Ivory Coast, then from Nigeria to Southern Cameroon; from Equatorial Guinea to Gabon through Togo and Benin [14]. It is thus

distributed along the coasts of West and Central Africa as far as Gabon [21]. Specimens of *A. subsigillata* studied come from Liberia, Ivory Coast, Ghana, Nigeria, and Cameroon [18]. Indeed, this species has been encountered in many forests of Central and West Africa. Thus, in Gabon it has been found in the Ivindo Valley, Wolen N'Tem, Lobaye Valley, Central African Republic, in the center of the flooded primary forest that covers the south-western part of the country [23]. Aubry-Lecomte collected this species in the Mondah forest (Libreville) [24]. [25] found this species exclusively in Ganganya in the flooded forest of the Likouala region of the Republic of Congo (Brazzaville). In West Africa, diversity studies on amphibian fauna have enabled this species to be recorded in many environments. In Cameroon, this is the dense forest of Ebamina [18]. [26] caught a sub-adult specimen of *A. subsigillata* near the port of Harcourt in Nigeria. [27] also observed this species in the Edo region of Nigeria, specifically in oil palm plantations and on the banks of the Niger River at Agenegbode. Similarly, it has also been observed in the swamp forests of the Niger River in Nigeria [28], [29]. In Ivory Coast, [30] recorded *A. subsigillata* in coconut plantation areas in agroindustrial zones. [31] noted this species in Ghana at the level of the Boi-Tano forest reserve and in southeast Guinea (classified forests of Diecké, Mont Béro, Ziama, Déré, Mont Nimba and Pic de fon). [32] observed *A. subsigillata* in a forest in southern Ghana. [33] recorded this species in Togo. In Benin, this species has been encountered in the gallery forest of Lokoli [34], as well as in wet grassland, marshland and forest areas of the Communes of Bonou, Adjohoun, Dangbo and Aguégués in the Department of Ouémé [13].

In these different regions of Africa listed, *A. subsigillata* occurs in the humid, shady parts of forest habitats, along stream banks; in the plains of dense equatorial forests [18]. Its natural habitat is therefore swampy areas [35]. This frog inhabits temporary ponds or muddy (silty) ponds with permanent water [18]. It prefers gallery forests, degraded secondary forest areas (scrubby environments). It adapts easily to several types of habitat and can be found in protected areas when it faces serious threats [35]. It is a night owl and it remains deeply buried during the day in soft, damp mud. It becomes active at nightfall. The tadpoles of this species after metamorphosis migrate from the aquatic environment to find themselves in abundance at the banks. They spend several weeks at the level of the banks before starting to dig [23].

3.3 Food Diet

Analysis of the stomach contents of *A. subsigillata* revealed the presence of *Epiplatys macrostigma* and *E. sheljuzhkoi* (Cyprinodontidae) (60%), young Aubria (18%), Arthropods (15.5%), *Hymenochirus boetlgeri (*3%), Aphyosemion sp. (Cyprinodontidae) (2%), Molluscs (1%), Plants (0.5%) [23]. According to the proportions of prey observed in the stomach, we distinguish the presence of ants, beetles (mainly aquatic), spiders, milliapods, grasshoppers, crickets moles, crabs, shrimp, molluscs, young achatinidae and succinidae, etc.. Large prey are also caught and consumed by *A. subsigillata.* These are tadpoles of *A. subsigillata* and other frog genera such as Hyperolius, Afrixalus (adult) and other young ranidae and caecilian (Geotrypetes). Large quantities of plant fragments and also small traces of pebbles are observed in the digestive tract of *A. subsigillata*. Pebbles observed in the digestive tract of *A. subsigillata* are certainly inadvertently swallowed [22], [23], [36], [18].

3.4 Parasitic diseases

Aquatic environments constitute the reservoir of chemical residues resulting from anthropic activities. They host numerous pathogens that are sources of disease for many species of frogs. Benthic invertebrates are the first level of pollutant transfer from sediments to higher organisms; they also represent intermediate hosts hosting numerous parasites. The mode of infestation can be oral through the food consumed (invertebrates, plants, stones) or integumentary (water pollution). In the genus Aubria and the species *A. subsigillata* in particular, a number of parasitic diseases have been observed. These are nematodes, cestodes and trematodes (Table 1).

Table 1: List of pests found in the *A. subsigillata* individuals and infestation sites

Groups	Parasites	Infested organs	References
Cestode	*Cylindrotaenia jaegerskioeldi*	Small intestine	[37], [38], [39], [40]
Trematode	*Mesocoelium monodi*	Intestine	
Trematode	*Mesocoelium monas*	Small intestine	[37], [38], [39], [40]
Trematode	*Pleurogenoides tener*	Small intestine	[40]
Trematode	*Haematoloechus aubriae*	Lung	[40], [33]
Trematode	*Diplodiscus fischthalicus*	Rectum	[37], [38], [39], [40]
Trematode	*Halipegus sp.*	Esophagus	[37], [38], [39], [40]
Trematode	*Opisthorcbis lomeensis*	Gallbladder	[33]
Nematode	*Chabaudus leberre*	Small intestine	[37], [38], [39], [40]
Nematode	*Camallanus dimitrovi*	Small intestine	[30]
Nematode	*Oxysomatium brevicaudatum*	Large intestine, Cloaca	[30]
Nematode	*Cosmocerca ornata*	Rectum, Large intestine, Small intestine, Cloaca	[37], [38], [39], [40], [30]
Nematode	*Microfilaria sp.*	Blood	[38]
Fluke	*Opisthorchis lomeensis*	Gallbladder	[33]

4. Discussion

4.1 Systematics, taxonomy and description of Aubria subsigillata

A. subsigillata, according to the systematic classifications proposed by many systematists, is a species that has long belonged to the family Ranidae [41], [16], [18], [42]. [23]

found that males and females of this species have a body shape typical of the ranidae with a pointed snout and a black-green to olive dorsal fin. For other authors, this species belong to dicroglossidae family [43]. These observations are not endorsed by [44] who in the study on comparative osteology and evolutionary relationships on the Ranidae of Africa noted that *A. subsigillata* is indeed a species very close to the Pycicephalidae and not to the Ranidae. Recently, [45] sequenced the mitochondrial genome of *Pyxicephalus edulis* and reconstructed the phylogenetic relationship with the Ranidae. The sequenced genome showed many rearrangements of significant length that the Ranidae do not share. He therefore concluded that the Pyxicephalidae formed a monophyletic group and they were sister taxa of Petropedetidae and Ptychadenidae. As for the Dicroglossidae family, they are very far from the Pyxicephalidae. Indeed, in West Africa only the species *Hoplobatrachus occipitalis* belong to Dicroglossidae family and it is more widely observed in all west Africa. It has a large head; the skin is often mottled black and it is large in size. Unlike *H. occipitalis*, the genus Aubria has a less broad head; the femoral glands characteristic of sexual dimorphism are present. It is smaller in size than Hoplobatrachus. However, [15] describes this species as stocky, while [18] calls it thin. It should be noted that the size of a species does not only depend on genetic traits but also on the physiological stage of the animal and also on the environmental conditions offered by the living habitat. Thus the average SVL length of the holotype of *A. subsigillata* observed in Gabon by [16] was 0.767 m in males and 0.084 m in females, whereas in Cameroon a male of 0.075 m was observed. [30], on the other hand, observed specimens in southeast of Ivory Coast with a SVL of 0.766 m in females and 0.0744 m in males. All these recorded lengths were significantly less than that noted by [17] which was 0.085 m. However, [17] did not notice the dimorphism in size observed by the other authors; while this observation is crucial. Indeed, sex differentiation in *A. subsigillata* has given rise too much discussion and confusion between species. *A. subsigillata* remained monospecific for a long time until [21] described *A. masako* as a species without femoral glands. But [18] saw that the authors confused A. *masako* with *A. occidentalis*. [46] corroborated his remark by acknowledging the presence in Cameroon of a species similar to A. *subsigillata* but with different vocalisation. But he did not attribute this species to A. *occidentalis*. [47] justified this by the existence of femoral glands located in the middle of the length of the femur, whereas in *A. subsigillata,* these glands are located close to the knees. [48] found first that the femoral and gill glands on individuals of *A. subsigillata* are characteristic of males. [21] found, on the contrary that femoral glands are present in both males and females of *A. subsigillata*. Referring to the description given by [21], the species *A. massako* was only found in Central Africa and furthermore it does not have femoral glands, which was not true. Thus, two species of Aubria are officially known and named. It is about *A. subsigillata* which has short legs and whose femoral glands are broad and developed in females, almost non-existent in males and *A. masako* presenting the same features as A. *subsigillata* with the difference that these legs are long as those of *A. subsigillata*. As for *A. occidentalis* it is considered a junior synonym of *A. subsigillata* [42]. However, recently [30] met *A. subsigillata* in the fish farm of the Banco National Park and always named it *A. occidentalis.* This shows that the two species of the genus Aubria are not yet widely accepted.

As far as coloration is concerned, it is very variable in *A. subsigillata,* but the tadpoles have an immutable black colour. As for sub-adults and adults, the coloration of individuals varies according to localities. Individuals of *A. subsigillata* observed in the Banco National Park in Ivory Coast for example were colored. Those observed in parks in other localities, such as in Ghana, are more beige or blackish-brown in colour [42]. Some individuals have a brown dorsal fin and a white spotted abdomen on a brown background. [30] found that the belly is translucent with round white spots. [15] noted that the oldest individuals have a white abdomen. These variations observed in the coloration of *Aubria subsigillata* individuals is indeed due to ecological factors in the living environment of these individuals that differ from one region to another and affect the dermal cells of the frogs' skin.

4.2 Geographical distribution

[23] believes that the distribution of *A. susigillata* is restricted and limited to Central Africa. That is, it extends from Guinea to the Congo forest. [49] describes *A. subsigillata* as an occasional host of the cosmopolitan. As for [14], in his work on Amphibian species of the world, he showed that *A. subsigillata* has a limited distribution in Gabon, Zaire (Congo) and southern Cameroon.

These authors ignored the extension of the distribution of *A. subsigillata* to West Africa although mentioned by other authors such as [50], [48], and [36]. [18] on the other hand, finds that its distribution extends only to West Africa from Guinea to Nigeria. [35] has taken a narrower view of the distribution of this species. For him it is a species present in West Africa and exclusively in Cameroon and towards the south. Thus, the delimitation of the distribution areas of this species differs between sources. Indeed, these authors did not agree on the geographical distribution of this species. In the 1970s, very little work was carried out on the diversity of amphibians and moreover, the sampling habitats were not exhaustive. Similarly, *A. subsigillata* was confused with other species during those times and it is only recently that its description has been complete. However, it should be noted that it is found in both Central and West Africa and therefore the geographical distribution presented by [35] requires updating.

Furthermore, [23] stated that he collected individuals of *A. subsigillata* at 0.5m depth in the mud of ponds when he was looking for Apods and the tadpoles of this species

started to dig into the earth to bury themselves after long weeks spent at the edges of water receptacles. This behavior could be explained by the fact that this frog seeks a dark environment, less disturbed by the sun's rays and human activities and constantly humid. Moreover, since anurans in general feed mainly on invertebrates, the benthic bottom is very diversified in invertebrates. However, the mode of excavation of this species is not yet elucidated. This suggests that pond rearing would not be very adequate for the production of this species; however, a grow-out in a snorkel or in a pond could bring satisfactory results. Because of its benthic character, its mode of reproduction is not yet clarified.

3.3 Food Diet

[23]in his study of the feeding habit of *A. subsigillata* in Gabon concluded that at certain times of the year this frog species feeds on fish of the genus Epiplatys. Taking into account the food composition observed in the digestive tract of this species, fish and invertebrates are the most representative. Thus, the protein requirements of this species are highly elevated and this species is therefore known by many authors as a powerful predator [22], [23], [36], [18]. From the point of view of the plants consumed, they are in small proportion. This presence of plants in the stomach of *A. subsigillata* is not accidental or opportunistic. Indeed, in anurans, many intestinal parasites are observed in the intestines [37], [38], [39], [40]. The insignificant presence of plants in their organism could be perceived as a contribution to the evacuation of intestinal parasites by the antiparasitic properties of the consumed plants [51]. To this end, further investigations should be carried out on the types of plants consumed by frogs and their therapeutic properties. In addition, [23] considers that pebbles observed in the digestive tract of *A. subsigillata* are inadvertently swallowed during prey capture. This is not entirely true because all living organisms require low proportions of minerals in their diet to satisfy their dietary needs. Pebbles are mineral stones whose mineralogical composition varies depending on where they are found. They generally contain silica, aluminum, potassium, sodium, calcium, magnesium and iron, which the body also needs for its functioning.

4.4 Parasitic diseases

[52] studied parasites of anurans in the fish farm of the Banco National Park in Ivory Coast. He noticed a high prevalence of nematode infestation. Indeed, nematodes are round worms, with segmented and long body. They are covered with a rigid cuticle and are capable of causing numerous pathologies that can lead to the death of their hosts [53], [54], [55]. Thus, [52] attributes this massive infection of amphibians by nematodes to the microhabitat. According to [56], nematodes are euryxene and have as their preferred habitat farmland and mud. This thus testifies to the degree of infestation of *A. subsigillata* by this parasite. Indeed, *A. subsigillata* prefers to bury itself in the mud of ponds during the day. It should be noted here that the prevalence of nematodes (68.36%) in the aquatic habitat would be favoured by the food supplies intended to feed fish in fish farms. A large part of the feed distributed in the ponds settles to the bottom of the water to feed the benthonts including nematodes. This could explain the level of nematode prevalence observed by [30] in the Banco National Park fish farm. This noted prevalence rate is highly higher than that observed by [40] in Nigeria in *A. subsigillata* nematodes (3%). As for trematodes (6.6%), their prevalence rate in southwestern Nigeria is higher than that of nematodes (3%) and cestodes (1.2%). From these analyses, it is appropriate to suggest for the breeding of *A. subsigillata* in ponds, breeding infrastructures such as happas to avoid contact with sediment. However, proper cooking of frogs before consumption prevents the transmission of these parasites to humans [57]. Furthermore, [58] noted that *Cosmocerca ornata* is a species recognized as a common parasite of amphibian species. It can be transmitted from contact between anurans in the wild or when species share the same biotope. It is therefore necessary to privilege the monoculture of *A. subsigillata.* Another flarid nematode specific to *A. subsigillata* has been identified in Nigeria by [40]. Only the genus was identified but not the species. This oioxene nematode is characterized by a length of 95.10^{-6}m and varies between 84.10^{-6}m and 117.10^{-6}m. Its body is sheathed and has a bulbous posterior at the end.

The adult is covered with a peritoneal cavity.[59] observed ciliates of the genus Nyctothera living in the terminal part of the digestive tract in many individuals of *A. subsigillata.* These are *Neonyctotherus reticulatus, Nyctotheroides brachystomus, Nyctotheroides purpureus* and *Nyctotheroides teocchii.* He states that these ciliates cannot, under any circumstances, be considered as parasites and that they must be qualified as endozoic or endocommensal organisms. Nevertheless, [60] asserted that it is possible that the Nyctothera occasionally feed on blood released from the intestinal wall by nematodes, as it is the case of *Balantidium entozoon,* which coexists with nyctothera in European Amphibians. It is therefore worth asking who benefits from the presence of these nyctothera in the anuran organism if these nyctothera are usless to the anurans. It should be remembered that contamination of anurans by nyctothera occurs essentially by ingestion of cysts at the tadpole stage, thus in the aquatic environment [46].

Opisthorchis lomeensis is an oioxene parasite of *A. subsigillata* whose biological development cycle is still unknown today. It seems that metacercariae form either in fish or in Amphibian tadpoles. In the latter case, it is more likely that adult individuals of *A. subsigillata* would infest themselves by eating their own young or those of sympatric anurans [33].

Conclusion

Aubria subsigullata is an aquatic frog with good performance in terms of body size. Even if its taxonomy has undergone many controversies over time, its binomial nomenclature and description are now complete. This species is stocky and the tadpoles are very plump. It presents a variability in coloration and according to the environment in which it lives. This coloration varies from beige to brown or can be olivaceous.

Research efforts allowed to identify the criteria of observable dimorphism between males and females of this species, to know the composition of the food diet of this species in the natural environment and the parasitic diseases that infest this species. Although it should be noted that *A. subsigillata* is an interesting species for the promotion of raniculture in Benin; nothing has been done on its reproduction, growth, and ecological preferences. The field of research on this species is really wide and it is indispensable to explore it in order to come up with satisfactory results that can advance science and preserve the biodiversity of anurans.

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