

Sexual dimorphism of the skin surface in *Pipa parva* (Anura: Pipidae)

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Abstract. The structure of the skin surface in *Pipa parva* is sexually dimorphic. Typically, the bodies of females are covered with warts and spines of various sizes, whereas males have smooth, keratinised plates on the back. The surface of each plate is composed of several stratum corneum cells, with small spines arranged around and between the plates. Juvenile males have skin similar to that of females; the plates become obvious when the males begin to call.

Key words. Amphibia, Anura, *Pipa parva*, skin, sexual dimorphism.

Anuran skin consists of two main components, the multi-layered epidermis, which is covered by the outer single layer of keratinised stratum corneum, and the dermis comprising typically a stratum spongiosum and a stratum compactum. In contrast to the stratum spongiosum, where collagen bundles are arranged loosely, the stratum compactum contains collagen bundles arranged in a criss-crossed manner (e.g., FOX 1986, 1994, DUELLMAN & TRUEB 1986). In both, the epidermis and the dermis, sexually dimorphic traits have been described. Nuptial pads are an example of a well known, primarily epidermal trait that is linked to the sexual cycle and testicular androgen production. The latter obviously changes parallel to the development of nuptial pads (e.g., INGER & GREENBERG 1956). Sexually dimorphic traits of the dermis that have been described in pipids are less obvious. The females of *Xenopus laevis* have a thicker skin than males and more numerous and larger glands dorsally (FUIJIKURA et al. 1988). The mechanical properties of the skins also differ (GREVEN et al. 1995). Females of the two *Pipa* species studied so far lack a distinct dermal stratum compactum in the dorsal skin (VON KLINCKOWSTRÖM 1894, GREVEN & RICHTER 2009), which has been suggested as facilitating the nidation of eggs (GREVEN & RICHTER 2009, GREVEN 2010).

In course of our studies on reproduction in *Pipa* spp. (see also BÜNTEN et al. 1992), we noticed a previously unmentioned sexually dimorphic trait of the epidermis in *Pipa parva*. In the original description of the species RUTHVEN & GAIGE (1923:2) characterized the skin of *P. parva* as “skin evenly tubercular, more smooth beneath”. However, TRUEB & CANNATELLA (1986:438) noted for the same species “all surfaces of the body are tuberculate” and that “the back is covered by depressed tubercles of variable sizes”.

Pieces of skin from a non-reproductive adult female, an adult male, and a juvenile male approximately 3 months old were fixed in 2.5% glutaraldehyde in 0.1 mol/l cacodylate buffer (pH 7.2) for several hours and postfixed in 1% osmiumtetroxide in the same buffer. For light microscopy (LM), pieces were embedded in SPURR (1969), sectioned 1 µm thick (semi-thin section) and stained with 1% toluidine blue plus 1% borax. For scanning electron microscopy (SEM), pieces were dehydrated; critical point dried and viewed in a Leitz 1001 scanning electron microscope.

The dorsal skin of adult, non-receptive females is densely covered with warts of various sizes. Each wart bears a blunt apical tip or spine, and is ringed by minute spines (Fig. 1 a, b). The epidermis of the juvenile, immature male principally shows the same surface sculpturing (Fig. 2). Warts are smaller,

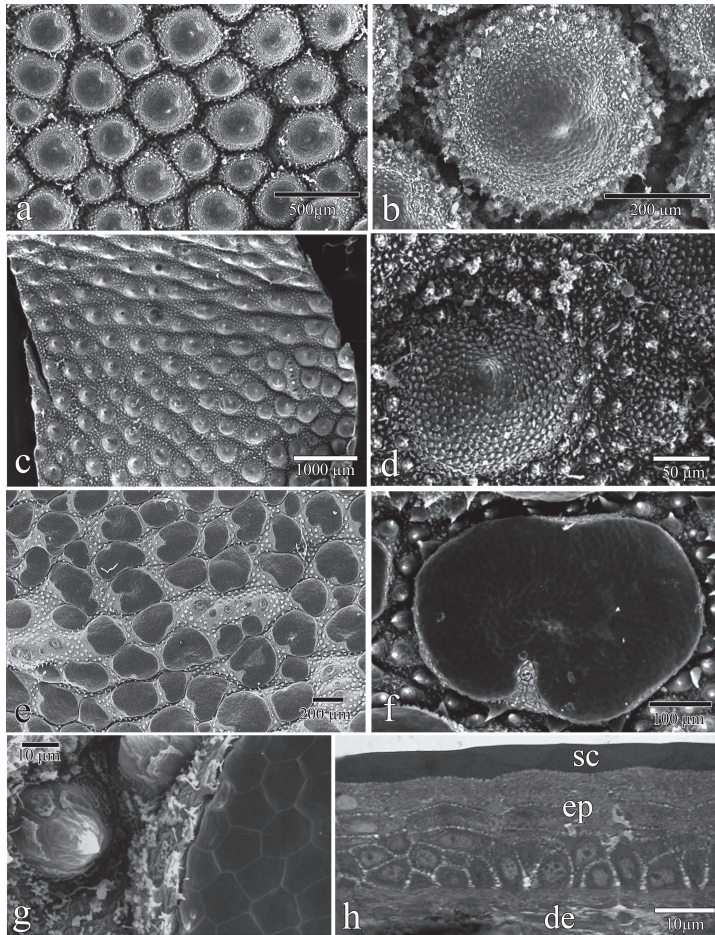


Fig. 1. Dorsal skin surface in *Pipa parva* (a-f: SEM; g: LM semi-thin section). **a, b** Adult, non-receptive female; note the densely arranged warts; **c, d** juvenile, immature male; warts have larger spaces between one another (compare with figure a). **e-h** adult male, note the smooth plates and artichoke-like spines between them. Plates consist of a single layer of keratinised stratum corneum cells (**h**). ep = living epidermis, de = dermis, sc = stratum corneum.

have blunt tips, and are less densely arranged than in females. Minute spines are arranged among the larger warts (Fig. 1 c, d). The surface of the dorsal skin of mature males, however, has smooth plates of various sizes with spines (like an artichoke) around them and between the plates (Fig. 1 e-g). Males are much less rough to the touch than are females or juvenile males. Greater magnifications and LM-sections reveal the smoothness

of the plates (Fig. 1 f, h) and the fact that their surfaces are formed by numerous polygonal stratum corneum cells (Fig. 1 g, h).

The sexually different skin surface described here is undoubtedly a secondary sexual character (dependent on gonadal hormones). The remodelling of the epidermis obviously occurs at onset of sexual maturity, i.e. when the male begins to call (unpublished), and is then retained permanently.

Currently, the adaptive value of this trait is unknown.

To our knowledge, a sexually dimorphic skin surface has not been described yet for any *Pipa* spp. (VON KLINCKOWSTRÖM 1894, ELIAS & SHAPIRO 1957, TRUEB & CANNATELLA 1986). For the related *P. carvalhoi* we can exclude the presence of this kind of sexual differentiation described herein (unpublished). However, it is amazing that this secondary sexual dimorphic trait had not yet been detected in *P. parva*, as it can be easily recognized either by touching the animal or through a magnifying glass. At the present time we rule out incorrect identification of our specimens, because they have, among other traits, one of the most valuable diagnostic features for *P. parva* – the special configuration of the fingertips (“one pair of lobes is distal, the second pair is located a short distance proximal and lateral on the finger” TRUEB & CANNATELLA 1986:437).

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