



Limb Malformation and Ocular Abnormality in a Large Odorous Frog, *Odorrana graminea* (Boulenger 1899) (Anura: Ranidae)

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The Large Odorous Frog (*Odorrana graminea*), a large ranid widely distributed in southern China and northern Indochina (Frost 2021), has significant female-biased sexual dimorphism in body size (SVL to 50 mm in males, to 100 mm in females) (Fei et al. 2012). This common species inhabits fast-flowing streams in montane forest, where breeding males emit diverse broadband signals that contain ultrasonic harmonics (Shen et al. 2011). We herein report an adult female *O. graminea* with a malformed left forelimb and an abnormal right eye.

At 2130 h on 21 February 2021, during a survey of Pak Kung Au, Lantau Island, Hong Kong S.A.R. (22°14'40.1"N, 113°56'44.5"E; elev. 245 m asl), we encountered a pair of Large Odorous Frogs in axillary amplexus on the bank of a small cascade (ca. 0.3–0.8 m wide, 0.2–0.5 m deep). Upon closer examination, we noticed ectromelia (absence of bony structures and stifle joints; Meteyer 2000) of the left humerus in the female (ca. 90 mm SVL) and that the upper part of the

right eye was opaque, cloudy, and had a smoky bluish-white reflection in the beam of a flashlight (Fig. 1).

A cataract is a clouding of the lens that can cause vision impairment and blindness. Because anurans are highly dependent on vision to obtain food and for predator avoidance (Wells 2010), eye abnormalities that impair vision reduce individual survival rates (Fite et al. 1998; Toledo and Toledo 2015). Consequently, cataracts are rarely documented in anurans in nature (Brown 2019).

Global reports of limb malformations in amphibians have increased over the past decade (Peltzer et al. 2011; Marín-Martínez and Botero 2019; Bosch and Marrero 2020), with most observations in polluted habitats, such as areas devoted to oil and gas development, agriculture involving pesticides, and livestock production (Lannoo 2008; Koleska and Jablonski 2016; Yeung and Yang 2021). Apart from anthropogenic disturbances, Ballengée and Sessions (2009) revealed that bites of aquatic predators during larval stages also can



Fig. 1. A pair of Large Odorous Frogs (*Odorrana graminea*) in amplexus showing the female with ectromelia of the left humerus (left) and a cataract in the right eye (right). Photographs by H.Y. Yeung.

lead to anuran limb malformations, although these types of limb deformities usually affect only the hindlimbs, as the forelimbs do not develop until just prior to metamorphosis. In the case described herein, the habitat is not subjected to substantial anthropogenic pollution, whereas numerous potential aquatic predators (e.g., freshwater crabs, dragonfly and fishfly larvae) were recorded in the stream. Therefore, although a forelimb was affected, we suggest that this malformation was most likely caused by predation.

Sower et al. (2000) indicated that frogs with limb malformations had significantly lower concentrations of androgens and GnRH (gonadotropin-releasing hormone), the latter a regulatory neurohormone central to the control of reproduction in vertebrates. Our report represents a rare record of an amphibian in nature with a malformed limb and an ocular anomaly that was nevertheless able to breed.

Acknowledgements

This study was supported by the Kadoorie Farm and Botanic Garden, Hong Kong.

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