

---

## Bicephaly in the anuran *Pseudophryne pengilleyi*

MICHAEL MCFADDEN<sup>1,3</sup>, PETER HARLOW<sup>1</sup> and DAVID HUNTER<sup>2</sup>

<sup>1</sup> Taronga Conservation Society Australia, PO Box 20, Mosman, NSW, 2088, Australia.

<sup>2</sup> NSW Department of Environment, Climate Change and Water, PO Box 733, Queanbeyan, NSW, 2620, Australia.

<sup>3</sup> Corresponding author: mmcfadden@zoo.nsw.gov.au

**B**ICEPHALISM, or axial bifurcation, is a congenital malformation in which a single-bodied embryo develops with two heads. This condition has been reported on numerous occasions in mammals and reptiles, especially snakes (Wallach, 2007) and turtles (Hildebrand, 1938; Diong et al., 2003). Despite malformations involving missing or extra limbs and digits occurring quite commonly in amphibians (Johnson et al., 2003; Lannoo, 2008), there have been very few reports of bicephalism.

Bicephalism has been reported in at least four caudate species (Pereira & Rocha, 2004; Velo-Anton et al., 2007) and five anuran species (Lebedinsky, 1921; Dragoiu & Busnitza, 1927; Schwind, 1942; Lynn, 1944). Each of these cases documents the condition in amphibian larvae only, rather than the adult form. Here we report a case of bicephalism in the Australian northern corroboree frog (*Pseudophryne pengilleyi*), that to our knowledge is the first record of a bicephalic amphibian tadpole successfully metamorphosing.

A small population of adult *P. pengilleyi* is held at Taronga Zoo, Sydney, as a component of a recovery programme for this endangered species. All adults were reared to maturity in captivity after being collected from the wild as eggs. On 4 July 2010, 79 live captive-produced *P. pengilleyi* eggs, representing clutches from up to six females sired by a single male, were retrieved from a communal nest located under moist sphagnum moss on a gravel base. Five of the females housed in the breeding enclosure were unrelated to the male, whilst one was a direct sibling, resulting in a 17% chance that offspring could be from closely related parents. The eggs, laid during February and March, were placed in 220 litres of water in a tank (135

x 55 cm, filled to 30 cm deep). They were fully developed at Gosner stage 25 (Gosner, 1960) prior to placement in the larval tank, and hatched between 4-13 July 2010. Delayed hatching is normal for this species, where eggs may not hatch until the nest is inundated.

In December 2010, a tadpole was discovered with two heads, including two pairs of eyes and nostrils and two apparently functional mouthparts (Figs. 1 and 2). It had a severely kinked tailed, so its swimming attempts were limited to gradual circular turns. At this time it measured 8.5 mm and weighed 0.25 g. It had not been seen earlier due to its coloration matching the silty substrate in the tank and its limited movement. There were no other abnormalities observed in this clutch.

The tadpole reached Gosner stage 42 on the 21 December 2010, when it developed two forelimbs. Metamorphosis was completed on the 28 December 2010 (Fig. 3). The frog was 8.1 mm in length and weighed 0.07 g, which is very small for this species. Four other metamorphs in this tank averaged 13.5 mm and 0.32 g.

Both heads appeared equal in size and neither seemed dominant. Each pair of eyes appeared functional and it was capable of opening both mouths. The frog was able to move through the sphagnum moss substrate of its enclosure but its movements were unstable. This was most apparent on a flat surface, with the frog frequently flipping over and unable to right itself. The frog demonstrated no feeding response when offered hatchling house crickets (*Acheta domestica*) and a wide range of appropriate sized leaf-litter invertebrates. Despite placing these directly in front of each head and on both its mouths, no feeding response was elicited. The individual died on 16 January 2011 and was preserved.

REFERENCES

Diong, C.H., Tan, L.K.A. & Leh, C.M.U. (2003). Axial bifurcation in a bicephalic *Chelonia mydas* embryo. *Chelonian Cons. Biol.* **4**, 727-727.

Dragnoiu, J. & Busnitza, T. (1927). Bicephalic *Bombinator igneus* tadpole. *C.R. Soc. Biol. Paris* **97**, 1015-1017.

Gosner, K.L. (1960). A simplified table for staging anuran embryos and larvae. *Herpetologica* **16**, 183-190.

Hildebrand, S.L. (1938). Twinning in turtles. *J. Hered.* **29**, 243-253.

Johnson, P.T.J., Lunde, K.B., Zelmer, D.A. & Werner, J.K. (2003). Limb deformities as an emerging parasitic disease in amphibians: Evidence from museum specimens and resurvey data. *Cons. Biol.* **17**, 1724-1737.

Lannoo, M.J. (2008). *Malformed Frogs: The Collapse of Aquatic Ecosystems*. Berkeley, CA:

University of California Press.

Lebedinsky, N.G. (1921). On a tadpole of bicephalous *Rana temporaria*. *C.R. Soc. Biol. Fr.* **85**, 791-792.

Lynn, W.G. (1944). Duplicitas anterior in the toad, *Eleutherodactylus alticola*. *Anat. Rec.* **89**, 345-355.

Pereira, R. & Rocha, S. (2004). *Chioglossa lusitanica* (Golden-striped salamander): Dicephalic larva. *Herpetol. Bull.* **87**, 29-30.

Schwind, J.L. (1942). Spontaneous twinning in the amphibia. *Am. J. Anat.* **71**, 117-151.

Wallach, V. (2007). Axial bifurcation and duplication in snakes. Part I. A synopsis of authentic and anecdotal cases. *Bull. Md. Herpetol. Soc.* **43**, 57-95.

Velo-Anton, G., Buckley, D., Daoudi, A.D. & Rivera, A.C. (2007). Bicephaly in *Salamandra salamandra* larvae. *Herpetol. Bull.* **101**, 31-33.



Figure 1. Dorsal view of bicephalic *Pseudophryne pengilleyi* tadpole.

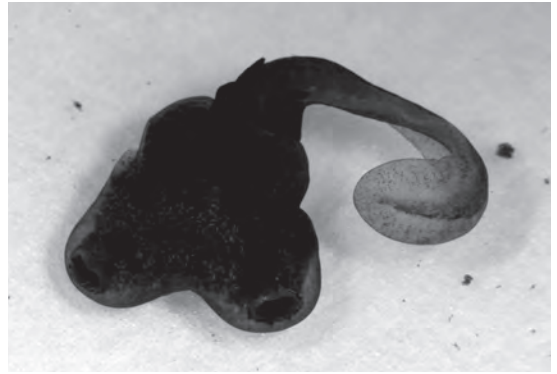


Figure 2. Ventral view of bicephalic *Pseudophryne pengilleyi* tadpole.



Figure 3. Bicephalic *Pseudophryne pengilleyi* at nine days post-metamorphosis.