The tadpole of the Lake Oku frog Xenopus longipes (Anura; Pipidae)

Article *in* Zootaxa · July 2015

DOI: 10.11646/zootaxa.3981.4.10

CITATIONS
4

READS
224

3 authors:

Benjamin Tapley
ZSL
79 PUBLICATIONS **404** CITATIONS
SEE PROFILE

Christopher Michaels
Zoological Society of London
55 PUBLICATIONS **242** CITATIONS
SEE PROFILE

Thomas Doherty-Bone
65 PUBLICATIONS **492** CITATIONS
SEE PROFILE

Zootaxa 3981 (4): 597–600
www.mapress.com/zootaxa/

Correspondence

ISSN 1175-5326 (print edition)
ZOOTAXA
ISSN 1175-5334 (online edition)

http://dx.doi.org/10.11646/zootaxa.3981.4.10
http://zoobank.org/urn:lsid:zoobank.org:pub:57797C11-27BF-4FBE-BED7-A65F27D6CFF5

The tadpole of the Lake Oku clawed frog *Xenopus longipes* (Anura; Pipidae)

BENJAMIN TAPLEY[1,3], CHRISTOPHER J MICHAELS[1,3] & THOMAS M. DOHERTY-BONE[2]

[1]*Zoological Society of London (ZSL), Regent's Park, London, NW1 4RY, United Kingdom.*
E-mail: ben.tapley@zsl.org; christopher.michaels@zsl.org
[2]*Conservation Research and Action for Amphibians of Cameroon (CRAAC), Royal Zoological Society of Scotland, Edinburgh Zoo, Corstorphine Road, Edinburgh, United Kingdom; and, School of Geography and School of Biology, University of Leeds, Leeds, West Yorkshire, LS2 9JT, United Kingdom. E-mail: tommy_dbone@yahoo.com*
[3]*Both authors contributed equally to this work*

Xenopus longipes Loumont and Kobel, 1991 is an aquatic polyploid frog endemic to the high altitude crater lake, Lake Oku in North West region, Cameroon (Loumont & Kobel 1991). The tadpole of *X. longipes* is currently undescribed. So far, only dead tadpoles have been found at Lake Oku during regular monitoring since 2008 (Doherty-Bone *et al*. 2013), with specimens too decomposed to make adequate descriptions. Captive breeding provides one opportunity to obtain fresh specimens for description.

A colony of *X. longipes* is maintained at the Zoological Society of London's (ZSL) London Zoo, as part of a conservation research programme that was developed to document the life history of this Critically Endangered species (IUCN 2004). Herein we describe the tadpole and compare it with other *Xenopus* tadpoles for which descriptions are available.

Frogs were bred naturally in captivity and ethical approval was granted to euthanise a sub set of the developing tadpoles to facilitate larval descriptions. Tadpoles were euthanised in Tricaine Methanesulfonate (MS-222) and fixed in 10% formalin. Sample size was kept to a minimum so as not to undermine attempts at establishing the species in captivity. The description is based on five specimens Nieuwkoop-Faber stage 43–57 (Nieuwkoop & Faber 1994) which corresponds to Gosner stage 25–39 (Gosner 1960). The studied specimens were deposited at the Natural History Museum, London (NHM UK 2013.351–5) (former acronym of this collection: BMNH). Measurements of morphology follows nomenclature of Altig & McDiarmid (1999) and are reported as mean ± SD, min–max. Due to the small size and fragility of the specimens measurements were taken by photographing each specimen with a millimetre scale, morphometric measurements were recorded in ImageJ (available at http:// rsb.info.nih.gov/ij). Data from these captive bred tadpoles were supplemented with observations from a further 8 field-collected tadpoles found dead at Lake Oku in 2008. These were fixed in 10% formalin and morphometric measurements were recorded using digital callipers accurate to 0.1 mm. Due to the degraded nature of some of the specimens collected in the field it was not possible to document a full suite of morphometric measurements for every specimen.

Captive reared tadpoles: Nieuwkoop-Faber stage 43–47 (Gosner stage 25–27), all measurements in mm (NHM UK 2013.351, 2013.352, 2013.353, 2013.354): Total length (23.9 ± 2.8; 20.4–27.5), body length (5.5 ± 1.0; 44.4–6.3), tail length (18.4 ± 2.8; 15.9–21.1), maximum tail muscle height (1.8 ± 0.1; 1.7–1.9), maximum tail height (3.0 ±0.6; 2.3–3.7), maximum tail muscle width (1.2 ± 0.3; 1.0–1.4), interorbital distance (3.6 ± 0.5 mm; 2.9–3.9), internarial distance (0.1 ±0.2; 0.6–1.1), maximum dorsal fin height (0.6 ± 0.3; 0.2–1.0), maximum ventral fin height (1.2 ± 0.4; 0.8–1.8), eye diameter (0.8 ± 0.1; 0.8–0.9), narial diameter (0.2 ± 0.0; 0.2–0.3), snout–eye distance (1.7 ± 0.2; 1.5–1.9), snout–nostril distance (0.3 ± 0.1; 0.2–0.4), body width (3.8 ± 0.1; 3.0–4.5), barbel length (0.1 ± 0.1; 0.0–2.5).

Nieuwkoop-Faber stage 57 (Gosner stage 39), all measurements in mm: (NHM UK 2013.3515) Total length, 65.8; body length, 15.8; tail length, 49.96; maximum tail muscle height, 6.0; maximum tail height, 13.7; maximum tail muscle width, 5.2; interorbital distance, 10.5; internarial distance, 1.9; maximum dorsal fin height 3.5; maximum ventral fin height, 7.6; eye diameter, 1.7; narial diameter, 0.6; snout–eye distance, 5.2; snout–nostril distance, 0.9; body width 11.5; barbel length 1.1.

Tadpoles found dead in field: Dead larvae were observed and collected at Lake Oku during or toward the end of Cameroonian wet season (late April–early October): 07.10.2008 (n = 1); 26.07.2010 (n=42, but not collected); 27.07.2010 (n=3); 14.08.2012 (n=17, a further four not collected); 18.08.2012 (n=2); 04.09.2012 (n=1). Tissue from the base of the tail of one specimen (BMNH 2008.441; a preserved specimen accessioned before the change of acronym)

Accepted by M. Vences: 16 Jun. 2015; published: 7 Jul. 2015

was fixed in 95% laboratory-grade ethanol and the 16S mitochondrial gene sequenced, verifying the species was *X. longipes*. Measurements of 8 field collected specimens (from August 2012) fixed in 10% formalin Nieuwkoop-Faber stage 50–57 (Gosner 28–39) specimens, all measurements in mm (NHM UK 2013.463–70) Total length (82.5 ± 8.13; 73.7–91.6 only 4 specimens in condition to enable measurement), body length (24.2 ± 2.08; 20.8–26.4, *n*=8), tail length (63.8 ± 7.23; 54.0–69.9, *n*=4), maximum tail muscle height (5.76 ± 0.65; 4.6–6.5, *n*=8), maximum tail height (11.1, 24.2 ± 1.92; 7.2–12.0 *n*=7), maximum tail muscle width (3.3 ± 0.87; 1.4; 1.4–4.5, *n*=8), interorbital distance (13.5 ± 1.00; 11.8–14.3, *n*=7), internarial distance (2.18 ±0.35; 1.8–2.6, *n*=8), body width (15.1 ± 1.66; 12.2–17.9, *n*=8), barbel length 3.5 (only one specimen from the series had a barbel).

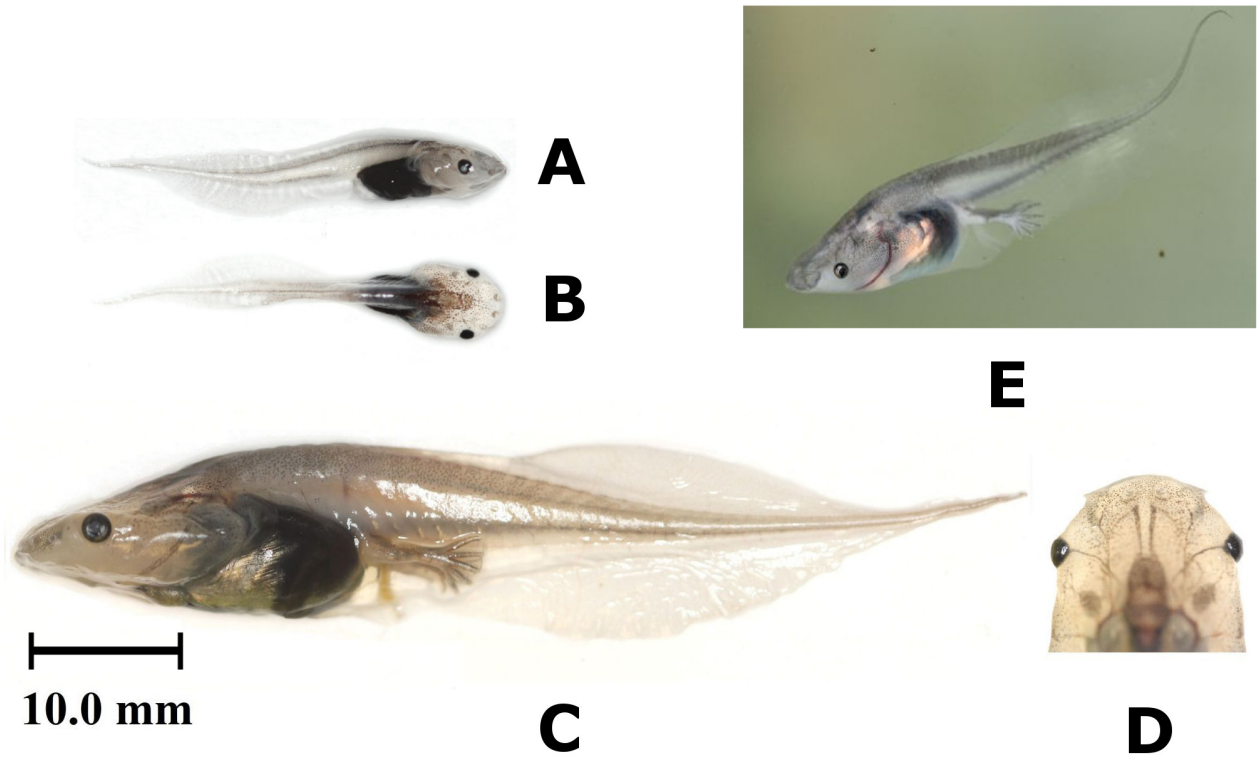

FIGURE 1. *Xenopus longipes* tadpole. A and B. Dorsal and lateral view of *Xenopus longipes* tadpole Nieuwkoop-Faber stage 47; Gosner stage 27, NHM UK 2013.3511. **C. Lateral view of *Xenopus longipes*** at Nieuwkoop-Faber stage 57; Gosner stage 39, NHM UK 2013.3515. **D. Dorsal view of *Xenopus longipes*** at Nieuwkoop-Faber stage 57; Gosner stage 39, NHM UK 2013.3515. **E. *Xenopus longipes* tadpole in life**, Nieuwkoop-Faber stage 58; Gosner stage 40, E. not to scale.

External Morphology: Body shape oval and depressed with dorsolaterally flattened head and body. Low dorsal fin originating at tail–body junction. Ventral fin higher than dorsal fin. Ventral fin originates mid abdomen appears as rounded lobe at the tail body junction. Height of ventral fin diminishes at the point at which the vent tube terminates but gradually increases, reaching its maximum height before tapering off towards the end of the tail. Tail tip terminates in flagellum. Nares transversely elliptical and parasagittal, situated nearer to the snout than the eyes. Vent tube medial. Eyes lateral. Spiracle dual, lateral. Mouth terminal and slit like (Figure 1A–E). Single relatively short barbel (Table 1) located at the corners of the mouth, barbel absent in 3 of the 4 specimens examined at Nieuwkoop-Faber stage 47; Gosner stage 27 (Figure 1A); this is not an artefact of preservation. Colour pattern in life uniformly pale but with widely scattered chromatophores. Chromatophores absent below the area directly below the eye (Figure 1E).

Colouration in preservative: Body translucent, tail fins transparent. Chromatophores brown.

Habits: Tadpoles of *X. longipes* in Lake Oku (Figure 1A–E) have only been observed dead at the lake shore (Doherty-Bone 2011, own unpubl. data). In captivity *X. longipes* larvae were, like other *Xenopus* species, mid water suspension feeders. However, post-hatching development was slow in comparison to other congeners, ranging from 193–262 days between hatching and metamorphosis (own unpubl. data). The behaviour, development and husbandry requirements of the tadpoles of *X. longipes* will be described in a forthcoming paper.

Comparison with other *Xenopus* tadpoles: In captivity some tadpoles grew larger (maximum 68.0 mm total length) than the measured specimens. In the field, those tadpoles with a measureable tail had a mean total length of 82.5 mm with a maximum length of 91.8 mm (Nieuwkoop-Faber stage 54–55; Gosner stage 34–35). This difference could be due

to diet, water parameters and temperature regimes differing between the captive environment and Lake Oku. The tadpole of *X. longipes* is relatively large when compared to the maximum recorded size of the adult; the maximum length of the tadpole is 2.5 times longer than the maximum recorded snout to vent length of the adult (Table 1). The relative size of the tadpole when compared to the adult frog is greater in *X. longipes* than in other congeners for which there is a tadpole description (Table 1). The barbels of *X. longipes* are relatively short when compared with other described *Xenopus* tadpoles (Table 1), although measurements of barbels that can be associated with specific Gosner or Nieuwkoop-Faber stages is lacking from the peer reviewed literature. Barbels in *Xenopus* tadpoles are thought to aid in navigation and mechano-reception (Ovalle 1979; Channing & Howell, 2006). The water in Lake Oku is clear (Kling 1988) and this may explain the shorter barbel length in *X. longipes*.

We have presented a description of the larvae of *X. longipes* based on captive bred specimens, with supplementation from larvae collected in the field that were found dead with varying degrees of decomposition. This demonstrates the convenience of verifying observations of compromised field specimens using captive bred and reared animals when studying life history.

TABLE 1. Morphometric comparisons (all measurements in mm) of the tadpoles in nine *Xenopus* species.

Species	Tadpole total length maximum reported size	Maximum reported adult SVL	Ratio of maximum tadpole length to adult size	Barbel size	Reference
X amieti.	40.0	57.0	0.7:1	Extends behind the eyes.	Kobel *et al*. 1980; Channing *et al*. 2012
X. fraseri	33.0	44.0	0.75:1	>16.0	Vigny 1979; Loumont & Kobel 1991;Channing *et al*. 2012
X. gilli	50.0	60.0	0.83 :1	7.1	Rau 1978; Minter *et al*. 2004; Channing *et al*. 2012
X. laevis	80.0	67.8	1:0.85	long	Vigny 1979; Evans *et al*. 2011; Channing *et al*. 2012
X. longipes	91.8	36.0	1:0.39	1.1	Loumont & Kobel 1991; This study
X. muelleri	100.0	90.0	1:0.9	25% of body length	Vigny 1979; Channing & Howell 2006; Channing *et al*. 2012
X. ruwenzoriensis	75.0	57.0	1:0.76	Extends full length of body	Channing & Howell 2006; Channing *et al*. 2012
X. victorianus	50.0	78.0	0.64:1	1/3 of body length	Channing & Howell 2006; Channing *et al*. 2012
X. wittei	60.0	61.0	0.98:1	Extends behind eye	Channing & Howell 2006; Channing *et al*. 2012

Acknowledgements

We thank Iri Gill, Sebastian Grant, Zoe Bryant and Luke Harding for their assistance with the captive husbandry of the *X. longipes* tadpoles. We thank David Gower for assistance with DNA barcoding. The captive colony of *X. longipes* was exported under permit from the Cameroon Ministry of Forestry & Wildlife (0928/PRBS/MINFOF/SG/DFAP/SDVEF/SC and 0193/CO/MINFOF/SG/DFAP/SDVEF/SC), following prior consultation with the Oku community, who also sanctioned access to their lake. We thank Gonwouo Nono LeGrand, Ndifon David, Oscar Nyingchia, Roland Ndifon, Henry Kolem and Robert Browne for logistical assistance within Cameroon. Field work was supported by the Royal Zoological Society of Scotland, an Erasmus Darwin Barlow grant from the ZSL, a Small Project Ecological Grant from the British Ecological Society, an Amphibian Conservation Fund grant from the European Association of Zoos and Aquaria and a Mohammed bin Zayed Conservation grant.

References

Altig, R. & McDiarmid, R.W. (1999) Body plan: developmental and morphology. *In*: Diarmind, M.C. & Altig, R. (Eds.), *Tadpoles – the biology of anuran larvae*. University of Chicago Press, Chicago, pp. 24–51.

Channing, A. & Howell, K.M. (2006) *Amphibians of East Africa*. Comstock Publishing Associates/Cornell University Press, New York, 418 pp.

Channing, A., Rödel, M.-O. & Channing, J. (2012) *Tadpoles of Africa – The biology and identification of all known tadpoles in sub-Saharan Africa*. Edition Chimaira, Frankfurt am Main, 404 pp.

Doherty-Bone, T.M. (2011) Unravelling the mysteries of Lake Oku, where the frog is "Fon" (King). *Froglog*, 97, 28–30.

Doherty-Bone, T.M., Ndifon, R.K., Nyingchia, O.N., Landrie, F.E., Yonghabi, F.T., Duffus, A.L.J., Price, S., Perkins, M., Bielby, J., Kome, N.B., LeBreton, M., Gonwouo, L.N. & Cunningham, A.A. (2013) Morbidity and mortality of the Critically Endangered Lake Oku clawed frog *Xenopus longipes*. *Endangered Species Research*, 21, 115–128. http://dx.doi.org/10.3354/esr00514

Evans, B.J., Greenbaum, E., Kusamba, C., Carter, T.F., Tobias, M.L., Mendel, S.A. & Kelley, D.B. (2011) Description of a new octoploid frog species (Anura: Pipidae: *Xenopus*) from the Democratic Republic of the Congo, with a discussion of the biogeography of African clawed frogs in the Albertine Rift. *Journal of Zoology*, 283, 276–290. http://dx.doi.org/10.1111/j.1469-7998.2010.00769.x

Gosner, K.L. (1960) A simplified table for staging anuran embryos and larvae with notes on identification. *Herpetologica*, 16, 183–190.

IUCN, Conservation International, and NatureServe (2004) Global Amphibian Assessment. Available from www.globalamphibians.org (accessed 30 May 2015)

Kobel, H.R., Du Pasquier, L., Fischberg, M. & Gloor, H. (1980) *Xenopus amieti* sp. nov. (Anura: Pipidae) from the Cameroons, another case of tetraploidy. *Revue Suisse de Zoologie*, 87, 919–926.

Kling, G.W. (1988) Comparative transparency, depth of mixing, and stability of stratification in lakes of Cameroon, West Africa. *Limnology and Oceanography*, 33**,** 27–40. http://dx.doi.org/10.4319/lo.1988.33.1.0027

Loumont, C. & Kobel, H.R. (1991) *Xenopus longipes* sp. nov., a new polyploidy pipid from western Cameroon. *Revue Suisse de Zoologie,* 98, 731–738.

Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. & Kloepfer, D. (Eds.) (2004) *Atlas and red data book of the frogs of South Africa, Lesotho, and Swaziland.* Smithsonian Institution, Washington, D.C., 360 pp.

Nieuwkoop, P.D. & Faber, J. (1994) *Normal table of Xenopus laevis* (Daudin). Garland, New York, 282 pp.

Ovalle, W.K. Jr (1979) Neurite complexes with Merkel cells in larval tentacles of *Xenopus laevis*. *Cell and tissue research,* 204, 233–241. http://dx.doi.org/10.1007/BF00234635

Rau, R.E. (1978) The development of *Xenopus gilli* Rose and Hewitt (Anura, Pipidae). *South African Museum*, 76, 247–263.

Vigny, C. (1979) Larval morphology of 12 species and sub-species of the genus *Xenopus*. *Revue Suisse de Zoologie*, 86, 877–891.