Cannibalism in the Critically Endangered Lake Oku Clawed Frog: a possible cause of morbidities and mortalities?

Article *in* Herpetology Notes · August 2018

DOI: 10.2305/IUCN.UK.2017-2.RLTS

CITATIONS
3

READS
62

3 authors, including:

Thomas Doherty-Bone

65 PUBLICATIONS **492** CITATIONS

SEE PROFILE

Benjamin Tapley

ZSL

79 PUBLICATIONS **404** CITATIONS

SEE PROFILE

Herpetology Notes, volume 11: 667-669 (2018) (published online on 24 August 2018)

Cannibalism in the Critically Endangered Lake Oku Clawed Frog: a possible cause of morbidities and mortalities?

Thomas M. Doherty-Bone[1,*], Oscar N. Nyingchia[2], and Benjamin Tapley[3]

Cannibalism is a widespread phenomenon that can have ramifications from the individual to population, communities and ecosystems (Polis, 1981). Cannibalism can be a useful mechanism to sustain a population with resources (van den Bosch et al., 1988) and promote a particular intraspecific lineage through kin selection (Pfennig, 1997). Cannibalism can however increase parasitism (especially in amphibians, Pfennig et al., 1991), leading to increased requirement for resources (Bunke et al., 2015). Increases in cannibalism can be an indicator of reduced food resources, of increased population density, and general stress in the population. Documentation of incidents of cannibalism in particular species, especially those requiring conservation management, is thus important for understanding population persistence and trophic ecology.

An incidence of cannibalism is here reported for the Lake Oku Clawed Frog (*Xenopus longipes* Loumont & Kobel, 1991). This is a Critically Endangered species endemic to a crater lake in Cameroon, threatened particularly by stochastic events such as fish introduction and has been observed to undergo mass mortalities and morbidities (Blackburn et al. 2010, Doherty-Bone et al. 2013, IUCN, 2017). These morbidities are often characterised by necrosis of limbs, though an infectious agent has not been identified (Blackburn et al., 2010, Doherty-Bone et al., 2013). One intensive study over one month noted a strong positive correlation with dead and morbid frogs with the number of frogs trapped on a given day (Doherty-Bone et al., 2013). The study combined short and longer term data to find no evidence of a disease-causing pathogen, nor for environmental factors other than a positive correlation of prevalence with phosphates. Routine monitoring at Lake Oku over the past ten years has noted that some frogs found dead had substantial loss of tissue around the bones, but frogs were too decomposed to assess if bite marks occurred. Out of 48 clinical specimens examined from 2008-2010, 37 showed necrosis or recently amputated limbs (Doherty-Bone et al., 2013). This included during routine trapping surveys, where dead frogs will have entered alive. This trapping method does not harm frogs and these incidents of dead frogs are generally rare, as dead frogs were recorded in only 15 out of 324 trap nights that otherwise consistently captured healthy individuals. It was thus probable that they died and their tissues consumed by a scavenger. It has often been uncertain whether this was due to the other frogs inside, or other organisms such as cased-caddisfly larvae (Trichoptera) that are abundant in the lake, and are known to scavenge dead frogs in other ecosystems (Wartenburg et al., 2017). *Xenopus longipes* is known to feed on aquatic invertebrates, including those larger than themselves (Tapley et al., 2016) and have been shown to have a flexible foraging strategy which is modulated based on chemosensory cues (Michaels et al., 2018).

While searching the shore of Lake Oku by torch light on the 10th October 2017 at 19:20 hrs (latitude - 6.2024, longitude - 10.4583, 2245 m a.s.l.), a dead *X. longipes* was found being consumed by at least three other individuals. The photo in Figure 1 shows one individual frog feeding after the other two frogs swam away in response to the torch lights. The remaining frog was engulfing half the body (from the legs past the pelvis), while the other frogs had apparently been trying to remove pieces of tissue from the rest of the carcass. The remaining frog continued to attempt to feed on this carcass, at one point releasing the legs of the carcass revealing one leg had already been removed, then

[1] Conservation Programmes, Royal Zoological Society of Scotland, Edinburgh, EH12 6TS, UK.
[2] Oku Community, Elak-Oku, North West Region, Cameroon.
[3] Zoological Society of London, Regent's Park, London, NW1 4RY, UK.
[*] Corresponding author. E-mail: tommy_dbone@yahoo.com

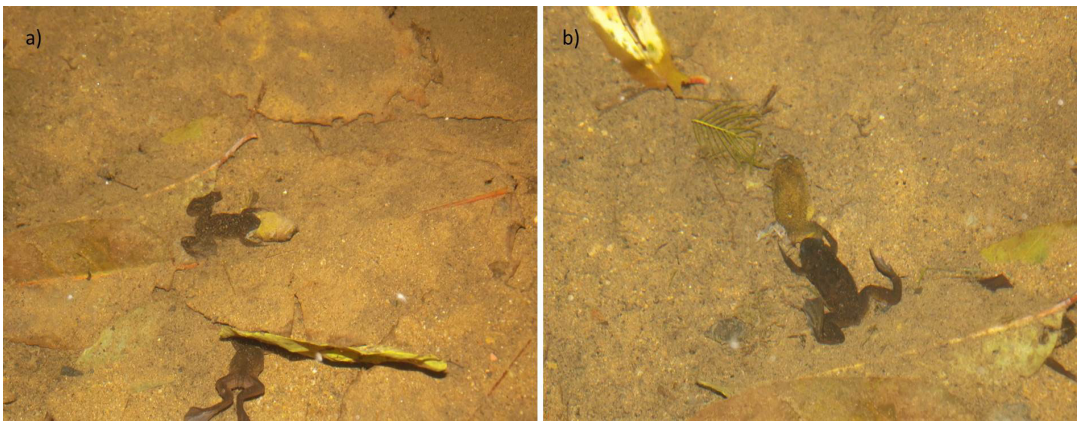

Figure 1. Lake Oku Clawed Frog, *Xenopus longipes*, consuming a dead conspecific, with nearly half the carcass engulfed by the frog (a), and subsequently taking smaller sections of the carcass (b).

engulfing the remaining limb. The carcass appeared relatively fresh, though could have been dead for several hours. This continued for another 20 minutes while the authors were present.

In captive populations of this species, cannibalism has not been observed, other than frogs biting each other without apparent injury, or frogs consuming freshly laid eggs (Browne et al., 2009, Tapley et al., 2016). There have been no observations of the morbidities in this species in captivity, despite ten years of the same groups being held by the authors. It has yet to be determined if these frogs are actually killing each other for consumption or if they are scavenging (utilising chemosensory cues) after frogs have died from other means. There is very little variation in body size of *X. longipes* post-metamorphosis where adults do not grow substantially in size compared to larvae, thus it is challenging for one individual frog to kill another. One possibility is to injure, then stalk a conspecific prey until it succumbs to infection. A more parsimonious scenario is that frogs are scavenged following death by other means, such as disease. If this is the case, that would be a potential mechanism for horizontal transmission of pathogens, such as the possible agent that has been causing disease in *X. longipes*. This is a mechanism by which some parasites are transmitted to novel hosts (Imhoff et al., 2012). It is noted however that it remains uncertain that this disease is caused by a pathogen, based on the absence of microbial particles in histology sections, as well as no consistent evidence of known amphibian-killing pathogens (e.g. *Ranavirus, Batrachochytrium dendrobatidis*) subjected to targeted molecular diagnostic assays (Blackburn et al., 2010, Doherty-Bone et al., 2013).

Cannibalism is a common behaviour in many species, including anuran amphibians, and is possibly a strategy used by individuals of *X. longipes* to obtain protein and nutrients. It has yet to be determined whether tadpoles are attacked by adults, these two life stages are seldom observed together, though larvae in the final stages of development are larger than adults (maximum SVL in an adult is 36.0 mm, maximum length of tadpole is 98.1mm; Tapley et al., 2015). Cannibalism in anurans is often described in larvae as opposed to adults (Kuzmin, 1991), though incidents of cannibalism in postmetamorphic anurans have been frequently recorded, including in Pipidae (Measey et al., 2015). Most reports of cannibalism by frogs is engulfing of a smaller individual by a larger one. This observation therefore represents a rare example of cannibalism by individual frogs of equal size. The absence of cases of cannibalism in captivity is likely explained by the greater availability of food, evidenced by larger body condition of captive versus free-roaming frogs. This could influence reduced aggression and need for cannibalism in free-roaming frogs. As captive diets improve to reduce apparent obesity in these captive populations, keepers should be aware that cannibalism will be a possibility.

As neither cannibalism nor morbidities experienced in Lake Oku have been observed in captivity, cannibalism could become a new candidate hypothesis for the cause

of morbidities and mortalities periodically observed in this species. This could explain the strong correlation between abundance and morbidity in this population, and represents a new avenue of research in understanding the ecology and conservation of this Critically Endangered, isolated frog.

Acknowledgements. The authors thank the Cameroon Ministry of Scientific Research and Innovation and Ministry of Forestry and Wildlife for granting permits, Arnaud Tchassemm and Ndifon David for assistance, and the people of Oku for their support. Field work was funded by the Royal Zoological Society of Scotland.

References

Bosch, F., van den, de Roos A.M ., Gabriel, W. (1988): Cannibalism as a life boat mechanism. Journal of Mathematical Biology **26**: 619–633.

Browne, R.K., Blackburn, D.C. , Doherty-Bone, T. (2009): Species Profile: Lake Oku Clawed Frog (*Xenopus longipes*). Amphibian Ark.

Bunke, M., Alexander, M.E., Dick, J.T.A., Hatcher, M.J., Paterson, R., Dunn, A.M. (2015): Eaten alive: Cannibalism is enhanced by parasites. Royal Society Open Science **2:** 140369.

Doherty-Bone, TM, 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.

Imhoff, E.M, Mortimer, R.J.G., Christmas, M., Dunn A.M. (2012): Horizontal transmission of *Thelohania contejeani* in the endangered white-clawed (*Austropotamobius pallipes*) and the invasive signal crayfish (*Pacifastacus leniusculus*). Parasitology **139**: 1471–1477.

IUCN SSC Amphibian Specialist Group (2017): *Xenopus longipes*. The IUCN Red List of Threatened Species 2017. Available at: http://dx.doi.org/10.2305/IUCN.UK.2017-2.RLTS.T58176A3067255.en. Accessed on 11 May 2018.

Kuzmin, S.L. (1991): The ecology and evolution of amphibian cannibalism. Journal of Bengal Natural History Society **10**: 11–27.

Measey, G.J., Vimercati, G., De Villiers, F.A., Mokhatla, M.M., Davies, S.J., Edwards, S., Altwegg, R. (2015): Frog eat frog: Exploring variables influencing anurophagy. PeerJ **3**: e1204

Michaels, C.J, Das, S., Tapley, B. (2018): Modulation of foraging strategy is elicited in response to both behaviourally distinct prey items and olfactory cues alone in the aquatic frog *Xenopus longipes* (Anura: Pipidae). Herpetological Bulletin **143**: 1–6.

Pfennig, D.W., Loeb, M.L.G., Collins, J.P. (1991): Pathogens as a factor limiting the spread of cannibalism in tiger salamanders. Oecologia **88**: 161–166.

Pfennig, D.W. (1997): Kinship and cannibalism. Bioscience **47**: 667–675.

Polis, G.A. (1981): The evolution and dynamics of intraspecific predation. Annual Review of Ecology and Systematics **12**: 225–251.

Tapley, B., Michaels, C., Grant, S., Harding, L., Bryant, Z., Gill, I., Chaney, N., Dunker, F., Freiermuth, B., Willis, J., Blackburn, D., Doherty-Bone, T. (2016): *Amphibian Taxon Advisory Group Best Practice Guidelines for the Lake Oku Frog* Xenopus longipes. European Association of Zoos and Aquaria

Tapley, B., Michaels, C.J., Doherty-Bone, T.M. (2015): The tadpole of the Lake Oku clawed frog *Xenopus longipes* (Anura; Pipidae). Zootaxa **3981**: 597–600.

Wartenberg, N., Reinhard, S., Nollert, A., Staniczek, A.H., Kupfer, A. (2017): Caddisfly larvae (Trichoptera: Phryganeidae) as scavengers of carcasses of the common frog *Rana temporaria* (Amphibia: Ranidae). Salamandra **53:** 458-460.

Accepted by Hendrik Müller