

Limb malformations in introduced populations of midwife toad *Alytes obstetricans* in Great Britain

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Amphibians are known to suffer from limb deformities for a number of reasons, including parasitic infection (Johnson et al., 1999), environmental pollution (Taylor et al., 2005), and ultraviolet radiation (Ankley et al., 2002). Deformities may also arise from errors during the regeneration process (Gray & Lethaby, 2010). There have been a few studies investigating the prevalence of malformed limbs in Britain (Ballengee & Sessions, 2009), although there have been several records of deformities for both anurans and urodeles (Jarvis, 2011; Allain et al., 2021; Jordan & Shadbolt, 2021).

The common midwife toad *Alytes obstetricans* is a small, cryptic species found throughout western Europe, although it is an alien species in Britain (Speybroeck et al., 2016). It grows to 5 cm in length and may be found in habitats such as parks, woodlands, gravel pits, and gardens. There are several introduced populations in Britain, one of which in Cambridge has been monitored since 2015 (Allain & Goodman, 2017). Currently, most of the introduced populations are restricted to residential gardens in urban and suburban areas. It is very likely that the first of these *A. obstetricans* populations found its way to Britain in a shipment of nursery plants in the early part of the 20th Century, before being dispersed with human assistance (Beebee & Griffiths, 2000). Currently, the species is monitored to assess distribution, check for disease, and to record any impacts on native fauna.

During surveys since 2015, we have recorded five cases of limb malformation from three separate garden populations of *A. obstetricans* (Table 1), which have been described according to the classification of Meteyer (2000). Photographs of each toad were taken while collecting morphometric data. Individuals were also swabbed for the presence of infectious diseases, such as the amphibian chytrid fungus *Batrachochytrium dendrobatidis*.

Despite having carried out more than 60 surveys across nine different populations, no other instances of limb malformations have been observed. It is likely that individuals exhibiting deformities are uncommon within British populations, with no deformed specimens observed within the Cambridge population since 2017, despite many additional surveys. A considerable number of other amphibians such as common frogs *Rana temporaria*, common toads *Bufo bufo*, and smooth newts *Lissotriton vulgaris* have also been encountered while surveying for *A. obstetricans*. No deformities of any kind have been observed in the native

amphibians present in the same gardens. In Spain, there have been cases of polymelia (Fernández, 2013) and polydactyly (Espasandín, 2017) in *A. obstetricans*.

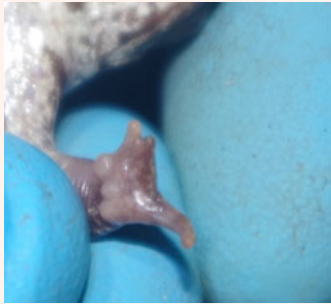




The locations in which deformities were observed were suburban. This appears to rule out pollution from agricultural run-off as a causative agent, which has been identified as a factor in other studies (Taylor et al., 2005). However, domestic garden pollution due to fertilisers, herbicides and rodenticides cannot be ruled out but this seems an unlikely cause given that other amphibians in the same habitats have been unaffected. Trematode infections in amphibians have previously been proven as the causal factor in some deformities in North America (Johnson et al., 1999), but to date the only such infection recorded in European amphibian populations is from Russia in water frogs of the genus *Pelophylax* (Svinin et al., 2020). Exposure to ultraviolet radiation is unlikely to be the cause of these deformities as *A. obstetricans* eggs are not left in the pond to mature as is the case with other amphibians. Instead, they are carried by the male who seeks shelter underground in warm, damp places. Here, he waits until the tadpoles are mature enough before finding a suitable body of water in which to deposit the eggs (Beebee & Griffiths, 2000). Midwife toads are also largely nocturnal, which when combined with their secretive behaviour, reduces the risk of ultraviolet radiation affecting their developing larvae.

Due to small founder populations and low dispersal rate at each site, it is possible that the *A. obstetricans* populations are significantly inbred. This could be a causal factor in the limb deformities (Williams et al., 2008), but in the absence of genetic testing this remains a tentative suggestion. During future surveys, we will continue to record deformities of both midwife toads and other amphibians to better establishing the frequency of their occurrence.

ACKNOWLEDGMENTS

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Table 1. Limb malformations observed in three British populations of *Alytes obstetricans* in gardens

Date & location	Sex	Weight (g)	SVL (cm)	Notes
28/06/17 Cambridge	F	5.8	3.3	 <p>Ectrodactyly - Three digits are present, although digits 1 and 2 are not properly separated and are shorter than normal, and digit 3 is missing completely. Closer inspection of the hand suggested that the metacarpals have not developed correctly</p>
28/06/17 Cambridge	M	3.9	3.4	 <p>Ectrodactyly - The tibulare and fibulare have developed correctly but the metatarsals show severe malformation, no phalanges are present</p>
24/08/19 Oundle	M	6.0	3.6	 <p>Ectromelia - The tibulare and fibulare of the right hind limb appear smooth and without skin pigmentation, this may be due to the skin being thin and translucent in the area; the pale colour may be the underlying bone</p>
24/08/19 Oundle	M	5.5	3.3	 <p>Ectromelia- The tibia-fibula of the right hind limb has the bone terminating further up the leg in the previous case (see above). The tibulare and fibulare are absent, with a kink in the tibia-fibula which may impede mobility</p>
8/05/21 Bedford	-	-	-	 <p>Polymely - A second front right limb is present with all digits which also exhibits a 180 ° rotation so the hand faces upwards</p>

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