

## **Toe Clipping of Anurans for Mark-Recapture Studies: Acceptable if Justified. That's What We Said!**

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Parris and McCarthy (2008) have over-simplified the arguments of Phillott et al. (2007) that toe-clipping is an acceptable method of marking anurans. We discussed six points in defending toe-clipping as a marking method:

1. The absence of unequivocal data to quantify the effect of toe-clipping on return rates. Parris and McCarthy (2001) and McCarthy and Parris (2004) used statistical projections, based on five studies with limited details of search effort to evaluate the likelihood of encountering a marked frog and hygiene procedures that may have influenced survival be-

yond current practices (Clarke 1972, Humphries 1979, Lemckert 1996, Williamson and Bull 1996, Lüddecke and Amézquita 1999).

2. The reasons for reduced return rates after toe-clipping. Mortality after an invasive marking procedure is a real and recognized concern. However, failure to encounter an individual after marking can also be due to behavioral changes that may or may not affect the fitness of the study animals.
3. Current hygiene practices minimise the risk of exposure to pathogens. These are less likely to have been or were not considered in the studies which Parris and McCarthy (2001) and McCarthy and Parris (2004) used as data sources.
4. Ethical concerns raised by May (2004) are unsubstantiated, yet have strongly influenced ethics committees, with some recommending the use of anesthetics that are at times inappropriate or have unknown dosage requirements that are likely to pose a greater threat to the well-being of the animals than toe-clipping.
5. Ethics committees have also favoured the use of other marking techniques, such as pit-tagging, over toe-clipping. The majority of these are still invasive, pit-tagging arguably more than toe-clipping, and their effects are at best no further understood than those of toe-clipping. They have certainly not been shown to pose less of a physiological or physical risk to animals.
6. Some field studies require the recognition of individuals, which for many species requires marking techniques such as toe-clipping. We believe such focused studies with measurable outcomes contributing to understanding and management of a species have value that outweighs the potential impacts on the species.

Parris and McCarthy (2008) responded to points 2, 3, 5, and 6. They are largely in agreement with these points although they do not distinguish between the importance of the effects of toe-clipping on mortality versus behavior. They argue that both are equally important because of the potential effect of changes in behavior on population fitness and study bias. Unfortunately there are no data to test whose opinion is correct. Parris and McCarthy (2008) point out that a minimum number of toes should be removed from all anurans; in general we agree but we stand by the intent of our comment that the function and importance of toes should equally be taken into account when toe-clipping. Parris and McCarthy (2008) also suggest that there is evidence that the effect of toe-clipping is no different from that of toe-tipping although the study they cite is confounded by species. In addition, they argue that toe-clipping may be unacceptable even if it is no worse than other invasive methods of marking animals. The point of our comment was that it is always best to use the most practical, least harmful method of marking, and that toe-clipping should be evaluated on that basis, along with other marking methods.

We believe that mark-recapture studies can contribute to the development of conservation management plans for many anurans in a variety of ways. McCarthy and Parris (2008) argue that the risk of toe-clipping is justifiable only if one is answering questions of direct relevance to management applications. Unfortunately, too little is known about many amphibian populations to know in advance what these questions might be. Correctly con-

ducted population studies can be the only means of identifying risk factors. Potential increases in mortality or emigration rates are generally quite small, but can be accounted for in a study and the need for information must be balanced against those risks.

Parris and McCarthy (2008) are surprised that the scientific validity of potentially biased data from studies using toe-clipping has received little attention. We acknowledge that any field research involving the capture and marking of animals may potentially affect return rates through altered survival and/or behavior, so all techniques violate assumptions related to population estimation models, and bias needs to be considered (Phillott et al. 2007). However, in the absence of evidence-based results that prove a lesser effect on return rates of alternative marking techniques, field researchers will continue with toe-clipping as it is known to have small effects that have been quantified for some species. We hope this discussion has shown that toe-clipping and toe-tipping are acceptable techniques if carried out appropriately, that their use needs to be justified, that their effects on a study need to be considered when analysing results, and that they will remain in use until alternative techniques are shown to be superior. We reiterate that controlled studies to evaluate the physical, physiological and behavioural effects of invasive marking techniques on a range of frog species are urgently needed.

Phillott et al. (2007) did not primarily aim to address Parris and McCarthy (2001) and McCarthy and Parris (2004) as we believe the weakness of their arguments was adequately discussed in Funk et al. (2003). Our concern is that animal ethics committees and government agencies have banned the use of toe-clipping as a result of these papers, but have done so without evidence that the procedure has a greater effect than the alternative marking methods. Our paper specifically demonstrated the problems with dismissing toe-clipping in favour of other, less understood invasive marking techniques.

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