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LETTER TO THE EDITOR

Crossing the great divide: telomeres and ecology

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In their recent paper 'The use of telomere length in ecology and evolutionary biology', Horn *et al*. (2010) aim to alert ecologists to some of the pitfalls in telomere-length analysis and interpretation that have arisen in human studies. As is often the case, there can be hiccups when technologically demanding techniques are transferred across disciplines, so this is a laudable and useful thing to do.

However, Horn *et al*. do somewhat misrepresent the current state of play in the ecological work. The published literature on telomere length from an ecological and evolutionary perspective is still very small indeed (only a few tens of papers); as yet, there has been no mad 'rush to publish' for which ecologists should be censured as the authors imply, though of course this may come. Horn *et al*. claim that telomere length has recently 'been adopted as a molecular marker for estimating age and fitness in an ecological and evolutionary context'. This is certainly not true. The majority of the studies that they cite in support of this contention was not trying or claiming to find a biomarker of chronological age. In general, substantial variation in telomere length amongst individuals of the same age has been found, and it has been repeatedly pointed out by ecologists that telomere length is likely to have very limited utility as an indicator of individual age (Monaghan, 2010; Haussmann and Marchetto, 2010). But understanding why things vary is what ecology is all about. It is important to realise that telomere dynamics are of interest to evolutionary ecologists mainly because of what this might tell us about individual state and about ageing rather than age. There is no search for some 'general marker' relationship that can be used across the board to give a measure of age or fitness. The interest is in the variability itself, in understanding why there might be differences amongst individuals or species in telomere length, in how it changes across lifetimes, in how it is influenced by environmental conditions and in how it might, or indeed might not, relate to organism health and to Darwinian fitness. It is still very early days; links between telomere biology and survival, reproductive performance and life history are currently being explored and some have been uncovered. The main challenge is getting individual-based, longitudinal information across a sufficient time scale and from a sufficient diversity of conditions and species. There is also a need for carefully controlled experimental work so that the effects of different environmental factors can be teased apart and identified. The pattern of inheritance of telomere length, still poorly understood (for example, Nordfjall *et al*., 2010), has great implications for many active research areas in ecology such as maternal effects, phenotypic plasticity, mate choice and sexual selection. There's certainly lots to be done.

Horn *et al*. rightly emphasise the need for standardisation in methodology across studies, which will be particularly important for among-species comparisons. They highlight a number of shortcomings in the current usage of the TRF method. However, they still present this as the 'gold standard'. The TRF method is treated as such largely because it was the first method developed and widely used; we cannot easily assess its accuracy. It is known to have a number of important shortcomings, including underestimating short telomeres (Baird, 2005), and so is likely to be less useful for tracking changes with age. Horn *et al*. highlight the conflicting views amongst themselves and some other authors over the correctness of one of the programs (telometric) that can be used in calculating telomere length in the TRF method. In none of the published work cited by Horn *et al*. as providing evidence either for or against its utility is any actual evaluation or explanation of the problem provided, so it is clearly important that this is scrutinised further. Horn *et al*. also usefully point out the problems associated with the use of quantitative PCR, particularly the failure in many biomedical studies to report amplification efficiency. What is being measured in the TRF method and the Q-PCR method is not the necessarily same entity (for example, the latter can include interstitial repeats but the former may not depending on the methodology), but individuals are likely to be ranked similarly by both techniques. At present, given the difficulties associated with obtaining estimates of actual rather than relative telomere length from Q-PCR, it is likely to be most useful for intra-specific comparisons, provided the appropriate methodology is followed.

For this kind of innovative, interdisciplinary work on telomeres to be successful, communication and collaboration are essential. Yes, there will be ups and downs, and some ideas will be right and others wrong, some methods won't transfer across species but others will, some techniques will be found wanting and others not. Provided we know which is which, we can make progress. Exploring the biodiversity of telomere biology is certainly going to be an exciting journey.

Conflict of interest

The author declares no conflict of interest.

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