**Discussion**

*Opening paragraph*

Global funding for nature conservation is far below what is required. To maximise conservation gains, it is therefore necessary to provide conservation managers with insights into the trade-offs between different approaches to long-term investment of limited resources in the context of increasing anthropogenic pressure on natural resources. To our knowledge, no studies have investigated the potential long-term consequences of existing funding mechanisms for conservation projects and organisations. Our results therefore provide crucial quantitative evidence that funders, conservation bodies, and landscape managers can use to develop more effective long-term investment strategies.

*Key results from S1:S3*

Our results have demonstrated that in a situation where human pressure on a landscape is increasing over time, and assuming that managers across all scenarios have access to the same total budget, the most effective funding strategy for a conservation manager is a stable, predictable budget. A constant budget is preferable to an increasing budget that starts too low, even when that budget increases beyond the value of the stable budget after 25 years. If a manager’s budget is too low at the start of the simulation period, initial forest loss is very high. The manager is able to reduce the rate of forest loss as their budget increases over time, but they are not able to make sufficient gains over 50 years to render the strategy better than a stable budget. Likewise, a fluctuating manager budget that reflects predictable grant cycles performs worse over 50 years than a stable budget. During periods of high budget, managers can develop effective policies that reduce forest loss, but these periods are not sufficiently long, and budgets not sufficiently high, to offset the damage that is done during periods of low funding. The loss of trees during periods of low funding increases over time, as community resources increase. If the manager was focussed on the conservation of a wildlife population that exhibited reproduction and thus population growth, the periods of high budget, and therefore effective protective policies, may be sufficient to maintain a healthy population. However, in the context of forests, the loss of primary forest cannot be effectively reversed over a period of 50 years (refs). Therefore, providing a manager with a stable budget that allows the development and maintenance of policies that minimise deforestation over the long-term is the optimal approach. Stable, predictable budgets in the real world allow conservationists and landscape managers to maintain staffing levels, invest in long-term relationships and partnerships with landscape stakeholders, maintain enforcement levels, and design policies and interventions that are strategic and adaptive over the long-term. Conservation projects that are initially underfunded will spend many years working to reach the same levels of protection as they would have had, had they been well-funded at the start. Projects that continually experience severe funding shortages due to grant cycles will not have the same capacity for long-term investment and strategic planning as projects with stable funding.

Human populations are increasing, as is pressure on landscapes. However, our results have shown that steady, stable budgets are preferable over increasing budgets that start too low, and fluctuating budgets, even when they go high. Managers require stability and predictability to be able to plan investments and policy. Periods of very high budget are great - they reduce forest loss greatly, but they do not make up for periods of very low budget, where real damage is done. The gains made during high periods are not sufficient to counteract periods of low budget. If the resource was a population of animals, which reproduced and where populations could recover, this would be different. But for forests, over a 50year time period, once they’re gone, for all intents and purposes, they’re gone.

Likewise, increasing manager budgets are great – the rate of forest loss decreases as manager budgets increase. But if they start too low, then you are just playing catch up the whole time. The damage is done during the periods when the manager budget is underfunded, and even over 50 years the manager is unable to bring deforestation levels back level to those of the stable budget. This highlights the dangers of low initial investment in conservation projects, and the dangers of chronic underfunding, even if funding increases gradually.

*Key results S4 and S5*

These scenarios highlight two very common situations for conservation projects or organisations – one with core funding so budgets cant drop too low, and one without, where budgets can drop dramatically. Our results demonstrate that budget variability and uncertainty/unpredictability is not actually that bad if there is a core budget that allows management to be maintained at a certain level throughout the period. In this situation, when there are peaks in budget, managers can increase activities or start new activities which will benefit nature, and when there are dips, because they are not too low, some activities would need to end or reduce, but management capabilities are not completely lost. Conversely, when there is no guaranteed core budget, uncertainty and unpredictability in budgets can be catastrophic. There may be examples when managers are successful in their fundraising abilities, and projects will be able to maintain forest cover as well as if they had a stable budget, but in other cases, if fundraising is unsuccessful, then projects can see very poor conservation outcomes.

*Key messages*

The dominant funding mechanisms in the real world today – ie grant cycles, are not optimal for conservation investment in landscapes. Large dips in funding, and uncertainty around funding, reduce the managers ability to set policy that benefits nature over the long-term. Short term bursts in funding only allow short term success. For longer-term success, stability and predictability in funding, at a certain level (i.e. not massively underfunded) maybe preferable to funding cycles and even increasing budgets that start too low. Simulation studies like this allow us to see possible outcomes over time period longer than we generally have data for in the real world. Monitoring data for conservation projects very rarely exist over time frames such as 50 years, and so short term monitoring can actually be misleading us. If you were to monitor a conservation project with scenario 1 funding between year 1 and year 6, or between years 11 and 19, you would conclude that the project was having success in reducing forest loss.

*Conclusions – what can be done?*

It is no secret that global conservation requires a huge increase in funding if we are to halt the decline in biodiversity and reduce the worst impacts of climate change. This study has provided crucial insights into existing funding models, and suggests that funding mechanisms need to be carefully considered. Our results suggest that increasing the number of grants available for projects and organisations to apply for, may not be the optimal solution over the long term. New funding mechanisms that provide secure, stable, long-term budgets that allow for strategic investment in nature conservation over periods much greater than five years, are required.

Examples of such mechanisms? Trusts? Commitments from international bodies, financial institutions, and statutory agencies?