although it is essential to manage genetic issues in conservation programs, the data from the studies assembled in [3] do not justify the recommendation that taxa with fewer than 5000 individuals should receive less conservation funding.

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Letters

Minimum viable population size: not magic, but necessary

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We agree with Flather and colleagues [1] that there is no 'magic number' or universal threshold around which one can plan for threatened species management to cover all contingencies; neither have we ever claimed so [2]. As Flather and colleagues reiterate [1], a minimum viable population size [MVP; the abundance above which the probability of extinction (over conservation-relevant timescales) is unacceptably low for any species] is illusory. There is substantial variation in MVP among species [3] and probably across subpopulations for widespread or spatially disjunct species, and there is no obvious 'decision threshold', as reviewed by Traill *et al.* [4] and elsewhere [5]. Yet even with this uncertainty, ignoring MVP because of concerns over its imperfections or risk of misuse, as Flather *et al.* [1] seem to prefer, would be imprudent.

First, we did not 'revive' the MVP concept. It is a core component, for instance, of the IUCN Red List of Threatened Species rules (e.g. Criterion D is based on minimum stable abundances and Criterion C on a combination of decline and population size; http://www.iucnredlist.org). Second, there is a strong relationship between extinction risk and population size that is supported by theory (e.g. inbreeding and loss of genetic diversity, demographic and environmental stochasticity, and extinction vortex), simulation studies and substantial empirical data (e.g. genetic–demographic experiments, island biogeography, and mammals on mountain tops) [3–8], especially when appropriate generational scaling is used [9]. Third, Flather *et al.* [1] completely side-step the issue of genetic erosion in small populations, and the substantial evidence that inbreeding does indeed matter profoundly for extinction risk [7,10] (the genetic arguments alone are sufficient to embrace MVP generalisations). They also object to our methods for standardising MVP to account for intermodel differences, varying life-history strategies and other scaling issues [4,5], but do not defend their implication that not to attempt any standardisation is preferable.

Beyond the scientific and technical debates about MVP, the broader issue raised by the Flather *et al.* review [1] is: what to do if MVPs are ignored? The authors claim to: 'offer suggestions for how conservationists might proceed in the absence of such estimates' but ultimately, provide little more than: 'there is no substitute for diagnosing and treating the mechanisms behind the decline of a population'. We agree, in principle (who could not?). However, there are serious limits to how much of this can be done in most countries, or for most species [2]. Therefore, we must rationally consider the alternatives as the conservation crisis mounts. One is to rely on expert opinion, but evidence shows that qualitative judgements and human intuition are not reliable in this and other complex areas [11]. Another is to be guided by general principles that are underpinned by theory, data and models, and which integrate multiple factors (including feedbacks and synergies), treating uncertainty and assumptions explicitly and transparently. Model-based estimates of population viability are analogous to other areas of complex system science, such as weather forecasting, in that they are at least able to be

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tested, refined and improved. They also offer a defensible quantitative tool for prioritising conservation actions for multiple species [2]. Flather *et al*. [1] imply instead that because of (obvious) complexities, generalities are impossible. Ecology and conservation biology would not be plausible scientific disciplines if this were true.

We agree, at least in some circumstances, that 'generalizing [too broadly] among species is a dangerous undertaking', but argue that ignoring the paucity of data for most threatened species is a greater ecological and conservation biology sin. Obviously, as Flather *et al*. [1] state, if there is a robust model for a species, it is preferable to use this to estimate extinction risk directly, rather than relying on an indirect approximation of MVP. However, for the vast majority of situations where no model exists and there are insufficient data or resources available to construct such models, what must one do? Lessons from body-mass allometry [6], experimental and observed dynamics [8], and the generational scaling of population variability [9] all show that useful generalities are possible (and on evolutionary grounds, one should expect them). Conservation biology is a crisis discipline akin to cancer biology, where one must act in a timely manner on the best information available. Decision-makers cannot afford the luxury of adhering to a 'null' philosophy that says everything is unique; rules of thumb are desperately needed, including quantitative goals such as MVP.

In our 2010 review [2], we stated that biologists should aspire to conserve 'at least 5000 adult individuals (or 500 to prevent inbreeding) whilst addressing concomitant mechanisms of decline'. Despite various protestations, Flather *et al*. [1] ultimately agree: 'We also suspect. . .that multiple populations totalling thousands (not hundreds) of individuals will be needed to ensure long-term persistence'. Yet the reality is that sizes that are one to two orders of magnitude lower are still being routinely used and promoted within the conservation community [12]. The setting of higher target numbers (and more extensive habitats) is more realistic and scientifically defensible than aiming for tens or hundreds of individuals, or having no population goal at all, especially given the fact that conservation threats are growing with human populations, concomitant habitat loss and global climate change. Decision-makers need to hear and act upon this message, and avoid distraction of minor scientific squabbles on what essentially amounts to quantifying (im)precision.

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Letters Response

A general target for MVPs: unsupported and unnecessary

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In a recent article in TREE [1], we reviewed evidence for a consistent standardised estimate of minimum viable populations (MVPs) across taxa [2–4] and found that the universal MVP of 5000 adults advocated by Traill *et al.* [5] was unsupported by reanalyses of their data. We identified shortcomings in the original analyses, and found substantial uncertainty in standardised MVP estimates, both within populations of the same species and among species. We concluded that neither data nor theory supported a generally applicable MVP.

No evidence refuting the technical problems that we identified in their original analyses was presented by

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