

# Should we implement monitoring or research for conservation?

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The primary aim of our paper on monitoring [1] was to inspire managers to think about how they allocate resources to monitoring conservation management actions. This is precisely what Geupel *et al.* [2] have done in responding to our work.

Having evaluated some of their own monitoring programs, they correctly contend that monitoring and research are not necessarily mutually exclusive. However, we would argue that, in most cases, if we were aiming for shrewd decision-making, they should be. Our paper was aimed at deciding whether monitoring to guide management is worthwhile, given a particular conservation problem. No amount of monitoring can guide management if the drivers of a decline or potential management options to stem that decline are not known. Although some advances in understanding threats and management actions might emerge serendipitously from untargeted monitoring, this is a long shot and could result in years of wasted effort. Targeted research activity will typically be the most rapid and cost-effective way to answer questions about the causes of a decline, and the management options for reversing it. The key point is that, even once such research activity has identified threats and management options, monitoring still might not be justified ([1] Figure 1; Recommendations 8, 10 and 15).

We argued that a primary purpose of monitoring the system state is to decide which management option to implement, given the state of the system ([1] Figure 1, Recommendation 6). Geupel *et al.* [2] warn against monitoring the system state instead of the management outcome in situations where the best management for a given system state varies unpredictably in space and time. We, however, only recommend monitoring the system state under the scenario where both the appropriate management action depends on the state of the system and managers know which management action is the best, given this system state ([1] Figure 1, Question 5: answer 'YES'). If the best management option for a given system state is unpredictable, then we cannot say we know the best management option ([1] Figure 1, Question 5: answer 'NO'). We believe, therefore, that the best recommendation here should flow from the latter questions in our decision tree

([1] Figure 1, Questions 9, 11 and 13): to implement passive or active adaptive management or, in more restricted circumstances, some form of decision analysis.

Geupel *et al.* [2] further point out that, even when the best management option is clear, the outcome of its implementation can rarely be confidently concluded without monitoring. When deciding to spend money monitoring the outcome of an intervention, it is important to establish why this is necessary. If the purpose is to report on the benefits of the investment, then some form of least-cost monitoring might indeed be required; however, this is not monitoring to inform management and is thus outside the scope of our decision tree. If the aim was to determine the benefits of an action to allow adaptation, then we suggest that the best management option is not clear ([1] Figure 1, Question 7: answer 'NO') and potentially some form of adaptive management might be recommended ([1] Figure 1, Questions 9, 11 and 13). Finally, if the best management option is clear, then monitoring for management is redundant ([1] Figure 1, Recommendation 8).

Geupel *et al.* [2] point out that insights from a monitoring program built around a particular conservation issue can benefit management at other times and in other places. We strongly agree and the use of such prior information to guide management is a growing part of applied ecology (e.g. [3,4]). However, in the current climate of limited funding, and given the urgency of many conservation endeavours, the challenge is to quantify how much time and money one should be prepared to spend within a particular project to deliver utility to other projects.

Finally, Geupel *et al.* [2] raise concerns with our suggestion that the allocation of resources between monitoring and management are flexible. We agree that, in some circumstances, this flexibility might not exist. When funding of monitoring is clearly not justified, we suggest redirecting that funding, either to a conservation project where monitoring is worthwhile, or to another management-focused activity within the current project. Only by making explicit decisions regarding monitoring will we challenge the seemingly systemic assumption that monitoring should automatically form a part of every conservation project.

The utility of decision trees such as ours lies in their simplicity, but inevitably, there are complex and difficult

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issues underpinning their use that need to be thought about on a case-by-case basis. We hope that our paper continues to stimulate discussion of the circumstances under which monitoring is justified in a cost-constrained world.

### References

1 McDonald-Madden, E. *et al.* (2010) Monitoring does not always count. *Trends Ecol. Evol.* 25, 547–550

- 2 Geupel, G.R. *et al.* (2011) Monitoring decisions: not as simple as they seem? *Trends Ecol. Evol.* 26, 107
- 3 Kuhnert, P.M. *et al.* (2010) A guide to eliciting and using expert knowledge in Bayesian ecological models. *Ecol. Lett.* 13, 900–914
- 4 McCarthy, M.A. and Masters, P. (2005) Profiting from prior information in Bayesian analyses of ecological data. *J. Appl. Ecol.* 42, 1012–1019

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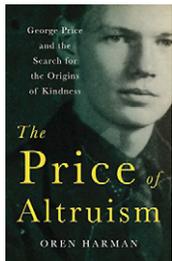
### Book Review

## Tortured genius

**The Price of Altruism: George Price and the Search for the Origins of Kindness** by Oren Harman. The Bodley Head, 2010. £20.00, hbk (464 pages) ISBN 978 1847920621

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Recent years have seen growing interest in the evolutionary theorist George Price. His life, work and death have been touched upon in academic papers, works of popular science, a BBC television series and even a murder/horror film. Despite this interest, Price has generally played only walk-on parts in the story of sociobiology, and aficionados of his story have had to piece together scraps of information from a range of sources. In answer to this neglect, Oren Harman's *The Price of Altruism* provides the first book-length biography of this enigmatic character.

Harman opens Price's story with his parents, William and Alice, and the home they made in 1920 s New York. Following William's death, Alice battled to raise her sons while keeping the family business afloat through the Great Depression. Price showed this same tenacity through his adolescence and adulthood, in his pursuit of girls and academic fame. His degree in Chemistry at Chicago led to work on the Manhattan Project, where he met his wife Julia, and from there to Bell Labs. During this time, Price pursued a bewildering range of interests: electronics, neurobiology, challenging the claims of ESP research [1,2] and apparently inventing computer-aided design. However, in his restlessness, he failed to capitalize on any of these achievements, and his marriage soon fell apart. A generous insurance settlement following a botched operation to remove a thyroid tumour offered him a fresh start and, during his late forties, Price relocated to London to pursue a new interest in evolutionary theory.

Working in public libraries, he derived what is now known as the Price equation [3,4], a completely general encapsulation of evolutionary change that applies to all species and all modes of inheritance, and now underpins whole disciplines, such as social evolution. This work led

Price to befriend W.D. Hamilton, who was laying the foundations of inclusive-fitness theory. A second contribution followed: the application of game theory to animal combat. Although Price's manuscript was initially declined, the reviewer (John Maynard Smith) saw promise in the approach, and the two men later collaborated on the seminal *Logic of Animal Conflict* [5], which launched evolutionary game theory. Finally, Price proved a central result of evolutionary theory: R.A. Fisher's fundamental theorem of natural selection. In a charming article [6], he catalogued with mild exasperation the "astonishing number of lesser obscurities, infelicities of expression, typographical errors, omissions of crucial explanations, and contradictions between different passages" in Fisher's 'exposition' that had caused the theorem to languish, misunderstood, for decades.

This period of discovery did not last. Even while developing the evolutionary theory that would make his name, Price was increasingly consumed by religious mania. Giving away his money, possessions and home to London paupers, he placed his own fate in God's hands. However, providence failed to materialize and, reduced to poverty, he finally committed suicide in a squatters' tenement, in the grip of painful, unrequited love for a young woman with whom he had become infatuated.

*The Price of Altruism* is a well-researched biography that has brought George Price, the man, into sharp focus for the first time. Harman paints a picture of a brilliant mind, obsessive and restless in equal measure, blessed with an ability to scrutinize the world and make it yield its secrets, but cursed with an aversion to commitment that sabotaged any prospect of a fulfilling academic career or a happy personal life. Curiously, I am still left with little impression of what made the man tick: the reasons for his eclectic interests and weird behaviour remain obscure. However, Price appears to have been just as distant from those who knew him personally. Harman's great achievement is to make the reader feel as though they were part of this inner circle.

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