On the Horns of a Dilemma: Management of 'at risk' Species in Protected Areas in the Age of Ecological Integrity

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Abstract

Two relatively new pieces of federal legislation may work at cross purposes with respect to guidance about the management of 'at risk' species in protected areas. The National Parks Act *compels that ecological integrity (EI) is the first priority in all matters of park management and defines EI as conditions "*characteristic for a *natural* region, including the composition and abundance of native species …, *rates of change* and supporting processes [italics added]*". Abundant ecological theory and data suggest that relative rarity is and has always been the* natural *state of abundance for the majority of species. Such species are thus* naturally *vulnerable to enhanced risk of extinction due to genetic, demographic and/or environmental stochasticity, implying that some natural, "background" extinction might be tolerated in protected areas managed for EI. One purpose of the* Species at Risk Act*, however, is "*to prevent wildlife species from being extirpated or becoming extinct*". Protected areas are increasingly referred to as 'last refuges' and 'safe havens' for rare species, implying that extinction should not to be tolerated in protected areas. This contradiction presents a significant challenge for managers who must decide what (in)actions might be appropriate for particular rare species in different circumstances. A resolution might be found if at least as much emphasis is placed on protected areas as places to conduct research as places to act as 'safe havens'. To resolve key ecological uncertainties about the extent to which certain species are actually at risk of extinction in protected areas requires that managers might not intervene in every suspected case of high risk, or conduct experiments, even with 'at risk' species. Two examples – wolves on Isle Royale National Park* *and flying squirrels in Point Pelee National Park – suggest that these options were not as risky as first perceived. The learning that results ultimately improves the reliability of knowledge upon which conservation policy is founded and might be used to focus conservation cost-effectively.*

Keywords: Species at Risk Act, National Parks Act, *ecological integrity, natural extinction*

Introduction

In the United States, once a species is listed, the *Endangered Species Act* is shy on direction about how to decide whether and which taxa are worthy of conservation, or to resolve endangered species conflicts, such as when one endangered species is a predator of another (Roemer and Wayne 2003). Similarly, Canada's *Species at Risk Act* (2002), or SARA, sets criteria to list individual species but provides little guidance to managers in the case of conflicts. Further, aspects of different pieces of federal legislation may actually exacerbate conflict. For example, golden eagles (*Aquila chrysaetos*) protected by the *Migratory Bird Convention Act* (1994) were killed to reduce the risk of predation on Vancouver Island marmots (*Marmota vancouverensis*) protected by SARA (e.g., Canadian Broadcasting Corporation 2004). Similarly, federal legislation with regard to the management of national parks appears to be at odds with SARA.

Federal Parks and Species at Risk Legislation

Environmental non-government organizations (ENGOs) had long sought, and the Panel on the Ecological Integrity (EI) of Canada's National Parks (Parks Canada 2000) endorsed, that the first priority for national parks should be the maintenance and restoration of EI. Consequently, a new *Canada National Parks Act* (2000) provided that the "*maintenance and restoration of ecological integrity, through the protection of natural resources and* natural *processes, shall be the first priority of the Minister when considering all aspects of the management of parks [italics added]*". Further, the *Act* defined EI as conditions "*characteristic for a natural region, including the composition and abundance of native species and biological communities,* rates of change *and supporting processes [italics added]*".

In response to petitions from many of the same ENGOs, the *Species at Risk Act* (2002) was subsequently passed. The purposes of the Act are "*to prevent wildlife species from being extirpated or becoming extinct, to provide for the recovery of wildlife species that are extirpated, endangered or threatened* *as a result of human activity, and to manage species of special concern to prevent them from becoming endangered or threatened*" (*Species at Risk Act* 2002). Coincidentally, protected areas are increasingly referred to as 'last refuges' and 'safe havens' for listed species.

Herein, however, lies the dilemma: rarity, a significant (albeit, not the only) listing criterion, is – and, so far as can be told from the historical record, has always been – the *natural* condition for the vast majority of species in any ecosystem. The maintenance and restoration of some "background" level of natural extinction in protected areas is thus implied by the purpose of the *Canada National Parks Act* and the definition of EI. In that sense, that Act places management for EI in protected areas directly at odds with the direction implied by the *Species at Risk Act*, namely, that protected areas should be managed so as to minimize extinction risk in 'last refuges' for listed species.

Natural Rarity and its Consequences in Protected Areas

Ecologists have long known that distributions of relative abundance of species, although potentially fit by different quantitative models with different biological implications, are nevertheless characterized by many rare species and very few common ones (e.g., Ricklefs and Miller 1999: 541-545). These patterns are usually depicted as species-abundance or rank-abundance curves. Like the species-area curve to which it is related theoretically (Tokeshi 1993), this pattern is among ecology's few genuine "laws". A consequence of this fundamental, *natural* pattern is that most species are prone *naturally* to extinction, at least locally, due to genetic, demographic and environmental stochasticity (Shaffer 1981) – that is, the tendency for chance events to cause less-abundant species, in particular, to disappear from local assemblages (e.g., Pimm 1991: 135).

Thus, sufficiently long time-series of species' occurrences, even in protected areas, can show considerable natural "turnover" as species are extirpated and replaced by others. When common species are locally extirpated, they may be relatively quickly replaced by individuals of the same species; rare species might be expected to be replaced by more abundant species by chance alone, but even rare species might be replaced by individuals of the same, or another, rare species. For example, Surette (in prep.) studied the dynamics of the assemblages of fish in the marsh ponds at Point Pelee National Park, which were sampled in 22 years between 1940 and 2004. The ponds are separated from Lake Erie, on the east side of the park, by a narrow beach ridge which is breached periodically during years when lake water levels are high. At these times, fish can travel between the ponds in the park and the lake. In 1940, three species – now listed as species at risk (SAR) – were detected. In 2003-4, despite considerably greater sampling effort, two of them were not found again, but two SAR, not found in 1940, were detected. Between five and 33 species were detected in different years, averaging about 15 per year. By 2004, the cumulative number of species detected was three times the yearly average (47), as expected if rare species, especially, "turned over" naturally.

However, over 64 years, different investigators had used different gear, which contributed to variable sampling effort over time. Thus, Surrette partitioned the total variation in species composition over time to gear type and to natural disturbance due to breaches. Greater interannual variation in fish species composition in the marsh ponds coincided with periods following breach events. The "natural condition", then, for fish at Point Pelee National Park has not been characterized by stasis, nor is it likely ever to be so. Rather, fish assemblages in the park are characterized by dynamic species turnover caused, at least in part, by natural events beyond the control of managers.

Indeed, a considerable body of theoretical and empirical evidence indicates that natural systems are characterized by dynamic equilibria between rates of colonization/local extinction and speciation/global extinction (e.g., Pimm 1991:143, Ricklefs and Miller 1999:594-596). Such natural dynamics have always existed, even within areas now designated as protected. In that context, it has only been since widespread landscape alteration around protected areas resulted in rates of recolonization unable to keep pace with local natural extinction, that extinction has been viewed as a "problem" in protected areas. Basically, before the advent of island biogeography theory (MacArthur and Wilson 1967), "what we didn't know didn't hurt us".

Importantly, extinction rates, even under pristine conditions, are not, nor appear to ever have been, zero. So, the problem facing managers is three-fold: First, to manage "naturally", including rates of change as required by one piece of legislation, requires knowledge of some appropriate estimate of a natural, "background" extinction rate. Second, even if that were available, managers are unlikely to be able to predict which species might be extirpated by chance, natural events, nor how human activity in and around protected areas might alter the risk of extinction due to chance alone. Third, in any case, managers are also directed by different legislation to prevent all extinction. Collectively, these problems might compel managers simply to adopt a precautionary approach as a safeguard: that is, better to mistakenly save a species that might have gone extinct naturally, than to not save one that was going to go extinct, especially if it was due to human activity. Regardless, the central dilemma remains: how to comply, on the one hand, with a legislative mandate to maintain and restore EI, of which extinction may be one natural process, with a legislative mandate to prevent extinction, using protected areas as a tool, on the other?

A Different Role for Protected Areas

One day, natural extinction in protected areas might be considered as sensible and commonplace as the maintenance and restoration of fire (which was once considered also to have no place in protected areas, but is now accepted as part of the "natural order" and an essential process [e.g., see Parks Canada 2000:5-4]). However, before that policy is embraced too fervently, it requires that (like fire) the phenomenon and its consequences be better understood. Appropriately, The Panel on Ecological Integrity (Parks Canada 2000) also affirmed the role of parks as places to conduct research about the ecology and evolution of natural systems for the very reason that the "natural courses" of nature are not, in fact, often well understood.

However, using protected areas as living laboratories to learn more about natural extinction and its consequences has an important implication. It would require that intervention to arrest extinction is not presumed in every suspected, impending instance. Instead, protected areas could be used to better study 'natural courses' of species' population dynamics and their causes, even to the point of experimentation with SAR (e.g., Boyce *et al.* 2005). Two examples illustrate that this approach may not, in fact, be as risky – in terms of losing species – as might first appear.

The grey wolves (*Canis lupus*) on Isle Royale National Park, which are protected in the 48 contiguous United States, have been alleged several times to be on the brink of extinction. Each time, the concern caused considerable debate about what to do if they did and, therefore, whether and how to avoid it. In the late 1980s, the "problem" was hypothesized to be genetic stochasticity caused by too few breeding individuals. In the 1990s, the "problems" were demographic stochasticity (reduced fecundity or survival) perhaps exacerbated by environmental stochasticity (population "crashes" of moose, the main winter prey). In each instance, the "natural experiment" on Isle Royale was allowed to run, wolves persisted, and the result is better insight into the validity of some aspects of current theory in conservation biology, and its management implications, than would otherwise be possible. Specifically, the cost of intervention to arrest extinction may not always be warranted if the predictions of theory don't always apply. In such cases, limited resources for conservation might be redirected to more needy causes.

Similarly, southern flying squirrels (*Glaucomys volans*), listed by COSEWIC as a "species of special concern," were extirpated from Point Pelee National Park about 1940. A reintroduction was proposed in the early 1990s, but detractors claimed it was pointless. According to popular theory in conservation biology, the reintroduced population would only go extinct again because, for instance, the population would be too small to withstand the effects of the same kinds of stochastic events alleged to be problematic for wolves on Isle Royale. Nonetheless, with the strong support of Parks Canada staff, the translocation was conducted as an experiment. It was designed, in the short term, to test the effectiveness of release techniques and habitat selection theory (Adams 1995) and ultimately, over the ensuing decade, whether genetic stochasticity relates necessarily to population persistence as predicted by theory (Bednarczuk 2003). Ninety-nine squirrels were released into the park over 1993 and 1994. Reintroduced squirrels did not require supplemental food or cavities to survive, and they abandoned nest boxes for natural cavities almost immediately on release. In 1993, survival was lower for squirrels released in May than later, so the release schedule was adjusted for 1994. By 2001, the population exceeded 500 squirrels and there was no evidence that a genetic "bottleneck" – the loss of genetic variation predicted by theory to result from the demographic "bottleneck" imposed on the founder population – ever occurred.

Conclusion

The theme of this year's Parks Research Forum of Ontario meeting – protected areas and species at risk – was timely in two senses. First, as outlined above, it presented an opportunity to reflect on recent advances in federal legislation in both areas and the implications for management of species at risk in protected areas. As a result, there appear to be more questions than answers about whether and how to manage species at risk, and whether management to arrest an (alleged) impending extinction of an "at risk" species is necessarily a good choice in all circumstances. The answers are uncertain.

The question, "*Is it acceptable to let a species go extinct in a national park?*" is not a scientific one; but reliable knowledge gained by scientific means can inform about the relative risks associated with not intervening in particular cases (see also Berger 2003). This is desirable if limited resources to manage for a particular "at risk" species means that other, perhaps more important issues, go undetected and/or unresolved – especially if the "at risk" species was actually less vulnerable to local extinction than presumed based on current scientific knowledge. That such circumstances might exist is the point of the Grey Wolf and Southern Flying Squirrel examples in this paper, but such examples will not assuage concerns that non-intervention is riskier than intervention; it is a question of values after all.

To better assuage such concerns, it would be desirable to have, where possible, populations of "at risk" species present in many reserves, such that not all the "eggs are in one basket" (Boyce *et al.* 2005). For example, Crowley (this volume) showed that some listed species of herpetofauna potentially occur in several protected areas, but others occur in fewer. Thus, it might be considered less risky to not intervene in the face of an hypothesized extirpation in a park in the case of the stinkpot turtle (*Stenotherus odoratus*; up to 60 parks) or Eastern hog-nosed snake (*Heterodon platirhinos*; up to 49 parks) than in the case of the spotted turtle (*Clemmys guttata*) or Eastern ratsnake (*Elaphe obsoleta*), where there are fewer parks within the geographic ranges of these latter species. Even then, the *Species at Risk Act* implies that impending extinctions that ought to be the focus of management attention are those considered to result from human activity. This should compel researchers and managers to conduct research to better distinguish between those local extinctions that result naturally, versus those likely to be caused by humans. The latter might then be potentially avoided by managing human activity appropriately in protected areas.

Second, the government of Ontario announced recently that it was moving forward with legislative agendas on these same two fronts and intends to introduce new provincial parks and species at risk acts. At the time of writing, the latter is on hold while the former moves ahead. Regardless of the timing, there might be some valuable lessons to be learned from the federal experience. Specifically, 'next generation' legislation in these areas might be improved by addressing the contradiction evident in federal counterpart legislation and providing guidance for managers to monitor or experiment in protected areas where the fates of rare species are uncertain. In these situations, there is opportunity to learn to improve the scientific knowledge upon which conservation policy and law are founded.

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References

Adams, I.T. 1995. *Effects of supplemental resources and habitat on the distribution of southern flying squirrels reintroduced to Point Pelee National Park*. MSc. Thesis, University of Guelph, Guelph, ON.

Bednarczuk, E.M. 2003. *Effects of population size reduction on genetic variability of reintroduced southern flying squirrels*. MSc. Thesis, University of Guelph, Guelph, ON.

Berger, J. 2003. Is it acceptable to let a species go extinct in a national park? *Conservation Biology* 17:1451-1454.

Boyce, M.S., S.R. Lele and B.W. Johns. 2005. Whooping crane removal enhanced by egg removal. *Biological Conservation.* 126:395-401.

Canada National Parks Act. 2000. Available on the Department of Justice website. http://laws.justice.gc.ca/en/N-14.01/19348.html. Accessed 20 July 2005.

Canadian Broadcasting Corporation. 2004. Eagles killed to protect marmots. Available on the Canadian Broadcasting Corporation website. http://vancouver.cbc.ca/regional/servlet/View?filename=bc_eagles20040318. Accessed 21 July 2005.

Crowley, J.F. and R.J. Brooks. 2005. Protected areas and the conservation of Ontario's reptile species at risk: safe havens or false hopes? in: Nelson, J.G. *et al.* (eds.) *Protected Areas and Species at Risk. Proceedings of the Ontario Parks Research Forum Annual General Meeting.* University of Waterloo, Waterloo, ON. Pp. 139-152.

MacArthur, R.H. and E.O. Wilson. 1967. *The Theory of Island Biogeography*. Princeton University Press, Princeton, NJ.

Migratory Bird Convention Act. 1994. Available on the Department of Justice website. http://laws.justice.gc.ca/en/M-7.01/ Accessed 21 July 2005.

Parks Canada. 2000. *Unimpaired for Future Generations? Conserving Ecological Integrity with Canada's National Parks*. Available on the Parks Canada website. http://epe.lac-bac.gc.ca/100/200/301/parkscanada/report_of_the_panel-e/report/report.htm. Accessed 21 July 2005.

Pimm, S.L. 1991. *The Balance of Nature? Ecological Issues in the Conservation of Species and Communities*. University of Chicago Press, Chicago, IL.

Ricklefs, R.E, and G.L. Miller. 1999. *Ecology*. 4th Edition. W.H. Freeman and Company, New York, NY.

Roemer, G.W., and R.K. Wayne. 2003. Conservation in conflict: the tale of two endangered species. *Conservation Biology.* 17:1251-1260.

Species at Risk Act. 2002. Available on the Department of Justice website. http://laws.justice.gc.ca/en/S-15.3/103526.html#rid-103535. Accessed 20 July 2005.

Shaffer, M.L. 1981. Minimum population sizes for species conservation. *BioScience.* 31:131-134.

Surette, H. (in preparation). *Factors affecting the distribution and abundance of fish species in Point Pelee National Park*. MSc. Thesis, University of Guelph, Guelph, ON.

Tokeshi, M. 1993. Species abundance patterns and community structure. *Advances in Ecological Research.* 24: 111-188.