

Future Directions: Assessing the effectiveness of biological conservation

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The conservation of biological diversity is a societal goal that is broadly supported by most governments, organizations and individuals. Very few would argue that there is not a need or desire to conserve biodiversity, but putting conservation into practice is often problematic. Traditionally, conservation has been achieved by setting aside defined areas and preserving them in what is believed to be a natural or near-natural state. However, the creation of strictly protected reserves often conflicts with a government's social or economic priorities in a region or country, and it is in areas where social and economic pressures are greatest that conservation needs may also be greatest (Innes and Er 2002; Adams et al. 2004). For example, many small tropical countries, particularly island states, are facing enormous population pressure, yet they are also important centres of biodiversity. In many cases, they contain substantial numbers of endangered, endemic species, making them a priority for global conservation efforts (e.g., Gillespie and Jaffré 2003). Elsewhere, such as in British Columbia, Canada, conservation efforts may be driven by concerns about local or regional extirpations, with threat to biological diversity being the continued conversion and development of natural ecosystems.

The pressure to adequately balance preservation, conservation and development is resulting in the development of tensions and conflict. Setting aside large areas undisturbed by human impacts is still possible in some areas (such as Canada, the USA, Russia and Brazil), but this option is becoming progressively more limited. The establishment of smaller reserves is still possible, and is widely practiced. The establishment of such reserves requires determining an appropriate balance between preservation and development, but in some cases, such a balance may be difficult or even impossible to achieve (Snyder et al. 2004). As a result, there is increasing interest in managing the matrix between such reserves more effectively. This requires the adoption of landscape-scale assessments, and the setting of large-scale conservation priorities that may be incompatible with the wishes of stakeholders concerned about local issues. Managing the matrix effectively will require the involvement of all stakeholders, not just those living in the areas immediately impacted (c.f. Souza 2005).

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Citation: Innes, J.L. 2007. Future directions: Assessing the effectiveness of biological conservation. Proceedings of the "Monitoring the Effectiveness of Biological Conservation" conference, 2-4 November 2004, Richmond, BC. Available at: <http://www.forrex.org/events/mebc/papers.html>

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The emphasis on matrix management creates some interesting questions for conservation. Matrix management suggests that management is conducted primarily at the scale of the management unit. What should the conservation objectives be at such a scale? For example, is it necessary to maintain viable populations of all species at such a scale, even if the management unit is very small? How, for example, could matrix management be implemented across all the small-scale forest owners in the southeastern United States of America? This would not only involve the surrender of some of the constitutional rights of private land-owners, but in the case of companies working collaboratively, it could violate U.S. anti-trust legislation. Much the same applies to regional planning of conservation, seen by some (e.g., Margules and Pressey 2000) as critical. A regional approach is attractive on the basis of what we know about conservation needs, but is likely to be extremely difficult to implement because of the type of problems described immediately above.

An approach to forest conservation that includes the management of the matrix between protected reserves has been increasingly adopted, and several of the contributions to this book have addressed this issue. The approach has been emphasized by Lindenmayer and Franklin (2002) in their suggested methods to improve the conservation of forest biodiversity. As they cogently argue, “the matrix matters”. Regardless of whether or not the basic premise that the conservation of biological diversity depends on the existence of both preserves and active matrix management is accepted, a critical part of any conservation plan will be the assessment of whether the approach adopted is actually working. This question has been the focus of this book, and it is clear that there are still a very large number of questions to answer. Some of these are listed below:

1. How do we determine the minimum viable populations for all species, not simply the endangered ones?
2. How do we determine these populations under realistic field conditions?
3. How do we deal with the issue of scale?
4. How should fragmentation and connectivity be built into conservation assessments?
5. Who is financially responsible for the monitoring and assessment of conservation effectiveness?
6. How can we adequately integrate the conservation of ecosystems, species and genes?

This last question in particular epitomizes the debate over “fine” versus “coarse” filter approaches. Assessments of the conservation status of individual populations and species have become widespread, especially in North America. For example, NatureServe (<http://www.natureserve.org/>) provides a website that lists the conservation status of species and ecological communities, allowing a rapid assessment of the potential presence of endangered species. The system provides the status of a species globally, in the USA and in Canada. The status of a species may vary across jurisdictions. For example, the yellow-breasted chat (*Icteria virens*) is listed internationally as being demonstrably widespread, abundant, and secure, yet in Canada, it is federally listed as facing imminent extirpation or extinction and in British Columbia it is listed as critically imperiled or imperiled. Consequently, a species that may be a conservation priority in a particular province may not necessarily be a conservation

priority for the whole of the country or for North America. Determining the effectiveness of conservation efforts for a species may therefore involve assessments made at different scales: local extirpations are not the same as extinctions, although local extirpations may be the precursor to extinction (e.g., Carroll et al. 2004).

Despite progress made on the use of “fine” filter assessments, there is still a tendency to focus on habitat rather than on species. Lindenmayer and Franklin (2002) consider that the maintenance of habitat across multiple spatial scales is critical, and set out five principles for the effective conservation of biological diversity in forests: 1) maintenance of connectivity; 2) maintenance of landscape heterogeneity; 3) maintenance of stand structural complexity; maintenance of aquatic system integrity and 5) the reduction of risk by adopting a range of different management strategies. Habitat assessments are relatively easy to undertake, and can be done over large scales. They are an attractive alternative when the assessment of the actual species of concern is difficult – as for example with the marbled murrelet (*Brachyramphus marmoratus*) (Mulder et al. 1999). Specific habitat attributes can be monitored on the assumption that these attributes determine the status of the species. This is problematic. In the cited example, the amount of nesting habitat can play a role in determining murrelet population size (Raphael et al. 2002), assuming that the requirements are fully understood, but other factors, such as food supply, may be as or even more important in influencing population size (Peery et al. 2004; Becker and Beissinger 2006). If habitat attributes are monitored as a means of determining the effectiveness of the conservation of a range of species, then the problems become even more acute. Clearly, it is impossible to assess the conservation status and trends of all ecosystems, species and genes. However, in concentrating on surrogates of these, it is important that the reliability of the surrogate is understood (Bunnell 1998).

Further questions relate to the readiness of governments to encourage the conservation of biological diversity over economic objectives. In British Columbia, the government has recently placed more emphasis on the ability of land managers, specifically professional foresters, to practice a form of forestry that is oriented towards the production of specific results. Working within the old ‘sustained yield’ model, the government has ruled that biodiversity must be maintained, but only insofar as it does not significantly impact the yield of timber from the forest estate. The conservation of biodiversity is seen as a constraint on timber production, and all constraints, including conservation, are only permitted to impact the annual allowable cut by a total of 6%. The emphasis that is placed on timber yield above all other values has led some (e.g., Luckert and Williamson 2005) to question whether sustained yield should really be a part of sustainable forest management. Clearly, it should not be.

Given these problems, how can the effectiveness of biological diversity conservation be determined? The many examples of efforts to assess effectiveness suggest that today there is a better understanding of what is meant by the concept. In the past, there has been a tendency to assume that the creation of a network of reserves based, for example, on a percentage land area target, was sufficient to ensure adequate conservation. Despite the clear benefits that parks have brought (see, for example, Bruner et al., 2001), we now know that such an approach was naïve. Not only are there major gaps in the global network of reserves (Rodrigues et al. 2004), but ecosystems are dynamic, as are the ranges of the species that occupy them. Lindenmayer and

Franklin (2002) caution that an approach based exclusively on preserves will fail, an argument that is increasingly accepted as, for example, the implications of climate change become better understood (see, for example, Huntley 1998 and Coulston and Riitters 2005). This is because natural processes do not respect park boundaries – in many cases, park boundaries are insufficient to protect against anthropogenic processes, whether it be pollution or incursions for resource development.

Effective conservation needs to address some fundamental questions, some of which at least are related to the questions about the basic science and application of biological conservation. For example, what exactly needs to be conserved in a defined area? Is it all aspects of biological diversity, or only part? If it is only part, how will it be ensured that there is adequate conservation of that part elsewhere? These questions are not new – they, and others, were raised by Bunnell (1998), and have been raised on many occasions since (e.g., Salafsky et al. 2002; Nicholson and Possingham 2006). It is unfortunate that we are still having to ask them.

Once decisions are taken as to what aspects of biological diversity require conservation, a suitable method has to be devised to determine whether or not the conservation goals are being attained. The extent to which this has not yet been done is surprising, but perhaps reflects the difficulty of making such effectiveness assessments, particularly with naturally variable populations of organisms. There has been a tendency to place too much weight on surrogates, particularly habitat supply, without fully understanding all the factors that can lead to a population decline (c.f. Becker and Beissinger 2006). The causes of a population decline need to be understood if management interventions are to be successful and, in turn, success of a particular action cannot be declared unless there is a clear cause-effect relationship between the action and a population recovery (Green 2002). Such relationships may be very difficult to determine, especially if behavioural changes are involved (Tuytens and MacDonald 2000).

It is clear that any assessment of the effectiveness of biological conservation needs to be conducted across a range of scales. In some cases, national assessments are required, in others, the assessments may be very localized. The conservation of a particular population of a species at a particular site may or may not be successful, but methods are needed to determine if the management strategy has succeeded. At a regional scale, the success of individual populations may be less important, especially if metapopulation dynamics are operating (McCullough 1996). However, methods are needed to determine whether this is indeed the case, or if some other more directional trend is operating. The larger the area and the greater the number of species that are involved, the more difficult (and expensive) the assessments will become. Large-scale inventories of the type undertaken in Alberta and Switzerland, and described in this book, may help identify trends, but they rarely help understand the causes of population changes.

Biological conservation, by its very nature, can be linked to management activities. Even the designation of a large, pristine, wilderness area constitutes a management activity. In the past, there has been an assumption that suitable management activities (such as the creation of large reserves) will result in success, but the evidence does not support this assumption. Many conservation attempts have resulted in failure (e.g., Curio 1996; Short et al. 1992), so it is critical that future management actions designed to conserve

biological diversity have, as a standard prerequisite, an appropriate plan for determining their effectiveness. While many management strategies directed at the matrix are likely to be beneficial for conservation, there is an urgent need for more experimentation and for more monitoring (Simberloff 2001; Niemelä et al. 2001). Without this information, the short- and long-term success of conservation of biological diversity both within and outside reserves will continue to be very uncertain.

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