A Mesofilter Conservation Strategy to Complement Fine and Coarse Filters

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Abstract: *Setting aside entire ecosystems in reserves is an efficient way to maintain biodiversity because large numbers of species are protected, but ecosystem conservation constitutes a coarse filter that does not address some species. A complementary, fine-filter approach is also required to provide tailored management for some species (e.g., those subject to direct exploitation). Mesofilter conservation is another complementary approach that focuses on conserving critical elements of ecosystems that are important to many species, especially those likely to be overlooked by fine-filter approaches, such as invertebrates, fungi, and nonvascular plants. Critical elements include structures such as logs, snags, pools, springs, streams, reefs, and hedgerows, and processes such as fires and floods. Mesofilter conservation is particularly appropriate for seminatural ecosystems that are managed for both biodiversity and commodity production (e.g., forests managed for timber, grasslands managed for livestock forage, and aquatic ecosystems managed for fisheries) and is relevant to managing some agricultural and urban environments for biodiversity.*

Key Words: coarse-filter conservation, ecosystem management, fine-filter conservation, matrix management

Una Estrategia de Conservación de Mesofiltro para Complementar Filtros Finos y Gruesos

Resumen: *La formación de reservas con ecosistemas completos es una forma efectiva para mantener a la biodiversidad porque se protege a un elevado número de especies, pero la conservación de ecosistemas constituye un filtro grueso que no incluye a algunas especies. También se requiere un método de filtro fino para el manejo de algunas especies (e. g., especies sujetas a explotación directa). La conservación de filtro medio es otro método complementario que enfoca la conservación de elementos críticos del ecosistema que son importantes para muchas especies, en especial las que probablemente son pasadas por alto por los métodos de filtro fino, como invertebrados, hongos y plantas no vasculares. Los elementos críticos incluyen estructuras, como troncos de árbol, tocones, charcas, manantiales, arroyos, arrecifes y cercos vivos, y procesos como incendios e inundaciones. La conservación de filtro medio es particularmente adecuada para ecosistemas seminaturales que son manejados tanto para biodiversidad como para la producción de satisfactores (e. g., bosques manejados para madera, pastizales manejados para forraje de ganado y ecosistemas acuáticos manejados para pesquerías) y es relevante para el manejo para biodiversidad de ambientes agrícola y urbanos.*

Palabras Clave: conservación de filtro fino, conservación de filtro grueso, manejo de ecosistemas, manejo de matriz

Introduction

Conservationists often use the metaphor of coarse filters and fine filters to convey two complementary strategies for maintaining biodiversity: The first focuses on conserving ecosystems and the second focuses on species (Noss 1987; Hunter 1991; Groves 2003). The coarse-filter approach seeks to protect a representative array of natural ecosystems and their constituent processes, structures, and species; however, some species fall through its

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pores, and coarse filters must be complemented by fine-filter strategies tailored to fit particular species. Species exploited by humans (e.g., game species) and rare species (e.g., plants confined to rare substrates that might not be "captured" through ecosystem protection) are often candidates for fine-filter conservation. When rigorously undertaken in concert, these two strategies are efficient and reasonably comprehensive. They are efficient because coarse filters conserve large numbers of species, the majority of which are too poorly known to be conserved individually (e.g., imagine species conservation plans for particular rotifers and nematodes). Together, the two strategies are reasonably comprehensive because all species known to be in jeopardy will receive needed attention.

Coarse-filter conservation focuses on the establishment and management of ecological reserves, places where maintaining biodiversity is a clear priority (Chape et al. 2003). Fine-filter conservation often takes place in the context of reserves too, but it also commonly extends into landscapes managed primarily for other purposes, such as seminatural ecosystems. Native forests managed for timber production, native grasslands managed for livestock forage, and aquatic ecosystems managed for native fisheries are three widespread examples of situations in which species of conservation concern often receive fine-filter, species-specific management (Samson & Knopf 1996; Hunter 1999; Boon et al. 2000; Lindenmayer & Franklin 2002). Less common, but still noteworthy, are situations in which fine-filter management takes place in farmlands and other cultivated ecosystems (e.g., altering mowing regimes to conserve grassland bird nests) or even in urban environments (e.g., hacking programs for Peregrine Falcons [*Falco peregrina*] in cities) (Gilbert 1989; Collins & Qualset 1999).

Collectively, these seminatural, cultivated, and urban ecosystems (where conserving biodiversity is, at best, a secondary goal) cover roughly 90% of the earth's land surface and a higher percentage of the oceans (Chape et al. 2003). This raises an important question: Can some of the efficiencies of the coarse-filter approach be achieved in these ecosystems that are not reserves? In other words, are there ways to manage these ecosystems that will benefit many of their species, the majority of which will not receive the special, tailored attention of fine-filter conservation? I argue that the answer to both these questions can be yes if a third strategy—mesofilter conservation—is implemented. Mesofilter conservation complements coarse-filter conservation in ways that fine-filter conservation misses.

The Role and Scale of Mesofilter Conservation

The key idea of mesofilter conservation is that most ecosystems contain certain features that are critical to the welfare of many species; thus, conserving those features can have a positive effect on a large suite of species. Logs in a forest, hedgerows in an agricultural landscape, reefs in an estuary, and streams and pools in many terrestrial ecosystems are all examples of ecosystem features that support far more species than one would predict based on their size alone. The importance of conserving these features is widely recognized but in an ad hoc, idiosyncratic fashion that often does not recognize the commonality between maintaining a hedgerow, a rock outcrop, and an ephemeral pool. By joining the conservation of ecosystem elements under a single umbrella term, I hope to increase the prominence of this approach to conserving biodiversity. By choosing a term that complements the well-established language of coarse and fine filters, I hope to illuminate how mesofilters play an intermediate role between coarse and fine filters. Furthermore, adding mesofilters to the vocabulary of conservation may help to avoid the polar constructs that sometimes divide the advocates of ecosystems versus species. Mesofilter conservation overlaps with many aspects of matrix management and ecosystem management (Szaro & Johnston 1996; Johnson et al. 1999; Lindenmayer & Franklin 2002). A key difference is its specific focus on ecosystem elements, which explicitly complements coarse-filter and fine-filter conservation.

Understanding how mesofilters can complement coarse filters requires a brief discussion of ecosystem scale. In theory the ecosystem concept can be applied at any scale. Therefore one could argue, for example, that logs are small ecosystems and thus conserving logs is an example of coarse-filter conservation (Hunter 1997). Of course, among conservation practitioners ecosystems are conventionally viewed at much larger scales (likely to be measured in hectares and square kilometers), and efforts to establish ecological reserves operate at these scales or even larger. Obviously, one would never establish a reserve around a single log. Therefore, a simple, practical dividing line between coarse-filter and mesofilter conservation would be the scale at which one would draw a boundary on a map to legally designate an ecological reserve. This scale will vary in different contexts: reserves in boreal Russia or Canada are typically measured in thousands of square kilometers, whereas reserves smaller than 1 km^2 occur regularly in densely settled parts of Europe. Mesofilter conservation focuses on smaller entities—perhaps readily mapped (e.g., streams) perhaps not (e.g., logs)—that are most easily conserved through laws and voluntary guidelines rather than by setting fixed reserve boundaries.

The primary way in which mesofilter conservation complements fine-filter strategies is by dramatically shortening the list of species that could require fine-filter conservation. For example, if a species of woodpecker fares well in partially logged forests where deadwood is retained, conservationists may not need to give it (and many other deadwood-dependent species) fine-filter attention.

In one context fine-filter and mesofilter conservation can overlap: when the target of fine-filter management is a highly interactive species (sensu Soulé et al. 2003) that provides resources needed by many other species. For example, conserving a rodent or tortoise species that digs burrows used extensively by other species constitutes fine-filter conservation for the particular rodent or tortoise and leads to mesofilter conservation for all its commensal species. This is analogous to the overlap between fine-filter and coarse-filter management that occurs when conserving a fine-filter species involves conserving entire ecosystems or landscapes that constitute its habitat (e.g., reserves for tigers [*Panthera tigris*] and other umbrella species).

Examples of Mesofilter Conservation

Logs and Snags

Most forest ecosystems have large numbers of dead logs and snags that are key resources for myriad species (McComb & Lindenmayer 1999). For some very small or sedentary species (e.g., fungi and some invertebrates), these may constitute entire habitats. For larger creatures (e.g., a mammal that uses logs for dens), these may be a critical element of their overall habitat. The richness of the deadwood biota is impressive—just two beetle families tightly tied to this resource (Buprestidae and Cerambycidae) contain about 50,000 species, roughly double the global number of amphibians, reptiles, birds, and mammals combined (Hunter 1990). Conserving deadwood in a forest managed for timber is quite straightforward; it simply means avoiding the destruction of existing deadwood and leaving some dead or dying trees behind after a logging operation (often these can be ones with little commercial value).

Springs, Pools, and Other Small Wetlands

Large wetlands such as the Okavango, Everglades, and Pantanal may preoccupy the imagination of many conservationists, but much smaller wetlands can also play a key role in biodiversity conservation. The unique biota that occupy many desert springs and the essential role these springs play in providing water for wide-ranging terrestrial animals are a classic example. The small, often ephemeral, pools that characterize many forests and grasslands are not just depauperate versions of ponds and lakes. They often have a special fauna of invertebrates and amphibians because they lack predatory fish, and in some cases, notably prairie potholes, they are very important to breeding water birds. Waterfowl advocates have long promoted conserving prairie potholes in agricultural landscapes, and recently forest managers have taken notice of amphibian breeding pools in the midst of forests managed for timber production (Calhoun & deMaynadier 2004; Calhoun et al. in press). One could make a case that these wetlands are small, independent ecosystems, but they are really too small to be candidates for a classic coarse-filter strategy and thus are best considered in a mesofilter context.

Streams and Riparian Areas

The streams and riparian vegetation that stretch across forest, grassland, and desert ecosystems are often the most biologically rich portion of a landscape because three sets of species coexist there: terrestrial, aquatic, and species tied to both realms (Pollock 1998). Furthermore, perennially available water and nutrient-rich sediments often make riparian vegetation more robust, and this helps support a diverse and abundant fauna. Protecting streams and riparian zones has long been a priority for people concerned with water resources, fisheries, and biodiversity (Verry et al. 2000). Sometimes stream conservation occurs by establishing reserves, for example when entire watersheds are set aside. More often, riparian-zone conservation involves enforcing regulations and encouraging voluntary practices designed to protect these areas in the context of other land uses (National Research Council 2002). Fencing to keep livestock away from streams, strips of vegetation to filter agricultural runoff, and limits on the intensity and type of logging that can occur near streams are all examples of mesofilter conservation.

Structures in Aquatic Environments

Although organisms are found throughout the water column of aquatic ecosystems, they are often concentrated where three-dimensional structures provide a substrate for attachment and cover for hiding. Kelp forests, coral reefs, mollusc beds, rocks, and logs are common examples. Sometimes these are large enough to conserve through delineating ecological reserves, but often it is more practical to conserve them in a manner that allows other human activities, notably fishing, to continue. Unfortunately, conservation in aquatic ecosystems is still in its infancy, making actual examples of mesofilter conservation uncommon. Laws prohibiting the destruction of coral heads with dynamite are one example. Limits on dragging the seabed with bottom trawls would be a good example of maintaining structural diversity if they could be widely established (Watling & Norse 1998). Creating artificial reefs by sinking ships and other structures is arguably an example, albeit somewhat controversial because of its artificial nature (see *Bulletin of Marine Science* 44[2] for 51 papers on artificial reefs).

Hedgerows

The middle of a crop field usually has a very impoverished biota, but the overall agricultural landscape can support a surprisingly rich community if some structural diversity is maintained through mesofilter conservation. I mentioned two of the most important examples previously: riparian zones and small wetlands. One element of structural diversity uniquely associated with agricultural lands is hedgerows, and conservationists are working assiduously to maintain them (O'Connor & Shrubb 1986). Similarly, maintaining the shade trees associated with shade-grown coffee cultivation has received considerable attention lately (Philpott & Dietsch 2003; Rappole et al. 2003). Using mesofilter conservation to conserve biodiversity in agricultural landscapes may be particularly important because agriculture often dominates areas with the most fertile soils and benign climates. In contrast, establishing coarse-filter reserves has often been shunted into landscapes where habitat suitability for humans is lowest, usually because of high elevations or low soil productivity (Hunter & Yonzon 1993; Scott et al. 2001). In other words, the coarse-filter-strategy goal of maintaining a representative array of ecosystems may be thwarted in regions where all the natural ecosystems have already been converted to agriculture. In these areas a mesofilter strategy may be making the best of a bad situation.

Fires and Floods

All the critical features of ecosystems described so far have been structural or compositional elements (i.e., logs, reefs, hedgerows, or pools). It is also reasonable to consider maintaining critical processes in ecosystems as a mesofilter strategy because they are widely relevant to maintaining the biota of seminatural ecosystems. Ecosystems that burn regularly (typically frequent, low-intensity ground fires), such as various grasslands and woodlands, are excellent examples (Whelan 1995; DeBano et al. 1998). They often harbor many species that are utterly dependent on these fire regimes and with careful fire management these species can be sustained along with production of timber and livestock forage. Similarly, ecologists have come to appreciate the importance of periodic floods to the integrity of riverine ecosystems and are beginning to experiment with managing dams to create artificial floods (Schmidt et al. 2001; Postel & Richter 2003). Managing processes is not exclusively a mesofilter function. Burning habitat specifically to maintain Kirtland's Warbler (*Dendroica kirtlandii*) is a fine-filter activity. When reserve managers manipulate fires to maintain entire large ecosystems, this could be called coarse-filter management.

Conclusion

Conservation biologists are not reluctant to criticize their young discipline. Members of the Society for Conservation Biology regularly encounter statements such as, "we need to incorporate the social sciences," and "we need to recognize the ultimate threats of overpopulation and overconsumption." Explicitly adding mesofilter strategies to our conceptual thinking, vocabulary, and tool box will help us address two of the more common self-criticisms: that we focus too much on the tiny portion of the earth's surface that is set aside in reserves, and we focus too much on a small number of species, chiefly vertebrates and some vascular plants, that we know and care about. Mesofilter approaches will encourage us to think about environments where we cannot set aside entire ecosystems and about the vast number of species that will never be targeted for species-specific management.

Developing mesofilter conservation will mostly involve case-specific information and implementation strategies, but there are some overarching issues that also merit attention. Ways to objectively assess how much is enough are needed. For example, what are the relative economic costs and ecological benefits of leaving 5 snags/ha after a logging operation versus 3 or 10 snags/ha? We also need further development of policies to encourage implementation of these ideas, such as green certification and other landowner incentive programs.

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